

AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY

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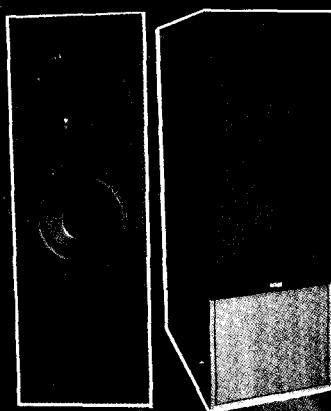
ELECTRONICS

FEBRUARY 1987

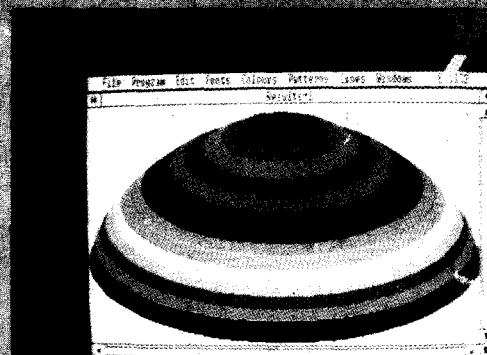
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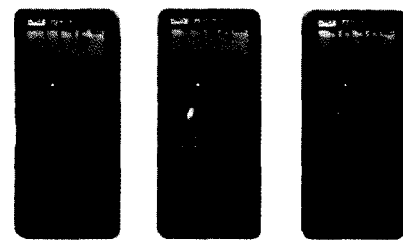
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Electronics Today

INTERNATIONAL

FEBRUARY
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FEATURES

Electronics in Western Australia	18
Business is coming out of the west	
ETI schools competition	24
The results and roundup	
Weather catastrophe	28
How we're affecting the climate	
Summer shortwave listening	66
Schedule of news from around the globe	
Buyers guide to modems	78
Features to look for and list of what's available	
Creating with electronics	90
The theory of amplifiers and oscillators	
Inside your computer	96
Speakers and screen	
pc board	104
Multilayered, multiwired . . .	

REVIEWS

Gallon performance in pint pot	70
Technics SB-R50 speakers	
The above-the-ordinary	76
Amstrad 1512 PC	
State-of-the-art in oscilloscopes	86
Philips PM3295	

PROJECTS

ETI-1616: 16-bit computer	41
ETI-1412: Stereo loudspeaker switcher	56
ETI-1408: Scan Audio hi-fi speakers	62

OFFERS

Subscriptions offer	108
----------------------------	------------

DEPARTMENTS

News Digest	4
Feed Forward	32
Sigh & Sound News	68
New Products	99
Advertisers Index	11
Dregs	110

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Innovation House, S.A. Tech Park

Another SA Tech Park success

The Electoral Roll Optical Scanner, EROS for short, inspired by SA Electoral Commissioner, Mr Andrew Becker, and developed by local engineers, CJ Abell & Co under contract to the Adelaide Innovation Centre, is poised to revolutionize many of the electoral offices in the world which use a similar electoral system to Australia: it gives them access to lists of non and multiple voters at elections.

To put the problem into better perspective, some 80,000 people in South Australia fall into this category.

At present it takes approximately 5000 hours, 500 staff and \$100,000 of public money each election to painstakingly scan electoral rolls for the non and multiple voters.

With EROS an entire electoral roll can be scanned in less than 24 hours — hence the tremendous interest in this new system.

EROS is unique in the world and the prototype, which took two years to design, is owned by the Adelaide Innovation Centre which plans to market

the system world wide.

Trials at the South Australian Electoral Department have proved so successful that the Department plans to install two machines at \$50,000 each for the next State election scheduled in 1989.

"The first election will virtually pay for the machines in savings on labour," Mr Becker said.

Simplified, EROS has two special lenses which simultaneously scan both sides of each page of the electoral roll and LEDs track the names of non and multiple voters.

The electoral roll number is noted and the information is sent for storage on disk which is linked to the Government Computing Centre. Then it is a simple task for the Centre to compile a list of names from the stored information on the disk.

Manually, this process usually takes the Department about six weeks to notify non-voters but with the aid of EROS the first notices can be processed within 10 days.

Operator interaction with

EROS is by means of an IBM microcomputer interfaced to the scanner which is capable of processing 9000 sheets per hour and involves searching 200 names on both sides of each sheet.

Overseas markets are being assessed and there is already considerable interest by electoral departments in other Australian States.

"We know that EROS performs brilliantly and now the task ahead is to attract buyers and more importantly, to see in which other areas this new technology and overall system could be applied," concluded Innovation Centre Manager John Taylor.

Further information contact **Mr J. Taylor, Adelaide Innovation Centre, Innovation House West, First Avenue, Technology Park, The Levels, SA 5095. (08) 260-8222.**

Computer fraud deterrent

For at least 10 years businesses have been terrified at the prospect of being robbed through computer fraud. And to make matters worse, there has also been that army of genius amateurs — the so-called hackers — who have been feverishly trying to break into computer systems, mostly just for the fun of it.

Now there is a new product on the market which the manufacturers claim will simply and effectively send frauds and hackers packing.

Would be computer cheats often access computer systems by telephone, quoting a password they have discovered by trial and error. They tend to ring from a public telephone system in their own home. A lot of passwords are easy to work out because they comprise someone's birthday or initials. Others are a bit harder.

A Melbourne-based computer company, Sendata, has launched Sendataguard

Prime Minister begins fibre race

OTC is now receiving tenders for the world's largest submarine optical fibre cable project. The OTC contract could well be one of the most lucrative communications contracts on offer anywhere in the world, and competition for the tender is certain to be fierce.

It will start with the Tasman 2 cable, scheduled for completion by 1991, and finish with a ring of cable stretching around the Pacific, from Australia to the west of the US, to Japan and back.

When the Pacific ring is complete, OTC will be the biggest single operator on the network. Together with Telecom's land lines, it will make Australia the world's fourth or fifth biggest user of optical fibre.

Given the size of the venture, it's hardly surprising that most of the world's communications giants are looking at the Australian scene with in-



terest. However, OTC seems committed to using the cable as the basis for a viable fibre optic industry in this country.

Just how seriously this is taken was evidenced by the fact that Prime Minister Bob Hawke was the keynote speaker at the ceremony to

mark the beginning of the tendering process.

Hawke is not known as the most technologically literate politician in Canberra, nor has he ever expressed much interest in the communications industry. However, the scale of the development is such that the industry could well develop into a significant employer and earner of foreign exchange.

He said: "The telecommunications industry is a powerhouse of economic growth. Over the last two decades, demand for communications has grown by 20% per annum. This exponential growth will probably flatten out, but all the same, Australians are expected to utilize 50 times our current international capacity in global communications systems."

The tenders are being announced earlier than would otherwise be the case, to allow tenderers sufficient time to make arrangements for local manufacturing, and to give contractors time to qualify any local manufacturing facilities or designs before the construction phase begins.

At this stage, firm favourites for the successful bid must include the two existing fibre companies, currently producing fibre for Telecom's land network. One of these is Optical Waveguides of Aus-

tralia owned by Metal Manufacturers, AWA and the US-based Corning Glass. According to Metal Manufacturers' Peter Robinson, talks have already been held with four of the biggest overseas fibre companies on the feasibility of a joint venture. These include STC, the US-based ATT, the French CIT Alcatel and NEC.

A major problem, still unresolved, is how much foreign ownership will be tolerated within the new industry. During a personal briefing after the presentation, Hawke refused to be drawn on the question, saying merely that Australia would continue to welcome foreign investment in the country.

However, he also said: "The balance of payments situation continues to be a major source of concern to the government. A significant component of this concern comes from the deficit in the Trade in Services, which last year totalled approximately \$4b".

It is also a major problem for the personnel within OTC considering the tenders. An offshore manufacturer along traditional lines is clearly not desired. However, it's difficult to see what inducements can be offered for local research and development, unless control of the company stays within Australia.



that password. However, if the caller is an international, using another phone than the one business is wanted, then the business has been trying to be secure in its computer system.

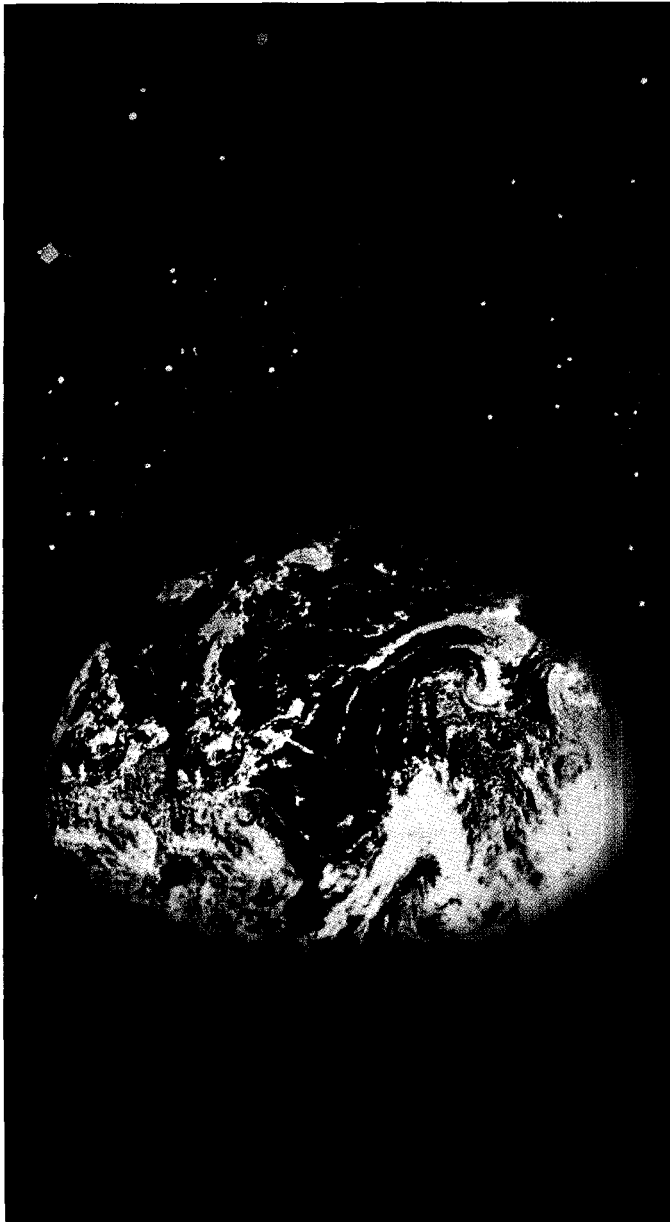
If the firm's computer system from the right phone is used, will be called back at night, another password will be needed. But the system is not the system.

But if it is not the system, says Jim Chappell, managing director of Sendata. He says the and "it's like the security from the safety of a secure location. It's not a system, even pointless to play it, break into the business, and there's just no need for it. So we're very confident that Sendata is going to be a success."

Sendata required a company to be bought separately, and it is restricted to users with low data computer equipment. In fact, according to Chappell, there's no compatibility in the system with this product.

For further information contact Ray Andrews, Ray Andrews & Associates, 63 Market St, South Melbourne, Tel: 03 690 2788.

which tells telephone callers who can correctly enter the appropriate password that it will call them back. Sendata-guard then immediately telephones the number filed with



Another comet

Comet-watching seems to have become something of a cult spectator sport over the last couple of years.

First there was the photographing of Comet Giacobini-Zinner in September 1985. Then we had the return last year of Comet Halley, with all its fanfare. And now, in late April, those of us in the Southern Hemisphere will be able to observe Comet Wilson, discovered last August by Christine Wilson of the California Institute of Technology.

Comet Wilson was first observed when it was about 512 million kilometres from the sun. Initial calculations indicate that it should come within 160 million kilometres of the sun on April 20-21, before returning to the outer regions of the solar system. Shortly after its closest approach to the sun, the comet will be within 90 million kilometres of the Earth and visible to the naked eye. It is known to be about as large as Comet Halley and is expected to be about as bright.

New QLD headquarters for IBM

More than 120 staff from IBM Australia's Queensland operations have moved into the new IBM Centre in Edward St, Brisbane. The 16-storey building, constructed on the site of the Old Trades Hall, replaces IBM's previous headquarters of 18 years in Brunswick St, New Farm.

The IBM Centre took 15 months to build and has panoramic views over much of the city, which is taken advantage of by the inclusion of two glass-fronted lifts.

IBM's Queensland branch manager, Kevin Dwyer, said the building was located on the fringe of the city in an expanding professional office area.

"These new offices are among the most advanced in Australia, using computers not only for office applications but to ensure maximum energy efficiency throughout the building," he said.

"The air conditioning adjusts automatically according to the ambient temperature. Solar reflective glass has been used for the building's exterior wherever possible to increase natural light on every floor."

The centre has been fitted with new furniture which can be adjusted to suit the needs of each individual. Managers' glass-fronted offices are lo-

cated in the centre of each floor, while other staff occupy workstations near the windows to take advantage of the natural light and the extensive views.

The IBM cabling system has been installed to reduce the cost and complexity of installing or moving computers and terminals within the building, and all staff use ROLMphones which are controlled by a ROLM CBX II (computerized branch exchange).

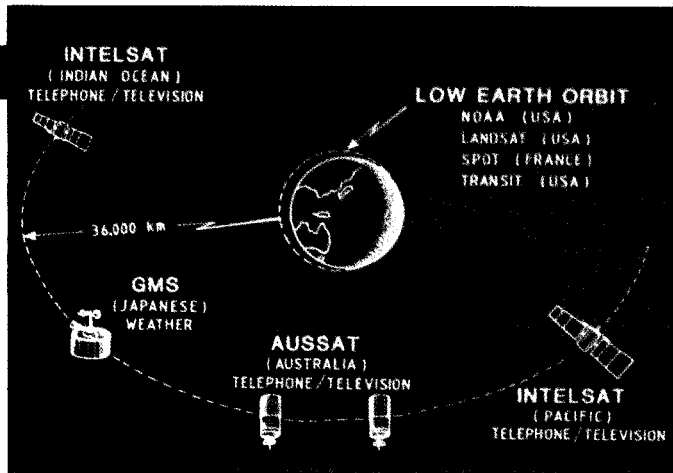
The new centre also incorporates a range of facilities to maximize customer service and support. It specializes in the small and intermediate range of products and associated application software, providing marketing and technical support to IBM customers.

A guided learning centre (GLC) has facilities where customers and IBM staff can be trained in the use of computer systems and conduct system software tests. GLC users can undertake self-education courses and make use of sophisticated audio visual equipment and IBM's technical library. The centre's computing facilities are available to customers who have an IBM System/36, System/38 or 4361 to assist in pre-installation activities.

In addition to the education and seminar facilities, the centre also has a comprehensive spare parts store which contains almost \$2 million worth of parts and accessories for IBM systems.



The new IBM Centre, located on the site of the Old Trades Hall in Edward St, Brisbane.



Two basic types of weather satellite are used for measuring atmospheric, ozone and other effects surrounding our globe: those in geostationary orbit and those in polar orbit. Courtesy COSSA.

NASA finds ozone 'hole'

Recent analysis of data collected by NASA over the last six years has provided strong evidence that ozone is disappearing from the stratosphere over the Northern Hemisphere and leaving a 'hole' over northern Europe.

The work, conducted by Donald Heath of NASA's laboratory for atmospheric studies, strengthens the case against

making products containing chlorofluorocarbons (CFCs) which remove ozone from the atmosphere. Already, several countries including the US and Canada have banned the use of CFCs in aerosol sprays, but now there is a considerable push for an overall reduction in worldwide production of these gases.

It is the ozone in the upper atmosphere that protects us, and our animals and crops, from harmful levels of ultraviolet light. Ozone is consumed by chlorine, and that's the

problem with CFCs: they raise the chlorine content of the stratosphere. Recent research suggests that CFCs also contribute to the warming of the Earth, known as the greenhouse effect.

Last December negotiations began in Geneva between the US and the EEC to limit CFCs. It's a move that's been applauded, even by some of the industrial giants.

The DuPont company, which invented a popular form of CFC called Freon, has suggested that worldwide production of the gases should be restricted by international regulations. The company says that the industry could find substitutes for all applications of dangerous CFCs within five years. Indeed, some have already been developed. For example, the CFCs that provide coolant for refrigeration could be replaced by another type of CFC, DuPont's F-22, which is less harmful to the atmosphere.

The new research by Donald Heath, which is based on data from an instrument

aboard NASA's Nimbus-7 weather satellite, reinforces the suspicion that the Earth's protective layer of ozone is not as uniform as was once believed. In the Southern Hemisphere, at certain times of the year, there is a virtual hole in the ozone layer over Antarctica. The decline in atmospheric ozone in the Northern Hemisphere is similar to that over Antarctica, but not as deep. Centred over Spitzbergen, halfway between Scandinavia and the North Pole, it extends across Northern Europe to Leningrad and shows up geographically as a cavity. The average annual decrease in ozone over the past six years has been around 1.5 to 2 per cent, with the largest declines in February and October (2.6 and 2 to 2.2 per cent respectively).

According to Heath it is too early to blame CFCs alone for the decline in ozone. Other factors such as the polar vortex (a large cyclonic pattern in the troposphere) or volcanic eruptions may also be contributing to the variations in ozone levels.

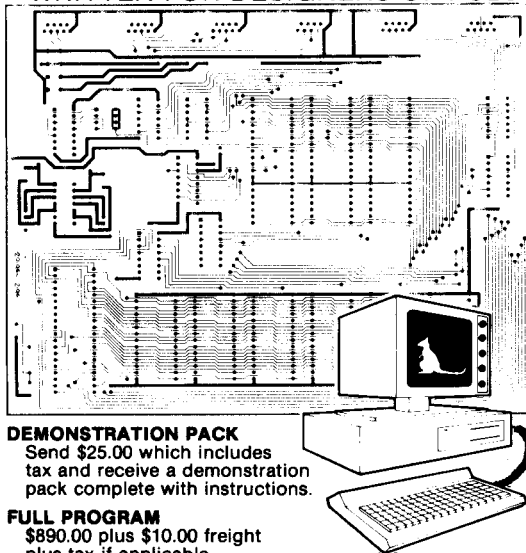
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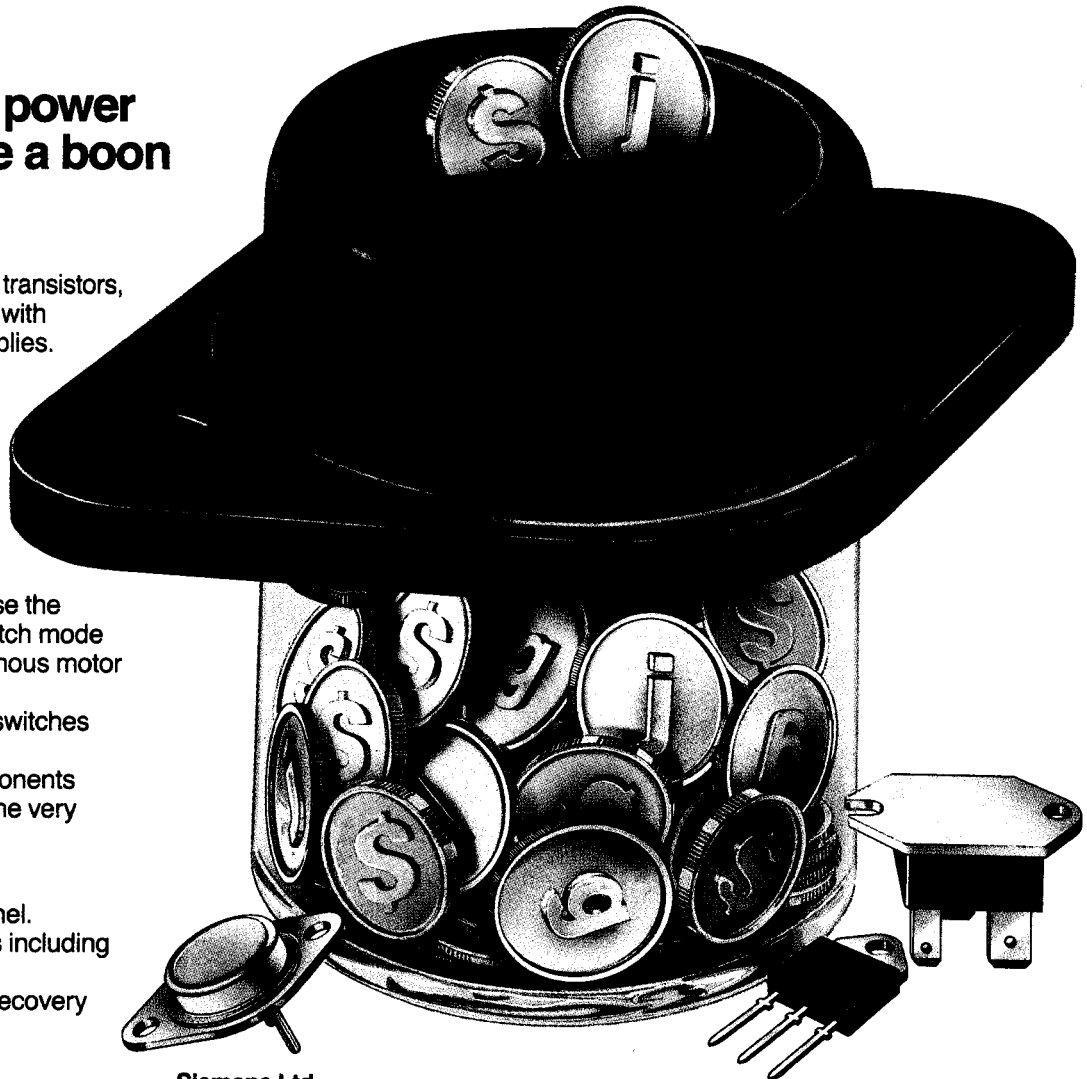
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Siemens. A higher technology

Webster Spectrum to assist ferries on Sydney harbour

The Urban Transit Authority of the NSW State Transport Department has installed an Australian Webster Spectrum minicomputer to assist it maintain a maximum safety watch and passenger service on its 24 ferries and five hydrofoils that operate within Sydney Harbour.

The Spectrum MD23LTY6, designed and manufactured by Webster Computer Corporation will schedule all docking, maintenance and overhaul periods of the diversified fleet to ensure that the vessels are always in a safe and peak efficient condition.

Special modules of the Mainman single-entry general business manufacturing software from Scientia of Sydney are being specially adapted by the UTA to its requirements.

The computer will monitor service periods for each vessel, to ensure maintenance times for major components within the times recommended by their manufacturers. It will also schedule complete overhaul periods.

The computer will also automatically prompt all safety checks required by the State Government and Statutory Survey Regulations. This includes such items as the length of time a vessel can be in the water before it goes to

dry dock, specified times when shafting and propellers must be repaired, and when all underwater areas of each vessel should be checked for watertight integrity.

An inventory section, currently being fed in, will keep track of all stock control, spare parts and how these are stored, enabling forward ordering control from UTA suppliers worldwide, monitoring

the delivery status of order, costs and transport details.

Management reports of total costing of all inventory, forward ordering and forward ordering breakdown will be available at any time. Likewise an itemization in dockyard maintenance hours on all work carried out will produce efficiency reports and highlight where most staff are needed for specific service

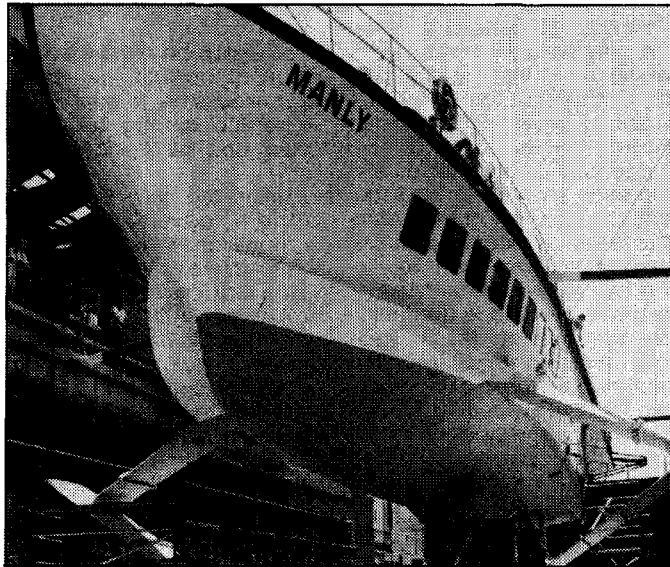
functions.

The total hardware cost \$44,263 and included the Spectrum (it has 60 Mb of fixed storage, a one Mb memory and back-up options of tape and floppy disc), six VDUs and three printers including one laser.

These will be distributed between the UTA's Balmain headquarters, storeroom and adjoining dockyard, the Department's Macquarie Street office, and Circular Quay depot whose reports have been manually delivered each day.

Additional software purchased includes Satsum word processing, database and spreadsheet, which the UTA is using for its management reports, maintenance and scheduling and the writing of new ferry specifications.

The computer purchase six months ago follows the UTA's move last November into its new \$3 million-plus Balmain headquarters. It is part of a campaign to streamline administration to increase its standards, patronage and profitability with the ultimate goal of expanding its vessel chartering and dry dock and machinery servicing to compete with private enterprise.



The hydrofoil 'Manly' in dry dock at the UTA's Balmain dockyard in Sydney. The recently installed Webster Spectrum minicomputer will automatically prompt future vessel safety checks, including the length of time in the water before drydocking.

Telescopic deal

It's now five months since we heard the first mootings that Australia might take up an offer of a half share in the important British Schmidt Telescope located on Siding Spring Mountain in New South Wales. But it seems starry-eyed deals such as this are fraught with complications and a definite decision has yet to be made.

The Schmidt Telescope, built by the Royal Observatory of Edinburgh in 1973, is one of the world's leading telescopes for taking photographs of wide regions of the sky. Its main purpose is to take wide-angle shots that can be studied later to pick

out interesting objects. Indeed, the telescope has been responsible for several important achievements including the discovery of many very distant quasars.

The Schmidt Telescope shares its site, but not its administration, with the Anglo-Australian Telescope (AAT), which is one of the world's largest reflecting telescopes. The AAT is administered by a board of scientists from Australia and the UK, and it is this board which is interested in merging operations with the Schmidt.

The Schmidt and the British half of the AAT are funded by Britain's Science and Engi-

neering Research Council (SERC). SERC has made the offer to Australia primarily as a cost-cutting measure. Just how much Australia would have to pay is unclear, but present running costs alone are around \$900,000 per year. In addition there are costs at Edinburgh, notably for storing and analyzing the large photographic plates produced from the Schmidt.

Naturally enough, the Edinburgh astronomers are worried that if the merger goes ahead the plates may remain in Australia. But SERC says it is committed to maintaining its measuring and library facilities in the UK and

that no jobs there would be lost. It also says that the deal would not automatically halve Britain's use of the Schmidt. It is currently used by British astronomers for only about 60 to 70 per cent of the time, the council points out, with a number of other countries taking up the remainder.

However, negotiations with Australia are still at a very embryonic stage so just what will happen, if anything, is up in the air. The AAT board is due to meet again within the next couple of months, so hopefully the situation will be clarified then.

New rule for TV ownership

The Government's recent decision to replace the 'two station rule' which prevented any person from holding a financial interest in more than two commercial television licences will help to alleviate the present domination of commercial television by Sydney and Melbourne, according to Communications Minister Michael Duffy.

Mr Duffy said the old rule, which operated for the past 20 years, was inequitable as it ignored the differing financial strength of licensees. "It counted Mount Isa as one station and Sydney as one station, even though the populations served by these two stations differ vastly," he said. "Instead of this unfair and anomalous rule, we have decided upon a new rule which takes account of the populations served."

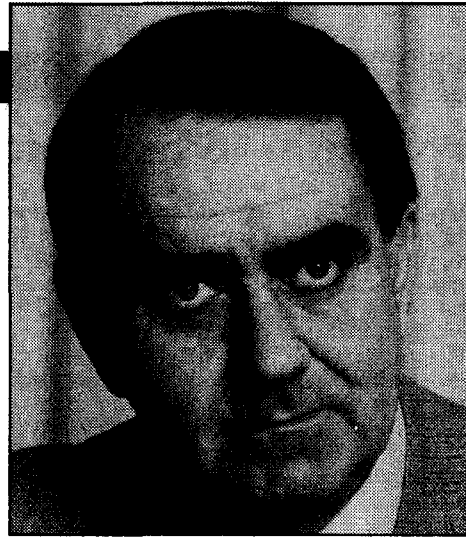
The effect of the new rule will be to limit the reach of any one television station owner to 75 per cent of Australia's population. Mr Duffy

pointed out that licensees will face competition in every market. They already do so in metropolitan markets, and the same situation will apply in regional markets under the Government's equalization policy.

"We believe this new approach will be widely supported by the industry and consumers alike," Mr Duffy said. "It will not only stimulate investment but will also give regional stations greater influence over programming decisions."

Mr Duffy said the change in the regulatory environment would assist the equalization of commercial television services by providing scope for those prepared to back their judgement and invest in new regional markets under the equalization of commercial television services indicative plan. However, licensees in the four newly approved markets who elected to use multi-channel service (MCS) permits rather than aggregate directly would remain under the two station rule, as would those with prescribed interests in such licences.

Mr Duffy said that if compe-



Communications minister Michael Duffy.

titution was to be enhanced, an essential part of the reform plan would be to limit cross-ownership among television, radio and newspaper interests.

"Lifting the two station rule would adversely affect competition if it simply allowed interests to own a television or radio licence and a newspaper in the same area and thereby have an exaggerated influence over local affairs," he said.

For this reason the Government has decided, in principle, to regulate cross-ownership of the media in Australia.

Such regulation would prevent a person from buying a television licence to serve an area in which he or she for example, already owned a licence for a monopoly commercial radio station or owned a daily newspaper whose main circulation was in the same area.

The Government does not intend to penalize those who have acquired their licences under existing rules, Mr Duffy said. However, future acquisitions of an interest in a television licence will require the new owner to conform to the cross-ownership test.

Group challenge to IBM

If the giant of the computer industry, IBM, has any vulnerability it's in the area of office systems where several users share a computer. That's the view of 10 smaller computer companies from Europe and the US which have joined together to challenge the huge multinational.

The gang of 10 has its sights set on customers who require a mini-computer or powerful micros capable of handling several terminals simultaneously, such as banks, supermarkets and professional offices. The companies involved — Digital Equipment, Hewlett-Packard, Siemens, Ericsson, ICL, Nixdorf, Philips, Olivetti, Unisys and Bull — recognize that this area accounts for only a small part of the world computer mar-

ket. But since that presently stands at \$100 billion annually even a tiny share would bring huge profits.

However, even in this area of office systems IBM has a formidable foothold. None of the 10 companies would be able to challenge it on their own, though they are hopeful that their combined efforts will have considerable impact.

The companies' assault on IBM is being based on software called Unix, which was developed by AT&T and has been available for some time.

Unix has gained a reputation of being, theoretically, an ideal operating system for multi-user and multi-tasking applications (ie, where there is more than one operator and where more than one program needs to be worked on at a time). However, the system has not gained the widespread popularity that it otherwise might, due to a

lack of applications programs. This situation has been brought about because there are several Unix standards and software writers have been wary of writing programs that cannot easily be switched between machines. Hardware manufacturers, too, have been deterred by the lack of a standard for Unix.

Calling themselves X/Open, the 10 companies have solved the problem by agreeing on a standard version of Unix. As well, they have been working for the past two years on a piece of software called the Common Applications Environment (CAE) which will ensure that Unix applications programs written for any of the X/Open computers will work on the others. These two moves, combined with a publicity campaign aimed at persuading software companies to write programs for X/Open machines, will, they hope,

create a sizable market for their products.

So far none of the 10 firms has produced any computers that work to the X/Open standard, though they are all committed to doing so this year.

They have established a \$15 million kitty to fund X/Open group activities. One such operation will be the setting up of a centre near London's Heathrow Airport to help software companies to translate, or 'port', their programs for use on X/Open systems. The group will also soon demonstrate various of its computers working together at the EEC offices in Luxembourg.

The X/Open group forecasts that the world market for the Unix systems is around 4-5 per cent of the \$100 billion spent annually on all systems and that its annual growth will be in the region of 50 per cent, at least in Europe.

ADVERTISERS' INDEX

Applix	40
Baltec Systems	93
Centre Industries	80
Control Data	51
Dick Smith Electronics	48,49
Duet Electronics	89
Elmeasco	IFC
Emona	102
Energy Control	93
ES Rubin	100
ETI Binders	75
ETI Book Sales	84,85
Geoff Wood Electronics	23
HST Industries	7
ICOM	93
IEI	81
ICS	51
Jaycar	52,53,54,55
Jesec	35
Morris Productions	107
Pennant Consulting	89
Penn Central	30
Precision Graphics	106
Pre-Pak Electronics	95
Quantum	89
Ritronics	34
Rod Irving Electronics	12,13,20,21,34
Rosser Communications	83
Scan Audio	61
Scientific Devices	35
Scope Laboratories	IBC
Siemens	8
Sprague Electric	89
STC	74
STC Cannon	74
Technics	31
Telecorp	82
Temple-Smith Aust	11
Truscott's	93
Wireless Institute Australia	103
Yamaha	OBC

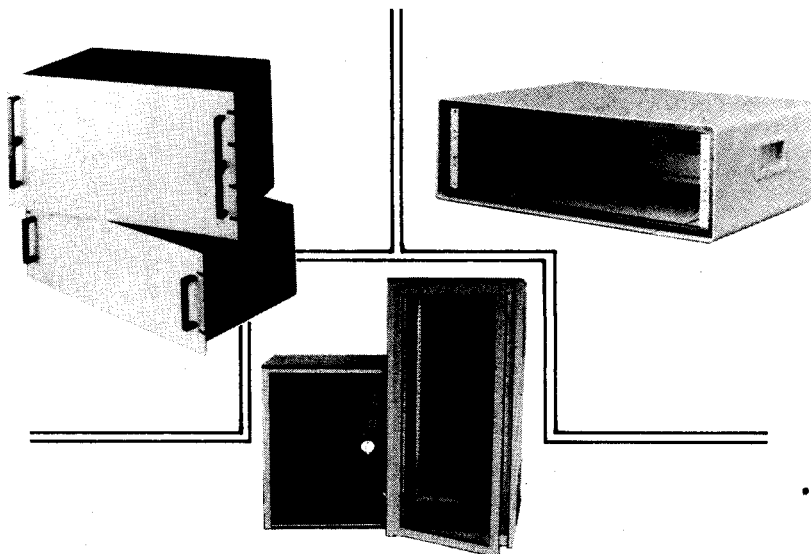
Govt centres for innovation

A national network of centres to develop innovation and entrepreneurship in Australia was officially launched in Canberra recently. The launch coincided with a major conference organised by the Department of Industry, Technology and Commerce, which involved leaders in innovation, technology, commerce and marketing from around Australia.

The conference focused on the role

the network can play in assisting industry to better capitalise on the current economic and technological climate by moving into more profitable areas of production. Keynote speaker, industry minister Senator John Button, sees the establishment of the Australia-wide network of 'Innovation Centres' and 'Centres for Development of Entrepreneurs' as a major step forward for Australian industry. "It is a central part of the Federal Government's strategy to promote improved international competitiveness among Australian enterprises," he said.

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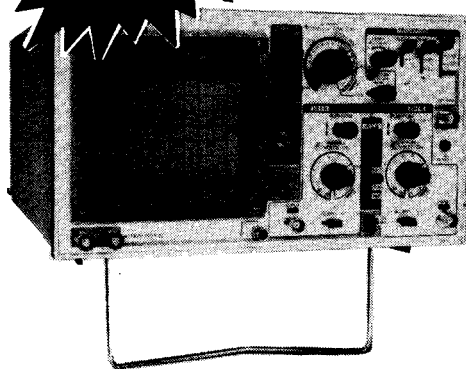
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Acceleration potential: 2KV

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Sweep Magnifier: 5 times (5X MAG).
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X-Y Operations: CH-A: Y axis. CH-B: X axis Highest Sensitivity: 5mV/div.

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Component Tester: Max AC 9V at the terminal with no load. Max current 2mA when the terminal is shorted. (Internal resistance is 4.7K ohm)

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BANDWIDTH: DC - 1MHz MAXIMUM INPUT VOLTAGE: 50V (DC + AC Peak)
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Power Requirements: AC: 100, 120, 220, 240V 20W
Weight: 7kg approximately.
Size: 162(H) x 294(W) x 352(D)mm.

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CIC6 6 conductor computer interface cable. Colour coded with braided shield. (to IE422 specifications).
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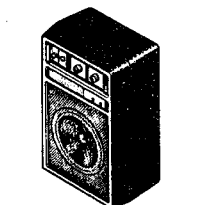
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Supply Voltage: 5 - 15V DC
Supply Current: 200uA typical
Max. DC Input Voltage: +20V
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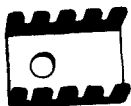
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Its size and simplicity makes this mixer very portable and easy to operate.
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Receiver: 5.0 (at -73dB)
Impedance:
Transmit: 500
Receiver: 5000
Cat. L19990 (Transmitter) **\$4.75**
Cat. L19991 (Receiver) **\$4.75**



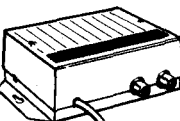
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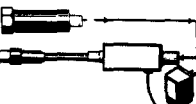
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With pins for easy board insertion.
Cat. C10170 1-9 10+
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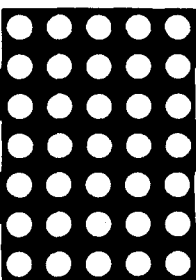
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Cuts 150-180MHz signals interference.
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Reduces loss from splitters and long cable runs. Suitable for use with antennas, coaxial feed lines and VCR's. A/C adaptor included.
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Adaptor (included)
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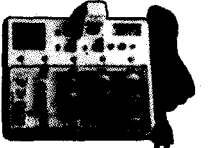
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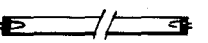
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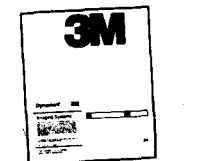
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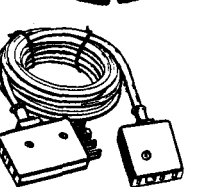
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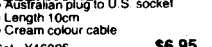
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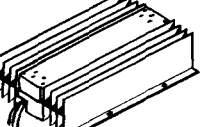
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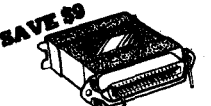
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Built on to a heavy duty aluminium heatsink with 7amps. Ideal for trucks and boats.
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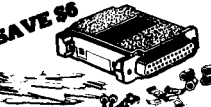
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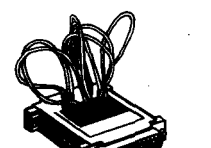
RS232 GENDER CHANGERS
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• All 25 pins wired straight through
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Cat. X15651 Male to Female
Cat. X15652 Female to Female
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Our Price \$14.95



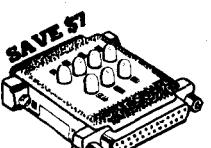
RS232C NULL MODEM ADAPTOR
• Converts RS232C connections
• Pins 2 and 3 reversed
• All 25 pins connected
Cat. X15657 Male to Male
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RS232 MINI PATCH BOX
• Interface RS232 devices
• 25 pin inputs
• 25 leads with tinned and supplied
• Complete with instructions
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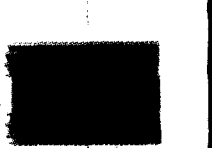
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• Male to female
• 25 Detachable plug on leads
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• Ideal for experimenting or temporary connections
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Normally \$35.95
SPECIAL \$29.95



RS232 MINI TESTER
• Male to female connections
• All pin wired straight through
• Dual colour LED indicates activity and direction on 7 lines
• No batteries or power required
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D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
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25 pin D-sub to 50 pin "D" socket
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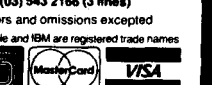


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Software

Two new computer software packages for the design of electronic circuit boards and custom microchips launched recently were designed under a Government Industry research and development contract placed with the Royal Melbourne Institute of Technology (RMIT) and the University of NSW (UNSW).

The software package developed by RMIT is targeted at companies requiring the capacity to design electronic sub-systems using printed circuit board, hybrid, gate-array or standard cell methodologies. The software package developed by UNSW is targeted at companies requiring full custom chip design solutions.

The RMIT package is capable of running on an IBM PC/XT or AT. The UNSW package requires a computer workstation of the power of a Labtam 3015/V32 for effective real-time performance. Both software suites are substantially technology independent and include highly sophisticated simulation, automatic routing and capabilities for user-generated circuit libraries.

Following the evaluation of tenders, the Department has selected Engsoft Pty Ltd, a Ballarat software development company, to be the main licensee to distribute the packages in Australia and overseas.

High tech ad agency

A full service advertising agency has been established in Sydney to cater specifically for high technology companies. Called Advanced Technology Advertising, it is the brainchild of entrepreneurial electronics designer-turned headhunter, Colin O'Brien, and will be headed by Garnet Meekings.

ATA is a sister company to O'Brien's existing enterprise, Advanced Technology Recruiters, a high technology recruitment consultancy.

O'Brien believes that most mainstream agencies are unable to provide the specialist services that high tech-

nology companies need. According to him they simply do not technically understand high tech products and their markets.

"We've selected our personnel very carefully to maximise our expertise in both technology and advertising," he said.

O'Brien's technology background is complemented by the extensive advertising experience of Meekings, who has held senior advertising management positions in high technology companies, including Philips (communications) and Utilux (electrical and electronic components).

ATA is geared to provide complete advertising and promotional services, including product launch management, audio visual production and public relations.

"Our high-tech clients often have special needs which require both unusual promotional solutions, and a high degree of technical understanding," said O'Brien. "So our agency offers a range of services beyond normal advertising programs."

ATA is currently servicing clients in fibre optics, data communications and electronic test equipment.

For further information call **Garnet Meekings on (02) 959-5015.**

CSIRO research crucial

CSIRO research is crucial to the technological renaissance of Australian industry according to the organization's new chairman, Mr Neville Wran.

Mr Wran, who resigned in July as NSW premier and federal president of the ALP, took up the position of part-time chairman of the CSIRO Board last December.

"The Board's primary role will be to align CSIRO's research priorities closely to national objectives," he said. "If Australia is to survive economically it must develop manufacturing and service industries as competitive and innovative as its agricultural and mining sectors. CSIRO's research is crucial to achieving



The new chairman of CSIRO, Neville Wran.

this objective."

Mr Wran acknowledged that the organization has already contributed billions of dollars a year to the country, both through the generation of income by primary industries, which it has assisted over many decades, and through savings that have flowed from its research in public health, environmental protection and resource management. It is also playing a leading role in introducing new technologies to existing industries and in the development of new industries based on space technologies, biotechnology, advanced materials and advanced silicon chip design.

"CSIRO is one of the world's most highly regarded national research organizations, and one of Australia's most respected public institutions," he said. "The task of the new Board will be to ensure that Australia gets the greatest benefit from this excellent resource."

New improved home shopping

Home telephone shopping for people living in south-east England has acquired a fresh dimension with the introduction of a British Telecom ordering service that centres around a new free-of-charge consumer magazine, *Boulevard*.

Instead of calling individual

shops to request advertised items, customers choosing goods from the magazine can telephone a central British Telecom bureau where staff with desktop computers will place the orders with the appropriate stores.

Customers will receive their goods either the same evening or the next morning, after giving their credit card details. Orders can be taken around the clock for goods which, in the first issue of *Boulevard*, range from lingerie, wine and cameras to the chance to test drive and buy a car.

The 350,000 homes receiving the magazine, which carries articles on general subjects as well as featuring advertisements, have been chosen from among likely customers for shops taking part in the scheme. These include the well-known stores of Selfridges and Harvey Nicols, the tobacconists Dunhill, the fashion specialists Janet Reger, and Oddbins which runs a string of wine and spirit shops.

Six issues a year of *Boulevard* are planned for areas in London and the south-east, although delivery of goods can be undertaken in other parts of Britain.

Boulevard editor David Smith said that the service was aimed at busy people who would normally be personal customers of the stores advertised but who did not always have time to visit them.

Infrared quasar

A team of US astronomers, surveying infrared sources detected by the IRAS satellite, believes it has discovered a previously unknown type of quasar which could lead to considerable advances in our knowledge of the origins and evolution of galaxies.

A quasar is the energetically active central region of a distant galaxy. Some 3500 quasars have been identified, showing a characteristic peak of energy in the ultra-violet part of the spectrum. The 'new' quasar, known as 13349+2438, emits 90 per cent of its energy in the infrared.

The discovery was made

during a search for faint stars known as 'brown dwarfs' in our own galaxy, conducted by astronomers from the California Institute of Technology, the US National Optical Observatory and the University of Arizona. One of the objects they picked out had a red shift of 0.1, equivalent to a distance of about a billion (10^9) light years from Earth and well beyond the Milky Way.

This 0.1 red shift is comparatively small. The largest recorded shift was over 4, or equivalent to a distance of more than 10 billion light years. However the discovery of 13349+2438 is important due to the nature of its radiation, which peaks at a wavelength of about 25 micrometres and has similarities to the radiation from the class of active galaxies known as Seyferts. Many astronomers have postulated a relationship between quasars and Seyferts, but the links have been obscure. The discovery of the infrared quasar may provide some answers.

Quasar 13349+2438 has a star-like appearance which the American astronomers explain as an effect of dust surrounding the central active core of the body. It may be a typical phase of quasar activity, and the better known appearance of quasars as optically bright bodies emitting strongly in the ultraviolet may simply correspond to a later stage in a quasar's lifetime when the dust has been blown away by the activity in its core.

It certainly seems likely that 13349+2438 is behaving in a way typical of all quasars at a certain stage in their evolution. No one has previously looked for quasars that are active in the infrared and there may well be many more of them waiting to be discovered.

\$1 million gift for AI

Deakin University has received a \$1 million-plus gift of equipment from Rank Xerox to set up a world class artificial intelligence labora-

tory within the school of sciences.

The gift is the largest received by the university. The equipment donated includes state-of-the-art computer hardware and software, which will be used to develop software tools for commercial, educational and investigative needs for both the home market and overseas.

Artificial Intelligence (AI) is the technology of making computers act with something akin to the human thought processes of evaluation, interpretation, reasoning and decision-making.

According to Deakin's Brian Garner, Foundation Professor of Computing, exports will come from three areas. Firstly, the laboratory will offer consulting services to commercial and industrial enterprises to refine or develop software environments and applications suitable for export. The second area would be the development of export-oriented software products such as expert systems shells and a range of software tools to enhance the attractiveness of the Xerox environment. And thirdly, there is the largely undiscovered area of developing knowledge bases which capture the knowledge of experts and make it available and understandable to novices.

"For example, the laboratory could provide a knowledge base used by, say, a specialist mechanic or electronics engineer in diagnosing a complex vehicle problem that could become a useful tool for all garages to implement," Professor Garner said. "We expect to be developing multiple knowledge bases or expert system shells that will find a ready market in both domestic and overseas environments."

In announcing the grant, which will comprise hardware, software and continuing support services, David Stringfellow, managing director of Rank Xerox in Australia, said that while Deakin was Australia's youngest university "it has established an enviable reputation both in Australia and abroad for its courses in information technology".

"We are expecting the development of software out of the Xerox laboratory at Deakin that will become a substantial income earner for Australia," he said.

Australia is currently exporting in excess of \$1 million of what is loosely termed high technology products. With what he terms "proper support and proper organization" Professor Garner believes that this could become

a \$10 billion export market within five years.

There are already several specific, commercial applications of AI most notably in the areas of oil exploration and medical diagnosis. In Australia, where Rank Xerox has become the first company to package and market AI hardware and software, its use has been extended into the accounting profession.

Shortage of frequencies

According to a Radio Nederland report from its representative at the World Administrative Radio Conference, Jim Vastenhou, two thirds of international broadcasters have made their requests known for frequencies they require in the next allocation period. In total 100 countries have specified their requirements.

Instead of picking a frequency shortwave broadcasters will have to nominate their requirements, such as the time and frequency band and the area to which they wish to broadcast. The

international body would allocate the power and frequencies to be used. The band most heavily requested in use was the 9 MHz band or 31 metres, with 7000 requests. Following that was the 11 MHz band or 25 metres, with 6500 requests; then the 6 MHz band, 49 metres with 6000.

By the end of 1987 the number of 500 kW transmitters will be more than the total of 100 and 250 kW transmitters in operation, so that one third of all shortwave transmitters will be 500 kW or over.

— Arthur Cushen



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FEBRUARY

Finance '87 Melbourne, an exhibition of money-handling technology, will be held at the World Trade Centre, Melbourne, 10 to 13 February. For further information contact BPI Exhibitions on (02) 266-9799.

MARCH

A series of seminars will be held in conjunction with the **International Technology Exhibition** in Canberra 3-7 March. For more information contact Total Concept Exhibitions on (02)938-2033.

An **International CAD/CAM Congress** on current realities and future directions will be held 17 to 20 March in Melbourne. Contact ACADS/FACE Congress Secretariat, 576 St Kilda Rd, Melbourne, Vic 3004. (03) 51-9153.

PC87, Eighth Australian Personal Computer Show, is on 17-20 March at Centrepoin in Sydney. Contact Australian Exhibition Services on (03)267-4500.

The Fourth South Pacific Area Conference of Computer Users, SPARC '87, will be held in Brisbane 17-19 March and is calling for papers. Contact Graham Coote on (07)57-7077.

The Queensland Electronic Distributors Association will hold its next exhibition 24-25 March at the Brisbane Entertainment Centre. Contact Bob Hunt (07)854-1911 or Bob Heelan (07)277-4311.

APRIL

The fourth workshop on small computer systems, organized by Queensland Institute of Technology, is on 13-15 April and calling for papers. Contact Dr C. Chesmond, QIT Dept of Elec Eng, on (07)223-2484.

Labex '87, international lab and equipment and products exhibition is on in Brisbane at the Science Pavilion, RNA Exhibition Grounds, 31 March to 2 April. Contact BPI on (02)266-9799.

ATUG '87 4th Australian Telecommunications Exhibition & Conference will be held at the Hilton Hotel in Sydney 7 to 9 April. Contact Riddell Exhibitions on (03) 429-6088.

The What's New in Electronics Exhibition — electronics in process control — will be held 14-15 April at the State Sports Centre, Underwood Rd, Homebush, NSW.

The 17th International Symposium on Industrial Robots will be held 26-30 April at the Chicago Hilton & Towers. Contact RI/SME Public Relations, 1 SME Dr, PO Box 930, Dearborn, MI 48121. Ph 313/271-0777.

MAY

Ausgraph '87 is on 11-15 May in Perth. Contact Conference Secretariat on (03)387-9955.

Photographics '87, an exhibition of the equipment and technology of photographics will be held 23 to 26 May at the RAS Showground in Sydney.

JUNE

Communications '87, the Australian International Office Technology Exhibition, is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03)267-4500.

PC87, The Ninth Australian Personal Computer Show is on 1 to 4 June at the Royal Exhibition Building, Melbourne. Contact Australian Exhibition Services on (03)267-4500.

Office Technology '87 will be held 1 to 4 June in Melbourne. Contact Australian Exhibition Services on (03)267-4500.

The 1987 Computing Systems Conference will be held 17 to 19 June in Brisbane. Contact the Institute of Engineers, Australia, 11 National Circ., Barton, ACT 2600. (062) 73-3633.

Videotex '87 Exhibition & Conference is on in Melbourne over three days in June. Contact Riddell Exhibitions on (03) 429-6088.

Videotex '87 to be held 30 June to 2 July at the Sheraton Hotel, Auckland. Contact the Secretariat on (649) 68-6955.

The Third National Space Engineering Symposium will be held 30 June to 2 July at the Australian Defence Academy in Canberra. Contact The Conference Manager on (062)73-3633.

The Third National Space Engineering Symposium will be held 30 June to 2 July at the Australian Defence Academy in Canberra. Contact The Conference Manager on (062)73-3633.

JULY

Automach '87, an exposition on automated manufacturing and sponsored by the SME, is scheduled for 7 to 10 July in Sydney. Contact Adolph Greco on (02) 875-2377.

AUGUST

A symposium on signal processing and its applications will be held at the University of Qld 24-28 August. Those interested in participating contact the Conference Secretariat, ISSPA 87, Uniquet Ltd, University of Qld, St Lucia, Qld (07)377-2733.

Nelcon '87 national electronics conference will be held 24-28 August at Auckland University, New Zealand. Contact B. S. Furby on (02)957-3017.

