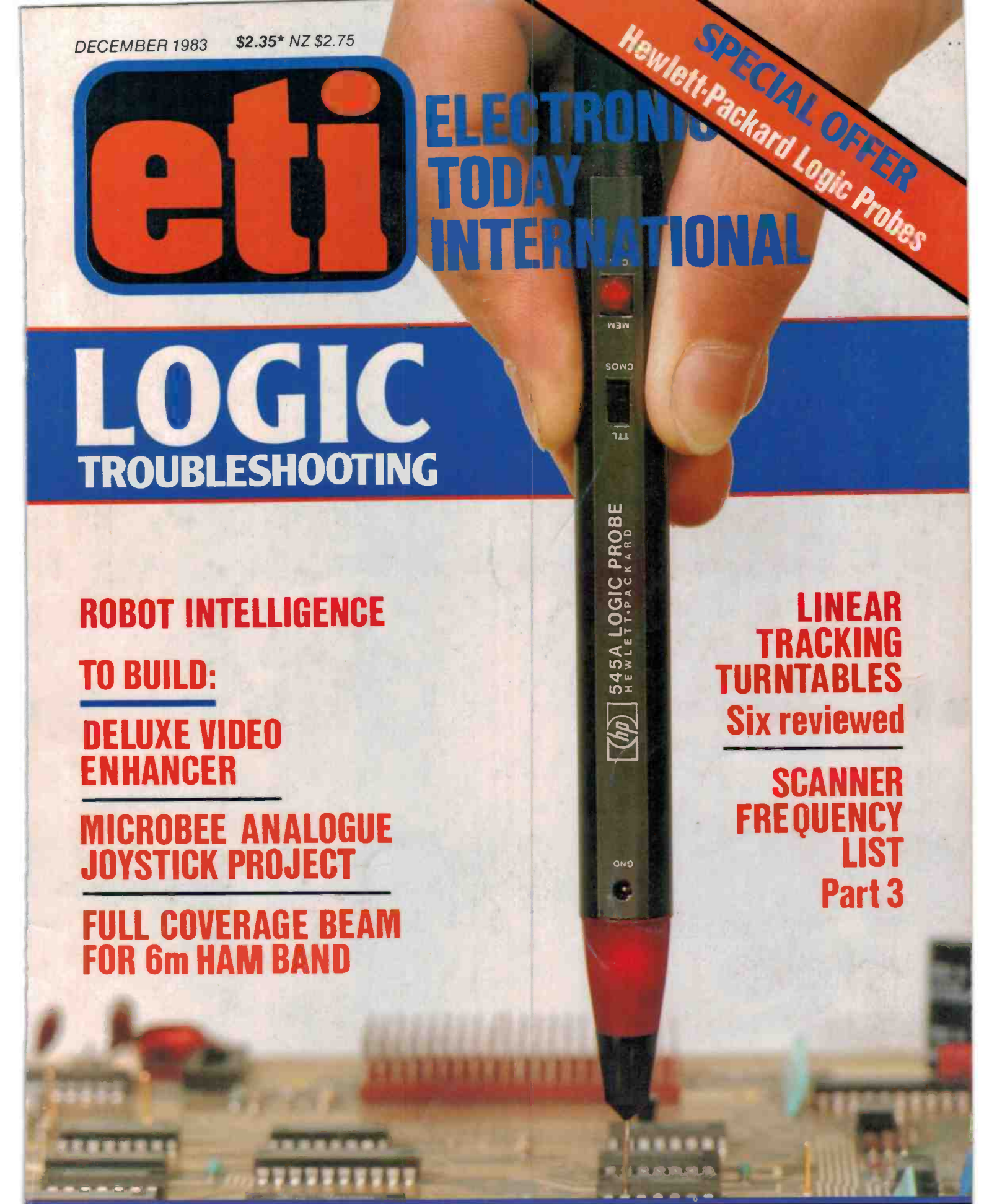
DECEMBER 1983 $2.35* NZ $2.75

eti

ELECTRONICS TODAY INTERNATIONAL

SPECIAL OFFER
Hewlett-Packard Logic Probes

LOGIC TROUBLESHOOTING



ROBOT INTELLIGENCE

TO BUILD:

DELUXE VIDEO ENHANCER

MICROBEE ANALOGUE JOYSTICK PROJECT

FULL COVERAGE BEAM FOR 6m HAM BAND

LINEAR TRACKING TURNTABLES
Six reviewed

SCANNER FREQUENCY LIST
Part 3

SPECIAL OFFERS: 'B-ETI' serial terminal • Texas Instruments printers

WHEN IT COMES TO PERSONAL COMPUTER SPECTRAVIDEO™ IS BEYOND ANY COMPARE!

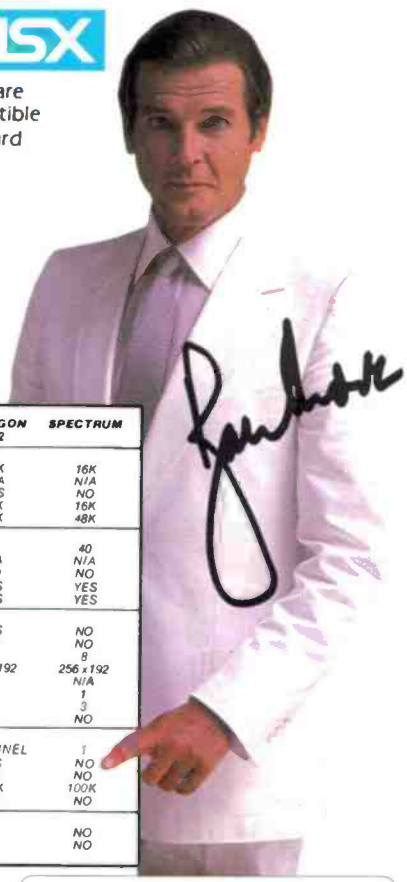
To the delight of our customers, and the dismay of our competitors, we now proudly present the most advanced, most capable personal computer system available today: Spectravideo™'s SV-318 and SV-328. While the SV-318 is "everything home computer users were waiting for," the SV-328 is specially designed "for the small business that doesn't plan to stay that way." These 2 computers, too, are beyond any comparison in their price range.

And they do not stand alone. Seldom, if ever, has a new computer been supported by so many peripherals. Of exceptional quality, all this hardware rides into you on the crest of the very last technology.

Additionally — and importantly — Spectravideo™ is very software oriented. With built-in CP/M compatibility, the SV system allows you to take advantage of thousands of pre-existing programs. And with the MSX software compatible standard, jointly launched by Spectravideo™ and most of Japan's largest electronics firms, Spectravideo™ can take advantage of all software developed by other MSX participants. Plus, Spectravideo™ is now producing its own line of top-quality software. Finally, the SV system includes several innovative and interesting accessories that you will want to use.

Because of product depth and ease-of-operation, the SV system will give you full usage from the moment you unpack it. Yet it is both capable and expandable enough to give you long-term usage, too. That's why Spectravideo™ is truly, "The computer system you'll grow into, not out of."

MSX
software compatible standard



	SPECTRAVIDEO SV 328	SPECTRAVIDEO SV 318	APPLE II E	ATARI 800	COMMODORE 64	BBC MODEL B	DRAGON 32	SPECTRUM
COMPUTING POWER FEATURES								
BUILT-IN ROM	48K	32K	16K	10K	20K	16K	16K	16K
EXPANDABLE TO	96K	96K	N/A	42K	N/A	64K	N/A	N/A
BUILT-IN EXTENDED MICROSOFT* BASIC	YES	YES	YES	ADDITIONAL COST	NO	NO	YES	NO
BUILT-IN RAM	80K*	32K***	64K	48K	64K	32K	32K	16K
EXPANDABLE TO	256K**	256K**	64K	NO	N/A	32K	64K	48K
KEYBOARD FEATURES								
NUMBER OF KEYS	87	71	63	61	66	73	53	40
USER DEFINE FUNCTIONS	10	10	N/A	4	8	10	N/A	N/A
SPECIAL WORD PROCESSING	YES	YES	NO	NO	NO	NO	NO	NO
GENERATED GRAPHICS (FROM KEYBOARD)	YES	YES	NO	YES	YES	YES	YES	YES
UPPER/LOWER CASE	YES	YES	YES	YES	YES	YES	YES	YES
GAME/AUDIO FEATURES								
SEPARATE CARTRIDGE SLOTS	YES	YES	NO	YES	NO	NO	YES	NO
BUILT-IN JOYSTICK	NO	YES	NO	NO	NO	NO	NO	NO
COLORS	16	16	15	128	16	16	9	8
RESOLUTION (PIXELS)	256x192	256x192	280 x 160	320 x 192	320 x 200	256 x 640	256 x 192	256 x 192
SPRITES	32	32	N/A	4	8	N/A	16	N/A
SOUND CHANNELS	3	3	1	4	3	1	3	1
OCTAVES PER CHANNEL	8	8	4	4	9	3	5	3
A.D.S.R. ENVELOPE	YES	YES	NO	NO	YES	YES	NO	NO
PERIPHERAL SPECIFICATIONS								
CASSETTE	2 CHANNEL	2 CHANNEL	1 CHANNEL	2 CHANNEL	1 CHANNEL	2 CHANNEL	2 CHANNEL	1
AUDIO I/O	YES	YES	NO	YES	NO	NO	YES	NO
BUILT-IN MIC	YES	YES	NO	NO	NO	NO	NO	NO
DISK DRIVE CAPACITY (LOW PROFILE)	256K	256K	143K	92K	170K	100K	100K	100K
	YES	YES	NO	NO	NO	NO	NO	NO
CP/M® COMPATIBILITY (Standard 80 column programs)								
CP/M® 2.2	YES	YES	NO****	NO	NO*****	YES	NO	NO
CP/M 3.0	YES	YES	NO	NO	NO	NO	NO	NO

Specifications are subject to change without prior notice.

* 64K user addressable plus 16K graphic support
** 240K user addressable plus 16K graphic support
*** 16K user addressable plus 16K graphic support
**** Apple II can accept modified 40 or 80 Column CP/M
***** Commodore 64 accepts 40 column CP/M

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P.O. Box 474, Edgecliffe, N.S.W. 2027. Ph: (02) 328-1190
Franklin Agencies, 3 Marie St., Milton, Qld. 4064. Ph: (07) 369-0496
Jerdon Agencies, 25 Gladstone St., E. Perth, W.A. 6000. Ph: (09) 328-5299
Dennington Enterprises, 46 Canning St., Launceston, Tas. 7250. Ph: (003) 31-8551

SPECTRAVIDEO™

MSX, Microsoft Extended BASIC is a trademark of Microsoft Corporation
CP/M is a trademark of Digital Research Inc.

SAD-83-004

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PROUDLY PRINTED IN AUSTRALIA

ELECTRONICS TODAY INTERNATIONAL is published monthly by the Electronics Division of the Federal Publishing Company Pty Limited, 140 Joynton Avenue, Waterloo, NSW 2017. Managing Editor: Bob Izzard. Typeset and printed by ESN-The Litho Centre, Sydney. Distributed by Gordon and Gotch Limited, Sydney. Cover price $2.35 (maximum and recommended Australian retail price only; recommended New Zealand price, $2.75). Registered by Australia Post, Publication No NBP0407. ISSN No 0013-5216.

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FEATURES

SIGHT & SOUND

COMPUTING TODAY

TECHNICAL

COMMUNICATIONS

GENERAL

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If you own a Commodore home computer,
here's an offer too good to miss.
Buy any Computer Classics VIC 20 game
and get Galactic Defender **free.**
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get Stratagem **free.**
Two explosive games for the price of one.
Only from Computer Classics.
Available from all leading software retailers.
COMPUTER CLASSICS
THE MINDBENDERS

ADVERTISERS' INDEX

COMMENT

Season's Greetings to all our readers and advertisers from ETI Editor & staff

Roger Harrison
Editor

NEXT MONTH

CIRCUIT SOURCE GUIDE

Our first Circuit Source Guide, published in the Feb. '82 issue, proved a popular feature, so it returns in January. The '84 Circuit Source Guide will contain dozens of practical circuit ideas for experimenters and engineers, tinkerers and technicians. Don't miss it — lots of holiday-time inspiration!

PROGRAM BUG DEBUGGER ▶

Ever burnt a program into an EPROM and found it wouldn't run? Without a logic analyser it's nigh on impossible to debug. This project costs far less than a logic analyser and gets you out of the jam. It provides 'mirror image' RAM (battery-backed, if you like), permits the addition of program breakpoints and removes R/W control. It plugs directly into a 2716/2516 socket. Use also for temporary RAM extension or program storage. Cheap, too.

JAPAN ELECTRONICS SHOW

Dennis Lingane brings you two reports on the All Japan Audio Show and the Electronics Show. Read all about the latest developments in audio, video and home computers.

LET CALLER

Play tennis, anyone? This unit provides you with clear indication when a ball 'tips' the net in flight — requiring a 'let' call. Our electronic let detector is more reliable than umpires and saves tennis court tantrums. Cheap and simple to build.

IMPROVING THE '668 EPROM PROGRAMMER

Our popular Microbee EPROM programmer has been improved at the suggestion of a number of readers. Geoff Nicholls combines the best suggestions for the '668 deluxe!

SERVICES

TECHNICAL INQUIRIES: We can only answer readers' technical inquiries by telephone after 4.30pm Mondays to Thursdays. The technical inquiry number is (02) 662-4267. Technical inquiries by mail must be accompanied by a stamped, self-addressed envelope. There is no charge. We can only answer queries relating to projects and articles as published. We cannot advise on modifications, other than errata or addenda. We try to answer letters as soon as possible. Difficult questions may take some time to answer.

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DICK'S PRICES MAKE GIVING A PLEASURE!

Metric Conversion Calculator

Take the hardship out of metric conversion with this pocket sized LCD calculator. Converts to metric and vice versa.
Cat Q-3025
$19.95

NOW YOU CAN HANDLE METRICS!

LOW COST RECHARGE

GE Quality NiCad Charger!
Handles 4 AA NiCads! Great GE brand...full instructions provided!

Cat M-9520
$8.95 WAS $10.95

SCOOP PURCHASE

QUALITY
PHILIPS Car Speakers
Twin cone for really thrilling sound! 4 ohms impedance and 20W rating. $40? No! $30? No! Thanks to a very special deal, our crazy price is just . . .
$9.95 ea
AMAZING! Cat A-6988

WARNING! You may see unknown brands at a lower price. They can cause $$$ damage to your video recorder heads as they may be highly abrasive. The wise video enthusiast sticks to the top brand names!

LOWEST PRICE IN AUSTRALIA

FOR QUALITY, TOP NAME POLAROID VIDEO CASSETTES
VHS 3 hr Cat C-3410
BETA 3 hr Cat C-3415
$12.50

RELAYS . . . RELAYS . . . RELAYS

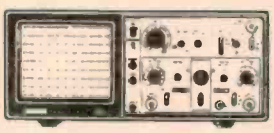
EXTRA HEAVY DUTY PCB
$3.50
High power rating - but a budget price! Operates from nominal 12V, has double pole, double throw contacts.
Cat S-7140

HIGH RATING POWER RELAY
$9.75
A small but high capacity relay ideal for power switching with a massive contact rating of 10A.
Cat S-7200

ILLUMINATED SPST (12V)

Intended for automotive use. The soft glow from the toggle is not distractive in night driving, the switch can quickly be located. 12V lamp operates from supply being switched.
Cat S-1214
$2.95

NEW 20 MHz HITACHI DUAL TRACE CRO



Not just a good CRO . . . a great one! Top brand name with huge 20MHz bandwidth, dual traces . . . it's got the lot! And all for our low, low price!
Features:
● Extra high bandwidth, ● Extra high sensitivity ● 5 display modes ● 1 touch wave form shifting.
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ONLY $699

NEW UNIVERSAL ANTENNA MAGNA BASE

$29.80
Ideal for company cars, etc, where drilling holes in the roof is a definite no-no! Extra strong magnet grips any ferrous surface and stays stuck even at high speed!
Cat D-4514

NEW 20k/V MULTIMETER (inbuilt logic probe)

Amazing Value!
Cat Q-1026
$32.50

SAVE $10 AND TIME WITH THE LOGIC PROBE

This outstanding Logic Probe hooks onto the circuit under test for its power (5V DC), and you can tell at a glance what the logic level is by which of the three LEDs is glowing. It is easily held in one hand - so your other hand is left free! Ideal tool for the hobbyist, technician, engineer etc.
Cat Q-1272 WAS $32.50
$22.50

SAVE SCOOP PURCHASE! Stereo Cassette Player

ONLY $29.95
From Bach to Beethoven to Beatles to B-52's, they'll all sound great on this brilliant little stereo cassette player. And at this low, low price, how can you look elsewhere?
Cat A-4055

NEW Piezo Transducer

Great for miniature audio alarms. Can be driven by transistor, C-MOS or TTL giving a piercing note around 80dB @ 30cm. Very low power needed - operates from around 3V to 30V peak to peak.
Cat L-7022
99¢

DELUXE FEATURES! 200FB BEARCAT SCANNER

What a beauty! A superb scanner for such a low price, with features like 16ch. memory, direct channel access, auto and manual memory scanning AND it can be used mobile! Cat D-2801
only $369

NEW PROTECT YOUR ANTENNA

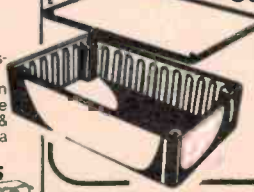
ANTENNA SPRING
Thwunk! You've just hit a low flying bridge - & your antenna is now a dipole. If you had a spring in the base it would have bounced back. Standard thread, suits most antennas.
Cat D 4500
$7.50

QUICK DISCONNECT
You didn't realise your antenna was pinched until you saw the smoke coming from your finals . . . A quick disconnect would let you put the stick in the boot as you leave the car! Removal & replacement takes a second or so.
Cat D-4501 $9.95

Sub Miniature DPDT Slide Switch

Countless applications - amazing low price!
Cat S-2010
45¢

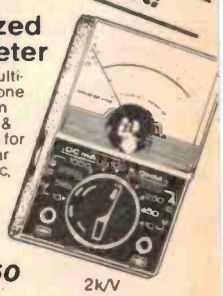
SAVE A FORTUNE! on comparable quality DIE CAST BOXES



Cat H-2206
150 x 50 x 80mm
$9.25

Fits your pocket! Mini Sized Multimeter

A fantastic multimeter for anyone starting out in electronics - & just as useful for the house, car etc. Economic, reliable and simple to operate.
Cat Q-1010
$13.50



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DICK SMITH Electronics

GREAT SAVINGS, BUILD YOUR OWN

DICK SMITH SERIES 200

Just cause you haven't got as much space, why skimp on sound quality? Build these superb Dick Smith Series 200 hi-fi speakers and you'll be amazed at the sound quality that could come from such a tiny package! And you'll be amazed at the savings made over built-up speakers! (See ETI September 1983)

Includes:
Speaker Grille Cat C-2608 $31.50
Enclosure Kit Cat C-2636 $128.50
Speaker Kit Cat C-2046 $89.50
Complete 200mm D.I.Y. Speaker Kit

$249.50

NOW HEAR THIS: FAMOUS SENNHEISER HEADPHONES

Just look at this! Superb headphones from one of the world leaders in audio products at an unbelievably low price! Check out the quality sound from these 'phones – you won't go elsewhere.
Cat C-4120
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SCOOP PURCHASE!

MOTOROLA QUALITY PIEZO TWEETER

A magnificent new addition to our range of quality speakers. This excellent piezo-ceramic tweeter is an ideal replacement tweeter. Handles up to 40 watts continuous. Add these to your system and you'll notice the difference.
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Transistor Checker Multimeter

The ideal test instrument for hobbyists, also great for the serviceman – rugged, low profile 25 ranges, highly visible display.
And you now save $10.00!
Cat Q-1136 WAS $79.95
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Fantastic – will not corrode!

ALL WEATHER HORN SPEAKER

At last – a horn speaker you can use anywhere! Until now all horn speakers have suffered a similar problem: corrosion. Now a plastic horn speaker which doesn't sacrifice any of the acoustic qualities of its aluminium counterparts – but doesn't suffer from corrosion!
Cat C-2705
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4 WAY POWER BOARD

Get rid of that ugly piggyback double adaptor with this new-look powerboard. 4 outlets.
Cat P-5612
ONLY $12.99

THE POCKET COM II WALKIE TALKIE

NO LICENCE REQUIRED!

Great gift for any child! Full 2-way transmission in a unit so compact it could fit into your pocket! Ideal for construction workers on the job or for mothers who want to know what Johnny is up to in the backyard. Makes an ideal Christmas gift!
Cat D-1101
Complies with spec. RFME001 of the Australian Dept. Of Communications.
$9.95

SAVE A FORTUNE!

4 SECTOR ALARM CONTROL MODULE

EASY TO INSTALL

Protect your home and valuables with this alarm control unit. Virtually identical in op. and circuitry to one of the advanced alarm control units you pay $$$ more for!
Cat L-5056
ONLY $69.50

EASY LISTENING!

PHONE AMPLIFIER

Are you forever sitting with a phone to your ear waiting for the person on the other end of the line to come back to the phone? Well now you can relax because this unit will let you know when there is a person on the other end. Easy to attach via the sucker supplied. Also ideal for conferences or for when those overseas relatives call – now everone can hear the caller.
Cat Y-1174
$12.50
OVER 8000 SOLD

NEW

WHAT A BUY!

Deluxe Slimline TEAC HI FI at a Dick Smith bargain price!

Looking for a great hi fi? Check these out: Teac's new A-505 DC integrated stereo Amplifier and the matching T-303 AM/FM Stereo Tuner. 30W plus per channel, full range of inputs and switching for the most demanding audiophiles. And the new slimline appearance looks a million dollars!

AMPLIFIER (Cat A-1305) $249

TUNER (Cat A-1505) $209

BOOK VALUE

GE OPTO BOOK
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NATIONAL LOGIC TTL DATA MANUAL
Contains complete information on the extensive National Semi conductor bi polar logic families.
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MOS MEMORY
Data book of Fairchild's MOS memory LSI & VLSI devices!
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$5.95

AUST'N RADIO FREQUENCY H'BOOK
Get into the exciting hobby of scanning with this superb publication. A must for any scanner enthusiast.
Cat B-9600
$12.95

See Page 101 for full address details.

DSE/A650/PAI

TELECOM-RUN NATIONAL VIDEOTEX SERVICE APPROVED

The Minister for Communications, Mr Michael Duffy has announced the approval for Telecom to establish a national videotex service.

Mr Duffy said that Telecom will soon invite tenders, from selected suppliers, for the sup ply, installation and commission ing of the necessary equipment. The service is likely to be oper ating towards the end of 1984.

Mr Duffy said. "There has been strong industry support, especially through the recently formed Australian Videotex Industry Association, for Telecom to provide a national videotex service giving Australians efficient, low-cost access nationally to such a service via the automatic telephone network."

"In effect, therefore, the national videotex service will serve as a decentralised national library, with an extensive range of information being made available via the telephone line."

The service is expected initially to be capable of working with existing Prestel terminals and data bases now operating in Australia. It is anticipated that later it will be able to handle other videotex systems as well.

A national system would boost employment in a variety of fields outside Telecom — manufacture, sale and rental of terminals, operators of data bases, information assemblers, etc.

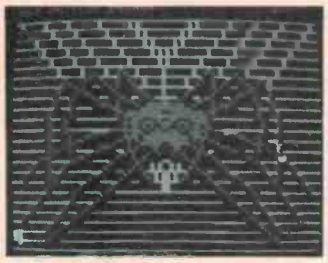
Mr Duffy emphasised that the provision of a national videotex service does not preclude other organisations from establishing systems to meet their own special requirements. Telecom will make facilities available for such systems at standard tariff rates.

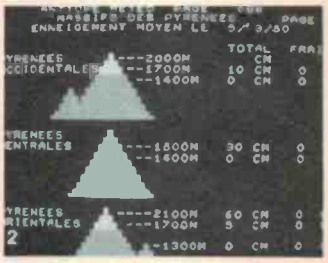
Meanwhile, the Australian Videotex Industry Association (AVIA) has welcomed the announcement by the Minister for Communications that Telecom will establish a national Videotex service for Australia.

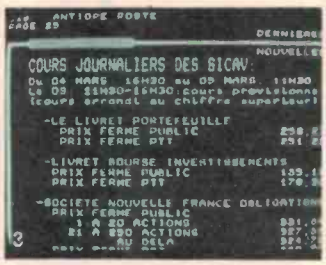
The Association anticipates that several large organisations who have previously lacked confidence in the future of the technology will now become active participants.

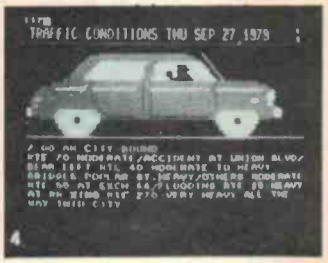
The national service will have special attraction for non-metropolitan users as it is understood that Telecom intends to offer the service at a uniform tariff.

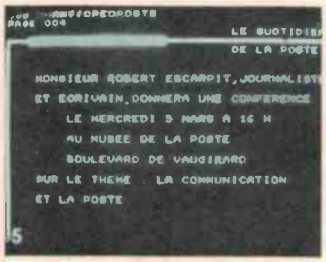
The Association believes that Telecom's role as a common carrier — offering information storage capacity only but with no involvement in information ownership, information provision, terminal manufacture or distribution — is the best approach. In this way the private sector will be presented with significant opportunities which will boost activity and employment.











PORTABLE SOLAR POWER PACK

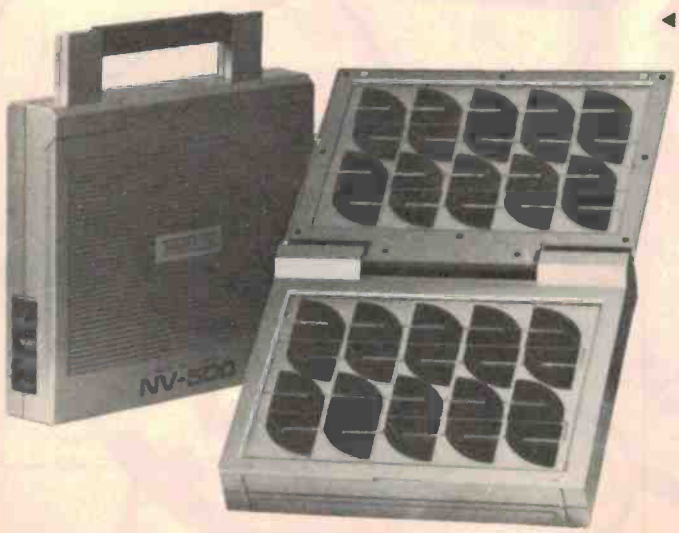
Since solar cells were first used in outer space, prices have gradually dropped, making them economical for an ever growing range of applications.

Amtex Electronics has released a portable solar power generator in a lightweight carrying case. Called the NV-500M, it can supply up to 5 W of dc power for a variety of appliances. It is especially useful for recharging batteries for portable video cameras which may be taken to the beach, a sports event or anywhere away from main electricity.

The unit produces 12 V at 0.5 A and has a built-in overload protector. It also has outlets for 3 V at 0.5 A, 6 V or 9 V at 1 A. The hinged, molded-plastic, attache-style case measures 330 x 350 x 65 mm and snaps shut to protect the cells during transport.

It simply needs to be opened flat to expose its solar cells, which immediately begin converting sunlight into electricity. The unit is priced at $389.

For futher information, contact **Amtex Electronics, 11 Spring Street, Chatswood 2067 NSW. (02)411-1323.**



LASERS COULD AID WEATHER FORECASTING

Weather forecasting is a subject that is taken very seriously in Britain and, in a bid to improve results, scientists at a northern England university are to start using data collected by satellite-based lasers.

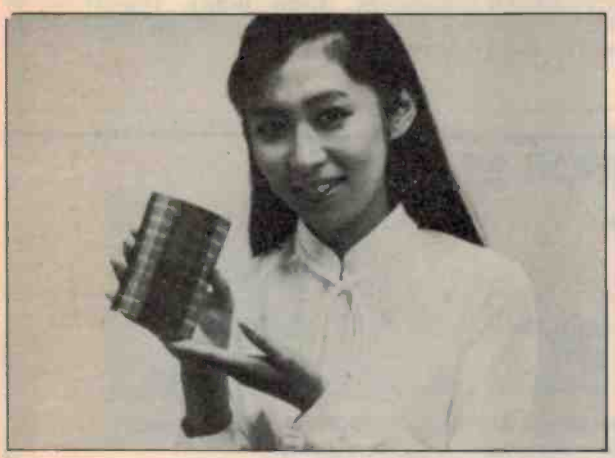
The University of Hull's Department of Applied Physics has been awarded a grant of almost $92 000 for work on atmospheric measurements using coherent laser radars. The research has applications for metereology in examining humidity and wind velocity and in the control of pollution.

Doctors Barry Rye and Eric Thomas are developing a technique for monitoring atmospheric gases which involves the absorption of infra-red laser beams passed through them.

Dust particles act as the "targets" of the radar system, while wind velocity can be determined from the speed of the dust using methods of measuring doppler shift analogous to those in police radar traps.

The researchers hope that, in the future, it will be possible to develop mobile systems for use on the ground and possibly from aircraft and satellites.

As the latter can be used to scan all the earth's surface, the measurements obtained would be far more comprehensive than those available from existing land-based sources, and could lead to a considerable improvement in weather forecasting, it is claimed.



NEW TYPE OF 'SOLAR BATTERY'

Sanyo Japan has announced the development of the 'flexible' Amorton — a layered amorphous solar battery which utilises both metal and resin substrates.

In contrast to the existing glass substrate Amorton used in calculators, electronic games and watches, the flexible metal and resin film substrate types are claimed to be superior in their mass production quality.

They are also adaptable to any sort of surface, including bends or curves.

Sanyo says this technology 'breakthrough' is highly significant for the future of applied solar energy.

New ideas for flexible solar cells include their use in curved-surface electronic products such as headphone radios and adaptation to products which combine energy from both solar light and solar heat.

Now that the Amorton strata can be accumulated on such metal bases as nickel and copper, says a Sanyo spokesman, it is possible to construct solar batteries on the surfaces of all kinds of machinery.

Sanyo Japan expects that a monthly production total of five million units will be reached by the end of the year.

NATIONAL STRATEGY FOR NEW TECHNOLOGY?

Barry Jones, the Minister for Science and Technology, has foreshadowed a national strategy for new technology.

Such a strategy would probably be formulated and discussed at a national technology conference in six months or a year's time. It would incorporate priority actions and ways of putting them into effect.

Mr Jones predicted the move at a three-day technology conference in Canberra in October. The conference was attended by 140 business and union leaders, scientists, academics and politicians from Australia and overseas.

He told the conference delegates in his closing speech that he thought it had been a valuable exercise in conscience raising and he hoped it would serve as a good basis for a national technology strategy.

The general thrust of the Labor Party's science-and-technology had come through the conference "comparatively unscathed", he felt, but he planned to revise the policy before next year's national ALP conference.

The Minister thought the conference had been successful in promoting dialogue between people and interest groups which had not met before and in drawing attention to the central role of technology in economics and politics.

Australia has changed from an industrial society into an 'information society', with more people employed in collecting, processing and disseminating data than farming, mining and manufacturing combined, but politicians and the community have been slow to recognise this shift, Mr Jones said.

ELECTRONICS INDUSTRY SUPPORTS TRADE MINISTER

The Australian Electronics Industry Association (AEIA) has supported the Federal Trade Minister, Mr Bowen, in his claim that non-tariff barriers would provide more protection for manufacturing industries.

The AEIA represents 50 of Australia's leading electronics and communications companies and pointed out that most developed countires support their technological and strategically significant industries by applying non-tariff barriers.

In many cases, the import tariffs they impose are low compared to Australia, but the non-tariff barriers give their local manufacturing sector adequate protection.

The AEIA executive director, Mr Ed Hodgkinson, says the Australian viewpoint of lowering tariffs the prime objective is one the association does not agree with.

"Too often the initial buying price is taken as the be and end all of the purchasing process. But in many cases, back-up service and support of systems and products are a major cost item, which can be minimised by having local manufacturing," Mr Hodgkinson said.

The association is keen to see Australian firms follow the example of companies such as Telecom, which buys local equipment and recognises the advantages of having the support of a viable manufacturing industry.

MARKETING SERVICES

Pat Daly, the former marketing manager for Dick Smith Electronics, has established a marketing services company.

Over the past few years, Mr Daly has successfully launched many new consumer products, including telephone products, video games, home products and answering machines.

For further information, contact **Pat Daly Marketing Services, 6 Chatswood Avenue, Chatswood NSW 2067. (02)411-7707.**

SUNSHINE FOR SUNRISE INDUSTRIES

High-tech 'sunrise' industries are being billed as the growth markets of the future and it seems sunburnt Australia is already embracing some of them with great enthusiasm.

In the solar power marketplace, market growth has been little short of phenomenal during 1983, according to one of the most experienced companies in the field, Amtex Electronics.

At a time when most companies are suffering from the stagnant economic conditions, Mr Jim Kuswadi, the company's general manager, claims sales of solar energy systems, as a replacement for electric and diesel power, have almost doubled since March.

"The major growth has been in NSW, Queensland and Victoria," said Mr Kuswadi.

"Seventy per cent of systems have gone to remote rural communities for domestic applications such as pumping water from dams and providing electricity for household appliances.

"The remaining 30 per cent are commercial applications such as microwave radio links for communications.

"The technology has been talked about for a long time and is now gaining credibility among the ordinary consumers," he said. "People now accept that it works. It's also economic and our system can be easily instaled by a handyman.

"It's a highly innovative market. Every week I'm confronted by somebody who wants to know if solar is the answer to their problems. In many cases it is the perfect solution." Amtex markets the Kyocera brand of solar energy systems. For further information, contact **Amtex Electronics, P.O. Box 285, Chatswood NSW 2067. (02)411-1323.**

EXPORT OPPORTUNITY FOR SECURITY SYSTEMS

Sales of security systems in the USA have almost trebled since 1980 as a counter to the increasing rate of crimes against people and property, making it an opportune time for the Australian security industry to increase its penetration of the US market at next year's International Security Conference (ISC) and Expo in New York from 27-29 August.

The Expo is a complete security forum for products, systems, and education, where qualified buyers from all industry segments can see and compare the latest technology available to solve their security problems.

In 1980 the US security equipment market was worth little more than $7000 million; today it exceeds $20 000 million; and by 1995 it could reach $31 000 million. The ISC exhibitors will have access to 35 000 executives, dealers, installers, end-users, new companies, and security professionals.

The Expo will feature hundreds of displays in all security categories, including alarm systems and components, access control, locking equipment, perimeter and space protection, monitoring equipment, smoke and fire detection equipment, and vehicles and accessories.

The demand exists for high quality, sophisticated security products which Australian firms can supply and Australian participants at the Expo will be exposed to an excellent cross-section of the market, conducive to establishing exports.

For further information, contact **The Promotions Officer, Chris Begley, Department of Trade, Canberra. (062)72-2527.**

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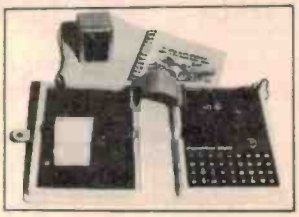

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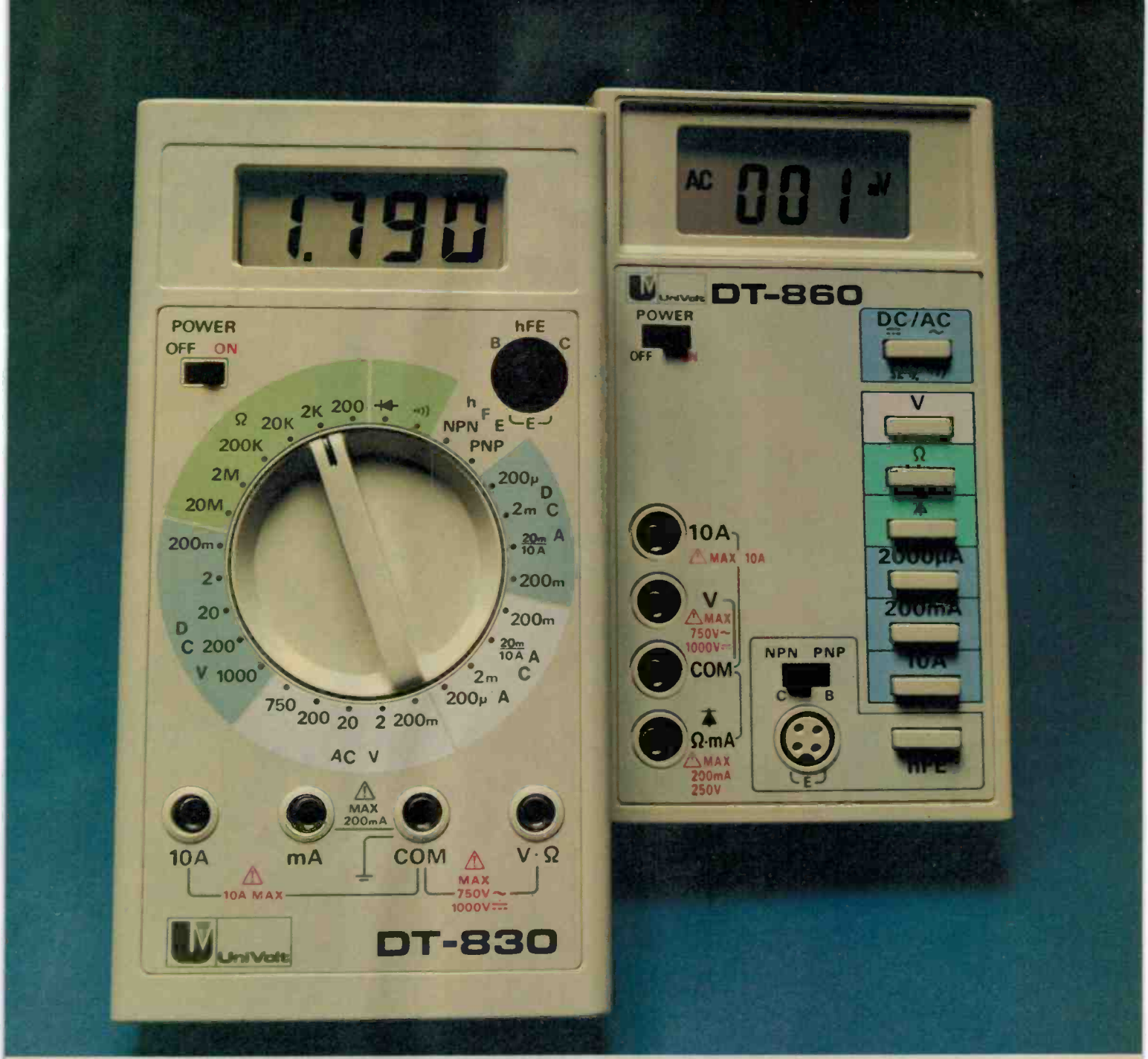

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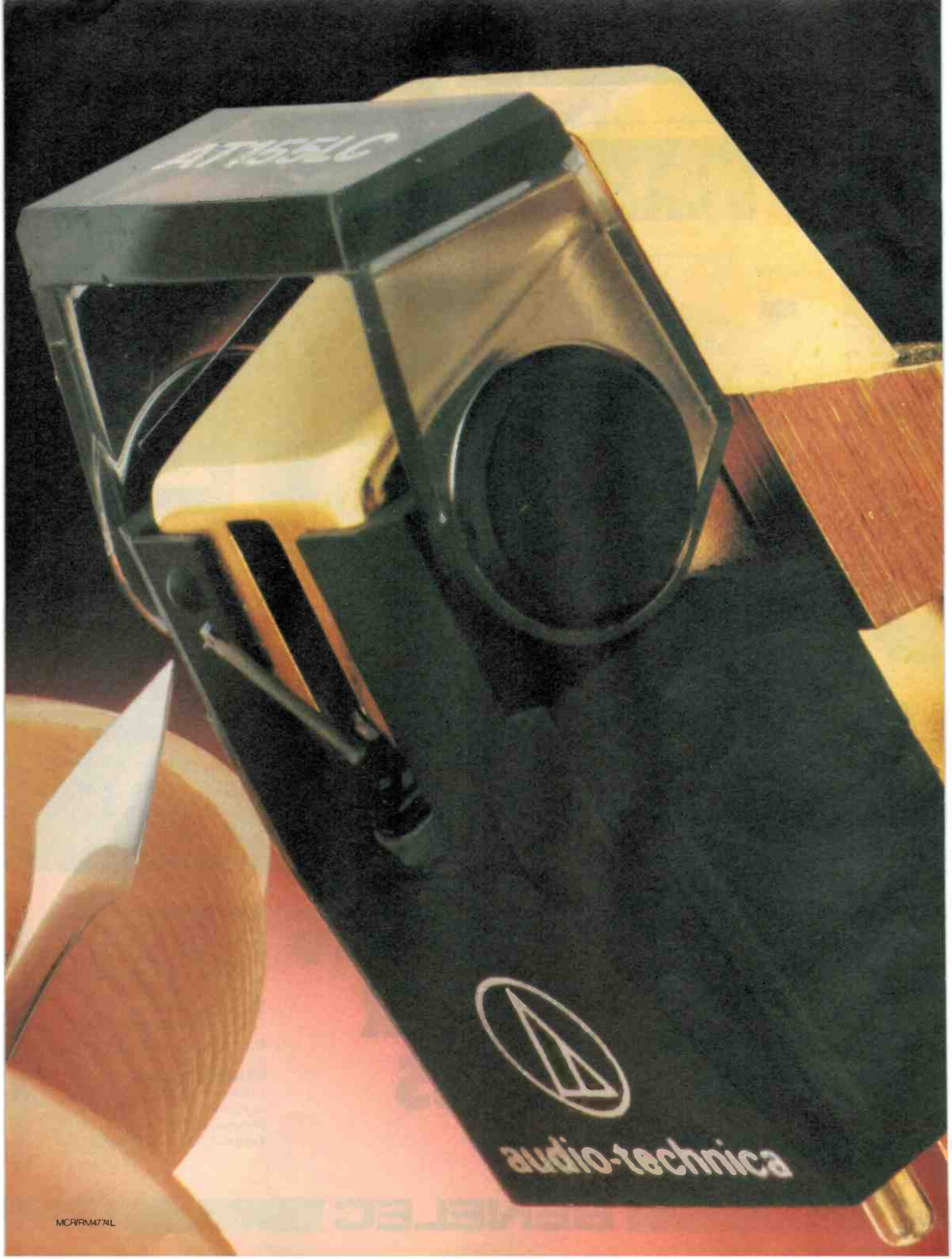
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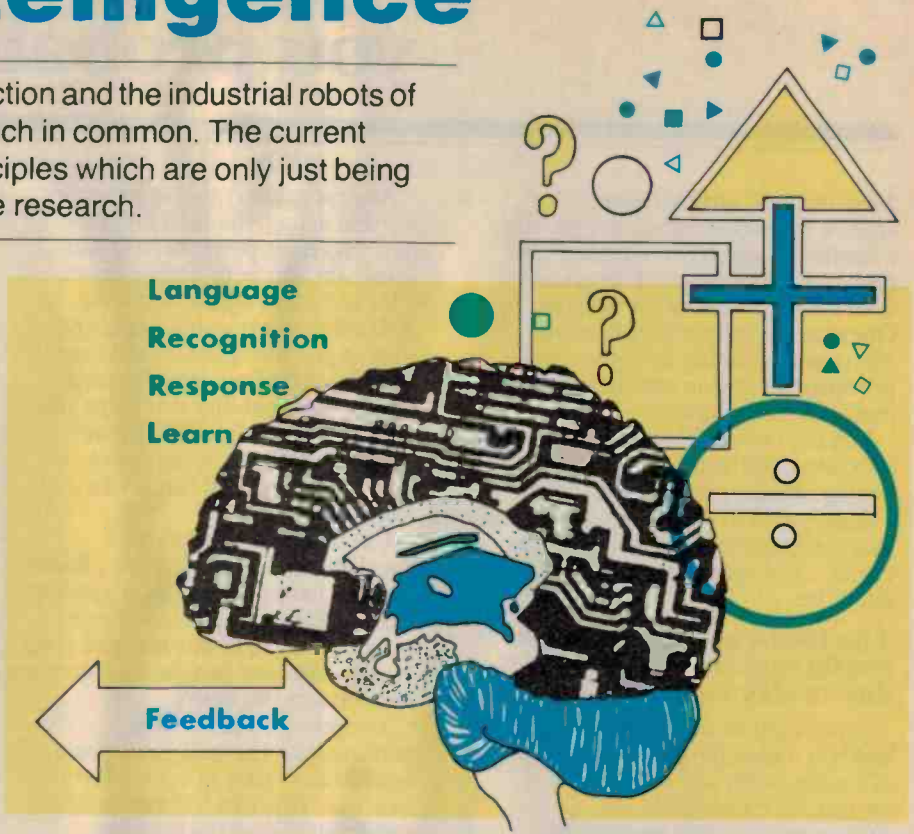
Robot Intelligence

The intelligent robots of science fiction and the industrial robots of today may not appear to have much in common. The current trend in robotics is based on principles which are only just being recognised in Artificial Intelligence research.

D.M.W. Powers
Department of Computer Science,
University of New South Wales



Unintelligent robots

The common understanding of 'robot' is as some sort of humanoid or Dalek-like box of computing tricks. This fantasy being is automobile and intelligent, endowed with human or even superhuman dexterity, language ability and visual acuity, and is typically self-aware, self-motivated and fictitious.

The more informed view of 'robot' will realise that eventually something like such a robot may be achieved. However, now robots are generally just glorified assembly-line or manipulation devices, apart from a few toys and turtles 'running' around research establishments.

When current robots are compared with the 'ideal' robot they are found to be deficient in precision and feedback responsiveness, in pattern recognition ability of a visual and tactile nature, and also in language and speech ability. The principle of self-activation, when a robot makes a decision based on its past experiences, is scarcely more than a dream.

There is, however, one aspect of intelligence that is becoming common in current robot technology. The programming of robots is changing from the familiar pattern of 'programmer and console' to one of 'guidance and learning'. There are still many problems related to the flexibility and tolerance of such systems, but it is clear that guidance, in whatever form it is given, has distinct practical advantages over conventional programming.

Adopting this learning pattern has ramifications far beyond the current usage. Various definitions of what characterises intelligence have been adopted throughout history; e.g: tool-making, language ability and generalisation ability. These features, said to distinguish man from the rest of the animal kingdom, must surely bear some relationship to those which will distinguish the intelligent computer or robot from its unintelligent counterpart.

Each of these characteristics has been disputed, or has been identified in certain other animal species. However, it is clear that the ability to deal with and develop the novel and the intangible is the basis of all these human characteristics. Only a system capable of learning could exhibit such characteristics.

It is not really a surprise that learning techniques should be so useful in industrial robots. What is surprising is that they are not applied more widely. After all, we don't program our children, but they acquire language, knowledge and motor skills naturally without being an intellectual drain on us (Derr77a).

As early as 1959 this technique was applied to draughts (checkers), and the learning program eventually reached master standard (Samu59a, Samu67a). Learning is, in fact, the main activity of our lives — not in a classroom sense, but in terms of everyday memory, in dealing successfully with what is novel, and in tackling a multitude of problems.

The proposition put forward is that it is learning which is the keystone of intelligence.

Philosophical Robots

As early as 1950, people were wondering about the nature and philosophical implications of this computing machinery they were hearing about. And in that year a paper of continuing significance was written addressing the question 'Can Machines Think?' (Turi50a). This paper has been reprinted a number of times in recent years and is still relevant; the imitation game suggested in it as a test of intelligence and thought has become a focus for argument as well as a goal for research.

The 'Turing Test' tests the ability of a machine to emulate a person and deceive an interviewer into thinking it is human. It is set up so that no communication or hint is conveyed except by typed messages. To fool a person, the computer must not only have language ability and logical inference ability comparable to a human's, but it must be either provided with or capable of providing a background as a personality in society.

These days the Turing Test is generally accepted as a test of intelligence. However, there are many who argue that it is invalid — that the test does not test for intelligence, but something that looks like intelligence yet is not the real thing (Sear80a). This problem of definitions is precisely what Turing hoped to avoid in defining a test rather than providing a definition of intelligence or thought.

But the philosophical discussion has a useful side-effect. It has focused our understanding of intelligence on purposeful behaviour and on the system of which it forms a part. It denies that an isolated 'black box' of 'intelligent' thought is intelligent; it is only in its involvement and relationships with the environment that intelligence can be construed, if even then. This again forces us to consider how sensory input, motor output, feedback loops and self-awareness, and the intentionality and purpose are involved in human intelligence.

The problem is best characterised in terms of whether a computer that is capable of answering questions, as if it were a person who understands the subject matter and the language, can itself be said to understand. When is it merely manipulating and transforming symbols from one code to another? When does it understand? When is a human merely translating between some sort of input code and some sort of output code? Is the human brain merely a translation program in this sense, translating input data (e.g: sensory) to output data (e.g: motor)?

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The 1630 also gives you interactive measurement capability for greatly enhanced analysis power. The ability to cross arm and trigger between state and timing analysers helps you get to the problem source quickly when the difficulty could be either a hardware or software malfunction.

Throughout the development cycle, you'll find the 1630 easy to use. That's because menus simplify operation. Label assignments let you view results in your system's terminology. And inverse assembly, via low-cost peripherals, displays listings in familiar target microprocessor mnemonics.

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Put the 64110A to work in the hardware test and debug phase and you can allocate high speed timing resources. For example, you might choose sampling speeds to 400 MHz. The resulting 2.5 ns resolution lets you make high-resolution measurements to resolve timing margin problems.

In addition, the timing analyser provides new triggering capability. The dual threshold mode lets you trigger on marginal signal levels, which helps you spot excessive fan-out, bus loading problems, and slow transition times. Other trigger modes include time qualification of pattern triggering, sequential triggering, pattern triggering ANDed with a transition or glitch, glitch triggering, plus other modes that simplify the analysis of handshake problems.

In software test and debug, the 64110A gives you unequalled tracing, triggering, and store qualification power. With its master enable function, 16-level sequencer plus 8 user-definable terms for trigger, store qualification and count functions, you'll have little trouble locating the specific portion of code you want and displaying only the information of interest... even in the most complex multiprocessor software.

For system performance analysis, the 64110A gives you a nonintrusive view of software in action in the form of histogram and graph displays. The histogram modes provide a fast way to locate system bottlenecks and identify inefficient portions of software. These display modes help you identify a processor stuck in a loop, see where software went into the weeds, or spot activity occurring in a forbidden area. A graph mode shows software performance data in chronological order.

Interactive measurements between all analyser subsystems multiplies the power of the 64110A far beyond the capability of other logic analysers. Cross arming and triggering between any of the analyser subsystems helps identify the source of difficult hardware/software interaction problems, and resolves hardware/software fingerpointing issues.

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here seems to be that understanding is bound up in terms of whether the input, the output and the feedback are all within the compass and purpose of the system. Understanding can then itself be seen as an internal modelling of the world — and from that perspective, modelling of understanding becomes less distinct from understanding per se.

What is the point of this philosophical argument? Merely that 'robot' is the category we must give to the species of composite computer system which is capable of directly sensing and manipulating its environment. And it is only in such a context that we can talk about understanding in the human sense. Of course we can simulate the robot (or the human) and inject the understanding system into a toy world which it is capable of sensing, and this has been done.

The proposition put forward is that it is sensory/motor context which is fundamental to understanding.

Intelligent robots

The most obvious feature of the computers and robots of science fiction is their ability to converse in English. At first this sort of language ability appears to be necessary, but on second thoughts a number of problems emerge — particularly concerning the accuracy with which we can specify something in a natural language, and the verbosity involved in making sure the meaning is clear. However, language remains one of the greatest barriers to the accessibility of the computer.

Language processing is not the only complex task we must face. If we have taken our language ability for granted, except as contrasted with lower forms of life, we have also taken visual (and tactile, motor, etc) abilities for granted, until coming face to face with the problems of robotics and pattern recognition. Visual processing is giving us just as much of a headache as language. Furthermore, these perennial problems turn out to be not so unrelated as they first appeared to be.

The connection operates both ways. Artists and poets throughout the ages have freely used analogies from each other's art. Our language reflects that 'a picture is worth a thousand words', and today we may claim that 'a novel is worth a thousand movies'. Philosophers have reflected on the language of art and of vision itself (Turb71a). Psychologists and neurologists have, at a number of levels, reflected on the language of vision and the language of the mind (Prib71a).

Neurologists have found that the mechanisms and transformations they have observed in the study of human vision are identical in nature with the processes used for the other senses. The functions of the brain for the different senses, and therefore for language as well, are the same. But these processes can only be perceived in terms of our visual maps of what occurs in the brain (Ecc167a).

The visual perspective may be characterised as follows. The pattern recognition which takes place in the retina is traced through the cortical layers. Different features of the patterns presented are recognised at succeeding levels; the lower the level, the more complex the feature or 'concept' recognised. The underlying levels use the simpler features recognised by the higher levels. The sequence progresses from specific areas to specific lines, to lines of specific orientation or rate of movement, and eventually to the more complex shapes and 'objects' (Hube79a, Mals73a).

The auditory pattern produced at the cochlea is transformed in a similar way when we perceive visually (if we map the auditory areas of the brain). We simply do not have the mechanism for dealing with musical composition and correlation of concepts derived from different senses are similarly difficult to identify.

Nonetheless, the pattern processing that occurs in the brain, despite our visual perspective, can be employed in a variety of ways — or in computer jargon, applications. We also find this with our more familiar computational tools. For example, the Fourier transform is employed in both vision and speech research.

The Fourier transform, however, is one of those rare techniques; we actually find it easier to think about in auditory terms than visual. Once we have transformed a visual pattern, we lose our orientation and understanding of it at a visual level. But we do understand it in terms of the frequencies (recurrent patterns) involved.

A more interesting example of a non-visual perspective is the linguistic metaphor employing another major technique of computer science — parsing. A scene may be broken down in the same way as language. Complex structures and concepts may similarly be broken down into simpler ones (Lern80a).

This view is the reverse of the previous transformational one in another sense too. The perspective here is coming from the deepest level toward the external input. But we may reverse this and employ a bottom-up parsing technique; building up the picture. This corresponds with the previous description of cortical layers. Interestingly, we represent parse information visually, using trees.

In fact, theories of the brain can and have been formulated in linguistic terms (Prib71a), and models of the world have been parsed in such a fashion (Powe83a).

It is at this point that the dividend is reached. The parsing technique of an appropriately universal linguistic theory may be applied to the language, the environment and the interrelationships. The hardware associative network or software logical description turns out to bear a close relationship to neurological evidence of linguistic and other sensory and cognitive processes.

The proposition put forward is that it is language which is characteristic of cognitive processes.

Conclusions

These thoughts have been arrived at after considering research and writings on Artificial Intelligence and Cybernetics. The ideas are based on certain neuropsychological theories which attempt to explain human intelligence. These same ideas are the basis of a research project at UNSW involving the writing on a computer system which relates language input with other modes of input in a simulated environment (Powe83a).

After thirty years of relatively unsuccessful work on isolated language understanding systems, it appears that an acquisitive approach, placing the onus of the computer, or robot, is required. In this way the language of the world and the natural language used may be correlated; semantics actually has a real meaning.

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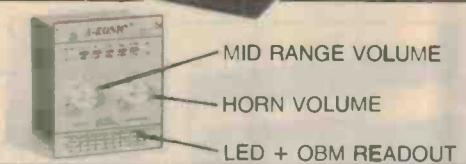

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PIONEER INTRODUCES NEW LASERDISC

Pioneer has finally launched its long-awaited Laserdisc players along with a range of videodisc packages for in-home use.

The Australian launch follows the successful release of Laserdisc in USA and Canada, latterly Japan, the United Kingdom and recently in Germany.

In January, 1981, Pioneer bought out all the interested parties in Discovision Associates in USA to become the sole owner. Pioneer also acquired world wide marketing rights for that optical Laserdisc system. This acquisition included the disc manufacturing facility in Carson, California, which has since been substantially remodelled. Pioneer also owns a disc replication plant in Kofu, Japan.

Les Black, Managing Director of Pioneer Electronics Australia said "response from both consumers and industry during recent shows and exhibitions has convinced Pioneer that this revolutionary product is ready to find a permanent place in the homes and boardrooms of Australia.

"On the home front," he said, "families will be able to enjoy what is a new dimension in home entertainment."

Laserdisc, as Pioneer describes it, 'stereo sound you can see' is poised to become the focal point of the home entertainment situation.

Mr Black went on to say "as an educational and merchandising tool, Pioneer's Laserdisc offers unique advantages to appropriate business houses and the acceptance of Laserdisc for it's industrial versatility had given the company great confidence about its future."

Pioneer will market their domestic Laserdisc LD1100 PAL format model. It is a videodisc player which uses a laser beam to read the permanently encoded information on a 30 cm acrylic disc providing high fidelity sound of very high quality and a television picture equal to or better than those received from off-air broadcasts when viewed on a television monitor, Pioneer claim.

The LD1100 can be simply integrated with existing television and hi-fi equipment, or become part of a component system with the result that recording artists covering all shades of musical tastes can be seen whilst they are heard.

A CX noise reduction system is included, which improves the signal-to-noise ratio up to 10 db.

A random access pause facility and ability to link the machine with teletext and interface it with personal or main frame computers makes the LD1100 extremely versatile.

Measuring just 525 mm wide by 143 mm high and 402 mm deep, the player is a very compact unit and it is anticipated that Pioneer will market the conept of a total integrated system consisting of speakers and monitor as they have successfully done in the USA and Japan.

Laserdisc went on sale at the end of October from approximately 100 retail outlets.

The LD1100 player is priced at $1299 recommended retail and videodiscs will retail between $35 and $50 from the Pioneer dealers, depending on the title.

Considering that newly released compact audio disc players are selling in excess of one thousand dolalrs, the additional feature of colour television to the high quality stereo sound of Laserdisc makes it a most appealing product, according to Pioneer.

For further information, contact **Mr Kevin Hoolihan, Manager, Laser Disc Systems, Pioneer Electronics Australia Pty Ltd, (03)580-9911.**

PORTABLE VIDEO SYSTEM

The Dumont Galaxy 2100 video centre, new to Australia, combines a 13 mm VHS video cassette recorder with a 100 mm colour screen.

Aimed at business people who need to show video programmes outside the office, the Galaxy 2100 weighs only 7.2 kg and is no bigger than an attaché case. Both screen and recorder are incorporated in the one unit.

The Galaxy 2100 uses the PAL system and accepts standard 13 mm VHS tapes.

For further details, contact **Results Audio Visual/Media-Craft, 7th Floor, 46 Holt Street, Surry Hills NSW 2010. (02)698-8799.**

LOW-PRICE DIGITAL MONITORS

English maker B&W Loudspeakers has launched a new pair of digital monitors on to the Australian market, the DM110 and the DM220.

Essentially, the two units are similar in concept. The smaller DM110 is a vented design employing two drive units. The DM220 is a sealed-box enclosure employing three drivers,

PHILIPS LAUNCH LASERVISION, TOO

Philips plans to release its Laservision video disc system for the educational, industrial and professional audio-visual markets. Laservision is the Philips-developed system based on the same revolutionary laser technology that is the heart of the Compact Disc.

Laservision discs can contain information in many different forms and are enormously versatile in educational, advertising and professional applications.

As well as conventional audio and video signals, Laservision can store complex graphics and text.

Philips Laservision for professional applications will be built around Philips state-of-the-art interactive television monitor which will allow infividual users to retrieve single messages from the large array stored on each video disc.

This monitor has a touch-sensitive screen so that cumbersome keying facilities are eliminated — users simply press the section of the screen displaying their area of interest. In a few seconds, that message is then located and displayed.

Philips will lend its expertise in creating software tailored to each application.

Further information from **Peter Brownlee, Philips Industries Holdings Limited, North Sydney NSW 2060. (02)925-3333.**

TOSHIBA'S FOUR-HEAD VIDEO

Toshiba's V-8700A video cassette recorder, now available in Australia, incorporates a four-head drum to enhance the 'still' and 'slow-motion' modes.

VCRs with two heads inevitably produce bar noise across the screen when in the still or slow-motion modes. This is because the heads must trace two recorded tracks.

Toshiba believes it has solved the problem with its four-head drum, the additional two heads being used exclusively for special-effect playback. These extra heads trace only one track.

Other features of the top-loading V-8700A, which uses the Beta system, include a wire-less remote-control headpiece, 3¼ hours of recording time and an audio dialing system.

For more information, contact **Toshiba Australia, 82-94 Talavera Road, North Ryde NSW 2113. (02)887-3322.**

PHILIPS DROP CD PLAYER PRICES

Philips' new Compact Disc digital audio players will be available at a much lower cost than earlier models.

Mike Orvis, group general manager of Philips Consumer Products, said that the price reduction demonstrated the increasing popularity of Compact Disc worldwide. These "perfect sound forever" disc players are supported by an increasing disc library with more than 500 titles already available and over 1,000 titles expected to be available before the end of 1983.

The new Compact Disc players are the CD202 (top-loading) and the CD303 (front-loading). These players have the basic features of the earlier Philips models CD200 and CD300 but have an additional digital display facility. An LED digital readout on the front of each player displays either individual track playing time or total elapsed time of the disc currently playing.

The suggested retail prices of the CD202 and CD303 players are $799 and $899 respectively. For further information, contact **Philips Industries, North Sydney NSW 2060. (02)925-3333.**

PRAGUE, MADE IN SYDNEY

Sydney's Audiosound Laboratories has developed the Prague 8045 control monitor, a high-performance medium-size two-way loudspeaker system designed for small studios, control rooms and situations where accuracy and high levels are required.

Audiosound claims the 8045, which is fitted with 3 dB precision attenuators for final balance of upper-midrange and treble, has a tonal balance that is close to imported studio monitors.

The 8045's extensive cross-over system utilises air-cored coils and polyester capacitors with an 18 dB/oct Butterworth filter.

Efficiency is 91 dB, and the 8045 is suitable for amplifiers from 10 to 100 W (RMS) output.

For more information, contact **Audiosound Laboratories, 148 Pitt Road, North Curl Curl 2099. (02)938-2068.**

with greater power-handling capacity and an extension in bass response over the DM110.

B&W Loudspeakers says the design brief for both models had three main requirements: high sensitivity (not less than 90 dB, 1 W at one metre); broad extended and linear frequency response; and a 'dramatic' reduction in production cost.

The end result is an Australian price tag of $399 for the DM110 and $599 for the DM220.

For furthur information, contact **Convoy International, 400 Botany Road, Alexandria NSW 2015. (02)698-7300.**

UHQR's 100-MINUTE TAPE

UHQR Sound Laboratories' new 100-minute cassette tape, the UHQR C-100, features a shell produced by the ULM — ultimate laboratory mechanism — method.

Under this system, the shell is moulded from a polycarbonate material and is so finely tooled that it takes up to 15 times longer to produce than conventional cassette shells.

The principle benefit, says UHQR Sound Laboratories, is that the shell 'remembers' its initial design form and always returns to its original shape, even after exposure to very high temperature.

The UHQR C-100, which gives 50 minutes of recording on each side, uses a cobalt-formulated tape with an 'amazingly' low residual tape-noise level.

Innovations in the shell, such as specially concave silicon slip-sheets with carbon-sputtred discharge stripes, are designed to provide what UHQR Sound Laboratories believes is perfect tape-spool support as well as being able to dissipate static build-up.

The UHQR C-100 cassettes, in gold packaging, are available as singles and in packs of six. They are priced at $9.95 for a single cassette and $59.95 for the six-pack.

For further details, contact **UHQR Sound Laboratories, 421 Forest Road, Bexley NSW 2207. (02)59-4727.**


LX-70
AIWA

Six linear tracking turntables reviewed

More than 60 years ago it was decided that only a linear tracking tone arm system could reproduce recorded sound with minimum distortion. So does a linear tracking system really have better tracking, better dynamics and lower distortion than the conventional pivoted tone arm turntables? Yes it does, but is it worth it?

Louis Challis

SINCE THE FIRST EDISON record player appeared, designers and manufacturers have been involved in developing tangential or linear tracking record players.

The original Edison recorder was the grandfather of the linear tracking record players; it used a mechanical lead screw to control the tracking of the sound head over the tubular recordings. Edison's equipment was far from being high fidelity as it converted the vertical modulation on the waxed tubular recording into a sound that only resembled and never faithfully reproduced the original sound.

Why Edison chose that particular method of tracking the record remains something of a mystery; there were many other ways in which he could have implemented his sytem.

A different method was used by another equally brilliant gentleman called Berliner who started a revolution with his circular, shellac recording discs. The difference between the two systems was very basic. The Berliner system was more practical and the circular recordings were far easier to mass produce than the Edison Ambirol gold recording system which it later eclipsed.

The trouble with the Berliner concept was that the replay system involved a pivoted tone arm that cannot position the headshell at exactly the same angle as the linear tracking recording head which was, and still is, the basis by which most masters are produced in the studio.

In 1906 that may not have mattered in terms of tracking angle error or even total distortion. But around 1920, and especially later on, a large number of clever gentlemen decided tha the pivoted tone arm system was not the correct way to reproduce the sound. They decided that only a linear tracking tone arm system could reproduce the recorded sound with 'minimum distortion'.

Whether you like them or not, pivoted arms have one major attribute — they are very simple and generally inexpensive. More research has gone into their design than the average buff may realise. Even now there are a large number of engineers and scientists working on improving their design, providing better and cheaper tone arms.

But no matter how good you make a pivoted tone arm, it will always suffer one major disadvantage — that of tracking angle error. From 1906 to 1946 that really didn't matter because I do not believe anyone could really tell the difference in sound quality when they were playing a shellac record using a steel-tipped needle, or even a sapphire or diamond stylus.

In 1983, with microgroove records offering superlative performance, it is possible to hear and measure the difference. The tracking error manifests itself as distortion products which purists believe should be removed. So the purists, fadists and technical buffs search for the perfection that the manufacturer's glossy brochures tell you can only be found in a linear tracking turntable.

Since the late 1920s there must have been hundreds of patents taken out in innumerable countries for various versions of linear tracking turntables. Not surprisingly, very few of these ever got into real production. I have only seen a few dozen of the latest generation working, and even fewer of the earlier generations. There were many models produced that never reached this country.

I was fortunate enough to view a number of rare units in the Smithsonion Institute of Washington earlier this year, most of which were developed before the Second World War; the majority were outstanding in their conceptual innovation. I would have liked to have heard them play but these units had been put in glass cases to prevent just that. (If any readers know of such units in Australia I would love to have a look at them and, with the Editor's approval, publish some photographs).

Not surprisingly, the majority of the linear tracking turntables developed between 1920 and 1980 proved to be less than perfect, both technical and financially. (See our review of the Garrard Zero 1000 turntable ETI 1973). Not one linear tracking turntable developed during that 60 year period proved to be a commercial match for the more conventional, and equally imperfect, pivoted tone arm record players.

Many of the best units developed over the last ten years have involved esoteric and expensive concepts which achieved only slight technical improvements over the best pivoting tone arms. The cheaper units managed to sell the concept but failed to capitalise on the most important attributes of the linear system; better tracking, better dynamics and lower distortion.

With these thoughts in mind I set out to review six units representative of those currently available in Australia: AIWA LX-70, Revox B791, Sony PS-X800, Technics SL-5, Toshiba SR-L7F and the Yamaha PX-3.

These units typify a wide range of units commercially in production at the present time; the marketplace has shown a positive acceptance of both the ergonomic and marketing features by which they are promoted. The major attribute of the smallest units is their physical size which is substantially smaller than that of most conventional record players.

By contrast, the largest units offer a technical performance which is excellent and which partially justifies the concept of linear tracking turntables. More importantly, this creates a niche in the market place which is sorely beset by the new competition from other sytems.

These units are strikingly different in just about every possible way; their recommended retail prices range from $299 to $1269, their weights range from 5.2 kg to 12 kg and their measured performances were equally diverse.

The objective testing of these units in the laboratory was aimed at assessing their conventional characteristics, as well as the technical improvements achieved through the use of the linear tracking system. The most important parameters were frequency response, wow and flutter, tone arm resonant frequency, bandwidth (the 'Q' of the tone arm), speed stability and, most importantly, improvements in trackability.

The subjective performance of all the players was assessed with two new outstanding records; Verdi's 'La Traviata' featuring Joan Sutherland and Luciano Pavarotti (Decca SXDL7562) and Gustave Holst's 'The Planets' featuring Herbert von Karajan (Deutsche Grammophon 2532019).

I will examine each unit in alphabetical order; many are innovative and technically exciting. ▶

AIWA LX-70

The AIWA LX-70 is described by the manufacturers as being a computer controlled, linear tracking tone arm system. It features a beautifully designed, lightweight plastic, moulded cabinet with rear-pivotted lid. Only a segment of the lid is clear acrylic, whilst the rest features a matt silver-grey finish, matching the base section of the unit. The lid is removable and the majority of the controls are located on the fascia.

AIWA has chosen to incorporate a host of electronic 'goodies', few of which are conventional in terms of record player control functions, while many are similar to the control features incorporated in the first generation of CD players.

