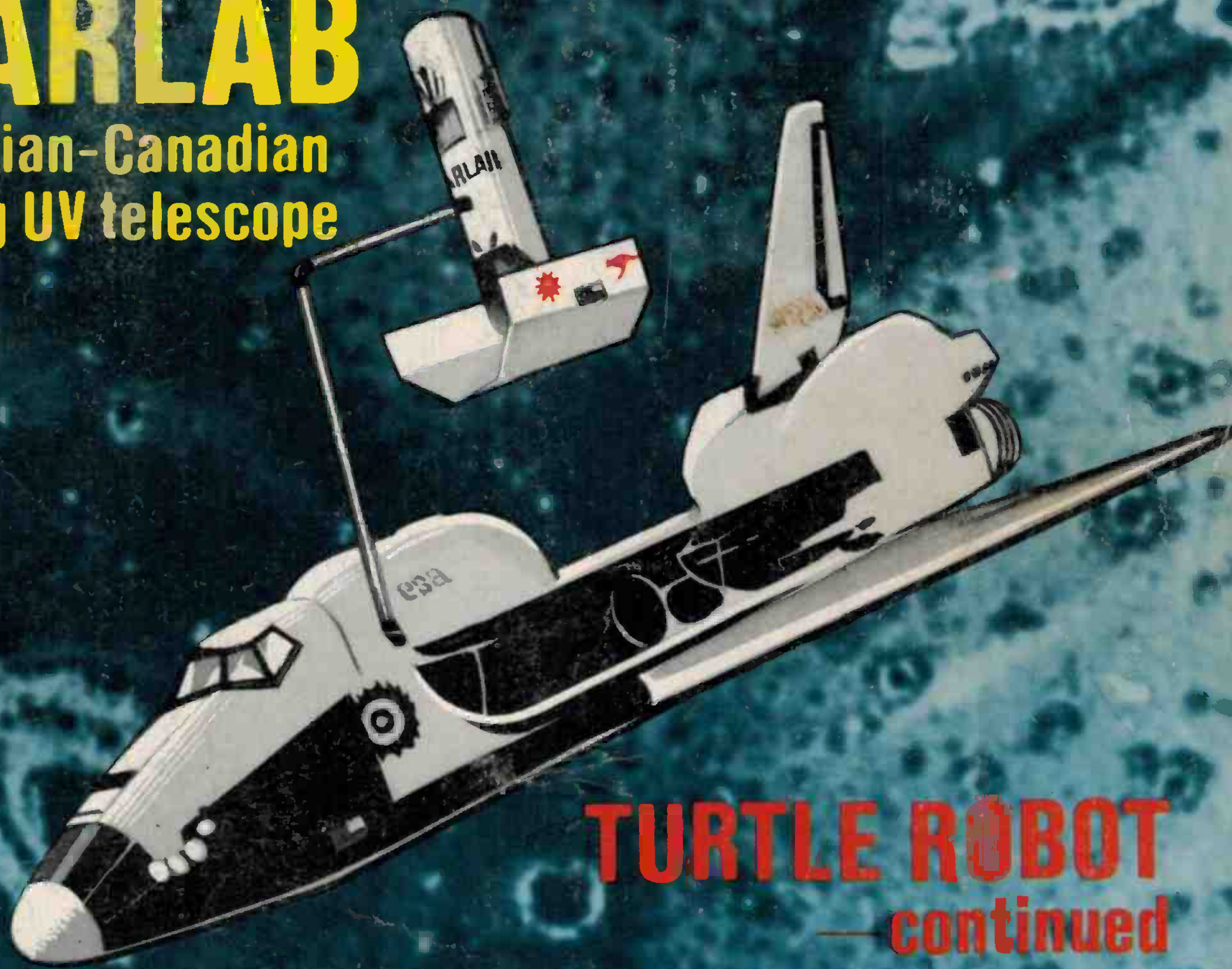
MAY 1982 $2.15* NZ $2.50

eti ELECTRONICS TODAY INTERNATIONAL

STARLAB

Australian-Canadian orbiting UV telescope



TURTLE ROBOT

—continued

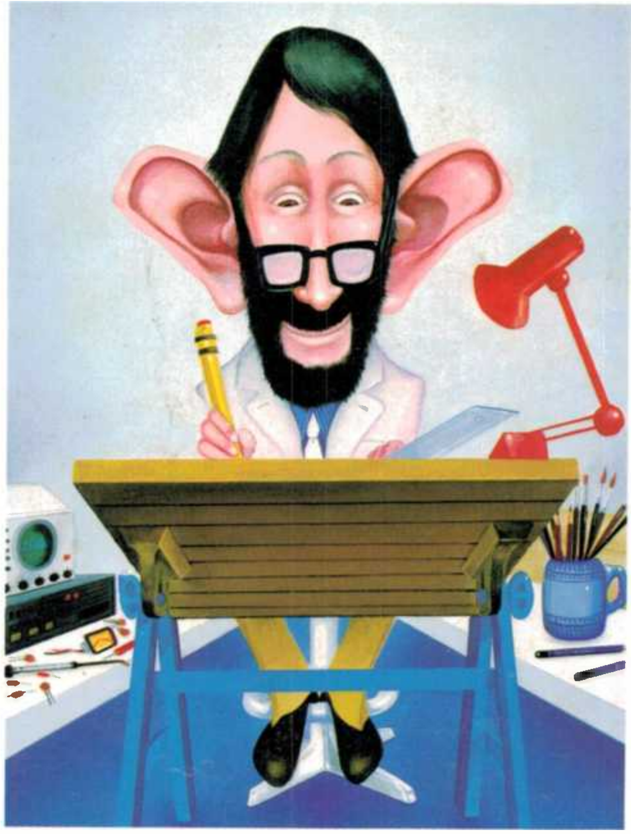
Improved text display on VDUs

NAD 6150C cassette deck reviewed

Low cost microcomputer keyboard to build

50 memberships to AUSTRALIAN BEGINNING to win!

The average hi-fi designer versus the human ear.



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

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

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

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

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

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

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

High Fidelity states "a receiver with such sophisticated performance and functions demands attention."

Popular Electronics on the Vector VCX 600 cassette deck, "Lower Flutter readings than those of the VCX 600 are hard to find... while not cheap, it affords excellent value."

Hi-Fi Buyer's Review sums up.

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

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

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

Name ______________________

Address ______________________

______________________ Postcode __________

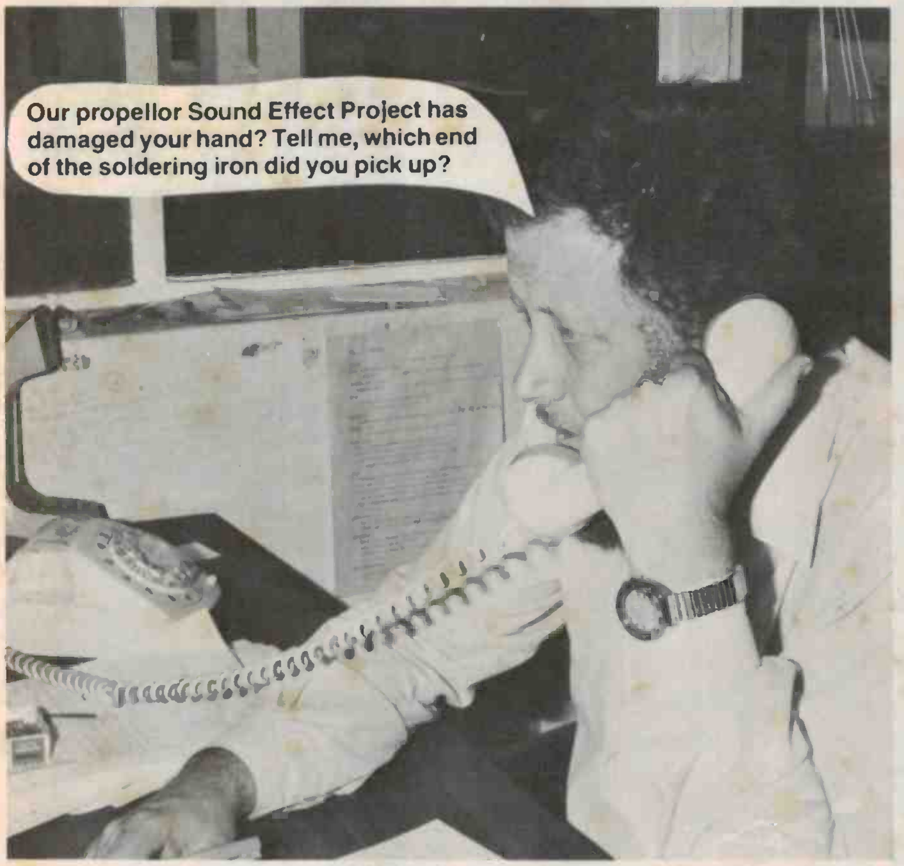
Keio International Pty. Ltd.
198 Normanby Road, South Melbourne 3205.
Telephone: (03) 64 3546.

KO 404 ETI

Vector Research. A fraction better than excellent.

Registered by Australia Post — Publication No. NBP0407
ISSN No. 0013-5216

ELECTRONICS TODAY INTERNATIONAL



Roger Harrison
Editor

QUICK INDEX

FEATURES

PROJECTS & TECHNICAL

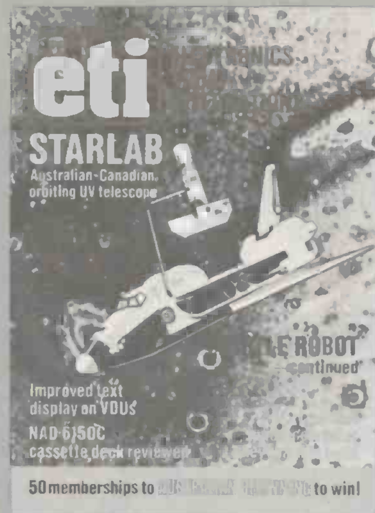
COMPUTING TODAY

SIGHT & SOUND

GENERAL

advertisers

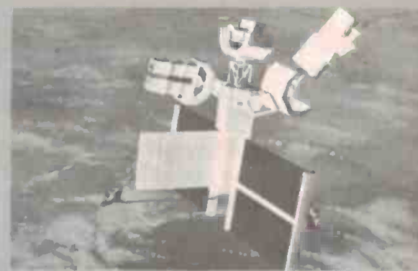
eti ELECTRONICS TODAY INTERNATIONAL



Will Australian science be allowed the chance to enter the 21st century? The Starlab project may be our last chance — but the Federal Government has to come up with the money. Jon Fairall gives a rundown on the project and the aspirations of those behind it.

*Recommended retail price only

features



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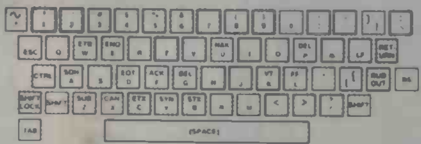
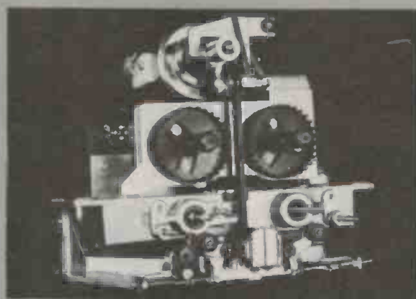


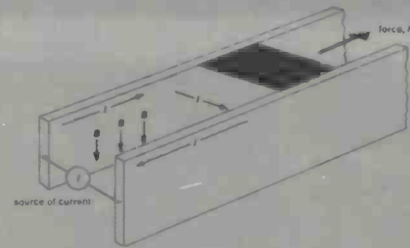
computing

sight & sound



general

next month



MACRON ACCELERATORS

Or 'How to Make Things Move Very Fast'. Elementary particle accelerators routinely produce atomic particles with velocities approaching the speed of light. Written by a US authority, Michael N. Kreisler, Professor of Physics at the University of Massachetts, making small bits of 'real' matter go very fast is the subject of this article. The Macron accelerator may eventually make energy available for use in a wide range of applications, including controlled thermonuclear fusion.

EMERGENCY LIGHT AND POWER

Don't sit glumly in the dark when the blackouts come! We have a project to power two 20 W fluorescent tubes and an article on how to provide emergency power. Even if the blackouts don't come portable 12 Vdc operated lighting comes in handy when working on vehicles, camping, prawning etc.

ETI-498 PA AMPLIFIER

Held over to ensure parts availability, this project is built around the ETI-499 150 W MOSFET module (March issue). A preamp is described along with complete construction, housing and use. The output will drive 70 V or 100 V lines for horn PA speaker systems, or conventional 4 ohm loads. The preamp includes a compressor and has provision for two mic inputs, a line input and an 'insert' input for a howlround stabiliser or graphic equaliser for feedback control.

USING APPLE GRAPHICS

The popular Apple II has three display modes. Here's a comprehensive article on how to make the most of them, plus a graphics character table.

MORE '660 SOFTWARE

Try your skill with a 'space dogfight'. This program has some interesting routines which CHIP-8 hackers will no doubt latch onto for future use.

TURTLE ROBOT — GET GOING!

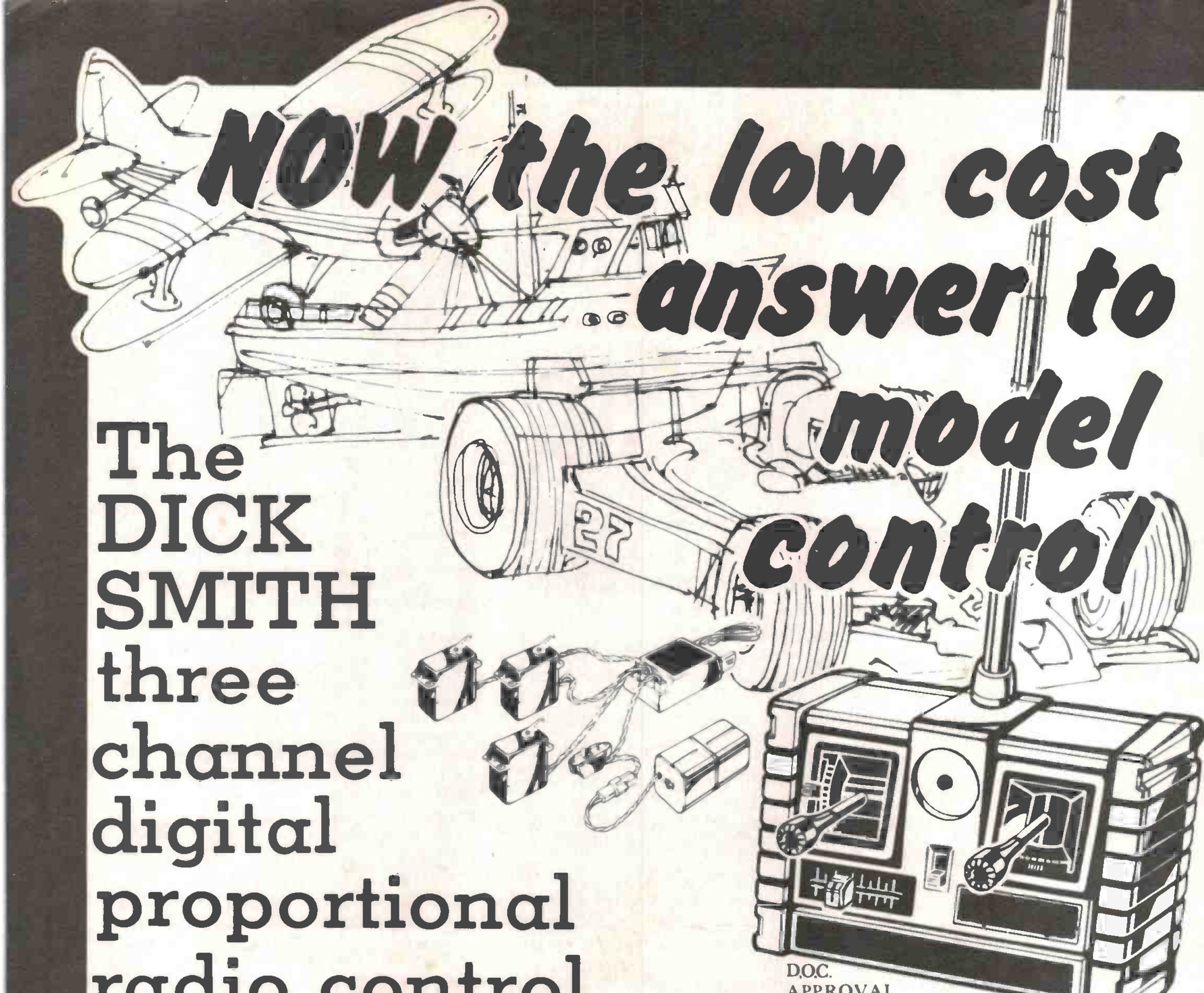
Powering up the Turtle and getting it mobile! From here on in you have a real live robot at your command!

PIONEER A8 AMPLIFIER REVIEW

". . . ignoring the frills, however, the A8 has one major virtue — the quality of the sound it can produce." And that, after all, is the bottom line in hi-fi. Louis Challis thinks this is one amplifier whose technical performance would be very hard to beat.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

NOW the low cost answer to model control



D.O.C.
APPROVAL
NO. 195003

The DICK SMITH three channel digital proportional radio control

Imagine! A fully digital proportional 3 channel radio control system for under $100.00! Compare elsewhere at $150 and more ....
This outstanding system features three individually controlled channels, with 'trim' offset controls. Two channels are joystick controlled, the third a slider control (ideal for throttle, etc.)

- Complete with receiver, battery holder and three servos (spare battery holders and servos available so you aren't tied to just one model!)
- Ideal for models of all types: boats, planes, vehicles, etc.
- Top range transmitter and ultra-sensitive receiver
- Crystals are changeable for different operating frequencies
- Requires 10 pen light cells. Cat. S-3003: 22 cents each

GET INTO RADIO CONTROL MODELS NOW!

A MASTERPIECE IN STATE-OF-THE-ART RADIO TECHNOLOGY

AVAILABLE SOON: 4 channel radio control. Cat Y-1240. $149.50.
See your local store for availability and further details.

Complete with transmitter; receiver; battery holder; 3 servos

DICK BREAKS $100 BARRIER

only $99

Cat Y-1230 P&P $4

DSE/A182/PA1

DICK SMITH Electronics

SEE OUR ADDRESS PAGE FOR FULL ADDRESS DETAILS

THE MAGIC OF HOLOGRAPHY!

Holography...the creation of amazing three-dimensional images which float in space.
A limited number of stunning holograms produced by some of the world's top holographers is now available in Australia.
Discovered in 1947 by Professor Dennis Gabor, holography gained for him the 1971 Nobel Prize for Physics.
This special selection has been brought together by the organisers of the popular SpaceLight Holography and Laser Spectacular exhibition which is currently touring Australia and which will be seen by 250,000 people in 1982. The following holograms are now available:

Pendant Holograms
Special jewellery holograms with incredible depth and beautiful opalescent colours. Measuring 38mm in diameter they are available in gilt or silver coloured mountings, as key rings or necklaces ($29.95).

Reflection Holograms
Sophisticated glass holograms fully visible in sunlight or ordinary household light. Mounted on special Designer plexiglass tilt frames. ($125-195) (125mm x 100mm).

Smaller Reflection Holograms
White light holograms of Venus & Atlas, so true to life you can almost touch the marble. Unframed ($49.95) (75mm x 70mm).

Embossed Holograms
New embossing process creates colourful aluminium holograms with mass appeal. Framed for immediate viewing ($27.95) (160mm x 160mm).

SpaceVisors
Brilliantly designed space-age diffraction goggles. Break up the light into rainbow colours ($7.95 & $5.95).

SpaceLight Book
Specially published for the Australian tour of the SpaceLight Holography and Laser Spectacular exhibition, this lavishly illustrated book provides detailed information on the science and the art of holography and lasers. Written by Paul Walton, Director, SpaceLight exhibition ($6.95)

		Number	Price	Total
Pendant Holograms Keyring ☐ or necklace ☐ Gold ☐ or silver ☐	The Eye	____	$29.95	____
	Dice	____	$29.95	____
	Dolphin	____	$29.95	____
	King Tutankhamun	____	$29.95	____
	Egyptian Pyramid	____	$29.95	____
Reflection Holograms	Saturn 125 x 100mm	____	$125.00	____
	Cocaine Implements 125 x 85mm	____	$125.00	____
	Train 125 x 100mm	____	$195.00	____
	Venus 75 x 50mm	____	$49.95	____
	Atlas 75 x 50mm	____	$49.95	____
Embossed Holograms	(all 160 x 160mm)			
	Wire Hands	____	$27.95	____
	Heart & Shell	____	$27.95	____
	Skull & Rocks	____	$27.95	____
SpaceVisors	Metallised	____	$7.95	____
	Black	____	$4.95	____
	White	____	$4.95	____
SpaceLight Book		____	$6.95	____
			Total:	____

Please post to:
SpaceLight Holographic Products
PO Box 870
Darlinghurst NSW 2010

Enclosed please find:
Cheque/money order for $______
I prefer to pay by Bankcard. Please charge my account for $______
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Expiry date___/___/___
Signature______________________

NAME______________________
ADDRESS______________________
______________________ POSTCODE ______
TELEPHONE (   ) ______________________
Please send me details of other available limited edition art and scientific holograms ☐

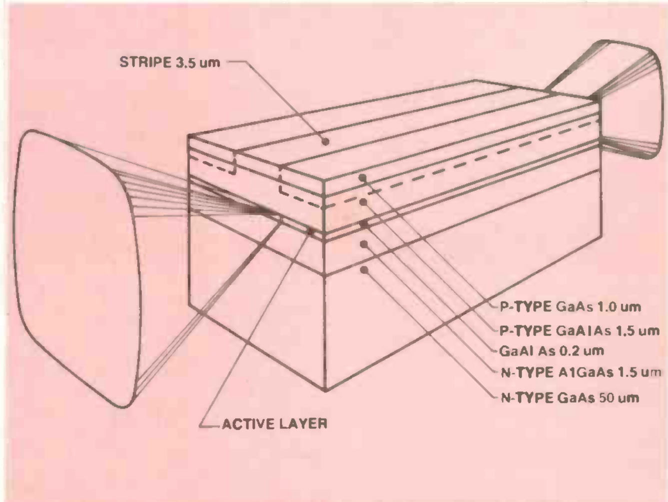
FREE OFFER

All orders over $30 receive free of charge a copy of the limited circulation poster for the popular SpaceLight exhibition.

NEWS digest

Semiconductor laser for video and audio work

A new type of gallium-aluminium-arsenide (GaAlAs) semiconductor laser diode developed by the Philips Research Laboratories in Holland is said to be easy to manufacture and to provide stable, low-noise operation. It is especially suitable for videodisc recording, audio disc readout and optical fibre telecommunications, say Philips.



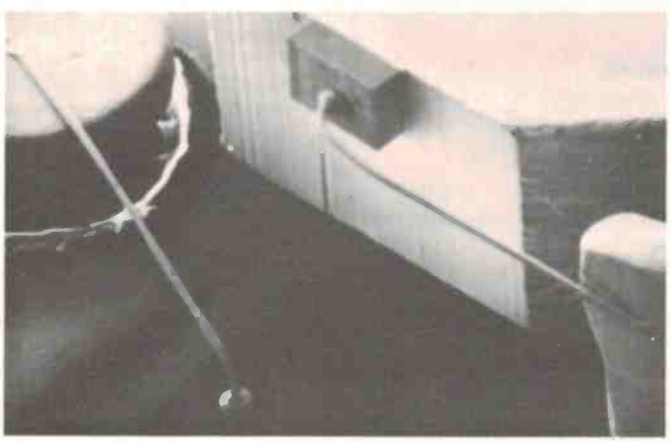
Philips' new laser diode for audio and video uses.

This new diode can operate at the short wavelength required for readout from LaserVision videodiscs and from Compact Disc digital audio discs. Further, the geometry of the laser beam can remain stable for nanosecond pulses of power in the 50 mW range, which is required for optical recording.

As indicated in the figure, this diode consists of a single gallium arsenide substrate carrying a number of layers of the same material in which some of the gallium atoms have been replaced by aluminium. Laser action occurs in a thin active layer when light photons generated by the recombination of positive and negative charge carriers injected into this layer from opposite sides are reflected repeatedly through the layer by end mirrors. The layers above and below the active layer have a rather lower refractive index for the light concerned than the active layer and therefore tend to confine it to the active layer, like a waveguide confines waves.

The light is confined laterally by the use of a narrow strip or stripe by increasing the resistivity of the material outside the stripe region using an ion-bombardment technique. Philips keep the stripe width in their new laser diodes down to 3 to 4 um, and the end mirrors are protected by a special coating. The laser element is mounted on a copper heatsink, which has a reference surface for the positioning of the laser beam without further adjustment.

A photodiode mounted beneath the laser can be used for monitoring the radiation from the rear mirror. The devices provide good noise characteristics even after prolonged operation at high temperatures. Let's hope this development will speed the Philips LaserVision system into wider use!


Internal view of the new diode, showing connections.

ILP Electronics expands range

ILP Electronics of Canterbury, England, who manufacture and distribute a wide range of audio modules for home electronics enthusiasts, recently announced several new additions to their product line.

The new modules are:
- two hi-fi preamplifiers
- a guitar preamplifier
- a stereo mixer
- a stereo headphone driver
- a mono VU meter.

All these modules are cross-compatible with ILP's other audio units, making it possible for home hi-fi enthusiasts to create almost any audio system they choose.

The new HY 73 guitar preamp, together with the recently released HD heavy duty power amps, takes ILP into the disco and live music market. It provides inputs for two guitars (bass and lead), plus microphone, and has facilities for separate volume, bass and treble controls and for the use of a mixer.

Also newly launched are the HY 72 voice-operated stereo fader for disco work, and the HY 13 VU meter. The HY 12 mono preamp is also a mixer, mixing two signals into one with facilities for separate bass, midrange and treble controls.

ILP Electronics will continue to expand its range of audio modules, but also expects to move into other areas, notably the CB market.

ILP transformers, particularly the toroidal transformer range, are used extensively in the electronics trade, largely because recently installed machinery at ILP's Canterbury factory has made this product more cost effective than most others. ILP is also a significant export earner for Britain, with 60% of sales going overseas.

The Australian distributors for ILP Electronics are G&H Electronics, 256 Stirling St, Perth, and Electromark Pty Ltd, 40 Barry Ave, Nortdale NSW 2223.

Batteries you can use over 500 times!

Sanyo Australia has just released a range of rechargeable batteries which offer a service life far in excess of the best conventional alkaline dry cell types available on the market today. They are available in three popular sizes — N-1U (D size), N-2U (C size) and N-3U (AA size).

In addition to their long life, Cadnica batteries are capable of being recharged more than 500 times with a small, convenient and simple to use recharger. Simply slip batteries into the recharger and plug in to any power point; recharging time is between 14 to 16 hours.

Cadnica rechargeable batteries can be used in place of conventional dry cells of the same size, yet are said to offer a number of advantages apart from their ability to be used hundreds of times. They are extremely suitable for appliances and equipment which perform better with a constant discharge voltage. The discharge voltage of Cadnica cells remains constant for about 90% of the discharge period.

Sanyo's Cadnica batteries are also claimed to be resistant to impact and vibration, and their hermetically sealed case eliminates damage due to electrolytic leakage. They are also less affected by changes in ambient temperature, and are capable of maintaining high performance over a wide temperature range with high levels of humidity.

Sanyo 'Cadnica' rechargeable nickel cadmium batteries are available now from electrical retailers throughout Australia, and from Sanyo service centres. Recommended retail prices for batteries are: N-1U (D size) — $12.50 for two; N-2U (C size) — $12 for two; N-3U (AA size) — $12.50.

Model NC 452 recharger is designed to charge four N-3U (AA size) batteries, and has a recommended retail price of $12. The NC 1230 recharger has been designed so that all three standard battery sizes can be accepted. It has a recommended retail price of $19.95.

For further information contact Mr.W. Fabiszewski, Sanyo Australia Pty Ltd. 225 Miller Street, North Sydney NSW 2060. (02)436-1122.

Data on videotape

Two channels of analogue data plus sound and vision can be recorded on normal videotape using a new unit available from Selbys Scientific Ltd of Melbourne.

Called the BioVideograph BV2 and manufactured in the United Kingdom by BioScience, it will be of use where it is necessary to monitor and record combined visual and analogue data on one tape and in synchronisation.

On playback, the sound and vision are reproduced in the normal way on a monitor and the analogue data signals can be fed to most types of ac or dc measuring instruments such as oscillographs and chart recorders.

A typical use would be for recording the rate of burning of welding rods correlated to temperature. Other applications involving parameters such as flow, strain, pressure, vibration and so forth can be readily fulfilled.

The unit is compatible with most U-Matic videotape recorders of the PAL, NTSC and SECAM types. It is supplied with all the necessary accessories and a calibration instruction videocassette.

More information is obtainable from Selbys Scientific Ltd, 352-368 Ferntree Gully Rd, Notting Hill, Melbourne Vic. (P.O. Box 11, Oakleigh Vic.)

Replacement for the VN10KM VMOS FET

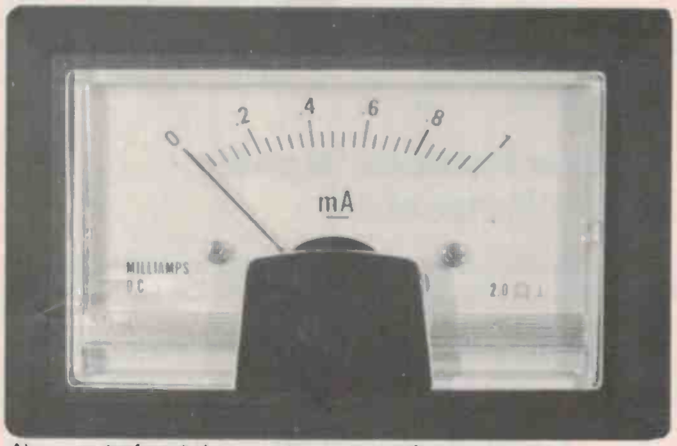
Supertex now has available a direct pin-for-pin replacement of Siliconix part no. VN10KM. Typical applications for this device include Telecom switches, relay/solenoid drivers, hammer drivers and dc stepper motor drivers. It is compatible with TTL/CMOS to high voltage interfaces.

Supertex can supply up to 100 000 pieces per month of this industry-standard VMOS part in TO92 packaging. The VN10KM features 60 V breakdown, 5 ohms on resistances (max.) and typical switching speeds of 10 ns.

For quantities of 100 or more, the VN10KM replacement costs $0.51. Samples are obtainable direct from Supertex. Contact Rich Siegel, Supertex Inc, 1225 Bordeaux Drive, Sunnyvale CA 94086. (408)744-0100.

New panel meter eliminates big problem

The BIG problem with panel meters is the necessity to drill or cut a BIG hole in the panel to which it mounts. A new meter solves that BIG problem!



Above: meter face; below: top view and mounting components.

Distributed by South Australian-based Electronic Components and Equipment, the meter only requires drilling three 3 mm holes — two for mounting screws and one for the meter leads to pass through.

The meter is available in a 1 mA, 2% class movement at present, but should shortly be available in a 5 A (internal shunt) range, 15 V and VU movement (yellow — A scale). All are 2% accuracy.

The 1 mA movement is retailing at $8.33, the 5 A and 15 V movements will be about $8.90 and the VU meter around $10 or so — all prices plus tax. The 1 mA movements are currently obtainable from Radio Despatch Service in Sydney and Stewart Electronics in Melbourne.

Further details from Electronic Components and Equipment, 64 Sturt St, Adelaide SA 5000. (08)212-5999.

New head for CSIRO Institute

A leader in industrial research and development in Australia, Dr. W.J. (Bill) Whitton, is to head CSIRO's Institute of Industrial Technology. His appointment as Director of the Institute for a five-year term was announced recently by the Chairman of CSIRO, Dr. J. Paul Wild.

"Dr. Whitton, the Research and Technology Director of ICI Australia Ltd, has had wide experience in the application of research to industry in Australia," Dr. Wild said. "At ICI, for example, he played an important role in guiding the company through a significant phase of innovation in the Australian chemical industry.

"He has also made significant contributions to industrial research and development in Australia through his involvement in the Academy of Technological Sciences, the Consultative Committee on Research for Development, as a past President of the Australian Industrial Research Group, various university faculties, and many other national bodies.

"He will bring to the Institute Director's role a strong background in both management and the role of research aimed at increasing the efficiency and competitiveness of Australian industry."

Dr. Whitton will retire from ICI Australia Ltd early in 1982. He will succeed the Institute's present Director, Dr. Hill W. Worner, who will retire in May 1982.

The CSIRO Institute of Industrial Technology is one of five research institutions within CSIRO, which between them comprise 40 research divisions and units. The divisions within the Institute of Industrial Technology are those of Applied Organic Chemistry, Building Research, Chemical Technology, Manufacturing Technology, Protein Chemistry, Textile Industry, and Textile Physics. An agricultural engineering group is also part of the Institute.

Soanar handles Stanley opto-electronics

Soanar Electronics Pty Ltd were recently appointed Australian distributor for the Stanley Electric Co Ltd of Tokyo, Japan.

Stanley Electric Co Ltd recently completed 60 years of business, during which time they have grown from a small trading firm manufacturing automobile light bulbs to one of the leaders in Japan's automotive lighting and related electronics industry.

A policy of research, development and diversification resulted in the full-scale production of semiconductors and associated electronic components in 1960, and by 1967 Stanley had developed the first high intensity light-emitting diodes (LEDs). They now manufacture the world's brightest LEDs in red, yellow, green, amber and infrared.

They have also been instrumental in developing new applications for LEDs, which are now being used in cameras, audio equipment, computers, automobiles, measuring instruments and communication equipment. In addition, they have just completed preparations for the production of coloured LCDs (Liquid Crystal Displays) in alphanumeric and graphic form.

Soanar will be marketing the full range of Stanley high intensity LEDs together with a comprehensive range of seven-segment displays in both LED and LCD types.

Enquiries should be directed to Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill Vic. 3128. (03)840-1222; telex 32286.

Soanar extend electrolytic ranges

Soanar Electronics Pty Ltd has extended its ranges of RBLL low leakage electrolytic and RG high capacitance electrolytic capacitors to cater for current demand.

The RBLL, previously only available in capacitances up to 100u, has had the values 200u, 330u and 470u added to the range.

The other highly popular electrolytic, the RG high capacitance can-type, has had its range extended to include 15 000u, 22 000u, 33 000u and 47 000u. This means that users of high capacity electrolytics now have a low-cost alternative to the high specification computer grade electrolytic, with only a marginal loss of performance. Cost differences can be as much as 50% in the majority of cases, resulting in significant savings.

Soanar have large stocks of RBLL low leakage, PW computer grade and RG can-type electrolytics at Soanar branches in all states, and can accept orders for ex-stock delivery. Information on the complete Soanar range of stock capacitors is available from Soanar Electronics Pty Ltd, 30 Lexton Road, Box Hill Vic. 3128. (03)840-1222.

New type of solar cells

The US Patent Office has granted coverage for a new type of solar cell that should reach efficiencies of close to 40 per cent. The patent was issued to Terry Chappell and Jerry Woodall, scientists at the IBM Watson Research Centre. This compares with maximum efficiencies of about 20 per cent in present silicon solar cells.

Patent 4 295 002 is titled 'Heterojunction V-groove Multijunction Solar Cell', and the cell is intended for solar energy systems in which the sun's light is concentrated by lenses or mirrors. This permits a large output of electricity from a small cell.

The high output is achieved by using several layers of carefully selected semiconductor materials, each of which strongly absorbs a different portion of the solar spectrum. The material choice and a novel electrical design produce high voltages — typically 70 volts per centimetre as compared to one or two in ordinary cells. This is important in concentrator systems because a high-voltage, low-current cell has lower electrical losses than the conventional low-voltage, high-current cell.

The different cell layers are isolated from each other electrically, so that the more efficient layers are not limited by the less efficient ones, and the maximum overall output is obtained.

IBM Research Highlights

HP note on persistence oscilloscope technology

A concise overview of variable persistence oscilloscope technology is covered in a new application note from Hewlett-Packard.

Application Note 314, with 10 drawings, diagrams and graphs, provides discussions on:

- Monitoring a microprocessor data buss line
- Comparing variable persistence scopes with digital storage and conventional oscilloscopes
- Step-by-step analysing of the storage process, erasure techniques and methods of achieving fast stored writing speed.

For further information contact Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn Vic. 3130. (03)89-6351. Branches in Adelaide 272-5911, Brisbane 229-1544, Perth 383-2188, Canberra 80-4244 and Sydney 887-1611, also in Auckland and Wellington, New Zealand.

CELEBRATION SA

THE CELEBRATION IS STILL GOING ON AT OUR NEW

drum SYNTHESISER KIT

Original design from the UK magazine "Electronics and Music Maker" April 1981. Self-contained unit produces a variety of fixed and falling pitch effects. Trigger by tapping the unit itself or by striking a drum to which the unit is attached. The Jaycar "SYNTOM" comes complete with high quality pre-drilled moulded all ABS box 152 x 80 x 47mm with professional silk-screened front panel.

FEATURES: Decay from less than 0.1 second to several seconds, pitch control, sweep control and volume on/off.

As used by WARREN CANN of "ULTRAVOX"

$36·50

FABULOUS "MOTOROLA"

Hi-Power Piezo Horn Tweeters. The almost universal choice in high power P.A. or HI-FI applications today

KSN 1005A 50WRMS 4KHz-40KHz ONLY $15.00

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quality motorola

1982 SHOWBAG

Once again, the response this year has been absolutely fantastic!

Also once again we completely ran-out long before demand was exhausted. If you missed out we apologise – please remember to ALWAYS order early when you see a great bargain like this.

EXPERIMENTER BREADBOARDS

We stock a great range of experimenter breadboards.

WB-TH – total 200 holes	$8.95
WB-2N – total 840 holes	$12.95
WB-4N – total 1680 holes	$24.50
WB-6N – total 2420 holes	$39.50

Speakers Slashed

High Power PA speakers slashed!!!!!

Well respected Plessy/Foster brand.

12" 50W rms C300K05

Normally $69.50
This month $39.50
SAVE $30.00

15" 240W rms C380K50

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Limited quantities

ETONE QUALITY

Remember! We have the best range of ETONE speakers in town – at the best prices.

Type No.	Size	Description	Power	Price
600	6"	Passive radiator	–	$18.50
605	6"	Midrange	120W(rms)	$32.00
608	6"	Woofer	80W(rms)	$34.55
108	10"	Woofer	50W(rms)	$35.00
518	12"	Woofer	100W(rms)	$49.00
		P.A. UNITS		
131	10"	Woofer	60W(rms)	$52.50
246	12"	Woofer, twin cone	100W(rms)	$79.00
267	12"	Woofer	150W(rms)	$133.00
801	15"	Woofer	200W(rms)	$218.00

WE ALSO CARRY HIGH POWER MIDRANGE AND HIGH FREQUENCY HORNS.

spring reverb

We have purchased a small quantity of high quality US-made spring reverb units. This 3-spring model is the one used in such amps as 'PEAVEY" etc. Grab a spare now or build a complete reverb system with free circuit supplied.

$34.50

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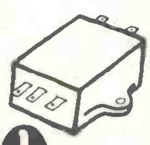

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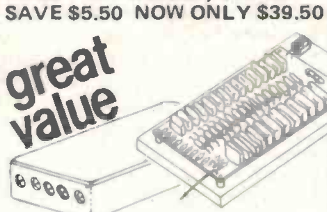

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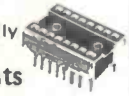

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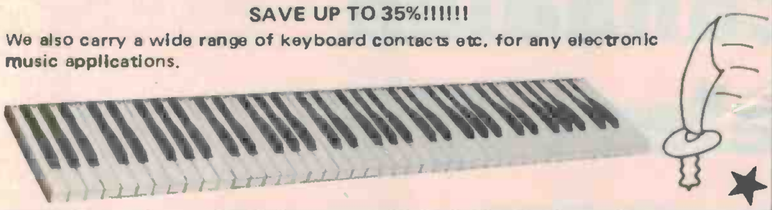

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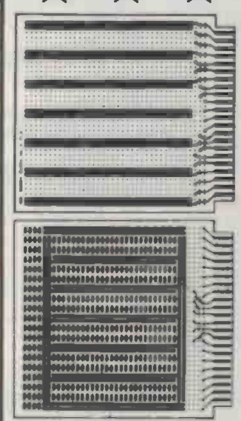

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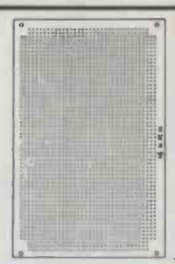

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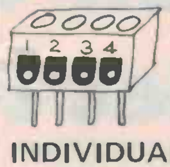

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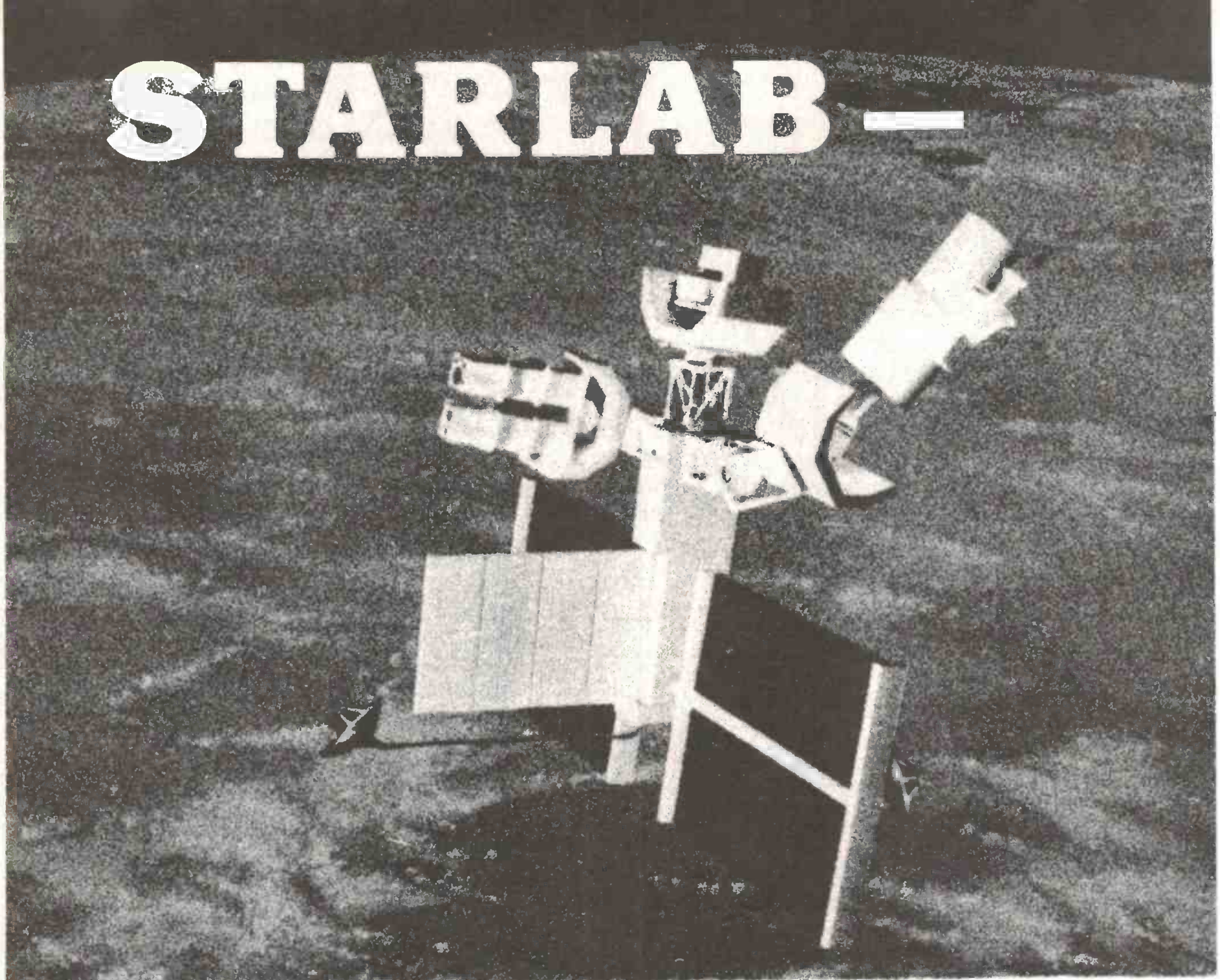


Artist's impression of Starlab (upper right) mounted on a 'space platform'.

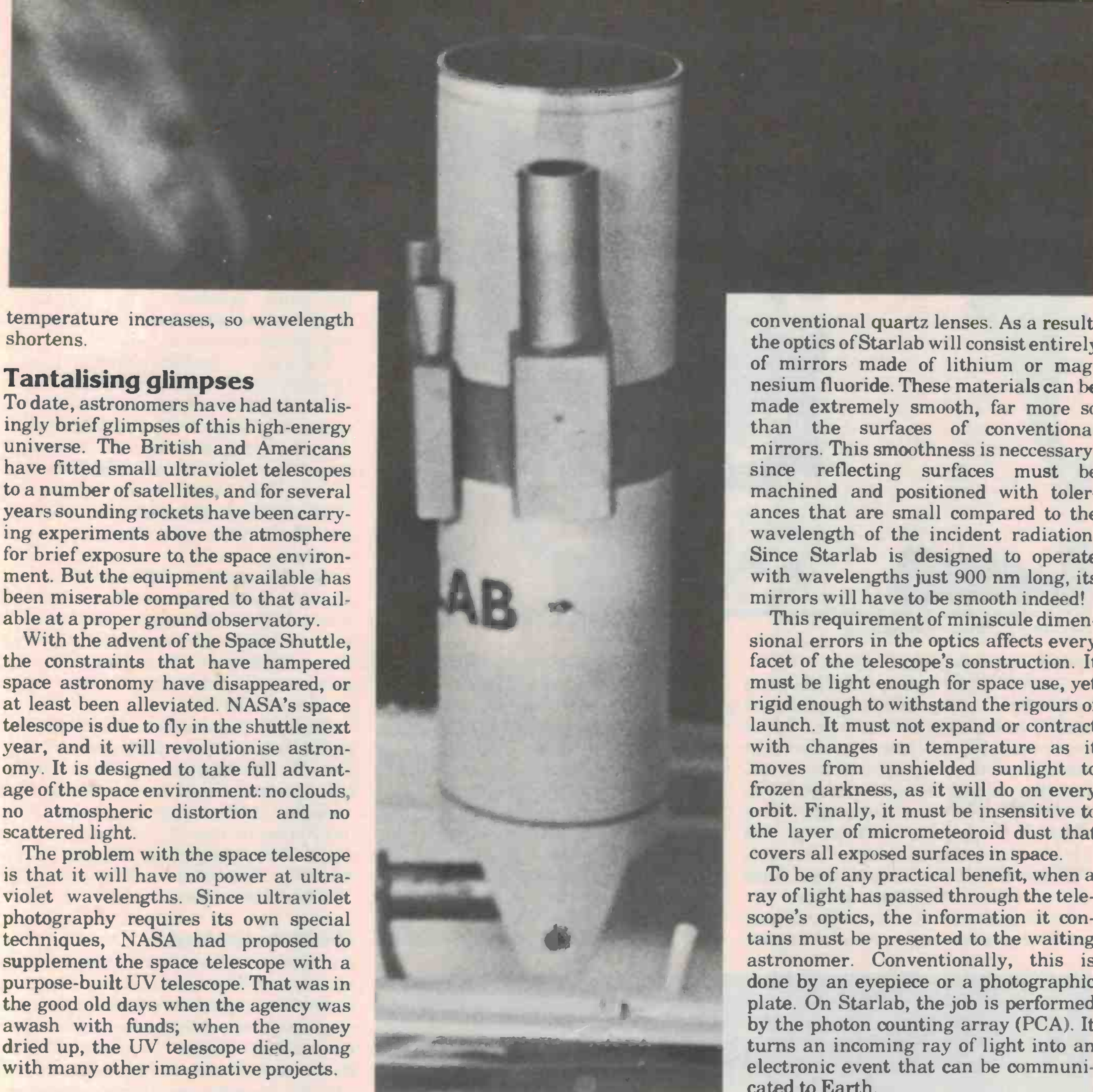
Australian-Canadian ultraviolet telescope

The Starlab project is likely to be the most exciting thing to happen to Australian science until well into the next century. It promises to revolutionise our knowledge of the universe, while at the same time assuring Australian astronomers a place in the front rank of world astronomy — providing the funds are made available.

Jon Fairall

ASTRONOMERS have been dreaming about telescopes above the atmosphere since the dawn of the space age. Free of weather and turbulence, space telescopes promise to allow observations of phenomenal accuracy and clarity. They open up the possibility of observing objects far too faint to be seen from the ground, and of observing those objects that broadcast most of their energy in the ultraviolet and X-ray portions of the electromagnetic spectrum. This part of the spectrum is invisible to us at the surface of the Earth because the atmosphere is opaque to the entire electromagnetic spectrum, except for 'windows' in the optical, infrared and radio portions of it.

The invisibility of ultraviolet sources has only recently become a problem in astronomy. The vast majority of stars broadcast at wavelengths near that of the Sun, and astronomers have had enough to do understanding these 'normal' stars. Increasingly, however, it is the atypical stars — stars of incredible densities, temperatures and turbulence, that interest astronomers. This is the realm of quasars, pulsars, neutron stars, and all the other exotica of modern astronomy. Substantially, this is an ultraviolet universe, since fundamental physical laws dictate that as



Model mock-up of the Starlab telescope.

temperature increases, so wavelength shortens.

Tantalising glimpses

To date, astronomers have had tantalisingly brief glimpses of this high-energy universe. The British and Americans have fitted small ultraviolet telescopes to a number of satellites, and for several years sounding rockets have been carrying experiments above the atmosphere for brief exposure to the space environment. But the equipment available has been miserable compared to that available at a proper ground observatory.

With the advent of the Space Shuttle, the constraints that have hampered space astronomy have disappeared, or at least been alleviated. NASA's space telescope is due to fly in the shuttle next year, and it will revolutionise astronomy. It is designed to take full advantage of the space environment: no clouds, no atmospheric distortion and no scattered light.

The problem with the space telescope is that it will have no power at ultraviolet wavelengths. Since ultraviolet photography requires its own special techniques, NASA had proposed to supplement the space telescope with a purpose-built UV telescope. That was in the good old days when the agency was awash with funds; when the money dried up, the UV telescope died, along with many other imaginative projects.

A golden opportunity

In 1979, Australian astronomers realised that a golden opportunity was lying around NASA's back door. The proposition was simple: if NASA could provide space in the shuttle, Australia would build the telescope.

By 1980 the specifications for the basic design were completed. The project had grown to include the Canadians, a highly sophisticated one-metre telescope, and a very state-of-the-art device called a Photon Counting Array (PCA).

During 1981, NASA and the Canadians managed to obtain funds for their parts in the project. Astronomers at the Australian National University, however, were still trying to convince the Federal Government that funds should be set aside for the construction of the Australian part of the project, the PCA. Plans at the moment call for all the research and development work to be completed by 1984. Building should commence soon afterwards and, if all goes well, the world's first large ultraviolet satellite will lift off from Cape Canaveral some time in 1989.

Although the physics of Starlab is well understood, building it will still be a complex operation. Much of the design will stretch the state of the art to the limits.

Design

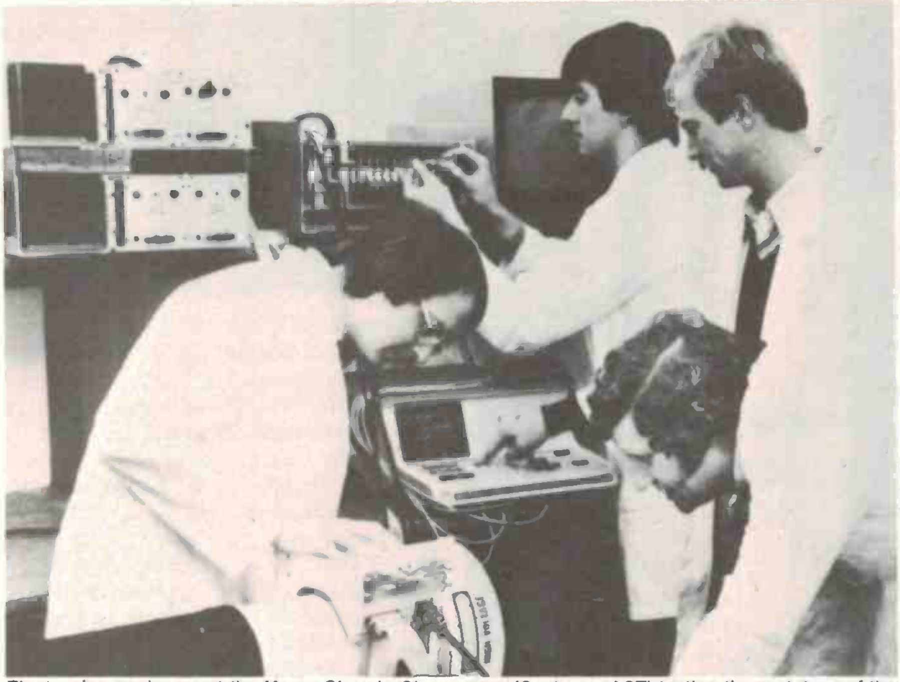
Ultraviolet light imposes special constraints on the design of a telescope. Because of the very short wavelength it is difficult to reflect ultraviolet waves, and impossible to refract them using conventional quartz lenses. As a result, the optics of Starlab will consist entirely of mirrors made of lithium or magnesium fluoride. These materials can be made extremely smooth, far more so than the surfaces of conventional mirrors. This smoothness is neccessary, since reflecting surfaces must be machined and positioned with tolerances that are small compared to the wavelength of the incident radiation. Since Starlab is designed to operate with wavelengths just 900 nm long, its mirrors will have to be smooth indeed!

This requirement of miniscule dimensional errors in the optics affects every facet of the telescope's construction. It must be light enough for space use, yet rigid enough to withstand the rigours of launch. It must not expand or contract with changes in temperature as it moves from unshielded sunlight to frozen darkness, as it will do on every orbit. Finally, it must be insensitive to the layer of micrometeoroid dust that covers all exposed surfaces in space.

To be of any practical benefit, when a ray of light has passed through the telescope's optics, the information it contains must be presented to the waiting astronomer. Conventionally, this is done by an eyepiece or a photographic plate. On Starlab, the job is performed by the photon counting array (PCA). It turns an incoming ray of light into an electronic event that can be communicated to Earth.

The first step in this process is to amplify the light. This is done in an image intensifier, which essentially consists of a plate covered with myraid holes 10 um across. Single photons of ultraviolet wavelength are admitted by these holes. A potential difference applied across the plate accelerates the photon onto a phosphor screen, causing a cascade of photons to fly off the other side. The process is effective enough to ensure that every incoming photon causes a million to be ejected from the screen.

This photon cascade is now ducted down fibre optics to an array of charged couple devices (CCD). A CCD is a device that will emit electrons when struck by photons. The current from the CCDs activates an on-board memory, which stores the information until directed to ▶



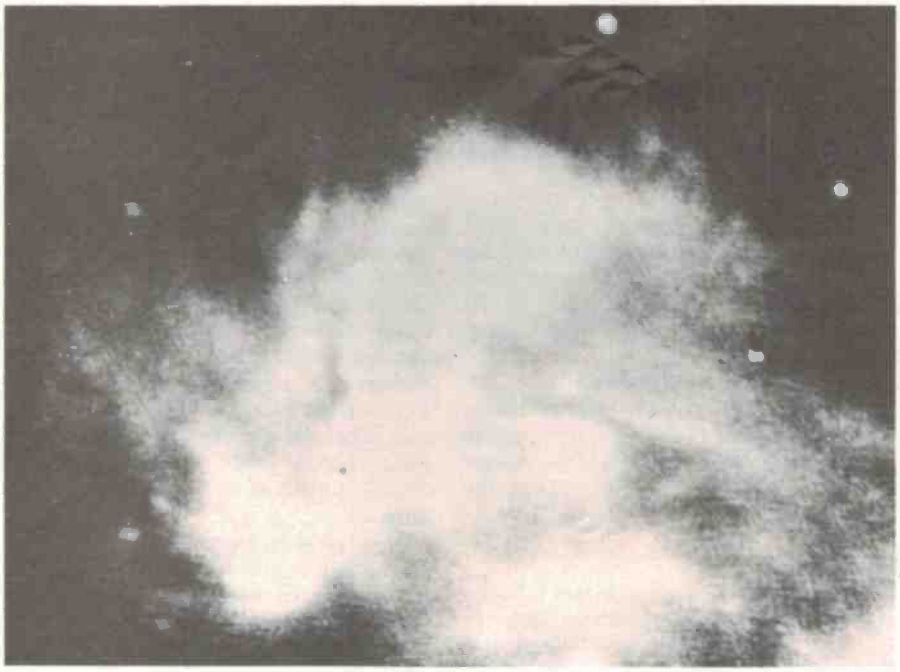
Electronics engineers at the Mount Stromlo Observatory (Canberra, ACT) testing the prototype of the large-format photon-counting array.

transmit it by a groundstation.

As with an audio amplifier, the main criterion by which a light amplifier is judged is its level of distortion. In the case of a light amp, however, what is at stake is not the shape of an input curve, but the position of input photons. The correct term for this is 'resolution'. It is defined in angular measure as the ability of an imaging system (telescope, PCA) to differentiate between two point sources (stars) very close together.

In Starlab's PCA, the stage of maximum distortion is the phosphor screen. We may expect that a single highly energetic photon will hit the screen in precisely the same relative position as it entered the system. However, the cascade that this impact causes will be widespread, and may be expected to illuminate a number of CCDs.

The solution is to statistically examine the distribution of the photon cascade across the CCDs. This has proved extremely effective experimentally, since the cascade is distributed symmetrically about the point of impact of the original photon. Using a statistical system like this, it is possible to make extremely fine distinctions in the visual field with only 43 CCDs.



N66, a nebulosity in the Small Magellanic Cloud, taken with the photon-counting array on the 1 m telescope at Siding Spring Observatory (near Coonabarabran, NSW).

The engineers and astronomers who are now designing the PCA for Starlab believe they will be able to achieve greater resolution with their device than will be achieved in the telescope optics. They already have a two-dimensional PCA working at Siding Springs Observatory so their optimism has some foundation, but the space environment places special strains on any electronic system.

For a start, Starlab's orbit will take it through the Van Allen radiation belts, where ionised particles in the Earth's magnetic field provide a constant radiation background to all the electronic events on board Starlab. Even when not in the Van Allen belts themselves, Starlab must still be immune to the output of the Sun and other cosmic ray sources.

Another problem will be heating. In a vacuum, with no convection to remove waste heat, all the components have to either radiate or conduct. Thus a great deal of attention has to be paid to the adequate heatsinking of every component on board.

Perhaps the most serious problem of all is that the space platform will only have 12 kW of power available to drive all Starlab's instruments. Since this includes a 50 megabyte memory, it is very possible that Starlab will demand large-scale integration of much of its circuitry. This would reduce both power and heating problems.

What to look at?

So, what will Starlab see? Plans at the moment call for an extensive study of Cepheid variables — a type of star that varies in size and brightness in a well-understood manner. They can be used as distance markers, and because they can be resolved as discrete stars in galaxies some considerable distance away, a study of Cepheids will give astronomers a valuable new aid to measuring the distances of galaxies.