IRECON '87 will feature digital technology when it is held 14 to 18 September. Contact Heather Harriman on (02)327-4822.

SEPTEMBER

The 4th Australasian Remote Sensing Conference will be held 14-18 September at the Adelaide Convention Centre. Contact John Douglas, South Australian Centre for Remote Sensing on (08)260-0134.

Labex '87 international laboratory equipment and products exhibition is on 21 to 24 September at the Royal Exhibition Building, Melbourne. Contact BPI Exhibitions on (02) 266-9799 or (03)699-9151.

OCTOBER

Computer Indonesia will be held in Jakarta 20-24 October. Contact Australian Exhibition Services on (03)267-4500.

NOVEMBER

CommuniTech and Computer '87 is on in Kuala Lumpur 11-14 November. Contact Australian Exhibition Services on (03)267-4500.



ELECTRONICS IN WESTERN AUSTRALIA

It's been called 'the State of excitement', and that's probably a pretty good description of the atmosphere in WA — at least in the electronics industry. The WA government regards electronics as the saviour of its manufacturing sector and is happily handing out substantial financial and other support.

The mining companies of Western Australia are known for their trains as much as anything. The trains haul iron ore from the mines at Newman and Mt Tom Price to the harbours at Port Hedland and Dampier where it is transferred to ships and sent all around the world. Economics dictate that the trains should be long, amongst the longest in the world. However, as the trains get longer, the stresses on the links between the trucks get greater, until the train breaks.

To avoid the ignominy of being stranded with a split train in the middle of the dry desert ranges requires drivers to have some experience. In particular, how to drive the train while putting the least possible stress on its components. It's not easy, and, of course, the experience is not cheaply gained.

This was a problem all through the 1970s. However, by 1980, lecturers from the University of Western Australia had developed a considerable amount of expertise in modelling these stresses in a computer. So they left the university, set up a company which they called Acet, and proceeded to build train simulators in which they could teach drivers how not to break them. If you're in the heavy train game, you've got to have one. So far they've sold five simulators at half a million dollars each inside Australia, and they are busily trying to extract export orders.

It's an interesting story if only because, out in the West, it's getting to be very

typical. For a start, the company is very new. Secondly, it's linked significantly to the existing economic order (mining, fishing or agriculture). Thirdly, it's expanding rapidly. Fourthly, it's highly specialized and, fifthly, the guys who head it up are almost unbelievably bullish about the possibilities for the future.

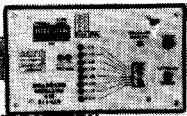
In a nutshell, that's WA's electronics. New, brash and growing fast.

Profile

The profile of the Western Australian electronics industry is in fact much like that of other booming manufacturing centres around the world. It also tends to be technology-driven by new money. It's unlike a lot of the rest of Australian industry.

Total employment in the industry rose 16 per cent last year. More than half its companies reported increases in sales of over 25 per cent. R&D is up, 40 per cent on average. Most significant of all, export sales amount to over 25 per cent of total revenue. Currently there are some 530 companies employing 6500 people. Investment is calculated at \$2b, and at current growth rates will exceed \$5b by 1990.

Electronics in WA has not specialized into any particular area. It's an industry in which the lack of a pattern is itself the pattern. A browse through an electronics directory reveals representatives from almost every branch of the industry. Some of the more noteworthy: Randata and ►



BIT PATTERN GENERATOR KIT

In applications where you are required to look for a particular byte of information in a serial or parallel data path, short of a logic analyzer or a storage oscilloscope, there is not a lot to help you. However, this Bit Pattern Generator gives you a simple and economical way to detect and display specific bytes of data. It may be used on both parallel and serial data paths.

(ETI 172, May '86)
Cat. K41720 \$54.95
(Serial/Parallel Kit)



ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!

(ETI Aug. '84) ETI 1524
Cat. K55240 \$39.95



AEM DUAL SPEED MODEM KIT

The ultimate kit modem featuring 1200/300 baud, case and prepunched front panel. Exceptional value for money!

(AEM 4600 Dec '85)
Normally \$169
SUPER SPECIAL, ONLY \$139



15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage, includes transformer.

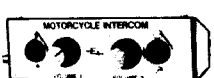
(ETI 581, June '78)
Cat. K45810 \$34.95



50V 5A LABORATORY POWER SUPPLY

New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design.

(EA May, June '83) 63PS5
Cat. K83050 \$199



MOTORCYCLE INTERCOM OVER 500 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!

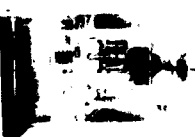
(EA Feb. '84) 84MC2
Cat. K84020 \$49.95

ON SPECIAL! SAVE \$5

VIDEO FADER CIRCUIT

Add a touch of professionalism to your video movies with this simple Video Fader Circuit. It enables you to fade a scene to black (and back again) without loss of picture lock (sync) or colour.

(EA Jan '86, 85F10)
Cat. K86010 Normally \$24.95
Special, only \$19.95



CAR IGNITION KILLER

Most car burglar alarms are easily circumvented, but not this cunning "Ignition Killer". This sneaky anti-theft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undrivable - a sure deterrent to thieves! (EA Feb. '84) 84AU1

Cat. K84010 \$24.95
(Our kit includes the box!)



30V 1A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec. '83) ETI 162

Cat. K41620 Normally \$69.50
SPECIAL, \$59.50



FOUR CHANNEL MIXER

This four channel mixer project gives professional quality with impressive specifications.

SPECIFICATIONS:
Max. input sensitivity - 50dB relative to -40dB
Signal to noise ratio: -78dB
Distortion: 0.03% at +4dB, 2kHz
Input Impedance: 3k ohm nominal
Output Impedance: 100 ohms
Frequency Response: 10Hz to 30kHz (-1dB)
(ETI 1404, ETI July '85)
Cat. K54040 \$99



MULTI SECTOR ALARM STATION

Protect your home and possessions from burglars with this up to the minute burglar alarm system. It's easy to build, costs less than equivalent commercial units, and features eight separate inputs, individual sector control, battery back up and self-test facility.

Specifications:
• Eight sectors with LED status indication.
• Two delayed entry sectors.
• Variable exit, entry and alarm time settings; entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
• Resistive loop sensing; suits both normally open and normally closed alarm sensors.
• Battery back up with in-built charger circuit.
• Built-in siren driver.

The RIE kit includes a superb printed and prepunched metal case and inside metal work, plus a gel battery! Unbeatable VALUE!
Cat. K85900 Normally \$169
SPECIAL, \$159



LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.

(ETI May '83) ETI 163
Cat. K41830 \$249



PARALLEL PRINTER SWITCH KIT

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently, so that you can select one or the other at the flick of a switch.

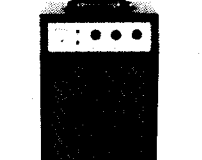
(ETI 686, Feb. '85)
Cat. K46680 \$79.95



UNIVERSAL RELAY BOARD

Operating a relay to switch heavy current or mains voltages is a common requirement in electronic control applications. This project permits a relay to be switched in a variety of ways and form a variety of inputs. (ETI May '81, ETI 257)

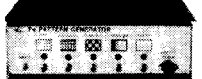
Cat. K41620 \$13.50



THE BUSKER PORTABLE AMPLIFIER

This handy amplifier is completely portable and is capable of operating from either the mains or a 12V battery. Main features include guitar and high-level inputs, an inbuilt loudspeaker, and bass and treble controls. It's just the thing for busking or for guitar practice.

(EA Feb. '85 85B25)
Cat. K85020 (excluding cabinet) \$99



CRYSTAL CONTROLLED TV PATTERN GENERATOR

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this superb unit which provides five separate patterns; dot, crosshatch, checker board, grey scale and white raster? Note: The RIE kit includes a large ABS type case!

(80pg8, EA June '80)
Cat. K80033 \$97.50



MODEL ENGINE IGNITION SYSTEM

Get sure starts every time, without glow plug burnouts on your model engines.

(ETI June '83) ETI 1516
Cat. K55160 \$49.50



RS232 FOR COMMODORE

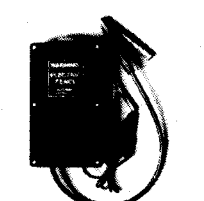
A simple project to give you Commodore RS232C compatibility. (ETI 1801, ETI July '86)
Cat. K56010 \$19.95



LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give you early warning of power failure, and makes a handy beginner's project.

(ETI 280, March '85)
Cat. K42800 \$9.95



ELECTRIC FENCE CONTROLLER

Restore discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design for use in rural areas.

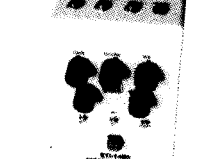
(EA Dec. '85, 85F11)
Cat. K85110 \$49.95



FAIR DINKUM RS232 FOR MICROBEE

The Microbee, among other home computers, has a "sort of RS232C" port in that it doesn't implement negative-going portion of its output signal (Tx-D). Most peripherals with an RS232C input can cope with that, but inevitably, there are those that can't. This project fixes that.

(ETI 676, ETI FEB '84)
Cat. K46760 \$39.50



DIGITAL SAMPLER KIT

Digital sampling is at the core of many of the special sound effects used by modern musicians. A trigger input (usually a construction drum pad) triggers a prerecorded sound from the digital sampler. This sound has been recorded into the 4K of onboard memory and can be digitally manipulated so that it sounds completely different on playback. The unit has controls for gain, regeneration and mixing. It also gives a choice of a number of different triggering methods.

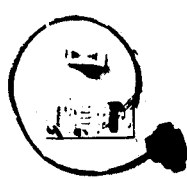
(ETI 1402, May-July '86)
Cat. K41420 \$119



50/500MHz 7 DIGIT FREQUENCY METER

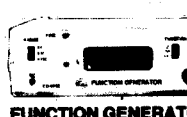
Want a high performance digital frequency meter that's easy to build? This unit uses just five IC's, measures period and frequencies up to 500MHz, and features a bright seven digit display. Save a small fortune over comparable commercial units.

Note: The RIE Frequency Meter Kit includes high quality prepunched and silk screened front panel! (50MHz: 811m10e, 500MHz: 811m10b)
50MHz Cat. K81120 \$149
500MHz option Cat. K81121
add \$29.95



RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. '83)
Cat. K47330 \$19.95



FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 100kHz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.

(EA April '82, 82A03A/B)
Note: The RIE Function Generator has a high quality screen printed and prepunched front panel!
Cat. K82040 \$109



PARABOLIC MICROPHONE

Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of components for this project is around \$15 including sales tax, but not the cost of batteries and headphones. (EA Nov. '83) 83MA11

Cat. K83110 \$14.95



STEREO ENHANCER

The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an "enhanced stereo effect" with a small unit which attaches to your amp.

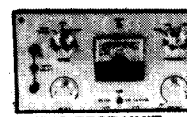
(ETI 1405, ETI, MAR '85)
Cat. K54050 \$79.50



MUSICOLOR IV

Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.

(EA Aug. '81) 81MC8
Cat. K81080 \$99



AUDIO TEST UNIT

Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to give the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder.

(81A010) (EA Oct '81)
Cat. K81101 \$59.50



DIGITAL CAPACITANCE METER MK.2

Updated from the EA March '80 issue, this Digital Capacitance Meter checks capacitor values from 1pF to 99.99uF over three ranges. Its main features include a nulling circuit and a bright 4 digit LED display.

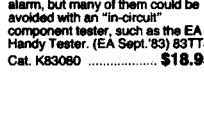
*Note: The RIE kit contains quality silk screen printed and prepunched front panel AND an exclusive High Intensity Display! (85cm9a, EA August '85)
Cat. K85090 \$99.95



TRANSISTOR TESTER

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8

Cat. K83080 \$18.95



PRINTED CIRCUIT BOARDS

ETI 044	.....	\$2.95
ETI 163	.....	\$12.95
ETI 164	.....	\$4.95
ETI 183	.....	\$6.95
ETI 256	.....	\$4.95
ETI 268	.....	\$4.95
ETI 278	.....	\$4.95
ETI 324	.....	\$4.95
ETI 412	.....	\$5.95
ETI 449	.....	\$4.95
ETI 453	.....	\$4.95
ETI 455	.....	\$4.95
ETI 458	.....	\$7.95
ETI 464	.....	\$4.95
ETI 466	.....	\$9.95
ETI 477	.....	\$10.95
ETI 478SA	.....	\$3.95
ETI 478SB	.....	\$3.50
ETI 478SC	.....	\$3.50
ETI 478SD	.....	\$3.50
ETI 480	.....	\$5.95
ETI 494	.....	\$4.95
ETI 496	.....	\$15.50
ETI 499	.....	\$9.95
ETI 581	.....	\$4.50
ETI 686	.....	\$6.95
ETI 688	.....	\$5.95
ETI 672	.....	\$4.95
ETI 688A	.....	\$5.95
ETI 688B	.....	\$2.95
ETI 699	.....	\$9.50
ETI 724	.....	\$5.95
ETI 733	.....	\$6.95
ETI 736A	.....	\$3.95
ETI 736B	.....	\$3.95
ETI 755A	.....	\$10.95
ETI 755B	.....	\$2.95
ETI 755C	.....	\$2.95
ETI 760	.....	\$4.95
ETI 1404A	.....	\$19.95
ETI 1404PS	.....	\$6.95
ETI 1405B	.....	\$69.95
ETI 1478MB	.....	\$23.90
90pa6	.....	\$15.95
90pg6	.....	\$7.95
90bm10	.....	\$3.95
82pa2	.....	\$6.95
82pw2	.....	\$4.95
82eg2	.....	\$2.95
82vc3	.....	\$4.95
82pa7	.....	\$11.95
82pc10	.....	\$3.95
83ma11	.....	\$5.95
84au1	.....	\$5.95
84ba5	.....	\$15.95
84ma11	.....	\$2.95
85a11	.....	\$7.95
AEM 4800	.....	\$23.95
AEM 3500	.....	\$6.95

HI FI SPEAKERS

A comprehensive range of matched appearance speakers, all with square silver gray frames and black cones - ideal for building up low cost speaker systems that will look and sound superb.



1 1/2" TWEETER
SPECIFICATIONS:
Sensitivity: 90dB
Freq. Response: 1.2 - 20 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10200 \$5.95



2 1/2" TWEETER
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 1.1 - 17 kHz
Impedance: 8 ohms
Power RMS: 10 watts
Magnet Weight: 2 oz
Cat. C10202 \$6.95



4" MIDRANGE WITH SEALED BACK
SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 650 - 15 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 3.6 oz
Cat. C10204 \$11.95



6 1/2" WOOFER
Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 96dB
Freq. Response: 55 - 7 kHz
Impedance: 8 ohms
Power RMS: 15 watts
Magnet Weight: 5.4 oz
Cat. C10208 \$17.95



8" WOOFER RIBBED CONE
Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 94dB
Freq. Response: 55 - 8 kHz
Impedance: 8 ohms
Power RMS: 20 watts
Magnet Weight: 5.4 oz
Cat. C10210 \$20.95



12" WOOFER RIBBED CONE
Cloth edge roll surround.
SPECIFICATIONS:
Sensitivity: 92dB
Freq. Response: 32 - 4 kHz
Impedance: 8 ohms
Power RMS: 30 watts
Magnet Weight: 13.3oz
Cat. C10214 \$49.95



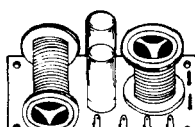
PHILIPS SPEAKERS

For the month of January, we are offering 20% off these prices! But, you'd better be quick as this offer is for a limited time only.

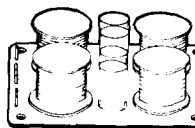
Description	Cat.No.	Price
AD01610T8 (C12030)	AD01610T8	\$24.95
AD02160SQ8 (C12040)	AD02160SQ8	\$69.95
AD0652W8 (C12042)	AD0652W8	\$69.95
AD07062OM8 (C12045)	AD07062OM8	\$69.95
AD12250W8 (C12050)	AD12250W8	\$129.00



2 WAY 60 WATT CROSSOVER NETWORK
• 6dB attenuation
• Cross over point 3,500 Hz
• Impedance 8 ohms
Cat. A16001 \$7.95



3 WAY 60 WATT CROSSOVER NETWORK
• 6dB attenuation
• Cross over point 800 and 5,000 Hz
• Impedance 8 ohms
Cat. A16003 \$12.95



3 WAY 100 WATT CROSSOVER NETWORK
• 12dB attenuation
• Cross over point 800 and 5,000 Hz
• Impedance 8 ohms
Cat. A16005 \$28.95



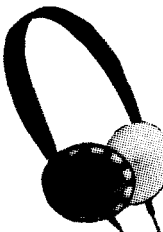
OMNI-DIRECTIONAL WIRELESS MICROPHONE
Tuneable: 92 - 104MHz
Freq. Response: 50 - 15kHz
Range: Over 300 feet in open field.
Modulation: FM
Power Source: 9V Battery
Type: Electret Condenser
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
Cat. A10450 \$19.95



CRYSTAL LOCKED WIRELESS MICROPHONE AND RECEIVER
MICROPHONE SPECIFICATIONS:
Transmitting Frequency: 37.1MHz
Transmitting System: crystal oscillation
Microphone: Electret condenser
Power Supply: 9V battery
Range: 300 feet in open field
Dimensions: 185 x 27 x 38mm
Weight: 160 grams
RECEIVER SPECIFICATIONS:
Receiving Freq: 37.1MHz
Output Level: 30mV (maximum)
Receiving System: Super heterodyne crystal oscillation.
Power Supply: 9V Battery or 9V DC power adapter.
Volume control
Tuning LED
Dimensions: 115 x 32 x 44mm
Weight: 220 grams
Cat. A10452 R.R.P. \$113
Our price, \$99

SENNHEISER HEADPHONES!!

The worlds best headphones are now available from Rod Irving Electronics!! 3 models to choose from, other models are available on request! (Phone Tony DiPaolo on (03) 543 2186)



SENNHEISER HD 40
The HD40 is feather light, at just 60g! This HiFi stereo headphone is uncommonly convenient to use. Its systems can be rotated so it can fit into any drawer. It is also available as a TV headphone.
SPECIFICATIONS:
Frequency Range: 22 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Approx. 1.5%; pressure on ear: approx. 1.3 N
Weight: Approx. 60g
Length of lead: 3 metres
Cat. A10515 \$49.95



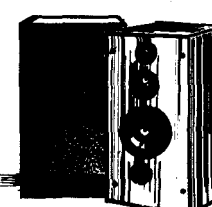
SENNHEISER HD 410 SL
The HD 410 SL embodies all the advantages of the new "Slim-line" concept: brilliant sound characteristics with an optimum of sound volume combined with high wearer comfort.
SPECIFICATIONS:
Frequency Range: 20 - 18,000Hz
Impedance: 600ohm
Distortion Factor: Less than 1%; pressure on ear: approx. 2.5 N
Weight: Approx. 82g
Length of lead: 3 metres
Cat. A10518 \$74.95



SENNHEISER HD 540 REFERENCE
The HD 540 reference headphones are open dynamic stereo headphones. They are among the best ever made. Designed according to latest findings in acoustics, their reproduction is of extraordinary transparency and the highest transients fidelity. The test with a CD player shows: their acoustic properties are outstanding. The ear cushions play a major role. They provide a completely resonance-free treble reproduction up to 25 KHz and assure an impressively clear bass reproduction down to 16 Hz.
SPECIFICATIONS:
Frequency Range: 16 - 25,000Hz
Impedance: 600ohm per capsule
Harmonic Distortion Factor: Less than 0.4%
Contact Pressure: Approx. 3 N
Weight: Approx. 250g
Length of lead: 3 metres
Cat. A10519 \$199



DUAL ATTENUATOR
• LED indicator
• Mid/High range for 3 way systems
• Impedance 8-10 ohms
• Power handling 18 watts RMS
Cat. A16013 \$17.95



VIFA/AEM 3 WAY SPEAKER KIT!
This superb 3 way speaker kit competes with systems that cost 2 - 3 times the cost of these units! (which may even be using VIFA drivers etc.) Never before has it been possible to get such exceptional value in kit speakers! Call in personally and compare for yourself!

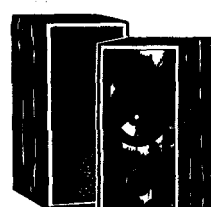
The system comprises...
2 x D19 dome tweeters
2 x D75 dome midrange
2 x P25 woofers
2 pre-built quality crossovers
The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbaffle, grill clips, speaker terminals, screws and ports.

D19 DOME TWEETER SPEAKER SPECIFICATIONS
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20kHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts
(to 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2ohms
Moving Mass: 0.2 grams
Weight: 0.28kg

D75 DOME MIDRANGE SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 350 - 5,000Hz
Free Air Resonance: 300Hz
Sensitivity (1W at 1m): 91dB
Nominal Power: 80 Watts
(to 500Hz, 12dB/oct)
Voice Coil Diameter: 75mm
Voice Coil Resistance: 7.2ohms
Moving Mass (incl. air): 3.6 grams
Weight: 0.55kg

P25 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 25 - 3,000Hz
Free Air Resonance: 25Hz
Operating Power: 5 watts
Sensitivity (1W at 1m): 89dB
Nominal Power: 60 Watts
Music Power: 100 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.7ohms
Moving Mass (incl. air): 44 grams
Thiele/Small Parameters:
Qm: 3.15
Qe: 0.46
Qt: 0.40
Vas: 180.1
Weight: 1.95kg

Complete Kit Cat.K16030 \$1,199
Speaker Kit Cat.K16031 \$949
Cabinet Kit Cat.K16032 \$349



VIFA/AEM 2 WAY SPEAKER KIT!
This exciting new speaker kit, designed by David Tilbrook (a name synonymous with brilliant design and performance) uses VIFA's high performance drivers from Denmark. You will save around \$800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. Call in personally and compare for yourself!

The system comprises...
2 x P21 Polycone 8" woofers
2 x D25T Ferrofluid cooled dome tweeters with Polymer diaphragms
2 pre-built quality crossovers
The cabinet kit consists of 2 knock-down boxes in beautiful black grain look with silver baffles, speaker cloth, innerbaffle, grill clips, speaker terminals, screws and ports.

D25T SPEAKER SPECIFICATIONS
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Frequency Range: 2 - 24kHz
Free Air Resonance: 1500Hz
Operating Power: 3.2 watts
Sensitivity (1W at 1m): 90dB
Nominal Power: 90 Watts
Voice Coil Diameter: 25mm
Air Gap Height: 2mm
Voice Coil Resistance: 4.7ohms
Moving Mass: 0.3 grams
Weight: 0.53kg

P21 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 26 - 4,000Hz
Free Air Resonance: 33Hz
Operating Power: 2.5 watts
Sensitivity (1W at 1m): 92dB
Nominal Power: 60 Watts
Voice Coil Diameter: 40mm
Voice Coil Resistance: 5.8ohms
Moving Mass: 20 grams
Thiele/Small Parameters:
Qm: 2.4
Qe: 0.41
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Vas: 80.1

Weight: 1.85kg
Complete Kit Cat.K16020 \$799
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SPECIFICATIONS:
SENSITIVITY:
Phono: 3mV
Mic: 1mV
Line (tape or tuner): 150mV
SIGNAL/NOISE RATIO:
Phono: 55dB
Mic: 60dB
Line: 65dB
FREQUENCY:
Phono: 20Hz-20KHz (RIAA + -2dB)
Mic: 20Hz-20KHz + -3dB
Line: 20Hz-20KHz + -3dB
CHANNEL BALANCE: 0.5dB
T.H.D: Less than 0.03%
HEADPHONE IMPEDANCE: 4-16 ohms
OUTPUT: 0.775V
EQUALIZER:
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Control Gain: + - 12dB
POWER SOURCE: 110V/60Hz or 220V/50Hz
Cat. A \$399



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D19 TWEETER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 2.5 - 20KHz
Free Air Resonance: 1,700Hz
Sensitivity 1W at 1m: 89dB
Nominal Power: 80 Watts
(to 5,000Hz, 12dB/oct)
Voice Coil Diameter: 19mm
Voice Coil Resistance: 6.2 ohms
Moving Mass: 0.2 grams
Weight: 0.28kg
Cat. C10301 \$38

C20 WOOFER SPECIFICATIONS:
Nominal Impedance: 8 ohms
Frequency Range: 35 - 6,000Hz
Resonance Frequency: 35Hz
Sensitivity 1W at 1m: 90dB
Nominal Power: 50 Watts
(12dB/oct)
Voice Coil Diameter: 25mm
Voice Coil Resistance: 5.5 ohms
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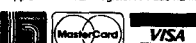
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ELECTRONICS IN WA

DTX, both specializing in data communications products; Geoscan, well known for its remote sensing products aligned to the needs of the mining industry; Laocon, one of a new breed of company producing highly sophisticated security systems; and Radiolab, which produces communications product for radio stations right around Australia.

Another interest in WA that stems from its own position and geography is in satellite downstation equipment. A number of companies have set up manufacturing for downstations for domestic purposes, and WA is proving one of the largest markets for domestic TVRO type systems. This market is expected to grow dramatically when the first commercial channel joins ABC on the satellite. Professional downstation equipment is being manufactured by Icom.

As one would expect, there is also a strong showing from companies which service these industries, the board makers and component suppliers. Jemal and Altronics will be familiar to regular readers of ETI. Perhaps less so is Circuit Technology with its multiwire boards (see elsewhere in this issue).

Government

In early 1986 the WA Government set up a strategic plan that established electronics as one of the first three sectors in the State's economy to be the subject of intensive study by the Department of Industry and Development. This process has been fruitful, although not without its controversy. Industry leaders in WA bewail a lack of consultation between government and industry. It's a complaint familiar in most industry/government dealings.

The government will hand out business development grants, product refinement loans, give grants for the purchase of equipment and even take equity in companies. By making good commercial decisions the government is hopeful of backing winners.

The government has also moved in other directions. Two years ago a Technology Park was set up in the suburb of Bentley. It's shown very limited growth until now, but according to development minister Mel Bryce, it is acting as a focus for a number of interesting R&D efforts.

Another step to increase the level of R&D was the introduction of the 'academic/industry interface', a scheme to provide opportunities for the R&D facilities of the tertiary institutions to be utilized to assist the industry solve specific problems and for the commercialization of results through joint projects and licensing agreements.

The Neville Stanley Studentships are another example of this. They were intro-

duced last year to allow students to be seconded into industrial settings to carry out research projects nominated by the company. For more advanced research, the government will pay \$15k on a dollar for dollar basis for academics to be used by industry.

University

The electrical engineering department at the University of Western Australia is tightly bound to the emerging industry. Staff are encouraged to do commercially relevant work outside the university by a scheme that allows them 33 per cent of the royalties that accrue from their projects. The university and the department share the rest.

Among the more interesting schemes under development at the moment is a joint venture company called QPSX. The other venturer is Telecom, and the aim will be to produce advanced PABX switching systems. A VLSI design centre

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One of the most significant differences between WA and the rest of Australia may well be that in WA they realize that getting to market is actually the whole point of the exercise.

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is under construction. Once operational the State government will put money in to turn it into a microelectronics design facility for the use of industry. ICs will be produced by AWA in Sydney.

According to the head of school, Associate Professor Yanni Attikiousel, the focus of the facility will be Western Australia for the first year, and then the rest of Australia and South-East Asia. He sees a booming market for the facility in Perth, in fact "they're already knocking down the doors" he says.

Investment

In the private sector, possibly the most important step forward was the creation of the second board. This is effectively a stock exchange without much of the legislation that makes it difficult for companies to list on the regular stock exchanges. The most significant difference is that the amount of capital the company must have is very much less.

This means that small start-up ventures

can go public right from day one, using public funds to develop their ideas. It sounds fine in theory, and it often works in practice, but the second board has also become a place for sharks. Sorting out the sharks from the genuine players, indeed, sorting out the sharks from their prey, is not a game for the faint-hearted. Big money is being made and lost.

Distance

If there is a common factor linking everyone in WA, it is distance. Not only distance from international markets, but also distance from major Australian markets in the Eastern States. This is something that has a psychological edge to it, but it also has a purely practical side; how to get goods and services to the marketplace.

One of the most significant differences between WA and the rest of Australia may well be that in WA they realize that getting to market is actually the whole point of the exercise. In all the other States, marketing is very much a problem for individual companies. It is not a government concern. The WA government has recognized this as folly and stepped in with marketing grants.

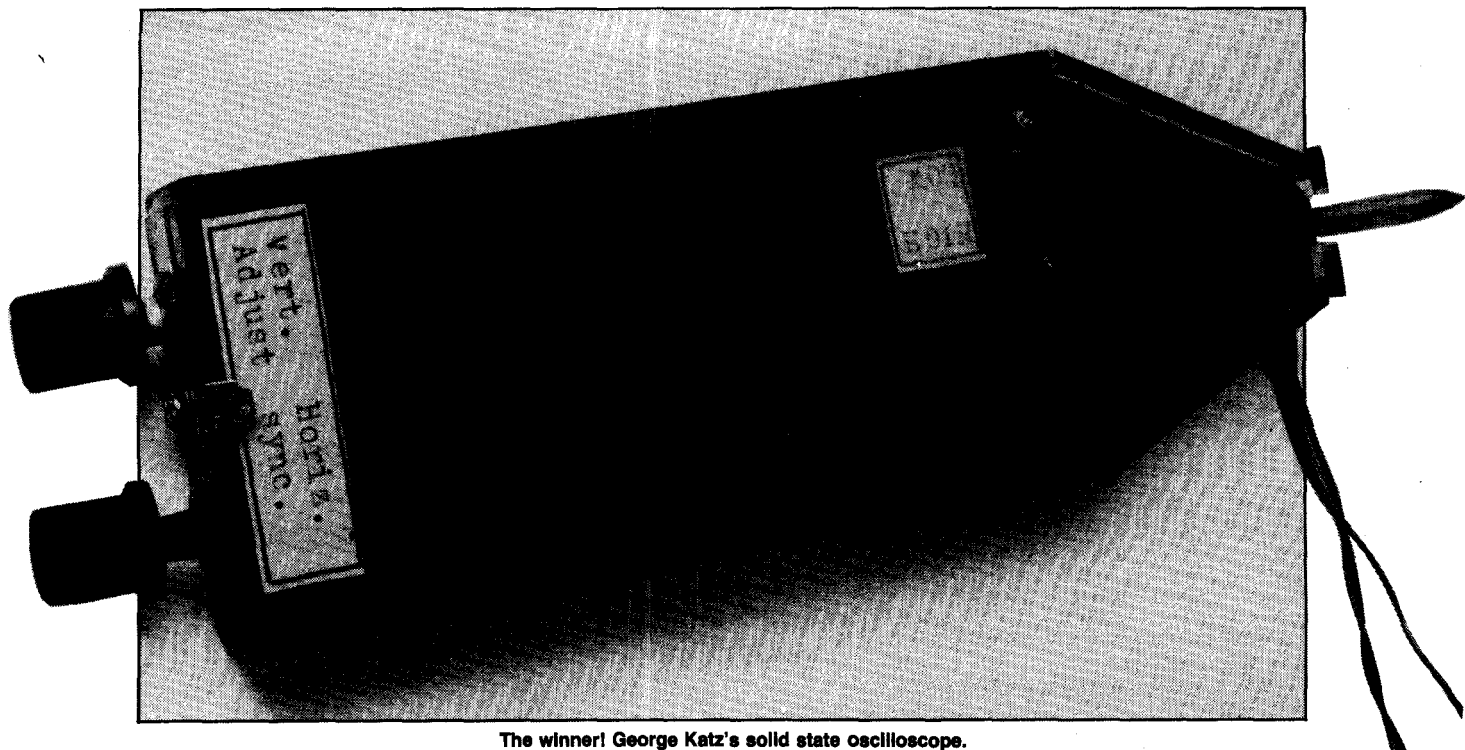
One of the more interesting forms this takes is to provide funds for attending exhibitions outside the State. At a more mundane level, the government will provide funds with repayments based on sales turnover. This means some relief from cash flow worries as well as money for marketing exercises.

Options

The WA Government regards the electronics industry as the saviour of its manufacturing industry. Like most of Australia, the WA experience was of a small manufacturing base supported by a huge primary industry. In the 1970s the manufacturing side of the economy essentially collapsed. For a while, the accepted wisdom was that the service industries would provide jobs and wealth. But as earnings from the primary sector contracted, that began to look like a recipe for disaster.

Although not big in dollar terms in exports or gross earnings, the industry is significant. It does contribute to export earnings, it has shown significant growth, and its prospects are bright, so it's hardly surprising if the government wishes to hitch a ride.

Questions remain about the propriety of giving so much in order that private companies can reap the reward. The answer appears to be that WA really has no options if it wants to preserve a manufacturing base all all. Government ministers are betting that by investing heavily in the industry, it will provide jobs and income well into the future. ●



The winner! George Katz's solid state oscilloscope.

THE ETI-SCHOOLS COMPETITION

The students of Australia and New Zealand show their imagination, knowledge and inventiveness! ETI acknowledges!

Last year, ETI invited schools to design and build electronic devices to be submitted in a competition. To encourage submissions we made the conditions of entry as wide as possible. The project could be designed by the contestant, or built up from one of our kits, but one way or the other, the submission had to demonstrate an understanding of the workings of the circuit. Thus the quality of the documentation that accompanied the device was of considerable importance.

One hundred and fifty schools across Australia and New Zealand submitted expressions of interest in the contest. Thirty or so actually submitted finished, working, documented prototypes. If nothing else, this demonstrates that Murphy's Law of electronics, which holds that it's always more difficult than it seems, is still operating.

Of the 30 or so projects that were received for judging at the State level, (that's the six States, the ACT and New Zealand), one winner was selected from each. In each State, the judging was done by a member of the Science Teachers Association and an ETI representative.

The winning entry of the first round from each State final was then brought into the ETI offices for final judging. To make things a bit more equitable, we allowed two from New South Wales and Victoria, since that was where the majority of entries came from.

Judging

The final judging was extremely difficult since all the entries were of such a high standard. An added complication was that all but one were original designs. One was an old ETI project, but considered be-

cause its documentation was exceptional and the construction extremely good, professional in fact.

The biggest variation between projects was in the documentation. Some people had done a really professional job of presentation, getting the report typed properly, thinking about how the information was to be presented and including pictures. Others had really regarded the documentation as an afterthought; with rough notes torn out of an exercise book. Old and grizzled engineers reading this will recognize the pattern as one common in the industry generally.

The problem is, of course, that no matter how good your circuit, or device, if you don't tell people about it in a way they can understand, then they won't be able to operate it and the project is next to useless. A few of the finalists lost heav-

ily because it took ages just to figure out what the box was supposed to do.

There was also considerable variation in the quality of the construction. Soldering is still a problem out there! Since all the projects worked, connections had actually been made, but some of them looked highly suspect.

One or two of the finalists had been able to get hold of photographic equipment and draughting tape to do a proper job of the circuit board. Others had been stuck with inking the tracks in with a Daylo pen. This certainly doesn't look as neat, but we accepted that people were restricted to the materials at hand.

In some cases, the final presentation of the project was well done, usually in a plastic jiffy box with Letraset lettering. Some presented the project rather badly. The same remarks apply here as apply to the problem of documentation. If you're doing it for yourself it probably doesn't matter if your circuit looks like a bird's nest and doesn't have a decent box. If you are trying to demonstrate it to people, much less convince them it's worthwhile, the presentation becomes vitally important. It's always handy to have the knobs labelled, so the punter knows what he's tweaking!

The projects

This is a description of some of the more interesting of the State finalists:

New South Wales 1

George Katz of Balgowlah Boys High in

Sydney presented a solid state oscilloscope. He says "probably the best advantage is its very small size and the fact that it can run off the power supply of the circuit being tested. Although it has a low frequency range, it can still be used for most circuits. Its poor resolution will still allow for most waveforms to be visualized."

This was pretty much the judges' own assessment of Katz's project. It uses a ma-

BB

The final judging was extremely difficult since all the entries were of such a high standard. An added complication was that all bar one were original designs.

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trix of 100 LEDs for a display, and does suffer from being slow and having rather poor resolution. Still, we could display a sine wave running at 500 Hz without trouble, that that's not all that dissimilar to commercial solid state oscilloscopes.

The circuit displays an understanding of the mechanics of displaying an analogue waveform. The timebase is simply a 555 generating a horizontal sweep, while the vertical amplifier is a 3914 with a trimpot

on the front. It's extremely simple, but it works.

The LEDs are multiplexed by a 4017 driven by the timebase. This arrangement reduces the current requirements considerably, no mean consideration when operating from the power supply of the device under test.

With a device like this, making the unit as small as possible is obviously a consideration. Katz decided to make his own box out of perspex so that he could make it just as big as the circuit board, and no bigger. He was also able to give the thing a fancy shape rather like a bought one.

On the basis that this project had the highest combination of imagination, design ingenuity, construction and documentation, we made it the national winner.

Tasmania

A group from Taroona High in Tasmania designed and built a universal timer. The group was composed of Vimal Pal, James McCoull, Campbell McKilligan, Edward Jager, and Rhyl Opie. The timer allows functions to be turned on or off in response to internal or external triggers, in a sequence defined by a set of 10 switches.

They say: "The timer became universal when we found many uses for it in the school. Some of them involved random flashing lights at the librarian's display, use as a photographic timer and controlling a tape recorder."

The timer is based around the 4046 phased-locked loop, the frequency of which can be varied by a 250k pot. The output is then divided down by 4017s and sent via a switch network to the relay driver circuitry. By appropriately manipulating the rate and the switches, you can turn the relay on or off as required.

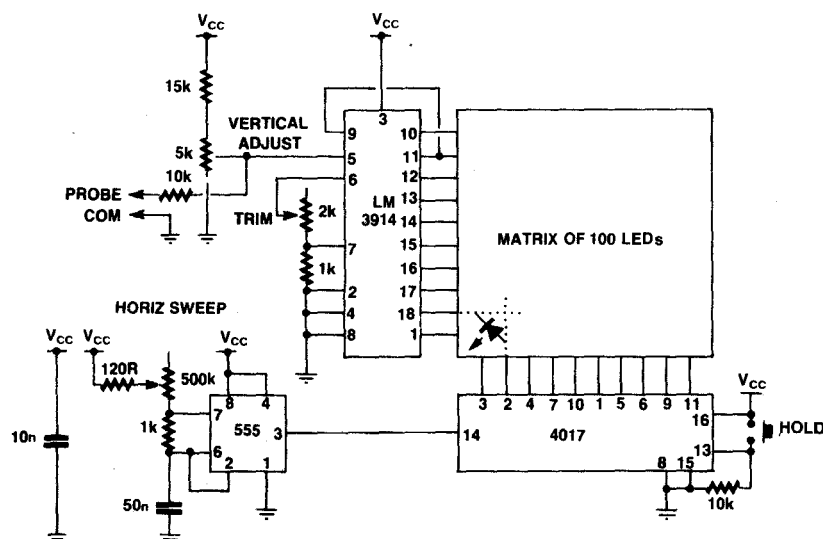
A clever sophistication of this basic idea is the VIA, or versatile appliance interface. This is designed to allow an external trigger to be applied to the unit. In the documentation that accompanies the device (excellent, by the way) they show how to connect it up so as to use a trigger from a digital clock to start the unit. This can then be used to turn on an appliance for a certain period of time.

New Zealand

Andrew Dickson from Rangitoto College in Auckland sent in a 'stable voltage and current power supply'. It features controllable voltage and current supply, with current limiting. It is capable of 4 amps and 60 volts.

It was originally designed for charging Nicads, but "the greatest use, for which this unit is tailor-made, is for electroplat-

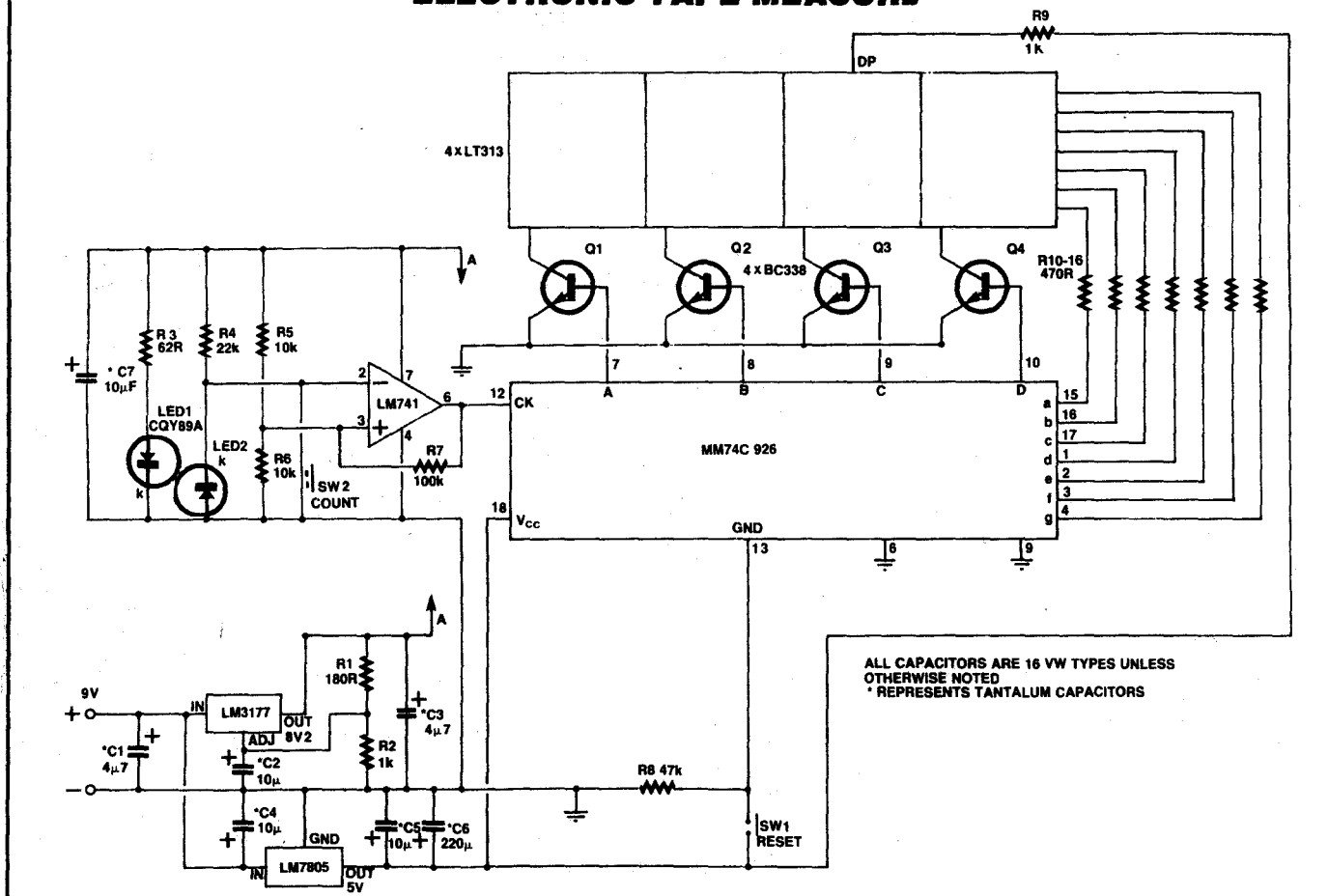
SOLID STATE OSCILLOSCOPE



ETI-SCHOOLS COMPETITION

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ELECTRONIC TAPE MEASURE



ing, where you need to limit the current so that the plating action doesn't occur too fast".

Another consideration was that the unit should be cheap. Dickson priced his unit out at \$80, which is very reasonable given the specifications.

Centre of the circuit is an LM339 quad op-amp which is used for voltage sensing and current limiting. The voltage sensor drives a Darlington pair made from a 3055 and a BD140 to provide the required output. The current sensor works by turning the output current into a voltage, and then comparing this with a preset value.

Victoria I

Darren Chandler of Keon Park Technical School sent in a car sonar. This project rated highly for imagination. The idea is that a sonar transmitter should be placed on the back bumper of a car, and the echoes received from another transducer, also on the bumper, should be used to drive an LED bar display. Since the intensity of received ultrasonic signals will go up with the bumper's nearness to a reflecting surface, this provides a very nice re-

verse parking indicator for getting into tight places.

The circuit is made up of a transmitter, receiver and display driver. The receiver is a simple oscillator based on a 4046 running at 40 kHz and driving the transducer directly. The received signal is fed to a stage transistor amplifier and then into a LM380 power amplifier. This output is then fed into the potentiometer to control its level, thence out to the display driver.

The configuration of the receiver seems somewhat odd. Chandler says "the difficulty . . . was that I couldn't make an amplifier with a high enough frequency rating, and when I did, it wouldn't give enough gain". The configuration chosen evidently does provide sufficient gain and bandwidth.

The display driver simply consists of a string of transistors, each connected via a string of diodes in series. The transistors turn on, switching an LED on at the same time, as the voltage rises in 0.6 volt steps.

Victoria II

Jason Sutherland of Broadmeadows West Technical School in Melbourne built an

adaptation of a digital clock circuit we published some time ago as the ETI-564. This project uses a series of counters to change the mains frequency into clock pulses. These drive a number of LEDs which are formed into bars to make up a seven-segment display.

During the course of construction, he experimented with the best way of building the project, having regard to requirements for low current drain, weight and readability.

He came up with a composite construction for the front panel. It starts with a clear plastic screen. Behind this is a mask of red filter paper, and then a sheet of black plastic, cut out to give shape to the digits. Behind the plastic there is a layer of thin tracing paper to act as a diffuser, and then a layer of polystyrene foam to act as a deflector. Then there is a layer of white plastic with the LEDs poking through. The LEDs are connected by wire to the pc board which is mounted below.

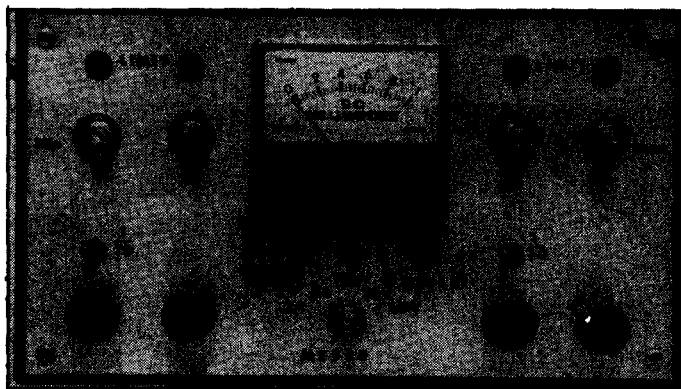
New South Wales II

David Adkins of Newington College in Sydney sent in an 'electronic tape mea-

Apart from the idea, which shows considerable imagination, the other noteworthy thing was the way the unit was presented. The wheel is attached to a small jiffy box, and is easy to run along irregular surfaces. A lead connects to an old calculator case, where the digits are displayed. A single switch on the front panel performs reset functions. It looks just like a bought one!

Three students in year 9 at Trinity Christian School in the ACT, Paul Munger, Bernard Kobier and David Conell, built an intercom for use in the school darkroom. Evidently, communications between the darkroom and the adjoining room are extremely difficult.

They used a modification of a simple two-transistor amplifier described in Dick Smith's *Fun way into Electronics*. Essentially, what they have done is to use the speaker as both microphone and speaker. An intercom can then be created by switching the inputs and outputs of a single amplifier between the speakers.



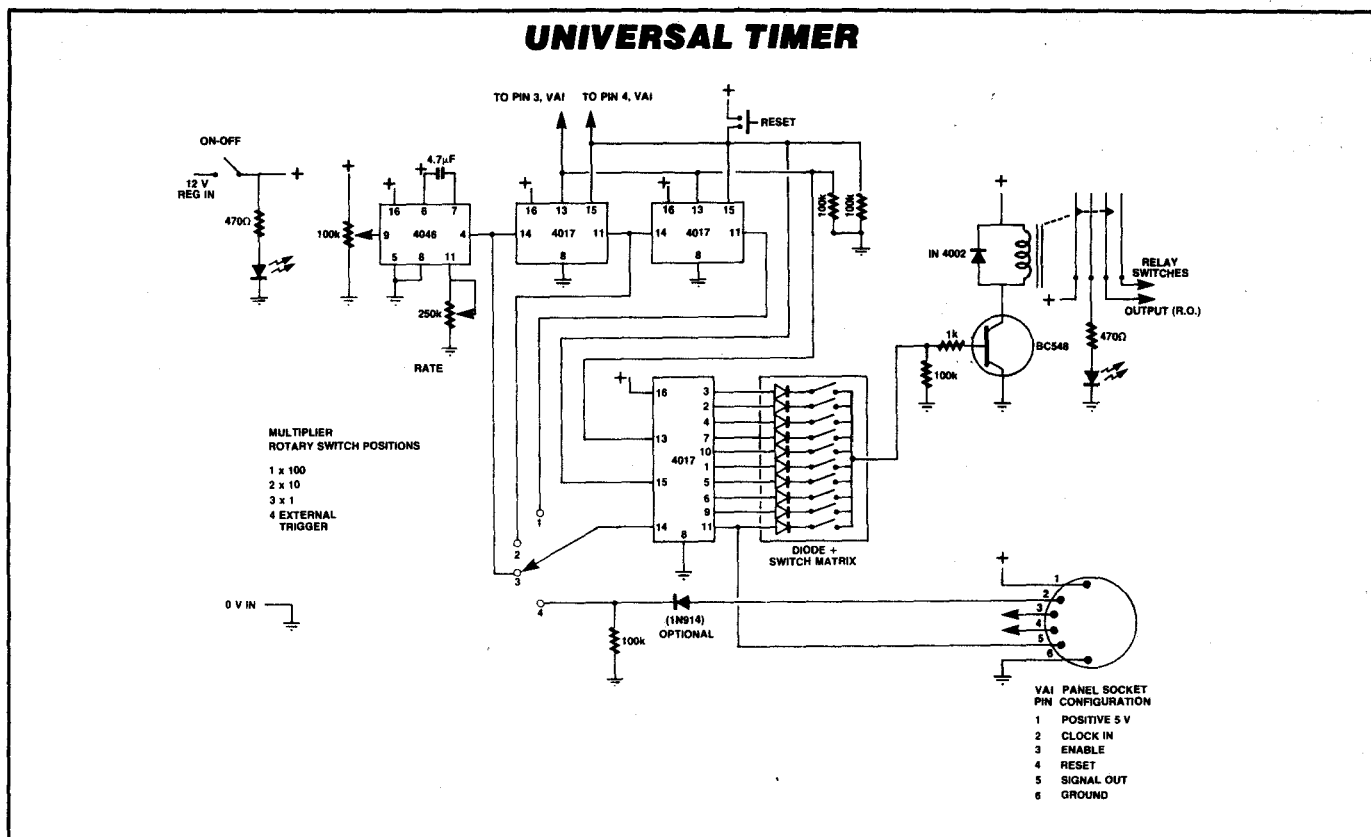
Andrew Dickson's 'stable voltage and current supply'.