From left to right across the fascia is an enlarged power ON/OFF switch, a row of seven very small programme select buttons, a switch labelled ALL CLEAR by which one can cancel a previous selection and a novel switch labelled INTRO PLAY/LIST. After all that has been written in the last few months about programme selection, you are now probably familiar with the concept of the user being able to preselect a random choice of tracks on a CD disc. To be able to perform the same function on a miniscule record player the size of this unit may be a little more difficult to grasp.

AIWA has managed to achieve this with a tiny tone arm. On the underside of the arm they have incorporated a track sensor element, duplicating one of the acclaimed advantages of the CD disc system. Obviously AIWA was not the first to offer this capability but it is probably one of the first to achieve it in such a small package.

I believe that the provision of the INTRO PLAY/LIST function is more exciting as this provides the user with the ability to preview the first *ten* seconds of each track on the record. You can then determine which tracks you want to listen to on those occasions when you don't want to listen to all of them.

The right-hand side of the fascia incorporates a recessed escutcheon with the main controls. At the centre of the unit is a stroboscope with a speed adjustment knob located immediately adjacent to it. Next to this are three pushbutton switches with illuminated bezel to indicate the function selected. The first button is REPEAT and the second and third buttons facilitate forward or reverse tone arm cueing across the record.

Three larger touch buttons are provided; one is to RAISE the tone arm and lower it, the second is for FORWARD SKIP and the third's for BACK SKIP, moving the tone arm by one track. Last, but not least, is the START/CUT control which is self explanatory.

Linear tracking

The conventional tone arm moves across the record in an arc of a circle so that the path of the stylus is as shown. When a record is being cut, however, the cutting arm moves inwards along a radius towards the centre of the record. Thus the cutting path is a straight line unlike the arc of the replaying stylus.

This leads to the important point that the direction of the motion of the recording head, relative to the record surface, is a tangent to the recording groove at all times. A conventional stylus cannot move at a tangent to the record groove at more than two places. At all other points there will be a small angle between the direction of relative movement and a tangent to the groove.

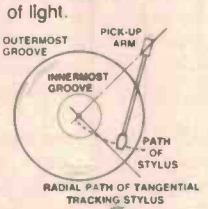
Many people feel that a stylus which follows the path of the cutting head across the disc as accurately as possible is likely to achieve a more faithful reproduction of exactly what is on the disc than a stylus which moves at an angle to the direction of movement of the cutting head.

In the linear tracking system the tone arm does not swing in an arc, but moves from right to left along a fixed bar at the back of the record. The stylus moves in a straight line along a radius of the record so that tangential tracking is achieved at all points.

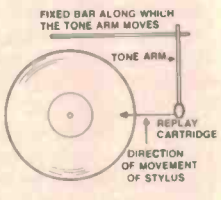
One of the major disadvantages of linear tracking systems is that the arm must be moved across the record surface by some type of motor drive system. This requires very careful design of the tone arm motor, if satisfactory performance is to be obtained.

Most manufacturers employ an optical feedback system to control the tone arm motor. In the normal or equillbrium position a beam of light from a lamp is blocked off by a shutter of the tone arm so that it cannot reach a photoresistive cell.

If the record now rotates so that the stylus is closer to the centre of the record, the position of the tone arm will be changed by a small amount so that the shutter no longer prevents the beam of light from reaching the photoconductive cell. The current through this cell activates the tone arm motor which moves the arm inwards towards the centre of the record until the shutter again blocks the beam of light.



A conventional tracking system.



A linear tracking system.

A successful optical system of this type must be extremey accurate, since the record grooves are very small and close together. The tone arm motor system must also be carefully designed to prevent 'hunting' in which excessive or inadequate movement of the tone arm takes place and the system hunts for the correct position.

Linear tracking systems generally provide tracking angles to within a few tenths of a degree of the desired angle, whereas conventional systems may have angles of up to a few degrees at some point on the record.

But what is the practical effect? Tracking error angles tend to introduce second harmonic distortion which, while obviously undesirable, is not nearly so objectionable as third harmonic distortion. There seems to be some controversy as to exactly how much distortion is introduced by such tracking angle errors.

The pickup arm of a conventional system will tend to 'skate' towards the centre of a record unless the correct amount of bias compensation is applied. If no bias or an incorrect bias is applied, the inner groove is likely to receive more force from the stylus; this will result in signals of an unequal amplitude in the two channels and is likely to cause the inner groove to wear at an increased rate.

These problems are said not to arise in linear tracking systems, whereas in conventional systems the application of bias is only a compromise; the required bias varies with the position of the tone arm on the record and with the modulation levels.

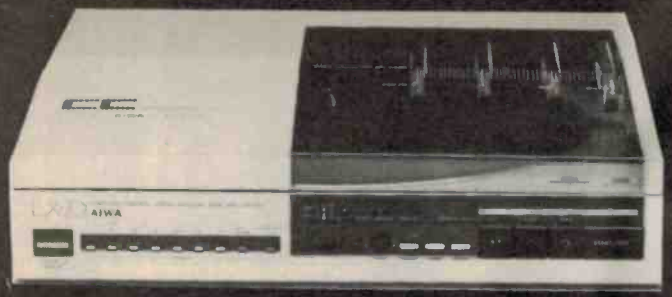
In a tangential tracking system the effective arm length can be relatively short and the equivalent mass low even if strong materials are used to obtain a highly rigid arm. This can bring the advantages of minimum vibrational levels and small resonance patterns, and hence cleaner reproduction.

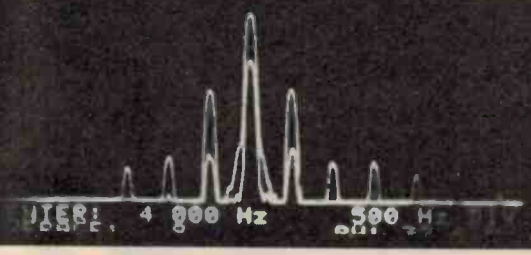
In spite of their important advantages, linear tracking turntables must be very carefully designed if they are to be better than conventional systems. The intending purchaser would be well advised to try any linear tracking equipment very thoroughly before making a commitment to purchase.

Make and Model	Recom. Retail Price	Dimensions W x H x D mm	Weight kg	Speed Accuracy %	% Range	Wow %	Flutter Weighted RMS	Rumble dB	Tone Arm Resonance	Rise Rating
AIWA LX-70	$465 (w/o cartridge)	330 x 88 x 330	5.2		±4.8	0.14	0.04	−60	15 Hz	8 dB
Revox B791	$1100 (w/o cartridge)	449 x 142 x 395	9.1	0.01	±9.9	0.06	0.03	−61	9 Hz	9 dB
Sony SP-X800	$1269 (w/o cartridge)	440 x 120 x 445	11.6	0.01	*	0.16	0.036	−62	12 Hz	1.5 dB
Technics SL-5	$359 (with cartridge)	315 x 88 x 315	4.4	0.34	*	0.02	0.02	−61	13 Hz	9 dB
Toshiba SR-L7F	$299 (with cartridge)	420 x 110 x 339	5.8	0.05	*	0.16	0.05	−64	14 Hz	7 dB
Yamaha PX-3	$999 (w/o cartridge)	469 x 149 x 428	12.0	0.01	*	0.02	0.015	−62	7 Hz	10 dB

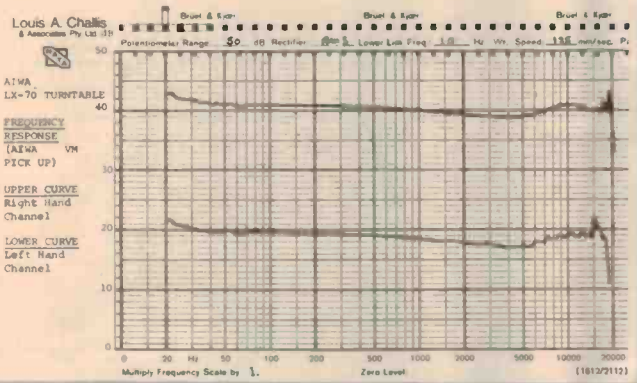
* no adjustment

AIWA LX-70



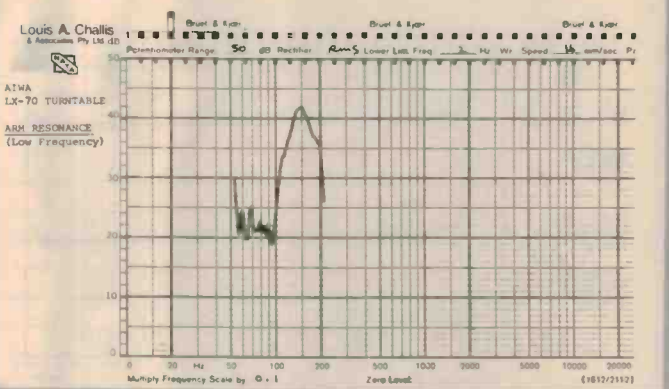


WOW AND FLUTTER	
Wow	0.12% peak to peak
Flutter	0.04% weighted R.M.S.
	0.06% unweighted R.M.S.
RUMBLE (Re 5.42 cm/sec)	-60.0 dB weighted (Band Pass)
SENSITIVITY	Right Channel 0.86 mV/cm/sec
	Left Channel 0.82 mV/cm/sec



Distortion components of test record and cartridge. At tracked velocities of 15 and 19 cm/s at a pressure of 1.25 g; 10 dB/div; 20 dBV full scale.

FREQUENCY RESPONSES	20Hz-20kHz (See curves)
SPEED ACCURACY	Strobe Adjustable
SPEED RANGE	33 1/3 and 45RPM ± 4.8%
TONE ARM RESONANCE	15 Hz (see graph) peak + 8 dB
TRACKABILITY	(Using Shure Disc TTR 103 400 and 4000 Hz)



On the forward front edge of the console, inside the lid, are two controls; the tone arm sensor sensitivity control enables the electronics to be optimally adjusted to cope with various record configurations and surface reflectivities.

This control is essential as the record sensor operates on an optical system to detect the presence or absence of grooves. The illumination effect can vary dramatically, depending on the choice of record moulding material. The 33/45 speed control also functions as an auto/manual switch when the 45 rpm position is selected.

The tone arm has a toy-like appearance and uses an extremely lightweight, plastic mounting. On its underside, immediately behind the fixed cartridge headshell, are a pair of protuberances. One of these incorporates a photoelectric emitter and the other is a matching optical detector. These cleverly sense the lead-in groove as well as the gaps between tracks required for both programme selection and the skip function.

Inside the cabinet at the rear of the unit is a small and cleverly designed motor-driven slide assembly. This runs on two tubular slides and supports the lightweight, plastic tone arm on a solid structure with full diecast gymbal assembly. This slide incorporates the miniature drive motors and electronic optical sensors to provide the parallel tracking function by detecting offset angle between the tone arm and the basic reference.

The most significant difference between this unit and the more expensive units is unquestionably the differences in tone arm and parallel slide design. In this unit they have apparently been designed with size and price, not performance, as the most important parameters.

The unit is, however, innovative and exciting as it contains a host of clever features by which a reasonable performance and some unusual, technical refinements are still achieved. The motor turntable is relatively light, featuring a precision diecast moulding with a total weight of less than one kilogram. With a unit as small as this, a greater platter weight would not really be possible.

Cartridge Type	Cartridge Rating	Overall Rating
VM Moving Coil	..	...
Shure TXE-SR Moving Coil	....	....
Sony XL30 Moving Coil	....	....
Technics P24 Moving Coil	...	...
Toshiba C-68M Moving Coil	..	...
Yamaha MC2000 Moving Coil	....	....

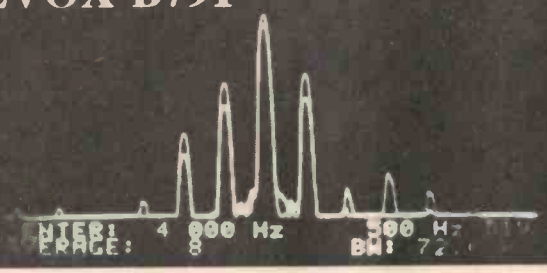
The objective testing of the unit revealed a frequency response that is reasonably flat over the frequency range of 20 Hz to 20 kHz, but not quite in the same class as some of the other units that we evaluated. The measured 'wow' is surprisingly good and the 'flutter' is quite acceptable. The measured weighted rumble was −60 dB which is quite good and so the more conventional parameters of the unit are generally acceptable.

The tone arm resonance is relatively high at 15 Hz and it exhibits a resonance curve which is reasonably sharp in terms of its bandpass characteristics. More significantly, the tone arm does not provide facilities for pressure adjustment and was measured with a tracking force of approximately two grams. The cartridge and arm will only track effectively to 19 cm per second on the Shure TTR103 test record and thus could be expected to mistrack on many high velocity sections in some of the most difficult tracks of modern recordings.

However, this unit is better than many other moderately priced conventional record players and features a range of operational attributes which are technically exciting in those situations where space and/or weight are limited.

In the subjective testing the voices on 'La Traviata' came through exceptionally well. However, the transients produced by the music in 'The Planets' was just a little too tough for the trackability of the cartridge. ▶

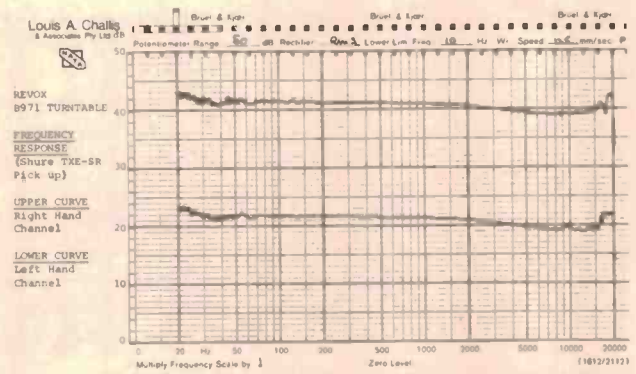
REVOX B791

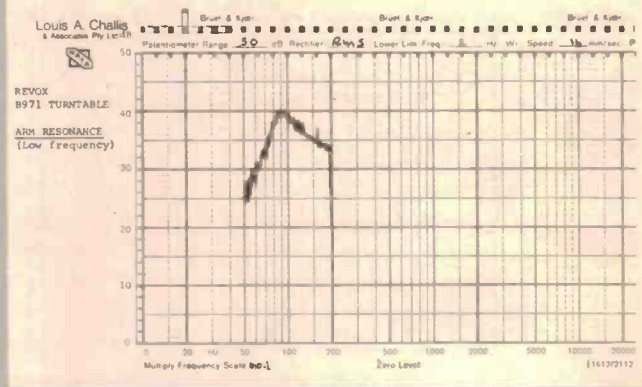


Distortion components of test record and cartridge. At tracked velocities of 19 and 24 cm/s at a pressure of 1.25 g; 10 dB/div; 20 dBV full scale.

FREQUENCY RESPONSES	20Hz-20kHz	(See curves)
SPEED ACCURACY		0.01%
SPEED RANGE	33 1/3 and 45RPM	±9.9%
TONE ARM RESONANCE	9.0 Hz (see graph) peak +9 dB	
TRACKABILITY	(Using Shure Disc TTR 103 400 and 4000 Hz)	

WOW AND FLUTTER	
Wow	0.06% peak to peak
Flutter	0.03% weighted R.M.S.
	0.04% unweighted R.M.S.
RUMBLE	-61 dB weighted (Band Pass)
(Re 5.42 cm/sec)	
SENSITIVITY	Right Channel 0.94 mV/cm/sec
	Left Channel 1.07 mV/cm/sec





Revox B791

The Revox B791 direct drive turntable is a completely different unit from the AIWA LX-70. It features a quartz-referenced, direct drive turntable incorporated in a relatively large enclosure with a very high, clear, hinged dust cover. This is required to provide clearance over the unusual linear tracking drive system.

The base of the unit is solid and heavy; the system exudes a solid, expensive feeling which the AIWA unit does not impart. The front of the unit incorporates a sloping fascia with three switches and bezels on the left and three on the right. Two speed control buttons at the centre flanking a digital display are for record speed and percent deviation.

The three switches on the left are the power ON/OFF switch and the other two are for selecting 33 rpm or 45 rpm. The three switches on the right are for cueing, forward and reverse, and raising and lowering the cartridge assembly.

In the centre, the two slides on either side of the bezel allow you to adjust the record speed precisely up or down (by ±9.9%) and shows the exact speed deviation in percent relative to the 33.33 or 45 rpm speeds. These features are, however, far less important than the linear tracking mechanism and its associated features.

Unlike all of the other systems reviewed this assembly pivots on the outer edge, therefore the cartridge assembly does not require a conventional tone arm. The tone arm is a relatively small assembly with which the designers could theoretically achieve any performance and resonance that they may desire. It is interesting that they have chosen to use a special cartridge assembly, designed specifically for this application by Shure Brothers of the USA.

Although the controls are generally simpler than those offered by the other linear tracking turntables, the electronics is still complex. Underneath the turntable cover is a large printed circuit board containing the complex electronic motor and turntable drive systems. This has been designed to provide very precise speed and drive characteristics; the pc board incorporates 31 integrated circuits, 26 transistors and numerous diodes, rectifiers and display units.

The turntable has a mass of 2.1 kg and achieves excellent wow figures of 0.06% and a good weighted flutter of 0.03%. The rumble is low at −61 dB and the general turntable characteristics are excellent.

It is undoubtedly the tone arm characteristics of this particular unit that are its forté. By discarding the conventional tone arm assembly, the designers have been able to fully optimise the dynamic characteristics of the cartridge assembly which feature a 9 Hz tone arm resonance and an unusually broadband 'Q'.

The breadth of this resonance characteristic is substantially assisted by the use of the brush assembly in front of the cartridge. This also further assists the user by removing some of the dust.

The cartridge appears to be a special version of the V15-IV and this provides a smooth frequency response which is essentially ±2 dB from 20 Hz to beyond 20 kHz.

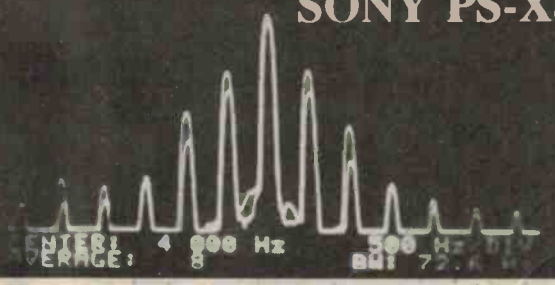
The Bruel & Kjaer test record which we used for this phase of the testing is not flat at the top end of the range and thus the results are substantially better than indicated on the level recordings.

The cartridge provides good trackability at recorded velocities of up to 24 cm/s, but fails to track perfectly at the highest level on the Shure TTR103 test record.

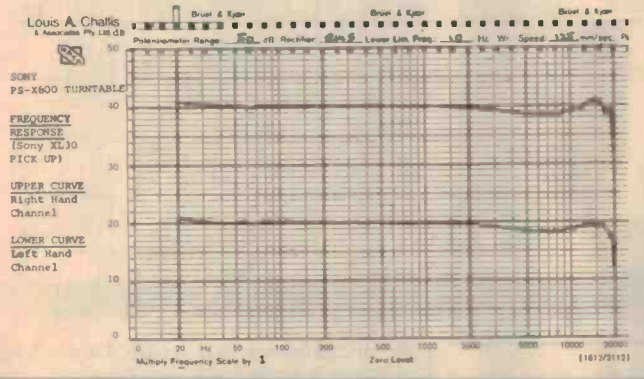
The subjective performance on both the 'La Traviata' record and 'The Planets' record proved to be outstanding and I believe that most listeners would be just as inpressed as I was.

The overall performance of the Revox B971 is excellent, although not markedly superior to the best conventional, pivoting tone arm record playing system.

SONY PS-X800

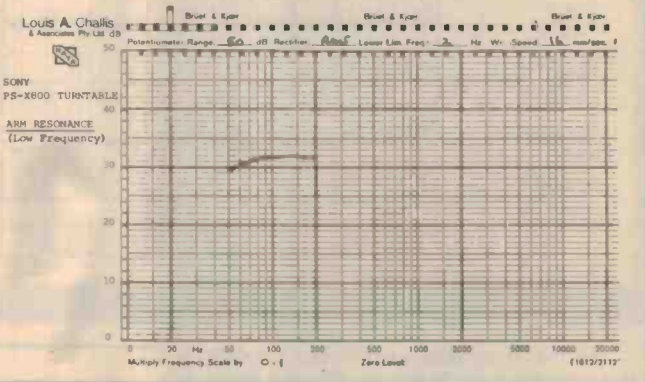


WOW AND FLUTTER	
Wow	0.16% peak to peak
Flutter	0.036% weighted R.M.S.
	0.057% unweighted R.M.S.
RUMBLE (Re 5.42 cm/sec)	-62 dB weighted (Band Pass)
SENSITIVITY	Right Channel 1.27 mV/cm/sec
	Left Channel 1.25 mV/cm/sec



Distortion components of test record and cartridge. At tracked velocities of 24 and 30 cm/s at a pressure of 2 g; 10 dB/div; 20 dBV full scale.

FREQUENCY RESPONSES	20Hz-20kHz	(See curves)
SPEED ACCURACY	Better than	0.01%
SPEED RANGE	33 1/3 and 45RPM	Not adjustable
TONE ARM RESONANCE	12 Hz (see graph)	peak + 1.5 dB
TRACKABILITY	(Using Shure Disc TTR 103 400 and 4000 Hz)	



Sony PS-X800

The Sony PS-X800 is a very attractive, if somewhat heavy, unit. The appearance of this unit is very different from the first two units in that it features a very large turntable with a heavy, diecast cabinet base and a high upturn at the rear. The high upturn incorporates the unusual parallel tracking tone arm assembly.

The clear plastic cover hinges from the top edge of this upturn and in the well-travelled unit that we received, the lid would stay up only at its uppermost position.

The controls located across the front of the unit consist of a power ON/OFF switch on the left-hand side and the arm transport controls of RAISE/LOWER, FORWARD and REVERSE and a FAST transport control in the middle. This design approach for the controls is sensible as it allows very fine adjustment or, alternatively, by pressing two of the controls, rapid transport at will.

On the right-hand side of the panel is a small inset fascia through which the words LOCKED or the speed, 33 or 45, is displayed. This panel is not particularly well illuminated. You have to be standing directly over the unit, in subdued lighting, to determine whether the speed is locked and to read what the speed is. On the right-hand side of this fascia is a small button which changes the turntable speed and beside this a REPEAT button by which the full record sequence may be recycled.

On the extreme right-hand side is a green START/STOP switch which, when activated, illuminates a bezel and raises the tone arm from its rest position, traverses it across to the turntable and lowers it onto the record.

The tone arm, labelled a 'Biotracer auto zero balance', allows for stylus forces in the range 0.5-3 gm by means of a control knob placed near the front of the turntable.

The tone arm runs on a single, polished stainless steel rod located at the rear of the unit. The arm and its assembly are relatively short and squat. It is a sqare section arm with a universal headshell coupling at its end. The unit was fitted with an XL30 moving coil cartridge which gives a very smooth frequency response; effectively ±1 dB from 20 Hz to 17 kHz and only 3 dB down at 20 kHz. the cartridge tracked well at 30 cm per second on the Shure TTR103 test record and it provided a performance which was generally better than the majority of the other cartridges reviewed.

Unlike the other arms, this unit's tone arm resonance is low and relatively flat right across the full range of frequencies from 5 Hz to 20 Hz. How they achieve this I don't know, but the results are quitre satisfactory. The turntable has a slightly high figure for wow of 0.16%, and an acceptable flutter of 0.036%.

These figures are most probably lower in a new unit as the unit we received appeared to have been 'kicking around the world' before it got to us, and showed many signs of general abuse. The measured rumble was low at −62 dB and the main objective tests of the unit were excellent.

The turntable rests on four large well-designed pneumatic and rubber shock mounts which seem to work better than those installed on any of the other units.

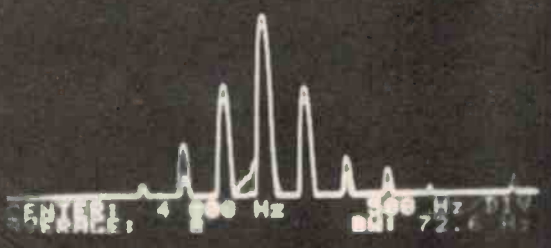
'The Planets' played very well and came through the test with flying colours. However, the residual record warp in the 'La Traviata' record seemed to worry the tone arm assembly which did not track this particular redord as well as most of the other linear tracking turntables. The performance on less warped records was excellent. Provided the records are not badly warped this unit will perform very well.

Technics SL-5

The Technics SL-5 direct drive automatic turntable is an extremely neat unit with avant garde design features which will endear itself to many users. This is a small unit, even smaller than the AIWA LX-70.

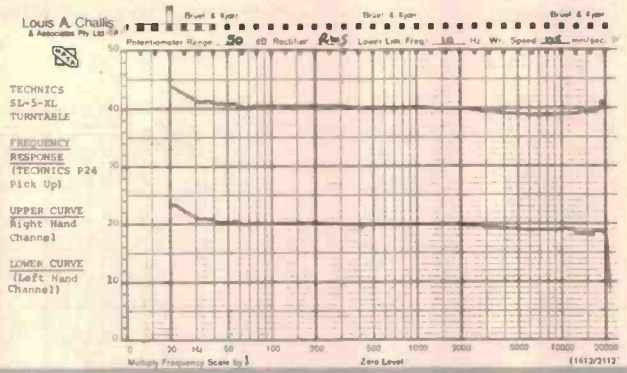
In typical Japanese fashion, this unit is 'something yet again' when compared to any of the other units. It is a more economical unit, based on the design principles developed to such a high degree in the much more expensive SL-10 linear tracking turntable. ▶

TECHNICS SL-5

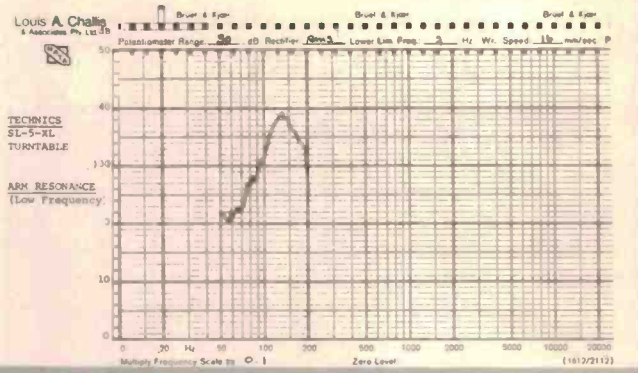


Distortion components of test record and cartridge. At tracked velocities of 15 and 19 cm/s at a pressure of 1.5 g; 10 dB/div; 20 dBV scale.

FREQUENCY RESPONSES	20Hz-20kHz	(See curves
SPEED ACCURACY		0.34%
SPEED RANGE		33 1/3 and 45RPM Not adjustable
TONE ARM RESONANCE		13 Hz (see graph) peak + 9 dB
TRACKABILITY	(Using Shure Disc TTR 103 400 and 4000 Hz)	



WOW AND FLUTTER	
Wow	0.02% peak to peak
Flutter	0.02% weighted R.M.S.
	0.035% unweighted R.M.S.
RUMBLE	-61 dB weighted (Band Pass)
(Re 5.42 cm/sec)	
SENSITIVITY	Right Channel 0.83 mV/cm/sec
	Left Channel 0.87 mV/cm/sec



The first thing that catches your eye with this particular unit is the way that the linear tracking mechanism, together with tone arm assembly and cartridge are all attached to the lid of the unit. When the lid hinges up they hinge up with it, achieving what must be one of the smallest and neatest designs of record players (irrespective of type) on the market.

The dimensions of the unit are so small (315 mm x 315 mm x 88 mm) that one must be impressed by the ingenuity of the designers who have put so much into such a small package.

The lid of the unit, unlike the AIWA, is clear right across its front and incorporates a calibrated scale on its rear edge. The tone arm incorporates an illuminated bezel so as to clearly indicate the position of the cartridge, even though you may be unable to see the cartridge below.

The controls are placed on the front edge of the front panel; an ON/OFF switch is on the extreme right-hand side, a small REPEAT button is near the centre, a cueing control switch is adjacent and two large buttons are for START and inward movement, and STOP and outward movement on the right-hand side of the panel. These controls are sensible and ergonomically well conceived.

The other controls are a single three-position switch inside the cover by which the 33 or 45 speeds are selected. There is also a stylus pressure control within the lid of the unit which allows for forces of 1, 1.25 and 1.5 gram.

The rear of the unit features a pair of coaxial sockets so that the signal lead may be disconnected and replaced by a longer or shorter pair of leads as required, a feature that some of the other manufacturers would do well to emulate.

The cartridge is one of the new "P" mount units (plug-in) and can be replaced by units from other manufacturers. These include Audio Technica, Shure, Ortofon and others who have cartridges available for this particular headshell configuration.

The wow on this unit is acceptable at 0.022% and the flutter is relatively low at 0.02%. The rumble is reasonably good at −61 dB while the tone arm resonance is only a trifle high at 13 Hz. The tone arm resonance 'Q' is moderately sharp but quite acceptable. The frequency response of the cartridge is excellent and a credit to the designers as it is ±1 dB from 30 Hz to 20 kHz, with a 3 dB rise at 20 Hz.

Regrettably, the cartridge trackability only allows it to track satisfactorily at velocities up to 19 cm per second. This robs it of the ability to faithfully track the best and most difficult of modern records which have velocities three times higher than these figures.

Ergonomically, the Technics SL-5 must be one of the neatest, smallest and most attractive record players available anywhere. It is only because of poor cartridge trackability that it cannot be classified as a true all-rounder.

The subjective evaluation of the SL-5 exhibited an excellent performance with 'La Traviata'. However, it failed to achieve a superlative performance with 'The Planets' as the highest velocities on this record caused the cartridge to audibly mistrack.

AIWA LX-70
Manufacturer: AIWA in Japan
Distributor: AIWA (Aust) Pty Ltd, 14 Gertrude St, Arncliffe NSW 2205. (02)597-2388.

REVOX B791
Manufacturer: Studer Revox, Regesdorf, Switzerland
Distributor: Syntec International, 53 Victoria Ave, Chatswood NSW 2067. (02)406-4700.

SONY PS-X800
Manufacturer: Hi-fi audio division of Sony Corp. in Japan
Distributor: Sony, 33 Talavera Rd, North Ryde NSW 2113. (02)887-6666.

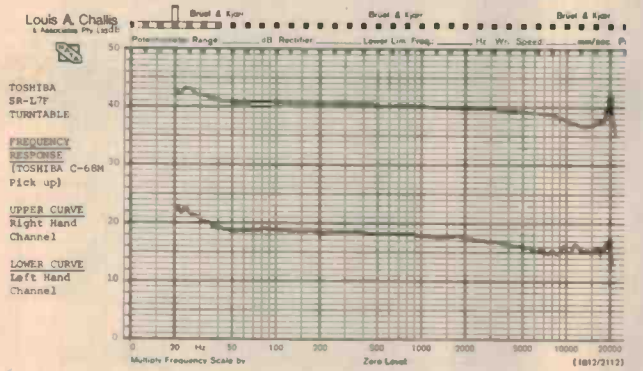
TECHNICS SL-5
Manufacturer: Matsushita Electric Trading Co, Osaka, Japan
Distributor: National Panasonic (Aust) Pty Ltd, 95 Epping Rd, North Ryde NSW 2113. (02)887-5333.

TOSHIBA SR-L7F
Manufacturer: Toshiba Corp, Tokyo, Japan
Distributor: Toshiba (Aust) Pty Ltd, Cnr Talavera and Alma Rds, North Ryde NSW 2113. (03)887-3322.

YAMAHA PX-3
Manufacturer: Yamaha Nippon Gakki Co Ltd, Hamamatsu, Japan
Distributor: Rose Music, 28 Kent St, Belmore NSW 2142. (02)750-8999.

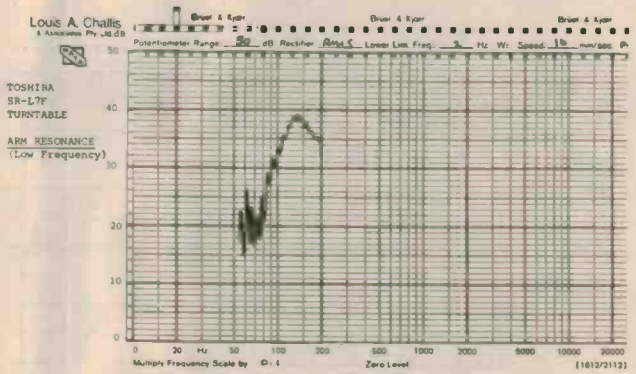
TOSHIBA SR-L7F

WOW AND FLUTTER	
Wow	0.16% peak to peak
Flutter	0.05% weighted R.M.S.
	0.07% unweighted R.M.S.
RUMBLE	-64 dB weighted (Band Pass)
(Re 5.42 cm/sec)	
SENSITIVITY	Right Channel 0.81 mV/cm/sec
	Left Channel 0.80 mV/cm/sec



Distortion components of test record and cartridge. At tracked velocities of 15 and 19 cm/s at a pressure of 2 g; 10 dB/div; 20 dBV full scale.

FREQUENCY RESPONSES	20Hz-20kHz	(See curves)
SPEED ACCURACY		-0.05%
SPEED RANGE		33 1/2 and 45RPM Not adjustable
TONE ARM RESONANCE		14 Hz (see graph) peak +7 dB
TRACKABILITY		(Using Shure Disc TTR 103 400 and 4000 Hz)



Toshiba SR-L7F

The Toshiba SR-L7F is another particularly good example of a fully automated linear tracking turntable. It is a trifle larger than either the AIWA LX-70 or the Technics SL-5, bit it resembles both of these units because of the materials from which the plastic cabinet has been moulded.

The lid has a different two-tiered shape which, instead of covering the whole of the plinth, is split five-sevenths of the way across the front. This provides a fixed plinth where the main controls and displays are located. The lid is emblazoned at the front with the letters L7F and is similar to the AIWA player as it incorporates a clear section through which the tone arm may be viewed. This clear section is carried through into the fixed sloping section which contains bezel lights to indicate the selection of the repeat function and also indicates the speed selected.

On the fixed sloping edge on the right-hand side of the unit there are six large rectangular touch buttons. The upper pair are for 33/45 rpm speed selection and REPEAT which allows the entire record to be replayed. The central pair provide the FORWARD and REVERSE cueing functions while the front pair provide START/STOP and CUEING of the tone arm. The only other control is a push-on STAND BY switch located on the very front edge of the plinth.

The turntable automatically detects the size of the records by means of a very simple but effective mechanical switch and consequently sets the rotational speed accordingly. If the automatic selection function happens to be incorrect then all you have to do is touch the speed selector switch to correct the mistake.

Under the plastic cover, which tilts up clear to the plinth, there is a simple tubular tone arm with a universal headshell assembly. This will accept a wide range of moving coil or moving magnet cartridges. The cartridge supplied is a Toshiba C-68M which is a normal issue with the turntable, however, it fails to optimise the dynamic characteristics or achieve the full performance that the turntable is capable of providing.

The arm and cartridge are attached by means of a rugged, precision assembly incorporating a photoelectric detection system to determine the carriage advance requirements. This part of the system, as we observed with most of the units evaluated, is very effective; it certainly avoids most of the problems which plague the conventional pivoting tone arm.

The short tone arm in this unit has a resonant frequency which is a little high at 14 Hz; it would probably perform better with a slightly heavier cartridge. The tone arm resonance is moderately sharp with an acceptable 7 dB rise in response at the peak frequency.

The turntable is a well machined diecasting, without user adjustment provided for the rotational speeds which were low by −0.5%. The turntable drive system is achieved by use of a direct drive using a dc servo motor with adequate torque; this produces a moderately high level of wow at 0.16% and a reasonable flutter performance of 0.05% (RMS weighted).

The unit has a rumble figure of −64 dB which is very good and lower than any of the other units.

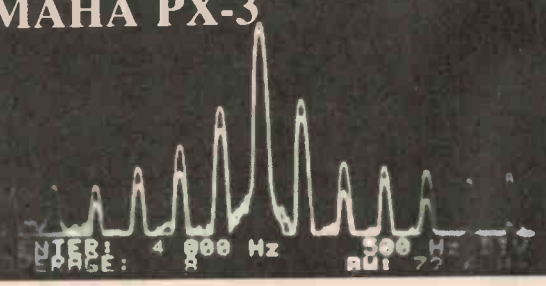
The moving magnet cartridge type C-68M does not achieve a very good frequency linearity performance as its response is +3 dB high at 20 Hz, ±1 dB from 30 Hz to 8 kHz and −3 dB from approximately 10 kHz to over 18 kHz. This frequency response differs substantially between left and right channels and indicates that either the parellel tracking is not as precise as it should be or that the frictional drag on the slide mechanism is too high.

It is significant that the cartridge does not track particularly well and will only track to 19 cm/s (the third highest velocity) on the Shure TTR103 test records. This is a shame as most of the other parameters are reasonably good and this desultory performance by the cartridge detracts from what would otherwise be a reasonable performance.

Mechanically the Toshiba unit is solid and reliable. It is a joy to use but the cartridge performance detracts from the sparkling sound that this unit should be offering.

During the subject evaluation with 'La Traviata' the performance was outstanding. However, with the highest velocities on 'The Planets', which most certainly exceed 40 cm/s, it failed to track faithfully. ▶

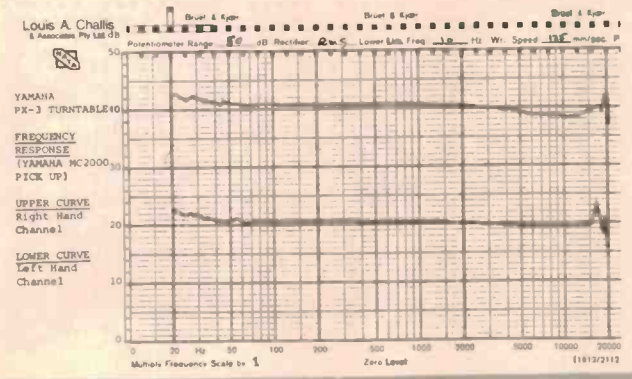
YAMAHA PX-3

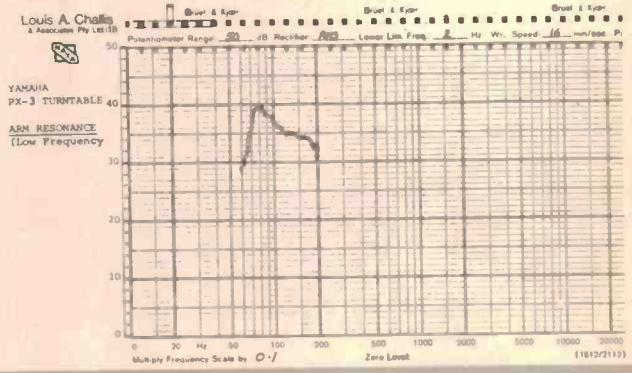


Distortion components of test record and cartridge. At tracked velocities of 19 and 24 cm/s at a pressure of 1 g; 10 dB/div; 50 dBV full scale.

FREQUENCY RESPONSES	20Hz-20kHz	(See curves)
SPEED ACCURACY		+0.01%
SPEED RANGE	33 1/3 and 45RPM Not Adjustable	
TONE ARM RESONANCE	8.0 Hz (see graph) peak + 10 dB	
TRACKABILITY	(Using Shure Disc TTR 103 400 and 4000 Hz)	

WOW AND FLUTTER	
Wow	0.02% peak to peak
Flutter	0.015% weighted R.M.S.
	0.02% unweighted R.M.S.
RUMBLE	-62 dB weighted (Band Pass)
(Re 5.42 cm/sec)	
SENSITIVITY	Right Channel 0.033 mV/cm/sec
	Left Channel 0.035 mV/cm/sec





Yamaha PX-3

The Yamaha PX-3 is the largest of the six units reviewed. This seems to typify one of Yamaha's design philosophies, designing units which are dramatically different to those of their competitors.

The first thing that strikes you about this unit is the unusual shape of the clear acrylic lid. Instead of being rectangular and angular, as are most of the other units on the market, the lid of this unit follows the circular contour of the turntable over one section and incorporates a sloped angular profile over the rest of the front. Surprisingly, the cover incorporates a rectangular notched profile to clear the elevated platform at the rear of the plinth.

The visual impression that this creates is of an expensive and complex form designed to cover the critical sections of the record player. This also frees the controls from the restriction created by the clear dust cover.

The turntable is extremely heavy with a weight of 12 kg, even outdoing the Sony which weighed in at 11.6 kg. Its major attributes include the very clear and large controls on the leading edge of the plinth. On the left-hand side is a power ON/OFF switch and a record speed selector switch; this illuminates on one side or the other to indicate the selected speed. These LED speed indicators are matched on the right-hand side by an illuminated bezel to indicate that the speed has been 'locked' by the crystal-controlled circuitry.

The turntable itself features a 1.6 kg diecast turntable which is driven by a quartz, phase-locked loop, servo, direct drive system incorporating a four-phase, eight-pole, coreless dc Hall-effect motor. This is a pretty effective drive system and it achieves an excellent wow of 0.02% and an even better flutter of 0.015%. The rumble is −62 dB and so this turntable is right up with the best of the turntables available on the market.

It is the tone arm design and presentation which is the 'piece de resistance'. This must be one of the most technically advanced tone arm support and drive systems available anywhere. The way Yamaha have executed it is unquestionably one of the most complex and advanced that I have seen.

Yamaha's approach to this involves a massive slide assembly with a large and complex machined structure. This incorporates a photoelectric tracking error sensing system by which the servo drive system detects tracking error angles created by the pivoting of the tone arm. These forces are created as a result of forces exerted by the two side walls of the 'V' groove in which the stylus is tracking. The net tracking error achieved by this system is claimed to be less than 0.15° and the tone arm smoothly and effectively traverses any record, provided the record is not damaged.

The tone arm itself features a relatively short tubular structure with a tone arm resonance which we measured at 8 Hz, although the literature indicates that this should have been at 12 Hz. The difference between our measurement and theirs must be attributed to an incorrect adjustment of either the counter weights or headshell weight and I believe I may have misinterpreted the instructions in the handbook.

The cartridge provides a very smooth frequency response which is ±2 dB on one channel and ±1 dB on the other channel. The cartridge supplied with the unit was a Yamaha MC2000 moving coil cartridge which the manufacturer's literature claims has the lowest equivalent mass of any cartridge in the world. The weight was claimed to be 0.059 mg which is intended to convey the concept that the unit provides superior trackability. Our testing did not fully substantiate this claim as the cartridge did not perfectly track the highest level on the Shure TTR103 test record.

The cartridge uses a 30 μm seven-strand wire for its cantilever suspension and two types of rubber dampers for variable damping of the cartridge assembly.

The subjective testing of the unit with 'La Traviata' and 'The Planets' revealed a particularly smooth performance which indicated that it was better than the objective test measurements showed.

Like the Sony model, this unit features gold plated leads and exemplifies the advanced engineering approaches that need to be applied to linear tracking turntables; optimum performance is based on the design criteria.

Conclusion

The subjective evaluation of the six record players was an extremely difficult task. The smallest units, the AIWA LX-70, Technics SL-5 and the Toshiba SR-L7F, were in many respects the neatest to use. However, they each suffered from the choice of cartridge in which the low level of trackability impaired their ability to provide the highest performance which most purchasers would be looking for in a linear tracking turntable. Notwithstanding, these three units shine in terms of their compact size, and their cartridge performance disabilities are partially compensated for by user convenience and ergonomic design.

Each of these three units exemplify some of the best features of Japanese innovative design, albeit in slightly different directions. The AIWA LX-70 provides some of the best features of the CD player for those people who are attracted by the advantages of a record player in which you can select the track you want to play. The design of the tone arm limits the dynamic performance and, in particular, trackability and in this unit a better cartridge would not necessarily enhance the quality of reproduction.

By contrast, the Technics SL-5 is the best unit of the six when it comes to avoiding the scratching of your records, as when you lift the lid you also lift the tone arm. The price of this unit is also attractive and it can be easily improved by choosing a better cartridge than that supplied.

The Toshiba SR-L7F is sensibly designed for shelf mounting and provides a striking appearance, excellent ergonomic design and reasonable technical performance. The tracking and trackability of this unit can also be readily enhanced by a better cartridge which would undoubtedly provide a much more exciting result.

The Revox B791 is a particularly large unit; its ergonomic features combined with cartridge trackability make it extremely attractive. Although the controls are simple their major attribute is their 'user friendly' layout, which is superior to that offered by all the other units. This particular unit tracks warped records better than any of the other units and consequently makes it a delight to use with old and badly warped records.

The Sony PS-X800 is an impressive record player and on good or above average records performs admirably well. It failed to perform well on a badly warped record as the vertical dynamics of the tone arm are inferior to the horizontal dynamics. Consequently, the Sony player does not provide perfect tracking on badly warped records. However, I must admit that the test record that I use specifically for warp tests is one that very few self respecting buffs would keep in their collection; it falls outside the limit that most people would regard as acceptable (thus its use for this specific test). The trackability of the Sony cartridge is, however, reasonably good and this record player is a well engineered and well executed piece of equipment.

The Yamaha PX-3 linear tracking turntable is an exciting piece of equipment, although its physical appearance is not as neat as some of the cheaper and smaller units. However, its technical performance is extremely good and it exemplifies the heights to which linear tracking turntables aspire. This particular unit tracks ordinary records very well, tracks warped records reasonably well and tracks difficult, high velocity content extremely well. It is very well engineered for what should be a long and trouble free life. It is also one of the most expensive of the units evaluated, so you tend to get what you pay for.

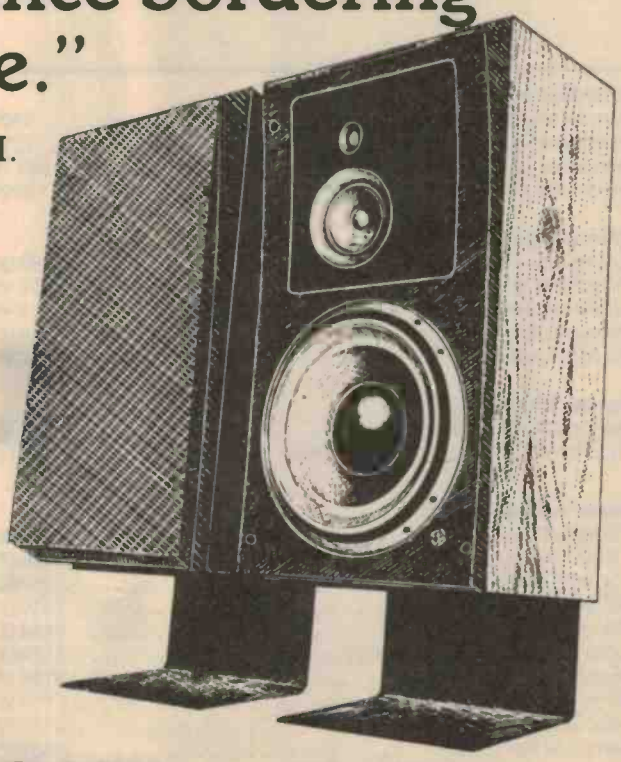
My overall impression of linear tracking turntables is that properly executed, they require complex engineering far outweighing the complexity of the best pivoting tone arms.

To achieve improvements in distortion and trackability requires superb engineering in the construction of their tone arm assemblies, for which the user must be prepared to pay. The cost of such engineering by and large outweighs the benefits when the final test results and improvements in performance are compared.

Finally, to make a linear tracking tone arm work the way it is intended to calls for skill and attention by the user which may not be achieved by simply following the manufacturer's instructions. With all our laboratory facilities we experienced problems and so it is reasonable to suppose that you might experience more. ●

"...offer a performance bordering on the superlative."

Louis Challis, ETI.



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Where to go for Spectravideo?

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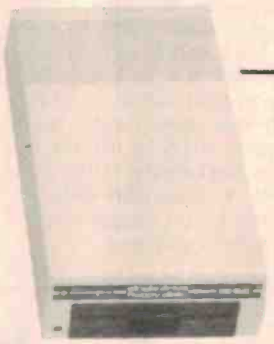
The remarkable Spectravideo SV318 is packed with features with a comprehensive range of state-of-the-art software available $499*

The Spectravideo SV328 is the computer for the small business that doesn't plan to stay that way.
It offers so many features and advantages we couldn't start to mention them. Come in for a demonstration. $799*



The Commodore 1541 Disk Drive. Uses standard 5¼ inch floppy disk and stores up to 170,000 characters of program or data information. Unit includes own microprocessor and memory system. $499*

The commodore 64 needs no introduction and are available ex-stock. $499*

Commodore stocks include:

Commodore 801 Printer	$399*
Commodore Printer/Plotter	$299*
Commodore Datasette	$49.75*
Commodore 1701 Colour Monitor	$499*

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Simons Basic	$80.00*
Hes Machine lang. Monitor	$59.95*
Ozi Sprite Generators (cassette)	$19.95*
Ozi Typing Tutor (cassette)	$19.95*
Ozi Typing Tutor (Disk)	$24.95*

Computer Education

Gortek and the microchips	$50.00*
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These are just a few of our most popular progrmmes for Commodore Come in soon and see the complete range. You still have until Nov 25th to enter Another Winning Spot Competition where you could win a Commodore 64. Entries available in store.

* All prices listed are recommended retail, including sales tax, which is exempt in some business purchases.

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IMAGOMAT 1092VC

COMPUTER SYSTEMS LEGALLY 'GOODS', RULES JUDGE

Buyers and sellers of computer systems will be affected by a judgment of major importance made by the Honourable Mr Justice Rogers in the Supreme Court recently.

Sales of computer systems comprising both hardware and software constitute 'sales of goods' within the NSW Sales of Goods Act (1923), and the Commonwealth Trade Practices Act (1974), ruled Mr Justice Rogers.

The judgement provides ammunition for dissatisfied users faced with suppliers disclaiming responsibility for a system's deficiencies. It should put an end to the practice of selling software (packaged with computers at least) before it is fully developed — and allowing early buyers to sort out the deficiencies. Such products must now be of 'merchandisable quality'.

The decision was part of an action brought by Toby Constructions Sales Pty Ltd versus Computer Bar Sales Pty Ltd.

Toby Constructions purchased a computer system which included Executive Five accounting, stock control, payroll, and (Wordstar) word processing software from the Ward Computer Company Pty Ltd — a company which the plaintiff also claims never existed.

It is claimed that the sale agreement included installation, maintenance, periodic updating, and staff training. The system is claimed to be deficient and the action is against three defendants in respect of losses alleged to have been suffered as a result.

Two of the three defendants sued failed to appear and judgement has been signed against them for want of defense — with damages to be assessed.

The third defendant is Kevin John Morrissey. Mr Morrissey is cited as acting for himself only, or as an agent for the first defendant, and/or the second defendant and the Ward Computer Company.

Counsel for Mr Morrissey claimed that the Deed of Sale did not provide for the sale of goods, but for work to be done, materials to be provided, and perhaps for the transfer of intellectual property. It was alternatively submitted that the agreement embodied in the deed was divisible and in so far as there was a sale of the software, and the claims concerned only the software, software not being 'goods', the legislation did not apply.

In his judgement dealing (solely) with part of the Amended Statement of Claim, Mr Justice Rogers said, "I come to the conclusion that a sale of a computer system, comprising both hardware and software does constitute a sale of goods within the meaning of both the Commonwealth Act and the State legislation. There is a sale of tangible chattels, a transfer of identifiable physical property . . ."

Mr Justice Rogers went on to note that "It may be a debatable question whether or not the sale of computer software by itself is sufficient to constitute a sale of goods within the meaning of the legislation I am considering. However, I have no doubt that the sale of a system in toto is within the legislation . . ."

Commenting upon whether software alone constituted 'goods', Mr Justice Rogers said, "I do not wish it to be thought that I am of the view that software by itself may not be 'goods' . . . the questions arising here are of considerable importance to the computer industry, and I think it is appropriate that those who attend to matters of law reform should consider whether or not legislative action is required to ensure the matter is put beyond argument."

The balance of the action was remitted to the District Court. Costs for the plaintiff were awarded against Mr Morrissey.

IBM PC TO BE MADE HERE

IBM Australia is expected to give a $100 million-plus boost to local hardware and software manufacturing over the next five years.

Planned projects include: the manufacture of the IBM Personal Computer at Wangaratta, Victoria for export to New Zealand and South-East Asia, sourcing Australian-made components for other IBM equipment in addition to the PC; establishment of a Software Development Support Centre (SDSC) in Sydney to promote Australian software and the transfer of production of PC software and documentation to Australia early next year.

The software centre will acquire software from local industry, encourage Australian software companies to develop products for marketing overseas and handle contracts awarded by the internal development division of the US parent company and other IBM subsidiaries to Australian software companies.

Mr Finn said, "IBM's plans for the SDSC fall in line with recent government encouragement of selected high technology industries. The largest of the sunrise industries clarified in the Espie report was the software industry."

In announcing the move, IBM Australia's managing director Mr Brian Finn predicted that the various projects would create more than 200 jobs over the next five years.

The manufacture of IBM PCs will begin at the Wangaratta plant by July 1984. The assembly of IBM Selectric typewriters at the plant will be phased out. The plant will become only the third in the world for manufacture of IBM PCs.

DICK THROWS DOWN CHALLENGE TO IBM

At a time when the top end of the personal computer market is somewhat saturated, it's a bold move to release yet another new model on to the Australian market.

Dick Smith Electronics has done just that with their latest entry to the computer stakes: the Dick Smith Challenger.

Dick Smith Electronics has been down a similar road a few years ago with the release of the System 80. That computer was made software compatible with the then acknowledged market leader, but sold for hundreds of dollars less.

The Dick Smith Challenger has been designed using exactly the same philosophy. A 16-bit machine, it is software compatible with all known programs for the IBM Personal Computer. IBM PC plug-in hardware is also compatible with the Dick Smith Challenger (even the keyboard).

The Dick Smith Challenger sells for less than half the price of a similarly configured IBM PC. A really usable IBM system costs around $7000 but the equivalent Challenger sells for $2990.

The expanded Challenger comes with over a thousand dollar's worth of business software included for no extra charge: famous Wordstar, Calcstar and mailmerge. They're the type of programs every business user needs (some may need not other software at all). The basic Challenger costs $995.

The Challenger is fully backed up by Dick Smith's technical and service centres. For further information, contact **Dick Smith Electronics. (02)888-3200.**

EPROM-BASED MICROBEE 'TOOLKIT'

Hobart electronics company, High-Tech Tasmania, has released a new Micobee software package in EPROM (Erasable Programmable Read-Only Memory). The 4K package containing eleven programs was written by Tom Moffat, a software author well known to Microbee users.

Although any of the programs can be called from BASIC, most of the package has been directed at machine code programmers. Included is a debugging routine that freezes a program in mid-run and displays the contents of all the Z80's registers.

There's also a memory dump facility that provides a hexidecimal listing of any memory area, to both the screen and a printer.

A program called "BASCON" provides on-screen conversions among the decimal, hexidecimal, and binary number bases, a task that's usually done from tables in a book.

The largest program in the package, occupying just under half the EPROM, is a disassembler that converts pure machine code into human-readable assembly language. It can also display the meaning of ASCII-coded data sections of a program.

The disassembler allows a user to study the workings of any machine language program, including the latest high-speed games.

And for the ultimate games study, a program called "SCRDMP" when called from within a program, provides an exact copy of the Microbee's screen to a C-ITOH printer, graphics and all.

For those who use the Microbee's editor/assembler as a word processor, there are some programs to make the task easier.

MANU sends control codes to a C-ITOH printer to set it up in manuscript format . . . big left margin, and double spacing.

WORDS provides a count of the words written into the EDASM's primary file. There's also a program to initialize the Microbee for use with a parallel printer. The Microbee does not do this itself except under BASIC.

Finally, three general use programs represent a "best of Tom Moffat" collection: The highly popular radioteletype decoding program, the facsimile "picture plucker" program, and the Microbee audio frequency counter.

The memory for the eleven programs, presented individually, would run to much more than 4K. The space saving is achieved by sharing subroutines among several programs. The package is available in a type 2532 EPROM for both the standard (2 MHz clock) Microbee, and the IC model (3.375 MHz clock). The cost, including postage and full instructions, is $50.00. Inquiries to **High-Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7101.**

PRO-LOG'S 32K RAM BUFFER

A 32K x 8 RAM buffer memory has been added to Pro-Log Australia's M980 and M910A PROM programmer control units. The Melbourne-based company has also announced that a 64K x 8 option will be offered when RAMS become available from memory-device vendors.

According to Pro-Log, the new option makes the M980 and M910A the only PROM programmers on the market to provide 32K memory support using CMOS battery-backed RAM devices.

Existing M980 and M910A control units with 8K x 8 or 16K x 8 RAM buffer memory configurations can be upgraded to the new 32K option.

In addition to PROM programmers, Pro-Log manufactures and markets microprocessor cards and systems based on the STD bass concept.

For more details, contact **Pro-Log Australia, 69 Canterbury Road, East Camberwell Vic. 3126. (03)836-3533.**

▲

QUME TERMINALS

Anderson Digital Equipment (ADE) is stocking a line of CRT terminals from Qume, a division of ITT.

Qume terminals boast such features as a menu set-up mode instead of DIP switches, a 25th status line, sculptured keys contoured to fit the fingers, high resolution 7 x 9 character format with descenders for superior readability and separate programmable function keys.

ADE also offers a complete set of line drawing characters so the user can create charts, graphs and forms.

The QVT 102 terminal combines simplicity with quality. This unit has all the standard Qume features in an 80-column 12" display.

The QVT 108 is a high power, low price terminal with 22 programmable function keys for power and flexibility. For further information, contact **ADE, 14 Whiteside Road, Clayton Vic. 3168. (03)544-3444.**

MEGS GINGERS UP BIRTHDAY CELEBRATIONS

Australia's oldest personal computer club — the Microcomputer Enthusiasts' Group of Sydney (MEGS) celebrates its 7th birthday in January.

Formed in 1977 the objective of the club was (and still is) to provide a meeting place where microcomputer enthusiasts and beginners can get together and discuss all sort of problems about hardware, software or whatever, and to pass information on to other members.

Members of MEGS include engineers, technicians, hardware and software experts, sales personnel and everyone from students to retired people having computers as a hobby.

MEGS is an 'all-systems' club with most types of computers being represented including Apple, Commodore, MicroBee and homebrew equipment.

MEGS has moved from its original meetings at the WIA Hall at St Leonards following sale of the building, and now meets in the hall at the rear of St Andrew's Presbyterian Church, 37 Anderson Street, Chatswood, on the third Monday of each month, commencing 7pm.

Club membership fees have been held at the 1977 level of $15 per year. MEGS also has a new mailing address; P.O. Box 1309. Chatswood NSW 2067.

For further information contact the **publicity officer Jim Hooke on (02)419-2568** or the president, **John Whitlock** on **(02)628-1142** between 7 and 9 pm, or by coming along to any meeting, preferably the next!

INVENTING THE STD BUS HAS GIVEN PRO-LOG A LOT TO ANSWER FOR...

And in the great Pro-Log tradition, they're practical, engineering-type answers.
STD Bus is for real-world projects like ☐ automation of manufacturing processes ☐ production control systems ☐ data acquisition ☐ microprocessor design and test equipment.

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STD Bus has become the standard throughout a wide variety of industries (including education) because it has proved to be: ☐ simple ☐ reliable ☐ flexible ☐ compact size ☐ highly modular ☐ inexpensive. Also because it has a well-defined Bus structure, and because it can be sourced from over 100 independent manufacturers from the USA, plus some excellent Australian manufacturers.

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SO WE'VE KEPT THE ANSWERS COMING!

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CHIP-8 LANGUAGE FOR THE MICROBEE

Dreamcards, the Melbourne-based software producer, expects to release the Chip-8 language in EPROM for the 16-32K Microbee before the end of the year.

Chip-8 is a language devised by RCA for its low-cost VIP computer systems and used in such machines as the VP-111 (from RCA), the US-produced ELF series and ETI's popular ETI-660 Learner's Micro.

It is a simple language, ideal for beginners, using a small set of 'mnemonic' style instructions that are easy to learn and use. A huge range of software has been produced for the machines available and a software column for the ETI-660 project has been running for two years in ETI.

Dreamcards' Chip-8 for the Microbee gives 'Bee owners instant access to another large software base for which many fascinating and exciting programs have been produced. (Just look back through the '660 Software columns in ETI!)

It comes in a 4K EPROM, containing an interpreter/coder which can be inserted in the 'Bee's Network ROM space. It can also be custom-loaded into other locations, if so desired. A detailed book on the Chip-8 language is included.

Dreamcards says the interpreter is fully compatible with earlier Chip-8 dialects. In addition, a number of extensions have been included, giving additional instructions which provide such things as full addressing capability over 64K, high-resolution graphics, standard alphanumeric characters (64 x 16), mixing of alphanumerics and hires with standard Chip-8 graphics, software sound-effects generator, joystick instructions, execution rate control (to speed up or slow down program execution), half-or full-tone cursor for standard graphics and a full-size screen display.

The interpreter is of the 'threaded' variety and is claimed to run four to five times faster than earlier Chip-8 dialects. The encoder/decoder converts the Chip-8 code to BASIC REM statements and back again. Chip-8 can be run from or mixed with BASIC to get the best of both languages.

Further details from **Dreamcards, 8 Highland Court, North Eltham Vic. 3095.**

HEAD-CLEANING KITS FOR DISK DRIVES

The Allsop 3 computer disk-drive head-cleaning kits are for 5¼" and 8' disk drives using ANSI compatible media diskettes.

The cleaning disk will remove deposits and negate static charge that can affect 'read' and 'write' functions, claims Allsop.

These kits can be used on single- or double-sided drives and contain two cleaning disks and a bottle of cleaning solution. Each disk can be used for 13 cleanings, providing up to 26 cleanings per kit.

Many computer owners don't realise that the drive heads should be cleaned regularly. It is recommended that drive heads should be cleaned every 40 operational hours, which implies that a heavily used drive would be cleaned once a week. Therefore, one Allsop kit will clean one drive for six months.

The cleaning process is based on the use of a porous, non-abrasive cleaning disk and a proprietary cleaning solution. The solution is applied to approximately 40% of the cleaning disk. As the disk rotates against the heads, the wet/dry cleaning process removes contaminants and buffs the surface of the heads.

These kits are recommended by major hardware manufacturers and it is claimed that the cleaning solution and the material used for the cleaning disk is completely safe in all drives.

More information about these drive-head cleaners can be obtained from **Allsop Fidelity Accessories, P.O. Box 246, Double Bay NSW 2028. (02)357-2022.**

SPHERE SET TO SPEAR TERMINAL MARKET

A new low-cost terminal, the Sphere CCT-100, for use with computer systems requiring an RS232C terminal, is available through Paris Radio Electronics.

Features include a low-glare 30 cm green phosphor monitor displaying 80 x 24 lines of text, a high-quality detachable keyboard and selectable baud rates from 75 to 19 200 bits per second.

In addition to its own range of editing and data transmission functions, the CCT-100 can also emulate three of the most commonly used terminal configurations, the Hazeltine 1500, Lear-Siegler ADM-3A and the ADDS Viewpoint.

A sound generator is also provided, responding to the ASCII BEL (decimal 7) code and self-test code which is entered when the terminal is first switched on. This reports errors in the terminal's RAM, ROM, serial interface and keyboard.

The CCT-100 is price around $799, plus tax. For further information, contact **Paris Radio Electronics, P.O. Box 380, Darlinghurst NSW 2010. (02)344-9111.**

LITTLE FLEX BOARD

Flex Electronics has released their model FMD-09 'Little Flex Board' single board microcomputer, capable of running an 'off-the-shelf' version of FLEX9 DOS.

The board has a 6809 microprocessor, WD2797 disk controller to handle up to four 5" floppy disks as standard (capable of double or single density operation), two RS232 ports, 56K of dynamic RAM and 4K of ROM with resident monitor and bootstrap routine.

The board measures 185 mm x 118 mm and enables users to construct a small but powerful FLEX9 computer system.

Most applications software available to run under FLEX9 will run on the board with little or no patches to be made to the code. Several commonly used programs have been run on the board with performance and speed the manufacturers claim is comparable to other systems available.

The Little Flex Board is Australian-designed and made. For further information contact **Flex Electronics, 14 Doonkuna Avenue, Camberwell Vic 3124. (03)830-1668.**

MOVE FOR LOGIC SHOP

One of Victoria's oldest computer outlets, The Logic Shop, has moved into the heart of Melbourne and the central business district.

New owner and managing director, Tom Zagon, said not only will The Logic Shop have an ideal location at 97 Franklin Street, but it will also have a new business policy — total computer solutions for hobbyists, small business and white-collar professionals.

Apple IIe, Apple III, TeleVideo and BBC personal computers are available from The Logic Shop, along with the NorthStar Advantage small-business computer. A full range of printers and peripherals are also available.

For more information, contact **The Logic Shop, 97 Franklin Street, Melbourne Vic. 3000. (03)348-1488.**

DATA GENERAL DESKTOPS

Data General has announced the first four models of a new family of professional desktop computer systems.

The new computer systems provide a unique bridge for users as they range from a small diskette-based entry level system to a large 30 megabyte disk system, believed to be the largest available, according to Data General.

Data General's new Desktop Generation models 10 and 10SP computers run most of the popular 'off-the-shelf' software packages and Data General's own software, too.

Models 20 and 30 are more powerful systems designed to run the full range of technical and commercial languages and operating systems, such as AOS, RDOS, COBOL and others.

Prices start at $4500 for an entry-level system comprising a processor, 128K of memory, 380K of diskette storage and a display.

The top of the range is priced around $17 500 for a four-terminal system with 1.5M of main memory, a 736K diskette system and 30M of Winchester type disk storage.

For further information, contact **Data General Australia, 32 Ellingworth Parade, Box Hill Vic. 3128. (03)831-3234.**

COMPUTER TECHNICS

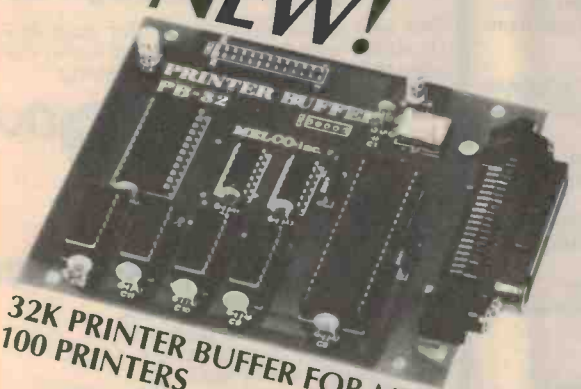
Computer Technics stocks a wide range of computer-related equipment, including the ETI light pen and radio teletype decoder.

This light pen for the Microbee works in the low-resolution graphics mode and connects directly to the I/O port. The kit comes fully documented with software examples and costs $24.50, including p&p. A built-up 'Optiwand' light pen for the VIC-20 and the Commodore-64 is available for $39.95.

The radio teletype decoder displays RTTY encoded messages on your monitor. The kit includes a DB15 plug and backshell for connection to the Microbee and costs $24.50, including p&p.

Computer Technics are now located at a new address, **123 Clarence Street (G.P.O. Box 4936) Sydney NSW 2000. (02) 29-7244.**

NEW!



32K PRINTER BUFFER FOR MX 80, 82, 100 PRINTERS

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★ 2 serial ports
★ EPROM with monitar & boot
★ WD2797 disk cantroller
★ 64K DRAM
★ Runs 'aff the shelf' FLEX9

★ ★ Australian made ★ ★

The FMD-09 "Little Flex Board" is manufactured in Australia by Flex Electronics. The board is a single board computer measuring 185mm x 118mm, capable of running a standard version of FLEX9. The board contains two RS-232 ports, normally dedicated to VDU and Printer. A Western Digital floppy disk controller WD2797 is used to control 5" disk drives, single or double density. 64K of dynamic RAM is supplied. The ROM socket contains a 2732 with resident monitor and FLEX9 bootstrap routine.