Supernovae, exploding stars, will be another target. It seems to be one possible fate of very massive stars that at a certain time in their lives, when all their atomic fuel has been used up, they undergo a massive explosion. Such is the violence of this event that fully 90% of the mass of the star may be blown away. At maximum intensity, it is not unusual for a supernova to outshine the rest of its galaxy, i.e: for one star to outshine 10^{11} stars, albeit for only a few days.

But not only the drama of a supernova explosion appeals to astronomers. They believe the cores of supernovae are the birthplace of all the metals heavier than

iron. In this maelstrom of heat and energy atoms of successively greater atomic mass undergo atomic fusion, building elements all the way to uranium and beyond. Studying this process in the ultraviolet may be very instructive.

Black holes

Closely allied to the supernovae are black holes. Some researchers hold that a very massive star, for reasons not clearly understood, may either blow itself up in a supernova or collapse into a black hole. Others hold that it does both, that the outer parts of the star *explode*, while its core *implodes* until it reaches so small a size and so high a density that light cannot escape. Whatever, for a long time part of the mystery of these singular objects was that they were, by definition, impossible to see. More recent work, however, has shown that black holes might be quite bright in the ultraviolet.

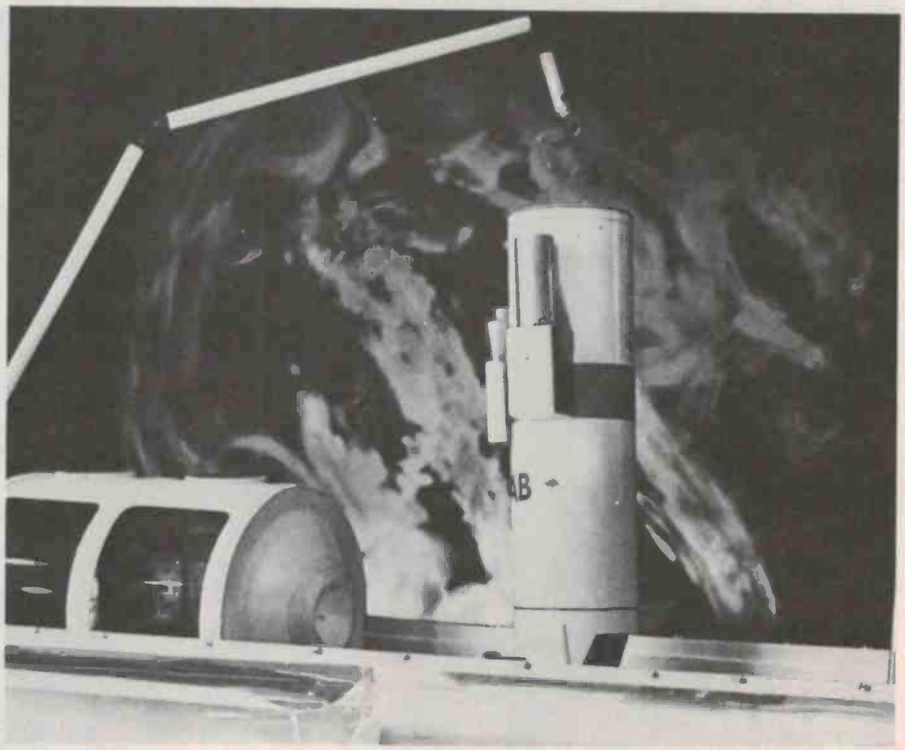
It is argued that if any gas or dust was in the vicinity of a black hole it would be sucked into the hole. In doing so it would be accelerated to the speed of light, which would cause the dust to radiate strongly in the ultraviolet. Early X-ray and ultraviolet satellites have already picked up one likely candidate: the source Cygnus X-I consists of a bright, massive star, and a dark, equally massive companion.

The idea that black holes are not quite so black is fuelled by current models of those enigmatic markers of deep space, the quasars. These hold that a quasar is simply a galaxy too big or too dense for its own good! The galaxy has formed a black hole at its centre and is now swallowing entire stars, releasing prodigious amounts of energy as it does so. Once again, Starlab should be able to test these theories by viewing the UV liberated close to the black hole.

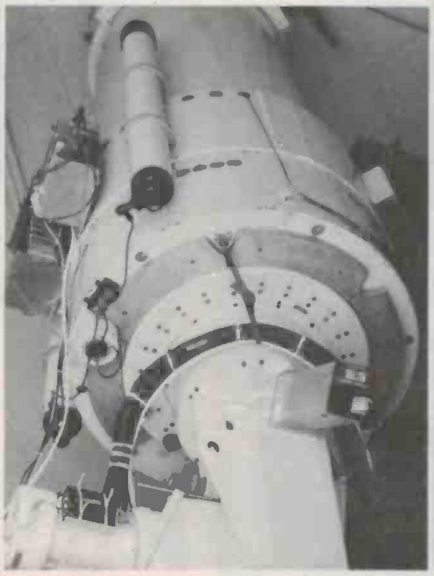
Other work

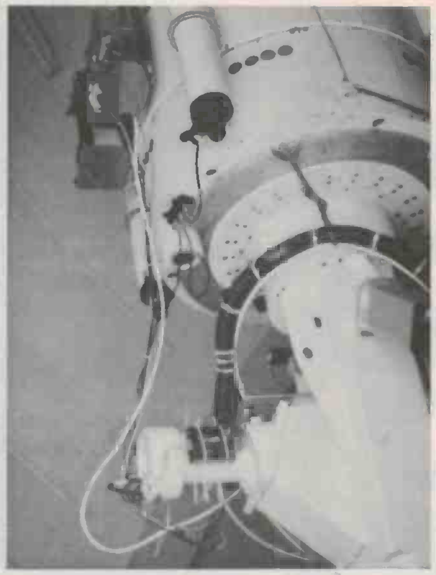
Although not as dramatic, other aspects of the work planned for Starlab are potentially as rewarding. Starlab will make sky surveys down to very faint magnitudes with unparalleled accuracy. It will study clouds of interstellar dust and gas that glow brightly in the UV, but are invisible visually. It will be used to study the planets, and astronomers hope that the new view of these familiar objects will answer some of their oldest questions.

But perhaps the most interesting work will be the testing of various cosmological models. Modern cosmology takes Einstein's theories as its starting point, and fortunately it can be demonstrated that there are only a few alternative models of the universe that fit the master's theorems. Broadly ▶



Mock-up model of Starlab being lifted out of the instrument bay of the Space Shuttle.

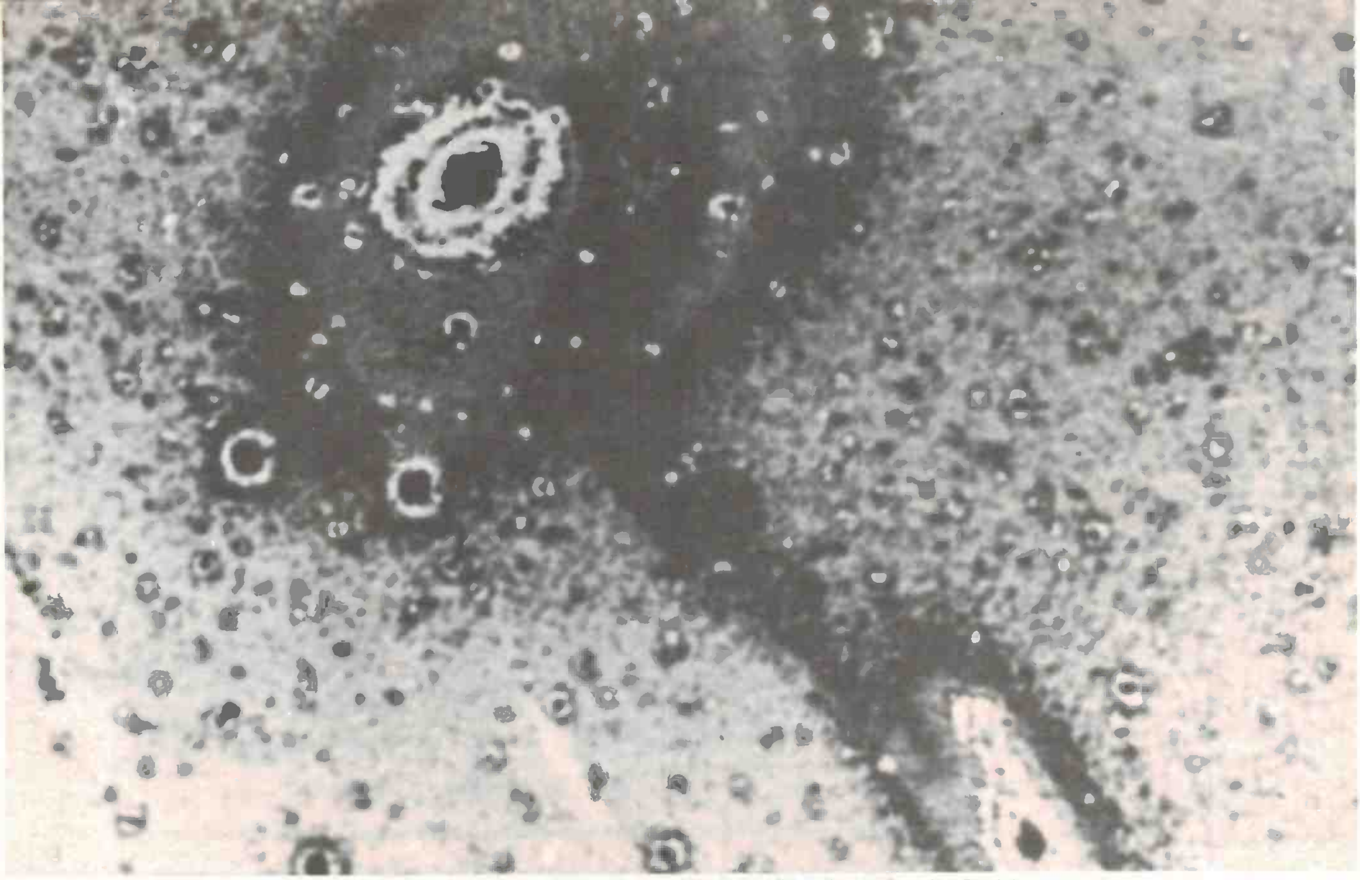




The Cassegrain Echelle Spectrograph and the 2D PCA on the 40-inch telescope at Siding Spring Observatory

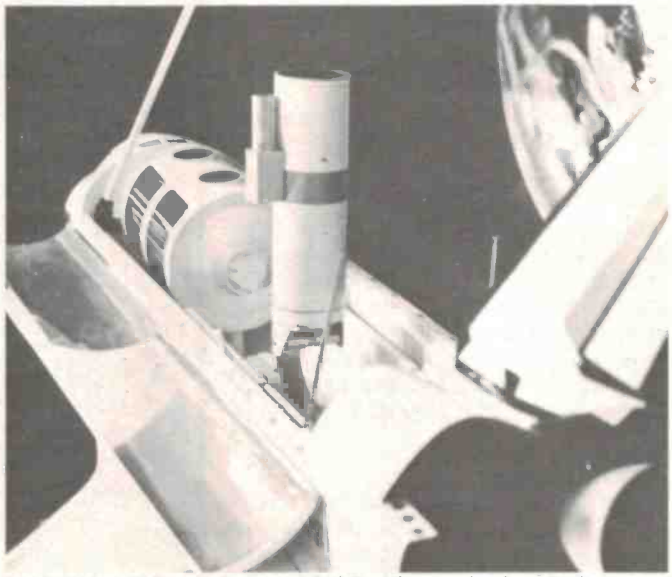
The Cassegrain Echelle Spectrograph, funded by the ANU Large Equipment Fund and built by Boller and Chivens, is now installed on the 40-inch telescope at Siding Spring. The spectrograph, which was designed to be compatible with the AAT, has a 4-inch beam: with the 79 groove mm^{-1} echelle, it gives a dispersion of λ(Å)/1000 Å/mm. Narrow emission lines have a FWHM of nine microns, and the instrument is stable to three microns over six hours of hour angle. At the detector (2D PCA — see right), 25 microns projects back to 2.5 arcsec at the slit, on the 40-inch telescope.

Development of the 2D photon counting array (PCA) progressed well in 1980, and the detector is now in use on the echelle spectrograph. At present, the front end is a 25 mm proximity focus, dual stage, chevron microchannel plate intensifier with an S-20 cathode on a quartz substrate. This is imaged on to a Fairchild CCD with enough gain to photon count an event centre to half a diode in the direction of dispersion. Currently the memory works at 10 MHz, with a 760 x 240 format. The pixel size is 15 x 36 microns, and the resolution in the direction of dispersion is 20% modulation at 20 line pairs mm^{-1}.



A picture (reverse) of Cygnus X-1, a likely candidate for study using Starlab.

A faint X-ray SNR is visible in the bottom right hand corner of this picture of a field of the Large Magellanic Cloud, taken with the 2D photon counting array fitted to the 1 m telescope at Siding Spring Observatory through a Hα filter in a 1000 second exposure.



Another view of the mock-up model of Starlab emerging from the instrument bay of the Space Shuttle.

speaking, the universe must either have started in a big bang and be expanding into eternity, or it must be oscillating from extreme density to extreme rarity, and back again.

The main observable difference between the two models lies in the density of matter at extreme distances from Earth. Unfortunately, the present generation of Earth-based telescopes is incapable of seeing quite far enough.

Starlab will be able to see objects as faint as magnitude 24, considerably better than the best ground-based observatories. At the Australian National University scientists are guessing that this will enable them to view objects receding from us at a massive 80% of the speed of light. That is most of the way back to the big bang, and should certainly be sufficient to decide the shape of the universe we live in.

If the money is forthcoming, the first mission will be in 1989. Current plans call for the shuttle to retrieve Starlab some six to twelve months later. After servicing and possible reinstrumentation there will be a second and longer flight.

There is no reason why Starlab should not be used until it becomes so obsolete that no more worthwhile astronomy can be done with it. One would think that by then we would certainly have got our money's worth out of it!

Most astronomers would bet that it will have changed the way we look at the universe. ●

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7406	.20c
7414	.33c
74164	.48c
74365	.37c
* 74LS00	.20c
* 74LS14	.40c
74LS47	.72c
* 74LS90	.42c
74LS161	.53c
81LS95	.87c
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Handheld digital multimeters should have wide appeal

The model DT-830 and DT-840 multimeters from Univolt, released here quite recently, have many features and attributes which should ensure their wide appeal.

The DT-830 measures 160 x 84 x 26 mm and costs $89.95 (rrp). The DT-840 measures 160 x 80 x 30 mm and costs $49.95 (rrp).

HANDHELD digital multimeters first came on the market a few years ago, but did not achieve very wide acceptance. Firstly, they had fairly small LED displays, with the drawbacks of poor visibility and high current consumption. Secondly, they were much more highly priced than their analogue counterparts and had fewer features. When the price of liquid crystal displays began dropping, handheld multimeters featuring them began to appear, and soon after instrument prices began to drop.

Early this year IFTA released two new Univolt multimeters, the DT-830 and the DT-840. We were presented with one of each to review, and here's what we found.

DT-830

This handheld instrument features a 3½-digit liquid crystal display and a large rotary switch for range selection. The instrument has 27 measurement ranges, plus a diode checker and continuity beeper. On dc volts it covers from 200 mV to 1 kV, on ac 200 mV to 750 V — each in five steps. On current it covers from 200 uA to 10 A — dc *and* ac — in four steps plus 10 A shunt. On resistance it covers 200 ohms to 20 M in six steps. The beeper continuity tester is a high impedance source and drives no more than 1 mA through the load.The diode checker is similar, driving about 1.5 mA through the device under test. Forward voltage is indicated when the red lead is on the diode anode. You can do in-circuit tests with this facility and not worry about ever damaging anything. Good one, Univolt!

The transistor checker facility is another exemplary feature of this instrument; you get a straightforward measurement of h_{FE} (dc gain). As with the diode checker, you need never worry about destroying a device. You can even check an unknown device for NPN or PNP type. You can obtain a plug which mates with the fitting and has clip leads for use with large-signal transistors.

Construction is of a high standard and the instrument is quite robust (it survived a 1.5 m drop onto hard floor . . .). The circuitry is built around four ICs — a TL062, a 4077, a 4011 and an ICL7106 — all familiar and readily available devices. Two double-sided, plated-through-hole pc boards are employed, both solder masked and with silk screen component overlays. The input fuse is easily accessed via the battery compartment. Power is supplied by a single 9 V No. 216 battery, consumption being a mere 25 mW. The display shows when the battery is low.

We checked each range for accuracy and the instrument was found to be within specifications in all cases.

On the rear of the case are two rubber strips which very effectively prevent the instrument slipping around the bench or whatever when in operation.

DT-840

This is a lower cost, simpler to operate unit than the DT-830 but is nonetheless a very useful instrument. It features a 3½-digit liquid crystal display, with auto-polarity indication. It is autoranging on all functions, except resistance where it reads to 1M on Hi and 1k on Lo. On dc volts it measures from 200 mV full-scale to 1 kV full-scale; on ac the top range is 600 V. The ac/dc function is selected by a front panel pushbutton which also serves to select Lo/Hi ohms on the resistance range. The current range measures to 200 mA full-scale.

The range switch is a large, centrally located rotary switch. The left-most position is OFF. The first function always selected is volts — a handy protective feature. As you select each range the internal beeper sounds, giving an audible indication of when you change functions. It also beeps during the autoranging operation. The display indicates the quantity you're reading by showing mV or V on dc, and AC at the top left with mV or V on ac. On resistance it shows kΩ on Hi ohms and kΩL on Lo.

The instrument was checked for accuracy on all functions and was found to be within specifiction in all cases.

The input is fuse protected, the fuse being accessible via the battery compartment — where a spare fuse is kept, too! Construction is of a high standard, as with the DT-830. Inside the case is a single pc board attached to the range switch, containing a single 74-pin (!!) LSI chip and the range resistors, etc. The unit is powered by two 1.5 V AA cells. On the Hi ohms range only 0.6 V appears at the meter prods, on Lo only 0.3 V, so you're not liable to damage any semiconductors. Another good one, Univolt!

The case could have usefully included the rubber strips on the rear that feature on the DT-830, but that's only a minor comment.

Gripe

We have one gripe. Not just with Univolt but *all* DMM suppliers. We have *never* seen anybody supply a decent pair of test leads with finger guards on the probes. It's only a little thing, but boy, when you're measuring several hundred volts and your finger slips down the end of the probe . . . it matters a hell of a lot! Please. Somebody. Make a pair of probes with a ring around the end just back from the probe tip. It makes them safer and easier to use. Yeah, yeah — one can make up leads with clip-type probes but there are plenty of occasions when the clip grips have nothing to grip.

More info?

For more information and/or where to purchase the Univolt DMMs, contact IFTA Australia, P.O. Box 21, Bondi Beach NSW 2026.

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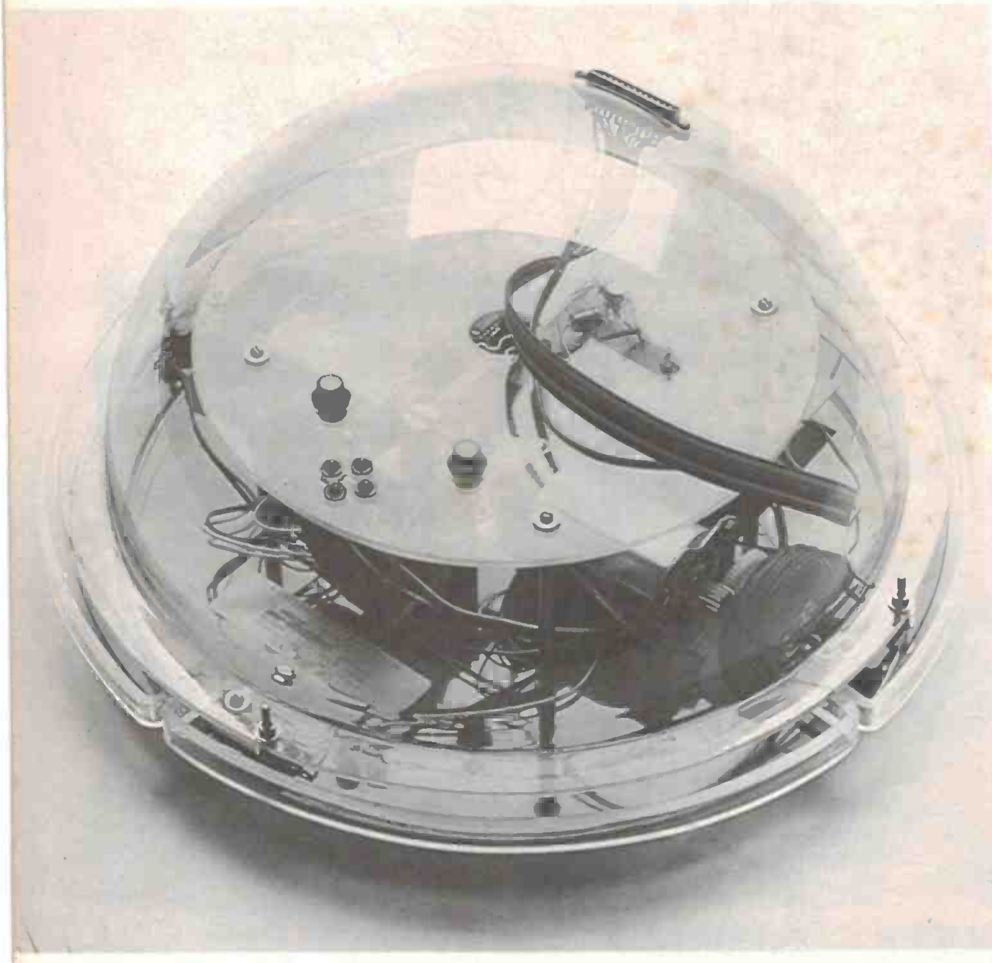


THE NEXT phase of construction involves the control board electronics.

Control board

Have a look at the pc board and orientate it so that it matches the component overlay diagram (Figure 11) here so that you can recognise where the components are placed. When looking at the track side of the pc board you will notice a cut track beneath the Q9 and Q10 positions. These two transistors drive the pen solenoid, which was previously mounted on the base. Now that it is mounted in an inverted position, the solenoid drive needs to be inverted and this modification, plus a link, effects that. All components mount on the non-copper side of the pc board, with the exception of R13.

First thing to do is identify all the components from the parts list. There are four IC sockets, one 8-pin, one 14-pin and two 16-pin sockets. These should be soldered into the pc board first. Make sure you orientate them correctly — the corner adjacent to pin 1 will be chamfered. All the transistors should be soldered in place next. Identify Q4, Q6, Q8 and Q10 — these are the four metal can types. A little tab on the base of the can adjacent to one lead indicates that it is the emitter lead. Solder these transistors in position, ensuring they sit right down on the pc board. All the other transistors are BC548s in small (TO-92) plastic cases. Mount Q3, Q5, Q7 and Q9 next — note that Q9 is turned so that the flat on the case faces out from the board (bend the base lead backwards) while the others have their flats facing inwards. Now solder the rest of the transistors into place. Always watch orientation.

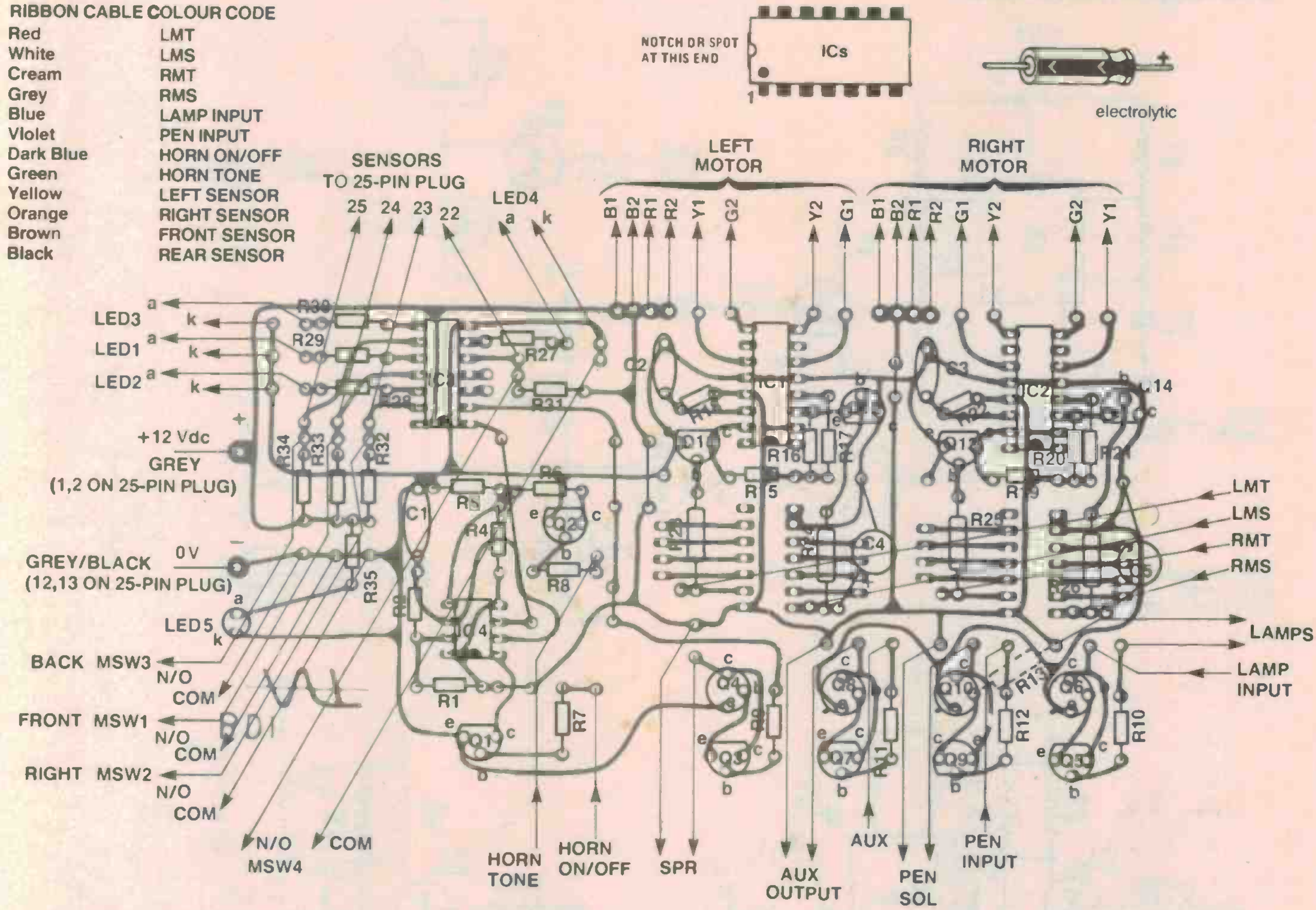
All resistors may be soldered in place next. They are not polarised components so it doesn't matter which way round they go. Note that R13 is placed on the copper side of the pc board. Mount it so that it sits up off the board a little. Solder the lead that goes to the base lead of Q10 first. Then solder the other lead. Having done that turn the board over and cut off the free lead protruding through the top of the board, leaving about 6-8 mm projecting to allow later connection of a lead.

At this stage all the links can be inserted and soldered in place. Note that there are seven links in all. The link running from pin 1 of IC3 to pin 3 of IC4 needs to be made of a length of insulated hookup wire. There is a link under the pc board that connects the emitter of Q9 to the emitter of Q10. This too should be ▶

PARTS LIST — ETI 645
TURTLE ROBOT CONTROL BOARD

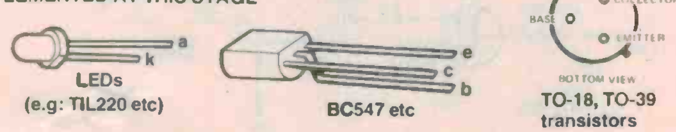
Resistors	all ½W, 5% unless noted
R1, 2, 6, 9, 10, 11, 12	15k
R4, R5	47k
R7, R8	1k
R13	470R
R14, 18, 22	100R, 1W
R15, 16, 19, 20, 31, 32, 33, 34	10k
R17, R21	680R
R23,24,25,26	4k7
R27, 28, 29, 30, 35	560R
Capacitors	
C1, 2, 3	100n ceramic
C4, C5	47u/25 V electro.
Semiconductors	
Q1, 2, 3, 5, 7, 9, 11, 12, 13, 14	BC547
Q4, 6, 8, 10	2N2102
IC1, IC2	SAA1027
IC3	74C04 or 4069
IC4	555
LEDs 1-5	TIL220R or similar large red LEDs

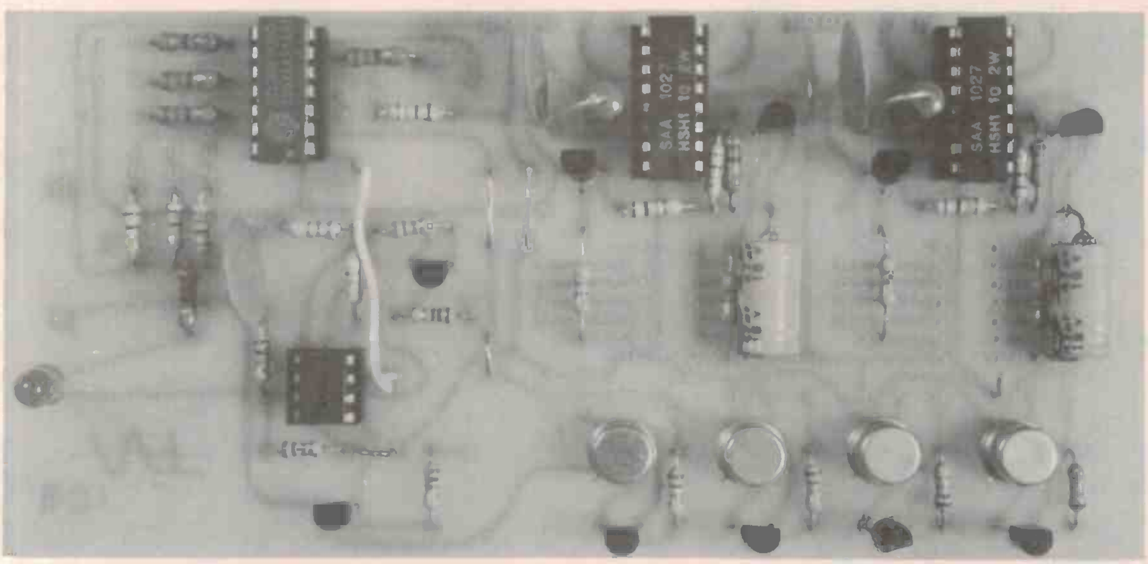
Miscellaneous
Turtle control pc board (BD1); 2 x 16-pin IC sockets; 1 x 14-pin IC socket; 1 x 8-pin IC socket.



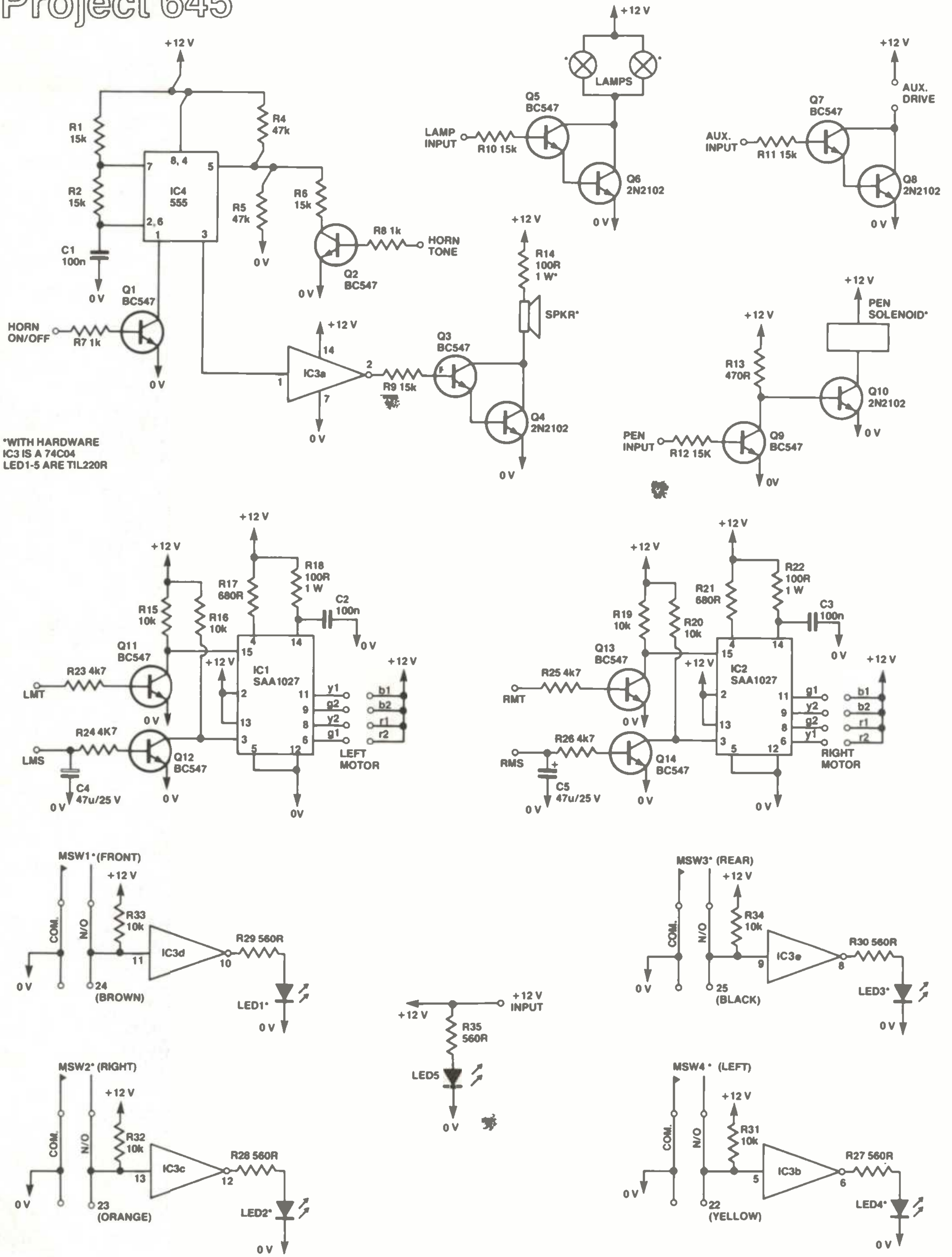
NOTE: AUXILIARY INPUT AND OUTPUT NOT IMPLEMENTED AT THIS STAGE

Figure 11. Component overlay for the control board showing external wiring terminations. The ribbon cable that goes to the 25-pin plug (see also Figure 23) is wired according to the above colour codetable, spare lengths being used to wire in the LEDs, lamps, speaker, microswitches, solenoid, etc.





The completed control board, prior to attaching the various cables.


+12 V
R1 15k
R2 15k
C1 100n
0 V
R4 47k
R5 47k
R6 15k
IC4 555
8, 4
7
2, 6
1
3
5
R8 1k
HORN TONE
Q2 BC547
Q1 BC547
HORN ON/OFF
R7 1k
LAMPS
Q5 BC547
LAMP INPUT
R10 15k
Q6 2N2102
Q7 BC547
AUX. DRIVE
AUX. INPUT
R11 15k
Q8 2N2102
R14 100R 1 W*
SPKR*
IC3a
14
1
2
7
R9 15k
Q3 BC547
Q4 2N2102
PEN SOLENOID*
R13 470R
Q10 2N2102
PEN INPUT
R12 15K
Q9 BC547
0V
*WITH HARDWARE
IC3 IS A 74C04
LED1-5 ARE TIL220R
R17 680R
R18 100R 1 W
C2 100n
R15 10k
R16 10k
Q11 BC547
R23 4k7
LMT
IC1 SAA1027
15
4
14
2
13
3
5
12
11
9
8
6
y1
g2
y2
g1
b1
b2
r1
r2
LEFT MOTOR
R24 4K7
LMS
Q12 BC547
C4 47u/25 V
R21 680R
R22 100R 1 W
C3 100n
R19 10k
R20 10k
Q13 BC547
R25 4k7
RMT
IC2 SAA1027
RIGHT MOTOR
R26 4k7
RMS
Q14 BC547
C5 47u/25 V
MSW1* (FRONT)
COM.
N/O
R33 10k
IC3d
11
10
R29 560R
24 (BROWN)
LED1*
MSW3* (REAR)
R34 10k
IC3e
9
8
R30 560R
25 (BLACK)
LED3*
+12 V INPUT
R35 560R
LED5
MSW2* (RIGHT)
R32 10k
IC3c
13
12
R28 560R
23 (ORANGE)
LED2*
MSW4* (LEFT)
R31 10k
IC3b
5
6
R27 560R
22 (YELLOW)
LED4*

TURTLE CONTROL BOARD — HOW IT WORKS

There are five circuit groups on the control board comprising: left and right motor control, microswitch 'sensors', horn, pen, lamps and auxiliary control.

MOTOR CONTROL

The motors used to propel the Turtle are stepper motors. This is not the place for a dissertation on stepper motors, so their description will be necessarily brief. Suffice to say that the shaft of a stepper motor can be rotated in discrete 'steps' by the application of pulses to the motor windings in the correct phase sequence. Reversing the phase of the pulse sequence reverses the direction of rotation of the shaft. The motors in the Turtle have a shaft rotation of 7.5° per 'step', giving a linear displacement of around one millimetre. Maximum speed is about two revolutions per second with 100 pulses per second drive.

Here, a special IC provides the motor control — IC1 for the left motor, IC2 for the right. Both are type SAA1027. The output pins — 6, 8, 9 and 11 — provide the correct drive to the motor windings. There are two control pins on the SAA1027. Pin 15 accepts the pulse train for driving the motor and pin 3 controls the phase of the pulses sent to the motor windings and thus the direction of shaft rotation.

As the operation of each motor drive circuit is essentially similar, we will only describe the operation of the left motor drive circuit. The LMT input ('Left Motor Toggle') is a series of pulses that drive Q11 on and off. This signal is inverted at the collector, which drives pin 15 of the SAA1027. The LMS input ('Left Motor Set') is set high or low to determine the direction of rotation of the motor shaft. Setting LMS low and RMS high while pulsing (or toggling) the LMT and RMT inputs will move the Turtle forward. A complete description of the logic operation is given later in this series.

MICROSWITCH SENSORS

The microswitch 'sensor' circuitry is pretty straightforward. There are four switches mounted around the circumference of the Turtle base: front, rear, left and right. Each switch connects directly to the 25-pin plug on the dome and communicates directly with the computer or whatever is controlling the robot. No switch debouncing is provided as this is done in software or by external circuitry if necessary. The sensor circuitry comprises MSW1 to MSW4, IC3 and LED1 to LED4. Each microswitch sensor is 'normally open'. When the sensor ring meets an object, say at the front of the Turtle, then MSW1 operates and the contacts close. This will pull the input (pin 5) of IC3b, an inverting buffer, low. Now the input of IC3b is normally pulled high via R31, which goes to the +12 V supply rail. Thus the output of IC3b, pin 6, will be low and no current will flow through LED1, which will be unlit. When MSW1 operates and pulls pin 5 of IC3b low, the output (pin 6) goes high, driving current through LED1, which lights, indicating which switch sensor has been operated.

Pin 22 of the 25-pin plug on the dome will also be high when MSW1 is not actuated, going low when it is. These two conditions are interpreted by the controlling computer or external circuitry (such as a manual controller) to determine the next action sequence of the robot.

All the microswitch sensors work in the same way, so a similar explanation applies.

HORN

The horn circuitry involves Q1, Q2, Q3 and Q4, IC4, one gate from IC3 and the speaker. There are two inputs to the horn circuit: HORN ON/OFF (pin 20 of the 25-pin plug) and HORN TONE (pin 21 of the 25-pin plug). IC4, a 555 timer, is connected as a gated astable oscillator. When the HORN ON/OFF input is driven high, Q1 turns on, turning on IC4 by pulling pin 1 low. Ignoring Q2 and R6 for the moment, IC4 will commence to oscillate. Its output drives the input of IC3a, one buffer from the hex buffer chip IC3. The output of IC3a, pin 2, then drives the input of a Darlington pair, Q3 and Q4, the collectors of which drive the speaker, and thus you hear the horn at a particular pitch, which is the LOW pitch in this case. When the HORN TONE input is driven high at the same time as the HORN ON/OFF input, Q2 is driven on, connecting R6 across R5, and causing the oscillation frequency of IC4 to increase, thus sounding the HIGH pitch of the horn.

PEN

The pen solenoid, mounted on the inner plastic disc, holds the pen in a clamp. The pen is lowered to 'draw' and raised when 'not drawing'. As the solenoid is mounted on the inner plastic disc, it needs to be operated to raise the pen in the 'not drawing' mode. When drawing, any unevenness in the surface will simply push the pen and solenoid plunger up and down, following the surface contour.

The pen circuit involves Q9, Q10 and the pen solenoid. When the PEN INPUT (pin 19 of the 25-pin plug) is low, Q9 is off and base current, via R13, turns Q10 on, operating the solenoid and raising the pen. When the PEN INPUT is high, Q9 is driven on and its collector current 'pulls' the base of Q10 low and Q10 turns off. The solenoid then releases and the pen is dropped down through the Turtle base to the surface on which it stands.

LAMPS & AUXILIARY

The lamp and the auxiliary drive circuits operate in the same way, so the description of the lamp circuitry will serve for both.

The lamp drive circuitry involves Q5 and Q6, which are connected as a Darlington pair. When the LAMP INPUT (pin 18 of the 25-pin plug) is low, no collector current flows in either Q5 or Q6 and the lamps are unlit. When the LAMP INPUT is driven high, Q5 and Q6 turn on and they draw collector current via the two parallel-connected lamps, which thus light up.

Note that the AUX.INPUT is not connected to the 25-pin plug and this facility is not implemented at this stage.

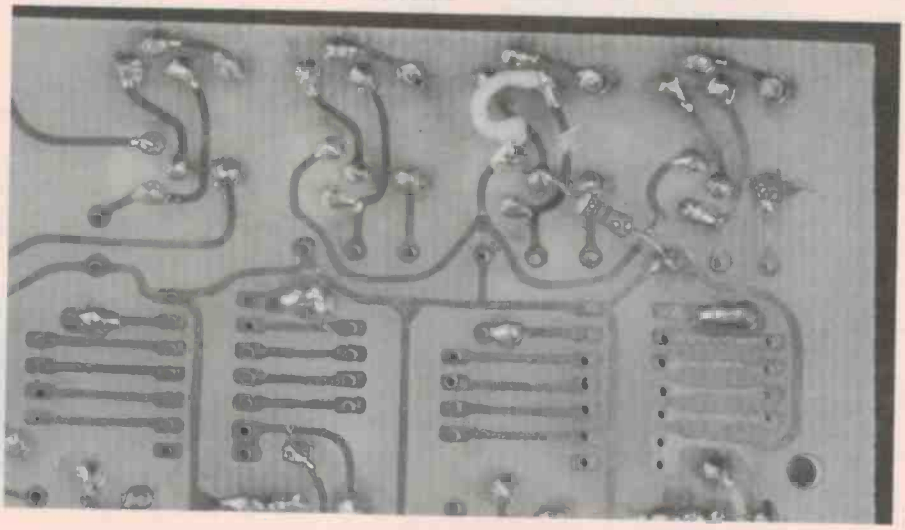
---

of insulated hookup wire. The placement of this link, and R13, is shown in the accompanying photograph, Figure 12. Last of all, mount the five capacitors. The two electrolytic capacitors, C4 and C5, need to be orientated correctly. Identify their positive (+) and negative (−) leads and place them as shown on the component overlay, Figure 11.

Having completed the assembly, check it over thoroughly and with care, making sure all components are in their correct positions and correctly orientated.

The four ICs may now be inserted in their respective sockets. Leave IC3 till last. This is a CMOS type and should be handled with care. Only pick it up by the two ends and avoid handling the pins.

Figure 12. View of R13 and the link under the board.



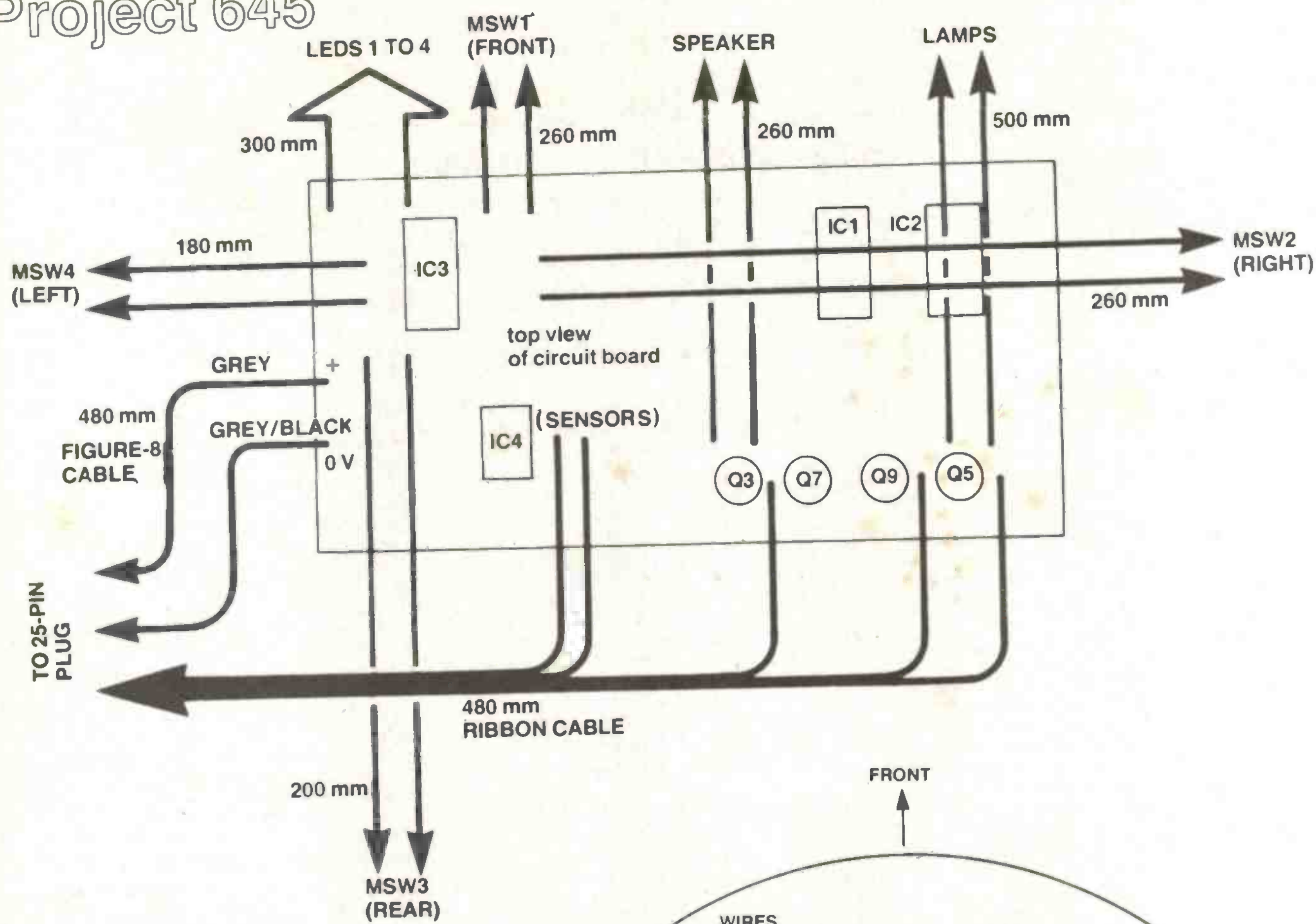


Figure 13. Lengths to cut the cables that run from the control board. Note that this drawing is only diagrammatic and does not indicate the actual termination points or dressage of each cable. The overlay, Figure 11, shows termination points, Figure 14 and 15 show dressage.

The various cables that connect the control board circuitry to the other components mounted on the Turtle can now be soldered in place and cut to length, as shown in Figure 13.

Internal wiring

Take the completed circuit board and place it so that ICs 1 and 2 face forward and the components are facing up. At this stage just leave the wires trailing from the board ready to be routed to various parts of the Turtle.

Screw the four ½" threaded spacers to the four disc mounting holes on the base, using ⅛" x ¼" screws and a washer under the base on each screw. These screws must be tight. The circuit board is then temporarily screwed to the two spacers at the back using short screws. The wires from the board can now be routed under the motors, as shown in Figure 14.

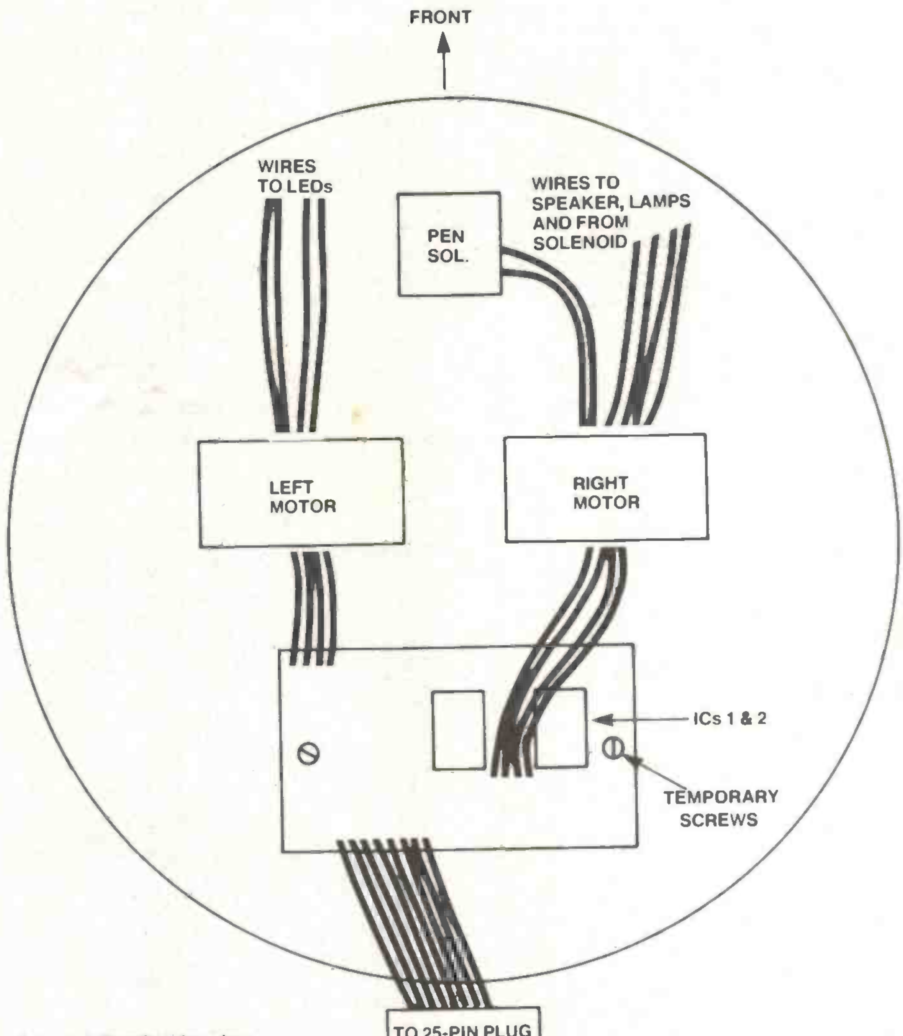


Figure 14. Routing the wires.

NOTES

There are a number of things we omitted from the last article which should be noted as they will assist construction:

Figure 5 (page 33): The screw used to secure the rear motor elbow bracket to the motor is the same screw that holds the rear plastic cover of the motor, as supplied.

Figure 9 (page 35): The drawing of the inner plastic disc shows it from the **underside**.

Adjusting the wheel mounting: If you can't get the wheels to turn freely after mounting the motor and adjusting the fittings, try putting a washer between the small elbow wheel axle bracket and the top of the base (best of all — use the washer between the nut and the base, as per Figure 4 on page 32, and screw the nut against the base).

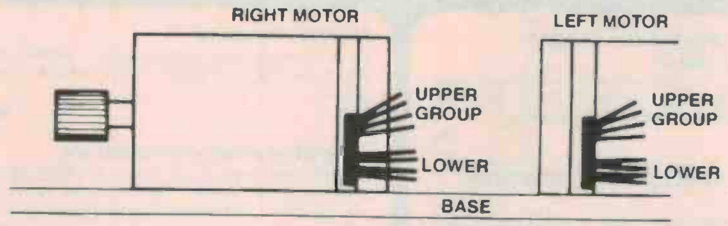


Figure 17. **Identifying the groups of motor wires.**

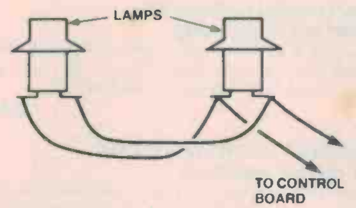


Figure 16. **Wire the two lamps in parallel.**

DEMONSTRATIONS

See the Turtle — live!

Walking, beeping, flashing, meandering and whatever. With the kind co-operation of several computer retailers, we have arranged for demonstrations of the Tasman Turtle, as featured here, to be carried out in our Sydney and Melbourne offices as follows:

Sydney: 4th Floor, 15 Boundary St Rushcutters Bay.
Monday to Thursday, 4:30 — 6:00 pm.
Apple II computer used for demonstrations supplied with the kind co-operation of Imagineering Pty Ltd, 22 Sir John Young Crescent, Woolloomooloo.

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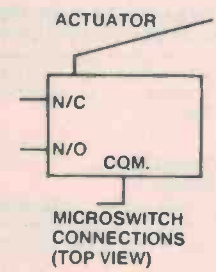

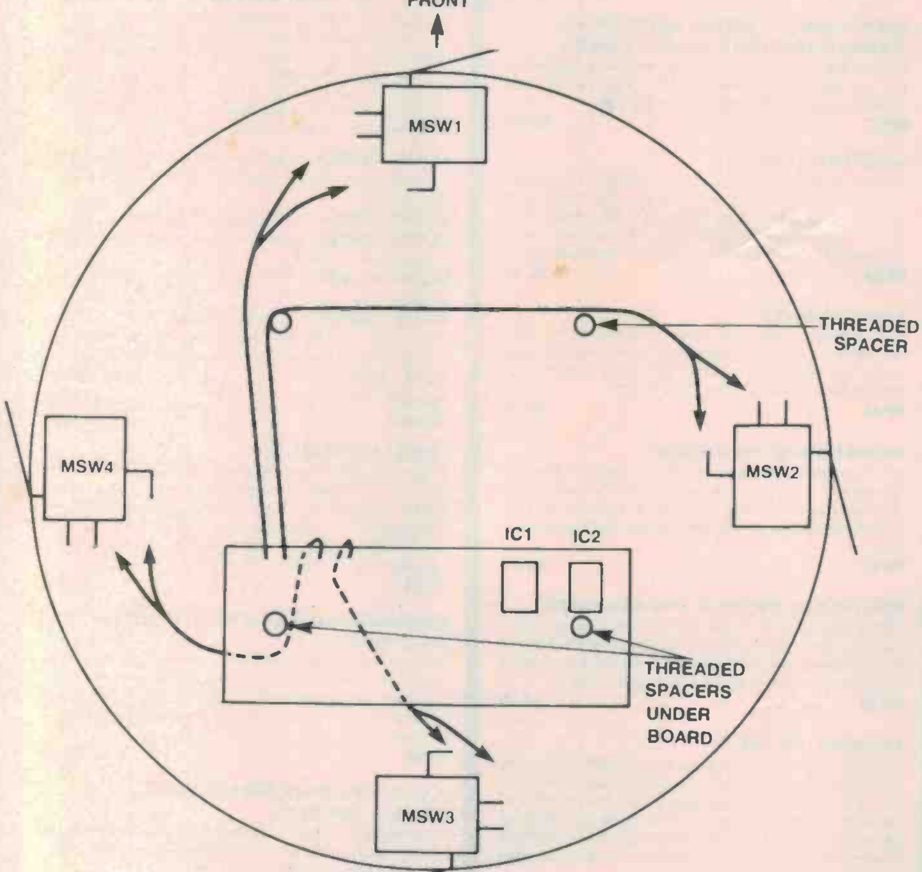

Figure 15. **Routing the wires to the sensor microswitches.**

Run the wires to the microswitches (MSW1 to MSW4) around the spacers, as shown in Figure 15, and solder the appropriate wire to the N/O (normally open) and COM (common) terminal of each microswitch. The appropriate wires can be identified from the component overlay, Figure 11. Now solder the solenoid wires to the two locations on the board (any wire to each hole). Next solder the lamps on the inner disc as shown in Figure 16 so that the two lamps are in parallel, and then solder the appropriate cable from the pc board to them.

The motor wires, which are still hanging out from the motors towards the front, are tucked under the motor so that a loop is formed and then brought up to the circuit board. Each wire from the stepper motors is identified separately and must be soldered to the circuit board in the correct sequence so the motors will operate properly. *It is important to take your time at this stage* to make sure everything is done carefully.

When viewed from the front of the Turtle the wires emanating from the front of each motor are divided into two groups of four wires each, one set from the uppermost hole and one from the hole closest to the base on each motor (Figure 17).

Each group has four different colour-coded wires:

UPPER		LOWER	
Grey	G1	Grey	G2
Yellow	Y1	Yellow	Y2
Red	R1	Red	R2
Black	B1	Black	B2

These wires are designated as shown above. Remove the two temporary screws holding the circuit board. Then solder the motor wires into the control ▶

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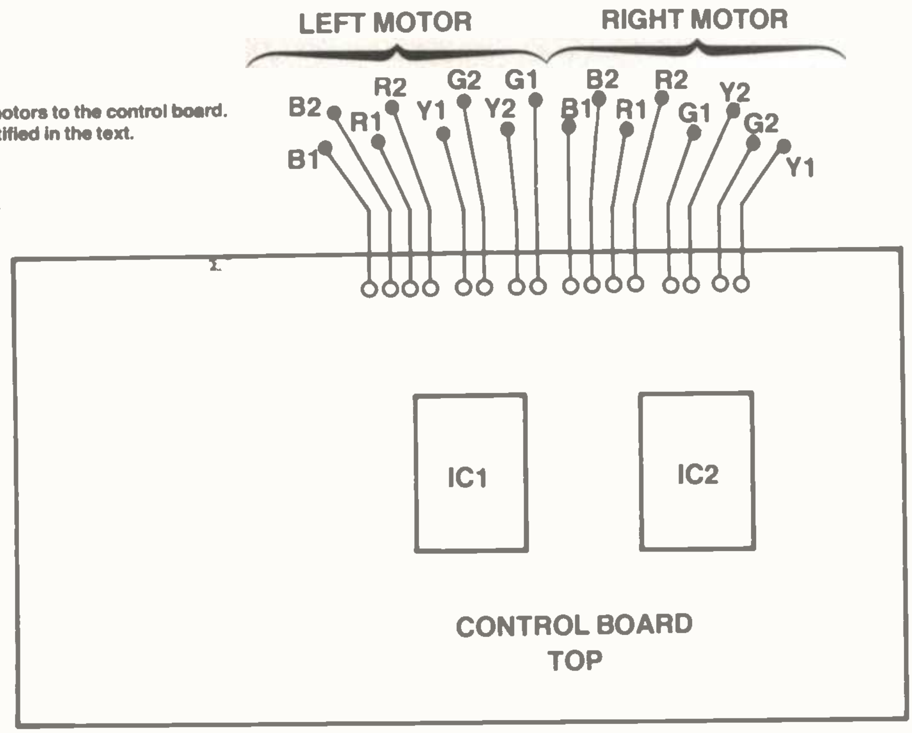


Figure 18. **Wiring the motors to the control board. Colour codes are identified in the text.**

board, as shown in Figure 18. (See also Figure 11, the component overlay). When this is finished, all the wires on each side can be gathered and tied with a cable tie or short length of hookup wire. Attach the tie on the cables between the motors and the control board.