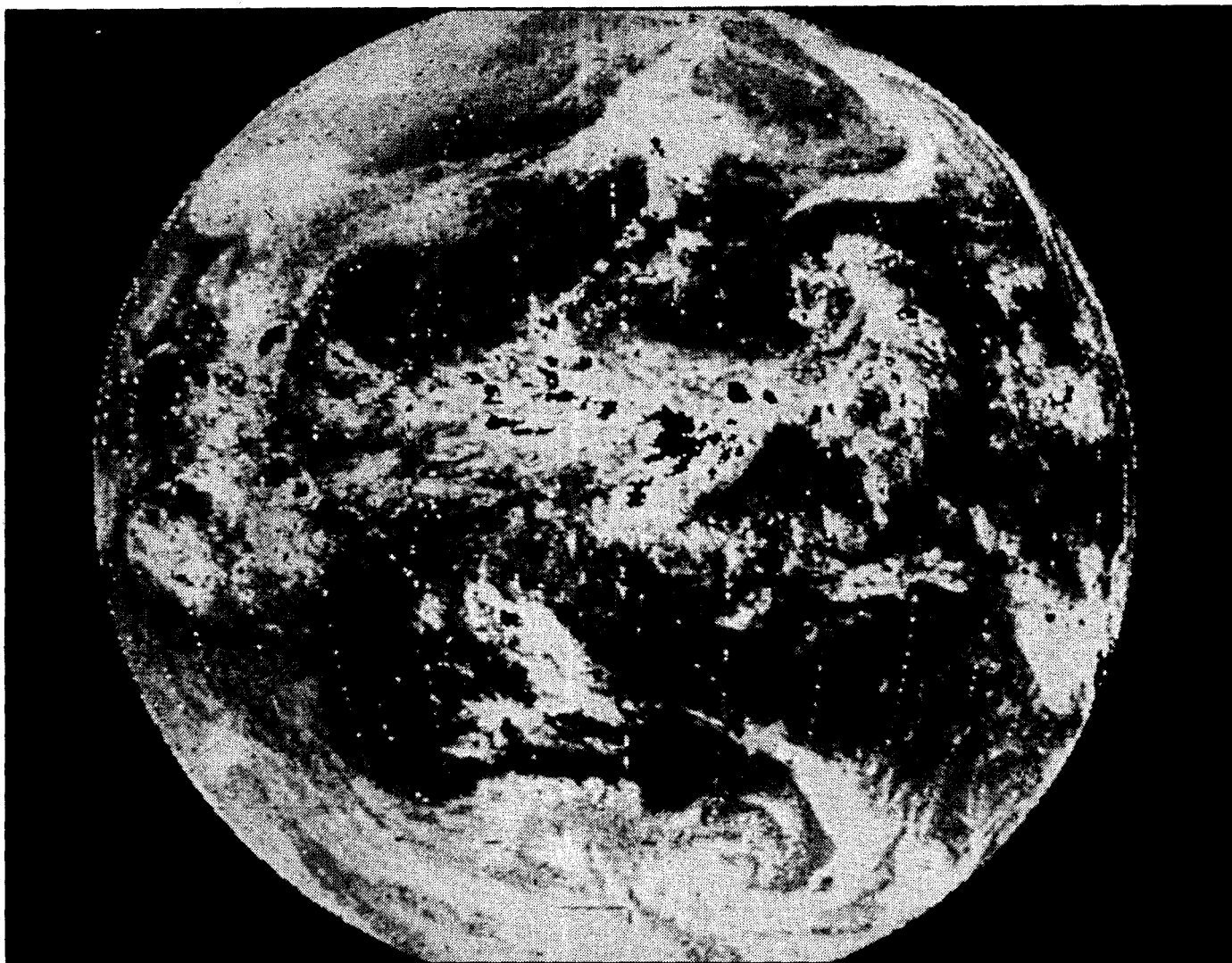
Congratulations to all who entered, especially to George Katz! Now go away and put your thinking caps on for next year!

At this time the arrangements for 1987 have not been finalized. However, science teachers at every high school in the country should receive notification in the first week of term of the arrangements for the 1987 contest. Look out for it! ●



George Katz from Balgowlah Boys High, NSW, received the Philips oscilloscope from Graham Adams, pictured here with Chris Binstead and Barry Longworth from the school.





Courtesy COSSA.

WEATHER CATASTROPHE

Of late, scientists have been talking about two meteorological theories that portent problems in the making. Will we fry or freeze?

Jon Fairall

The study of climate has progressed enormously over the last 20 years. Satellites have enabled scientists to extend their vision as never before; computers have enabled them to crunch numbers on a grander scale than their fathers. The atmosphere, that vast seething mass of gas, is at last starting to yield some of its secrets.

Not only are we learning about the

weather today, but we are learning about the weather of yesterday. From ice fragments 30 metres deep in the Antarctic ice sheet, from ocean sediment 600 million years old, from fossil pollens at Lake George near Canberra, from ancient tree rings, we are beginning to know what passed for a fine spring morning a hundred years ago, or a hundred million. It's given us a baseline by

which to measure the present.

And the news is not good. Mankind has started to change the weather.

The greenhouse effect

According to a recent report in the British science magazine *Nature*, the world will be between one and five degrees warmer by 2050. There is doubt about the figures; it could be more, or less.

But there is little doubt about the trend.

The temperature of the Earth is determined mainly by the amount of energy received by the sun. Incident energy can be either absorbed or reflected and the final temperature depends on the balance between the two. There are many factors that influence the final result. One of them is the composition of the atmosphere. The more certain elements are present in the atmosphere, the more energy will be absorbed. What happens is that solar radiation is admitted to the atmosphere at one frequency. In the normal course of events it would be re-radiated at a different frequency, and lost to the atmosphere. With a certain cocktail of additives in the air, however, the atmosphere will refuse to transmit this re-radiated radiation. The principle is the same as that used to keep a glass-house warm.

Researchers around the world have been using weather satellites and the latest in remote sensing equipment to track the growth of these gases during the last decade. Among the gases identified as problems: carbon dioxide, ozone, nitrous oxide and chlorofluorocarbons (CFC). The chief culprit is carbon dioxide. There are two main mechanisms causing its level to rise. On the one hand, burning fossil fuels release carbon dioxide into the air. On the other hand, the main scavenger of carbon dioxide, trees, are being cut down at a furious rate.

NASA research

Using methane is another starter in the greenhouse stakes. Until recently its effect was ignored, but it now turns out that methane is increasing more rapidly than carbon dioxide in the atmosphere. The theory is that when vegetable matter is burned, as is happening with the large-scale clearing of forests, carbon monoxide is the most significant byproduct. The monoxide links with OH molecules floating in the atmosphere and produces methane.

As with carbon dioxide, the methane absorbs energy from sunlight. Air bubbles trapped in Antarctic ice show that the amount of methane in the air has doubled in the last 300 years, so presumably the amount of energy trapped in this way has doubled too.

Nuclear winter

Hot or cold? One way to stop the greenhouse effect would be to destroy the civilization that produces it. And the fastest way to do that is through the mechanism of nuclear war.

Massive nuclear strikes on cities in the Northern Hemisphere would cause large clouds of smoke and dust to rise high in the atmosphere. By analogy with an ordinary cloudy day, the temperature would drop. In the normal course of events clouds don't last for very long, but the point made by nuclear winter theorists is that a smoke pall would rise into the stratosphere, mix with smoke from fires and spread right around the world. The effect could last for weeks, possibly months. If there were enough smoke, the sun would be completely blanked out.

There is little doubt that the effect is real enough. The unknown is exactly how cold it would get; a nuclear winter, or a nuclear autumn?

The original nuclear winter studies showed that the effect would be quite striking, perhaps reducing the temperature by 20-40°C within a few days. Other studies have been more optimistic, perhaps only a few degrees for a few weeks.

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Hot or cold? One way to stop the greenhouse effect would be to destroy the civilization that produces it. And the fastest way to do that is through the mechanism of nuclear war.

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Consequences

It seems we are talking small numbers here. Maybe the greenhouse effect will make the Earth five degrees warmer; maybe a nuclear winter could reduce the temperature by 20°C. This would be unpleasant, but hardly seems life threatening.

In fact, the consequences would be dire. A paper presented in 1975 by the University of Wisconsin's Reid Bryson, and still currently accepted, suggested that a one degree change in average temperature would reduce the world's food crop by 27 per cent. A change of 2.4 degrees would lower the world harvest by over 50 per cent. We would starve.

Those not frozen or starved would have other problems. Heat melts ice, cold freezes it. Either way sea level changes dramatically, as the oceans exchange water with the polar ice sheets. Apart from changing local living condi-

tions, it would also change local climate. Australia would be particularly badly hit. During the last ice age when the temperature was 10°C colder, Australia was one third bigger than it is now.

The biosphere

There has been vociferous debate in the general media and the scientific press over both the greenhouse and nuclear winter theories of climatic catastrophe since they were first announced. The starting point for much of the criticism of the disaster theorists has been the view that man's activities are so puny next to the activities of nature that it's unthinkable we could be about to poison the atmosphere. Yet this is not the first time that living things have changed the atmosphere, nor would it be the first environmental catastrophe.

The original atmosphere of the Earth was a noxious mixture that contained large amounts of ammonia, carbon dioxide and methane, much as do the atmospheres of the other planets today. However, something happened on planet Earth that set it apart from the others. Because of our fortunate distance from the sun, the temperature of the Earth was mainly between 0° and 100°C. As a result liquid water could, and did, form. Liquid water is an ideal place for chemicals to mix together in more and more complex forms. Eventually, maybe as a result of a lucky chance, or maybe not, a group of chemicals clumped together in such a way that they were able to reproduce themselves. That early slime grew ever more complex, climbed painfully out of the sea and even, one day, became aware of itself.

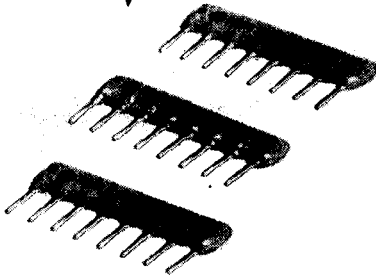
These early life forms had many interesting attributes, but for our purposes the most interesting of all was that one of their waste products was the gas oxygen. Give a millennium or two, give a billion or so generations, and the atmosphere had changed beyond recognition. Mostly it was composed of the inert gas nitrogen. Some 20 per cent was the highly reactive gas oxygen, excreted from plants. A couple of per cent was given over to carbon dioxide, and there was a small admixture roughly accountable for by the elements of the Earth's crust.

Changes

But the position was far from stable. Over the eons that followed the weather had fluctuated wildly, as we can see from the record of fossil animals and plants. Once hippopotami roamed the fields of England and tropical ferns grew ►

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WEATHER CATASTROPHE

along the Thames. Ice sheets spread over Australia's Great Divide and the Sahara was the garden of Africa. The Earth's average temperature, betrayed by the amount of sea water locked up in ice in the ice caps, has rocketed up and down over the millennia.

Why the weather should fluctuate, no one knows, although most scientists working in the field favour astronomical answers. Certainly, it has not been because of significant changes in the composition of the atmosphere. Mainly, the answers rely on the fact that the energy budget, the amount of energy received and absorbed or reflected, has changed in some way. This could be because the energy from the sun itself has changed, or the distance of the Earth from the sun, or even because, as some have suggested, clouds of interstellar gas has gotten in the way of the sun's rays.

Each time the weather changed, it favoured certain groups of animals. Those animals well adapted to one particular type of weather would often disappear with a change in the climate. One of the less successful would suddenly find the time just right. Alternatively, new climates would create new opportunities, and existing animals would adapt to exploit them.

Certainly this seems to have happened when the last ice sheet gripped Europe some 50,000 years ago. Then a small hunting primate out of Africa saw an opportunity to improve himself and followed the cold weather animals into the blizzards of the north. It was an environment that favoured the resourceful, and the cunning. When the ice retreated, *Homo sapiens* emerged full blown, and inherited the first green fields of Europe.

Extinctions

Another interesting point to emerge from the research of recent years has been the fact that some of these climatic changes have been surprisingly rapid. One of the more spectacular has been the announcement of a thin layer of the rare earth indium in strata all around the world. Dating shows it to be about 65 million years old. The indium, apparently, would be consistent with a massive meteorite strike causing atmospheric havoc. The date is significant because 65 million years ago the dinosaurs died out.

This extinction of 65 million years ago is not the only one either. Researchers have now identified several periods when animals were wiped out quite suddenly. In fact so many have been reported that some theorists have thought they could see some sort of periodicity in the dates. This led to the idea of Nemesis, a com-

panion star that periodically approaches the sun, disturbs the comets and causes some of them to crash into the Earth.

There are many problems with such a theory, but for our purposes it's only necessary to note that massive changes in the weather are not unusual.

Solution

The environment is sending us messages that we are running big risks. Are there ways of avoiding both heat and ice?

Clearly, nuclear winter is just another one of the consequences of nuclear madness, and as such, beyond sane comprehension. One commentator has expressed the belief that maybe the opposing sides would try to hit targets that liberated little smoke instead of going for oil refineries. It's difficult to take seriously.

Dr Carl Sagan, one of the original gurus of the scientific winter hypothesis, has argued that arms reduction talks should be aimed at reducing the world's nuclear arsenal to about one per cent of the present stocks. This would be enough for deterrence, but not enough to cause a nuclear winter. As yet there are no signs that the rationality of Sagan's argument has penetrated either the Kremlin or the White House.

But there are signs that governments in the Northern Hemisphere are starting to take the threat of atmospheric pollution more seriously. The US government is moving to ban CFCs; motor car emissions are also being tightened up to reduce the amount of carbon monoxide they produce.

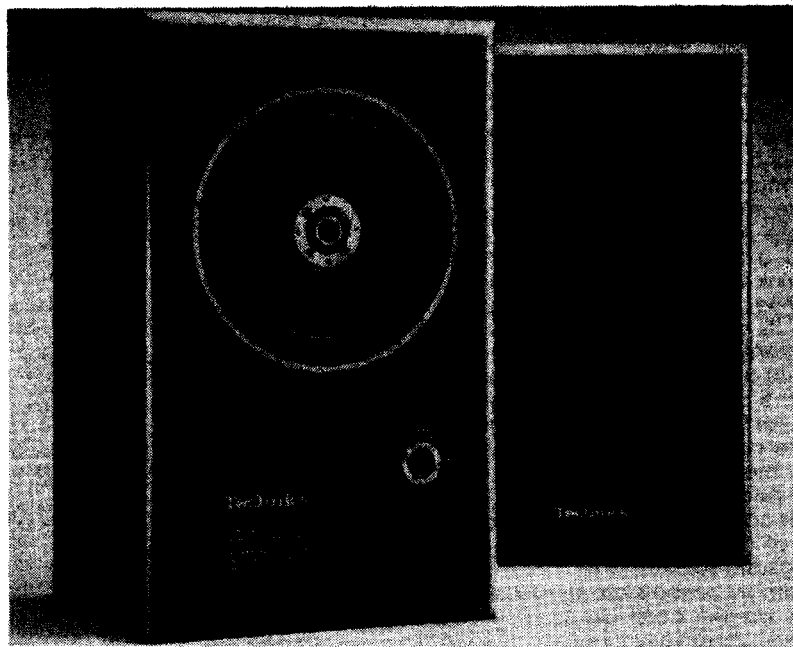
The real problem is still seen as the burning of fossil fuels, mainly coal in power stations. It's ironic that in the current anti-nuclear, post-Chernobyl mood the main beneficiary of nuclear reluctance will be the biggest environmental polluter of all.

Is it possible to create coal-fired power stations without sending carbon dioxide up the flue? Technically the answer is yes. However, recent studies in the US show that electricity would be 70 per cent more expensive to produce from a clean power station.

More practical might be economic systems that forced companies to use energy more efficiently, thus cutting the need for electricity. Studies around the world have shown consistently that more efficient energy use is actually quite cheap and thus practical to achieve.

The question though, is how long do we have before we trigger irreversible changes in the atmosphere? There's a strong body of opinion that holds it's already too late.

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Editorial

Lead times being what they are, this is being written in the first full flush of summer. Beaches call, we blow away the cobwebs on the boat trailer, spend an entire day hunting up last year's cozzle; life's good.

This editor likes to lie on the beach and contemplate sand grains just two inches away. Looking at the universe ... I find it quaint to think of people toiling to turn them into integrated circuits and optical fibres. In certain moods, this editor finds it quaint to think of people toiling at all.

Yet some do. Students in school for instance. But what do they study? Not the sciences it seems. A meeting of University Deans of Science last month argued that the school system has an entrenched bias against science and technology. The Deans warned that unless it can be changed, Australia will have to look overseas for science graduates by the next decade. Where is not clear, since education establishments in Britain and the US, our main suppliers of qualified people, suffer much the same malaise.

The news is all the more worrying when one considers that most commentators see Australia heading for a technology led recovery, and a technology sustained future.

It's also rather sad to think that our society depends so much on technology, while the subject remains totally opaque to the majority of its citizens. Has there ever been a time when so many citizens of a country have been so ignorant about so much that affects them so profoundly?

We must blame it on the schools. If the end result of education is to fit students for life, then the school system is failing, mainly because the quality of technical training in our schools is appalling. The schools entrench the view that there are two types of people in the world: the humanist and the scientist. Neither can talk to the other. The scientist is the nerd, innocent of culture. The humanist neither knows, nor cares, why things are so.

The cycle starts early. Primary schools are mostly staffed by women. But Australian women don't do science subjects at school, so are almost universally innocent of scientific sophistication. If a child starts at high school with an interest in science at all, it will be despite, not because of, the teachers.

The chances are better in high school, but the dice is still loaded against the technologist. If any encouragement to do science is extended, it will almost certainly not be extended to the girls. The girls do humanities, and become teachers.

And it's not getting better. Many education departments are trying to make their units more generalist, by which they mean, less rigorous. This suits arts and humanities type thinking, but it plays havoc with the teaching of maths or science.

Is there a solution? The NSW Education Department has taken to giving science graduates a crash course in teaching. It's one answer, but it has all the marks of a stop gap measure. Perhaps a better answer might be to require all teachers to do some science as part of their course.

Jon Fairall
Editor



>LIST

```
00010 REM#SHOOTOUT*
00020 REM#PETER OCHMAN*
00030 GOSUB390:POKE220,20
00035 FORB=1TO64:CURB,3:PRINT"1":NEXTB
00036 FORB=1TO64:CURB,13:PRINT"1":NEXTB
00040 CURB,2:PRINT"hh"
00050 CURB,12:PRINT"hh"
00060 CURB,14:NORMAL:PRINT"MEXICAN  "C;"  "A;"  "ID:PCB
00070 REM#MOVEMENT OF YOU*
00080 B$=KEY$:IF B$=""THEN130
00090 IF B$="A"ORAI$="a"THEN180
00100 IF B$="\"THEN210
00110 IF B$=" "THEN240
00120 REM#MOVEMENT OF MEXICAN*
00130 Y=INT(RND*5)+1
00131 IF Y=2 ANDA>0 THEN132 ELSEGOTO140
00132 A=A-1:CURB,2:PRINT"hh":GOTO80
00140 IF Y=3 AND A<63 THEN 142 ELSE GOTO 150
00142 A=A+1:CURB,2:PRINT"hh":GOTO80
00150 IFY=4 THEN320
00160 GOTO80
00170 REM#MOVEMENT LEFT*
00180 IFB>0THEN185ELSEGOTO80
00185 B=B-1
00190 CURB,12:PRINT"hh":GOTO80
00200 REM#MOVEMENT RIGHT*
00210 IFB<63 THEN215ELSEGOTO80
00215 B=B+1
00220 CURB,12:PRINT"hh":GOTO80
00230 REM#FIRE*
00240 CURB,2:PRINT"C"
00250 OUT2,64:OUT2,0
00270 IFA=BTHEN280ELSECURB,2:PRINT"n":GOTO40
00280 D=D+1:CURB,2:PRINT"de"
00285 PLAY24,4
00290 FORQ=1TO1000:NEXTQ
00295 CURB,2:PRINT"hhh"
00300 IFD=10THEN280ELSELETA=63:GOTO40
00310 REM#MEXICAN FIRE*
00320 CURB,12:PRINT"C"
00330 OUT2,64:OUT2,0
00350 IFB=A THEN360ELSECURB,12:PRINT"n":GOTO40
00360 C=C+1:CURB,12:PRINT"fg"
00365 PLAY24,4
00370 FORQ=1TO1000:NEXTQ
00376 CURB,12:PRINT"hh"
00380 IFC=10 THEN560 ELSELETB=3:GOTO50
00390 CLS:INPUT"WHAT IS YOUR NAME?";AI$
00400 P=63488+97+16
00410 FORZ=PTOP+(16*9)-1:READT:POKEZ,T
00420 NEXTZ:PCB
00430 REM#DATA FOR PCB CHARACTERS*
00440 DATA 16,56,254,84,108,124,16,56,84,84,16,40,40,68,68,68
00450 DATA 124,124,124,124,16,56,68,146,146,146,16,40,40,68,68,68
00460 DATA 137,137,74,74,44,44,24,248,31,24,52,52,82,82,145,145
00470 DATA 0,0,0,117,85,117,101,85,0,0,0,32,40,124,253,127
00480 DATA 0,0,0,213,85,213,0,21,0,0,0,0,0,1,199,254
00490 DATA 0,0,0,117,85,117,101,85,0,0,0,0,0,64,112,63
00500 DATA 0,0,0,213,85,213,0,21,0,0,0,0,0,4,15,239,255
00505 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
00506 DATA238,255,0,255,0,255,0,0,0,0,0,0,0,0,0,0
00510 A=60:B=2:C=0:D=0:CLS:RETURN
00520 NORMAL:CLS:PRINT"WELL DONE ";AI$;"!!! YOU HAVE WON!!!"
00525 PLAY10,2;5;5;7,2;5,2;0,2;9,2;10,2
00530 PRINT:INPUT"ANOTHER GAME Y/N?";Q1$
00540 IF Q1$="Y"ORQ1$="y"THENRUN
00550 CLS:POKE220,111:END
00560 NORMAL:CLS:PRINT"BAD LUCK ";AI$;"!!! THE MEXICAN WON!!!"GOTO530
```

Shootout

This program has been designed for use with Microworld BASIC. It shows PCG graphics without needing machine code programming.

The object of the game is to win the battle between the Mexican and yourself. The Microbee controls the Mexican. You are equipped with a gun. The keys are: A to

move left; \ to move right; and SPACE to fire gun.

The Mexican is equipped with a gun. The method of scoring is as follows: 1 point for a direct hit on the Mexican, 1 point for you being hit. The first person to reach 10 points is the winner.

Peter Ochman
Koondoola, WA

```

00100 REM   Greek Alphabet Printout
00110 REM   S.L. Robjohns Dec 1983
00120 DIM C$(14),C1(25)
00130 CLS:CURSOR=454:INPUT "GREEK ALPHABET - Ready printer then press <RETURN>" :GOSUB
00140 A=0:EOS=CHR$(27):OUTL$:LPRINT CHR$(27):"B"
00150 FOR Z=1 TO 14:READ C$(Z):NEXT Z:FOR Z=1 TO 25:READ C1(Z):NEXT Z
00160 LPRINT EOS;"-"(CHR$(1)):"Greek Alphabet" :EOS;"-"(CHR$(0))
00170 LPRINT:FOR J=1 TO 50:IF FLT(J/2)-FLT(J)/2=0 THEN 190
00180 LPRINT C1$(J/2+1):FOR Z=1 TO 11-LEN(C1$(J/2+1)):LPRINT " ":NEXT Z
00190 ON J GOTO 230,250,230,250,240,250,240,250,230,250,230,250,230
00200 ON J-13 GOTO 250,230,250,240,250,230,250,230,250,240,250,230,250
00210 ON J-25 GOTO 250,230,250,240,250,230,250,240,250,230,250,240
00220 ON J-37 GOTO 250,230,250,240,250,240,250,230,250,240,250,240,250
00230 A=A+1:LPRINT C$(A) " ":GOTO 290
00240 K=0:GOTO 260
00250 K=1
00260 LPRINT CHR$(27) "K"(CHR$(10)) :CHR$(128))
00270 FOR I=1 TO 11:READ R:LPRINT CHR$(R):NEXT I
00280 IF K=0 THEN LPRINT:LPRINT " ":ELSE LPRINT
00290 NEXT J
00300 DATA "A","B","E","F","Z","H","I","K","M","N","O","P","T","X"
00310 DATA "Alpha","Beta","Gamma","Delta","Epsilon","Digamma","Zeta"
00320 DATA "Eta","Theta","Iota","Kappa","Lambda","Mu","Nu","Xi","Omicron"
00330 DATA "Pi","Rho","Sigma","Tau","Upsilon","Phi","Chi","Psi","Omega"
00340 DATA 0,0,28,34,34,28,20,34,0,0,0
00350 DATA 0,0,0,1,42,82,82,44,0,0,0
00360 DATA 0,0,44,44,124,44,44,96,0,0,0
00370 DATA 0,0,44,44,38,25,102,0,0,0
00380 DATA 0,0,4,10,18,34,18,10,4,0,0
00390 DATA 0,0,0,108,82,82,12,0,0,0,0

```

```

00400 DATA 0,0,0,0,28,42,42,0,0,0,0
00410 DATA 0,0,0,0,0,0,0,0,0,0,0
00420 DATA 0,0,0,44,50,41,41,4,0,0,0
00430 DATA 0,0,32,44,60,44,44,63,0,0,0
00440 DATA 0,0,0,60,82,82,60,0,0,0,0
00450 DATA 0,0,0,28,42,42,28,0,0,0,0
00460 DATA 0,0,0,0,60,2,2,0,0,0,0
00470 DATA 0,0,124,16,40,68,64,4,0,0,0
00480 DATA 0,0,4,8,16,32,16,4,0,0,0
00490 DATA 0,0,6,72,80,60,2,2,0,0,0
00500 DATA 0,0,1,124,4,4,124,4,0,0,0
00510 DATA 0,0,0,44,40,2,68,56,0,0,0
00520 DATA 0,0,0,64,82,82,64,0,0,0,0
00530 DATA 0,0,0,168,84,85,85,66,0,0,0
00540 DATA 0,0,0,28,34,34,34,28,0,0,0
00550 DATA 0,0,44,124,44,44,44,124,64,0,0
00560 DATA 0,0,32,44,124,44,32,62,64,0,0
00570 DATA 0,0,31,48,72,72,48,0,0,0,0
00580 DATA 0,0,0,70,104,82,64,66,0,0,0
00590 DATA 0,0,28,34,34,40,32,64,0,0,0
00600 DATA 0,0,32,44,44,42,34,34,44,0,0
00610 DATA 0,0,32,44,44,42,64,44,32,0,0
00620 DATA 0,0,44,60,2,2,48,56,0,0,0
00630 DATA 0,0,60,66,44,255,44,44,66,0,0
00640 DATA 0,0,0,28,34,127,34,28,0,0,0
00650 DATA 0,0,0,34,34,28,18,34,0,0,0
00660 DATA 0,0,44,120,5,255,5,120,44,0,0
00670 DATA 0,0,44,120,4,255,4,120,0,0,0
00680 DATA 0,0,2,58,70,64,70,58,2,0,0
00690 DATA 0,0,28,34,2,12,2,34,28,0,0

```

Greek alphabet

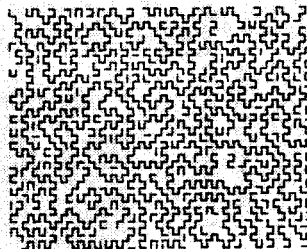
In many mathematical and scientific applications there is a need for symbols that are not readily available in the standard printer library.

The following program is

designed to give a printout of the Greek alphabet in upper and lower case on the Microbee MB-80 dot-matrix printer. While some characters are similar to standard

English symbols, those that cannot be represented in this manner are defined in data statements at the end of the program.

S.L. Robjohn
Somerton Park, SA



```

?SYNTAX ERROR
JPRW0
J

```

```

?SYNTAX ERROR
JLIST

```

```

0 REM   PATTERN BY CHARLES HACKER
1 DIM SP(56,38): TEXT : HOME : PRINT "COLOUR (1=WHITE SCREEN/0=BLACK)="
2 GET OH
3 OH = SGN(OH): IF OH < 0 THEN 1
4 HGR2
5 HCOLOR= OH * 7
6 HPLLOT 0,0: CALL 62454
7 AO = 0
8 X = 1:Y = 1:XX = 1:YY = 1:I = 0:AM = 0:HA = 0
9 FOR YU = 0 TO 54:SP(YU,0) = 50:SP(YU,38) = 50: NEXT YU
10 FOR YU = 0 TO 38:SP(0,YU) = 50:SP(56,YU) = 50: NEXT YU

```

```

25 HCOLOR= NOT (OH) * 7
26 DEF FN N(X) = INT (RND (1) * X + 1)
27 SP(1,1) = 500
30 R = FN N(2)
31 AO = AO + 1
32 IF AO > 4 THEN 220
40 ON I + 1 GOTO 50,80
50 ON R GOTO 60,70
60 YY = Y + 1: GOTO 110
70 YY = Y - 1: GOTO 110
80 ON R GOTO 90,100
90 XX = X + 1: GOTO 110
100 XX = X - 1
110 IF XX < 1 OR XX > 55 THEN 30
120 IF YY < 1 OR YY > 37 THEN 30
130 IF SP(XX,YY) > 5 THEN 220
140 HPLLOT X * 5,Y * 5 TO XX * 5,YY * 5
141 AO = 0
150 X = XX:Y = YY:SP(X,Y) = 50
160 I = NOT (I): GOTO 30
170 X = FN N(55):Y = FN N(37)
171 AO = 0
190 IF SP(X,Y) > 5 THEN 170
195 SP(X,Y) = 50:XX = X:YY = Y: GOTO 30
210 END
220 ON I + 1 GOTO 230,300
230 YY = Y - 1
240 IF SP(XX,YY) < 5 THEN 110
250 YY = Y + 1
260 IF SP(XX,YY) < 5 THEN 110
270 GOTO 170
300 XX = X + 1
310 IF SP(XX,YY) < 5 THEN 110
320 XX = X - 1
330 IF SP(XX,YY) < 5 THEN 110
340 GOTO 170

```

Pattern

This program produces the graphics pattern shown above. It has two options; white lines on a black screen or black lines on a white screen.

The program is designed for an Apple computer, but can be altered for a different type of computer. Also, for computers with colour, the program can be modified to

produce coloured lines for an even better effect.

C. Hacker
Rockhampton, Qld

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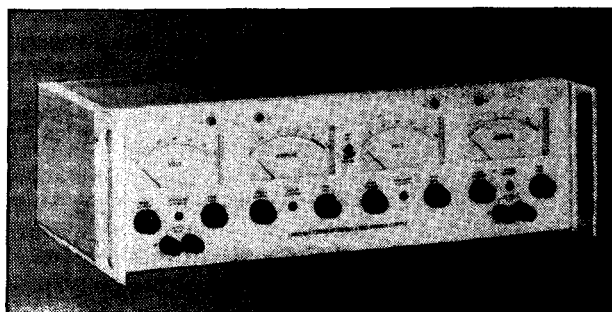
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ETI February 1987 — 35

Letters to the Editor

ALTERNATIVE WORDSTAR INTERFACE

I AM A SUBSCRIBER to your magazine and I never regret the outlay.

I have just read with great enthusiasm the idea of the month for November 1986, Wordstar Interface. After the purchase of my computer I long considered the design of just such a circuit. My reasons for not pursuing the design were a lack of time and the discovery of an alternative solution but I compliment the designer for an ingenious design which I will certainly build.

The solution I spoke of involves using one of Wordstar's user definable characters. I used control Q, the character generated when the user types control Q. To assign this character I used Winstall, the Wordstar Installation program. To the character control Q I assigned the hex values of 00 00 00 1B. This will send the ASCII escape to the printer. Note that the 1B is last. This is because the printer turns off the escape mode if it sees 00 hex before the characters following the escape reach the printer.

Most of the Epson print features may be activated using escape sequences. This involves sending escape followed by some other ASCII characters. For example, to turn on near letter quality the sequence is <ESC>x1 and to turn it off <ESC>x0. To turn on underline <ESC>-1 and to turn it off <ESC>-0.

Examples, is done by ^Q-1Examples^Q-0

Text file: ^Qx1This is near letter quality^Qx0
Result: This is near letter quality

Text file: ^QW1Enlarged print^QW0
Result: Enlarged print

Text file: ^Q4Italic mode^Q5
Result: Italic mode

Text file: ^Q50S^Q1uper and ^Q51S^Q1ub script are also possible.
Result: Super and sub script are also possible.

This does not solve all the problems that the printer interface will solve but it will be much easier to implement, and is much cheaper.

J. Hancock
Morphet Vale, SA

ETI-684 KIT BUYERS BEWARE

I RECENTLY PURCHASED a kit for your Intelligent Modem Project ETI-684 and ran into a few troubles which I will detail below for the benefit of any other readers who may be having the same type of problems.

Not all kits may have these faults but the kit I have was a source of concern.

1. Check the board for shorts between adjacent tracks. Mine had no less than five.

2. Check any plated through holes. Mine had an extra one that shorted IC8/10 (LIVE ON OUT) on the motherboard component side to IC11/8 (DTR OUT to IC7/23) on the lower side causing a breakdown of both IC8 and IC11. Although I checked for shorts this was something I didn't count on especially since the pcb layout was not provided with the kit.

3. One brand of 555 IC will not work in the 8 volt generator circuit. It just doesn't have the necessary drive for this application supplying only 6 volts while the 1488 IC needs at least 7 volts negative to make it switch.

4. Make sure that SK3 (REMOTE) is insulated as it can ground through the Scotchcal label to the other sockets

and your cassette recorder may just happen to switch battery causing a burn out in your recorder.

5. My 6.2 volts Zener diode (ZD1 in the power supply) was only 5.9 volts. As there is approximately 1.3 volts dropped across the circuit of the emitter/base junction of Q1 and D6 this resulted in a standby voltage of 4.6 volts.

6. Check all holes with the component overlays. My boards had no ground holes for C30 and C32 on the interface board or for the RS232 ground on the motherboard. Some 2.4576 MHz crystals have a wider set on the pins and may require redrilling of these holes.

7. IC15 on the motherboard must be either 74C154 or 74LS154 but not a 74HC154 as these chips although faster are not physically compatible with the board holes.

While on this subject, the 74LS series was found to work quite well in place of the 74C series of chips and in most cases is not only faster but also cheaper.

8. Check all components in your kit. I found two 4069s in place of two 74C02s (electronically incompatible); and a SPDT 12 volt relay for the power supply (electrically and physically incompatible).

9. The original power transformer was an A&R 2155 and some replacements may not be up to it and overheat.

10. R8 (4k7) pulldown resistor in the power supply is duplicated by R6 (3k3) on the motherboard resulting in 2.3 volts instead of over 4 volts to the LIVE ON line. Remove R6 from the motherboard.

11. Looking at the underside of the interface board, the DIL switch should have SW8 closest to IC32 (SW1 towards C23). This makes the DIL switches have the following applications:

ON = 1 OFF = 0

SW1	SW2	SW3	WORD	STOP	PARITY
0	0	0	8	1	ODD
1	0	0	8	1	EVEN
0	1	0	8	1	NONE
1	1	0	8	2	NONE
0	0	1	7	1	ODD
1	0	1	7	1	EVEN
0	1	1	7	2	ODD
1	1	1	7	2	EVEN

Finally I would like to thank Mr Hul, the designer of this project for his very kind assistance and generosity in helping me debug my unit.

Howie Moore
Everton Park, Qld

LASER & ELECTRO OPTICS SUPPLIERS

I AM A second year Electronic Engineering student at the University of Western Australia, with an insatiable interest in electronics. I am also the Vice President of the University Computer Club, an institution devoted to the real side of computer programming and electronics. I have collected Electronics Today International magazines since 1975 and followed with interest, your magazine since way back.

The main concern of the University Computer Club is, as its name suggests, the building and programming of computers. However, there are a large number of students with a strong footing in electronics and a desire to tinker with the latest and greatest.

One of our experimental entities is a robot of sorts, which was developed by past members and has festered lately in a corner. Many members are now interested in designing and building various peripherals, one of which is a laser-based range finding device. The brain is a 68000 microprocessor so we have the necessary number crunching power to effect this system. Other projects are an arm, and possibly artificial intelligence.

It is with more than usual interest, that I read the articles of July 1980 which described the low power helium-neon laser kit and how to build it. Unfortunately, the power output of this laser is insufficient to overcome the ambient noise in a range finder configuration. I was also hoping to see some follow up in the way of interesting laser projects to tempt the electronics hack into the optics field, which, by all accounts, is well on its way to being the alter ego of the electronic logic systems.

My reason for writing to you is to obtain the names of retailers of laser components in Australia. We are hoping to obtain a medium power (around 10 to 20 milliwatts) helium-neon laser. I have been informed that to purchase such a device from the United States through a company that has a franchise deal on lasers could cost anything up to \$4000 Australian for the tube alone (a bit much for poor students!!).

I would also like to register my appreciation of a magazine that continues to provide details for the experienced hacker and hints for the novice.

D. Emrich
Perth, WA

I suggest you approach Mr Sunda Silva of the Department of Industry, Trade & Commerce (062) 72-3338, who recently completed a report on laser and electro optics in Australia. The report contains a list of all the major electro optical players in Australia. Unfortunately, it's too long to print here.

— Ed

ALARMING THOUGHTS

I HAVE BEEN studying the requirements for fitting the VCR alarm (ETI-284) described in the November 1986 Issue. The most dismaying fact I found was the relative costs of the sections. The electronics on the pc board add up to about \$5. The piezo alarm is about \$4. The keyswitch is about \$7 to \$8!

This, together with the obvious difficulty of disguising a key operated switch on a VCR, caused me to consider what other (and cheaper) means of accomplishing the desired result were available.

What costs around 50 cents if you haven't already got 10 in the spare parts box? Answer — a 3.5 mm panel mounting jack. These normally have a break contact when the plug is inserted.

What would look totally in place on the back panel of a VCR? Answer — a 3.5 mm panel mounting jack labelled "AUX".

Any 3.5 mm plug can be inserted to silence the alarm when necessary and a thief is more than likely to pull out all the cables when making off with the VCR. He definitely won't expect to have to plug something in to shut it up.

W. G. Neuman
Yeerongpilly, Qld.

Minimart

FOR SALE: MINI-TESTERS, break out boxes, 2-way gender benders, etc. Plated through boards \$5 each, 4-way gender bender boards \$16. For more info send SAE to Don McKenzie, 29 Ellesmere Cres, Tullamarine Vic 3043

FOR SALE: VIC-20 software library. Games, utilities, educational and misc programs available. Discount tapes. Send SAE to Chris Groenhout, 25 Kerford St, Watson, ACT 2602 for list.

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WANTED: Circuit diagram or service manual suit ATA SEA-COM 75A marine transceiver. Will pay reasonable price. Brian Pearce, PO Box 545 Lae, Papua New Guinea. Phone 42-4380 (bh).

FOR SALE: BWD506 CRO 15 MHz with manual, as new, \$250 ono. 280 starter kit, 48K, KB, VDU, RS232, Centronics, all manuals and listings, 40 2114 memory chips; P/S 5V/10A, 10V/1A, -15V/1A, 25V/25mA to suit; \$200 ono. T199/A with ext BASIC and 10 games; \$250 ono. Uwe Knop, 13 Want St, Parkes, NSW 2870.

FOR SALE: SONY SCANNER ICF-2001 PLL synthesized AM/FM/SSB/CW and many more features. Exc condition \$240. (08)268-6469.

FOR SALE: COMPLETE set of 75 ETI magazines from September 1980 to November 1986 \$250. Jim Berry, 619 Burbridge Rd, West Beach, SA 5024.

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The circuit is fundamentally a voltage integrator that has been designed to operate over extremely long periods between counts. At maximum charging current there is one output pulse every 20 minutes and this can extend to several hours for reduced charging currents. A conventional voltage integrator approach is unsuitable due to the very high values of capacitance and resistance re-

At this point, the comparator C changes state and generates a positive going signal which drives transistor T1 to reset the integrator. This

Adjustment of the circuit is quite simple, with the zero potentiometer being adjusted with no input signal for

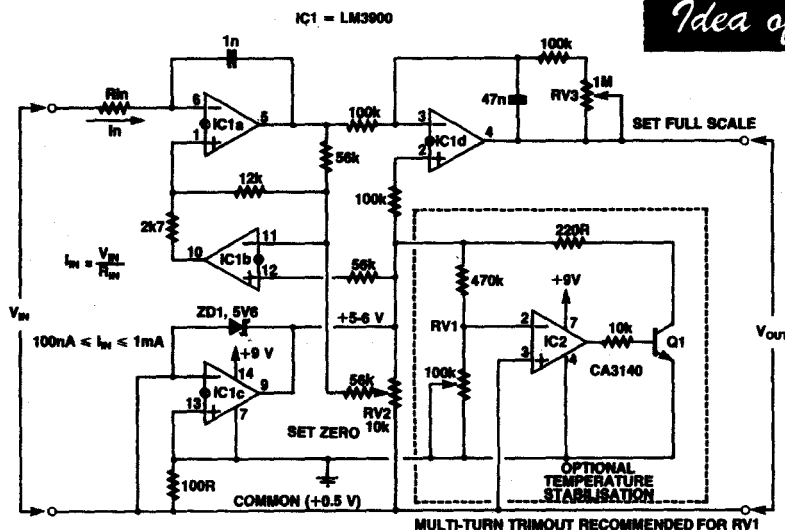
N. R. Strong
St Ives, NSW

Logarithmic amplifier

Taking advantage of the unique input characteristics of LM3900 type current input mode amplifiers, this circuit generates an output voltage which is logarithmically proportional to an input current.

Typical applications include photographic light meters, sound level meters and test instruments for audio equipment. The circuit is ideally suited for operation on a battery or other floating power supply.

The logarithmic current-to-voltage conversion is performed by IC1a and IC1b in an active feedback configuration. IC1c provides a stabilized bias voltage for the circuit, while IC1d is a straightforward inverting output buffer. Optional temperature stabilization is included to minimize output voltage drift which might otherwise occur due to temperature changes in IC1. This uses the base-emitter junction of one of the input transistors in IC1 as a convenient on-chip temperature sensor.



IC2 controls the conduction of a transistor Q1 in response to the (base-emitter) voltage which appears between pins 7 and 8 of IC1. Q1 in turn acts as a variable load on the output of IC1c, thus affecting the whole power dissipation in IC1. By negative feedback action, the conduction of Q1 is continually controlled to maintain IC1 at a substan-

tially constant temperature.

Before calibrating the circuit, connect a voltmeter between pins 7 and 8 of IC1 and adjust RV1 to obtain a reading of about 0.5V. Now calibrate by first adjusting RV2 to obtain a reading of zero at the output with, say, 100 nA of input current applied. Then adjust RV3 to get a suitable output voltage

reading with, say, 1 mA of input current applied. The circuit is now calibrated over a 4-decade input range. If calibration over a narrower range is required, adjust RV2 and RV3 in the same manner but with two levels of input current applied appropriate to the required range.

H. Nachnovich
Gulgong, NSW

Feed Forward needs your minds. If you have ideas for circuits that you would like to enter in our idea of the month contest, programs for the computing columns or just want a word with the editor, send your thoughts to:

Feed Forward
ETI, Federal Publishing,
PO Box 227,
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Contributors can look forward to \$20 for each published idea/program which should be submitted with the declaration coupon below.

Programs MUST be in the form of a listing from a printer. You should indicate which computer the program is for. Letters should be typewritten or from a printer, preferably with lines double spaced. Circuits can be drawn roughly, because we have a draughtsman who redraws them anyway, but make sure they are clear enough for us to understand.

'Idea of the month' contest

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Soldering Station (model ETC60L) worth approximately \$191.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine.



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

The winner will be advised by telegram. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each coupon. Photostats or clearly written copies will be accepted. You may send as many entries as your wish.

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ETI Magazine December 1986

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APPLIX 1616

Andrew Morton & Paul Berger Part 2

16-BIT COMPUTER

This is the second article in a series which will describe the operation, construction and use of the 1616 computer. In this month's issue we give an overview of the MC68000 microprocessor and a description of how the 1616's hardware operates.

AT THE CENTRE of the 1616 is the 68000 microprocessor, supported by its RAM and ROM. In this article, we take a close look at the 68000 and its operation, and the way it talks to the rest of the circuit.

About the MC68000 family

Motorola's MC68000 series microprocessor family was first introduced in 1980, at a time when advances in VLSI fabrication and design techniques were permitting manufacturers to put an entire 16-bit microprocessor on a chip.

At this time some manufacturers (most notably Intel) elected to design their 16-bit micros as upgrades to their 8-bit ones. Motorola on the other hand produced an architecture which was derivative of none of its previous microprocessors — it was a multi-register device which was designed from scratch to support high-level compiled languages, multi-tasking operating systems, and multiple processors.

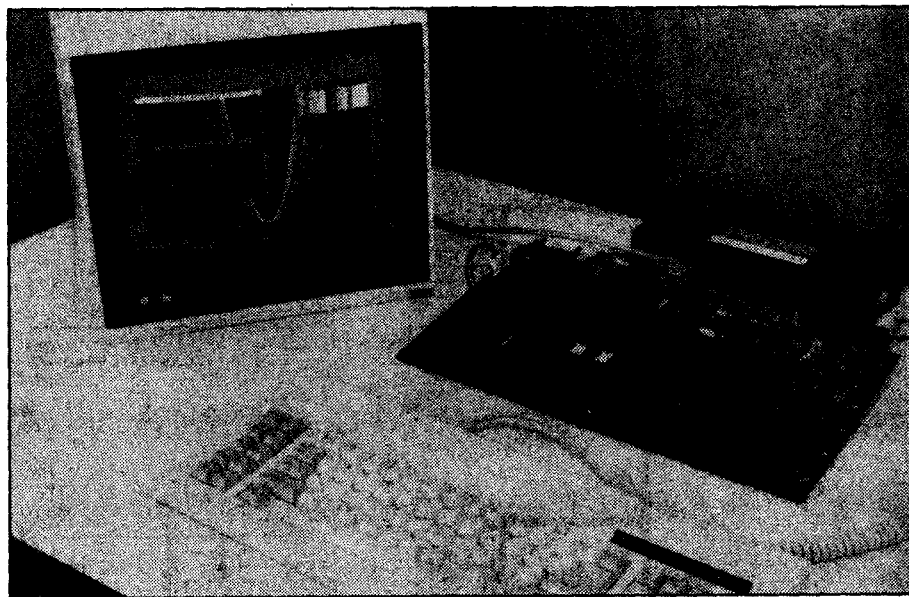
Motorola has excelled in designing microprocessors for the programmer. Its MC6809 was the best of all the 8-bit microprocessors from the programmer's point of view and the MC68000 family instruction set certainly indicates that the software boys made a large contribution to its design.

The microprocessors in the MC68000 family are:

MC68000: A 64-pin IC, with a 16-bit external data bus, 32-bit internal data bus, 12.5 MHz maximum available clock speed.

MC68008: With 48 pins, an 8-bit external data bus, a 32-bit internal data bus and a 12.5 MHz maximum available clock speed the MC68008 was designed to bridge the gap between existing 8-bit subsystems (such as memory and I/O cards) and a 32-bit microprocessor.

MC68010: This device is very similar to



the MC68000. It has some extra instructions some of which have been made more efficient, but the main rationale for the introduction of the MC68010 is probably as a 'fix' for a limitation of the MC68000 which prevented it from resuming a program after a memory fault — a capability which is necessary for large operating systems. This MC68010 feature is not needed in a system of the 1616's size.

MC68020: The MC68020 is a 127-pin microprocessor IC with 32 address pins, 32 data pins, on-board instruction cache, 25 MHz clock speed, dynamic bus sizing, etc, etc. This is a very powerful microprocessor.

MC68030: Rumours abound. This device is apparently being shipped in sample quantities at present and it must go like a free beer.

A hardware description of the 68K

Memory transfers

The MC68000 can address 16 Mbytes of memory. This is a 24-bit address range —

the microprocessor's internal addresses are in fact 32 bits but the eight most significant address lines (A24-A31) never see the light of day due to IC packaging constraints.

As with all of Motorola's microprocessors, memory and I/O devices are mapped into the memory space. The MC68000 does not use a separate I/O space with its associated special I/O instructions, as do the Intel and Zilog microprocessors. I/O devices are written to and read from in the same way as memory.

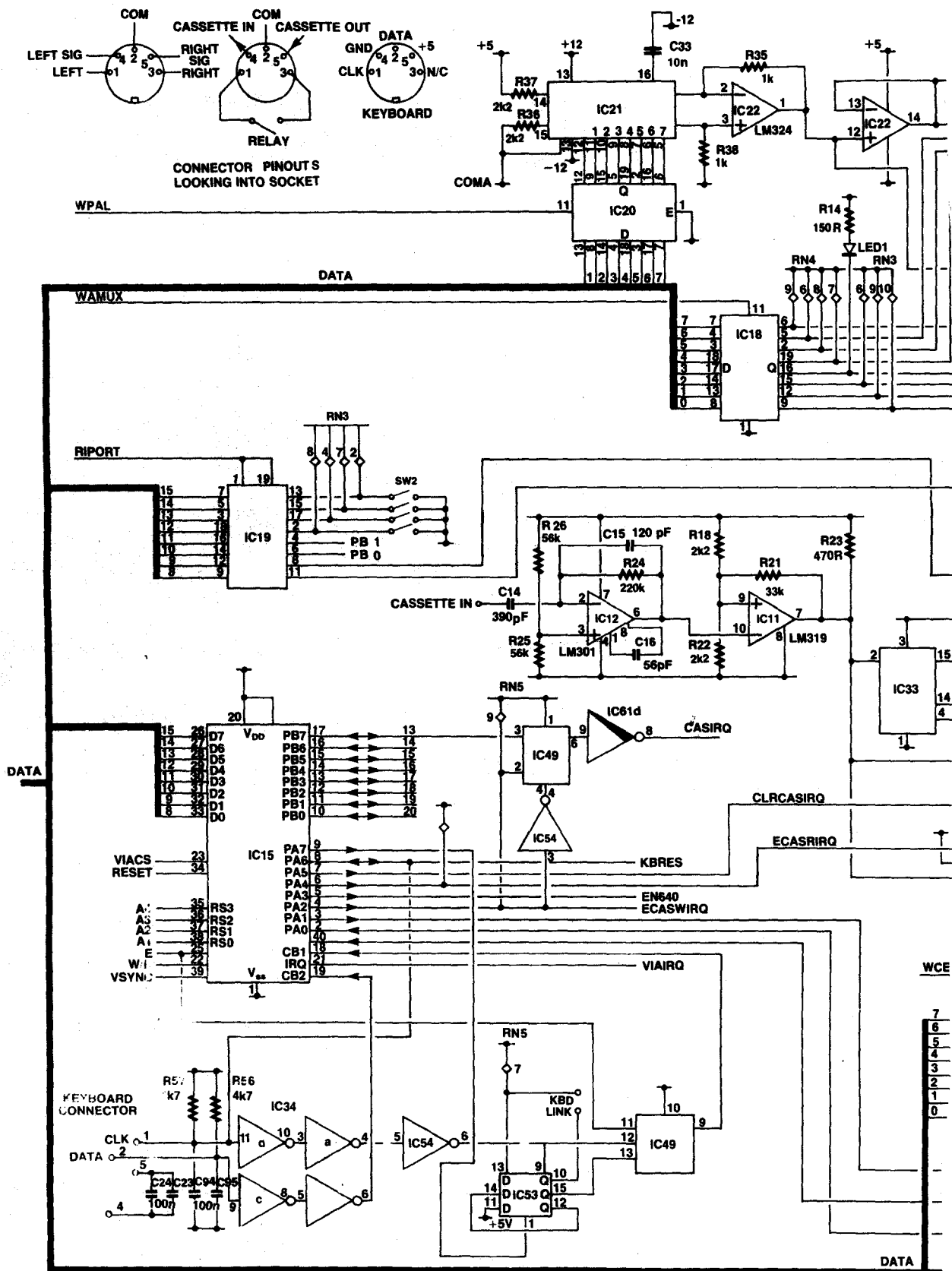
Data alignment

There are 16 data lines connecting the microprocessor to its memory. The MC68000 may read or write data in either 8-bit or 16-bit quantities. The signals which determine the amount of data to be transferred are $\overline{UDS}$ (upper data strobe) and $\overline{LDS}$. If $\overline{UDS}$ is asserted (set low) during a memory cycle, 8 bits are transferred across D8-D15. If $\overline{LDS}$ is asserted, 8 bits are transferred across D0-D7. Asserting $\overline{UDS}$ and $\overline{LDS}$ together causes a 16-bit transfer.

Although the data bus is 16 bits wide, ►

Signals with a bar across the top are active low. This means that when the signal is activated, it goes low.

Project 1616





the MC68000's addresses refer to byte (8-bit) quantities. Bytes which are at even addresses are transferred on data lines D8-D15 ($\overline{UDS}$ asserted). Odd address transfers occur across D0-D7. This is why the microprocessor has no A0 (address line zero) pin; the least significant address bit is kept internally and is used to determine which of $\overline{UDS}$ and $\overline{LDS}$ is to be asserted during a byte transfer.

Reading or writing a 16-bit quantity at an odd address would require two memory accesses to two different 16-bit addresses. The MC68000 does not permit this. The 32-bit reads and writes are accomplished by doing two accesses to consecutive 16-bit addresses.

Data transfer mechanism

The MC68000 uses asynchronous memory transfers. This means that instead of having a fixed memory access timing scheme, the MC68000 requests access to a memory location and waits until external hardware signals that the memory has responded. The signals which are used to indicate a memory access are $\overline{AS}$ (address strobe), $\overline{UDS}$ and $\overline{LDS}$. When the external memory address decoding hardware detects the assertion of these signals, along with a valid address it waits until the memory has had time to respond and then asserts then negates (raises) $\overline{AS}$ and terminates the memory cycle.