Bare board only FMD-09-B	Complete kit FMD-09-K	Complete board A&T FMD-09-A
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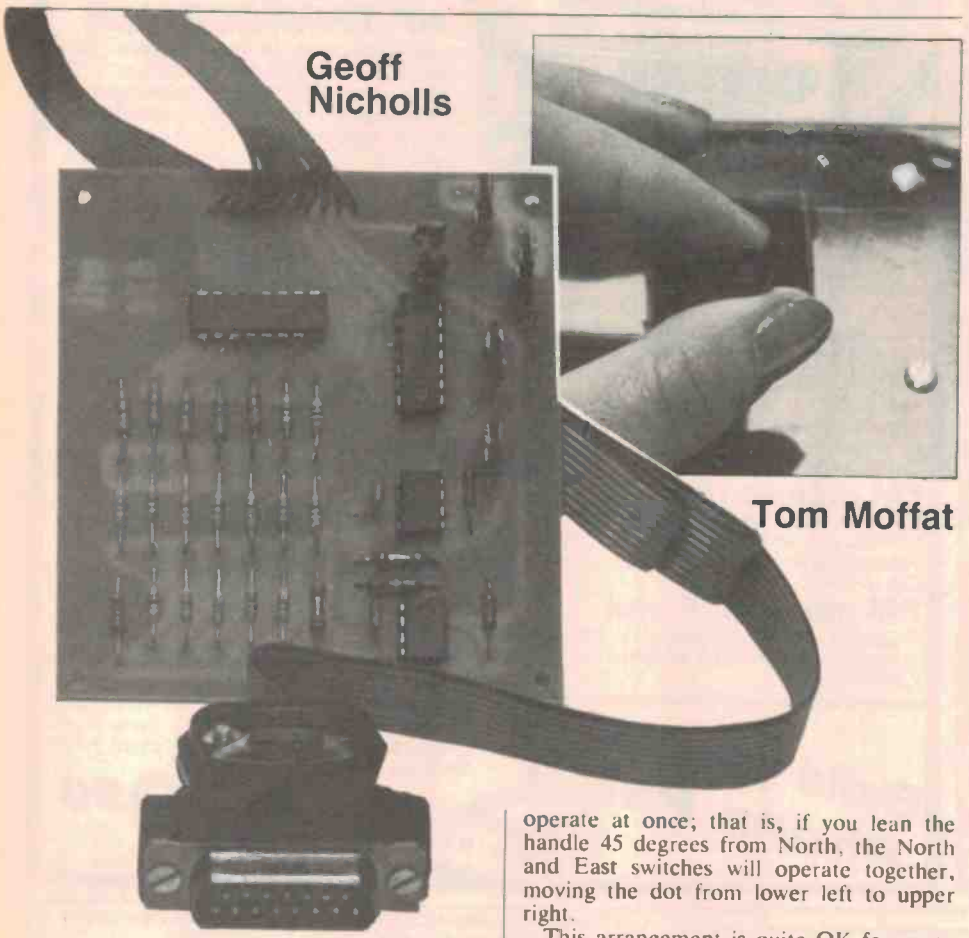
Geoff Nicholls

Tom Moffat



MOST COMPUTERS offer joysticks as options. And most of them aren't as snazzy as this one. Your average home computer joystick, or games controller, is nothing more than four switches, actuated by a central handle. Leaning the handle one way or another actuates the appropriate switch, which tells the computer to drive a dot or other shape across the screen in the direction given. Some computers allow two switches to operate at once; that is, if you lean the handle 45 degrees from North, the North and East switches will operate together, moving the dot from lower left to upper right.

This arrangement is quite OK for many applications, but you can only move at one speed, in only eight different directions. Now, consider the true analogue joystick. On the outside it looks the same . . . a vertical handle that can be moved around. BUT . . . when you move the stick say 24 degrees from North, the dot will follow exactly. If you move quickly the dot moves quickly. If you move the stick slowly the dot just creeps along, and it stops or changes direction when you do. Here's where the really subtle control becomes available for such tasks as a precision landing of a lunar module. You can even write your name with it.

All analogue joysticks must use an analogue-to-digital converter. Many computers have them built in but the Microbee doesn't, so we have to supply one. Two, actually, one for vertical values and one for horizontal. Six-bit conversion is used, giving 64 different values each way. The seventh bit tells the joystick whether an X or a Y value is required, and the eighth bit feeds results back into the computer. So, the whole business works through one eight-bit port.

A bit approximate

Before the joystick can be used, a short driver routine must be loaded into the computer, usually as part of the main program requiring the joystick. The program, and the joystick A/D converter, form a device called a "successive approximation converter". It is a very fast scheme that works in the following way:

Imagine you have a piece of coaxial cable, and some ratbag has stuck a pin in it, and broken the pin off. You know the cable is shorted, but you don't know where. There are two ways to find out . . . first you can cut off a metre at a time until it comes good. If luck isn't with you you will end up with a nice collection of one metre lengths of coax, with the short in the very last one. (Shades of Monty Python's "stringettes" — 3" lengths of string, good for tying small parcels, ideal present etal — Ed.)

In the "sensible" method you cut your losses, so to speak. You first cut your coax in half, knowing that will leave one good bit and one bad bit. You then cut the bad bit in half, leaving half of that good and half bad. You keep on cutting the bad bits in half until you have localised the short. The beauty of this system is that no matter where the short is, it takes exactly the same number of cuts to find it. And it's the fastest way to find the short.

In the joystick we cut its value in half, and then look at a comparator. If the value is above half the maximum it tells the computer to store a bit, and then cuts the upper half in half, looking for a "too high" or "not high enough" indication. And so it goes for all six bits. The result is a binary representation of the joystick value, stored in the computer.

The "halves" are generated by that

HOW IT WORKS — ETI-674

The circuit includes most of a successive approximation analogue-to-digital converter. The rest of the converter is actually the Microbee!

Resistors R4 to R22 form a binary ladder network, also called an 'R-2R' network. The actual resistance of the resistors in the network is not critical, provided they are closely matched. IC4 is used to ensure that the digital signal levels from the computer's PIO will swing to within millivolts of the supply rails, i.e: 0 or 5 volts. If the six-bit number applied to IC4 is 'n', then the voltage at the junction of R4-R6 will be Vcc x n/96. Thus, If n=0 the voltage will be 0 and If n=63 the voltage will be 3.28 volts.

Resistors R1, R2 and R3 are chosen to shift the voltage range to match the output voltage range from the joystick. Trimpots RV1-RV4 are used to fine-tune the joystick range.

Comparators IC1 and IC2 compare the voltage from the joystick ports to the voltage from the ladder network; if the latter exceeds the former, then the comparator output is high, and vice versa. IC3 selects either the horizontal or vertical comparator output to feed to the computer, according to the state of bit 6, which is set by the software as required.

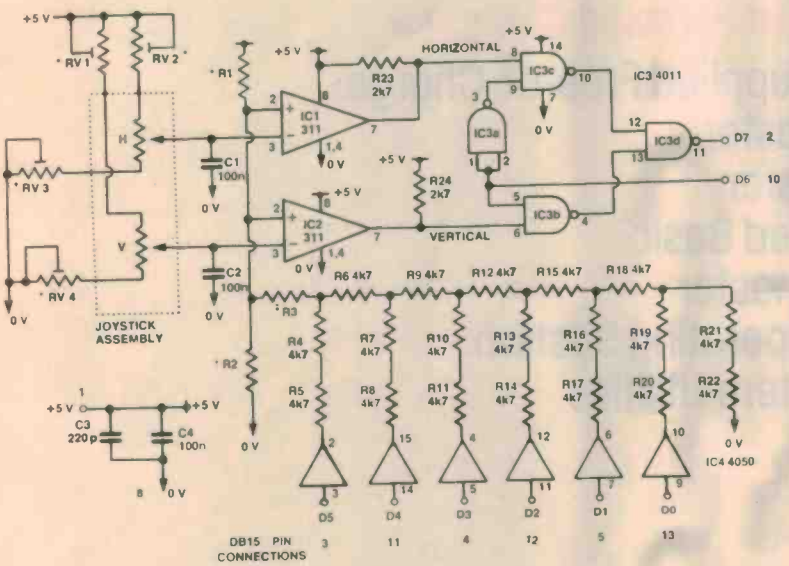
To read the joystick, the computer selects the pot (horizontal or vertical), then starts outputting six-bit data via D0-D5, while reading the comparator output. As outlined in the text, this process is done one bit at a time, so only six operations are required, independent of the actual value. This technique is called successive approximation.

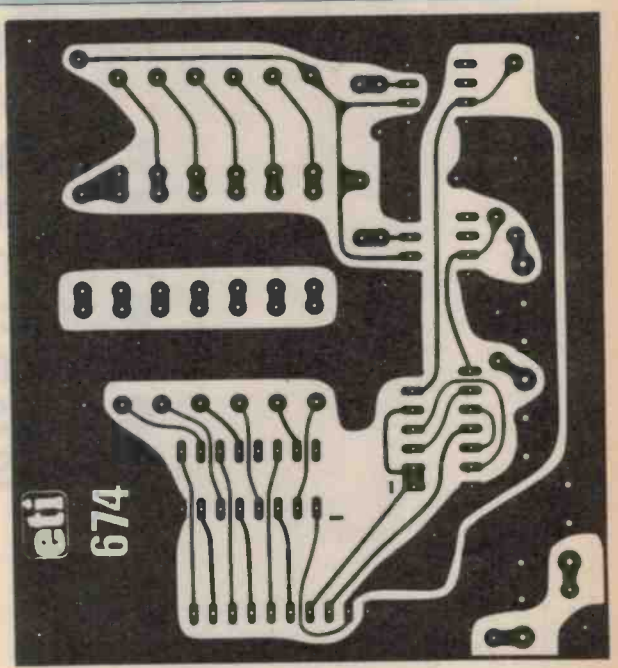
```
ADDR    CODE LINE    LABEL   MNEM     OPERAND

                00100 ;JOYSTICK DRIVER ROUTINES, Tom Moffat, 1/12/82
                00110
0400            00120          DEFR     16        ;ASSUME HEX VALUES
0800            00130          ORG      0800
                00140
                00150 ;Initialize the PIO:
                00160
0800 3ECF       00170          LD       A,0CFH    ;SET FOR CONTROL
0802 D301       00180          OUT      (1),A
0804 3E80       00190          LD       A,80      ;DDR 10000000
0806 D301       00200          OUT      (1),A
0808 C9         00210          RET
                00220
                00230 ;Joystick routine, get X if C=00, get Y if C=40.
                00240
0809 79         00250          LD       A,C       ;SELECT X OR Y (BIT 6)
080A 1620       00260          LD       D,20      ;SET "TRY" BIT (BIT 5)
080C B2         00270 LOOP     OR       D         ;COMBINE THE TWO AND...
080D D300       00280          OUT      (0),A     ;SEND TO A/D CONVERTER.
080F DB00       00290          IN       A,(0)     ;GET THE RESULT.
0811 CB7F       00300          BIT      7,A       ;TEST COMPARATOR BIT.
0813 2801       00310          JR       Z,$+3     ;IF LOW SKIP NEXT INSTR.
0815 AA         00320          XOR      D         ;KILL "TRY" BIT IN A REG.
0816 CB3A       00330          SRL      D         ;SHIFT TO NEXT POSITION.
0818 30F2       00340          JR       NC,LOOP   ;DO AGAIN UNTIL FINISHED.
081A E63F       00350          AND      3FH       ;CHOP GARBAGE OFF FRONT.
081C 4F         00360          LD       C,A       ;LOAD WHAT'S LEFT INTO C.
081D C9         00370          RET                ;AND RETURN TO BASIC.
0000            00380          END
00000 Total errors

LOOP    080C
```

LISTING 1





great network of 4k7 resistors, with the output feeding two comparators at once. Each joystick pot, X and Y, goes to one comparator. A series of NAND gates selects which comparator output goes back to the computer. The NAND gate X/Y selector is driven by bit 6 from the computer. An assembly language listing of the A/D converter driver is provided for those interested.

There are actually two subroutines necessary for the joystick to be used in a BASIC program. First the routine at 2048 must be called to set up the parallel port for the joystick. This need be done only once at the start of the program. Then the routine at 2057 is called to get a joystick value. The "USR" function in MicroWorld BASIC makes this easy, since you can pass information both to and from a machine code routine. You send in a "0" to get a horizontal value, or a "64" to get a vertical value. To specify a point on the screen you must do each one.

The BASIC demonstration program given in Listing 2 shows how this works. The program only writes dots to the screen, leaving a trail of dots behind. Anything more elegant must come from your own imagination. ▶

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Joystick types

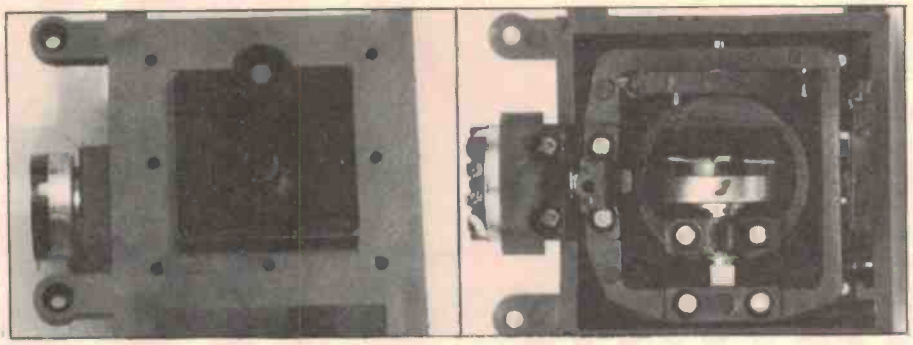
There are a number of different joystick assemblies around, and the type you use affects some components in the circuit. The important parameters are;

(1) Ratio of minimum resistance to total resistance.

(2) Ratio of maximum resistance to total resistance. The project has been built up twice, once by Tom Moffat and once by ETI. Tom used a joystick with pots of about 100k total resistance, with minimum and maximum resistances of 0 and about 90k.

The ETI version used pots with minimum resistances of around 8k and maximums of around 12k out of a total resistance of 20k. We understand that the most common type supplied will be mechanically identical to ours but will have a total resistance of around 5k. This means that the ratios mentioned earlier will be the same as ours, but the trimpots would be reduced from 5k to 2k to give a useful range adjustment.

The table here gives the component values to suit the three types of joystick discussed.



Close up. Front and rear views of the joystick used.

Construction

First work out where the joystick will mount in the box, remember that the pc board has to fit as well! Put the joystick right up one end so that a large area is left to rest the wrist on — you don't want to develop an ache after a few minutes use. A square cut-out was required for our stick (obtained from Benelec). Drill lots of holes and file out to exactly fit the flange on the stick. The unit is secured with four self-tappers through the box to bite into the plastic mounts on the stick base. Solder wires to each lug on the pots, around 200 mm allows slack when the pots are moved.

File a bevel to allow the ribbon cable to pass between the box and its lid, and the mechanical stuff is done.

The pc board can be made up now, start with the 4k7 resistors, and be careful not to put them where R2 and R3 have to go. Solder in the remaining resistors and the four capacitors and trimpots. The ribbon cable comes next, if you are using a solder-type DB15 plug then simply follow the overlay diagram. Some suppliers may provide insulation-displacement (ID) plugs, you'll have to carefully work out the wires if you get one — watch the 0 V wire, it is out of sequence.

The wires from the joystick pots can be soldered in now. Next, solder the ICs in place. Take particular care to orient them correctly and avoid touching the pins of IC3 and IC4 — they are static sensitive. Solder their Vcc and 0 V pins first.

The pc board was held in place with double-sided sticky pads, one also being used to secure the ribbon cable to the inside end face of the box.

JOYSTICK	R1	R2	R3	RV1,2	RV3,4
5K	100K	82K	180K	2K	2K
20K	100K	82K	180K	5K	5K
100K	none	91K	91K	20K	none

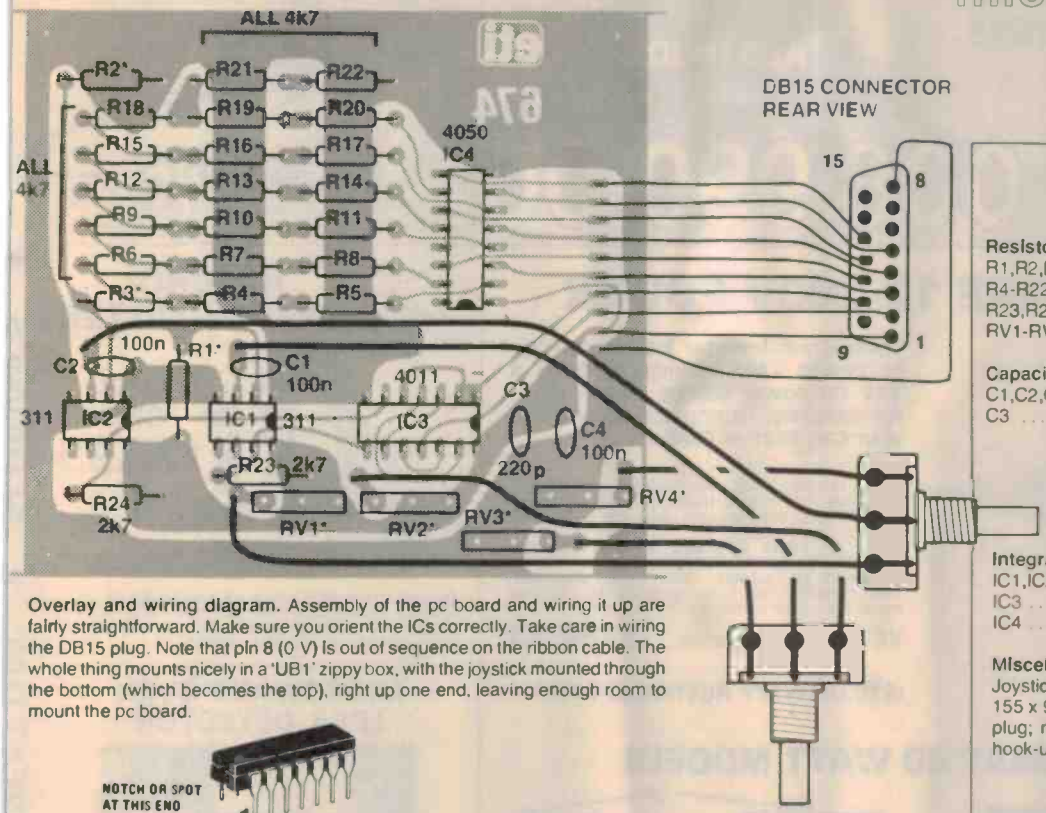
Note that, when using the 100k version the 0 V wires from the pots have to return to 0 V on the PC board.

LISTING 2

```
00100 REM Test programs for ETI 674 joystick project.
00110 REM
00120 REM Initialize
00130 GOSUB 450
00140 REM
00150 PRINT"1 : A-D test"
00160 PRINT"2 : Range test"
00170 PRINT"3 : Drawing"
00180 INPUT"Program no.?";P
00190 IF P<1 ORP>3 THEN 180
00200 CLS:ON P GOTO 220,300,380
00210 REM
00220 REM #1 : A to D converter test.
00230 PRINT "Measure voltage at pin 2 of IC1"
00240 PRINT "Type test no.s from 0 to 63."
00250 PRINT "To exit type 64"
00260 INPUT A: IF A>63 THEN STOP
00270 OUT 0,A
00280 GOTO 260
00290 REM
00300 REM #2 : Range adjustment program.
00310 CLS
00320 X=USR(2057) :REM Get horizontal value
00330 Y=USR(2057,64) :REM Get vertical value
00340 IF X=Z THEN 350 ELSE CURS 66:PRINT [I4 X]
00350 IF Y=T THEN 360 ELSE CURS 80:PRINT [I4 Y]
00360 Z=X : T=Y
00370 GOTO 320
00380 REM #3 : Screen drawing.
00390 HIRES
00400 X=USR(2057)
00410 X=8*X REM Expand to screen width
00420 Y=4*Y REM Expand to screen height
00430 SET X,Y : GOTO 400
00440 REM
00450 REM Machine code loader routine.
00460 REM Pokes subroutines to 0800H
00470 FOR A=2048 TO 2077
00480 READ B
00490 POKE A,B
00500 NEXT A
00510 DATA 62,207,211,1,62,128,211,1,201,121,6,32,176,211,0
00520 DATA 219,0,203,127,40,1,168,203,56,48,242,230,63,79,201
00530 REM
00540 X=USR (2048) : REM Initialize the PIO.
00550 RETURN
```

Testing and setting up

Having built the unit, the next step is to type in the test program and check that all's well. It is wise to save the program before plugging in the joystick in case a spike stuffs a bit or two. The first test covers the D-to-A converter and you will need a digital multimeter connected to read the voltage at the comparator's positive input. The most convenient place to attach the probes is across R2. Now run the #1 test and type a few different numbers in, noting that the voltage changes with the number, with '0' you should read around 1.8 volts, while a '63' should read about 2.75 volts. If you go through the range from 0 to 63 you should observe an increase with each number. If you get a decrease at some points then either a 4k7 resistor is open circuit or the data is not getting from the port through to the outputs of the 4050, IC4. ●



Overlay and wiring diagram. Assembly of the pc board and wiring it up are fairly straightforward. Make sure you orient the ICs correctly. Take care in wiring the DB15 plug. Note that pin 8 (0 V) is out of sequence on the ribbon cable. The whole thing mounts nicely in a 'UB1' zippy box, with the joystick mounted through the bottom (which becomes the top), right up one end, leaving enough room to mount the pc board.

PARTS LIST — ETI-674

Resistors ..... all ¼ W or ½ W, 5%
R1,R2,R3 ..... See table
R4-R22 ..... 4k7
R23,R24 ..... 2k7
RV1-RV4 ..... See table

Capacitors
C1,C2,C4 ..... 100n ceramic bypass
C3 ..... 220p disc ceramic

Integrated circuits
IC1,IC2 ..... LM311 etc.
IC3 ..... 4011B
IC4 ..... 4050B

Miscellaneous
Joystick assembly; ETI-674 pc board; zippy box 155 x 95 x 50 mm; DB15P 15-way subminiature plug; ribbon cable; double-sided adhesive tape, hook-up wire, solder, etc.

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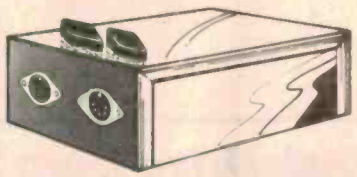

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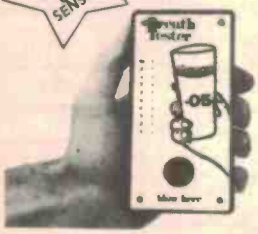


K1583
ONLY
$29.95
(SEE EA MAY 1983)

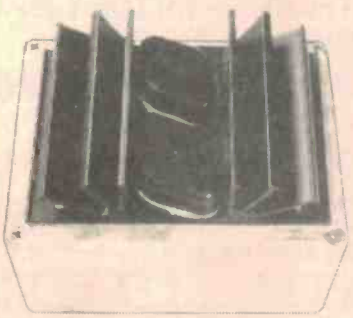
This Great new Kit from EA will be a smash hit with all the smashed people at your next party. Fun to build. Fun to calibrate and Fun to use. More seriously, this unit could save lives.

MICROWAVE OVEN LEAK DETECTOR

ETI PROJECT
Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter.
Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter.
Genuine Hewlett Packard Hot Carrier Diode supplied.

K1724..... (still only) **$14.50**

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION



The Altronics Kit includes all components for the modifications, detailed by Electronics Australia Feb. 1983.
Yes, it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop. Easy to build!

K4010..... **$35.00**

POWER DOWN
MAINS APPLIANCE TIMER
(ETI JULY '82)

Clever new design from ETI, mains appliance is turned on at the press of a button and automatically turned off some preset time later.
Use for electric blankets, bathroom heaters, patio light. If your inclined to fall asleep while watching TV late at night — this is the kit for you.
SEC Approved Transformer · Screened Front Panel · Complete Kit as per ETI article, includes every last part.

K6265..... only **$32.50**

See EA November, 1982

POWER UP

A MUST FOR YOUR COMPUTER SYSTEM

This great new Project from EA is the answer to a Maidens Prayer.
What Does it Do?
A single 240v mains plug and lead feeds one unswitched master 240v outlet plus 4 switched 240v outlets. With say a hi-fi system, plug your main equipment item (e.g. Amp) into the master outlet and whenever you "switch on" your amp – presto – mains power is applied to the other 4 outlets i.e. simply "turning on" your amp turns on your tape cassette, tuner, turntable, graphic equaliser without mains spikes, plops etc.
Just the shot for your Computer System. The Altronics Kit includes case and all outlets.

K6000..... **$39.50**

• FOR DESPATCH P&P CHARGES AND ADDRESS DETAILS PLEASE REFER TO OUR AD. ON PAGE 95

QUALITY VIDEO KITS

Video has been booming for quite a while, finally a range of video accessories in kit form.
Two **video amplifiers** for both VCR and Computer use, a brand new **Video Enhancer** and our popular **VCR Stereo Synthesizer.** All four represent outstanding value for money and all are assembled with Altronic's Extra Care.

VIDEO AMPLIFIERS

DISTRIBUTION TYPE
Simple, low-cost project will allow you to drive five video monitors from one source, such as a video cassette recorder or a computer. Great for piping video around the house, or for clubs meetings when screening lectures etd, or for computer demonstrations.

★ **THE ALTRONICS KIT** includes all components as specified by ETI plus all power supply components.

K5830..... Only..... **$45.00**

SINGLE OUTPUT

INVERSE AND NORMAL OUTPUT
Brilliant new kit from EA. **Super cheap** and **Super Effective.** Whilst our K5830 is suitable primarily for VCR use this video amplifier is best suited to use with computers. The EA documentation supplied is extremely well written and provides details for installation into television sets.

NO MORE SMEARY COLOURS, SIGNAL BEATS OR RF INTERFERENCE

NOTE ★ NOT SUITABLE FOR USE WITH LIVE CHASSIS TV SETS.

K5850..... **$14.95**

VIDEO ENHANCER

Here's a **simple** but **effective** Video Enhancer that is super **easy to build** at a fraction of the cost of commercial models.
Unit sharpens picture detail, and can actually improve the quality of a copy by amplifying the top end of the video signal.

AT LAST A VIDEO ENHANCER KIT

K5825..... **$35.00**

ENJOY THE PLEASURES OF STEREO SOUND
(See EA Sept. 1982)

STEREO SYNTHESIZER FOR VCR'S AND TUNERS

Synthesize realistic stereo from virtually any monophonic source by simply connecting this unit between the source and your stereo amplifier.

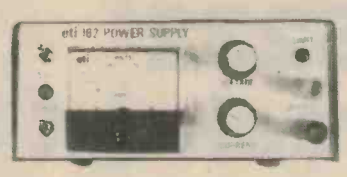
- ★ Quality Phillips MN3001 (not second source dropout).
- ★ Provision for 2 different signal sources.
- ★ Selection of either source via front panel switch.
- ★ Normal or stereo sound selection.
- ★ Complete kit includes all hardwear, cables etc., even solar.

Important ★ beware of kitset suppliers who sell this kit for **less** ★ you get **less!**

K5810..... **$55.00**

POWER SUPPLIES

If you're thinking of buying a power supply then buy from us, we are the experts on power supply kits and carry a supply to suit most enthusiast and professional requirements..... READ ON.



BENCH STANDARD
- ★ 3-30v Output @ 1 Amp.
- ★ Fully Regulated, Fully Protected from Thermal Overload and Short Circuits.
- ★ Based on EA Design.

K3200..... **$42.50**

- ★ All the features of above PLUS Current Limit.
- ★ ETI Design.

K3205..... (PICTURED)..... **$49.50**

DUAL TRACKING
- ★ ± 1.3 to ± 22v Output @ 2 Amps.: + 5v @ 0.9 Amps.
- ★ Fully protected.
- ★ 10 turn pot enables voltage adj. to within 10mV.
- ★ EA Design (March '82).

K3220..... **$89.50**

HIGH CURRENT

MICROCOMPUTER PS
★ + 5 Volts @ 3 Amps. ★ + 12 Volts @ 2 Amps. – 12 Volts @ 200 milliamps.
This universal design has enough grunt to power most disk drives.

K3350..... **$59.50**

13.8 VOLTS @ 10 AMPS HAM'S & CBER'S
Save the expense of a Mains Powered Rig.

K3250..... **$89.50**

HIGH CURRENT — DUAL METERING

EA SWITCH MODE DESIGN
- ★ 2-50 Volts at massive 175 Watts.
- ★ CLEVER DESIGN — a fully mains isolated supply with a 'Switchmode' low voltage circuit.
- ★ Easy to build.

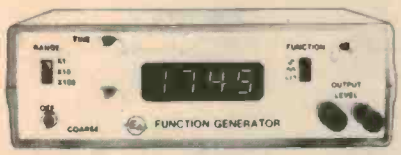
K3300.. (EA MAY, JUNE '83).. **$139.00**
K3301... (10 TURN VOLTAGE CONTROL OPTION)... **$10.00**
K3302..... (± 12V OPTION) EA JULY '83..... **$12.50**

ETI SERIES REGULATOR DESIGN
- ★ 0-40 Volts @ 5 Amps — **thats 200 Watts.**
- ★ Current limiting 0-5 Amps variable.
- ★ Specifications Second to None.
- ★ Free from the hum and noise sometimes associated with other techniques.

A PROFESSIONAL SUPPLY

K3325.... (PICTURED).... **$175.00**

FUNCTION GENERATOR



The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator. This design utilizes the latest circuit techniques to produce stable, low distortion waveforms.

A truly versatile unit at a bargain price.

☆ 4 digit frequency readout (eliminates tiresome dial calibration) — typical accuracy ± 2% ☆ 3 overlapping ranges x1, x10, x100 ☆ 600 OHM Nominal Output — continuously variable 3MV — 2.5V P-P ☆ Distortion — sinewave : less than 0.7% @ 1KHz ☆ Linearity — triangle wave: better than 1% @ 1KHz ☆ Squarewave rise time — 6V/uz maximum output ☆ Amplitude stability — better than 0.1dB on all ranges.

With the exception of the display all components mount on a single PCB making this kit suitable for all constructors.

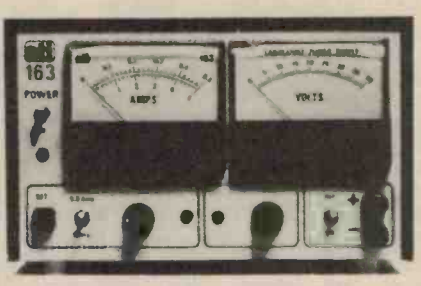
K2505..... **$85.00**

DIGITAL CAPACITANCE METER

NEW DELUXE FINISH
We are pleased to announce the release of the **Digital Capacitance Kit housed in our Deluxe H0480 ABS Instrument Case.**
This superb Test Instrument Kit now compliments our top selling Digital Frequency Counter and Function Generator Project Kit. Electronics Australia Project. Measures capacitance of both polarized and non-polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges.
Check values of unmarked capacitors, especially those little trimmers that are never coded.
Select precise values for filters and timing networks within ease.

☆ **EXCLUSIVE TO ALTRONICS** ☆
Each kit includes precision measured capacitors for accurate calibration of each range.

K2521..... **$55.00**



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You could well pay up to 32½% more.

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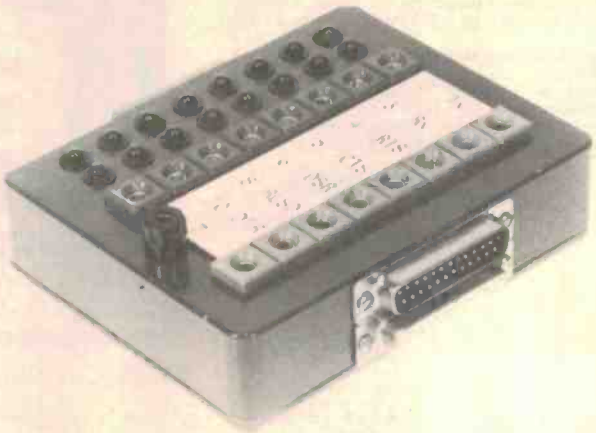
RS232 breakout box



Here's a handy little 'Saturday arvo' project for all those computer hobbyists who've ever wrestled with RS232 cabling, 'sexing' and troubleshooting.

A. Bendili
CSIRO Division of Applied Physics, Sydney 2070

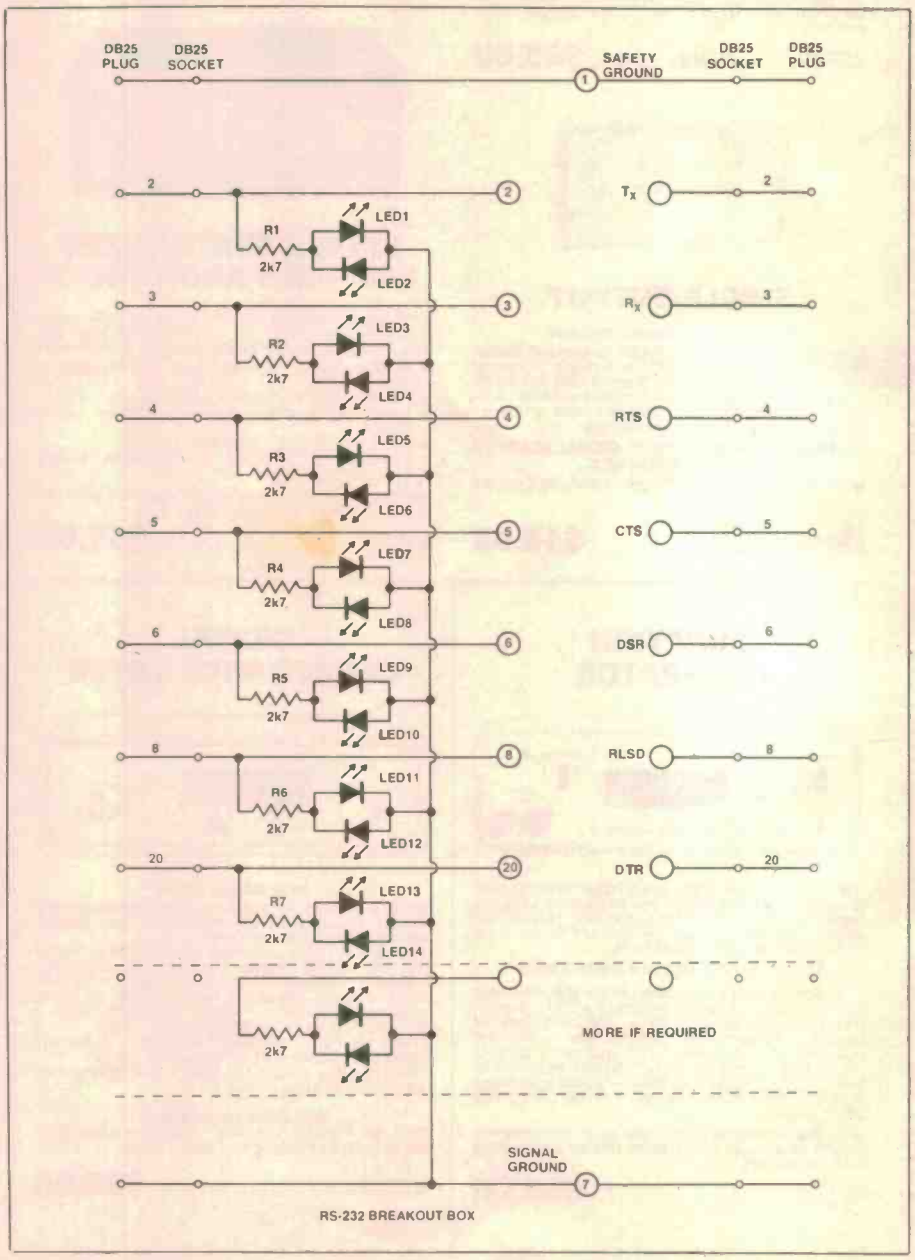
RECENTLY, there have been a number of articles describing monitors and troubleshooting aids for RS232 communication lines, e.g: ETI Sept. 1982 *RS232 Troubleshooter*. There are also commercially available breakout panels/monitors suitable for use with RS232 equipment. These units invariably require some form of external power either via a battery set or plugpack. It is quite probable that, with infrequent use, the battery will be flat when you least expect it, or you cannot get hold of a double adaptor or a long extension cable for your plugpack.

The recent availability of high efficiency LEDs (e.g: Stanley ESBR-5531) has eliminated the power supply problem. These high efficiency LEDs typically emit 160 mcd at 20 mA; as a result, only 2 mA is needed to obtain the same light output as a standard LED driven with 20 mA.

Description

To eliminate the power supply requirement, standard LEDs were not used since they would require at least 80 mA each. However, the high efficiency LEDs operating at 1 mA emit adequate light to indicate activity. For each signal line shown in the circuit, two high efficiency LEDs are wired back-to-back, not only to indicate whether the signal line is mark/space or disconnected but also to provide reverse bias protection to each other. The 2k7 series limiting resistor is high enough not to adversely load the RS232 lines and low enough so that the LED is still visible (albeit dim) with a 3 V signal through a 500 Ohm combined line and line driver resistor. There is no circuit definition as to which end is the input or output. The input could logically be the side associated with the LEDs.

There are always two permanent connections to be made; these are the safety ground (pin 1) and signal ground (pin 7). The other pins usually depend on the usage, e.g: Tx and Rx could be reversed; some peripherals use RTS instead of DTR.



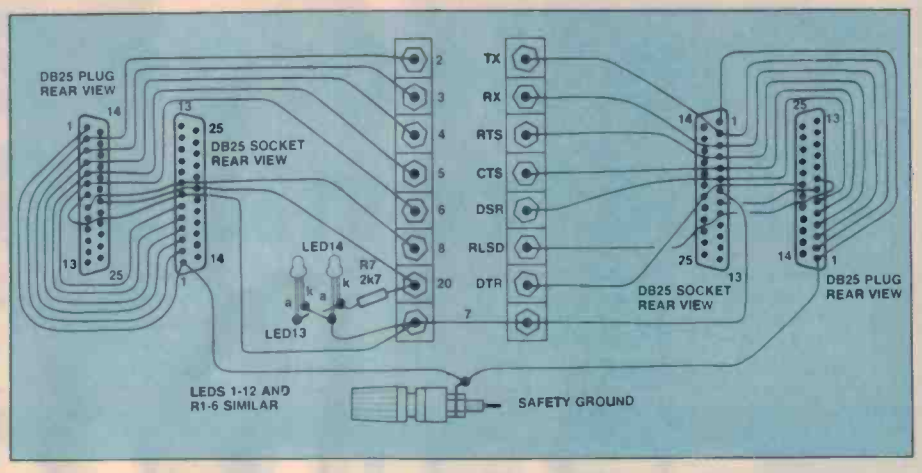
A spare, unlabelled LED could be connected to any of the 4 mm sockets to monitor its status. I found that a set of eight leads consisting of a flexible (Datwyler) wire about 100 mm long terminated at each end with a stackable 4 mm plug is sufficient to link, stack, strap, crossover, pull up and monitor.

A double row of 4 mm sockets allows the connecting of input to output according to the situation in hand.

Construction

As shown int he accompanying photograph, the unit was built in a diecast box. A connector pair consisting of a plug and socket on each side of the box allows for cables with either termination to be connected to the breakout box. A Scotcheal label between the two rows of sockets identifies the pin number and its conventional designation. As it is highly unlikely that all 21 RS232 signals will be monitored, the minimum set of signals shown on the circuit diagram would be adequate for nearly, if not all, situations.

A further improvement to reduce loading would be the use of even higher efficiency LEDs, e.g: the Stanley ESBR-500 which has a light output of 500 mcd at 20 mA. However, the present cost of over $2 each precludes their use for the time being. ●



HOW IT WORKS — ETI-658

Back-to-back high efficiency LED pairs, LEDs 1-14, are connected across the RS232 signal lines with a 2k7 current limiting resistor in series. The plug/socket pairs on the left and right can be linked via the central column of sockets, the LEDs indicating the presence or absence of signal and its polarity on the lines.

PARTS LIST — ETI-658

Resistors.....all ½W, 5%
R1-7 .....2k7
Semiconductors
LED1-14.....Stanley ESBR-5531 or similar
Miscellaneous
Diecast box to suit; 16 x 4 mm 'banana' sockets; 1 x 'banana' socket-terminal; 2 x DB25 chassis-mount plugs; 2 x DB25 chassis-mount sockets; 5 mm LED clips; hookup wire, etc.

Sendata 300 Modem Direct Connect

A new direct connect 300 bps modem that is no taller than a 50c piece and fits snugly under the base of a telephone, has been released by Australian communications manufacturer, Electromed. Called the Sendata 300 the modem is simple to operate and does not require operator training. It attaches to the existing telephone wall socket plug and becomes fully operational with the flick of a switch by the operator.

- No installation costs.
- Simple operation.
- Fits under telephone base.
- Attaches to existing telephone plug.

SENDATA

OEM AND DEALER ENQUIRIES WELCOME

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ELECTRO-MEDICAL ENGINEERING P/L
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VICTORIA 3143, AUSTRALIA
TELEPHONE: (03) 509 5844.
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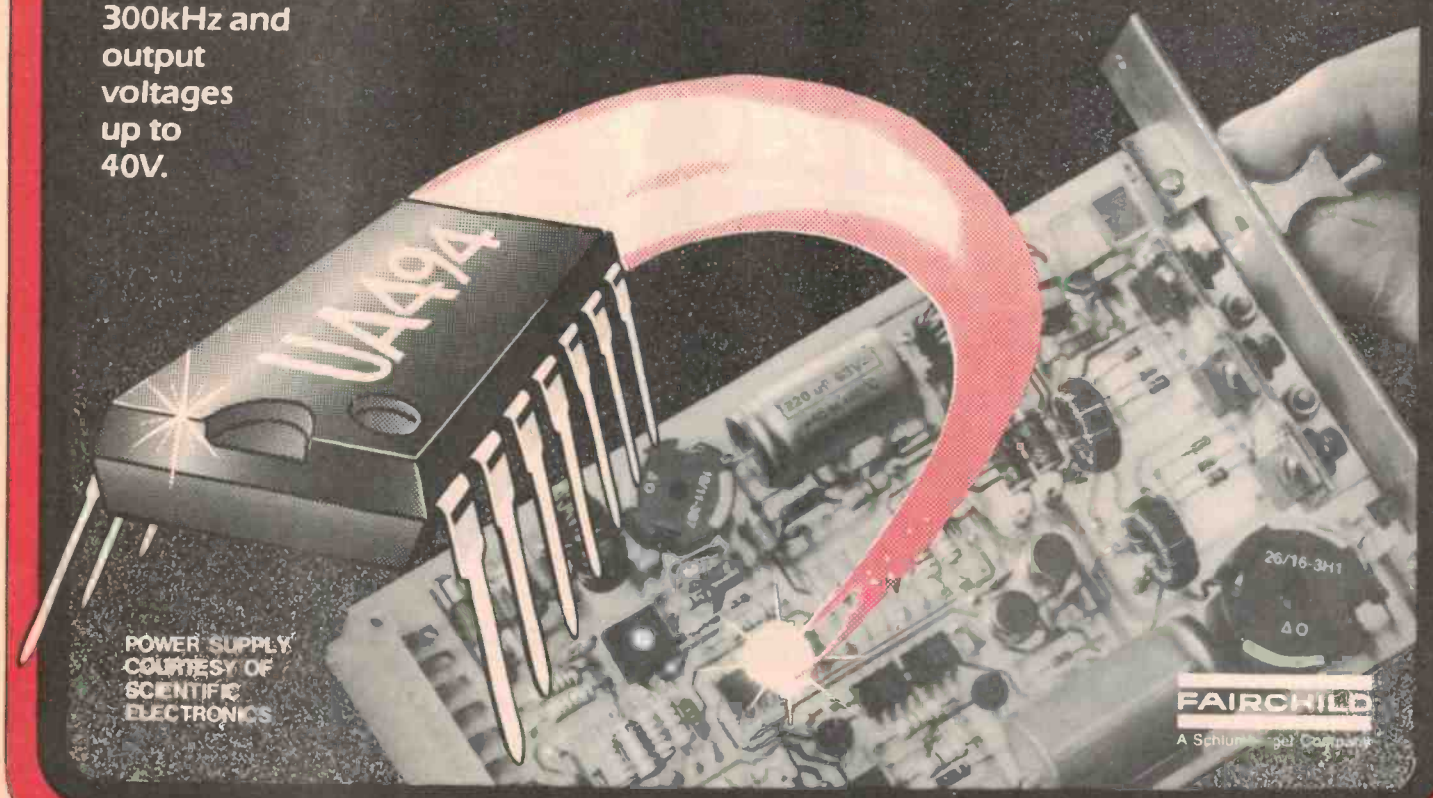
REGULATORS

The more efficient μA494.

The μA494 is a monolithic integrated circuit which includes all the necessary building blocks for the design of pulse width modulated switching power supplies, including push-pull, bridge and series configurations. The device can operate at switching frequencies between 1.0kHz and 300kHz and output voltages up to 40V.

μA431 Does it All!

The μA431 Is a 3-terminal Adjustable Shunt Regulator with guaranteed temperature stability over the entire temperature range of operation. The output voltage may be set at any level greater than 2.5V up to 36V merely by selecting two external resistors that act as a voltage divided network. Due to the sharp turn-on characteristics this device is an excellent replacement for many zener diode applications.



EXCLUSIVE ETI READER OFFER

THE "B-ETI" LOW-COST SERIAL TERMINAL

By special arrangement between ETI magazine and Applied Technology, makers of the famous Microbee personal computer, we introduce the B-ETI serial terminal.

Essentially, the B-ETI makes a low-cost "glass teletype". It consists of a 'stripped-down' Microbee. It operates at 300 & 1200 baud transmission speeds in either half duplex or full duplex modes. The B-ETI emulates the popular ADM-3A terminal format and most of the 'Televideo 912' format. This makes it simple to install in CP/M systems as either of these formats can be chosen. Transmission uses eight data bits with one stop bit and no parity. Interfacing is via the serial port on the rear.

The B-ETI has dozens of applications with computer, and computer-related, project and equipment. It is ideal as a low-cost terminal for the ETI-690 Little Big Board computer published in the October '83 issue of ETI for example, or as part of a radioteletype system in an amateur radio station.

The screen format is 80 characters wide by 24 lines. Upper and lower case characters are available and each character key auto-repeats if held down longer than one second.

The video output can be plugged directly into one of the low-cost monitors currently available. Many of these have a 12 Vdc output socket which can power the B-ETI directly. Alternatively, it can be powered from any suitable 12 V dc source capable of supplying 700 mA. A power pack is not included. As the low-cost monitors available are generally priced at around $200 or less, *you can have a complete serial terminal for less than $500!*

This is an introductory offer. The B-ETI serial terminal has not yet been offered for sale through retail stores. When it is, it is expected to sell in the $330-$340 range so you save around 20-25% by taking advantage of this offer.

This offer is made by Applied Technology Pty Ltd (Incorporated in NSW) in cooperation with ETI magazine and ETI is acting as a clearing house for orders. All orders will be despatched by road freight for $10, insurance included, anywhere in Australia. While deliveries will be generally ex-stock, please allow up to four weeks for delivery to cover order processing and any delays that may occur.

INTRODUCTORY PRICE

90 DAY WARRANTY

The B-ETI is manufactured especially for ETI readers by Applied Technology and a full 90-day warranty is available as well as normal backup service.

APPLICATIONS

- low-cost computer terminal. Use with ETI-690 Little Big Board.
- use with modem as remote computer terminal.
- use with radioteletype (RTTY) converter/modulator in amateur radio station.

FEATURES

- 300/1200 baud operation, software selectable.
- powered from 12Vdc supply.
- low cost — only $275.
- 80 characters x 24 lines screen format.
- auto-repeat on all character keys and space bar.

OFFER CLOSES 31 DECEMBER 1983

HOW TO ORDER YOUR B-ETI SERIAL TERMINAL

Fill out the coupon here, or a photostat of it, and enclose a cheque, bank cheque or money order for the amount required, made out to **APPLIED TECHNOLOGY PTY LTD.**

Cut out the coupon and send it to: **B-ETI TERMINAL OFFER** c/o ETI Magazine, P.O. Box 21, Waterloo, NSW, 2017.

Please rush me ..... B-ETI Serial Terminal(s) @ $275 each plus $10 freight. Offer closes 31 December 1983.

I enclose $..... total.

Cheque or Money Order No.....

Signature .....

Name .....

Address .....

..... Postcode .....

2 YEAR WARRANTY

NEW 20 WATT P A AMPLIFIER

UNCONDITIONALLY STABLE

The AS-20 is a **rugged, reliable general purpose public address amplifier.** Designed and manufactured in Australia this amp is suitable for use by **schools, sporting clubs, function centres** and in **professional installations** (paging systems, background music).

- Balanced Low Z mic input
- Unbalanced Low Z mic input
- Mic muting function (mutes program music with PA announcement)
- 4-16 OHM output ☆ AUX Treble and Bass controls
- 100V Balanced line output
- Full 20 Watts RMS into 8 OHMS
- Short circuit load protection
- Less than 1% Distortion.

WHY PAY OVER $200.00 FOR AN INFERIOR UNIT?

A2000..... **$149.00**

TOP QUALITY

PAGING MIC

STURDY ROBUST BASE

Has tapered low frequency response for articulate speech reproduction. Low impedance balance line. PTT switch with lock facility. Additional switch contacts for remote switching, muting etc. Gooseneck approx. 350mm.

C0166..... **$59.95**

SUPER SPECIAL

SPEAKER TWIN FLEX

2 x 19/.193

WO204 .... RED TRACE **35c/m**
WO205 BLACK TRACE **$34/200m**

PROFESSIONAL

HORN SPEAKERS

BOTH MODELS FULLY WEATHER PROOF

NOW IN USE WITH THE WEST AUSTRALIAN EDUCATION DEPT AND PWD

30 WATT WITH LINE TRANSFORMER

Multitap inbuilt line transformer allows taps 330/30W, 660/15W, 1000/10W, 2000/5W. Universal swivel mounting bracket supplied.

C2033..... **$69.95**
4 or more..... **$67.80**

15 WATT WITH LINE TRANSFORMER

Multitap inbuilt line transformer allows Z taps 660/15W, 1K/10W, 2K/5W, 4K/2.5W. Mounting bracket clears line TX allowing rear wall mounting.

C2030..... **$59.95**
4 or more..... **$56.00**

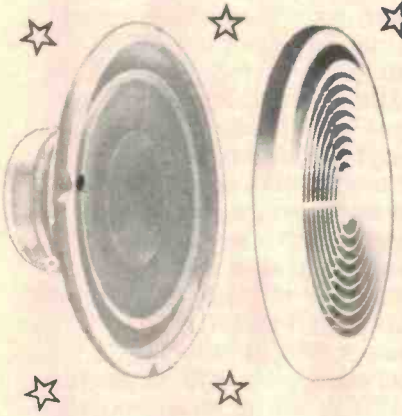
8 INCH WIDE RANGE DUAL CONE SPEAKER

200mm (8 in.). 10 Watts Max. power input. Public Address, Background Music. Ideal HI FI extension speaker. Includes transformer holes at 51mm. Over 30,000 sold in Australia! Mounting holes 140 x 140mm.

C2000..... **$9.50 ea**
10 Up..... **$8.70**

8 INCH CEILING SPEAKER GRILL

C0800..... **$2.75**
10 Up..... **$2.00**



20W HIGH POWER SPEAKER TRANSFORMER

Primary Power Taps (100V Line) 1.25/2.5/5/10/15/20W (Halve these for 70V line) Secondary Taps 4/8/16 OHMS.

M1120.... **$10.80**
10 or more **$9.90**

4W MULTI-PURPOSE SPEAKER TRANSFORMER

Primary: 2.5K, 5K OHMS
Secondary: 2, 4, 8, 16 OHMS
Frequency Response: 30 Hz - 12 KHz. Mounting hole centres 51mm. Ideal for high quality constant voltage PA systems.

M1105..... **$4.95**
10 Up each **$4.50**

GRAIN ORIENTED STEEL CORE

SAVE 25% THE SET OF TEN
B9995..... **$79.50**
PLUS $10 P&P

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IF YOU MISSED OUT LAST TIME, ORDER NOW!
LATEST EDITIONS JUST ARRIVED

MOTOROLA CMOS DATA
B 1105..... $11.50

A comprehensive reference covering 40XX, 45XX CMOS family's along with specialty devices such as LCD drivers, telephone and general communication functions and industrial control.
862 pages essential in all spheres of electronics.

MOTOROLA MECL DATA
B 1100..... $9.95

Emmiter Collector Logic (ECL) is today's fastest form of digital logic providing the most direct way of improving system performance. **This previously hard to get** manual provides data on the 10KH, 10K and III families, MECL memory and PLL CHIPS.

MOTOROLA OPTO DATA
B 1118..... $8.95

Handy reference provides data and application notes on opto couplers, infra red LEDS, Photo transistors and a complete chapter on fibre Optics, a communications system which is fast gaining usage worldwide. **VERY EDUCATIONAL.**

MOTOROLA POWER DATA
B 1101..... $12.95

Motorola are the undisputed world leader in Power Transistors. Renowned for their low cost and reliability. Book includes a 9 page selection guide, application notes and Data Sheets for over 700 Devices, 989 pages. Previously over $20.00.

MOTOROLA MASTER SELECTION GUIDE
B 1104..... $7.95

The most useful book ever printed. Covers MOS IC'S listed by function, LINEAR IC S listed by function, INTERFACE IC'S listed by function, LSI memory, TTL ECL power products, SCR'S, diodes, transistors listed by application and ratings, RF, small signal and opto devices listed by application and ratings. Essential Data given for all devices. **TERRIFIC VALUE**

MOTOROLA LINEAR IC'S
B 1114..... $9.95

Popular data manual. At last readily available. Approx. 800 pages, full Data Design proceedures and equivalent listings for 1000's of devices under headings OP AMPS, VOLTAGE REGULATORS, CONSUMER CIRCUITS (eg. TV AUTOMOTIVE, POWER), HIGH FREQUENCY CIRCUITS and SPECIAL-PURPOSE CIRCUITS.

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B 1115..... $11.50

Complements the Linear IC Manual. Gives data, design proceedures and equivalent listings for: MEMORY/MICROPROCESSOR SUPPORT, LINE DRIVERS/RECEIVERS, TELEPHONY, COMPARATORS, VOLTAGE REFERENCE AND DATA CONVERSION DEVICES **includes comprehensive selector guide.**

MOTOROLA MICROPROCESSOR DATA
B 1120..... $14.95

Over 1200 pages covering all aspects of motorola's microprocessor, microcomputer and peripheral components. A clearly written Manual providing all the data necessary to design and build a working computer system from scratch. **100's of circuit examples, flow charts, Truth Tables and programme routines.**

MOTOROLA MEMORY DATA
B 1113..... $8.95

An absolute must for the microprocessor Buff. This is the latest reprint of Motorola's famous Memory Data Manual and includes all the latest specifications and design application data on TTL RAM, TTL PROM, MECL MEMORY, MECL RAM, MECL PROM, MOS dynamic RAM, MOS static RAM, MOS EPROM, MOS EE PROM and MOS ROM **worth many dollars more!**

SCHOTTIKY TTL DATA
B 1109..... $9.95

Essential reference for the enthusiast and engineer alike. Designing, building and servicing digital circuitry is an absorbing pastime. Data for the LS, ALS and FAST families along with design considerations and circuit characteristic are logically presented in this manual, making it quick and easy to use.

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The Microprofessor Sound Generation Board

The Microprofessor MPF-1 has an optional Sound Generation Board accessory known as the SGB-MPF. This board provides a programmable complex sound generation facility.

Lance Wilson

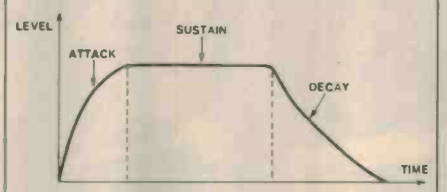
ANY MUSICAL or non-musical sound has a waveform which varies in a way which can be specified by a series of parameters; that is, a group of numbers which, in the case of a musical sound, describe the pitch and 'quality' of the note. The most fundamental of these parameters is the frequency, which would be the frequency of the fundamental for some complex wave, such as that emitted by a trumpet (look up any good text on electronics under Fourier analysis for more details).

As well as the fundamental there will be the presence of harmonics to affect our perception of the sound; i.e: whether it is raspy or relatively pure, and so such presence requires specification also. When we generate sounds digitally, we are usually working with square waves, which have a high proportion of harmonics.

The way the sounds build up and fall away is also of fundamental importance and other parameters are used to specify these properties, the most important ones being 'attack' — the time to build up to full level, sustain — which is how long it stays at full level, and decay — the time it takes to die away.

The SGB-MPF is a sound generation board designed to operate with the Microprofessor as the controller. It incorporates a complex sound generator chip, the AY-3-8190, to provide sounds of the required parameters as programmed by the MPF-1 CPU board. On-board is an EPROM which contains a demonstration program segment of preprogrammed sounds and many useful subroutines which one may use to obtain certain desired and unusual effects. These include gun shots, explosions, laser-type sounds as well as some PacMan game-type noises. Thus, one may make up a program on the MPF-1 which calls the particular sounds as required.

The SGB-MPF. You get a board and speaker.



Envelope. The various portions of a sound 'envelope' affect its character.

As well as the unmelodious sounds above, the EPROM has a routine which converts the pushbuttons of the MPF-1 to the keys of a simple 'electronic piano' which has the added provision of a range of rhythm accompaniments, e.g: cha-cha and rock.

However, these preprogrammed sounds are not the only ones availble via the board since one may provide a series of bytes to the SGB board which specify the various sound parameters and so you can produce sounds tailored to order.

Summary

The SGB-MPF provides the facility of sound generation to those users of the Microprofessor who are into the synthesis of various sounds for use in programs or to record for a myriad of purposes. It is fairly easy to operate although the Chinese-English handbook does not facilitate this to a great degree. However, once completely familiar with its use, the serious 'sonophile' would probably find this board a useful tool in investigations into the complexities of sound, before graduating to the delirium (and expense) of a Fairlight Computer Musical Instrument at around 2000 times the price.

The SGB-MPF is available through Emona Computers, CBC Bank Bldg., 661 George Street, Haymarket, Sydney 2000. NSW (02)212-4815. ●

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Specifications:

PROCESSOR: Z80A running at 3.375 MHZ

KEYBOARD: 60 key FULL SIZED QWERTY layout with full travel.

MEMORY: 44K comprising of 16K user RAM (expandable on-board to 32K), 20K ROM software, 4K character ROM, 4K graphics and screen memory.

DISPLAY: Direct video to external monitor or modified TV. 80 by 24 and 64 by 16 character display modes, high resolution PCG graphics to 512 by 256 pixels. Upper and lower case with full programmability at any screen location.

SOFTWARE: MICROWORLD 16K BASIC V5.22 in ROM, MICROWORLD Z80 machine code monitor, built-in diagnostics, NETWORKING with programmable baud rates from 110 to 4800 Baud, 7,8 bit formats, half, full duplex transmission and complete file transfer using the 'HOBBY' standard Christensen protocol.

INPUT/OUTPUT: Programmable 8 bit input/output parallel port, programmable RS232 port, cassette interface, direct video, 50 way Z80 expansion bus.

microbee Series 2 EDUCATOR

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KEYBOARD: 60 key FULL SIZED QWERTY layout with full travel.

MEMORY: 36K comprising of 8K user RAM (expandable on-board to 16K), 20K ROM software, 4K character ROM, 4K graphics and screen memory.

DISPLAY: Direct video to external monitor or modified TV. 80 by 24 and 64 by 16 character display modes, high resolution PCG graphics to 512 by 256 pixels. Upper and lower case with full programmability at any screen location.

SOFTWARE: MICROWORLD 16K BASIC V5.22 in ROM, MICROWORLD Z80 machine code monitor, built-in diagnostics, NETWORKING with programmable baud rates from 110 to 4800 Baud, 7,8 bit formats, half, full duplex transmission and complete file transfer using the 'HOBBY' standard Christensen protocol.

INPUT/OUTPUT: Programmable 8 bit input/output parallel port, programmable RS232 port, cassette interface, direct video, 50 way Z80 expansion bus.

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By popular request, the low cost **microbee Series 2 Experimenter** has been designed for those who are starting out in the fascinating world of computers or those who want to share the fascination of exploring the exciting developments in the fast moving MICRO WORLD.

Demand for projects using the **microbee** is so great that 'Electronics Today' are now planning to run a **microbee** project every month during 1984. So far ETI has described the light pen, EPROM programmer, a radio TTY printer, the World's first home facsimile receiver and ROM expander board for the **microbee**. Virtually every local computer magazine has run reviews and/or columns devoted entirely to the **microbee**. If you want to be part of the MICRO-COMPUTER GENERATION in 1984 then **microbee Series 2 Experimenter** is the ideal starting point.

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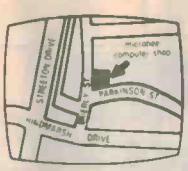

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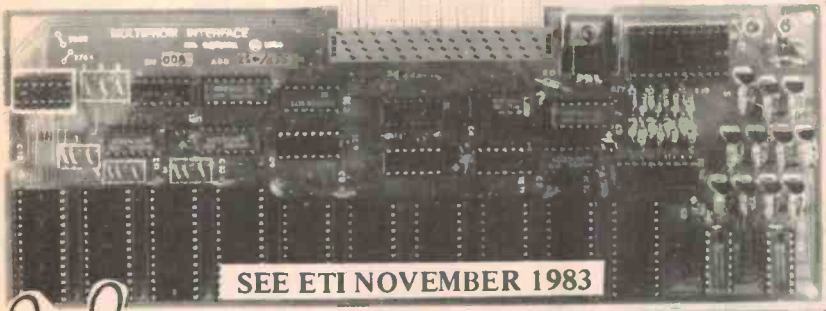
The Avtek kit includes a plated through board plus all components to make this exciting project. There is also provision on the board to change the address of the ports used for eprom selection and input/output.



SEE ETI NOVEMBER 1983

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XM-1 – This is a totally new product developed EXCLUSIVELY for AVTEK – It takes two sets of EPROMs (e.g. WORDBEE and EDASM) and allows you to choose between them by simple KEYBOARD COMMANDS. It will take a short time to assemble and is simply installed inside the MICROBEE with one DIP plug (supplied) and two solder connections.
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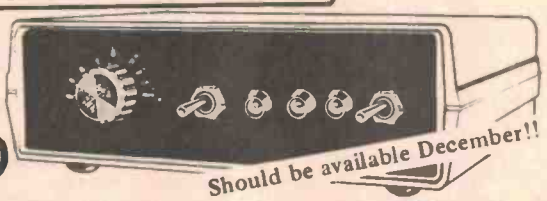

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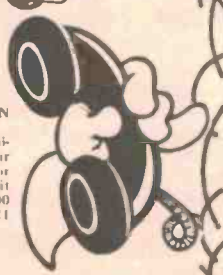

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ENFIELD OPEN ON SUNDAY

The Microbee is a popular computer and we've been encouraging your enthusiasm with special Microbee projects and this column. Some interesting programs have been sent to this column; keep them coming in.

But when you do send in a program make sure that it has been given a name, describe what it is intended to do, how it works, what the controls are, etc. We will not publish a program which does not have any description with it.

Microbee Column, August '83, page 61. J. Murfet's program 'Typing Tutor' had a few typing mistakes (ironical, isn't it?).

00280 should be for I = K to K + 16 * 3 – 1
00330 should be Read L: Poke I, L
00410 should be for I = K to K + 16 * 5 – 1

TEST PATTERN

D. J. Whyatt, Sth Plympton SA

To set up a monitor it is often useful to fill the screen with a character. This program does this if the 'ESC' key is pressed before another key. To reposition the screen, just press 'ESC' twice before the positioning key.

This may not sound very exciting, but it does illustrate the use of the 'ESC' key to run a machine code program directly.

The POKE in the BASIC program sets the Input Device Vector to point to the routine at 15000 instead of the routine in BASIC. The routine then calls the BASIC so that normal operation is possible, but checks for the 'ESC' key. If found, control is then directed to a call as specified; in this case, the FILL routine.

In the BASIC program the third Data line is the routine to be called. Hopefully, the Assembly listing shown will help to illustrate this technique.

TEST PATTERN — ASSEMBLY LISTING

```
ADDR    CODE      LINE    LABEL   MNEM    OPERAND

                  00100 ; Program to display screen full of
                        test character
                  00110
0400              00120           DEFR    16
8006              00130 KEY       EQU     8006
A3E9              00140 BASKEY    EQU     0A3E9
001B              00145 ESC       EQU     1BH
3A98              00150           ORG     3A98
                  00160
                  00170 ; Control directed here on any key
                        entry from BASIC.
                  00180
3A98 CDE9A3       00190           CALL    BASKEY
3A9B F5           00200           PUSH    AF
3A9C FE1B         00210           CP      ESC
3A9E 2802         00220           JR      Z,ESCKEY
3AA0 F1           00230           POP     AF
3AA1 C9           00240           RET
                  00250
                  00260 ; Control directed here if 'ESC' key
                        found.
                  00270
3AA2 F1           00280 ESCKEY    POP     AF
3AA3 CD0680       00290           CALL    KEY
3AA6 FE1B         00300           CP      ESC
3AA8 C8           00310           RET     Z
3AA9 CDAD3A       00320           CALL    FILL
3AAC C9           00330           RET
                  00340
                  00350 ; Screen is filled with character in A.
                  00360
3AAD 010008       00370 FILL      LD      BC,800
3AB0 2100F0       00380           LD      HL,0F000
3AB3 5F           00390           LD      E,A
3AB4 73           00400 LOOP1     LD      (HL),E
3AB5 23           00410           INC     HL
3AB6 0B           00420           DEC     BC
3AB7 78           00430           LD      A,B
3AB8 B1           00440           OR      C
3AB9 20F9         00450           JR      NZ,LOOP1
3ABB C9           00460           RET
0000              00470           END
00000 Total errors
LOOP1   3AB4    FILL    3AAD    ESCKEY  3AA2    ESC     001B
BASKEY  A3E9    KEY     8006
```

TEST PATTERN — BASIC LISTING

```
00100 FOR L=15000 TO 15035:READ D:POKE L,D:NEXT L
00110 POKE 194,152:POKE 195,58
00120 END
00130 DATA 205,233,163,245,254,27,40,2,241,201
00140 DATA 241,205,6,128,254,27,200,205,173,58,201
00150 DATA 1,0,8,33,0,240,95,115,35,11,120,177,32,249,201
```

CONES AND PYRAMIDS

Jason McLaren, Labrador Qld.

This program is designed to draw and calculate the volume of cones and pyramids.

It contains a combination of hi-res graphics and text. The subroutine, lines 470 to 580, is interesting as this contains a circle drawing routine. The speed and definition may be varied by altering the step size in line 490 e.g.: 0.01.

CONES AND PYRAMIDS

```
00100 REM PROGRAM
00110 CLS:PRINT
00120 UNDERLINE:PRINT"THIS CALCULATES THE VOLUME OF PYRAMIDS
      AND CONES":NORMAL
00130 PRINT:PRINT"DO YOU WANT CONE OR PYRAMID"
00140 INPUT E1$
00150 IF E1$="CONE" THEN 170
00160 IF E1$="PYRAMID" THEN 260
00170 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
00180 PRINT:PRINT:PRINT:PRINT:PRINT
00190 INPUT"WHAT IS THE RADIUS"A1
00200 INPUT"WHAT IS THE HEIGHT"B1
00210 GOSUB 470
00220 CURS 1,15:PRINT"THE RULE IS 1/3 AREA OF BASE x HEIGHT"
00230 LET R1=3.14*(A1)^2*(B1)/3
00240 PRINT"THE ANSWER IS "R1
00250 GOTO 330
00260 INPUT"WHAT IS THE SIDE OF BASE MEASUREMENT"D1
00270 INPUT "WHAT IS THE HEIGHT"G1
00280 CLS
00290 GOSUB 370
00300 LET U1=(D1)^2*(G1)/3
00310 PRINT"THE RULE IS 1/3 AREA OF BASE x HEIGHT"
00320 PRINT"THE ANSWER IS "U1
00330 PRINT"DO YOU WANT TO ENTER ANOTHER SUM. YES OR NO"
00340 INPUT L1$
00350 IF L1$="YES"THEN CLS:GOTO 130
00360 IF L1$="NO" THEN PRINT"OK":END
00370 HIRES
00380 PLOT 150,127 TO 230,110
00390 PLOT 230,110 TO 230,50
00400 PLOT 150,127 TO 150,70
00410 PLOT 150,70 TO 230,50
00420 PLOT 230,50 TO 320,120 TO 150,127
00430 PLOT 230,110 TO 320,120 TO 150,70
00440 CURS 38,11:PRINT"HEIGHT "G1
00450 CURS 13,13:PRINT"SIDE "D1
00460 RETURN
00470 CLS:HIRES
00480 PI=355/113
00490 FOR T0=0 TO PI*2 STEP .1
00500 X=INT(255+25*COS(T0))
00510 Y=INT(127+25*SIN(T0))
00520 SET X,Y
00530 NEXT T0
00540 PLOT 255,152 TO 400,127
00550 PLOT 255,102 TO 400, 27
00560 CURS 18,9:PRINT"RADIUS "A1
00570 CURS 40,10:PRINT"HEIGHT "B1
00580 RETURN
```

UHF AMPLIFIER SENSATION

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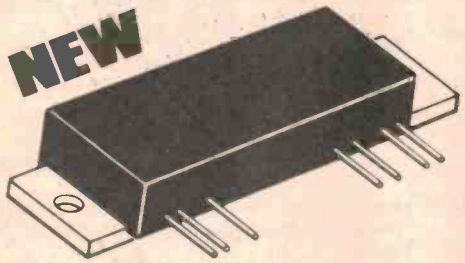

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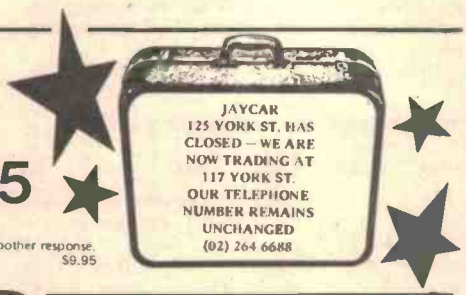

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This is the 650 volt version (for extra safety) of the C122E SCR which we use in the popular 'Fluorescent Lamp Starter' Kit as described in October 1982 EA. Normally $1.50 each. This month only $0.95 each! (Minimum 5 pieces). Makes the Fluoro starter kit very cheap!
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Cat. ZX7022
(8 amp 650V SCR)

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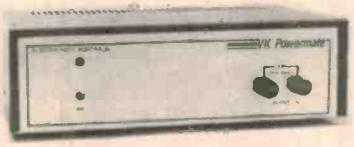
Get up to 13.8V @ 10 amps to run those mobile rigs at home! The Jaycar kit is complete.