LED wiring

The four LEDs on the inner disc are now wired to the control board. Refer to Figure 11, the component overlay, and Figure 19 here to see how each is connected. Take care with the polarity of the LEDs and make sure they are wired in the correct order. If the wiring for the LEDs is incorrect then those with wrong polarity will not work or a LED will incorrectly indicate which microswitch has been activated.

Last of all, solder the speaker wires from the control board to the speaker and resistor (any wire to each).

Inner disc assembly

At this stage you will have the control board largely wired in, save for the 25-pin plug, with the loudspeaker trailing around and the inner plastic disc attached by several 'umbilicals'.

The general assembly of the inner disc and control board to the main base is shown in Figure 20. Note that there are spacers either side of the control board. This allows another pc board to be added to the Turtle later on, mounted between the 2" spacer and the ½" spacer beneath it.

With the inner disc mounted, the speaker is positioned next. Place the speaker's magnet on the pen solenoid frame (which faces the front of the Turtle). The magnet will hold it temporarily in place, allowing you to ▶

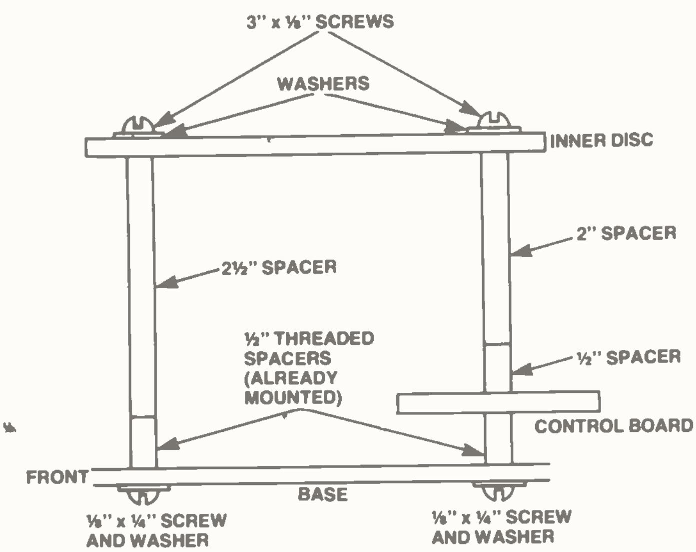
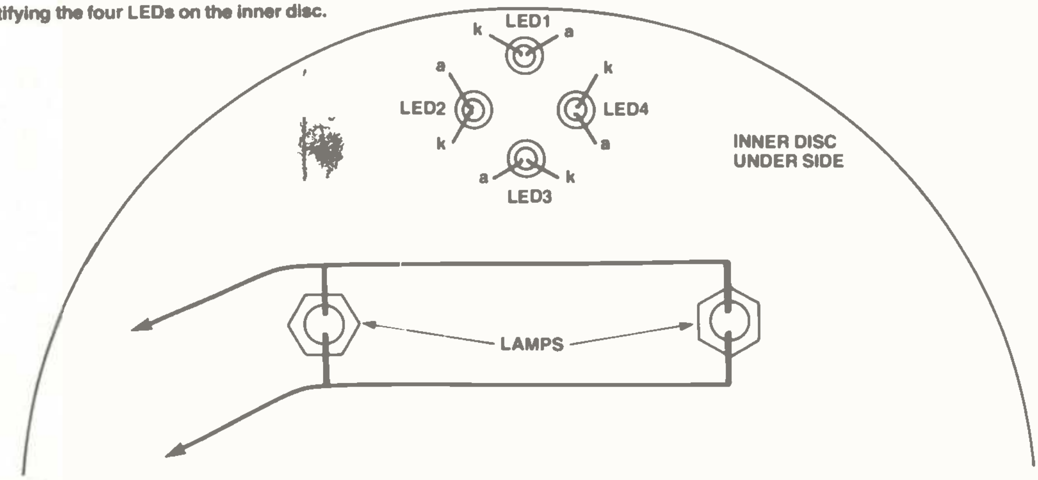


Figure 20. **Assembling the inner disc and control board to the Turtle base.**

Figure 19. **Identifying the four LEDs on the inner disc.**



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15 Boundary St
Rushcutters Bay NSW 2011

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Melbourne: Murray Publishers, 22nd Floor
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DEMONSTRATIONS: see the Turtle — live!

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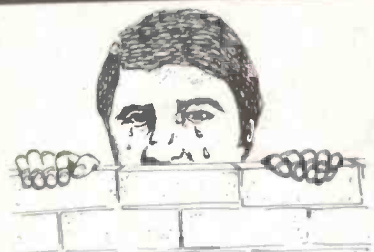

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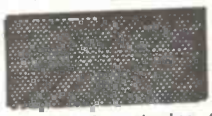

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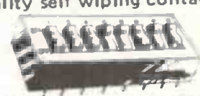

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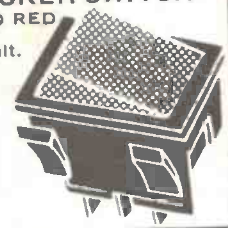

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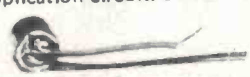

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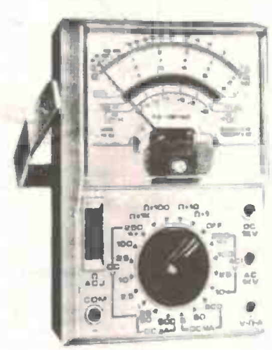

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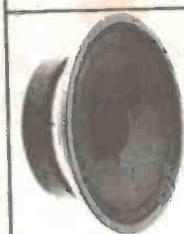

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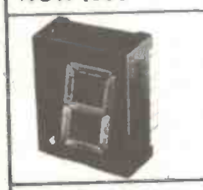

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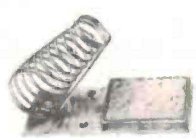

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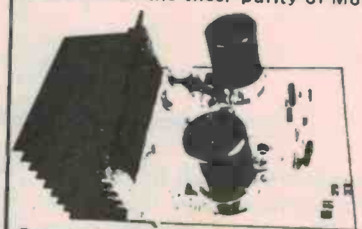

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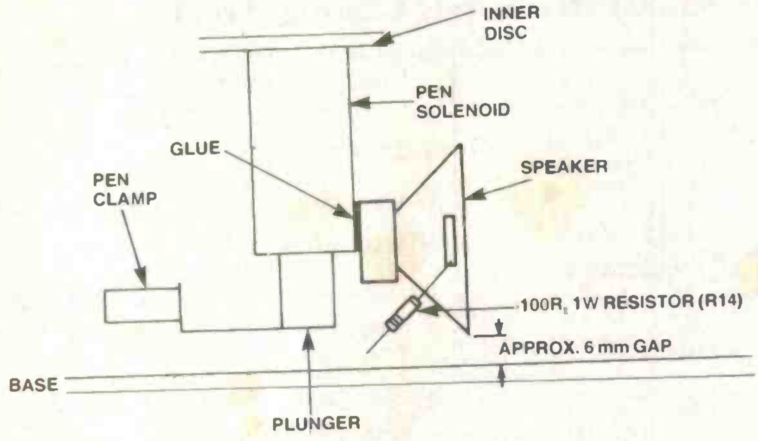


Figure 21. Mounting the speaker.

adjust the speaker's position such that the bottom of its rim is about 6 mm above the Turtle base, as shown in Figure 21. Secure the speaker with latex glue, (e.g: Silastic or similar).

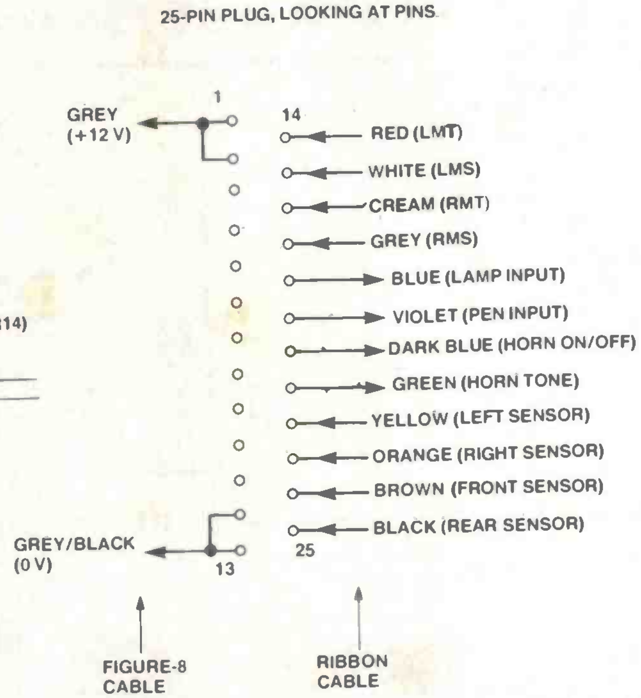


Figure 23. Wiring the 25-pin plug to the ribbon cable and figure-eight (12 Vdc) cable.

'Bump' band and dome

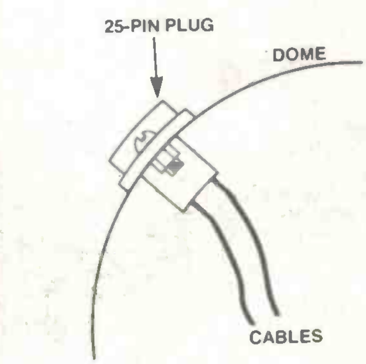
The sensor or 'bump' band and dome are assembled next. Place the sensor band on the base and around the four microswitches so that it can move freely. The band just sits there with its four short spokes holding it on the base. If the band doesn't return when operated or if it grabs for some reason, check that wiring is not interfering with it.

It is important to have a small space between the microswitch actuator and the band (about 3-4 mm). The switch may have to be adjusted to ensure this gap is sufficient.

Next screw the 25-pin plug into the dome without using washers and with the nuts on the inside (Figure 22). Now wire it up. The pin designations are in Figure 23 and you will need to refer to Figure 11 (component overlay) to identify the wires. Check it carefully when you have finished.

With the 25-pin plug all wired up, the dome can be assembled to the base.

Figure 22. Mounting the 25-pin plug to the dome.

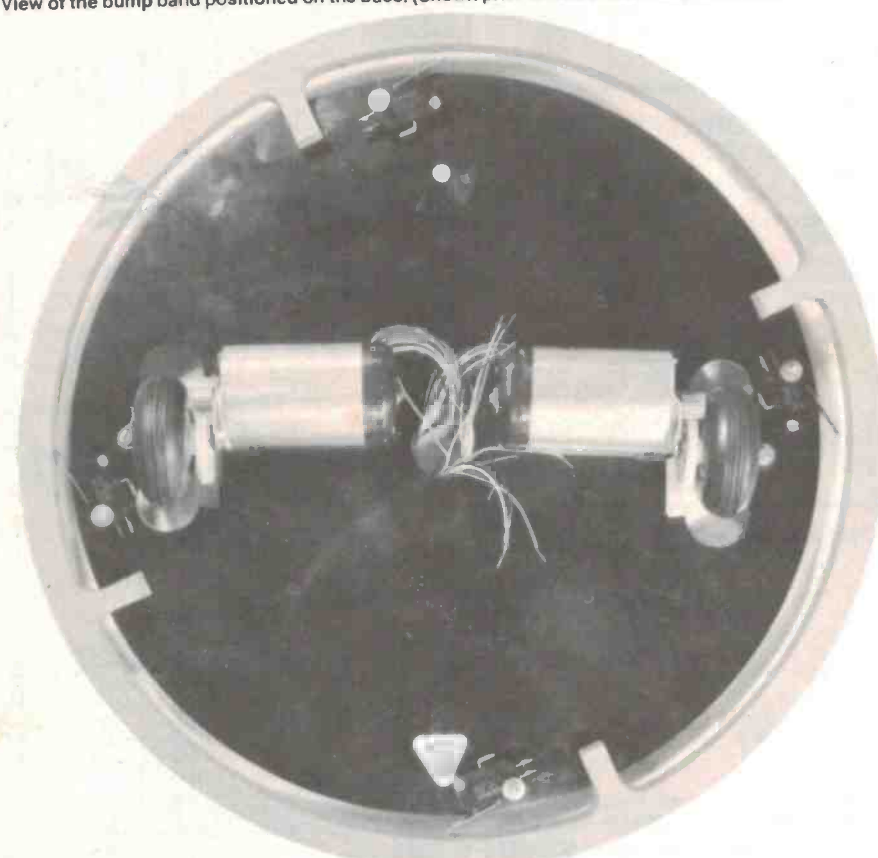


Place two washers on each large screw holding the microswitches (Figure 8b in Part 1). Place the dome over these screws so that the 25-pin plug faces to the rear of the Turtle. Push the dome down over the screws and secure it with a nut and washer on each of the four screws around the base.

Now you are ready to roll! ●

(. . . to be continued)

View of the bump band positioned on the base. (Shown prior to rest of assembly for clarity).



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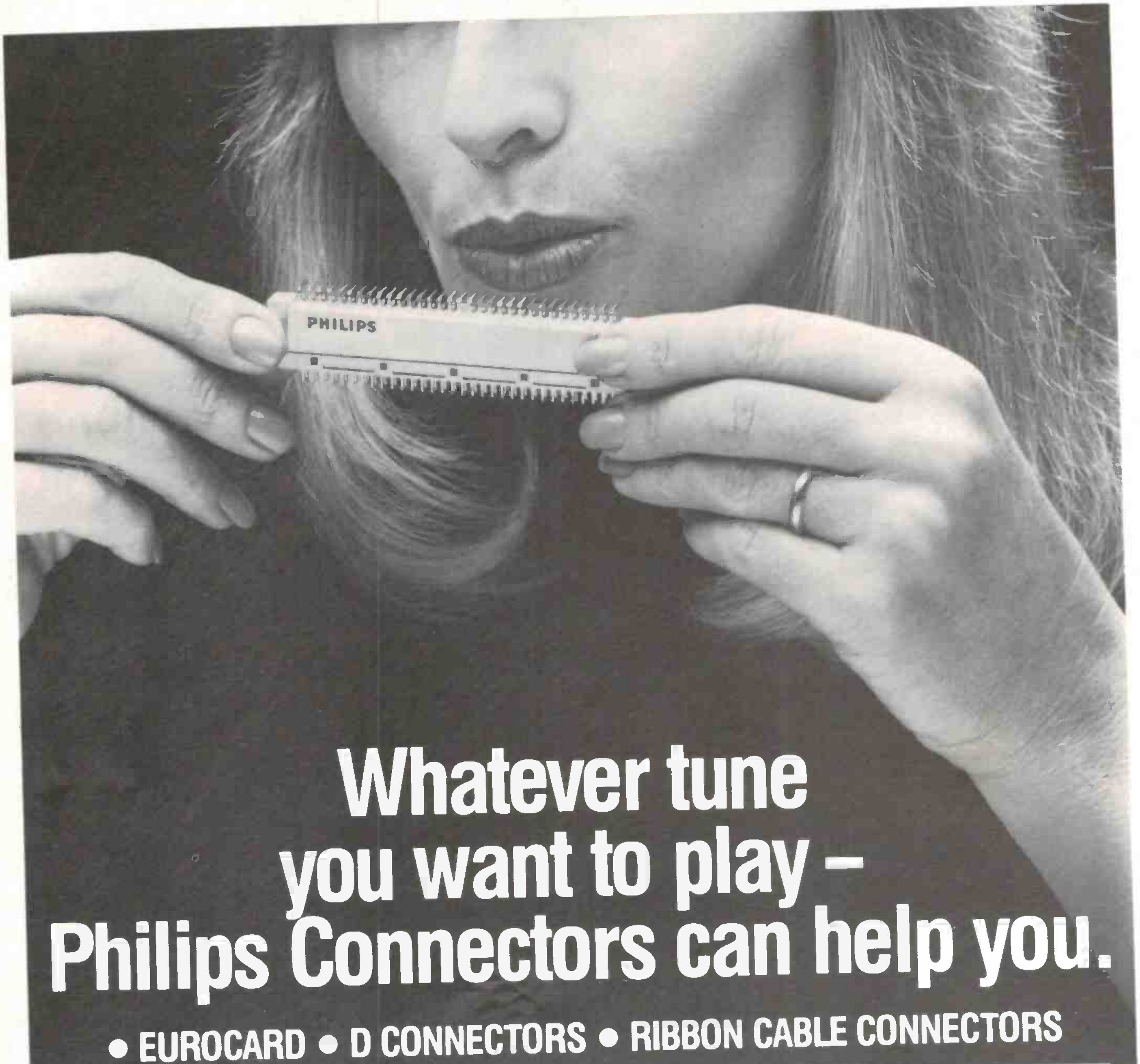

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Clock or square wave generators

How to use transistors, op-amps and 555 timers to make a variety of square wave or 'clock' generator circuits.

Ray Marston

THE 'SQUARE WAVE' generator is one of the most basic circuit blocks used in modern electronics. It can be used for 'flashing' LED indicators, for generating audio tones, or for 'clocking' logic or counter/divider circuitry, etc. The generators themselves may produce either symmetrical or non-symmetrical waveforms, and may be of either the free-running or the 'gated' type.

Square wave generator circuits are quite easy to design, and may be based on a wide range of semiconductor technologies, including the humble bipolar transistor, the op-amp, the 555 timer chip or on CMOS logic elements, etc. In this month's edition we'll confine our discussion to designs based on the transistor, the op-amp and the 555; next edition we'll continue the subject by showing 22 different CMOS-based square wave generator circuits!

Transistor astables

One of the easiest and cheapest ways of generating repetitive square and rectangular waveforms is to use the basic, two-transistor astable multivibrator circuit shown in Figure 1. A major advantage of this rather old-fashioned transistor circuit is that it can quite happily operate from supply voltages as low as 1.5 volts or, with a slight modification, from supply voltages up to several tens of volts.

The Figure 1 circuit acts essentially as a self-oscillating regenerative switch, in which the on and off periods of the circuit are controlled by the C1-R1 and C2-R2 time constants. If these time constants are equal (C1=C2 and R1=R2), the circuit acts as a square wave generator and operates at a frequency of approximately

$$1/(1.4\,C1\,R1)$$

Thus the frequency can be decreased by raising the values of C1-C2 or R1-R2, or vice versa. The frequency can be made variable by using twin-gang variable resistors (in series with 10k limiting resistors) in place of R1 and R2.

Outputs can be taken from either collector of the Figure 1 circuit, and the two outputs are in antiphase. The operating frequency of the circuit is substantially independent of supply rail values in the range 1.5 to 9 volts. The upper supply voltage limit is set by the fact that, as the transistors switch regeneratively at the end of each half-cycle, the base-emitter junction of the transistor is reverse-biased by an amount roughly equal to the supply voltage. Consequently, if the supply voltage exceeds the reverse base-emitter breakdown voltage of the transistor (typically about 9 volts), the timing operation of the circuit will be upset. This snag can be overcome by using the circuit modification shown in Figure 2.

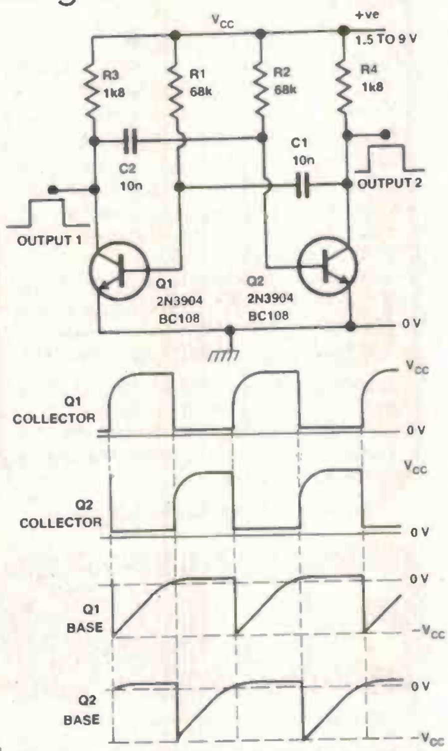


Figure 1. **Circuit and relevant waveforms of basic 1 kHz transistor astable multivibrator.**

Here, a 1N4148 diode is wired in series with the base input terminal of each transistor and effectively raises the reverse base-emitter breakdown voltage of each transistor to about 80 volts. The maximum supply voltage of the circuit is then limited only by the collector-emitter breakdown characteristics of the transistors, and may be several tens of volts. In practice, the 'protected' circuit of Figure 2 gives a frequency variation of only 2% when the supply voltage is varied from 6 V to 18 V.

The leading edges of the output waveforms of the Figure 1 and Figure 2 circuits are slightly rounded. The lower the values of R1 and R2 become relative to collector resistors R3 and R4, the worse this rounding becomes. Conversely, the larger the values of R1 and R2 relative to R3 and R4, the better the wave shape will be. The maximum permissible values of R1 and R2 are equal to the products of transistor current gain (say 90) and the R3 (or R4) values (1k8 in this case), so the maximum possible values of R1 and R2 are 162k in the Figure 1 and Figure 2 circuits.

The rounding of the leading edges of the basic astable circuit occurs because the collector voltage of each transistor is prevented from rising immediately to the positive rail voltage as the transistor turns off, because of loading by its cross-coupled timing capacitor. This deficiency can be overcome, and excellent square waves obtained, by effectively disconnecting the capacitor from the collector of its transistor as it turns off, as in the 1 kHz generator of Figure 3. Here, D1 and D2 are used to disconnect the timing capacitors at the moment of regenerative switching. The main time constants of the circuit are

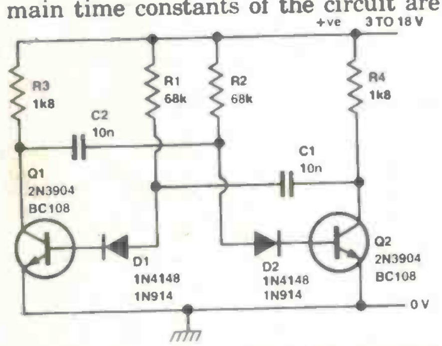


Figure 2. **This version of the 1 kHz astable has frequency correction applied via D1 and D2**

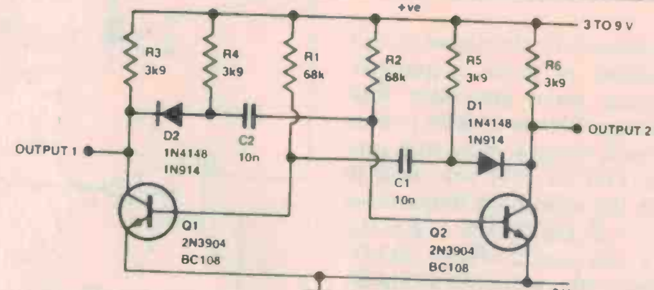


Figure 3. **This version of the 1 kHz astable has waveform correction applied via D1 and D2 and produces excellent square waves.**

again determined by C1-R1 and C2-R2. The effective collector loads of Q1 and Q2 are equal to the parallel resistances of R3-R4 and R5-R6 respectively.

Operation of the basic astable multivibrator relies on slight imbalances of the transistor characteristics, so that one transistor turns on slightly faster than the other when power is first applied. If the voltage to the circuit is applied by slowly increasing it from zero volts, both transistors may turn on simultaneously, in which case oscillation will not occur. This snag can be overcome by using the sure-start circuit of Figure 4, in which the timing resistors are connected to the transistor collectors in such a way that only one transistor can ever be turned on at a given moment.

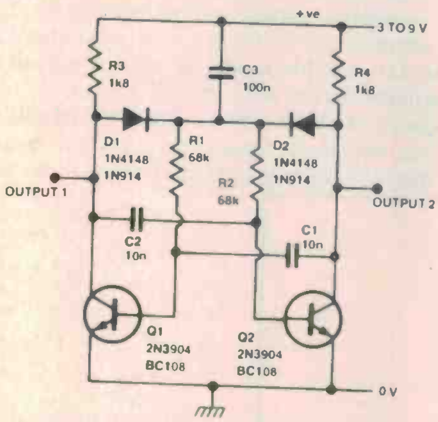


Figure 4. **The 1 kHz astable with 'sure-start' facility.**

The transistor astable circuits we have looked at so far are designed to give a symmetrical output waveform, with a 1:1 mark-to-space ratio. A non-symmetrical waveform can be obtained by simply making one set of astable time-constant components larger than the other. Figure 5a shows the connections for making a fixed-frequency (about 1100 Hz) variable mark-to-space ratio waveform generator, in which the ratio can be fully varied over the range 1:10 to 10:1.

The leading edges of the output waveforms of the above circuit may be objectionably rounded for some applications when the mark-to-space control is set to its extreme positions. Also, the circuit may be difficult to start if the supply voltage is applied to the circuit slowly. Both of these snags can be overcome by using the connections of Figure 5b, in which the circuit is fitted with sure-start and waveform-correction diodes.

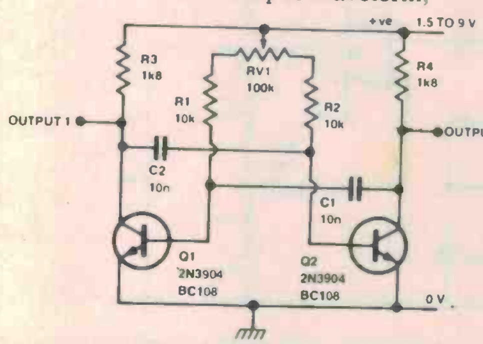


Figure 5a. **Basic variable M/S ratio astable operating at about 1100 Hz.**

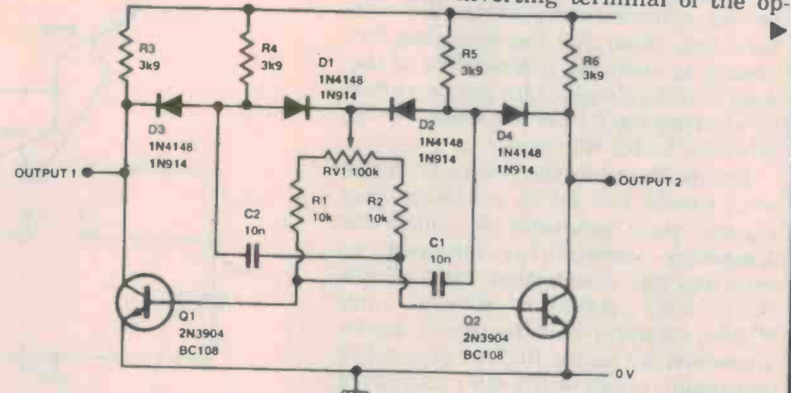


Figure 5b. **Improved version of variable M/S ratio astable with waveform correction and sure-start facility.**

Op-amp generators

Good square waves can be generated by using a fast op-amp, such as the LF351, in the basic relaxation oscillator configuration shown in Figure 6. This circuit requires the use of dual power supplies and, because of the slew-rate limitations of op-amps, its output waveform rise and fall times are not as good as those obtained from transistor, 555, or CMOS astables. The op-amp circuit has, however, some distinct advantages over these alternative types of square wave generator; specifically, it has excellent frequency stability and the waveform can be varied over a wide range by altering any *one* of its four passive component values.

The basic operation of the Figure 6 cirucit is fairly easy to follow. The output of the op-amp alternatively switches between the positive and negative supply rail values and thus applies a positive or negative 'reference' voltage to the non-inverting terminal of the op-amp, this reference voltage being a fixed fraction or ratio (determined by the R2-R3 ratios) of the supply voltage.

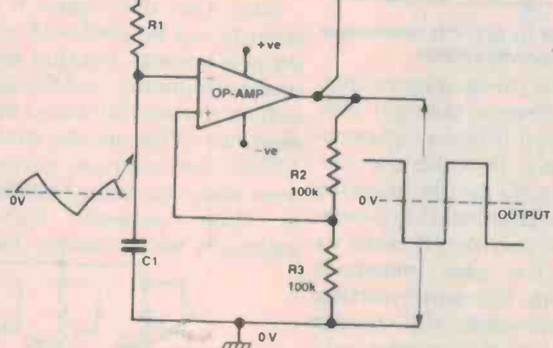


Figure 6. **Basic op-amp relaxation oscillator.**

Suppose initially that C1 is discharged and the op-amp output has just switched positive. In this case C1 will charge positively via R1 until its voltage reaches the positive reference value on the non-inverting terminal of the op-

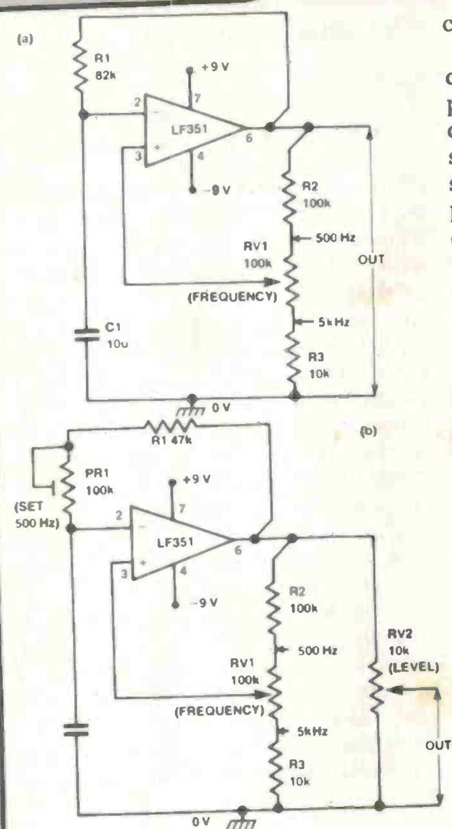


Figure 7. **(a) Simple 500 Hz to 5 kHz squarewave generator and (b) an improved version.**

amp, at which point the op-amp voltage (and thus the reference voltage) will start to fall and thus initiate a regenerative switching action in which the output switches abruptly to the negative rail voltage. C1 will then start to charge in a negative direction via R1 until its voltage reaches the new (negative) reference value on the non-inverting terminal, at which point the op-amp output will again switch regeneratively high and initiate a new action in which the whole sequence repeats itself.

The action of the op-amp circuit is such that a symmetrical square wave is developed at the output of the op-amp, and a non-linear triangle waveform is developed across C1; each waveform swings symmetrically about the zero volts line. Note that the operating frequency is virtually independent of the supply rail voltages, but can be varied by altering the R1 and C1 values, or by altering the R2-R3 ratios.

Figure 7a shows the practical circuit of a simple 500 Hz to 5 kHz op-amp square wave generator in which the frequency variation is obtained by altering the attenuation ratio of the R2-RV1-R3 potential divider, and Figure 7b shows how the circuit can be improved by using PR1 to preset the frequency range of the RV1 frequency control to a precise minimum value, and by using RV2 as an output amplitude control.

Figure 8 shows how the above circuit can be modified to make a general-purpose square wave generator that covers the range 2 Hz to 20 kHz in four switched decade ranges. Note that preset controls PR1 to PR4 are used to precisely set the minimum frequencies of the 2 Hz — 20 Hz, 20 Hz — 200 Hz, 200 Hz — 2 kHz, and 2 kHz — 20 kHz ranges respectively, without calling for the use of precision components.

Finally, Figure 9 shows how the basic relaxation oscillator circuit can be modified so that it provides both a variable frequency and a variable mark-to-space ratio output. The mark-to-space ratio is variable via RV1, and the circuit action is such that C1 alternately charges positively via R1-D1 and the left-hand side of RV1 and charges negatively via R1-D2 and the right-hand side of RV1. The mark-to-space ratio is variable over the range 11:1 to 1:11, and the frequency is variable over the approximate range 650 Hz to 6.5 kHz via RV2; varying the mark-to-space ratio setting causes only slight interaction with the frequency control.

Note that the Figure 6 to Figure 9 circuits can be used with virtually any types of op-amp, but that the maximum usable frequency and the quality of the output rise and fall times depend on the slew rate of the op-amp that is used; the LF351, for example, gives a performance about ten times better than the 741 in these respects. Also note that although we've shown the circuits as

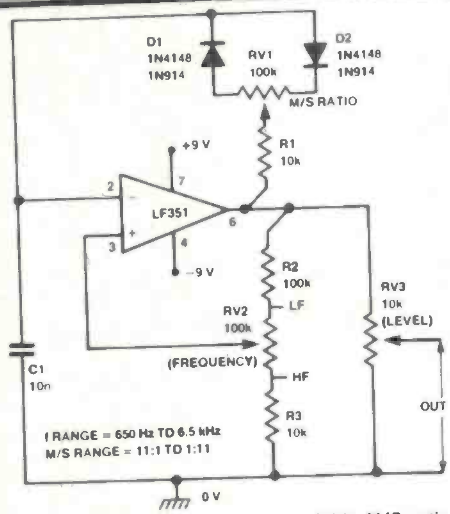


Figure 9. **Variable frequency, variable M/S ratio generator.**

being powered from 9 volt split supplies, they can in fact be powered from any split supplies in the range 5 to 18 V.

555 astables

The IC known as the '555 timer' makes an excellent square wave generator when used in the astable mode. The device is readily available, inexpensive, and is housed in an 8-pin dual-in-line (DIL) plastic package. It can be powered by any supply in the range 4.5 to 15 volts, has a low-impedance output that can source (supply) or sink (absorb) load currents up to 200 mA and, when used in the astable mode, generates output square waves with typical rise and fall times of about 100 ns. The 555 astable has excellent frequency stability, can span the frequency range from near zero

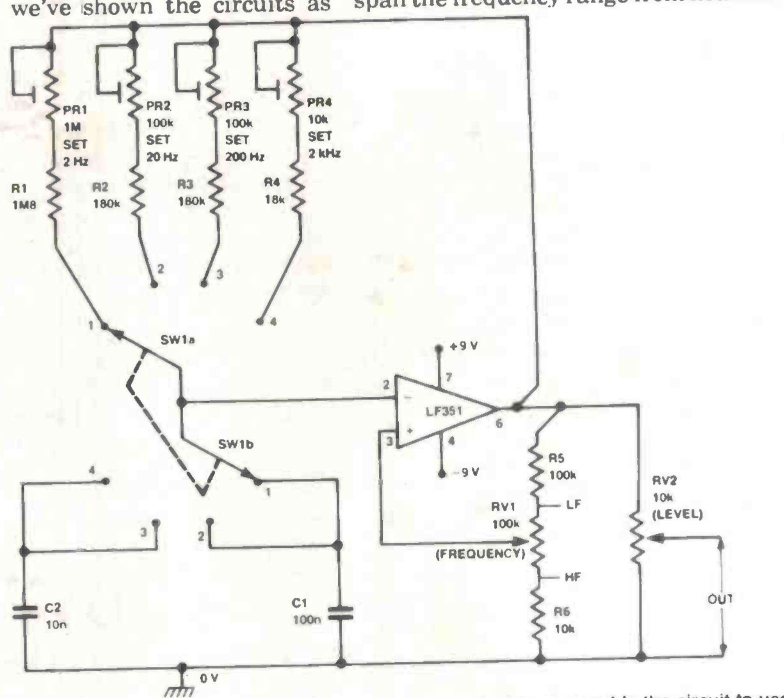
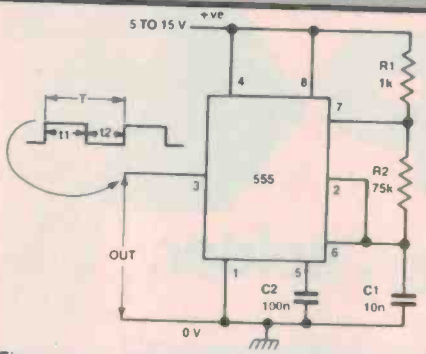


Figure 8. **Four-decade (2 Hz to 20 kHz) square wave generator. The presets enable the circuit to use a single calibrated frequency scale.**



$t1 = 0.7(R1 + R2)C1$
$t2 = 0.7(R2)C1$
$T = 0.7(R1 + 2R2)C1$

$$f = \frac{1.44}{(R1 + 2R2)C1}$$

IF R2 >> R1:
$t1 = 0.7 \times R2 \times C1$
$t2 = 0.7 \times R2 \times C1$
$T = 1.4 \times R2 \times C1$

$$f = \frac{0.72}{R2 \times C1}$$

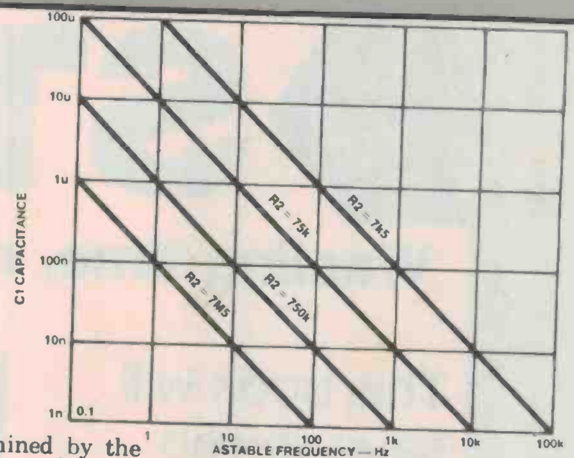


Figure 10. **(a) Basic circuit of a 1 kHz 555 astable with design formulae. (b) Approximate relationship between C1, R2 and f for the 555 astable when R2 is large relative to R1.**

to about 100 kHz, and its frequency and mark-to-space ratio can be accurately controlled with two external resistors and one capacitor.

Figure 10a shows the practical circuit of a basic 1 kHz 555 astable, together with the formulae that define the timing of the circuit. The circuit operation is such that C1 first charges exponentially via the series R1-R2 combination until eventually its voltage rises to two-thirds of the supply voltage, at which point a regenerative switching action takes place and C1 starts to discharge exponentially via R2 until eventually its voltage falls to one-third of the supply voltage. At this point a second regenerative switching action takes place and C1 starts to re-charge towards two-thirds of the supply voltage via R1-R2, and the whole sequence repeats. C2 is used in this circuit (and those that follow) to decouple the internal circuitry of the 555 chip from the effects of supply line transients.

Note that the operating frequency of the above circuit is virtually independent of the supply voltage value, and that both the mark-to-space ratio and the frequency are determined by the R1-R2-C1 values. Also note that if R2 is large relative to R1, the operating frequency is determined mainly by the R2 and C1 values and that an almost symmetrical output waveform is generated. The graph of Figure 10b shows the approximate relationship between frequency and the C1-R2 values under the above condition. In practice, the R1 and R2 values can be varied from about 1k to 10M.

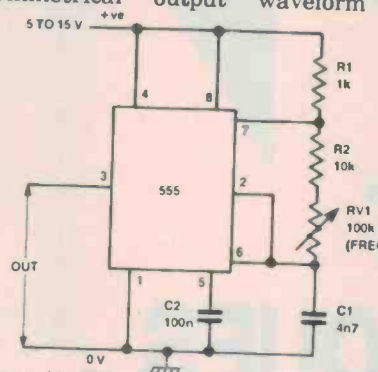


Figure 11. **This variable frequency generator covers 1.4 kHz to 15 kHz.**

The basic Figure 10a circuit can be modified in a number of ways. Figure 11, for example, shows how it can be made into a variable frequency square wave generator by replacing R2 with a fixed and a variable resistor in series. With the component values shown, the frequency can be varied over the approximate range 1,4 kHz to 15 kHz via RV1.

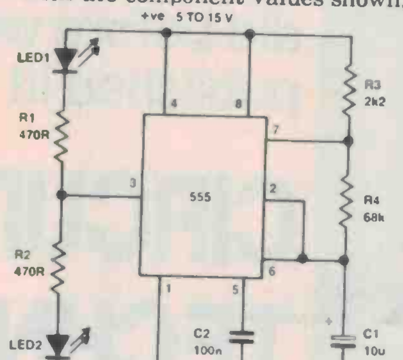


Figure 12. **This two-LED flasher operates at just under 1 Hz. The LEDs flash alternately.**

Figure 12 shows how the circuit can be used as a two-LED 'flasher' unit, in which one LED turns off as the other turns on, and vice versa. The circuit ▶

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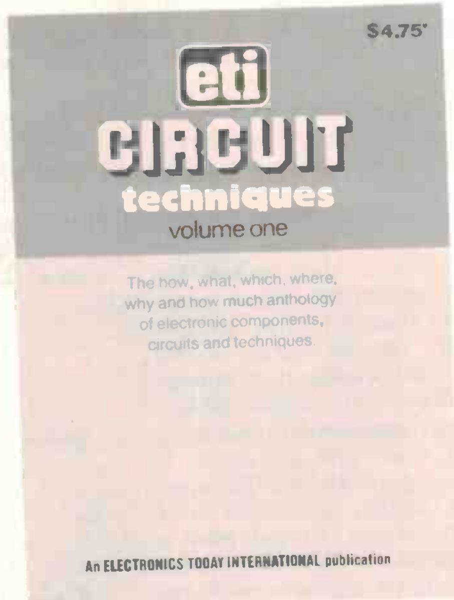

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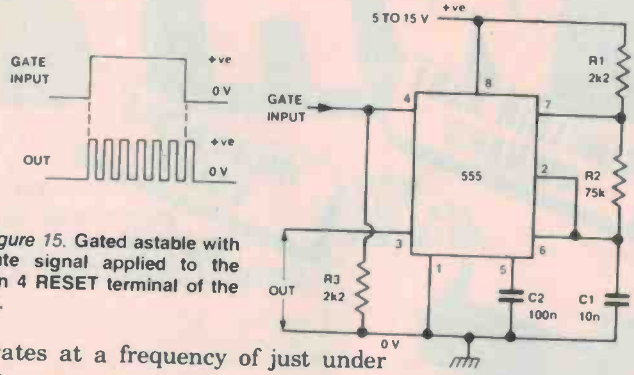


Figure 15. Gated astable with gate signal applied to the pin 4 RESET terminal of the IC.

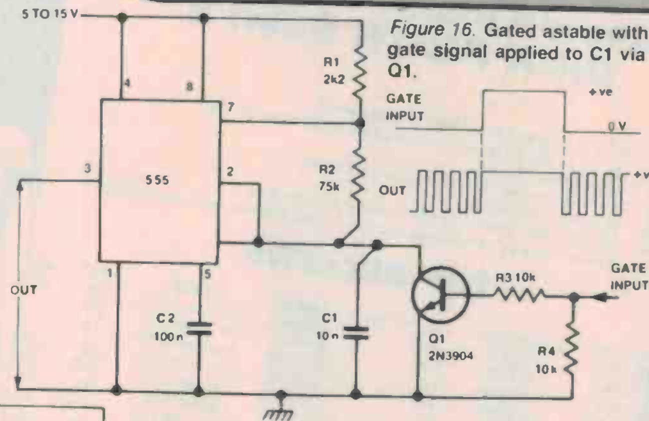


Figure 16. Gated astable with gate signal applied to C1 via Q1.

operates at a frequency of just under 1 Hz.

Figure 13 shows how the circuit can be modified so that its mark and space periods are independently variable over the approximate range 15 us to 1.5 ms.

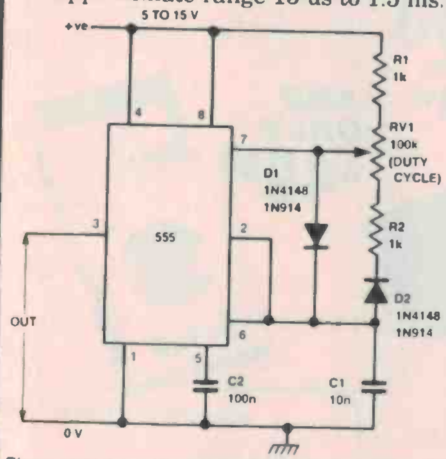


Figure 13. Astable with mark and space periods independently variable over about 15 us to 1.5 ms.

Here, timing capacitor C1 alternately charges via R1-RV1-D1 and discharges via RV2-R2-D2.

Figure 14 shows how the circuit can be modified so that it acts as a fixed-frequency square-wave generator with a mark-to-space ratio or duty cycle that is fully variable from 1% to 99% via RV1. Here, C1 alternately charges via R1 and the top half of RV1 and D1, and discharges via D2-R2 and the lower half of RV1. Note that the sum of these two timing periods is virtually constant, so the operating frequency is almost independent of the setting of RV1.

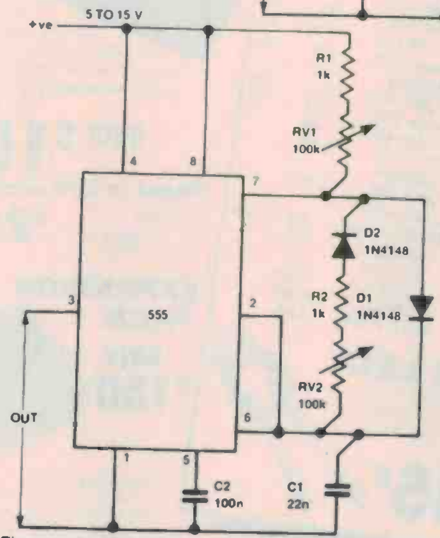


Figure 14. 555 astable with duty cycle variable from 1% to 99%. Frequency is almost constant at about 1 kHz.

The 555 astable circuit can be gated on and off (enabled or disabled) either by applying a gate signal to pin 4 or by disabling or enabling the main timing capacitor via a transistor switch.

Figure 15 shows how the circuit can be gated via the pin 4 (reset) terminal. The characteristic of this terminal is such that if the terminal is biased above a nominal 0.7 volts, the astable is enabled, but if it is biased below 0.7 volts by a current greater than 100 uA (by taking pin 4 to ground via a resistance less than 7k, for example) the astable is disabled and its output is grounded. Thus in the Figure 15 circuit the astable can be turned on by applying a high or logic 1 signal to pin 4, or off by applying a zero or logic 0 signal to pin 4.

Finally, to complete this month's look at square wave generator circuits, Figure 16 shows how the 555 astable can be gated on and off via a transistor wired across the main timing capacitor, C1. Here, with zero gate drive applied, Q1 is cut off and the astable is free to operate in the normal way, but when a high gate signal is applied, Q1 is driven on and discharges C1, thus disabling the astable. Note that the output of this circuit is driven high when the astable is disabled in this way. ●

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.

Simple LED bar/dot level meter

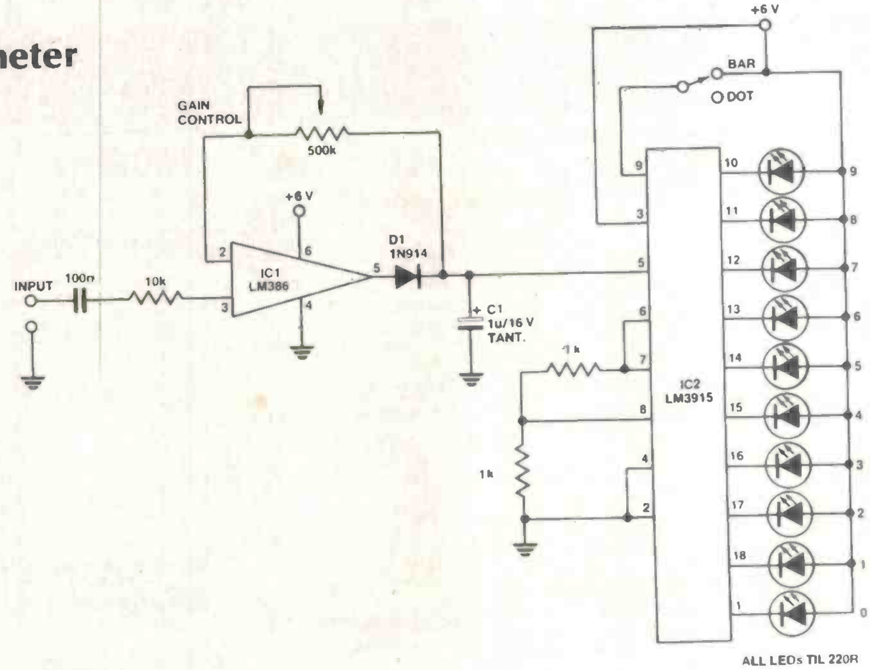
This simple level or 'power' meter can be arranged to give a bar or dot display for your hi-fi system, according to **D. Ellis of Glengowrie, SA.**

The LM386 op-amp plus D1 and associated components provide an 'absolute value' signal to charge C1. The voltage on C1 hangs on, enabling transients to be seen. The voltage on C1 is applied to the input of an LM3915 log LED display driver.

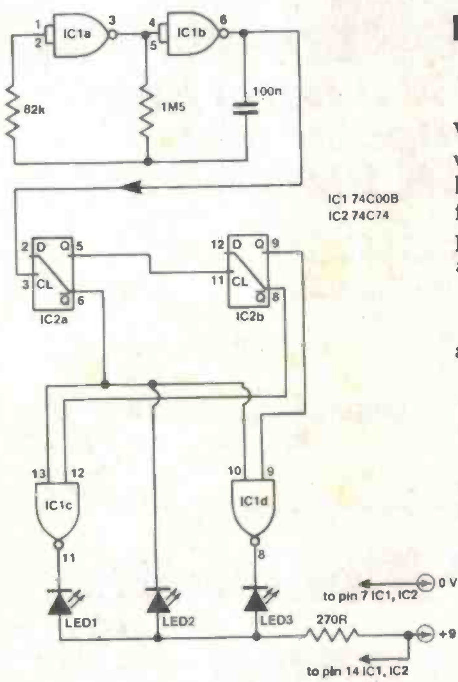
For LEDs 0 to 7, I used green LEDs, for no.8 I used a yellow one and for LED 9 a red one — the last to indicate peak power.

The gain control is provided to enable calibration on the equipment with which the unit is used.

The unit draws some 200 mA, so a power supply is advisable, rather than running the unit from batteries.



Electronic pendulum



The following circuit, from **G.N. Vayro of Broadmeadows, Victoria,** was used to provide a simulated pendulum effect in an electronic clock by flashing three LEDs in a particular repetitive sequence. The LEDs were arranged as follows,

○ ○ ○
1 2 3

and the sequence is 1, 2, 3, 2, 1.

The sequence is set for one second with the values shown and the visual effect is excellent.

The clock is a digital modular type, mounted in a highly polished wooden cabinet, resembling the grandfather clock style, but it is only 150 mm high.

The circuit was added to my clock for aesthetic reasons and has nothing to do with the clock timing. Readers may find other uses for the circuit as it is simple and uses all gates of two ICs.

It works as follows. Two gates of the 74C00 are used as a clock driving the two D-type flip-flops, which are connected to toggle by joining the D and Q. Frequency of operation can be changed by changing the C on the clock circuit. The two flip-flop outputs are decoded using the remaining two 74C00 gates to provide the required effect.

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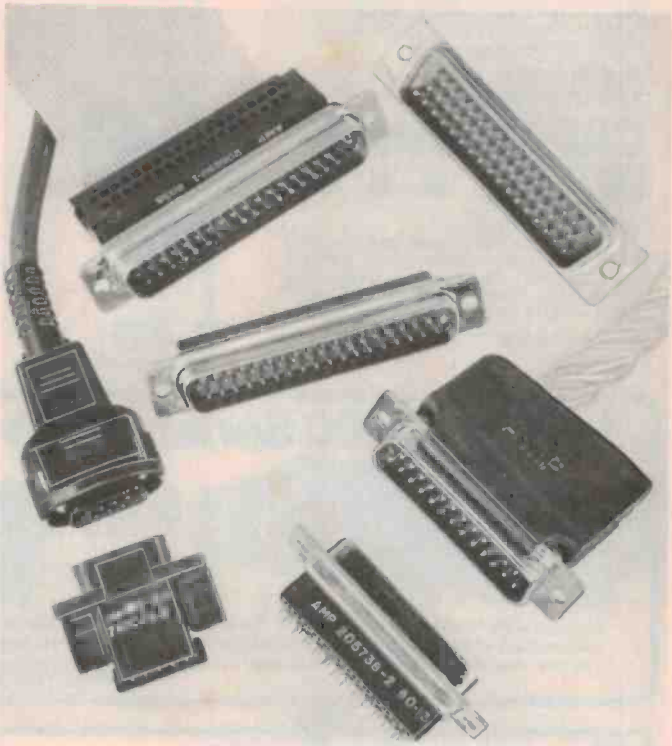

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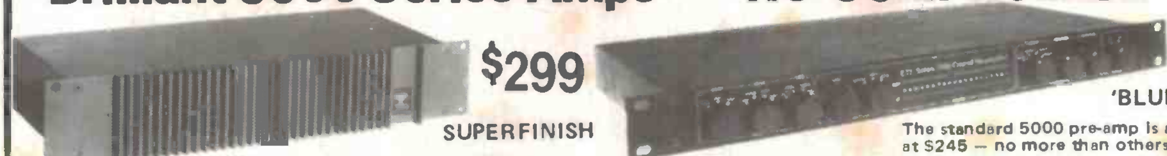

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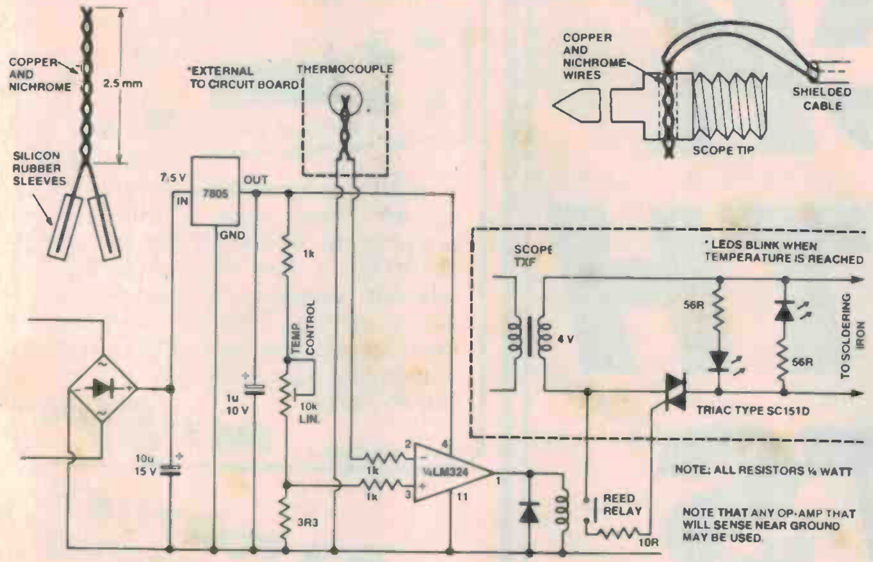
Ideas for Experimenters



IDEA OF THE MONTH
Max J. Sciara
Abbotsford NSW

Temperature control your Miniscope!

My Miniscope soldering iron had been a good friend for a number of years when I came to the conclusion that a temperature-controlled soldering iron was becoming more and more a necessity and not a luxury.

This necessity, plus my reluctance to part with the above-mentioned iron, led to the following circuit, which transformed it into a five-second, heat-variable, temperature-controlled soldering iron.

A simple, jury-rigged thermocouple provides a sensor. The LM324 op-amp senses the thermocouple voltage at pin 2 (with the wires used this voltage is about 11 mV at the solder melting point) and compares it to the reference level at pin 3. RV1 allows this voltage to vary between about three and 20 millivolts.

When the thermocouple voltage reaches the trip level, set at the comparator, the output goes low, de-energising the reed relay and thus turning the triac off. At this point the iron tip cools, the thermocouple voltage decreases and the comparator output goes high again, thus repeating the cycle.

The thermocouple was constructed by twisting together two short lengths of copper and nichrome wire (the nichrome wire was salvaged from a wirewound resistor).

A 1mm hole is drilled into the Miniscope tip, just before the thread begins, and the twisted pair is inserted into this hole. A firm squeeze with a pair of pliers will complete the job.

The circuit is not at all critical, save for the fact that shielded cable must be used to connect the thermocouple to the circuit board (the thinnest microphone cable will suffice). With a suitable change in divider resistors, the supply voltage may be anything from 4 to 15 V. The voltage regulator is used to stop the voltage from fluctuating as the iron is switched on and off (this happens in my case because I have used a transformer with two windings, one for the iron and one for the controller).

An improvement in temperature regulation would be obtained by using an optocoupler instead of the reed relay, as the former is a much faster device. Further, the thermocouple may be made up from different types of wire as long as a suitable output is obtained at the solder melting point.

✱ 'IDEA OF THE MONTH' CONTEST ✱

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

RULES

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

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

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

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

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

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

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

COUPON

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

* Breach of copyright is now a criminal offence.

Title of idea ....
Signature ....
Name ....
Date ....
Address ....
.... Postcode ......

Cut out and send to: Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

DICK SMITH KITS

EASY TO BUILD

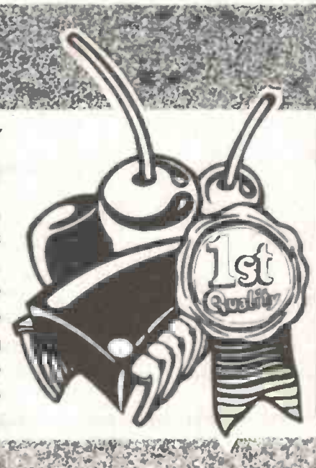
We supply everything you will need to assemble the kits, right down to the last nut and bolt. We even include full instructions rewritten by our technical specialists to make construction easy.

LOOK SO GOOD

Imagine how proud you will be when you are able to show a fully assembled kit to your friends and say 'I built it myself!' They look so good your friends will never believe you.

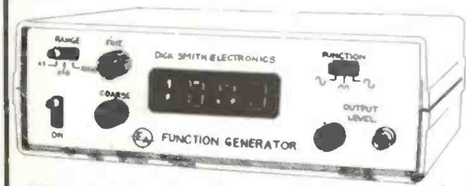
QUALITY COMPONENTS

We only use brand new, prime spec components in our kits. If we do have to make parts substitutions we check these out with the designer of the project first before we make the change.



NEW

FUNCTION GENERATOR

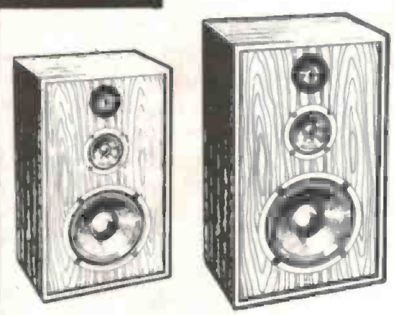


This kit produces sine/triangle and square waves over a frequency range from below 20Hz to over 160KHz! It has four digit LED readout enabling accurate frequency setting. This kit makes an ideal companion for our frequency counter kit (Cat K-3439).
Cat K-3520

SEE ETI APRIL 82

ONLY $59.50

SAVE A FORTUNE ON THESE QUALITY SPEAKER KITS!



Famous Playmaster

Now Dick Smith offers you these superb speaker kits just right for your needs. All are manufactured to exacting standards of E.A. specifications. All kits include 3 magnificent speakers (woofer, mid-range and tweeter), superbly re-designed cabinets to suit any decor, full instructions, wiring harness with clip on connections (no soldering required). All kit prices are per pair.

8" 3 WAY SYSTEM
200mm SPEAKER KIT
Cat C-2046 **$89.50**
BOX KIT Cat C-2626 **$82.00**

ONLY $171.50

10" 3 WAY SYSTEM
250mm SPEAKER KIT
Cat C-2044 **$149.00**
BOX KIT Cat C-2624 **$115.00**

ONLY $264

$100's less than equivalent pre-built units!

STOCKS LIMITED AT THIS PRICE - SO HURRY!!