Bus errors

The asynchronous memory transfer mechanism essentially involves inserting memory wait states into the processor's bus cycle. Different types of memory have different access (response) times and so the address decoding circuitry must ascertain from the address what type of memory is being accessed and insert an appropriate wait period. If the processor attempts to access an address which no external circuitry recognizes, it will never receive a $\overline{DTACK}$ signal and will wait indefinitely. Note that such an address is an invalid one to which no device is mapped, and a reference to it could only arise from a programming fault.

Such an indefinite wait is terminated by yet more external hardware, which watches for a processor memory request (an assertion of $\overline{AS}$) and when one is detected its duration is timed. If it is determined that $\overline{AS}$ has been asserted for too long, then it is assumed that the processor is accessing an undecoded (invalid) address and the external circuitry asserts the MC68000's $\overline{BERR}$ (bus error) signal. This causes the processor to abort the offending memory access and to commence execution of a user-supplied error handling routine.

The mechanism of externally detecting an access to an invalid address by measuring the bus response time is known as a bus error, or a bus timeout, or a memory fault.

6800 device interface

The MC68000 signals E (enable clock), $\overline{VMA}$ (valid memory address) and $\overline{VPA}$ (valid peripheral address) facilitate a simple interface to devices from Motorola's 8-bit microprocessor family, the MC6800 series. When the address decoding circuitry recognizes an access to an MC6800 series device, it drives the MC68000's $\overline{VPA}$ signal low, and the processor then uses an MC6800 style memory transfer timing scheme which is quite different from that described above.

The 1616 uses this mechanism for addressing all of its I/O except the 8-bit output latches. This includes, of course, the 6845 CRTC and the 6522 VIA, both of which have MC6800 compatible bus timing.

Interrupt implementation

The MC68000 uses a prioritized interrupt scheme. It supports eight interrupt levels. The processor has an internal register which determines its current interrupt priority level. This ranges from zero (lowest) through to seven (highest). External hardware requests an interrupt by encoding a number onto the MC68000's interrupt request pins IPL0-IPL2. If the encoded

The 1616 is a complex circuit, and this, in a break from our usual policy, is not a complete description of how the thing works. Since we don't have an infinity of pages, you'll have to forgive us. If you are interested in a more detailed description, contact Applix directly.

number exceeds the processor's current priority level, the current priority level is moved up to that which was requested and the MC68000 commences execution of a user-written interrupt handling program. When this program is completed, the processor returns to its previous priority level.

Using this scheme, external interrupting devices may be organized according to the urgency with which their interrupt request must be handled. A high priority interrupt request may temporarily pull the processor out of handling a lower priority interrupt. An example of this may be seen in the 1616's interrupt organization. None of the VIA's interrupt sources need be serviced with great urgency, so the VIA is put at interrupt priority level two. For high speed communications we wish to respond quickly to the serial I/O interrupts, so the SCC is put at priority level three. This means that if the processor is dealing with a VIA interrupt when the SCC makes its higher priority interrupt request, the VIA interrupt handler will be temporarily suspended whilst the SCC interrupt is processed. The converse does not apply: if an SCC interrupt is being serviced when the VIA requests an interrupt, the VIA request will be ignored because its level is 2 whilst the processor is currently at priority level 3. The level 2 request will be recognized when the processor's priority returns to level 1 or level 0.

Hardware description

EPROMs:

The EPROM decoding circuitry is very simple. Any address in the range \$500000-\$5ffff (hex) enables the EPROMs.

The flipflop IC60 is used to get things under way when the processor is reset. The MC68000 requires valid data at addresses \$000000 to \$000007 immediately after it is reset. This is provided by initially enabling the EPROMs at all addresses throughout the entire memory map. The processor shortly commences execution in the normal EPROM address range at \$500000 and the memory map is restored to normal as soon as the processor performs a write operation.

Decoding RAMs

The 1616 sports 512 kilobytes of dynamic RAM on board organized as 256K of 16-bit words. The base address of the on-

ABOUT PALS

A PAL (programmable logic array) is a 20- or 24-pin IC which may be once-only programmed in a manner similar to bipolar fusible-link PROMs. A PAL may replace as many as 10 catalogue logic ICs when used to implement complicated logic functions.

The 16R8 PALS used in the 1616 consist of an array of AND gates which drive an array of OR gates, the outputs of which are latched and then passed to the outside world. When the device is in its unprogrammed state the inputs and the AND array are connected to all of the IC's inputs and to all of its outputs. A PAL is programmed by electrically removing some of the internal fuses which connect the AND array to the PAL's inputs and outputs. Designing a PAL fuse map involves selecting those fuses which are required to implement the desired logic function and then blowing all of the others in a suitable programmer.

A useful feature of the 16R8 PAL is its output registers. A group of eight latches on the outputs permit the storage of previous state information for the generation of complex timing sequences. The latches virtually eliminate timing skew between the PAL's output signals; when the PAL is clocked all of the output changes occur within a very short period, which eliminates many design uncertainties concerning device propagation delays.

board RAM may be set at either the 0, 1, 2, 3 or the 4 megabyte boundary using the 'mem' strapping block. For software reasons it is intended that all the RAM in the system be in one block, starting from address \$000000. Any expansion RAM boards will have either 1, 2, 3 or 4 megabytes of storage, and when they are installed the on-board RAM's address will be shifted up to the next address beyond the expansion RAM.

Timing

The 1616's memory timing scheme is quite complicated and lies at the very heart of the system.

The complexity of the timing is due to the need to resolve any contention between the MC68000's RAM accesses and those of the video circuitry. The video absolutely must read 16 bits from the RAMs at a rate of 1.875 MHz or else the display image would be affected. For this reason the processor access is synchronized to that of the video. For most of the time the interleaved video/processor memory accesses are quite transparent and the processor runs without any wait states — the video accesses are squeezed into the first half of the MC68000 bus cycle. Occasionally the MC68000 will lose synchronism with the video and it must be delayed (by retarding $\overline{DTACK}$) in such a way as to cause the processor to resynchronize.

It should be noted that this synchronization only applies to the on-board RAM. All other devices on the bus are accessed in a more conventional manner. This is possible because the video data paths are isolated from those of the rest of the system by the buffers IC28 and IC30. The video essentially has a private data bus and must only synchronize with the MC68000 when there is to be an exchange of data.

Benchmarks indicate very little speed difference between programs which run in RAM and those in ROM, indicating that the synchronization delays are not significantly slowing the processor.

Note that the MC68000 and the video circuitry accesses result in the on-board RAM being accessed at a continuous rate of 3.75 MHz. There are 7.5 megabytes per second going across the data bus and the RAMs are being cycled at 267 ns. The minimum specified cycle time for 150 ns dynamic RAMs is 250 ns and it is this which limits the 1616's processor clock frequency to 7.5 MHz.

A 16R8 PAL (IC51) and a 74F74 flip-flop (IC50) are driven at 30 MHz and together they perform the following critical timing functions:

- generation of the 7.5 MHz, 3.75 MHz and 1.875 MHz signals for system timing control functions;
 - processor/video synchronization by appropriately delaying $\overline{DTACK}$ and the RAM control signals;
 - generation of the RAM $\overline{RAS}$ (row address strobe) signal.
 - generation of the $\overline{MUX}$ signal which multiplexes the memory address (from either the MC68000 or the video circuitry) onto the RAM chips;
 - generation of the $\overline{CASU}$ and $\overline{CASL}$ (column address strobe upper and lower) signals which enable the RAM chips — the assertion of these signals corresponds to the assertion of the $\overline{UDS}$ and $\overline{LDS}$ MC68000 signals;
 - generation of the $\overline{LPULSE}$ (load pulse) signal which causes the video shift registers (IC29 and IC31) to be loaded from the RAM chip outputs;
 - enabling the $\overline{RAMWE}$ (RAM write enable) signal;
 - enabling the $\overline{DBRE}$ (data bus read enable) signal which turns on IC28 and IC30, driving the system data bus with the data read from the RAM.
- How's that for two chips?

Processor support

There is an amount of random logic around the processor which does the following things:

Bus fault timer: IC33 is a retriggerable monostable (or one-shot) which monitors $\overline{AS}$ and asserts $\overline{BERR}$ on a timeout.

Interrupt encoding: IC56 is an 8-input priority encoder which is used to encode the level of the highest priority interrupt which is currently pending onto the processor's interrupt request pins.

$\overline{DTACK}$ generation: IC57 and IC58 are used to generate the processor $\overline{DTACK}$ signal when the decoding circuitry detects a valid memory reference.

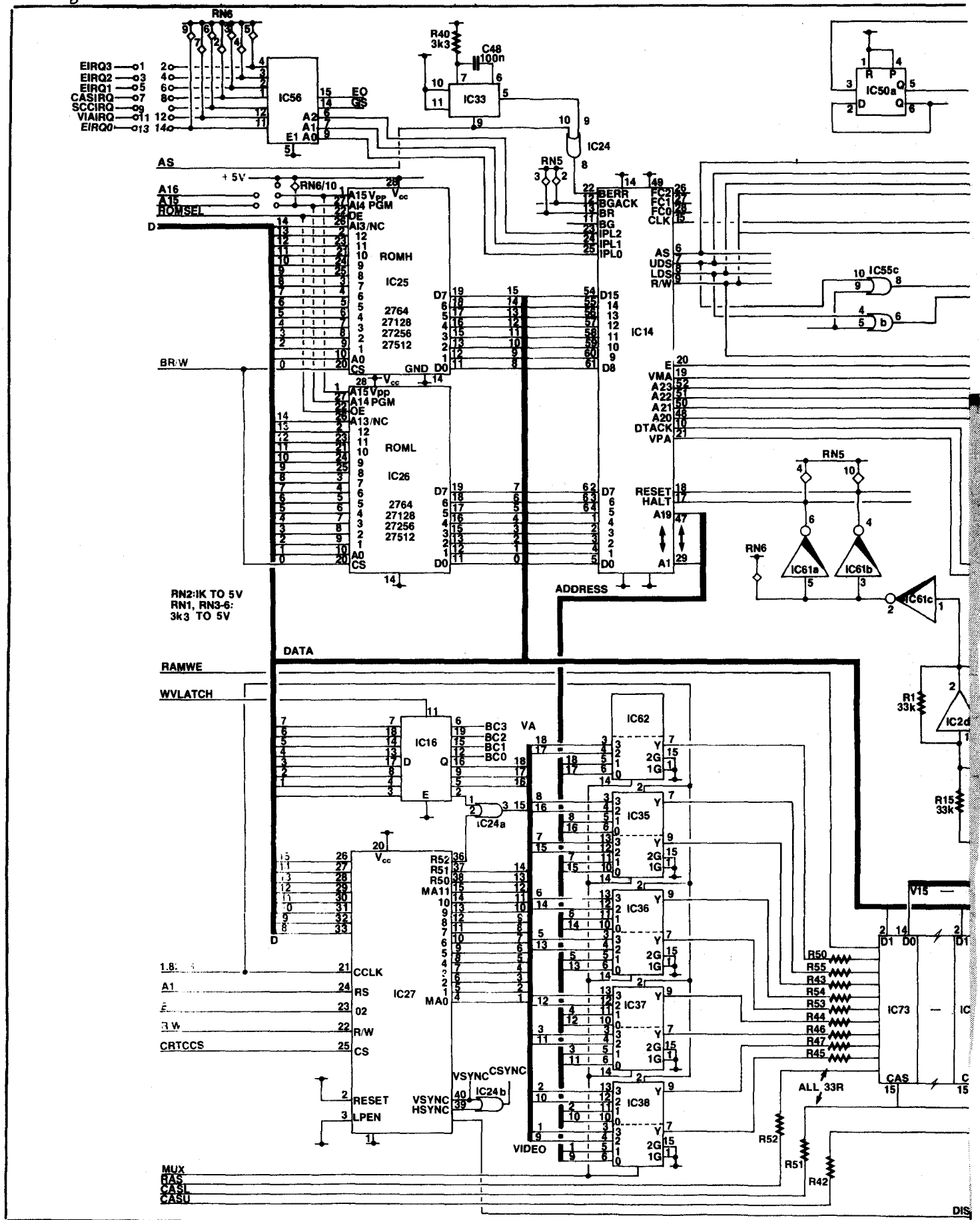
VPA generation: IC54 and IC57 detect when the MC68000 is addressing an MC6800 type address and inform the processor of this by asserting $\overline{VPA}$. The $\overline{VPA}$ signal is also asserted when the processor is first responding to an interrupt to inform the processor that the interrupting device does not support the MC68000 vectored interrupt scheme.

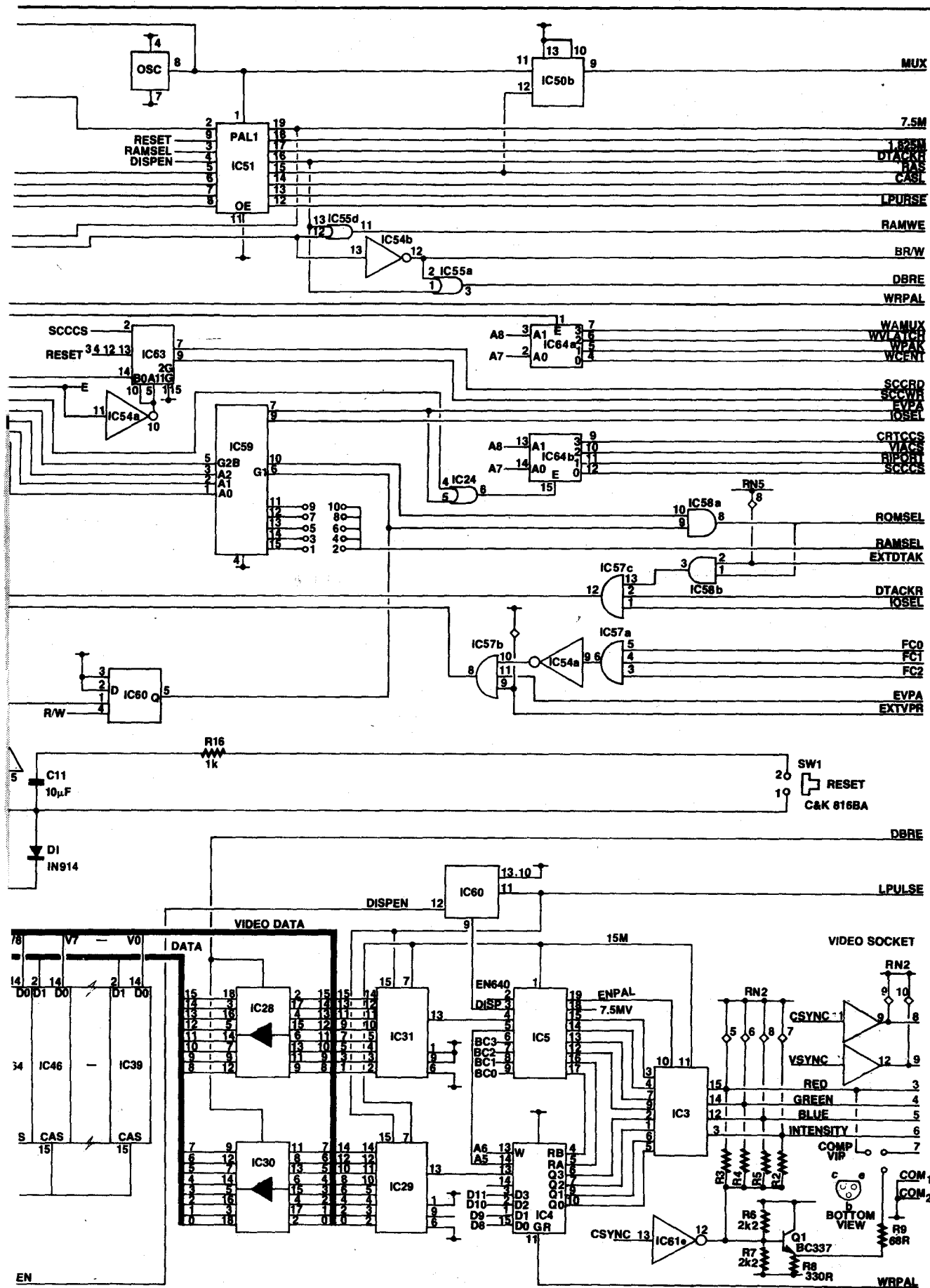
Reset circuitry: This logic handles the assertion of the MC68000's $\overline{RESET}$ and $\overline{HALT}$ signals to force reinitialization.

Address decoding.

Due to a lack of space on the circuit diagrams, we have not put chip type numbers on the diagram. Use this key to find out.

IC1	74LS374	OCTAL D FF	IC38	74LS153	MUX
IC2	74LS244	HEX INVERTER	IC39	41256	RAM
IC3	74LS298	MUX	IC40	41256	RAM
IC4	74LS670	MUX LATCH	IC41	41256	RAM
IC5	16R8	PAL2	IC42	41256	RAM
IC6	1489	HEX INVERTER	IC43	41256	RAM
IC7	1488	DRIVER	IC44	41256	RAM
IC8	1489	HEX INVERTER	IC45	51256	RAM
IC9	1488	DRIVER	IC46	41256	RAM
IC10	4051	ANALOGUE MUX	IC47	SPARE	
IC11	LM319	DUAL OP-AMP	IC48	SPARE	
IC12	LM301	OP-AMP	IC49	74LS74	FF
IC13	LM377	OP-AMP	IC50	74LS74	FF
IC14	MC68000P10	CPU	IC51	16R8	PAL1
IC15	R6522	VIA	IC52	SPARE	
IC16	74LS374	OCTAL D FF	IC53	74LS174	HEX FF
IC17	Z8350	SCC	IC54	74LS04	HEX INVERTER
IC18	74LS374	OCTAL D FF	IC55	7432	QUAD OR
IC19	74LS244	LINE DRIVER	IC56	74LS148	8 TO 3 ENCODER
IC20	74LS374	OCTAL D FF	IC57	74LS11	TRIPPLE AND
IC21	DA0800	DAC	IC58	74LS08	QUAD AND
IC22	LM324	QUAD OP-AMP	IC59	74LS138	MUX
IC23	4052	ANALOGUE MUX	IC60	74LS74	DUAL D FF
IC24	7432	QUAD OR	IC61	74LS05	HEX INVERTER
IC25	2764	ROM HIGH	IC62	74LS153	MUX
IC26	2764	ROM HIGH	IC63	74LS153	MUX
IC27	MC6845	CRT CONTROLLER	IC64	74LS139	MUX
IC28	74LS244	LINE DRIVER	IC65	SPARE	
IC29	74LS166	8 BIT SHIFT REGISTER	IC66	41256	RAM
IC30	74LS244	LINE DRIVER	IC67	41256	RAM
IC31	74LS166	8 BIT SHIFT REGISTER	IC68	41256	RAM
IC32	74LS74	FF	IC69	41256	RAM
IC33	74LS123	FF	IC70	41256	RAM
IC34	74LS14	HEX INVERTER	IC71	41256	RAM
IC35	74LS153	MUX	IC72	41256	RAM
IC36	74LS153	MUX	IC73	41256	RAM
IC37	74LS153	MUX			





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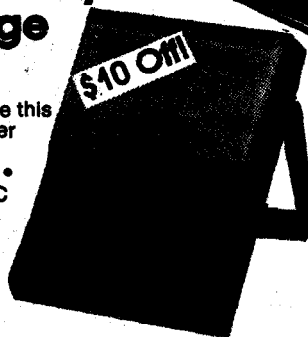


\$12⁹⁵
Was \$16.95

Ranges:
AC & DC Volts:
10, 50, 250 & 1000
DC Current: 0.5, 100mA
Resistance: x10, x1k

Buzzer continuity & 10A DC range included!

It's the extras which make this 19 range/20,000 ohms per volt meter such a good buy! • Audible continuity • Battery checker • 10A DC range • Diode and fuse protection. Includes mirrored scale and banana plugs. Cat Q-1022



\$24⁹⁵
Was \$34.95

RANGES:
DCV: 2.5, 10, 50, 250, 1000
ACV: 10, 50, 250, 1000 DC (mA): 5, 50, 500
& 1A RES: x1, x10, x1k Batt: 1.5V, 9V
Continuity



4.5 Digit Multimeter

Affordable 4.5 digit bench top that's versatile enough to take with you! Extremely accurate with high resolution. Cat Q-1550

• 10 voltage ranges — accuracy .05% DC
• 6 resistance ranges — accuracy .15%
• 200uA min — 10A max AC/DC
• 6,000 hours battery life.

Was \$289 **\$199**

Virtually a work bench in one meter!

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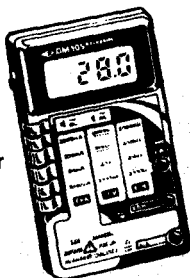
RANGES:
DCV: 0.25, 2.5, 10, 50, 250, 1000

(100k/V) ACV: 4, 10, 50, 250, 1000 (10k/V)
DC: 10mA, 2.5mA, 25mA, 500mA, 10A
AC: 10A Decibels: -10 to -82
Resistance: x1, x10, x1k, x10k
Transistors: Hfe 0-1000 Ico 0-50uA
Capacitance: 50pF-3uF, 0.01uF-50uF

Was \$125 **\$80**

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Pocket-size LCD meter that's brilliant value! 3.5 digit, wide angle display for accurate readings from virtually any position. RF shielding for stable readings. Overload protected too! Cat Q-1520



\$49⁹⁵ Was \$64.95

DC Voltage: 2000mV, 20, 200, 1000
AC Voltage: 200V, 750V
Resistance: 2000, 20, 200, 2000 ohms

Hot value... Temperature/multimeter

Versatile meter for all standard checks PLUS conductance, capacitance and temperature measurements! Temperature range covers an impressive -20° to 1370° Celcius for testing heatsinks, amplifiers, etc.



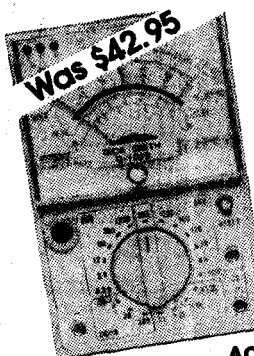
Includes: • 3.5 Digit display • Overload protection • Buzzer continuity. Cat Q-1512

RANGES:
DCV: .2, 2, 20, 100, 1kV
ACV: .2, 2, 20, 200, 750V
DC: 2, 20, 200mA, 10A
AC: 2, 20, 200mA, 10A
RES: 200, 2k, 20k, 200k TEMP: -20° to 1370°C
CAP: 2000pF, 2uF, 20uF

\$169
Was \$199

Meter with logic tester!

Double value at a bargain price! This superb 20 range multimeter includes a built-in logic tester indicating 'HIGH' 'LOW' and 'PULSE' states of logic circuits. Cat Q-1026

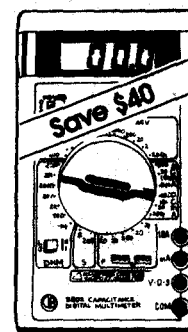


NOW \$32⁹⁵

RANGES: DCV: .3, 3, 12, 60, 300, 1200
ACV: 6, 30, 120, 300, 1200
DC: .06 3, 30, 300mA RES: x1, x10, x1k, x10K

3.5 Digit meter/cap checker

A reliable work bench companion that offers more than multimeter functions. Also checks:
• 5 ranges of capacitance
• 2 ranges of conductance.
Added features include:
• Auto polarity • Diode check position • Over-load protection • High input impedance (10M). Cat Q-1460



\$89 Was \$129

RANGES: DCV: .2, 2, 20, 100, 1kV
ACV: .2, 2, 20, 200, 750V DC: 200uA, 2, 20, 200mA, 10A
AC: 200uA, 2, 20, 200mA, 10A
RES: 200, 2k, 20k, 200k, 2M, 20M
COND: 2uS, 200nS
CAP: 2, 20, 200nF, 2, 20uF
DIODE TEST: 1mA, -2.8V

3.5 Digit with MEMORY...

• Simple press button memory retains reading until cleared!



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Save \$30!

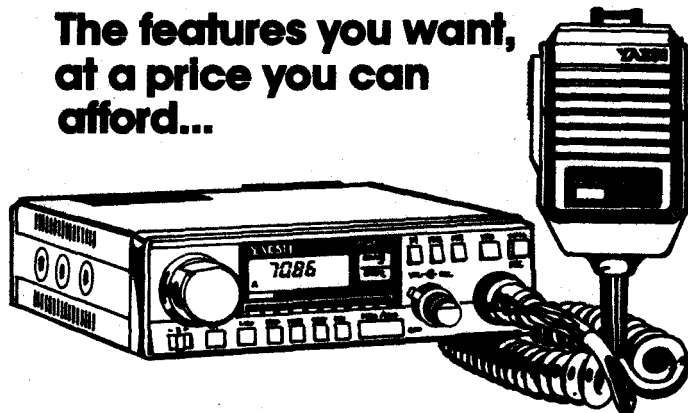
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HF Linear amp

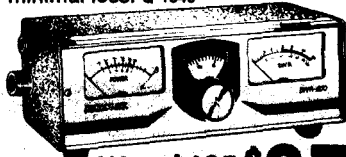
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• 3-Level RF power selection
• Input/output impedance: 50 ohms nominal. Famous TOKYO HY-POWER Brand. Cat D-2547



\$99 Was \$299

Famous Oskerblick HF Power/SWR meter

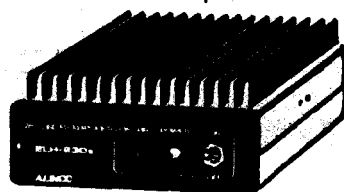
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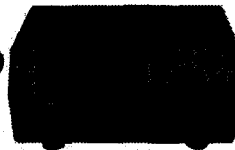
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Project 1616

Video

The MC6854 CRTC video controller generates timing and addressing signals which interact with the timing PAL to load 16 bits of data from the RAMs into the shift registers (IC29 and IC30) every 533 ns. This data is shifted two bits at a time into the video PAL (IC5) at 15 MHz.

The 8-bit video latch (IC16) holds the video border colour (4 bits) and the video display RAM address offset (4 bits). Using this latch the video display RAM may be set to start at any 32K boundary within the on-board RAM. This permits the use of multiple display pages to implement

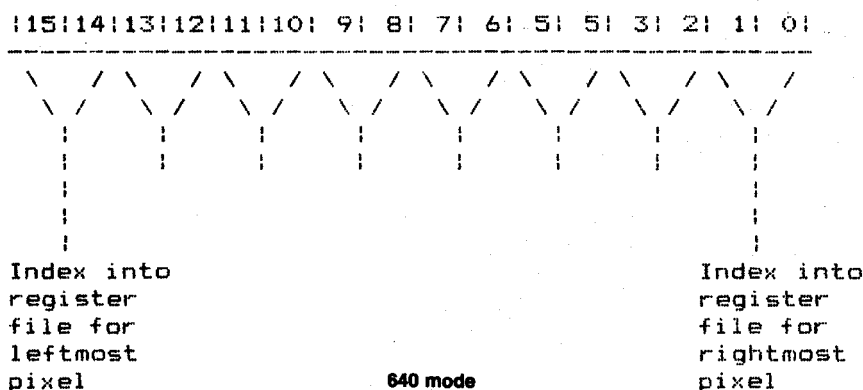
7.5 MHz stream of 4-bit words.

The border colour may be any of 16 colours, independent of the video mode.

The data selector IC3 selects the video data from either the PAL or the register file, latches it internally and presents it to the video mixing circuitry.

The video mixing circuitry converts the video data into both a standard IBM RGBI output and into a 16 grey scale composite sync signal.

Memory mapping: In 640 and 320 column mode, each word (16-bit quantity) in the 1616's video display memory is represented on the screen as below.



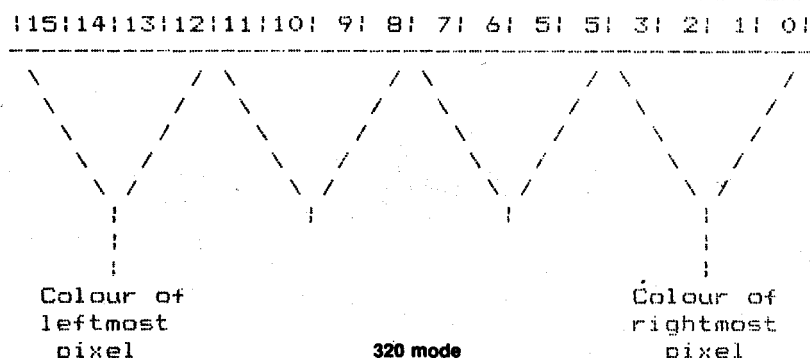
animated displays. The 1616 operating system ROMs fully support this feature.

640 column mode: In this mode, video data is shifted out at 15 MHz. The two bits coming from the shift registers are used as an index into the 4x4 bit register file, IC4. The 4x4-bit words in the register file are written by the processor and allow the programmer to map each of the four colour combinations into one of the 16 available colours.

320 column mode: In this mode the RGB and I signals are generated by the video PAL, rather than being read from the register file. The PAL simply remembers the previous two bits from the shift registers and presents them alongside the current two. This is essentially a serial-to-parallel conversion and it produces a

Note that the most significant bits of a word appear toward the left side of the display. The mapping of screen memory addresses to screen coordinate positions is quite complicated. This is due to the use of the MC6845 RS0, RS1 and RS2 signals to address the memory, and to the use of the MC6845's hardware scrolling capabilities. There is extensive software support for video display manipulation in the 1616's operating system ROMs.

The 1616 video, unlike most computers, has no text-only mode. Due to the speed of the MC68000 it is possible to draw characters onto the screen from a table of character shapes stored in memory. This table is stored in a compressed format in the 1616's ROM and is transferred into main memory at power on. There are two



main advantages to this method. Firstly, it allows an infinite number of display formats, including different font styles and sizes, and secondly, it simplifies the design of the video circuitry.

The use of an MC6845 allows the programmer to select a wide range of video formats, including interlaced mode and variable horizontal and vertical formats. The 1616's video drivers initialize the CRTC for 640 (or 320) columns, and 200 scan lines. This requires 32K of video RAM. The number of columns and lines may be increased or decreased, but the programmer will have to write his own drivers to support non-standard configurations.

BUYING THE 1616

The 1616 is available directly from its designers, Applix. As of writing we have been approached by many anxious distributors so you may eventually be able to purchase it elsewhere also.

When designing the 1616 our aim was to make it a useful, cost-effective, high performance kit computer. We have tried to make the kit as appealing and flexible as possible. The response to the introductory article was in a word "overwhelming", especially as the pricing and distribution had not been finalized.

KITS

The Mini Kit costs \$239 and includes the 1616 printed circuit board, EPROMs, PALs, 30 MHz oscillator, MC68000 processor and socket, and the user/construction manual. This kit would be for people who can source their own components and are familiar with a project of this type.

The Basic Kit costs \$449 and includes all the components, connectors plus the contents of the Mini Kit. This kit would appeal to most people and works out significantly cheaper than purchasing the Mini Kit and sourcing the components commercially. But it is also important to note that this kit does not include the necessary components to implement the serial, Centronics and user ports, as most people would regard these as optional. It also does not include IC sockets.

OPTIONS

The I/O Kit costs \$59.95 and includes all the necessary components to implement the serial, Centronics and user I/O ports.

The IC Socket Set costs \$29.95. Due to the controversial nature of the use and type of IC sockets we have decided to make them available separately. The sockets included in the kit are of sufficient quality for a project of this type. You may use your own (machined, etc) or, if you are brave, use none at all. As stated elsewhere we only offer service/repair to fully socketed Basic Kits.

The keyboard is \$139. A high quality 'IBM AT style' detachable keyboard.

The power supply is \$69. Standard 'Apple type' switching power supply with suitable power connector.

Applix will also be offering competitive prices on other related products but you are certainly not restricted to buying everything from us.

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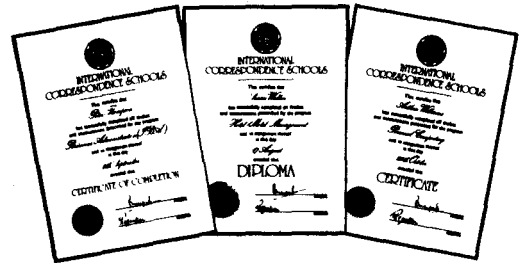
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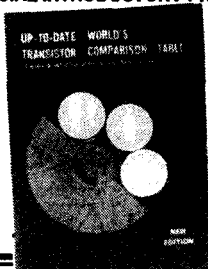
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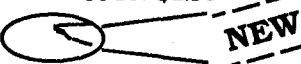
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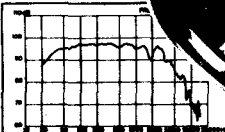
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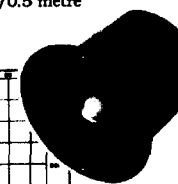
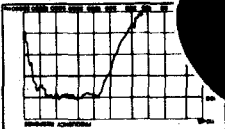
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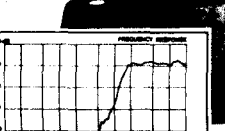
\$22.50



PIONEER 2 1/2" TWEETER

This super efficient tweeter will suit most 3 way speaker systems. 8 ohms, frequency response 2kHz - 20kHz, nominal sensitivity 100dB/W @ 0.5 metre, 60 watts rms system power handling. Cat. CT-2002

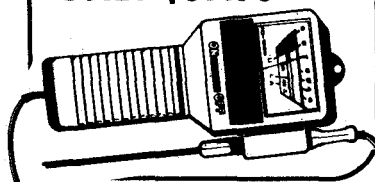
\$7.95



pH & CHLORINE METER

Two probes coming out of one end of this hand held device are inserted into the water to be tested. An instant reading of the Chlorine level & pH value is given on the panel meter display. Put an end to messy chemical tests for your pool this summer. Great for fish tanks too! Battery powered. Cat. QM-6135

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INCREASED SLIDER POT RANGE

slider pots have become almost impossible to buy lately. We have a range ex-stock with some values in huge quantities for OEM's.
RP-3904 2K LIN 45mm \$3.95 \$3.50
RP-3908 5K LIN 45mm \$3.95 \$3.50
RP-3910 50K LOG 45mm \$3.95
RP-3912 50K LIN 45mm \$3.95 \$3.50
RP-3920 100K LIN 45mm \$3.95 \$3.50
RP-3925 500K LIN 45mm \$3.95 \$3.50
RP-3932 250K DUAL LIN 45mm \$5.50 \$5.00
RP-3938 10K LOG 60mm \$5.50 \$5.00
1-9 10+



DOUBLE SIDED COPPER CLAD PCB

Back in stock and in two brand new sizes too! Fibreglass.
8" x 5" (210 x 120)
Cat. HP-9518

\$ 4.95

6" x 6" (150 x 150)
Cat. HP-9519

\$ 5.75

12" x 12" (300 x 300)
Cat. HP-9520

\$12.95

THIN DOUBLE SIDED COPPER CLAD BLANK PCB

We now stock a high grade fibreglass PCB material that is about HALF as thick as normal PCB. The copper (double sided) is the same thickness as normal PCB. It is ideal for applications where weight is important i.e. model aircraft, cars, etc., wireless microphones, etc. It is also good for RF work as the ground plane effect is greater (because the sides are closer together). It is also fairly flexible.

It is available as double sided only. If you want single sided etch one side off completely.



DIRT CHEAP!!
LAST(?) CHANCE
ever to buy
quality 1/4" reel-to-reel
tape at dirt cheap prices!

That's right! Once again Jaycar has purchased the entire remaining stock of 5" reel 1/4" "BASF" brand quality Ferro LH Hi Fi magnetic recording tape.

Type LP35 275 metres or 900 feet. This tape will run for 45 minutes at 33 1/3 L.p.s. There is a fair amount of stock. It is better quality because the Mylar backing is slightly thicker and therefore is less likely to stretch.

1-9 **\$3.95** 10- 19 **\$3.00**

20 plus **\$2.50**
Cat. AR-1512

BASF

C20 CASSETTES

Exceptionally good quality leaderless blank cassettes in the usual plastic case.

Cat. XC-4715

**NORMALLY \$1.50 each
THIS MONTH 90 cents each!
10 up 75 cents each**

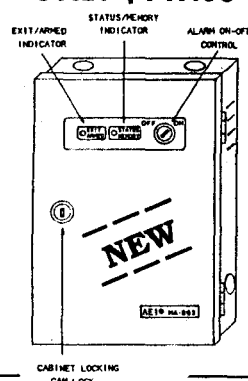
HOME ALARM PANEL

The latest in home control panels.

- 3 sectors N/O or N/C
- Triggers instantaneously if any sensor wiring cut
- 24 hour instant circuit
- 2 relay outputs, ideal for strobe
- Power supply to suit \$29.50 (Cat. MP-3021)
- Backup battery \$28.50 (Cat. SB-2480)

Cat. LA-5162

ONLY \$149.50



3 SIZES

3" x 6" (75 x 150)
Cat. HP-9522

\$2.25

6" x 6" (150 x 150)
Cat. HP-9523

\$3.95

12" x 12" (300 x 300)
Cat. HP-9524

\$9.95

ULTRAVIOLET EPROM ERASER

It's all very good being able to program EPROMs easily but how do you ERASE them quickly and safely? You can put them out in the sun for an undetermined time or use a special high-power UV-tube in an unprotected fluoro batten. You could also end up with a white walking stick!

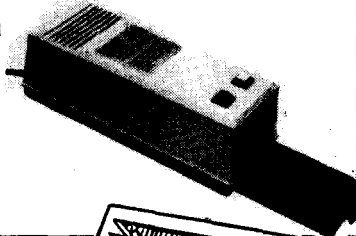
If you need to regularly erase the contents of EPROMs (even NEW EPROMs could be corrupted with random data) then this is your most cost-effective solution. It will erase up to 9 x 24 pin devices in complete safety to your eyes and your chips, in around 40 minutes for 9 chips (less for less chips). This US-designed product has a special safety conductive-foam chip drawer and has a double-insulated design for your safety.

FEATURES

- Erase up to 9 chips at a time
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures thorough erase
- Engineered to prevent UV exposure
- Long UV tube life

Cat. XE-4950

ONLY \$99.50



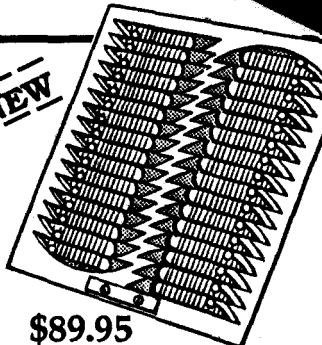
LOW COST SOLAR PANEL

- WILL CHARGE A LEAD ACID 12V BATTERY

We have purchased the surplus stock of a well known brand solar panel. The panel will deliver 16 volts at up to 200mA in bright sunlight. This is sufficient to slow charge a car battery!

The units are made in the USA and are completely epoxy sealed. They can be screwed into any flat panel. Ideal for boats, farms, etc.

Cat. M-9008



\$89.95

WERE SELLING FOR \$149.50 ELSEWHERE

COMPONENT VALUE PACKS

- 6 new component packs that represent unbelievable value for money. These are an ideal start to that junk box that is essential to all electronic enthusiasts.

MIXED CAPACITOR PACK

Don't miss this bargain! This pack contains approx. 150 assorted capacitors.

Not junk values, most are normal stock lines. Here's what you get:

RT Electro 1uF, 4.7uF, 25uF, 100uF, 220uF, 470uF most 63V, 10,000uF 16V

RB Electro 1uF, 2.2uF, 25uF, 47uF

GreenCap 100V .0022, .01, .22, 1uF

GreenCap 630V .0022uF, 0.1uF

Ceramic 4.7pF, 47pF, 220pF, 470pF, 0.022uF

Polystyrene 220pF, 820pF, 2200pF

1kV Ceramic 330pF, 470pF, 680pF - PLUS LOTS MORE

150 PRIME SPEC CAPACITORS FOR \$10.00

That's only 6.6 cents each!! SAVE 84%

At our current prices these caps are worth \$61.00 Cat. RE-8260

*We reserve the right to make changes to this pack if stock shortages occur.

SEMICONDUCTOR PACK

This pack includes EPROMs, RAM, CMOS, TTL Transistors, diodes and Zeners - the EPROMs alone are worth \$10.00!!

Cat. ZP-8990

100 SEMIS FOR \$10.00 - SAVE MEGABUCKS!!

NUTS AND BOLTS

A pack of 80 assorted 1/8" whitworth nuts and bolts for hobbyist work. Bolts include both round head and countersunk types from 1/2" to 1 1/2" long.

Cat. HP-0380

ONLY \$1.95 - they would normally be worth \$6-\$7

TANTALUM PACK

This pack contains 25 Kemet type RT tantalums. These are military spec and much higher quality than the resin dipped type we are used to. These Tantalums are worth up to \$5 each!! Here's what you get:

4 - 0.1uF, 4 - 4.7uF, 4 - 6.8uF, 3 - 10uF, 4 - 15uF, 2 - 22uF, 2 - 47uF, 1 - 100uF

Cat. RZ-6692

ONLY \$5 That's only 20 cents each!!

SEE RESISTOR & DIODE PACKS

4164 MEMORY SALE

Quality MOSTEK brand

150nS 1-9 \$3.50, 10-24 \$3.25,
25 + \$3.00 Cat.ZZ8422

200nS

1-9 \$3.25, 10-24 \$2.75,
25 + \$2.50 Cat.ZZ8420

QUANTITIES LIMITED.

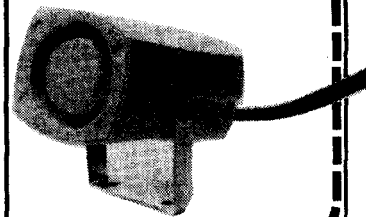
Brand new prime spec parts.

TWEETY PIE - 116dB

This incredible little piezo screamer measures 57(L) x 33(H) emits a 116dB wail. It's deafening! As used in the screamer car alarm kit.

Cat. LA-5255

\$16.95



NEW SEMIS

100V 35A STUD DIODE

We now carry a standard D0-5 stud mount diode that will carry 35 amps RMS at 100V peak inverse. Quality Motorola brand.

Part No. 1N1184

Cat. ZR-1042

\$5.00 each

10 up \$4.50 each

8 BIT DAC

MOTOROLA MC1408LS

(Similar to DAC-08)

This is a high quality ceramic based $\pm 1/2$ LSB D/A converter in a 16 pin DIL package. Settling time 300nS typical. Data sheet \$0.50.

Cat. ZZ-8060

\$5.00 each



8T-26A/MC6880A QUAD BUS EXTENDER

This is the Motorola Schottky TTL inverting data bus extender. They are tri-state and bi-directional, quad packaged in a 16 pin DIL.

Cat. ZZ-8082

\$1.95 each

10 up \$1.50 each



AND ONE OLD SEMI!!

1702 EPROM 256 x 8

The original! Now out of production but still needed as a spare. Brand new stock.

Cat. ZZ-8451

\$2.95 each

10 up \$2.00 each



QUARTZ CRYSTAL CLOCK MOVEMENT

*Very compact * Powered by one 1.5V AA battery that lasts for one year * 56mm square, 15mm deep * Very accurate.

Fit your own custom clock face. Great for novel applications such as fitting to pictures. Supplied with 3 sets of hands.

Cat. XC-0100

\$12.95



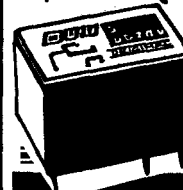
24V PCB MOUNT S.P.D.T. RELAY

Quality Japanese made relay at a bargain price. One normally closed and one normally open contact. Each rated at 3 amps. Convenient PCB mount. Connection diagram provided.

Cat. SY-4067

\$1.95 (cheap!!)

NEW



CONCORD NOW OPEN ON SATURDAY FROM 9am - Noon

RESISTOR PACK SENSATION!!

RESISTORS FOR LESS THAN A CENT EACH!!

We have made a jumbo resistor pack. Each pack contains over 1,000 1/4, 1/2, & 1 watt resistors of computer selected useful values! This is a once only offer and cannot be repeated. We estimate that you only need to use 10% of this pack to recoup your outlay.

Cat. RR-1682

ONLY \$7.50 for over 1,000 Resistors!

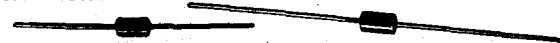
NEW DIODE PACKS

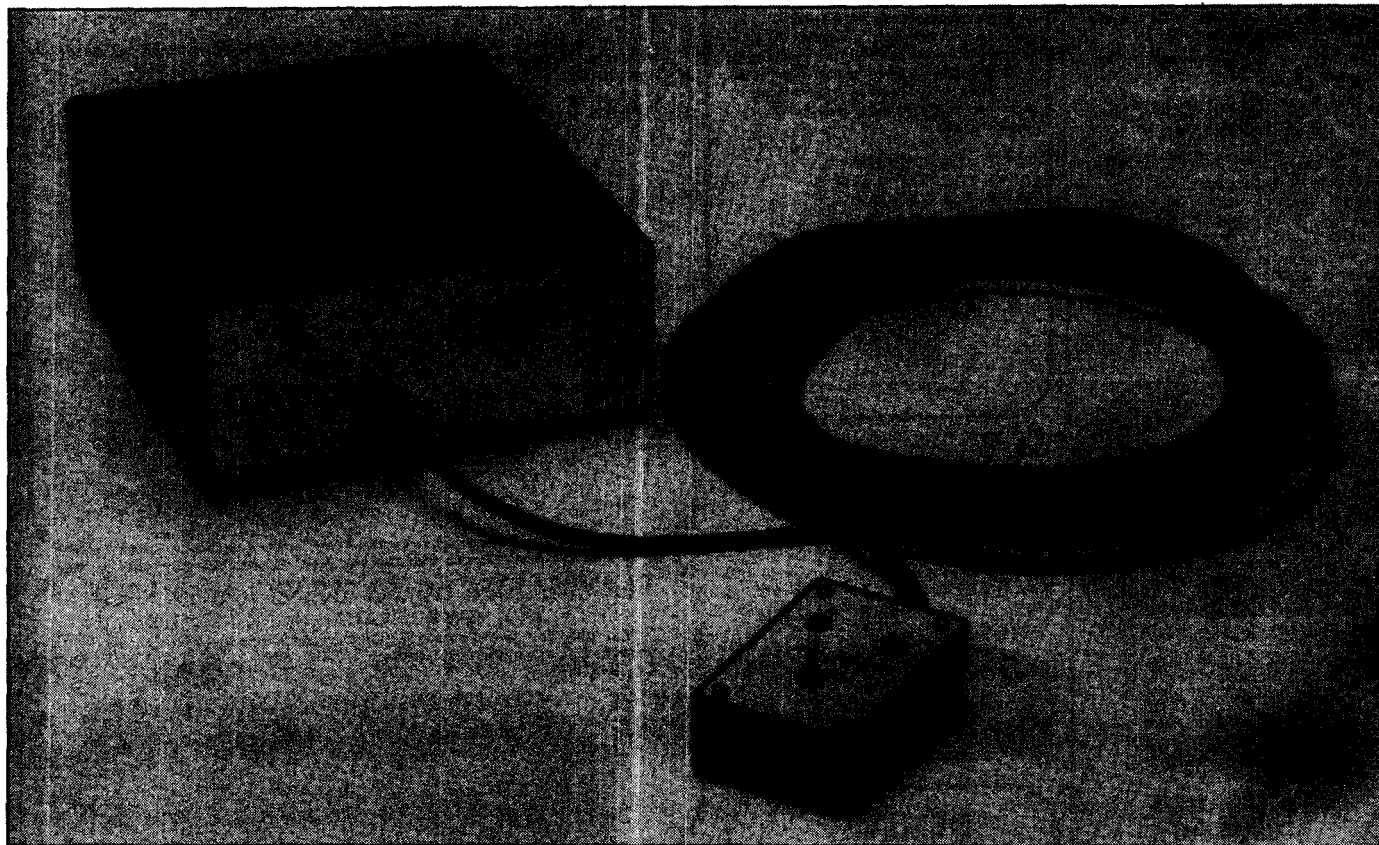
1N4004 400V 1A - pk 100 \$7.50

Cat. ZR-1005

1N4007 1000V 1A - pk 100 \$14.00

Cat. ZR-1006





STEREO LOUDSPEAKER SWITCHER

Terry Kee

Have you ever wanted to switch between two pairs of loudspeakers to confirm that your favourite pair is simply the best? If so then read on. This ultra-useful project includes an anti-thump circuit and also finds an application in the recording or home studio.

A LOUDSPEAKER SWITCHER is extremely simple in concept yet it finds a wide range of applications for the audiophile and in the recording studio. The most obvious application would be to use it as an A/B loudspeaker switcher. Subjective listening tests on the sound quality of two stereo speaker systems can be made while the switcher is used to quickly switch between the two pairs under test.

In a recording studio environment it is often required to use at least two pairs of monitor speakers whilst doing a recording or during a mixdown. A high quality pair is used to monitor the sound quality of the recording, the other pair is used to give the engineer an idea of the way it would sound in a typical hi-fi set-up in the home. The loudspeaker switcher would also be an economical approach to switching be-

tween the two pairs using a common amplifier. Do I hear whoops of delight from those who have been denied music because the amplifier in the lounge has walked into the studio in the spare room?

Another feature of the ETI-1412 is its anti-thump circuit. At switch-on in an audio set-up the first sign of life is normally heard as a thump from the speakers. In a system where many audio processors are interconnected, eg, in a studio, where powering up via a single mains switch is common practice, the thump can be quite a problem. In extreme cases it can actually damage the speakers. Some amplifiers produce loud thumps on their own at switch-on. The anti-thump circuit is incorporated to reduce these problems.

loudspeaker switcher

Description

A toggle switch is used to select loudspeaker A or B and two LEDs indicate which pair is selected. The switch and LEDs are housed in a hand-held remote control box connected via cable to the main unit.

In the early stages of designing the anti-thump circuit, it was decided to avoid having any form of circuitry connected across the loudspeakers as it would inevitably detract from the speaker units under test.

Furthermore deriving a trigger signal for the anti-thump circuit and power source from the amplifier was also avoided as it would mean dismantling and groping deep into the depths of your prized amplifier.

A simple solution used in the switcher is to have the anti-thump detector circuit across the power amplifier output only for the switch-on period. The trigger signal is actually derived from the audio output of the left power amplifier. When power is applied to the switcher, the relay contacts

are configured so that the speakers are disconnected from the amplifier. At this point the anti-thump circuit is connected

across the amplifier output and waits for a signal. When a change of dc level or an audio signal exceeds the threshold level of

ETI — 1412 — HOW IT WORKS

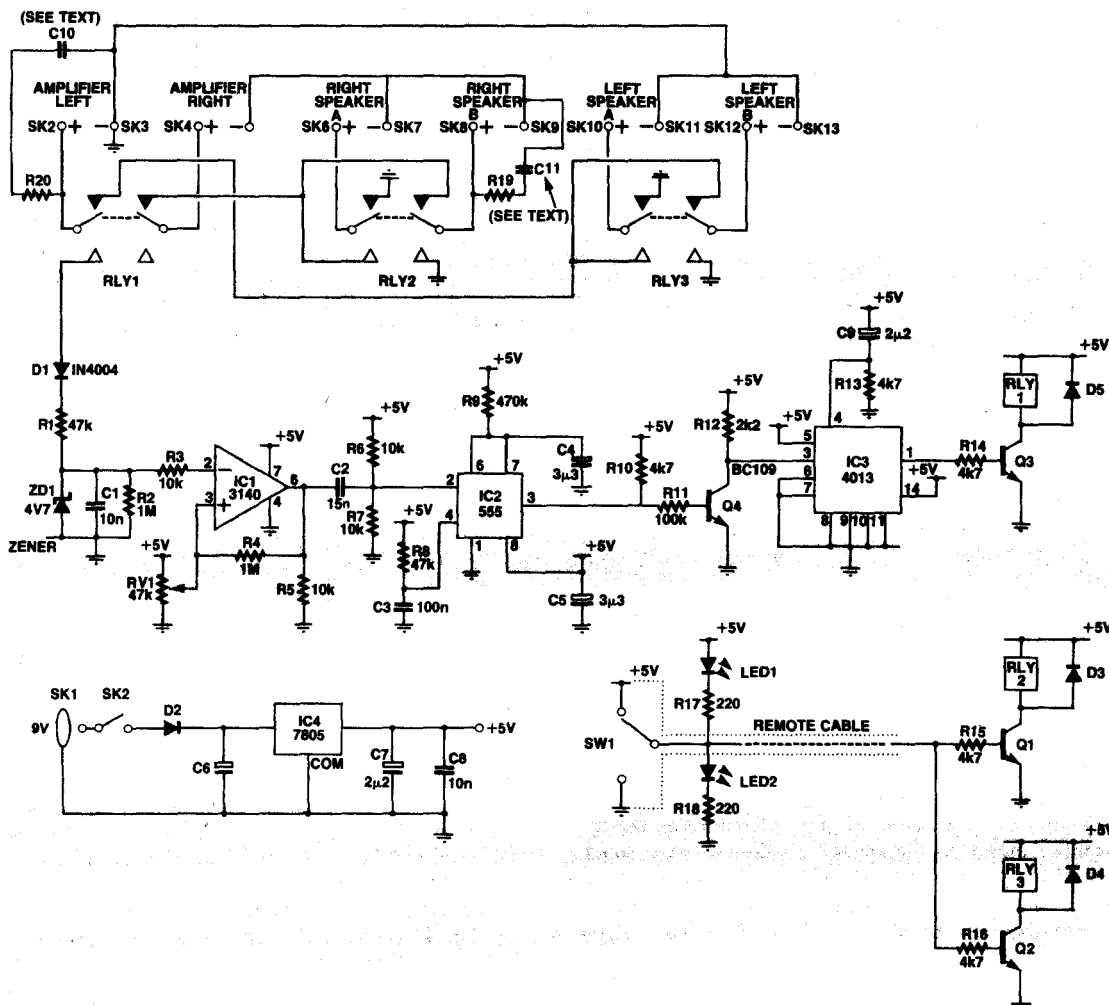
Relays RLY2 and RLY3 actuate the speaker switching from pair A to pair B and vice versa. The relays are configured to ground the speaker pair that is not selected to minimize crosstalk, eg, if pair A is selected then pair B is grounded. Q1 and Q2 are the transistor coil drivers of RLY2 and RLY3 respectively. The switching voltage is derived from SW1 in the remote control.