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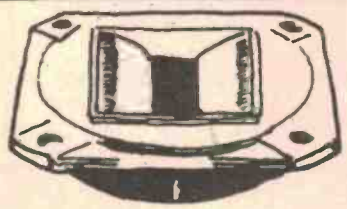
BD677 Popular Philips Darlington Transistor
The BD677 is an NPN, TO-126, 60 volt 4 amp Darlington transistor. Its gain (hFE at 1.5A) is – would you believe 750!
We have a bulk-buy of this snappy little transistor so you save!

ONLY 75 cents each 10 up 65 cents each

from **65¢**



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Cat. CE-2042 NORMALLY $36.50 ea

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- BIFURCATED SELECTOR SWITCH CONTACTS!
- ABS IMPACT–RESISTANT CASE!
- LARGE! MEASURES 90(w) x 135(h) x 45(d)mm

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0 – 0.25	0 – 10
0 – 10	0 – 50
0 – 50	0 – 250
0 – 250	0 – 1000
0 – 1000	AT 9,000 ohms/volt

AT 20,000 ohms/volt

RESISTANCE	DC CURRENT
0 – 5K	0 – 0.05
0 – 50K	0 – 25
0 – 500K	0 – 250mA

dB: -20 to +22dB
BATTERY CHECK FACILITY: AA, C & D CELLS
ACCURACY: DC +/–3% F.S. AC +/–4% F.S.
OHMS +/–3%
BANANA PLUG PROBES AND BATTERY INCLUDED
This is an unbelievable meter bargain. Normally this unit would sell for around $25. Japanese made quality.
Cat. QM-1005 $17.95

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Sensitivity	98 (dB/W)
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Flux Density	8,300 Gauss
Net Weight	1,540 gm

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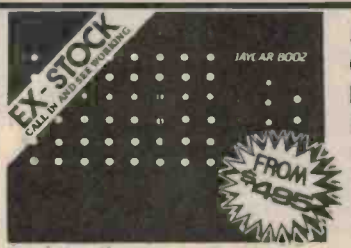

8 CHANNEL MIXER KIT

Ref: EA March/April 1983
This great 8 channel 'live' mixer is perfect for bands, churches, theatre groups, home recording, disco etc.
Each input channel accepts either microphone (balanced) or line (1V) levels. Powerful equalisation foldback effects facilities are provided. The left and right master channels can drive balanced or unbalanced lines with 5 band "graphic" equalisation. Separate foldback and "effects" are provided.
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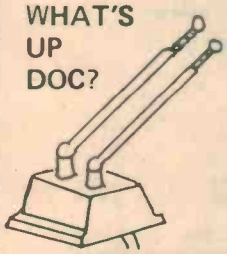
Complete 8 channel mixer
(19" rack mount) Cat. KJ6504 $495.00
Console mount chassis, power supply and wooden end pieces
Cat. KJ6505 $98.00
You end up with a $1500+ unit for under $600

WHAT'S UP DOC?



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THE VIC-20 COLUMN

★ENCOURAGEMENT★

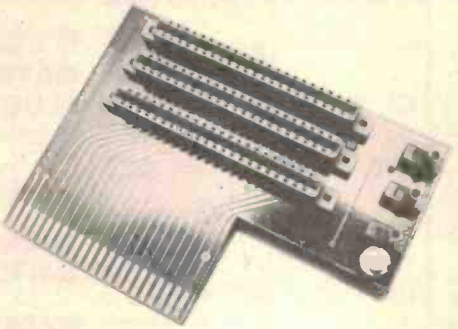
Ozi-Soft, in conjunction with Computer Technics, is offering to donate a VIC-20 expansion board for the best software item submitted to this column every month.

The board is Australian-designed and manufactured and simply plugs into the VIC-20's expansion slot. It features three sockets that can be independently switch-selected, plus an on-board reset switch. With it you can plug in up to three separate expansion units to your VIC-20 and avoid the hassle of plugging things in and out and turning the computer on and off each time.

It is distributed by **Computer Technics, 123 Clarence Street, Sydney (G.P.O. Box 4936) NSW 2000. (02)29-7244.** The board costs $59.95.

All submissions must be accompanied by a signed letter from you stating that it's your original work. The winning submission will be judged by the Editor and no correspondence will be entered into. All published submissions will be paid for.

Send entries to: **The Editor, VIC-20 Column, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**



The winner of the VIC-20 expansion board this month is Chris Groenhout who wrote the program 'Alphabet'. This multi-function program teaches children to recognise shapes, learn the alphabet and also gives them useful keyboard skills.

ALPHABET

Chris Groenhout, Watson ACT

Alphabet is an educational program aimed at educating children between the ages of three and six. It increases the ability of the younger children in the group to recognise shapes. It is also intended to teach keyboard skills which will be useful throughout life.

When the program is run it shows a menu of either a sequential order of letters or a random order as a means to exit the program.

If you chose the first it clears the screen and prints a character eight times its usual size then waits for you to match it with one from the keyboard. The character you pressed is shown in a large size below the first and if the answer is correct the program continues on to the next letter in sequence until Z is found. The program is then rerun. If an incorrect answer is given a descending sound is generated and the question asked again. When the answer is correct the program continues.

If the random option is chosen the action is the same as previously described but instead of appearing in alphabetical order, the letters appear in a random order until 26 have been chosen. The program then reruns.

The program can be returned to the menu at any stage by pressing the up-arrow key. The program fits easily into the unexpanded VIC and can be SAVEd without any problems.

Lines 10-80 are the menu and option determination, lines 90-180 are the sequential letter routine, lines 190-280 are the random letter routine, line 290 is the end routine and lines 310-320 are the big character routine.

ALPHABET

```
5 REM **** (C) CHRIS GROENHOUT 1983 ****
10 PRINT"■"CHR$(142)CHR$(8):PRINTTAB(7)"■ALPHABET":PRINTTAB(7)"──────"
20 PRINT:PRINT"■ ■1■)SEQUENTIAL"
30 PRINT:PRINT"■ ■2■)RANDOM"
40 PRINT:PRINT"■ ■3■)EXIT PROGRAMME"
50 PRINT"■■■■■ENTER NUMBER..."
60 GETA$:IFA$=""THEN60
70 ONVAL(A$)GOTO90,190,290
80 GOTO50
90 POKE36878,15:FORG=1TO26:PRINT"■";:POKE7680,G+128:POKE38400,0:PRINT"■■■M"G:A=G
100 PRINT"■":GOSUB310
110 POKE198,0
120 GETA$:IFA$=""THEN120
130 IFA$="↑"THENRUN
140 H=ASC(A$):A=INT(H-64):IFA(1ORA)26THEN110
150 PRINT"■":GOSUB310:IFA=GTHEN170
160 PRINT"■■NO!■":FORS=200TO127STEP-1:POKE36874,S:NEXT:PRINT"■■■■■■■■■■■";:GOTO11
0
170 PRINT"■■YES!■":FORS=200TO254:POKE36876,S:NEXT:POKE36876,127:FORT=1TO500:NEXT
:NEXT
180 RUN
190 FORI=1TO26:PRINT"■";:A=INT(RND(1)*26+1):POKE7680,A+128:POKE38400,0:PRINT"■■■
#"I
200 POKE36878,15:J=A:PRINT"■":GOSUB310
210 POKE198,0
220 GETA$:IFA$=""THEN220
230 IFA$="↑"THENRUN
240 H=ASC(A$):A=INT(H-64):IFA(1ORA)26THEN210
250 PRINT"■":GOSUB310:IFA=JTHEN270
260 PRINT"■■NO!■":FORS=200TO127STEP-1:POKE36874,S:NEXT:PRINT"■■■■■■■■■■■";:GOTO21
0
270 PRINT"■■YES!■":FORS=200TO254:POKE36876,S:NEXT:POKE36876,127:FORT=1TO500:NEXT
:NEXT
280 RUN
290 PRINT"■■■■":END
310 B=32768+8*A:FORC=8TO8+7:D=PEEK(C):POKE=1TO8:F=146:D=D*2:IFD>255THEND=D-256:F
=18
320 PRINTCHR$(F)CHR$(32);:NEXT:PRINTCHR$(146):NEXT:RETURN

READY.
```

ROAD RACE

Stuart Young, Cardinia, Vic.

This game program was written by a Year 10 student at Endeavour Hills Technical School.

```
0 REM■  CHANGE THE       IFQWE=1 IN LINE 8
  TO IFQWE=5 SO       THAT IT IS  EASIER
1 GOSUB800:BV=1:DELAY=80:PRINT"■"
2 X=7694:POKEX,22
3 R5=PEEK(36866):POKE36878,15
5 RC=11
8 QWE=QWE+1:IFQWE=1THEN:QWE=0:GOTO10
9 GOTO 20
10 VNM=VNM+1:IFVNM=30THENVNM=0:GOTO550
11 BNM=BNM+1:IFBNM=100THENASD=ASD+1:BNM=0:GOTO500
12 ZXC=INT(RND(1)*2)+1
13 IFZXC=1THENRC=RC+1
14 IFZXC=2THENRC=RC-1
15 IFRC<(1THENRC=1
16 IFRC=>12THENRC=12
20 PRINTTAB(RC)"■■■■      ■■■"
30 GETA$
33 IFA$="Z"THENZ=Z-1
34 IFA$="/"THENZ=Z+1
42 IFPEEK(X+Z)=170THENPOKEX+Z,86:GOTO200
43 POKEX+C+Z,22
50 IFA$="■"THENBV=1:DELAY=80
51 IFA$="■"THENBV=2:DELAY=40
52 IFA$="■"THENBV=3:DELAY=20
53 IFA$="■"THENBV=4:
99 SC=SC+BV:IFBV=4THEN8
100 FORI=1TODELAY:NEXTI:GOTO8
200 PRINT"■■■SMASH■":POKE52,0:POKE36878,15
202 FORM=1TO300:NEXTM
203 FORL=1TO17:GOSUB670:NEXTL:POKE36867,130:FORI=1TO300:
    NEXTI
204 IFSC>HSTHENSS=HS:HS=SC:GOTO210
205 IFSC<HSANDSC>SSTHENSS=SC
209 GOTO301
210 FORL=17TO8STEP-1:GOSUB670:NEXTL:POKE36866,R5:
211 INPUT"■■PRINT YOUR NAME";NAME$
301 POKE36879,46:PRINT"■■■■YOUR SCORE■"SC"■■■■■■■■■■RND
    YOU■"ASD"■■."BNM"■■ KM I N".
302 PRINT"■■■■TOP SCORE■"HS"■■■■■■■■■■BY■ "NAME$
303 PRINT"■■■■ND SCORE■"SS"
304 FORL=17TO8STEP-1:GOSUB670:NEXTL:POKE36866,R5:
    POKE36878,0
305 INPUT"■■ANOTHER GO";AC$
306 IFAC$="N"THENPOKE36879,27:PRINT"■":END
306 SC=0:PRINT"■":RC=11:Z=0:C=0:POKE36879,92:ASD=0:
    DELAY=80:BNM=0:VNM=0:GOTO5
500 PRINTTAB(RC)"■■■■■"ASD"■■■■■■"
510 GOTO30
550 PRINTTAB(RC)"■■■■■ ■■■■■":GOTO50
670 REM
680 POKE36877,230+L
690 POKE36864,12+L
700 POKE36865,38+2*L
710 POKE36866,R5-L
720 POKE36867,174-L*2
730 RETURN
800 POKE36879,92
810 PRINT"■■ ■■     ROADRACE■                BY S.YOUNG■■"
820 PRINT"■■ CONTROL YOUR CAR      THE ■■■ ALONG
    THE ROAD USING KEYS"
830 PRINT"■■ Z-LEFT   ?-RIGHT■■
    AND TO CHANGE GEARS■■       F1-1ST GEAR
840 PRINT"     F3-2ND GEAR
    F5-3RD GEAR          F7-TOP GEAR"
850 PRINT"■ ■    ■ HIT SPACE ■■
860 GETA$:IFA$=""THEN860
870 RETURN

READY.
```

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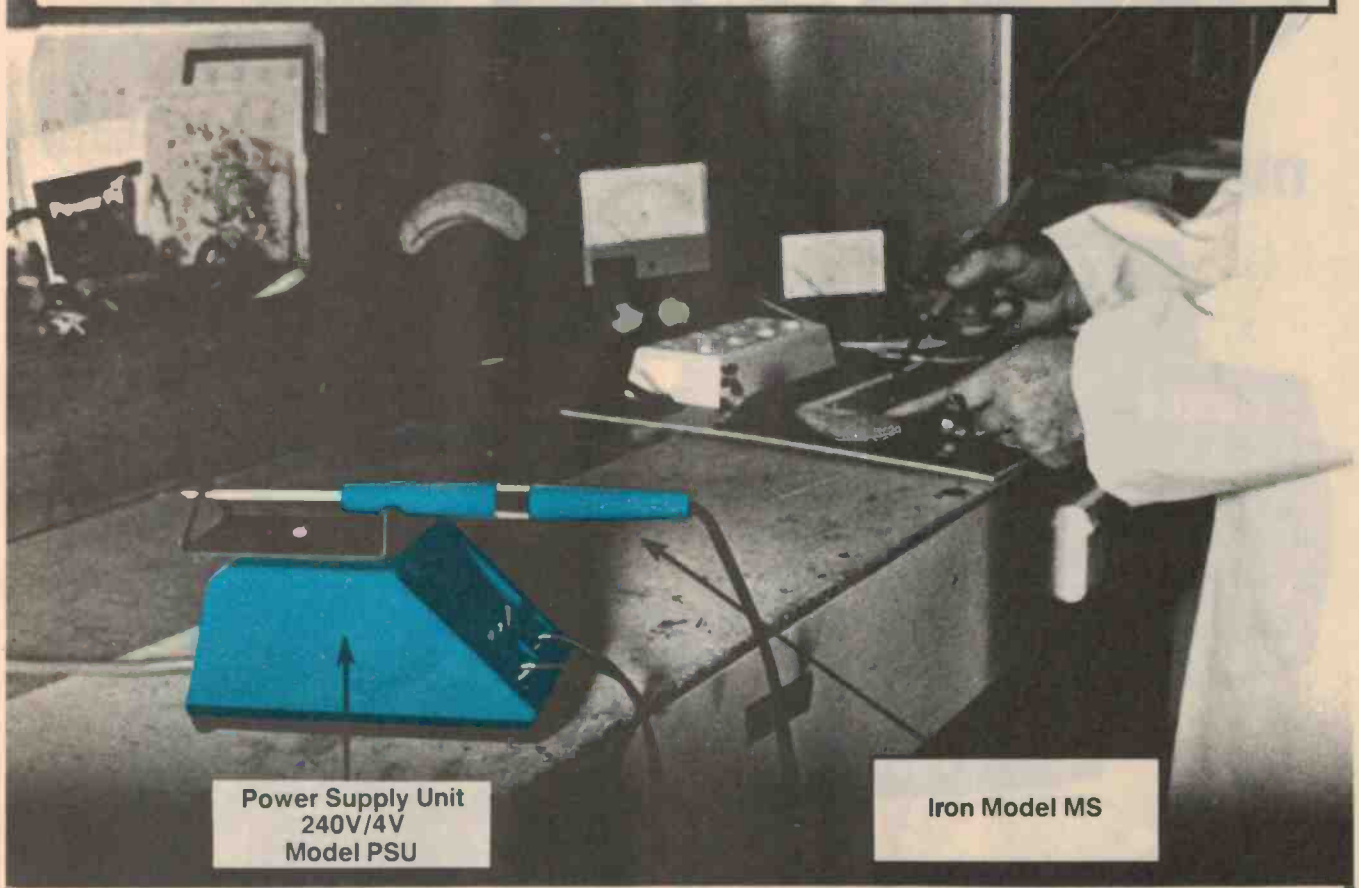

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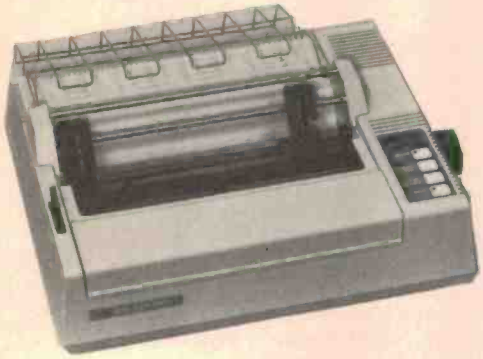


Here is an unbeatable opportunity to purchase a top quality printer from a well known and respected manufacturer, Texas Instruments, at a saving of over 30% on their normal list price.

TI 850 PRINTER

$760 exc. tax
$912 inc. tax

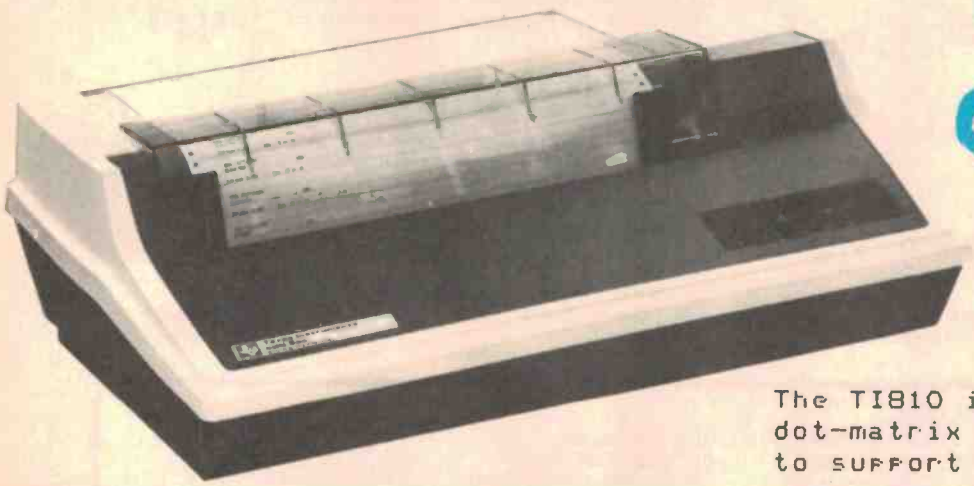
Normal list price on this printer is $995 exc. tax; save $235!

SPECIFICATIONS TI 850 PRINTER

TI 850 SPECIFICATIONS

POWER REQUIREMENTS	
Voltage	90-132 Vac, 47 63 Hz, single phase or 187-264 Vac, 47 63 Hz, single phase
Power	100 W maximum
PHYSICAL DIMENSIONS	
Size	412 mm (16.2") wide 220 mm (13.0") deep 127 mm (5.0") high
Weight	6.8 kg (15lb) excluding options and accessories
CHARACTER SETS	
Type	Full US ASCII and 7 international
INDICATORS	
Light	Power, on-line, pitch SFL
DATA	
Parallel interface:	
Line levels	0 or +5 Vdc
Characters per second	1000 cps maximum
Line control	Strobe acknowledge
Serial interface:	
Specification	EIA RS-232-C standard subset
Line levels	−12 or +12 Vdc
Type code	ASCII and similar international codes
Bits per second	200, 300, 600, 1200, 2400, 4800, 9600
Receive buffer	256 characters, expandable to 4000 characters
Line control	Printer ready busy
PRINTER	
Method	Wire-matrix impact
Speed	Print 150 cps
Pattern	9 x 9 dot matrix (standard print) 15 x 9 dot matrix (enhanced print)
Characters per inch	10 cpi and 16⅔ cpi (standard) 5 cpi and 8⅓ cpi (double-wide)
Characters per line	80 characters at 10 cpi (standard), 132 characters at 16⅔ cpi
Line length	Full line at 10 cpi or 16⅔ cpi requires 203 mm (8")
Lines per inch	6 lpi and 8 lpi
Paper drives	Friction-roller or tractor
Paper width	76 mm to 254 mm (3 to 10 in)
PAPER	
Type	Sheet, roll or fanfold (single or multipart)
Width	254 mm (10in) maximum
Roll	127 mm (5.0 in), maximum diameter
Thickness	Single part 0.254 mm (0.01 in) Multipart, 0.34 mm (0.014 in) maximum for original plus two copies (No cards permitted except on last copy)

TI 810 PRINTER



$1410 exc. tax
$1692 inc. tax

Normal list price on this printer is $1890 exc. tax; save $480!

The TI810 is a fast, draft-quality dot-matrix printer which is built to support continuous throughput.

SPECIFICATIONS TI 810 PRINTER

TI 810 PRINTER

PRINTER	
Technique	Seven-wire matrix impact
Character matrix	9 x 7 (9 wide, 7 high) dot matrix
Character set	64-character limited ASCII
Characters per inch	10
Characters per line	132 maximum
Lines per inch	6 or 8 (operator — or software — selectable)
THROUGHPUT	
Print speed	150 characters per second
Lines per minute	64 at 132 characters per line, and up to 450 at 10 characters per line
Line feed	33 milliseconds
Paper slew	170 mm per second (6.67 inches per second)
PAPER	
Paper width	Adjustable from 76 to 381 mm (3 to 15 inches)
Paper loading	Rear or bottom feed
Number of copies	One original and five copies
CONTROL SYSTEM	
Electronics	8080 microprocessor system
Printing method	Bidirectional
Buffer (FIFO)	256 characters
Horizontal tabs	Software Programmable
Vertical format control	Software and operator programmable
Self-test	Prints ASCII characters in a rotating pattern (barberpole)
Bell	Pulsing adjuble tone
COMMUNICATIONS	
Interface	Serial (EIA RS-232-C)
Baud rates	110, 150, 300, 1200, 2400, 4800, 9600
Parity	ODD, EVEN or ignore
INPUT POWER	
ac voltage	100, 120, 220 or 240 Vac (+ 10% to −15%)
Frequency	47 to 63 hertz
Watts	200
Power fuse	100 or 120 Vac range, 5 A, 250 V fuse 220 or 240 Vac range, 2.5 A, 250 V fuse
PHYSICAL DIMENSIONS	
Weight	25 kg (55 pounds)
Height	203 mm (8 inches)
Width	654 mm (25.75 inches)
Depth	508 mm (20 inches)

OPTIONS

Serial EIA cable for 810 printer: $50 exc. tax, $60 inc. tax.
Serial cable for 850 printer: $55 exc. tax, $66 inc. tax.

4K buffer for 850 printer: $100 exc. tax, $120 inc. tax.
All items carry normal warranty.

OFFER*

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TOP QUALITY TEXAS INSTRUMENTS PRINTERS

TI850 PRINTER

The Model 850 printer is a reliable, versatile dot matrix impact printer featuring 150 cps bi-directional operation and 9 x 9 or 15 x 9 dot matrix characters with true descenders. Mosaic graphics are possible with a squared-off pattern six dots wide by 12 dots high. It is also capable of raster graphics.

It comes with a serial/parallel interface as standard; all you do is change the cable. There is a 256-character buffer inside and a 400-character buffer option is offered, too. The 850 can handle single sheets of paper or fanfold paper up to 254 mm (10") wide and roll paper up to 127 mm (5") in diameter. A comprehensive, copiously illustrated, 108-page manual is supplied with the printer.

This is an example of STANDARD print made by the Model 850 Printer.

This is an example of ENHANCED print made by the Model 850 Printer.

This is an example EMPHASIZED print made by the Model 850 Printer.

This is an example of COMPRESSED print made by the Model 850 Printer.

The Model 850 Printer made this example of DOUBLE-WIDE print.

TI810 PRINTER

The Texas Instruments Omni 800 Model 810 printer is a receive-only, forms-programmable impact printer. It features a microprocessor system which controls all character recognition, printing and paper movement. Basic operating, data processing and self-test routines for the microprocessor system are stored in ROM. Random-access memory stores vertical format control routines, which may be locally programmed by the operator or remotely programmed through the communications line.

A single seven-dot-column printhead produces the 9 x 7 dot matrix for character generation. Printing is bi-directional at the rate of 150 characters per second. A full 132-character line is printed in less than one second.

The standard print format is 10 characters per inch (cpi) horizontally and six or eight lines per inch (lpi) vertically. The printer produces one original and up to five copies using sprocket-fed paper in widths from 76.2 to 381 mm (3" to 15").

A detailed, comprehensive, A4-format, 76-page manual is included.

Serial/parallel interface is standard; all you do is change the cable.

There's nothing flash about the Texas Instruments 810 printer — but it's an ideal printer. It prints quickly and cleanly, and it's as close to unbreakable as we've seen. We run three of them in this office — one has been on-line for more than a year without missing a beat. It literally never gets switched off, and runs up to 24 hours a day, all the time.

When we want to move cables in the ceiling, we stand on the printer to get to them! Most printers these days would collapse as soon as you even thought of doing such a thing.

The TI810 is recognised throughout the industry as a reliable, fast workhorse. It's claimed to run at 150 characters a second, and it comes closer to its rating than anything else we've tested. On a solid-text printing test that shows 80 cps machines are actually running at around 34 cps, the 810 comes up just under 130. That's fast.

Its dot matrix typeface is obviously draft quality, without full descenders, but it is clear and readable. If speed and real bullet-proof reliability are what you need, this is the machine.

Normal retail price is around $2200 before tax, and it's good value even at that price.

This is a sample of the dot-matrix print quality of the high-speed Texas Instruments TI810.

HOW TO ORDER YOUR TI PRINTER

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See page 120 for address details

A618/TH

& look at these exciting ways to expand your system

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Cat X-7235

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If you can't guess the mystery word (8 letters) the figure on the screen is hanged – you lose! Based on the popular children's game, this program helps kids with spelling and vocabulary.
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NOTE: Some programs may require 16K memory module.

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ZX COLUMN

LIFE FOR THE ZX 80

J. L. Elkhorne, Chigwell Tas

This program is a machine code version of the John Conway 'Life' simulation. It displays a 16 x 16 matrix on the screen. It was developed on the 'old ROM' ZX80 and uses slightly more than 2K of memory.

It could be made shorter by treating the machine code as a saved variable, but an inadvertent RUN would require a reload from tape. Loading takes 47 seconds and transferring the machine code after RUN takes 10 seconds.

Once this is accomplished, you are prompted for cell entry. Zero is the upper left hand corner and 255 is the lower right. After cells are entered, any larger number goes to the machine code routine and displays the resultant pattern. Each new line will continue the process.

If the pattern disappears or stabilises, entering 'S' will tell you how many generations the initial pattern went. To continue with a new simulation, enter GO TO 100.

LIFE FOR THE ZX 80 — BASIC LISTING

```
10      DIM A (255)
20      LET M$ = "FDE50600DD2A0A40FD2
        A0840FD23FD231600DD7E00FE762004D
        D2318F578E60F4FB778D6103820DD7EE
        FFE80200114792808DD7EEEFE8020011
        479D60F2808DD7EF0FE8020011479280
        8DD7EFFFE8C20011479D60F2809DD7E0
        1FE80200214B73EEF903823792808DD7
        E11FE80200114792808DD7E10FE80200
        114"
25      REM TO HTST
30      LET ML = 19200
40      GO SUB 5000
50      LET M$ = "79D60F2808DD7E12FE8
        0200114DD7E0082FD770078C60147280
        7DD23FD23C3104BDD2A0A40FD2A0840D
        D23FD23FD23FD7E0057D68228117AD68
        3280C7AD60328073E00DD770018023E8
        0DD7700DD23DD7E00FE762002DD23FD2
        3047820D1FDE1C9"
60      GO SUB 5000
100     LET I$ = "X"
110     LET N = 0
120     LET D = 0
130     LET R = 0
140     LET H = 0
150     LET L = 0
160     LET G = 0
170     LET P = 0
200     FOR L = 1 TO 16
210     PRINT ,,
220     PRINT
230     NEXT L
233     PRINT
234     PRINT "E TO ENTER CELLS"
300     INPUT I$
310     IF I$ = "S" THEN GO TO 6000
320     IF I$ = "E" THEN GO TO 500
330     IF I$ = "" THEN GO TO 1000
500     PRINT "ENTER 0-255 FOR LIVE CELLS"
505     PRINT ">255 TO GO"
510     INPUT N
520     IF N>255 THEN PRINT "S TO STOP OR N/L
        FOR GENERATION"
530     IF N>255 THEN GO TO 1000
600     LET D = PEEK (16396) + 256 * PEEK (16397
610     IF PEEK (D) = 118 THEN GO TO 640
620     LET D = D + 1
630     GO TO 610
640     LET D = D + 1
650     LET R = N/16
660     POKE D + R + N, 128
670     GO TO 510
1000    LET R = USR (19200)
1010    LET G = G + 1
1020    GO TO 300
2000    REM J.L. ELKHORNE
2020    REM HOBART, TASMANIA
5000    LET H = CODE (M$)
5010    IF H = 1 THEN RETURN
5020    LET M$ = TL$ (M$)
5030    LET L = CODE (M$)
5040    POKE ML, 16 * (H - 28) + L - 28
5050    LET M$ = TL$ (M$)
5060    LET ML = ML + 1
5070    GO TO 5000
6000    PRINT
6010    PRINT "THERE WERE "; G; " GENERATIONS"
```

LIFE FOR THE ZX 80 — MACHINE CODE

```
GETADR  FDE5        PUSH IY
        06 00       LD B, 0          No. of Cells
        DD2A 0A40   LD IX, (nn)      Find Display File
        FD2A 0840   LD IY, (nn)      Find Variables
        FD23        INC IY
        FD23        INC IY

POINTR  16 00       LD D, 0          Clear result counter
        DD7E 00     LD A, (IX + D)
        FE 76       CP, 118          Look for N/L char.
        20 04       JR NZ, L/RTST
        DD23        INC IX
        18 F5       JR E, POINTR + 2

L/RTST  78          LD A, B
        E6 0F       AND A, 15
        4F          LD C, A          Store L/R test
        B7          OR A

TOPTST  78          LD A, B
        D6 10       SUB A, 16
        38 20       JR C, DTST

BTST    DD7E EF     LD A, (IX - 17)  Back a row + N/L
        FE 80       CP, 128          Live Test
        20 01       JR NZ, ATST
        14          INC D

ATST    79          LD A, C
        28 08       JR Z, CTST
        DD7E EE     LD A, (IX - 18)
        FE 80       CP, 128
        20 01       JR NZ, CTST
        14          INC D
CTST    79          LD A, C
        D6 0F       SUB A, 15
        28 08       JR Z, DTST
        DD7E F0     LD A, (IX - 16)
        FE 80       CP, 128
        20 01       JR NZ, DTST
        14          INC D

DTST    79          LD A, C
        28 08       JR Z, ETST
        DD7E FF     LD A, (IX - 01)
        FE 80       CP, 128
        20 01       JR NZ, ETST
        14          INC D

ETST    79          LD A, C
        D6 0F       SUB A, 15
        28 09       JR Z, BTMTST
        DD7E 01     LD A, (IX + 01)
        FE 80       CP, 128
        20 02       JR NZ, BTMTST
        14          INC D
        B7          OR A             Clear carry flag

BTMTST  3E EF       LD A, 239
        90          SUB A, B         Neg. answer on
        38 23       JR C, RESULT     bottom row

GTST    79          LD A, C
        28 08       JR Z, FTST
        DD7E 11     LD A, (IX + 17)  Forward a row + N/L
        FE 80       CP, 128
        20 01       JR NZ, FTST
        14          INC D
FTST    79          LD A, C
        28 08       JR Z, HTST
        DD7E 10     LD A, (IX + 16)
        FE 80       CP, 128
        20 01       JR NZ, HTST
        14          INC D
HTST    79          LD A, C
        D6 0F       SUB A, 15
        28 08       JR Z, RESULT
        DD7E 12     LD A, (IX + 18)
        FE 80       CP, 128
        20 01       JR NZ, RESULT
        14          INC D

RESULT  DD7E 00     LD A, (IX + 0)   Get Cell
        82          ADD A, D         plus neighbors
        FD77 00     LD (IY + 0), A   Store in array

ENDTST  78          LD A, B
        C6 01       ADD A, 01
        47          LD B, A
        28 07       JR Z, REFILL
        DD23        INC X
        FD23        INC Y
        C3 104B     JP, POINTR       Absolute address!

REFILL  DD2A 0A40   LD IX, (nn)
        FD2A 0840   LD IY, (nn)
        DD23        INC IX
        FD23        INC IY
        FD23        INC IY

DISFIL  FD7E 00     LD A, (IY + 0)
        57          LD D, A
        D6 82       SUB A, 130       Cell with 2 neighbors
        28 11       JR Z, SETCEL
        7A          LD A, D
        D6 83       SUB A, 131       Cell with 3 neighbors
        28 0C       JR Z, SETCEL
        7A          LD A, D
        D6 03       SUB A, 03        No Cell but 3 neighbors
        28 07       JR Z, SETCEL

CLRCEL  3E 00       LD A, 0
        DD77 00     LD (IX + 0), A
        18 02       JR, PUT

SETCEL  3E 80       LD A, 128

PUT     DD77 00     LD (IX + 0), A
        DD23        INC IX
        DD7E 00     LD A, (IX + 0)
        FE 76       CP, 118
        20 02       JR NZ, N/L + 2

N/L     DD23        INC IX
        FD23        INC IY
        04          INC B
        78          LD A, B
        20 D1       JR NZ, DISFIL
        FDE1        POP IY

        C9          RET
```

SEAFIGHT

C. Huebel, Macquarie ACT

You are in control of an aeroplane circling over a submarine and you have to hit the submarine. You have an unlimited amount of bombs and the bombs are released by pressing any key. But watch out for the battleships because if you hit one of them your five lives will be lost.

The game requires 16K to run it.

```
SEAFIGHT
    1 REM SEAFIGHT
    2 REM
    3 REM (C) C.HUEBEL 1983
    4 REM
   10 PRINT "[graphics]
[graphics]"
   20 FOR N=1 TO 13
   30 PRINT "[graphics]";TAB 31;"[graphics]"
   40 NEXT N
   50 FOR N=1 TO 6
   60 PRINT "[graphics]
[graphics]"
   70 NEXT N
   80 PRINT "[graphics]
[graphics]"
   85 LET H=0
   86 PRINT AT 2,0;"[graphics]
[graphics]"
   87 PRINT AT 1,1;"SCORE=";S;TAB
  11;"HI-SCORE=";H;TAB 24;"LIVES=
";L
   90 LET A$="  [graphics]  "
  100 LET B$="[graphics]"
  110 LET C$="  [graphics]  "
  120 LET D$=" ([graphics]  "
  130 LET E$="[graphics]  "
  140 LET F$="[graphics])  "
  150 LET F=INT (RND*5)+1
  160 PRINT AT 12,F;A$;AT 13,F;B$
;AT 12,F+7;A$;AT 13,F+7;B$;AT 12
,F+14;A$;AT 13,F+7;B$;AT 12,F+21
;A$;AT 13,F+21;B$
  170 LET G$="[graphics]"
  180 LET I$="[graphics]"
  190 LET G=1
  200 FOR N=23 TO 1 STEP-1
  210 PRINT AT 4,N;D$;AT 3,N;C$;A
T 18,N;I$
  220 IF INKEY$ <> "" THEN GOTO 1
000
  230 NEXT N
  240 LET G=2
  250 FOR N=1 TO 23
  260 PRINT AT 4,N;F$;AT 3,N;E$;A
T 18,N;G$
  270 IF INKEY$ <> "" THEN GOTO 1
000
  280 NEXT N
  290 GOTO 190
 1000 REM **FIRE ROUTINE**
 1005 FOR M=5 TO 13
 1010 PRINT AT M,N+((G=2)*4);"V"
 1020 LET N=N+(G=2)-(G=1)
 1030 IF N=1 OR N=23 THEN GOTO 20
00
 1040 IF G=1 THEN PRINT AT 4,N;D$
;AT 3,N;C$;AT 18,N;I$
 1050 IF G=2 THEN PRINT AT 4,N;F$
;AT 3,N;E$;AT 18,N;G$
 1055 PRINT AT M,N+(((G=2)*4)-1)-
((G=1)*2);" "
 1060 NEXT M
 1070 IF N+((G=2)*4)=F+4 OR ((G=2
)*4)=F+11 OR ((G=2)*4)=F+18 OR (
(G=2)*4)=F+5 OR ((G=2)*4)=F+6 OR
 ((G=2)*4)=F+12 OR ((G=2)*4)=F+1
3 OR ((G=2)*4)=F+19 OR ((G=2)*4)
=F+20 THEN GOTO 1080
 1075 GOTO 3000
 1080 FOR M=14 TO 18
 1090 PRINT AT M,N+((G=2)*4);"V"
 1100 LET N=N+(G=2)-(G=1)
 1110 IF N=1 OR N=23 THEN GOTO 20
00
 1120 IF G=1 THEN PRINT AT 4,N;D$
;AT 3,N;C$;AT 18,N;I$
 1130 IF G=2 THEN PRINT AT 4,N;F$
;AT 3,N;E$;AT 18,N;G$
 1140 PRINT AT M,N+(((G=2)*4)-1)-
((G=1)*2);" "
 1150 NEXT M
 1160 GOTO 4000
 2000 PRINT AT M,N+(((G=2)*4)-1)-
((G=1)*2);" "
 2005 IF G=1 THEN GOTO 240
 2010 IF G=2 THEN GOTO 190
 2999 REM **FIRE FAILED**
 3000 PRINT AT 10,10;"FAILED...."
 3005 PAUSE 50
 3010 PRINT AT 5,N-1;"          ";A
T 6,N-1;"          "
 3020 LET L=L-1
 3025 IF L=0 THEN STOP
 3027 LET C=1
 3028 PRINT AT 10,10;"          "
 3030 GOTO 4010
 3999 REM **FIRE HIT**
 4000 PRINT AT 10,10;"HIT......."
 4002 PAUSE 50
 4005 LET C=2
 4010 PRINT AT 18,N;"[graphics]"
 4020 PRINT AT 3,N;"          ";AT 4
,N;"          ";AT 12,1;"
                          ";AT 13,1;
"
  ";AT 10,10;"          "
 4030 LET S=S+((C=2)*10)
 4040 IF H<S THEN LET H=S
 4050 GOTO 87
 9998 SAVE "SEAFIGHT"
 9999 RUN
```

NUMBERS

Frank Papadopoulos, Dulwich Hill, NSW

The computer prints a random number and the player must then enter this number. Each time a new number is added to the existing one, and the player has a limited amount of time to recall this number and enter it.

At the end it shows how many times the player guessed the number.

```
  5 REM NUMBERS
 10 LET A$=""
 20 LET Y=1
 30 LET X=INT (RND*10)
 40 LET A$=A$+STR$ (X)
 50 PRINT A$
 60 PAUSE 1000/Y
 70 CLS
 80 INPUT B$
 90 IF A$<>B$ THEN GOTO 190
100 IF Y<5 THEN PRINT "THAT'S
O.K."
110 LET Y=Y+1
120 IF Y>=5 AND Y<8 THEN PRINT
"WELL DONE"
130 IF Y>=8 THEN PRINT "THAT'S
EXCELLENT..."
140 GOTO 30
190 PRINT "TOO BAD..."
200 PRINT A$;" WAS THE ANSWER"
210 PRINT B$;" WAS YOUR ANSWER"
220 PRINT "YOU LASTED FOR ";Y;"
GOES"
```


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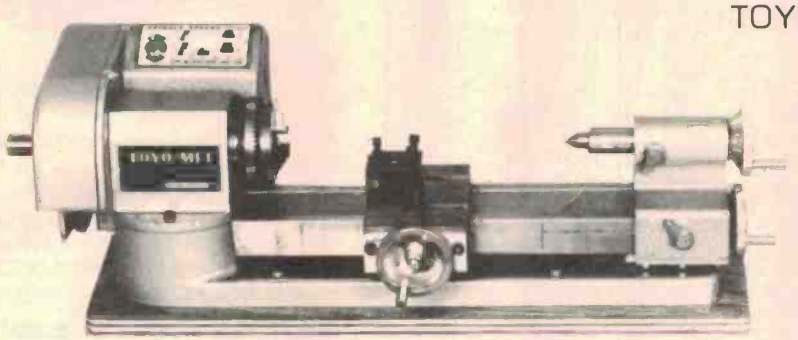

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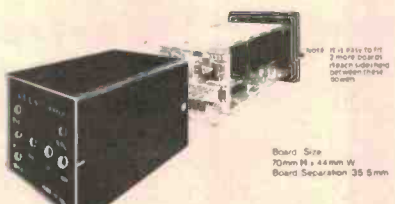
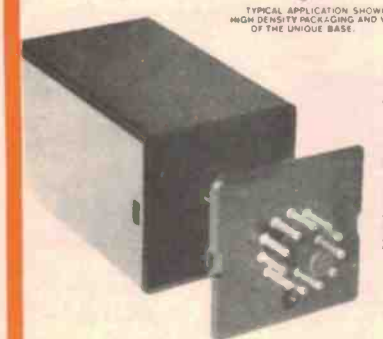


TYPICAL APPLICATION SHOWING HIGH DENSITY PACKAGING AND VERSATILITY OF THE UNIQUE BASE.



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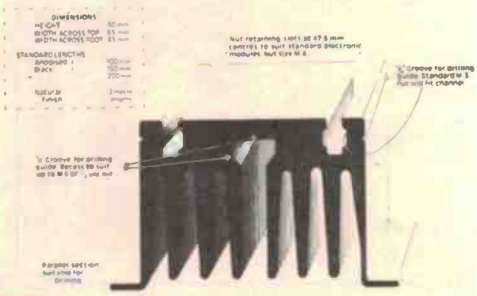

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KILOPEDE & GHOST MUNCHER are two super arcade games that were originally to sell for $17.50 each but a typing error in our catalogue placed them together by mistake! We have decided to leave them together for what must be the best value in this catalogue.

KILOPEDE revolves around a nasty Centipede charging down through the garden towards you. When your beetle makes a direct hit, the Centipede breaks into two! Now you have double trouble. Watch out for the flees, bugs and most of all, the gardener's boot!

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Both games together on the one cassette. **$20.00**

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MYTEK WORDPROCESSOR is the MicroBee's most up-to-date electric typewriter. Although powerful beyond belief, the MYTEK WORDPROCESSOR is quick and simple to use. Handwritten letters and typewriters are a thing of the past. Any member of your family, club or office will be able to save time and improve the look of their essays, letters, assignments, documents, accounts and all other correspondence. Everybody can benefit from this Wordprocessor.

The MYTEK WORDPROCESSOR is available on both cassette and EPROM chip. If the serial number of your MicroBee starts with nine (9) then your MicroBee takes an 8K EPROM. Otherwise it takes two 4K EPROM. Please specify.

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TRSBEE is a package of three programs that loads TRS-80 Model 1 and 3 program tapes into the MicroBee without any additional hardware. Although some program editing will still be required prior to their running, the majority of program typing time is saved by TRSBEE. The first program loadsTRS-80 BASIC programs into MicroWorld BASIC. Most programs may then be edited and run. The second program in the package loads any TRS-80 machine code file into MicroBee memory. The third program loads TRS-80 assembler files into the MicroBee EDITOR/ASSEMBER. Any TRS-80 Model 1 or 3 tape may be loaded. TRSBEE opens up a whole new world of possible software on your MicroBee! **$30.00**

TAPE DOCTOR is an easy to use programming aid for loading and saving programmes on tape. TAPE DOCTOR will load nearly any program from tape, regardless of protection system. BAD LOAD files may be loaded also and TAPE DOCTOR will aid in finding the faulty byte. Saving files of any type become a breeze. Create Auto Start BASIC files and files that include both BASIC and machine code subroutines. Comes complete with a monitor. If you use tapes at all, TAPE DOCTOR is a must. **$17.50**

DEBUG is a utility program to enable the debugging of machine code programs as they are written on the MicroBee using EDASM. The program operates at the assembler level. Break points are inserted in the source code as calls to a subroutine. The source code, with included breakpoints, is then assembled and the resulting code is executed in the normal way. Program execution will halt at the first break point encountered with a display of the internal Z80 registers. With execution halted, registers can be examined and modified as can memory locations. Execution can then proceed until the next breakpoint is encountered. By means of breakpoints inserted in the source code, the programmer can examine all or any part of the operation of the program on a statement by statement basis. **$17.50**

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LOGO BEE is a graphics language. Specifically designed to introduce children to computer programming, LOGO BEE is destined to become a standard on the MicroBee. Both simple and intricate designs may easily be drawn on the screen in hi-res through use of short and easy to understand LOGO BEE programs.

LOGO BEE programs are based on an imaginary turtle moving about the screen leaving a trail behind him. The turtle may be moved in any direction for a given distance. He may then be turned any number of degrees and moved again. The trail may also be turned on or off. Each short routine is given a name, such as SQUARE, CIRCLE or TRIANGLE, depending on the shape created. These routines may be used within other routines. In this way, the concepts of programming can be easily introduced to young children and adults who have had no previous computer experience.

LOGO BEE was written specifically for MicroBee graphics. The program is essentially idiot proof and is a joy to use. **$22.50**

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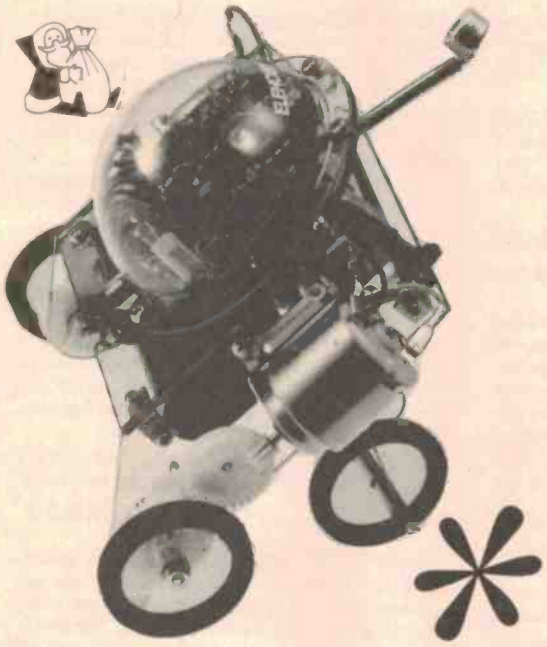

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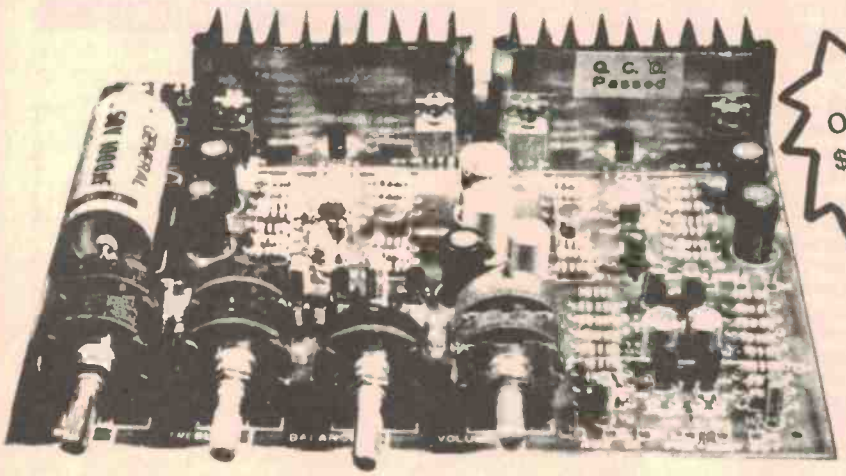

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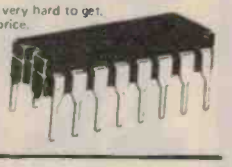

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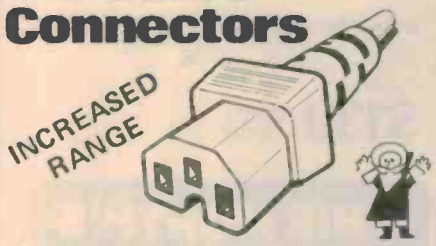

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- 5 Signal handling capability not less than 1.35 volts p-p. (Sync. is clipped first.
- 6 Power 12V AC @ 100mA
- 7 Controls, ON/OFF, ENHANCE, ENHANCE/BYPASS SWITCH, CORE/GAMMA CONTROL
- 8 Input connector, RCA socket
- 9 Output connector, RCA socket x 3

DESIGN FEATURES

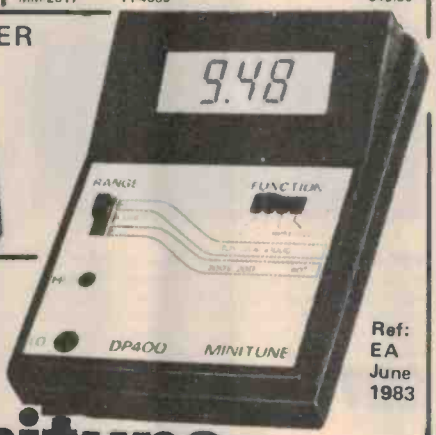
- 1 A unity gain notch at the colour subcarrier frequency, whose purpose is to prevent chrominance to luminance errors at high enhance levels.
- 2 A closed loop configuration with lead lag compensation to achieve stable, well defined gain
- 3 DC coupling, eliminating large capacitors in series with the video signal and achieving DC response for applications requiring it.
- 4 Low output impedance prior to termination resistors, enabling up to three outputs to exist and be used or left unterminated.
- 5 A level dependant closed loop response or Gamma control ('Core')
- 6 Clip on negative going signals at –67 volts into 75 ohms to prevent sync errors owing to overshoot.

NEW ETI JOYSTICK CONTROLLER

Ref: ETI Dec '83

True proportional control with this kit. Includes recommended joystick unit.

ONLY $24.95



Ref: EA June 1983

minitune $42.95

Following the spectacular success of the DP2010 Digital Multimeter kit, we now have an ENGINE ANALYSER KIT! But the spectacular thing is the price! It is ACTUALLY CHEAPER than the DPM-05 Display and Case!! The Minitune will measure voltage, resistance (down to a very low range), RPM and Dwell Angle.

Cat. KJ-7012 $42.95

TEST LEADS TO SUIT ONLY $2.95

Specification

Function	F.S.D	Resolution	Accuracy
Voltage (d c)	20V	10mV	0.5% ± 1 digit
	200V	100mV	0.5% ± 1 digit
Resistance	200Ω	100mΩ	0.5% ± 1 digit
	20kΩ	10Ω	0.5% ± 1 digit
R P M	20,000r p m	10r p m	1% + 3 digits
Dwell	90	0.1	2% + 3 digits

CX-230 ELECTRONIC CROSSOVER

Cat. AZ-5030 ONLY $257

See previous ad for technical data

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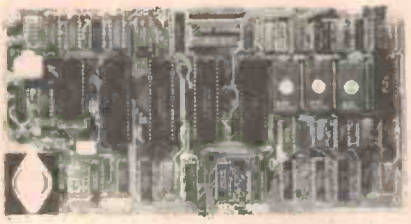
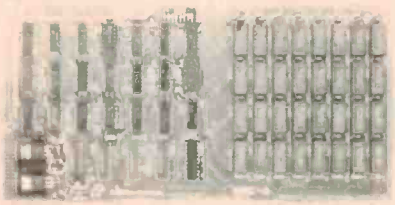
K-NAR COMPUTER CARDS

S100 Z80 System Card Specialists



SBC-800. 4 Mhz Z-80 CPU, two serial RS232 ports, software programmable Baud rate gen., Centronics parallel port, 22 prog. I/O lines, real time clock (battery backed), 2K CMOS RAM power on reset/power fail detect battery backed as standard, etc. List Price $495.

$415 OUR PRICE

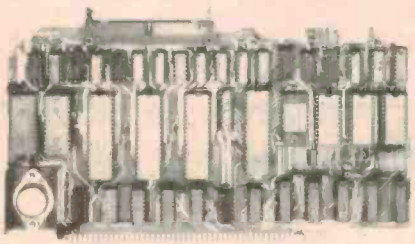


256 DYNAMIC RAM - DRC-II.
- Companion RAM for SBC-800
- Ideal for CP/M plus 3.0. List Price $865.

$795 OUR PRICE

FDC-II. Enhanced floppy disk controller, IBM 3740 compatible, operates 5" & 8" and single/d. density drives, handles up to 4 drives, runs multi-density CP/M2.2 & MP/M 2. Vectored interrupt operation optional.
List Price $465.

$389 OUR PRICE



CRC-64. Fool-proof memory system. State-of-the-art 64K CMOS memory card with memory protection, on board battery back-up, compatible with DRC-II, write protection enable/disable. List Price $675.
Our Price $565.

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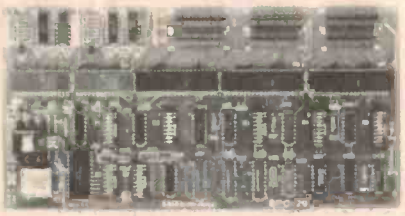
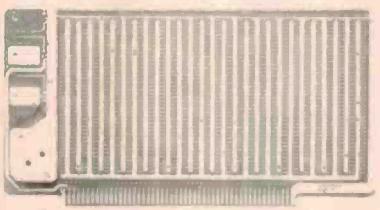


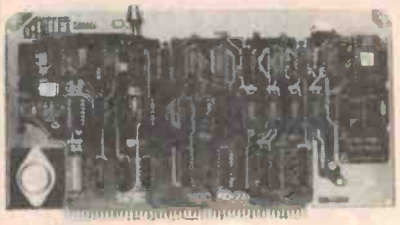
SPC-29. High performance dual serial & 9 parallel port I/O CARD, with full I/O address decoding. Switch selectable baud rates. Link patch area, programmable modes for strobed/latched I/O. List Price $295.

$247 OUR PRICE



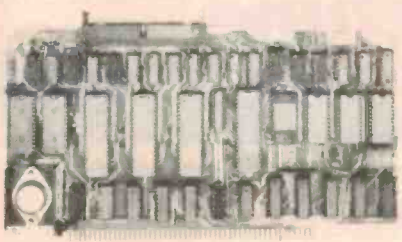
S-100 WIRE WRAP CARD. Gold-plated edge connectors, through hole plating, provisions for four regulators, distributed power rails. I/O connector provision on top of card.

$33 OUR PRICE



VDC-8024. The low cost alternative to stand-alone terminal. Flexible 80 x 24 memory mapped video display board with full ASCII, semi graphics. Inverse and hall intensity video, flicker free screen updating. Battery backed option offers diagnosis of system shut downs. List Price $325.

$278 OUR PRICE



SERIAL MULTICHANNEL I/O MPC-6.
Intelligent 6 channel RS232C communications with I/O buffering and drivers. • Build a multi-user, multi-tasking system.

$450 OUR PRICE

MINI CARD CAGE. Compact card cage frame with 5-slot motherboard plated through hole. Five edge connectors.
Was $150.

$130 OUR PRICE

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Combine one palette mixing card with up to eight display cards. Resolution 512 x 490, up to 256 colours simultaneously, user programmable intelligence, software available. • Build your own CAD/CAM System. • A special low cost for a high performance graphics system. Price plus software.

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TOUCHDOWN

Peter Easdown, Kew NSW

In this program I have used the 'Message Maker' program published in ETI March '83.

It is a lunar lander program. Once you have successfully landed on the surface you then have to take off and battle with gravity and Newton's first law to dock with a section on the top of the screen.

There are three modes to the program — Menu, Create Moon and Play Game.

In the Menu mode you are asked what you wish to do, play the game or create a new lunar surface. The appropriate key must be pressed.

In the Create Moon mode, using keys 0, 1 and 4, you construct a landscape on which you must land. Key 4 creates a flat surface for landing. Key 0 moves the dot up, key 1 moves the dot down. Once finished press any key to return to Menu.

When you start the Play Game mode the surface is redrawn with borders around it. Your trusty ship appears on its side and procedes towards the left of the screen. When you think the ship is above the landing pad press key 4. The ship will then turn and lower itself to the surface, but due to gravity the ship will crash unless you are careful.

Key 0 is your upward thrust and key 4 will cut all engines. Press key 4 when you think you have landed. If you press it when still above the surface then . . . *Wow* what an explosion.

If you succeed in landing, the word 'touchdown' will appear. When it disappears a block will appear at the top of the screen with a hole which is just a perfect fit for the nose of your rocket. Now you've got to get it in there.

When it takes off you have some new key functions: 2-right retro rocket; 3-left retro rocket; 0-upward thrust; 4-neutral retro rockets.

You must remove the upward thrust if you want to go left or right, but gravity also pulls you down. Key 4 simply stops your sideways movement.

If you ever manage to dock you get the message 'success' and that's it. A bit anticlimatic but a hard game requiring skill.

TOUCHDOWN

```
600 6A19 6B00 6C00 A800 FC1E 272E 7C01 3C04
610 1606 7B06 6A19 602A 2732 2734 2734 2734
620 6C00 6A00 6B0F A804 FC1E 272E 7C01 3C0F
630 1626 7B0A 6A00 6C00 A813 FC1E 272E 7C01
640 3C10 1638 6BA0 FB00 FB18 7BF0 6A00 EAA1
650 168E 6A04 EAA1 1692 1646 6100 6020 6201
660 E2A1 7001 6200 E2A1 70FF 186C F315 F307
670 3300 166E A774 D101 AE00 F11E F055 7101
680 F100 F118 3140 165E F80A 00E0 1600 00E0
690 165A 00E0 6100 AE00 F11E F065 A774 D101
6A0 7101 3140 1696 6000 611F D011 71FF 3100
6B0 16AA AE3F F065 8200 6000 72FF A774 D011
6C0 7001 303F 16BC D021 72FF 32FF 16C6 A824
6D0 6130 6203 D127 4F01 1942 D127 71ff 6404
6E0 E4A1 16E6 16D4 D127 2710 D127 A82B D128
6F0 2710 D128 A833 D128 2710 D128 2854 7202
700 D128 4F01 1942 D128 6404 E4A1 171C 1840
710 650A F515 F507 3500 1714 00EE 6F00 D128
720 4F01 1942 7208 D121 3F01 199C 18B2 F000
730 F065 273C DAB5 7A04 FC18 00EE ---- ----
```

73C - 7FF CHARACTER GENERATOR
MARCH 1983 ISSUE OF E.T.I.

```
800 160E 171E 1C1D 0A1B 1D2C 100A 160E 2C29
810 262C 040C 1B0E 0A1D 0E2C 1618 1817 2C29
820 262C 0000 0508 36DA 3608 0580 6651 3C18
830 5040 2010 1028 3854 AA38 82FE EEEE C6C6
840 6400 E4A1 184A 6500 16FC 75FF 8254 45FB
850 65FC 16FC 7650 F600 F618 7606 F600 F618
860 660A F615 F607 3600 1864 00EE 6404 E4A1
870 1876 6305 166E 6700 A774 D101 AE00 F11E
880 F055 7101 7701 4700 1890 4140 1688 1875
890 6305 166C 1D18 1E0C 110D 1820 172F 6A03
8A0 6B05 6C00 A894 FC1E 272E 7C01 3C0A 18A4
8B0 00EE 289E 6F50 FF15 FC07 3F00 18B8 289E
8C0 C72F 7705 6801 A91A D786 A833 D121 72F8
8D0 D128 72FC D128 4F01 1942 D128 6402 E4A1
8E0 76FF 6403 E4A1 7601 6400 E4A1 2908 7201
8F0 46FD 66FE 4603 6602 8164 4202 1900 1912
900 9710 1920 1912 00FF 75FF 45FD 65FE 8254
910 00EE 6404 E4A1 6600 18D4 FEEE EEC6 C682
920 D128 6A03 6B0F 6C00 A93A FC1E 272E 7C01
930 3C08 1928 F80A 00E0 1600 1C1E 0C0C 0E1C
940 1C2F 00FF A98E D128 8320 7308 5410 8510
950 7509 74FF 2974 73FF 74FF 7501 5320 1954
960 6600 7301 2974 7301 74FF 7501 7601 360A
970 1964 1934 A996 D433 A999 D533 C70F 7780
980 F700 F718 A996 D433 A999 D533 00EE 8140
990 2400 4610 1C3E 9600 2828 C0D2 72F8 1942
```

CAR RACE

Peter Easdown, Kew NSW

In this program you steer a car to the left and right to dodge the other cars which come down the screen at you.

To one side is your fuel gauge which shows how much fuel you have left. Once you run out you can go on to your next car.

After five cars your score is shown. To play use keys '4' and '6'.

To load this program use 0480 at 0400 and 08FF at 0402.

CAR RACE

```
0600 172E 6200 A738 D121 7201 322F 1604 6130
0610 6200 D121 7201 322F 1612 613C 6200 630F
0620 F329 D125 622A 630E F329 D125 6206 A73A
0630 D121 7201 3229 1630 613E 6206 D121 7201
0640 3229 163C 6206 613D D121 6228 D121 6208
0650 D121 7201 3228 1650 2762 6220 633D 6408
0660 6500 C70F 7706 6902 690F 7916 6A05 2774
0670 D78A D9AA A746 D12E 4F01 16E6 D12E 6604
0680 E6A1 71FE 6606 E6A1 7102 A73C D78A D9AA
0690 7803 7A02 CE02 4E02 77FF 4E00 7701 4E02
06A0 7901 4E00 79FF 4705 6706 4714 6713 4916
06B0 6917 492B 6929 4A2F 16BE 26CC 166E 7B02
06C0 FB00 F618 1662 A73A D341 00EE 7501 6E01
06D0 6D80 7D40 FD00 FE18 3505 00EE 6500 26C6
06E0 7401 3428 00EE A754 630A C42F 7410 F400
06F0 F318 F315 F607 3600 16F4 73FF D12E 3300
0700 16EA 7C01 4C05 170E 1732 00FF 00FF 00E0
0710 6310 6410 A7F0 FB33 F265 F029 D345 7304
0720 F129 D345 7304 F229 D345 F10A 1600 6C00
0730 6B00 00E0 6100 1602 1800 8000 5A7E 5A18
0740 3C7E 3C99 FF99 185A 7E5A 183C 7E7E 7E3C
0750 BDFF 9918 AA55 AA55 AA55 AA55 AA55 AA55
0760 AA55 A786 6118 6200 D124 7208 3220 1768
0770 611F 00EE 6E18 6D00 A786 DED8 7D08 3D20
0780 177A A73C 00EE 1010 1010 1010 1010 ----
```

ASTEROIDS

Peter Easdown, Kew NSW

Yes, it's another asteroids game but this one is better. In this game your cannon starts in the centre of the screen with three asteroids moving down the screen.

This time your cannon can spin around by hitting keys '4' and '6'; '5' will fire and '8' will send you forward in the direction you are facing.

Your score is shown after five cannons have been destroyed.

To load this program use 0480 at 0400 and 08FF at 0402.

ASTEROIDS

```
0600 6E00 6800 6401 6112 00B0 A822 6018 6B00
0610 6C06 6605 C50F C70F 7718 C90F 7920 D566
0620 D7B6 D9C6 2666 4F01 16D4 6D05 EDA1 16DC
0630 2666 6D06 EDA1 7401 6D04 EDA1 74FF 6D08
0640 EDA1 268A 4409 6401 4400 6408 FC00 F418
0650 A822 D566 D7B6 D9C6 7602 7B01 7C03 4C20
0660 160A A822 161E 4401 A7F2 4402 A7F8 4403
0670 A7FE 4404 A804 4405 A80A 4406 A810 4407
0680 A816 4408 A81C D016 00EE 4401 16AC 4402
0690 16B0 4403 16B6 4404 16BA 4405 16C0 4406
06A0 16C4 4407 16CA 4408 16CE 00EE 71FF 00E0
06B0 71FF 7001 00EE 7001 00EE 7001 7101 00EE
06C0 7101 00EE 7101 70FF 00EE 70FF 00EE 70FF
06D0 71FF 00EE 7801 3805 1608 17D2 6D15 FD00
06E0 FD18 7DFF 3D00 16DE 8200 8310 4401 170E
06F0 4402 1722 4403 173A 4404 1750 4405 1768
0700 4406 177E 4407 1796 4408 17AA 1630 7202
0710 73FF A802 D231 4F01 17BE D231 3300 1710
0720 1630 7206 73FF A802 D231 4F01 17BE D231
0730 7201 73FF 3300 1728 1630 7204 7302 A802
0740 D231 4F01 17BE D231 7201 323F 1740 1630
0750 7206 7306 A802 D231 4F01 17BE D231 7201
0760 7301 332F 1756 1630 7202 7304 A802 D231
0770 4F01 17BE D231 7301 332F 176E 1630 72FF
0780 7306 A802 D231 4F01 17BE D231 72FF 7301
0790 332F 1784 1630 7302 72FF A802 D231 4F01
07A0 17BE D231 3200 1798 1630 72ff 73FF A802
07B0 D231 4F01 17BE D231 3300 17AA 1630 7E01
07C0 00FF D231 6D40 FD00 FD18 7DFF 3D15 17C6
07D0 1630 00E0 A8F0 FE33 F265 F029 6310 6410
07E0 D345 7304 F129 D345 7304 F229 D345 F10A
07F0 1600 2070 50F8 0000 14A8 4428 1008 80E0
0800 80E0 8000 0810 2844 A814 F850 7020 0000
0810 4020 5088 54A0 1070 D070 1000 A054 8850
0820 2040 1876 DFED 6E18 ---- ---- ---- ----
```

NASTIES

Peter Easdown, Kew NSW

This is a game of speed. The aim of the game is to 'run over' all of the black dots with your flashing dot, as fast as possible.

At the bottom of the screen your score is shown along with the time left. The maximum time is about two minutes and twenty seconds.

To move your dot use these keys: 4 — left; 6 — right; 8 — up; 2 — down.

To load this program use 0600 at 0400 and 07FF at 0402.

NASTIES

```
0600 26E4 64FF 6E64 A60E C8FF C91F 16FC 80E0
0610 6A10 6B28 2626 80E0 6A10 6B28 2626 7EFF
0620 3E02 1606 1644 A7F0 F033 F265 F029 DAB5
0630 7A04 F129 DAB5 7A04 F229 DAB5 6501 FE00
0640 F518 00EE 6E00 80E0 6A10 6B28 2626 CC3F
0650 DCD1 6A00 6B27 A70A DAB6 A710 7A06 DAB6
0660 6A1F 6B27 A716 DAB6 7A06 A71C DAB6 6A30
0670 6B28 8040 2626 A616 DCD1 4F01 26BE 6504
0680 E5A1 7CFF 6506 E5A1 7C01 6508 E5A1 7DFF
0690 6502 E5A1 7D01 4CFF 6C00 4C40 6C3F 4DFF
06A0 6D00 4D20 6D1F DCD1 6A30 6B28 8040 2626
06B0 7701 4704 16DA 166E 00FF 00FF 00FF 80E0
06C0 6A10 6B28 2626 7E01 80E0 6A10 6B28 2626
06D0 4E64 1706 A616 DCD1 00EE 6700 74FF 3400
06E0 166E 1706 A722 6A00 6B00 DAB8 7A08 3A40
06F0 16EA 6A00 7B08 3B20 16EA 00EE D891 4F01
0700 160E D891 1608 F10A 172A 7088 4030 8870
0710 7088 8080 8870 F820 2020 2020 F820 2020
0720 20F8 FFFF FFFF FFFF FFFF 00E0 1600 ----
```

NASTIES

This is a game of speed. The aim of the game is to 'run over' all of the black dots with your flashing dot, as fast as possible.

At the bottom of the screen your score is shown along with the time left. The maximum time is about two minutes and twenty seconds.

To move your dot use these keys: 4 — left; 6 — right; 8 — up; 2 — down.

To load this program use 0600 at 0400 and 07FF at 0402.

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Cat. KE4202

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

FEATURES
- EXTREMELY CLOSE TRACKING TO RIAA PHONO EQ
- GOLD PLATED CONNECTORS ON ALL INPUTS
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- LOW NOISE 1% 50ppm METAL FILM RESISTORS USED
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- LOW CAPACITANCE SCREENED CABLE USED THROUGHOUT
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- SPECIAL REAR PANEL
- MULTICOLOURED RECTANGULAR LEDs USED

$299

5000 POWER AMPLIFIER

REF: ETI JAN/MARCH 1981

Cat. KE4200

BLACK MONOLITH

unbeatable value

ONLY $319

5000 SERIES GRAPHIC EQUALISERS

SPECIFICATIONS:
Signal-to-Noise: -102dB with respect to 1 Volt
Frequency Response: 12Hz - 105kHz to -1dB
Boost/Cut: 14dB (28dB total)
Distortion: 100Hz 0.02% 1kHz 0.007% 10kHz 0.008%
(essentially irrespective of cut or boost)
Current consumption (DC) Approx 100mA @ 15V (Requires 30V AC CT)
Output short-circuit proof.

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

Cat. KE4204

$199 each

SAVE A FORTUNE!

LOW COST DIGITAL MULTIMETER KIT

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

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

DP2010 kit Cat. KJ7010 ONLY $45

"LEARN ELECTRONICS AND END UP WITH A USEFUL PIECE OF TEST GEAR IN THE END"

SPECIFICATIONS

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

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

AMAZING VALUE

$39.95

Lyrebird Piano Kit

REF: EA 11/81-1/82

GREAT NEW FEATURES!!
- FREE! A stand (like the one illustrated but not exactly the same). Worth around $50 but yours at no extra charge with each 73 or 88 note kit.
- FREE! A soldering iron (worth around $19). Yours to keep to give years of faithful service after you have completed your Lyrebird. (88 note only)
- FREE! A 200g roll of solder. You will need some to build the Lyrebird but there will be plenty left over for other projects. (73 & 88 note versions).
- FREE! Quality IC sockets provided in both kits.