SOUND LEVEL METER

This unit will measure noise in its many forms. Measures levels of less than 20dB to levels greater than 120dB with fast or slow response times. A large VU meter gives easy readings and the meter range is selectable in 9 steps. The kit is mounted in a zippy box and is battery powered.
Cat K-3476

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NEW

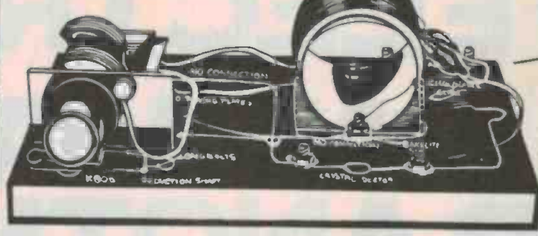
PERCUSSION SYNTHESIZER

Now we've got rhythm with this percussion synthesizer. Produces the sounds of drums, cymbals, snares and bongos. You can play manually or by total electronic control. By the simple connection of a sequencer you can have automatic rhythm, just right for learning the basics of timing in music.
Cat K-3517

ONLY $47.50

NEW

FOR FAMILY FUN REDISCOVER THE CRYSTAL SET WITH THE



DICK SMITH CRYSTAL SET

- ★ No batteries
- ★ Surprisingly good sound
- ★ Foolproof circuits

A most satisfying project that will give you lots of satisfaction. It can pull in a surprising number of broadcast stations and produce good sound when connected to a stereo system. AND it even works during a blackout!
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SEE EA APRIL 82

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Ever been embarrassed by running out of petrol at the wrong time? This easy to assemble kit will help prevent this from happening. Single PCB project with audible and visual alarm.
Cat K-3260

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NEW IMPROVED

SOUND EFFECTS GENERATOR

Now supplied with Tiger Moth sound 'free of charge'
(See ETI March '82)

One of the attractions of the more sophisticated video games is the realistic sound effects that match the action - gunshots, bomb whistles and explosions etc. This kit employs just one IC to do all the hard work.
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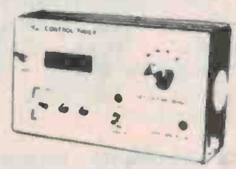
ONLY $17.50

240V CONTROL TIMER

Switch an appliance on for a preset period any time, night or day. Large lighted LCD clock and tough die-cast case combine to give rugged reliability.
Cat K-3085

ONLY $49.00



HOT CANARY

This great gimmick kit will keep any child, or adult, amused for hours. An electronic bird noise maker that sounds just like a real bird! Cat K-3395

ONLY $15.50

BUILD IT YOURSELF FOR UNDER $100!

The Dick Smith Professional Frequency Counter

*500MHz, 7 digit resolution *with optional pre scaler

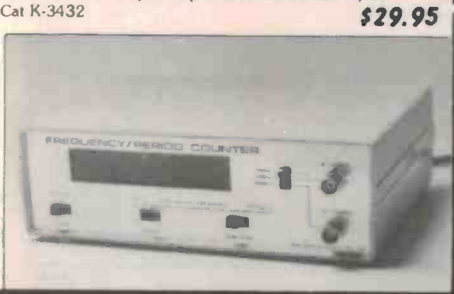
A completely new frequency & period counter using the latest IC technology. The low component count makes it a very reliable and easy to build unit. It will measure frequency to 500MHz (with optional pre scaler) and period both with a 7 digit resolution.
Features include ★Professional design and finish - use high quality instrument case ★Easy to build with virtually all wiring on PCB's ★High accuracy ★All switches are integral to the display board and front panel. Based on E.A. design Dec. 81 issue.
Cat K-3439

with exclusive DICK SMITH simplified circuit board wiring, step-by-step instructions & quality pre-punched & printed front panel

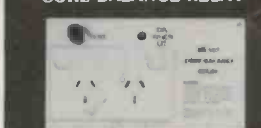
$99.50

PRE SCALER

Convert your Cat K-3439 Frequency Counter to 10-500 MHz with this optional pre-scaler. It's a must for just
Cat K-3432 **$29.95**



PROTECT YOUR LIFE & EQUIPMENT
CORE BALANCE RELAY



This could save your life and protect your equipment. The Core Balance Relay electronically detects fault currents and trips a relay which cuts the power. The relay cannot be reset until the fault has been corrected. Portable unit moulded into a tough plastic case and runs off 240V.
Cat K-3315

$52

Multi-function Timer Stopwatch

Use as a stopwatch, countdown timer or event timer! Selectable timing rates between 0.01 and 1.0 seconds make this ideal for sporting events, darkrooms etc. Wiring for the unit for any of seven different functions is possible.
Cat K-3435

ONLY $39.50

YOU COULD WIN A MILLION!

LOTTO/POOLS SELECTOR

Push button, with large LED display makes it easy. Supplied with an attractive front label. Good luck!
Cat K-3392

$19.95

LEDS AND LADDERS

Based on the old 'Snakes and Ladders' game, we've replaced snakes with LEDS! This kit has been updated with new circuitry and simplified controls so the whole family can enjoy playing. Complete kit includes front panel sticker and zippy box.
Cat K-3390

ONLY $16.50

DICK SMITH Electronics

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DSE/A239/PAI

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At International Correspondence Schools, we have at least 15 career courses you can take in electronics and other inter-related fields, like computers and television. These are the fields of the future that you *should* progress in now. And they are all ideally suited to home study. And ICS, being the largest institution of its kind in the world, has access to the latest world-wide developments and among the best teachers Australia has to offer. So, if you're interested in one or more of the courses below, mail the coupon to ICS, and we'll send back everything you need to begin a more successful career.

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Postcode .... Occupation .... Age .... Tick here if currently full time student ☐

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Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.

ETI-645 Turtle Robot

As notified last month, a complete kit of parts for this project is being offered at a special introductory price by Flexible Systems, and ETI is acting as a clearing house for orders and despatching kits; see page 33 for further details. You can call into our Sydney or Melbourne offices during business hours to see a Tasman Turtle and purchase kits. In Sydney, you'll find us at:

4th Floor, 15 Boundary St,
Rushcutters Bay.

In Melbourne, at:

22nd Floor, 150 Lonsdale St,
Melbourne.

Note that 'Tasman Turtle' is a registered trademark of Flexible Systems.

ETI-670 Keyboard

Complete kits will be stocked by several suppliers — try All Electronic Components and Rod Irving Electronics in Melbourne and Electronic Agencies in Sydney. Both firms can supply by mail order if you wish.

For those not following our assembly, the keyboard may be obtained separately through the above-mentioned suppliers or direct from Amtex Electronics, P.O. Box 285, Chatswood NSW 2067. (02)411-1323.

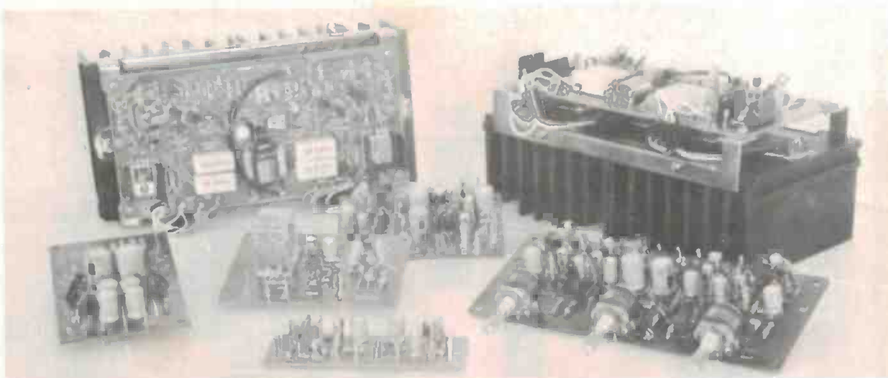
ETI-469 Percussion synth.

Altronics, Jaycar, Electronic Agencies, All Electronic Components, Dick Smith Electronics and Rod Irving Electronics are all stocking this project, featured last month, in kit form. There's not much need to shop around for this one!

Sundays

Jaycar advise that they no longer open on Sundays. Dick Smith's Auburn store and Electronic Agencies' Concord store ceased Sunday trading some months ago.

In general, Sunday trading has had the kibosh put on it in NSW by pressure on the Government from the Shop, Distributive and Allied Employees union since a wide range of stores commenced Sunday trading last year, and the State Government has warned stores they will be fined if they trade in contravention of the state laws on Sunday trading. The situation is apparently under review. One hopes that, for the fostering of the community's electronic geniuses, Sunday trading returns in the future.

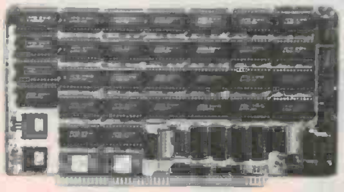


INEXPENSIVE KIT STEREO AMP.

Pre-Pak Electronics are offering this modular stereo amplifier kit with a power amp specified at 120 W per channel RMS! The complete kit comprises two power amps, a tone control module, a phono preamp module, a mic preamp module, a speaker protector and a power supply (regulators) module — seven in all. The kit comes complete with circuits and suggested wiring and layout details. To power it all you need to add a transformer delivering 44-0-44 Vac at 5 A and 8 Vac at 300 mA, plus a bridge rectifier and two 10 000u/65 V filter caps. The modules are well made, each board being solder masked on the copper side and silk-screened on the component side. The tone controls usefully include detents so you get 'step' control. The complete kit costs $125 ($5 p&p). Modules can be bought separately. Contact Pre-Pak Electronics, P.O. Box 43, Croydon NSW 2132, or stores at 1A West St, Lewisham and 1190 Canterbury Rd, Punchbowl.

★ NEW PRODUCTS ★ NEW PRODUCTS ★

64K STATIC RAM BOARDS



S100 and SS50 buses both boards are only **$425.00** each ASSEMBLED AND TESTED ($379 tax exempt).

NEW VDU & KEYBOARD CASE

Room for CPU Boards, power supply, two four inch Drives, Monitor and Detachable Keyboard Case.

ALL THIS FOR ONLY

$239 + Tax

TERMINALS NOW AVAILABLE

Green Phosporous Intelligent terminals from only **$1099 + Tax.**

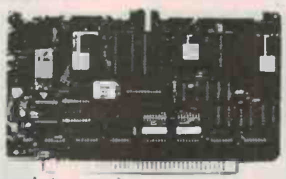
68PDC04

Processor and Disc Controller Card.

• Accepts Motorola 6802 and 6809 microprocessors • Monitor available • Single 2716 (+5V) or 2732 EPROM for each microprocessor • 1k scratchpad RAM • Extended addressing range • Software/Hardware trace facility • Full RS232 with handshaking • Parallel port with control lines • Single/Double density, 5¼/8 inch, Single/Double sided Floppy Disc Controller interface • Motorola Exorciser Bus compatible. ONLY $95. A&T $495 + Tax

68GPB03

The ultimate in microprocessor I/O.



• 16 channel ADC (with 12 bit resolution). • 2 channel DAC (with 8 bit resolution). • 32 bit programmable I/O (2 x MC6821). • 6 programmable timers (2 x MC6840). • 2 serial synchronous/asynchronous interfaces. • Hardware and software programmed baud rate generation. • High quality double-sided PCB. • Motorola Exorciser Bus and outline compatible. • Occupies only 32 consecutive bytes.

68MB02

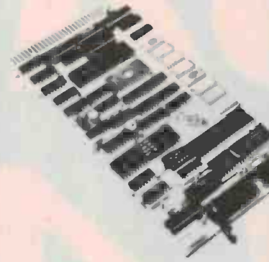
Two boards in one

• 16K RAM (2114) expandable in 1K increments. • 16K EPROM (2716, plus 5V) expandable in 2K increments. • Two 8K RAM blocks selectable in 8K increments. • Two 8K EPROM blocks selectable in 8K increments. • High quality double-sided PCB. • Motorola Exorciser Bus and outline compatible. • Motorola Exorciser Bus compatible.

SPECIAL ONLY $60*

*All prices add 17.5% S/T (if applicable) and subject to change without notice. P&P $2.

NEW SINGLE BOARD COMPUTER



We call this our ***"Little Big Boards"*** after the fantastic success of our first ***"Big Boards".***

ALL THIS FOR ONLY $749 + Tax

Major breakthrough in the field of single board Micro Computers.

Series 6000 single board Micro has the following features:
Dimensions: 4.5" x 8.025" (will fit in S.T.D. Bus card frame).
C.P.U.: Z80 A (4MHz).
R.A.M.: 65536 bytes.
Disk Controller: Will support up to 4, 8" or 5.25" double or single sided, double or single density floppy disk drives with a 50 way cable connector on board.
Input/Output Ports: 2 RS232C bidirectional ports.
Bus Structure: Full S.T.D. bus configuration that will permit off board D.M.A., up to 56K of additional R.A.M., the capacity to have another C.P.U. control the Pulsar C.P.U. and the facility to access many other S.T.D. cards now in production.
Real Time Clock: Battery backed up real time clock which features leap years, 12 or 24 hours format and a 99 year calendar.

SINGLE & DUAL POWER SUPPLY CASES

With and without disk drives now available.
1. 2 MP151 Drives in dual case with power supply and cable for SYSTEM 80 $659 + Tax.
2. Other drives can be fitted to these cases so please enquire about disk expansion for your computer.

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	1-9	10-25	25 plus
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DICK'S DIRECT IMPORT PRICES

SAVE ON 40CH

Cat. D-1447

40Ch AM
STALKER VIII

Don't take chances in buying CB radio . . . buy your CB from Dick Smith, Australia's CB expert!
The superb Stalker VIII CB features the new legal 40 channels, complete with microphone and mounting bracket.
Large LED channel readout, easy to use and has maximum legal output.

~~$149.00~~
NOW ONLY
$97.50

FANTASTIC VALUE!

DOC Approval No. 249A001

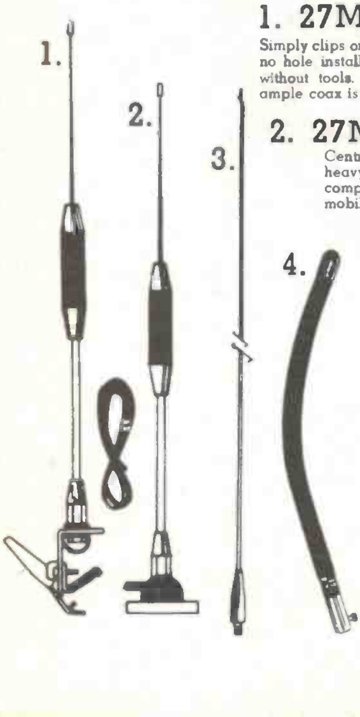
Cat. D-1710

40Ch AM/SSB
UNDER $250! That's the
DICK SMITH HORNET II

This unit is the latest in 40 channel CB technology. With the massive 12 watts p.e.p. output on SSB, this set meets the high DOC standard RB249A. Frequency range is 26.965MHz to 27.405MHz and accessories include DC power cable with built-in fuse and microphone clip.

$239.50

DOC Approval No. 249A006



1. 27MHz Gutter Grip — **$25.00**
Simply clips onto the rain gutter of any vehicle. Features no hole installation and can be installed or removed without tools. Antenna has centre loading coil and ample coax is supplied. Cat. D-4411

2. 27MHz Magnet Base — **$25.00**
Centre loaded stainless steel construction with heavy magnetic base. 16 feet of coax supplied, complete with PL259 plug. Ideal for 'instant' mobile use. Cat. D-4412

3. ¼ Wave Whips — Cat. D-4415 **$15.50** / Cat. D-4416 **$19.95**
Your choice of stainless steel or fibre-glass. Each is approx. 2.75m long, ideal for marine or CB use.

4. 'Rubber Duck' — **$8.50**
Indestructable and very flexible, perfect for handheld sets. Only 300mm long, great replacement antenna! Cat. D-4629

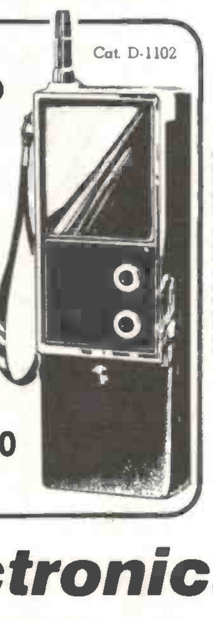
TOP VALUE HAND HELD

Cat. D-1102

For the weekend boatmen who don't want the more expensive full power transceivers, but who still need that reassurance of having a safety transceiver on board. Three channels available, one fitted with 27.620MHz, the others left blank for your own choices. Crystals are reasonably priced and easy to fit. This set takes 8 'AA' pencell batteries.

GREAT VALUE!

ONLY **$51.00**



FULL RANGE OF ACCESSORIES AT LOW DICK SMITH PRICES!

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DSE/A234/LM

The ZX PRINTER — designed for use with ZX81 and ZX80 with 8K BASIC ROM. Alpha-numerics! Graphics!

$190 incl. Sales Tax

$199 COMPLETE

sinclair ZX81 PERSONAL COMPUTER

* *excluding mains adaptor*

sinclair

COMPLETE WITH BASIC MANUAL, LEADS, ONLY $199

16K-BYTE RAM PACK $150

Higher specification, lower price — how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

The ZX81 comes complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

New, improved specification

- Z80 a microprocessor — new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function — useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet — but coming soon)!
- Advanced 4-chip design, microprocessor, ROM, RAM, plus master chip — unique, custom-built chip replacing 18 ZX80 chips.

ZX Software Cassettes

Send for free catalogue of Games, Business, Educational, Junior Education. Encl. S.A.E.

FREE New Basic ZX81 Manual

ORDER FORM: SINCLAIR EQUIPMENT (A'SIA) P/L

86-88 Nicholson St., Abbottsford, Vic. 3067. Ph. (03) 419 3033.

QUANTITY	ITEM	ITEM PRICE	TOTAL
	Ready assembled ZX81 Sinclair Personal Computer including leads, BASIC manual, excluding mains adaptor.	$199	
	16K-BYTE RAM pack (optional extra)	$150	
	1.2 Amp Adaptor	$ 17.50	
	ZX Printer	$190	

I enclose cheque/Bankcard/Diners Club/Amex ☐☐☐☐☐☐☐☐☐☐☐☐☐

Total ______

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QUEENSLAND: Myer (all branches); Bundaberg — Datacom; Taringa — Software 80; Rockhampton — Purely Electronics Pty. Ltd.; Townsville — Scott's Audio-Optical.
ACT: Fyshwick — Steve's Communication Centre. **TASMANIA:** Hobart — J. Walsh and Sons Pty. Ltd.; Launceston — Birchalls; Hobart — Quantum Computers.
VICTORIA: Myer; Prahran — The Logic Shop; West Melbourne — Radio Parts Group; Northcote — Rod Irving Electronics; Bendigo — Minit Computer Service; Mildura — C. & G. Computers Pty. Ltd.; South Melbourne — B.B.J. Computer Shop Pty. Ltd.; Croydon — Mindbenders of Croydon; Melbourne — Strachan Office Supplies; Melbourne — Computerland.
WESTERN AUSTRALIA: Perth — Microbase. **SOUTH AUSTRALIA:** Myer (Adelaide store); Adelaide — Acuis Australasia Pty. Ltd.; Mt. Gambier — Omni Computing.
NORTHERN TERRITORY: Alice Springs — Ascom Electronics; Wulagi — Eyles Computer Services.
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The time-saver

Philips new PM 3207 oscilloscope will make you think twice about how you're spending your measuring time.

This compact unit has time saving measuring features galore.

Big, easy to read screen. High 5 mV sensitivity on both channels. Auto triggering. Add, B invert, and triggering from A or B channel. TV triggering and double insulation.

Plus a 15 MHz bandwidth which will enable you to load it up with all kinds of different jobs to do.

Add Philips' robustness, reliability and quality components to this list and there's only one more question to ask.

Fine. What about price?
Much less than you expect.

Our brochure will open your mind as to how the PM 3207 can save time and money for you.

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LETTERS

Dear Sir,

Thank you for ETI-825. The idea is fantastic; only one problem — the cost of making four of them for the eight-lane circuit I'm building looks a bit expensive! Mind you, it's peanuts compared with the cost of 100 metres of track.

The only extra I need now is the ultimate competitor, computer-controlled drivers for the other seven lanes. It wouldn't be too difficult to do, just have the computer monitor the supply voltage through each corner over a number of runs, evaluate the maximum permissible speed for each corner, and reproduce the effect each lap. I'm sure your whiz programmers could do that.

Anyway, when you figure it all out jot it down, print it up in the next issue and I'll be the first to use it!

Jim Wood
Kingsford NSW

We're one jump ahead of you! An associate of Jonathan Scott has pressed an Apple into service to race one lane of a four-lane track on a Scalextric set (the one on December's cover!). They're still trying to work out how to beat the god-damn computer without actually cheating . . . so it might be some time before you see anything in print! (It's a sight to behold, I tell you . . . grown men down on their elbows and knees amongst a great snake of slot car track, the computer in the corner silently guiding this little plastic and metal racecar replica around the track at equivalent speeds of 300-400 kph, while these 'grown men' shout encouragement and invective and go alternately red and white in the face . . .).

Dear Sir,

After using the excellent ETI-1500 Super Metal Detector for some months, I have noticed that when in VLF mode the tuning tends to wander quite noticeably when the batteries are aged but still test OK. With fresh batteries the wander is still there but not as pronounced.

Regardless of battery state the +10 V rail is low, i.e: +8.2 to +8.5 V when ZD1 is 5V1 not 5V6.

Basic Ohm's law indicates that resistor R53 should have about 300 uA through it, whereas the zener needs at least 2 to 3 mA to work correctly. Consequently the regulator cannot possibly work correctly.

I suggest that R53 be changed to 2k2 to keep the zener current low to prolong battery life.

When R53 is altered the +10 V rail goes to +10 V ± 0.3 V and the tuning becomes very stable, as it should be.

Peter Burbidge
Chirnside Park Vic.

Many thanks for the suggestion; we have passed it on to readers experiencing problems similar to yours and this note should spread the word more widely.

Dear Sir,

I have just completed testing the ETI-1500 metal detector, and I am pleased to say that it performs as well if not better than all the over-priced commercial units that I have used.

But I did encounter one problem which may be of interest to you. My detector responded the reverse to what would be expected, the meter pointer moving to the left when aluminium was brought near the head, the ground control also being ineffective. Changing the polarity of the receive coil and transmit coil resulted in a very insensitive detector. Further investigation revealed the receive signal to be 180 degrees out of phase. This was corrected by making IC4b non-inverting, connecting pin 5 to 'L', and pin 6 to +5 V. The detector now works very well and is an excellent project.

R.J. Lovel
Ararat Vic.

Dear Sir,

I am a beginner to electronics, having gained interest only six to eight months ago. Originally I was scared to death to even think about transistors, ICs and such, but eventually I took the plunge, bought several books (ETI publications are prominent) and eventually some bits and pieces, and found it not so scary at all! And enjoyable to boot.

I don't think I will ever become an electronics engineer or such, but I have managed to construct one or two kits that seem to work as intended.

Living in Elliston on Eyre Peninsula in South Australia, the quest for parts is quite a nightmare, with long delays and high costs with local dealers. Thank heaven for mail order firms in Sydney! They are very cheap and, considering the distance, are quite quick to deliver the goods, about seven to nine working days at most.

If this sounds bad just consider the example of three transistors purchased in Port Lincoln only 160 km away, which cost $3.80. From a Sydney firm they cost only $1.38 and $1.00 postage — only $2.38 from by far further away! Lucky city dwellers don't even have to pay postage!

Thank you for your valuable space for this item and keep up the good work in the best electronics magazine printed. Finally I would like to urge all others who are like I was, scared, to give it a go, and I hope they get as much fun and enjoyment out of electronics as I have. I wish them every success.

D. Hallett
Elliston SA

Dear Roger,

Your article on the Sound Bender suggests some possible relief for those persons with severe auditory impairment of a type that is an increasing percentage of cases. I enclose audiograms of two such cases as an example. As can be seen, these people have no measurable hearing above 1 kHz, and this eliminates the most important part of the speech range.

The question raised is, therefore, can the XR2206 IC be used to transpose the band of 1-2 kHz down to 0-1 kHz so that this 'cueing' information can be added to the existing range up to 1 kHz to improve speech discrimination?

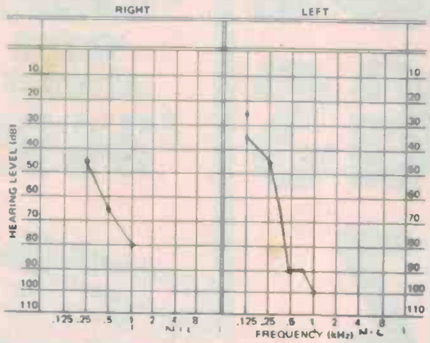
Apparently transposing low frequencies has many problems; the lowest transposed are the range 4-8 kHz. However, little speech information resides therein.

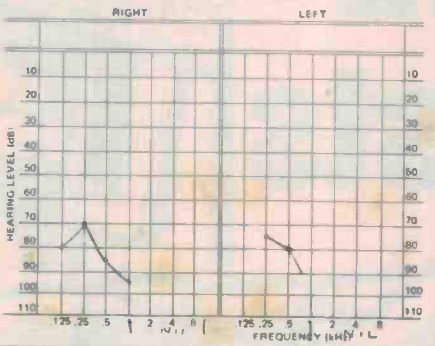
Our next step is to build Figures 4 and 5 (Feb. issue, p.40) with some additional circuitry, for which we need a very sharp cut-off filter above 1 kHz.

Are there any other similar ICs suitable for this type of work, or any advice you could give? Design is not really one of our fortes. Perhaps some of your readers are affected by this type of problem.

David Pither
Audigene Pty Ltd
Suite 501, Manchester Unity Building
220 Collins St, Melbourne.

Can any readers assist? — Ed.

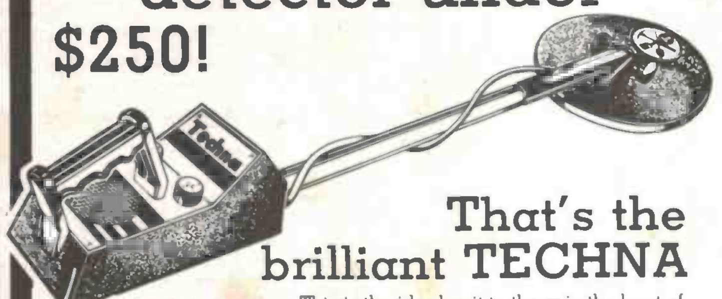




BIG SAVINGS for NZ hobbyists

For the convenience of our thousands of New Zealand customers, Dick Smith Electronics now has a retail centre open in Auckland. With a large range of quality Dick Smith products (as much as we're allowed to bring into New Zealand), this store is open to both retail and wholesale customers. It offers prices up to 50% less — and more — than the prices you've been forced to pay in the past — and since we've opened, we've found many of our competitors prices have dropped — which is good for all hobbyists, whether they're Dick Smith customers or not. We also have a large number of authorised re-sellers throughout New Zealand, so you're never far away from quality, value & service.

A discriminating detector under $250!



That's the brilliant TECHNA

FANTASTIC VALUE AT ONLY $249.50 NZ

This is the ideal unit to throw in the boot of the car when you go away for a weekend or on holiday. What better way to pay for that holiday than to find a hidden cache of treasure or a gleaming nugget of gold. It so easy to use the whole family can join in AND it discriminates between rubbish and treasure!
Cat Y-1066.

NOTE: Although written for Australia, this book is equally applicable to N.Z.

METAL DETECTING

This fantastic book covers all aspects of treasure hunting using metal detectors. Techniques in finding coins, bottles and other items are covered in detail. Hundreds of diagrams and photographs.

Cat B-4520 .... NZ $6.50

THE AUST'N GOLD FINDER

A superb piece of writing from someone who has been out in the bush searching for Gold. This book gives the latest techniques in looking for Gold and more importantly where and how to look for it.

Cat B-4525 NZ $2.60

AUST'N GEM & TREASURE HUNTER YEAR BOOK 1981

127 pages for the serious treasure hunter and for the person who uses the latest in hunting techniques.

Cat B-4536 NZ $3.25

WANT THE ULTIMATE?

If you want the best available metal detector, then this is the one for you. A precise instruction sheet is included which allows you to operate the unit quickly, but it is intended for the serious prospector who is willing to learn the intricacies of the unit.

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Features ★VLF/TR discrimination circuitry & selector switch ★Push button retuning mounted in the handle ★Waterproof search coils ★Uses 4 x 9V transistor batteries.
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ONLY $695.00 NZ

GREAT IDEA FOR THE HANDYMAN!

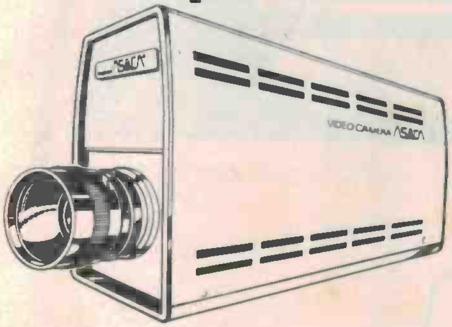
Ideal for use in the home, office or factory.

METAL & PIPE LOCATOR

How often have you needed to find a nail in a wall or piece of timber, locate a gas or water pipe, or wires behind plaster? This little beauty will do just that, and lots of other jobs requiring metal location. Has sensitivity control and a metal indication light, and operates from a single 9V battery.
Cat Y-1060

VALUE AT $14.95 NZ

The basis of a LOW COST CCTV or surveillance system



DICK SMITH'S B & W VIDEO CAMERA

There are numerous cameras on the market today that can be used in surveillance systems, or with video cassette recorders etc. They are generally colour cameras and cost between $1,000 to $20,000 or more. This CCTV camera will be ideal for nearly 99% of all general use and as such represents outstanding value for money! Comes complete with instruction book, lens and co-ax connector

LOOK AT SOME OF THE FEATURES

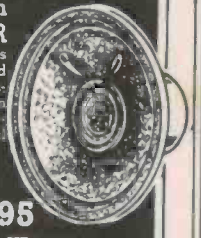
★Uses modern solid state circuitry ★2/3 inch SEPARATE MESH Vidicon tube for high quality pictures ★Switchable video/RF output means it will work directly into a TV set or into a special TV monitor ★Low noise picture ★Can be used in wide range of lighting conditions

Cat Y-1195

AND LOOK AT THE LOW PRICE $795.00 NZ

COMPARE OUR PRICES

57mm MINI SPEAKER

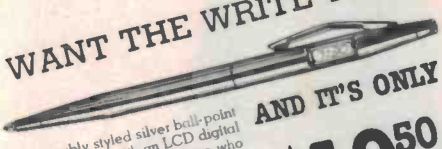


This 57mm mini speaker has performance - in fact we found that it offered more performance than speakers up to 75mm in diameter! Nominal impedance of 8 ohms make it ideal for many purposes.

Cat C-2222

WHY PAY MORE
THOUSANDS OF USES
$2.95 NZ

WANT THE WRITE TIME?



A superbly styled silver ball-point pen complete with an LCD digital clock inside. Great for those who don't like to wear watches. The clock shows day, date and seconds, and the pen has a retractable nib and uses standard Parker refills.

Cat Y-1030

AND IT'S ONLY $19.50 NZ

QUALITY HEADPHONES

These ultralight mylar headphones are so light, you'd hardly know you were wearing them. Earpads are soft foam that are acoustically transparent so that every sound is faithfully reproduced. They come with lead and 3.5mm stereo jack. Cat C-4106

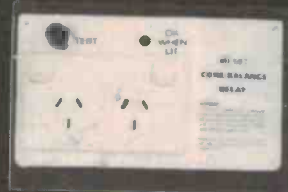
ONLY $19.95 NZ

NEW KITS

PROTECT YOUR LIFE & EQUIPMENT

The Core Balance Relay electronically detects earth fault currents and trips a relay which cuts the power. The relay cannot be reset until the fault is repaired. Designed to run 240V, this unit is portable and built into a tough moulded plastic case.

Cat K-3315



ONLY $74.50 NZ

DIGITAL CLOCK/ THERMOMETER

This kit gives you all the features of a digital alarm clock as well as a thermometer. The thermometer will display in either Fahrenheit or Celsius and the clock will even turn your radio on for you. Fitted with an alarm (speaker included) and snooze button, the clock is mains powered with battery back up. No case is supplied.

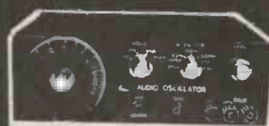
Cat K-3436

UNBEATABLE VALUE $94.00 NZ

LOW DISTORTION AUDIO OSCILLATOR

The Audio Oscillator uses the characteristic low noise of a VMOS device to give an ultra-low distortion output. The kit comes in a sturdy chassis with black perpsex front panel, silkscreened with white lettering. LED power indicator also acts as dial marker.

Cat K-3467



ONLY $99.50 NZ

ETI METAL LOCATOR

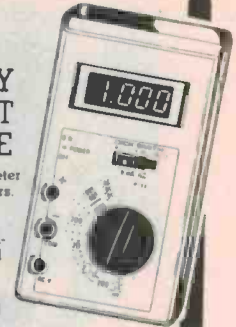
From Electronics Today International, this detector is the equivalent of many induction balance detectors in the hundreds-of-dollars bracket. You build it yourself - so you save! All components are supplied but the coil former and dowel for the shaft is left up to you. Are you ready to go out and find a fortune? You could with this beauty!

Cat K-3100

ONLY $59.00 NZ

LCD MULTIMETER

SAVE $20!



QUALITY
3.5 DIGIT
20 RANGE

We're proud to offer this superb multimeter to hobbyists, technicians and engineers. It offers exceptional performance, together with a highly legible liquid crystal display for very low power consumption. PLUS this unit has overload protection - so you won't 'cook' it if you make a few errors!

Cat Q-1450

ONLY $75.00 NZ

POWER/SWR METER

Now you can measure the output power of a CB transmitter and the matching conditions between transmitter and antenna. Large easy to read measurements.

Cat Q-1350

$19.95 NZ

LOW COST SIGNAL INJECTOR

Check out both audio and RF circuits (harmonics extend to many MHz) simply and easily. Self contained, battery operated with probe and earth clips.

Cat Q-1270

AND ONLY $11.50 NZ

ECONOMICAL DIGITAL LCD MULTIMETER

Ideal for the hobbyist and the professional — makes an ideal addition to any tool box. Has 13 ranges, liquid crystal display, bonus carrying case and probe.

Cat Q-1445

ONLY $65.00 NZ

GIVE YOUR PROJECT A PROFESSIONAL FINISH!

ALUMINIUM KNOBS FOR METRIC POTS

A new large knob with a diameter of 40mm.
Cat H-3846 $1.95 NZ

Smaller version in the same style as the above. Diameter 20mm.
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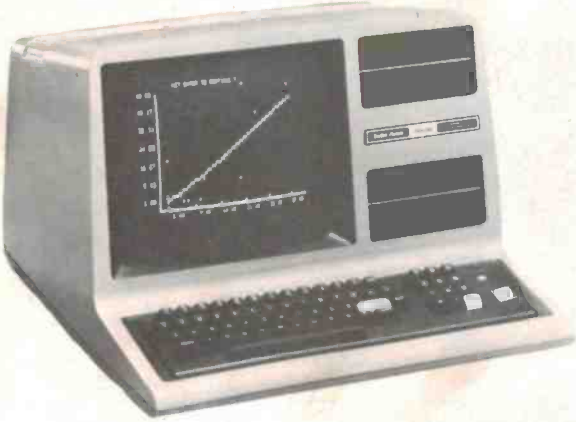


THE AUSTRALIAN BEGINNING CONTEST

The Australian Beginning is on line!

50 MEMBERSHIPS TO WIN

The Australian Beginning is Australia's first computer information service directly aimed at giving the average microcomputer and word processor user access to the computer data banks and massive storage of mainframe installations.

The launching of the Australian Beginning computer network is probably the most singularly important event yet to take place in the microcomputer industry in this country. For the first time, the world of huge data banks and massive computer capacity — previously only available to large corporations and government departments — can now be put in any home or office.

Through the Australian Beginning system, microcomputer users, word processor system owners and owners of 'dumb' terminals will be able to:

1. Have access to a wide variety of information sources and data banks, which will include such things as the news, the weather, both domestic and international airline schedules, a wide range of investment advisory services, sports and government information.
2. Communicate nationwide with other Australian Beginning users.
3. Have the capability to make use of the system computer's huge storage capacity to use its large program's on-line applications and put their programs on the system for disaster back up.
4. Have access to a myriad of computer programs that include entertainment, educational aids, programming and diagnostic tools, and a wide range and variety of financial and business applications.
5. Take advantage of a 'shopping by computer' system to get the best price on many consumer and business needs.

While initially the first installation is headquartered in Melbourne, duplicate installations will be available in Sydney, Adelaide, Perth and Brisbane by the end of the year.

To join the Australian Beginning network, the only hardware requirements will be to have an approved microcomputer system, terminal or word processing system, and an acoustic coupler. Those who join pay a once-only (lifetime) membership fee and an hourly usage charge.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of The Australian Beginning Pty Ltd, Computer Country Pty Ltd, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for the contest is 30 June 1982. Entries received within seven days of that date will be accepted if postmarked prior to and including 30 June 1982.

Winners will be advised by telegram the same day the result is declared. The names of the winners, together with the winning entries, will be published in the next possible issue of ETI.

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

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

Entrants must sign the declaration accompanying this contest that they have read the above rules and agree to abide by their conditions.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of this page. You must put your name and address on the entry form and sign it where indicated.

Please read the contest rules carefully, especially if sending multiple entries.

Membership normally costs $100 — but you can win a free membership by entering this contest! A total of 50 memberships, worth $5000, are to be won!

In using the system, members are charged $10/hour during 8 am — 6 pm during the week and $4.50/hour 6 pm — 8 am during the week and all day during the weekends.

TO ENTER

The Australian Beginning wants to know what sort of services potential users want beyond what is already available on the system, as outlined above. Winning entries will be judged on the 50 best suggestions for any of the following:

- additional data banks
- additional electronic shopping opportunities
- additional services in general

Write your suggestions on a piece of paper — you may make two or more suggestions if you wish — fill out the coupon below, and send it to the address given before the due date.

JUDGING

The staff of Electronics Today magazine have kindly consented to judge the entries in conjunction with The Australian Beginning. The judges' decision will be final and no correspondence will be entered into.

COUPON

Fill out this coupon and sign the declaration. Send it to:

Australian Beginning Contest
ETI Magazine
15 Boundary St
Rushcutters Bay NSW 2011

Whether you cut out this coupon or copy it, you must cut out and send with it the page number below.

I have read the contest rules and agree to abide by their conditions.

Signature ....

Name ....

Address ....

.... Postcode ....

Simple UHF antenna

Geoff Pearson VK5ZGP

A simple, make-in-an-afternoon antenna from scrounged parts.

THE ARRIVAL of UHF translators on the Adelaide scene offered new hope for the 10% of viewers in poor locations. The translators are grouped on top of the Grenfell Centre, a 28-storey building in the city centre, and the antennas are aimed to give about 180° coverage to the foothills area. About this time we graduated from a 12" B&W to 14" colour TV — with UHF tuner, naturally — and although we have line-of-sight to the main VHF towers about 15 km away, we now had glorious colour ghosts, courtesy of a large, steel-clad factory about 600 m away. Hence the desire to try UHF. Figure 1 shows the problem!

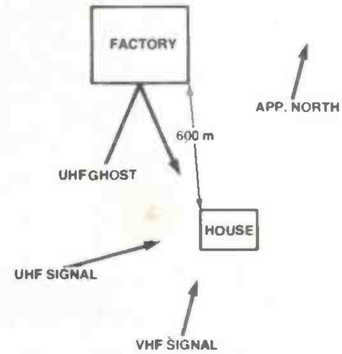


Figure 1. A nearby factory brings UHF ghosts!

Some careful study suggested a corner reflector would do the job, needing a reflector about 300 x 1000 mm. Alas, the nearest piece of junk was a punched metal sheet 300 x 900 mm. Reference to the RSGB UHF handbook revealed a version known as the 'trough' and away we went.

Figure 2 shows the theoretical sizes of the 'corner' and the 'trough'. Punched or expanded metal is recommended to reduce wind loads on the antenna.

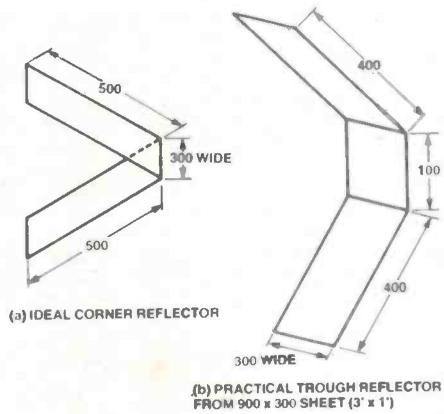


Figure 2. 'Corner' and 'trough' reflectors. Apex angle in both cases is 45°.

Parts List

The following was all scrounged from my shed:

- at least 600 mm of ½" galv. waterpipe.
- ½" galv. socket.
- ½" galv. flange
- ½" galv. elbow.
- ½" PVC connector — PVC pipe to threaded ½" male.
- about 200 mm of 3/16" brazing rod.
- 300 x 900 mm of punched or expanded metal sheet.
- 75 ohm coax
- auto body filler — two-part polyester.
- Superglue — a few drops.
- 2 x 3/16" gutter bolts.

Reflector: The 900 x 300 mm sheet of punched metal is bent up 45°, 400 mm from each end, to form the reflector 'trough'. Cut a clearance hole, about 20 mm diameter in the centre to pass the ½" pipe through. Drill and bolt the reflector to the ½" flange.

Support: Cut a thread onto the ½" pipe about 120 mm long. Cut off 100 mm of the threaded pipe using a few drops of Superglue, or wrap pipe thread tape on pipe to lock the flange.

Element: Cut two pieces of brazing rod, each 95 mm long. Drill each side of the unthreaded section of the PVC fitting, and insert the dipole halves. Solder the coax feedline to the dipoles, set up so that a 10 mm gap exists at the feedpoint, and fill the PVC fitting with auto body filler and allow to set. Push the feedline through the pipe and screw the dipole into place.

Install the complete antenna on your choice of mounting — chimney, barge or whatever.

Results

The antenna has been in use since September '80, and no problems have

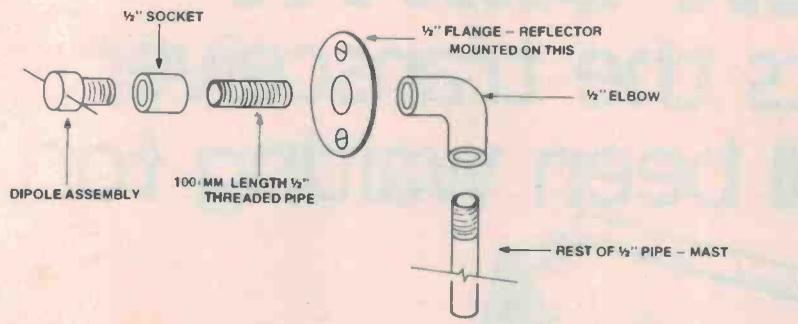
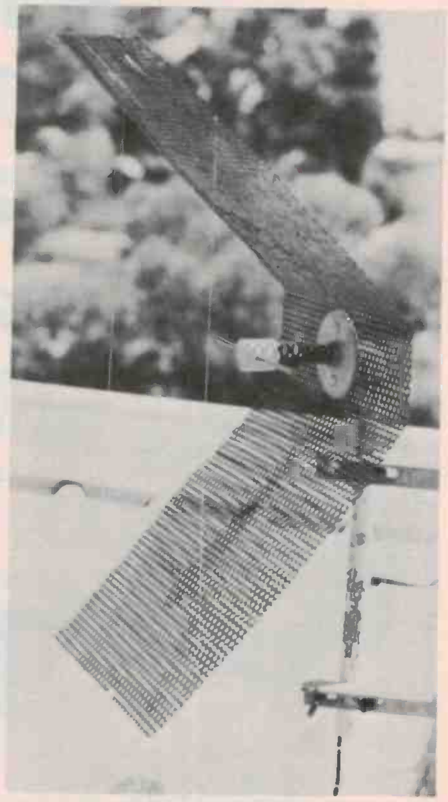


Figure 3. How the antenna support structure is made.



been evident. The actual installation is aimed at a point halfway between the commercials and the local ATV repeater, and all signals are rock solid and free of ghosts.

The range to the commercials is about 10 km, the ATV repeater is 25 km away, and the lines are 12° apart. There is a large gum tree plumb centre in the sight line to the commercials!

All dimensions are derived from ARRL and RSGB formulae, and are tailored to cover from channel 34 (ATV) to channel 52. ●

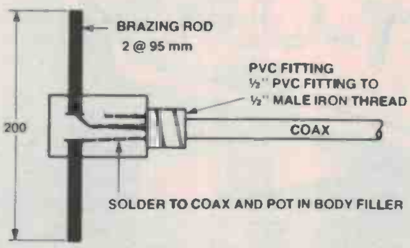


Figure 4. Construction of the dipole.

DICK SMITH

presents the transceiver you've all been waiting for

Chosen by Dr David Lewis for the 1982 Antarctic Scientific Expedition

look at these features

- ALL mode – even FM* – so you can 'go anywhere' – on its own, or teamed up with a transverter. It's brilliant!
- ALL band – it receives from 150kHz to 30MHz continuous, with resolution down to 10Hz! And the transmitter includes all the new WARC bands.
- ALL microprocessor controlled – which makes operation nice and easy for you (including keeping track of the FT-ONE's 10 VFO's!)
- ALL area operation: run it from 100 – 120 or 200 – 240V AC in the shack, or 13.5V DC when mobile!
- ALL solid state (of course!) with a massive complement of 659 semiconductor devices, including over 70 IC's!
- ALL performance – with better than 0.3uV sensitivity and more than 100W PEP output (SSB).

You've dreamed of owning a transceiver like this Now your dreams can come true!

No longer in the 'luxury' category, Yaesu's new FT-ONE is very affordable – especially when you compare it to other general coverage transceivers.

If you want a transceiver that commands the bands, you won't do better than the FT-ONE.

And you won't do better than buying your Yaesu from Dick Smith Electronics: Australia's leading factory-approved Yaesu agent . . after all, we're the ones who give you a full 12 month guarantee AND guarantee to match or better any genuine Yaesu price offered by other suppliers!

all this for only **$1795**

* *FM board optional at extra cost* — Cat. D-2852

DICK SMITH Electronics

Sydney : Canberra : Melbourne : Adelaide : Perth : Brisbane : Newcastle : Wollongong

DSE/A127/LM

Law-abiding CB users?

Before the use of CB radio (with frequency modulation only) became legal in Britain on November 2 1981, it was widely anticipated that those people who had been illegally using amplitude modulation equipment in the 27 MHz band would continue to defy the law rather than buy new equipment or have their equipment modified.

Although no official information appears to have been issued on the present use of CB in this band, it seems that the change has been quite spectacular in most (or possibly all) parts of the country. The new FM channels appear to be extensively used, yet hardly anyone is using the (pirate) AM system.

The writer has noted that there seems to be far less interference with the weaker signals in the VHF broadcast band than was previously the case when AM equipment was used in many vehicles for CB, although many observations in other parts of the country would be needed to draw any significant conclusion.

The Home Office report that about 90 000 licences have been sold for CB use during the first two months of their availability. They stated that FM equipment seldom causes any interference and what little interference that remains is arising from the older, illegal CB equipment.

Strangely enough, it seems that most of the interference problems in the 27 MHz CB are now coming from illegal SSB operation by CB operators — although some of this doubtless comes from overseas sources (like the USA).

One wonders whether Britain will make it illegal to possess any form of AM SSB equipment instead of merely making it illegal to use any such equipment. However, it seems that a great improvement has already occurred and it usually takes time before further improvements can follow!

Brian Dance

8th annual eastern US VHF/UHF conference

This event, an important one on the international amateur VHF/UHF calendar, will be held over 14-16 May at the Sheraton Inn, Foxboro, Massachusetts.

Technical talks will be hosted by well-known US VHF/UHFers. There will be 'rap sessions' for the various bands, a banquet and much more — as they say.

Registration is required before 10 May and is a mere $13.50 ($US) or $20 at the door. For info or to register — and don't miss this if you happen to be Stateside around then — contact Rick Commo, K1LOG, 3 Pryor Rd, Natic MA 01760.

Low-cost 2 GHz receiving system

GFS Electronic Imports of Mitcham, Victoria, have just announced the availability of a low cost 2 to 2.7 GHz downconverter system.

Known as System-20, it consists of a 600 mm parabolic reflector, feed horn, masthead-mounted downconverter, remote mounted power supply tuning unit and associated mounting hardware, as well as interconnecting coax cables.

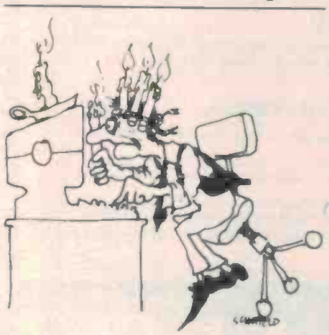
Also available as an option is a low-noise, mast-mounted RF amplifier, Model 2001. It provides 20 dB gain with a 2.6 dB noise figure at 2.5 GHz, according to the specifications.

The System-20's parabolic reflector and feed horn have a gain of 21 dBi and a beamwidth of 13 degrees at 2.5 GHz. This, coupled with the RX-2300 downconverter's built-in low-noise preamp, provides a high overall system gain. The preamplifier exhibits a 2.4 dB noise figure with the downconverter providing an overall conversion gain of 25 dB, GFS claim.

The System-20 is continuously tunable over a frequency range of 50 MHz from the power supply tuning unit. This may be preset anywhere between 2 and 2.7 GHz.

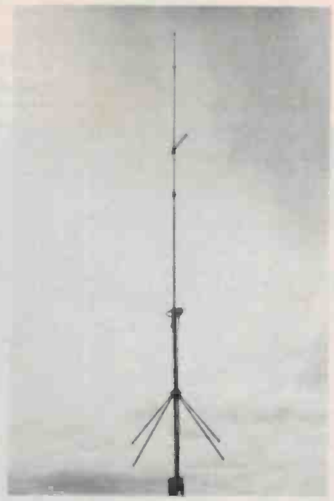
The System-20 is expected to have application in many areas, including the monitoring of electronic news gathering systems (ENG), point-to-point links, weather satellite reception (with the 1.6 GHz version) as well as the 2.3 GHz amateur band.

Cost of the System-20 is a rather remarkable $399, plus sales tax, while the 2001 low noise amplifier is $199 plus tax. Further details from GFS Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03)873-3939.



Decoupling radials for 2 m ringo

GFS Electronic Imports of Mitcham, Victoria have just announced the availability of a set of decoupling radials to suit most types of 2 metre extended ringo antennas.



It has for some time now been widely publicised, particularly in US magazines, that an improvement in performance can be gained by introducing a set of decoupling radials below the ring matching section of gamma ring type verticals.

With this in mind GFS have made available a kit, the Model RK-2, consisting of four solid aluminium radials and a mounting ring, which can be easily installed on an existing 2 metre ringo installation.

The RK-2 is suitable for use on masts up to 27 mm diameter, and is priced at $16 plus $3 post and packing. It is currently only available directly from GFS Electronic Imports, 15 McKeon Road, Mitcham Vic. 3132. (03)873-3939; telex: 38053.

SERG annual convention

The South-East Radio Group Inc in Mount Gambier will be holding its 18th Annual Convention over the Queen's Birthday long weekend from 12-14 June.

Usual events such as fox-hunts, hidden transmitter hunts and scrambles will be held, plus several beam heading competitions, a night fox-hunt and various new events for both amateurs and their families. For those without DF equipment an observation sightseeing trial is planned for the Saturday afternoon. Excellent prizes will be awarded in all events.

Last year's convention was well attended by trade exhibitors, and plenty of trade space will also be available this year, with excellent security provided for the exhibits.

One of the main features of past conventions has been the excellent catering arrangements, and this year these are expected to live up to past glories.

Convention registration forms will be available from most VK3 and VK5 clubs, or may be obtained by sending an SAE to the Registrar, SERG, P.O. Box 1103, Mount Gambier SA 5290. Enquiries can be made by checking into the SERG net on Monday nights at 2030 CST on 3.585 MHz.

64K SS50 STATIC NOW AVAILABLE $399 + TAX

64K S100 STATIC NOW AVAILABLE $399 + TAX

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S100 COMPUTER PRODUCTS

16K EPROM CARD-S 100 BUSS

$89.50 KIT

BLANK PC BOARD $49

USES 2708's!

Thousands of personal and business systems arouno the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $5.90EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $36

32K S-100 EPROM CARD

NEW!

$99.95

KIT
USES 2716's
Blank PC Board — $59
ASSEMBLED & TESTED
ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $5.90 EA. With Above Kit.

KIT FEATURES
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible
4. Addressable as two independent 16K blocks
5. Cromemco extended or Northstar bank select
6. On board wait state circuitry if needed
7. Any or all EPROM locations can be disabled
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

* * * AVAILABLE AGAIN * * *

- 16K Dynamic Ram Board
- Fully Expandable to 64K
- Assembled, tested and guaranteed
- S100 Compatible

16K Dynamic RAM Board assembled and tested. Special $269 plus tax (4mHz) $299 plus tax (4mHz) This must be the best offer available on quality tested dynamic RAM boards.

32K Assembled and tested $289 plus tax (4mHz)
48K Assembled and tested $309 plus tax (4mHz)
64K Assembled and tested $329 plus tax (4mHz)

16K STATIC RAM KIT-S 100 BUSS

KIT $179
A&T $199

KIT FEATURES
1. Addressable as four seperate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard) Allows up to 512K on line
3. Uses 2114 (450NS) 4K Static Rams
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board with solder mask and silk screened layout Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes ALL parts and sockets
8. PHANTOM is jumpered to PIN 67
9. LOW POWER under 1.5 amps TYPICAL from the +8 Volt Buss
10. Blank PC Board can be populated as any multiple of 4K

BLANK PC BOARD W DATA $55
LOW PROFILE SOCKET SET $22
SUPPORT IC S & CAPS $29
ASSEMBLED & TESTED-ADD $30

OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$199 KIT
A&T $219

FULLY STATIC AT DYNAMIC PRICES

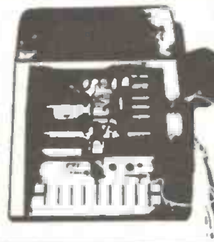
32K STATIC ALSO AVAILABLE

KIT FEATURES
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board Solder mask and silk screened layout Gold fingers
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

FOR SWTPC 6800 BUSS!

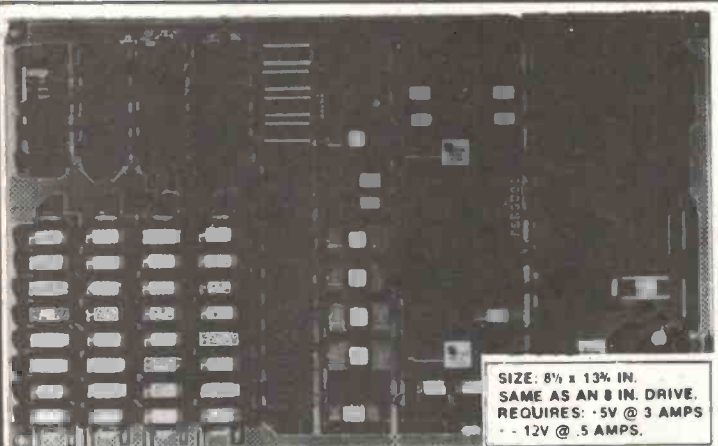
BLANK PC BOARD — $49 COMPLETE SOCKET SET — $22 SUPPORT IC'S AND CAPS — $45

ETI 660 THE $99 COMPUTER!



FEATURES INCLUDE
Colour capability, operates from optional 8 V plugpack, 1K memory expandable to 3K on-board, single-board construction, cassette interface, audio output, simple to program (uses Chip-8)
Expansion projects coming up include ASCII keyboard, light pen, games software, etc.
Starter Kit (1K RAM, B&W Video) $99.00
8 V, 1 amp plug pack to suit $12.50
Colour video option $13.50
RAM Expansion (add to PCB) $16.00

ETI636 7 SLOT MOTHERBOARD WITH ACTIVE TERMINATION
Kit of Parts $89.00. Assembled and tested $115.00. inc tax.
RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg. 10A, ± 16V Unreg. Kit of parts $89.90 inc tax A&T $109.00 inc tax
Write for list of other power supplies. Tax free prices also available.



SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

SINGLE BOARD COMPUTER KIT NOW ONLY $499 + TAX (17½%)

Also available: Blank PCB's with Roms $275 + Tax.
Assembled & Tested $599 + Tax.

THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, and an enclosure: and you have a total Business System for about 1/3 the cost you might expect to pay.

FEATURES: (Remember, all this on one board!)

64K RAM

Uses Industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $65

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

FOUR PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O $29

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $19

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. It does not occupy any of the 64K of system RAM!

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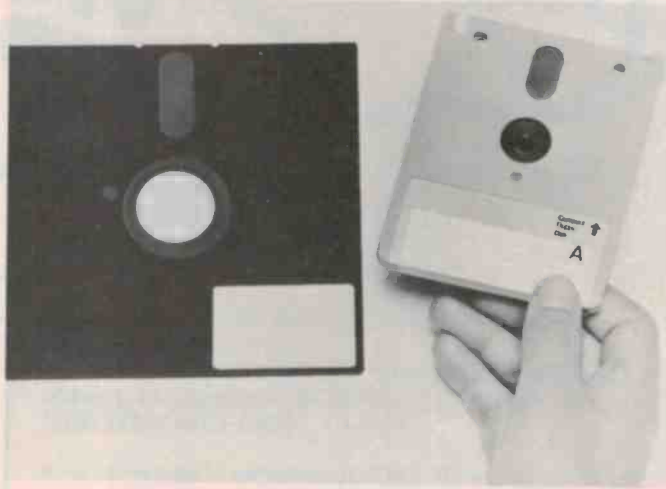
PLEASE WRITE OR RING FOR THE BEST POSSIBLE PRICES ON DISC DRIVES, PRINTERSAND OTHER COMPUTER COMPONENTS.

5-82/4

64K SINGLE BOARD COMPUTER KIT NOW ONLY $499 +TAX.

'Compact floppies' set to go

Matsushita Electric Industrial Co Ltd, Hitachi Ltd, and Hitachi Maxell Ltd recently announced they have standardised a new 'compact floppy disk' format among the three companies. The new 3-inch (76 mm) compact floppy disk is compatible with and has the same recording capacity as the 5-inch (130 mm) mini-floppy disk widely used as external memory for office and personal computers.



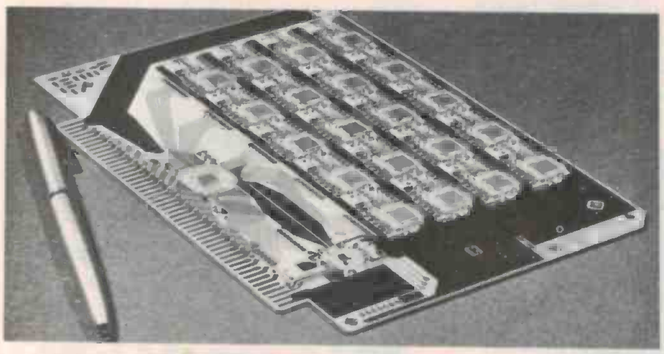
Each company has been conducting research on the development of the small-size floppy disk. In order to help promote wide acceptance and use of this new disk, the three companies established the new format as a standard among the companies. They will also propose the new format to disk and hardware manufacturers as a new standard for the industry.

The companies anticipate that due to the compact disk's size and ease of use it will be ideally suited for the growing business and home computer applications.

Although similar-sized floppy disks are already on the market, there is no compatibility among companies or with the popularly used 5-inch disk.

In order for the new floppy disk to be widely accepted and used, the rotation speed, data transfer rate, recording capacity per track and other specifications are designed to be the same as the specifications of the mini-floppy disk, and therefore the new disk drive system can be used in place of the conventional mini-floppy disk drive system.