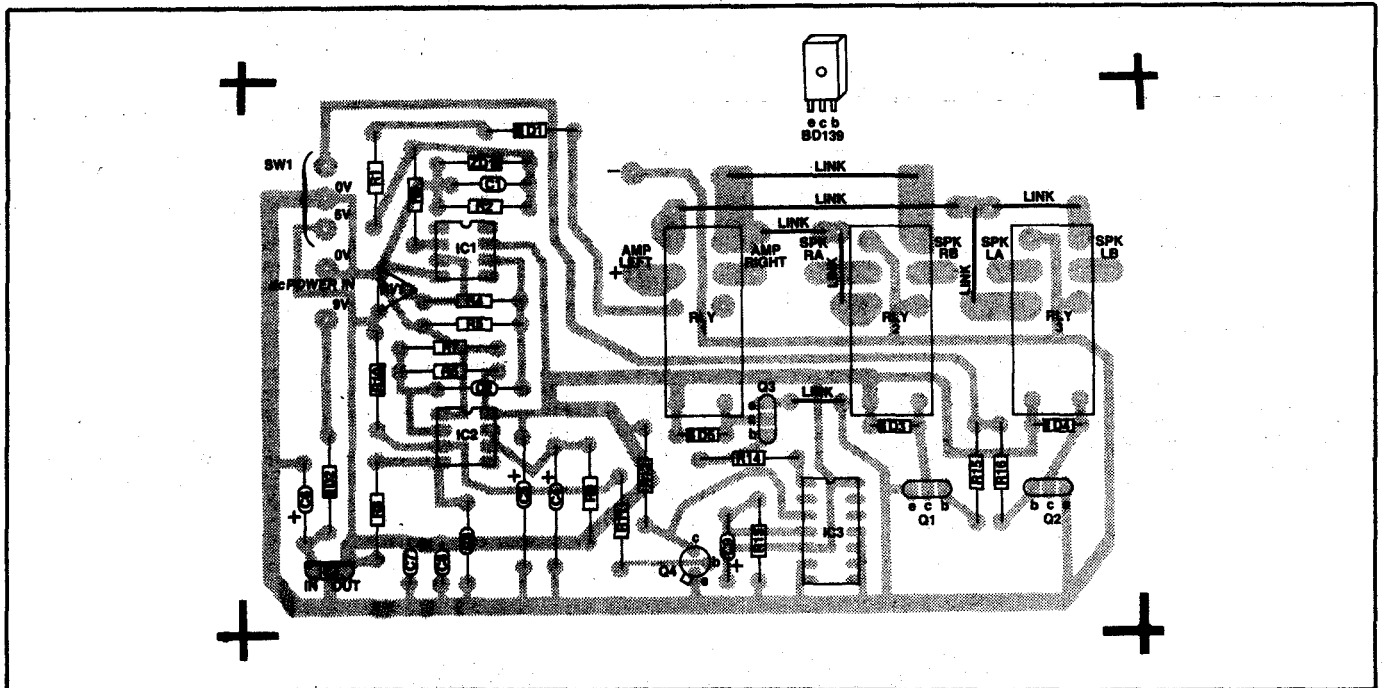
D1 is a half-wave rectifier and with C1 derives a dc signal from the output of the left amplifier to trigger the anti-thump. ZD1 clamps the voltage to 4.7 V for large voltage excursions. The rectified voltage is fed to IC1 which is configured as a Schmitt trigger.

The non-inverting input of IC1 has its threshold voltage varied by RV1. When the threshold level is exceeded the output of IC1 is driven low and triggers the 555 timer. When triggered, the timer will drive its out-

put (pin 3) to a high for the timing period of about 2 seconds in this case. The on period cannot be re-triggered until it times itself out and is determined by R9 and C4 (see text). On powering up C3 and R8 ensure that the 555 is reset. IC3 is a D-type flipflop and latches its output to a high when the timing period of the 555 expires. This in turn will drive Q2 on and switch over the relay contacts of RLY1. Once the flipflop is latched, the only means of resetting it would be to turn off the dc supply. On powering up the flipflop is reset by C9 and R13.

The dc supply is derived from a 9V power pack and IC4 provides a 5V regulated voltage rail. The switcher draws a maximum of around 210 mA and occurs when RLY1, RLY2 and RLY3 are driven on. D2 protects the circuit from power supply reversal.





ETI-1412 — PARTS LIST

Resistors.....all 1/4 W, 5%, unless noted

R1, 8.....	47k
R2, 4.....	1M
R3, 5, 6, 7.....	10k
R9.....	470k
R10, 13, 14, 15, 16.....	4k7
R11.....	100k
R12.....	2k2
R17, 18.....	220
R19, 20.....	8R2 5 W (see text)
RV1.....	47k vertical preset

Capacitors

C1.....	10n greencap
C2.....	15n greencap
C3.....	100n greencap
C4, 5.....	3µ3 electrolytic 25 V
C6.....	220µ electrolytic 25 V
C7, 9.....	2µ2 electrolytic 25 V
C8.....	10n ceramic 25 V
C10, 11.....	220n greencap

Semiconductors

LED1, 2.....	5 mm LED
D1, 2.....	1N4004
ZD1.....	4V7 Zener 1 W

D3, 4, 5.....	1N4148
Q1, Q2, Q3.....	BD139
Q4.....	BC109 or equiv
IC1.....	3140 FET input op-amp
IC2.....	555 timer
IC3.....	4013B dual D flipflop
IC4.....	7805 5 V regulator

Miscellaneous

RLY1, 2, 3.....	pcb mounting DPDT 6 V, 5 A 72 ohm coil resistance (Fujitsu 621D006)
SW1.....	miniature SPDT toggle
SW2.....	miniature on-off toggle
SK1.....	dc power socket (2.1 mm)
SK2-SK13.....	banana sockets or sockets of your choice:

ETI-1412 pcb; metal cabinet (185 x 70 x 160 mm); Zippy box (28 x 54 x 83 mm); 9 V plugpack 300 mA; loudspeaker cable; 6 m twin shielded cable; regulator clip-on; heatsink.

Price estimate: \$80
(excluding plugpack)

a Schmitt trigger things start to happen. A 555 timer will be triggered for around 2 seconds and when the delay period expires, the relay contacts will close and connect the amplifier output to the speakers. This should allow sufficient time for the various power supplies to complete charging their smoothing capacitors.

The anti-thump circuit is now set and can only be reset by turning off the power supply. In normal use this function is quite

adequate and resetting is only required when the audio system is switched off.

Construction

Building the switcher should not present any problems as most of the components, except for the remote control, are mounted on the pcb. Start by checking the board for bridged or broken tracks. Once you are satisfied that the board is acceptable, drill all the necessary holes, includ-

ing those for mounting.

Next insert and solder the links, resistors and capacitors, taking care to get the correct orientation of the electrolytics. The IC sockets come next. Make sure that they are pressed down properly on the board when soldering. Do not insert the ICs themselves until later on. Next proceed by mounting and soldering in the relays, RV1 and finally the diodes, transistors and regulators. Ensure that the polarity of the diodes is correct and that the transistors and the regulator are oriented the correct way. Refer to the component overlay.

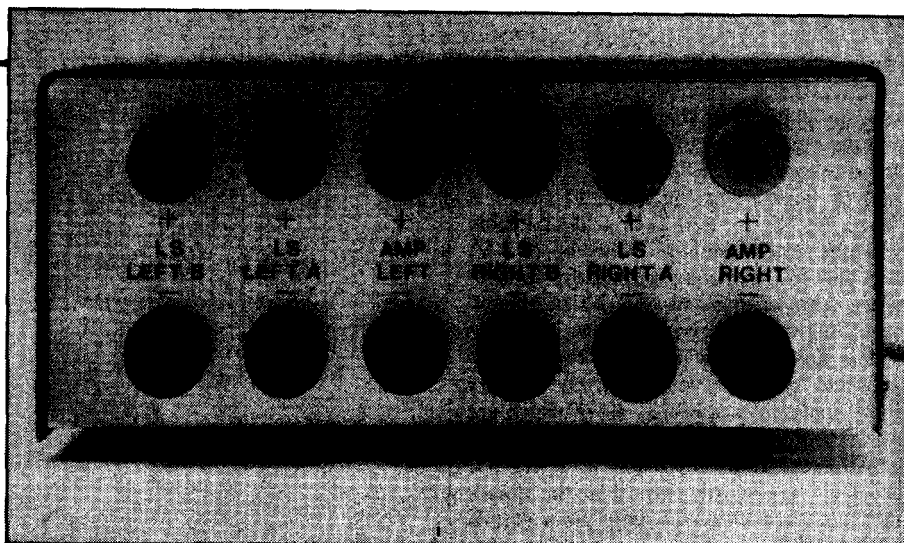
Tin the copper tracks of the relay connections to the amplifier and speaker as they will be carrying high currents under load.

Before the wiring to the pcb can be completed, the switch and sockets need to be mounted on the front and back panel of the box. I have opted to use banana sockets for the speaker and amplifier connections, however other socket types may be used. Starting with the back panel, drill the holes for the banana sockets or sockets of your choice. Then proceed with the holes for the on-off switch, dc power switch and remote cable on the front panel. Once that is done mount the sockets and switches into position. A clamping rubber grommet should be used to fasten the remote cable where it leaves the box.

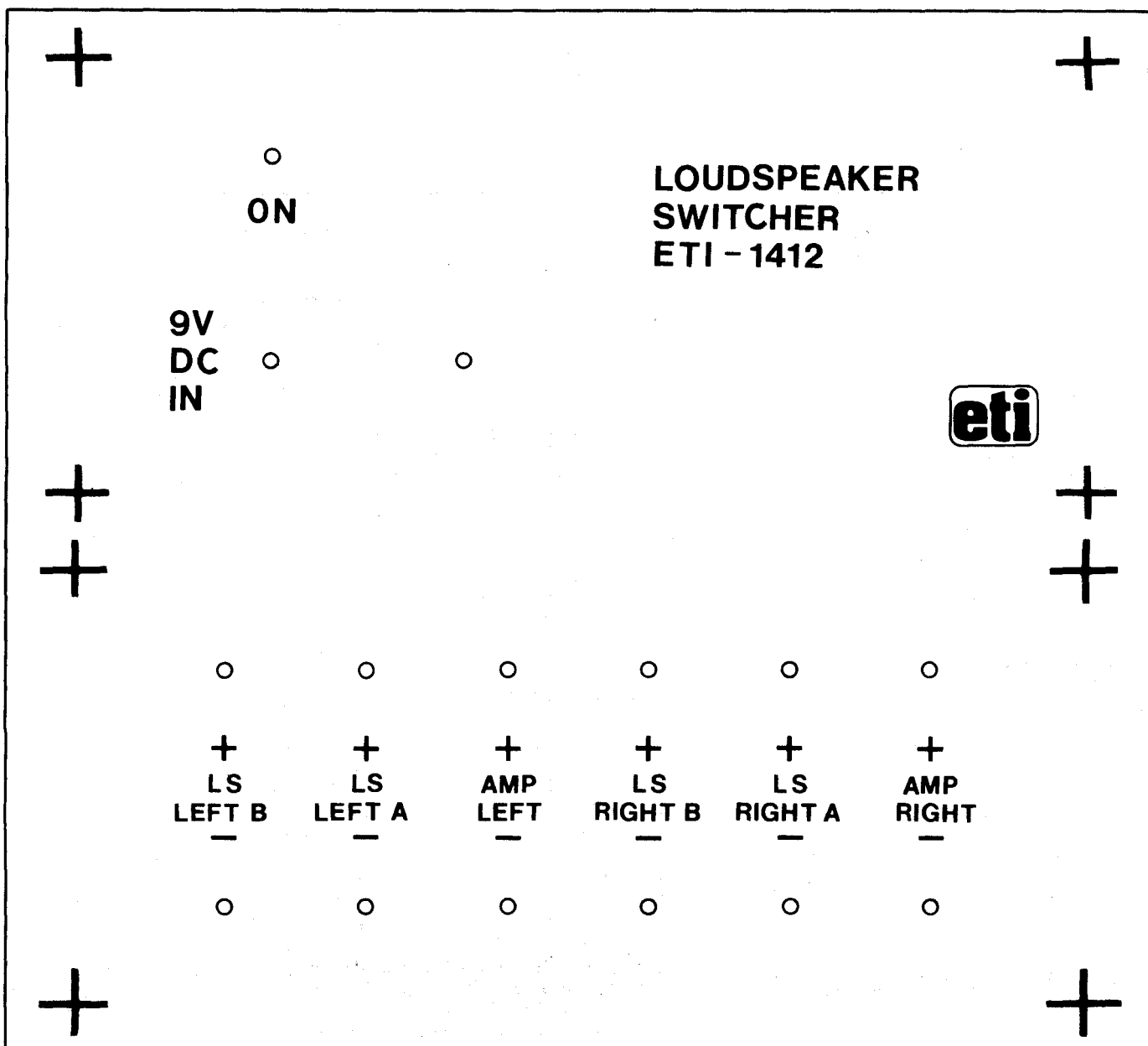
Use tinned copper wire (22 swg) to connect the negative terminal of the left amplifier to the negative end of the left A

and B loudspeaker at the sockets on the back panel. (Refer to the wiring diagram.) Similarly do the same for the right amplifier and right A and B speakers. It is important to ensure that the negative terminal of the left and right channels is not connected as unwanted hum-loops can develop. Also make sure that the correct polarities are observed. Use suitable loudspeaker cable for the speaker and amplifier to socket connections. Note that only the negative terminal of the left amplifier is connected to 0 V on the pcb. The on-off switch and plugpack dc socket can now be wired in.

The construction of the remote control can now be started. Drill the holes for the



Sockets on the rear panel.



Project 1412

selector switch and the two LEDs on the top plate of the box. Drill another hole on the side for the remote cable. Use a grommet or tie knot in the cable to fasten it down. I chose to use a twin screened cable with the outer braiding connected to 0 V; 6 m should be adequate for most applications. The writing can now be completed according to the wiring diagram.

The next exercise is to go back to the pcb and check it very carefully for dry joints and solder splashes, all of which are quite common even for the experienced constructor. It is important to check for short circuits in the vicinity of the amplifier and speaker connections as a simple solder splash can be an expensive one. Once you are convinced that all is well, insert the ICs into their sockets making sure of their correct orientation. Take the usual precautions with handling the CMOS devices.

Testing

Connect the 9 V plugpack and switch on the dc power switch. If the measured voltage rail is not within 800 mV of 5 V, disconnect the plugpack and re-check the circuit in the vicinity of the supply rail. If all is well, one LED on the remote will light and toggling the selector switch will toggle RLY2 and RLY3. The relay switching can be heard as the contacts change over.

Next, measure the dc voltage at pin 3 of IC1 and adjust RV1 for a reading of 600 mV on the multimeter. This is the maximum sensitivity for triggering the anti-thump circuitry. Connect the amplifier and speakers to the unit and once that is done, power up the amplifier with the volume control turned right down. Gradually increase the volume control, with a sound source connected to the amplifier, of course. When the signal level exceeds the threshold level, IC1 will trigger and start the delay time thereafter connecting the speakers. The sensitivity can be decreased by adjusting RV1 for a higher threshold voltage. If you want the time delay changed then it is a simple matter of changing the value of R9 or C4. The time delay is given by the equation: $td = 1.1 \cdot R \cdot C$.

Once the circuit is triggered it is time to use the switcher for switching. Toggling the switch on the remote should switch-over your speakers from pair A to pair B or vice versa. If not, then check your wiring to the back panel of the unit and then the amplifier and speaker connections.

The 5V regulator (IC4) will get warm as the circuit will draw around 210 mA when all the relays are driven on. A small heat-sink clip mounted on the regulator will help dissipate some of the heat.

A

B

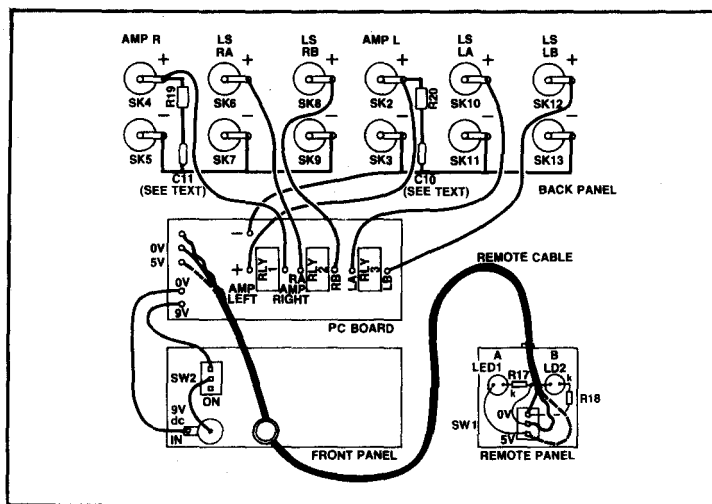
ETI-1412

In use

The switcher will cope with a maximum power rating of 100 W into 8 ohms per channel with the stated relays. We recommend you do not switch near or at full power due to the problems of switching highly inductive loads. It's far better to be safe than sorry. Furthermore the life ex-

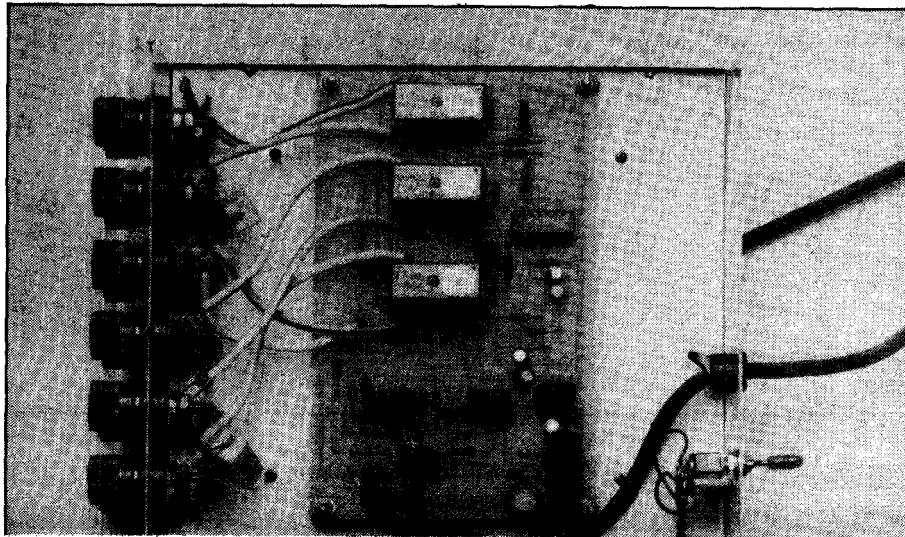
pectancy of the relays tends to decrease when switching high currents.

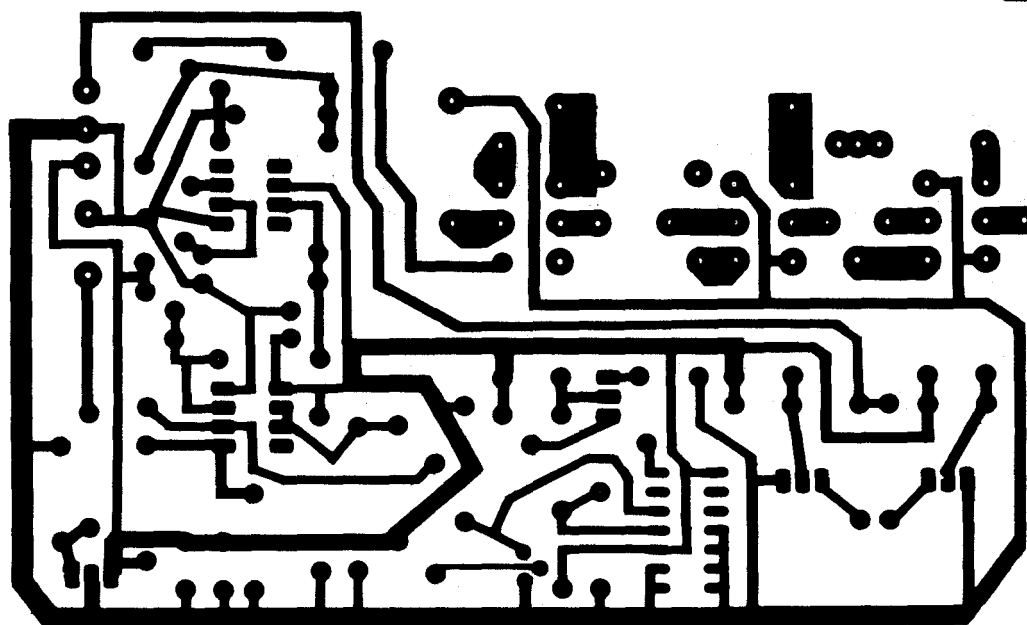
Some switching noise will be apparent due to the switching of inductive loads and open-circuiting the amplifier outputs for the change-over period. For these reasons it is imperative to use an amplifier that remains stable under these conditions. Certain valve amplifiers, for example, will protest quite strongly by exterminating themselves under no load conditions. Also, avoid using ac coupled output amplifiers, remember them? The switching noise heralds itself as a click and is dependent on signal level, amplifier, cross-over and speaker type. As an option, connecting in R19, C11 and R20, C10 across the right and left amplifier respectively should help reduce the switching noise a little by introducing a load at high frequencies. These components can be mounted at the sockets on the back panel (see the wiring diagram). My colleagues and I felt quite strongly about having minimal additional circuitry in the audio path and at average listening levels the transient noise is negligible.



Wiring diagram.

The pc board inside the box.





\$13,000 REFERENCE MONITORS

— also available in kit form.

Readers of overseas hi-fi magazines often wonder why imported quality loudspeakers sell for over twice the price in Australia. The answer is simple – but for good reasons not advertised.

Fully imported speakers incur such cost factors as:

- * 25-30% freight
- * 30% sales tax
- * 25% import duty
- * 28% handling charges (typically)

Not one of these factors improve the sound – they only contribute to the extremely high Australian price tag. A pair of fully imported 4-way DYNAUDIO reference speakers is today priced at \$13,250 in Australia.

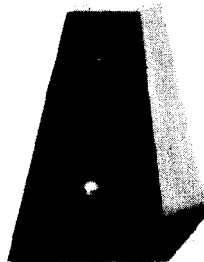
By importing the drivers only and utilising world renowned Australian technology (Thiele & Small) together with local genuine timber craftsmanship, it is now possible to acquire a pair of these speakers fully assembled at less than half this price.

For the technically minded hi-fi enthusiast further savings are possible by assembling the speakers yourself. Pre-built enclosures and crossovers make this task a mere breeze. A good soldering iron and a Phillips head screwdriver will save you a further 30%. Should you happen to be in the furniture production industry, enclosure plans can be supplied with the kit (drivers and crossovers) for even greater savings.

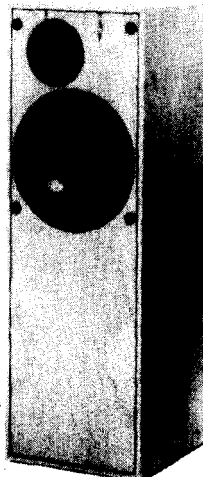
To audition the \$13,000 DYNAUDIO reference monitors, contact SCAN AUDIO for full details and the name of your nearest authorised DYNAUDIO specialist.



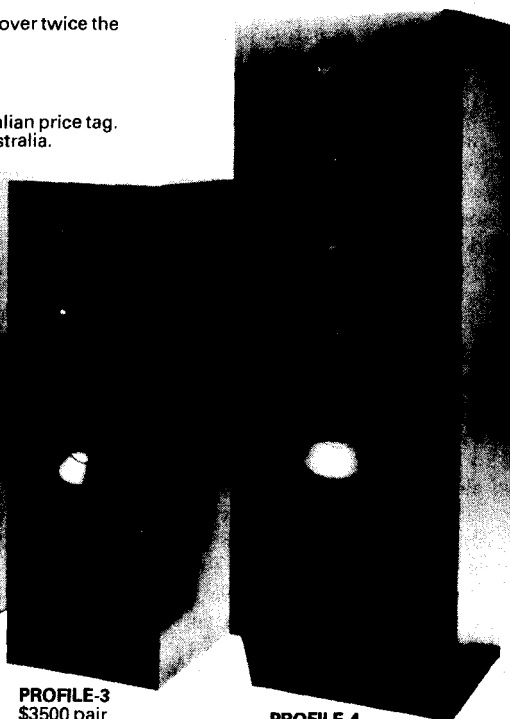
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SCAN AUDIO Pty. Ltd., 52 Crown
 Street, Richmond, Vic. 3121.
 Phone: (03) 429 2199 (Melbourne)
 (02) 871 2854 (Sydney)
 (07) 357 7433 (Brisbane)



SATELITE-2
 \$1700 pair
 (\$1200 as kit)



PROFILE-2
 \$2500 pair
 (\$1700 as kit)



PROFILE-3
 \$3500 pair
 (\$2400 as kit)

PROFILE-4
 \$5200 pair
 (\$3600 as kit)

HI-FI SPEAKERS

This is a no-expense-spared, high quality speaker project. It uses the best components available on the market. The result is a speaker that costs less than \$2000, but will give you performance better than that of a \$10,000 speaker.

Mike Henriksen

Mike Henriksen is the managing director of Scan Audio.

OVER THE PAST two years we have seen an increase in the number of well designed loudspeakers on the market. However, with the fall of the dollar, they are becoming more and more expensive, to the extent that a decent speaker is now a luxury item. For this reason we decided to try our hand at designing a hi-fidelity loudspeaker.

The idea was that the speaker should use the best possible components and have the best possible performance, but at a realistic cost. We recognized that the cost would not be insignificant, but at least it wouldn't be outrageous.

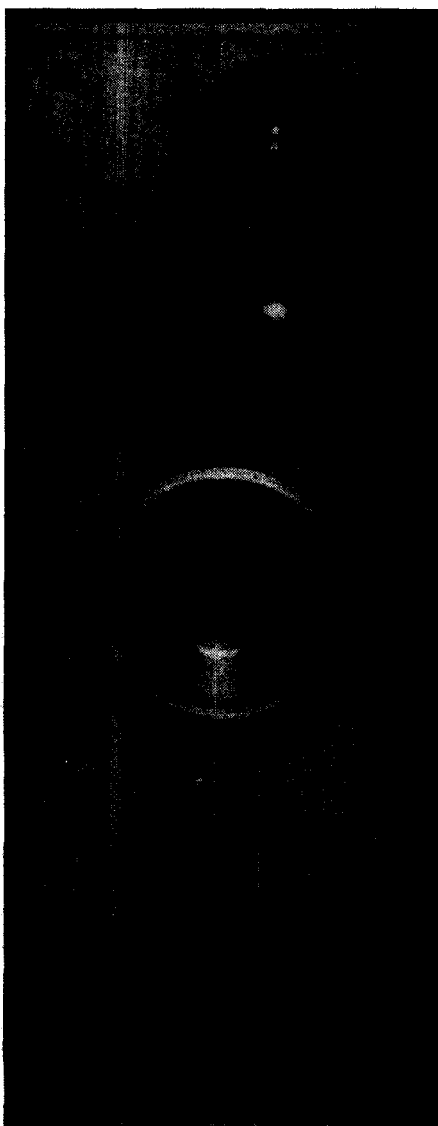
The aim was to design a speaker that could compete with some of the most expensive fully imported speakers available on the Australian market.

The first question to be answered was: what drivers? Many are good, but we held the view that overall the best of the lot were those from Dynaudio in Denmark. If Denmark seems like an odd choice of country, read the accompanying specifications.

Drivers

The woofer chosen for this system is an 8" model 21W54. The basket is heavy-duty diecast magnesium with a 125 mm magnet fitted to the back. The voice coil is a 54 mm aluminium former with Dynaudio's hexagonal shaped aluminium voice coil wire. The peak linear excursion is 7 mm and a massive 29 mm maximum excursion ensures that this driver is capable of generating the lowest deep bass in a correctly tuned cabinet even at high volume.

The surround is a foam surround fitted to Dynaudio's PHA (phase homogeneous area) diaphragm, which is a polymer



based mixture enriched with metal oxide particle for higher damping.

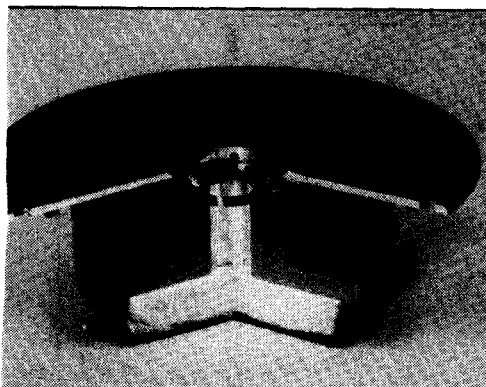
This woofer has a total Q factor of 0.303 and a VAS of only 60 litres making it ideal for a medium sized bass reflex cabinet.

We used a complicated computer program to optimize the bass reflex cabinet for this woofer. After modelling on the computer for a few hours we found that a box volume of 55 litres and a port tuned to 37 Hz would give a flat frequency response down to 40 Hz and a 3 dB down-point of 35 Hz; at 30 Hz it would be down only 6 dB.

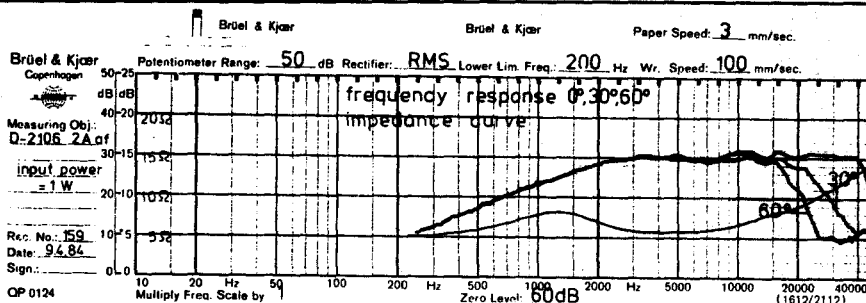
As midrange we chose the 52 mm soft textile dome midrange from Dynaudio, the D52AF.

This midrange is a very interesting construction as the voice coil is working in a ferro-fluid cooled air gap, ensuring the highest possible power handling capacity and excellent damping qualities of the diaphragm. A hole has been drilled in the pole piece making access to a rear chamber behind the magnet which is damped with long fibre wool. In this way the free air resonance has been lowered considerably to only 350 Hz, making this driver ideal for a 3-way system with low crossover frequency point. The frequency response is almost ruler flat between 700 and 7000 Hz and its dispersion characteristics are down only 3 dB at 60° off axis at 5000 Hz.

An ideal tweeter for this 3-way system was the D21AF Dynaudio Super Tweeter. Its construction is very similar to the D52 with aluminium wire voice coil with a hexagonal shaped aluminium wire, double chamber cabinet with low free air resonance and superb dispersion characteristics

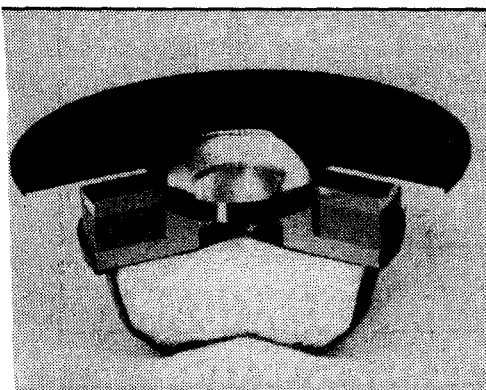


Cross section of the tweeter.

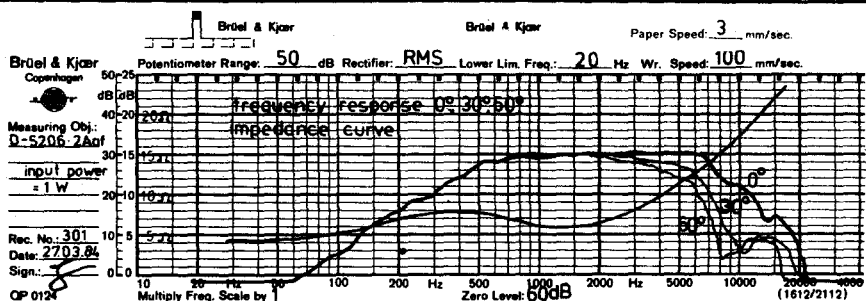


Frequency response from 3.000 up to 40.000 Hz ± 1 dB!! The impedance curve shows the resonance well damped.

D-21 AF

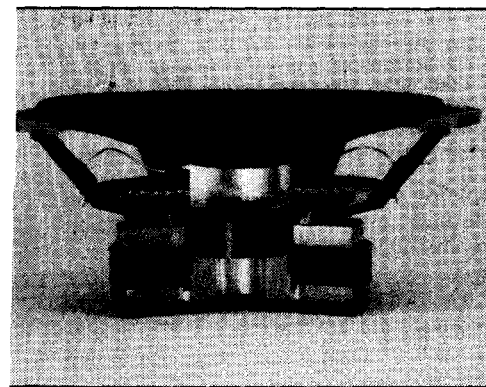


Cross section of the midrange driver.

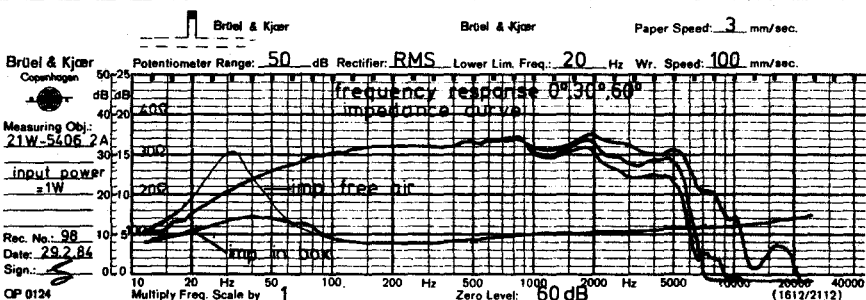


The curve indicates wide dispersion and smooth dropping at both ends which is the correct behaviour of a midrange.

D-52 AF



Cross section of the woofer.



Balanced response up to 4 kHz, important in 2way combinations. Early roll-off and high but narrow resonance impedance indicate high magnetic damping and energy.

21W-54

(see frequency response chart). The response of this tweeter is flat from 3000 to 40,000 Hz, its only variation ± 1 dB.

The cabinets

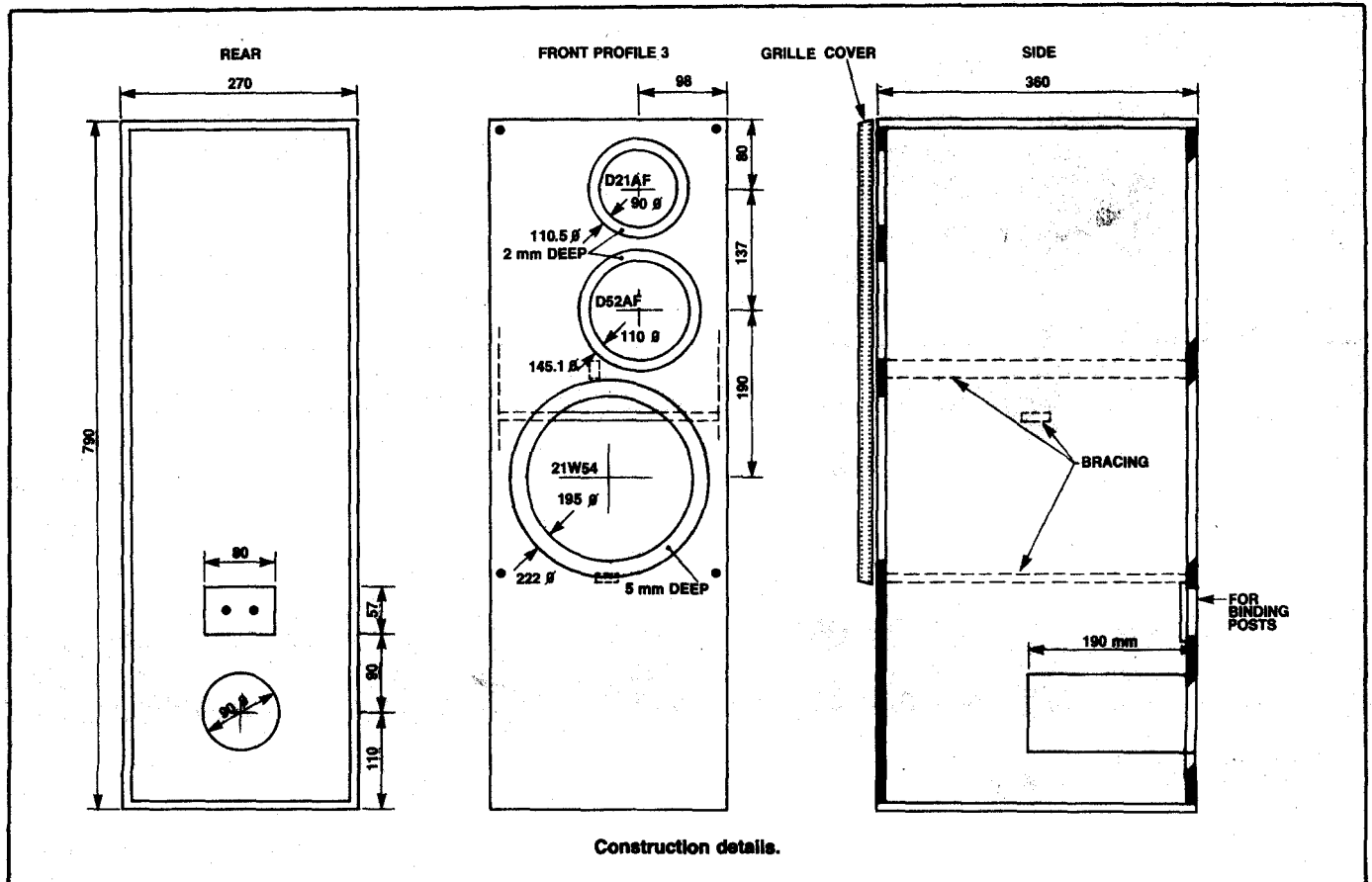
In designing the cabinet we aimed for a tall slim floor-standing cabinet for various reasons. By making the cabinet as slim as possible the beaming effect from the front

panel would be as small as possible, and another advantage would be that the speaker would look smaller in a domestic situation.

By off-centering the tweeter and midrange we would achieve better stereo imaging because the physical distance would be different from the two edges of the cabinet. We made the cabinet fairly high,

so that the tweeter and midrange would be as close to ear level as possible when the listener is positioned in an ordinary lounge chair, which we considered would be the most common listening position.

As mentioned earlier, the system was designed as a bass reflex cabinet and we had various options in positioning the port. We decided to position the port in ►



DANISH LOUDSPEAKER HISTORY

Since the very early days Denmark has played an important role in loudspeaker technology and electro-acoustical engineering. As far back as 1820 the Danish physicist Hans Christian Oersted discovered the electro-magnetism, the basis for a loudspeaker. It is for this reason that the unit of magnetic field strength has got the name Oersted.

In 1918 it was two Danes, Axel Petersen and Arnold Poulsen, who were the co-founders of Ortofon, which invented the first synchronized sound to a movie.

The first primitive loudspeakers were constructed by American Edison and German Siemens, but in 1923 it was again a Dane who designed the first electro-static loudspeaker. His name was K. Rahbek.

It wasn't until 1925 that the first moving coil dynamic loudspeaker was designed. Again a Dane by the name of P. L. Jensen, the founder of Jensen loudspeakers in America, played an important role in this respect. It is this basic design that is still used in most loudspeakers today, but with some brands perfecting it to a level which makes it possible to design loudspeakers with an almost identical sound quality to the original sound. One of these companies is Danish Dynaudio.

the rear of the cabinet for three reasons. One, we would have minimal high frequency radiation out through the port towards the listener. Two, we would have one less hole in the front panel which would mean a weakening of the front baffle; and three, by positioning the port in the rear, it is easy to adjust the bass output by positioning the speaker closer or further from the wall.

We have braced the cabinet on two points from front to rear to stiffen the front baffle after it has been weakened by the hole cuts. Another brace between the two side walls has also been provided.

The crossover

As seen from the frequency response curves the three drivers have an extremely smooth roll-off in both ends. We are therefore able to use the ultimate crossover slope which is 6 dB per octave.

The 6 dB per octave crossover will give us a linear amplitude, a linear phase response, and good impulse or transient response. Crossover frequency was decided at 700 Hz and 5000 Hz.

The components used in the crossover network have been chosen with no com-

BUYING

To find out where to obtain these speakers, and see them demonstrated, contact Scan Audio on (03)429-2199. The full bit will be available for \$2400, but you can buy the components separately if required. The D21 costs \$188, the DS2Af costs \$288 and the 21WS4 is worth \$378. The crossover is available for \$182.

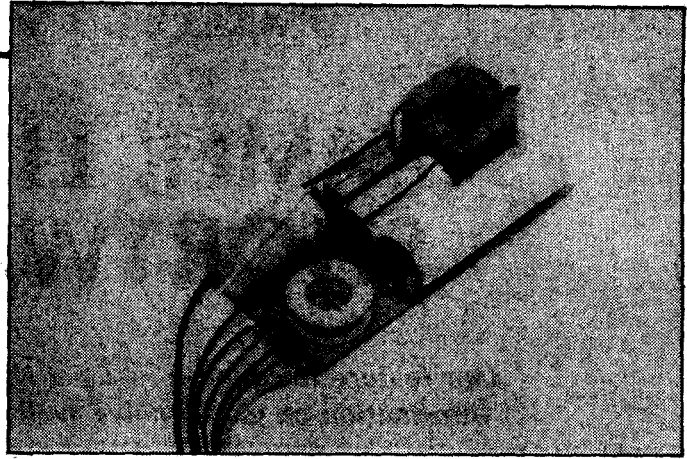
promise in mind. The drivers are among the finest ever manufactured and it would be absolutely wrong to try to cut any corners.

The two coils for the bass driver and the midrange are low impedance, high quality air coils of thick copper wire. The inductors used are metallized polypropylene capacitors manufactured by Rifa in Melbourne. As a by-pass shunt capacitor in parallel with the metallized polypropylene capacitors are two small 10mF polystyrene capacitors for ultimate speed in the highest frequencies. An attenuation for the tweeter and midrange was necessary and here a number of non-inductive resistors have been put in parallel, causing no audible deterioration of the sound.

The wires that have been used to con-



Looking down at the bottom brace.



The crossover network.

nect the input terminals to the crossover and from the crossover to the drivers are 516-strand pure copper cable manufactured by Multi-Contact in Switzerland. These have extremely low resistance and are designed for internal wiring.

At the rear of the cabinet are the input terminals which are banana sockets for the best possible connection.

Construction

Construction is quite straightforward. For the cabinet, use 18 mm high density chip-board, preferably with a genuine timber veneer. Follow the cutting diagram included here, noting the position of the bracing, which is most definitely not optional.

The speakers themselves should be re-bated into the front panel. This is to achieve maximum dispersion and to minimize edge dispersion. Apart from the audio qualities, this will also increase the aesthetic appeal of the job.

Before you insert the front panel, remember to include the damping. This should consist of one inch at least of medium density foam on the rear panel and on the floor. On the side panel only take it half way to the top. This will eliminate standing waves in the cabinet and back radiation of the higher frequencies onto the woofer diaphragm.

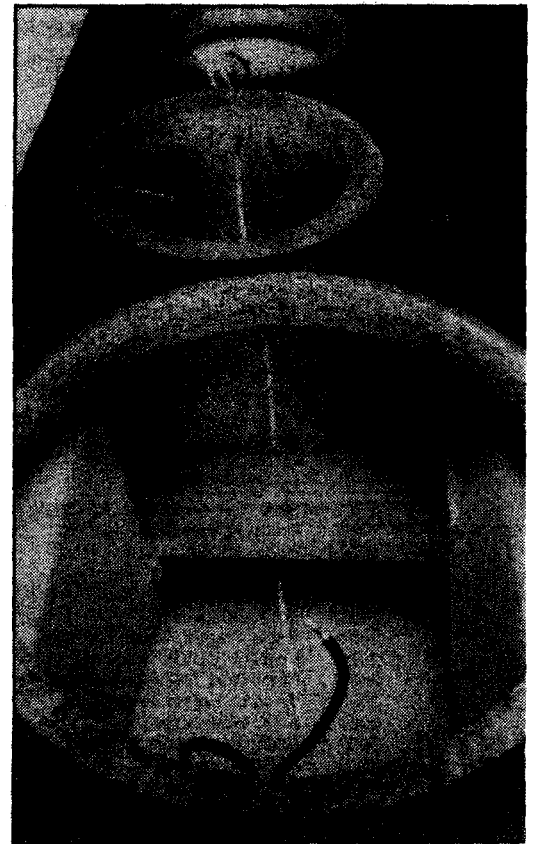
Performance

The ETI-1408 speakers are every bit as good as the performance graphs would indicate. It's clear that computer simulation of the box size resulted in a close to optimum result in terms of matching woofer against box size.

In fact, the response is particularly good right across the range. The midrange is obviously working well, but the most spectacular part of the system is the D21 tweeter. According to Dynaudio the D21 goes out to 40,000 Hz before it hits the half power point, and it sounds like it. ●

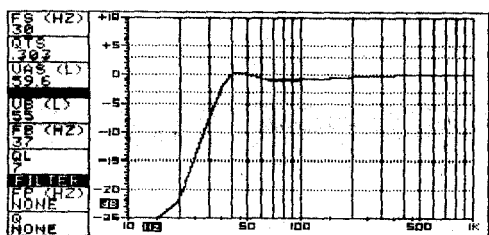
DYNAUDIO PROFILE 3 KIT SPEAKER 3-WAY FLOORSTANDING BASS REFLEX SYSTEM

Power handling:	160 Wrms (250 W peak)
Nominal impedance:	8 ohms
Sensitivity:	9 dB/1 W/1 m
Frequency response:	31-35,000 Hz $\pm$ 3 dB 24-40,000 Hz $\pm$ 8 dB (DIN 45,500)
Internal volume:	55 litres
Cabinet resonance:	37 Hz
X-over type:	1st order parallel filter
X-over frequencies:	700/5000 Hz
DRIVERS	
Woofer:	Dynaudio 21W54
Midrange:	Dynaudio D52AF
Tweeter:	Dynaudio D21AF
Dimensions:	790 x 360 x 270 mm (h x d x w)
Weight:	21 kg each

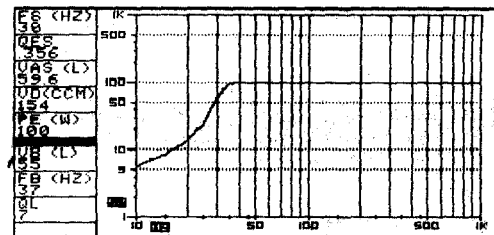


Inside the box. The crossover network is hidden by the foam at the back of the box.

DATE: 5/17/86 VENTED SYSTEM - FREQUENCY RESPONSE
DRIVER: MODEL, DYNAUDIO
21W54 WOOFER.



DATE: 5/17/86 VENTED SYSTEM - DISPLACEMENT LIMITED POWER
HANDLING DRIVER: MODEL, DYNAUDIO



SUMMER LISTENING TO SHORTWAVE NEWS

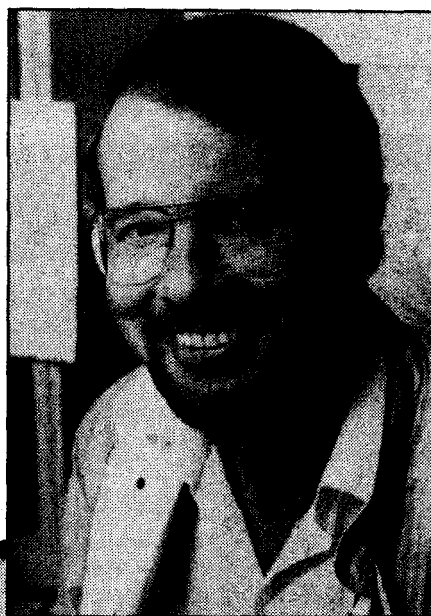
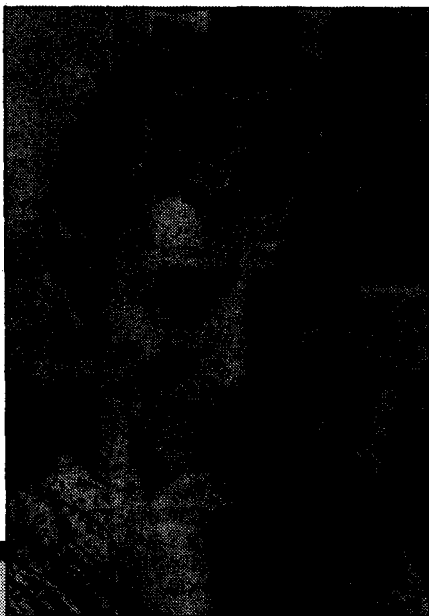
Our feature this month looks at shortwave news broadcasts and provides information on global news available during the normal listening hours.

Arthur Cushen

The service is weighted towards evening listening in Australia as during our summer the higher frequencies will be more active and signals from Asia and Europe should be at their best. The list indicates the time, location and/or the station name and the best frequencies for reception. In all cases the information covers November-March; the location of some stations is not given, only their slogan.

A list at the end of this feature gives a fuller address of some international broadcasters, but it is generally found that an address such as: "Radio Australia, Melbourne, Australia" is sufficient for postal deliveries. Times indicated are UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time, and the frequencies given are in kHz.