7½ OCTAVE (88 NOTE) VERSION $589

REMEMBER!! THE LYREBIRD OUTPERFORMS READY BUILT PIANOS COSTING UP TO THOUSANDS OF DOLLARS MORE. WHY PAY MORE WHEN YOUR CONSTRUCTION KNOWLEDGE CAN SAVE YOU A FORTUNE?

The stand that we provide for the piano kit is not the same as the one shown in the illustration.

88 NOTE VERSION
$589

73 NOTE VERSION
$475

Musicolor IV

KE3025 $89.90

JAYCAR KITS ARE THE BEST AND COST NO MORE

Digital Delay Line

The Digital Delay Line is designed to produce a huge variety of electronic effects. It works very well but the amazing thing is the low low price! The effects depend on the time delay selected and some of those included are: Phasing, Flanging, Chorous, ADT (Automatic Double Tracking), Echo, and Vibrato. The delay time can be varied from 0.32ms to 1.6 seconds! Because the signal is stored in digital form there is, unlike analog systems, no degeneration of the signal with time and unlimited repetition is provided by use of the freeze control.

All the controls mount directly upon PCB's to eliminate wiring and to further simplify construction the main board is 'plated-through' i.e. there are no wire links or link-through pins. The whole of the memory whether for the basic 400ms machine or the fully expanded 1.6 second model all fits on the main board. The cabinet which is free standing but also suitable for 19" rack mounting, is fully finished to a very high standard. The panel is deep blue whilst the cover is psrayed with a durable black enamel. The kit is available for only $449 -- compare that with inferior uints that can cost over $2,000!!
Cat. KJ-6621

ONLY **$449** COMPLETE **KIT** 400ms VERSION

NOW IN STOCK!!

BBD EFFECTS BOX

Fantastic low-cost instrument using the versatile MN3001 Bucket-Brigade Delay Line to achieve brilliant sonic effects. Now you can emulate the commercial rock groups with Phasing, Flanging' Reverb and Echo. The Jaycar kit includes all components INCLUDING IC sockets and the TU-04 box. (Not cut down but this is easily done). Jaycar has a specially built cabinet for this kit with all holes pre-punched etc., at only $10 extra but only if you buy the original kit from us. Available as a separate item for $29.50. WHEN THE KIT IS PURCHASED WITH THE DE-LUXE CASE THE TU-04 CASE WILL NOT BE SUPPLIED.

Special cabinet to suit $10.00
Cat. HB6445

COMPLETE KIT

Cat. KE1522
$79.00

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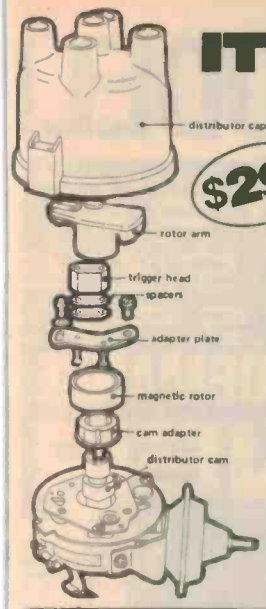

IT HAD TO HAPPEN

$29.95

PLEASE NOTE
this system must be used in conjunction with an electronic ignition. The Hall Effect device will not switch enough current to replace the contact breaker points on their own!

With this kit and the interface electronics you can forget about contact breaker point problems!
Cat. KJ-6655 $29.95

New PCB for TAI Kit includes Hall Effect interface. Cat. HP-8786 ONLY $3.95

A professionally engineered electronic ("breakerless") contact breaker system.
Yes, only Jaycar has a complete Hall-effect triggerhead assembly designed to adapt to an extensive number of cars. Each kit contains the following:
- HALL EFFECT TRIGGER HEAD
- MAGNETIC ROTORS FOR BOTH 4 & 6 CYLINDER CARS
  OVER 6 CAM-LOBE ADAPTORS
  OVER A DOZEN DIFFERENT ADAPTOR PLATES FOR YOUR PARTICULAR DISTRIBUTOR
  OTHER HARDWARE (i.e. SCREWS etc.)
  YOU CAN REMOVE THIS SYSTEM AND RE-EQUIP YOUR CAR WITH THE ORIGINAL
- BREAKER POINTS WHEN YOU SELL THE CAR!
  AS EASY TO INSTALL AS A SET OF POINTS!
- INSTRUCTIONS (SIMPLE-TO-FOLLOW) INCLUDED!

This set is designed to fit most European and Japanese cars. In fact it will also fit many Australian cars fitted with Lucas, Bosch, Motorcraft, AC Delco or Autolite electrics. If you wish to check first, please send SAE for car/distributor list.
Because we have no way of knowing, you get the fitting set for ALL of the distributors available. Basically you end up with a jar full of parts that you don't need to use! (Perhaps for your next car?)
Quite frankly, we are amazed that we can supply such a comprehensive kit for this price. To produce a kit that will adapt to the dozens of different distributors around is amazing!
Remember, once you have installed a breakerless system it will never wear out and that part of your system will remain in tune FOR EVER.
We expect this kit to sell well. To ensure that you receive one, check with us early!
Cat. KJ6655

Call Us

Jaycar and Electronic Agencies have the largest range of kits in Australia. We stock kits for most of the projects described by the magazines over the last few years. Space does not permit us to include ALL kits in our ads, all the time. So if you are after a specific kit – call us first.
We can probably help you!!

ETI 492 Sound Bender

Ref: ETI Feb 1982
Short form kit of a device to give either your voice, musical instrument or other source that Dalek, metallic sound – as well as other sounds!
$24.50

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XE3530	C10	1.10	.99	.90
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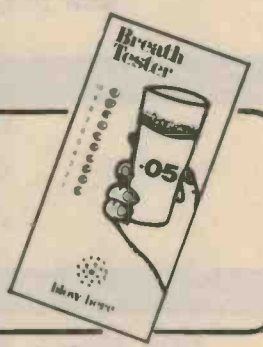
The quality tapes are supplied to us in boxes of 20, so to make it easier we've got a special price for 20.

Breath Tester $29.95

In all states and territories in Australia it is an offence to drive a vehicle with an alcohol/blood concentration above a certain limit. In most states it's 0.05 others 0.08. Either way it's only a relatively small number of alcoholic drinks.
Because it's only a small number of drinks, many people (quite wrongly) believe that they remain below the statutory limit.
The KA1522 Breath Tester can help here. A unit with the same circuit diagram was featured in May "Electronics Australia". It CANNOT give you an actual blood/alcohol content reading, however it can go close. And it can give you a relative reading between inebriated friends!!! Great at parties!!!
Grab the whole kit now for only $29.95. You never know, it may save your licence or your life!

Cat. KA1522



VIDEO ENHANCER

Ref: EA Oct 1983
Get improved performance from your VCR.
Cat. KE-7016

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TRANSISTOR TESTER KIT

Check your transistors in circuit. Saves removing them.
Ref: EA sept. 1983.
Cat. KA-1532
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TV Crosshatch/Dot Hatch Generator

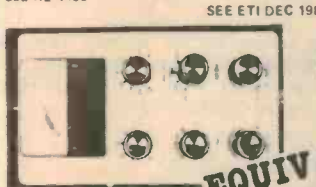
Ref: EA Nov. 1983
Great new version of this handy piece of test gear. Now you can generate Crosshatch, Dots and Blank (white) video signals. This is handy for TV/Video alignment.
Cat. KA-1530 Basic (short form) kit inc. Jiffy box ONLY $24.95
Cat. LT-3800 Video Modulator to suit $8.95
Power Supply to suit $9.95

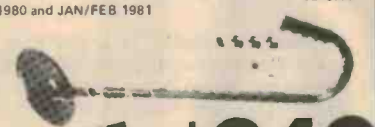
ONLY $24.95

ETI15000 METAL DETECTOR

The Performance of a $500 metal detector for only $219! This is a fully discriminating VLF T/R instrument (yes! the same principle as those expensive American ones) with ground balance. Control facilities are comprehensive – including an 'auto tune' button. This kit includes all parts including a fully built search head and handle assembly and special meter and case.
Cat. KE-1460 $219.00

SEE ETI DEC 1980 and JAN/FEB 1981





EQUIVALENT TO $500 units

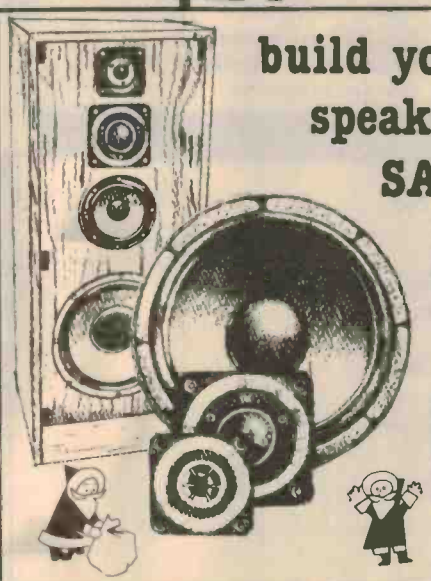
$219

Touch Sensitive Light Dimmer

Ref: EA April 1983
Cat. KA1508

Complete kit including quality HPM wall plate with attractive brushed metal insert. The Jaycar kit is absolutely complete including a small dial spring which can be used to connect the PCB to the wall plate. (Beware of other kits that do not include this). In addition to the above, we supply the High Voltage Resistors ALREADY SOLDERED in as a foolproof safety feature!

only $19.95



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For user installation to a standard phone socket without Telecom assistance, the new **Cicada 300T 300-Baud data modem** features fully integrated phone for maximum convenience. With all the legendary performance and reliability of the standard Cicada 300.

Or, buy the continuously improved standard Cicada 300 for use with your own telephone. Now operated by hundreds of government, business and private users, the Cicada series modems carry a full, meaningful warranty.

Specifications (Both modems): Compact answer-and-originate units for direct connection to phone lines and for computer interface utilising either RS232C or V24/28 systems. Unit measures 203mm x 152mm x 63.5mm. Telecom approval number C83/37/1011.

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UNIVERSAL COUNTER-TIMER FEATURES VERSATILITY

Global Specialties Corporation has introduced a new universal counter-timer, the Model 5001, which offers a very versatile combination of time and frequency-measuring capabilities plus signal-conditioning facilities.

Operating at up to 10 MHz as a frequency counter, the 5001 also provides the functions of period and multiple-period averaging, time-interval and multiple-time-interval averaging, frequency-ratio measurement, and unit or event counting.

The Model 5001 has two dc-coupled BNC inputs both of 1M plus 20 pF input impedance and having a sensitivity of 20 mV RMS.

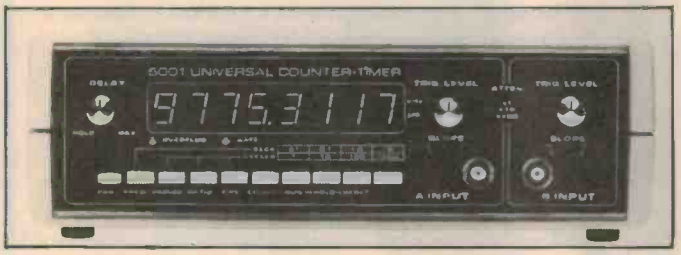
Each has a three-position attenuator (x1, x10 and x100), a positive/negative-going slope selector and a variable trigger-level control. Maximum frequency at the 'A' input is specified as 10 MHz and at the 'B' input as 2 MHz.

An 8-digit, 7-segment filtered LED display with 11 mm high digits is used to ensure easy readability in all ambient light conditions.

For ease in noting or recording displayed readings a variable-delay control is provided to add between 75 ms and 7.5 sec to the usual display time of one gate period (which can be 0.01, 0.1, 1 or 10 sec); subsequent measurements are also postponed by this variable delay, and a 'hold' position is provided if it is required to maintain the displayed reading indefinitely.

Power consumption is 10 W and the unit operates from 105-130 V_{ac} or 210-250 V_{ac} supplies with full performance over the supply frequency range 47-63 Hz. The Model 5001 measures 76 mm high x 254 mm wide x 178 mm deep.

Further information can be obtained from the Australian distributors, **Vicom International Pty Ltd, Head Office, 57 City Road, South Melbourne Vic. 3205. (02)62-6931.** ▼



CAVITY GENERATORS NOW COVER TO 18 GHZ

The HP8683D (2.3 to 13.0 GHz) and HP 8684D (5.4 to 18 GHz) cavity-tuned signal generators now include an internal doubler band to extend frequency range and provide doubled FM deviation.

With their dc-to-10 MHz modulation rates and +/−10 MHz deviation, the generators now can be considered for satellite-video modulations.

Both generators also feature high-performance pulse modulation in the main and doubled bands for use in radar and EW applications (less than 10 ns rise/fall times and greater than 80 dB on/off ratio.)

The internal pulse generator has pulse rates of 10 Hz to 1 MHz, pulse widths of 100 nanoseconds to 100 milliseconds and pulse delays of 50 nanoseconds and 100 milliseconds. Amplitude modulation is available at depths to 70% and rates to 10 kHz.

One of the main advantages of cavity-tuned generators remains their excellent non-harmonic spurious characteristics at less than −80 dBc. Single-sideband phase noise is less than −72 dBc/Hz at 10 kHz offset in S-band. Cavity technology also allows a broadband noise floor from −135 to −150 dBc. ▶

LOW-COST A-D-A CONVERTER ▲

Roland Corporation has released the ADA-200, a low-cost general purpose analogne-to-digital converter that reconfigures under software to digital-to-analogue.

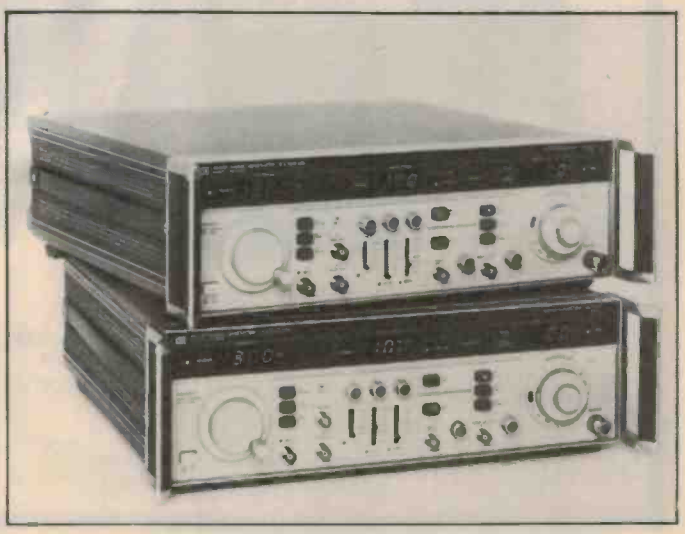
The unit is highly portable and may be configured to act as a controller for equipment having a voltage control facility, including audio equipment, machine tools and laboratory equipment, and electronic musical instruments.

It may also be configured as a joystick/paddle interface, and software is available for its use as a data logger in scientific applications, as a wave form generator, to produce digital oscilloscope displays, and as a waveform analyser in voice recognition and synthesis.

The Roland ADA-200 is compatible with a wide range of CPU chips and buss structures. Connection to the host processor is made via 50-ribbon cable, and interfacable processor chips include 8080, Z80, 6800, 6502 and 6809.

The A-D and D-A modes are selected by software switch, and the convertor produces an 8-bit parallel binary stream at a maximum sampling rate of 44 kHz. The unit is fitted with input and output filters to prevent aliasing and for smoothing the staircase wave output.

The Roland ADA-200 Convertor is available from **Roland, 23 Cross Street, Brookvale 2100. (02)938-3911.**

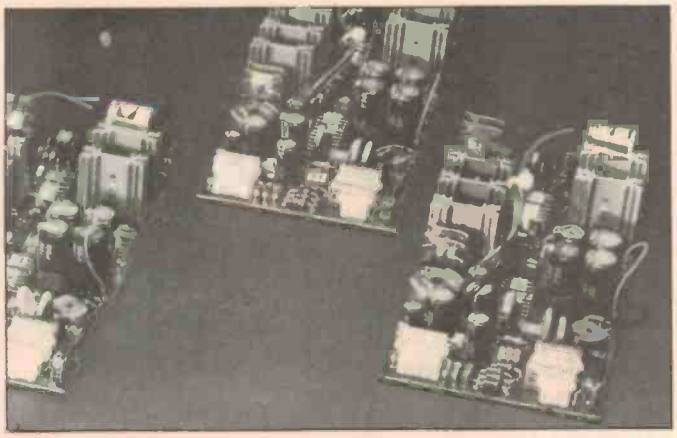


Equipment NEWS

▶ Output power in the doubled bands is calibrated from −3 to ×130 dBm. Pulsed power is peak-leveled and can be corrected for connecting cable loss vs frequency.

According to HP's Instrument Group Marketing Manager, John Schmidt, the HP 8680-series generators are proving very popular with defence and communications users because of their unique combination of performance, reliability, ruggedness and serviceability.

Contact **Hewlett-Packard, 31-41 Joseph St, Blackburn Vic. 3130. (03)890-6351.**



OPEN-FRAME POWER SUPPLY FAMILY ▲

The SM80 series of power supplies from Australian manufacturer, Scientific Electronics, offers all of the features needed by the micro designer — low cost and small size coupled with high performance and reliability.

These open frame power supplies — the SM80AE1. 2 and 3 have all been designed and manufactured by Scientific Electronics in Australia to meet Telecom specification 1302.

All are rated at 80 watts, the model 1 being five rail, model 2, four rail and model 3, six rail. All three units offer standard output rails as well as output rails to customer specifications.

All outputs are short circuit protected and total allowable power is 80 watts continuous, at greater than 3.5 kV and efficiency greater than 60% at full load.

All models measure 108 x 240 x 45 mm and are fully supported by a five year warranty and complete local technical back-up from Scientific Electronics.

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

CURRENT AND POWER GUNS

Elmeasco Instruments is now handling F. W. Bell's range of six hand-held current and power/power factor gun products.

Two models, CG100A and CG103A measure current to 200 A and 500 A and ac and dc with a frequency response to 1 kHz on conductors up to 19 mm diameter. They are fitted with output jacks to connect to a multimeter, 'scope or chart recorder.

Next in the range is the model PG200D digital power meter which will measure real power to 199.9 kW, dc or ac (to 400 Hz).

The latest addition is the model PFG360D. This unit measures power factor in all quadrants plus phase angle from 0-360° over the frequency range of 45 to 65 Hz.

For more information please contact **Paul Twigg at Elmeasco on (02)736-2888.**

MODEL 175 AUTORANGING BENCH/PORTABLE DMM

KEITHLEY INSTRUMENTS

The new Model 175 Autoranging Bench Digital Multimeter, from Keithley Instruments, Inc., combines the measurement capabilities of much higher-priced system DMMs with several new features to extend its utility, yet retain simplicity of use. Ideal for use as a bench meter in production or lab work, this 4-½ digit autoranging DMM also has a field-installable battery option, making it fully portable. Fast autoranging (up to 200ms per range change on DCV) enables the user to concentrate on getting the reading without worrying about choosing the appropriate range.

The Model 175 features digital calibration for reduced cost of ownership, as many users can now calibrate the meter in-house. With the Model 1753 IEEE-488 (GPIB) option, the 175 is the lowest-priced IEEE-interfaceable DMM available.
Model 175's 100-point data logger monitors drifts, determines rates of change, and collects response curve data without a printer, output cables, or complicated hook-ups. The data logger has six different store rates from one reading/400ms to one reading/hour, and data recall is "push-button" easy.

Other features of the Model 175 include:
- 4-½ digit LCD display with annunciators for function, range, and feature indication
- 10μV/10mΩ/10nA sensitivity
- 0.03% basic DCV accuracy
- True RMS AC
- 10A capability
- 100kHz bandwidth in AC
- dBm/relative function
- Relative reference
- Max/Min reading hold
- Safety input jacks
- Front panel accessible amps fuse

For more information on the Model 175 Autoranging DMM, or on a variety of other industrial electronic testing and measurement equipment, contact:

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HOW TO BUILD YOUR OWN SOLID-STATE OSCILLOSCOPE
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electronic music and audio/video

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H0143B **$6.95**
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UNDERSTANDING COMPUTERS
H0148A **$20.95**
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THE UCSD PASCAL HANDBOOK
K0197P **$23.75**
Language descriptions organised in a quick and easy reference are given in this book for readers with no prior experience of Pascal programming.

PASCAL
K0199A **$21.95**
For people with little or no programming experience, this book gives lots of examples that clearly explain proper usage of language features. Discusses top-down programming, debugging, self-documentation, etc. ●

All prices of publications in this catalogue listing are subject to change without notice.

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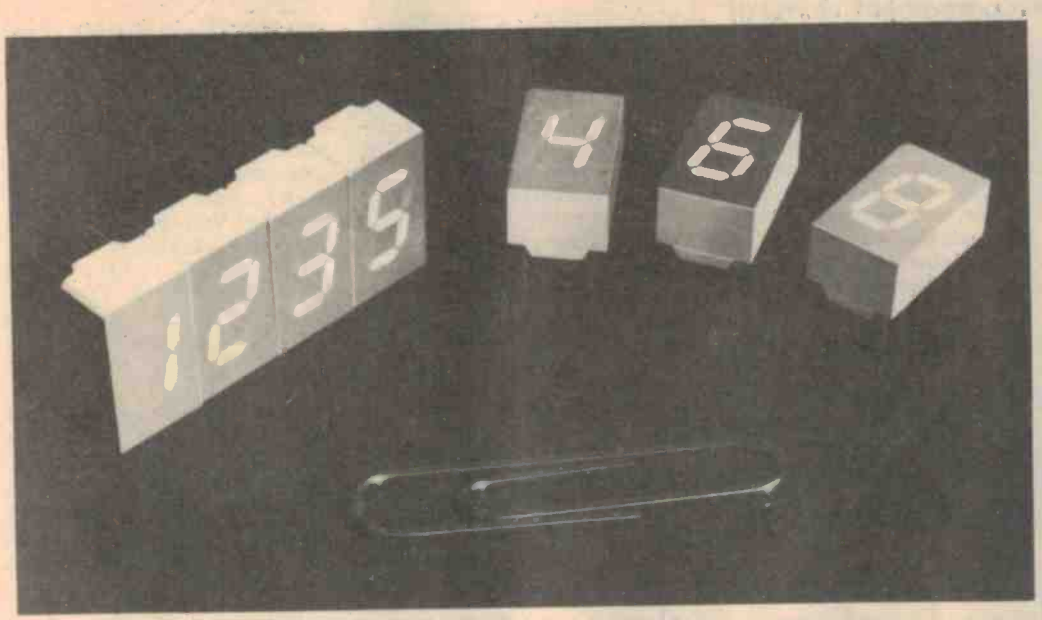

HEWLETT-PACKARD INTRODUCES SUPER-BRIGHT, SEVEN-SEGMENT DISPLAY FAMILY, PIN-FOR-PIN COMPATIBLE WITH FND 35X/36X

A new 7.6 mm (0.3") seven-segment LED display available in standard red, high-efficiency red, yellow and green has been announced by Hewlett-Packard featuring pin-for-pin compatibility with Fairchild's FND 35X/36X display.

Fairchild quit the opto and display market earlier this year and inventories of most Fairchild opto products are currently run out or very low.

Features such as bright, evenly lighted segments for high ambient-light viewing, a low forward-drive current, a small, space-saving package and an attractive character font characterize these new HDSP Series displays.

The displays require a lower drive current to achieve the same brightness as HP's existing family of 7.6 mm LED displays. This new family requires up to 25% less current and can still be viewed at distances up to three metres.

Increases up to 50% in viewed brightness are possible when the displays are driven at typical drive currents of 6 to 10 mA. This makes the displays well suited for high ambient-light applications.

The display package measures 7.62 by 12.7 mm. Their Mitred Segments and categorisation for luminous intensity assure an attractive front-panel appearance. Yellow and green displays are also categorized for colour.

Price and delivery information are available through authorised HP components distributors, or contact **Hewlett-Packard, 31-41 Joseph St, Blackburn Vic. 3130. (03)890-6351.**

NEW CONTROL IMPROVES S/N OUTPUT BY 20 dB

Philips' new TDA1524 active tone/volume control for stereo audio systems incorporates its own internal gain to give a signal-to-noise ratio up to 75 dB. This is 20 dB higher than similar devices.

The four functions of this bipolar integrated circuit are bass and treble control, volume control with built-in loudness (which can be switched off) and balance, all of which are controlled by dc voltages from potentiometers or a D/A converter.

Bass and treble boost is up to 15 dB and is set by one external capacitor each per channel. Channel separation is typically 60 dB, while the volume control range is −80 to +21.5 dB.

The TDA1524 is suitable for car radios, stereo television receivers and low-cost mains-fed stereo audio equipment. It will operate from supply voltages between 7.5 V and 16.5 V, over a temperature range of −30 to +80°C.

For further information, contact **Philips Electronic Components and Materials, 67 Mars Road, Lane Cove NSW 2066. (02)427-0888.**

TELEDYNE'S CONVERTER WITH A DIFFERENCE

The Teledyne TSC800, a 15-bit plus sign-integrating analogue-to-digital converter, is designed to improve the conventional two-cycle dual slope conversion cycle by incorporating systems zero and integrator output zero phases.

Offset error sources are automatically zeroed, and overrange recovery time is reduced. The integrating conversion technique is immune to the noise spikes that introduce errors in successive approximation converters.

The externally adjustable clock allows integration periods which are integral multiples of 50 Hz or 60 Hz for maximum power-line noise rejection. By using the 2.4576 MHz crystal oscillator mode, 50, 60 and 400 Hz signals are rejected.

Microprocessor interphase signals support eight- or 16-bit parallel data transfers.

For further information, contact **Promark Electronics, Suite 102, 6-8 Clarke Street, Crow's Nest NSW 2065. (02)439-6571.**

A SHARP SHUNT

Fairchild has announced the availability of the μA431 precision adjustable three-terminal shunt regulator with guaranteed temperature stability over the entire temperature range of operation.

The output voltage can be set at any level greater than 2.5 V (V ref.) up to 36 V by selecting two external resistors that act as a voltage divider network.

The sharp turn-on characteristics make the device an excellent replacement for many zener diode applications.

Other features include low output noise, programmable output voltage and an average temperature coefficient of 50 ppm/°C.

For further information, contact **Fairchild Australia, 366 Whitehorse Road, Nunawading Vic. 3131. (03)877-5444.**

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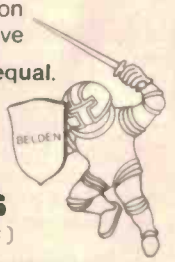

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Component NEWS

QUICK MOS

Philips has released samples of the new PC54/74 high-speed CMOS logic circuits. The total program includes 240 devices, including a full range of TTL-compatible circuits, and is being alternate-sourced with RCA.

The devices have the low power dissipation, high input noise immunity and wide operating temperature range of CMOS devices and the TTL attractions of high speed and high drive capability.

The low power dissipation of the high-speed CMOS series improves reliability, simplifies power supplies, can eliminate heatsinks and fans and allows components to be packed more densely. This makes for a substantial reduction in equipment size and weight.

The new devices dissipate negligible power due to leakage when they are not switching. Dissipation is still extremely low under operating conditions. With a 5 V supply, typical gate operating current is 3 μA at 10 kHz, 30 μA at 100 kHz and 300 μA at 1 MHz. This compares with the currents of 400 μA (up to 100 kHz) and 560 μA (at 1 MHz) of LSTTL gates.

Encapsulations are plastic and ceramic DIL and plastic SO (mini-pack). For further information contact **Philips Electronic Components and Materials Division, 67 Mars Rd, Lane Cove NSW 2066. (02)427-0888.**

NEW VARISTORS

General Electric has released a new high-energy MOV-varistor to protect heavy duty industrial motors and machines against damage caused by high-energy transients.

Rated at 70 000 amps and 10 000 joules, the newly designated 'B' Series is packaged in a new pyramid-shaped epoxy package that is easily mounted through two base screw holes.

They are designed to work in multiple parallel and series configurations where necessary.

G.E. claims the new varistor out-performs existing technology at lower cost, has lower V_c (clamping voltage) than Silicon Carbide and a faster response and lower V_c than spark gaps.

Major applications include ac/dc motor control, traction/transportation, induction heating, mining, welding (high-energy), power supplies and oil drilling rig systems.

For further information, contact **General Electric, P.O. Box 174, Willoughby NSW 2088. (02)888-8111.**

INTEL'S TOP-SECURITY MICROCONTROLLER

Intel has announced that it is making the erasable PROM version of its 8051 single-chip microcontroller in the HMOS (high-performance metal-oxide semiconductor) technology.

The new version, called the 8751H, matches the 8051AH's architecture and speed, and is primarily for the prototyping of systems that are based on the 8051.

A key feature of the 8751H is that it provides software security. When a program has been developed and finalised, a security bit can be programmed to make it virtually impossible to access the internal program. This capability is used for protecting proprietary software from unauthorised examination and copying.

During prototyping and production ramping, users can program the EPROM program memory in the 8751H. These programs can be erased and modified until a final version is developed.

During that phase, it is both efficient and economical to use the 8751H. Once users have developed and debugged their programs, factory-programmed 8051AHs can be ordered in large volumes.

For further details, contact **Total Electronics, 9 Harker Street, Burwood Vic. 3125. (03)288-4044.** ●

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Cat. XE-5100	MicroBee 32K Plus	$559.00
Cat. XE-5150	MicroBee 32K IC	$599.00
Cat. XE-5200	MicroBee 64K Plus	$699.00
Cat. XE-5250	Single Disc System	$1099.00
Cat. XE-5255	Add-on Disc	$559.00
Cat. XE-5260	Dual Disc Drives	$1599.00
Cat. XE-1205	Printer Cable Interface	$49.95

MICROBEE

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

ETI 649 MicroBee Light Pen. Ref: ETI August 1983. This simple, low cost device plugs into the Bee's 8 bit port. The "pen" gives you an entry into the world of light pens and interactive software.
Cat. KE-4656 SHORTFORM $19.50
SPECIAL PROBE CASE TO SUIT (as specified in ETI article) Cat. HB-6400 $19.95

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

Parallel Interface Kit for the MicroBee. Includes 15 pin 'D' plug – add $15.00 if Centronics plug required.
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CANNIBALS AND MISSIONARIES
The old logic problem game of transferring 3 Cannibals and 3 Missionaries from one side of a river to the other in a boat that holds two. If there are more Cannibals than Missionaries on either side at any time the Cannibals revert to their favourite form of feeding.
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COMPOSER BEE
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WORD ADVENTURE
A program with very good graphics using little characters to entice the user to think what word is either a synonym, antonym or homonym of the word they are showing. Everytime you get it wrong you are given more clues. After the clues run out you must face the Dragon when you must spell the word he is holding correctly before you.
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PONTOON
A quality fast moving card game where up to 6 players can play against the computer who is banker.
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MUSIC – B – MYTEK
MusicB is a music Composer/Editor that lets you create and save music and sound effects with a flexibility that makes chopsticks of the Basic PLAY command. MusicB is a great way to learn and play music! Comprehensive instructions are included.
Cat. XE-7010 $20.00

TRSBEE – MYTEK
TRSBEE is a package of three programs that loads TRS-80 Model 1 and 3 program tapes into the MicroBee without any additional hardware. Although some program editing will still be required prior to their running, the majority of program typing time is saved by TRSBEE. The first program loads TRS-80 BASIC programs into MicroWorld BASIC. Most programs may then be edited and run. The second program in the package loads any TRS-80 machine code file into MicroBee memory. The third program loads TRS-80 assembler files into the MicroBee EDITOR/ASSEMBLER. Any TRS-80 Model 1 or 3 tape may be loaded. TRSBEE opens up a whole new world of possible software on your MicroBee!
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HOUSEHOLD REGISTER
This program will simplify the task of determing the value of yout home's contents for insurance purposes, as well as providing descriptions of all listed items in the event of their loss or destruction. Effects are catalogued by name, description and value. Nine separate rooms are provided, and up to 28 items may be listed in each.
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STAT PACK – STATISTICS
This program is a general purpose graph plotting, linear regression, line of best fit and correlation program. It features a t-test of significance for the correlation coefficient and, if no evidence of correlation is found, a determination of minimum sample size is performed.
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BASIC TUTORIAL
Is a super teaching aid for any classroom. Basic Tutorial is a set of 9 interactive exercises designed for teaching Basic to the computer novice. No previous knowledge is assumed. Basic Tutorial uses a unique double screen technique to display both the normal computer output and the tutorial exercises at the one time. This allows the student to use the MicroBee in the normal way, while the tutorial instructions appear in the lower half of the screen.
Cat. XE-6860 $20.00

MACHINE CODE TUTORIAL – MYTEK
Consists of 8 interactive exercises designed for teaching machine code programming and related topics as they apply to the MicroBee computer. Only a general knowledge of the BASIC language is assumed. Machine Code Tutorial is designed to bridge the gap bewteen BASIC programming and being able to understand and use typical Z80 manuals.
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BUDGET – SPREADSHEET
This program is designed to speed up and simplify the task of framing a usable financial budget. Applications range from personal or household to small business finances. A quality program.
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DECODE
Basic decoder and listing formatter
This programme will be an invaluable aid to any one taking first steps in understanding machine code or wants to expand their library of proven machine code routines. Decode will (a) print imbedded machine code routines fully and accurately (b) print all unprintable characters (c) provide a clearer, easier to read listing and send all output to a printer if so required. ED ASM is not required.
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DATABEE
This program is a well written data base management system that utilised the MicroBee to its fullest to provide a Data Management System similar to those found on larger and more expensive systems. This comes complete with large bound manual.
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ASTEROIDS PLUS – MYTEK
Asteroids Plus is one of the finest high resolution graphic arcade games available for the MicroBee computer. It features 3-D point by point resolution graphics, shields, sound effects, intelligent objects, guided missiles, black holes and a score board. If you enjoy playing computer games, you will be captivated by Asteroids Plus.
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SPACE INVADERS
One of the most popular programmes ever released. This version was written especially for the MicroBee.
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PSYCHOTEC By Dreamcards
Psychotec provides a striking example of artificial intelligence, allowing a dialogue in English between computer and operator, the computer playing the role of psychiatrist and the operator being a "patient" on the couch. Leaves other "similar" types for dead.
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MERLIN By Dreamcards
Merlin is a 32K adventure set in England during the dark ages. Your task is to search through the dark forest inhabited by robbers, outlaws and creatures with awesome magic powers to find a legendary sword. An excellent adventure.
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LOG – GENERAL PURPOSE INDEX
This program is designed to suit a wide range of records where indexing (and later searching) can be on one or two words, or on a string of up to 15 characters. Each record consists of its index heading, plus up to 12 lines of text. Each line can contain up to 41 characters.
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You are a tank running around a maze gathering all the supplies you can. It sounds easy, but you have a guided missile hot on your trail. Your only defence is a remote controlled mine which you drop and explode at will. A very fast joystick or key controlled game.
Cat. XE-6960 $14.95

PENETRATOR
A low resolution graphic version of the popular game "Scrambler". You must defeat the rockets and bomb the radars in an effort to get to the next stage which is even harder. This game can be either controlled by a Joystick or by keys. Being in Lores graphics it is a very fast game. If you are bored with the same land pattern you can devise your own.
Cat. XE-6955 $19.95

SPACE PATROL
A lot like Penetrator but in high resolution graphics. You must battle your way through the various stages where at the last stage you have four chances of blowing up a neutron bomb shelter. If you are successful, the next round is a lot harder.
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BACKGAMMON – FROM MYTEK
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POOLS AND LOTTO
Two programs to help make life easier for the Pools and Lotto enthusiast. The first program chooses your numbers for the week and the second program allows you to input your numbers into a program and when Lotto night arrives you can input the winning numbers and the computer will check your Lotto for you.
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WONDER WORDS
This program allows you to input 20 words and the computer will create a Wonder Word puzzle. This can be either sent to a printer or solved on the screen or let the computer solve it. Just the program for Wonder Word enthusiasts.
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Logic troubleshooting tools and techniques

Digital circuitry has had an explosive growth over the past decade and now pervades virtually every facet of electronics. Whilst the reliability of devices and equipment has improved dramatically during that period, things still do go wrong and equipment still needs servicing when it breaks down. 'Board level' servicing can solve problems quickly in the field, but economics demands those removed boards be repaired and recycled. This article details the problems encountered and the tools and techniques employed to fix them.

DIGITAL integrated circuits range from simple buffers and two-input gate packages through to complex purpose-built controllers and microprocessors. Finding faults in digital equipment requires a *fundamentally different* approach from fault-finding in analogue circuitry, where the multimeter and oscillator are the prime tools and component characteristics can be individually measured. In digital electronics, most 'components' are contained within the ICs — which are often multi-functional. Thus there is need for a different troubleshooting approach to be developed, and different tools used, based on the type of faults that develop and the 'signatures' they leave. Of necessity, this article does not cover microprocessor-based equipment — *that's* a whole subject on its own!

Faults & effects

When fault-finding circuits built from discrete components, the task is one of verifying relatively simple characteristics such as resistance, capacitance, or turn-on voltages of components with two or at most three nodes. (A 'node' is an active junction in a circuit, usually an input or an output.) While the function of the total circuit may be quite complex, each component in that circuit performs a relatively simple task and proper operation is easily verified.

In Figure 1, each diode, resistor, capacitor and transistor can be treated using a signal generator and a voltmeter, ohmmeter, diode checker or oscilloscope — the traditional servicing tools. But when this circuit is built in integrated circuit form, these components are no longer accessible. It now becomes necessary to test the operation of the complete circuit function.

Thus an important difference between discrete circuitry and circuits built from digital ICs is in the complexity of the functions performed by these 'components'. Unlike the resistor, capacitor, diode or transistor, which must be interconnected to form a circuit function, digital ICs perform complete, complex functions. Instead of observing simple characteristics, it is now necessary to observe complex digital signals and decide if these signals are correct according to the function the IC is meant to perform.

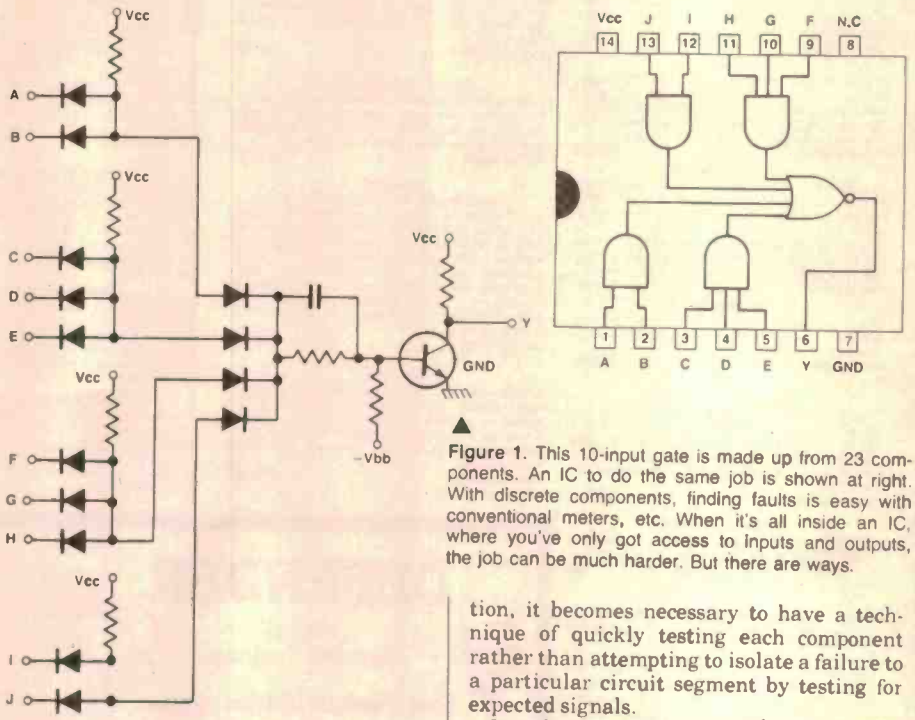


Figure 1. This 10-input gate is made up from 23 components. An IC to do the same job is shown at right. With discrete components, finding faults is easy with conventional meters, etc. When it's all inside an IC, where you've only got access to inputs and outputs, the job can be much harder. But there are ways.

Verifying proper component operation now requires 'stimulating' and observing many inputs (in Figure 1 there are 10 inputs) while simultaneously observing several outputs (up to two or three and at times as many as eight).

Thus another fundamental difference between circuitry built from discrete components and digital ICs is the number of inputs and outputs associated with each component, and the need to stimulate and observe these simultaneously.

In addition to the problems of simultaneity of signals and complexity of functions at the component level, the digital IC has introduced a new degree of complexity at the circuit level. Circuits which perplex all but their designer are commonplace. Given enough time, these circuits can be studied and their operation understood, but this is not an affordable luxury for those involved in troubleshooting electronic circuits. Without understanding a circuit's intricate operation, it becomes necessary to have a technique of quickly testing each component rather than attempting to isolate a failure to a particular circuit segment by testing for expected signals.

In order to solve these problems and make fault-finding of digital circuits more efficient, it is necessary to take advantage of the digital nature of the signals involved. Tools and techniques designed to service analogue circuits do not take advantage of this digital nature and thus are less efficient when used to troubleshoot digital circuits.

Figure 2 shows a typical TTL (Transistor-Transistor-Logic) signal. This might as well be any analogue signal when viewed on an oscilloscope. The oscilloscope displays absolute voltage with respect to time, but in the digital world absolute values are unimportant.

A digital signal exists in one of two or three states — high, low and undefined or in-between level — each determined by a threshold voltage. It is the relative value of the signal voltage with respect to these thresholds that determines the state of the digital signal, and this digital state determines the operation of the IC, not absolute levels.

In Figure 2, if the signal is greater than 2.4 volts, it is a high state and it is unimportant whether the level is 2.8 or 3.0 volts. Similarly for a low state the voltage must be below 0.4 volts. It is not important what the absolute level *is* as long as it is below this threshold. Thus when using an oscilloscope, the serviceman must over and over again determine if the signal meets the threshold requirement for the desired digital state.

Within a digital logic family, such as TTL, the timing characteristics of each component are well defined. Each gate in the TTL logic family displays a characteristic propagation delay time, rise time and fall time. The effects of these timing parameters on circuit operation are taken into account by the designer. Once a design has been developed beyond breadboard or prototype stage and is into production, problems due to design have (hopefully) been corrected.

An important characteristic of digital ICs is that when they fail, *they fail catastrophically*. This means that timing parameters rarely degrade or become marginal. Thus, observing on an oscilloscope and making repeated decisions on the validity of timing parameters is time consuming and contributes very little to the fault-finding process. Once problems due to design are corrected, the fact that pulse activity *exists* is usually enough indication of proper IC operation without further observation of pulse width, repetition rate, rise time or fall time.

Figure 3 shows a problem created by the TTL logic family. The output stage of a TTL device is a transistor totem pole. In either the high or low state, it is a low impedance. In the low state it is a saturated transistor to ground. It thus appears as 5-10 ohms to ground. This presents a problem to in-circuit stimulation.

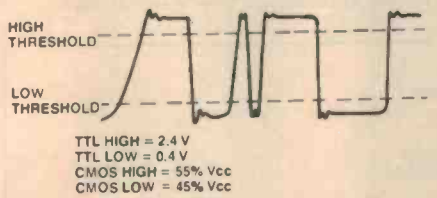


Figure 2. Digital circuits work on 'thresholds', and signals must be 'above' or 'below' the given high and low thresholds, which are different for the different 'families' — CMOS and TTL. ▲

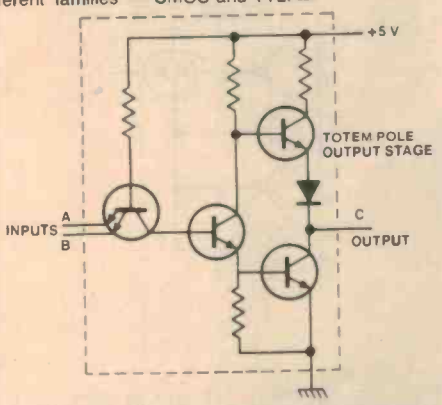


Figure 3. TTL ICs have 'totem pole' output stages, as shown above. When attempting to 'stimulate' an output node, such as C above, it is necessary to override the low impedance output stage, which consists of a saturated transistor. ▲

A signal source used to inject a pulse at a node which is driven by a TTL output must have sufficient power to override the low impedance output state. If you use a square-wave signal generator for fault-finding it must provide this capability, otherwise it is necessary either to cut printed circuit traces or pull out IC leads in order to stimulate the circuit being tested. Both of these practices are time consuming and lead to unreliable repairs.

Thus the use of the traditional oscilloscope and the traditional signal sources is inefficient. Since the diodes and transistors are packaged in the IC, use of diode checkers is also marginal, if not impossible.

These tools are general purpose tools that can be applied to any situation if you have enough time. But with the quantity and complexity of today's electronic circuits, it makes sense to find the most efficient solution to the problem at hand. This suggests using the oscilloscope, diode checkers and voltmeters on analogue circuits where they really shine, and using instruments that take advantage of the digital nature of signals on the digital circuitry to be repaired. We'll get to them a little later.

In order to repair digital equipment efficiently, it is important to understand the type of failures found in digital circuits. These can be categorised into two main classes — those caused by a failure *internal* to an IC and those caused by a failure in the circuit *external* to the IC.

Four types of failures can occur internally to an IC. These are (1) an open bond on either an input or output, (2) a short between an input or output and Vcc or ground, (3) a short between two pins (neither of which are Vcc or ground), and (4) a failure in the internal circuitry (often called the steering circuitry) of the IC.

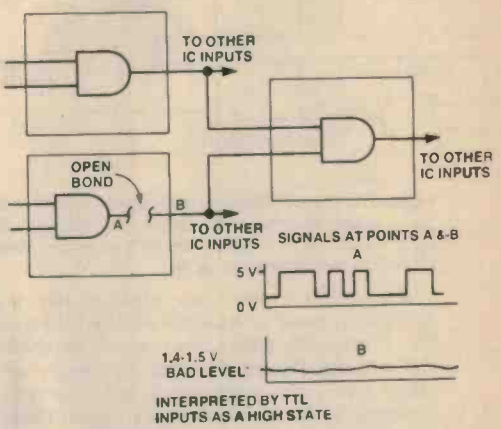
In addition to these four failures internal to an IC, there are four failures that can occur in the circuit external to the IC. These are (1) a short between a node and Vcc or ground, (2) a short between two nodes (neither of which are Vcc or ground), (3) an open signal path, and (4) a failure of an analogue component.

Before showing how to detect each of these failures we will discuss the effect each has upon circuit operation.

The first failure (internal to an IC) mentioned was an open bond on either an input or output. The failure has a different effect depending on whether it is an open output or an open input bond. In the case of an open output bond (Figure 4), the inputs driven by that output are left to float. In TTL circuits a floating input rises to approximately 1.4 to 1.5 volts and usually has the same effect on circuit operation as a high logic level. Thus an open output bond will cause all inputs driven by that output to float to a bad level since 1.5 volts is less than the high threshold level of 2.0 volts and greater than the low threshold level of 0.4 volt. In TTL a floating input is interpreted as a high level. Thus the effect will be that these inputs will respond to this bad level as though it were a static high signal.

In the case of an open input bond (Figure 5), we find that the open circuit blocks the signal driving the input from entering the IC

Figure 4. An open output bond allows all inputs driven by that output to float to a 'bad level', usually interpreted as a high. Signals at points A and B illustrated below. ▼



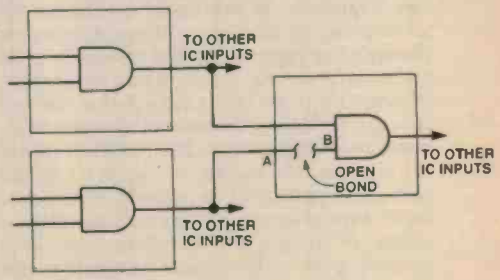


Figure 5. An open input bond blocks the incoming signal, allowing the input to float to a 'bad level' — interpreted as a high. Signals at points A and B illustrated above. ▲

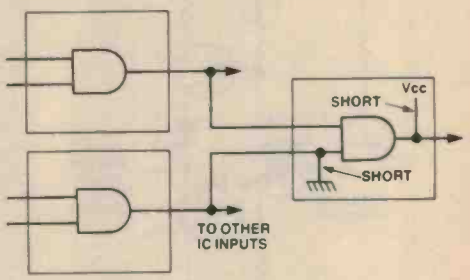


Figure 6. When you get an internal short to ground, the affected node is always pulled low. When shorted to Vcc (supply), the affected node is always pulled high. ▲

chip. The input on the chip is thus allowed to float and will respond as though it were a static high signal. It is important to realise that since the open circuit occurs on the input inside the IC, the digital signal driving this input will be unaffected by the open circuit and will be detectable when looking at the input pin (such as at Point A in Figure 5). The effect will be to block this signal inside the IC and the resulting IC operation will be as though the input were a static high.

A short between an input or output and Vcc or ground has the effect of holding all signal lines connected to that input or output either high (in the case of a short to Vcc) or low (if shorted to ground) (Figure 6). In many cases, this will cause expected signal activity at points beyond the short to disppear, and thus this type of failure is catastrophic in terms of circuit operation. ▶

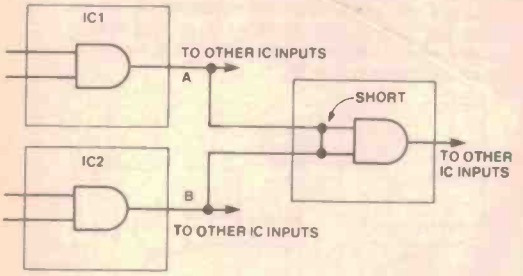


Figure 7. A short between two inputs makes a low-going driver pull the other driver low too. In IC2 at right, if B is low, it is pulled low by a saturated transistor, which pulls A low too. ▲▶

A short between two pins is not as straightforward to analyse as the short to Vcc or ground. When two pins are shorted, the outputs driving those pins oppose each other when one attempts to pull the pins high while the other attempts to pull them low (Figure 7). In this situation the output attempting to go high will supply current through the upper saturated transistor of its totem pole output stage, while the output attempting to go low will sink this current through the lower saturated transistor of its totem pole output stage. The net effect is that the short will be pulled to a low state by the saturated transistor to ground. Whenever both outputs attempt to go high simultaneously, or to go low simultaneously, the shorted pins will respond promptly. But whenever one output attempts to go low the short will be constrained to be low.

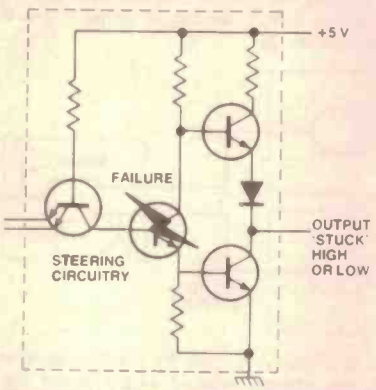
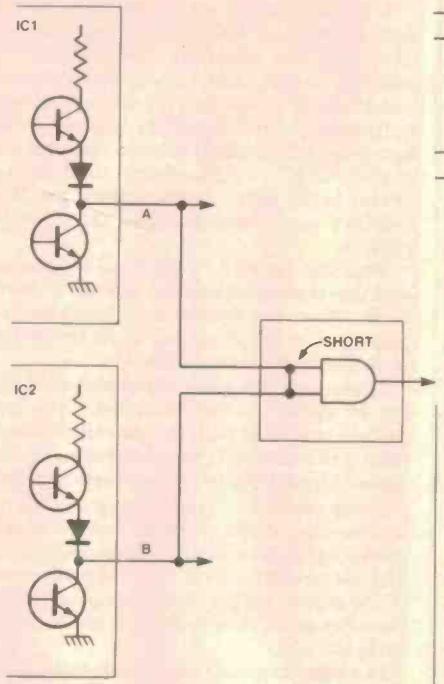


Figure 8. An internal failure of the steering circuitry will either cause the output to be 'stuck' high or low. ▲

The fourth failure internal to an IC is a failure of the internal steering circuitry of the IC (Figure 8). This has the effect of permanently turning on either the upper transistor of the output totem pole, thus locking the output in the high state, or turning on the lower transistor of the totem pole, thus locking the output in the low state. Thus this failure blocks the signal flow and has a catastrophic effect on circuit operation.

A short between a node and Vcc or ground external to the IC is indistinguishable from a short internal to the IC. Both will cause the signal lines connected to the node to be either always high (for shorts to Vcc) or always low (for shorts to ground). When this type of failure is encountered a very close physical examination of the circuit may reveal if the failure is external to the IC, but it can be determined using 'pulsing' and 'tracing' tools, as explained later.



An open signal path in the circuit has a similar effect to an open output bond driving the node (Figure 9). All inputs to the right of the open will be allowed to float to a bad level and will thus appear as a static high level in circuit operation. Those inputs to the left of the open will be unaffected by the open and will thus respond as expected.

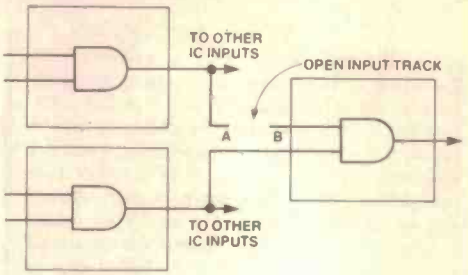


Figure 9. An open input track (external to the IC) has a similar effect as an open driver output bond. B will float to a bad level while A will still have signal on it. ▲

The problem of open-collector outputs — 'wired-ANDs', 'wired-ORs' — is different from the other cases described. Open-collector outputs differ in that they do not have an active logic-high current source. Instead, the output stage collector (Q3 in Figure 10a) is left unconnected. Thus the output stage can *sink* current in a logic low state, but cannot *source* any current in the high state. This is provided by the 'pullup' resistor R_L. Generally, you will find several open-collector gates are interconnected in parallel, as shown in Figure 10b.

So long as every output stage is turned off, the voltage at the common connection node is near Vcc, but when *any one* gate output is driven on, the node voltage drops to the low state (near 0 V). The common node thus acts as an AND gate in itself (hence 'wired-AND'). This circuit is 'wired-NAND' in TTL circuits if the inputs and outputs are active low. In other families, it's an OR function. When looking for faults here, the output has to be looked at in conjunction with the input. ▶

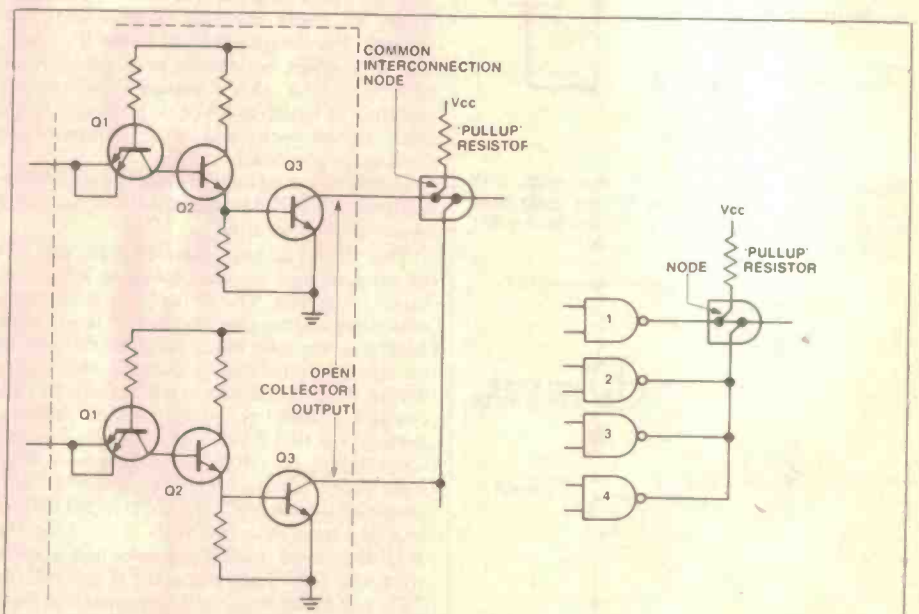


Figure 10. The 'open collector problem'. Open collector output stages do not have an active high source, this being provided externally by a 'pullup' resistor. When gates are connected in the 'wired-AND', 'wired-OR' configuration, the output of one IC can constratin the node to be.In a state other than that defined by the gates' truth table.

ACKNOWLEDGEMENT

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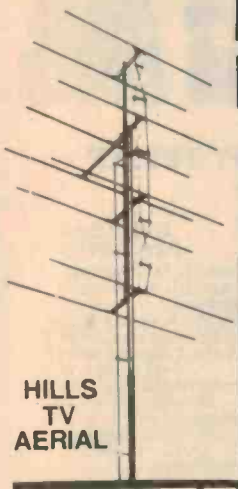

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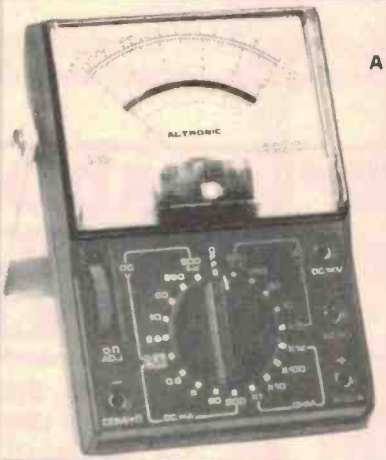

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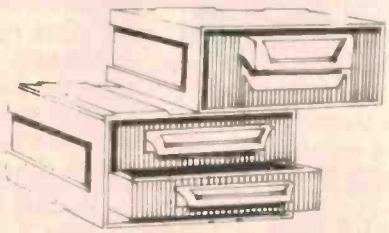

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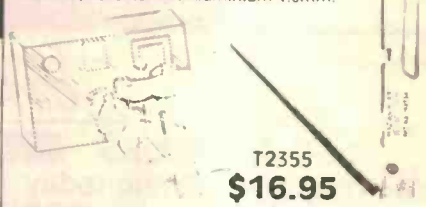

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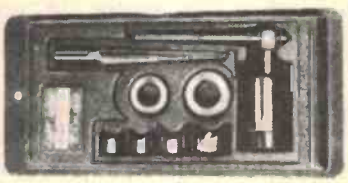

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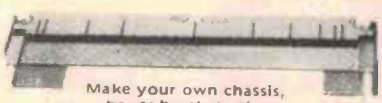

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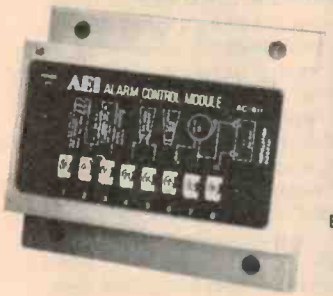

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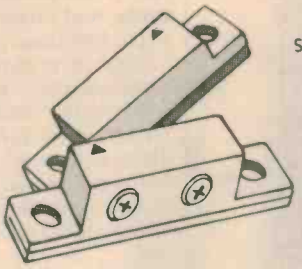

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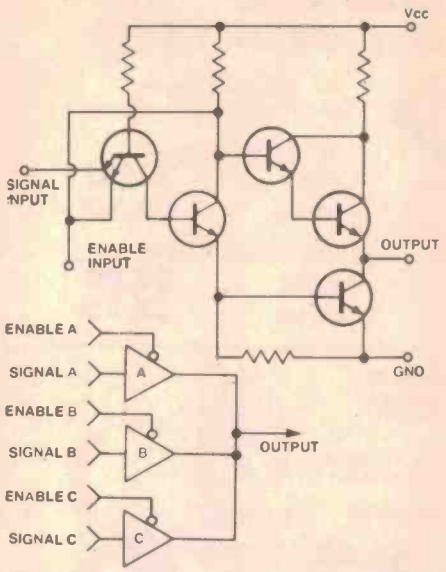


Figure 11. The internal circuitry of a 'tri-state' driver is shown above. The output can be high, low or open-circuit. Outputs are generally wired in parallel, as in the wired-AND circuit. ▲

A now widely used logic type, known as 'tri-state' logic, is a development of this idea. It is found extensively in microprocessor equipment. It is particularly found in *bussed* systems where a multitude of devices might share a common, multi-track buss. Figure 11a shows the general internal circuitry of tri-state logic. The output can be high, low or (virtually) open circuit. The control input determines whether the output is 'enabled' (i.e. operative) or not. The outputs of tri-state logic are wired in parallel, sharing the same line. Only one driver is enabled at a time. It operates in a similar fashion to the wired-AND, the difference being that an 'enable' signal *must* be present for a particular gate's output to be active, otherwise the outputs remain in the open state.

Tools

There are two fundamental classes of tools employed in logic troubleshooting — *'stimulators'* and *'indicators'*. A stimulator is nothing more than a relatively simple pulse signal generator that is used to 'stimulate' sections of a faulty circuit into action. Hence the generic name. However, they are often called simply 'pulsers'. An indicator is just that — a device that will indicate the state of a point in a digital circuit; whether it's high, low, sitting at a bad level or pulsing. Generally a LED or other light indicator is used to signal the condition, some makes using several, coloured indicators.

There are two types of indicators — the *contact* type, where a connection is actually made to the circuit, and the *non-contact* type which picks up currents flowing in the circuit interconnections (generally called 'current tracers').

For user convenience, these tools are generally built into handheld, pen-sized cases with a sharp 'probe' point at the business end. Hence they are generally known as probes — *pulser probes* for the stimulators, *logic probes* for the indicators (because they indicate logic states). Actually, the use of the word 'probe' here is a misnomer. A probe is in fact a blunt instrument. Examine a logic probe, and except for the current tracer type you'll find they have sharp points!

Since it is necessary to observe dynamic signal activity, as well as the static levels, logic probes usually have pulse stretching circuitry that can detect pulses as narrow as 10 ns and stretch them so that a readily visible blink can be seen. Thus if a low signal pulses high, the logic probe will blink 'on'. If a high signal pulses low, the probe will blink 'off'.

With some logic probes, a pulse memory may be provided. This enables the probe to monitor a signal line for single shot or low frequency pulses over extended periods of time. If a pulse occurs, this will be indicated by the device, which will remain 'on' until reset by the user.

The existence of a pulse train is indicated by flashing the lamp indicator at a constant rate (typically 10 Hz) when a pulse train is present.

Thus a logic probe enables you to view static (high or low) logic levels, single-shot pulses and pulse trains. Automatic threshold detection is generally included as it eliminates the need to determine repeatedly whether a signal is above or below the threshold, and can be employed to show open-circuit conditions also. A TTL/CMOS switch is a necessity so that a probe can be used on both device families. Some makes work on both families, without a switch.

Current tracer logic probes require no contact with the circuit at all. At the business end of a current tracer probe is a small magnetic pickup, generally consisting of a coil wound on a tiny core which has a split, permitting any external field to induce currents into the winding. Of necessity, it works on pulse (ac) signals, detecting *current change*, not dc levels. Pulses are stretched so that the display, usually a LED, can be easily seen. Sensitivity can be arranged so that the current tracer will detect the current it takes to charge the gate input capacitance of CMOS devices.

Current tracers are very useful in sorting out 'stuck' nodes, particularly where there are many elements common to the node and too few ways to isolate the one bad component. It can be done, too, without cutting pc board tracks or lifting IC pins. They are also very useful in tracing signals on multi-layer boards.

Poke & peek

The mainstay of all digital troubleshooting is stimulus-response testing. It is necessary to apply a signal and observe the response to determine if the device is operating properly. As was pointed out earlier, this can sometimes be very difficult to do in TTL circuitry.

A logic pulse provides the solution. It is used to inject into the circuit a single pulse of proper amplitude and polarity — *forcing* something to happen. If the node happens to be low, it will be pulsed high, and if high, it will be pulsed low.

Generally, logic pulsers are capable of supplying both continuous pulse trains and single-shot pulses.

A logic pulser used in conjunction with a current tracer probe is particularly useful in tracing supply rail short circuits and stuck nodes having many common elements.

These tools are useful in troubleshooting both sequential logic circuits (counter, timer and simple control systems, etc) and parallel bit circuitry (microprocessor systems, etc). However, in parallel systems which are partially working it becomes necessary to see the simultaneous action of many lines or nodes, and a more complex technique, called *signature analysis*, is necessary. A signature analyser is the appropriate tool hre, and they come in many forms. Signature analysis, though, is a whole subject in itself and we'll have to leave that to another time.

Techniques

Your first 'port of call' should *always* be the power supply, particularly in the case of total collapse. If the power supply itself proves OK, but the rails on the pc board show a volt or less, then shorted rails should be suspected. If the supply rails are healthy, then the very next step is to attempt to narrow down the malfunctioning area as much as possible by examining the observable characteristics of the failure. Try to localise it to a circuit section or to as few sections as possible. Then you can proceed to eliminate circuit components step by step by looking for improper key signals between circuits — which is where the logic probe and current tracer come into their own. Table 1 details the general run of faults and how to detect them using the stimulus-response technique.

Dependence upon a well-written service manual is the key to this phase of troubleshooting. Isolating a failure to a single circuit requires knowledge of the instrument or system and its operating characteristics. A well-written manual will indicate key signals to be observed. The logic probe will provide a rapid means of observing the presence of these signals.

Once a failure has been isolated to a single circuit, the tools described can be used to observe the effect of the failure on circuit operation and to locate the failure to its cause (either an IC or a fault in the circuit external to the IC).

The logic probe is used to observe the signal activity on inputs and to view the resulting output signals. From this information, a decision can be made as to the proper operation of the IC.

For example, if a clock signal is occurring on a decade counter and the enabling inputs (usually reset lines) are in the enabled state, then the output should be counting. A logic probe will allow the clock and enabling inputs to be observed, and, if pulse activity is indicated on the outputs, then the IC can be assumed to be operating properly.

As stated before, usually it is not necessary to see the actual timing of the output signals, since ICs fail catastrophically. The occurrence of pulse activity is often enough indication of proper operation.

When more detailed study is desired, or when input signal activity is missing, the logic pulser can be used to inject input sig-.

TABLE 1.

FAULT	INDICATOR	STIMULUS	TEST METHOD
Shorted node	Current tracer	Pulser or circuit signals(1)	• Pulse node • Follow current pulses to short
Stuck data buss	Current tracer	Pulser or circuit signals(1)	• Pulse buss line • Trace current to device holding the buss line in a stuck condition.
Signal line short to Vcc or ground	Logic probe and/ or current tracer	Pulser	• Pulse and probe test point simultaneously • Short to Vcc or ground cannot be overridden by pulsing • Pulse test point, and follow current pulses to the short with tracer
Vcc to ground short	Current tracer	Pulser	• Remove power from test circuit • Disconnect electrolytic bypass capacitors • Pulse across Vcc and ground • Trace current to fault
Suspected internally open IC	Logic probe	Pulser or circuit signals(1)	• Pulse device input • Probe output for response
Solder bridge	Current tracer	Pulser or circuit signals(1)	• Pulse suspect line(s) • Trace current pulses to the fault (Light goes out when solder bridge passed)

1. Use the pulser to provide stimulus, or use normal circuit signals, whichever is most convenient.

nals, and the probe used to monitor the response. This technique is especially good when testing gates and other combinatorial devices. A logic pulser can be used to cause the inputs to go to a state which will cause a change in the output state.

For example, a three-input NAND gate which has high, low, low inputs will have a high output. By pulsing the two low inputs high using a logic pulser, the output will pulse low, and can be detected by a logic probe. This then indicates that the IC is operating properly.

A logic pulser is also valuable for replacing the clock in a digital circuit, thus allowing the circuit to be single-stepped while the logic probe is used to observe the changes in the circuit's state.

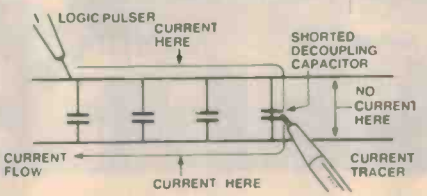
The first step might be called the 'mapping' step, since the effect is to *map out* the problem areas for further investigation. It is important to do a complete 'mapping' of the circuit before proceeding to analyse each of the indicated failures. Prematurely studying a fault can result in overlooking faults which cause multiple failures, such as shorts between two nodes. This often leads to the needless replacement of a good IC and much wasted time. With a complete trouble-area 'map' you can begin to determine the type and cause of the failures. This is done by systematically eliminating the possible failures, as discussed earlier.

The first failure to test for is an open bond in the IC driving the failed node (the Figure 4 problem). A logic probe provides a quick and accurate test for this failure. If the output bond is open, then the node will float to a bad level. By probing the node, the logic probe will quickly indicate a bad level. If a bad level is indicated, then the IC driving the node should be replaced and retested.

If the node is not a bad level, then a test for a short to Vcc or ground should be made next (the Figure 6 problem). This is best done using a logic pulser and current tracer. The problem is to determine if the driver is dead, or if a shorted input is clamping the node to a fixed value.

Use a logic probe and pulser to test the node's logic state and to see if the state can be changed (shorts to Vcc or ground cannot be

Figure 12. Tracing a supply rail short. ▼



Use the probe and pulser to test the node's logic state and to see if the state can be changed (shorts to Vcc or ground cannot be overridden by pulsing). By pulsing the node you can follow the current directly to the faulty input using a current tracer (Figure 13).

If the node is shorted to Vcc or ground there are two possible causes. The first is a short in the circuit external to the ICs and the other is a short internal to one of the ICs attached to the node. The external short should be detected by an examination of the circuit. If no external short is found, then the cause is equally likely to be any one of the ICs attached to the node. The only suggestion that can be made (based on experience) is to first replace the IC driving the node, and if that does not solve the problem try each of the other ICs individually until the short is eliminated. (It might be noted that on occasion analogue components such as resistors or capacitors attached to the node have shorted.)