Size of the disk case is 80 mm wide by 100 mm long by 5 mm thick, almost half that of the 5-inch disk. Since it is as small as pocket diary, it can easily slip into a shirt pocket. Accordingly the disk drive system can also be made smaller.



Advanced 32-bit processing system

A fully integrated 32-bit VLSI processing system with mainframe-like performance was the subject of a paper presented by the Hewlett-Packard company at the recent International Solid-States Circuit Conference in San Francisco.

Geoff Foley, Systems Engineer with Hewlett-Packard Australia's Instrument Group, revealed that the system is built around the 'super chip' announced by HP at last year's conference. He then described five other custom VLSI chips, of similar proportions, that will be packaged with that processor. The system provides a good indication of custom VLSI trends in the computer industry.

Foley did not indicate what HP product or products might eventually incorporate the new chip set, but HP has said that it hopes to introduce a product in about a year.

The entire chip set consists of a 32-bit processor, memory controller, random access memory, (RAM) real only memory (ROM), I/O processor and clock generator.

Each chip is implemented on one-micron NMOS-III technology, providing three to eight times the circuit density of today's commercially available processors. The processor chip, which is a quarter-inch square and about as thick as a sheet of heavy paper, contains 450 000 transistors. The system RAM is actually the most dense with 660 000 devices.

Foley commented that the reasons for attempting such a compact, highly integrated design relate to simple physics: the less distance an electrical signal travels, the higher the speed and system performance; and increased density means fewer chips for significantly lower system cost and improved reliability.

The innovation goes beyond the compact technology. Said Foley, "Most computers are designed by mixing and matching off-the-shelf and custom chips to form a system. We designed this one from the ground up in the interest of better system performance. Each chip in the set is designed to complement and enhance the performance of the others."

Augmenting the performance of the chip set is a 32-bit internal data buss operating at a transfer rate of 36 megabytes per second. The system design centre also allows for an advanced, built-in, self-test function.

Details on the chip set are available from Hewlett-Packard Australia, 31 - 34 Joseph St, Blackburn Vic. 3130.

Software conference

The Microprocessor Special Interest Group of the Australian Computer Society is sponsoring a conference on 'Microcomputer Software' in Canberra over 18 — 20 August, 1982.

Topics proposed to be covered include: operating systems, instrumentation, communications, copyright, game generation, word processing, language standards, etc.

The conference is intended as a forum for both the hobbyist and professional. Full details are available from Peter Bramwell, MICSIG, P.O. Box E237, Canberra ACT 2600.

Why pay more?

THE NEW VIC 20 COLOUR COMPUTER IS $200 LESS THAN TANDY'S

See how they compare

FEATURE	VIC 20	TANDY
Typewriter style keys	YES	NO
Number of keys	66	53
Programmable special function keys	YES	NO
Graphics symbols on keyboard	YES	NO
Maximum memory size	32K	32K
ROM area as supplied	20K	8/16K
Displayable characters	512	256
Upper & lower characters standard	YES	NO
Video PLUS RF output	YES	NO
Horizontal scrolling	YES	NO
Full Screen Editor	YES	NO
COMPUTER PRICE	$399	$599

Why waste hard earned money on a more expensive computer? With the Dick Smith VIC-20 Colour Computer, you get the latest technology, at a price YOU CAN AFFORD!

The Commodore VIC is a real computer — typewriter style keyboard — realistic sound effects and all in colour. You can even write your own programs!

and a great range of plug-in programs . . .

Here's just some of the great games available on cartridge, and from only $39.95 each — Jelly Monsters — Super Alien — Draw Poker — Midnight Drive — Rat Race — Superslot We have loads of exciting educational and business programs on cassette from only $14.00 each — Biorhythm — Space Math — Personal Finance — Loan and Mortgage — VIC Typewriter — Home Inventory — plus much more!

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YES, THAT'S RIGHT ONLY $399!

WIN A DATSUN STANZA

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When you purchase a VIC-20, System 80 or Sorcerer computer from Dick Smith Electronics you become eligible to win this superb

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So hurry in for your fabulous System 80 NOW!

HURRY IN NOW!

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DSE/A233/LM

HIGH RESOLUTION, HIGH VISIBILITY GRAPHICS

MicroBee brings you unsurpassed graphics facilities under easy to learn BASIC control. In low resolution mode (128x48 units) you can generate 'chunky' graphics and run Tandy programmes. For finer control a couple of keystrokes, switch you to high resolution graphics (512x256 units) and still let you combine them with text. Doing all this is easy for MicroBee. It shares the same intelligent VDU controller IC with IBM's new personal computer. So, like the IBM, MicroBee has a fully programmable screen display. MicroBee's standard 16 line by 64 character upper/lower case format can be updated to the professional 80x24 format to run CP/M programs. No need for expensive add ons.
Simple, easy to use BASIC commands make using your MicroBee easy, even if you're just getting into computers.

UNIQUE CONTINUOUS MEMORY AND BUILT IN SOUND

Only MicroBee brings you this great facility. You can hold programs and data in continuous memory when you switch off, or move to a new location. There's no longer any need to store on cassette or floppy discs at the end of the day. A power failure doesn't mean the loss of valuable programs or data. An inbuilt battery holds everything in memory until power is restored or you switch on again. MicroBee, your portable terminal.
MicroBee's built in sound facilities bring you two octaves of music to tune up your programming skills. Again under simple to use BASIC control. Add sound to your game programs. Or maybe write your own music. The speaker is inbuilt. And it's so easy to learn. MicroBee brings you unique facilities and opens up new programming opportunities.
MicroBee, the personal computer that never forgets.

SERIAL AND PARALLEL PORTS READY.

Your MicroBee is fully equipped to interface and communicate with the outside world. The programmable RS232 standard port means connecting a serial printer, modem or another computer is as simple as plugging it in. MicroBee's built in software means you're ready to run at 300 or 1200 baud. When you're ready to go further, use MicroBee's parallel port and connect up joysticks, Centronics type printers or any other peripherals needing a parallel port. Even the cassette interface has something special. It will store and load programmes at 300 or 1200 baud in either BASIC or Z80 code as well as letting you merge lines into an already existing BASIC program.
MicroBee works happily with your ordinary audio cassette recorder, and gives you a good load and save every time, even at the higher (1200 baud) rate. It's as simple as plugging it in with MicroBee.

microbee does

EXPANSION POWER

If you're not sure how you'll be using your MicroBee in the future, we've thought of that too. MicroBee is designed for inexpensive future expansion. The basic MicroBee with 16K of user RAM easily converts to 32K with a changeover board. Adding ROM (Read Only Memory) up to 28K is as easy as plugging it in to the memory board. Want S100 expansion? MicroBee goes one better. Its unique Z80 expansion bus lets your MicroBee interface with S100 as well as all the other expansion busses.

And if you're thinking of using disc drives and want to be able to run world standard CP/M Software, MicroBee's still with you. The soon to be released memory board and factory mod convert your MicroBee to 48K RAM, running CP/M with the ability to take disc drives. So you can run the same programs as IBM, DEC, Xerox and HP do on their Micros. MicroBee, ready when you are.

POWERFUL 16K MICROWORLD BASIC

Programming has never been simpler. Novice or experienced programmer, you'll find MicroBee's 16K BASIC in ROM a delight to use. MicroWorld gives you everything you get with other BASICs plus extra help. Like special error reporting and editing. And support of the built in sound and graphics facilities. So MicroBee's powers aren't hard to use. The BASIC also controls printers and modems. Writing programs is simpler because of the BASIC's search and replace ability. When you want to go further, **MicroWorld Editor/Assembler helps** you use Z80 code and write USR subroutines. It's in ROM for instant access. Or get going right away with **Cassette Programs.** From only $6.95 each. Chose from games like Chase, Target, ZTrek, Solitaire, Wumpus, Biorythm, Calender Maker or utilities like Typing Drill, Diagnostic, Textmaster.

SOFTWARE SUPPORT

As a MicroBee owner, you'll become a member of the MicroWorld Users' group, and receive our newsletter and updates. Your kit comes on 14 day satisfaction guarantee. And there's a $50 complete cover service coupon if you have trouble.

You can phone order MicroBee on (02) 487 3798. Use your Bankcard. Or to Mail Order your MicroBee just write to:- **MicroBee, Box 311, Hornsby NSW 2077**

Due to enormous demand, MicroBee deliveries have been delayed.

Complete kit
Includes 16K RAM, 16K ROM BASIC, all manuals.
$399

Software includes:
Editor/Assembler (ROMs, Manual) $49.50
Cassette software (each) $6.95

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Club Call

The **Ballarat Computer Users' Group** recently informed us of their existence, and would like to hear from people interested in membership. Contact the Publicity Officer, John Preston, on (053)31-4363 for more details. The club meets on the first Thursday of each month at the Hopetoun St Community Education Centre in Ballarat, and members are mainly hobbyists, with a sprinkling of Apples, TRS80s, etc. Membership is $5 per year, mainly to cover the cost of postage of the newsletter.

The **Microcomputer Enthusiasts' Group (MEGS)** of Sydney has been established for over six years, and meets on the third Monday of each month at the Wireless Institute of Australia Hall, 14 Atchison St, St Leonards NSW, at 7 pm. Beginners to experts of all ages are members, and the club provides the ideal forum for discussion on all aspects of computing, with the opportunity to develop contacts and friendships with other computer enthusiasts. Almost every known micro is represented within MEGS' membership ranks. Meetings offer discussion groups as well as guest speakers and equipment demonstrations, and attendance is typically in excess of 40 members. Visitors are welcome to attend a meeting or two in order to find out what is involved before committing themselves to a membership fee, and it is not even necessary to own a computer to join MEGS. Membership ($15 per year) is open to all categories of enthusiasts, including professionals, hobbyists and students of all grades. The club has obtained some computer machinery over the years and recently purchased a locally designed computer kit to be assembled by members for training experience; it will subsequently be used for programming and interfacing courses. The group has limited access to disposal equipment, but has refrained from software piracy as many members would rather see a buoyant market for their program sales; however, there is a considerable amount of co-operation between individual members. For further information visit a meeting, or ring John Whitlock (MEGS President) on (02)638-1142.

The **Sorcerer Users' Group of South Australia** has a new meeting place — 1st Floor, Commodities Exchange Building, 123 Pirie St, Adelaide. They meet on the second Wednesday of each month, and interested people should write to the above address.

The **Tasmanian Small Computer Users' Group** meets at 7.30 pm on the first Tuesday of each month in the Elizabeth Matric Computer Centre, Warwick St, North Hobart. The postal address is P.O. Box 474, Sandy Bay Tas. 7005.

A new computer club for the Blue Mountains area in NSW was recently started, calling itself the **Blue Mountains Computer Club.** Meetings are held at the Springwood Civic Centre on the first Friday of every month. Interested people are invited to attend meetings, and further details may be obtained by contacting Eric Lindsay, 6 Hill Crest Ave, Faulconbridge, (047)51-1044 bh; or Greg Baulman, (047)51-3221 after 7.30 pm, or (02)648-5542/5336 bh.

The **Queensland Sorcerer Users' Group,** founded in 1980, aims to fulfil the needs of as many Sorcerer owners and users in the area as possible. Since its inception members have worked on modifications to both the word processor pac and the development pac, and have prototypes for a new monitor and an EPROM burning pac. Various members have written new software for CP/M, the BASIC pac, file management, graphic movement and games, plus improving existing software. On the hardware side the QSUG has available a simple light pen, various joysticks, and an acoustic modem to provide simple automatic transmit and receive communications between Sorcerers. Anyone interested is welcome to meetings, which are held on the last Sunday of each month at the University of Queensland In Brisbane. Annual membership fee is $10, or $5 a half-year. For further details contact the Secretary, K. Saggers, 43 Stubbs Rd, Woodridge Qld 4114.

CUWEST is a club in Western Australia for Compucolor/Intecolor micro enthusiasts, and claims to have well over 100 members. The club meets every month, and membership is $10 per year, which entitles members to the club newsletter and a copy of the large software library. Contact John Newman, CUWEST Convenor, 8 Hillcrest Drive, Darlington A 6070. (09)350-7384 bh.

The **Sord M100 Users' Group (SMUG)** has advised us of a change of address; they have now moved to 13 Stratford Square, Wantima Vic. 3152.

ETI is at present compiling a list of computer clubs throughout Australia, and would like to hear from any club which hasn't already contacted us, plus changes of address, contacts, etc, for clubs we already know about.

Line conditioner

Ferguson Transformers has designed and produced a computer line conditioner to provide a supply voltage which remains essentially constant, sinusoidal and free of transient 'spike' voltages.

When a computer is connected to a conditioner it will not lose memory due to low voltage or a momentary loss of supply, and will be protected from damaging high voltage transients which plague supply systems.

The computer line conditioners are attractive, free-standing units which will complement any office setting, Ferguson claim. They are supplied with a standard card and plug ready for connecting to a power outlet. Installation costs are eliminated.

Standard types are suitable for 240 volts supply, plus or minus 15%, 50 Hz, and retain a nominal output of 240 volts 50 Hz. Models are rated at 250 watts, 500 watts, 1000 watts and 2000 watts.

The Ferguson design uses a ferro-resonant transformer which inherently features short circuit output protection. The ferro-resonant transformer during switch-on may provide an output voltage transient up to twice normal voltage. This design incorporates a short-time delay relay which connects the transformer output to the outlets after the transient has subsided.

For futher details, contact: Ferguson Transformers Pty Ltd, 331 High St, Chatswood NSW 2067, or Ferguson Transformers Pty Ltd, 181-183 Hawke St, West Melbourne Vic. 3003.

ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. (03) 489-8131.

ELECTRONIC COMPONENT SUPPLIERS, DESIGNERS & MANUFACTURERS.
RITRONICS WHOLESALE (03) 489-7099. MAIL ORDERS (03) 481-1436.
TELEX: AA38897

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DIP SWITCHES SPST

P/N	No. Switches	Price
SD3	3	1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

WIRE WRAP 3-LEVEL

	1-9	10-25
8 Pin	1.00	.90
14 Pin	1.10	1.00
16 Pin	1.20	1.70

18 Pin	1.50	1.40
20 Pin	1.80	1.60
22 Pin	1.90	1.70
24 Pin	2.00	1.80
28 Pin	2.20	2.10
36 Pin	2.60	2.40
40 Pin	2.90	2.70

COMPUTER GRADE ELECTRO.

2900uf	40V	6.50
6800uf	16V	6.40
10,000uf	16V	9.00
10,000uf	25V	9.50
10,000uf	40V	11.90
15,000uf	40V	12.00

22,000uf	25V	12.90
22,000uf	40V	23.00
27,000uf	35V	23.50
33,000uf	16V	23.50
68,000uf	16V	21.50
100,000uf	10V	20.50

MULTISTRAND RIBBON CABLE

Price per metre

	1-9	10+
10 Way	.90	.80
12 Way	1.00	.90
16 Way	1.20	1.10
20 Way	1.70	1.69
40 Way	3.20	3.00

SUPER SPECIALS

2708	$ 4.50	BU326	$ 1.90
2716	$ 4.90	Z80S10	$21.00
2732	$ 8.00	1771	$19.00
6800	$ 7.90	1791	$59.00
6802	$11.00	1795	$59.00
6809	$22.00	4116	$ 1.95
8085	$12.50	2114	$ 2.50
8080	$ 7.00	TA7205	$ 3.30
6821	$ 3.50	100 Red Leds	$ 9.00
Z80P10	$ 5.00	BUX80	$ 3.90
		BU126	$ 1.90

CMOS

4000	.40
4001A	.40
4001B	.40
4002	.50
4006	1.10
4007	.50
4008	1.00
4009	.80
4010	.50
4011	.40
4012	.50
4013	.80
4014	1.70
4015	.90
4016	.70
4017	1.50
4018	1.50
4019	.60
4020	1.20
4021	1.10
4022	1.05
4023	.70
4024	1.00
4025	.50
4026	2.20
4027	.60
4028	.90
4029	1.20
4030	.60
4031	2.20
4034	3.00
4035	1.30
4039	.70
4040	1.70
4041	1.05
4042	.70
4043	.70
4044	.70
4046	1.20
4047	1.20
4048	.60
4049	.60
4050	.60
4051	1.00
4052	.80
4053	.80
4060	2.00
4066	.80
4068	.60
4069	.70
4070	.50
4071	.60
4072	.50
4073	.60
4075	.60
4076	1.20
4077	.50
4078	.60
4081	.60
4082	.60
4089	1.00
4093	.80
4503	.60
4510	1.50
4511	1.50
4512	1.10
4514	2.50
4516	1.40
4518	1.50
4519	.55
4520	1.60
4522	1.25
4527	1.20
4528	1.25
4529	1.60
4539	1.60
4541	1.60
4543	2.00
4553	5.50
4555	1.00
40097	.95
40098	.95
40175	1.00
74C SERIES	
74C100	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	.90
74C20	.40
74C30	.40
74C32	.40
74C42	1.10
74C48	1.55
74C73	.75
74C74	.70
74C76	.75
74C83	1.40
74C85	1.20
74C86	.80
74C90	.80
74C93	1.40
74C95	.95
74C107	.70
74C150	3.40
74C151	1.00
74C160	.90
74C192	.90
74C164	1.10
74C173	1.00
74C174	.80
74C175	1.00
74C192	1.20
74C195	1.00
74C221	1.90
74C373	1.80
74C374	2.00
74C901	.90
74C902	.90
74C905	11.20
74C906	.90
74C907	.80
74C915	1.50
74C922	3.80
74C923	5.00
74C925	7.50
74C926	7.50
74C927	5.90
74C932	5.50
80C SERIES	
MM80C95	.90
80C96	.90
MM80297	.90
80C98	.90
LINEAR	
LH0002	9.50
LH0022CD	16.60
LH0042CH	8.60
LH0070	12.70
LH0071	12.70
TL071	1.00
TL072	1.50
TL082	1.50
SAK140	2.20
UAA170	3.50
UAA180	3.50
TCA220	2.20
LM301	.50
LM301-H	.50
LM304-H	1.70
LM305-H	.80
LM307-CN	.40
LM307-H	.90
LM308	.70
LM308-H	1.20
LM310-N	2.20
LM310-H	2.60
311	.60
LM311	.60
LM311-H	1.20
LM318	2.80
LM322	3.90
LM324	1.20
LM325	3.10
LM329-DZ	1.40
LM334-Z	1.30
LM335	12.40
LM336-Z	3.20
LM339	.90
LM348	1.10
LM349	1.80
LF351-N	.70
LF356-AN	1.10
LF357	1.10
LM358	.70
LM373	4.10
LM374	5.40
LM376	.70
LM377	2.90
LM379	5.70
LM308 8PIN	1.30
LM380 14PIN	1.50
LM318A-N	2.40
LM318N	1.80
LM382N	2.00
LM383	2.70
LM384	2.40
LM386	1.00
LM387	1.30
LM391	1.80
LM393	.80
LF398	5.00
8038	6.00
NE530	1.10
OM350	9.90
555	.40
556	1.10
LM565	1.30
LM565CH	2.00
NE566	2.50
LM567	1.50
NE571	6.50
LM709 14PIN	.70
UA710CA	.60
LM710-CH	.90
711	.80
UA711-H	.85
UA716HC	6.25
723	.50
LM723CH	1.10
LM725	3.90
LM733	1.20
UA739	2.00
741	.25
LM741-H	1.20
UA747	1.00
UA747HC	2.20
UA748	.50
UA748HC	1.25
UA753	1.80
UA760HC	4.10
UA777	2.40
UA777HC	2.65
9334	1.70
UA743	1.80
UA760HC	4.10
UA796HC	1.70
LM802	1.10
LM1310N	2.40
1408	4.90
LM1458	.60
UA1488	1.50
UA1489	1.50
MC1495	7.30
MC1496L	11.40
LM1558	1.50
LM1596	1.40
LM1380	3.10
LM2902	1.40
LM2917 8PIN	2.80
LM2917	3.10
CA3028	1.80
LM3039	.90
CA3046	1.70
3065	.45
LM3080	1.20
LM3089	3.90
CA3130T	1.40
CA3130E	1.80
CA3140	1.40
3401	.70
3611	1.10
LM3900	.90
LM3909	1.00
LM3914N	3.90
4136	1.40
LM4250	1.75
UA4558TC	1.40
MM5837	2.50
LM7555	1.80
MC10116L	.95
LF13741	.60
LF1374-1H	.70
DS75452	.60
76477	4.90
75451	.60
75491	1.40
75492	1.40
TTL (s)	
74S00	.80
74S02	.80
74S04	.80
74S10	.75
74S11	.75
74S32	.75
75S51	.75
74S74	1.20
74S86	1.40
74S112	1.20
74S135	2.20
74S138	3.20
74S157	2.95
74S158	2.95
74S182	3.30
7400 SERIES	
7400	.40
7401	.40
7402	.40
7403	.40
7404	.40
7405	.50
7406	.50
7407	.50
7408	.40
7409	.40
7410	.40
7411	.40
7412	.40
7413	.50
7414	.70
7416	.50
7417	.60
7420	.40
7421	.40
7423	.50
7425	.45
7426	.40
7427	.40
7430	.40
7432	.40
7437	.40
7438	.50
7440	.50
7441	1.00
7442	.50
7443	1.40
7444	1.20
7445	1.10
7446	1.00
7447	1.00
7448	1.00
7450	.50
7451	.50
7453	.40
8T26	2.20
9300	.60
9307	1.80
9308	1.20
7454	.60
7472	.60
7473	.60
7474	.60
7475	.60
7476	.60
7480	.65
7482	1.80
7483	.80
7485	.80
7486	.60
7489	2.60
7490	.70
7491	.55
7492	.60
7493	.60
7494	.90
7495	.45
7496	.80
7497	2.50
74107	.80
74109	.60
74116	2.20
74121	.45
74122	.65
74123	.60
74125	.55
74126	.60
74132	.80
74141	1.10
74145	.85
74147	2.00
74148	1.40
74150	1.20
74151	.60
74152	4.90
74153	.70
74154	1.20
74155	.90
8T28	3.00
9310	.65
9311	1.00
9312	1.35
74156	1.50
74157	.60
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	3.75
74185	1.20
74190	1.00
74191	1.50
74192	1.70
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
73293	.90
74365	.80
74366	.80
74367	1.00
74368	1.00
8T96	1.80
9314	1.30
9368	1.75
9370	2.00
74LS SERIES	
74LS00	.40
74LS01	.40
74LS02	.40
74LS03	.40
74LS05	.40
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS13	.50
74LS14	.90
74LS15	.40
74LS20	.40
74LS21	.40
74LS22	.40
74LS26	.40
74LS28	.40
74LS30	.40
74LS32	.40
74LS33	.40
74LS37	.50
74LS38	.50
74LS40	.50
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.40
74LS54	.50
74LS55	.50
74LS58	.65
74LS73	.55
74LS74	.60
74LS75	.45
74LS76	.50
74LS78	.50
74LS83	1.00
74LS85	1.00
74LS86	.50
74LS90	.70
74LS92	.90
74LS93	.80
74LS95	.65
74LS96	1.55
74LS107	.60
74LS109	.60
74LS112	.60
74LS113	.65
74LS114	.50
74LS122	.50
74LS123	.75
74LS125	.50
74LS126	.50
74LS132	.80
74LS133	.50
74LS136	.50
74LS138	1.20
74LS139	.85
74LS151	.75
74LS153	.80
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	1.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.90
74LS174	.90
74LS175	.90
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	1.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.80
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.90
74LS266	.90
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.50
74LS366	.70
74LS367	.90
74LS368	.90
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	11.50
11C90	19.50
81LS96	2.10
81LS97	2.10

TRANSISTORS

2N301	2.20
2N657	.60
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.00
2N2219A	.60
PN2222	.20
PN2222	.30
2N2463	.35
2N2484	.65
2N2646	.70
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.30
2N3053	.60
2N3054	.90
2N3055	.90
2N3301	.40
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.30
2N3564	.30
2N3569	.30
PN3565	.30
PN3566	.30
PN3567	.30
2N3568	.30
2N3638	.30
2N3639	.30
2N3640	.30
2N3641	.30
2N3645	.30
PN3642	.30
PN3643	.30
PN3644	.30
2N3646	.30
2N3692	.50
2N3693	.35
2N3702	.30
PN3694	.30
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.50
2N3866	2.00
2N3904	.30
2N3906	.30
2N4030	1.10
2N4032	.55
2N4033	.90
2N4036	1.00
2N4037	.90
PN4121	.30
2N4233	1.60
2N4235	1.90
2N4236	2.20
2N4248	.30
PN4249	.30
2N4250	.30
2N4258	.30
2N4292	.70
2N4354	.30
2N4355	.30
2N4356	.30
2N4398	5.00
2N4401	.50
2N4402	.50
2N4403	.50
2N4416	1.00
2N4906	2.80
PN4868	.30
2N5088	.30
2N5089	.30
2N5179	1.90
2N5303	3.30
2N5320	.80
2N5401	.70
2N5458	.70
2N5459	.70
2N5461	.70
2N5484	.70
2N5485	.70
2N5486	.70
2N5769	.25
2N5770	.25
2N5830	.25
2N5831	.30
2N5856	.30
2N5873	1.10
2N5874	1.40
2N5961	.30
2N5963	1.10
2N6027	.60
3N201	.90
AC127	.70
AC128	.70
AC187	.70
AC188	.70
AD149	2.50
AD161	1.70
AD162	1.70
BC318	.30
BC319	.18
BC327	.15
BC328	.30
BC337	.30
BC338	.30
BC547	.15
BC548	.15
BC549	.15
BC549C	.40
BC557	.16
BC558	.16
BC559	.16
BC637	.25
BC638	.36
BC639	.80
BC640	.80
BCY70	.85
BCY71	.85
BD115	1.50
BD135	.70
BD136	.70
BD137	.70
BD138	.70
BD139	.70
BD140	.70
BD235	.65
BD234	.50
BD237	.50
BD262	1.20
BD301	.75
BD302	.75
BD263	1.25
BD435	.75
BD646	1.70
BD647	1.80
BD675	.80
BDV64B	4.50
BDV65B	4.50
BF115	.50
BF173	.70
BF180	.70
BF195	.30
BF198	.30
BF199	.30
BF336	.80
BF337	.80
BF458	.90
BF494	.40
BFX85	.75
BFY50	.90
BFY90	1.30
BSV17	1.00
BU126	3.00
BU208	3.00
BUX80	7.90
FT2955	1.40
FT3055	.75
MEL12	.90
BU326A	3.40
MJ2955	1.00
MJ4032	7.40
MJ802	3.40
MJ4035	6.90
MJ4502	3.70
MJE340	1.20
MJE350	1.70
MJE295	1.90
MJE8055	1.90
MJE3521	.60
MJ15003	4.00
MJ15004	4.00
QF102	.60
MPF131	1.40
MPSA05	.60
MPSA06	.60
MPSA12	.60
MPSA14	.60
MPSA42	.60
MPSA56	.80
MPSA92	.60
MRF475	4.40
TT318	.90
TI3PIC	1.00
TIP32B	.90
TIP32C	1.00
TIP33A	1.10
TIP34A	1.20
TIP24B	1.50
TIP42B	1.10
TIP110	1.30
TIP120	1.30
TIP2955	1.20
TIP3055	1.20
VN88AF	2.50

MICRO CHIPS

ADCO 800	12.00
DACO 080	2.00
2012 200 NS	2.00
2102 350 NS	2.00
2102 450 NS	1.40
2102 650 NS	1.40
2111	8.60
2114 150 NS	11.15
2114 300 NS	3.90
2114 450 NS	3.50
8-31	3.30
32 up	3.10
2513	14.50
2516	55.00
2532	69.00
2650	23.00
2708	8.50
2716	12.00
4116	5.50
5101	9.00
MM5204	12.50
MM5220	7.20
MM5307	18.00
MM5309	6.50
MM5312	9.00
MM5369	2.60
5387	8.50
MM5395	6.50
6502	10.50
6508	5.50
6520	5.50
6522	10.00
6523	17.00
6551	17.00
MC6900P	9.00
MC6802	13.60
MC6808	12.50
6810A	4.90
6820	5.50
6821	6.00
6850	5.15
6852	6.40
7106	12.60
7107	15.00
7210	13.20
Z80 CPU	14.00
Z80A CPU	16.00
Z80 P10	13.80
Z80A P10	16.50
Z80 CTC	13.80
Z80A CTC	16.50
Z80 DMA	40.70
Z80 S10/0	56.90
Z80 S10/1	56.90
Z80 S10/2	56.90
Z80A S10/0	63.00
Z80A S10/1	63.00
Z80A S10/2	63.00
8035	27.00
INS8050	15.00
INS8080	8.00
P8085	25.00
8155	22.00
8165	22.00
8205	5.00
P8212	4.00
8214	8.00
8216	5.90
8224N	5.50
8224	7.50
8226	5.90
8228	9.50
8238	8.00
8243	8.00
8251	14.00
INS8251	6.50
8253	19.50
8255A	8.60
8257	99.00
8259	99.00
8275	99.00
8278	99.00
8295	25.00
DM8578	3.50
Ay-5-2376	19.56
8748A	99.00
8755A	99.00
MCT2	.80
MCT6	3.30
MCT275	1.50
MCC671	3.00
4N28	.85
4N33	1.20
4N26	.85
MM80C95	.90
80C96	.90
MM80C97	.90
8098	.90

OPTOCOUPLERS

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

VOLTAGE REGULATORS

78L05	.40
LM341P-5	.80
7805	1.00
7905	1.70
LM309K	1.20
7805K	2.10
LM323-K	6.90
78H05KC	8.50
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79H12KC	8.00
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79L15	.65
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7915CT	1.80
7915KC	2.60
78H15KC	6.50
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7818	1.40
78L24	.35
79L24	.65
7824	1.10
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KBP604	2.60
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KHPC1002	2.60
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5-82/1

Graphics printer package suits Apple

Datatel, agents for Micro Peripherals Inc., recently announced the availability of the first of a series of products designed to greatly enhance the present capabilities of small computer systems using the MPI series of graphic printers.

The AP-PAK (short for applications package) product line consists of hardware and software products designed specifically for each computer system.

This initial release is the Apple AP-PAK for the popular APPLE II and contains an Auto Plot printer control card, interface cable, MPI-developed software programs and instruction manuals.

The Apple AP-PAK gives the Apple owner the ability to use all the graphic capabilities of the Model 88G or 99G graphics printer. With the Apple AP-PAK you can print an unlimited number of character fonts, large headlines, intermix type fonts on a line, do graphic dumps of HI-RES files, automatically generate individualised computer letters, and many more things that have till now been difficult or impossible with other printer systems.

In addition, the package comes with Letter Post and Font Writer software, plus a series of demonstration programs that illustrate the versatility and usefulness of graphic printing for the Apple user. The Apple AP-PAK will be available in Australia at around $150 plus tax.

Further details may be obtained from: Datatel Pty Ltd, 3 Raglan Street, South Melbourne Vic. 3205. (03)690-4000.

New switchmode computer power supplies

Two new switchmode computer power supplies by Boschert Inc were released here recently by Amtex.

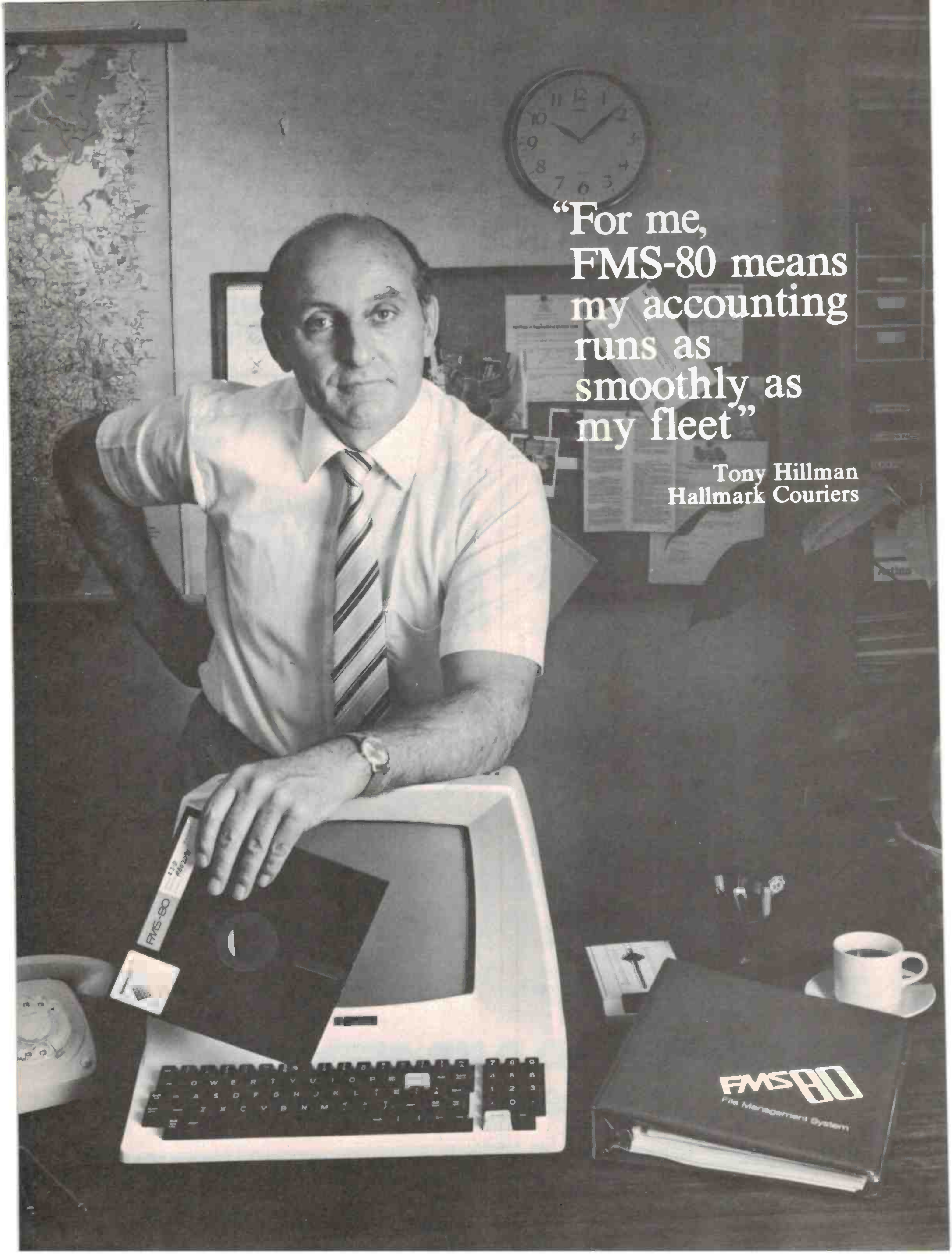
The models XL51 and XL53 feature a 3.7 kV isolation spec and have been designed to eliminate noise and interference problems.

The XL51 delivers 40 W, commonly required by dumb terminals, while the XL53 delivers 65 W, generally required by smart terminals. Both are four-output designs — +5 V, −5 V, +12 V, −12 V — and are said to be suitable for Apples (and obviously, the 'Concorde'). Each employs open-frame construction and features a new proprietary current-controlled feedback network to achieve tight regulation and low ripple and noise, the makers say.

The XL51 measures 197 x 108 x 57 mm, while the XL53 is 12 mm longer. Both have short circuit and input surge current protection. Input voltage range is selectable for either 90 — 132 Vac or 180 — 264 Vac. They can be used to power CRTs, micros, mini-floppy drives, cassettes and small printers.

One-off price is $172 for the XL51 and $210 for the XL53. They are available ex-stock from Amtex Electronics, P.O. Box 285, Chatswood NSW 2067. (02)411-1323.


DECISION I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Lab Notes

Improved text display for video monitors

Modify your video monitor to uncramp the lines of text. Here are the principles and practical circuitry.

Graham Wideman

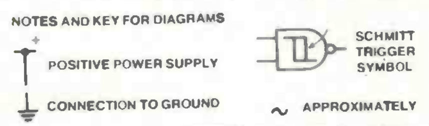
REMEMBERING WHAT we were all playing with ten years ago, there is no denying that today's personal computers are marvellous pieces of equipment, and whatever your brand preference, tremendous value for money. And that sentiment is doubled for those of us who use a computer for 'serious' purposes — in our work. However, the serious user will notice that most personal computers sacrifice some degree of convenience of use for particular specialised applications. This is not surprising, as the manufacturers have tried to make their products as generally appealing as possible without unnecessarily increasing their prices with luxury features.

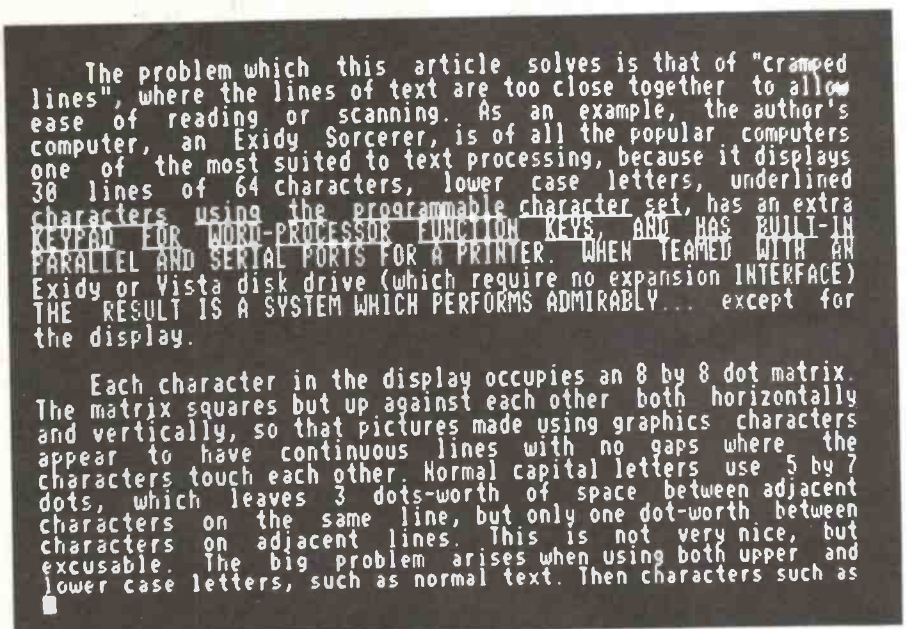
One such area is that of text display, where many personal computers 'trade in' some text readability in order to accommodate graphics capabilities. For many users this is of little consequence, but it becomes a major headache when using the computer for word processing, or even for long hours of programming. This article describes a method whereby a video monitor can be modified to counteract one of these shortcomings, and provide a display which will save your eyes and your temper.

Cramped lines

The problem which this article solves is that of 'cramped lines', where the lines of text are too close together to allow ease of reading or scanning. As an example, the author's computer, an Exidy Sorcerer, is of all the popular computers one of the most suited to text processing because it displays 30 lines of 64 characters, lower case letters, underlined characters using the programmable character set, has an extra keypad for word processor function keys, and has built-in parallel and serial ports for a printer. When teamed with an Exidy or Vista disk drive (which require no expansion interface) the result is a system which performs admirably . . . except for the display.

Each character in the display occupies an 8-by-8 dot matrix. The matrix squares butt up against each other both horizontally and vertically, so that pictures made using graphics characters appear to have continuous lines with no gaps where the characters touch each other. Normal capital letters use 5-by-7 dots, which leaves three dots' worth of space between adjacent characters on the same line, but only one dots' worth between characters on adjacent lines. This is not very nice, but excusable. The big problem arises when using both upper and lower case letters, such as normal text. Then characters such as 'y' and 'p', which have 'tails' (descenders) hanging below the line, use the bottom row of dots in the matrix for these tails. Now there is no space between lines, and for example a 'g'





You can turn this screen display into . . .

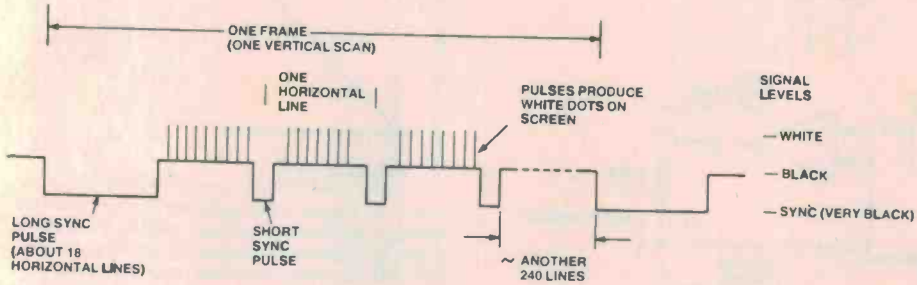


Figure 1: **Simplified diagram of the composite video signal.**

appearing above a 'T' will touch. In addition, underlined characters are most unreadable, since they too use this bottom row of dots in the matrix. It is thus desirable to be able to introduce some more space between each row of characters.

More space

There are several methods which are potentially useful in obtaining the desired spacing. One possibility is to modify the computer so that it allows a picture scan-line (or two) in between each row of characters. This proves to be unfeasible in the case of the Sorcerer because its 30 lines of characters already occupy 240 of the approximately 256 scan lines that you might be able to squeeze onto your monitor, which doesn't provide even one spare line per row of characters. In any case, such a modification to the computer could be rather messy.

Consequently, it is logical next to look at the video monitor itself to see if it could be modified to provide space between rows of characters. The answer is *yes*. The following description of how this is done is *not* a complete design for any particular monitor, but is instead intended to be adapted to whatever monitor you have. The simple circuitry shown was incorporated into a 'monitorised' TV set, and demonstrates the techniques involved.

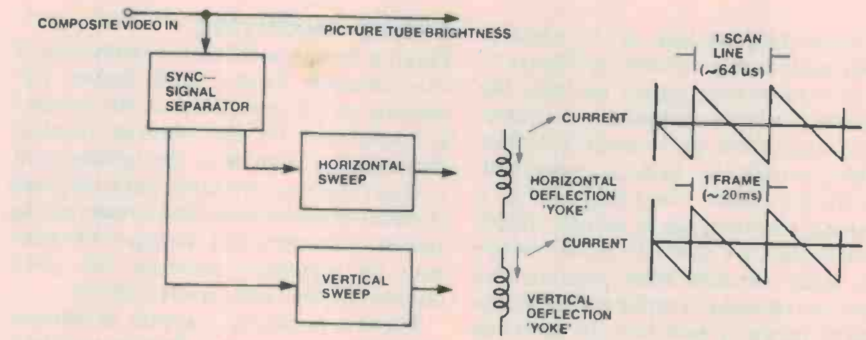
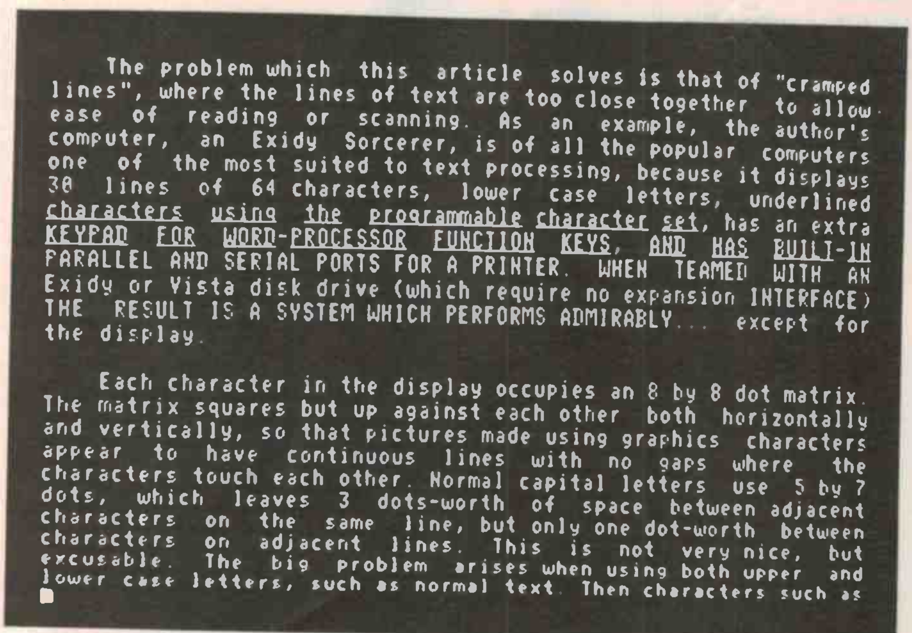


Figure 2: **Conceptual picture of TV or monitor sweep sections.**

Vertical sweep operation

Before proceeding to the design of the 'line uncramper' itself, it is necessary to describe the salient features of the vertical and horizontal scanning systems in a typical monitor. The signal which is passed by your computer to the monitor is called 'composite video' and looks something like Figure 1 when displayed on an oscilloscope. The signal is 'composed' of three separate sets of information added together. They are: the actual picture information which tells where white dots are to appear on a line; the horizontal synchronising pulses which identify the beginning of a line and tell the monitor to start a new line at the left side of the screen; and the vertical synchronising pulses which tell the monitor to start a new frame at the top of the screen. What happens to these signals is shown in Figure 2.

The electron beam inside the picture tube is scanned from side to side and from top to bottom by two sets of electromagnets, called the horizontal and vertical 'yokes' respectively. An electromagnet deflects the electron beam away from the centre of the screen by a distance which is more or less proportional to the amount of current flowing through the magnet coil. Thus it is not surprising that in order to provide a smooth sweep rate over the screen followed by a rapid retrace to the starting position, the current through the coils in both horizontal and vertical cases is a sawtooth wave shape, as Figure 2 shows. ▶



. . . this screen display. Letters on adjacent rows no longer touch, and a screenful of text (only a small area is shown here) becomes far more easily readable.

Lab Notes

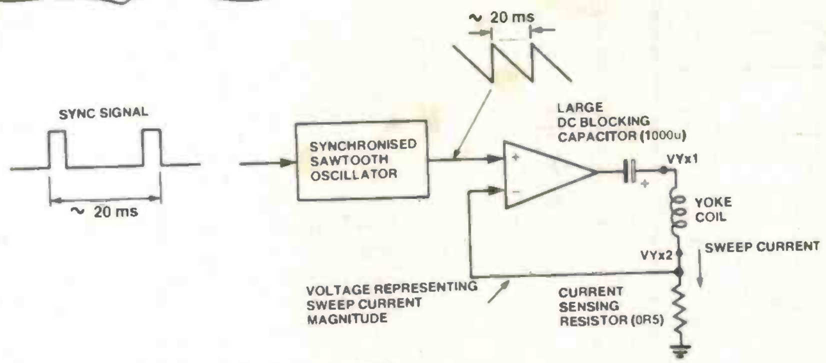


Figure 3: **Simplified look at vertical sweep section.**

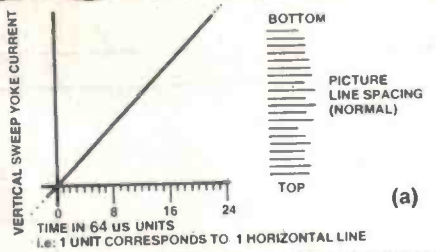


Figure 4a: **Graph showing the vertical yoke current during a portion of the sweep. Beside the graph is a representation of the spacing of the scan lines with this normal (unmodified) sweep current.**

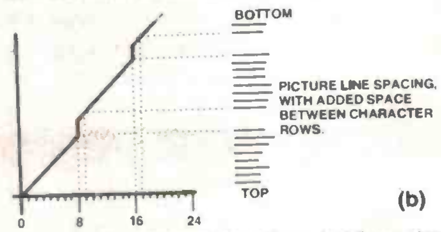


Figure 4b: **Graph shows the effect of adding a step of current after each character row. Note the spaces in the scan lines.**

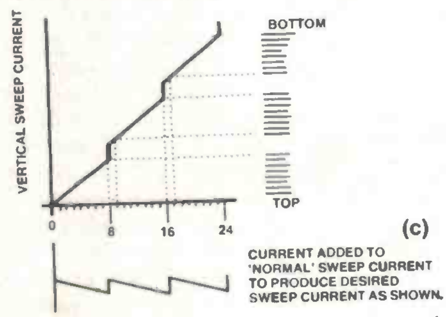


Figure 4c: **In this graph the scan lines for each character row are vertically squeezed together to obtain a space between rows. The current to be added to the normal yoke current is shown beneath.**

A more detailed look at the vertical sweep section is provided by Figure 3. The synchronising signal controls the frequency of the sawtooth oscillator. The sawtooth voltage is amplified, then applied across the vertical yoke coil. The output from the amplifier is a sawtooth-like waveform which varies between, say, 1 V and 7 V. However, the yoke must conduct both positive and negative currents in order to deflect the electron beam up and down to cover top and bottom of the screen. The vertical amplifier cannot generate a waveform with both positive and negative voltages, since it is supplied with only a 'single-sided' positive power supply. Hence a large dc blocking capacitor is inserted so that the voltage applied to the yoke averages out to zero and thus must have both positive and negative parts, say −3 V to +3 V.

A small-value resistor (typically half an ohm) does little to reduce the sweep current through the yoke to ground. Instead, the small voltage generated across it is used as a measure of the yoke current, and is fed back to the negative input of the sweep amplifier. Here it is compared to the intended sawtooth, and any correction is made. The result is that a sawtooth *current* is supplied through the yoke, and a sawtooth *voltage* may be observed at the 'top' of the current-sensing resistor. However, the voltage waveform observed at the top of the yoke (output from the capacitor) is a somewhat distorted sawtooth because the yoke coil has inductance.

This is a simplified description of how the vertical sweep section works, but it points out the three components (yoke, dc blocking capacitor and current-sensing resistor) which are important to the line uncramper. If you are contemplating modifying your monitor then you must be able to locate these three components both inside the monitor and on the monitor circuit diagram.

Sweep modifying

Having recognised that the deflection of the electron beam (and hence the spacing of the scan lines on the screen) is controlled by the current flowing through the yoke, it is straightforward to conclude that we could add a little bit of extra space between the bottom of one row of characters and the top of the next row by somehow altering the yoke current at the appropriate instant.

Figure 4a shows a graph of normal vertical sweep current during a portion of a frame (about 20 lines' worth), and the relative spacing of the picture lines. It would be possible to add current in steps after each character row, as shown in Figure 4b (one character row here is shown as consisting of eight lines, as would be the case for the Sorcerer). This would provide the desired space between character rows; however, all the additional spaces would add to the total picture height, possibly making the picture too high for the screen even with the monitor's picture height adjustment set to minimum. In any case this arrangement would require readjustment of picture height when switching between graphics and text modes.

The basic solution lies in Figure 4c. Here, each set of eight lines belonging to one row of characters is vertically squeezed together. This makes the characters less tall, the skrinkage leaving the desired space between character rows. Figure 4c also shows the waveform of the basic current to be added to the normal yoke current to achieve this result.

The circuitry

Now the actual line uncramper circuitry can be discussed. The circuitry has been broken into sections so that the function of each can be clearly understood, and so that, where necessary, modifications can be made simply. Figures 5 to 11 show these circuit modules.

The line uncramper needs to be supplied with power. This can most readily be obtained from the monitor itself, as shown by Figure 5. Needless to say, it is assumed that the monitor or TV set in question is a transistor or IC type and has such voltages available. (Modification of valve type monitors is not recommended, both from safety and practicality viewpoints.) The 'power supply' circuitry filters the supplied voltage so that any noise on the monitor's supply line will not interfere with the line uncramper, and perhaps more importantly, vice-versa. The voltage supplied to the line uncramper can be anywhere between 9 V and 15 V; the components are not very fussy.

Horizontal and vertical signals

The line uncramper needs to be informed of the start of each horizontal line (so it can count them) and the start

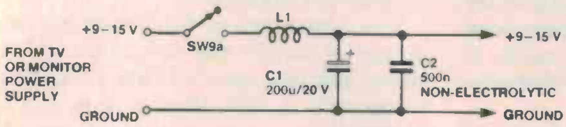


Figure 5: Schematic of 'power supply' for Line Uncramper.

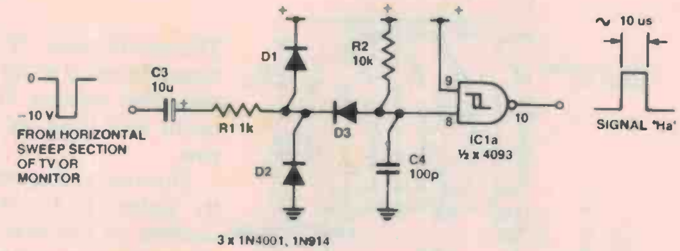


Figure 6: This circuit is the horizontal pulse conditioner, taking a signal from the monitor and producing a well-defined pulse at the beginning of a scan line for the subsequent circuitry to use.

of each picture frame (so it can properly register the spaces between character rows). To facilitate this, signals are taken from the horizontal and vertical sections and conditioned into nice pulses for use by the rest of the circuitry. This job is done by the circuits shown in Figures 6 and 7. In the TV set which the author modified, a 0 V to −10 V pulse was found in the horizontal sweep section. The horizontal pulse conditioner converts this first to a +10 V-to-0 V pulse (components C3, R1, D1, D2) then generates a 10 us pulse on the falling edge of the input pulse (D3, R2, C4) which is inverted and squared up by IC1a. (Note the use of Schmitt trigger-type gates. These give more 'positive' switching action, which is important when attempting to change relatively slowly varying signals into digital pulses. Although the 4093 is shown, any CMOS Schmitt inverters will do).

The vertical signal used was taken from the yoke (point VYx1 on Figure 3). This signal is less 'nice' than the horizontal signal used, and its pulse conditioner consequently is fancier. The waveform is a sort of sawtooth with a pulse on top of each peak, and it measures 1 V to 7 V. This is 'floated' by C5, and the average voltage adjusted by RV1 and R3 (i.e: the signal is moved up or down) so that the signal which feeds into IC1b produces a stable and reliable pulse at IC1b's output, as shown. This pulse triggers a pulse generater (C6, D6, R6, RV2 and IC1c) whose output pulse width is 60 us ±30 us approximately. (Pulse width adjusted by RV2.)

This gives us two nice pulses indicating the start of the horizontal and vertical sweeps. It is quite likely that the signals available in your monitor or TV will differ from the ones shown here; you will have to try to find signals that you can use either by studying the monitor circuit or prodding around with an oscilloscope. The techniques shown in Figures 6 and 7 are quite generally applicable and should be useful in most cases. In any event, your input signal conditioners should provide the same kind of pulses for the subsequent circuitry to work with. ▶

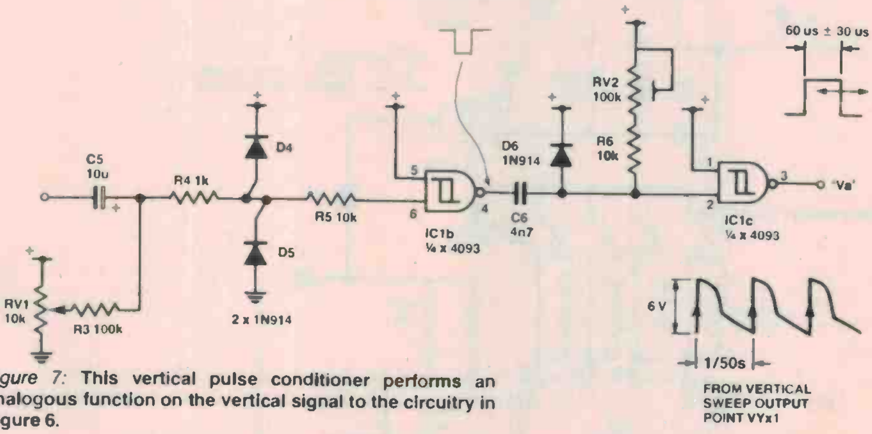
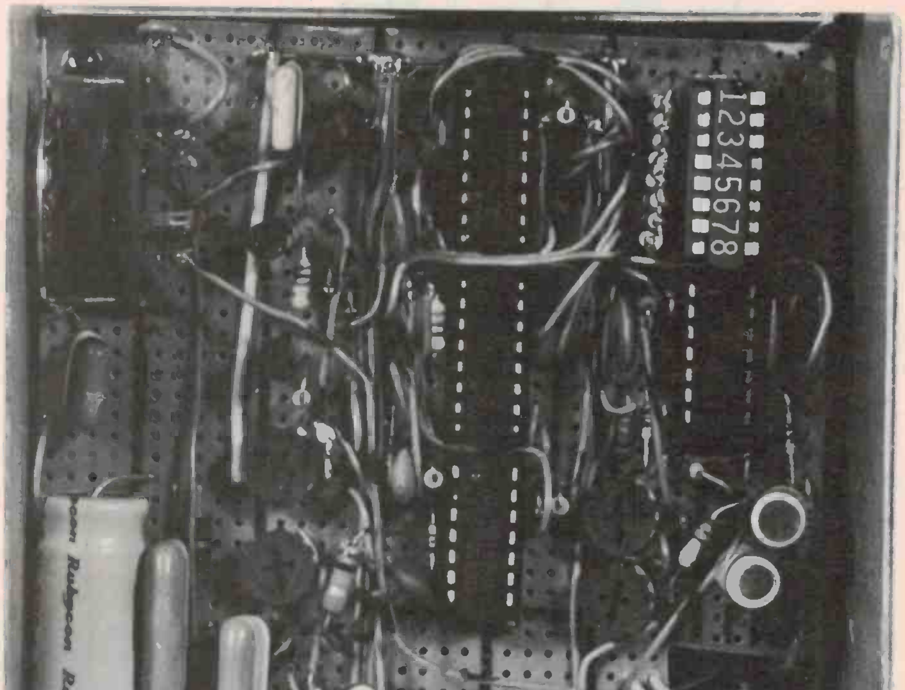


Figure 7: This vertical pulse conditioner performs an analogous function on the vertical signal to the circuitry in Figure 6.



The Line Uncramper fits neatly into a small metal box attached to the side of the TV set/monitor. The circuit board is supported by the rotary switch only. Connections to the TV set pass through a hole behind the board through the box and TV set cabinet walls.