UTC	STATION AND/OR LOCATION	FREQUENCY (kHz)
2000	Radio Australia	7215, 9580
2000	Radio Baghdad, Iraq	15120
2000	BBC London	7145, 7325, 9410, 9570
2000	Radio Canada	11945, 15325
2000	IBA, Jerusalem	9008, 9815, 11960, 12080
2000	Radio Prague, Czechoslovakia	5830, 7345
2000	Moscow, USSR	7320, 9470
2000	Radio New Zealand, Wellington	11780, 15150
2000	Voice of Turkey, Ankara	7215, 7225, 9560, 17770
2000	VOA, Washington	6040, 9790, 11780
2000	Radio Yugoslavia, Belgrade	6100, 7240, 9620
2030	Radio Nederland	9715, 9895, 11740
2040	Havana, Cuba	11725, 15300
2100	Radio Australia	8580, 15240
2100	DW, Cologne, Germany	7130, 9785
2100	Moscow, USSR	15130, 15155, 15385
2110	Damascus, Syria	7455, 9855
2115	Cairo, Egypt	9805
2130	Radio Canada	11945
2200	AIR, Delhi, India	8585, 9810
2200	BBC London	6195, 9410, 9570
2200	Radio Canada	9755
2200	Helsinki, Finland	9575
2200	VOA Washington	15185, 17740
2200	VOFC Taipei	11855, 15370
2200	Voice of Turkey, Ankara	9580, 17770
2300	AFRTS, Los Angeles	15345, 17765
2300	Radio Australia	15180, 15240
2300	Moscow, USSR	13865, 15425
2300	VOA Washington	15185, 17740
0000	AFRTS, Los Angeles	11790, 17765
0000	BBC London	9410, 9915
0000	Madrid, Spain	9630
0000	Radio New Zealand	15150, 17705
0000	VOA Washington	11760, 15185, 17740
0030	Brussels, Belgium	9625
0100	DW, Cologne, Germany	9545, 11785
0100	Moscow, USSR	12050, 13635, 15140
0100	Radio Prague, Czechoslovakia	9830, 9740, 11990
0100	RAE, Buenos Aires	9990, 11710
0200	AFRTS, Los Angeles	11790, 17765
0200	Radio Australia	15240, 17795
0200	BBC, London	9410, 9915
0200	Berne, Switzerland	9725, 9885, 12035
0200	Radio Braz, Brazilia	11745
0200	Radio Canada	9755
0200	KBS, Seoul, Korea	11810, 15575
0215	Cairo, Egypt	9475, 9675
0230	Radio Nederland	9895
0230	Radio Pakistan, Karachi	11745, 15115
0230	Radio Sweden, Stockholm	9695
0300	Radio Budapest, Hungary	9835, 12000
0300	Radio Canada	9755
0300	DW, Cologne, Germany	9545, 9640
0300	Radio Prague, Czechoslovakia	9630, 9740, 11990
0300	Voice of Turkey, Ankara	8580, 17770
0315	Cairo, Egypt	9475, 9675
0315	RFI, Paris	9535, 9790, 9800
0330	UAE, Dubai	9640, 11840
0340	Athens, Greece	7430, 9420, 11585
0350	Rome, Italy	11905, 15330, 17795
0400	AFRTS, Los Angeles	11790, 17765
0400	Radio Australia	15240, 17795
0400	BBC, London	5975, 9410
0400	Berne, Switzerland	9725, 9885, 12035
0400	Havana, Cuba	6100, 9740
0400	Sofia, Bulgaria	11765, 15140
0400	VOA, Washington	6040, 7200, 9670
0415	RFI, Paris	9550, 9790, 9800
0430	Radio Nederland	9895
0500	DW, Cologne, Germany	5960, 6120, 9690
0500	IBA, Jerusalem	7410, 9009, 9435
0500	Madrid, Spain	6125, 9630
0510	Radio Botswana	4820
0530	UAE, Dubai	15435, 17775, 21700
0600	BBC, London	7150, 9640, 15360
0600	Kuala Lumpur, Malaysia	15295
0600	Moscow, USSR	15130, 15385, 17730
0600	Radio New Zealand, Wellington	15150, 17705
0600	KBS, Seoul, Korea	15395
0600	VOA, Washington	6040, 7200, 7325
0615	Radio Canada	7155, 9760, 11840
0620	HCJB, Quito, Ecuador	6205, 11835
0630	ORF, Austria	11820, 15410
0630	Radio South Africa	11900, 15270



0630	Tirana, Albania	7090, 9500	1300	AFRTS, Los Angeles	9030, 9700, 15265
0630	Warsaw, Poland	6135, 7270, 9875	1300	Radio Australia	5095, 7215, 9580
0645	Bucharest, Roumania	11940, 15250	1300	BBC, London	16070, 17795
0700	AFRTS, Los Angeles	9030, 11790	1300	VOA, Washington	6110, 9780, 11715
0700	BBC, London	7150, 9410, 15360	1330	AIR, Delhi, India	9945, 11810, 15935
0700	Tokyo, Japan	11955, 15230	1330	UAE, Dubai	11940, 17775, 21605
0730	Radio Nederland	9930, 9715	1400	Beijing, China	11600, 15165
0730	Radio Prague, Czechoslovakia	11855, 17840, 21705	1400	Moscow, USSR	6020, 6050, 7315
0800	BBC, London	9410, 9640, 15380	1400	Stockholm, Sweden	11765, 15345
0800	BRT, Brussels, Belgium	9880, 17595			
0800	Kuala Lumpur, Malaysia	15295			
0800	Pyongyang, North Korea	11830, 13650			
0830	Berne, Switzerland	9960, 15305, 15570			
0830	FEBC, Manila	11850, 15350			
0830	Radio Nederland	9630			
0830	ORF, Austria	11840, 11915, 15410			
0830	Radio Prague, Czechoslovakia	11855, 17840, 21705			
0830	Radio Vnuatu	3945, 7260			
0900	Radio Australia	6040, 9655			
0900	BBC, London	6185, 15070, 15310			
0900	DW, Cologne, Germany	16185, 17800			
0900	Moscow, USSR	16130, 17730			
0900	Papua New Guinea	5365, 4680			
0900	Tokyo, Japan	11875, 15235			
0915	Seoul, Korea	6480			
0930	Beijing, China	9700, 11755, 15440			
0930	Helsinki, Finland	11935			
0930	Radio Sweden, Stockholm	15390			
1000	AFRTS, Los Angeles	9030, 9680			
1000	AIR, Delhi, India	15335, 17875			
1000	Berne, Switzerland	11745, 15670			
1000	Hanoi, Vietnam	9840, 12035			
1000	Oso, Norway	16180, 15230 (Sunday)			
1030	Colombo, Sri Lanka	11835, 15120, 17850			
1030	Radio Nederland	6020, 9650			
1100	Radio Australia	6060, 7215, 9580			
1100	BBC, London	6185, 11750, 15070			
1100	Berne, Switzerland	11795, 15585			
1100	KBS, Seoul, Korea	15575			
1100	Radio New Zealand, Wellington	9820, 11780			
1100	Radio Pakistan, Karachi	15000, 17680			
1100	VOA, Washington	6110, 11715, 15425			
1100	Voice of Asia, Taiwan	7445			
1115	RBI, Berlin	17705, 21540			
1115	Tehran, Iran	11790, 15084			
1130	Bangkok, Thailand	9655, 11905			
1200	BBC, London	15070, 17780			
1200	Radio Canada	9550, 11855			
1200	Tashkent, USSR	7340, 9850, 9715			
1200	VOA, Washington	6110, 9780, 11715			
1230	Dhaka, Bangladesh	15525, 21630			
1230	Radio Ulan Bator, Mongolia	9575, 15305			

The full addresses of those stations listed above which only contain the slogan or initials of the broadcaster are as follows:

Armed Forces Radio & TV Service (AFRTS), 1016 North McCudden Place, Los Angeles, CA 90038, USA.

Radio Australia, Box 428G, Melbourne, Vic 3001.

BBC World Service, Bush House, The Strand, London WC2B 4PH UK.

Radio Botswana, Private Bag 0060, Gaborone, Botswana.

Radio Braz, Brasilia 70710, DF, Brazil.

Radio Canada International, Box 6000, Montreal, Quebec H2L 4S5 Canada.

Deutsche Welle, Voice of Germany, PO Box 10 04 44, Cologne, East Germany.

Far East Broadcasting Co (FEBC), PO Box 2041, Manila, Philippines.

KOL, Israel Broadcasting Authority, PO Box 1082, Jerusalem 910-10.

Radio Nederland, PO Box 222, Hilversum, Holland JG 1200.

ORF, Austrian Radio, A-1136 Vienna, Austria.

National Broadcasting Commission, Box 1359, Boroko, Central District, Papua New Guinea.

RAE, Box 555, 10000 Buenos Aires, Argentina.

Radio Berlin International (RBI), Nallespastrasse 18-50, Berlin 116 GDR.

Radio France International (RFI), BP 9516, F-75-16 Paris, France.

Radio South Africa, PO Box 4559, Johannesburg 2000, South Africa.

Radio Tashkent, Tashkent, Uzbekistan, USSR.

UAE Radio, PO Box 1695, Dubai.

Radio Vanuatu, PO Box 49, Port Vila, Vanuatu.

Voice of Free China (VOFC), PO Box 24-38, Taipei, Taiwan.

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Radio Botswana, Private Bag 0060, Gaborone, Botswana.

Radio Braz, Brasília 70710, DF, Brazil.

Radio Canada International, Box 6000, Montreal, Quebec H2L 4S5 Canada.

Deutsche Welle, Voice of Germany, PO Box 10 04 44, Cologne, East Germany.

Far East Broadcasting Co (FEBC), PO Box 2041, Manila, Philippines.

KOL, Israel Broadcasting Authority, PO Box 1062, Jerusalem 910-10.

Radio Nederland, PO Box 222, Hilversum, Holland JG 1200.

ORF, Austrian Radio, A-1136 Vienna, Austria.

National Broadcasting Commission, Box 1359, Boroko, Central District, Papua New Guinea.

RAE, Box 555, 10000 Buenos Aires, Argentina.

Radio Berlin International (RBI), Nalespastrasse 18-50, Berlin 116 GDR.

Radio France International (RFI), BP 9516, F-75-16 Paris, France.

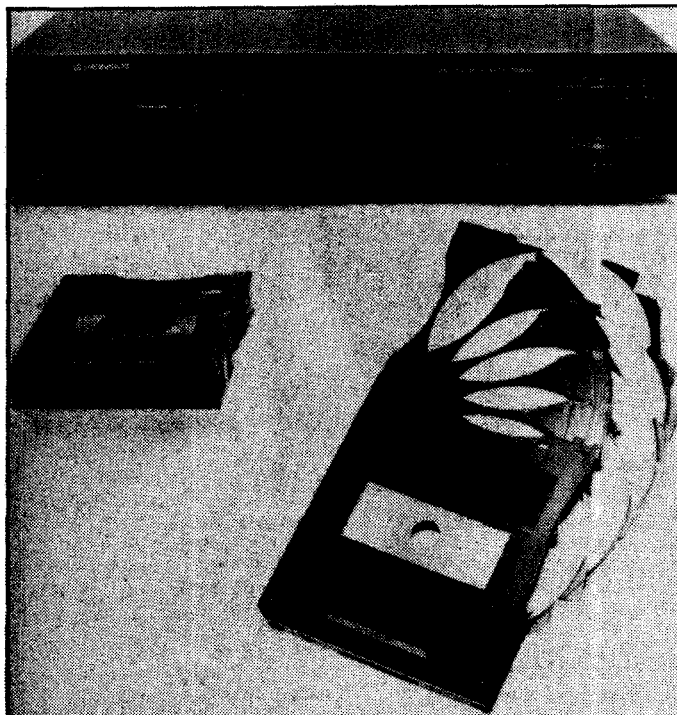
Radio South Africa, PO Box 4559, Johannesburg 2000, South Africa.

Radio Tashkent, Tashkent, Uzbekistan, USSR.

UAE Radio, PO Box 1695, Dubai.

Radio Vanuatu, PO Box 49, Port Vila, Vanuatu.

Voice of Free China (VOFC), PO Box 24-38, Taipei, Taiwan.



Endless music

Music, music, music. That's the promise of Pioneer's new CD-M6 compact disc player, which can be programmed to give 'endless' hours of music with its multi play feature.

The attributes of the Pioneer PD-M6 were acknowledged by the audio industry when it won the CD product of the year award at last year's CGSA Hi-Fi Grand Prix.

The player has a six disc multi play magazine which gives versatility in the selection of compact disc tracks. You have the choice of programming your entertainment, or letting the PD-M6 select the music for you at random. Another option is using the player conventionally with a single disc at a time.

If you pre-program you simply choose up to 32 selections from the discs in the magazine, and then sit back to enjoy the music without having to move a muscle. You can even press the repeat button if you want the music to play endlessly. If you tire of listening to your programmed discs being

played in the same sequence, you can set the CD so that its micro computer selects the tracks at random.

"The PD-M6 is the juke box of the 80s," according to Pioneer's hi-fi and video manager, Frank Fragale. "It gives you the random selection of your favourite music at home without constant handling and changing of discs." The multi play facility is undoubtedly the major feature of this new CD. It's also worth noting that the multi play magazine doubles as a convenient storage space, and additional holders will be available as accessories. A single disc magazine, allowing the PD-M6 to play as if it were an ordinary single play CD, is also available.

There are also four repeat modes (for repeating all discs, a single disc, program or single track), three-speed manual search to quickly find a desired track, full remote control, subcode output for future disc technological development and headphone output with volume control.

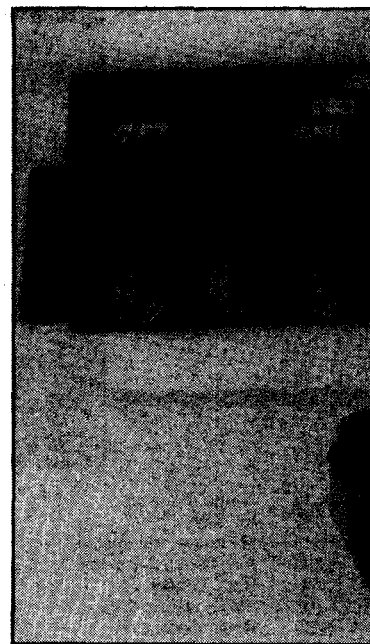
rf switches from MFJ

GFS Electronic Imports has announced the release of two new coaxial rf switches from MFJ Enterprises.

The first, the MFJ-1701, is a six-position switch which allows switching between six antennas without the need to unplug cables. It can be used on both 52 and 75 ohm systems, and will handle 2000 W SSB or 1000 W CW. It's fitted with seven SO-239 connectors and gives negligible insertion loss on HF bands.

All unused inputs are automatically grounded for static, lightning and rf protection. Equipped with mounting holes for desk or wall mounting it measures approximately 250 x 75 x 38 mm and is priced at \$154 plus \$12 p&p.

The other new coax switch is the Model MFJ-1702, a two-position switch designed for 50 ohm systems. It is capable of handling 2.5 kW PEP and has an insertion loss of less than 0.2 dB. Isolation is better



than 60 dB at 300 MHz and 50 dB at 450 MHz. VSWR is less than 1.2:1. The unused terminal is grounded for static, lightning and rf protection. The MFJ-1702 measures 75 x



Technics flat speaker

The acoustic research laboratory of Matsushita (maker of National, Panasonic and Technics products) has developed an ultra flat panel speaker that is ideal for wall-mounting and for use with digital audio systems.

The new speaker has been developed mainly for home use but it is expected that it will also be used for profes-

sional purposes. It is 6 cm deep and occupies about a square metre of wall space. A feature is its 'twin cabinet' construction: the speaker's nodal operation with four voice coils drives the flat diaphragm of woofers and mid-low, each in its own cabinet-type enclosure, yet resident in one speaker.

The new audio flat panel (AFP) speaker features a wide frequency response, from 35 to 40 kHz, and offers especially accurate reproduction at the low range —

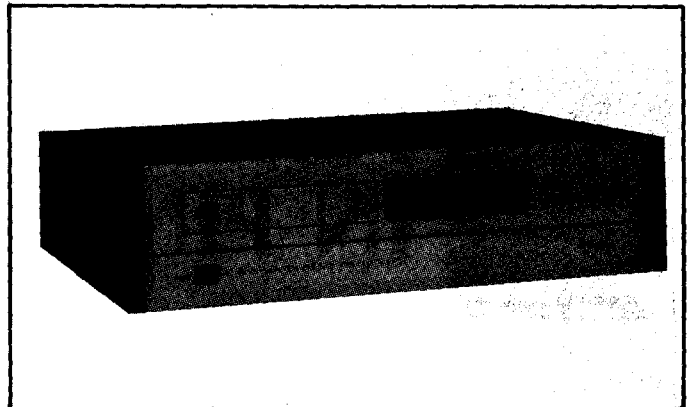
Combination CD player

One of the major attractions of digital audio — and its standard bearer, the compact disc — is that the sound quality recorded at the studio or concert hall can be reproduced accurately in the home.

Joining the growing array of compact disc equipment now making an impact in the Australian marketplace are two new products from Accuphase: the DP-80 CD player and the DC-81 digital processor. The company claims that this CD player and digital processor combination will offer as high quality as any system currently available.

The DP-80 CD player reads digital signals from compact discs and the DC-81 digital processor converts those digital signals into audio signals.

The output digital signals are transmitted by Accuphase's optical fibre transmission system, which the company claims will com-



pletely block spurious radiation and thus give excellent sound quality. The DP-80 is equipped with a coaxial cable output of standard format so that not only the DC-81 but also digital processors

of other makes can be connected to the CD player. The laser pickup is driven by a linear motor and controlled by an 8-bit microprocessor. Access time of less than one second has been achieved.

Digital storage



The Hagemeyer (Australasia) company has moved into the field of digital audio for broadcast with an interesting new product called the Sirius 100.

Strong interest was shown in this new system at last year's IBC Show in London. According to company publicity, the digital audio memory system is a logical extension of its wide experience in digital processing technology.

The Sirius 100 offers 1000 minutes of audio stored on hard disc at 16-bit quality. There are eight channels of audio processing and com-

puter editing facilities. In addition, it can take up to eight remote control stations, connected via a single coax.

Basic applications include audio editing systems, computer controlled playback, commercials and music segments, station ID and announcements, and background sound effects. In fact, it is being marketed as a replacement for tape cartridge machines.

It's expected to be available for sale in early 1987.

For more information contact Hagemeyer on (008)22-5044.

50 x 50 mm and is priced at \$99 plus \$10 p&p.

For more information contact GFS Electronic Imports, 17 McKeon Rd, Mitcham, Vic 3132. (03)873-3777.

seven times better than other conventional units when wall-mounted. It handles up to 350 W of music and an output sound pressure level of 88 dBW/m.

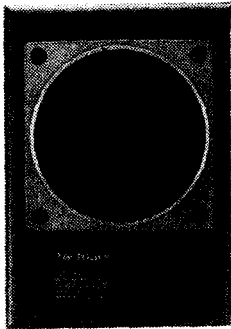
Until now, audio designers have employed large enclosures to achieve powerful low-range sound reproduction. This conventional approach, however, has resulted in the loss of sound pressure level and an increase in distortion due to the non-linear movement of the damper and supporting edge at the low range. It also adds more bulk and weight to speakers.

To overcome these drawbacks, Matsushita designers used three-dimensional computer analysis to create the new twin cabinet acoustic enclosure. The company also developed new acoustic material to take full advantage of the speaker's relatively flat shape. The woofer's

diaphragm in the AFP speaker is made from a pulp composite reinforced with mica and a hard chitinous-like natural high molecule. Matsushita, with the support of the Shizuoka Paper Industrial Laboratory, developed this unique material to improve the strength and sensitivity of the woofer's diaphragm.

The company also developed a special mica and thermosetting resin composite for the mid-high and tweeter diaphragms. The composite, which is vapour deposited, forms a diamond-like layer surface.

For home application the AFP speaker can be used in combination with VTRs, hi-fi equipment, new AV systems (video projector, etc) and even an electronic organ. Professionally, it can be used in broadcast by stations, at discos and for public address equipment.



GALLON PERFORMANCE IN PINT POT

Only 300 x 480 (mm), these new Technics SB-R50 speakers put out a sound and a half. With some advances over their predecessors, the SB-R100s, Louis thinks they're a good buy.

Louis Challis

JUST over two years ago during my visit to the Osaka acoustic laboratories of Matsushita Electric, I met a quiet and unassuming, brilliant young Japanese engineer named Mr Nakao. As the engineer in charge of Matsushita's research program, he conducted me through the laboratories and proudly revealed some of the advanced research projects and techniques whose development he had initiated or led.

By the time I arrived Mr Nakao had long since developed his SB-R100 loudspeakers (see ETI June 1985). I am still convinced that they are one of the most exceptional small speakers that you can buy. I naturally asked him whether it was his intention to produce a larger version that would provide the obvious improvements in low frequency performance. Of course he was and he proudly showed me some of his computer modelling associated with that particular development. It was not surprising that at his request I have now received the first pair of reviewer's SB-R50 speakers to reach Australia.

What Mr Nakao set out to achieve was a speaker with all the attributes of the SB-R100 (which really does offer superlative performance from a modest 90 Hz to beyond 25 kHz), supplemented by a low frequency response which could rival many if not most of the larger studio monitors and far more expensive consumer oriented loudspeakers.

Design and appearance

The enclosure is at first sight relatively small and deceptively inconsequential. The size of the enclosure belies its weight which at 16.5 kg appears to have a much higher density (weight per unit volume) than any other speaker I have yet seen.

This high mass comes as a result of the massive diecast speaker assembly. This speaker incorporates two large ferrite magnet assemblies one of which provides the sensitivity and long throw capabilities of the main voice coil; the second is provided simply to reduce the stray magnetic flux leakage which is so important when speakers of this type are used in close proximity to a TV set or other recording equipment.

Obviously a completely separate magnetic circuit is required for the coaxial tweeter and National/Technics has used a space age samarium cobalt magnet assembly that is remarkably powerful and remarkably small. The fundamental design of this speaker is based on the same concepts which went to make the SB-R100. A centrally mounted tweeter (with Brüel & Kjaer type microphone diaphragm assembly cover) is retained. Around this the annular aluminium honeycomb flat piston drive assembly of the SB-RX50 is almost conventional in terms of the depth to diameter ratio. At that point all similarity with other speakers tends to disappear as this driver assembly provides an electro-acoustic performance which is substantially better than any other coaxial speaker system previously developed or currently available.

The whole driver assembly is mechanically screwed into a large specially recessed flat plate mounting escutcheon on the front of the heavy plastic-veneered particleboard enclosure. The edges of this cabinet front have been specially smoothly contoured to reduce the sound diffraction effects. The low frequency response of the enclosure system has been extended by a rear-mounted 25 mm diameter vent pipe. Although relatively effective, this will still

result in a step response when tested under anechoic conditions which the miniscule speaker volume is incapable of fully compensating for. When tested in proximity to a rear reflecting wall the additive effect of this mounting arrangement compensates for the low frequency step response.

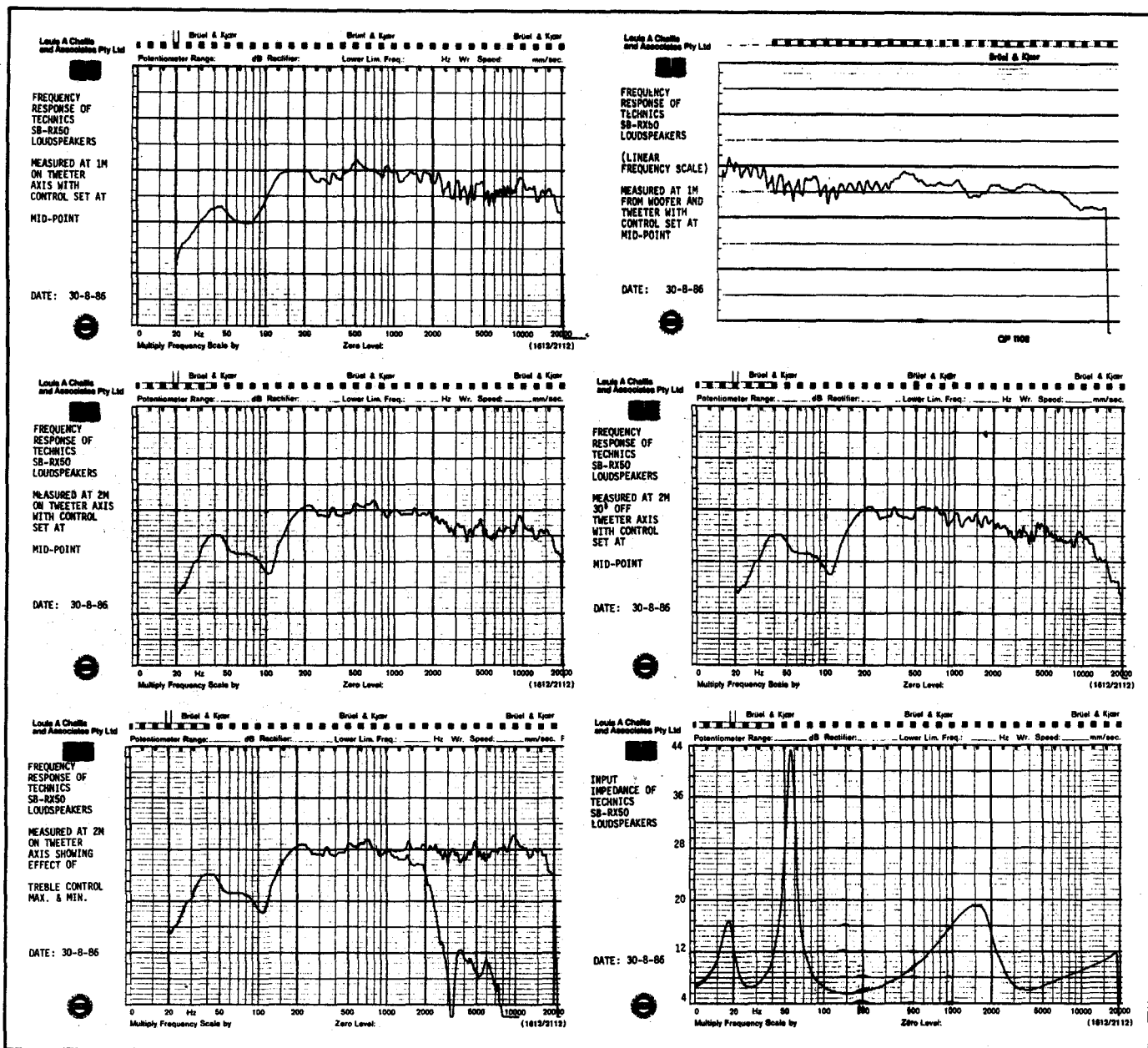
The tweeter directional dispersion is modified and effectively broadened through the use of a physical diffraction element which has been carefully placed on the central axis directly in front of the tweeter diaphragm.

The designers have provided a supplementary high frequency level control which is sensibly mounted on the front face of the speaker. For some unknown reason when fully rotated to the maximum cut position this provides a dramatic attenuation of the tweeter response, so that over the range 3 kHz to 8 kHz you can provide more than 20 dB of attenuation and at higher frequencies, more than 30 dB of attenuation.

Each enclosure is provided with an almost transparent black cloth-covered removable speaker grille, which provides minimum attenuation across the band and minimum impact on the high frequency sound diffraction. The rear of the cabinet (which is not veneered) incorporates two universal spring loaded speaker terminals designed for accepting bare speaker wires.

Objective testing

Of the objective tests, one of the most telling is the free field frequency response evaluation which generally shows different figures from those that the manufacturers show in their literature. The on-axis frequency response at 2 m measured in my anechoic room soon revealed a frequency



response that was in practical terms, flatter than that provided by the SB-R100s, over the range 150 Hz to 20 kHz. However, the performance at the low frequency end of the spectrum exhibited a somewhat 'bumpy' response between 30 Hz to 150 Hz. I had hoped to find a flatter response in this particular region where it should be noted the SB-R100s have an almost inconsequential output. As it transpired, the low frequency performance of these speakers is still commendable particularly when mounted on a shelf, fixed to a wall or close enough to a wall

for the rear mounted venting port to do what it was originally intended to do.

The tweeter control, when advanced to maximum attenuation, decimates the high frequency response so that you are left with a response that is flat to 2 kHz, beyond which point the output really 'crashes'. With the tweeter control set at mid-point, there is less than 5 dB of attenuation over the range 3 kHz to 17 kHz and most listeners would still find this position more than acceptable. However, the most sensible way to use this speaker is with the high frequency attenuator set

in the fully anti-clockwise position where the high frequency response is absolutely superb and equal to the best that I have yet recorded.

The diffraction and dispersion effects of such a speaker are equally important even in the small rooms and monitoring type situations for which I believe the speakers will primarily be used. The measured frequency response at 30° from the main axis is only 5 dB down at 10 kHz; 10 dB down at 15 kHz; and only 14 dB down at 19 kHz. These results are excellent and the group of measured polar responses are ▶

TECHNICS SB-RX50s

LOUDSPEAKER DATA SHEET

MEASURED PERFORMANCE OF: TECHNICS SB-RX50

SERIAL NO: TK 6412A 29H

FREQUENCY RESPONSE: 30 Hz - 20 kHz

CROSSOVER FREQUENCY: 2.2 kHz

SENSITIVITY:

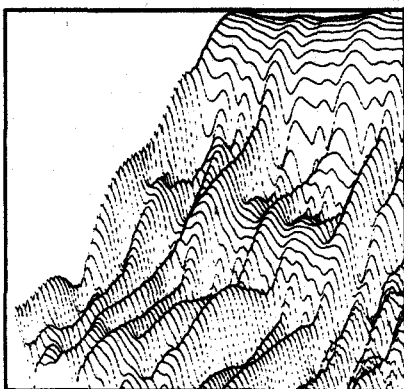
(for 96 dB average at 1m) 10.0 V r.m.s. = 16.7 Watts (nominal into 6 Ohms)

HARMONIC DISTORTION:
(for 96 dB at 1m)

	100Hz	1kHz	6.3kHz	
2nd	-26.0	-	-55.4	dB
3rd	-30.7	-69.3	-57.5	dB
4th	-	-	-	dB
5th	-48.3	-	-	dB
THD	6.5	0.034	0.22	%

INPUT IMPEDANCE
ONE TEST:

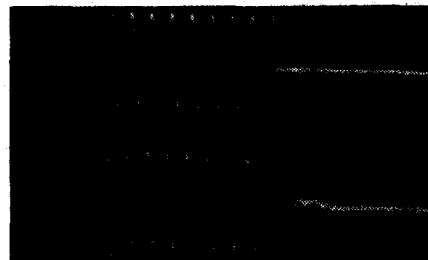
	100Hz/7kHz 4:1
100Hz	6.4 ohms
1kHz	16.0 ohms
6.3kHz	7.2 ohms
Min at 150 Hz	5.6 ohms



Decay response spectra.

Tone burst response for 90 dB steady state SPL at 1 m on axis. Upper trace is electrical input; lower trace is loudspeaker output.

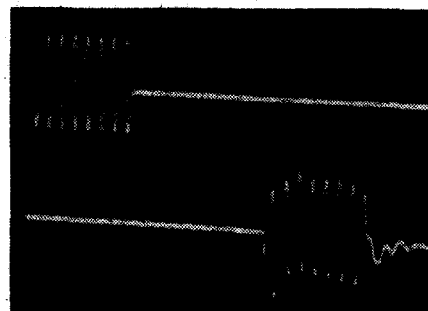
100 Hz (20 ms/div)



1 kHz (2 ms/div)



6.3 kHz (0.5 ms/div)



TECHNICS SB-RX50 LOUDSPEAKERS

Dimensions: 300 mm (wide) x 480 mm (high)
x 282 mm (deep)

Weight: 16.5 kg

Manufacturer: Technics Division of Matsushita
Electric, Osaka

RRP: \$795 (each)

without any hesitation or doubt, amongst the best I have seen from any speaker.

The measured phase response is also remarkably smooth and reveals that the coaxial design has not robbed the driver system of one of the most critical design aims.

It is the decay response spectra which are the most exciting objective test results for the SB-RX50s. The multi-contour graphs exhibit an exceptionally smooth response with minimal signs of perceptible

resonant frequency or unwanted radiation energy apart from a few low level resonance peaks in the 3-5 kHz and 15 kHz regions. With decay response spectra exhibiting such a small number and with such a low level of resonance characteristics, I anticipated a distinct lack of colouration and a general purity of sound.

The tone burst responses revealed no significant anomalies or inconsistencies over the normal frequency range, although in the range of 5-6.3 kHz, I was aware of a general low level inconsistency. The decay response spectra also exhibited this.

The impedance curve exhibits an unusually large resonance peak at 55 Hz and somewhat smaller peaks at 18 Hz and at 1.5 kHz. The lowest output impedance is 6 ohms and the speaker is not intended to

be used in parallel with other speakers when connected to normal consumer amplifiers.

The distortion characteristics of the speakers are relatively low at power levels up to 20 watts after which the low frequency distortion climbs fairly rapidly and at a much faster rate than the high frequency distortion. The distortion over the frequency range 30 Hz to 100 Hz is somewhat higher than I would desire but this must be accepted if you try to achieve so many conflicting requirements in such a tiny package. The efficiency of these speakers is relatively low, with an input signal of 10 volts being required to produce 90 dB output at 2 m.

Subjective testing

Although the objective performance of the

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TECHNICS SB-RX50s

speaker is remarkably good and especially when the size of the speaker cabinet is considered, it was during the subjective appraisal that I really became aware of the full potential of these little speakers.

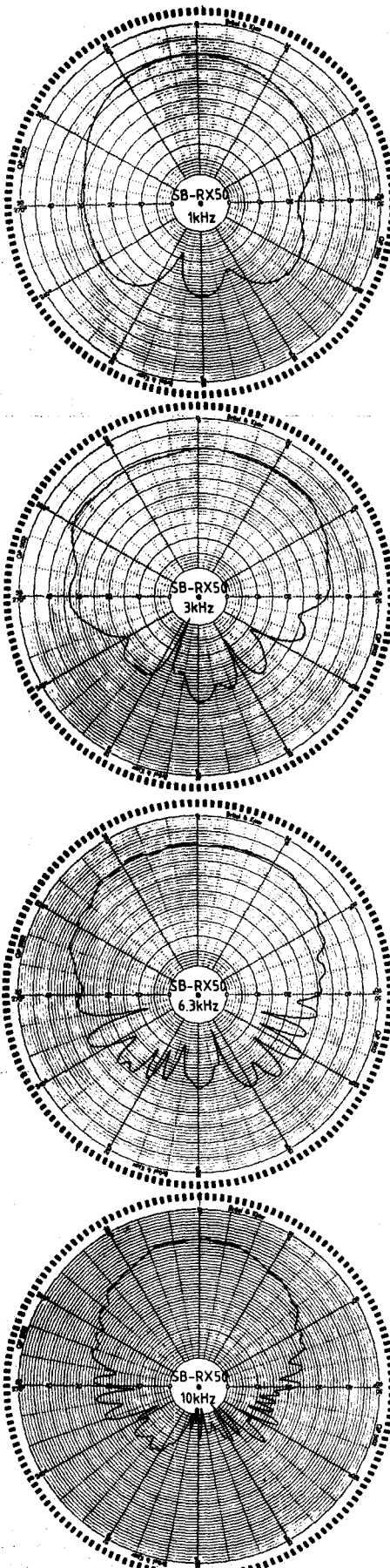
There are few speakers in this size range which are capable of readily accepting peak input powers in excess of 400 watts and conversely which are capable of producing peak output sound pressure levels in the range 110-120 dB at the normal listening position in my monitoring suite. I connected the SB-RX50s to a Yamaha M80 power amplifier, which is capable of delivering peaks in excess of 400 watts and to which I mercilessly subjected both speakers.

The first new disc I listened to was Suppe's *Light Cavalry Overture* with Charles Dutoit conducting the Montreal Symphony Orchestra (Decca 414 408-2). On track 1, this disc provides an excellent piece of rollicking orchestral music; it is a particularly good test piece for it utilizes practically the full range of orchestral instruments that a symphony orchestra contains. The SB-RX50s produced an audible signal with exceptional clarity and which during subsequent A-B testing against my reference speakers, could not be readily separated or ranked in terms of differential quality of performance.

The second disc I listened to was Buddy Rich on a new Denon disc *Tuff Dude* (33C38-7972 EX). On the "Chameleon" track, the speakers produced such a faithful rendition of the human voice that with my eyes closed I felt that Buddy Rich was really singing to me in the room. The stereo imaging and localization was superb and I believe that this attribute is one primary result of the unusual coaxial speaker symmetry, which is one of the unique features in these particular speakers.

I listened to a number of other older vinyl discs both with singing and spoken voice. I still retained my initial impression that the reproduction of the human voice by these speakers is outstanding and that this characteristic puts them into a 'mini-monitor' class. This will attract many potential users in small recording studios and similar locations where often the problem of lack of space compromises the user's ability to install or purchase appropriate quality speakers.

During this phase of the evaluation, I experimented with the speakers mounted in a range of different positions relative to a rear reflective wall and subsequently to a rear absorptive wall. With a spacing of approximately 300 mm out from the wall and a double fullness curtain interposed, I found that I could readily compensate for the drop in output signal between 50 Hz and 100 Hz so that the resulting frequency



Polar response plots.

then produced a subjective signal without noticeable non-linearity and no discernible step in the 40 to 200 Hz region.

The last classical disc that I listened to was Dvorak's "Symphony No 9" (Deutsche Grammophon 415 509-2) in which the speakers provided a sound virtually indistinguishable in quality and faithful fidelity from my reference speakers, except for frequency components below 40 Hz.

The last disc I 'auditioned' was played with the volume control set at much higher levels than I normally recommend. The peak signals were logged on the amplifier's monitoring meters as providing peak inputs in excess of 500 watts to the speakers and the resulting sound pressure levels were in excess of 110 dB at my listening position. The disc was one of the Australian group INXS's latest hits entitled *The Swing* (WEA 250 389-2) and the example that I chose to experiment with was "Original Sin".

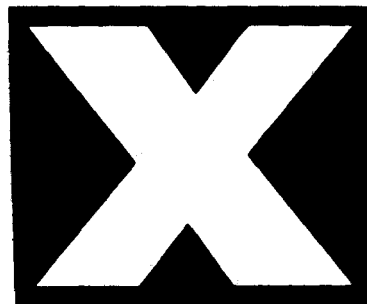
I was apprehensive about the speaker's ability to handle the peaks (quite apart from the average signal in the troughs). With peak signals repeatedly topping 110 decibels, there were obviously traces of audible distortion, but to a much lesser degree than I expected. After cautiously playing the first track, I listened to the remaining tracks at the same level and was more than pleasantly surprised to perceive how well these almost miniscule speakers 'womped' out the bass — as if the speaker cabinets were four times the size and had twice the peak sound rating.

No, I didn't destroy the speakers. I was left with an overall impression which I can only convey in three words: an exciting performance.

The overall results of my reviewing were inspiring, for although the low frequency performance of the speakers measured under anechoic conditions is plainly between 6-10 dB down over the range 30 Hz to 150 Hz, the subjective appraisal of their output when they are correctly positioned in the listening room, does not noticeably result in that characteristic. Part of this compensated perception must be attributed to the rear venting hole which, when installed in the intended or conventional way on either a bookshelf or adjacent to a rear reflecting surface, provides a significant change in the output response vis-a-vis the anechoic room response.

There are not many speaker designers who have managed to achieve a 'gallon of performance in a pint pot' and Mr Nakao at the Technics Laboratory on Osaka has unquestionably achieved that result. The SB-RX50s are just about the only speaker system that I have yet heard which can justly claim this accolade.

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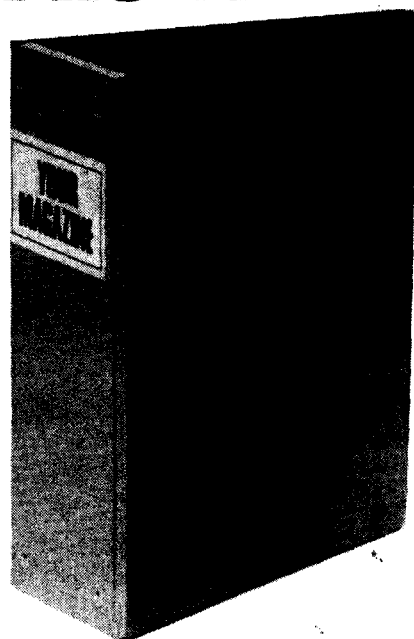
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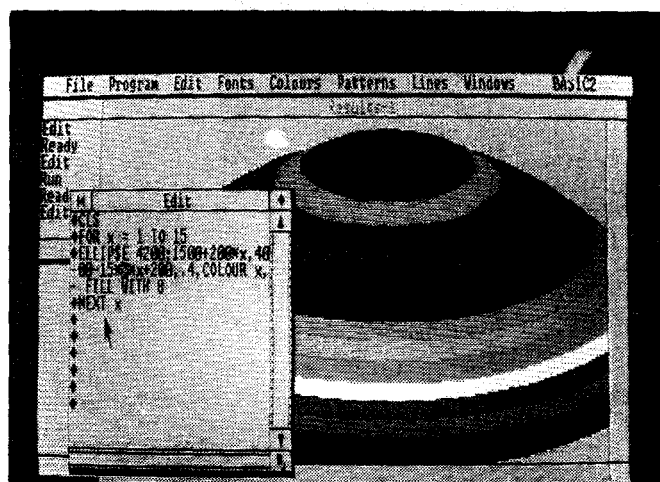
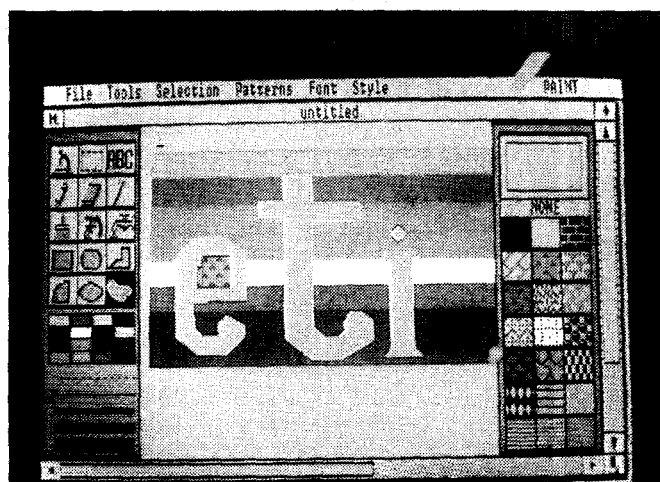
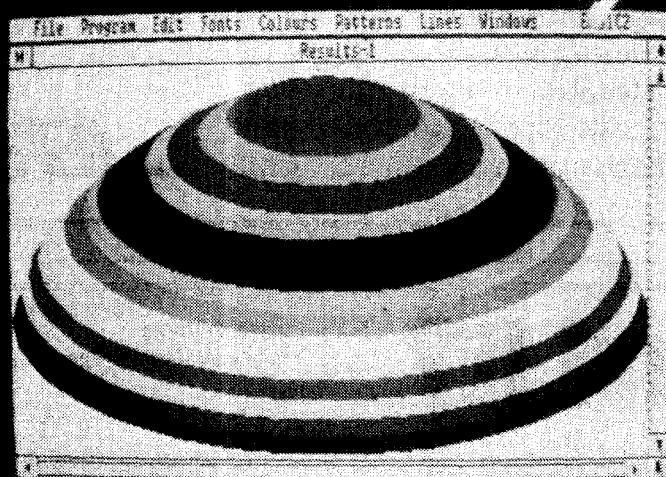
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REVIEW

THE ABOVE-THE-ORDINARY AMSTRAD 1512

The new computer from Amstrad offers performance and price that's hard to beat.

Jon Fairall



You can pick up the new PC 1512 for about \$1500 in its base configuration, and about \$2500 fully expanded. The base version has a single 5¼-inch drive and a black and white screen. Fully expanded it comes with two drives and a colour monitor.

Either way you get 512K (expandable to 640K) driven by a 16-bit 8086 running at 8 MHz. A hard disk version has already been released in the UK and will be available here shortly. There is a real time clock backed up by four small pen-light batteries. A mouse is standard, so are serial and parallel ports.

The Amstrad PC 1512 comes with four disks, one containing MS-DOS, another DOS Plus, a third GEM (Graphics Environment Manager) and fourth with GEM Desktop and Locomotive BASIC 2. Locomotive BASIC is a special implementation that uses the windowing capabilities of GEM for input/output. MS-DOS makes the 1512 compatible with IBM. Digital Research's DOS Plus allows you to run CP/M-86 IBM. In short, the Amstrad will run just about anything.

All of which is to say that the Amstrad 1512 is probably the best value for money in a small computer on the market today. It would be excellent value purely as an IBM-compatible, but added to that is a special graphics capacity courtesy of GEM, which takes it up into the class of the latest 16-bit offerings from Commodore, Tandy or Atari.

As you might guess, the Amstrad is not a conventional clone. Its CPU is the 8086, not the 8088 as in the IBM PC. Both use the same code, but the 8086 is substantially faster and has a different data bus arrangement. Amstrad has surrounded the CPU with a number of proprietary chips (gate arrays apparently) to achieve, amongst other things, a standard IBM hardware interface.

In fact, the 1512 has bog standard expansion slots, albeit only three of them. That's less than the traditional half dozen or so on a normal PC, but then the need for them is so much less. You don't need graphics cards, I/O cards and so on, as these facilities are all provided on the motherboard. Indeed, Amstrad has gone to the trouble of providing a socket for an 8087 maths co-processor, so there's reduced need for high speed processing boards.

The extended graphics card, currently the biggest selling IBM add-on in the US, runs but not well. It will only work in the Amstrad's low resolution mode with results only marginally better than using

high resolution minus the board.

However, one board that Amstrad is apparently very serious about is the network card, which will allow Amstrads to form part of a local network. This is becoming increasingly vital for business and educational applications.

Another advantage of customizing the hardware is that it saves in manufacturing costs. By using gate arrays the Amstrad people have managed to put much of the discrete logic that clutters an IBM board inside a few chips. The result is fewer steps on the production line, and cheaper costs. To maximize things even further, British-based Amstrad has made the 1512 in Korea, where labour costs are cheap.

One disadvantage of this unique architecture is that because it's so different, there are sure to be plenty of IBM programs that won't run on the Amstrad. I

66

It would be excellent value purely as an IBM-compatible, but added to that is a special graphics capacity courtesy of GEM, which takes it up into the class of the latest 16-bit offerings from Commodore, Tandy or Atari.

99

tried dBase III, Wordstar 2000 and Flight Simulator 2.1. All appeared to work without any vices, but if you have any other programs in mind, you'd be well advised to check them out before buying.

The MS-DOS installed in the Amstrad seems pretty much bog standard. There are all the usual commands, plus some extra ones associated with the mouse and so on. I understand that Microsoft supplied not only its latest version of MS-DOS, but also mouse drivers, and special patches for the real time clock and RAM disk.

The other side of the 1512 is GEM. It's designed as a graphics oriented input/output system, perhaps the most efficient non-keyboard I/O system designed so far. In this implementation it makes full use of the graphics capability of the machine. The built-in colour adaptor provides a number of different modes. In Alpha, it

can do either 16-colour, 40 by 25, or 16-colour, 80 by 25 character. In graphics mode, it can do four-colour, 320 by 200 pixels, or two-colour 640 by 200.

There are a number of applications in the GEM pack, BASIC and GEM paint both being worth a mention. Also included in the software package are two screen drawing programs: Dr Doodle and Gempaint. Gempaint is an extremely sophisticated electronic painting program (at least for computers in this price range). With patience you should be able to create quite complex drawings. Dr Doodle is somewhat simpler and easier to use, but fun nevertheless.

The BASIC is called Locomotive BASIC 2. It's terrific to use, and seemed exceptionally fast, although I didn't have a benchmark to quantify it. The opening screen shows three windows, labelled 'dialogue', 'edit' and 'results'. Edit is where the program is actually constructed. Results is where it runs, and dialogue is where you talk to the system: load, save, quit and so on.

Editing is done via a text editor, and changes can be made by moving a cursor with the arrow keys and inserting and deleting as required. Line numbers are unnecessary except as the destination of GOTO commands. In such a graphics oriented version of BASIC, it's no surprise to hear that there are a number of powerful graphics commands to make screen drawing very easy.

I'm sure I didn't get anything like the full benefit from the BASIC, however. For some unaccountable reason Amstrad supplies only a cursory overview of Locomotive BASIC in the manual of the machine. If you want to know more you have to go out and buy a separate manual.

The supplied manual is no more than OK. It's incredibly big, and would scare any neophyte user with its bulk alone. I had the review machine for about three weeks, and in that time never got comfortable with finding things in the manual. In fact, it took two weeks to find out that there is a list of MS-DOS keywords in the middle somewhere. I think I would rather have seen several slimmer volumes; one on MS-DOS, one on DOS Plus, another for GEM and a fourth for the BASIC.

Unfortunately, this is not mere carping. The Amstrad is intended for the education market, and will be the first computer exposure many people get. Other reviewers have pointed out, and I would agree whole-heartedly, that the Amstrad 1512 may herald the greatest computer publishing boom this year. ●

CHOOSING A MODEM

Hayes-compatible, CCITT standards, V21, V22, V23, Bell, Smart, auto-dial, carrier-detect . . . There's a lot to think about in choosing a modem, so let's start at the beginning and consider: what's in a mode? Matt Whelan provides the answers . . .

In choosing a modem, you must begin by deciding which mode suites your communications needs — CCITT V21, V22, V23, V22 bis (from a French word which has the same meaning as encore) or even Bell 103, 202 or 212. It's a mouthful, but is relatively simple.

First, let's look at the two standards (the standards define the frequencies the modems will use, their operating modes and so on).

The Bell standard is the one used in the United States, at least for the slower (up to 1200 bits per second) speeds used by PC modems. These standards are almost exclusively US-based, which is why we missed out on the enormous range of cheap, feature-packed modems we read about in the American magazines in the past. Fortunately, the Americans are using international standards for their higher speeds (2400 bps), so there is now some degree of compatibility.

International CCITT standards are used in most other countries, including Australia. Here's what the various standards you'll hear quoted mean:

V21: The basic 300 baud (or, more correctly, bits per second) full-duplex modem standard, used by virtually all the private and user-group bulletin board systems, and available on most major commercial networks. If you could have a modem meeting only one standard, this would be it for the moment — 300 bps is the 'universal language' of communications for now. It's an ideal speed for reading the information as it is transmitted to your screen, but feels excruciatingly slow for large file transfers.

V22: Four times as fast is four times the fun, as long as you can find someone to talk to! V22 provides for operation at 1200 bps full duplex, the rate offered by most high-speed dial-in systems. Only a few bulletin boards operate at this speed, so you're restricted to business systems and large networks like OTC's Midas, Telecom's Austpac, and so on.

V22 bis: Transmission at 2400 bps full duplex means you can shift around 3000 words a minute, or transfer the contents of a 360 Kbyte IBM diskette in 25

minutes. Until recently 2400 bps was considered the highest speed possible (with any reliability) on the voice-grade telephone network. Of course, there aren't too many other 2400 bps modems around for you to talk to just yet.

V23: A bigger number, but not more speed. V23, used by Telecom's Viatel and other videotex services, is meant to be an in-between standard, providing lower-cost 1200 bps communication using half-duplex or a limited form of full-duplex transmission. It can be a real pain. With modems, half duplex means you can receive or transmit, but not at the same time (rather like two-way radio), so you need software

which can handle the switches between modes. The limited full-duplex mode provides a 75 bps back channel, but again, in many cases, you need software to handle the speed changes or a serial port which can handle the split baud rate.

Bell: The Bell standards break down much the same way as CCITT, but happen to use different frequencies. Bell 103 is the 300 bps standard equivalent to V21, 202 is the equivalent to V23 (but doesn't provide for a 75 bps back-channel — it's a half-duplex standard only), and 212A is the 1200/1200 match for V22. For high-speed work, the Americans can use the same V22 bis standard.

Most of the new local multi-standard modems incorporate Bell modes as well as CCITT — what you really have to watch out for is the people (and there are some) who are selling Bell-only modems into the Australian market.

The Public Switched Telephone Network (PSTN) consists of voice-grade circuits with a bandwidth of around 3.4 kHz — from 400 Hz to 3.8 kHz. That is a reasonably sized pipe through which to 'pour' information if the line is clean.

However, our phone network is far from clean. And once you slice a chunk out of each side of the bandwidth to avoid the areas of highest attenuation, then divide what's left into two to allow full-duplex communication, flow through the pipe is reduced to a trickle unless new techniques are used to squeeze the information along.

For speeds up to 300 baud (and at that speed bps and baud measures are still equal . . .) the job is relatively simple — there are no problems squirting one bit at a time down the pipe, and the connection will usually be reliable. Most modems use a principle known as frequency shift keying, or FSK for short. Basically, there is a carrier frequency which is transmitted constantly and is modulated up or down to represent binary 1 or 0. For example, if the carrier frequency is 1700 Hz then 2200 Hz could represent 1 and 1200 could represent 0.

However, at faster transmission rates we ►

MODEM PHONES

Several modems come equipped with their own phones attached, which is convenient because you can simply pull your current phone out of the wall socket and replace it with the phone/modem unit.

However, it's also a nuisance because in most cases the supplied phone is one of those awful, cheap Asian echo-boxes.

We recommend you buy a modem without a phone, or at least take one which allows you to select your own phone and plug it in (Netcomm, for example, provides this option).

Don't fall into the trap of asking Telecom to install an extra socket for connection of a modem only to the line (to allow use of your current phone) — it costs upwards of \$40, and in these days of deregulation you can buy an approved Telecom Mode 3 double adaptor for \$19. This, of course, gives you complete versatility as you can take the whole lot with you to home, the office, or when you travel.