If the node is not shorted to Vcc or ground, nor is it an open output bond, then we should look for a short between two nodes. This can be done in one of two ways. First the logic pulser can be used to pulse the failing node being studied, and the logic probe can be used to observe each of the remaining failing nodes. If a short exists between the node being studied and one of the other failing nodes, then the pulser will cause the node being probed to change state (i.e: the probe will detect a pulse). To ensure that a short exists, the probe and pulser should be reversed and the test made again.

If the failure is a short there are two possible causes. The most likely is a problem in the circuit external to the ICs. This can be detected by physically examining the circuit, but shorts are not always obvious if only

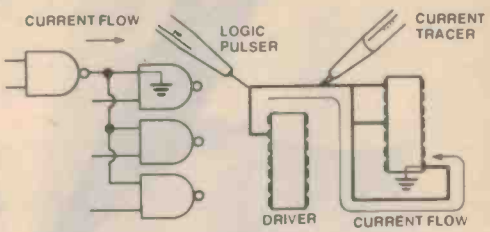


Figure 13. Tracing a stuck node. ▲

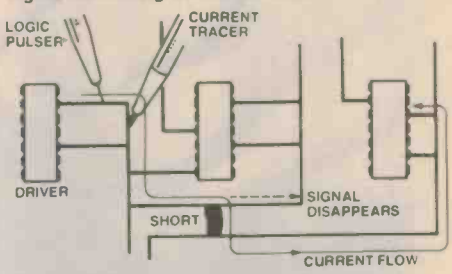


Figure 14. Tracing a track short. ▲

traced down to an area. A current tracer is best to pinpoint a short between tracks by tracing current from the pulser. When the short is passed, the signal disappears (see Figure 14).

If the two nodes which are shorted are common to one IC, then the failure must be internal to that IC (the Figure 7 problem). If after examining the circuit no short can be found external to the IC, then the IC should be replaced.

If the failure is not a short between two nodes, then there are only two possibilities left. They are that the failure is an open input bond or a failure of the internal circuitry of the IC (Figures 5 and 8 problem). In either case, this IC should now be replaced. Thus by systematically eliminating the IC failures, the cause can be located.

An important step at any point where an IC is replaced is the retesting of the circuit. If the testing again indicates a failure, then more study of the problem must be made with the knowledge that the failure is not in the IC that has just been replaced.

An open track on the pc board (the Figure 9 problem) is best located with a logic probe, using either circuit signals or a pulser to provide the stimulus. The logic probe provides a rapid means of not only detecting but also physically locating the open.

Since an open signal path allows the input to the 'right' of the open to float to a bad level, the logic probe can be used to test the input of each IC for a bad level. Once an input floating at a bad level is detected, the logic probe can be used to follow the circuit back from the input looking for the open. This can be done because the circuit to the 'left' of the open will be a good logic level (either high, low or pulsing), while the circuit to the 'right' will be a bad level, precisely locating the open. The open can then be repaired and the circuit tested.

This systematic elimination of possible failures in digital circuits by the use of such special tools will ensure a rapid and accurate repair. Because these instruments provide a digital solution to the digital problem, improvements in servicing time of at last 4:1 are easily achieved over the use of analogue instruments. ●

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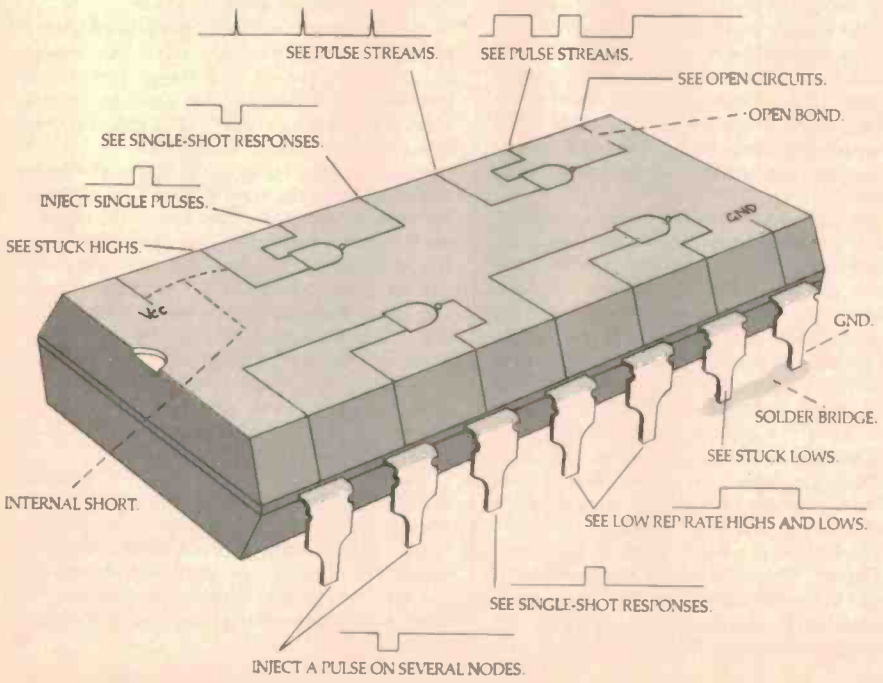

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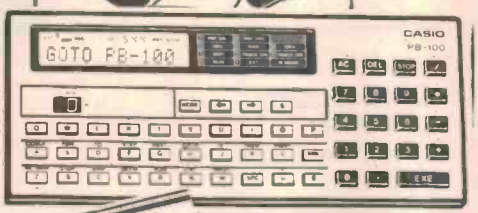

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An electronic sling psychrometer

'What in the name of Beelzebub's left horn is a sling psychrometer?", I hear you ask. The very name itself conjures up images of smug mid-Victorian (era, not state) scientists airing their knowledge of classical languages. The machine is nowhere near as complicated as its name though, and all it does is measure humidity, or the amount of moisture in the air.

Ian Thomas

TO MOST OF US humidity is a rather poorly understood quantity and we are only aware of it when we are hot and sticky and our cold tinny leaves wet rings all over the place. The measurement and control of humidity, however, has a host of applications in industry and research as well as at home. For example the growing of a lot of exotic plants requires that the humidity where they are raised be kept under some sort of control.

Before we go on to the actual construction of the project and how to use it, it is interesting to look at the phenomenon of humidity itself and how it is defined and measured.

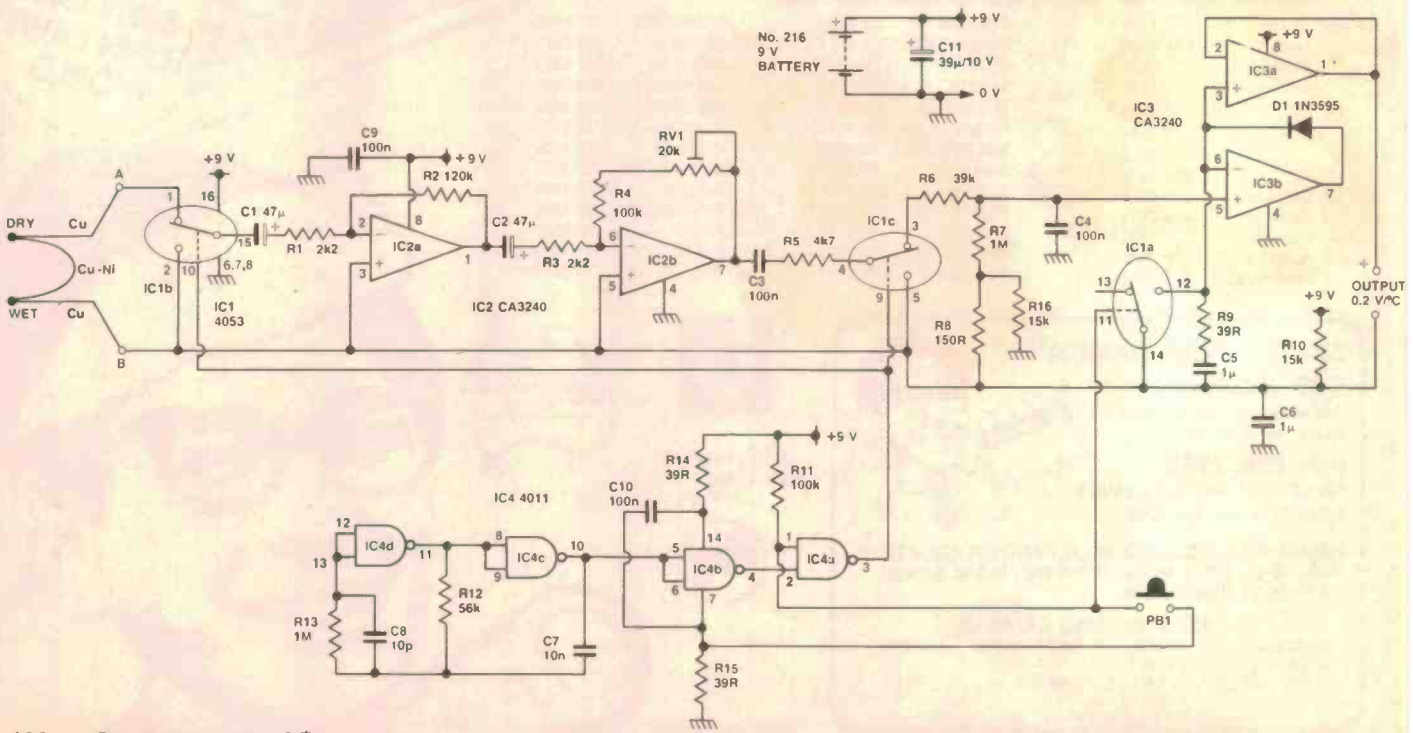
Humidity

Humidity is simply the amount of water vapour that is present in the air, but this seemingly straightforward quantity can be measured in many ways. Probably the easiest to understand is *Absolute Humidity* which is simply the amount of water vapour, expressed as either a mass or volume, that is contained in a given amount of air. This can be expressed as parts per million on a volume basis or mass basis, or grams per kg of air (or, in all probability in days gone by, decigrains per cubic rood — please don't ask me to define it). These units are nice and easy to understand but don't directly relate to the subjective feeling of how comfortable or uncomfortable we feel.

Another way of expressing Absolute Humidity is to measure the Dewpoint of the air. Air at a given temperature is only capable of holding so much water and the hotter the air the more water it will hold. If air that contains a certain amount of water is cooled to below its Dewpoint then the water will come out as a liquid (fog, rain or dew) or solid (snow or frost). The relationship between the Dewpoint temperature and absolute humidity is very well known and tables are published giving the exact amount of water vapour that is present for a given Dewpoint.

Measuring the Dewpoint is an accurate way of determining humidity but it's a bit clumsy as you have to have a method of cooling the air to see when mist or frost starts to form. This is usually done by cooling a mirrored surface in the air until it starts to mist over, then measuring the temperature of the surface. Another way is to expand the air to cool it and measuring the temperature of the air when fog starts to form. Either way is 'fiddly' at best and can give rather variable answers depending on how things were set up.

By far the most common way of expressing humidity is *Relative Humidity*



and this is how you see it on the weather forecasts. Relative Humidity is the ratio of the amount of water vapour present in a given volume of air to the amount of water vapour that would be present if the air had its Dewpoint at the same temperature. It shows how much water is in the air as a ratio of how much water the air will carry before mist starts to form and is a very good indication of how we feel (sticky and uncomfortable means close to 100% and sore throat and eyes hurting means close to 0%). The measurement of relative humidity can be done in many ways also, depending on whether the readings are wanted continuously for control purposes or just spot readings. This brings us to the project for this article; the psychrometer.

We're all aware that if a surface is wet and air is blown over it then the surface is cooled (the fact is drawn to our attention when we get out of a swimming pool on a windy day).

This principle is used to make measurements of Relative Humidity.

Normally, two mercury-in-glass thermometers are used with one thermometer's bulb surrounded in water-soaked cotton.

The two thermometers are mounted in a 'sling' so they can be whirled around in the air to create a draught.

The dry bulb thermometer records the ambient air temperature and the temperature difference between the two thermometers gives the so-called Wet Bulb Depression or the degree of cooling caused by the water on the wet bulb. Using these two figures it is possible to look up the Relative Humidity from tables.

The whole assemblage of thermometers, sling, water reservoir and wick to cover the wet bulb, is called a *sling psychrometer* and so long as the wick is kept clean and pure water is used, will give reliable and accurate humidity readings.

HOW IT WORKS — ETI-1502

The circuit can be divided into six separate stages which will be described separately. They are:

(1) The temperature difference sensing thermocouple. Thermocouples have been used for many years and can give very accurate temperature measurements. Even today they are still used to calibrate semiconductor diffusion furnaces where the temperature must be correct to about ¼°C at 1100°C, a remarkable feat of control. Our needs are not quite so dramatic but as the voltages out of a thermocouple are very small, care must be taken.

The couple used is copper-constantan one which gives, for small temperature differences, about 38.5 microvolts per °C. Constantan is an alloy of 60% copper and 40% nickel and the copper constantan couple is normally used between −200°C and +300°C. The thermocouple consists of two pieces of copper wire which are soldered onto the printed circuit board close together. The two free ends of the wires are connected together by a piece of constantan wire. About five millimeters of the copper and constantan wire are twisted together tightly to form the actual couple and may be soldered if the same solder is used for both junctions. The junction whose copper side is connected to the low voltage terminal is the cold junction (in our case the junction which is covered with wet cotton wool) and the junction whose copper side is connected to the amplifier input is the hot junction.

(2) The input chopper. This is a simple CMOS analogue switch which, in this case, is a CD4053BE. The integrated circuit consists of three separate single-pole double-throw semiconductor switches, all of which have separate control inputs. The thermocouple is connected to one input of the switch and the ohter input is connected to a reference voltage which is common to the whole circuit. The control line for the switch is driven from a 500 Hz square wave so that the output from the switch is a 500 Hz square wave with an amplitude equal to the thermocouple voltage (plus a few bonus spikes from the switching).

(3) The ac amplifier. The low level signal from the input chopper is then amplified up through two stages using common or garden operational amplifiers. C1 ensures that the first stage of gain has unity gain for dc and the two resistors R1 and R2 set the gain for ac signals. It is about 54.5 for the stage, which is still well below the open loop gain for the op-amp at the chopping frequency so the gain will be stable with temperature and power supply voltage. The output from the first stage is ac-coupled to the second stage through C2 and the second stage gain is set by R3, R4 and RV1. RV1 is used to calibrate the gain of the whole amplifier so the output of the complete circuit is 0.2 volts/°C. The output of the amplifier is a square wave whose peak-to-peak voltage corresponds to the dc voltage we want.

(4) The synchronous switch for dc recovery. In order to convert the square wave out of the amplifier into a dc voltage again a second section of the CMOS analogue switch is used. The ac signal from the amplifier is coupled through a capacitor C3 (and resistor R5 to prevent any large currents from flowing and upsetting the op-amp output) to the 'pole' of the analogue switch. One switched output from the switch is connected to the common reference voltage. The other output is connected to a simple RC low pass filter formed by R6 and C4. The control line for the analogue switch is driven from the same signal that drives the input chopper. When the input chopper connects the reference voltage to the amplifier input the amplifier output is also connected to the same voltage and C3 is charged to any residual dc voltages that may exist due to op-amp offsets.

When the input is connected to the thermocouple input the amplifier output is switched to R6 and charges C4 to the amplified thermocpouple voltage. The overall effect is that the output analogue switch acts as a very accurate fullwave rectifier and converts the ac output from the amplifier back into a dc voltage referred to the common reference voltage.

Because the two amplifier stages together have a gain of about 2500 as well as amplifying the thermocouple voltage, a lot of noise and switching spikes are amplified as well. R6 and C4 filter these out so the dc signal on C4 is an accurate representation of the dc input. Resistors R7 and R8 form a bleed so that when the whole circuit is reset C4 is discharged to the reference voltage (more about this later).

(5) The output peak hold circuit. The dc voltage on C4 will vary as the temperature changes on the thermocouple input and, as we want to measure the largest voltage we can generate by whirling the whole thing around in the air, we need a way of capturing the peak output so it can be measured at leisure. This is done by IC3 and C5.

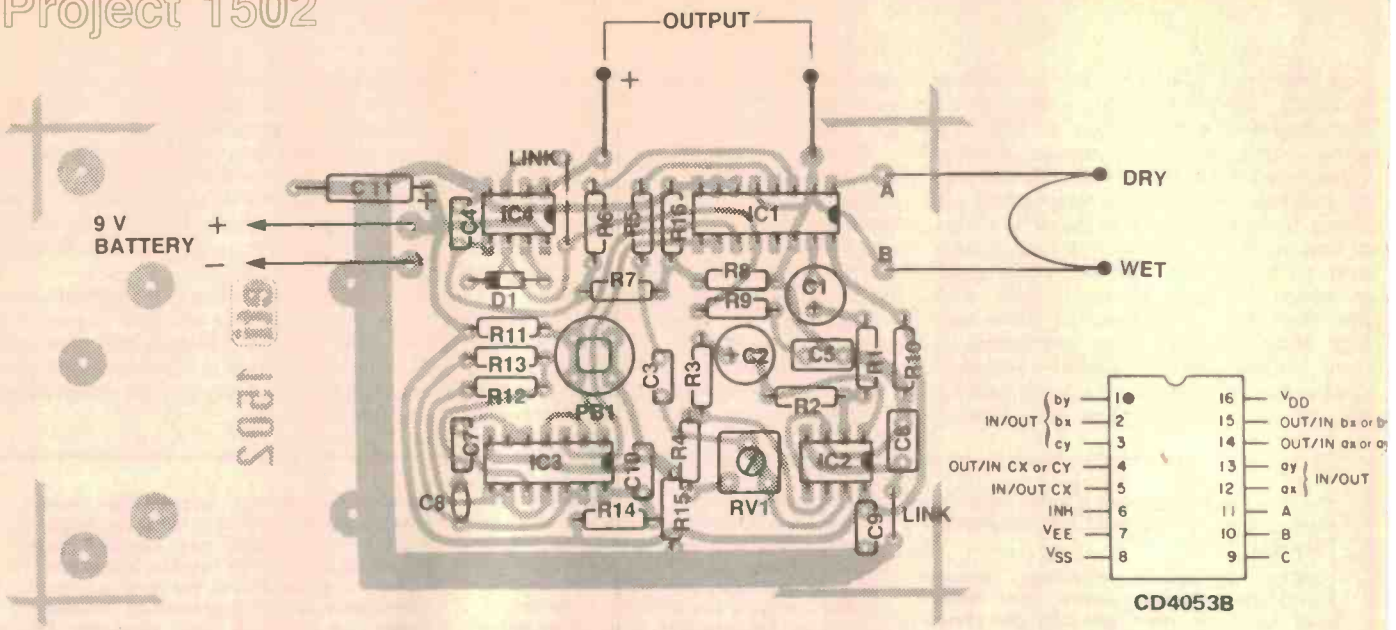
The varying dc voltage is connected to the non-inverting input of the op-amp, pin 5 and feedback is connected around the op-amp through a low leakage diode, D1. When the non-inverting input (pin 5) moves more positive the op-amp output also moves positive and charges C5 to the same voltage. If pin 5 moves slightly more negative, then the output also swings negative and reverse biases the diode. In fact, the op-amp output immediately swings to ground as the diode breaks the feedback loop. Capacitor C5 therefore holds exactly the peak dc voltage that is applied to the non-inverting input to the op-amp. R9 is in series with C5 so, once again, the op-amp output does not have to drive directly onto a large capacitor (if it is left out the op-amp will oscillate when the diode is turned on and the peak detector accuracy falls to pieces). The second op-amp of IC3 is used as a very high impedance input unity gain buffer.

The peak dc voltage is only held as a charge on a capacitor so, in order to be able to take measurements with any voltmeter, the capacitor voltage must be buffered. It is very important to use FET-input op-amps for this part of the circuit and MOSFET input op-amps such as the RCA CA3240 are about the best cheap ones available.

As the voltage on C5 can only go more positive, a way is needed to reset the peak detector when the reading has been taken. The last section of the analogue switch is used as a reset circuit. The common input to the analogue switch is connected to the reference voltage and the input which is off. When the control line is high it is connected to C5. The control line is pulled high by R11 and the analogue switch is off when measurements are being taken. When the reset switch, SW1 is operated C5 is shorted to the reference voltage and at the same time the filter capacitor C4 is allowed to discharge through R7 and R16. The oscillator driving the two synchronous switches is also disabled by SW1 so C4 will not be charged through R6 when the circuit is being reset.

(6) The switch drive oscillator. The 500 Hz square wave which drives the two synchronous analogue switches is generated by a simple CMOS oscillator formed by IC4, R12 and C7. This circuit is used so commonly that it doesn't really need to be described. Two extra gates, the last of which is also used to gate off the output when the circuit is being reset, square up the drive so the analogue switches are switched cleanly. the whole chopper stabilised amplifier is not sensitive to drive mark-space ratio so no attempt is made to ensure that the drive output is symmetric.

Resistors R14 and R15, together with C10, filter the supply for IC4, preventing supply rail switching pulses from being coupled into the rest of the circuitry.



Component overlay. Assembly is pretty straightforward. Watch the orientation of the 'polarised' components — diodes, ICs and electrolytic capacitors.

Doing it with wires

The project reads wet bulb depression directly by using a copper-constantan thermocouple to measure the temperature difference between ambient and a junction covered with wet cotton. For the temperature differences we're interested in, the potential difference generated by the thermocouple is a linear function of temperature and is approximately 38.5 microvolts per °C. This gives us our first problem as amplifiers which have input dc offset voltages much less than one microvolt are pretty thin on the ground and usually cost a bomb. The answer to this is to use a chopper-stabilised amplifier so all the gain is produced for ac signals only where offsets are no problem (see How It Works).

The next problem was that the theromocouple responds very fast to temperature changes and stopping whirling the device around and attaching the probes to the amplifier output terminals gave the thermocouple time to change its reading considerably. A simple peak hold circuit had to be incorporated to keep the peak value of the output voltage until it could be read. Even with this peak hold included it was necessary to use a low leakage diode in the peak charging feedback path as diodes such as the old favourite 1N914A have a reverse leakage of about 20 nA at room temperature and this caused the output temperature reading to drift by about 0.1°C per second. (This may not sound like much but it was nigh on impossible to connect the DVM probes and get a good reading in time). The 1N3595 that I used has a reverse leakage of only 1 nA and made things much more manageable but unfortunately the better performance costs — these diodes are not cheap.

Construction

If you are using the artwork supplied then building up the project will give no trouble. First assemble all resistors and capacitors. This is a good general rule when using CMOS integrated circuits as it makes it harder to zap the IC with static charge. Then insert the integrated circuits, making very sure that they are all in the right way (everyone harps on this but its an embarrasingly easy mistake to make as I can personally testify). The orientation of the two coupling electrolytic capacitors, C1 and C2, is not important as the only dc voltage that ever appears across them is the offset voltage of the operational amplifiers and this voltage is very small and can be of either polarity. It's bending the rules a bit to reverse bias an electro but the 10 mV or so doesn't really matter. The polarity of the power supply filter capacitor C8 *does* matter though, so take care.

After all the components except the pushbutton PB1 have been inserted and neartly soldered, it is necessary to thoroughly clean and deflux the board. Parts of the circuit (mainly the node connecting IOC3 pins 3 and 6 to C5, D1 and IC1 pin 12) are very sensitive to leakage and if dirt or flux is left on the board you will waste the money you spent on the 1N3595. The best way to thoroughly deflux the board is to use an el-cheapo 25 mm paint brush, whose bristles have been cut to about 10 mm long, and acetone solvent. Both can be purchased at the local hardware store.

Tip some of the acetone out into a shallow *glass* dish (if you use a plastic dish its bottom will immediately dissolve and you will have acetone everywhere dissolving everything in sight — it's a very good solvent!) and thoroughly wet the short bristles of the brush. Scrub the soldered side of the board and immediately mop the board dry with a clean rag or paper towel. The board must be patted dry as if you try to wipe it the towel will catch on all the cropped component leads but it is important that the board be dried off completely and quickly as if the acetone is left to dry on the board the dissolved flux will be deposited on the board again and can be seen as a white deposit, usually in the spaces between tracks and IC pins. Repeat the scrubbing and mopping dry until the board appears completely clean when the acetone is dried off completely (this usually takes several applications).

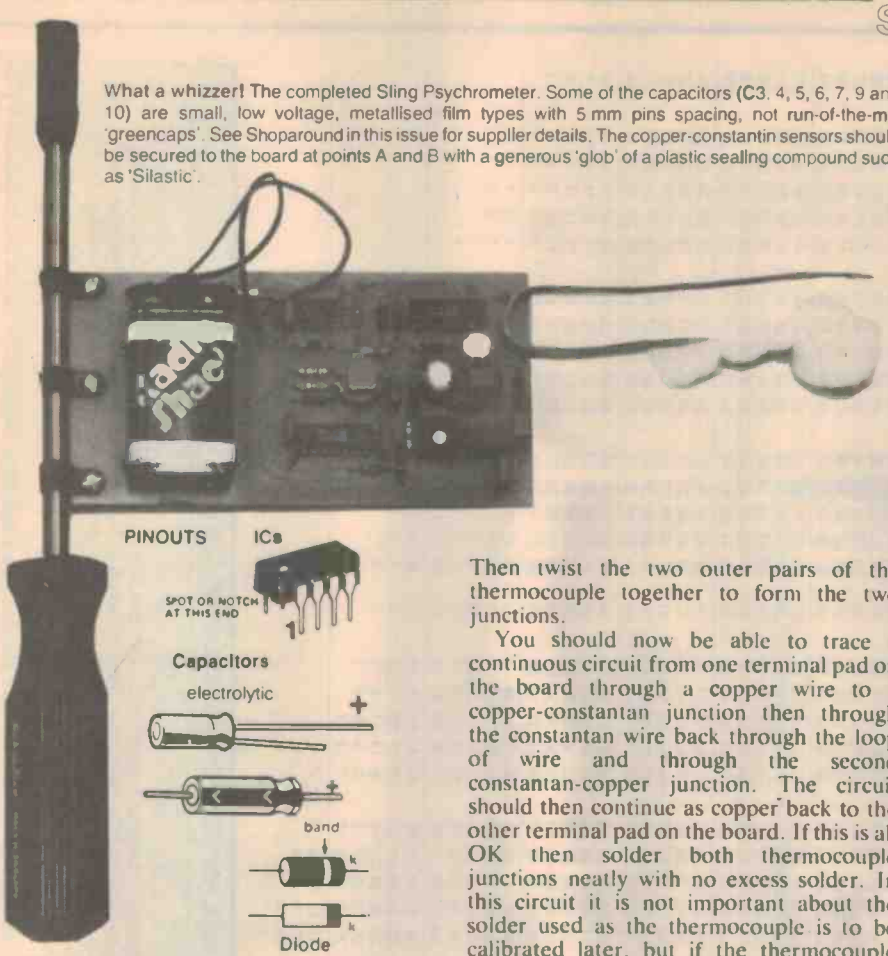
PARTS LIST — ETI-1502

Resistors ..... all ½W, 5% unless noted
- R1, R3 ..... 2k20, 0.4W, 2% metal film
- R2 ..... 120k 0.4W, 2% metal film
- R4 ..... 100k 0.4W, 2% metal film
- R5 ..... 4k7
- R6 ..... 39k
- R7, R13 ..... 1M0 ¼W, 10% carbon film
- R8 ..... 150R
- R9, R14, R15 ..... 39R
- R10 ..... 15k
- R11 ..... 100k
- R12 ..... 56k
- RV1 ..... 20k cermet trimpot, Allen-Bradley type E or similar.

Capacitors
- C1, C2 ..... 47µ/10 V electro, radial leads
- C3, 4, 9, 10 ..... 100n/63 V metallised film, Wima type RS-21 or similar
- C5, C6 ..... 1µ/50 V metallised film, Wima type RS-21 or similar
- C7 ..... 10n/63 V metallised film, Wima type RS-21 or similar
- C8 ..... 10p ceramic
- C11 ..... 39µ/10 V electro, axial leads

Semiconductors
- D1 ..... 1N3595
- IC1 ..... 4053B
- IC2, IC3 ..... CA3240E
- IC4 ..... 4011B

Miscellaneous
ETI-1502 pc board; length of copper-constantin thermocouple (about 150 mm); Spintate nut driver (with 4" or 5" shaft); small cable clamps (5 mm i.d. or to suit Spintate shaft); battery snap and battery clamp for No. 216 9 V battery; No. 216 9 V battery, piece of cotton wool.



What a whizzer! The completed Sling Psychrometer. Some of the capacitors (C3, 4, 5, 6, 7, 9 and 10) are small, low voltage, metallised film types with 5 mm pins spacing, not run-of-the-mill 'greencaps'. See Shoparound in this issue for supplier details. The copper-constantin sensors should be secured to the board at points A and B with a generous 'glob' of a plastic sealing compound such as 'Silastic'.

Do this out in the open or in a well-ventilated room. Acetone is flammable, so do not smoke or have anyone smoking nearby while you're doing it and keep away from possible arcs and sparks. Avoid getting the acetone on your skin.

The pushbutton can be soldered in when defluxing is finished. If you insert the switch before cleaning the board there is a very good chance that some flux will be deposited in the contacts and give unreliable operation.

The next step is to attach the thermocouple wire. I used standard copper-constantan insulated thermocouple wire that is available from most scientific supply houses (i.e: Selby Scientific). Only about 150 mm of the pair is needed for the psychrometer, but if you want to use the project for remote temperature sensing as discussed later, much longer runs can be attached with no ill effects.

To prepare the short thermocouple as shown in the photograph, first take about 150 mm of the pair and bare both ends of both wires for about 10 mm. Then lay the pair flat on the table and very carefully trace the *copper* wire back to the centre of the pair. Separate the two insulated wires for about 10 to 15 mm from the centre and cut the copper wire (if you cut the constantan wire you've ruined it). Bare the two ends of the copper wire that you've just cut for about 5 mm and solder them into the printed circuit board. The insulated constantan wire should form a neat loop between the two terminated copper wires. Then twist the two outer pairs of the thermocouple together to form the two junctions.

You should now be able to trace a continuous circuit from one terminal pad on the board through a copper wire to a copper-constantan junction then through the constantan wire back through the loop of wire and through the second constantan-copper junction. The circuit should then continue as copper back to the other terminal pad on the board. If this is all OK then solder both thermocouple junctions neatly with no excess solder. In this circuit it is not important about the solder used as the thermocouple is to be calibrated later, but if the thermocouple was to be used directy into a meter then care would have to be taken to use the same solder for both junctions.

All that remains now is to solder in the battery clip-lead and the circuit is ready for test and calibration.

Amplifier calibration

To calibrate the thermocouple-amplifier combination you will need two kitchen drinking glasses, some ice from the freezer and a reasonably good thermometer. While thermometers expounding the virtues of Bert's Big Ends or Clives Clutches are all good and fine in their place they really aren't accurate enough here. I bought a −10° to +510°C mercury-in-glass thermometer from Selby Scientific at North Ryde (Sydney, NSW) but most scientific supply houses stock them (see your local 'phone book). The thermometer is also used when actual humidity readings are taken and you will find it quite useful round the house as well, and I found the $8.40 really well spent.

Calibration is done by establishing an exactly known temperature difference between the two junctions of the thermocouple and adjusting RV1 until the voltage difference at the output terminals reads correctly. The cold junction is set to 0°C by immersing it in water with plenty of ice in it and the hot junction is immersed in ordinary tap water.

The temperature of the hot junction must be between 18°C and 20°C to give accurate calibration and if the water out of the tap is hotter or colder than this a judicious admixture of ice or hot water will be necessary. Fill one of the tumblers with ice from the freezer then fill it up with water to create a 0°C reference and fill the other glass with water mixed as described. If you have no faith you can check that the ice-water mixture is really at 0°C (alternatively, this could be considered to be a check on your thermometer). Then measure the temperature of the warmer water and note it down. Make sure that the thermometer is left in the water long enough for the reading to stabilise (60 seconds or so is long enough).

Connect the battery to the amplifier and, as a quick check to make sure that all is working, your DVM to the output terminals. If you hold the hot junction with your fingers the output voltage should climb to about 0.5 V in a few seconds (unless it's a very hot day in which case your fingers may actually be cooler than ambient). This test just measures the temperature difference between your fingers and the air temperature and ensures that the amplifier is working correctly.

When the hot junction (the junction whose copper side connects to pin 1 of IC1) is released the output voltage should *very* slowly drift towards zero. In the prototype, the drift was about 1 mV every two or three seconds but if you used a 1N914 in place of the 1N3595 the drift will probably be about 20 mV per second.

After you are satisfied that the amplifier and peak hold circuit are working OK, press PB1 and make sure that the output voltage goes to zero. There will be a slight residual offset due to the input offset voltages of the two op-amps of IC3 but if the output is within ±20 mV of zero all is well.

The final step is to adjust RV1. Place the two tumblers of water that you've prepared close side by side and immerse the hot junction in the warmer water and the cold junction in the iced water. Both junctions should be about 20 mm below the surface. The DVM reading should rapidly climb to about 1.8 to 2.0 volts. Adjust RV1 fully clockwise to set the amplifier to its lowest gain and operate the zero switch for a few seconds to start adjustment from the lowest voltage. Then, slowly adjust the potentiometer until the output voltage equals the thermometer reading (2.000 volts = 20.00°C). If you overshoot the desired reading and want to come back, then you must operate the zeroing switch after every clockwise adjustment because the peak hold circuit will not allow a gain reduction to be displayed. Make sure that the cold junction is right in the middle of the ice in the tumbler and not at the bottom of the glass as the water at the bottom is probably not at 0°C.

It is a good idea to check this adjustment several times as a 1°C error by misplacing the two junctions in the tumblers or incorrectly measuring the temperature of the hot junction is easy to make and gives a 5% error. Once this adjustment is made the psychrometer is ready to be assembled onto its sling handle. ▶

WET BULB DEPRESSION (DEGREES CELSIUS)

DRY BULB TEMPERATURE (DEGREES CELSIUS)

	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0
50	100	99	98	97	96	95	94	93	91	90	89	88	87	86	85	84	83	82	82	81	80	79	78	77	76	75	74	73	72	71	71	70	69	68	67	66	66	65	65	64	63	62	61	61	60	59	58	57	57	56	55	54
49	100	99	98	97	96	95	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	77	76	75	74	73	72	71	70	69	68	68	67	66	66	65	64	63	63	62	61	60	59	59	58	57	56	55	55	54
48	100	99	98	97	96	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	73	72	71	70	69	68	67	67	66	66	65	64	63	62	61	60	60	59	58	57	56	56	55	54	53
47	100	99	98	97	96	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	70	69	68	67	66	65	65	64	63	63	62	61	60	59	58	58	57	56	55	54	54	53
46	100	99	98	97	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	66	65	65	64	64	63	62	61	60	60	59	58	57	56	55	55	54	53	52
45	100	99	98	97	95	94	93	92	91	90	89	88	87	86	85	83	82	81	80	79	78	77	76	75	74	73	73	72	71	70	69	68	67	66	65	64	64	63	63	62	61	60	59	58	57	57	56	55	54	53	53	52
44	100	99	98	96	95	94	93	92	91	90	89	88	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	67	66	65	64	64	63	62	62	61	60	59	59	58	57	56	55	54	53	52	51
43	100	99	98	96	95	94	93	92	91	90	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	63	62	62	61	60	59	58	58	57	56	55	54	53	52	51	51
42	100	99	98	96	95	94	93	92	91	89	88	87	86	85	84	83	82	81	80	79	78	77	75	74	73	72	71	70	70	69	68	67	66	65	64	63	63	62	61	60	59	58	57	57	56	55	54	53	52	52	51	50
41	100	99	98	96	95	94	93	92	90	89	88	87	86	85	84	83	82	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	62	61	61	60	59	58	57	56	55	54	53	53	52	52	51	50	49
40	100	99	98	96	95	94	93	92	90	89	88	87	86	85	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	62	61	60	59	58	57	56	55	55	54	53	52	51	50	49	48
39	100	99	97	96	95	94	93	91	90	89	88	87	86	84	83	82	81	80	79	78	77	76	74	73	72	71	70	69	68	67	66	65	64	63	62	61	61	60	59	58	58	57	56	55	54	53	52	51	50	49	49	48
38	100	99	97	96	95	94	92	91	90	89	88	86	85	84	83	82	81	80	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	61	60	59	58	57	56	55	54	53	52	51	51	50	49	48	47
37	100	99	97	96	95	94	92	91	90	89	87	86	85	84	83	82	80	79	78	77	76	75	74	73	72	70	69	68	67	66	65	64	63	62	61	60	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	46
36	100	99	97	96	95	94	92	91	90	89	87	86	85	84	82	81	80	79	78	77	76	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45
35	100	99	97	96	95	93	92	91	90	88	87	86	85	83	82	81	80	79	77	76	75	74	73	72	71	70	68	67	66	65	64	63	62	61	60	59	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44
34	100	99	97	96	95	93	92	91	89	88	87	86	84	83	82	81	79	78	77	76	75	74	72	71	70	69	68	67	66	65	64	62	61	60	59	58	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	44
33	100	99	97	96	95	93	92	91	89	88	87	85	84	83	82	80	79	78	77	76	74	73	72	71	70	69	67	66	65	64	63	62	61	60	59	58	58	57	57	55	54	53	52	51	50	49	48	47	46	45	44	43
32	100	99	97	96	94	93	92	90	89	88	86	85	84	83	81	80	79	78	76	75	74	73	71	70	69	68	67	66	65	63	62	61	60	59	58	57	57	56	55	54	53	52	51	49	48	47	46	45	45	44	43	42
31	100	99	97	96	94	93	92	90	89	88	86	85	84	82	81	80	78	77	76	75	73	72	71	70	69	67	66	66	65	64	62	60	59	58	57	56	56	55	54	53	52	51	50	49	48	47	46	44	43	43	42	41
30	100	99	97	96	94	93	91	90	89	87	86	85	83	82	81	79	78	77	76	74	73	72	70	69	68	67	66	64	63	62	61	60	59	57	56	55	55	54	53	52	51	50	49	48	47	46	44	43	42	41	40	39
29	100	99	97	96	94	93	91	90	88	87	86	84	83	82	80	79	78	76	76	74	72	71	70	69	67	66	65	64	63	61	60	59	58	57	56	54	54	53	52	51	50	49	48	47	46	44	43	42	41	40	39	38
28	100	98	97	96	94	93	91	90	88	87	85	84	83	81	80	79	77	76	76	73	72	71	69	68	67	66	64	63	62	61	59	58	57	56	55	53	53	52	51	50	49	48	47	46	44	43	42	41	40	39	38	37
27	100	98	97	95	94	92	91	89	88	87	85	84	82	81	79	78	77	75	74	73	71	70	69	67	66	65	64	62	61	60	59	57	56	55	54	53	53	51	50	49	48	47	46	44	43	42	41	40	39	38	37	36
26	100	98	97	95	94	92	91	89	88	86	85	83	82	80	79	78	76	75	73	72	71	69	68	67	65	64	63	61	60	59	58	56	55	54	53	52	52	50	49	48	47	46	44	43	42	41	40	39	38	36	35	34
25	100	98	97	95	94	92	91	89	87	86	84	83	82	80	79	77	76	77	73	71	70	69	67	66	65	63	62	61	59	58	57	55	54	53	52	50	50	49	48	47	46	44	43	42	41	40	38	37	36	35	34	33
24	100	98	97	95	94	92	90	89	87	86	84	83	81	80	78	77	75	77	72	71	69	68	67	65	64	62	61	60	58	57	56	54	53	52	5	9	49	48	47	46	44	43	42	41	39	38	37	36	35	34	32	31
23	100	98	97	95	93	92	90	89	87	85	84	82	81	79	78	76	75	73	72	70	69	67	66	64	63	62	60	59	57	56	55	53	52	51	49	48	48	47	46	44	43	42	40	39	38	37	36	34	33	32	31	30
22	100	98	97	95	93	92	90	88	87	85	83	82	80	79	77	76	74	72	71	69	68	67	65	64	62	61	59	58	56	55	54	52	51	50	48	47	47	46	44	43	42	40	39	38	36	35	34	33	32	31	30	28
21	100	98	96	95	93	91	90	88	86	85	83	81	80	78	77	75	73	72	70	69	67	66	64	63	61	60	58	57	55	54	53	51	50	48	47	46	46	44	43	41	40	39	37	36	35	34	32	31	30	29	27	26
20	100	98	96	95	93	91	89	88	86	84	83	81	79	78	76	74	73	71	70	68	66	65	63	62	60	59	57	56	54	53	51	50	48	47	46	44	44	43	41	40	39	37	36	35	33	32	31	29	28	27	25	24
19	100	98	96	94	93	91	89	87	86	84	82	80	79	77	75	74	72	70	69	67	65	64	62	61	59	58	56	55	53	51	50	48	47	46	44	43	43	41	40	38	37	36	34	33	31	30	29	27	26	25	23	22
18	100	98	96	94	92	91	89	87	85	83	82	80	78	76	75	73	71	70	68	66	65	63	61	60	58	56	55	53	52	50	49	47	46	44	43	41	41	40	38	37	35	34	32	31	29	28	27	25	24	23	21	20
17	100	98	96	94	92	90	89	87	85	83	81	79	78	76	74	72	70	69	67	65	64	62	60	59	57	55	54	52	50	49	47	46	44	42	41	39	39	38	36	35	33	32	30	29	27	26	24	23	22	20	19	17
16	100	98	96	94	92	90	88	86	84	82	81	79	77	75	73	71	70	68	66	64	62	61	59	57	56	54	52	51	49	47	46	44	42	41	39	38	38	36	34	33	31	30	28	27	25	24	22	21	19	18	16	15
15	100	98	96	94	92	90	88	86	84	82	80	78	76	74	72	71	69	67	65	63	61	60	58	56	54	52	51	49	47	46	44	421	41	39	37	36	36	34	32	31	29	28	26	24	23	21	20	18	17	15	14	12
14	100	98	96	94	92	90	87	85	83	81	79	77	75	74	72	70	68	66	64	62	60	58	56	55	53	51	49	47	46	44	42	40	39	37	35	34	34	32	30	29	27	25	24	22	20	19	17	16	14	12	11	9
13	100	98	96	93	91	89	87	85	83	81	79	77	75	73	71	69	67	65	63	61	59	57	55	53	51	49	48	46	44	42	40	38	37	35	33	31	31	30	28	26	24	23	21	19	18	16	14	13	11	9	8	6
12	100	98	95	93	91	89	87	84	82	80	78	76	74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	33	31	29	29	27	25	24	22	20	18	17	15	13	11	10	8	6	5	3
11	100	98	95	93	91	88	86	84	82	80	77	75	73	71	69	67	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	26	25	23	21	19	17	15	14	12	10	8	6	5	3	1	
10	100	98	95	93	90	88	86	83	81	79	77	74	72	70	68	65	63	61	59	57	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	24	22	20	18	16	14	12	10	8	7	5	3	1			
9	100	97	95	93	90	88	85	83	80	78	76	73	71	69	66	64	62	60	57	55	53	51	48	46	44	42	40	38	35	33	31	29	27	25	23	21	21	19	17	15	13	11	9	7	5	3	1	5	3	1		
8	100	97	95	92	90	87	85	82	80	77	75	72	70	67	65	63	60	58	56	53	51	49	46	44	42	40	37	35	33	31	29	26	24	22	20	18	18	16	14	12	9	7	11	9	7	5	3	1				
7	100	97	95	92	89	87	84	81	79	76	74	71	69	66	64	61	59	56	54	51	49	47	44	42	40	37	35	33	30	28	26	23	21	19	17	15	15	17	15	13	11	9	7	5	2							
6	100	97	94	92	89	86	83	81	78	75	73	70	67	65	62	60	57	55	52	50	47	45	42	40	37	35	32	30	27	25	23	25	23	20	18	16	16	13	11	9	7	5	2									
5	100	97	94	91	88	86	83	80	77	74	72	69	66	63	61	58	55	53	50	47	45	42	40	37	34	32	34	31	29	26	24	21	19	16	14	12	12	9	7	5	2											
4	100	97	94	91	88	85	82	79	76	73	70	68	65	62	59	56	53	51	48	45	42	43	41	38	35	33	30	28	25	22	20	17	15	12	10	7	7	5	3													
3	100	97	94	91	87	84	81	78	75	72	69	66	63	60	57	54	54	51	49	46	43	40	37	35	32	29	26	24	21	18	16	13	11	8	5	3	3															
2	100	97	93	90	87	84	80	77	74	71	68	67	64	61	57	54	51	49	46	43	40	37	34	31	28	25	23	20	17	14	12	9	6	3	1																	
1	100	97	93	90	86	83	81	77	74	71	68	64	61	58	55	52	49	45	42	39	36	33	30	27	24	21	18	16	13	10	7	4	1																			
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−1	99	95	92	88	84	81	77	73	70	66	63	59	56	52	49	46	42	39	36	32	29	26	22	19	16	13	9	6	3																								
−2	98	94	90	87	83	79	75	71	68	64	60	57	53	50	46	42	39	35	32	28	25	21	18	15	11	8	4	1																								
−3	97	93	89	85	81	77	73	69	65	62	58	54	50	46	43	39	35	32	28	24	21	17	13	10	6	3																								
−4	96	92	88	84	79	75	71	67	63	59	55	51	47	43	39	35	31	27	24	20	16	12	8	5	1																								
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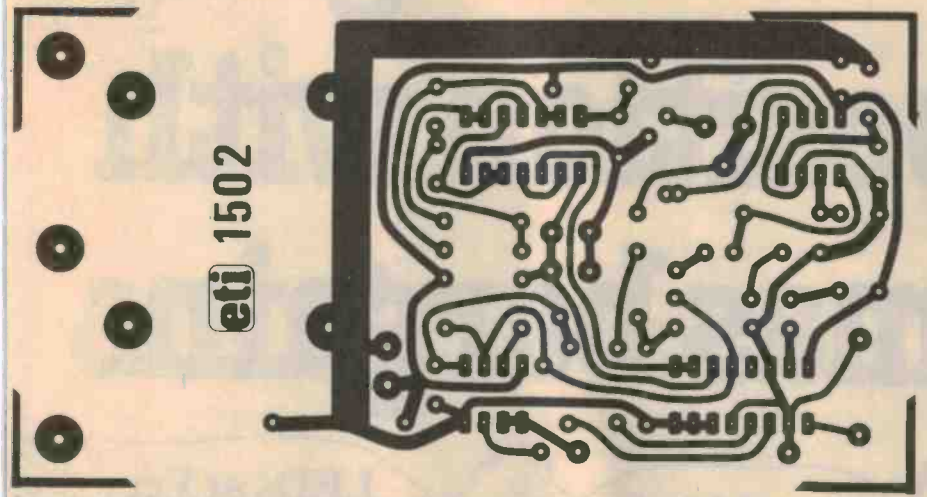
−6	94	90	85	80	76	71	67	62	58	53	49	45	40	36	31	27	23	18	14	10	6	2																												
−7	93	89	84	79	74	69	65	60	55	50	46	41	36	32	27	23	18	14	9	5																												
−8	93	87	82	77	72	67	62	57	52	47	42	37	32	27	23	18	13	8	3																												
−9	92	86	81	75	70	65	59	54	49	44	38	33	28	23	18	13	8	3																												
−10	91	85	79	74	68	62	57	51	45	40	34	29	23	18	13	7	2																														

TABLE FOR DETERMINING RELATIVE HUMIDITY

For use at elevations between mean sea level and 250 metres. This table has been constructed from publication #EC87 of the Commonwealth Bureau of Meteorology. This publication, obtainable from Bureau offices (see your 'phone directory), contains three tables covering various temperature ranges and wet bulb depression ranges to suit differing climates. The table here covers the generally useful range of condtilons likely to be encountered locally.



Printed circuit. Full-sized artwork for the printed circuit board.

Tie the battery down to the printed circuit board with twist ties (the things you use to close garbage bags) as firmly as possible as it would be most embarrasing to sling the battery through a window, and mount the whole assembly on a suitable handle. I used a spare 'Spintite' nut driver that I had or you could use a screwdriver but make sure that the tip of the spintite is bigger than the clamps that you use to attach the board to the handle (it would be just as embarrasing to sling the whole lot through a window).

Mount the board to the handle using three 'P' cable clamps and the three holes marked on the board so the board can rotate freely around the shaft of the handle. Wrap a piece of cotton wool around the cold junction of the thermocouple and tie it on securely with cotton thread. It is a good idea to bend the last 5 mm of the thermocouple wire back on itself and bury it in the cotton wool to make sure that it remains covered at all times with the wool. Your sling psychrometer is now ready to try out.

Making measurements

In order to take a humidity reading, the first thing to do is wet the cotton wool around the cold junction. Drip tap water on the cotton wool until it is thoroughly wet but not completely dripping. You must be extremely careful not to get any water on the board itself as you've spent a lot of money on low leakage diodes and water would not improve the leakage properties of the board surface one little bit. Allow the wet cotton wool to stand a while to allow the water to reach room temperature, five minutes or so should be enough, then connect the battery and whirl the psychrometer around in the air for 60 seconds or so.

If you had too much water on the cotton wool this will get rid of it most effectively and at the same time creates the necessary draft over the wet wool to cool the cold junction of the psychrometer. After it has been spun for the required time place the psychrometer on an insulating surface (a formica tabletop for instance) taking great care not to touch the back of the board at all and connect your DVM to the two output terminals.

The *wet bulb depression temperature* can be read off directly by multiplying the volts by 10 and calling them degrees Celcius. Next, measure the actual air temperature with the accurate thermometer used to calibrate the amplifier. Finally, look up the tables given at the end of this article to determine the actual relative humidity.

First use the air temperature to find the correct row in the tables then use the psychrometer reading to find the column which has the actual humidity value. As an example, I took a reading and found that the air temperature was 23.7°C and the wet bulb depression from the psychrometer was 7.63°C (it is interesting to note that the electronic psychrometer is a great deal more accurate than the normal wet and dry bulb so we must round the wet bulb depression reading off to 0.2°C). Rounding the temperature off to the nearest degree gives an ambient temperature of 24°C and rounding the wet bulb depression off gives 7.6°C.

Referring to the tables we have a row of humidity values which start with 49% on the left (wet bulb depression = 7.0°C) and go to 10% for a wet bulb depression of 14.0°C on the right. The fourth value in from the left corresponds to our wet bulb depression of 7.6°C and gives the result of 46%. As is always the case when using tables to work anything out it is not possible to find the exact value, but even so the humidity readings obtained this way are accurate to about 1% (*if* you calibrated the amplifier accurately!).

As a thermocouple amplifier

The psychrometer can also be used as a straightforward thermocouple amplifier to measure temperature in differences from ambient temperature. The peak hold function can be left in, or removed in the following way. First remove C5 and R9 then replace D1 with a piece of wire. This converts the op-amp IC3 pins 5,6 and 7 to the simple unity gain buffer and allows the amplifier output to follow temperature differences continuously. The thermocouple wire connected to the amplifier input can be as long as necessary to monitor the desired temperatures, but as there is no input filtering care should be taken to avoid gains hum pickup.

If the wire is very long and you want the reference temperature to be the ambient then it is not necessary to have both thermocouple junctions remote from the amplifier. Simply use a length of copper-constantan wire pair with one end of the pair bared and twisted together to form a junction and the other end of the pair bared and soldered onto the two amplifier input terminals. The terminal where the constantan wire is soldered onto the board becomes the second junction of the thermocouple and temperature differences are measured from the temperature of this connection.

Calibration of the amplifier is a bit more complicated in this case as you can't very well immerse the whole amplifier in a glass of water to establish a reference temperature. I calibrated the setup in the following way. First power up the amplifier and connect the DVM to the output terminals. Make up a 0°C reference again with ice and water in a tumbler as was done to calibrate the psychrometer and immerse the sensing junction in it (once again, make sure that the junction is right in the middle of the ice and not at the bottom of the tumbler). Rest the mercury-in-glass thermometer on the amplifier and leave the whole lot to stabilise for 15 minutes or so. The amplifier should be away from any draughts or direct sunlight as the thermometer is supposed to measure the temperature of the printed circuit board and any outside sources of heat or cold will create temperature gradients which will destroy the accuracy of the reading.

When everything appears to have settled down adjust RV1 until the amplifier output reads the same as the mercury-in-glass thermometer. As the peak hold circuit is no longer functioning you can adjust either way with no trouble. As the sensing junction is at 0°C the temperature difference for the thermocouple is the temperature of the board (and reference junction) directly. If you want to reverse the polarity of the output readings then reverse the two thermocouple wires connected to the amplifier input; both input terminal pads and copper and the amplifier will work just as well.

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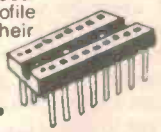

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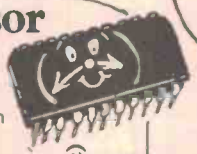

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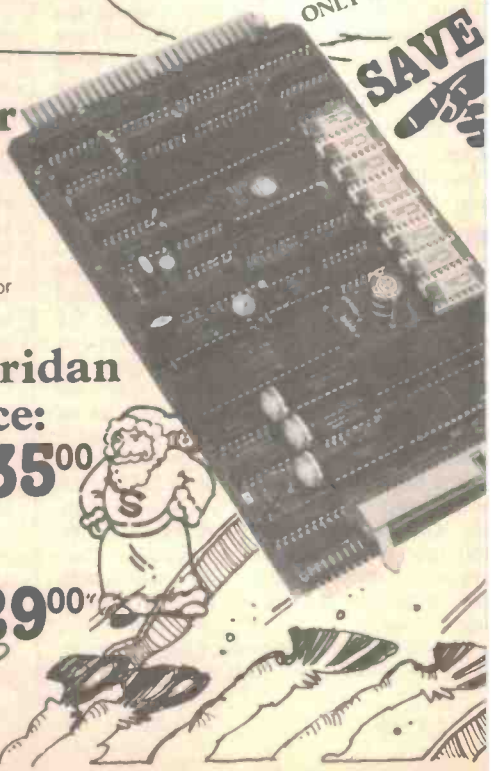

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DC Current: 60uA, 600uA, 600mA
Resistance Ranges: RX1, RX100, RX10K, RX1M
Accuracy: Within 3%
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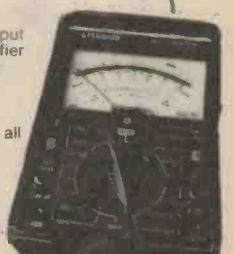

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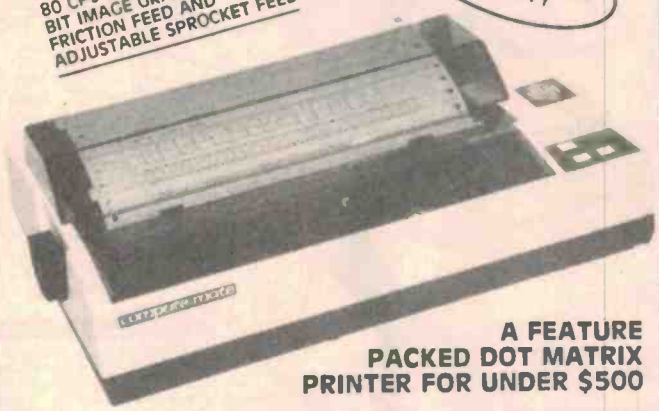

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228 ASCII Characters, Handles **4" to 10" Paper**
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P 0895 DB15	Backshell		2.85	2.50	2.30
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D1020..... 16K IC..... **$499.00**
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"THE LITTLE BIG BOARD"

64K on board RAM, Z80A based running at 4mHz (Top speed) Floppy disk controller, Real time clock.

That's right! A fully configured Z80 computer running at maximum capacity, on a single **PCB. On board disk controller** drives up to four double sided, double density drives either 8" or 5¼". **2 by RS232 I/O Ports,** both may be software configured, use one for a terminal the other for a printer or modem etc. **Battery backed real time clock** software accessible for automatic dating of documents, timing during games. Fully **STD buss compatible** — choose from thousands of ready available plug in card options. **Bootstrap Monitor** on board — boots to **CP/M.** Choose from the world's **largest range of software.**

ALTRONIC KIT FEATURES

Two versions of the bootstrap monitor supplied. One set **for 1200 baud operation** enables connection to **MICROBEE 16 & 32K IC'S** utilizing their terminal emulation facilities. The other set for **9600 baud** operation.
Complete set of IC sockets.
Double sided plated through **PCB** — solder masked and pretinned.
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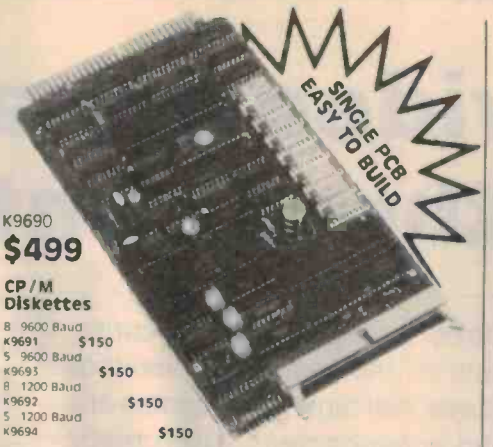

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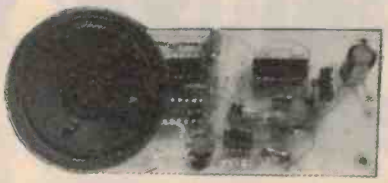

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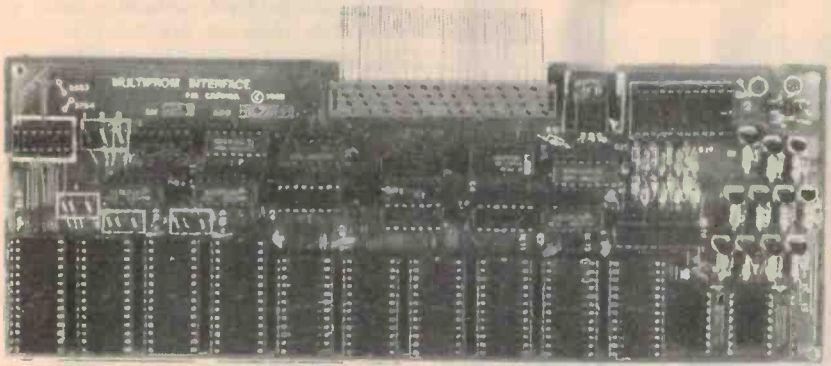
MULTIPROM INTERFACE FOR THE MICROBEE

(ETI NOV. '83)

44K OF PROGRAM STORAGE ★ FULLY SOFTWARE SELECTABLE ★ SUITS BOTH IC AND PLUS MACHINES ★ 8 OUTPUTS FOR CONTROL APPLICATIONS ★



A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage — acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

The Altronics kit comes complete in every way
- ★ Full set of IC sockets.
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- ★ Assembled connection lead to Microbee.
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- ★ Cassette monitor included (plus sourcefile).

THE MICROBEE KIT OF 1983

K9673..... **$99.50**

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50 PIN EXPANSION SOCKETS

Right angle type to suit Microbee, floppy disk controllers etc.
Mounts on PCB and mates with IDC sockets.

D1196... **$8.50** EA... 10 +... **$7.50**

PRINTER INTERFACE KITS FOR THE MICROBEE

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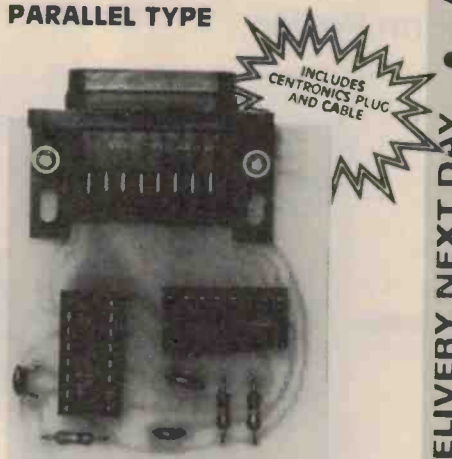

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A simple kit to build — takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer.

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TTY TYPE

Teleprinters are cheap, so is this kit. If you've got an old Teleprinter this is for your.

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★ KIT SUPPORT FOR THE MICROBEE ★

EPROM PROGRAMMER

(ETI JAN. '83)

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versatile, low cost and easy to build. Plugs straight into the microbee I/O port. Suitable for 2716, 2732, 2532, 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time.

KIT FEATURES Sockets for all other IC's 1 x 2716 supplied — get started straight away. Front Panel and Mains (SEC approved) transformer. 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included). DB 15 Plug. Complete to last nut and bolt.

(See Review ETI AUGUST 1983)

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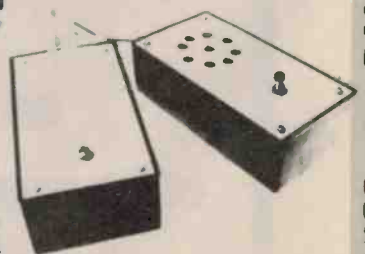

K9733..... **$24.50**

This project allows you to decode the signals of shortwave stations transmitting radio facsimile weather maps, satellite pictures etc. and then reproduce them on your dot-matrix printer.
• Complete kit of parts includes DB15 Ribbon Cable.
• SOFTWARE LISTING.

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Project 1518

'Deluxe' video enhancer features three controls

This simple to build project features three controls for curing video 'image ills' — *floor* which cuts off the low-level noise that causes snow; *ceiling* — which ensures that high-level signals are not enhanced, causing ringing; and *enhancement*, which really 'crisps up' those soggy signals, providing up to 8 dB of boost.

John Power

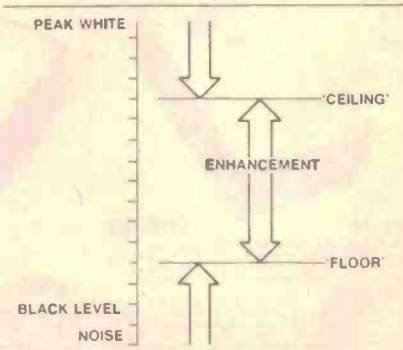
THIS PROJECT has been designed to team with the ETI-1517 Video Distribution Amplifier (September issue), but can be used 'stand alone' if you wish. It's easy to build, low in cost and effective in use.

The problems one meets with video signals, particularly when recording and replaying, have been explained by Jonathan Scott in '*The ins and outs of video enhancers*', in the October issue. This project has been designed to avoid the problems that can arise in trying to compensate for video bandwidth degradation. I have included a 'notch' at the 4.43 MHz colour subcarrier so that it will not be 'enhanced' — to the detriment of the picture! — and have provided controls that set the limits of enhancement so that noise at one extreme, and high-level signals at the other, are not boosted, which can also further degrade a picture.

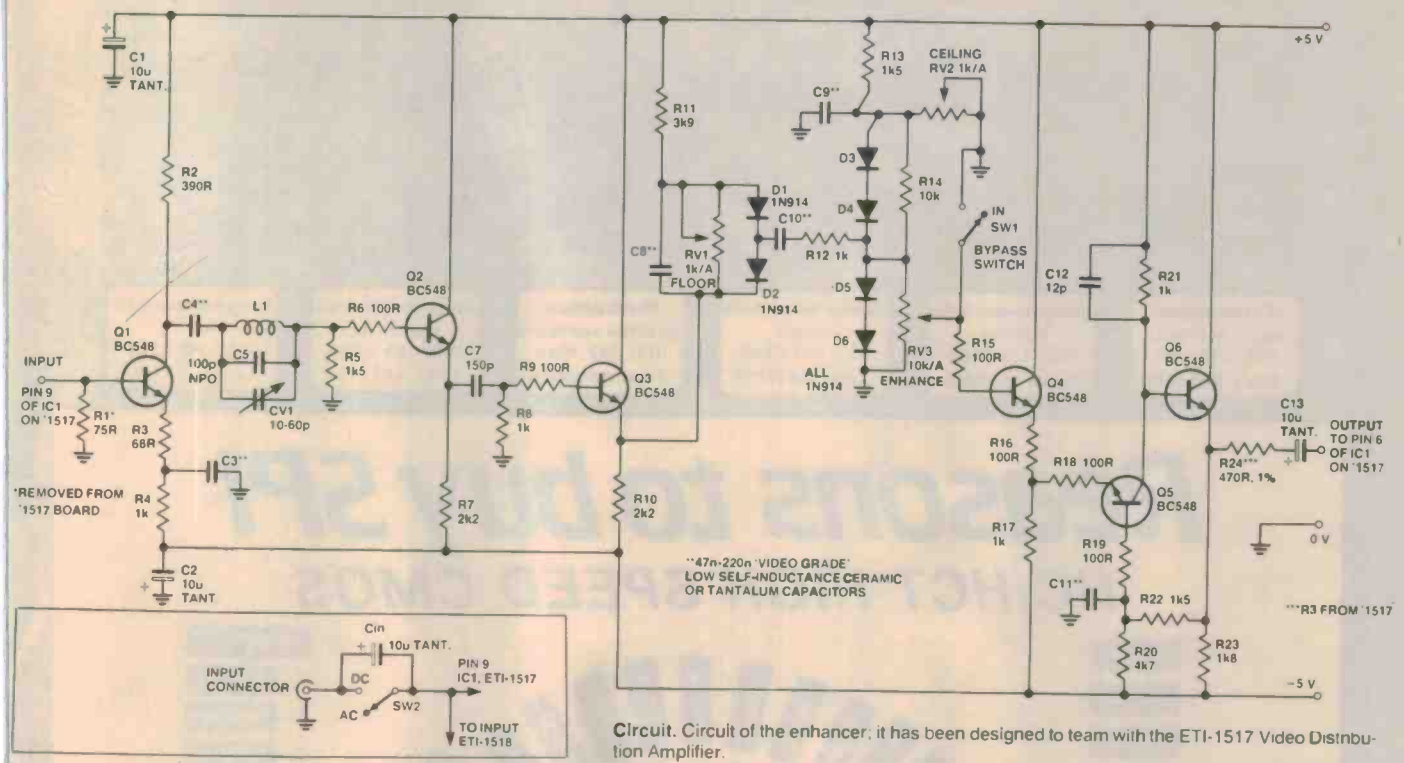
Many 'economy' video enhancers I've seen simply provide a single control, which sets the level of boost in the 2-5 MHz region. From experience, this is only effective on certain signals which have not suffered much degradation at all. Too many cases occur where you need to have some control of the signal level range over which the boost is applied. Thus, you see some commercial enhancers with a 'gamma' or 'core' control, which is there for just this purpose.

After some experimentation, I hit on a scheme that provided controls to adjust separately the minimum level from which boost is applied and the maximum level beyond which enhancement ceases. The minimum level I have dubbed *floor* and the maximum level control I have dubbed *ceiling*. Their function is obvious from the names. I prefer to work on the KISS theory ('Keep It Simple, Sam') and avoid jargon. Between the floor and ceiling, the amount of boost or enhancement can be varied from none to maximum with a control simply labelled *enhancement*. See? Simple, but 'deluxe'.

I notice that some VCRs have a direct-coupled output which sits at a mean dc level



Controls. The enhancement control works between the limits set by the floor and ceiling controls.



Circuit. Circuit of the enhancer; it has been designed to team with the ETI-1517 Video Distribution Amplifier.

HOW IT WORKS — ETI-1518

I will assume you are familiar with the operation of the ETI-1517 Video Distribution Amplifier. You will recall that it consisted of a differential amplifier with the signal applied to the non-inverting input and equal value resistors placed from output to inverting input and inverting input to ground, giving a gain of exactly two from input to output before termination loss, and a gain of exactly one after.

The enhancer section of this project takes the input signal, removes the low frequency part of it, inverts it, processes it according to the control settings, then adds it (out of phase) to the original signal by applying it to the inverting input of the differential pair in the '1517. By maintaining the output impedance of the final processing stage at the value of the lower leg of the feedback divider in the '1517 (470R) the original signal path gain remains unchanged.

The effective addition of the processed high frequency content of the signal to the unaltered original is equivalent to boosting that high frequency information, which is enhancing.

Referring now to the circuit of the enhancer section, Q1 is a buffer stage with a gain of −4 approximately. Here the inversion necessary to reverse the eventual inversion of the differential pair is introduced. Q1 is biased in such a manner as to clip off sync pulse tops without saturating. This prevents them being fully enhanced, which is desirable.

It may be necessary to remove dc from the incoming signal to ensure that no video is clipped as well. For this reason, provision to ac couple the whole system is included. Most VCR inputs are expecting only ac coupling, and most outputs are not dc offset, so maintenance of dc levels is not as crucial as it sometimes is in circuits not equipped to 'dc restore' off the sync waveform.

Coil L1 and surrounding components form a 'trap' which excludes from the circuit the colour subcarrier. This should not be enhanced, so a notch is introduced at 4.43 MHz. The subcarrier thus passes only through the distribution amp and remains unaltered.

Transistor Q2 is a common collector buffer stage, giving a low output impedance for C7/R8, which form a low cut filter which is 3 dB down at 1 MHz. This selects only the high frequencies for further processing. Q3 is another buffer stage to prevent different processing steps interacting. The base decoupling resistors prevent possible buffer instabilites in the face of reactive loading.