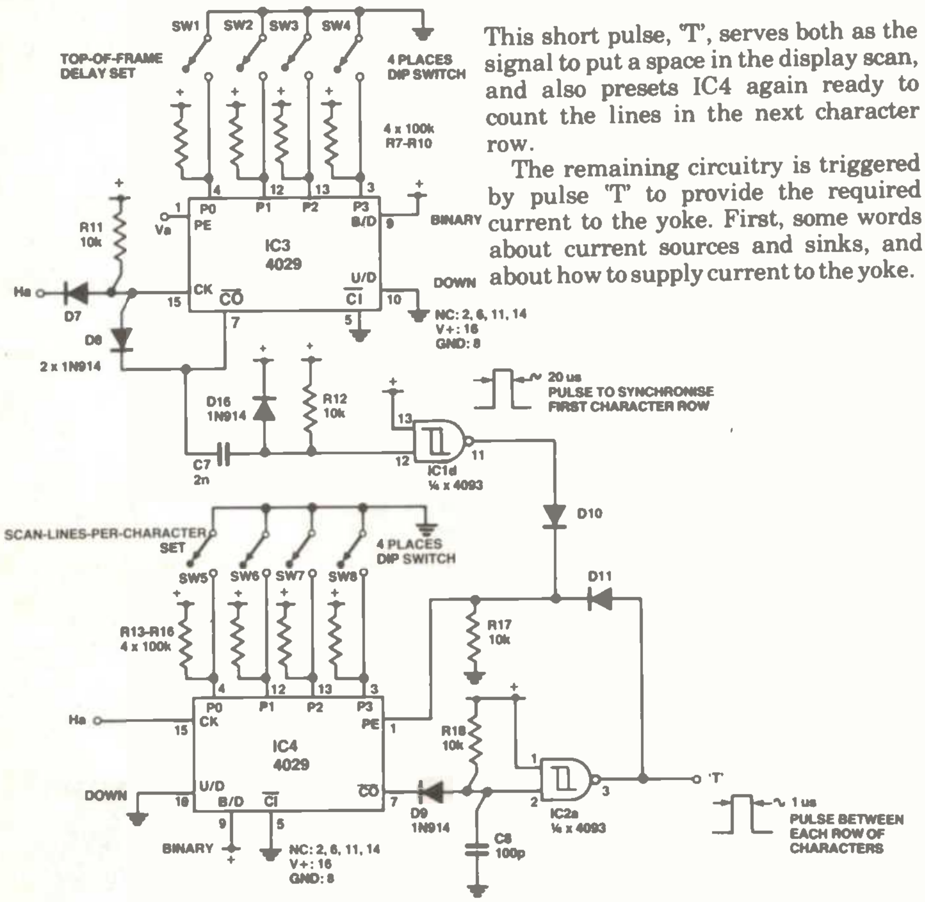


Figure 8: **The timing circuitry is the real heart of the Line Uncramper. It determines where the first space will appear on the screen, and the number of scan lines between subsequent spaces.**

Timing

The purpose of the section shown in Figure 8 is to generate a pulse which indicates that a space is to be made in the screen scanning. It therefore must determine where the first space must occur, and then must repeatedly signal a space after the bottom of each character row. Counter IC3 handles the first part of this task. The pulse from the vertical signal conditioner, 'Va', loads this counter with the number set on DIP switches SW1 to 4. The counter is set up to count in binary, and to count downwards, and it counts the horizontal pulses 'Ha'. When it counts down to zero its 'carry' output synchronises the second counter IC4 by presetting it (via pulse generator C7-D16-R12-IC1d, and then D10) with the value on DIP switches SW5 to 8. This value is the number of lines in a character, which for the Sorcerer is eight or 1000 binary (SW8 open, SW7 to 5 all closed). IC4 also counts downward, and each time it reaches zero its 'carry' output triggers a pulse generator (D9, R18, C8, IC2a). This short pulse, 'T', serves both as the signal to put a space in the display scan, and also presets IC4 again ready to count the lines in the next character row.

The remaining circuitry is triggered by pulse 'T' to provide the required current to the yoke. First, some words about current sources and sinks, and about how to supply current to the yoke.

Current sinks

Some current sources and sinks are shown in Figure 11. In each case the collector lead (marked 'c'), if connected to some other circuit, is able to supply (source) or draw away (sink) a predetermined amount of current, *without* affecting the voltage present on that other circuit (within limits). In Figure 11a, for example, the current drawn away is labelled Ic (collector current). For our approximate purposes, Ic is the same as Ie. Ie in turn is determined by Ohm's Law to be the voltage across resistor R, divided by R. The voltage across R is Vb, less the fixed base-emitter voltage of 0.6 V. Consequently, by setting Vb we can determine Ic. As a formula:

$$Ic = (Vb - 0.6)/R$$

The formula for Figure 11b is the same, while those for Figures 11c and d are similar except that there are two base-emitter voltages, and hence the formula is:

$$Ic = (Vb - 1.2)/R$$

(These circuits, of course, only work for positive values of Ic.

The advantage of the two-transistor design is simply that about 50 to 100 times less base current (Ib) is required to operate it. The limit within which these circuits must operate is that the voltage on the circuit to which the current sink or source is connected must allow at least a certain minimum voltage from collector to ground (11a and 11c) or from collector to the positive supply V+ (11b and 11d). This minimum is Vb−0.4 V approximately.

Uncramper outputs

Now, looking back to Figure 3, what we are attempting to do is to add to, or subtract from, the current flowing in the yoke. Increasing the current through the yoke can be done by feeding more current into point VYx1, or drawing more current away from VYx2. In the first case a current source would be attached to VYx1, while in the second a current sink would be attached to VYx2. The second of these two is not feasible since the small voltage across the current-sensing resistor is insufficient for a current sink to operate.

To reduce the current through the yoke, a current sink may be attached to VYx1, or a current source attached to VYx2. (It may be thought that where the current added or subtracted affects the voltage across the current-sensing resistor, the negative feedback would cause the vertical amplifier to 'correct' for the difference and cancel the desired addition or subtraction. This does not happen because in fact the amount added or subtracted is relatively small, and the indicated feedback loop is not the only feedback path.)

The basic sawtooth current to be added to the yoke is generated by the circuit of Figure 9. Here, the pulse 'T' turns on Q1 and Q2 for a short time. Q2 forces the voltage across C9 to about 2 V. When Q2 turns off, C9 slowly charges via R21 and RV3. The repetition of these events results in a sawtooth waveform at the base of Q3, the height of which is adjusted by RV3. This sawtooth voltage controls a current source (Q3, Q4, R22) which supplies a sawtooth current to the yoke.

That *should* finish the job. Unfortunately, the sawtooth current source is not able to force the drop in current at the end of each tooth to occur fast enough, due to the slowing effect of the yoke's inductance. The result is that the space which should occur *between* scan

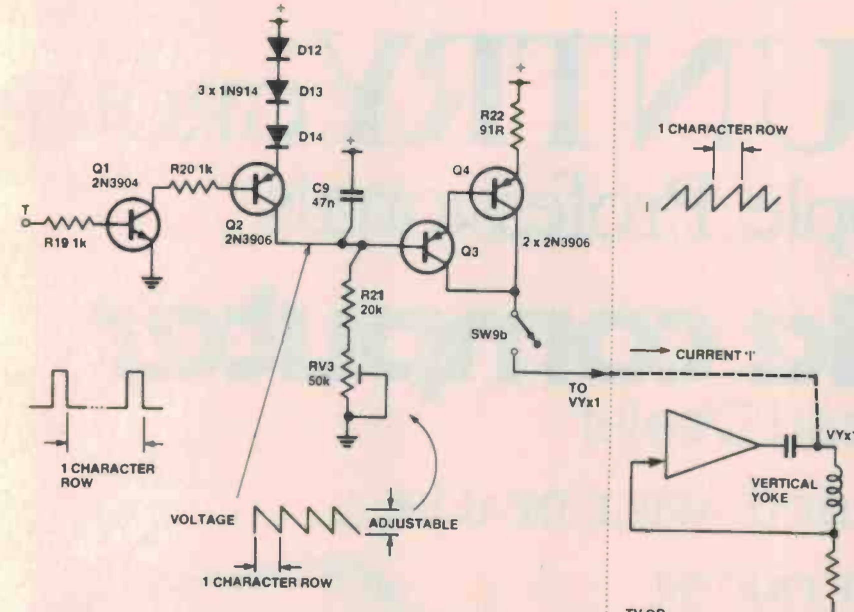
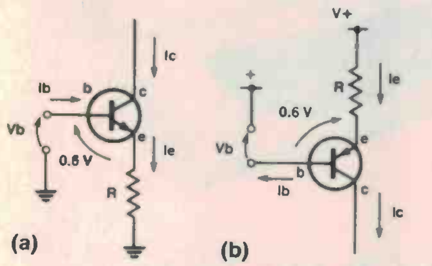
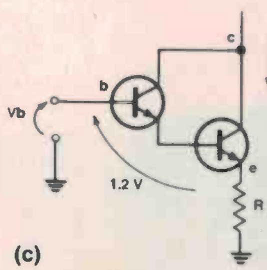


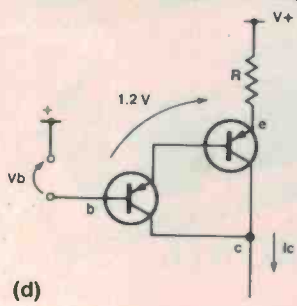
Figure 9: A sawtooth current is generated by this circuit, which feeds the vertical yoke and causes the vertical squeezing of the scan lines belonging to one character row.



11a: NPN current sink. *11b:* PNP current source.



11c: Two-transistor ('Darlington' arrangement)



11d: Darlington current source.

Figure 11: Circuitry for current sources and sinks.

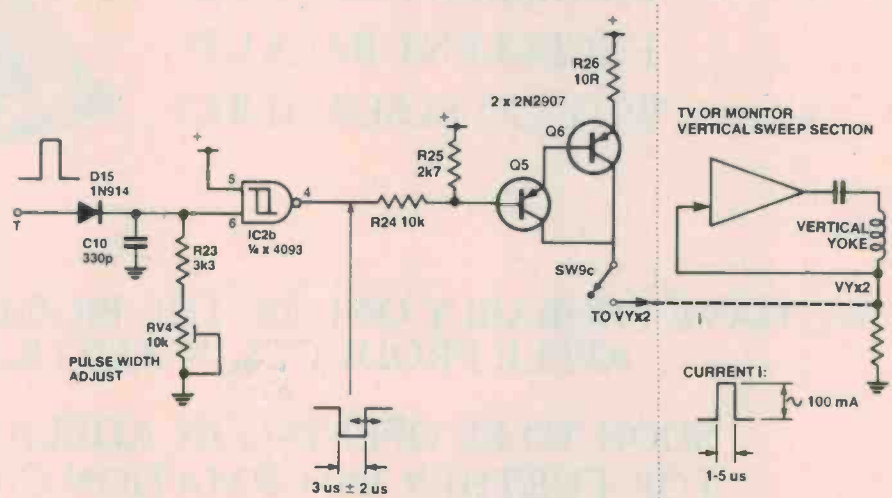


Figure 10: This circuit sends a pulse to the yoke to make the between-row step in the scan occur sharply.

lines (in about 5 us or less) actually takes so long (about 50 us) that the top scan line of each character row is on an angle, the left end joined to the upper row of characters, and the right end finally dropped down to join with the lower row of characters. What is needed is to give the yoke a swift kick to cause the step in the vertical sweep to occur smartly. This function is performed by the circuitry of Figure 10.

Pulse 'T' is 'stretched' by D15-C10-R23-RV4 and produces a pulse at the output of IC2b which is 3 us ±2 us long. This pulse is applied to a current source (R24, R25, Q5, Q6), which supplies a pulse of current to VYx2, sharply reducing the voltage across the yoke for a few microseconds.

Switch SW9a-b-c turns on the power to the uncramper, and connects the two current sources to the monitor.

Construction

Any construction method which you have found satisfactory for digital circuitry should be appropriate for the line uncramper. The author's prototype was constructed on Veroboard and mounted in a small metal box attached to the side of the TV set/monitor. Rotary switch SW9 is mounted on the front of the box, and supports the circuit board. Wires into the TV pass through a hole drilled through the box and TV walls.

Adjustment

An oscilloscope will probably already have been needed to find the necessary horizontal and vertical signals in the monitor, and will be required now for setting up the uncramper. First set all trimmer potentiometers for the middle of their ranges. Then power up the modified monitor and quickly ensure that the supply voltages on the uncramper are as supposed to be, and that nothing is getting extremely hot, etc. With your computer connected to the monitor, the horizontal and vertical pulse conditioners should be adjusted and verified for proper operation. (It is probably a good idea not to connect the two current sources to the monitor until this stage is reached and the generally satisfactory operation of the uncramper has been checked with the 'scope.)

Next, DIP switches SW5 to 8 can be set for the appropriate number of scan lines per character row. The display ▶

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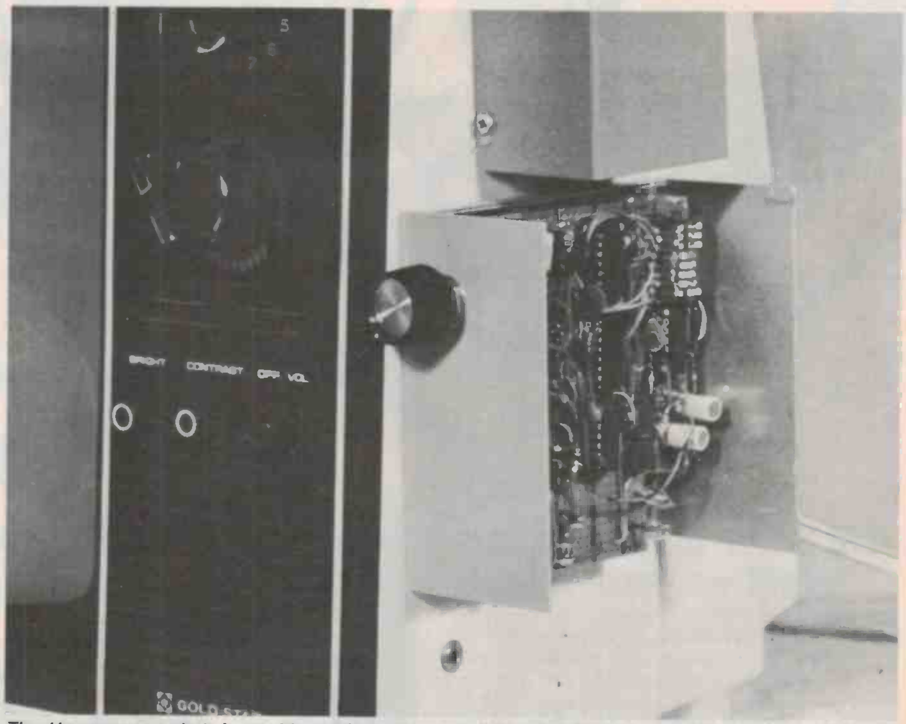
Lab Notes

PARTS LIST

Resistors	**all 5%, ⅛ W or greater unless noted**
R1, R4, R19, R20	1k
R2, R5, R6, R11, R12, R17, R18, R24	10k
R3, R7-10, R13-16	100k
R21	20k
R22	91R
R23	3k3
R25	2k7
R26	10R ¼ W
Trimpots	**all linear, miniature, multiturn units are desirable but not necessary.**
RV1, RV4	10k
RV2	100k
RV3	50k
Capacitors	
C1	200u or greater/20V electrolytic
C2	500n non-electrolytic
C3, C5	10u/25 V electrolytic
C4, C8	100p
C6	4n7
C7	2n2
C9	47n
C10	330p
Inductor	
L1	1 mH or greater RF choke
Semiconductors	
D1-D16	1N914 or similar silicon signal diode
Q1	2N3904, BC107, BC547
Q2, Q3, Q4	2N3906, 2N5139, 2N3250
Q5, Q6	2N2907, 2N3645, 2N4143
IC1, IC2	4093
IC3, IC4	4029
Switches	
SW1-8	8-section DIP switch
SW9	3-pole 2-position



The Uncramper switch is positioned in a convenient location for operation alongside the TV set's controls. The upper box attached to the set is the monitor input circuit, allowing the TV set to use the computer video signal directly.

should be looking somewhat reasonable, with horizontal black spaces appearing in the picture. (Increase the brightness so that you can see what the scan lines are doing.) Now switches SW1 to 4 can be changed until the black lines are between rows of characters. Finally, RV3 and RV4 must be alternately adjusted to provide the desired amount of space and proper vertical stepping respectively.

The line uncramper should provide you with a video monitor which is easier to read, and a computer system which is more enjoyable to use. It is a device which may not be necessary with future generations of computers, but in the meantime you can save your eyes . . . and perhaps some enterprising company would like to pick up the idea and provide uncramper kits for the more popular monitors? ●

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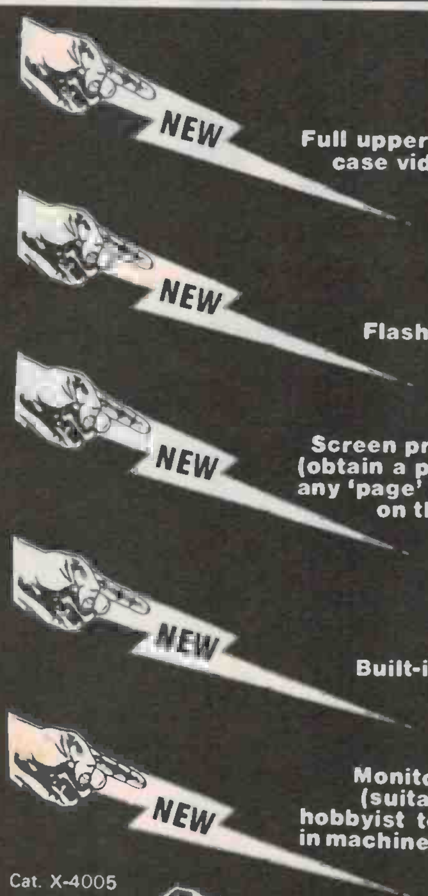
WAS $920!



Full upper and lower case video display capability

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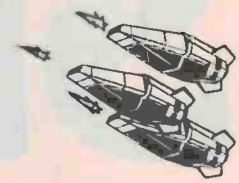

GHOST HUNTER

The aim is to eat the energy dots in the maze before the ghost can get you. Random 'power pills' will assist you in chasing them.
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The SBC-800, a very powerful Single Board Computer, provides all of the necessary facilities needed for a standalone processor.

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Serial I/O consists of a DART which provides 2 serial ports which may be modems, terminals or printers. Each one of these serial ports operates independently of the other.

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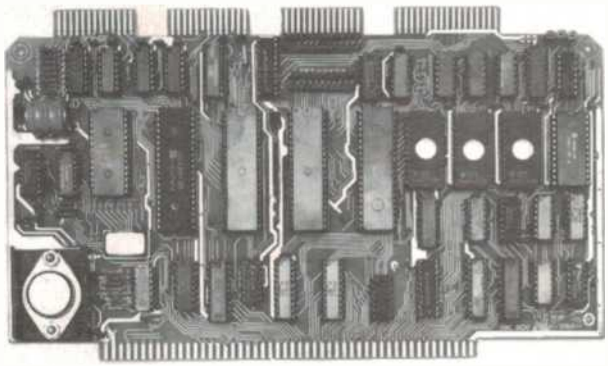
The board also provides four 24 pin sockets for installing up to 16 Kbytes of Eprom, using 2732 devices, or 8 Kbytes of Eprom, using 2716 devices. The sockets have provision for installing 2 Kbytes of ram in up to 3 sockets, to provide 6 Kbytes of Static Ram in lieu of Eprom.

An on board, rechargeable battery, provides power for the Real Time Clock, as well as the CMOS static memory which has been fitted to the board.



FEATURES

- S100 Bus Compatible (IEEE 696)
- Z-80 Microprocessor running at 4 Mhz.
- Two Serial RS232 Communication Ports.
- Software programmable Baud rate generator.
- Parallel Centronics Printer Port.
- 22 Programmable, General Purpose I/O Lines.
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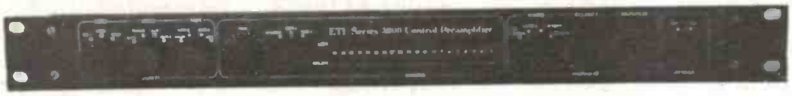
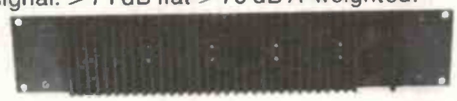
As designed by ETI



SERIES 5000 PREAMPLIFIER — SPECIFICATIONS

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



N.B. Picture is only of original heatsink supplied with this project. Our one is tapped from the rear so that no screw heads are visible. New picture next month.

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

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

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5-82/3

Figure 2. The completed project, showing keyboard layout.

Project 670

Low-cost microcomputer keyboard

This keyboard, whilst designed to team with the ETI-685 2650 S100 computer board, can be used with any computer with a suitable input. The keyboard has 59 keys and the encoder provides standard ASCII output.

Ron Koenig

THE MOST common method of communicating with a microcomputer is via an alphanumeric keyboard. As its name suggests, an alphanumeric keyboard contains the 26 letters of the alphabet and the numerals 0 to 9, plus several punctuation and mathematical symbols. For the computer to interpret which character is being transmitted the keyboard must generate different binary codes. Several standard key codes exist, but the most popular format is the American Standard Code for Information Interchange, or ASCII. This is a 7-bit code which provides for 128 different combinations. These 128 codes are predefined, 96 being for alphanumerics and symbols and 32 for special 'control' purposes (refer to Figure 1).

This keyboard has been designed to provide the student or computer hobbyist with a low-cost, full-featured ASCII keyboard. Although the keyboard has been designed for use with the ETI-685 2650 Single Board Computer (Dec. 1981 ETI), it is a general purpose ASCII keyboard and can be used with any computer or video terminal which uses 7-bit parallel data and a positive strobe.

The design features an automatic repeat at approximately 10 characters per second for any key held operated for more than one second, and an 'Alpha Shift Lock'. This shift lock places only the 26 alphabetic keys into upper case, and lock condition is indicated by a LED.

The major components for this keyboard are provided in a 'basic' kit ▶

HEX			MSD		0	1	2	3	4	5	6	7
	BITS			b6	0	0		0	1	1	1	1
				b5	0	0	1	1	0	0	1	1
LSD	b3	b2	b1	b4 / b0	0	1	0	1	0	1	0	1
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
1	0	0	0	1	SOH	DC1	!	1	A	Q	a	q
2	0	0	1	0	STX	DC2	"	2	B	R	b	r
3	0	0	1	1	ETX	DC3	#	3	C	S	c	s
4	0	1	0	0	EOT	DC4	$	4	D	T	d	t
5	0	1	0	1	ENQ	NAK	%	5	E	U	e	u
6	0	1	1	0	ACK	SYN	&	6	F	V	f	v
7	0	1	1	1	BEL	ETB	'	7	G	W	g	w
8	1	0	0	0	BS	CAN	(	8	H	X	h	x
9	1	0	0	1	HT	EM	)	9	I	Y	i	y
A	1	0	1	0	LF	SUB		:	J	Z	j	z
B	1	0	1	1	VT	ESC	+	;	K	[	k	{
C	1	1	0	0	FF	FS	,	<	L	\	l	|
D	1	1	0	1	CR	GS	−	=	M	]	m	}
E	1	1	1	0	SO	RS	.	>	N	^	n	~
F	1	1	1	1	SI	US	/	?	O	—	o	DEL

CONTROL CHARACTERS

NUL	Null	FF	Form Feed	CAN	Cancel
SOH	Start of Heading	CR	Carriage Return	EM	End of Medium
STX	Start of Text	SO	Shift Out	SUB	Substitute
ETX	End of Text	SI	Shift In	ESC	Escape
EOT	End of Transmission	DLE	Data Link Escape	FS	File Separator
ENQ	Enquiry	DC1	Device Control 1	GS	Group Separator
ACK	Acknowledge	DC2	Device Control 2	RS	Record Separator
BEL	Bell (audible or attention signal)	DC3	Device Control 3	US	Unit Separator
BS	Backspace	DC4	Device Control 4 (Stop)	DEL	Delete
HT	Horizontal Tabulation (punched card skip)	NAK	Negative Acknowledge		
LF	Line feed	SYN	Synchronous Idle		
VT	Vertical Tabulation	ETB	End of Transmission Block		

Figure 1. ASCII code assignments.

distributed by Amtex Electronics and available through some component suppliers. A few extra components and our pc board will have to be purchased to complete this design, although some kit suppliers have indicated they will provide the kit complete (see 'Shoparound').

The basic kit consists of a pre-assembled 'QWERTY' keyboard, the AY-5-2376 keyboard encoder IC, a few TTL ICs and a couple of resistors, capacitors and IC sockets. The assembled keyboard consists of 49 double-shot moulded character keys, a space bar in grey colour and nine function keys in blue, all mounted on a sturdy black steel frame. A double-sided plated-through pc board connects the keys in a matrix to match the keyboard encoder IC, and terminates at a 22-pin connector and four solder positions on the top of the pc board.

The keyboard encoder circuit consists of six ICs and a 16-pin DIP connector, which are assembled on a small double-sided printed circuit board. The printed circuit board supplied in the 'basic' kit is not used.

Construction

The construction of the ASCII keyboard has been greatly simplified by the pre-assembly of the keyboard unit (from Amtex or your kit supplier — see 'Shoparound'). However, an error has been located on the keyboard module and, to correct this, one track must be cut and two links wired on the back of the keyboard printed circuit board. This is detailed in the photograph, Figure 3.

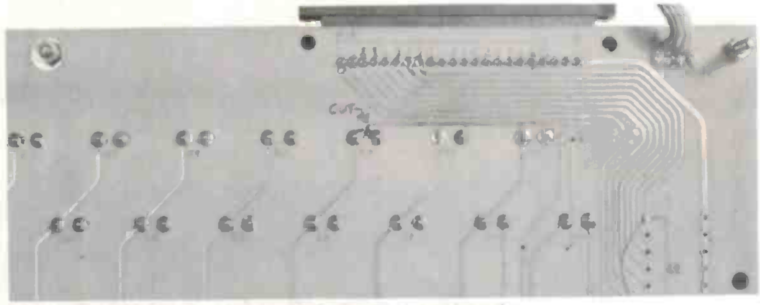


Figure 3. Modifications required to the rear of the keyboard pc board.

The encoder pc board supplied with the keyboard module is discarded, but a number of components are used — indicated in the parts list by an asterisk. Identify these and set them aside. Our encoder is built on a small double-sided board. The front or component side of this board is marked *'ETI 670 f'*. Note that it is the side with the least number of tracks. Examine both sides of the board to make sure there are no broken tracks or short circuits — particularly where tracks run between IC pins.

If all is well, all the feedthrough links may be soldered in. These are marked with a • on the component overlay. *Check carefully* when you are finished to see that you have them *all* in place. Note also that component leads that need to be soldered on *both sides of the board* are similarly marked.

All the resistors should be mounted and soldered in place next. Remember to solder those leads specially indicated on *both sides* of the board for R1, R3, R5, R6 and R10.

We recommend two IC sockets to be used and these should be soldered in place next. Use a 40-pin socket for the encoder chip (IC1) and a 16-pin socket for the output (marked 'DIP CONNECTOR' on the overlay). Follow by soldering ICs 2 to 6 in place. Note that pin 7 of IC2 needs to be soldered *both sides of the board,* as do pin 1 of IC3 and pin 11 of IC6.

The capacitors may be soldered in place now, but take care with the polarity of the tantalum capacitors. Last of all, solder the two three-terminal regulators in place. Watch how you orient

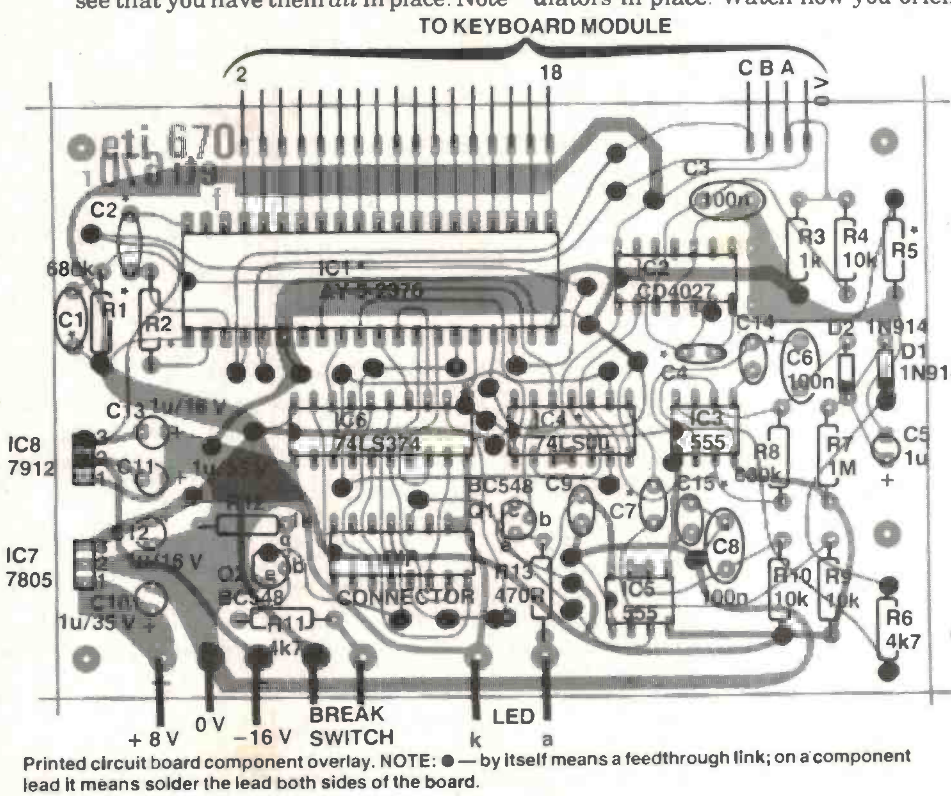
PARTS LIST — ETI-670

Resistors	all ½W, 5%
R1	680k*
R2	120k*
R3, R12	1k
R4, 9, 10	10k
R5	12k*
R6, 11	4k7
R7	1M
R8	680k
R13	470R
Capacitors	
C1, C7	0.022u* (22n)
C2	50p*
C3, C6	100n ceramic
C4, 9, 14, 15	0.04u* (39n)
C5	1u/10 V tant.
C8	0.1u* (100n)
C10, 11	1u/35 V tant.
C12, 13	1u/16 V tant.
Semiconductors	
IC1	AY-5-2376*
IC2	4027
IC3, IC5	555
IC4	74LS00*
IC6	74LS374*
IC7	7805
IC8	7912
Q1, Q2	BC548
D1, D2	1N914
D3	TIL220R red LED

Miscellaneous

ETI-670 pc board; Keyboard module*; SPST push switch; IC sockets — 1 x 16-pin, 1 x 40-pin; wire, etc.

*Denotes components supplied with keyboard module



Printed circuit board component overlay. NOTE: ● — by itself means a feedthrough link; on a component lead it means solder the lead both sides of the board.

		Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
	C	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	DC1	DLE	SI
X0	S	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	DC1	@	_
	N	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	DC1	P	O
	C	DLE	VT	FF	SO	CR	NAK	SYN	ETB	CAN	EM	SUB
X1	S	DLE	[		^	]	NAK	SYN	ETB	CAN	EM	SUB
	N	DLE	K	L	N	M	NAK	SYN	ETB	CAN	EM	SUB
	C		FS	GS	RS	US				SP		US
X2	S	=	FS	GS	RS	US	<	>	,	SP	.	_
	N	-	FS	GS	RS	US	<	>	,	SP	.	_
	C			DLE	US		BS	ESC	GS	CR	LF	RUB
X3	S		*	P	DEL	`	BS	{	}	CR	LF	
	N	0	!	p	_	@	BS	[	]	CR	LF	OUT
	C					CR	SO	STX	SYN	ETX	CAN	SUB
X4	S	+	?	>	<	M	N	B	V	C	X	Z
	N	;	/	.	,	m	n	b	v	c	x	z
	C	FF	VT	LF	BS	BEL	ACK	EOT	DC3	SOH	FF	ESC
X5	S	L	K	J	H	G	F	D	S	A	FF	ESC
	N	l	k	j	h	g	f	d	s	a	FF	ESC
	C	SI	HT	NAK	EM	DC4	DC2	ENQ	ETB	DC1	HT	VT
X6	S	O	I	U	Y	T	R	E	W	Q	HT	VT
	N	o	i	u	y	t	r	e	w	q	HT	VT
	C										RS	FS
X7	S	)	(	'	&	%	$	#	"	!	~	|
	N	9	8	7	6	5	4	3	2	1	^	\

Figure 4. **AY-5-2376 code assignment chart.**

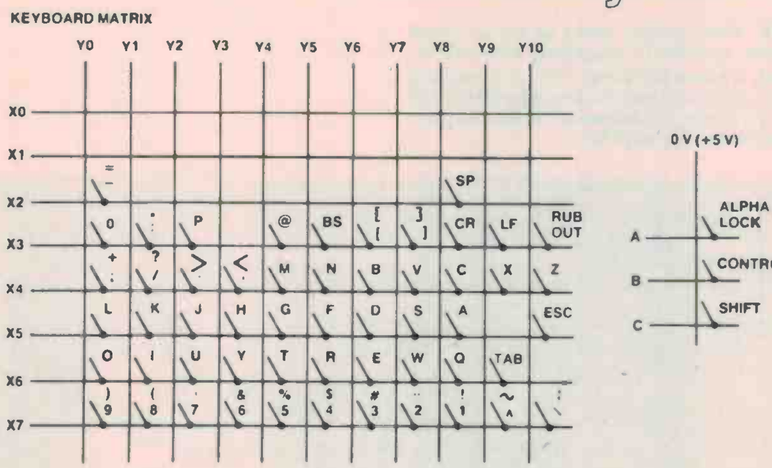


Figure 5. **Keyboard matrix.**

them. Their metal tabs face towards the *outside* of the board. Note that pins 2 and 3 of IC8 (7912) need to be soldered on *both sides of the board.*

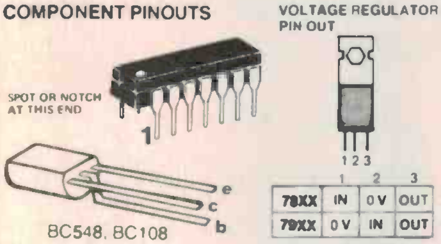
Having completed this stage of the assembly, make a thorough visual check of both sides of the board to ensure that all components are in place and correctly oriented. Also look for solder 'bridges', particularly between IC pins and where tracks run between IC pins.

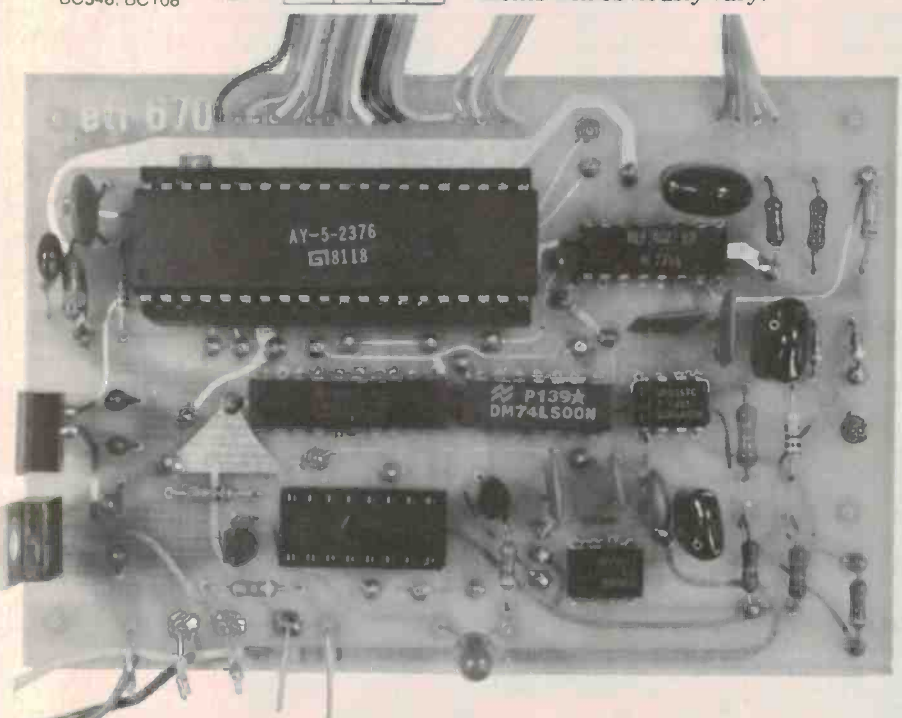
Connection to the keyboard module is made via ribbon cable. We used the 22-pin plug supplied with the keyboard module for the X and Y line connections which run from pin 2 to pin 18 on the connector. The other four connections (A, B, C and 0 V) were made by soldering ribbon cable directly between the keyboard module and the pc board.

The BREAK switch and ALPHA LOCK indicator LED may be mounted anywhere convenient and wired direct to the pc board. We'll leave the mounting details to you as individual requirements will obviously vary.

COMPONENT PINOUTS

VOLTAGE REGULATOR PIN OUT





View of the completed encoder board.

To test it

You are now ready to connect the +8 V and −16 V power supplies and check the output of the voltage regulators. Don't forget the 0 V line. Both outputs should be within plus and minus 10% of their rated values.

After checking your wiring you are now ready to insert IC1 and test the operation of the complete keyboard.

You don't *have* to have a computer to test the project. We first used our ETI-630 Hex Display module (Dec. '76) to verify operation of the completed unit. If you use this module, connect its strobe input to 0 V so that it operates in transparent mode.

Figure 4 has been drawn up to assist in identifying all the ASCII codes that are generated by the keyboard in the Normal, Shifted and Control Modes.

Figure 5 illustrates which matrix positions are occupied by keys. This diagram may be used by those ever-irrepressible hobbyists who may wish to wire up their own keyboard module, or add additional keys to the matrix (e.g: a hex or cursor keypad).

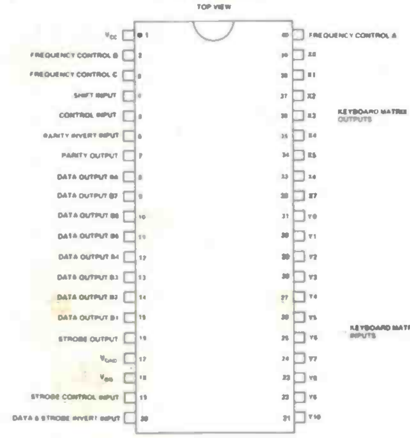
Testing the unit with a computer was pretty obvious. Just plug the output from the 16-pin DIP connector into your computer's keyboard port and see what happens when you press the keys! Uh — you should get sensible results if your computer is working correctly.

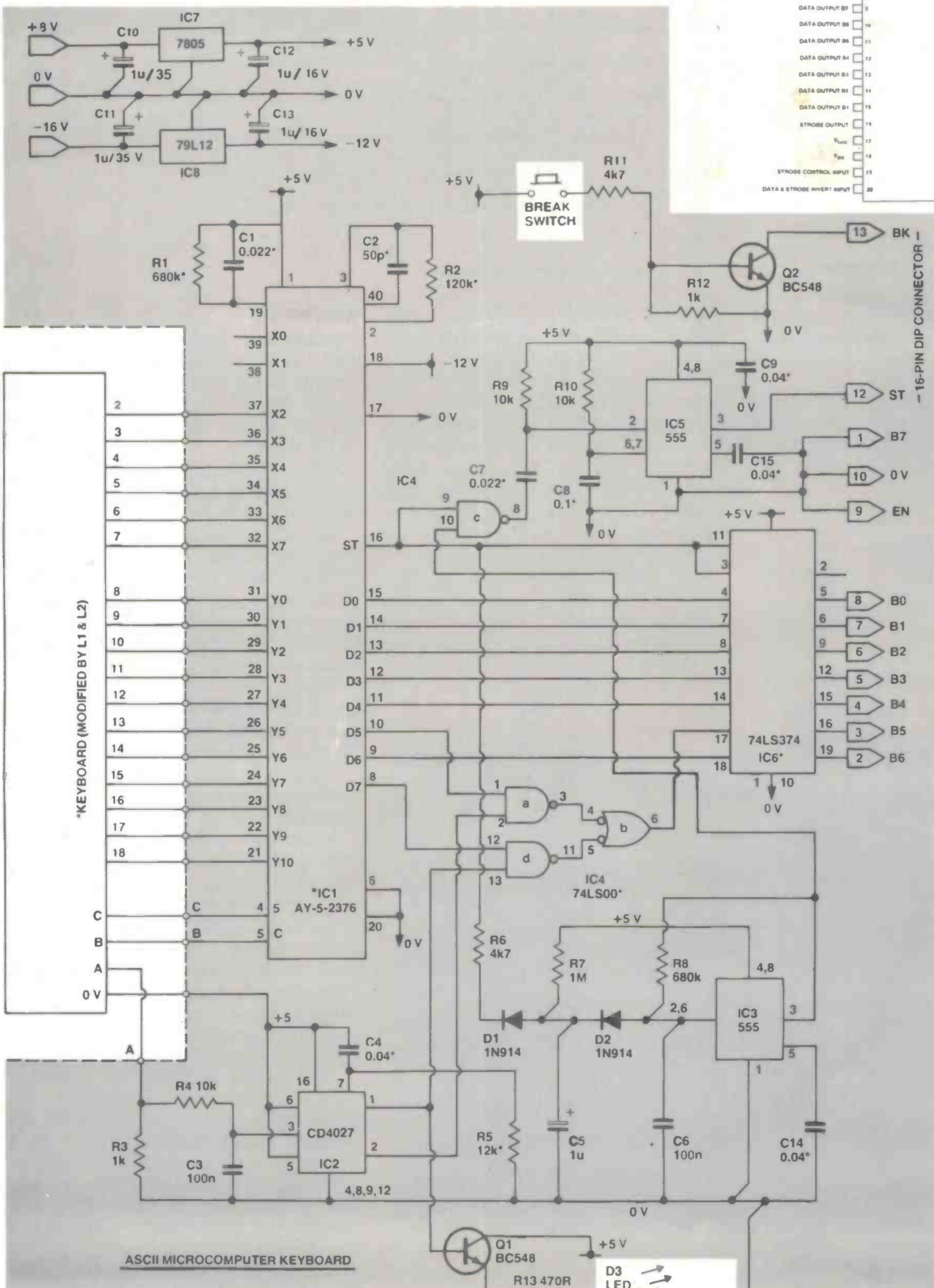
Now all you need to do is . . . *learn to type!* (Here's a hint — there are two basic typing methods: known as the 'French lover's method' — *use both hands!* — and the 'Biblical method' — *seek and thou shalt find!* The French one is favoured by journalists and secretaries, the latter by editors and computer hacks. Then again, ETI recently had a lady typesetter who favoured the Biblical method and was so fast she'd put a court reporter to shame!) ▶

Project 670

NOTE: Good quality prints of the pc board artwork, suitable for producing your own pc board, are available direct from us by sending a stamped, addressed A4 envelope to: ETI-670 PC ARTWORK, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

AY-5-2376





ASCII MICROCOMPUTER KEYBOARD

*PARTS SUPPLIED IN BASIC KIT

HOW IT WORKS — ETI-670

The main job of scanning and encoding the 59 keys of the keyboard is provided by the AY-5-2376 Keyboard Encoder IC. This device contains a 2376-bit ROM, 8-stage and 11-stage ring counters, an 11-bit comparator, an oscillator circuit, a delay network and data output buffers. The ROM is arranged into three groups of 88 nine-bit words. The appropriate group is selected by the shift and control keys.

The 8-stage and 11-stage counters scan the keyboard in a X-Y matrix. When a key is depressed a single path is completed between the output of the 8-stage counter and the input of the 11-bit comparator. After a number of clock cycles a match will occur between the comparator and the 11-stage counter. The comparator generates a signal to stop the clock and, following a delay, the strobe output. The data and strobe outputs remain stable until the key is released.

KEYBOARD MODES

The keyboard has three modes of operation, selected by the shift and control keys. When *both are released* the keyboard is in the *unshifted or 'normal'* mode, where the bottom row of numbers and symbols is scanned and the alphabetic characters are encoded in 'lower case'. The operation of the *shift key* places the keyboard into the *'shift mode'* where the upper row of symbols is generated and the alpha characters are encoded in 'upper case'. When the *control key* is operated the keyboard is in the *'control' mode* and special ASCII characters are generated by alpha keys. Some of these characters are printed as an 'upper row' on the alpha keys on the keyboard.

SHIFT LOCK

An 'Alphabetic Shift Lock' has been included in the circuit to provide a 'continuous' upper case mode for the alpha characters without affecting the encoding of the numeral and symbol keys. This feature is required to simplify keying in data, such as monitor commands and hexadecimal numbers, as single key entries. On power-up, the keyboard is placed into the alpha shift mode and the LED D3 is illuminated. With each alternate operation of the 'Shift Lock' key the keyboard will be returned to the normal mode and the LED extinguished. The LED should be mounted in a suitable location on the keyboard enclosure.

The alpha lock function is provided by IC2 and part of IC4. IC2 is a CMOS J-K flip-flop which is set and reset on each alternate operation of the shift lock key, and R5 and C4 produce the power-up 'set' condition. The 'set' and 'reset' outputs are used to operate IC4 as a single-pole data switch to select either D5 or D7 from the keyboard encoder as the key code bit 5. As only seven of the eight key data bits from the keyboard encoder are used at any instant, the generated parity bit is invalid and is ignored. IC6, the 74LS374, is used as a latch-buffer for the seven-bit ASCII key code generated by the encoder circuit. The data is latched in by the rising edge of the keyboard encoder (IC1) strobe output from pin 16. A keyboard 'data-valid' strobe is generated by the monostable 555 timer, IC5, by the rising edge of the strobe output signal. This data strobe is a positive pulse of approximately 1 ms, determined by the values of R10 and C8.

AUTO REPEAT

The auto-repeat function is provided by the 555 timer IC3 and a delay network comprising R6, R7 and C5. While a key is held operated the strobe output of IC1 remains high and can be used as a 'key down' signal. When all keys are released, the strobe output is low, and C5 and C6 are held discharged via D1 and D2. While any key is held operated, the strobe output of IC1 remains high and can be used as a 'key down' signal. For the first half-second after the strobe has gone high, C5 charges via R7 to provide a delay before IC3 starts oscillating. IC3 will continue to oscillate until the key is released and each cycle retriggers IC5 to produce additional data strobes. The repeat rate is approximately ten characters per second, as determined by R8 and C6. The auto repeat function can be disabled by shorting C5 with a suitable switch.

BREAK KEY

A keyboard break function has been included in this design. As the keyboard used does not contain an uncommitted key, a separate switch will have to be used and mounted in a suitable location on the keyboard enclosure. On the SBC-2650 the break signal is periodically tested by the CPU sense pin and is used to terminate (or 'break') the operation of certain programs.

POWER SUPPLY

Two three-terminal voltage regulators are used to generate the +5 V and −12 V supplies required by the circuit. In an S100 computer system the unregulated +8 V and −16 V inputs required can be obtained from the buss power supply. Alternatively, a suitable 12 V and 5 Vac transformer, bridge rectifiers and filter capacitors could be mounted in the keyboard enclosure. ●

RPN — the number crunching demon! . . . part the second

Most micros can just about manage addition and subtraction — try anything else and you're in real trouble! Mike James shows you the way out.

MICROS ARE awful at arithmetic! They can just about manage addition and subtraction, but division and multiplication are usually beyond them. It's obvious that if we are going to evaluate arithmetic expressions, something has to be done about this situation. The usual solution is to write machine code subroutines to carry out each of the four simple operations of arithmetic. This set of routines is often referred to as a 'maths package', and there may be one available for your microprocessor already. If there is, then the best thing to do is to buy it! Otherwise you've got a lot of work to do in writing one.

Maths packages usually come in two sorts:

1. Floating Point
2. Integer

Floating point packages carry out arithmetic on so-called 'real numbers'. A real number is anything like 3.256, i.e: it can have a fractional part. An integer, however, cannot have a fractional part. For example 3, 10, −1, 0 are all integers but 3.5, .2, −0.02, 4.0 are all real numbers. Notice that the last example of a real number, 4.0, could be considered to be an integer, i.e: 4. The point is that you can represent an integer as a floating point number simply by writing .000 after it, but you cannot represent a floating point number as an integer.

For the rest of this article we will assume that all the arithmetic is done by a 16-bit integer package. The reason for this will become clear as we go on. Briefly, the principles are the same for floating point as for integer and a 16-bit package is easy to write for most micros. With a 16-bit integer the maximum number that we can handle is 32767 and the minimum is −32678, so things are still usefully large.

Compilers and subroutines

The purpose of a compiler is to take high-level language statements and translate them into machine code. There are a number of ways in which this can be done. For example, if we are interested in compiling the statement:

A = B*3

we could use subroutines from the maths package we discussed above and simply generate a subroutine call to multiply B by 3. Some people would say that this is not a true compilation! A true compiler shouldn't avoid the problem of how to do multiplication but should generate the necessary code rather than jumping to a subroutine. Personally I think this argument is silly when applied to a microprocessor. It takes a lot of instructions to do multiplication and to generate them each time is wasteful. From now on the sort of compiler that we will be considering will try to compile high-level language into a sequence of subroutine calls. This is sometimes referred to as a 'threaded code' compiler.

If we are going to be generating a sequence of subroutine calls there is another simplification we can make to our compiler. Instead of translating to machine code we can make use of assembly language. If our compiler produces assembly language we can leave a lot of boring jobs to the standard assembler which is available for every micro. The sort of jobs I'm thinking of are converting decimal constants to binary and looking after the absolute addresses of everything. This may seem a messy way to write a compiler because you need another program, i.e: the assembler, before you get the final code. The procedure is to run the compiler which outputs assembly language and then use this as the input to an assembler. This approach has a few advantages, though; the assembly language output can be altered and added to, using a text editor, and the incorporation of other programs, such as the very necessary maths package, can be done by simply appending the two text files. The criticism that this method is slow is true, but it should be remembered that most compilers have to read through the text of the program a number of times, and by using an assembler we can make do with one, or at most two, passes.

Evaluating Reverse Polish

Generating machine code or assembly language for an arithmetic expression is a matter of following the rules that we gave last month for evaluating Reverse Polish.

> 'Scan the expression from left to right until you meet an operator. When this happens the operator is applied to the two variables to the left. The result is left in the expression, replacing all the variables and symbols used to produce it.'

Only, instead of carrying out the arithmetic when we find an operator, we produce instructions that will carry out the arithmetic. For example, consider AB*C+. The first thing we hit is A, then B — neither of which we are interested in at the moment. Then we hit *, which means do a multiplication on the last two variables we passed over, i.e: A and B. So our compiler must output "JSR MULTIPLY". We suppose that the subroutine MULTIPLY can find the last two variables automatically and output its result in such a way that it becomes the last variable passed over. At this point I hope the words LIFO stack are ▶

flashing somewhere in the back of your mind! If we stack each variable as we meet it the last two variables are easy to find. They are simply the last two items! So if all our arithmetic subroutines work on the top two items on the stack and place their results back on the stack, everything looks after itself.

Using a stack and a set of stack-orientated arithmetic subroutines the evaluation of AB*C+ generates the following code:

```
STACK A
STACK B
JSR MULTIPLY
(This multiplies A and B and puts result
back on the stack)
STACK C
JSR ADD
(This adds C to the result of A*B)
```

Of course, the result is left on the stack but can easily be printed out using another subroutine, 'PRINT', which prints and removes the top item on the stack. The instructions STACK A, etc, have to be written in whatever assembly language you're using, i.e: 6502, Z80, etc.

There are other ways of evaluating an arithmetic expression. Some result in faster code and a lower memory use — using a stack results in some unnecessary pushing and pulling and extra copies of data. However, the stack method has the advantage of being simple to implement, easy to understand and, in a lot of cases, not too bad in terms of speed and memory use. Some computer manufacturers have taken this liking of the stack method to its logical conclusion by building computers with no other memory than a stack (or sometimes two).

The code generator

If we look at the program for generating 6502 code, it looks very complicated, but the first half from 5000 to 5420 is simply a version of the Reverse Polish converter which was described last month. The only real addition to the original program is the insertion of a blank in front of every constant, i.e: string of digits. This is done by keeping a count of the number of digits since the last non-digit character (lines 5245-5250 and 5066). The really new section is the subroutine in lines 5500 to 5685. This is the code generator subroutine. The program begins by asking for an arithmetic expression to work on, in line 2. It then calls subroutine 5000 which, using the algorithm discussed last month, converts the string in A$ into Reverse Polish in C$. For interest (and to check that the program is working!) A$ and C$ are printed at line 4. A call on subroutine 5500 generates the 6502 assembly language for the expression. Each instruction is printed as it is generated. A 'real' version of this program would save the instructions on disk or tape for later use by an assembler, but that's something for you to do. If the character is a letter, it is assumed to be a variable. (Notice that we can only handle single letter names.) The names of all the variables are changed to VAR followed by one letter. This is so that other assembly language routines know which names to avoid using. So, lines 5540-5560 generate code to push the variable onto the stack. In the case of the 6502 this has to be done in two attempts because each variable is 16 bits and the 6502 can only move eight bits at a time. For example, if the variable X is found in an expression,

```
LDA    VARX
PHA
LDA    VARX+1
PHA
```

is generated. For this to work, it is necessary for some other part of the code generator program to produce

```
VARX  FDB  0
```

to reserve space for the variable. To do this you can either keep a list of all the variables used, or have FDB statements for variables A-Z (all 26 of them). As this latter option uses only 52 bytes, it is obviously the one to use for now.

If the character is a digit, then a constant must be stacked. First we must somehow create the constant. As we are using an assembler, this is easy. Suppose the constant 415 was in the expression, all we have to do is generate something like:

```
C2  FDB  415
```

The assembler would take care of the conversion to binary later! The only trouble is that we have to keep count of how many constants we are using and give them all different names, i.e: C1, C2, . . . Cn. This is what goes on in line 5572. The constant itself is created in lines 5574 to 5619. In this case it's not good enough to print out the code at once because data storage areas are normally separate from the program. The solution is to use an array, C$, and store the FDB instruction for constant N in C$(N) and print out C$ at the end of the code generation. This is what subroutine 5700 does. After creating the constant all that's left is to stack it and this is done exactly as for variables, in line 5573, only the name used is C1, C2, ... etc.

Finally, if the item isn't a letter or a digit it must be an operator. Lines 5625 or 5680 check which operator and generate the correct subroutine jump.

The run time package

The assembly language produced by the code generator has to be added to the maths package and the data area declaring the variables (i.e: 26 FDB instructions). In a complete compiler the code that has to be added to that generated by the compiler is often called the run time package. Although our run time package is small, real packages can be very large — about 12K to 16K — and if you want to go on to produce a compiler in BASIC then be prepared to spend as much time on the run time package.

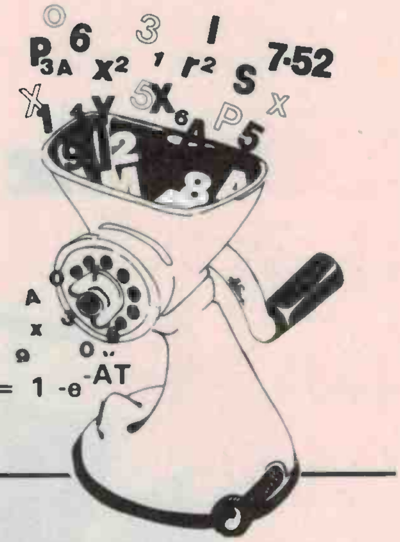
Conclusion

If you've followed so far you should be capable of going on to write an entire compiler in BASIC. The machine you write it for is up to you — all you need to do is change the run time package and the way subroutines are called and items stacked. (For example, on the 6809 the stacking can be done by LDX 0ARA; PHSS X, and for the Z80 subroutine calls are done by CALL ADD.) Even the language you write it for is up to you, but there is a very surprising advantage in writing a BASIC compiler in BASIC. Once you've finished your compiler you can (if you've finished it well enough) run the BASIC program that is the compiler through the compiler! The result is a machine code BASIC compiler that runs fast! Another advantage in sticking to BASIC is that one of the most difficult parts of writing a compiler is finding and dealing with errors in programs that you are trying to compile. For example, our code generator would pass things like A(+C without any sign that anything was wrong. It would even generate code for it! If we stick to BASIC then we can forget about trying to track down errors and suppose that all the programs that are to be compiled are error-free. The way this can be achieved is to run and debug all of them using the BASIC interpreter that the compiler is run under.

As you make progress with your BASIC compiler the LIFO stack will crop up time and time again. After a while you'll wonder how you ever managed without it. When you come to implement FOR . . . NEXT loops, for example, each FOR instruction can stack the index variable and the value that it must reach to terminate the loop, and each NEXT instruction simply increments the value on the top of the stack and compares it to the limit. This method of implementation takes into account the normal 'nesting' rules for FOR loops automatically.

The evaluation of arithmetic expressions also proves to be of general use. The simple arithmetic operators can be extended to include logical operators, such as AND and OR, operating on Boolean variables. (A Boolean variable is often implemented as an integer that has two special values, e.g: 0 and −1, usually referred to as 'true' and 'false'.) Your only problem in using the Reverse Polish stack method is in deciding the priorities to be assigned to the operators. In IF statements, the relational tests (=, <, >, <>, etc.) can also be treated as binary operators and similarly evaluated. Their action is to compare the top two items on the stack and place a Boolean variable on the top, indicating whether the relationship is true or false.

After all this it may come as no surprise to discover that it is possible, although not practical, to convert, in its entirety, any BASIC program to Reverse Polish and evaluate it using the techniques described in these two articles. ●



$$F(T) = \int_0^T p(x)dx = \int_0^T Ae^{-Ax}dx = 1 - e^{-AT}$$

Program Listing

```
   1  DIM Z(25),W(5),C$(10)
   2  INPUT A$:I=1
   3  GOSUB 5000
   4  PRINT A$,C$
   5  GOSUB 5500
   6  GOSUB 5900
   7  END

5000  U$="-+*/()"
5010  Z$="":C$="":X=1:O=1
5020  W(1)=1:W(2)=1:W(3)=2:W(4)=2:
      W(5)=0
5030  FOR J=1 TO 25:Z(J)=0:NEXT J
5040  IF LEN(A$)<I THEN 5470
5050  B$=MID$(A$,I,1)
5060  IF B$="[SPC]" THEN I=I+1:GOTO 5050
5070  K=0
5080  FOR J=1 TO 6
5090  IF B$=MID$(U$,J,1) THEN K=J
5100  NEXT J
5110  IF K=0 THEN 5260
5120  D=0
5130  IF K=6 THEN 5380
5140  S=W(K)
5150  IF S=0 THEN 5230
5160  IF S=1 THEN 5420
5170  O=1
5180  IF X=1 THEN 5230
5190  IF Z(X-1)<S THEN 5230
5200  C$=C$+LEFT$(Z$,1)
5210  X=X-1:Z$=RIGHT$(Z$,LEN(Z$)-1)
5220  GOTO 5180
5230  Z(X)=S
5240  Z$=B$+Z$:X=X+1:I=I+1
5250  GOTO 5040
5260  O=0
5270  IF B$<"A" THEN 5310
5280  IF B$>"Z" THEN 5310
5290  C$=C$+B$
5300  I=I+1
5310  IF B$>"9" THEN 5040
5320  IF B$<"0" THEN 5040
5330  D=D+1
5340  IF D=1 THEN B$="[SPC]"+B$
5350  C$=C$+B$
5360  I=I+1
5370  GOTO 5040
5380  IF LEN(Z$)=0 THEN I=I+1:GOTO 5040
5390  B$=LEFT$(Z$,1):Z$=RIGHT$(Z$,LEN(Z$)-1):
      X=X-1
5400  IF B$="(" THEN I=I+1:GOTO 5040
5410  C$=C$+B$:GOTO 5380
5420  IF O=0 THEN 5170
5430  S=6
5440  IF B$="-" THEN B$="!"
5450  IF B$="+" THEN B$="?"
5460  GOTO 5170
5470  C$=C$+Z$
5480  RETURN
5490  J=1
5500  IF J>LEN(C$) THEN RETURN
5510  B$=MID$(C$,J,1)
5520  PRINT
5530  IF B$<"A" THEN 5600
5540  IF B$>"Z" THEN 5600
5550  PRINT " LDA VAR";B$
5560  PRINT " PHA"
5570  PRINT " LDA VAR";B$;"+1"
5580  PRINT " PHA"
5590  J=J+1:GOTO 5500
5600  IF B$<"0" THEN 5730
5610  IF B$>"9" THEN 5730
5620  N=N+1
5630  PRINT " LDA C";N:PRINT "PHA ":
      PRINT " LDA C";N;"+1":PRINT " PHA"
5640  C$(N)="C"+STR$(N)+" FDB "
5650  IF B$<"0" THEN 5730
5660  IF B$>"9" THEN 5730
5670  C$(N)=C$(N)+B$
5680  J=J+1:IF J>LEN(C$) THEN RETURN
5690  B$=MID$(C$,J,1)
5700  IF B$>"9" THEN 5520
5710  IF B$<"0" THEN 5520
5720  GOTO 5670
5730  PRINT
5740  IF B$="+" THEN PRINT " JSR ADD"
5750  IF B$="-" THEN PRINT " JSR SUB"
5760  IF B$="*" THEN PRINT " JSR MUL"
5770  IF B$="/" THEN PRINT " JSR DIV"
5780  IF B$="!" THEN PRINT " JSR NEG"
5790  PRINT:J=J+1:GOTO 5500
5900  FOR I=1 TO N
5910  PRINT C$(I)
5920  NEXT I
5930  RETURN
```

This is the Reverse Polish generator from last month with the extra routines necessary to write 6502 code.