Watch out for the modems that use parallel connection instead of Mode 3 — if you use a Mode 3 connection for these they'll disable the phone. Parallel adaptors are also available, and cost even less, so even if you buy both you'll be ahead of the Telecom job. I've paid for enough modem connections (even after deregulation) to know just how useful these little devices are.

And don't forget to check with your supplier, or Telecom, if you're planning to use a modem through a PABX or Commander telephone system, as special connections may be required.

1987 MODEM BUYERS GUIDE

COMPANY	MODEM	SPEED	AUTO DIAL	AUTO ANSW	HAYES	SOFT	SELF	CCITT	BELL	BUFFER	VIATEL	AUTO BAUD	DIMENSIONS	RS232C	PRICE	DISTRIBUTOR	
Auttek	Mini Modem	300	n	n	n	n	y	V21,V23	n	n	y	n	95x50x35	y	\$184.60	Auttek/Jaycar Electronics	
	Mark 2	1200/75	n	y	n	n	y	V21,V23	B103	n	y	y	205x50x160	y	\$324.00	Auttek/Jaycar Electronics	
	Multi Modem	300	n	n	n	n	y	V21,V22,V23	B103	y	y	y	150x40x220	y	\$649.00	Auttek/Jaycar Electronics	
	Mega Modem	1200/75	y	y	y	y	y	V21,V22,V23	B103 B212 B202	y	y	y	150x40x220	y	\$649.00	Auttek/Jaycar Electronics	
Acetronics	Thunderer	1200/75	n	n	n	n	y	V23	B202	n	n	n	180x62x125	y	\$190.00	Acetronics	
	Mark 1	300	n	n	n	n	y	V23	B202	n	n	n	180x62x125	y	\$150.00	Acetronics	
AWA Eel Communications	Nokia 053563	75/1200	n	n	n	n	y	V23	n	n	n	n	270x230x40	y	poa	AWA Regents Pk	
	Pulsar Sem	300	y	y	y	y	y	V21,V22,V23	B103	y	32K	y	y	83x205x261	y	\$750.00	Balttec Systems
Baltec Systems	GE321	1200/75	y	y	n	y	n	V21	n	n	n	n	280x190x50	y	\$195.00	Case Communicat Systems	
	Case Communication Systems	300	y	y	n	y	n	V21	n	n	n	n	280x190x50	y	\$195.00	Case Communicat Systems	
Computer Haven	Nile Modem 1	300	n	n	n	n	n	V21,V23	B103 B202	n	n	n	200x160x70	y	\$227.00	Computer Haven	
	Nile Modem 2	1200/75	y	y	y	y	n	V21 V22 V23	B103 B202 B212	n	n	y	160x40x250	y	\$552.00	Computer Haven	
Consolidated Electronics	Nokia 053624	300	n	n	n	n	y	V21	n	n	n	n	270x230x40	y	poa	AWA Regents Pk	
	Nokia 053671	300	n	n	n	n	y	V21	n	n	n	n	270x230x40	y	poa	AWA Regents Pk	
	Cedata 212340	1200/75	y	y	y	y	y	V21,V23	B103 B202	y	64K	n	n	270x230x40	y	\$460.00	Consolidated Electronics
	Cedata 2123	1200/75	n	y	n	n	n	V21,V23	B103 B202	y	64K	n	n	270x230x40	y	\$400.00	Consolidated Electronics
	Cedata 12340	1200/1200	y	y	y	y	y	V21,V22,V23	B212 B103 B202	y	64K	n	y	270x230x40	y	\$899.00	Consolidated Electronics
	Cedata 2301	1200/75	n	n	n	n	n	V21,V23	B103	n	n	n	170x50x190	y	\$255.00	Consolidated Electronics	
Datacraft	Datacraft	1200/75	n	y	n	n	n	V21,V23	B103 B202	n	n	n	150x230x30	y	\$395.00	Datacraft	
	5312AA	300	n	y	n	n	n	V21,V23	n	y	n	y	300x40x230	y	\$676.00	Datacraft	
Dick Smith Electronics	Dataphone	300	n	n	n	n	n	V21	n	n	n	n	135x95x47	y	\$179.72	Dick Smith Electronics	
	Dataphone	1200/75	n	y	n	n	n	V21,V23	B103 B202	n	n	n	205x160x64	y	\$326.23	Dick Smith Electronics	
Esis	Pulsar Sam 1275	300/300	y	y	y	y	y	V21,V22,V23	n	y	256K	y	y	180x70x170	y	\$750.00	Esis
ETI-684	Intelligent Modem	1200/75	y	y	y	y	n	V21,V23	n	y	48K	n	y	270x85x55	\$320.00	Hi-Com	
	Intelligent Modem	1200/75	y	y	y	y	n	V21,V23	n	y	48K	n	y	270x85x55	\$320.00	Hi-Com	
Hypac Electronics	Hypac	1200/75	n	n	n	y	n	V21,V23	B202	n	y	n	150x45x200	y	\$230.00	Hypac Electronics	
	Hypac	300	n	n	n	y	n	V21,V23	B103	n	y	n	150x45x200	y	\$230.00	Hypac Electronics	
Micro Educational	GFA Super Modem	1200/75	y	y	y	y	y	V21,V23	B103	y	8K	y	y	85x190x250	y	\$359.00	Micro Educational
	Beemodem	300/300	n	n	n	n	n	V21,V23	B212	n	n	n	150x90x55	y	\$165.90	Micro Educational	
Microbee NetComm	SN650	300	n	n	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$299.00	Microbee	
	SN650	1200/75	y	n	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$495.00	NetComm	
NetComm	SN690	1200/75	y	y	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$593.00	NetComm	
	SN690	300	y	y	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$593.00	NetComm	
NetComm	SN691	1200/75	y	y	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$671.00	NetComm	
	SN691	300	y	y	y	y	y	V21,V23	B103	y	y	y	200x160x32	y	\$671.00	NetComm	
NetComm	SN640	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$1188.00	NetComm	
	SN640	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$1188.00	NetComm	
NetComm	SN642	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$1260.00	NetComm	
	SN642	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$1260.00	NetComm	
NetComm	SN645	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	1448.00	NetComm	
	SN645	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	1448.00	NetComm	
NetComm	SN647	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$1520.00	NetComm	
	SN647	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$1520.00	NetComm	
NetComm	IN620	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$1000.00	NetComm	
	IN620	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$1000.00	NetComm	
NetComm	IN625	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$1240.00	NetComm	
	IN625	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$1240.00	NetComm	
NetComm	IN600	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	200x160x32	y	\$593.00	NetComm	
	IN600	300	y	y	y	y	y	V21,V22,V23	B212	y	y	y	200x160x32	y	\$593.00	NetComm	
NetComm	64/128	1200/75	y	y	n	y	y	V21,V23	n	y	y	y	100x160x32	n	\$299.00	NetComm	
	64/128	300	y	y	n	y	y	V21,V23	n	y	y	y	100x160x32	n	\$299.00	NetComm	
Microbee Systems Ltd	Beemodem	300/300	n	n	n	n	n	V21,V23	n	n	n	n	150x90x55	y	\$165.90	Microbee	
	Beemodem	1200/75	n	n	n	n	n	V21,V23	n	n	n	n	150x90x55	y	\$165.90	Microbee	
Racal Milgo	Automodem	300/300	y	y	n	y	n	V21,V23	n	n	n	n	225x95x90	y	\$244.20	Microbee	
	Automodem	1200/75	y	y	n	y	n	V21,V23	n	n	n	n	225x95x90	y	\$244.20	Microbee	
Sendata	Racal 123	1200/75	y	y	y	y	y	V21,V22,V23	B103	y	y	y	250x260x60	y	\$910.00	Racal Milgo	
	Racal 123	300	y	y	y	y	y	V21,V22,V23	B103	y	y	y	250x260x60	y	\$910.00	Racal Milgo	
Sendata	300AA	300	n	n	n	n	n	V21	B103	n	n	n	230x150x30	y	\$200.00	Sendata	
	300AA	300	n	n	n	n	n	V21	B103	n	n	n	230x150x30	y	\$300.00	Sendata	
Sendata	1275	1200/75	n	n	n	n	n	V21,V23	B103	n	n	n	230x150x30	y	\$260.00	Sendata	
	1275	300	n	n	n	n	n	V21,V23	B103	n	n	n	230x150x30	y	\$260.00	Sendata	
Sendata	1275 Int	1200/75	y	y	y	y	n	V21,V23	B103	n	y	y	int 18M expansion	y	\$560.00	Sendata	
	1275 Int	300	y	y	y	y	n	V21,V23	B103	n	y	y	int 18M expansion	y	\$560.00	Sendata	
Sendata	700	1200/75	n	n	n	n	n	V21,V23	B103	n	n	n	270x85x55	y	\$249.00	Sendata	
	700	300	n	n	n	n	n	V21,V23	B103	n	n	n	270x85x55	y	\$249.00	Sendata	
Telecorp	Tulip	1200/75	y	y	y	y	y	V21,V23	B103 B202	y	2K	n	y	260x270x64	y	\$493.00	Telecorp
	Intelligent Modem 103	300	y	y	y	y	y	V21,V23	B103 B202	y	2K	n	y	260x270x64	y	\$493.00	Telecorp
Telecorp	Tulip	1200/1200	y	y	y	y	y	V21,V22,V23	B103 B202 B212	y	2K	n	y	260x270x64	y	\$829.00	Telecorp
	Intelligent Modem 123	1200/75	y	y	y	y	y	V21,V22,V23	B103 B202 B212	y	2K	n	y	260x270x64	y	\$829.00	Telecorp

MODEM BUYERS GUIDE

start to run into the limitations of the phone line. We can't reliably send 1200 bits along our noisy, cluttered pipe in a second.

The solution is to compress the information, using phase shift keying (PSK) techniques to send two bits at a time. By shifting the phase in 90 degree increments we can send what are known as dibits, which give four possible combinations (00, 01,

10, 11) compared to the two (0 and 1) available under FSK.

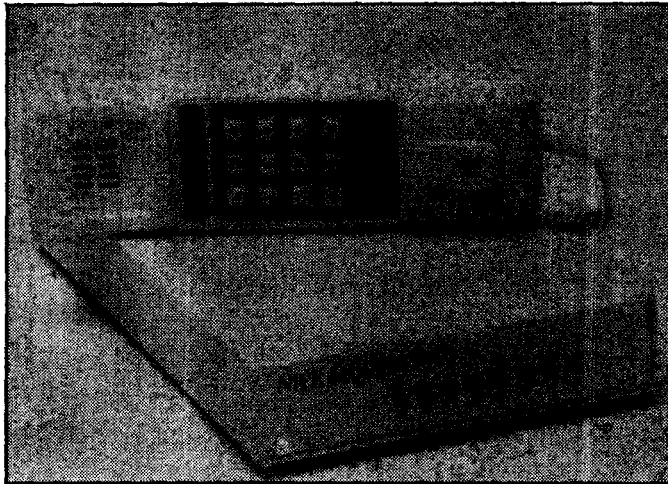
Thus 1200 bps is really 600 baud — it's 600 state-changes per second. The PSK technique allows us to send two bits for each state change.

Similarly, 2400 bps is 600 baud: again we use the same number of state changes, but take the compression technique even further by sending four bits at once.

The rocketships

Super-fast modems are starting to appear, and have an obvious application in some areas — usually dedicated corporate dial-up links. The problem, of course, is there is no real standard for these 10,000 bps hotshots, so your \$10,000-or-so investment (you need two units) is useful only for its intended purpose.

The methods used for obtaining these ►



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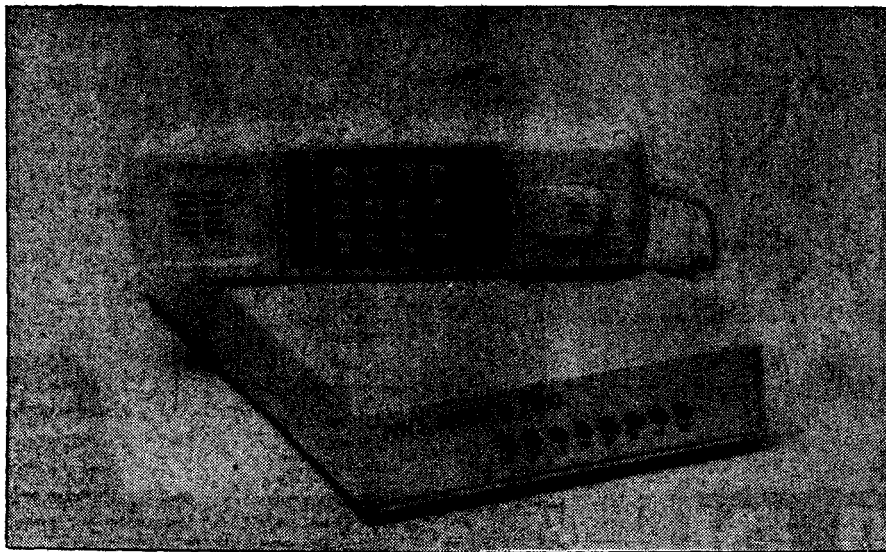
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COMMUNICATIONS TERMINOLOGY

Baud: The number of transmission per second along a data communications line.

Bit: Binary digit, being the basic unit of data storage. Either 1 or 0, off or on, true or false.

Binary Synchronous Communications: A type of protocol that synchronizes both ends of the communication line, then transmits binary data across the line.

Byte: A computer word eight bits wide. A byte in memory can hold a character or a binary number between zero and 255 (or -128 and 127), or a computer instruction.

CCITT: Consultative Committee on International Telegraphy and Telephony. The committee sets standards for various aspects of telephone and telegraph usage.

EBCDIC: Extended Binary Coded Decimal Interchange Code; an 8-bit character-coding system — IBM's answer to ASCII.

DCE: Data Communications Equipment — one end of the RS232 connection. It needs to be set up differently (some wires reversed) to the other end, DTE. Modems are typically DCE.

DTE: Data Terminal Equipment: the other end ... a computer configured as DTE will talk to a modem configured as DCE. If the gods are willing and the moon is right, a straight-through cable should do the trick.

File transfer protocol: A protocol that only exchanges disk files with the host. This type of protocol does not allow you to communicate interactively with the host.

Handshaking: A technique for controlling data communication between two devices; data flow only occurs when the receiving device sends a signal indicating it is ready to receive.

Host: The computer that is in control in a data communications network. The host may be a mainframe, mini or microcomputer.

Interactive protocol: A protocol that lets you communicate interactively with the host. In this kind of protocol, part or all of the contents of the screen display are sent to the host when you press RETURN; you do not have to communicate with the host by sending it disk files.

Interface: The (hardware or software) connection between any two devices.

Modem: Modulator/demodulator device used to link a computer to the telephone line. It encodes digital bits into frequencies, and vice versa.

Packet switching: A system of communicating data by dividing it into small packets addressed to particular receivers.

Parity: An extra bit on the end of a character or byte, which is used for error detection.

Protocol: The rules governing the exchange of information between two devices.

RS232: (also RS232C) Registered Standard 232C. A widely used standard for connecting components in a computer system.

Synchronous: A mode of transmission in which the transmitter and receiver are in step with each other.

Serial transmission: Movement of data one bit at a time. One byte will be sent as eight bits, one following the other. Cheap and slow.

UART: This is a Universal Asynchronous Receiver/Transmitter, which handles the serial-to-parallel and parallel-to-serial conversion of bits in a data message.

Viatal: Telecom's videotex system.

Videotex: Also known as viewdata. A technology which uses slightly modified domestic televisions to access data from a computer database along the telephone lines. Prestel in the UK was the first such system. Australia's version is called Viatal.

incredible speeds vary. The Tulpi Fast-com, for example, uses a similar compression technique to the 2400 bps standard discussed, while the Netcomm Trailblazer employs a complex system of multiple carrier channels, examining each to test its quality and then sending the most data down the good channels. Just the thought of the design work that must have gone into that unit knocks me out . . .

Another standard

American modem manufacturer D.C. Hayes established another standard we should know about — the 'AT' standard for control of intelligent modems.

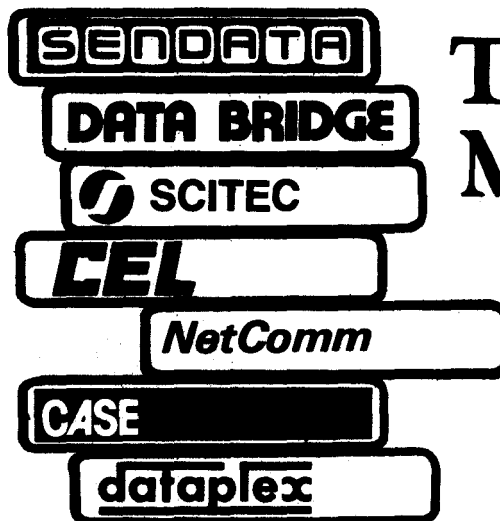
Virtually all auto-pilot communications software is designed to drive a Hayes-com-

patible modem — usually offering a menu selection of numbers to call, calling the selected number automatically, connecting at the right baud rate, hanging up the line when asked, and so on. (Some programs provide 'drivers' for modems using different standards, while a few are configurable to suit the modem — however, sticking with Hayes compatibility is really the only way to go.)

You can control a wide range of modem functions with the AT command set (so named because the modems recognize commands preceded with AT, known as the attention character) and, because it has become the de facto standard, you should consider it a primary feature to look for in an intelligent modem. ●

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STATE-OF-THE-ART IN OSCILLOSCOPES

Designed for advanced research and engineering applications, Philips' PM 3295 350 MHz oscilloscope features practical sized tubes with practical voltages as well as processor-controlled switch buffering. Not surprisingly, it's making waves at the top end of the market.

Jon Fairall



The first time I saw the PM 3295 350 MHz oscilloscope was over a year ago, shortly after it was first released in this country. It's taken this long to organize a review because, according to the people from Philips, the oscilloscopes tend to get whisked off to purchasers as soon as they arrive.

I'm inclined to believe them. At about \$14,000 each, Philips doesn't keep many hanging around the warehouse. To justify the price, Philips points to superb performance; and superb it is. At 350 MHz for the half power points, there are only three other oscilloscopes available in Australia with performances going beyond it, and they both use fancy display tech-

niques, and even fancier prices, to get there.

Not that the 3295 is a slouch when it comes to the technology stakes. There are perhaps two things that make this oscilloscope special, the tube, and the micro-based architecture.

The tube

The problem in designing a high performance tube is that when things start to move really fast, the time it takes the electrons to travel down the tube becomes a significant fraction of the time taken to write on the screen.

There are ways around this problem. One can make the deflection area very

short, so reducing the time it takes for electron transit. The problem then is that one needs extra power to achieve more deflection. One can increase the aspect ratio of the tube, ie make it long and narrow. Then less deflection will achieve a greater spread in the beam at the screen. But there are practical limits to that as well; the box becomes impossible to move around, and the acceleration voltage becomes overly large.

In any event, with the best of modern techniques these methods run out of steam at about 200 MHz. To get more band-

66

In any event, with the best of modern techniques these methods run out of steam at about 200 MHz. To get more bandwidth one has to be a little bit smarter. Philips has decided to use travelling wave deflection in the 3295.

99

width one has to get a little bit smarter. Philips has decided to use travelling wave deflection in the 3295. This allows practical sized tubes with practical voltages.

The object of travelling wave deflection is to ensure that each electron sees a constant deflection voltage as it flies through the deflection zone of the tube. Since the deflection voltage travels at the speed of

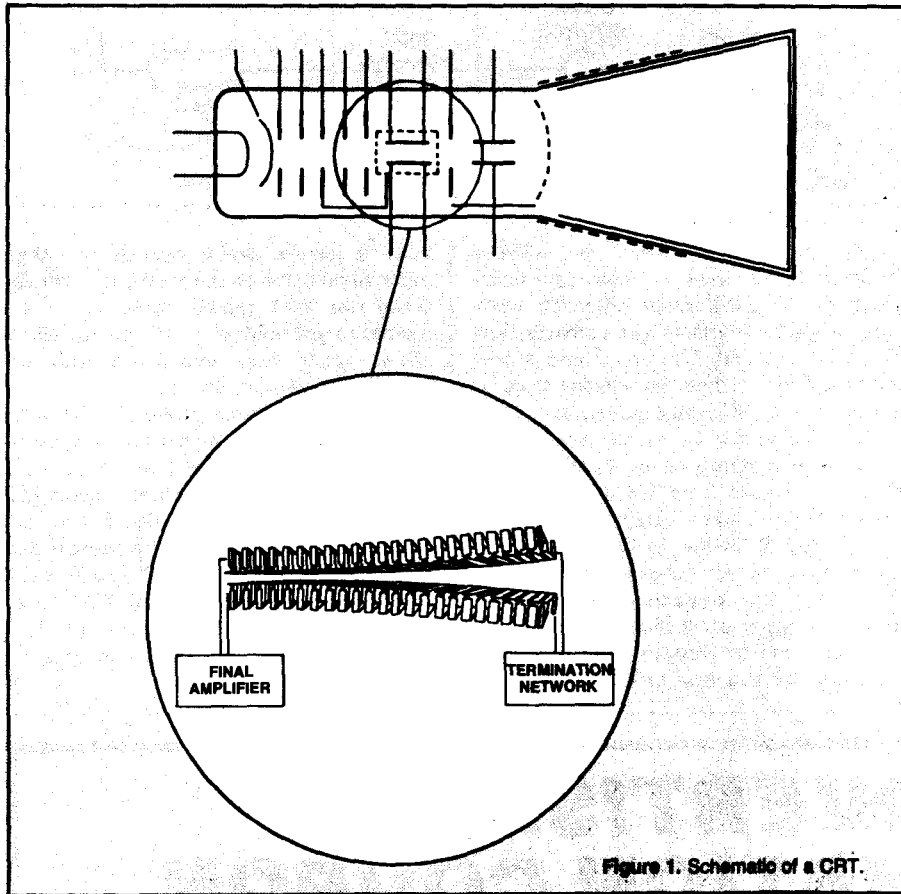


Figure 1. Schematic of a CRT.

light and the electrons in the beam travel at only 10 per cent of this, there is a problem.

This problem is solved in the 3295 with an extremely simple solution, the helical 'slow wave' structure. All this means is that the wire is twisted up into a helix shape so that the effect of the voltage is propagated more slowly.

Architecture

The other really noteworthy technical feature of the 3295 is the processor-controlled switch buffering. By putting a micro between the user and the tube, a number of interesting facilities suddenly become rather simple to devise.

First and foremost is the autoset facility. Push the button and the micro looks at the input signal and then sets the oscilloscope for you. It rarely gives you exactly what you want, but adjusting it then becomes a simple matter of fiddling with the timebase and vertical amplifier. The extensive knob twiddling that accompanies a conventional oscilloscope is eliminated.

The micro also makes it rather easy to put a control bus on the 3295. I didn't have the facilities to play around with this feature, which is a pity, because computer control in repetitive test situations is probably a common application for an oscilloscope of this type. However, according to the manual, the IEEE 488 allows full control of all functions.

This is possible because all the switches are mechanically decoupled from their electrical values. As a result, the display of the settings of the various knobs and switches becomes a major problem. This is solved in three ways. Firstly, each button has a light on it to indicate its status. Initially, this seems like a bit of a gimmick, but it quickly becomes something one learns to rely on. A quick scan of the panel is all that's necessary to indicate the status of the machine.

The second facility is the display of timebase, delay and amplitude settings on the screen. On first acquaintance with the machine I found myself looking at the knobs for this information but it quickly

becomes second nature to look at the screen. The intensity of these graphics can be set independently of the main display, so you can get rid of them completely, if you wish. My only gripe about this is that it's not done well enough. When are we going to get an oscilloscope with a proper graphical display, all the axes, values and labels in the right place?

The third form of display is the LCD windows. There are five of these, containing settings of the two vertical amplifiers, the timebase, and the delay line. Like all LCD displays, they can be hard to read at times. After a little experience with the machine they actually seem rather superfluous. I found myself watching the information on the display, rather than the LCD windows, even when I was twiddling the knob.

Using the oscilloscope

For this review I hauled out an old TV we have hanging around in the lab, and poked around in the innards of it. A TV set hardly gets the PM 3295 up and running of course, but our lab doesn't run on hundreds of MHz!

In practice, it's a delight to use. The screen is nice and bright, easy to read. The focusing wasn't all I could have wished, but the Philips people assured me this was only an adjustment problem on the model I was using.

The front panel is laid out in a logical pattern. Vertical deflection is to the left, and horizontal to the right. Looking from the top down, triggering and deflection are at the top, the amplifier and delay settings are in the middle and an extensive input conditioning network is at the bottom. Tube controls such as intensity, focus and scale illumination, are sited under the display.

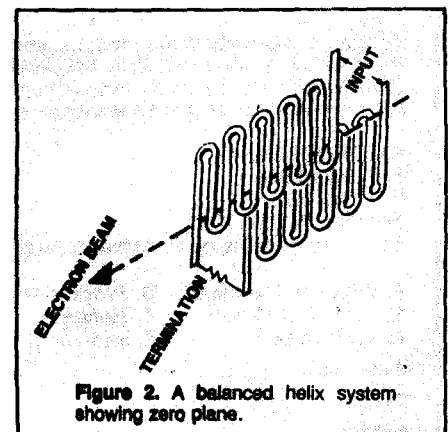


Figure 2. A balanced helix system showing zero plane.

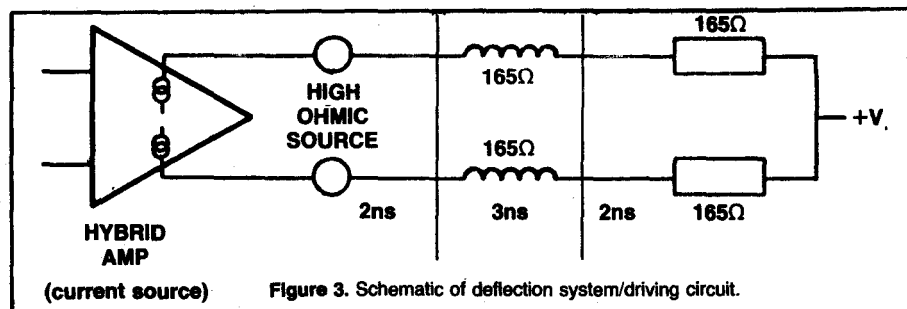
PHILIPS PM 3295

Operation of the front panel controls is fairly conventional for the most part. The delay and cursor facilities I rather liked. To set up a delay, part of the main timebase can be intensified with the use of the MTB INTENS switch. The intensified part of the screen is moved over the trace until it's in the desired position by using the DELAY knob. Then the DEL'D TB knob can be used to set up its width. When the DTB button is activated the region is spread right across the screen, either with or without the original trace. The length of delay and the width of the timebase are both displayed.

The cursors are also easy to use. Pressing either the (V) or (t) button will display time or amplitude cursors, together with a read out of the distance between them. This can be adjusted by the main CURSOR knob which makes possible extremely accurate measurement of the artefacts on the trace. Another small quibble though: why not provide a setting to invert the time information so that positioning the cursor over one period of a waveform would yield its frequency?

VHF

There are two other knobs on the 3295



worth mentioning. One is labelled 20 MHz, and is used to reduce the bandwidth of the oscilloscope when its wide-band response starts to get embarrassing. The other is labelled 50 ohms, and is used for changing the input impedance from its normal 1M, 9 pF setting to 50 ohms.

This 50 ohm setting is necessary because the input impedance of the standard input begins to deviate from 1M at frequencies much above 1 MHz. Above 100 MHz it could easily be as low as 1k, according to the manual. To prevent loading the device under test, high frequency measurements have to be made at 50 ohms.

Another aid to accurate high frequency measurement is a new probe. Philips pro-

vides a passive probe with 10 M, 10 pF input impedance at the probe tip, but for really fast work (above 50 MHz) it's advisable to get hold of a FET probe, which allows really high impedance with extremely low capacitance.

Armed with a fancy probe and the 3295, you have a genuine high frequency measurement instrument. However, there are a lot of problems with getting meaningful figures at VHF speed. Many of these are covered in the comprehensive manual that Philips supplies with the 3295. The main one is that the test point on the device under test must have precisely 50 ohms output impedance if a valid measurement is to be made.

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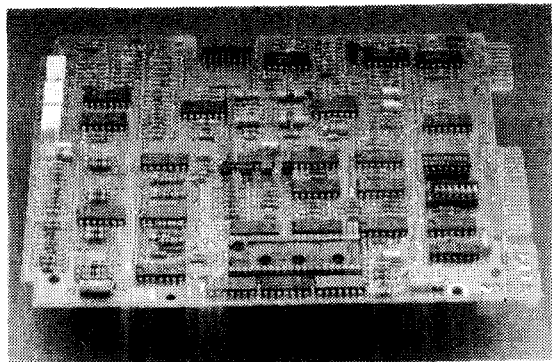
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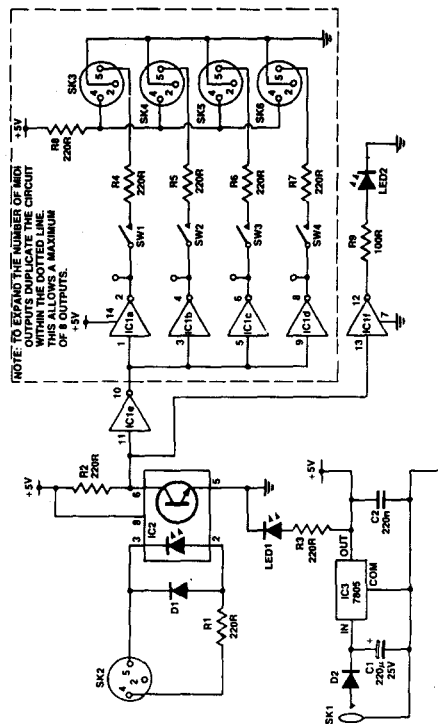
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OSCILLATORS AND AMPLIFIERS

Part 1

The fundamental electronic system is the audio amplifier. Next in the hierarchy comes audio amplifier test equipment. This article commences a three part presentation of the design and construction of a general purpose power module and a sine-square audio oscillator. We start with some overall concepts and background information that leads into the design of a highly useful piece of test equipment that will provide all the facilities needed to test audio components and amplifiers.

Peter Phillips

This series has two overall aims. The first is to provide readers with some technical background by using a mix of theory and hands-on approach to circuit design. The second, which supports the first, is to provide and analyze designs for a useful range of low cost test equipment that can form the basis of typical workshop. We have previously presented a simple regulated power supply and the related theory (see October, November '86). Now it's time for audio test equipment and amplifiers.

The project will consist of an integrated audio power amplifier module and a sine-square audio oscillator. This two-in-one device will provide most of the facilities needed to service and test audio equipment. Because some possibly unfamiliar concepts are embodied in the project this article offers most of the background theory needed to understand the circuitry involved.

The heart of analogue or linear electronics is the amplifier. Amplifiers may incorporate a range of devices, including transistors, FETs and op-amps, and like anything, they must have certain characteristics that match them to the required task. Typical variables to consider include the amount of amplification, the frequencies involved, the nature of the load and the type of signal source. This implies that all amplifiers are not the same, and that a range of techniques to design the required characteristics into an amplifier circuit must be explored. One avenue that is

commonly employed is the use of feedback.

A basic amplifier is a fairly simple thing, but tailoring it by using feedback introduces extra circuitry that can start to complicate things a little. However, feedback is present in nearly all amplifiers to determine and stabilize their performance characteristics. As well, feedback of various forms in conjunction with an amplifier is often used to produce a system that can perform various functions other than amplification. An oscillator is an example of an amplifier with feedback, and the feedback circuitry is often more complex than the amplifier.

We'll start with amplifier characteristics, then proceed to describe feedback and its effects.

Amplifier characteristics

There are four fundamental considerations in amplifier design. The first is the type and amount of amplification or gain needed. An amplifier may provide voltage, current or power gain, or perhaps a combination of these. Gain is the ratio of the output signal to the input signal. If measured as volts out to volts in, a voltage gain is determined. Usually an amplifier must provide power to a load, and a power stage, often with unity voltage gain, is then added to the circuit. Knowledge of actual power gain, however, has limited applications, as it becomes difficult to determine how much power is present at the input terminals of the amplifier. Current gain is fairly restricted as a useful figure for the same reasons. So, for most pur-

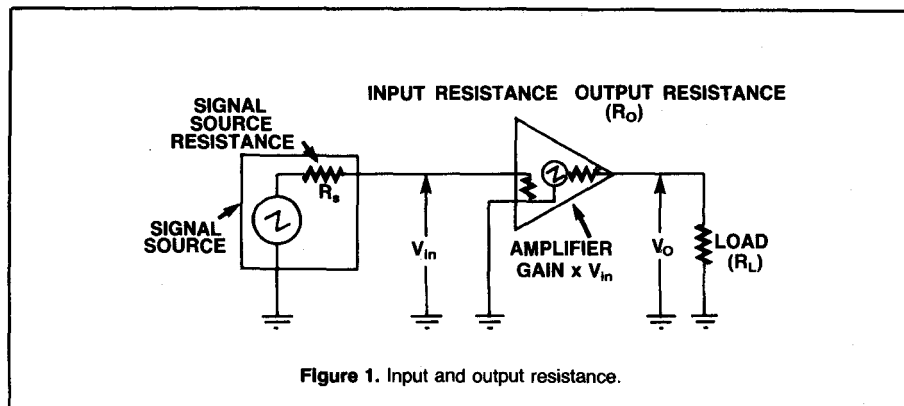
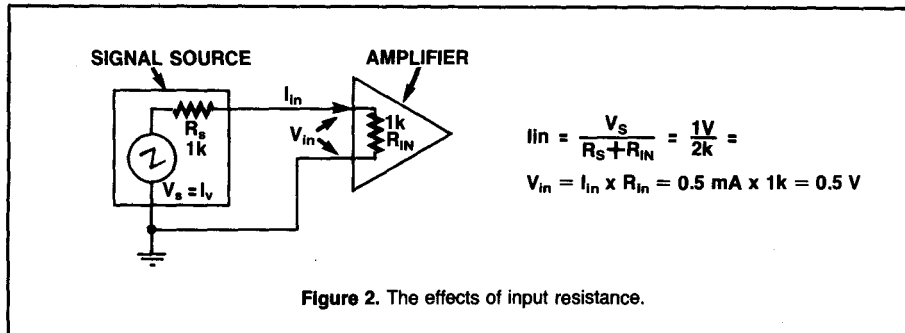


Figure 1. Input and output resistance.



poses, voltage gain is the usual way of discussing the gain of an amplifier, and is determined using the following equation:

$$A_v \text{ (voltage gain)} = \frac{\text{voltage out}}{\text{voltage in}}$$

To discuss the next two characteristics, referring to the block diagram of Figure 1 is useful. This diagram shows the symbol of an amplifier, an input signal source and a load across the output. The amplifier symbol includes two resistors, labelled R_{in} and R_{out} . By reducing an amplifier to this form, the next two characteristics, viz, input resistance and output resistance can be introduced.

Input resistance

Input resistance of an amplifier is a measure of how much the amplifier will load the signal source. Trying to start a car using a torch battery is an example of excessive loading by the starter motor on the undersized battery. However, if the input resistance of the load is much higher, the battery can cope. In the same way, if the signal source, like the torch battery, has limited capacity, then the amplifier it is feeding must have a high enough input resistance to prevent all the available signal being dropped across the internal resistance of the signal source. All signal sources, eg, microphones, tape recorder heads, etc, have some value of internal resistance (called R_s in Figure 1) that depends on the device.

Ohm's law allows a mathematical appraisal of the effects of an amplifier's input resistance. If it is assumed that the values of R_s and R_{in} in Figure 1 are both equal at 1k ohm, then the circuit of Figure 2 can be used to see what is happening. Notice how the signal source has an internal voltage generator, in this case producing a value of 1 volt. The voltage value produced by the generator can be found in practice by disconnecting the signal source from any load, and measuring the now

open-circuit voltage with either a high impedance ac voltmeter or a CRO.

When the signal source is connected to the amplifier, a current, I_{in} , flows with a value that is determined by the next equation:

$$\text{input current, } I_{in} = \frac{V_{in}}{R_{in}}$$

In this case the current will be 0.5 mA. The value of the input voltage to the amplifier, V_{in} , can be established in two ways. As $V = IR$, V_{in} can now be found using this equation:

$$\begin{aligned} \text{input voltage to amplifier,} \\ V_{in} = I_{in} \times R_{in} \end{aligned}$$

Alternatively, the voltage can be found by subtracting the amount dropped across R_s from the open-circuit voltage (V_s) of the signal source as follows:

$$\begin{aligned} \text{input voltage to amplifier,} \\ V_{in} = V_s - (I_{in} \times R_s) \end{aligned}$$

Either way, we are left with 0.5 volts. Had the input resistance of the amplifier been higher, a greater percentage of the available signal voltage would have been presented to the input terminals of the amplifier. The amplifier can only amplify the voltage at its input terminals, but if it causes losses across the internal resistance of the signal source, then extra gain is necessary to compensate.

The most suitable value of input resistance for an amplifier depends on the signal source. In general, a high input resistance covers most cases, with some reservations. Occasionally a specified value must be used to ensure correct performance with a specific input device. For example, many phonograph pickups require an input resistance of 47k ohms for correct operation. Other times, particularly when the amplifier is some distance from the signal source, it is better to opt for a low

input resistance for the amplifier and, naturally, also for the signal source. This prevents random noise pickup. It is possible to calculate input resistance for a given circuit, but we will deal with this when it arises.

Output resistance

When considering output resistance the amplifier can now be regarded as the signal source, this time connected to a load denoted as R_L . Again the load resistance must be compatible with the amplifier's source, (or output) resistance. It is pointless connecting an 8 ohm loudspeaker to an amplifier with an output resistance of, say 1k ohm, as all the signal developed by the amplifier (shown as an internal generator labelled $A_v \times V_{in}$ in Figure 1) will be lost across the 1k ohm resistance. Output resistance is a prime consideration for a power amplifier, as low resistance devices such as speakers must be driven. However, it is an important characteristic in most cases if best results are to be obtained.

For power stages, the ideal output resistance is zero. Where the output resistance is high, say greater than 10 ohms, maximum power is transferred from the amplifier to the load when the load resistance equals the output resistance. In this case, 50 per cent of the power is lost across the output resistance, and 50 per cent remains for the load. However, if the output resistance is zero, or much lower than the load resistance, the efficiency is much higher. When considering voltage, rather than power, the higher the resistance of the load compared to the output resistance the better. Power transfer is one thing, voltage transfer another, but in both instances the value of the load resistance should be compatible with the output resistance value.

Frequency response

The ability of an amplifier to equally amplify a range of frequencies is a measure of its frequency response. Audio amplifiers should, as a minimum, be able to handle frequencies from around 20 Hz to 20 kHz, as this is the approximate range of human hearing. Because hearing follows a logarithmic scale, it turns out that perceived loudness at a particular power output level is virtually the same as that heard when the power output is halved, or doubled. When power output falls to half its original value, the voltage across the load will have fallen to around 71 per cent of its previous value.

It is standard practice to establish the 'half power' points when conducting a fre-

CREATING WITH ELECTRONICS 3

quency response test on an audio amplifier. This is done by connecting an audio oscillator to the input of the amplifier, and establishing the two points at which the output voltage of the amplifier falls to 71 per cent of its original value. These points are known as the lower cut-off point — f_1 and the upper cut-off point — f_2 . The range of frequencies between these two points is the bandwidth or frequency response of the amplifier.

When designing an amplifier, the values of the capacitors establish the bandwidth. A capacitor can pass high frequencies, but becomes an open circuit as the frequency approaches dc or 0 Hz. Figure 3 shows two diagrams that illustrate how the presence of a capacitor in conjunction with a resistor will affect the output voltage as the frequency of the input voltage is varied. When the capacitor is in series with the signal path as in Figure 3(a), the low frequency signals are affected. If the capacitor is in parallel with the signal path as in 3(b), the high frequencies are lost.

It turns out that a fairly simple equation applies to determine the values of the two frequencies. The equation, for both cut-off points is:

$$f = \frac{1}{2\pi RC} \text{ Hz}$$

The difficulty is usually in establishing the value for the resistance R, as this value

will be a combination of many other individual values. However, knowing the basic ideas allows a great understanding of how to achieve the desired frequency response, and where to look when measurements show an inadequate response.

Feedback

Most systems, either mechanical or electrical, employ feedback of some sort to ensure certain operating characteristics. The block diagram of Figure 4 shows the usual method of applying feedback around an amplifier. In principle, a sample of the output voltage is added to the input voltage using an arrangement to sum the two signals. The amount of feedback is determined by the network contained within the feedback block. The overall effect depends on whether the feedback is 'positive' or 'negative'.

Negative feedback is the usual type of feedback. This is achieved when the feedback voltage is of the opposite polarity to the input voltage. For ac signals this implies that the two voltages must be out of phase with each other by 180° . The resultant voltage that the amplifier sees is therefore *less* than the actual input voltage. As a result, the overall gain of the circuit is lower than it was without feedback. While this may seem to be a problem, the benefits of negative feedback are

many, and loss of overall gain is a small price to pay.

The terms 'open-loop gain' and 'closed-loop gain' are frequently encountered in the literature, and bear explanation. An amplifier is always just that: an amplifier with a certain amount of gain, called the open-loop gain. If feedback is applied, the amplifier is now part of a system which will then have an overall closed loop gain of a certain value. For negative feedback, the closed-loop gain is less than the amplifier's open-loop gain. However, the actual amplifier, if it can be singled out, still has its original open-loop gain. Because the feedback may be integral with the amplifier circuitry, the original open-loop gain figure becomes largely irrelevant. In effect, the amplifier is really amplifying a smaller signal, equal to the combination of the actual input voltage less the feedback voltage.

Because gain is a ratio of output over input, the system gain, or closed-loop gain, is really the important figure, and is the measurable gain. Figure 5 illustrates this in block diagram form. Some figures are included by way of example to help show how open-loop gain is an amplifier characteristic, and closed-loop gain a system characteristic. Often, of course, the system is only an amplifier anyway, and closed-loop gain is the final gain figure.

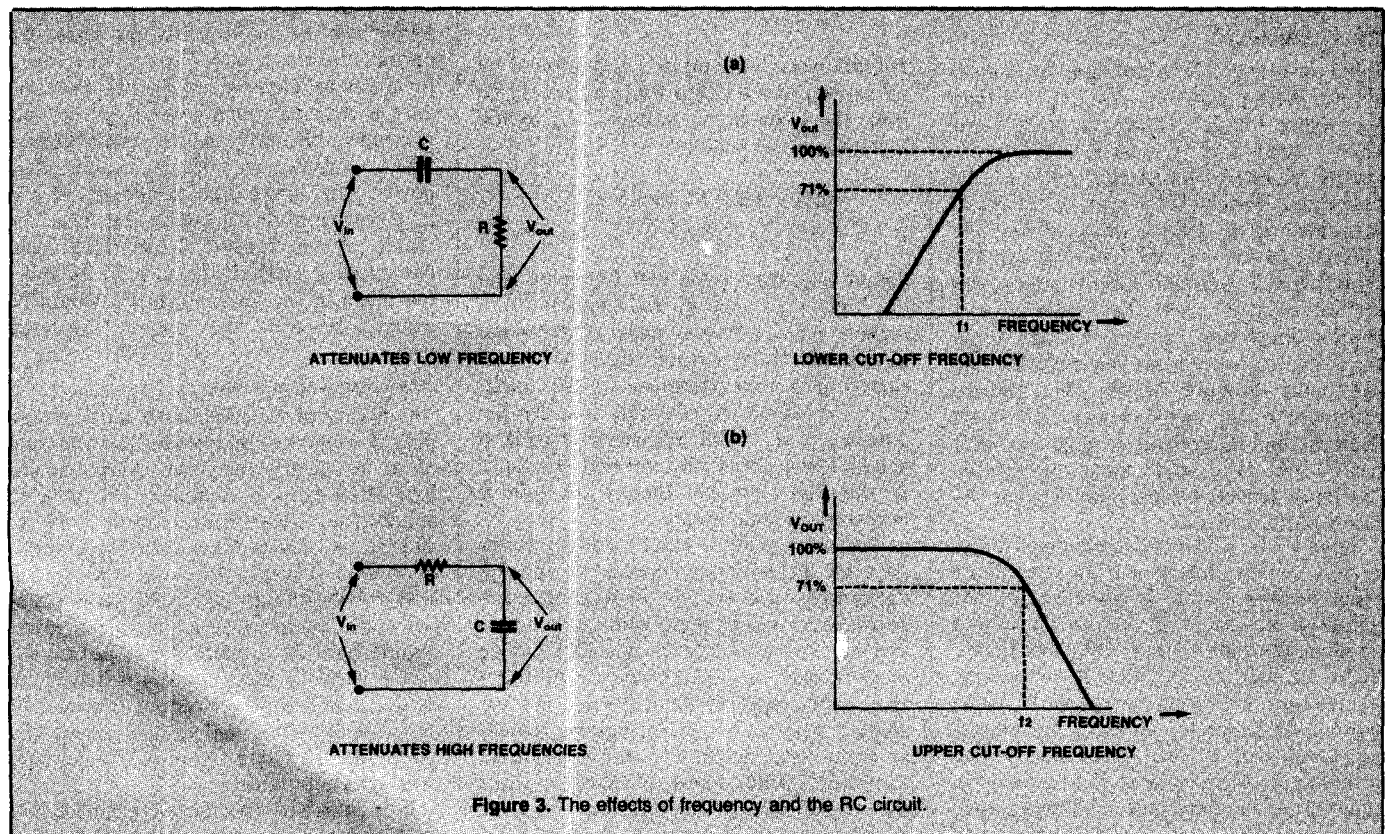
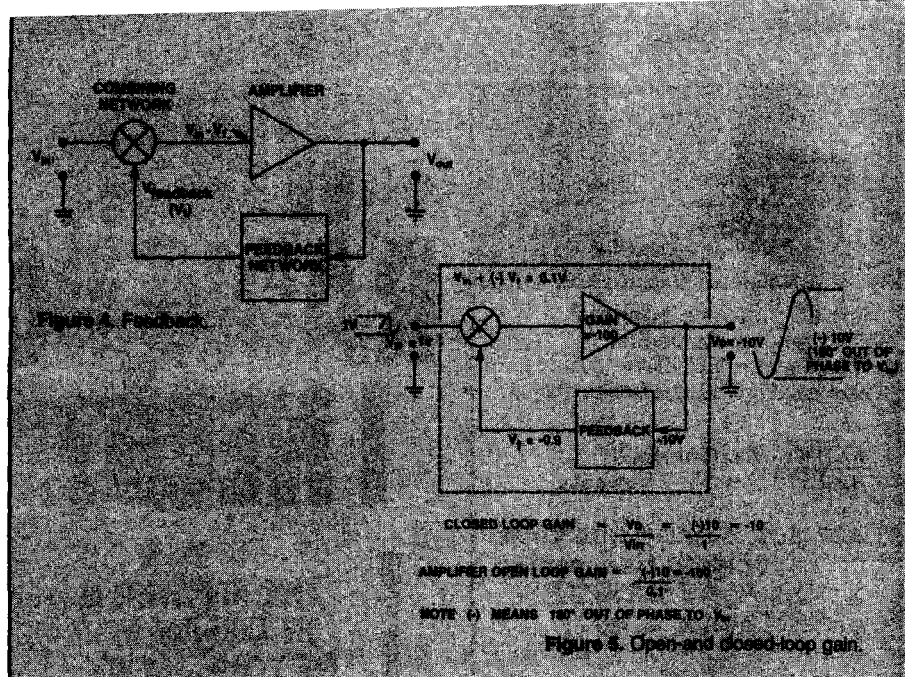


Figure 3. The effects of frequency and the RC circuit.



The foregoing has relevance where operational amplifiers are used, and will help explain circuits incorporating these devices.

Effects of negative feedback

Negative feedback is a complex issue, but in general is used to establish the characteristics discussed previously. As already explained, the gain is reduced, often considerably. If the open-loop gain of the amplifier is very high, reducing it with feedback is essential. Most op-amps have open-loop gain figures approaching 100,000, which is too high for normal use. The amount of feedback needed to establish a gain of, say, 10 is substantial. In many cases it is the feedback that determines the characteristics of the overall system, and the amplifier is only a minor consideration. This means that the feedback network is all that has to be examined when calculating gain. This is particularly true of the op-amp, but discrete component amplifiers can also fall into this category.

Negative feedback will also modify the original input and output resistance values, as well as the frequency response, distortion and noise figures. Depending on how the feedback is applied, input resistance can be increased and output resistance reduced by a ratio equal to the amount of feedback applied. Frequency response is increased, distortion and noise reduced when negative feedback is applied, the extent again depending on the amount of feedback. So, it's all good news with negative feedback.

However, one cannot go on adding negative feedback indefinitely to try to get super performance. Firstly, the gain will finally be too low to be useful; the second reason concerns overall stability. Negative feedback is fine while it's negative. If the feedback voltage shifts in phase so that it

starts to become in phase with the input voltage, the resultant voltage applied to the amplifier will increase. This can occur at particular frequencies, and manifests itself as a loss of stability. The feedback is now positive, with all the problems that are inherent with this type of feedback.

Positive feedback

The classic example of positive feedback within a system is the effect created when a microphone is too close to the speaker reproducing the original input. The sound output of the speaker reinforces the original sound, and the amplifier boosts the reinforced output of the microphone. A closed loop dedicated to making the sound as loud as possible culminates in eventual loss of control. A characteristic of positive feedback is oscillation. A PA system will tend to oscillate at a particular frequency when positive acoustic feedback is present. The frequency is determined by the system as a whole, including the environment, type of speakers, microphone etc, and can be altered by changing any of these constants.

An oscillator, such as that to be described in following sections is really only an amplifier with positive and negative feedback around an amplifier. The negative feedback stabilizes the amplifier, the positive feedback makes it oscillate. The type of network in the positive feedback section has to be designed to cause oscillation at a specified frequency, and the negative feedback must then control the output level. The system oscillates only when the two feedback loops cancel, giving an overall loop gain of unity.

The dc requirements

As already discussed, the amplifier is the basic building block of the project. To ensure variety, FETs, transistors and operational amplifiers are all used in the design.

The ac conditions have now been discussed; it remains to generalize on the dc conditions essential for proper functioning of the active devices.

The term 'biasing' is frequently used, and in an electrical sense means the presence of a dc voltage that the ac signal may appear in conjunction with. The dc supply is therefore used for two purposes. The first is to supply the necessary power to the device, the second is for biasing. The polarity and method of applying a bias voltage varies with the requirements of the circuit and the device.

Most FETs require a reverse bias, which implies that no current flows in the reverse biased pn junction. Transistors need forward bias to supply a dc voltage that causes a current to flow in the biased junction. The signal voltage is superimposed on the bias voltage to cause the device to amplify the signal. FETs are voltage-operated, transistors current-operated, meaning the input *voltage* is varied for FETs, the input *current* for transistors. All voltage-operated devices offer a high input resistance to the signal source, and FETs find their greatest use for this reason. Transistors are essentially low resistance devices, and special circuit configurations are needed if high input resistance is required.

Operational amplifiers are different in concept. Their internal circuitry can contain FETs or transistors, but their high gain property allows feedback to be used to establish the required operating characteristics. The op-amp is really a complete amplifier on a chip, and is not really a device but a collection of devices. Usually an op-amp needs a dual polarity power supply, but by use of suitable biasing, single supply operation can be achieved.

Biasing is generally provided by a resistive network associated with the active device. Only rarely are special biasing power supplies used, as it is more economical to utilize the main power supply. However, special precautions are needed as the possibility of unintended positive feedback through the power supply becomes real. The need for extra filter capacitors, called decoupling capacitors, is essential to prevent this problem.

In conclusion

The foregoing has presented an overview of the concepts that are contained within the projects to follow. As the series develops, the practical implications of the contents of this article will be explained along with their implementation. Ideally, readers should then be able to not only successfully commission the projects, but be in a position to modify them to suit particular requirements. ●

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INSIDE YOUR COMPUTER 7

SCREEN AND SPEAKER

The two most-used personal computer output devices are the computer's screen and loudspeaker. This month we look at how the PC talks to you.

Phil Cohen

There was a time when the only input and output from a computer was via a printer and keyboard. Personal computers went through a phase of being sold as glorified electronic games (I believe that phase is now over), and as a result their ability to produce complicated sounds (other than just beeps) and sophisticated graphics (pictures on the screen) was significantly enhanced.