Potentiometer RV1 and surrounding components form the floor or gamma processing stage. The aim of this stage is to make it possible to selectively pass higher amplitude signals. The motivation for this is that noise, particularly 'snowy' effects, is predominantly present in the high frequency part of the signal, but needs to be minimally enhanced. The noise is also predominantly lower in amplitude than brightness transitions in the video signal, which it is desirable to enhance. Hence it is possible to apply more enhancement to higher-amplitude components without enhancing noise. This function is sometimes referred to as 'core'. However, I think the label 'floor', for its obvious connection, or 'gamma' (less obvious) are more descriptive of its function.

Potentiometer RV2, plus D3-6 and associated components, provide the reverse function, which I labelled 'ceiling'. This section basically permits the setting of a level above which enhancement is reduced, by smoothly limiting the signal. I am not entirely convinced of the utility of the function, but include it for purists on the theory that winding the control clockwise removes it anyway. The idea behind this process is that the problem when enhancing certain signals is that ringing on full amplitude transitions induces nasty shadow lines; thus there is something to be gained by limiting enhancements of the high end of the amplitude range.

Both floor and ceiling circuits work in a similar way. Diodes, two in the former case and two pairs in the latter, are subjected to varying forward dc bias conditions.

To proceed further down the signal path (to the right on the circuit diagram), the video signal must get through the diodes in the floor case, and not get shorted out through the diodes in the ceiling case. If the difference between the dc bias present on the diodes and that necessary to make them conduct is larger than the instantaneous signal amplitude, the signal will not pass without attenuation. Of course, the effect is not that sharp, as the levels are chosen to make use of the diodes' turn-on characteristics to produce no gross discontinuities in the waveform.

In the floor circuit, RV1 sets the bias on D1 and D2. Adjusted for maximum resistance, RV1 permits current to flow in the diodes turning them) on sufficiently to pass all the signal. At zero resistance only signals exceeding about half a volt pass, and then only their high-amplitude parts. These two extremes bound the useful region where mild selectivity of response is applied.

Signals not limited by the ceiling circuit are passed to RV3, which acts as a level control, setting the amount of signal passed back to the differential amplifier and hence the degree of enhancement. Transistors Q4-6 form a dc-coupled amplifier (in the form of a long-tailed pair and an emitter follower) which provides a gain of eight and a low output impedance. C13 and R24 pass the signal out and provide a precise 470 ohm impedance to ground for the feedback signal from distribution amplifiers.

The video amplifier output stage in the '1517 was designed to limit negative-going signals to an amplitude of about a volt. Thus, any gross overshoot on the partially limited sync pulses will be limited at that point. This occurs because the voltage gain is entirely vested in the differential pair, further stages providing only current gain. Q3 in the '1517's differential pair will saturate at a voltage corresponding to an output voltage of −2 V before matching loss.

The George Brown Electronics Group.

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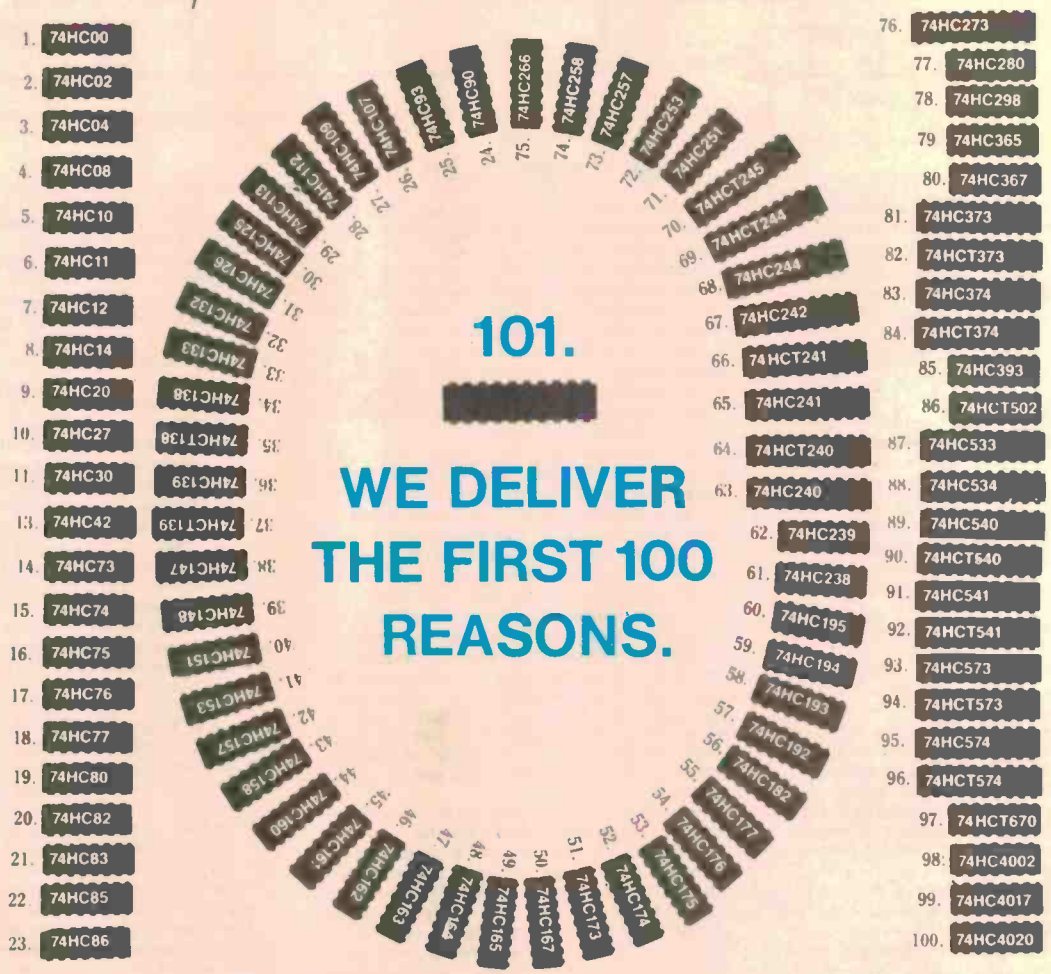


SPI Solutions in Silicon

of one to two volts or so. In a direct-coupled enhancer/distribution amp, this dc level can wreak havoc, clipping the video signal. Hence, I have provided the option of switching between ac and dc coupling. With ac coupling, some low frequency roll-off can be expected, but it's only slight.

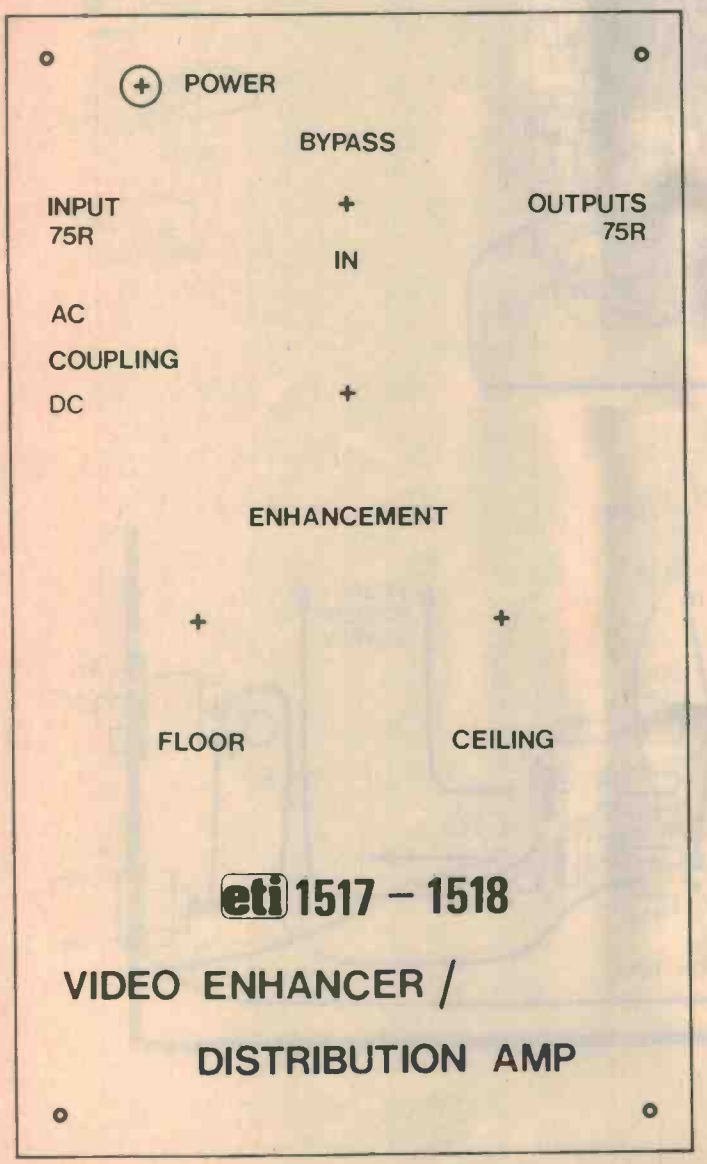
Construction

For the purposes of this discussion, I assume you have already built, or at least are prepared to build, the ETI-1517 Video Distribution Amplifier. The circuit presented here is designed to be used in conjunction with the previous circuit, as indicated in the article which accompanied that project.

The first thing to do is locate a suitable position within the box for the new pc board and the new switches and potentiometers. There are three pots and one switch directly related to the enhancing section, and one additional switch to be added to permit ac coupling of the incoming signal.

The dc/ac coupling selection switch is ideally located near the input connector. The other controls may be laid out as you see fit or according to the front panel design reproduced here. If you're using a different layout, the controls should be as close as practical to each other and the location of the Video Enhancer board. The new enhancer is best located adjacent to the distribution amp board, but a few centimetres of spacing can be tolerated if required.

Once the layout is decided and the appropriate holes drilled in the case and panel, the board may be assembled according to the overlay diagram. As I anticipate that a number of our constructors will be basically video enthusiasts, not electronics enthusiasts, I will take the liberty of stressing how vital it is not only that each component be inserted the correct way around, but that each solder connection be clean and neat. Only the resistors and ceramic capacitors may be put in either way around without impairing the operation of the circuit. It is best to put in only half a dozen items at a time, starting with the resistors and capacitors, and then solder these into place, cutting the component leads after soldering. Resistors R2 and R24 should be left out for now.



Front panel. Full-size reproduction of the front panel artwork.

Next, two modifications need to be made to the ETI-1517 board, or the whole must be constructed with these two variations taken into account. The first consists of removing the termination resistor from the input side of the ETI-1517 circuit. A termination resistor, nominally of 75 ohms and preferably a 2% type, is provided in the enhancer (R2), and hence the one in the distribution amp is unnecessary. It may be used as R2 in the enhancer circuit if you wish. A wire may then conveniently convey the input signal from the ETI-1517 to the ETI-1518, using the hole vacated by the resistor you have just removed or transferred.

The second modification also consists of transferring a resistor. This time it is R24 in the enhancer circuit. Resistor R3 in the ETI-1517 (nominally 470R), running to ground from pin 6 of IC1, should be moved to R24 on the enhancer board. Recall that this resistor was a 1% or 2% type, or at least a selected value resistor. This is why it is transferred; the precise gain of the distribution amp is not disturbed. A wire is again run, using a vacated hole, this time from pin 6 of IC1 on the ETI-1517 to the output of the ETI-1518 enhancer board.

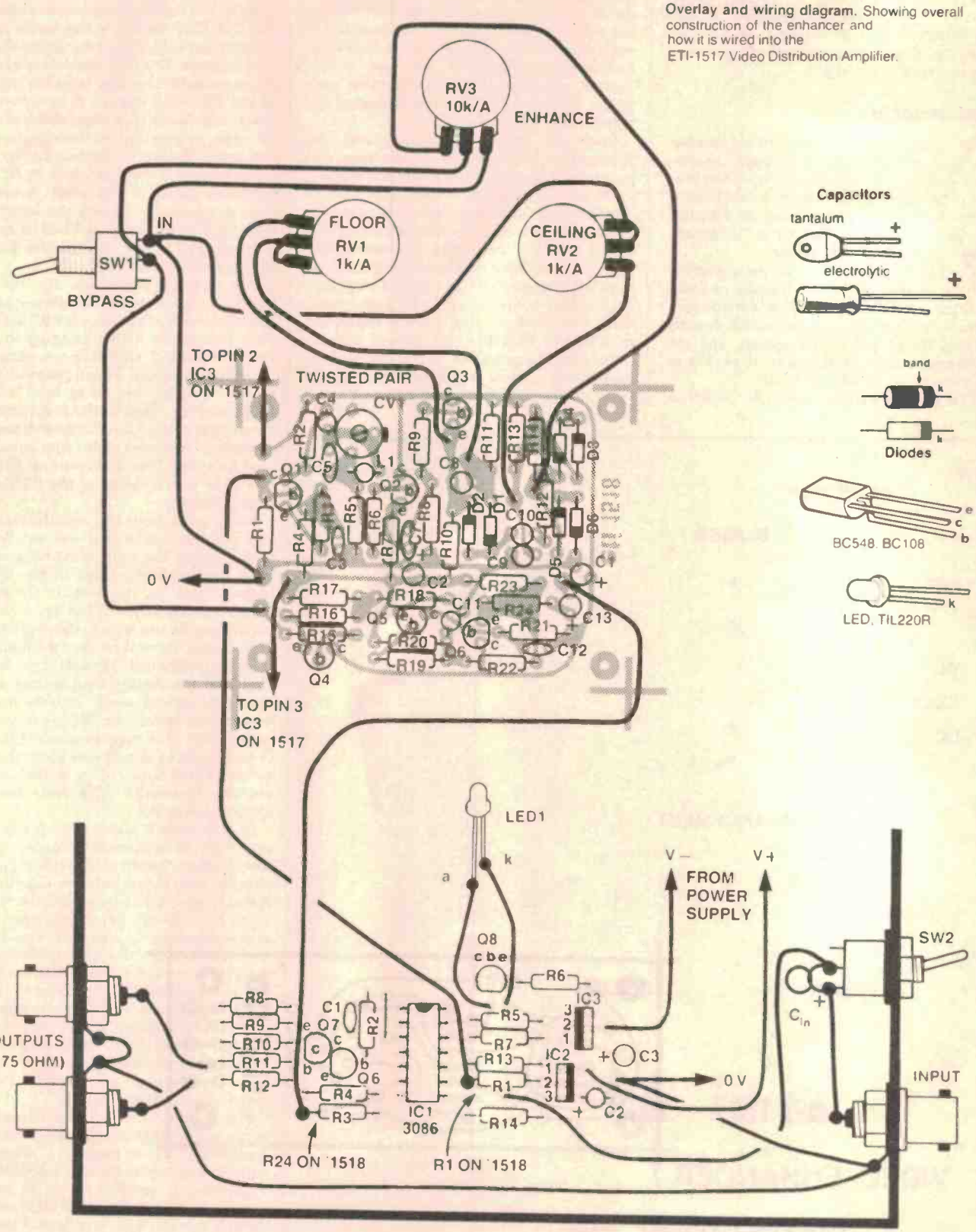
Now, apart from any beautification process you may wish to use, such as a Scotchcal panel fascia, the only remaining job is to hook up the flying leads to the ETI-1518 board. There are the leads to the pots and bypass switch, an earth and +/−5 volt leads, which may be run from underneath the ETI-1517 board, as well as the two signal leads already mentioned. My prototype layout is shown in the overlay/wiring diagram. Note that the various earth returns from connectors and boards, etc, all run to *one* convenient point. It is important to avoid any excessive lengths or tortuous paths in the signal and earth return leads, as this can easily provoke instability in a wide bandwidth circuit such as this.

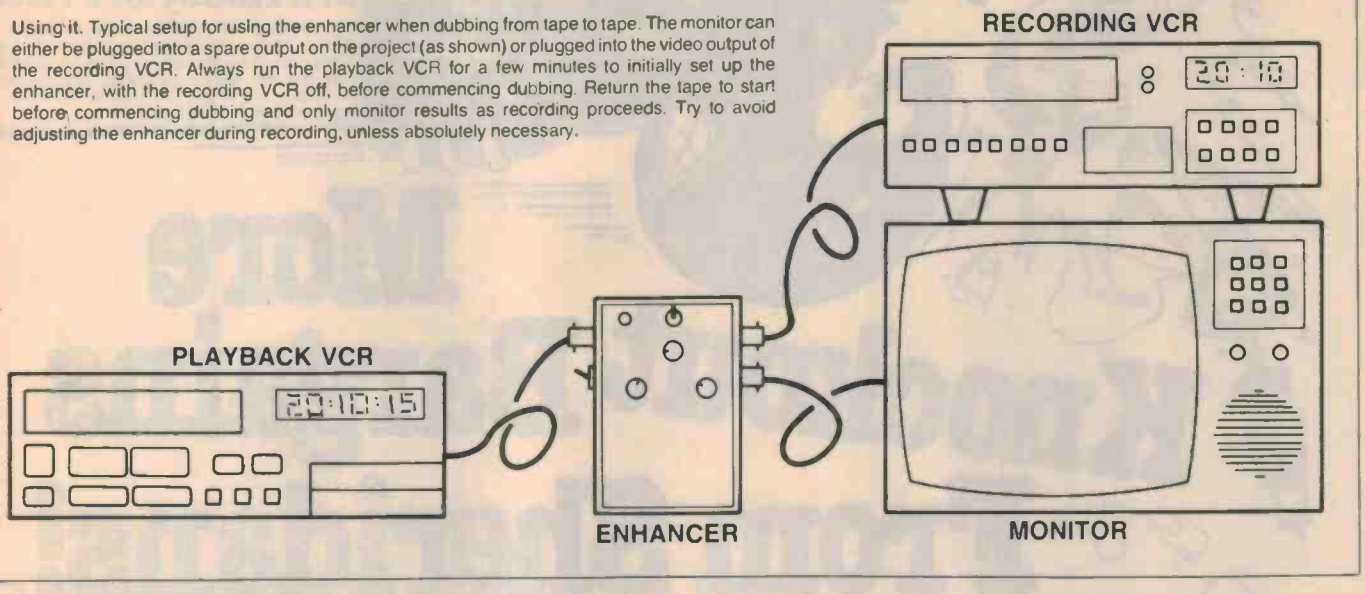
At this point it seems appropriate to indicate that the compensation capacitor in the distribution circuit, the 27 pF capacitor in parallel with the collector resistor in the differential pair (C1), may require increasing to 33 or even 39 pF. Depending upon layouts and component tolerance, it appears that some units could exhibit unstable behaviour, especially on black-to-white transitions in the video signal. While my prototype was quite happy in a 'clean' environment, mismatches and other variations have subsequently been found to upset it. If supervideo frequency ringing is evident on square-wave transitions with short risetimes, proper matching will cure it.

Finally, the video subcarrier trap must be adjusted. This entails adjusting the variable capacitor (CV1) to produce a 'notch' in the enhancer amplifier train at 4.43 MHz.

Connect a generator, set to deliver a sinewave signal at 4.43 MHz of about 200 mV p-p into a 75 ohm load. Viewing the output with the bypass switch closed so as to pass unenhanced signal, verify that the output is the same as the input when terminated correctly. Switch in the enhancer part of the ▶

Overlay and wiring diagram. Showing overall construction of the enhancer and how it is wired into the ETI-1517 Video Distribution Amplifier.





Using it. Typical setup for using the enhancer when dubbing from tape to tape. The monitor can either be plugged into a spare output on the project (as shown) or plugged into the video output of the recording VCR. Always run the playback VCR for a few minutes to initially set up the enhancer, with the recording VCR off, before commencing dubbing. Return the tape to start before commencing dubbing and only monitor results as recording proceeds. Try to avoid adjusting the enhancer during recording, unless absolutely necessary.

PARTS LIST — ETI-1518

Resistors ..... all ¼ W,5% unless noted
R1 ..... 75R, 1%*
R2 ..... 390R
R3 ..... 68R
R4,8,12,17,21 ..... 1k
R5,13,22 ..... 1k5
R6,9,15,16,18,19 ..... 100R
R7,10 ..... 2k2
R11 ..... 3k9
R14 ..... 10k
R20 ..... 4k7
R23 ..... 1k8
R24 ..... 470R,1%*
RV1,RV2 ..... 1k/A pots.
RV3 ..... 10k/A pot.
*may be taken from ETI-1517 board

Capacitors
C1,2,13 ..... 10u/35 V tant.
C3,4,8,9,10,11 ..... 47n-220n ceramic (low inductance)
C5 ..... 100p ceramic NPO
C7 ..... 150p ceramic
C12 ..... 12p ceramic
CV1 (C6) ..... 10-60p trimmer
Cin ..... 10u/35 V tant.

Semiconductors
D1-D6 ..... 1N914
Q1-Q6 ..... BC548,BC549 etc.

Miscellaneous
L1 ..... 10 uH RF choke (Q of at least 50)
SW1,SW2 ..... SPST or SPDT min. toggle switches

ETI-1518 pc board; power supply +/−5 V (can come from ETI-1517); ETI-1517 (if you wish); Scotchcal front panel.

Price estimate
$18-$24 (alone)
$45-$50 (with ETI-1517)

circuit, setting the floor low and the ceiling high (RV1 to maximum and RV2 to minimum resistance). Adjust RV3 to mid-position. Now adjust C6 for a minimum of output signal. This will be near, though not necessarily exactly at, the original output level before enhancement.

If you do not have access to the equipment needed to do this adjustment, you will not be able to set the enhancer trap correctly, but a setting satisfactory to your recorder should be obtainable simply by selecting that setting of CV1 which leaves the *colour* of the picture minimally disturbed throughout the travel of the enhancement control. If a range of settings fits this bill, leave the trimmer at the centre of the range.

Operation

Operation of the enhancer is quite straightforward, though some experience is necessary in optimising the control settings. The effects are subtle, but worthwhile if you do a lot of viewing and recording of video material.

Connect the enhancer between the video source you wish to enhance and the monitor or receiving VCR. If possible, choose some material with plenty of contrast and colour — commercials are good for this, if little else.

Initially, adjust the floor *down* and the ceiling *up*. Wind up the enhance knob. You will observe that the image first gets 'crisper', with fine print and signs, labels etc becoming more easily read. Eventually the snow and general noise gets significant, or perhaps the bright/dark transitions get shadowy, indicating too much boosting.

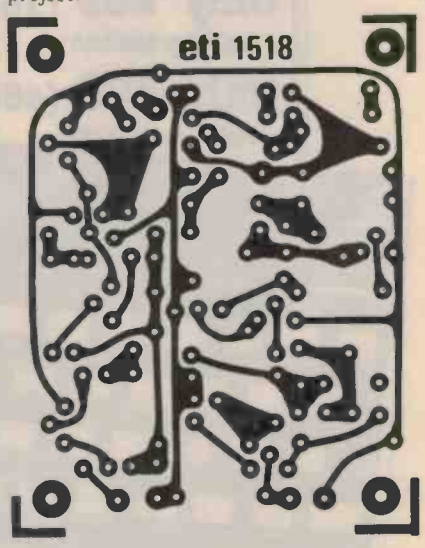
The noise problem can often be improved with judicious fiddling with the floor level. You will find that the floor and enhance functions are interactive to some extent. This is really a very fine point, because the amount of extra boost you can squeeze in with the use of the floor level control is usually minimal, but it is there.

Likewise, the transition overshoot problem, manifesting itself as rippled edges, can be improved with the ceiling function. This function may be rarely useful, but seeing the logic behind it, I included it for you to try out.

This control is also interactive, so the adjustment of all may be finnicky. I had better results by adjusting the enhance and floor controls until just too much enhancement was evident, then 'backing off' ceiling to just correct it.

A further check can be made by immediately playing back the copy. It is possible that over-enhancement to the immediate viewer can be just right when the signal has gone through another record-replay stage; sort of pre-enhancement.

About here is where the written advice is superseded by on-the-job fiddling with the knobs. I wish you all the best with your new project.



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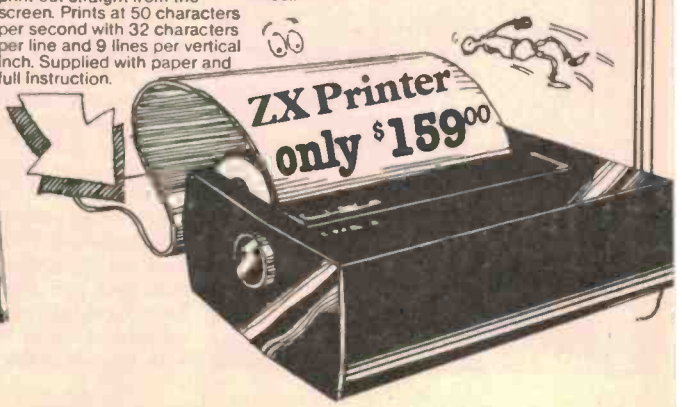

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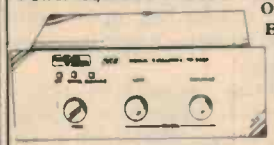

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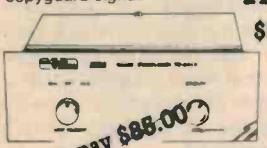

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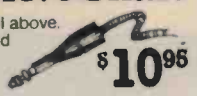

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Further thoughts on train controller design

The ETI-1508 Train Controller (December '82 issue) proved a popular design and occasioned much reader comment. Though seemingly elaborate, many readers said we han't gone far enough! After many months of experience, some improvements suggested themselves (a clever train controller!). Here they are, plus further thoughts on new design possibilities.

Jonathan Scott

OUR LAST train controller project, the ETI-1508, has stirred above-average comment and enthusiasm, it seems. It was a fairly imaginative design (read oddball if you are one of the school that disapproves of radical steps). In a way, the more sceptical people had a point, for there are two drawbacks with the design, one brought on by lack of experience with different train systems on my part, and the other a purely cost-based one. This article talks about the problems, suggests short term measures to improve the situation, discusses the inherent design problems and points the way to the next generation design — work upon which continues.

The first thing to note from reader responses is that many of the heavy enthusiasts are willing to accept rather high component counts, and hence cost. When the '1508 was designed, a lot of attention was paid to keeping the circuit reasonable in size so that beyond the transformer, the cost could be low. True, the hardware was not cheap, especially if you built it entirely from scratch, but it was cheap if you used a cheap box and an existing power supply. I should have spent more time than I did wandering in model shops, because if you look at how much trains cost, controllers aren't big chips. However, remembering my days of cannibalising old equipment and buying AC127s in ones (oops, dated now) we played Scrooge. At this point, it seems fitting to mention the first inescapable design decision on train controllers.

Decisions, decisions

There are two radically separate controller designs. The ''1508 epitomises one, and perhaps the Hornby 'Zero-One' the other. The Zero-One places 16 volts ac on the tracks at all times and controls engines (plural), points, signals and all accessories using only the two connections of the track. This it does by sending control signals as well as raw available power down the lines, rather like the SEC controlling off-peak systems with control tones. These are picked up by small switching units in the controlled items which do their stuff, drawing from the rails whatever power is required. This gives ease of wiring and the ability to control several trains separately without isolating track sections.

In a way, it is quite superior to the '1508 type, which needs on train per circuit and that is all it will handle. However, it sacrifices feedback. This means no 'real train feel', no erratic response to hills, no difficulty in control and no open/short-circuit indication, etc. It is also costly as every item on the system needs an 'implant'; one is likely to pay about $200 for a starting setup, and each new item added demands another 'implant'. It is also a rather cut-and-dried design; there is little room for tinkering and improvement, because of the lack of feedback. So if you want to go that way, we can see the reason. It probably produces the best effect as far as looking is concerned, in that lights are always on and models always moving in a 'controlled' way. There are far fewer wires and fewer things to twiddle. The professional's system it is, in every way.

Jerking off

The '1508 is a sensitive analogue approach, for which we pay in complexity and 'fiddliness'. So, back to its problems. Engine takeoffs are often 'unsmooth' and sometimes need the train to be nudged. If you have the throttle up too far the train can jerk off, entirely ruining realism. If the current rises slowly, the train may never shift without a nudge, or may appear to jam for a while and then, when the power is enough to overcome static friction, it takes off at a pace.

These effects are aggravated by the fact that the unit is regulating current rather than voltage. We found that Hornby trains, which are significantly less smooth than other makes, are particularly susceptable. Airfix or Jouef ones proved quite OK in this regard. Some Hornby pickup systems are virtually the same as they were on their locomotives over twenty years ago! Tradition is nice but often painful. Even Rolls Royce have begun to change their grille design!

A voltage regulation regime gives improvement, but tends to remove the very real (steam era) effect that a locomotive engine develops more power as it speeds up, giving a positive feedback effect, demanding care and concentration from the driver. What is required is voltage regulation in the short term (seconds) and current regulation in the longer term (tens of seconds and up).

The modification shown in Figure 1 can be added quickly to the '1508 and gives this effect. Startup is smoother and far less critical. It has one drawback on the '1508: namely, that the open-circuit sensor uses the fact that there is current drive, and since the current drive is effective only after 5-10 seconds, the o/c light may take up to this long to respond.

In future designs the current sense requirement of the o/c detector can be removed so that the drawback is overcome (at a small cost of increased component count).

The suggested modification requires only three points of connection to the pc board and is thus quickly added in situ, and removed if you do not like it. Startup only requires that you use more throttle than you thought before; the margin for miss-estimation is greatly reduced. In addition, the engine appears to have more inertia when encountering a sudden hill or extra carriages, though the need for attention to the throttle in the long term is still present, which I feel is important.

You may wish to reduce the basic acceleration time constant and the idle-slowdown time constant as well, in order to restore the original feel of inertia, as the circuit here will suggest an increase

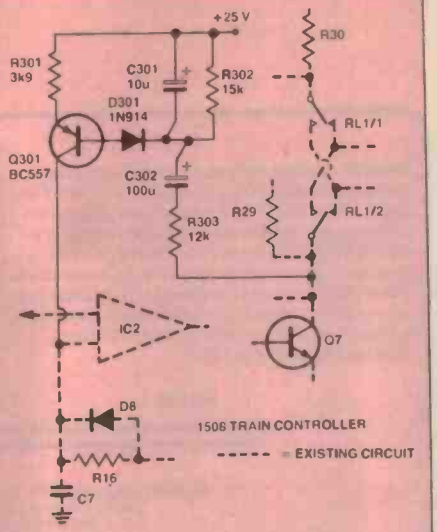
HOW IT WORKS — ETI-1508 MOD.

The function of the modification is to apply feedback to the main regulation amplifier in order to produce output voltage regulation effects for frequencies in the 0.1 Hz region. It achieves this by converting changes in output voltage in this frequency area into current and adding this to the signal presented to the feedback input of the control operational amplifier.

Clearly, Q301 will be turned off in the quiescent dc state by R302. Together, R302, C301, R303 and C302 form a filter which passes frequencies near 0.1 Hz to the base of Q301. When load voltage increases, the voltage at the collector of the output transistor falls with respect to the +25 V rail. This is passed on to the base of Q301 which conducts sourcing current, the amount determined by R301. Thus R301 defines the transconductance of the system at the frequency of peak gain.

Although the whole circuit may have a large ripple component because the +25 volt line has large ripple on it, this is not passed down to the op-amp because of the constant current output characteristic of the transistor.

The sourced current for a rise in load voltage in turn induces the drive to the output of the controller, effectively holding load voltage constant. Owing to the required Vbe drop of Q301 and that of D301 there is a small dead band before which the regulating action occurs, meaning that there is no effect for small signals. This, plus the bandwidth limitation of C301, assists stability and also



reduces the lag before the o/c detector responds. The bandwidth limitation is such that the turn-on pulse is not significantly affected. D301 also protects the transistor b-e junction against reverse biasing when a low load impedance is suddenly added.

Sudden load reductions, as in braking or collecting extra carriages, represent rises in the output transistor collector voltage, which serves only to turn Q301 further off so that its action occurs only at or near acceleration points.

overall. (i.e: reduce R4 and R7 to around half or a little more of the previous values.)

The second half of the problem, the effect of jamming whereby the train does not take off at all without mechanical persuasion, is not solved even by the voltage regulation technique. It was hoped that the initial impulse delivered at the point of accceleration would overcome this to a large extent, which it does, but it still occurs annoyingly often.

The effect occurs because the friction of the gears and engine mechanicals requires more force to be initially applied than is necessary to sustain movement. It is worse in certain designs.* The Hornby wormgear drive is again not the best way to do it. Also, engines with a higher top speed, and hence usually a lower reduction ratio, are worse. Oiling and cleaning are partially effective, but are not cures. It seems as though applying power in pulses is very helpful. this suggests that a switchmode power delivery scheme would be beneficial. I did not use a switchmode supply in the '1508 because, firstly, it did not seem justified as a power economising measure and because it tends to make engines 'sing' at the switch frequency. As the '1508 applies power, albeit a tiny amount, even when at a standstill, the engine would sing even when standing at a station. To apply the technique while avoiding obtrusive noise, excessive component count and disturbance and s/c and o/c detectors, is tricky. I have not solved this stumbling block as yet.

To summarise the needs and changes which should be implemented in a next design: (1) The o/c sense will be of an independant type, as is a s/c in the 1508, so that (2) one can use voltage regulation for frequencies above about 0.1 Hz and current regulation below this point. (This constrains the gain and configuration of the feedback loop in order to guarantee stability — for example, the drive must not permit the load impedance to affect gain of the final stage, as does the 1508 where it does not matter.**)

(3) The power delivery mechanism should be switchmode, with a frequency and duty cycle optimised for overcoming friction yet minimising noise. The circuit must apply pulses with a rate comparable to the armature time constant in order to exercise maximum force momentarily to overcome static friction, yet be fast enough to give smooth travel at low speed and hopefully be inaudible. It must also respond to input changes faster than the actual inertia of the train permits *it* to respond, and also deliver a current which it is practially possible to average out faster than the train can respond. The latter condition is necessary in order to maintain apparently slothful response in the actual model, despite real world effects like dirty contacts, which are instantaneous. ●

** This may also be due to demagnetisation effects, especially if you have ever made the mistake of dismantling the engine (motor) itself.*

*** This is the limitation of effectiveness of the modification suggested earlier. Any tighter regulation of train voltage at higher frequencies (than the circuit offers) gives rise to oscillation when load impedance rises, disabling the o/c indicator totally. Reduction of the BC557's 3k9 emitter resistor would tighten the regulation, smoothing response further, but permitting instability for large load impedance. Curing that by reducing loop gain bandwidth elsewhere defeats the turnon impulse. That resistor may be selected (1k-10k range) to give best train response for stability.*

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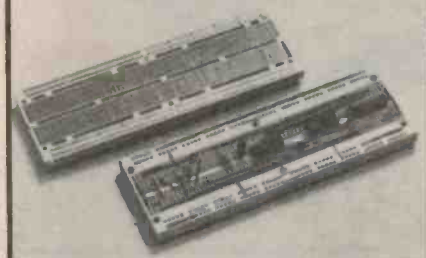

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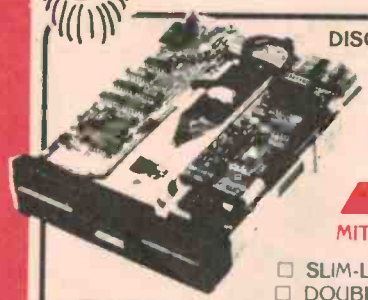
KIT SUPPORT FOR THE MICROBEE



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EPROM PROGRAMMER

Versatile, low cost and easy to build. Plugs straight into the microbee 1/0 port. Suitable for 2716, 2732, 2532, 2732A and 2764 Eproms. Burn your games programmes and eliminate cassette loading time. KIT FEATURES Sockets for all other IC's 1 x 2716 supplied – get started straight away. Front Panel and Mains (SEC approved transformer 28 pin and 16 pin wire wrap sockets to flush mount personality plugs (2 included) and ZIF socket (included) DB 15 Plug. Complete to last nut and bolt.

K9668 $55.00

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Display RTTY encoded messages on your video Monitor. Receive up to date weather information, International News before the Papers, all sorts of coded military info. Simple circuit uses PLL techniques Single PCB Construction. Kit includes DB15 Plug and backshell for connection to microbee. Shielded pretinned PCB.

Great Value!

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DIGITAL MULTIMETER

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- Rugged construction
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- 3½ Digits
- Low Cost

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NEW

MICROBEE LIGHT PEN

AT LAST – a light pen for the Bee. This pen works in the low-resolution graphics mode and connects directly to the 1/0 port

- Complete kit including DB 15 2m CORD
- Fully documented with software example.

PROVIDES DIRECT PERSONAL CONTACT WITH YOUR BEE!

K9649 $19.95

FAX-DECODER

This project allow you to decode the signals of shortwave stations, transmitting radio facsimile weather maps, satellite pictures etc and then reproduce them on your dot-matrix printer.

- Complete kits of parts includes DB15 Ribbon Cable
- SOFTWARE LISTING

K9733 $24.50

TC48/ TC64-IC TEST CLIPS

14 PIN	$7.00
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28 PIN	$22.44
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MULTIPROM INTERFACE FOR THE MICROBEE

* 44K OF PROGRAM STORAGE * FULLY SOFTWARE SELECTABLE * SUITS BOTH IC AND PLUS MACHINES * 8 OUTPUTS FOR CONTROL APPLICATIONS *

A sensational new kit for the MICROBEE, requires no modification to the computer except for the fitting of a 50 pin expansion socket. This project is easy to build and will allow you to store and software select up to 44K of eprom storage – acts like a mini disk drive system with the speed of RAM. Extra units may be added to further increase storage.

- Full set of IC sockets
- Double sided, plated through board
- Assembled connection lead to Microbee
- Fully documented
- Cassette monitor included (plus sourcefile).

K9673 $99.50

THE MICROBEE KIT OF 1983

STEREO SYNTHESIZER FOR VCR'S AND TUNERS

Synthesize realistic stereo from virtually any monophonic source by simply connecting this unit between the source and your stereo amplifier.

- Quality Phillips MN3001 (not second source dropout).
- Selection of either source via front panel switch.
- Normal or stereo sound selection.
- Provision for 2 different signal sources.
- Complete kit includes all hardwear, cables etc., even solder.

K5810 $55.00

ETI SERIES REGULATOR DESIGN

- 0.40 Volts @ 5 Amps – that's 200 Watts
- Current limiting 0.5 Amps variable
- Specifications Second to None
- Free from the hum and noise sometimes associated with other techniques.

A PROFESSIONAL SUPPLY

K3325 $175.00

POWER SUPPLIES K3300 $139.00

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YOUR GAMES WILL NEVER BE THE SAME

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ALL PRICES INCLUDE SALES TAX

* EXPERIMENTAL KIT-PCB, COMPONENTS & SOFTWARE

K9834 $26.50

KITS

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ELECTRONIC IGNITION	$31.88
MICROBEE EPROM PROGRAMMER	$52.96
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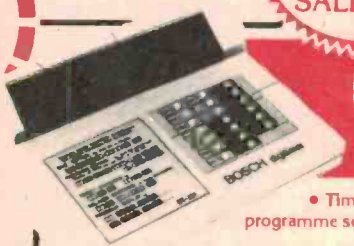
SUPER BARGAINS AT MAGRATHS



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CENTRONICS INTERFACE FOR THE MICROBEE

A simple kit to build – takes about 20 minutes, save on the cost of a built interface and save the cost of a serial printer.

K9671 $29.95

TTY TYPE INTERFACE FOR THE MICROBEE

K9672

Teleprinters are cheap, so is this kit, if you've got an old teleprinter, this is for you.

$17.50

SEMI-CONDUCTOR SPECIALS

$68A21P 1.5 MHz PIA — $3.68
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What Does It Do?
A single 240V mains plug and lead feeds one unswitched master 240V outlet plus 4 switched 240V outlets. With say, a hi-fi system, plug your main equipment item (e.g. amp.) into the master outlet and whenever you "switch on" your amp. – presto – mains power is applied to the other 4 outlets, i.e. simply "turning on" your amp. turns on your tape cassette, tuner, turntable, graphic equaliser without mains spikes, plops, etc.

Just the shot for your computer system.

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SPHERE CCT-100 TERMINAL AS REVIEWED IN EA JULY '83

SPECIFICATIONS

COMMUNICATION	• Code:	128 ASCII characters
	• Baud rate:	75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200
	• Parity:	odd, even, mark space
	• Operating Mode:	full duplex, half duplex or block mode
	• Interface:	EIA RS-232C or 20mA Current Loop
EMULATION	• LEAR SIEGLER ADM-3A, HAZELTINE 1500, ADDS VIEWPOINT	
SCREEN PRESENTATION	• Display format:	24 lines x 80 characters
	• Display unit:	12-inch, non-glare CRT
	• Character type:	7 x 9 dot matrix
	• Character set:	96 ASCII characters, 15 graphic symbols, 32 control character symbols
	• 5 screen attributes:	blink, underline, blank, reverse, dual intensity
	• Cursor type:	selectable slow, fast blinking or steady cursor, block, underline or invisible cursor

PLUS MANY MORE FEATURES!

ONLY $1029.25

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100 pages of application notes and tips for the Microbee Personal Computer. $15.00

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MAGRATHS THE RIGHT CONNECTION (AMPHENOL) CENTRONICS CONNECTORS

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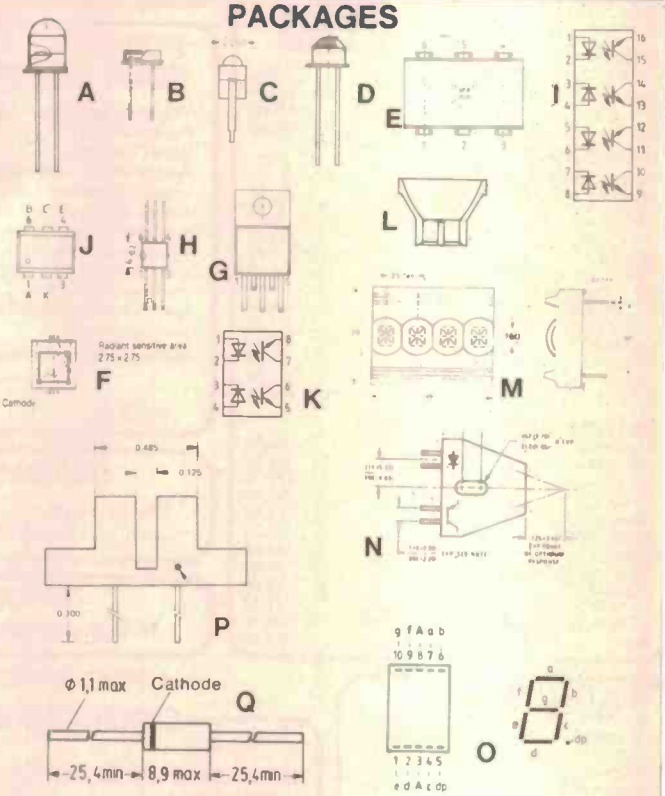

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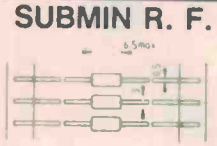

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47	Microhenry	4.7	Millihenry

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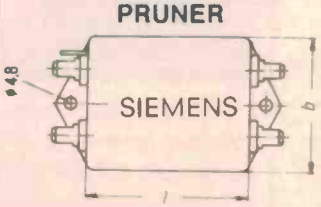

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MILITARY GRADE
CSR13

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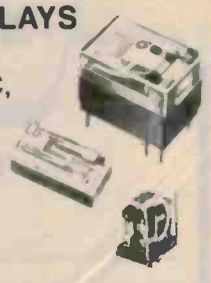

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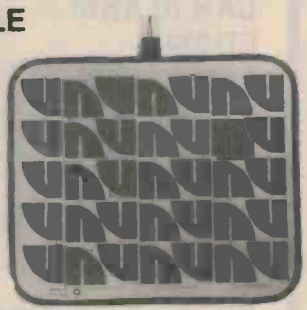

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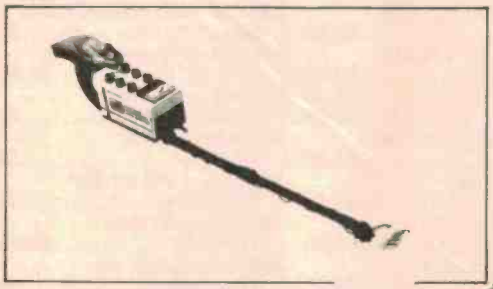

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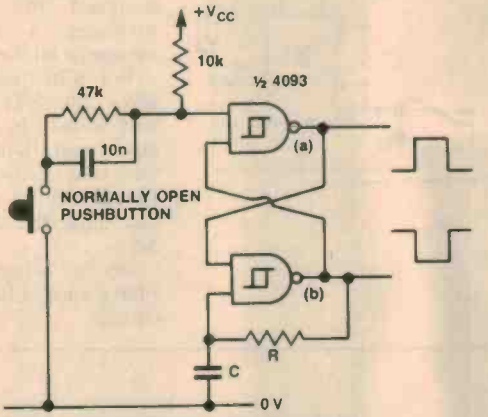
IDEAS FOR EXPERIMENTERS

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



CMOS monostable

Geoff Nicholls, ETI project engineer, designed this circuit which was adapted from the familiar RS flip-flop by adding R and C.

Two gates, (a) and (b) from a 4093 quad Schmitt NAND gate, form a useful monostable multivibrator.

On power up, C ensures that the mono is in the reset state, and is charged up to the rail by R. If the pushbutton is operated, gate (a) goes high and (b) goes low. R then discharges C to the switching point when the monostable resets, thus charging C back up ready for the next period.

The recharging may be sped up by adding a diode across R, with the cathode to the capacitor side. The timing period, with R = 1M and C = 100n, was 100 ms.

Two mode light show

This light show circuit was designed by **A. Taylor of Glen Forrest, WA**. It has two modes — chaser and pulser.

In the first mode, two inverters are set up as an oscillator with a frequency which varies from about 3 Hz to 300 Hz (adjustable by VR1). This clocks a 4017 and flashes the LEDs in sequence; if set up in a line or a circle they appear to chase each other.

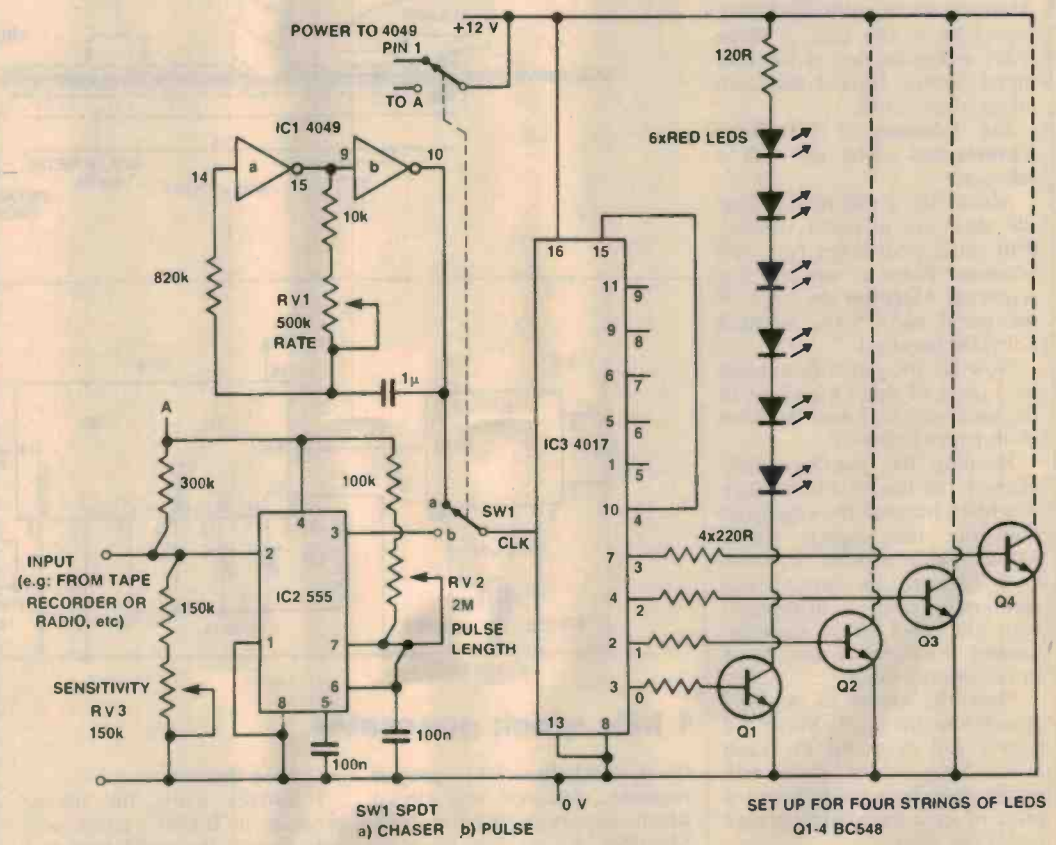
In the 'pulse' mode a 555 timer is used to provide an output pulse whenever the input goes above 0.5 V. The input could be an audio signal or an output from a solar cell; it could be used to respond to other flashing lights like this.

The sensitivity control VR3 sets the voltage which the input must exceed in order to trigger the device. VR2 sets the length of the output pulse and hence sets the number of pulses that the circuit can respond to in a given period. It cannot trigger again until pin 3 has gone low. By adjusting this control a variety of different effects can be obtained.

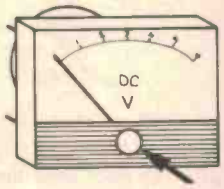
Up to 10 LED strings can be used off the 4017. One pin, the next highest in the sequence, must go to reset, unless all 10 output pins are used, to prevent an annoying pause in the sequence.

With a 12 volt supply up to six LEDs (1.6 V drop each) can be used per transistor unless two strings of LEDs are paralleled, each with its own limiting resistor, per transistor.

The 120R resistor limits the current to about 20 mA per string and therefore two strings per BC548 can be used without exceeding its ratings.



Novel position for pilot light



LED REPLACES THE ADJUSTING SCREW

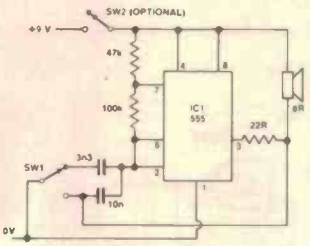
When V. Starr of Higgins, ACT was finishing the ETI Dual Power Supply project he was trying to decide on the best place to put the pilot light and came up with this idea.

The LED was placed into the hole used to adjust the needle movement, after removing the adjusting screw. In my case a 5 mm LED fitted almost perfectly.

The plastic case on most meter movements is easy to prise off. You can adjust the movement before replacing the plastic front and after fitting in the appropriate LED.

Take care in running wires or the appropriate dropping resistor from the LED.

Mosquito imitator



Matthew Sorrell of Clarence Park SA is 10 years old and designed this circuit which produces a sound like a mosquito buzzing.

For Christmas 1978 I was given the ETI-062 AM tuner with which I had a great deal of enjoyment. Since then I have built other projects from Project Electronics on a SK-10 board including the Morse Practice Set.

My dad brings home ETI and I have a lot of fun trying out the circuits.

Drilling Scotchcal 8005 panels ▶

Scotchcal 8005 panels (black on Aluminium) are difficult to drill, especially in the case of large holes where tearing of the thin metal occurs. Burred and torn edges often result.

Ian Johnston of Mt Eliza, Victoria has come up with a solution.

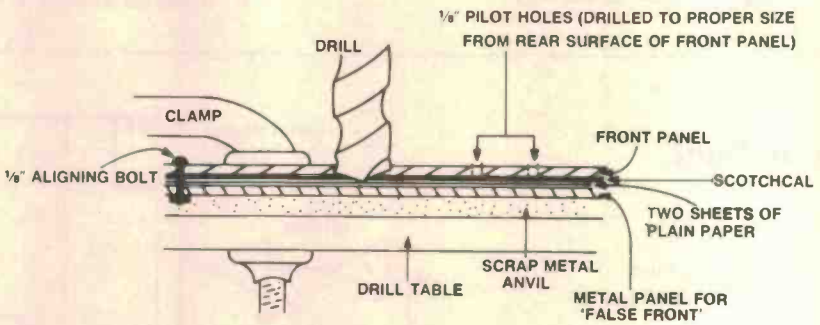
Mount the panel material on the sheet metal panel surface, drill small pilot holes (say 1/8") wherever holes of any size are required. Mark on the back of the panel surface the finished hole size required.

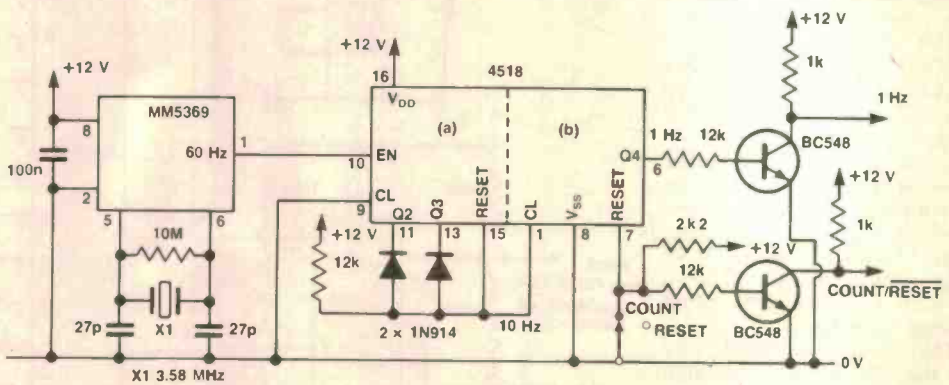
Now lay the panel face down on a piece of sheet metal cut to the same size with two layers of plain paper between.

Keeping the panels exactly aligned, run the 1/4" drill through two holes (near to the edge) and bolt the two panels firmly together with 1/4" bolts. Now drill each hole to its correct size (preferably using a drill-press) with the heel of a G-clamp holding the panels firmly down to the drilling table.

Place the clamp as close as possible to the drill. Move the panel, and re-clamp for each hole. Neat, clean holes will result. It is best to drill into a piece of scrap metal plate placed under the work.

When drilling is finished the extra plate can be used for a 'false front', which many instrument panels require anyway.





1 kHz clock generator

Geoff Nicholls, ETI project engineer, designed this circuit which has been used with a Microbee to get lap times at sporting events.

The 1 kHz and COUNT/RESET signals were connected to CLK and CTS of the serial port, and the port supplied the +12 V to the circuit.

I initially wrote the timing program in BASIC, which was able to poll the serial port fast enough to work alright. However, the latest program is, in machine code and takes advantage of the Z80 PIO's control mode interrupt feature.

The COUNT/RESET switch resets the last decade divider, so the overall timing is accurate to within 0.1 second of switching to COUNT. The other half of the dual decade divider is set up to divide by six by resetting the counter to zero when Q2 and Q3 are high.

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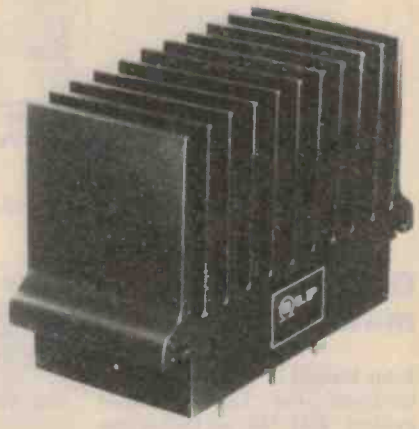

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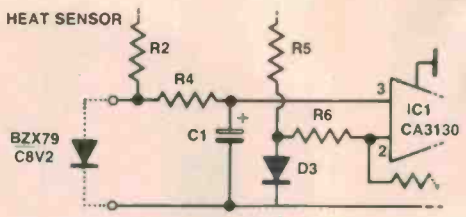
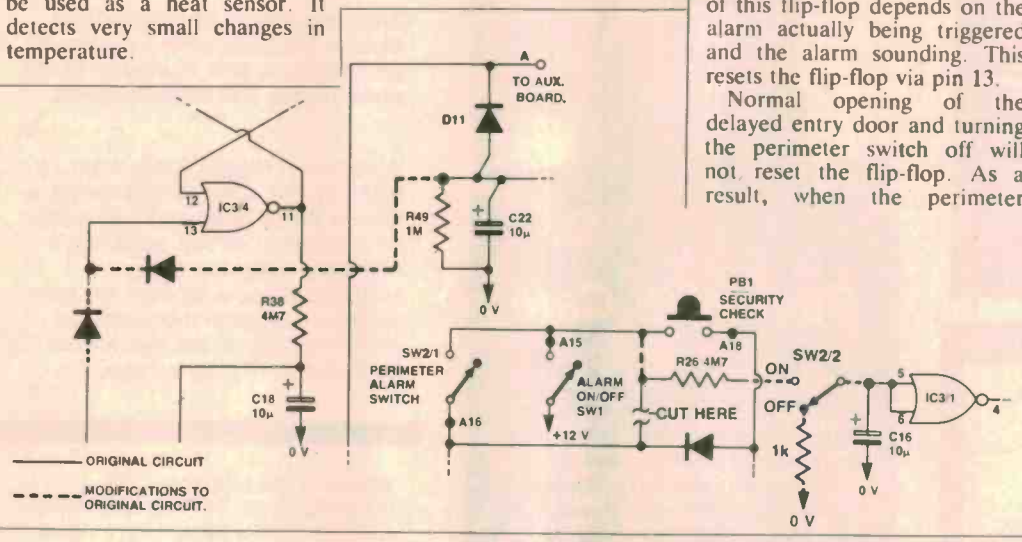


GSR monitor modification

John Russell of **Whyalla SA** has modified the GSR monitor project, ETI-546, so that it can be used as a heat sensor. It detects very small changes in temperature.

The circuit diagram illustrates the input section of the GSR monitor with the necessary modification shown dotted in. It can be mounted in a probe or in situ with the GSR monitor.



ETI-582 House alarm modification

This goes way back to one of the early projects. **Lloyd Davies** of **Paddington NSW** had a few problems when constructing the house alarm project, ETI-582, published in ETI July 1977.

I found that the unit was extremely unreliable when switching the perimeter/internal switches on and off, this action alone being sufficient to cause the alarm to trigger. The fault lies in the way the flip-flop IC3/3 and 4 is reset. The reset of this flip-flop depends on the alarm actually being triggered and the alarm sounding. This resets the flip-flop via pin 13.

Normal opening of the delayed entry door and turning the perimeter switch off will not reset the flip-flop. As a result, when the perimeter switch is again turned on the alarm will sound because the circuit of R38 and C18 is at 1 rather than 0.

This fault was corrected by the addition of a reset facility from A17 and a diode (see the modified circuit).

Another problem arose because the time delay of 30 seconds on leaving the house is taken from the time the security button is depressed. This is not a serious difficulty, but could cause erratic operation and I decided to use a double-pole switch for SW2; this caused the time delay to start when the perimeter switch is turned on. The 1k resistor was added to discharge the delay circuit of R26 and C16, allowing the house to be entered and exited in quick succession.

I also found the use of NiCd batteries and a constant current charger to be very useful.

C'MON, ALL YOU EXPERIMENTERS!

You'll have to do better than the last lot of entries — we couldn't find a decent idea worthy of the prize. It's holiday time, so redouble your efforts and get those entries in!

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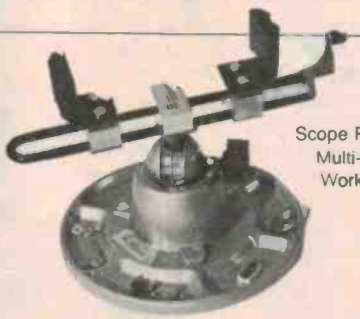


Scope Panavise Multi-Purpose Work Centre.

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Panavise Multi-Purpose Work Centre, Model 376/300/312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $90! Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

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

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

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

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

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

OVER THE COUNTER

This occasional column introduces readers to those people on the other side of the counter in the electronics retail business — where you buy your equipment and component requirements. It serves to 'put a face' to the people who own and run the businesses you may deal with in the course of your job or pursuing your hobby, and to give some background on the business itself.

Sheridan Electronics

164-166 Redfern St, Redfern NSW 2016
(02)699-6912, 699-5922

MIKE SHERIDAN is something of an institution in the Sydney electronics retail scene. He's been in the business now for 13 years, first as M.S. Components, latterly as Sheridan Electronics, and has always been located in Redfern; in Regent St until 1976 then moving to the present location in Redfern St, the suburb's 'main drag'.

If location counts for much, then Sheridan Electronics seems well located. Many major commercial customers are nearby — Sydney University, Wormalds Security, various Telecom inner-city establishments etc. The store is located a short block away from Redfern station and Redfern post office is less than 100 metres further on — very handy for mail order customers. Sheridan Electronics has 'commanded' the locality ever since opening. Indeed, a certain multinational electronics retail chain opened a branch in Redfern Street almost opposite them some years ago, but after a year or so of desultory trading, they closed up and sought greener pastures.

Sheridan Electronics is a family business; Mike and his energetic son Barry, managing it between them. You can meet the proprietors behind the counter almost any day you care to pop in. They pride themselves on low prices and a huge range of components.

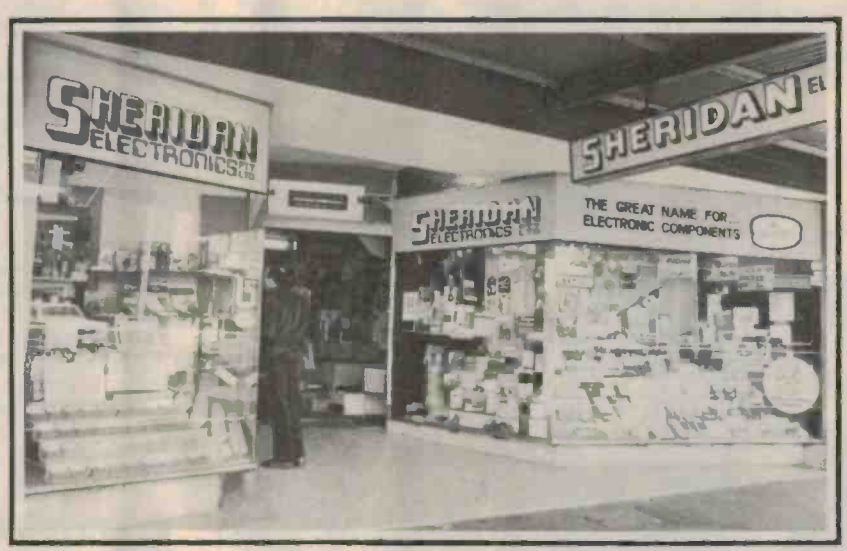
"Customers tell us we have the widest range of components they've ever seen," Mike reports. "We keep our prices low, always stock a wide range of just about every type of component and offer friendly personal service."

Apparently, Barry was instrumental in stocking a huge range of component data books recently. "If you sell components, you've got to have data," Barry says. On a set of floor-to-ceiling shelves about three metres wide you'll find data books from major semiconductor manufacturers like Fairchild, General Electric, National Semiconductor, Motorola and others.

The Sheridans have never produced a catalogue because, as Mike and Barry say, "price movements — both up and down — make a catalogue obsolete almost as soon as you produce it.

"Also, the cost of a catalogue raises prices and we like to keep our prices low."

Sheridan Electronics' business has greatly expanded in the past four years, they say, largely as a result of broadening the product range offered. Apart from the 'run-of-the-mill' components, you'll find all sorts of power devices, opto-devices, RF components and ferrites in the store. They also specialise in manufacturers' surplus components — and it's possible to pick up some top bargains almost any time. Whilst a major customer group is the hobbyist, industry and government instrumentalities represent a significant slice of their sales. Current turnover is reported to be around the $1 million mark. ●



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SHOP AROUND

Newcomers

We are happy to welcome two newcomers to the Sydney electronics scene, one in the inner city, the other out west.

If you're looking for ready-made printed circuit boards for your projects, or if you want boards made up from your own artwork, then try **Better PC Boards, 112 Robertson Road, Bass Hill 2197. (02)645-1241.**

Sydney's latest electronics retail outlet is called **Geoff Wood Electronics**, and is located in historic downtown **Rozelle** at **656A Darling St**, just off Victoria Road, opposite the 105-year-old school and near the corner of National Street. What a coincidence, G.W. specialises in National semiconductors! Proprietor is the affable Geoff Woods, who has been in the trade around 30-odd years (some of them very odd!); a familiar face behind the counter at a certain long-established electrical/electronic despatch house and previously known on the 600 ohm line as 'radio despair'! (Not a broadcast station.) Geoff's knowledge of the business and his contacts are legion. His semiconductor inventory has to be seen to be believed.

Meanwhile, **Avtek** now has a second store, located in Sydney's south-western suburbs. If Avtek's York St store could be described as 'adequate', the Enfield store is positively palatial! It's located at **172 Liverpool Rd, Enfield**, and is open Sundays. Check your requirements by 'phone on (02)745-2122.

ETI-1502 psychrometer

Be your own weatherman! This project will likely be stocked as a kit by **Jaycar** in Sydney and **Rod Irving Electronics** in Melbourne, for starters. You might also try **Altronics** in Perth and **All Electronic Components** in Melbourne.

Components for the project should be generally available, with the exception of the metallised film capacitors used. This is where we put in a plug for low-voltage metallised poly capacitors. They are high-quality, have low self-inductance and are packaged with a 5 mm pin spacing in values right up to 1u! They are good for all applications from bypassing to coupling (dc to MHz), timing to . . . whatever. And they're cheap. Because of their small size, you can fit them where you can't fit greencaps. And they're cheap.

Wouldn't it be a good idea if your favourite electronics store stocked them? Low-voltage metallised poly capacitors made by Wima are distributed by **Semikron (02)745-4533**. The same sort of capacitor, with 5 mm pin spacing, made by Ernst Roderstein, are distributed by **Mayer Kreig (02)684-1900**. Values from 150n to 1u are type MKT 1826, values below that are type MKT 1817.

The temperature sensors for this project employ copper-constantin thermocouple wires which can be obtained from scientific supply houses — see your local 'phone directory (Selby Scientific carry it).

If you want to etch and drill your own pc board, positive or negative film artwork can be obtained from 'ETI-1502 Artwork', ETI Magazine, P.O. Box 227, Waterloo NSW 2017, for the positively low price of $2.80, post paid. Make sure you request positive or negative, according to your requirements.

ETI-1518 deluxe video enhancer

Put the 'punch' back into your pictures with our deluxe enhancer. At time of going to press, the following firms indicated they would be supporting the project: **Rod Irving Electronics** in Melbourne and **Altronics** in Perth. Try also **All Electronic Components** in Melbourne. In any case, all parts should be available over the counter virtually anywhere.

If you're making your own pc board and/or front panel Scotchcal, positive or negative film of the artwork is available from us. The pc artwork costs $1.20, the front panel artwork $3.40, post paid. Send your orders to: 'ETI-1518 Artwork', ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Make sure you ask for the artwork you want (pc board or front panel, or both) and specify positive or negative film according to what you require.

ETI-674 Microbee joystick

Bound to be a popular project! We understand that kits will be available from **Altronics** in Perth, **Jaycar** in Sydney (four locations), plus **Rod Irving** and **Magraths** in Melbourne — just for starters. Try **Avtek** in Sydney, too. They're an Altronics agent. With the exception of the joystick itself, components are generally available. The joystick, though, will likely be stocked by several firms as a standard component.

Making your own pc board and want film of the artwork? Just send $2.70 in rust-proof money or its equivalent to: 'ETI-674 Artwork', ETI Magazine, P.O. Box 227, Waterloo NSW 2017.

Project 658 RS232 breakout box

Every computer hobbyist should have one! Occasions will inevitably arise when you need to sort out that 'standard' RS232 interface. All the bits are 'bog standard', as they say, available virtually anywhere. Most stores stock super-bright LEDs these days, but the Hewlett-Packard types specified are recommended. Shop around.