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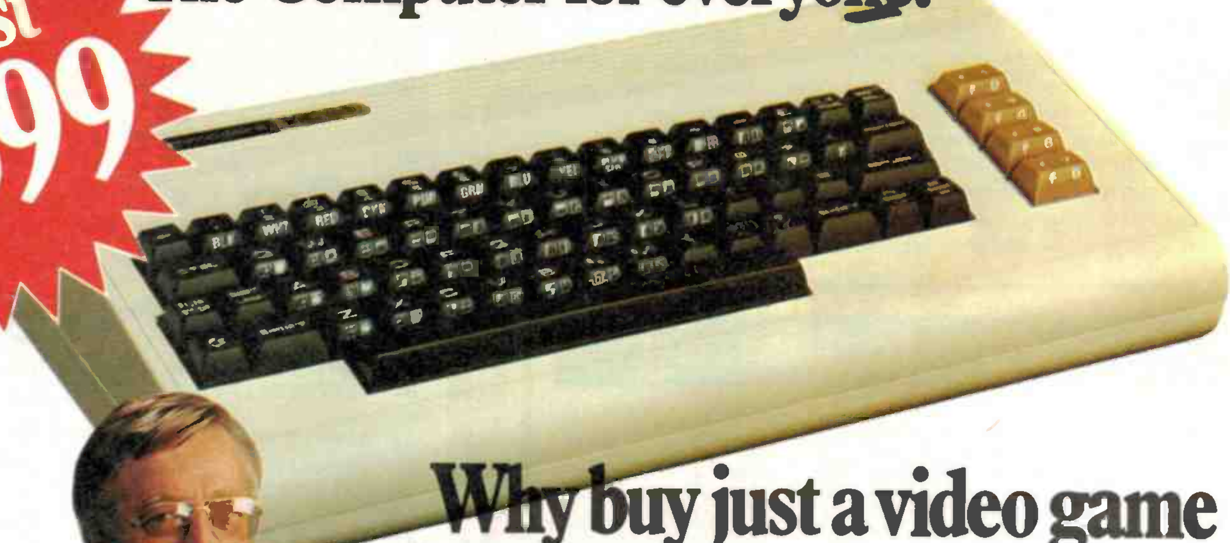

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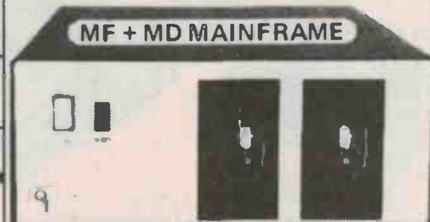

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Sorcerer graphics

Get the best from your Sorcerer's user-defined graphics facility.

Terry Poole

WRITING ABOUT Sorcerer graphics looks easy enough at first sight, but one has to approach the matter carefully. There are no less than 18 446 744 073 709 550 000 different graphics shapes that the Sorcerer can be made to produce, and defining them all would take up a lot of pages which might otherwise be put to better purposes!

On the other hand, the shapes could be defined quite briefly by saying that they are based on an 8 x 8 matrix, with any point in the matrix set to black or white. But that would be rather inadequate. Those not familiar with the system would want to know how it was done.

So, as a start, it seems best to explain the underlying mechanics of the system. We must begin by looking at the Sorcerer memory map.

The memory map

With a full complement of chips, the Sorcerer RAM extends from address 0 to address BFFF hex. Above that come the ROM areas, first the 8K plug-in ROMPAC (which can be replaced by a further 8K of RAM, making 56K in all) and then the 4K monitor. This accounts for 60K of store, and the remaining 4K belong — with minor but significant exceptions — to the display system.

The screen RAM occupies the **F000-F7FF** hex address range, and the **F800-FFFF** hex segment is devoted to character definition. This means establishing the bit pattern of each character or graphic, eight bytes being required for each definition. The first 128 characters — the standard alphanumeric set — are defined in ROM, the remaining 128 characters can be held in RAM, which is the key point of the whole scheme. Each of these RAM-defined characters is user-definable, bit by bit.

Defining 128 characters for each program might prove rather a chore, so the lower half of the graphics range is set up to a series of standard shapes at switch-on and whenever Clear Screen is called, but these can be changed at will in other circumstances.

The screen RAM provides one location for every character position on the 30 x 64 screen, the location being set to the ASCII code for the character or graphic to be displayed. The ASCII code forms part of the address used to access the character-defining ROM or RAM, the remainder of the address being defined by the three least significant digits of the scan line number. This accesses a data byte which is passed to a shift register to generate the data part of the video signal.

Since there are 1920 character positions on the screen, and 2048 locations in the screen RAM chips, there are 128 spare RAM locations, but these need to be used with care, for reasons which will emerge later. The locations F000/1 hex serve the important purpose of defining the pivot address of the monitor stack and workspace, and other locations are used by certain programs, but the area otherwise tends to be quietly forgotten.

The display counters

During normal display action, the screen RAM addresses are provided by the line and frame counters, each of these being a pair of four-bit synchronous counters. The crystal-controlled master clock, running at 12.638 MHz, is used directly to control the output of dot elements to the screen; it is divided by two to generate the 6.319 MHz line scan counter drive; it is also divided by six to generate the 2.106 MHz CPU clock.

The line scan counter carry drives a bistable, the output of which is fed back to set the count alternatively to 256 and 149. Data is passed to the screen during the count of 256, and the 149 count corresponds to the flyback period. The line sync pulse is generated between the 11th and 43rd counts of the 149 count phase. At every fourth count during the data output phase a pulse is generated to read out another byte to the video shift register.

Frame scan timing is similarly controlled, but the process is complicated by facilities for selecting either a 50 Hz or 60 Hz frame scan by operating a DIL switch. The count is always 240 during the data phase, but the count for the flyback phase is 73 for 50 Hz and 21 for 60 Hz. During this phase, the frame sync pulse is output, there being just enough room for it in the 60 Hz case.

The relatively high dot frequency makes the use of a proper video display desirable, and the standard Sorcerer does not incorporate a TV modulator. A fairly satisfactory display can be obtained on a television screen, but precise tuning is needed and drift is often apparent.

Screen RAM addressing

Since screen RAM addresses run from F080 to F7FF hex, the Fxxx content can be taken for granted. The next six bits, reading downwards, are supplied by the frame scan counter, the three least significant bits of that counter being used as part of the address of the character-defining store, and the six lowest bits of the screen RAM address come from the line scan counter.

Work through it gently, and it may become clearer. It is very obvious that someone put a lot of thought into the design, and it would be ambitious to expect to understand how it works at a glance.

The addresses for the definition store ▶

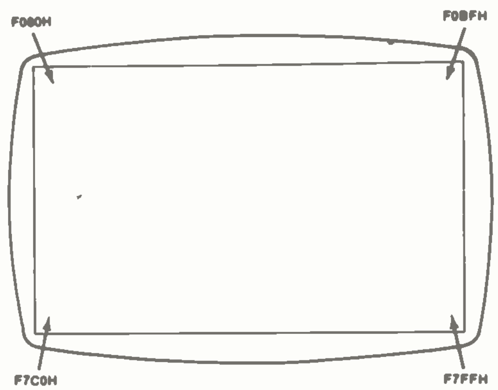

Figure 1. **These are the four corner addresses of the screen. Format is 30 lines of 64 characters, so there are 1920 available locations.**

Figure 2. **The user-defined graphics set is located from ASCII 192 to 255 and can be directly accessed from the keyboard by using the shifted GRAPHIC key. The hex number at the top of the key is the starting address of the character in RAM.**

are generated in the same sort of way. The top five bits are all 1; the next eight come from the ASCII code read from the screen RAM; the last three come from the least significant bits of the frame scan count, to indicate which of the eight rows of the character area is being scanned.

Some of the address bits are in fact generated by a special ROM with the endearing name of 'Bruce', which simplifies matters a good deal in hardware terms.

Screen store access

When the processor calls an address in the Fxxx area, Bruce switches the display system address and data lines to the main computer buss, and read and write action occurs as with any other area of store. While this is happening, normal service on the video output is suspended, which produces a short black line on the screen. This also happens when any of the spare screen RAM locations in the F000-F07F hex area are accessed, and that is why this region must be used with caution.

And hereby hangs a minor mystery. According to Victor Tolomei, in his 'Software Internals Manual for the Sorcerer', the monitor routine at E1A2 hex ensures that reference to the pivot address held in F000-1 hex can only occur during 'vertical retrace', which is what we would call frame flyback. This is certainly what ought to happen. The routine does check an output of the scan counters, waiting about 50 us thereafter before accessing F000-1 hex. But the signal checked is generated by the line scan counter, in fact by the bistable which selects the alternate 256 and 149 counts. The access to F000-1 hex is held off until the line flyback period, *not* the frame flyback period. Did somebody pick the wrong signal?

The point isn't too important, though it means that there is only time for a brief access before the screen comes alive again, whereas the frame flyback blanking lasts for a much longer period. This means that there is rather more screen flicker, the VIDEO routine also being timed by E1A2 hex, but the effect is rarely annoying. Indeed, the minor flicker that can be seen during tape loading is quite useful when the FILES facility is in use, as disappearance of the flicker announces that the end of a file has been reached.

Graphics creation

Suppose a reverse video 'a' is wanted. The coding for a normal 'a' is 00,00 for the two blank lines at the top, then 38, 04, 3C, 44, 3C for the character, and a final 00 blank line at the bottom. Writing out these hex numbers in binary gives:

```
00000000            --------
00000000            --------
00111000            --XXX---
00000100     OR     -----X--
00111100            --XXXX--
01000100            -X---X--
00111100            --XXXX--
00000000            --------
```

Complement each byte, to give FF, FF, C7, FB, C3, BB, C3, FF, and the black and white areas change places. This can be done most simply by using the original 'a' coding (stored in ROM) as a basis, when the following BASIC program will set up the reversed character on the key which normally produces lower case 'a':

```
10 FOR X=1 TO 8
20 A=255-PEEK (X-1273)
30 POKE (X-817),A
40 NEXT X
```

The eight locations, starting at −1272, are read, inverted, and set in the eight locations starting at −816. The first location is determined by multiplying the ASCII codes for the required character by eight and then subtracting 2048. The second is listed in the Sorcerer BASIC Manual.

Press the 'A' key with the shift lock off, and 'a' will appear normally. Now press the graphics key as well, and the reversed form will appear. However, a Clear Screen will cause the character to revert to a quarter circle in the upper left-hand corner of the character space. Run the program with this character showing on the screen, and you will see it change, line by line, to a reversed 'a'.

As noted at the start, each graphics character can be set to an astronomical number of forms, and it would be pointless to try to describe the possibilities, which are only limited in practice by the ingenuity of the user. Since adjacent character areas touch, both vertically and horizontally, a number of characters can be combined to form a single shape. For that matter, a whole area covered by 128 characters can be defined dot by dot.

Before leaving the subject of 'created' graphics, it is worth mentioning that an approximation to the six-pixel graphics of the Tandy type can be obtained by the following sort of pattern:

```
XXXX----
XXXX----
--------
----XXXX
----XXXX
--------
XXXX----
XXXX----
```

Standard graphic forms

The 64 standard graphic forms set up in the lower half of the graphics RAM area at switch-on and after Clear Screen are listed against the appropriate codes in the major table (including the ones not normally seen), as the video routine does not put ASCII characters of value less that 20 hex on the screen. They can be brought out by direct screen access, however, a facility which allows any section of code to be moved into screen RAM. One thoroughly unfair use of this is to explore 'Adventure' programs for character strings which might give useful hints! Every character other than space shows up in one form or another.

If the Sorcerer graphics system has a disadvantage, it is the amount of time we are tempted to spend in exploring its boundless possibilities! It does not attempt to compete with true high resolution systems, which may be so complex that they need processors of their own, or with colour, which would probably waste even more of our time without necessarily producing results of greater practical value. It does, however, provide a valuable addition to the Sorcerer's other capabilities. ●

CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL	CODE	SYMBOL
0		32		64	@	96	`	128		160		192		224	
1		33	!	65	A	97	a	129		161		193		225	
2		34	"	66	B	98	b	130		162		194		226	
3		35	#	67	C	99	c	131		163		195		227	
4		36	$	68	D	100	d	132		164		196		228	
5		37	%	69	E	101	e	133		165		197		229	
6		38	&	70	F	102	f	134		166		198		230	
7		39	'	71	G	103	g	135		167		199		231	
8		40	(	72	H	104	h	136		168		200		232	
9		41	)	73	I	105	i	137		169	─	201		233	
10		42	*	74	J	106	j	138		170	─	202		234	
11		43	+	75	K	107	k	139		171		203		235	
12		44	,	76	L	108	l	140		172		204		236	
13		45	-	77	M	109	m	141		173		205		237	
14		46	.	78	N	110	n	142		174		206		238	
15		47	/	79	O	111	o	143		175		207		239	
16		48	0	80	P	112	p	144	┌	176		208		240	
17		49	1	81	Q	113	q	145	┐	177		209		241	
18		50	2	82	R	114	r	146		178		210		242	
19		51	3	83	S	115	s	147		179		211		243	
20		52	4	84	T	116	t	148		180		212		244	
21		53	5	85	U	117	u	149		181		213		245	
22		54	6	86	V	118	v	150		182		214		246	
23		55	7	87	W	119	w	151		183		215		247	
24		56	8	88	X	120	x	152		184		216		248	
25		57	9	89	Y	121	y	153		185		217		249	
26		58	:	90	Z	122	z	154		186		218		250	
27		59	;	91	[	123	{	155		187		219		251	
28		60	<	92	\	124	¦	156		188		220		252	
29		61	=	93	]	125	}	157		189		221		253	
30		62	>	94	^	126	~	158		190		222		254	
31		63	?	95	_	127		159		191		223		255	

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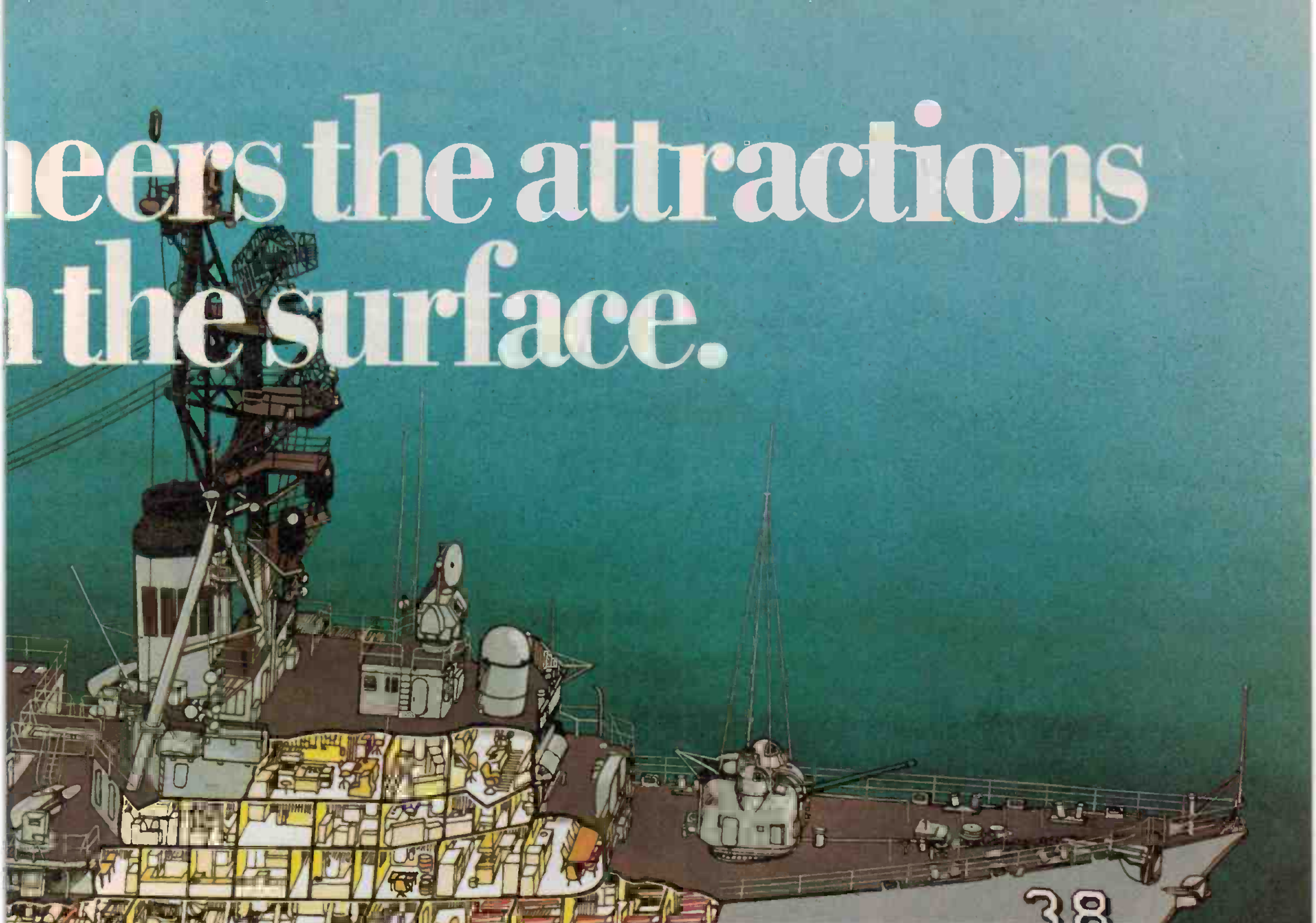

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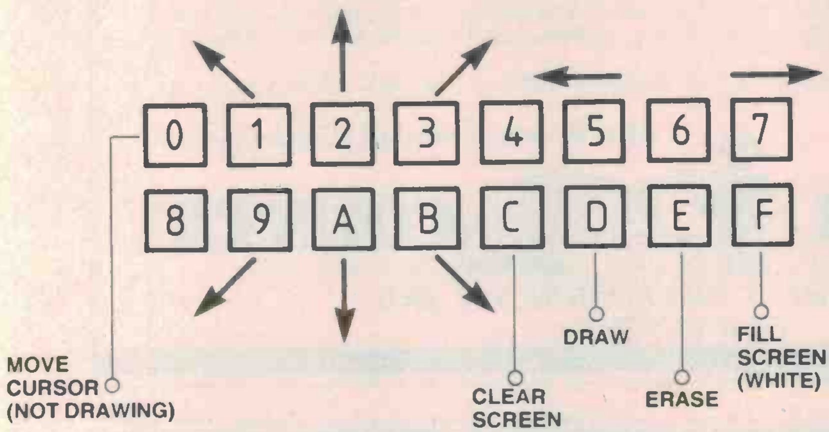
DSE/A163M/LM

VIDEO DRAWING

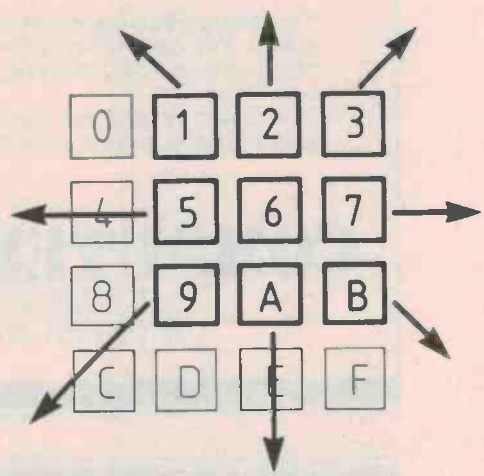
This program comes from Frank Rees of Boort in Victoria, and is great for investigating graphic patterns on your screen. It's also handy as a 'video billboard' — and we'll leave the use of that to your imagination! The original version of this program was by Udo Pernisz, written for the 1802, but with a different monitor. The two diagrams show which keys do what on the keyboard — both for the 'standard' '660 keyboard and common hex keyboards.

You can draw white over the background ('normal'), or by pressing key 'F', you can draw in 'reverse'. There are 3072 pixels available on the whole screen, both in normal and reverse drawing modes. You have 64 pixels across and 48 pixels down. You can design shapes on a piece of squared graph paper ruled accordingly and then step your cursor (not drawing) around the screen to commence drawing, counting pixel moves as you go. It's easier doing it than writing about it! Don't try to draw too fast as the processor has to have time to scan the keyboard and it's possible for key presses to be missed.

Contributions of programs (original or rewritten — but please quote original source if the latter) are always welcome, along with any hints or tips (Ed.).



The 'standard' '660 keyboard showing the functions of each key. The heavy arrows indicate which way the cursor moves when you press that key. One press moves the cursor one pixel position.



If you're using a hex keyboard like this, the heavy arrows indicate cursor movement for the relevant key. Keys 0, C, D, E and F have the same functions as the 'standard' keyboard.

Program Listing

```
0600  00 FF   DO NOTHING
      A6 62   SET I = 0662
      F4 65   V0:V4 = M(I)
      6E 00   VE = 00
      A6 67   SET I = 0667
      F0 65   V0:V0 = M(I)
      40 00   SKF V0 ≠ 00
      16 5E   GOTO 065E
0610  E0 9E   SKF V0 = KEY PRESSED
      16 0A   GOTO 060A
      48 00   SKF V8 ≠ 00
      16 1E   GOTO 061E
      38 06   SKF V8 = 06
      16 32   GOTO 0632
      78 FF   V8 = V8 + FF
      70 FF   V0 = V0 + FF
0620  67 FF   V7 = FF
      80 35   V0 = V0 - V3
      3F 01   SKF VF = 01
      16 2E   GOTO 062E
      77 01   V7 = V7 + 01
      70 FF   V0 = V0 + FF
      16 22   GOTO 0622
      70 02   V0 = V0 + 02
0630  16 A6   GOTO 06A6
      78 01   V8 = V8 + 01
      A6 70   SET I = 0670
      F0 65   V0:V0 = M(I)
      E0 A1   SKF V0 ≠ KEY PRESSED
      8E 00   VE = V0
      30 00   SKF V0 = 00
      16 36   GOTO 0636
0640  3E 0C   SKF VE = 0C
      4E 0F   SKF VE ≠ 0F
      16 76   GOTO 0676
      A6 62   SET I = 0662
      D1 21   SHOW 1 @ V1,V2
      3E 00   SKF VE = 00
      3F 00   SKF VF = 00
      D1 21   SHOW 1 @ V1,V2
0650  4E 0E   SKF VE ≠ 0E
      D1 21   SHOW 1 @ V1,V2
      F4 15   TIMER = V4
      F6 07   V6 = TIMER
      36 00   SKF V6 = 00
      16 56   GOTO 0656
      16 08   GOTO 0608
      68 00   V8 = 00
0660  16 34   GOTO 0634
      80 00   V0 = 00
      00 03   CALL 0003 SUBROUTINE
      01 01   CALL 0101 SUBROUTINE
      02 03   CALL 0203 SUBROUTINE
      05 07   CALL 0507 SUBROUTINE
      09 0A   CALL 090A SUBROUTINE
      0B 00   CALL 0B00 SUBROUTINE
0670  0C 0F   CALL 0C0F SUBROUTINE
      0D 0E   CALL 0D0E SUBROUTINE
      00 00   RETURN TO MONITOR
      3E 0C   SKF VE = 0C
      26 8A   DO ROUTINE AT 068A
      3E 0F   SKF VE = 0F
      00 E0   CLEAR SCREEN
      60 0E   SET V0 = 0E
0680  3E 0C   SKF VE = 0C
      60 0D   SET V0 = 0D
      A6 51   SET I = 0651
      F0 55   V0:V0 = M(I)
      16 02   GOTO 0602
      60 FF   SET V0 = FF
      61 80   SET V1 = 80
      A4 80   POINT I TO START OF SCREEN
0690  F0 55   M(I) = V0:V0, STORE V0
      71 01   V1 = V1 + 1
      31 00   SKF V1 = 00
      16 90   STORE V0 @ 0690
      61 00   RESET V1 TO 00
      A5 00   POINT I TO 0500
      F0 55   M(I) = V0:V0, STORE V0
      71 01   V1 = V1 + 1
06A0  31 00   SKF VI = 00
      16 9C   STORE V0 @ 069C
      00 EE   RETURN TO 067A
```

SIGHT & SOUND

Sony unveils flat pocket TV with 50 mm screen

Sony Corporation has developed a flat pocket TV which employs a newly developed cathode ray tube only 16.5 mm thick with a 50 mm (diagonal) screen.

Called the 'FD Tube' (Flat Display Tube), the new ultra-thin picture tube is shaped like a miniature paddle and allows the flat TV to be only 33 mm thick. The FD-200 was expected to be available in Japan from late February this year, costing 54 800 yen.

The FD-200 has a futuristic feel and can be enjoyed in a manner like the Walkman, Sony say.

Considerable work has been done on the development of flat display devices, and a number of prototypes have been announced, but up to now none have been commercialised because of the difficulty of mass production and other technical problems.

Unlike conventional picture tubes, the electron gun of this tube is positioned parallel to the phosphor screen. The electron beam from the electron gun is deflected by deflection plates to the phosphor screen (similar to the Sinclair — see Oct. '81 ETI, p.14).

In order to obtain a low-distortion picture, an electrostatic deflection system with a small deflection angle is employed for vertical deflection, and an electromagnetic deflection system with a larger deflection angle is employed for horizontal deflection. The deflection yoke is relatively thin because it incorporates only the horizontal-deflection coil assembly. Two ferrite initial deflection plates are employed in order to reduce the power required for horizontal deflection and to minimise the length of the deflection assembly.

In order to obtain a uniformly focused picture, automatic focusing is performed in the vertical direction. By connecting the deflection plate on the screen panel to the transparent electrode and connecting the opposite deflection plate to the high-voltage electrode on the electron gun, the thickness of the electronic lens is automatically adjusted for accurate vertical focusing.

The screen panel is plate glass, and phosphor is screened onto the flat screen. A new glass manufacturing process allows the funnel to be formed with high precision. These three factors make mass production of the new flat picture tube a reasonable proposition.

The FD-200's reduction in size and thickness has been made possible by the following innovations: a miniaturised flyback transformer (a high-voltage circuit which occupies considerable space in a conventional TV); a very thin deflection yoke; extensive use of ICs in the power supply circuit and deflection compensation circuit; and generous use of chip components throughout.

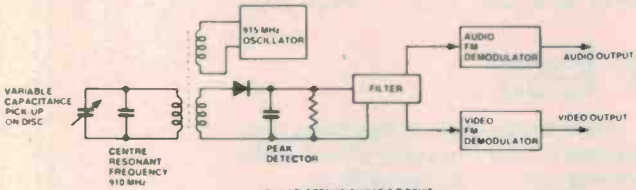
By means of the TV/Sound switch, the TV sound can be enjoyed by itself, while the screen is turned off to save battery power. Electronic tuning covers the VHF and UHF TV bands. External jacks are provided for household power and car battery power sources.

We do not know when, or if, the FD-200 will be available in Australia.

Sight & Sound

Selectavision principles

RCA have released some information on the basic principles used in the replaying of their SelectaVision videodiscs (see also ETI, May '81, p.129).



RCA SELECTAVISION BASIC CIRCUIT

As the disc rotates, the information stored on it produces capacitance variations in a special capacitance pickup system, which is incorporated in the type of circuit shown. The pickup and its associated components resonate at a centre frequency of 910 MHz. Both the video and the audio information are picked up in this circuit.

A very stable 915 MHz oscillator is inductively coupled to the pickup circuit so that the oscillator signal is mixed with that from the pickup circuit to produce an amplitude modulated signal. The latter is fed to a simple peak detector to form an FM signal corresponding to the signal recorded on the disc.

The FM signal is separated into its components by a suitable filter and the separated audio and video signals are then detected by FM demodulator circuits. The video bandwidth is about 3 MHz. In the NTSC version of the circuit, the chroma signal is present on a 1.53 MHz subcarrier and the luminance and chrominance components of this signal are separated by a filter.

Brian Dance

Peterson 'Model 6' speakers

Peterson's 'Model 6' monitor speakers have been well-known since their introduction in January 1978. They have recently been updated, the new version providing extended dynamic range, good transient response and reduced intermodulation distortion, according to Peterson.

Overall size of the units is 790 mm high by 390 mm wide by 390 mm deep, giving a capacity of 82 litres. The box is heavily braced internally and constructed of 19 mm chipboard. The finish is woodgrain and black vinyl.

According to Peterson, the new Model 6 has a frequency response that is within ±3 dB from 50 Hz to 17 kHz, and a smooth impedance curve showing a nominal average of 9 ohms, with the lowest impedance point being 7 ohms.

The new Model 6 is a three-way system employing a 310 mm (12") bass unit featuring a 'curvalinear' cone and aluminium voice coil. The 150 mm (6") mid-range driver is enclosed in its own spun metal chamber, and a modified horn tweeter, as used on the Peterson 'Andromeda' range, is employed. The system is a tuned reflex type with two twin ports. Suggested amplifier power is given as 10 watts to 100 watts, the speakers being rated at 120 W RMS.

Recommended retail price is under $800. The new Model 6 loudspeakers are available from most hi-fi outlets nationally.

Further details from Peterson Speakers Laboratories, 7 Alex Ave, Moorabbin Vic. 3189.

Videodisc can record too?

The Sharp Corporation of Osaka, Japan, has developed a videodisc system which can be used for user-recording as well as replaying.

Unfortunately the system is not a simple one, requiring a silicon laser in addition to a 127 mm (5 inch) terbium-dysprosium-iron based disc (somewhat similar to a floppy disc) which can store up to 200 Mbytes of information using a thermomagnetic effect.

The technological development is currently being transferred from the laboratory to the manufacturing section of Sharp's organisation in Nara, Japan. It is expected that it could become available within the next two years, but applications will initially be confined to the business office field.

Later it is hoped that the cost can be greatly reduced so that the read, write and erase system will eventually find its way onto the consumer market.

Brian Dance

SIGHT & SOUND

Allsop disc cleaner

Allsop, well-known for their audio and video cassette recorder cleaning products, have produced a disc cleaning device featuring a unique action.

The device consists of a large weighted pad which rotates about a pivot that fits in the spindle hole of the record, as shown in the accompanying picture.

The record is placed on a non-static-inducing rubber mat and the cleaning device fitted after spraying the pad with the cleaning fluid supplied. The pad is then rotated around the tracks, removing the dirt. A brush is supplied to remove particles from the pad.

The Allsop record cleaner comes in an attractive and functional case and is due for release through record and hi-fi stores this month. More details from the importers, Communications Power Inc, P.O. Box 246, Double Bay NSW 2028.

Allsop's Orbitrac cleaner.

By the way, Allsop now have a Beta VCR cleaner to complement their VHS type.

The closest thing to perfection . . .

The latest release in the cartridge range from Audio Technica has created minor traffic jams at the exhibits in the Audio Fairs of Europe and USA since its introduction late last year.

It was the most expensive cartridge yet to be released in the general market, but after listening to the Audio Technica AT 1000 E through its matching transformer the audiences ceased talking of the price and spoke only of its incredible clarity and realism, according to Maurice Chapman, AT's local agent.

Only sixty of the AT 1000 E were manufactured, each one hand-crafted in the research division of the company.

The most radical change from previous designs was the all-diamond cantilever. Gem mounting and polishing techniques were employed to achieve angle and finish, and laser-type measuring gauges were used for physical measurements.

The AT 1000, however, was only half the story. The transformer, weighing an almost unbelievable seven kilos, was a piece of laboratory precision in itself, designed to parameters where distortion was totally unmeasurable on the most sophisticated instruments available, Maurice says.

To those audiophiles who had seen only ruby cantilevers the end result was a sound that few could describe. Of the sixty produced, ten were reserved for Australia. The price is high: $1195 for the AT 1000 and $1190 for the 1000 T transformer. But Maurice says it is a once-in-a-lifetime chance to own ". . . the closest thing to perfection".

More details from The Maurice Chapman Group Pty Ltd, 44 Dickson Ave, Artarmon NSW 2064. (02)438-3111.

Where do you get it? . . .

We've been a little tardy in telling people where to get goodies we've reviewed or featured in stories recently.

The KEF 105 Speakers: Arrow Electronics of 342 Kent St, Sydney, have them on show — and for sale, naturally — so give tham a bell on (02)29-6731 for an appointment. While you're there, make sure you see and hear the new Shure cartridge, already receiving rave reviews in the overseas journals.

The Nakamichi turntable: We thought **everybody** knew that Convoy International Pty Ltd, of 4 Dowling St, Woolloomooloo 2011 were the Nakamichi agents. If you need more info on the TX-1000, or wish to arrange an audition (but call your bank manager/stockbroker first) then call them on (02)358-2088.

SAALEN 58/82

The versatile Sharp-Optonica RT-9100 cassette electronic tape processor.

Modern tape recorder technology

Part 2

This article concludes Brian Dance's look at the technology and techniques employed in modern analogue tape and cassette recorders.

Brian Dance

Practical amplifiers

The frequency response required for a tape playback amplifier or for a recording amplifier is most easily obtained using a feedback network. A very simple playback amplifier is shown in Figure 9, where the components R2C2 and R3C3 form circuits with time constants to provide the required response.

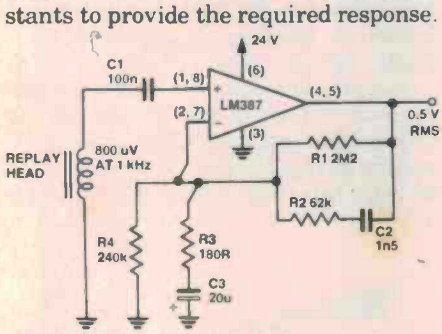


Figure 9. A simple playback amplifier with equalisation (National Semiconductor).

In a practical circuit the design would be far more complex, partly because of the required switching and logic circuitry and partly because many manufacturers employ discrete transistors rather than monolithic devices.

The recording equalisation amplifier of the Teac 35-2B open-reel tape deck contains the circuit of Figure 10 for the adjustment of the equalisation at high frequencies. When the slider of VR1 is set to the far left position in Figure 10, the circuit becomes equivalent to that of Figure 11; so the FET Tr1 remains off.

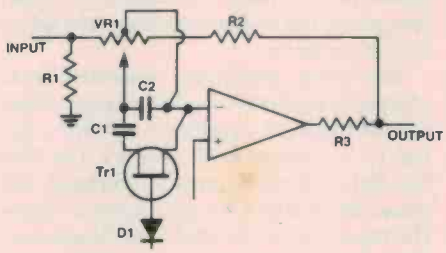


Figure 10. Part of the equalisation circuit of the Teac 35-2B recorder.

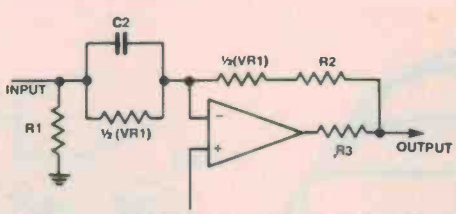


Figure 11. Equivalent circuit of Figure 10 when VR1 slider is on the left (Teac).

High frequency signals can now pass through C2, which bypasses the left hand half of VR1 so that the level of these signals at the input of the amplifier is increased and the high frequency gain is raised.

When the slider of VR1 is set as far to the right in Figure 10 as possible, this provides the minimum high frequency gain. The circuit is now equivalent to that of Figure 12, with C2 in the negative feedback loop so that feedback is a maximum, and the gain a minimum, at high frequencies.

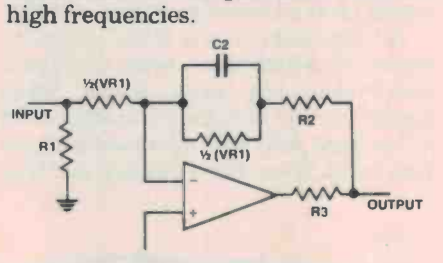


Figure 12. Equivalent circuit of Figure 10 when VR1 slider is on the right (Teac).

At the centre position of VR1, C2 is shorted out and the amplifier has a level response. If the tape speed switch is set to the 'low' position, Tr1 is turned on so that C1 is placed in parallel with C2 to optimise the time constant. The circuit provides a maximum equalisation of about ±8 dB at 10 kHz and eliminates the need for adjusting the recording equalisation circuit manually each time the tape speed selector is changed. ▶

Dyneq

Tandberg employ a dynamic equalisation system known as 'Dyneq'. The conventional recording amplifier has a steadily rising gain at high frequencies in order to obtain a flat frequency response over the audio range. However, this rising gain equalisation can have a bad effect at high recording levels in loud passages where a low distortion is more important than a level characteristic.

In a Dyneq recording amplifier, the gain at high frequencies is automatically adjusted so that tape overload is prevented. If the output is low at high frequencies, no alteration in the equalisation curve (the −30 dB curve of Figure 13) is required. However, as the high frequency signal level increases, the high frequency gain is reduced until no boost at all is provided (0 dB curve of Figure 13). It is claimed that this reduces the high frequency distortion from over 60% to under 10% and the high frequency signal-to-noise ratio (where signal-to-noise ratio is most vital) by up to 15 dB. As the Dyneq system operates only in the recording chain and not in the replay amplifier, tapes recorded using it are fully compatible with other systems. Without the Dyneq system, the 0 dB curve of Figure 13 would have the same shape as the −30 dB curve, and the 20 kHz peak would be at a level of just over +20 dB.

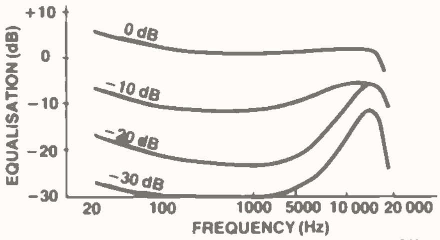


Figure 13. **Equalisation frequency response of the Tandberg Dyneq system.**

All tape users know of the excessive distortion which arises when the tape is overloaded, but what is not often appreciated is that the saturation level of the tape falls with increasing signal frequency. Teac have pointed out that most manufacturers quote the frequency response at each tape speed of their equipment, but few manufacturers quote the level at which the response was measured; usually this level is some 10 to 20 dB below the operating reference level (0 dB or 0 VU on the signal level meter). As shown in Figure 14, the response at the 0 dB level may be considerably inferior to the quoted response, but this will not usually matter in practice, since the level of high frequency signals in music is usually considerably lower than the level of the lower frequencies.

The bias oscillator

The bias oscillator should operate at a frequency far above the maximum signal frequency to be recorded, or unwanted 'beats' may be generated with the signal. In addition, the bias noise becomes smaller as the frequency is increased, although there is little to be gained by the use of a frequency above about 120 kHz. The use of an unnecessarily high frequency results in greater power losses, so the bias oscillator must operate at a high level.

It is important that the bias oscillator should produce a low distortion waveform without any direct current component which would produce asymmetrical magnetisation of the tape and hence noise. The presence of unwanted harmonics in the bias signal increases the chance of unwanted beats being produced. Similarly, the oscillator frequency should be stable so that its frequency does not wander into regions where it causes beat notes. In addition, if the bias frequency changes, the rejection provided by the bias trap (see later) will be impaired.

The bias oscillator operates only when the equipment is being used in the record mode. It supplies a 100 kHz signal to the erase head (Figure 15). The oscillator current passing through the erase head must be adequate to cause the tape to be saturated for efficient erasure, but as the tape moves away from the head it is taken through hysteresis cycles of smaller and smaller amplitude until the amplitude becomes zero and virtually no magnetism remains on the tape. The erasing efficiency rises very rapidly indeed with the current passing through the erase head (Figure 16).

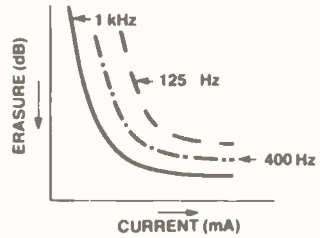


Figure 16. **Erasure obtained with various values of the erase head current (JVC).**

The output of the bias oscillator is also coupled through a capacitor or an RC network to the record head. The input signal from the recording amplifier is also applied to the record head, as shown in Figure 15. The bias trap, L1C1, resonates at the bias frequency and prevents any appreciable amount of bias current from flowing into the recording amplifier, where it could cause distortion, beat with the signal or produce an incorrect signal level indication. An additional series tuned circuit, L2C2, may be used (shown dotted in Figure 15) to provide further bias rejection.

Why bias?

If the ac input signal is applied to the recording head without the use of any high frequency bias, a signal can be recorded on the tape, but (as shown in Figure 17) it is severely distorted. When the instantaneous value of the input signal is very small, it produces no permanent magnetisation of the tape and this results in a very bad crossover distortion effect on the tape. Additional distortion is added by the non-linearity of the hysteresis curve.

It is possible to record by using a permanent magnet to bias the tape to saturation, but this results in much inferior results as regards distortion and signal-to-noise ratio than when high frequency

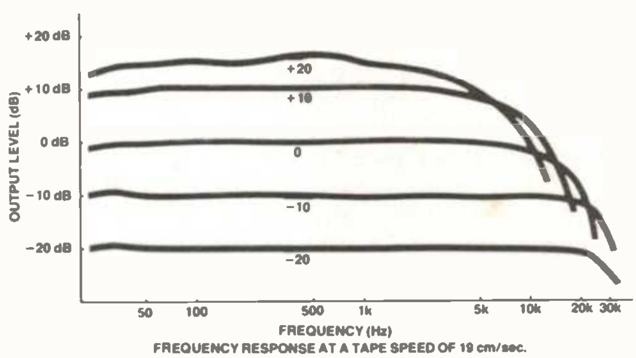


Figure 14. **Frequency response falls at high signal levels (Teac).**

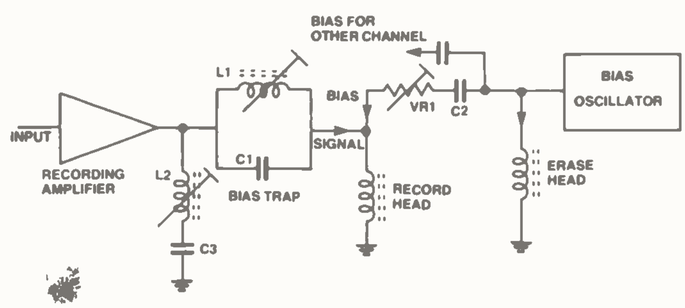


Figure 15. **A basic bias oscillator circuit connected to the erase and record heads.**

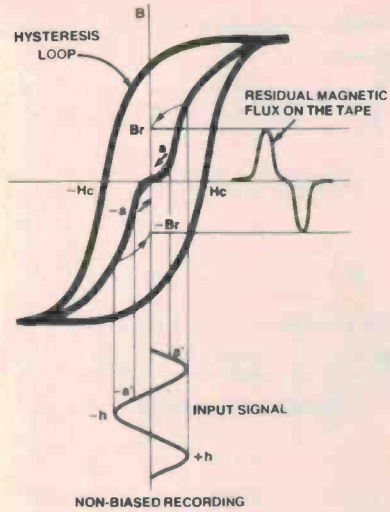


Figure 17. **Recording without bias produces severe distortion (Teac).**

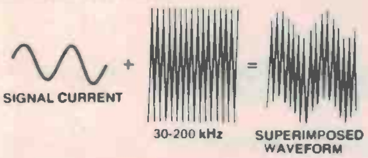


Figure 18. **The addition of HF bias to the signal produces a composite wave (Teac).**

bias is used. In the circuit of Figure 15 the signal current and bias currents combine to produce a composite modulated waveform, as shown in Figure 18. The recording head receives the composite waveform, and the non-linear portions of the initial magnetisation curve are masked by the bias current so that the composite signal effectively uses only the linear portions (Figure 19).

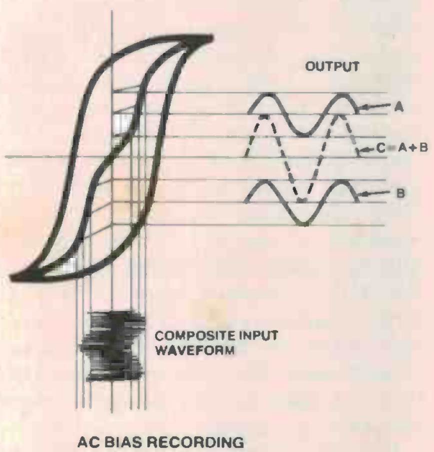
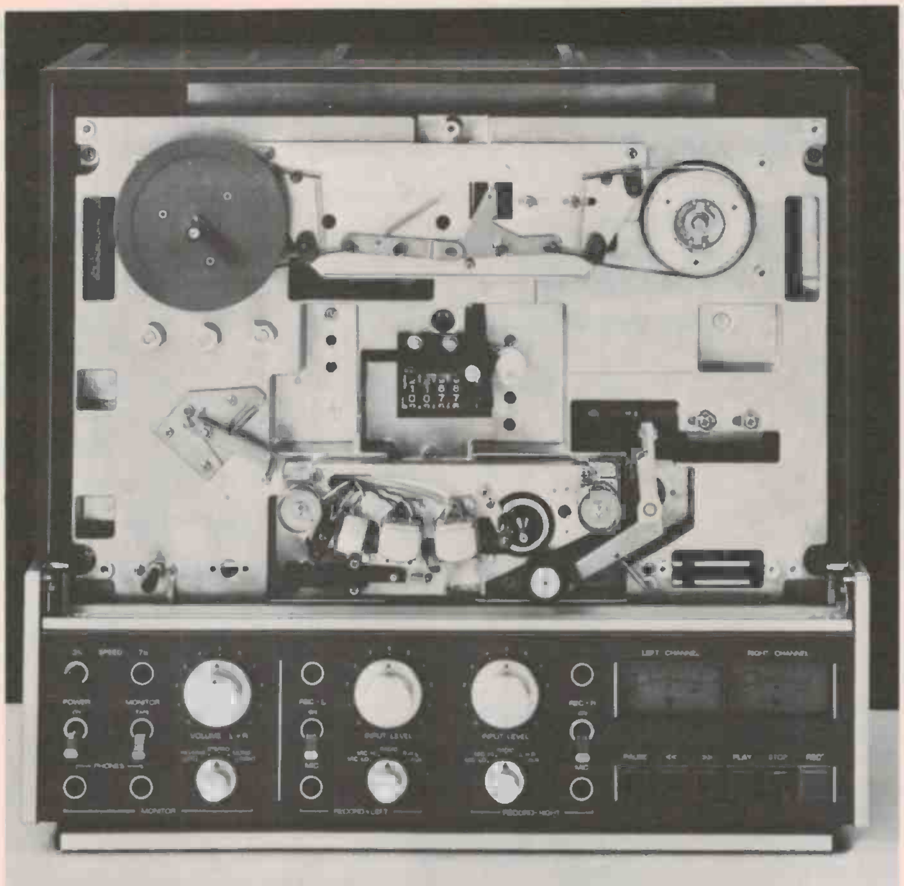


Figure 19. **Recording the signal plus bias can produce low distortion (Teac).**

It is important that the bias current is near to the optimum value. As the bias current is increased, the distortion level falls and the signal amplitude recorded on the tape rises, reaching a maximum before falling again at high values of the bias current, as shown in Figure 20 for a typical system. The bias characteristics are affected by the head and by the tape used, so the bias current should be adjusted to its optimum value for each type of tape used. The bias level affects the frequency response. In Figure 16 the bias level is adjusted by VR1.

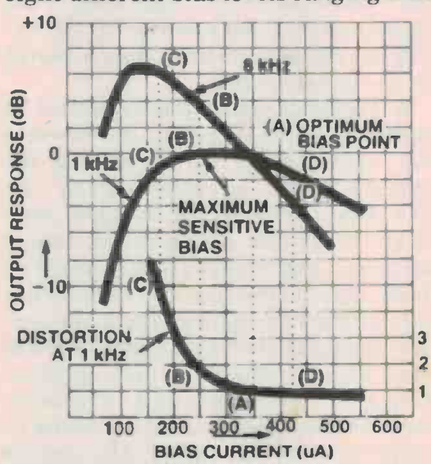


A view of the Revox B77 open-reel deck with the top cover removed to show the tape heads, etc.

B.E.S.T. System

JVC have introduced a computer system for automatically adjusting the equipment circuit parameters (bias, equalisation and sensitivity) to meet the exact needs of each type of tape employed. Known as the B.E.S.T. (Bias, Equalisation, Sensitivity of Tape) tuning system, it performs tests for about 25 seconds in order to set the parameters to their optimum value, no matter whether conventional gamma-iron-oxide, chrome, ferrichrome or metal tape is being used. Each of these four categories of tape can vary widely in characteristics and the B.E.S.T. system 'tunes' the equipment for optimum performance, not just for the category of tape (as would be the case with a four-position switch), but to optimise the parameters for the measured characteristics of the tape used.

When the start button is operated, a LED flashes and the tape runs for about 1.6 seconds to take up the leader tape, after which it operates in the recording mode for 2.8 seconds with no signal applied whilst working conditions are attained. Marker signals of 60 ms duration are then recorded, followed by eight sets of 1 kHz and 7 kHz test signals at eight different bias levels ranging from ▶



BIAS CURRENT VS. RELATIVE OUTPUT LEVEL/DISTORTION

DISTORTION (%)

POINT	SENSITIVITY 1 kHz	SENSITIVITY 8 kHz	DISTOR-TION
(A)OPTIMUM	OPTIMUM	OPTIMUM	GOOD
(B)	HIGHER	HIGHER	POOR
(C)	LOWER	HIGHER	POOR
(D)	LOWER	LOWER	GOOD

Figure 20. **Effect of bias current on distortion and recording level (JVC).**

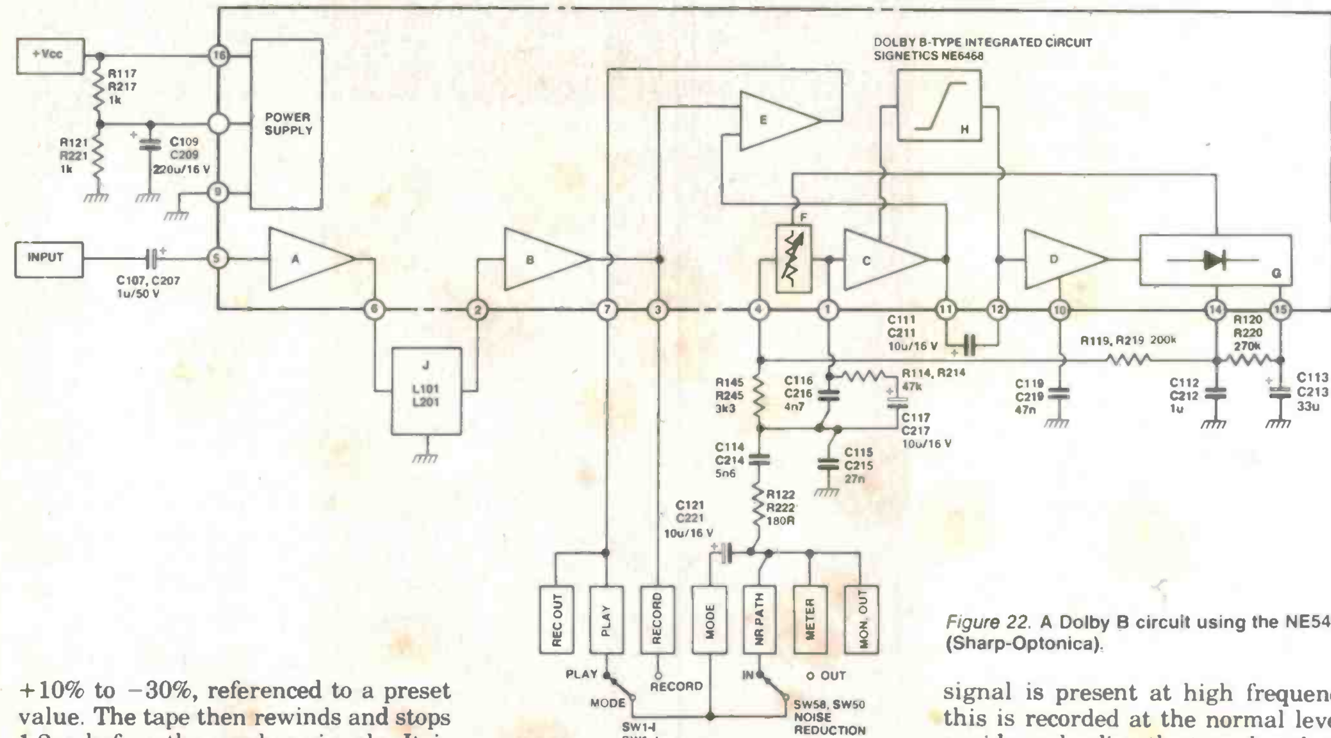


Figure 22. **A Dolby B circuit using the NE546B IC (Sharp-Optonica).**

+10% to −30%, referenced to a preset value. The tape then rewinds and stops 1.2 s before the marker signals. It is automatically played back while the output levels of the paired 1 kHz and 7 kHz signals are compared until two with matched outputs are found, so that the bias level can be selected.

The recording mode then follows, with no signals applied for the first 2.8 s, after which two markers and a 1 kHz reference signal are recorded. A 12.5 kHz signal is recorded every 60 ms with the equaliser peaking frequency sweeping in eight steps from the lowest to the highest so that the best equalising setting can be chosen. This is then repeated for the left channel.

A 1 kHz signal is then recorded in eight amplitude steps from the lowest to the highest every 60 ms, so that the sensitivity can be automatically set. The deck then rewinds the tape, stopping 1.2 seconds ahead of the second markers, and automatically plays it back. The 1 kHz and 12.5 kHz output signals from the right channel are compared and matched with levels stored in the memory, followed by the left channel signals. The memorised 1 kHz reference level is subsequently compared by computer with the eight 1 kHz signals recorded for sensitivity adjustment, and the matched signal is then memorised. Finally the tape is rewound ready for use with all settings at their optimum value!

A microcomputer chip has been especially developed for this application — a 4-bit, 42-pin device containing 2K of ROM. Figure 21 shows frequency response curves obtained before and after equipment parameter setting with the B.E.S.T. computer system.

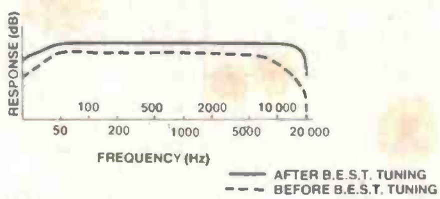


Figure 21. **Improvement claimed by setting the parameters using JVC's B.E.S.T. system.**

Noise reduction

One of the main problems in designing hi-fi tape recorders for operation at relatively low tape speeds is that of ensuring that high frequency noise (hiss) is unobtrusive, even during quiet passages. Various noise reduction systems have been employed to combat this problem, the best known being from Dolby Laboratories, but as these have often been described in detail, only a general review will be included here.

The Dolby A system is employed in top-quality recording systems. It is complex; the whole audio spectrum is divided into four frequency bands, each of which is separately processed. The Dolby B system is much simplier and is extensively used in cassette and other recorders. When the signal level at frequencies above 1 kHz is relatively low, the gain of the recording amplifier is increased so that the low-level signal is recorded at a higher level than normal. On playback the signal is attenuated at high frequencies to bring the level back to normal, and in doing so the high frequency tape hiss is also attenuated so that it is not obtrusive. If a high-level signal is present at high frequencies, this is recorded at the normal level to avoid overloading the tape, but the hiss does not cause a problem in the presence of such high-level signals.

It should be noted that the Dolby system involves both the recording and the replay processes, although there have been proposals for the radio broadcasting of Dolby companded signals. Dolby B offers up to 10 dB reduction in noise.

The Dolby B system can employ a fairly simple circuit using the specially produced Signetics integrated circuit NE546B. The circuit shown in Figure 22 is that employed in the Sharp-Optonica RT-1616 series of cassette recorders. Two normal amplifier stages are marked A and B, whilst the Dolby summing amlifier E inverts the polarity and has a gain of −1. A high speed Dolby side chain limiter F, C, D and G operates on the high or medium frequency signals. The output signal from the Dolby side chain amplifier is added to the ordinary signal from B in the record mode to provide the amplitude compression, whilst in the replay mode they are subtracted from each other to provide the expander characteristics.

Pioneer, amongst a number of manufacturers, has selected the fairly new Dolby C circuit for their latest cassette decks. Like the Dolby B system, Dolby C compands only the mid and high frequencies, but produces a noise reduction of some 20 dB. Dolby C offers a dynamic range as wide as 90 dB. The anti-saturation and spectral skewing circuits in Dolby C systems prevent saturation-induced clipping of the audio waveforms and increase the MOL (Maximum Output Level) at high frequencies.

A number of other noise-reducing systems compete with Dolby circuits. JVC have developed their ANRS Automatic Noise Reduction System and their 'Super ANRS'. ANRS operates on low-level, high frequency input signals in much the same way as Dolby circuitry, but Super ANRS also operates on high-level, high frequency signals. An identical response can be obtained from ANRS and Dolby, but not from Super ANRS and Dolby. The Super ANRS system records high-level, high frequency signals at a level on the tape which is below its saturation level, whereas they are reciprocally compensated during playback. Super ANRS produces a response like ANRS and Dolby circuitry when the signal level is low.

JVC state that these systems can improve the signal-to-noise ratio by 5 dB at 1 kHz and by 10 dB at 5 kHz and above. The Super ANRS system has now been miniaturised by the use of a special integrated circuit.

Perhaps it should be made quite clear that the noise reduction systems discussed can reduce only the noise added between the recording part of the noise reduction system and the replay part of this system. They are not likely to affect hum, clicks or other such forms of noise.

The JVC type KD-A11 stereo cassette deck.

Signal meters

A tape recorder requires some form of indicator to show the level at which the recording is taking place, since if the level is too high tape overloading and severe distortion on playback will occur, whereas if the level is too low the tape noise will be much higher than it need be. It may be noted that tape overloading occurs well before amplifier overloading.

One type of meter is the VU or 'volume unit' meter. This provides an indication of the mean signal level being applied to the tape, ignoring any very short, high value peak transient voltages in the signal since the mechanical inertia of the meter prevents the needle from moving very rapidly to accommodate short transients. However, such a meter should provide a response fast enough to provide an indication of about 99% of the signal level within about ¼ second, and similarly the meter indication should return fairly rapidly to zero when the signal is removed.

A VU meter scale may be calibrated from about −20 dB up to the 0 VU mark, which is the normal recording level, and the part of the scale on the right hand side of this 0 VU mark is often in red.

Another type of meter circuit indicates the peak signal level even though the peaks may be of very short duration. The rise time of the meter indication is very short (a few ms), but the decay time of the indication is much longer (somewhat less that 1 s) so that the user has time to read the peak indication given.

Transport systems

Electronic techniques are now becoming far more widely used for the control of tape transport systems. For example, the Sharp-Optonica RT-1616 series employs a phase-locked loop circuit to ensure that the running of the tape is always kept as steady as possible during operation. The quartz crystal reference signal is divided down in frequency and the resulting high stability is signal compared in phase with a signal produced by a tacho-generator on the servo motor, the frequency of this latter signal being proportional to the motor speed. A feedback system locks the speed of the motor rotation to the reference signal from the quartz oscillator so that variations of the supply voltage are minimised.