Consequently, the architypal business personal computer, the IBM PC, is capable of producing some quite pretty colour pictures on its screen. And other machines claiming to be aimed at the business market, such as the Commodore Amiga, have stereo sound synthesis built in.

Text on screen

Most computers have two or more modes of displaying information. One is generally called 'graphics mode' and the other 'text mode'. For the purposes of this discussion we will look only at 'memory-mapped' screen systems, in which the contents of a particular block of RAM determines what appears on the screen. There are other systems, but they are outside the scope of this article.

A particular range of RAM addresses is set aside for use by the graphics part of the computer. This range is called 'VDU RAM' ('VDU' stands for the archaic term 'visual display unit'), and it is usually a few K long. The ASCII value in a particular address in this part of RAM corresponds to the character that is to be displayed on the screen at that point, so that each character position on the screen corresponds to a particular address.

For example, address 1000 may correspond to the top left-hand corner of the screen (row 1 column 1), address 1001 to the next position along (row 1, column 2), and so on up to address 2919, which corresponds to the bottom right-hand corner (row 24, column 80 on most machines).

By altering the contents of a particular address, the computer can make the screen display change. Normally this is

handled by a special chip (called a 'VDU controller') which does things like keep track of the position of the cursor. Each time the processor tells the VDU controller to 'put a character onto the screen', the controller will work out what the next position is, change the relevant address in VDU RAM to the ASCII value of the character, and that will be that.

Another part of the computer is mean-

66

Just to make things more complicated, some computers have an area of RAM called 'programmable character generator RAM', or 'PCG RAM'. This has the same function as the character generator ROM, except of course that the shapes of individual characters can be altered at will by the software, which is useful if you want your machine to display Chinese or Russian!

99

while working away at taking the values stored in VDU RAM and converting them into a video signal suitable for a monitor or TV set.

Pixels

The video output (ignoring colour systems for the moment) is made up of a large number of individual dots or 'pixels' (picture elements), each of which can be either on or off. To form a letter on the

screen, the pixels in the area where the letter is to appear must be set to a particular pattern that corresponds to that letter.

An area of ROM called the 'character generator ROM' holds the pixel patterns for each of the possible characters the computer is capable of displaying. The machine forms the picture by continually looking up each character in the VDU RAM, finding its pixel pattern from the character generator ROM, and converting that to a stream of pixels for the video output. Of course, the whole screen has to be output at video frame speed, so this is no mean feat.

Just to make things more complicated, some computers have an area of RAM called 'programmable character generator RAM', or 'PCG RAM'. This has the same function as the character generator ROM, except of course that the shapes of individual characters can be altered at will by the software, which is useful if you want your machine to display Chinese or Russian!

For special attributes, like flashing characters, underlined characters, characters in reverse video (black on white), or characters in colour, another area of RAM, called 'screen attribute RAM' is set aside. Again, each address corresponds to a particular character position on the screen, but the value stored at each address holds information about which of the possible attributes (flashing, reverse, etc) is on or off for that particular character position.

When it comes to graphics, there are two possible approaches. For 'block graphics', of the sort which might be needed to display a form on the screen with borders around particular parts of the screen area, most machines have a special part of their 'character set' (the set of characters that they can display) set aside for this purpose. One block graphic character might be a vertical line, another a corner, and so on. A lot of graphics can be achieved by mixing these with normal text.



CAD

Of course, this is not nearly good enough for applications such as CAD (computer-aided design or the use of a computer for drawing diagrams). For this, a special graphics mode has to be used.

This uses a larger amount of VDU RAM, and holds the particular value of each set of eight pixels in one RAM address. In some complex systems, *each* pixel is represented by a whole address, which holds details of the colour, intensity, and so on for that one pixel. That takes a *lot* of memory.

By changing the values of particular pixels, the computer can draw lines on the screen which are one pixel wide, and even get enough resolution to produce a believable colour photographic likeness.

Graphics applications take a *lot* of computer power, but there are two new ways to speed things up. The first is the use of a special graphics processor (such as the one in the Amiga) which deals with all of the graphics while the main processor gets on with something else. The other approach is to build a special 'reduced instruction set computer' (RISC), such as IBM's new RT, which has a processor specially designed to work with graphics, and as a consequence is a bit slower at some other things.

Sound

Back in the dim and distant past, computers went 'beep'. That was the only sound you could get out of them, and it got pretty boring after a while, especially

when you found you couldn't change the pitch *or* the volume! It was standard practice with one of the older home computers to tape a piece of cardboard over the speaker to keep it a little quieter.

The beep was produced in one of two ways. The first was to use a special beep circuit which took a dc output from part of the machine as a signal to go beep.

The second was to use a 'bit-bashed tone', which is to say that an output more or less direct from the processor was amplified and fed to the speaker. By turning that output on and off a few hundred times a second, the computer could produce a square wave sound from the speaker.

The second method was generally considered to be better, because the computer ►

INSIDE YOUR COMPUTER 7

could vary the length between transitions under software control, and so change the pitch of the beep. In fact, things got a bit further than that, even to the extent of basic speech synthesis by altering the pitch and other characteristics of the tone.

Nowadays, specialist chips have been developed which take instructions directly from the processor and generate sounds according to those instructions. Most of these 'music chips' are capable of producing three or more tones simultaneously (which means they can play musical chords or harmonies), and once instructed by the processor, need no further attention from it until the next note is to be played.

One of the problems with the bit-bashed tone approach was that while the processor was producing the tone it couldn't do much else.

Music chips also allow you to alter the 'envelope' of the note (see Figure 2), and add white noise and other fancy effects.

The Amiga's music chip is particularly sophisticated, and could almost rate as a music synthesiser in its own right.

Glossary

Attack: the rising part of an envelope.

Attribute: information about how a particular character or pixel is to be displayed, such as whether it is to flash, what colours are to be used, etc.

Bit-bashed tone: tone generated by a processor turning an output on and off a few hundred times a second.

Block graphics: the use of special characters to form lines, boxes, etc, on the screen.

CAD: computer aided design.

Character: a letter, number or symbol.

Character generator ROM: ROM used to store the actual shape that each character will take on the screen.

Character set: the set of all possible characters that a particular computer can display.

Column: position across the screen — column 1 is at the left.

Computer aided design: the use of a computer for drawing diagrams.

Decay: the initial falling part of an envelope.

Envelope: the way in which the volume of a note changes with time, split into attack, decay, sustain and release.

Graphics: the use of a computer to display things other than text.

Graphics mode: a display mode in which each pixel on the screen is represented by a particular part of memory — see also 'Text mode'.

Memory-mapped: used to describe systems in which a particular area of RAM is set aside for holding what is to be displayed on the screen.

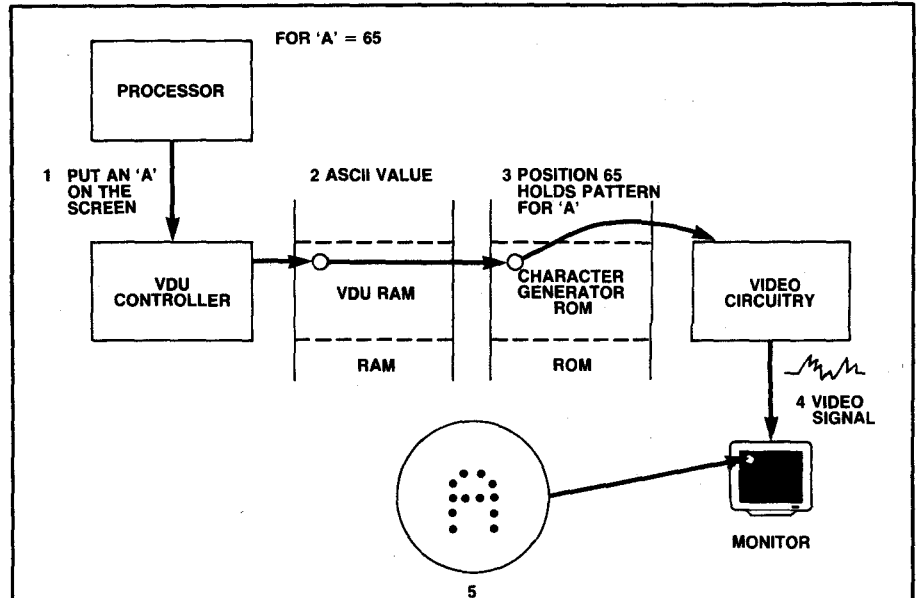


Figure 1. Block diagram showing how a character gets onto the screen.

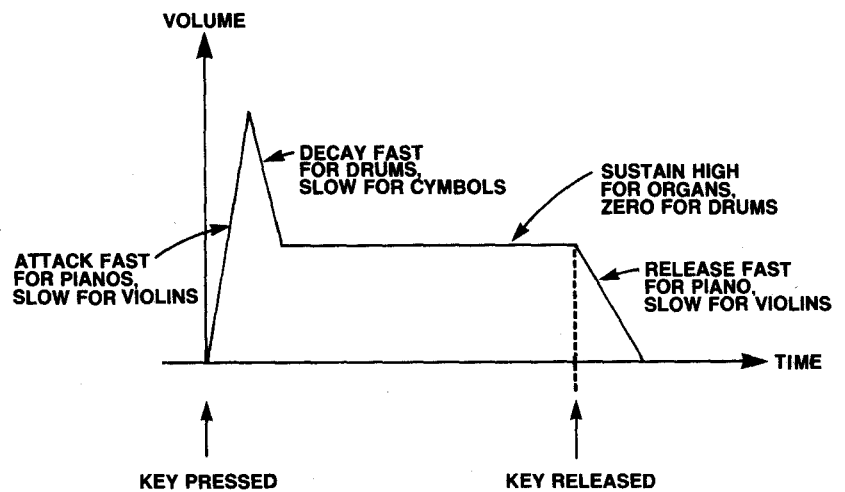


Figure 2. A sound 'envelope' — the volume of a note at various times after it has been played. Each of the parameters (attack, decay, sustain and release) can be under software control.

Music chip: a specialized integrated circuit for producing sounds according to instructions from the processor.

PCG RAM: see 'Programmable character generator RAM'.

Pixel: picture element — a point on the screen which can be set on or off by the computer.

Programmable character generator: a system in which an area of RAM is set aside to perform as a character generator ROM.

RISC: reduced instruction set computer — built around a special processor which is particularly suited to graphics.

Release: the second falling part of an envelope.

Row: the distance down the screen — row 1 is the top row.

Sound chip: same as music chip.

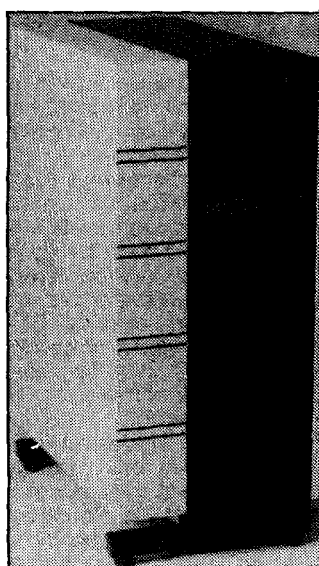
Sustain: the constant part of an envelope, between decay and release.

Text mode: in which each address of the VDU RAM defines what appears in a particular row and column on the screen — the pixels in that row and column are defined by the character generator ROM.

VDU: visual display unit — old term for a monitor and associated circuitry.

VDU RAM: RAM set aside to hold what is to be displayed on the screen.

VDU controller: special-purpose chip for administering the VDU RAM.



Horse-powered micro launch

The power of microprocessor technology has hit the world of multiuser applications enabling a 100 user system to be achieved.

Computer Micrographic Services (CMS) recently launched the American-made IBC Ensign 2 on to the Australian market.

The Ensign 2 is aimed for multiuser establishments and businesses at a lower cost than the minicomputer, according to the director of CMS, John McIntosh.

There are three basic systems in the Ensign 2 series ranging from a single Moto-

rola 68010 processor through to a 32-bit 68020 processor using the 68010 as a slave.

The basic eight-user system can be expanded to a 100-user system by simple upgrading of the existing design to customer requirements. The S-6810 will support up to eight serial I/O ports; the D-6810 will support 16, 32 or 44 serial ports; and the top of the range T-6820 will support up to 100 serial I/O ports. The storage options can also be configured to suit different applications.

The system can accommodate one floppy disk drive

that is capable of running 1M, and 1.6 M of high capacity formats, a 60 M tape streamer and up to three 5.25" hard disk drives.

The Unix System Five Ensign 2 has the operating system Unibus+ from Unisoft. A wide range of high-level languages are available for program development as well as application software, development tools and utilities. Full maintenance, hardware and software support is available.

For further details contact the distributor CMS, 232 St Pauls Tce, Fortitude Valley, Qld 4006. (07) 52-99666.

New ATE from Marconi



Marconi Instruments is showing its recently-launched Checkmate bench-top ATE tester. The device offers high-speed digital testing, analogue functional and in-circuit capability with a GPIB interface and fully interactive programming.

Checkmate is the first bench-top tester to be announced by one of the 'big five' ATE companies. It is a functional and in-circuit tester — a stand-alone system, including a high-resolution colour monitor, and twin 3½" floppy disks and is no larger than many office photocopiers.

The tester is modular and designed to accept up to 21 measurement/function cards in its maximum configuration.

Each of the 13 different card types incorporates a Z80 processor with its own firmware to increase test speed and simplify calibration. Functions include function generator, counter/timer, digital multimeter, oscilloscope, discrete Fourier transform waveform analyzer and sampling oscilloscope. As an analogue tester, Checkmate uses these cards in conjunction with either dry reed or mercury-wetted relay switching cards for

signal routing to and from the test fixture.

For digital ATE use, Checkmate can be fitted with two complementary groups of cards. One provides up to 320 digital test points plus 20 node force points. The other forms a logic analyzer with up to 64 channels at a sampling rate of 100 MHz. Checkmate can be fitted with two or more independent groups of digital function cards. This gives the ability to perform multiple digital tests on a unit or board asynchronously.

The integrated logic analyzer cards offer debugging, diagnostic and design evaluation facilities and eliminate the need for a more expensive stand-alone logic analyzer.

According to Marconi, checkmate tests digital circuits faster than any other bench-top tester. In the signature analysis mode, sample rates of up to 20 MHz can be supported. For stimulus-response-compare tests, files can be loaded from a logic simulator and propagation delays of logic functions can be determined down to 25 ns with a resolution of 5 ns.

For in-circuits use, up to 1000 test points are provided for continuity checks and up to 900 test points for testing resistors, inductors, capacitors, complex impedances and semiconductor functions. Six-wire guarded measurements

allow component values to be measured accurately in the presence of others, providing fault diagnosis down to single component level.

The operating principles of Checkmate's software are derived from Climate, the language developed by Marconi Instruments for its range of functional testers. Checkmate's software uses an interactive editor which allows the user to try out program sections live, without compiling. GPIB profiles for external instruments can be produced easily using standard routines, allowing full integration with Checkmate's internal facilities.

By connecting the test fixture straight into the function cards, wiring between the ATE and fixture is eliminated thus ensuring maximum test performance. Two main styles of fixtures are available; bed-of-nails with vacuum actuation for in-circuit use, and a platen for functional tests.

These low-cost fixtures overcome many of the expense problems previously encountered with other low-cost testers.

An expansion slot in the system controller will allow for the addition of extra memory or additional system facilities in the future.

For further information contact Marconi Instruments, 2 Giffnock Ave, North Ryde, NSW 2113. (02) 887-6117.

NEW PRODUCTS

Australian-designed music software for NEC's APC-III

A new Australian-designed music software package for NEC's APC-III microcomputer will cut some studio operating costs by up to 90 per cent according to Mr Lionel Murray, managing director of Windwood Studios and co-designer of the software.

Called 'Music Master', the software is aimed especially at music studios, bands, music publishers and professional musicians, and requires little or no knowledge of computers.

"We've designed the pack-

age especially for NEC's APC-III because of its high speed and high-resolution colour graphics," Murray said.

The package uses the MIDI interface that links digital synthesizers to microcomputers and is composed of three components — Multi Track Recorder, Song Librarian and Song Conductor.

The NEC-driven software offers two powerful features not currently available in other music software packages sold in Australia. The first is that up to 16 MIDI-linked Instru-

ments can be recorded simultaneously onto 16 separate tracks, the second feature is the revolutionary Song Conductor component which allows screen painting of a predefined song structure using standard musical notation, such as first and second time bars, repeats, codas, fine and others. Using the musical structure as painted on the screen, the computer will drop in and out as required while recording.

The computer also executes the necessary actions

denoted by the structural symbols, in order to provide a completed musical work during playback mode.

The Song Conductor component provides an automatic transposing facility that can change a song by up to 127 semi tones in either direction. This allows material to be recorded in the easy key of F, for instance, and transposed automatically into the more awkward key of F sharp.

The Multi-track recorder component includes a quantization on-record facility which automatically corrects notes played in incorrect time. This facility allows independent setting of different quantization factors for each track during the same recording session, thus providing far greater recording flexibility.

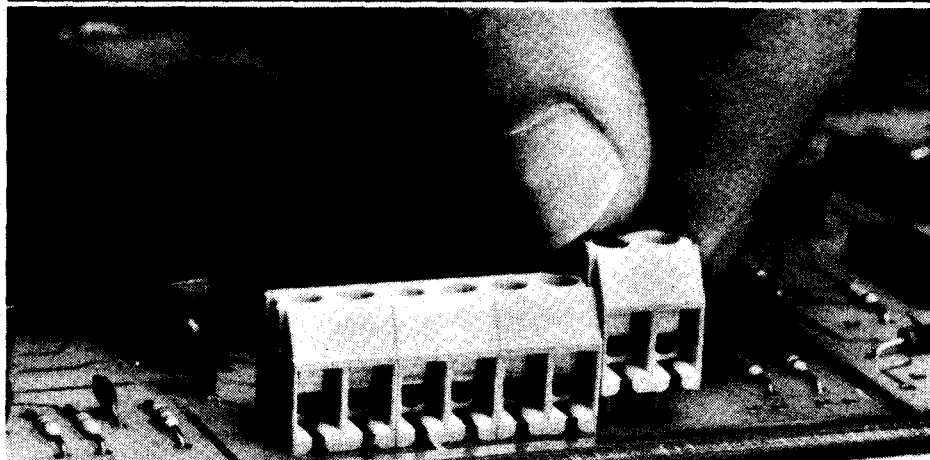
Before each recording session, up to eight pairs of punch in/out points (editing points) per track can be preset wherever desired, thus eliminating the need for recording engineers in this area. Similarly, up to eight pairs of mute points per track can be preset before mix-down sessions.

According to Lionel Murray NEC gives reliable back-up support to its systems. "Also we can custom design features into the software upon request, unlike the suppliers of other music software packages that come mostly from overseas."

An enhanced version of the NEC-driven music package will become available within the first half of 1987. It will contain such features as dynamic channel editing, sequencer mode (including chaining, etc), full score display and printing in standard musical notation, SMPTE interface, full musical analysis and chord chart, remote control unit and user help tutorials.

For more information contact Lionel Murray on (047) 59-1244 after 5 pm.

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Opto-electronic switch has memory

Exciting possibilities are being opened up through research by Professor John Simons and Dr Roger Green at the School of Electrical and Electronic Engineering at Bradford University, in northern England. Their work involves incorporating opto-electronic switching within a semiconductor device, in particular the metal polysilicon semiconductor switch (MPSS).

The basic structure of an MPSS device takes the form of a substrate that has been heavily doped with acceptor impurity atoms (p^+). One surface of the substrate is a thin metal conductive layer. This usually forms the ground terminal of the device. On the other surface is an n-type epilayer several micrometres thick.

This, in turn, is surmounted by a semi-insulating layer of between 100 and 500 nm thickness, topped by a very thin metal layer that forms a transparent conducting electrode. Electrical bias potential is applied between the two outer layers of the device which

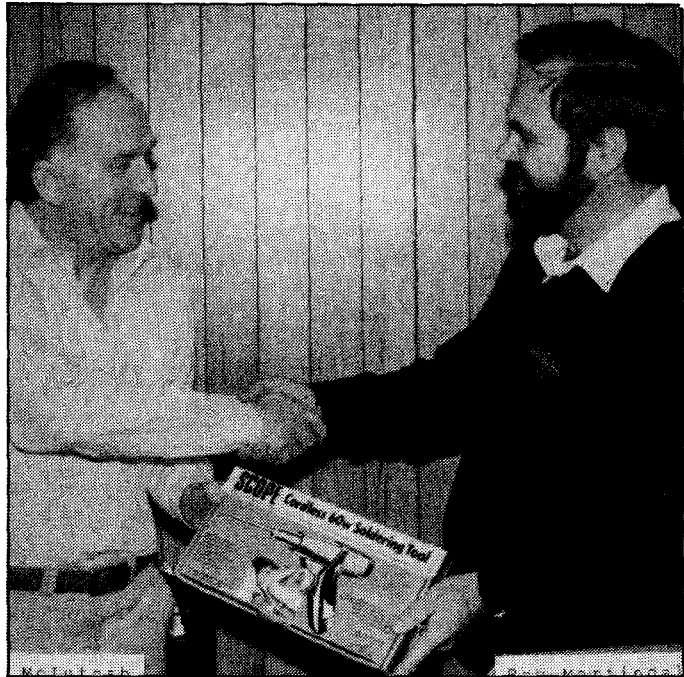
then operates as a two-terminal switch.

Major operating parameters of the device can be altered simply by varying the operating temperature or the intensity of the incident light falling on the transparent layer. However, the switching action can also be initiated by the introduction of a third control terminal which can be combined with the optical operation.

It is this property of the device that is attracting so much attention at Bradford, particularly when it was discovered that the three-terminal device exhibited a memory effect.

The research team at Bradford has recently completed an optimization program, mainly directed at the implementation of an area array of three-terminal devices that can be used as an optical sensing system.

Some of the many potential applications foreseen for the new device are optical logic interfaces, robotic sensors and optical memories.



Winner second time around!

Bob Martindale is a senior engineer with Telecom.

Winner of the Scope idea of the month for the second time, Mr Martindale is shown being presented with his prize of a Scope soldering iron by Barry McIntosh, sales manager of Scope Laboratory.

The Australian-made 60 W cordless is now exported to New Zealand and the United Kingdom with initial orders just being secured for the North American market.

Version 3.0 Protel PCB

HST Technology Hobart has announced the release of Version 3.0 of Protel PCB printed circuit board design software, for use with IBM or compatible PC/XT and AT computers.

HST manager John Powell, says that feedback from the Australian and widespread international distributor network, plus the experience of HST and Protel Systems with the software, has led to some very significant features being added to their software package.

Powell congratulates Nick Martin for developing the net list features of Version 3.0 in such a way that the user has a choice of either manual or semi automatic operation. A low rather than high level of automation has been deliberately included in the software, to reduce the complexity and learning time for users. He

claims 30 individual improvements to the program.

Standard or enhanced graphics (EGA adaptor) are now selectable providing up to 16 colours on a 640 x 350 pixel display. An extra level of zoom is available when using the EGA adaptor.

It is now possible to load a net list from a schematic package and print out a subsequent connection list. Additional features also include the ability to display total connection length.

By user demand the program output supports Epson printers for a check plot while still maintaining the plotter output for final artwork or rapid check plots in colour.

The plot routine now includes a board sort to reduce plot time by optimizing the plot sequence.

Powell emphasizes that the program is still a simple com-

mand driven, yet functionally packed software, developed by people who design printed circuit boards as part of their business.

Protel PCB now incorporates some features only found on more expensive software. The inclusion of power and ground planes with thermal relief is an added bonus, as is segment dragging, layer/track swapping, smaller text, text in components, block copy and rotation, block read with component intact, track stack and area fill commands, etc.

The software will design printed circuit boards as large as 32 x 19 inches. Expanding or contracting of the layout by zooming allows precise component placement and track laying. Six zoom levels are available from 1.6 x 0.95 inches expandable to the full 32 x 19 inch

work space.

On screen, users can select from nine grid sizes 1, 5, 10, 25, 100, 125 and 200 mils (1 mil = 0.001 inches) for the precise placement of component shapes such as DB25 connectors and edge connectors with odd spacing.

Version 3.0 of the software still supports the Microsoft mouse but the program places more emphasis on the mouse function keys to rotate and manipulate components and blocks on the layout.

Early this year HST will be releasing a schematic program which will be compatible with Protel PCB Version 3.0.

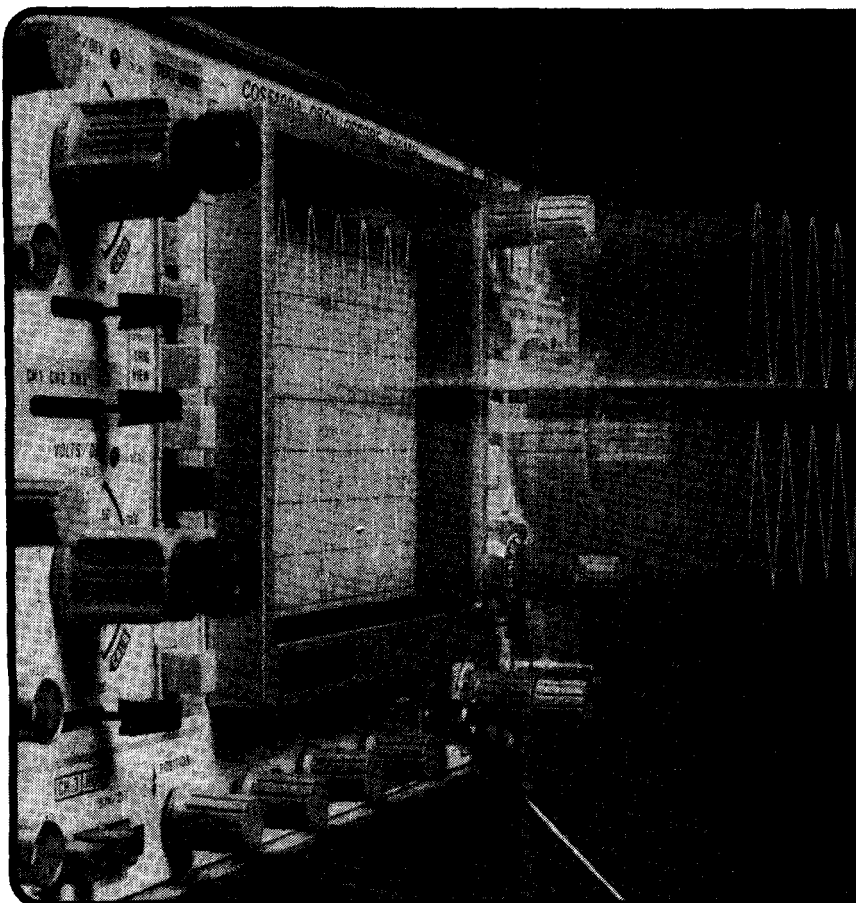
Licensed Version 2.0 owners of the PCB package will be offered the opportunity to purchase Version 3.0 at a reduced price.



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PRINTED CIRCUIT BOARDS: MULTILAYERED, MULTIWIRED OR . . .

Well, that is today's standard, by 'tomorrow' (the 1990s), it is probably going to be a lot narrower. With the world market for printed circuit boards (pcbs) estimated to reach approximately \$US25 billion in the early 1990s and the total electronics market expected to reach \$US1000 billion at the same time, it is worth taking a moment to look at where pcb technology is today, where it is going and how some Australian manufacturers are placed to capitalize on the future trends.

Printed circuit boards started with solder tracks on one side of a board for interconnecting various components which were subsequently attached to the board. Needless to say, none of the solder tracks could cross the path of another or else there would be a short-circuit.

The next step was to drill holes through the boards, plate the holes all the way through and use the underside of the board to lay more circuit tracks. That was a double-sided board and it could carry more components and was more complex in design than a single-sided board.

With the advent of pcb technology, the electronics industry has intensified its search for the Golden Fleece — the one that allowed the maximum number of components to be packed into the smallest volume, at the lowest cost, for the greatest profit.

Is high density so desirable, apart from the obvious profit, size and weight factors? Yes. Where fast logic circuits are involved, short path lengths reduce electromagnetic interference, they have less pulse ringing problems and less voltage induction (noise).

Conventional multilayer pcb technology now has the capacity to routinely produce 18 layers of circuitry packed into boards not much thicker than the original single-sided boards. The circuit design within the layers is extremely complex, especially as no track is allowed to cross another.

In the laboratory it has been possible to produce pcbs with up to 54 layers — but they are horrendously expensive and by no means practical for routine production. They serve to explore the limits of pcb technology and to satisfy the obviously masochistic tendencies of the people who designed them. In terms of what is practical in the commercial world, 18 layers seems to be about the limit. However, no-

one has issued a design and contract for anything more complex, so the 'limit' is probably relative rather than absolute.

Two ways of circumventing the 'limit' are new methods of attaching devices to boards and new ways of laying the circuits within the layers. These approaches are changing the physical features of multilayer boards but retaining the multilayer concepts. For example, by allowing insulated tracks to cross one another, the routine production of pcbs with the equivalent of 40 to 60 conventional layers becomes a practical possibility. Given the current trends, the designer in 1990 or so, will have to decide whether his application will be better suited to a multilayer board, worth the design effort of going to a VLSI chip or if he should use some features of both. The deciding factor will be the quantity to be produced.

It is easier to understand multilayer if one talks about 'interconnection technology', that is, the methods of connecting components together. There are two methods for interconnection: the print and etch process that is used in conventional multilayer boards and the physical wiring of the components in Electrowire multilayer boards. Perhaps the major differentiating factor between the two processes is that conventional multilayer technology is more economical where large production batches of 'medium density' boards are concerned.

Both processes are influenced by changes in the methods by which chips and other devices are mounted on the surface of the boards.

Conventional multilayer boards

The most common multilayer board is the 4-layer kind found in computers, for example. Four-layer boards are characterized by being double-sided boards with power and earth planes making up the two internal layers.

As the requirement for higher density increases, one approach is to reduce the thickness of the tracks so that three tracks can be run between the 'pads' of the device holes. Such boards are called 'fine wire' boards and they can double the density of a 'standard' board. With further increases in density, the overall surface area of the board is reduced by mapping more and more of the connection paths onto internal layers. For example, 10-layer 'pad-

ded' boards — boards with no external solder masks other than the solder pads for devices — are becoming more commonplace.

But as the number of internal layers increase, two new problems arise — physical manufacturing limitations and the physical size of the devices to be attached to the board.

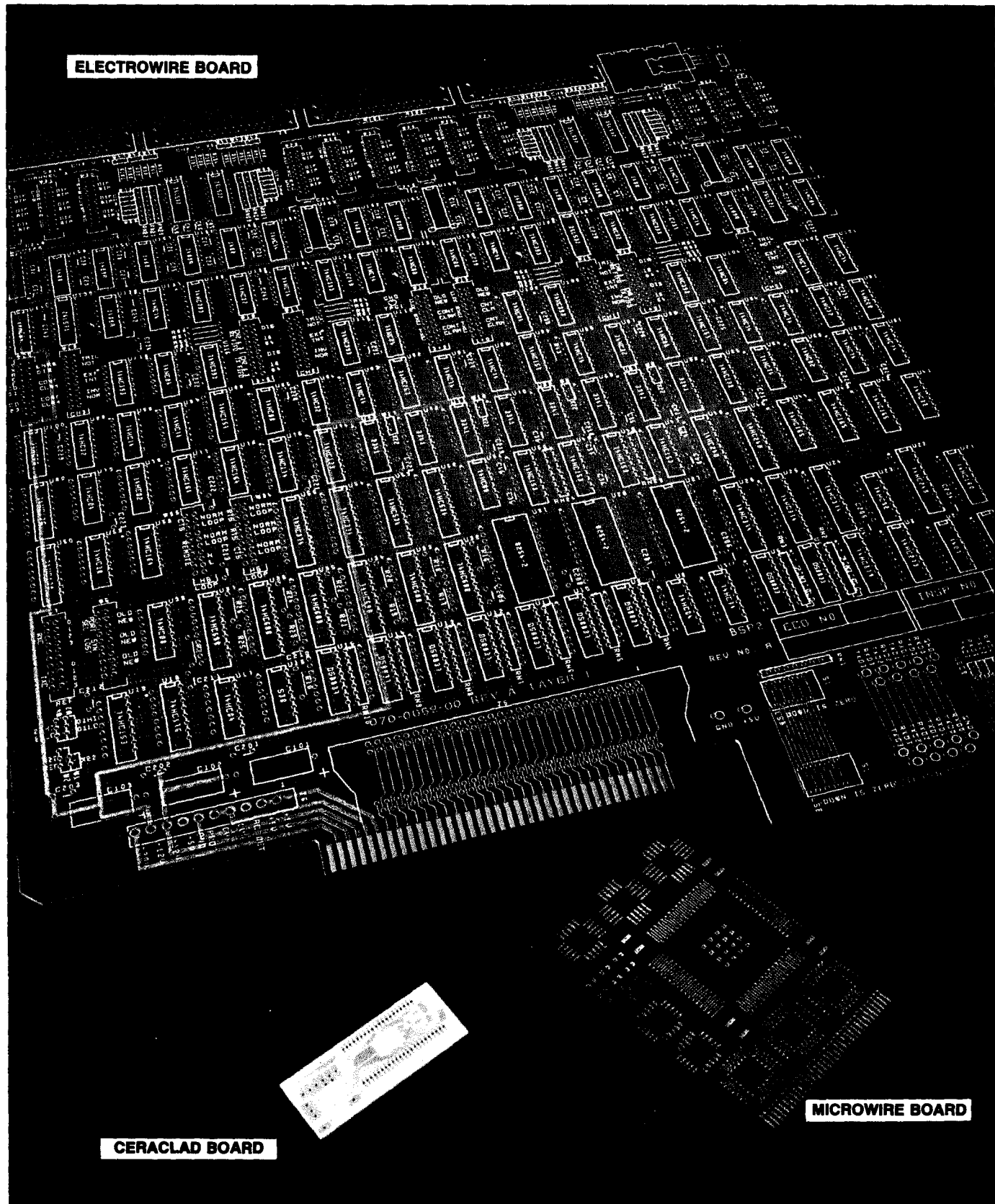
Increasing the number of layers in a board increases the design problems. Remember, no individual track is allowed to cross the path of another track. Without CAD techniques, Multilayer designs would be uneconomical, if not impossible, to produce. The design component is a major factor in making 18-layer boards at least 10 times more expensive per unit area than 2-layer boards.

Another manufacturing problem is how to accurately align 16, 17 and 18 pieces of film so that every track is in its correct position. This is where the margin for error is reduced to about one-thousandth of an inch. Basically, the alignment is achieved through the physical placement of film with respect to 'pin' holes. The main cause of misalignment is small dimensional changes in the film itself due to environmental fluctuations in temperature and humidity. To go beyond 20 layers requires the use of glass masters rather than film as phototooling for the etching process. The design is produced directly onto glass from the CAD photo-plot. Glass is not affected by micro-changes in the temperature and humidity and so the accuracy of the etch is increased considerably — but so is the cost.

Relative to the size of the components attached to the board, there is still plenty of room between the tracks of a multilayer board. The next step in reducing board size is to reduce the component size. The chip that is housed in a standard EPROM, for example, is significantly smaller than the support housing around it which mainly serves to provide the pins or legs for attaching the chip to the board. Why not take away the housing and attach the chip directly to the board? That is exactly what is done with surface mounted devices or SMDs. The surface of the board has a 'footprint' to match the pinouts on the chip itself. By substituting an increasing number of SMDs for conventional housings, the size of the board can be reduced. Reducing the empty space in the layers

How do you measure success? By counting dollars or tones of goods shipped? How about measuring success in terms of one-thousandth of an inch — by the 'skin of your teeth'? That is where the manufacturers of high density multilayer printed circuit boards stand or fall — on one-thousandth of an inch.

Robert Phillips



MULTILAYER BOARDS

any further only increases the design complexity and reduces the margin for error to less than one-thousandth of an inch. The trade-off is that boards can be made smaller by using SMDs without significantly increasing the manufacturing problems by trying to pack the lines in the layers any tighter.

Two Australian companies, Printronics and Morris Productions dominate the local scene which has a total of approximately 25 pcb manufacturers. Both companies have been very successful in exporting their technology against stiff worldwide competition. Printronics was selected ahead of companies from Canada, Britain and Japan, to provide a series of complete turnkey electronics factories to China (that includes planning, specifying, construction, commissioning, staff training, transport and material supply). It also beat the international competition a second time when it was invited to participate in a major joint venture activity to build and run a pcb plant in Shanghai. Within Australia, Printronics has been the pioneer of the SMDs.

Morris Productions is one of only four companies in the world that has been approved by Hughes Aircraft as a supplier of

multilayer pcbs for the Australian FA-18 fighters. The boards are 14 layers deep and they are used in the on-board radar system. Started in the early 70s, Morris Productions has developed all its own technology. It does not pay royalties or fees to anyone. Since 1973 it has successfully competed in the highly exacting fields of defence and aerospace electronics. During the mid-70s Morris Productions supplied state-of-the-art 6-layer boards for the Jindalee, the Australian over-the-horizon radar, 8-layer boards for Mulloka, the Australian Navy sonar system and boards for AFDAS, the Aircraft Fatigue Data Analysis System.

Both companies are heavily export oriented and both are, without doubt, producing some of the best and the most sophisticated pcbs in the world today. They are also becoming increasingly involved in the emerging domestic market for 'conventional' 4- to 8-layer boards. This means they are successfully displacing imported boards on the grounds of quality and price. Mind you, they have almost always been able to produce good quality, competitively priced boards — it is the Australian users of such boards that are finally discovering the advantages of local supply.

Electrowire technology

Western Australian company, Circuit Technology Australia, uses a different interconnection technology. Electrowire is its own enhancement of an American process called Multiwire: Electrowire is electroplated Multiwire. Circuit Technology uses actual wires to make the connections between the components. It sounds retrogressive, until you find out what the CT people can do. For starters, the wire they currently use is 0.160 mm (0.0063") in diameter and it is *insulated*. This means that the previous prohibition on tracks crossing one another no longer applies. Still don't see the significance? Try this — a 2-layer Electrowire board can be equivalent to approximately 10 or 12 conventional multilayers!

Circuit Technology is also in the process of producing 0.100 mm (0.0040") wire; it will allow production of the equivalent of 30-layer boards. A new product, Micro-wire, 0.063 mm (0.0025") wire, will enable the production of the equivalent of 60-layer boards which will be 10 times smaller than the Electrowire boards. And the surprises do not stop there. You want a whole board wired to a specific impedance? Just call, Circuit Technology can do it. Its process improves the electrical characteristics of the board by eliminating many, if not all, of the unnecessary holes ('vias') in the multilayer configuration that are used solely for interlayer connections. It 'simply' runs the wire from point to point.

Circuit Technology is also heavily export orientated: 70 per cent of its business. One of its major customers is the Harris Corporation in America and it supplies boards to McDonnell Douglas for incorporation in the ground systems of the FA-18 fighters. It is also hopeful of concluding contracts this year to supply boards for two US mainframe computer manufacturers.

What next?

Circuit Technology will soon release a new method of attaching chips to the pcbs which extends the SMD idea even further. A VLSI chip can have anything from 50 to 500 pinouts. By bonding the VLSI chip to a ceramic base called Ceraclad and using chemically deposited copper paths on the surface of the ceramic, a whole new order of miniaturization is achieved — about 60 to 100 times smaller than an Electrowire board. In Western Australia, 'tomorrow' has just about arrived. So much so, that Circuit Technology has gone public to finance expansion of its production capacity so that it can handle an order run rate of \$A1 million a month, starting 'tomorrow'. ●

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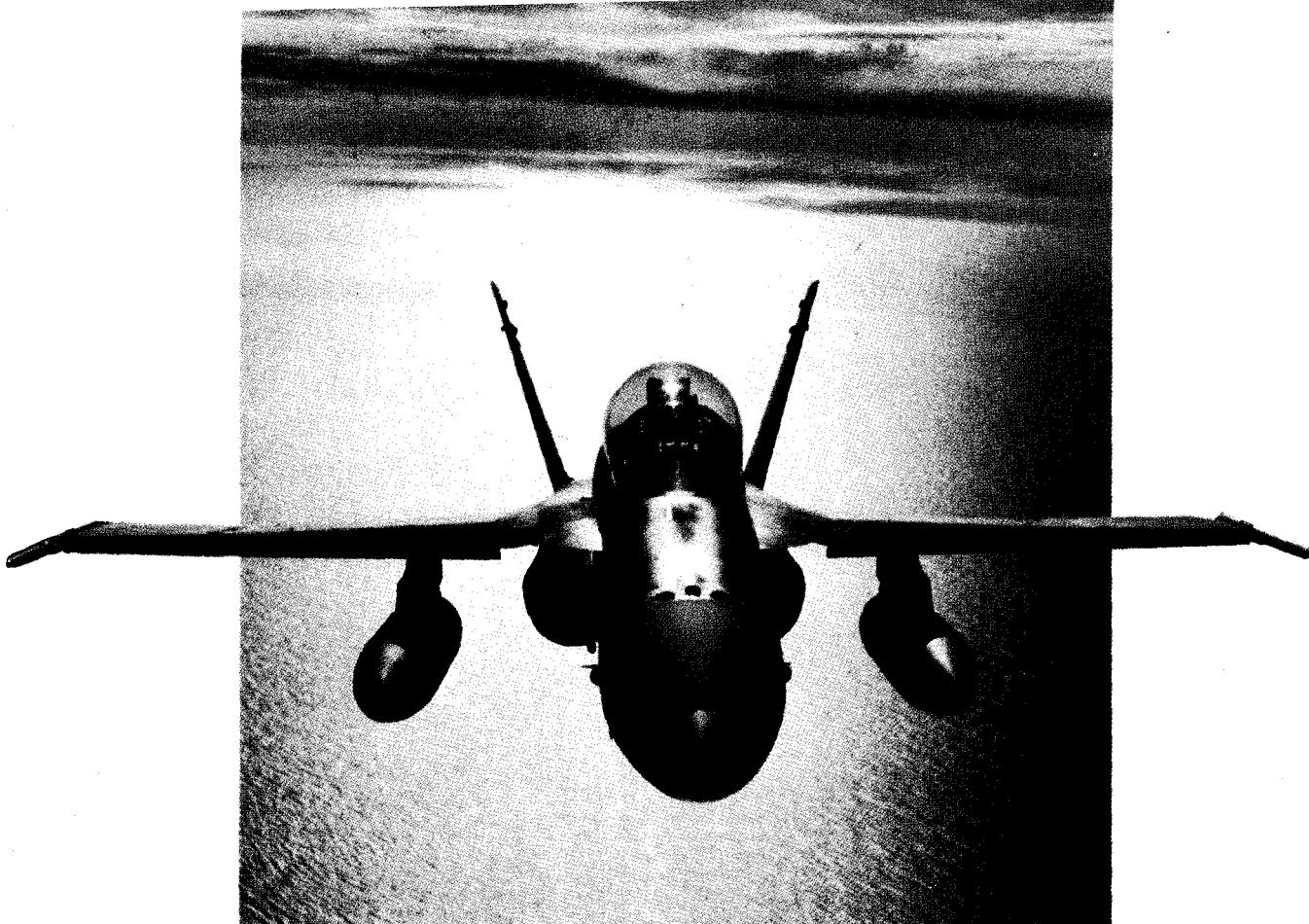
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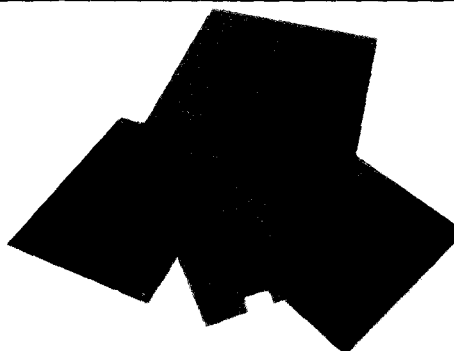
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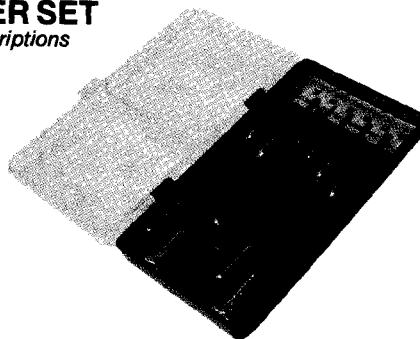
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Once again, the Dregs Hack, your collector of all that is marvellous and slightly bloody silly from the world of electronics and science brings you a potpourri of items from around the world. For instance, we pass on, without comment, a Pioneer press release that came our way:

Sensual sound

"The Pioneer Bodysonic 800 is a stylish, reclining chair wired for sound and body vibration. The three bass drivers positioned in the back, seat and footstool deliver spine tingling, muscle massaging music throughout your body. Wing speakers positioned at ear level ensure hi-fi sound even at low volume.

"With the Bodysonic plugged into your audio and video equipment you now not only hear and see but also feel the action. This is a sensual experience.

"The Bodysonic is just the thing to relax at the end of a tiring stressful day. Just put on a little classical disc music, or videotape, sit back, put your feet up and . . . ahhh . . . oooh!

"Your body may never be the same."

Dumb faith

And we note from *New Scientist* magazine that American students are having a hard time sorting out where they came from.

"A poll of 1000 university students in California, Texas and Connecticut has revealed that more than half of them are creationists.

"The students believe that God created Adam and Eve and that Noah's Ark existed. About one third said that they also believed in aliens, ghosts, Big Foot — a hairy man-like creature reputed to live in the mountains of northwest America — and the lost city of Atlantis.

"The survey showed that those who believed in creationism were more politically conservative, less likely to read books, and did less well in university examinations than those who held a contrary view, such as Darwinism.

"For a leading scientific nation, this is not a good sign of the effectiveness of our science education, Francis Harrold, a professor of archaeology at the University of Texas at Arlington, said. Harrold, who helped conduct the survey, said that science in high school should be strengthened to combat the trend.

"The students, aged between 18 and 22 filled out a questionnaire on their beliefs. Most of them were white students studying humanities. One surprising finding was that although belief in pseudo-science was widespread, only 15 per cent had any faith in astrology."



The bodysonic chair: Now you know why she's smiling.

Don't snigger at this. The yanks don't have it all to themselves. The Queensland minister for education Lin Powell, was recently spotted by the hack in the letter pages of the journal *Nature* trying to say that the Queensland government both was and was not teaching creationism and he personally both did and did not believe in it, and anyhow you southerners . . . blah, blah, blah. Oh dear.

Rambo madness

We also received this in the Dregs office:

DoD withdraws ADA support

In a surprise move, the Department of Defence today abandoned its push toward the ADA programming language standard. Shell-shocked defence related companies are scrambling to respond to this unexpected manoeuvre.

According to the DoD, ADA was regarded as being "too wimpy" for the American computers to use, and so the department was withdrawing its support for the language.

Instead, a new computer language (tentatively named 'RAMBO-TRAN') will be required for all future DoD contracts.

RAMBO-TRAN is reportedly a column-dependent, unstructured computer language which relies heavily on GOTO statements, denial returns, and arithmetic IFs.

All statements MUST start in column 1, eliminating the possibility of indenting source code. Although character strings are supported, they are limited to a maximum of 4-letter words.

Perhaps the most controversial feature

of the new computer language is that RAMBO-TRAN does not support comments. (As Casper Ghostberger puts it: "Comments make it easy for commie spies to steal and decipher American software.")

Asked if the lack of comments wouldn't make software maintenance considerably more difficult, Ghostberger replied that "Real" programmers don't like to comment anyway. (In a related move, there are apparently efforts being made on Capitol Hill to link the words 'Comment' and 'Commie'.)

Unlike most of the current programming languages which offer extensive error-checking capabilities, RAMBO-TRAN makes NO provision for errors. ("Real programmers don't make errors," asserts Secretary Ghostberger.) Instead, the programmer initially targets a 'mission' for his task; then if an unexpected error arises, the program begins performing immediate GOTO operations, all designed to bring the program closer to that 'Ultimate Goal'.

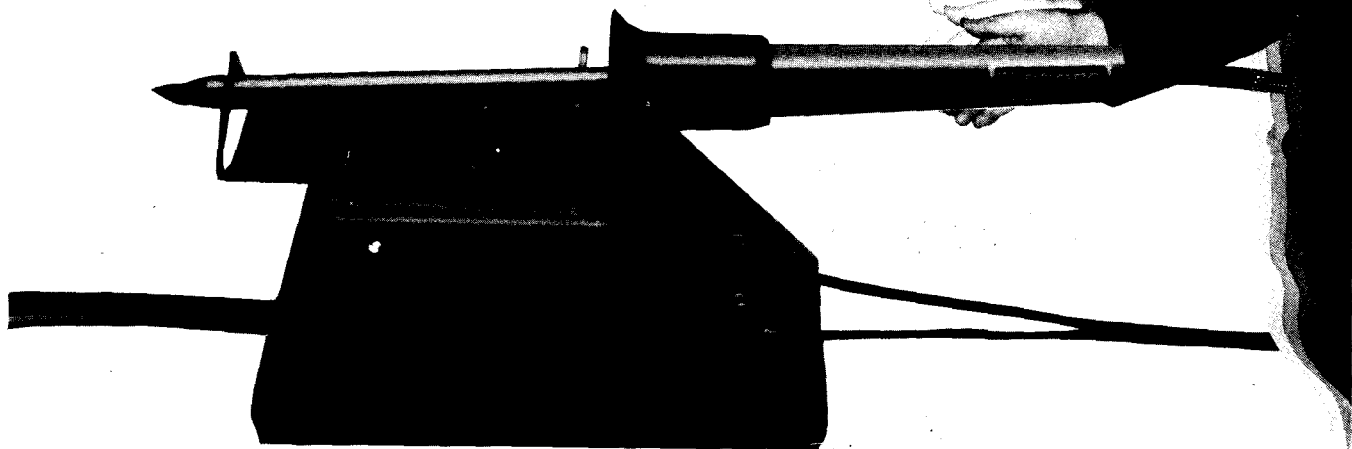
If the program is nevertheless thwarted from performing its mission, it self-destructs (taking as many other programs with it as possible).

In a related move, the Ghoulish Computer Company announced that it had already met 80 per cent of the RAMBO-TRAN standards, particularly those involving self-destruction. The company is reportedly gearing up for an expected increase in DoD-supported business.

— With thanks to Trevor Long of Telecom Research Labs who sourced it off Unix World. We always wondered what you guys did for fun!

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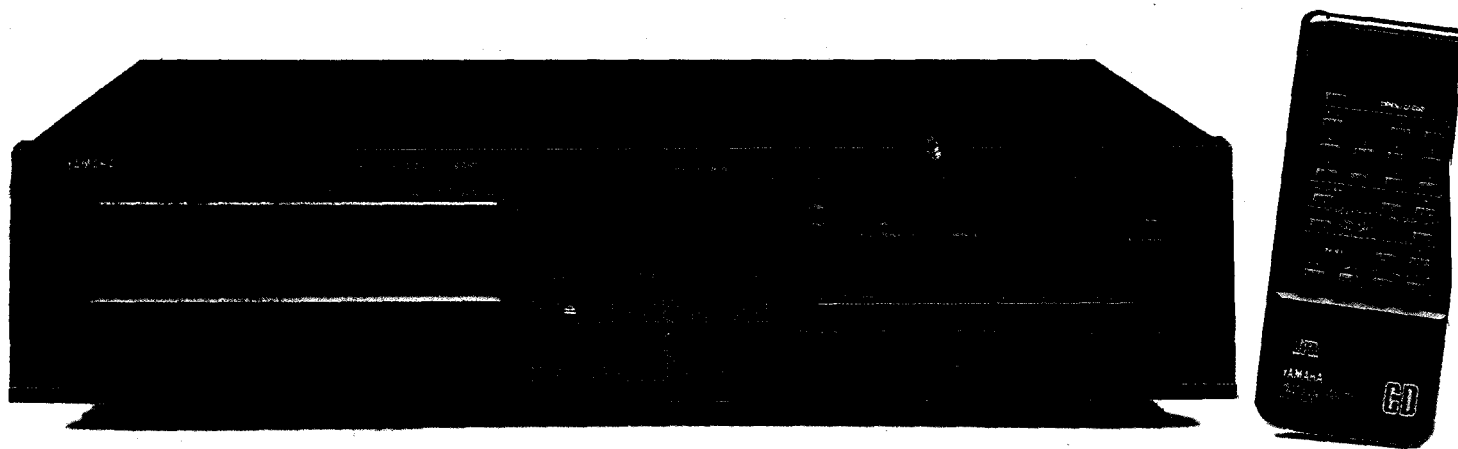
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