ETI-750 6 m beam

Get amongst the long-haul DX on 50 MHz or slide on up to 53.450 MHz for a chat on the FM channel — you can do it with this beam. Specialist aluminium supply houses (i.e: Alcan centres) stock the 9.5 mm aluminium tube, and some will even cut it to length for you. See your local 'phone directory. Some hardware stores stock 9.5 mm aluminium tube, too. Wood and screws can be purchased from hardware stores. If you're into the 'plumber's delight' construction, try **Dick Smith Electronics** for element-to-boom clamps (catalogue no. D-4652). ●

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Basic Accuracy	.5%	.5%	.5%	.5%
AC Current	1μA-10A		1μA-10A	
Basic Accuracy	.5%	.5%	.5%	.5%
Resistance	.1-20Meg		.1-20Meg	
Basic Accuracy	.2%	.5%	.2%	.5%
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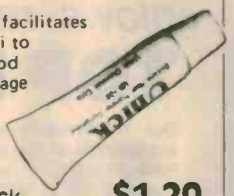

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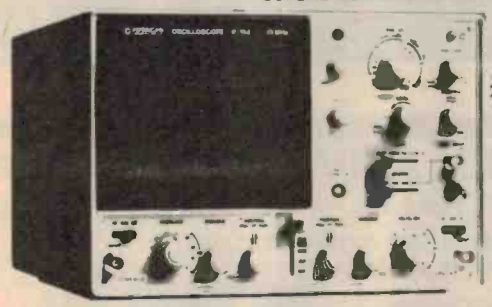

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SPECIFICATIONS

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Sensitivity	5mV/div to 5V/div 5% 10 calibrated steps 1mV div to 1V div -6% (When using ×5 amplifier) Uncalibrated continuous control between steps 1 - 2.5 (provided with click positioning function)
Bandwidth	DC to 15MHz, -3dB (at 4div) DC to 7MHz, -3dB (at 4div) (When using ×5 amplifier)
Rise time	24 ns, (for ×5) 70ns typ
Signal delay line	
Max. input voltage	600Vp-p or 300V (DC + AC peak, at 1kHz)
Input Coupling	AC, GND, DC
Input impedance	Direct 1M ohm, approx. 30pF
Operating modes	CH1, CH2, DUAL, ADD, DIFF
X-Y operation	CH1 X axis, CH2 Y axis
Sensitivity	5mV/div to 5V/div (when using ×5 amplifier, 1mV/div)
Phase difference	DC to 10kHz within 3
X bandwidth	DC to 500kHz, -3dB
Dynamic range	4div or more
CH1 output	
Output voltage	20mV/div or more (terminated into 50Ω)
Band width	50Hz to 5MHz, -3dB
Output impedance	Approx. 50Ω

• Horizontal deflection	
Trigger modes	AUTO, NORM, TV (+), TV (-)
Trigger source	CH1, CH2, LINE, EXT
Trigger coupling	AC
TV sync	TV sync separation circuit
Internal	8div or more (TV sync signal)
External	1Vp-p or more (TV sync signal)
Trigger sensitivity	Frequency / Internal / External: 20Hz to 2MHz: 0.5div / 200mV; 2 to 15MHz: 1.5div / 800mV
AUTO low bandwidth	30Hz
Trigger slope	
External trigger input	Input impedance approx. 1M ohm, 30pF or less. Max. input voltage 100V (DC + AC peak, at 1kHz)
Sweep time	0.2s/div to 0.2s/div ±5% 19 calibrated steps Uncalibrated continuous control between steps 1 - 2.5 (provided with click positioning function)
Sweep time magnifier	10 times (±7%)
Max. sweep time	100ns/div (20ns/div and 50ns/div, not calibrated)
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Waveform	Approx. 1kHz ±10% (typ), square wave
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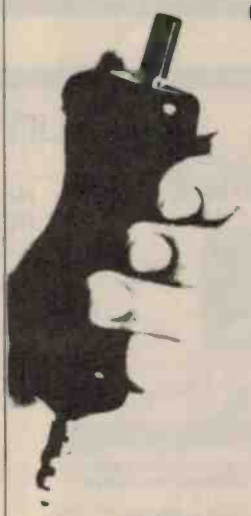

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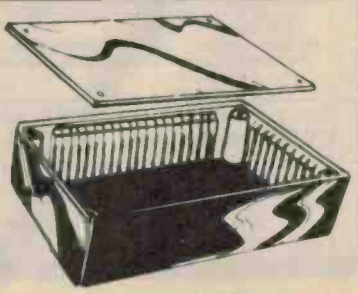

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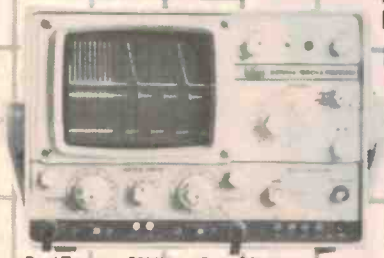

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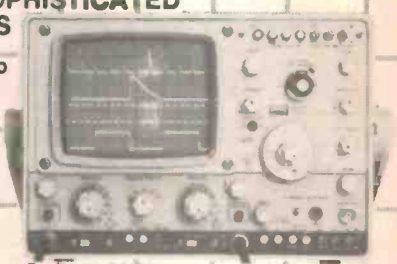

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RADIO COMMUNICATIONS BILL TABLED

The Radiocommunications Bill and its associated Bills, which will provide modern administrative machinery to manage use of the radio frequency spectrum, were introduced into Parliament on 22 September.

The Minister for Communications, Mr Michael Duffy, said that the legislation would replace the outdated *Wireless Telegraphy Act* 1905 and its associated Regulations which, because of technological advances, were now inadequate to control use of the spectrum.

Mr Duffy said that at first sight the Radiocommunications Bill hardly seemed to concern the average person. But the spectrum was a limited natural resource and without proper control over its use much of the business of daily life could not run smoothly.

"Most people make frequent use of the spectrum in one way or another as many services commonly used are dependent on it," Mr Duffy said.

Mr Duffy said the major intent of the legislation was to control interference to and between radiocommunications services.

The Bill was made available for public comment earlier this year. Initial comment received was favourable and the Government incorporated many of the ideas received into the Bill. This was evidence of the Government's general commitment in policy-making to consultation with interested parties, the Minister said.

Mr Duffy said the associated Bills dealt with transitional matters and radiocommunications licence fees. These licence fees were currently set as taxes under the Radiocommunications Licence Fees Act. The associated minor tax Bills would replace this Act and have a similar legal effect.

AMATEUR LOG-KEEPING OPTIONAL

The Department of Communications has announced that, following consultations with the Wireless Institute of Australia, it has agreed to ammend requirements for log-keeping by amateur radio operators.

A spokesman said that, in future, log-keeping would be optional with these exceptions; every amateur station is required to have a log-book in which to record distress and emergency traffic. In a case of a network carrying emergency traffic, a log is to be kept by the control stations and a log is to be kept by an amateur if requested to do so by an officer of the Department of Communications.

Club stations are still required to maintain a log of all transmissions in accordance with the format detailed in paragraph 6.11 and Appendix 15 of the 'Amateur Operator's Handbook'.

The changes were made under the provisions of the Wireless Telegraphy Regulation 31(1).

NEW PHILLYSTRAN AGENT

High-performance Phillystran non-metallic flexible rope is now available from Antenna Engineering Australia.

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

IMARK TAKE SAIKO

The Saiko SC7000 scanning receiver is now imported by Imark. The Saiko SC7000 uses a Z80 microcomputer chip and is ideal for listening to CFA, MFB, SES, police, public authority, ambulance, taxis and airport frequencies.

The scanner covers the VHF lo-band (60-90 MHz), the VHF hi-band (140-180 MHz), the UHF band (380-520 MHz) and the air band (108-138 MHz). It also has 2.5 kHz steps on the VHF and air bands and 25 kHz channel steps on the UHF band.

The unit's operator convenience functions include; scan between limits, scan 70 memory frequencies, scan any memory bank of 10 frequencies, scan with the ability to capture, monitor and automatically store frequencies for later recall and a priority channel feature. There is also a tape recording facility, a digital 24-hour clock and a 'memory keep alive' option.

The Saiko SC7000 boasts solid-state design, a double conversion superheterodyne receiver, two monolythic crystal filters and a ceramic filter to provide excellent receiver sensitivity and selectivity.

The Unit weighs 3.1 kgs and measures 270 mm x 90 mm x 230 mm. For further information, contact **Imark Pty Ltd, 167 Roden Street, West Melbourne Vic. 3003. (03)329-5433.**

GROUP TO EXAMINE MOBILE LICENSING

The Australian Electronics Industry Association Mobile Radio Product Division (AEIA MRPD) and the Australian Business and Industrial Radio Association (ABIRA) have established a joint working party to examine the basis of mobile radio licensing and structure of licence fees.

This follows the Budget announcement to substantially raise licence fees for more than 150 000 Australian users of mobile radio.

Mr Harry Court, Chairman of ABIRA said, "We believe that there must be . . . a balance between the requirements of users of the radio communications spectrum, industry supplying these users, and the policies of Government regulating the use of the radio spectrum.

"We are very concerned that fees have been increased without addressing this fundamental point."

For further information, contact **Harry Court, Chairman, ABIRA, c/- Taxis Combined Services (02)331-2124.**

A full coverage beam for the six metre band

With the 50 MHz end of the six metre band now available to Australian amateurs, a beam to cover the full band is a natural requirement. This log-period yagi design does it, and then some!

Roger Harrison VK2ZTB

AS HAS BEEN long observed, long-distance (DX) propagation on the six metre amateur band is definitely frequency sensitive, particularly with regard to ionospheric F-layer modes that take advantage of the equatorial F-layer 'anomolies' sited north and south of the geomagnetic equator. Afternoon-type or Class I transequatorial propagation being the favourite for contacts to the US, Japan and other Pacific regions. And the lower the frequency, the longer and more frequent the openings. Amateurs in countries across the 'big pond' (Pacific Ocean) are permitted to operate over 50-54 MHz whereas, until recently, Australian and New Zealand amateurs have been permitted to use only 52-54 MHz. That 2 MHz has caused some difficulties. The popular segment of the band in the Australasian region is around 52.000 MHz to 52.500 MHz, whereas, in other countries it's around 50.000-50.300 MHz or so. Most of the local area beacons, widely used to indicate improving propagation conditions, are spread between 51 MHz (ZL1UHF, Auckland 51.020 MHz) and 52.500 MHz (VK7RNT. Launceston 52.470 MHz and ZL2MHF, Mount Climie 52.510 MHz).

The most popular antenna on six metres is the Yagi, generally of four to six elements. These generally have a bandwidth of around 5-6%, which gives adequate coverage of part of the band if cut at an appropriate centre frequency, but when narrow bandwidth matching methods (like the common gamma match) are used, overall bandwidth may drop to 1% — 500 kHz! A Yagi like this, cut and matched for best performance at 52 MHz, does poorly at 50 MHz as many frustrated operators will attest.

A better bet is the log-periodic Yagi array, or log-yagi as it has been dubbed in some quarters. This design is based on the ETI-714 VHF Log-Periodic Antenna published in the February 1978 issue of ETI. It comprises a three-dipole log-periodic array with passive reflector and director elements added. It has been cast to cover 45-55 MHz and should yield a gain of some 6-7 dB over a dipole. Balanced feed is necessary and a simple coax feedline balun is all that's necessary for matching. Feedpoint impedance is in the 60-70 Ohm region and VSWR across the band should remain below 1.5:1 which is quite acceptable, there being generally little point in trying to better that.

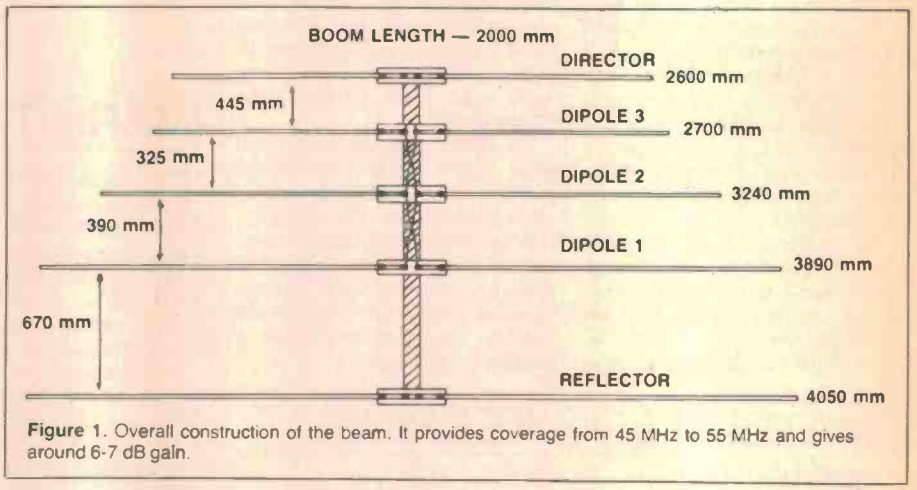


Figure 1. Overall construction of the beam. It provides coverage from 45 MHz to 55 MHz and gives around 6-7 dB gain.

Construction

The beauty of log-periodic designs is that they're tolerant of construction variations. At these frequencies, tolerances of ±10 mm can be accommodated without serious (if noticeable) effects on performance. Figure 1 shows the overall construction dimensions. Each of the dipole halves must be insulated so an insulted boom is required, along with some convenient method of mounting the dipole elements on it. There are two basic ways of achieving this — using a wooden boom and wooden element support brackets; or using a boom of high density water pipe of a suitable diameter and conventional element-to-boom brackets.

The boom for the model illustrated in Figure 1 is a two metre length of 25 x 50 mm (dressed size) wood such as maple, though western red cedar is also good. It must be a straight-grained and knot-free and suitable for outdoor use if sealed with a stain or Estapol. Wattle 'Forestwood' or one of the Cabot outdoor stains are fine and will ensure a long life.

The elements consist of two halves screwed to a wooden support block which is affixed to the boom. These blocks are cut from a length of 42 x 19 mm (dressed size) timber of the same type as used in the boom. The element halves are 10 mm diameter aluminium tube which is generally available from hardware stores or specialist aluminium suppliers (look them up in your local 'phone book). The measurements for element length given in Figure 1 are tip-to-tip dimensions. Cut the element halves 5 mm shorter than required to leave a 10 mm gap in the centre. The reflector should be made from a single length, if you can possibly do it, otherwise, use two, two-metre lengths and bond them thoroughly in the centre to get electrical contact. (If it has to be 50 mm short, it won't hurt all that much). Figures 2 and 3 show the general assembly details for the dipoles.

The position of each dipole support block should be marked out on the boom before assembling the dipoles. Drill the two bracket-to-boom screw holes in the brackets a little oversize so that the elements can be lined up parallel and at right angles to the boom, for appearance's sake. Note that the

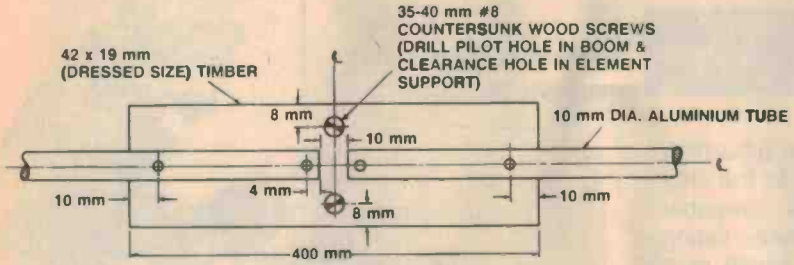


Figure 2. Dipole-to-boom bracket using wood construction.

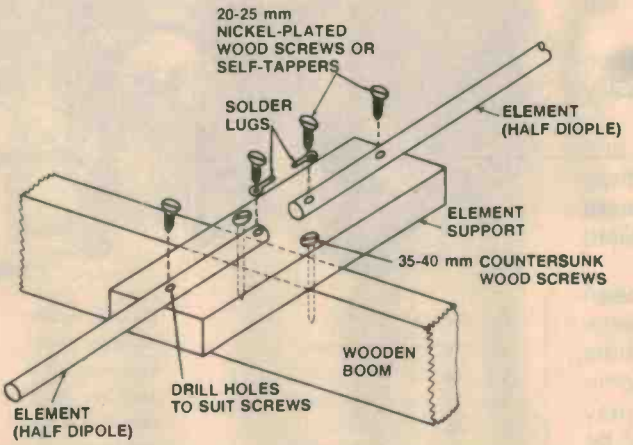


Figure 3. Element-to-boom mounting using wood construction. Estapol or stain all wooden components before assembly.

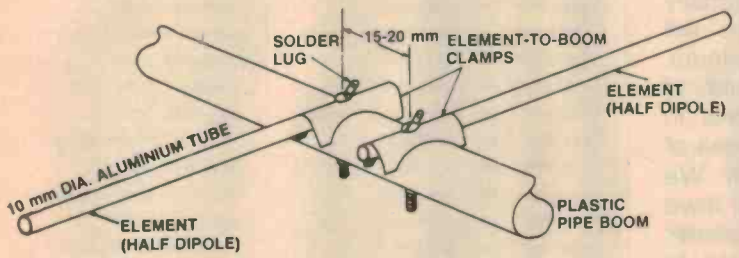


Figure 4. 'Plumber's delight' assembly using a plastic pipe boom.

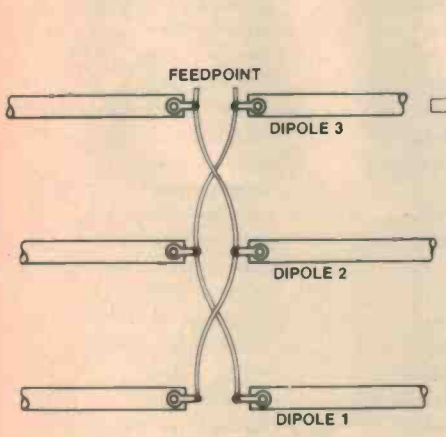


Figure 5. Showing the feedline connections between dipoles, and the feedpoint termination.

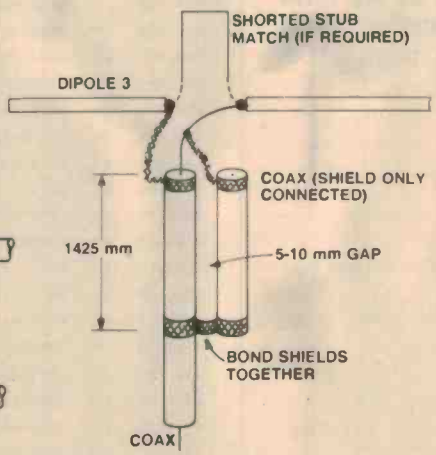


Figure 6. Suggested balun and matching arrangement.

element-to-element spacings given in Figure 1 are dipole centre-to-centre dimensions.

Figure 4 shows 'plumbers delight' assembly. Standard element-to-boom brackets are used. If you can obtain, or modify, element brackets to suit a 50 mm booms, do so, but common brackets are designed for 20 mm booms. A plastic boom will need supporting from the mast to prevent considerable droop. Alternatively, the boom can be drilled to pass the elements which can then be secured with long self-tapping screws through the top of the boom. Make sure you drill the boom reasonably accurately so that the elements lie in the same plane. Mainly for the sake of appearance.

The dipoles are cross-connected (Figure 5) and the feedline is attached to the shortest — dipole 3. Use heavy duty (24 x 0.2 mm) hookup wire for the dipole interconnections. Balun details are given in Figure 6. Seal the ends of the coax with a good sealing compound like Silastic. Tape the balun piece to the main line with electrician's tape, maintaining a spacing of 5 mm or so with small chunks of plastic placed very 100 mm or so between the two coax pieces. Plastic clothes pegs are just great for this! Tape the balun to the boom adjacent to the feed point or secure it with a cable saddle.

Let the balun section hang down from the boom a little, loop the feedline back up and either tape it to the boom toward the reflector end or secure it with a cable saddle.

I'll leave the boom-to-mast clamping arrangements to you as individual circumstances will vary.

A quick VSWR check with the antenna mounted with the reflector about a metre or so off the ground and pointed skyward should tell you all is OK — or not — before you hoist your 'baby' to the top of the tower. If you want to adjust the VSWR, an open-wire line stub, connected at the feedpoint, shorted at the opposite end and about 1400 mm long to start with can be employed. Shorten the stub successively until you reduce the VSWR to what you want. Tack the stub to the boom, away from the feedline, when you've established its final length.

Now call CQ DX on 50.110 MHz! ●

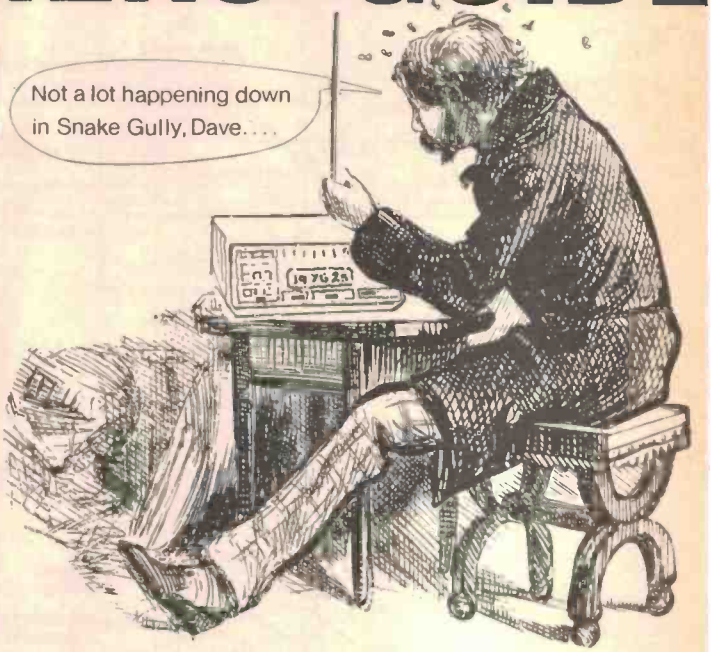
PARTS LIST — ETI-750

(all-wood construction)

- 2000 mm of 25 x 50 mm (dressed size) timber: maple or w.r. cedar.
- 2000 mm of 19 x 42 mm (dressed size) timber: maple or w.r. cedar.
- 16.5 metres total of 10 mm diameter aluminium tubing.
- 20 x 20 mm or 25 mm nickel-plated wood screws or self-tappers.
- 10 x 35 mm or 40 mm countersunk wood screws.
- Heavy duty hookup wire (24 x 0.2 mm)
- 6 x large solder lugs.
- RG8/U coax, length to suit.
- Boom-to-mast clamp to suit.
- Several cable saddles.
- Electrician's tape.

VHF LISTENERS' GUIDE

Part 3 400-550 MHz



This last part of our listing covers the ultra-high frequency (UHF) region from 400 MHz up to the limit where the coverage of most receivers available seems to stop. As in Part 2, the National listing includes some New Zealand frequencies which may be observed under enhanced propagation conditions, but reception would probably be limited to the Australian eastern seaboard.

Note also that, where several services are listed on the one channel, they are likely to be geographically separated.

A large number of public authorities and emergency services have moved or expanded their communications to the UHF bands in recent years and the crowded taxi channels on VHF have spilled over to the UHF.

The complete list, parts 1, 2 and 3, has been compiled from generally publically available material and sorted using a computer. We make no claims regarding its accuracy or completeness and welcome any additions, deletions or corrections readers may wish to submit so that a revised edition may be compiled and published at a later date.

In Parts 2 and 3, the amateur 2 m and 70 cm band listings in the 'National' section indicate the nationally agreed-upon 'band plans' and specific usage will vary from area to area. The Radio Amateurs' Callbook, published by the Wireless Institute of Australia, includes listings of repeater channels in use in various areas and this will give you an idea of which channels may be heard from your locality. We did not include UHF CB repeater listings as we have incomplete information on activity and repeater locations as yet. Very few have been approved to date. The Public Automatic Mobile Radio Telephone Service frequencies have been left out as we have been advised it is an offence to monitor these frequencies (see Scanners World, page 159, September '83).

NATIONAL

433.025	FM	NATIONAL	REPEATER INPUT 70 CM AMATEUR BAND
433.050	FM	NATIONAL	REPEATER INPUT
433.075	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
433.100	FM	NATIONAL	REPEATER INPUT
433.125	FM	NATIONAL	REPEATER INPUT
433.150	FM	NATIONAL	REPEATER INPUT
433.175	FM	NATIONAL	REPEATER INPUT
433.200	FM	NATIONAL	REPEATER INPUT
433.225	FM	NATIONAL	REPEATER INPUT MOBILE VOICE SECONDARY
433.250	FM	NATIONAL	REPEATER INPUT
433.275	FM	NATIONAL	REPEATER INPUT RTTY
433.300	FM	NATIONAL	REPEATER INPUT
433.325	FM	NATIONAL	REPEATER INPUT
433.350	FM	NATIONAL	REPEATER INPUT
433.375	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
433.400	FM	NATIONAL	REPEATER INPUT
433.425	FM	NATIONAL	REPEATER INPUT DATA
433.450	FM	NATIONAL	REPEATER INPUT
433.475	FM	NATIONAL	REPEATER INPUT
433.500	FM	NATIONAL	REPEATER INPUT
433.525	FM	NATIONAL	REPEATER MOBILE VOICE PRIMARY
433.550	FM	NATIONAL	REPEATER INPUT
433.575	FM	NATIONAL	REPEATER INPUT DATA
433.600	FM	NATIONAL	REPEATER INPUT
433.625	FM	NATIONAL	REPEATER INPUT WICEN
433.650	FM	NATIONAL	REPEATER INPUT
433.675	FM	NATIONAL	REPEATER INPUT MOBILE VOICE SEC
433.700	FM	NATIONAL	REPEATER INPUT
433.725	FM	NATIONAL	REPEATER INPUT SSTV
434.275	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
434.300	FM	NATIONAL	REPEATER INPUT
434.325	FM	NATIONAL	REPEATER INPUT RTTY
434.350	FM	NATIONAL	REPEATER INPUT
434.375	FM	NATIONAL	REPEATER INPUT
434.400	FM	NATIONAL	REPEATER INPUT
434.425	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
434.450	FM	NATIONAL	REPEATER INPUT
434.475	FM	NATIONAL	REPEATER INPUT
434.500	FM	NATIONAL	REPEATER INPUT
434.525	FM	NATIONAL	REPEATER INPUT
434.550	FM	NATIONAL	REPEATER INPUT
434.575	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
434.600	FM	NATIONAL	REPEATER INPUT
434.625	FM	NATIONAL	REPEATER INPUT
434.650	FM	NATIONAL	REPEATER INPUT
434.675	FM	NATIONAL	REPEATER INPUT
434.700	FM	NATIONAL	REPEATER INPUT
434.725	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
434.750	FM	NATIONAL	REPEATER INPUT
434.775	FM	NATIONAL	REPEATER INPUT
434.800	FM	NATIONAL	REPEATER INPUT
434.825	FM	NATIONAL	REPEATER INPUT

434.850	FM	NATIONAL	REPEATER INPUT
434.875	FM	NATIONAL	REPEATER INPUT MOBILE VOICE
434.900	FM	NATIONAL	REPEATER INPUT
434.925	FM	NATIONAL	REPEATER INPUT
434.950	FM	NATIONAL	REPEATER INPUT
434.975	FM	NATIONAL	REPEATER INPUT
435.025	FM	NATIONAL	UOSAT AMATEUR SAT DATA DOWNLINK
438.750	FM	NATIONAL	SIMPLEX
438.775	FM	NATIONAL	SIMPLEX RTTY
438.800	FM	NATIONAL	SIMPLEX
438.825	FM	NATIONAL	SIMPLEX VOICE SECONDARY
438.850	FM	NATIONAL	SIMPLEX
438.875	FM	NATIONAL	SIMPLEX DATA
438.900	FM	NATIONAL	SIMPLEX
438.925	FM	NATIONAL	SIMPLEX SSTV
438.950	FM	NATIONAL	SIMPLEX
438.975	FM	NATIONAL	SIMPLEX
439.000	FM	NATIONAL	SIMPLEX VOICE NAT PRIMARY
439.025	FM	NATIONAL	SIMPLEX
439.050	FM	NATIONAL	SIMPLEX
439.075	FM	NATIONAL	SIMPLEX
439.100	FM	NATIONAL	SIMPLEX
439.125	FM	NATIONAL	SIMPLEX VOICE SECONDARY
439.150	FM	NATIONAL	SIMPLEX
439.175	FM	NATIONAL	SIMPLEX
439.200	FM	NATIONAL	SIMPLEX
439.225	FM	NATIONAL	SIMPLEX
439.250	FM	NATIONAL	SIMPLEX
476.425	FM	NATIONAL	UHF CB CHANNEL 1
476.450	FM	NATIONAL	UHF CB CHANNEL 2
476.475	FM	NATIONAL	UHF CB CHANNEL 3
476.500	FM	NATIONAL	UHF CB CHANNEL 4
476.525	FM	NATIONAL	UHF CB CHANNEL 5 EMERGENCY
476.550	FM	NATIONAL	UHF CB CHANNEL 6
476.575	FM	NATIONAL	UHF CB CHANNEL 7
476.600	FM	NATIONAL	UHF CB CHANNEL 8
476.625	FM	NATIONAL	UHF CB CHANNEL 9
476.650	FM	NATIONAL	UHF CB CHANNEL 10
476.675	FM	NATIONAL	UHF CB CHANNEL 11
476.700	FM	NATIONAL	UHF CB CHANNEL 12
476.725	FM	NATIONAL	UHF CB CHANNEL 13
476.750	FM	NATIONAL	UHF CB CHANNEL 14
476.775	FM	NATIONAL	UHF CB CHANNEL 15
476.800	FM	NATIONAL	UHF CB CHANNEL 16
476.825	FM	NATIONAL	UHF CB CHANNEL 17
476.850	FM	NATIONAL	UHF CB CHANNEL 18
476.875	FM	NATIONAL	UHF CB CHANNEL 19
476.900	FM	NATIONAL	UHF CB CHANNEL 20
476.925	FM	NATIONAL	UHF CB CHANNEL 21
476.950	FM	NATIONAL	UHF CB CHANNEL 22
476.975	FM	NATIONAL	UHF CB CHANNEL 23
477.000	FM	NATIONAL	UHF CB CHANNEL 24
477.025	FM	NATIONAL	UHF CB CHANNEL 25
477.050	FM	NATIONAL	UHF CB CHANNEL 26
477.075	FM	NATIONAL	UHF CB CHANNEL 27
477.100	FM	NATIONAL	UHF CB CHANNEL 28
477.125	FM	NATIONAL	UHF CB CHANNEL 29
477.150	FM	NATIONAL	UHF CB CHANNEL 30
477.175	FM	NATIONAL	UHF CB CHANNEL 31
477.200	FM	NATIONAL	UHF CB CHANNEL 32
477.225	FM	NATIONAL	UHF CB CHANNEL 33
477.250	FM	NATIONAL	UHF CB CHANNEL 34
477.275	FM	NATIONAL	UHF CB CHANNEL 35
477.300	FM	NATIONAL	UHF CB CHANNEL 36
477.325	FM	NATIONAL	UHF CB CHANNEL 37
477.350	FM	NATIONAL	UHF CB CHANNEL 38
477.375	FM	NATIONAL	UHF CB CHANNEL 39
477.400	FM	NATIONAL	UHF CB CHANNEL 40

425.750	TV	NZ	ATV VIDEO 2 70 CM AMATEUR BAND
431.250	FM	NZ	ATV SOUND 2 70 CM AMATEUR BAND
432.200	SSB	NZ	SSB SIMPLEX CALLING 70 CM AMATEUR BAND
433.300	FM	NZ	FM SIMPLEX CALLING 70 CM AMATEUR BAND
433.350	FM	NZ	FM SIMPLEX 70 CM AMATEUR BAND
433.400	FM	NZ	FM SIMPLEX 70 CM AMATEUR BAND
433.450	FM	NZ	FM SIMPLEX 70 CM AMATEUR BAND
443.250	TV	NZ	ATV VIDEO 1 70 CM AMATEUR BAND
448.750	FM	NZ	ATV SOUND 1 70 CM AMATEUR BAND

ACT

468.400	FM	ACT	POLICE
468.425	FM	ACT	POLICE
468.475	FM	ACT	POLICE
468.700	FM	ACT	POLICE
470.250	FM	ACT	HERALD
491.750	FM	ACT	TV CH7

NSW

432.420	CW	NSW SYDNEY	VK2RSY AMATEUR BEACON
445.775	FM	NSW	SERVICE COMPANY
453.925	FM	NSW	HEALTH COMMISSION
454.000	FM	NSW	MARITIME SERVICES BOARD
454.175	FM	NSW	ANSETT AIRLINES
454.275	FM	NSW	MARITIME SERVICES BOARD
454.700	FM	NSW	ANSETT AIRLINES
455.200	FM	NSW	RAILEX
458.050	FM	NSW	TECH EDUCATION
463.150	FM	NSW	UTA AIRLINES
463.300	FM	NSW	TWO WAY CONTAINER DEPOT
463.400	FM	NSW	SINGAPORE AIRLINES
464.200	FM	NSW	UNIVERSITY OF NSW
465.300	FM	NSW	PAN AM AIRLINES
465.625	FM	NSW	TAXI
465.825	FM	NSW	THAI AIRLINES GROUND
467.300	FM	NSW	TAXI
468.250	FM	NSW	POLICE
468.275	FM	NSW	MARITIME SERVICES BOARD
468.300	FM	NSW	POLICE WOLLONGONG
468.355	FM	NSW	TAA AIRLINES
468.400	FM	NSW	POLICE SYDNEY CITY
468.425	FM	NSW	POLICE SYDNEY WEST
468.450	FM	NSW	POLICE SYDNEY NORTH
468.475	FM	NSW	POLICE BATEMANS BAY NTH
468.500	FM	NSW	POLICE SYDNEY CENTRAL
468.525	FM	NSW	POLICE
468.550	FM	NSW	POLICE
468.555	FM	NSW	POLICE SYDNEY EAST
468.625	FM	NSW	HEALTH COMMISSION
468.700	FM	NSW	POLICE SYDNEY CENTRAL
468.725	FM	NSW	POLICE SYDNEY NORTH
468.750	FM	NSW	POLICE MERIMBULA BEGA
468.775	FM	NSW	POLICE LICENCE CHECKS
469.725	FM	NSW	MARITIME SERVICES BOARD
469.800	FM	NSW	AWA MARINE

QLD

432.440	CW	QLD BRISBANE	VK4RBB AMATEUR BEACON

SA-NT

468.450	FM	SA	POLICE
468.475	FM	SA	POLICE
468.500	FM	SA	POLICE
468 700	FM	SA	POLICE
468.725	FM	SA	POLICE
468.775	FM	SA	POLICE

VIC

406.750	FM	VIC	DINHOL PTY LTD
406.750	FM	VIC	COLORSHIELD
415.415	FM	VIC	PORT EMERGENCY
415.475	FM	VIC	PORT EMERGENCY
416.075	FM	VIC	PORT EMERGENCY
416.250	FM	VIC	COLORSHIELD
416.250	FM	VIC	DINHOL PTY LTD
429.000	FM	VIC	ESSO OIL RIGS
432.450	CW	VIC MT BUNUNYONG	VK3RMB AMATEUR BEACON
450.675	FM	VIC	FOREST COMMISSION CENTRAL
450.800	FM	VIC	FOREST COMMISSION CENTRAL
453.450	FM	VIC	MFB CHANNEL 4 HAND HELD UNITS
454.300	FM	VIC	ALBERT SMITH & STAFF - TX MOBILE
454.875	FM	VIC	GOLDEN MESSENGERS
455.900	FM	VIC	CROWN CONTROLS TX MOBILE
456.250	FM	VIC	AWA
456.350	FM	VIC	ASSOCIATED OWNER DRIVERS TX
457.775	FM	VIC	MUTUAL AID EMERG FIRE SERV ALTONA
459.300	FM	VIC	MOTOROLA MOBILE TX
460.000	FM	VIC	FOREST COMMISSION FIRE TOWER
460.200	FM	VIC	FOREST COMMISSION CENTRAL
461.575	FM	VIC	TV STATION GTV9 HAND HELDS
463.150	FM	VIC	MFB CHANNEL 3 MLC BUILDING
463.150	FM	VIC	CHANNEL 9 UHF
463.175	FM	VIC	DONNELLY SAND SUPPLY
463.225	FM	VIC	MFB CHANNEL 2 MLC BUILDING
463.225	FM	VIC	MFB CHANNEL 1
463.275	FM	VIC	MFB CHANNEL 1 REPEATER
463.275	FM	VIC	MFB CHANNEL 2
463.450	FM	VIC	EPA
463.800	FM	VIC	ALBERT SMITH & STAFF - RX
464.375	FM	VIC	GOLDEN MESSENGERS
465.200	FM	VIC	ERRAND MESSENGERS BASE RX
465.400	FM	VIC	CROWN CONTROLS RX MOBILE
465.700	FM	VIC	ERRAND MESSENGERS BASE TX
465.750	FM	VIC	AWA VH3HS
465.850	FM	VIC	ASSOCIATED OWNER DRIVERS RX
467.200	FM	VIC	WESTGATE BRIDGE CONTROL
467.275	FM	VIC	MUTUAL AID EMERG FIRE SERV ALTONA
467.275	FM	VIC	PETRO CHEMICALS ALTONA
467.625	FM	VIC	CRB
468.050	FM	VIC	PETRO CHEMICALS ALTONA
468.300	FM	VIC	VICTORIAN RAILWAYS
468.400	FM	VIC	POLICE HAND HELDS
468.425	FM	VIC	POLICE HAND HELDS
468.450	FM	VIC	POLICE HAND HELDS
468.475	FM	VIC	POLICE HAND HELDS
468.525	FM	VIC	SES REPEATER DOWNLINK
468.600	FM	VIC	SES REPEATER DOWNLINK COUNTRY
468.625	FM	VIC	SES REPEATER DOWNLINK COUNTRY
468.650	FM	VIC	SES REPEATER DOWNLINK
468.675	FM	VIC	SES REPEATER DOWNLINK
468.800	FM	VIC	MOTOROLA MOBILE RX
468.925	FM	VIC	POLICE HAND HELDS
469.525	FM	VIC	ST JOHNS AMBULANCE SIMPLEX
470.075	FM	VIC	SECURITY SERVICES
470.125	FM	VIC	SECURITY SERVICES
470.550	FM	VIC	SECURITY SERVICES
470.850	FM	VIC	SECURITY SERVICES
480.865	FM	VIC	MMBW CHANNEL 10
483.000	FM	VIC	YELLOW CABS
483.300	FM	VIC	SILVER TOP TAXIS
483.325	FM	VIC	SILVER TOP TAXIS
483.350	FM	VIC	SILVER TOP TAXIS
483.375	FM	VIC	SILVER TOP TAXIS
483.425	FM	VIC	SILVER TOP TAXIS
483.525	FM	VIC	SILVER TOP TAXIS
483.575	FM	VIC	SILVER TOP TAXIS
483.600	FM	VIC	SILVER TOP TAXIS
483.675	FM	VIC	YELLOW CABS
483.700	FM	VIC	YELLOW CABS
483.725	FM	VIC	YELLOW CABS
483.775	FM	VIC	YELLOW CABS
483.900	FM	VIC	BLACK CABS
483.925	FM	VIC	BLACK CABS
484.000	FM	VIC	EASTERN GROUP TAXIS
485.375	FM	VIC	BANK SECURITY
486.650	FM	VIC	BOX HILL COUNCIL
486.975	FM	VIC	SECURITY SERVICES
487.175	FM	VIC	MMB
487.325	FM	VIC	WORMALDS
487.775	FM	VIC	STATION 3MP
488.500	FM	VIC	SILVER TOP TAXIS
488.525	FM	VIC	SILVER TOP TAXIS
488.550	FM	VIC	SILVER TOP TAXIS
488.575	FM	VIC	SILVER TOP TAXIS
488.625	FM	VIC	SILVER TOP TAXIS
488.725	FM	VIC	SILVER TOP TAXIS
488.775	FM	VIC	SILVER TOP TAXIS
488.800	FM	VIC	SILVER TOP TAXIS
488.875	FM	VIC	YELLOW CABS
488.900	FM	VIC	YELLOW CARS
488.925	FM	VIC	YELLOW CABS
488.925	FM	VIC	VICTORIAN RAILWAYS
488.975	FM	VIC	YELLOW CABS
489.000	FM	VIC	YELLOW CABS
489.100	FM	VIC	BLACK CABS
489.125	FM	VIC	BLACK CABS
489.200	FM	VIC	EASTERN GROUP TAXIS
490.125	FM	VIC	RACV CHANNEL 5
490.150	FM	VIC	RACV CHANNEL 6
490.175	FM	VIC	RACV CHANNEL 7
490.200	FM	VIC	RACV CHANNEL 8
490.550	FM	VIC	TELECOM
490.725	FM	VIC	DEPT EDUCATION
490.735	FM	VIC	SECURITY SERVICES
492.275	FM	VIC	STATION 3AW
493.475	FM	VIC	SEA PILOTS RX
494.150	FM	VIC	METROPOLITAN SECURITY SERVICES
495.325	FM	VIC	RACV CHANNEL 1
495.350	FM	VIC	RACV CHANNEL 2
495.375	FM	VIC	RACV CHANNEL 3
495.400	FM	VIC	RACV CHANNEL 4
496.100	FM	VIC	MMBW CHANNEL 11
496.100	FM	VIC	FOREST COMMISSION FIRE TOWER
498.675	FM	VIC	SEA PILOTS TX
500.175	FM	VIC	TELECOM

WA

432.410	CW	WA CARNARVON	VK6RTT AMATEUR BEACON

JAYCAR FOR VALUE!

PLEASE RING YOUR NEAREST STORE FOR EXTENDED TRADING HOURS OVER THE CHRISTMAS PERIOD

PLEASE RING YOUR NEAREST STORE FOR EXTENDED TRADING HOURS OVER THE CHRISTMAS PERIOD

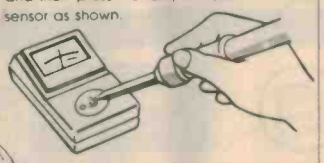
MUSICAL CHRISTMAS CARD

Incredible but true. Send a friend a card that plays a tune!
Each card is fitted with an electronic watch module, battery and flat transducer. An appropriate seasonal tune plays when the card is opened. Now no more expensive than ordinary high quality Xmas card.

ONLY $2.95

EASY TO USE!

Apply solder to the tip of soldering iron and then press the temperature sensor as shown.



SOLDERING IRON TEMP. TESTER

READS TEMP IN DEGREES CENTIGRADE!

Temperature is the most important factor for soldering!
Prevent precision parts from burning intermittent connection.

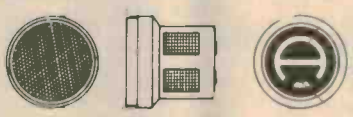
When you solder electronic parts to the printed circuit board, you should know the proper temperature.
Improper temperature can cause damage to parts or cold soldering.

$29.95

NEW

Cat. QT-2100

Ideal for all temperature controlled irons



UNIDIRECTIONAL ELECTRET MICROPHONE INSERT

Just out in time for the new EA Parabolic Microphone project! (Ref: EA Nov. '83).
This brand-new direct import unit has an average sensitivity around 7dB BETTER than the common low cost Electret insert.
The unit (Cat. AM-4012) has a front-to-back ratio of 1.5:1. The power requirements are the same as for the low cost mic. insert.
Each insert is supplied with a comprehensive data sheet which includes connection details, specs, and frequency response graph.
Be early as they may be in short supply around Xmas.
Cat. AM-4012

ONLY $3.95

NEW only $3.95

Amazing Value

PROFESSIONAL COMPUTERISED CAR ALARM WITH FLASHING LIGHT $69.95

This alarm has all the features of those expensive types. These include:—
* Flashing light for visible protection
* Automatically switches on when ignition key is in off position and switched off with same key — no switches
* Exit and entry delay and unit chirps when exit delay begins
* Sounds for one minute, then resets
* Pulsating or steady alarm tone selectable
* Can be used with optional N.O. Motion sensor
* Bonnet, boot, car stereo and CB protected
* All hardware, wire and two warning decals supplied

Cat. LE-8600 $69.95

16 bit computer KIT Slashed

WAS $1299
SAVE $500!!
NOW $799
Comp. Kit
Cat. KJ-6630

DIGITAL MULTITESTER

THE ALL SINGING ALL DANCING MULTIMETER

Scoop purchase of quality "KAISE" Japanese 3½ digit LCD digital multimeter.
– Manual range override (Normally auto-ranging)
– A must. Zero adjust button. Calibrates meter if you change test probes
– Virtually "open circuit" input impedance
– Magnificent clear LCD readout
– Most significant digit flashes if out of range
– Tone beeper for status identification
– +/–1000V DC, 600V AC
– Resistance & Current ranges (AC & DC)
– Lo ohms range for checking semis
– 4mm banana plug leads on industry standard 19mm centres
– High current shunt available
– Fuse protected. Spare fuse provided – inside case.

Cat. QM-1525

NEW $59.95

MACHINED PIN GOLD CONTACT IC SOCKETS. . .

Expensive. But the best for professional work. Each pin is machined out of solid material (not punched out of a flimsy sheet). High quality heavily gold plated inserts form the socket end of the pin. The pins are then precision moulded into a high quality plastic housing. Ideal for use in equipment where high field service costs are a distinct possibility or where high reliability is essential.

Cat. No.	Description	1–9	10+
PI-6452	8 WAY SOCKET	$0.90	$0.84
PI-6454	14 WAY SOCKET	$1.15	$1.10
PI-6456	16 WAY SOCKET	$1.25	$1.15
PI-6458	18 WAY SOCKET	$1.45	$1.35
PI-6460	20 WAY SOCKET	$1.60	$1.50
PI-6462	22 WAY SOCKET	$1.75	$1.60
PI-6464	24 WAY SOCKET	$1.95	$1.80
PI-6466	28 WAY SOCKET	$2.25	$2.10
PI-6468	40 WAY SOCKET	$2.95	$2.75

Amazing

WE'VE GOT THE EDGE!

Quality Australian made cabinets. Aluminium and Marviplate construction with handles.

Cat. No	Description	1–9
HE-1452	84/6V 203(D) x 102(H) x 153(W)	$18.50
HE-1454	84/8V 203(D) x 102(H) x 203(W)	$20.00
HE-1457	84/10V 203(D) x 102(H) x 254(W)	$21.50
HE-1458	84/12V 203(D) x 102(H) x 305(W)	$23.00
HE-1459	84/17V 203(D) x 102(H) x 432(W)	$28.00
HE-1461	93/8V 228(D) x 76(H) x 150(W)	$16.50
HE-1462	93/8V 228(D) x 76(H) x 203(W)	$18.00
HE-1463	93/10V 228(D) x 76(H) x 254(W)	$19.50
HE-1467	93/12V 228(D) x 76(H) x 305(W)	$22.00
HE-1469	93/17V 228(D) x 76(H) x 432(W)	$25.50

Horwood Instrument Cases

Jaycar Incorporating ELECTRONIC AGENCIES

SYDNEY SHOWROOMS
117 YORK STREET – PHONE: (02) 264 6688 and (02) 267 1614
TELEX: 72293

CARLINGFORD
Cnr. CARLINGFORD & PENNANT HILLS ROAD – PHONE: (02) 872 4444

CONCORD
115 – 117 PARRAMATTA ROAD – PHONE: (02) 745 3077

HURSTVILLE 121 FOREST ROAD – PHONE: (02) 570 7000

NUMBER 1 FOR KITS

POST AND PACKING CHARGES
$5 – $9.99 ($1.50) $10 – $24.99 ($3.20)
$25 – $49.99 ($4.50) $50 – $99.99 ($6.50)
$100 – $198 ($8.00) Over $199 ($10)
"Free INSURANCE for Road & Registered Post over $200"
All heavy or bulky items (over 20kg.) sent Comet Road Freight $12.00 anywhere in Australia.

SHOP HOURS CARLINGFORD, CONCORD & HURSTVILLE
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SHOP HOURS SYDNEY
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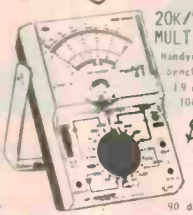

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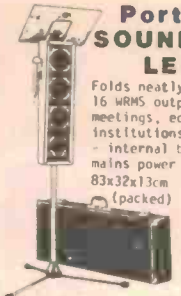

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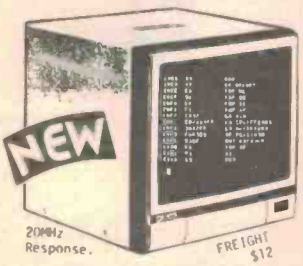

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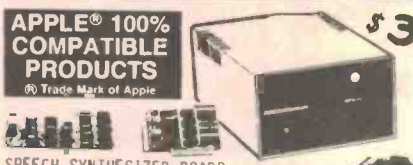

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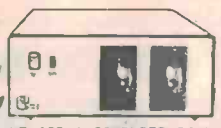

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100,000uF	10v	$ 6.50	47,000uF	25v	$ 8.50	22,000uF	50v	$10.00
150,000uF	10v	$ 6.75	50,000uF	25v	$ 9.00	29,700uF	50v	$10.00
160,000uF	10v	$ 7.00	55,000uF	25v	$10.00	34,800uF	50v	$14.00
184,000uF	10v	$ 7.50	17,500uF	30v	$ 5.00	20,000uF	55v	..$10.00
200,000uF	10v	$ 8.00	24,000uF	30v	$ 7.00	7,800uF	60v	$ 5.00
17,000uF	15v	$ 3.50	30,000uF	30v	$ 9.00	20,000uF	60v	$11.00
21,000uF	15v	$ 3.75	37,000uF	30v	$ 9.00	30,000uF	60v	$17.00
30,000uF	15v	$ 4.00	40,000uF	30v	$10.50	25,000uF	62v	$12.00
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38,000uF	15v	$ 4.50	60,000uF	30v	$12.00	5,000uF	75v	$ 4.00
43,000uF	15v	$ 4.75	100,000uF	30v	$18.00	10,000uF	75v	$ 9.00
50,000uF	15v	$ 5.00	15,000uF	35v	$ 6.50	12,800uF	75v	$10.00
54,000uF	15v	$ 5.00	25,000uF	35v	$ 8.00	16,800uF	75v	$12.00
60,000uF	15v	$ 5.50	30,000uF	35v	$ 9.00	20,000uF	75v	$14.00
63,000uF	15v	$ 5.50	2,700uF	40v	$ 2.00	28,000uF	75v	$15.00
73,000uF	15v	$ 6.00	6,800uF	40v	$ 4.50	2,800uF	100v	$ 3.50
80,000uF	15v	$ 6.50	10,000uF	40v	$ 5.00	8,500uF	100v	$ 8.00
83,000uF	15v	$ 7.00	12,000uF	40v	$ 6.00	14,500uF	100v	$13.00
140,000uF	15v	$ 8.00	12,000uF	40v	$ 6.50	20,000uF	100v	$15.00
16,000uF	16v	$ 4.00	20,000uF	40v	$ 7.50	3,000uF	150v	$ 4.00
60,000uF	16v	$ 8.00	21,000uF	40v	$ 8.00	3,000uF	200v	$ 6.00
10,000uF	20v	$ 3.50	23,500uF	40v	$ 8.00	3,300uF	200v	$ 6.50
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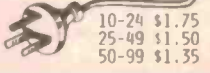

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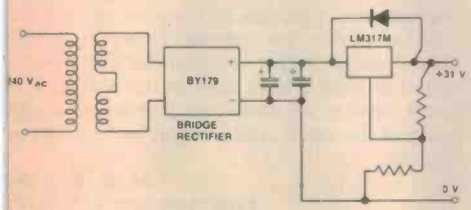
LETTERS

Dear Sir,

In the course of my job I design (nothing spectacular), construct and commission electronic equipment. I recently built a power supply for an IMPATT microwave source. It actually consisted of three separate supplies, one of which was to supply 31 V at a current of up to one amp; regulation was not critical.

I opted to use a 30 Vac, 40 VA Ferguson low profile transformer (PL30/40 VA), with a fullwave bridge rectifier, two 2200 µF capacitors followed by an LM317M high voltage, three-terminal adjustable regulator. The LM317M was a bit of an over-kill but it was easy to use.

I thought that it was all pretty ordinary, simple and effective. So you can imagine my surprise when the circuit started to sag around 700 mA. I checked the capacitors and the bridge rectifier diodes, replacing them, etc, etc.



However, the problem was with the transformer, which I also replaced but to no avail. The problem was saturation. The oscillographs in Figures 1, 2 and 3 illustrate this clearly. The supply was isolated from ground so there was no hassle in plugging a CRO into the secondary winding.

The 31 V stated supply did give 31 V (31.5 V in fact) unloaded, and the 30 Vac secondary seemed to be alright. The dc input voltage to the regulator was about 46 V.

However, when the transformer was loaded the story was totally different. The ac waveform was badly clipped, shown in Figures 1 and 2. The load voltage was 30.5 V and the current, measured with a Fluke multimeter, was 738 mA.

The dc input voltage to the regulator dropped to 32 V and the secondary ac voltage was 32 V, measured with the Fluke multimeter, a true RMS model. The peak voltage, as shown in the photographs, was only about 35 V. The RMS secondary current (again measured with the Fluke) was 1.04 A.

So for a dc output of 24.5 W from the filter circuit, the output from the transformer was 33.3 VA. It seemed to me that this 40 VA transformer was hard pushed, although it was technically within the specifications as the RMS output voltage is rated at 30 V with a full load.

For comparison, Figure 3 shows a similar oscillograph for another supply which is also part of the original IMPATT supply. It uses a PL15/20 VA, BY179 bridge, 5600 µF capacitor (about 4400 µF for the 31 V) and a 7815 IC. The problem is not quite so bad. The load current for the 15 V supply was 738 mA at 14.7 V which is comparable to the 31 V supply, without the same sogginess.

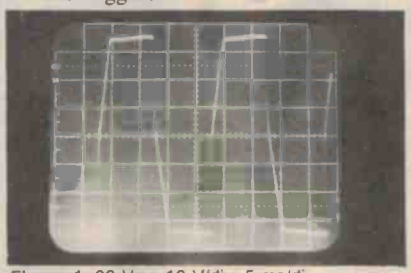


Figure 1. 30 Vac: 10 V/div; 5 ms/div.

As it turned out, the 31 V supply has only to supply 200-300 mA. The specified 1 A was an over-kill, so I was saved from trying to shoehorn a larger transformer into the available space.

All this tends to vindicate my thoughts on the design of power supplies. My measurements also back up certain statements made in several editions of the National Semiconductor Voltage Regulator Handbook i.e: if a transformer (and hence a power supply) is intended to run near its rated maximum output current for a reasonable length of time (which would be as low as one second in my particular case) then the VA rating of the transformer should be *at least* 50% higher than the dc power taken off at the filter capacitors.

National quote figures more like 80%. This is not surprising at all, considering that the peak secondary current of the transformer can easily be five to ten times greater than the dc output current, due to the highly nonlinear nature of the rectifier/filter capacitor circuit.

Two points should be made.

1. The problem was mainly that the peak voltage of the secondary dropped quite drastically when loaded. I have been told that Ferguson transformers can be good at this sort of sogginess.

2. The reluctance of the 20 VA transformer's core is probably less than that of the 40 VA; the core cross-section appears to be the same but the magnetic path length for the 20 VA is shorter.

I am bringing this to your attention because I think you may find it valuable in your work, and ETI readers may wish to know. I have criticised statements published in ETI before, with respect to transformer rating and supply output power.

Figure 2. 30 Vac: 20 V/div; 5 ms/div.

Let me state my case clearly. It is not sufficient to use a transformer where the secondary is rated as E volts RMS at I amps, for a dc output of $\sqrt{2}$ x E volts dc at I amps dc (neglecting diode drops and other considerations).

I am not saying that ETI magazine is guilty of this, but it does seem to be a pervading idea that I have often come across. In fact, I do not think that it would be wise to choose a transformer that has a VA rating on the secondary equal to the expected dc power drawn.

A full analysis of the operation of a power supply would be extremely tedious due to the non-linear nature of rectifiers and transformers (I have seen some bizarre capacitors too) and I do not think that it is necessary.

In most cases power supplies can be built by 'rule-of-thumb'. However, I have come across so many poorly designed power supplies that I am convinced that many people have short thumbs when it comes to designing simple power supplies.

Overspecifying transformer and rectifier ratings (say 50%-100% over) is not as ludicrous as it may appear to be. Large devices operating at a low power usually run cooler than small devices operating at the same power. Therefore, the larger devices are probably more efficient and certainly more robust.

I wonder how many hobbyists consider the effects of the hot Australian summer on circuits they construct. A transformer in its case, running at the full rated VA, can easily reach a temperature of 40°C-50°C in a room which is only at 20°C-25°C.

Phillip Denniss
Chippendale NSW

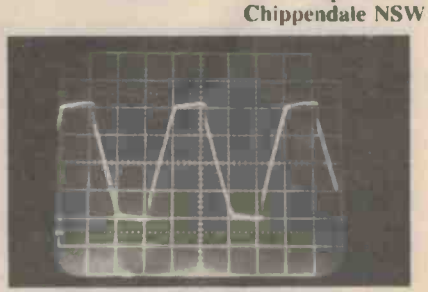
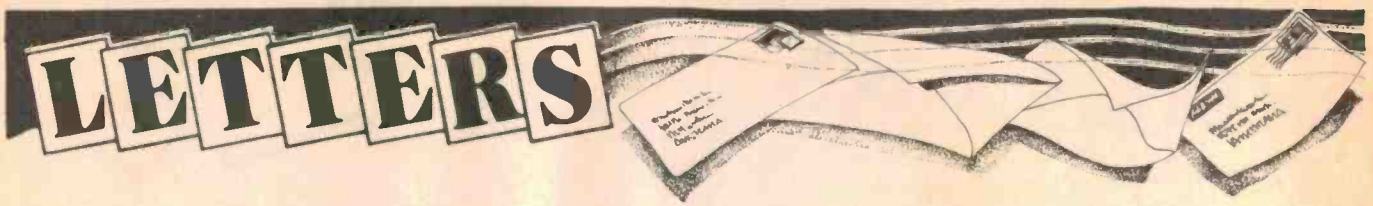


Figure 3. 15 Vac: 10 V div; 5 ms/div.



The following comments are listed in order to assist your readers in choosing suitable transformers, rather than being disappointed, as was Phillip Denniss.

1. If the results achieved by Phillip Denniss are compared with the literature on Choke Input Filters it will be seen that, in effect, the PL30/40 VA is acting as both a transformer and a choke. Whilst a choke input filter requires a higher applied voltage to produce the same output voltage as that of a capacitor input filter it has the advantages of cheaper rectifiers and filter capacitors. Filtering requires less capacitance of lower ripple rating.

2. The leakage inductance of the PL30/40 VA is in the order of 30 mH when referred to the secondary. The PL20/40 VA is in the order of 10 mH and a tightly coupled transformer could be less than 1 mH.

3. The 'PL' range of Ferguson transformers has been designed to meet the requirements for a low profile transformer, achieving outputs that could not be obtained with conventional transformers meeting the same limiting dimensions. The design, with separate bobbins or separate bobbin sections, provides the ultimate in electrical safety.

4. The 'PL' range is designed with Class 'E' (120 °C) materials which allows a 90 °C rise on 25 °C ambient (75 °C and 40 °C). Since the case is designed to dissipate heat (the copper/case differential can be as low as 15 °C) the transformer runs much cooler in a metal case acting as a heat sink. Generally the limiting temperature will be that which the associated electronic componentry can tolerate.

5. If a 30 V stock transformer is required, the Ferguson Selection Guide lists types from 0.17 A to 4.0 A. Phillip Denniss answers his own question when he says "The specified 1 A was 'overkill', so I was saved from trying to shoehorn a larger transformer into the available space".

Roy Robinson,
Senior Design Engineer.
Ferguson Transformers

(Ferguson Transformers are only too willing to discuss any problems you may have with their transformers, so don't hesitate to contact them. — Ed.)

Dear Sir,

As you may be aware there has been sold a large quantity of radiocommunications equipment, including scanners, capable of being used to intercept radiocommunications.

While the court ruled in the *Golds v Comerford* case that the operation of a receiver for interception purposes without a licence is not an offence under the Wireless Telegraphy Act, I understand that its use to monitor communications carried on Telecom's public automatic mobile radio telephone system (AMTS) would constitute an offence against Section 7 of the Telecommunications (Interception) Act 1979.

Furthermore, if a person prints or publishes any writing which incites, urges, aids or encourages any person to commit the above offence, it may constitute a breach of Section 7A of the Crimes Act 1914. That Section creates the offence of incitement to break Commonwealth or Territory laws.

I feel it is my duty to draw the above matters to your attention, and also to point out the need for care in publishing technical articles and advertisements for radiocommunications equipment in your magazine to ensure that you do not encourage the unlawful use of receivers.

In particular, references in advertising material to the ability of certain receivers to intercept radiocommunications carried on Telecom's public automatic mobile radio telephone system should be carefully considered.

M. R. Ramsay
First Assistant Secretary,
Radio Frequency Management Division

Many thanks for your letter regarding the use of receivers to monitor communications on Telecom's public automatic mobile radio telephone system (AMTS).

I would like to know how the various acts relate to a person using a scanning receiver, or some other type of receiver covering the appropriate frequencies, monitoring (intercepting, if you like) channels used by State and Federal Police, Customs and government or non-government security services?

I would be interested in a reply, not only with regard to how it affects my publication, but how it affects readers who use scanners, as well.

Roger Harrison
Editor, ETI

Dear Mr Harrison,

The following discussion is presented in response to your request for information on how current legislation effects the use of receivers to intercept communications on various other services.

In accordance with Sections 4 and 5 of the Wireless Telegraphy Act a person may not establish, erect, maintain or use stations and appliances for the purpose of transmitting or receiving messages by means of wireless telegraphy, unless he has been granted a licence by the Minister.

As I mentioned previously, the Court of Golds v Comerford decided that receiving within the meaning of the Wireless Telegraphy Act does not include interception, and the operation of a receiver for interception purposes without a licence is, therefore, not an offence under the Wireless Telegraphy Act.

It should be remembered, however, that the judgement in question was handed down by a single judge of the Victorian Supreme Court. It is, therefore, only binding on Victorian District and Magistrates' Courts. As far as other Courts are concerned it has pursuasive authority only.

Assuming the law to be as laid down in Golds v Comerford, the interception of communications on services other than AMTS would not constitute an offence against Commonwealth law.

Regarding relevant State legislation, I understand that the New South Wales Government is planning to legislate against the use of devices for bugging. However, as my knowledge of the subject at this stage is limited to what I have seen in the media, it is not clear to me how such legislation would affect the interception of radiocommunications.

M. R. Ramsay
First Assistant Secretary,
Radio Frequency Management Division

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SELL: Series 5000 preamp and power amp, Blueprint. Black Monolith. T200 speakers, 150 WRMS, 400 W p-p. Aurex (Toshiba) deck, Dolby/Adres. Akai turntable, direct drive, quartz lock and Ortofon Concord cartridge. All new with warranties, reasonable offer. (02)646-4662.

MISCELLANEOUS

WANTED: ONE job. I am currently doing the COT (electronics) at Boxhill TAFE. I am enthusiastic to learn. G. Anastasi, 37 Churchill Way, Kilsyth Vic. (03)723-1988.

WANTED: TALKING ELECTRONICS Nos 3, 6, 7, 8 and 9. Will buy or swap magazines for same. Sell DX160 speaker, $10. T. Dodsworth, P.O. Box 917, Ingham Qld 4850.

CRYSTAL OVENS: SIEMENS, two only, 100 kHz, ex ABC, valve. One fixed output, $55, the other variable output, $75. Mark (02)816-1498 bh.

FOR SALE: 103 assorted new and near new TV valves, approx. value $300, including popular EHT valves, sell for $95 ono. C. Chapman, 15 Merinda Cres, Kooringal NSW 2650. (069)22-4305.

SELL: PAST issues of ETI, EA, WW, PW and PE. Over 250 magazines, Kevin Wilson, P.O. Box 208, Applecross WA 6153. (09)364-2843 ah or (09)420-6901 bh.

FOR SALE: LOW LOSS coax cable, RG34, black, 16 mm dia, loss 1.4 dB/100 ft at 100 MHz, 300 ft drum, $100. Coax PT29M, 10 mm dia, 70 ohm 70 c/yd. VK2ASZ, 179 Rusden Rd, Blaxland NSW 2774.

COMMUNICATIONS

FOR SALE: CREED 7B teleprinter with loop supply, manual, supplies, etc, 240 Vac. Can deliver to city, VGC, $50. D. Hutchinson, 69 Bulla Rd, Bulla Vic. 3047. (03)307-1368.

FOR SALE: FREQUENCY meter, 1 GHz, ETI. Built and tested by professional engineer, modified and improved, $250 ono. A. Lay, 44 Swales St, Mundingburra Qld 4812.

WANTED: TELETYPE Model 15 or ASR33. E. Plunkett, Hill St, Eugowra NSW 2806. (068)59-2472.

FOR SALE: TWO No. 14 teleprinters, one three-head TD sender, $40. Teletype power supplies contain 240/115 V, 400 W transformer, swinging choke, etc, $10. VK2ASZ, 179 Rusden Rd, Blaxland NSW 2774.

FOR SALE: STEEL tower, self supporting, 15 ft at base, 70 ft high, brand new in box, ready to assemble, ex DCA with plans, $1200 ono. VK2ASZ, 179 Rusden Rd, Blaxland NSW 2774.

FOR SALE: NATIONAL DR-31 SW/MW/FM receiver, only 16 months old. Bargain at $240. John (03)363-7773 ah.

COMPUTERS

FOR SALE: DGZ80, S100, 32K, PCG, documentation, Software: Dissem Edtassem, games, level II BASIC (ROM). Card case (10-slot), PSU, fan, STD keyboard, $700 ono. Michael (002)44-4148.

WANTED: SYM-1 with monitor 1.0 or 1.1, working or not. Write Glenn Dabrera, c/- 8/11 Walsh St, Ormond Vic. 3163. (03)578-9045.

WANTED: MISCELLANEOUS and game programs to suit Commodore Vic-20. M. Kenshaw, 4/141 Hotham St, Saint Kilda East Vic. 3183.

MICROBEE: 32K, EDASM, Wordbee, Ritron monitor, Sharp cassette player. Heaps of games, etc, on tape, $650 ono. Andy Hardy (045)70-2184 bh.

MICROBEE: MYTEK Machine Code and BASIC tutorials. Brand new and still in original packaging. Works on pre-IC models only. $12.50 each. (02)713-9473 ah.

FOR SALE: PRINTER for TRS80-PC1 and Sharp PC1211 pocket computer. All the accessories included, $95. Frank Rees, 27 King St, Boort Vic. 3537.

WANTED: DGZ80 CPU board. Terry Smith, Lot 77, Jeffrey Ave, St Clair NSW 2232. (02)670-4110.

COMPUTER TERMINAL: GE Terminet 30" with paper and magnetic tape accessories. Photos and specifications available, $1500. H. Johnson, 47 Wahroonga Rd, Kanwal NSW 2259. (043)53-2274 bh.

SELL: ZX81 as new, leads, manual, 1.2 A power pack, tapes etc. Also 16K RAM pack, $80. Many constructional projects. Write to F. Papadopoulos, 13 Kroombit St, Dulwich Hill NSW 2203.

FOR SALE: 8" floppy disk drive, single sided. No controller, box or power supply. Ex IBM370 Microcode loader, $150 ono. Stever (03)573-2266 bh.

SELL: ETI-660, colour, 3K modulator, hex-keyboard, transformer, step-repeat function, cassette software, fibreglass case, $120 ono. TV game, two cartridges, joystocks, $20. M. Samerski (02)542-1365.

MICROBEE: FOUR reel poker machine plus free copy of Battleships, only $9.95 plus $1 postage. Send mail order to David Peters, 190 Bourke Rd, Umina NSW 2257.

VIC-20 COMPUTER: Excellent condition, great games machine and home computer, still in box, $240. Mr Begg (08)31-0310 after 5 pm.

ACT VIC-20 bimonthly magazine: Many interesting articles and programs. December issue $1.50. Bimonthly $8 per year. Write to Chris Groenhout, 25 Kerferd St, Watson ACT 2602.

NORTH STAR HORIZON: Z80A, 64K RAM, two 340K disks, 12-slot S100 motherboard, two serial, parallel ports, considerable software, perfect condition, $3300 ono. (07)30-1460.

SELL: ETI-660, 8K RAM, case, articles, programs, cassette included, $100. (03)743-5129.

FOR SALE: EXIDY SORCERER computer, 56K RAM, two disk drives, 610K storage, word processor and heaps of software. Must sell, only $1800. Many extras. Tony (02)449-4163 after 6 pm.

FOR SALE: MEMORY board, S100 buss, 16K static RAM with manuals, $115. Gordon (07)369-8013.

WANTED: 8" disk drives, either one or two with power supply. Prefer SS SD but will consider better drives. Paul Shields, 2/39 SMQ, Dampier WA 6713. (091)83-1724 ah or (091)83-1000 bh.

FOR SALE: PRINTER terminal, GE Terminet 30, with magnetic tape accessory, little used, excellent condition, $350 ono. (043)92-6838.

FOR SALE: ZX81 software, ZX Monopoly (two players), $12 Tape copier, $9. Shape table plotter, $9. The lot, $25. N. Kefford, 120 Church St, Yass NSW 2582.

DREGS

NOW THE STORY can be told. Now, that is, since David Tilbrook is no longer here to look over the Dregs editor's shoulder and censor what I am about to divulge.

Just so you all know who I'm talking about, that's him below.

As has been our practice over many years, when the engineers needed a few tools and components for the project laboratory from time to time, they would go out and purchase their requirements, submitting the store's docket to our Accounts Department along with a Petty Cash Claim form for a refund of the amount spent. Standard business practice.

Every now and then some pretty substantial purchases were made (to an accountant, any purchase over $10 is 'substantial'). As is their wont, the Accounts Department would occasionally send someone down to the ETI lab to query randomly chosen claim dockets. Fair enough I suppose, accountants can't really be expected to know or understand a docket that says "10 x SC141, 30 x 100k/5%, 6 x 4011BE . . . etc". It would be duly explained, the objects paraded for viewing and the delegated Accounts Department person would go away with a quizzical facial expression, mollified, but believing.

Then, one day, an Accounts Department person who had never previously been delegated the job, wandered into ETI's office area with a docket in hand, with a very puzzled expression, and enquired who might be the David Tilbrook person who had submitted the docket in question. Said Accounts Department person was pointed toward David Tilbrook who happened to be standing nearby.

Accounts Dept. person's expression turned from one of puzzlement to *thunderous disbelief* on sighting the famous D.T.

"What seems to be the problem?", David enquired in his characteristic gentle manner.

"What are *you* doing putting in a claim for a *hair dryer*?", blurted out Accounts Depart. person!

Amid the uproar of mirth that swept the office, much to the embarrassment of Accounts Dept. person, David, in his characteristic calm, logical manner, explained:

"It's for drying pc boards after they've been etched."

Accounts Department person slunk out amid hoots, laughter and general chyacking.

We haven't had a visit from them since.

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

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

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

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Ladies and gentlemen, be seated. (While you tune your rec

The best place to tune your receiver is where you listen to it, sitting down.

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South Melbourne, Vic 3205.

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