The quartz crystal (marked HC-18U in Figure 23) generates a 10.24 MHz signal which IC2 divides to 2.5 kHz. The latter is applied to pin 6 of the M51728L phase locked loop (IC1). Any phase difference between the motor tacho and reference signals is converted into an error voltage, which appears at pin 1 of IC1. This passes through a low-pass filter and is smoothed by an integrating circuit before being passed to the motor control Darlington transistor, Q1, which provides the motor current. ▶

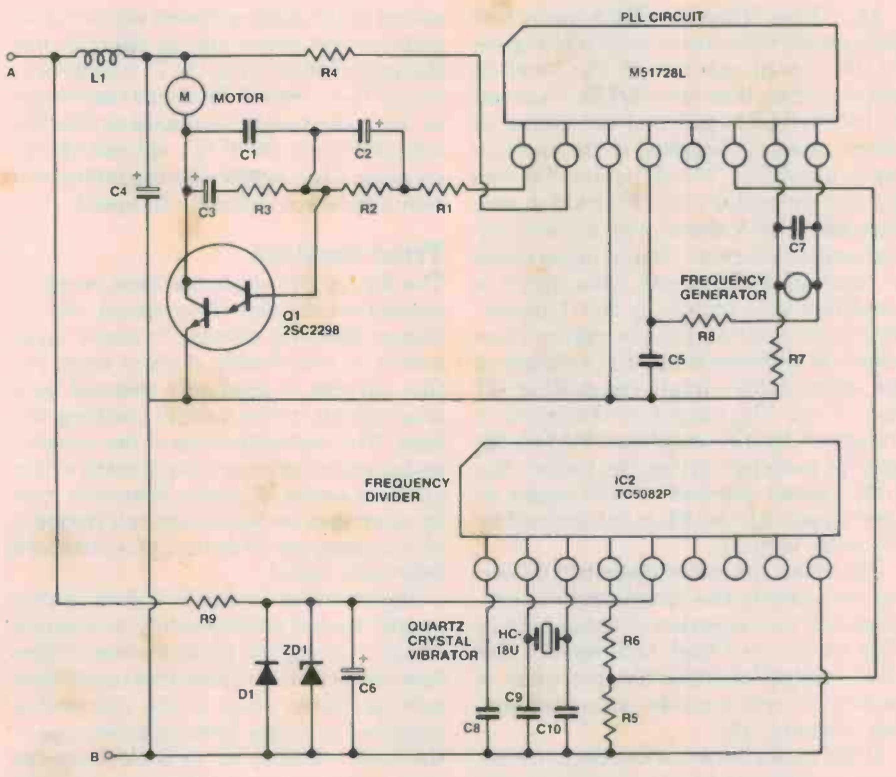


Figure 23. A quartz-stabilised phase-locked loop for motor speed control (Sharp-Optonica).

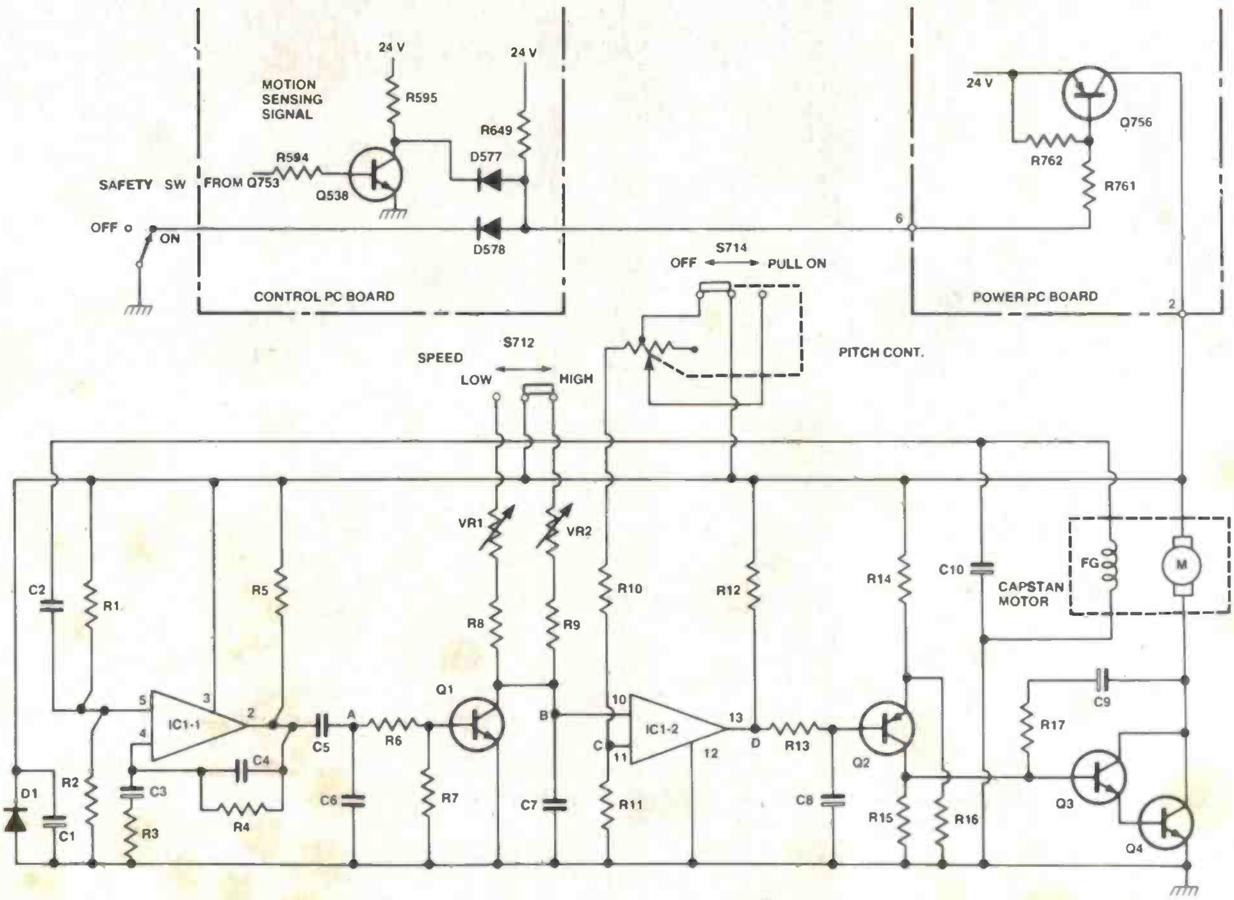


Figure 24. The servo speed control circuit used in the Tascam 35-2B deck.

The Teac Tascam 35-2B open-reel deck employs the servo circuit of Figure 24 for speed control of the capstan motor. When transistor Q756 is turned on by current to pin 6 of the power pc board, power is supplied to the capstan servo amplifier. The dc motor has frequency generator coils (FG) which produce a sinewave signal with a frequency and amplitude proportional to the speed of rotation of the motor. This signal is amplified and shaped by IC1-1 to produce a constant amplitude square wave which is differentiated and coupled to the monostable circuit comprising Q1 and IC1-2. The output of the latter is smoothed by C8, amplified by Q2, Q3 and Q4 and then drives the motor. The motor speed depends on the mean dc level at point D, which is determined by the pulse width T.

Therefore the motor speed can be varied by altering the charging time constant of C7 by selection of either VR1 or VR2 for low and high tape speeds. The pitch control changes the potential of point C so as to provide tape speed control of about ±6%.

If the motor load is increased, the frequency generated by the coil FG tends to decrease, resulting in an increased period of the differentiated waveform at point A and hence also at point D, but the pulse width at point D is kept constant. The mean dc level at D decreases as the pulse period increases so that the collector currents of Q2, Q3 and Q4 all increase so as to increase the motor current and hence maintain its speed.

Triac control

The Revox B77 open-reel deck employs motors which can be supplied with a higher starting current to move large and relatively heavy reels of tape, but this current is gradually reduced by a triac circuit to the normal running voltage. The circumference of the capstan motor rotor contains a set of teeth which create a series of pulses; these are read by a tachometer head and their frequency is compared with that of a standard reference signal.

Tape motion in the B77 deck is constantly sensed automatically by a circuit using a magnetic pickup sensor. This tape motion sensor prevents tape transport problems even if the recorder is switched from fast forward to play, since the logic circuitry of the deck stores the play instruction until the tape has virtually ceased moving before carrying it out. This is especially important in a recorder designed to carry 267 mm (10½") reels, which have considerable angular momentum on fast wind.

Apart from speed control of the tape system, tape recorders often employ brushless Hall effect motors, which avoid the noise generated by sparking at the brushes of conventional motors and which provide greatly improved reliability, since motor brushes wear down more quickly than most other components of tape recorders. However, Hall effect motors require transistor switching circuitry for their operation and this adds to the circuit complexity of the recorder.

The new Pioneer series of CT decks employs three brushless Hall effect motors which are controlled by special drive and control ICs. In the top CT-9R model speed is controlled by reference to a quartz-stabilised oscillator by a servo system. It is claimed that the Hall effect motors driving the reels exert a very constant amount of tension on the tape, which allows the most intimate contact between the tape and the heads, and that this results in fewer dropouts, reduced output level variation and less modulation noise.

Search systems

Many modern recorders quickly find the required part of a tape without replaying a large portion of it. Sharp-Optonica employ an APSS (Auto Programme Search System) on some of their cassette recorder models. This enables the tape to be scanned at high speed until a blank section without a signal is located between sections of the programme. The tape then stops or automatically starts to play back, with a facility for the skipping or repetition of the succeeding part of the tape. This APSS system is actuated by electronically controlled solenoids.

JVC have developed a Music Scan System to provide direct access to any part of a tape in much the same way as one has direct access to any part of a disc recording. In the single music scan system, the model KD-A55 uses a third monophonic head in addition to the normal record/play and erase heads to sense the blanks between musical selections. This third head detects blanks of half a second or more and sends an output to a transistor amplifier and a high-gain dual op-amp IC, which in turn triggers the playback function. It can be used to find the beginning of the next section or the beginning of the previous section automatically. JVC also employ their Multiple Music Scan system in decks such as the KD-A22, in which the record/play head doubles as a scan head.

Some JVC decks also employ their 'Search and Look' system, which searches out the maximum input level and locks it around the +3 VU mark as the peak level so that one can record with minimum distortion over the entire audio range. Unlike the automatic gain and automatic level control used by some manufacturers the search and look system does not alter the input/output response.

The Pioneer CT-R decks all include 'CAC' (Computer Aided Convenience), in which microprocessor control enables the user to press a blank search button to automatically set fast forward or reverse wind to seek out the blanks between the recorded items of a duration of over 8 s; rewinding to the point where there is a 4 s space between the last recorded portion and the point where the recording will begin again is automatic. In addition, a scanning system enables about the first 7 s of each section on the tape to be replayed one after the other, skipping the remainder of each section unless the play button is operated. This facility is available in forward or rewind directions. The system also allows one to return to the beginning of a section at the touch of a button, to repeat a section as many times as one wishes or to move rapidly to the next section. ●

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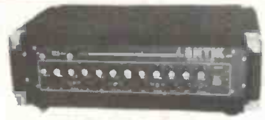

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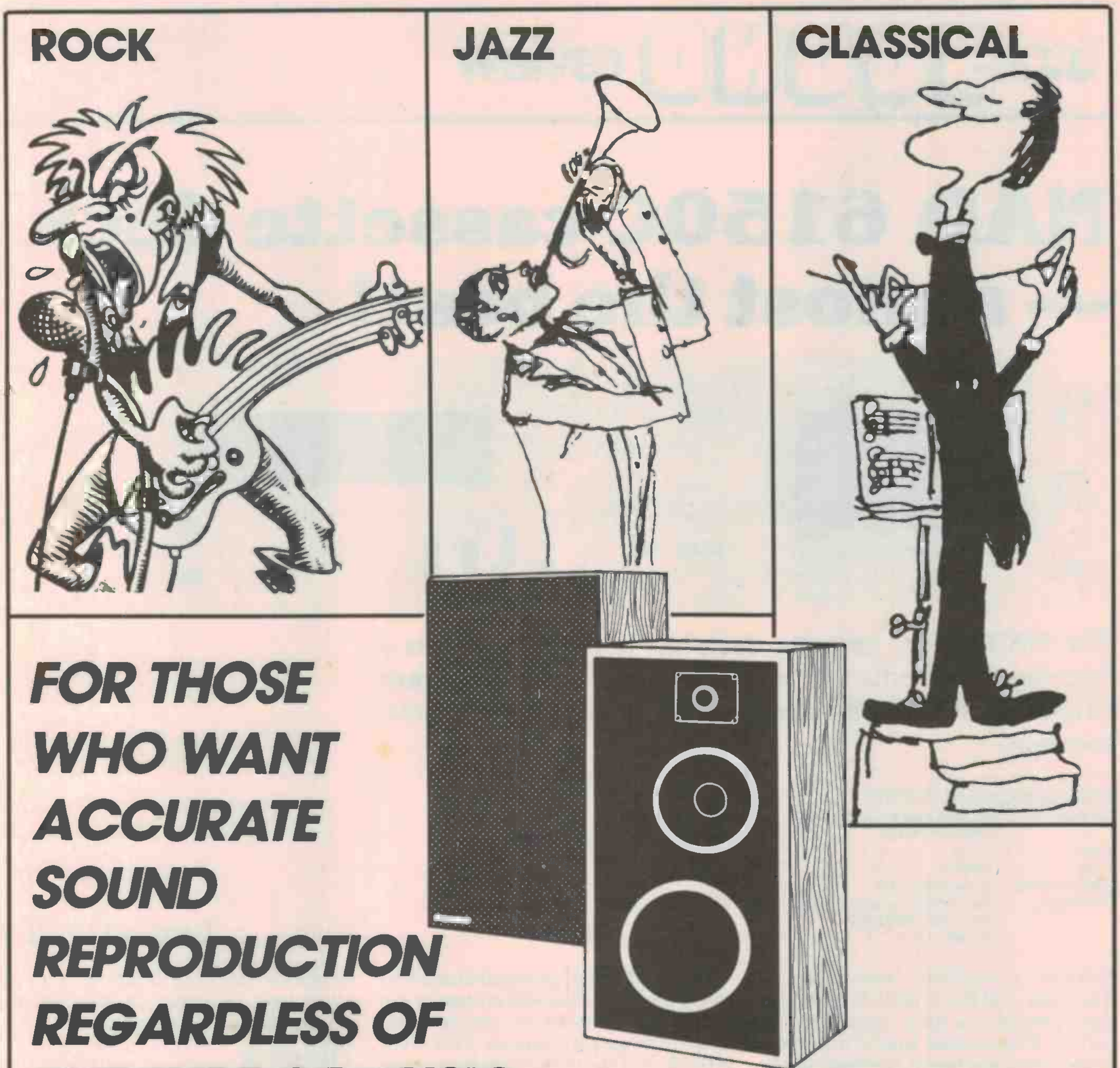

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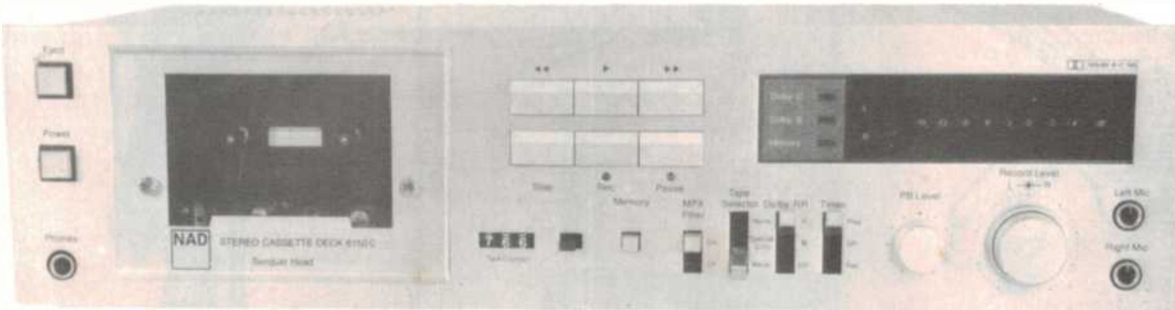


The NAD 6150C cassette deck has been designed as a high-quality product at a competitive price, and Louis Challis found that its performance was certainly above average.

NAD 6150C CASSETTE DECK

Dimensions:	*420 mm wide x 112 mm high x 263 mm deep*
Weight:	*5.5 kg*
Price:	*$439 rrp*
Manufactured:	*In Japan by NAD*
Distributor:	*Falk Electrosound, 28 King St, Rockdale NSW 2216. (02)597-1111.*

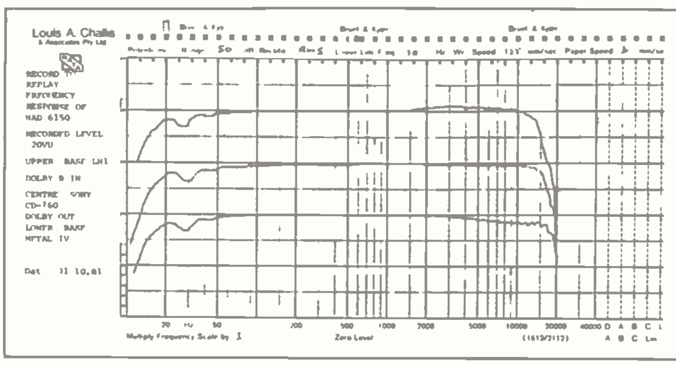
Louis Challis

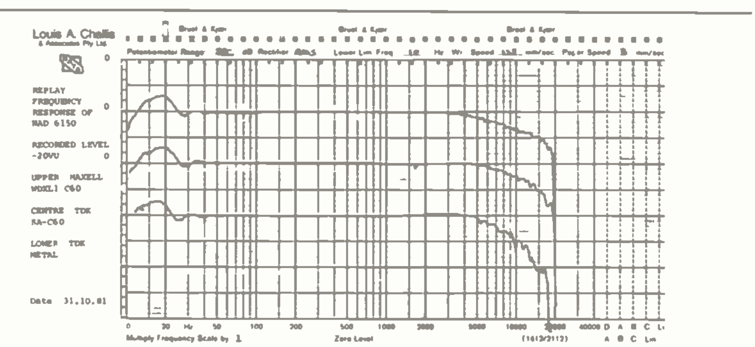
NAD is a relatively new name in Australia, and this is only the second of their products to have reached us for review. The avowed aim of the NAD Corporation has been to produce equipment in the upper quarter of the possible quality range, with US prices that generally lie well below their competitors' prices. One obvious question is whether that philosophy has been carried through to the Australian market as well.

The NAD 6150C is a good example of how a progressive design philosophy can produce a competitive product with above average performance. This is one of the first of the Dolby C decks released by NAD and as such its performance can be directly compared with a number of other decks incorporating Dolby C that we have reviewed over the last six months. The design philosophy on the 6150C deck has been to provide the minimum number of essential controls commensurate with achieving an adequate user flexibility, good ergonomic design and good performance.

The deck

The deck has its controls and display functions grouped into three main sections. On the left hand side, adjacent to the cassette well, is a rectangular eject button, a similarly shaped power on/off switch and immediately below a tip-ring-and-sleeve headphone socket. The





activation of the power socket brings on a white illuminated light behind the cassette well together with two of the LEDs in the recording level display at the right hand end of the deck.

The cassette well itself is a trifle unusual, in that activation of the eject button brings into play a mechanical, geared flywheel and associated cord and spring assembly. This slows down what would otherwise be a rather violent movement as the lid tips forward. This system contrasts with some of the pneumatic and alternative types of dashpot dampers that we have seen recently, and in my opinion it does not provide as smooth a performance as those other possible options. Nevertheless it performs its function reasonably well, and is in keeping with the designers' philosophy of putting the high-performance functional components where they are most needed. The cassette drive mechanism features a two-head configuration and, as we will see later, the machine does not markedly suffer from this choice.

At the top centre of the deck are six elongated controls laid out in two rows of three, one above the other. The top row incorporates the servo control buttons for Rewind, Play and Fast Forward in a logical manner, while the bottom row has Stop, Record and Pause buttons. The Record button is supplemented by a red LED and the Pause button by a green one. The control switches are all interlocked and it is possible to transpose directly from almost any given function. Any such action is coped with simply and straightforwardly, without fuss or bother. The Record switch is interlocked with the Play switch in the conventional manner and presents no problems in use because the designers have sensibly placed the Record button immediately below the Play button.

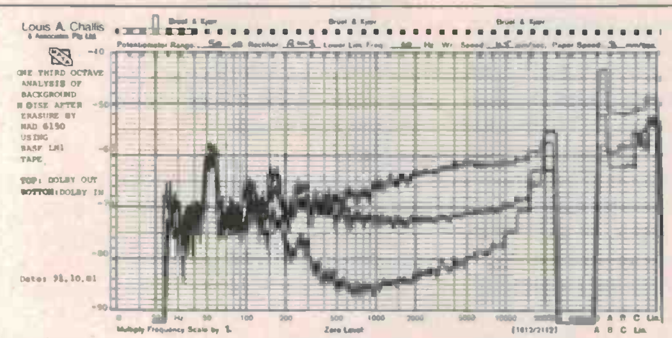
Below these primary controls are a three-digit tape counter with reset, a memory on/off switch, which allows you to rewind directly back to the 000 position, a multiplex filter which allows you to record off FM and reject all frequencies above 17 kHz (specifically the pilot tone carrier of the transmission), a tape selector switch for normal gamma ferric oxide, special or any chrome equivalent tapes with a 70 microsecond equalisation, and the new metal tape formulations. The Dolby noise reduction switch provides an off position and Dolby B as well as Dolby C for the widest possible noise reduction. The unit also incorporates a timer switch, so that by using an external switching timer unit the cassette recorder will automatically start recording from line or microphone or playing back a prerecorded tape, as selected by the switch.

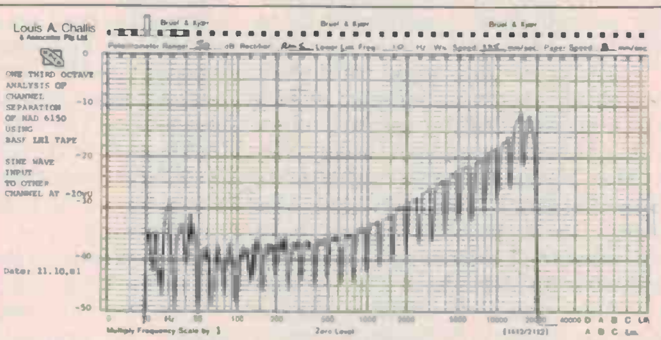
At the top right hand side of the deck is the LED peak reading level display, which shows that the power is on as well as processing direct peak reading indication from −18 dB to 0 dB using green LEDs, and from +2 to +4 dB using red LEDs. This is flanked on the left hand side by a simple escutcheon with three LEDs to indicate that the memory function has been selected or that Dolby B or Dolby C modes have been selected. Immediately below is a sensible playback recording level control and dual concentric left and right channel record level controls. At the extreme right hand side of the deck are two standard 6 mm tip-and-sleeve sockets to accept unbalanced inputs from either dynamic or electret microphones.

The front panel on this particular unit is in brushed satin aluminium with stencilled lettering; black-fronted units are also available. The cabinet is in black painted steel rather than the more usual (and cheaper) plastic, with white silk-screened printing on the back panel.

The rear panel incorporates the normal coaxial line input and line output sockets, supplemented by a DIN recording and playback socket. Immediately above this is a potentiometer bias level control to allow the user to optimise the linearity of the recorder on either special tapes or to suit a particular brand, should you know the correct setting. The manufacturers do not, however, provide additional information on what the correct setting ought to be for various types or even for the popular brands of tape. The only other control on the rear panel is a remote control socket to enable the unit to be connected with the manufacturer's own remote control unit, which would increase the overall flexibility. The mains flex is a two-cord lead with a two-pin plug to meet Australian requirements. The chassis is of all-steel construction, thereby minimising spurious hum pick-up which could otherwise be a problem in many situations.

The inside of the unit has a delightfully simple layout featuring one large, inverted motherboard with all the components on the right hand side of the deck. A small supplementary board to provide the boosting or attenuation of the bias signal is located immediately behind the rear panel to provide the fine bias capability. At the front of the deck are two small boards, one of which is placed immediately behind the LED display and incorporates its own pair of large-scale integrated circuits for demodulating the signal, whilst a separate switching board is located behind the control buttons to provide electrical connection through to the servo-control system. ▶





The deck drive in this particular unit is rather large compared with most other units we have recently seen, and is based on a sensible combination of a rugged steel chassis, together with a mix of steel and plastic moulded components to provide what appears to be a well-designed mechanism. The flywheel used is unusually large and is intended to minimise the wow and flutter problems which plague many other medium and low-priced decks. The servo control also increases the size of the drive and is an obvious reason for using a steel-framed drive mechanism.

Immediately behind the cassette drive is a small printed circuit board, on which is mounted the small microprocessor, integrated circuits and transistors which provide the automated functions, as well as the timer and remote control capability. The unit features one large servo motor and an array of solenoids to automate the control function. The mains transformer, which is located at the left rear of the deck, is regrettably relatively close to the drive mechanism, and although it features external screening it is none the less obviously placed in what is possibly the worst location within the limited space available. Whilst the design does feature a series of radially disposed holes to select the position for the lowest possible level of mains pickup, it is clear that even this range of hole settings cannot positively obviate unwanted magnetic flux leakage.

We received no pre-release information on the unit, and the handbook provided only one minor reference to electrical performance, suggesting that the wow and flutter would be typically 0.04% weighted RMS. As a consequence I had an open mind as to what I might find.

MEASURED PERFORMANCE OF NAD MODEL 7150C

S.N. 109057

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Tape	Dolby	Lower - 3dB Point	Max. Point and Frequency	Upper - 3dB Point
BASF LH1	IN	18Hz	1dB 3kHz	15kHz
SONY CD- 60	OUT	19Hz	-	18kHz
BASF METAL IV	OUT	17Hz	-	18kHz

SPEED ACCURACY: +0.35%

WOW AND FLUTTER:

WOW:	Average	0.25% PP
FLUTTER:	Unweighted	0.3% RMS
	Weighted	0.05% RMS

Performance

The replay frequency response of the NAD 6150C is *amongst the flattest I have seen from any deck,* being almost ruler straight from basically 30 Hz to 3000 Hz and then rolling over smoothly as a result of the slight difference between the azimuth alignment on this particular deck and the azimuth alignment of our reference tapes. Were it not for the manufacturer's unfortunate choice of azimuth alignment tapes, this machine most probably would have been capable of producing a ruler flat response from 30 Hz to 15 kHz. Be that as it may, even at the bottom end the frequency response is basically within ±3 dB from 10 Hz through to 10 kHz on replay and only 6 dB down at 17 kHz on two of the three reference tapes. As if to underscore the point, the record-to-replay frequency response extends from 18 Hz to approximately 15 kHz on Type 1 gamma ferric oxide tape, from 19 Hz to 17 kHz on Sony GAB chromium equivalent tape and from 17 Hz to 18 kHz on BASF metal tape.

The performance on all three of these tapes was fully in keeping with our measurements of the replay response, is almost ruler flat and is a credit to the designers. This performance would be the envy of many reel-to-reel recorder manufacturers, very few of which can even approach this performance.

The speed accuracy of the unit is +0.35% (high) whilst the wow and flutter features a wow component of 0.25% peak-to-peak, an unweighted flutter of 0.3% RMS and a weighted flutter of 0.05%, which is only a shade higher than the figure quoted in the handbook. The distortion characteristics of the deck are quite commendable at 0 VU, being typically 2.5% at 100 Hz, 0.85% at 1 kHz and 1.4% at 6.3 kHz. At −6 VU these figures have dropped down to 0.84% at 100 Hz, 0.3% at 1 kHz and 0.65% at 6.3 kHz. The maximum input level for 3% third harmonic distortion at 1 kHz is +3 VU, indicating that the manufacturers have adjusted their VU meter correctly so that +4 VU is in fact the upper limit of acceptable recording.

The dynamic range of the unit is shown up graphically in the third octave band signal-to-noise analysis, with Dolby out, Dolby B and Dolby C systems activated. From this is can be clearly seen that the primary factor stopping the unit from achieving the ultimate in dynamic range figures is the level of third harmonic mains frequency with both Dolby out and with Dolby B selected. In the Dolby C mode, however, it is the second harmonic and fundamental of the mains at 50 Hz. It is clear that by using Dolby C the designers have achieved a basic midband signal-to-noise improvement of as much as 13 decibels, and this only becomes insignificant at frequencies of 10 kHz and above. At frequencies above 15 kHz in the Dolby C mode, the level of the background noise actually increases, compared with both Dolby B and Dolby out modes. Even so, the effective range of improvement provided by the Dolby C compared with Dolby B or no Dolby extends from approximately 150 Hz all the way through to 15 kHz.

Surprisingly, the *erasure ratio of this unit is better with metal tapes* than it is with gamma ferric oxide tapes, the actual measured figures being 81 dB erasure on BASF metal 4 tape and 69 dB on BASF LH1 tape.

To use

In normal home use *this deck is delightfully easy to use.* The sensible provision of servo-controlled microswitches and the minimum number of other control options necessary to achieve reasonable performance is a very desirable one.

On straight replay it provides ex-

HARMONIC DISTORTION:

Tape: BASF LHI

		100Hz	1kHz	6.3kHz
OVU:	2nd	-48.8	-	-46.3dB
	3rd	-32.2	-41.1	-37.8dB
	4th	-61.6	-	- dB
	5th	-64.6	-	- dB
	T.H.D.	2.5%	0.85%	1.4 %
-6VU:	2nd	-48.5	-	- dB
	3rd	-42.5	-50.2	-44.2dB
	4th	-	-	- dB
	5th	-	-	- dB
	T.H.D	0.84%	0.30%	0.6%

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion at lkHz)

Tape: BASF LHI +3VU

DYNAMIC RANGE:

Tape: BASF LHI

Dolby Out	52dB(Lin)	54.5dB(A)
Dolby B In	56dB(Lin)	62dB(A)
Dolby C In	57dB(Lin)	65dB(A)

ERASURE RATIO:

(for lkHz signal recorded at OVU)

Tape:	BASF LHI	-69.4dB
	BASF METAL IV	-81.9dB

emplary performance, only limited by the original choice of the azimuth alignment selected by the recording company whose product you happen to be playing. When playing a range of specially produced digital mastering cassettes recorded live by the Nakamichi Corporation, the performance of this deck proves to be particularly good. There is no trace of hiss or background noise levels till one advances the amplifier's output up to the equivalent of 50 or 100 watts peak level, and even then the background is detectable only when sitting very close to the loudspeakers. The dynamic range achievable under these conditions is a 65 dB A-weighted, which is very good. Obviously if the manufacturer had chosen to use a fully encapsulated power supply a higher figure would have been achievable.

When recording one's own cassettes, either live or by one of the other various options available to you, the quality of the product is no longer limited by somebody else's azimuth alignment and the frequency response extends to at least 17 kHz, which, if I might make so bold, is about as far as the amateur recordist really needs to go.

The addition of the fine bias adjustment on the rear panel has proved to be a less suitable position than the manufacturer may have realised, and its repositioning on the front panel would be a decided advantage. Even in the practical situation when mounted in the rack system that I use at home and where I have free access to the back panel, this rear panel adjustment version proved to be inconvenient.

On headphones the output of the socket on the front panel, even with the playback recording level set to maximum, is inadequate for most headphones and as such provides only a monitoring capability rather than a high fidelity listening capability.

The peak-reading VU meters work exceptionally well and I believe have all but replaced most of the conventional VU meters as the preferred system for recording level control.

Summary

The NAD 6150C cassette deck performs very well, the only minor criticism being the A-weighted signal-to-noise performance, which theoretically should have been able to achieve almost 70 dB but is limited to 65 dB because of the choice of screening of the mains transformer. In this I believe the designers have skimped too much in order to keep the total cost down to an acceptable level. The only other improvement that I would recommend to the designers would be the desirability of repositioning the variable bias control on the front panel and supplementing that facility with some practical advice to the intending user on the wide range of preferred tapes that is available.

This is an excellent deck with sensible features and generally good to above average performance. It warrants either three stars or close to four out of a possible five and would be an almost perfect choice for the intending buyer who wants almost the best possible performance at a reasonable price. ●

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the speaker system you'll be proud to build!

look how easy

Dick Smith brings you this superbly styled speaker system to suit your room, your decor — and your pocket! It has been acoustically designed by Neville Williams, MIREE (Aust.) Editor-In-Chief of Electronics Australia magazine. We're proud of this outstanding new design, just as proud as you'll be when you hear them perform for you. They feature a completely new format and appearance, starting with the strikingly new grilles featuring the new 'Playmaster' logo. And the design doesn't end with the appearance. Special steps have been taken to ensure this Playmaster kit meets or exceeds the standards of commercial speakers — the ones you'd pay hundreds of dollars more for! You don't need special tools, material or skill to build this superb kit. All you need is a couple of hours of your time, a tube of glue plus a couple of hand tools. They'll look and sound so great your friends will never believe you built them!

and look at these new features

★All-new design in attractive woodgrain finish to complement decor ★Separate level control for high and mid ranges - tailor the sound to suit your listening environment. ★Special speaker sealant material supplied to ensure absolute air tightness ★New design ribbed woofer with massive 30cm cone for accurate bass reproduction ★Built-in plinth to raise speaker off floor level for minimum audio colouration ★Manufactured to the exacting standards of the original design published in Electronics Australia magazine. ★Acoustically transparent silk-like grille cloth heat welded to support frame

▶ Assemble the cabinet and insert the crossovers as per instruction supplied. Bind the final join with masking tape to give strength while the join sets.

▲ Mount tweeter and mid range speakers. Connect the faders, seat them and screw into position. Note the use of a gasket (above) for prevention of air leaks.

▲ Place and connect the woofer making sure a gasket is in place first. The pic above shows the correct method of "guarding the cone". One hand covers the cone and guides the screwdriver blade. By using this method you can prevent costly damage to your speakers.

Fitting the front grille to the completed speaker. After you've done this you're finished. Happy listening! ▼

look at these low prices

300mm SYSTEM KITS

TOTAL KIT SYSTEM ONLY $374 PAIR!

SPEAKER KIT CROSSOVERS & FADERS

The ultimate! As well as the huge 300mm woofer for the best bass reproduction, this kit includes high and mid range faders, and 3 way crossover with high power handling capacity.
Cat C-2042

LOW $175.00 PER PAIR

ENCLOSURE KITS

The 'big daddy' of them all; a pair of large 70 litre cabinets for the ultimate in sound reproduction. A magnificent performer you'll be proud to own.
Cat C-2632

LOW $159.10 PER PAIR

DELUXE SPEAKER GRILLES

Give your speakers high class quality with these superb speaker grilles. Handsome new design featuring the new 'Playmaster' logo.
Cat C-2612

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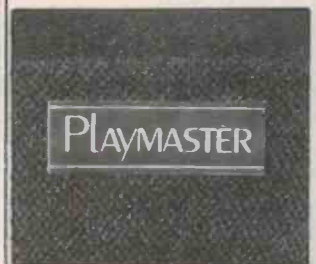
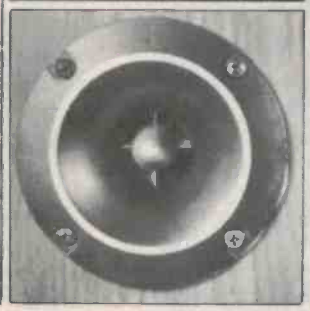
Another superb easy-to-build DICK SMITH KIT

$100's Cheaper than equivalent units!

look at the superb finish



The handsome design of the new 'Playmaster' logo adds a touch of class to your speakers. Superbly finished in silver on black background they help to give your speakers an appearance you'll be proud to show. SUPPLIED WITH ENCLOSURE KIT



A magnificent addition to our range of quality speakers, this superb tweeter is an ideal replacement for the tweeter in your speaker system, or as an addition to your Playmaster kit. They can be used with or without crossovers and will handle up to 40 watts continuous power rating. Cat C-2005

$12.95

PLAYMASTER

These high quality faders give you the control you need over the sound from your system. Dual concentric, heavy duty wire wound elements ensure proper loading of the crossover and amplifier at all times. One high and one mid-range fader is included in the 300mm System kit, but they are also sold seperately should you wish to upgrade your existing system. SUPPLIED WITH C-2042 SPEAKER KIT

Cat C-7210 .... Mid Range **$7.95**

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"... the new Playmaster 3-70L has generous power handling capacity so that it can give a good account of itself on virtually any type of music."

Neville Williams & Leo Simpson
(EA, March 1982.)

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DSE/A224/PAI

SOUND review

B&W DM12 mini-monitors

Have B&W managed to create a small speaker system with all the attributes of their famous 801 series? It seems a tall order for a so-called 'mini-monitor' system, but read what Louis Challis has to say about the result — the B&W DM12.

Louis Challis

THE DM12 loudspeaker system started out as a twinkle in the eye of the technical development section at Bowers & Wilkins, whose avowed aim was to produce a loudspeaker with some of the attributes of the illustrious 801 series but with a far more modest volume of only some 12 litres. The aim was to produce a mini-monitor system with a frequency response and acoustical output that justified its use as either a professional monitor or as a component part of a high-quality home installation, particularly where a larger and more efficient loudspeaker system would not necessarily be desired. This speaker was initially the smallest system produced by B&W, although since that time other even smaller systems have been developed.

The '12

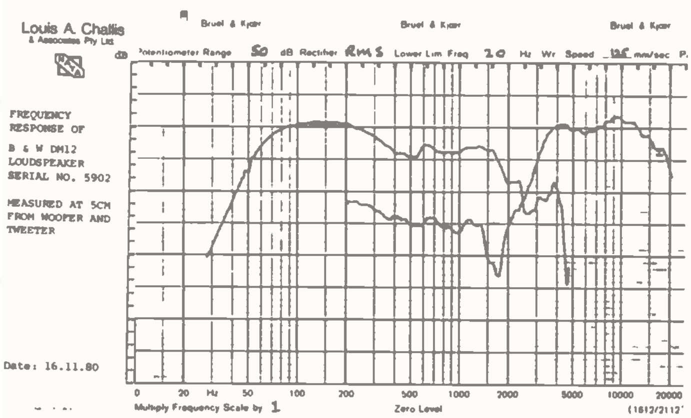
The DM12 features two drivers. The bass-midrange transducer, which is based on the DM150/12, uses a relatively small 150 mm diameter Bextrene cone supplemented by heavily damped PVA compounds to produce a relatively resonance-free diaphragm system. The modest 26 mm diameter high-temperature voice coil has a phenolic resin impregnated, foil-lined former to achieve a healthy power handling capacity from such a small driver. The voice coil is effectively isolated by the flexible surround so that minor structural resonances in the enclosure are substantially reduced, particularly when compared with more conventional drivers in similarly small systems.

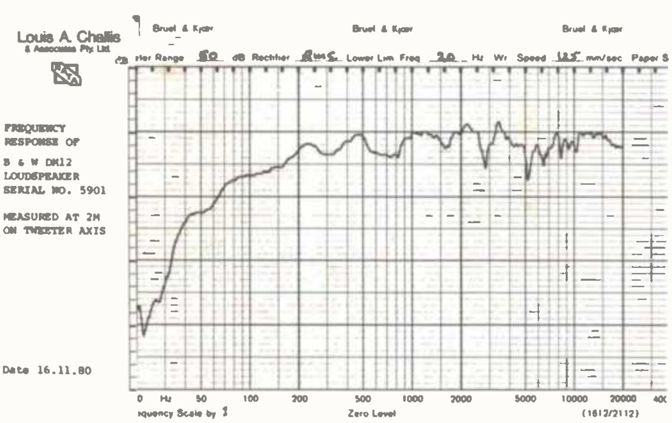
The high frequency driver is the well proven TW26. This features a 26 mm diameter polyester weave dome incorporating a 26 mm diameter high-temperature voice coil. The mass of this tweeter system is limited to a miniscule 300 mg, thereby ensuring excellent transient response and a frequency response that *really does* extend beyond 20 kHz.

Both the bass-midrange driver and the tweeter are recessed into the face of the speaker cabinet. Over this face is located a very carefully and sensibly designed front fascia panel. This features an internal foam surround in the vicinity of the tweeter to reduce diffraction effects and to improve the frequency distribution without significant reflections of the type that would otherwise result from the hard surfaces or the framing.

The base of the unit features an overload protection circuit described as an APOC ('audio-powered overload circuit'). This provides three-way protection against high transient signals, against prolonged thermal loading which would damage the voice coil of the drivers, and against dc signals which would cause the premature destruction of the loudspeakers. This circuit is completely automatic in its operation and as it derives its power from the audio signal, unlike the B&W 801s, it does not require changing of the batteries or any other attention such as resetting of the overload switch, which is essential with the B&W 801s. In the event of an overload the small LED indicator lights up and the audio power to the loudspeaker is dramatically attenuated. When the fault is removed the signal returns to its normal level. The indicator is located at the left hand bottom edge of the speaker and protrudes past the edge of the fascia panel so that it is visible over a wide frontal arc.

The cabinet on the units supplied featured a walnut veneer with a grooved inset located some 20 mm immediately behind the front fascia panel. The rear of the cabinet features two unusual, but very effective, spring-loaded colour-coded terminals which slide up and down to reveal 4 mm holes into which the bared ends of the cable are easily inserted. These terminals take up far less depth of cabinet space than would be required by conventional terminal blocks.





The manufacturers provide excellent documentation in the handbook with recommendations on listening room conditions and useful information relating to various mounting options and to the optimum configuration for effective listening in the average residential situation.

Supplementing this data is the frequency response graph for each speaker, measured under anechoic conditions. As I would have expected, this is performed with the time-honoured approach of using a long averaging time on the level recorder to smooth out the minor peaks and dips of the frequency response that all 'real' speakers exhibit. The DM12s incorporate internal crossover networks which are very carefully designed with components that are computer matched, and together with the APOC result in a substantial increase in weight when compared with the previous DM10 series loudspeakers, which are only approximately two-thirds of the weight.

On test

The objective testing of the DM12s proved that the manufacturer's literature relating to frequency response is essentially correct in terms of general shape, although obviously using a more conventional writing speed produces a more accurate presentation of the 'real' frequency response. This frequency response, as the level recordings show, extends basically from approximately 60 Hz to beyond 20 kHz with a ±6 dB deviation, and from 160 Hz to 20 kHz with a ±3 dB deviation. The low frequency response rolls over fairly smoothly, as would be expected from a sealed enclosure of this type. The off-axis response only varies slightly from the on-axis response, and the top end extends to beyond 15 kHz with only a slight change of output between 4 kHz and 7 kHz.

Subtle differences were apparent between the two loudspeakers tested, particularly for the on-axis frequency response, but they are not significant.

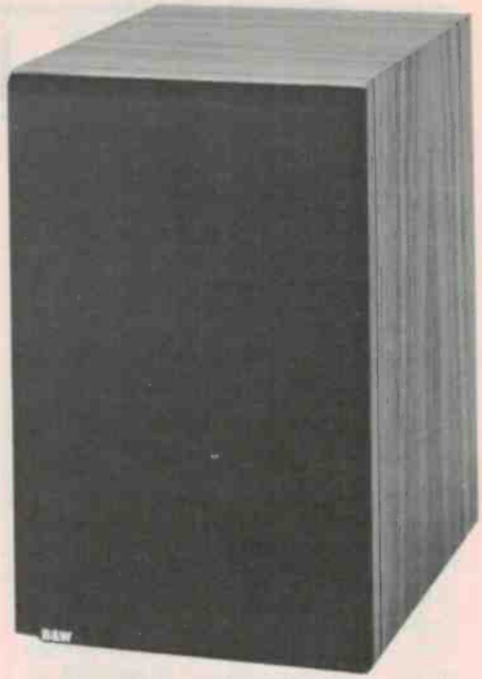
The phase response is particularly smooth and in the frequency region 200 Hz t0 20 kHz deviates by less than 180°. The manufacturers have obviously solved the phase relationship problem between the woofer and the tweeter, and their laser holography technique for optimising the speaker design shows itself to be effective and very successful.

The impedance curve of the DM12 reveals that whilst the lower level of impedance is just within the manufacturer's 8 ohm rating, the impedance follows the expected form by rising sharply at 10 Hz, at 80 Hz and again at 1200 Hz, with a peak impedance of 40 ohms.

This speaker system is well suited for paralleling with other speakers and would not create problems for a conventional solid state amplifier or even a valve amplifier.

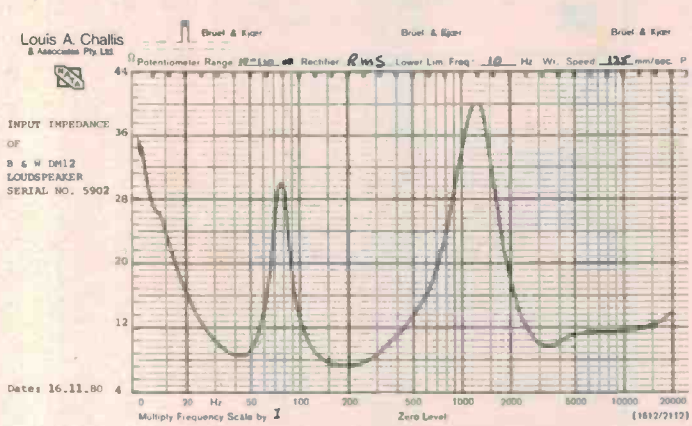
The overload circuit operates at approximately 100 watts peak level and performs its task extremely well. The distortion characteristics at the low frequency end of the spectrum are only fair, and at 100 Hz at a sound pressure level of 85 dB at two metres the distortion rises to 5.4%, whilst at 90 dB at 1 kHz and 6.3 kHz it is a far more modest 0.23% and 1.7% respectively. This increase in low frequency distortion is most probably the major limitation in the performance of the DM12.

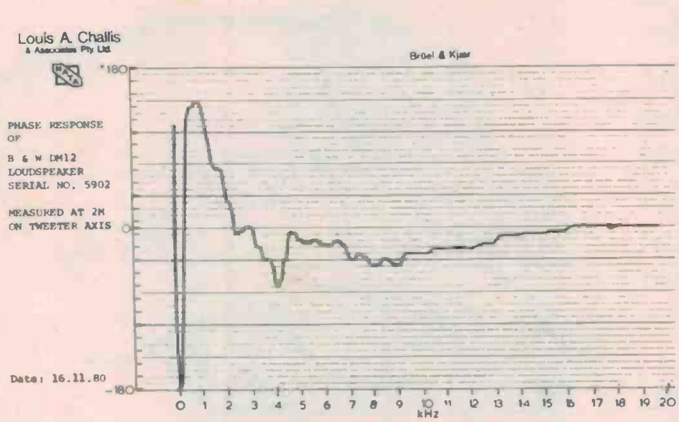
The tone burst response at 100 Hz and 1 kHz is good, whilst at 6.3 kHz it displays a residual level of ringing, which was enough to cause some apprehension as to the overall high frequency stability of the tweeter. A more exacting and detailed picture of the system's transient performance is presented in the decay response spectrum. This shows a significant ringing in the region of 3.5 kHz, which is just beyond the crossover frequency, with a smaller resonance 'fold' in the decay resonances in the 6 kHz region. Apart from these two resonances any other resonances are typically 20-30 decibels below the fundamental, and as such are little cause for concern. Beyond 6 kHz the transient response of the speaker is *impeccable* and has characteristics not unlike those displayed by the 801 series and some other notable speakers which we have recently reviewed.



Listen hard

The objective testing of the DM12s revealed that the system has some major attributes as well as some significant limitations. The subjective testing, which occupied two separate periods separated by some nine months, proved that the majority of the manufacturer's claims are achieved. We were fortunate enough during the latest testing to be able to play a number of new records. These include one of the latest CBS mastersound half-speed mastered ▶





recordings, 'Guilty', featuring Barbra Streisand and Barry Gibb (CBS 86122). This produced a performance from the loudspeaker which was exemplary.

On normal classical music and with singing of the quality displayed in the 'Guilty' record the speaker displayed characteristics which could justify the claim of its being a 'mini monitor'. In particular on tracks like 'Love Inside', written by Barry Gibb, the quality of the vocal and musical rendition from the electric guitar synthesisers and background vocalist is quite outstanding. By contrast, on another new record from Robin Archer, 'A Star is Torn' (from Trafalgar/Pretty Limited production ARM 5002), the initial narrative and commentary by Robin Archer reveal that the speaker is just not as good on straight speech as it is on music and singing.

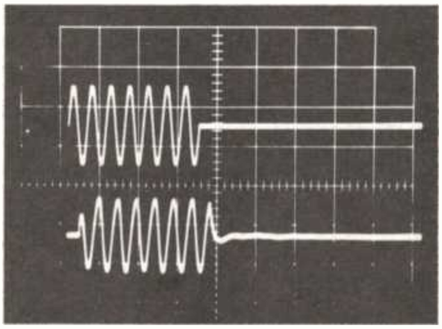
I heard Robin Archer perform live in concert immediately before I listened to this record and was able to made a direct and accurate comparison between her spoken voice as produced on a set of 801 monitors and then produced by comparison on the DM12s. The DM12s, whilst giving a good rendition, were not capable of presenting the same degree of fidelity as the 801 series speakers. The prime reason underlying this imperfection comes as a result of the resonance characteristics in the 3.5 kHz region as much as from the limited low frequency response. On most other music, including my favourite 'Trial by Torture' record from the Swedish Hi-Fi Institute (Ljud och hur det ska lata), the speakers revealed themselves capable of handling low frequency modulated signals in the 40-80 Hz region without cone break-up, although significant distortion was apparant at levels over 90 dB. On records like EMI's 'The Enjoyment of Stereo' (SCOM6), the speaker illustrates that it has excellent stereo imaging even though there is a trace of harshness, again in the 3-4 kHz region.

Summary

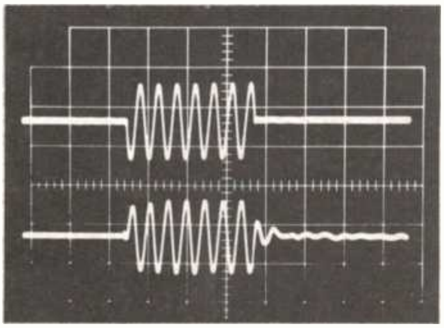
My overall impressions of the DM12 are that it has many attributes of the best of the latest B&W loudspeakers, limited only by its inability to produce very high levels of bass sound without audible distortion and significant colouration in the 3-4 kHz region. Apart from these features it would otherwise justifiably be able to claim the title of mini-monitor speaker system. B&W have produced an innovative little speaker system, but it lacks the panache and quality of the big brothers in the team. ●

B&W DM12 MINI MONITOR LOUDSPEAKER SYSTEM

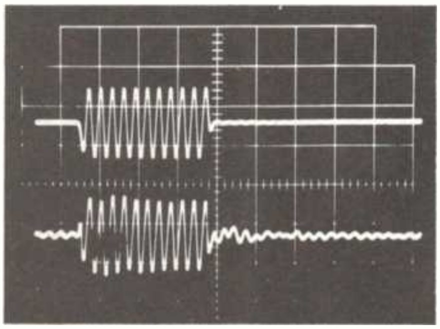
Dimensions: 355 mm high x 220 mm wide x 270 mm deep
Weight: 9.6 kg
Price: $675 rrp
Manufacturer: B&W Loudspeakers Limited, West Sussex, UK.
Distributor: Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088



100 Hz (20 ms/div.)

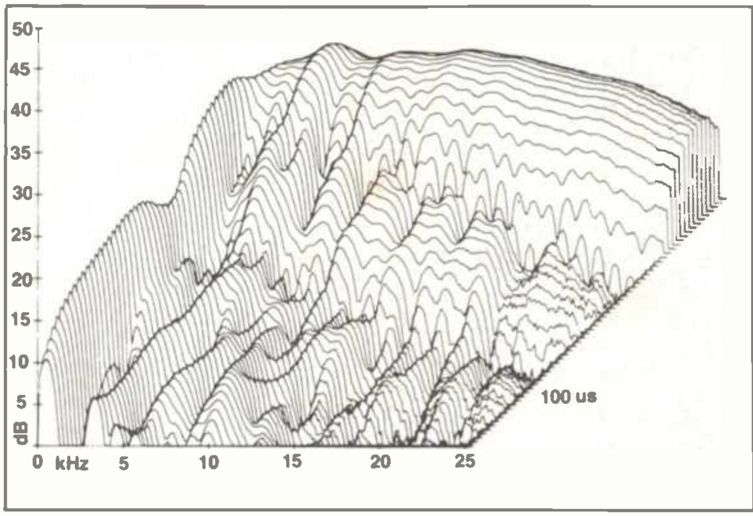


1 kHz (2 ms/div.)



6.3 kHz (0.5 ms/div.)

Tone burst response of B&W DM12 loudspeaker serial no. 5902 (for 90 dB steady state SPL at 2 m on axis). Upper trace is electrical input, lower trace is loudspeaker output.



MEASURED PERFORMANCE OF B & W DM12 LOUDSPEAKER
SERIAL NUMBER 5902

FREQUENCY RESPONSE: 80Hz - 20KHz

CROSSOVER FREQUENCIES: 3KHz

SENSITIVITY:
(for 90dB average at 2M) 9.1 VRMS = 10.3 Watts (nominal into 8Ω)

HARMONIC DISTORTION:

(for indicated dB at 2M)	100Hz (80dB)	100Hz (85dB)	1KHz (90dB)	6.3KHz (90dB)	
2nd	-31.8	-22.1	-72.7	-45.4	dB
3rd	-35.6	-29.3	-51.1	-39.8	dB
4th	-	-37.8	-70.3	-58.6	dB
5th	-50.8	-55	-65.6	-	
THD	3.1%	8.7%	0.29%	1.1%	

INPUT IMPEDANCE:

	100 Hz	13.5 Ω
	1KHz	34 Ω
	6.3KHz	11.2 Ω
Minimum at	200 Hz	7.2 Ω

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FOR SALE: Data terminal, large keyboard, approx 20 pc boards, barrel fan, large cabinet, 2 4004s, $120. Contact Andrew, 2 Webb St, Salisbury SA. ph (08)258-1302.

PRINTER, Base 2, Model 800, all options, 100 cps, $650. Memory board, Semcon 8K, $100. All in good condition. C. Stockdale, P.O. Box 871, Morwell Vic. 3840 or (051)67-1498.

SELL: OSI Superboard II, 8K RAM, power supply, manuals, books, Dabug, magazines, $250 ono. Phone Chris (02)939-7141 (ah.)

FOR SALE: SYM1 evaluation microcomputer system, complete with manuals, documentation and edge connector sockets. Just add +5 Vdc supply and it's ready to run. Excellent condition, $155. (03)870-4537 ah.

TELEPRINTER: RS232 Olivetti TE300 series. One working plus one for spares, with manuals, TRS80 cassette interface. $350. Phone Colin (02)498-4158 ah.

SELL: ZX80/81 8K ROM, 4K RAM, pwr supply, manuals, plus extra books and programs on tape. As new in orig. packing, bargain at $280. (08)271-5350.

ONE STRINGY FLOPPY drive for sale, vgc, for TRS-80, plenty of software, electric pencil with ESF patch, big five, etc. etc. Only $300 ono. Phone Frank (03)318-4297 ah.

ASR-33 TELETYPE and punch, gc, $200 ono. Teleray 3300 VDU 80*24 1200 bps, vgc, $200 ono. Pertec 6809 SBC, $150 ono. MSI 6800 SS50 CPU card with 2K monitor, $150 ono. Phone John (03)306-1464.

FOR SALE: ZX80 8K ROM, 4K RAM, power supply, 4K, 8K manuals, 4K ROM. Cost $475, sell $250. R. Kostecki, 12 Burdon St, Elizabeth Park SA 5113. (08)255-0647.

SELL: ZX-80, 16K exp, all bks, Space Invaders prog and other progs. Worth over $400, sell at $300. (03)489-5863, after 5 pm.

WANTED: 6800 evaluation kit, D2 or D3. Phone (02)399-3304 ah.

BALLARAT COMPUTER USERS' GROUP — meets on first Thursday of every month at the Hopetoun St Community Education Centre in Ballarat. Interested people should contact the Publicity Officer, John Preston, on (053)31-4363. Members are mainly hobbyists, with Apples, TRS80s, etc. Membership is $5, mainly to cover postage of newsletter.

2114 450 NSEC National RAM. 32 available, $1.70 ea or $1.50 ea in one lot (total $48). Add postage. U. Knop, 13 Want St, Parkes NSW 2870. (068)62-3359 ah.

2650 PLUS VDU, with 3000B dump/load, 11K RAM, many programs in machine code, microbasic. Calculator chip with microbasic, $300. Phone Orange (063)62-2819.

SELL: 4 memory modules for HP-41C calculator, $20 each. Ring S. Sidoti (02)660-5120 after 5.30 pm Mon, Tues, after 9.30 pm Wed, Thurs, Fri.

FOR SALE: DREAM 6802, as in EA June, July '79, slight modifications, works beautifully, $100. Ring S. Sidoti (02)660-5120 after 5.30 pm Mon, Tues, after 9.30 pm Wed, Thurs, Fri.

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DREGS

IT IS INDISPUTABLE that, from time immemorial, man has desired to quantify things. Almost nothing escapes the application of measurement. By now, though, one would have expected most units of measurement to have been well established, and that expectation is borne out as it is very rare to see a new unit defined and announced to the world.

Then came the **Lipshitz**. . . . the what?!

The Lipshitz. No, it's not a measure applied to the ramblings of certain types who frequent bars, pubs and clubs. Believe it or not — it's the **official unit of scuffle!** What's more, it's metric.

The Lipshitz is defined as the amount of wear on the central portion of a basalt pavement produced by one family in twenty years. One Lipshitz produces rounded corners on basalt cobbles with an apparent radius of curvature of about 2 mm. Useful, eh?

It is named after one Mose Lipshitz, an inhabitant of the Yave'el kibbutz in Israel who had a path from his front door to the street paved with basalt cobbles that was measured over a period of 18+ years.

Great. But what is it useful for? Thought you'd ask.

Using this standard an American archaeological geologist, Robert Folk, determined that a late Roman-Byzantine paved surface dug up in Tel Yin'am had a 'scuffle factor' of a half Lipshitz. From this, he was able to determine that it was probably a thoroughfare to a private room and not a public street.

Is nothing sacred?! Just think — in 5000 years from now they'll be making laser Lipshitz measurements of your bathroom tiles to determine how often you went in and out (and probably what you did!).

Courting war?

Court Acoustics, well-known London-based firm famous for their PA speakers and systems, are reported to have developed a PA speaker that is 'small, powerful and near perfect'. The new mini-system, called the Proflex, is so small that two speakers can be carried in a Mini — most PA speakers need a utility, at least. Despite their small size they can handle a kilowatt. Apparently the reproduction from the Proflex speakers is so realistic that the British Army has bought some! But why? Ah — that stems from a little demonstration Court put on at the Tokyo hi-fi show. Court freaked out Japanese audio buffs by reproducing the sound of Chieftain tank guns at such a level that unsuspecting listeners fell off their chairs!

Apparently the British Army lads believe that in certain situations they may be able to camouflage the speakers and blast out the sound of tank fire in order to trick a small enemy force into believing they're outnumbered.

Engineer Stephen Court, the man behind the Proflex system, is reported to have denied rumours that the IRA purchased a quantity.

Power you can taste.

Sony's new TA-AX5 amplifier with memory is a high fidelity feast.

Its multiple memory lets you create your own acoustic "flavours." Bass and treble tone settings, turnover frequencies, high and low filter are all programmable.

At a touch you can instantly recall the recipe for bittersweet country, hot 'n' spicy rock, or a well-seasoned Stravinsky. And electronic displays graphically show you everything the amp is cooking up.

Sony's Audio Signal Processor means that every function is touch controlled. This knifes through the usual maze of audio circuitry for a streamlined design of the future. Pure and simple, it sounds delicious.

The ideal companion for this tasty new amplifier is Sony's ST-JX4 synthesizer tuner. Why not make a reservation for two?

TA-AX5

ST-JX4

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