AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY!

Electronics Today INTERNATIONAL

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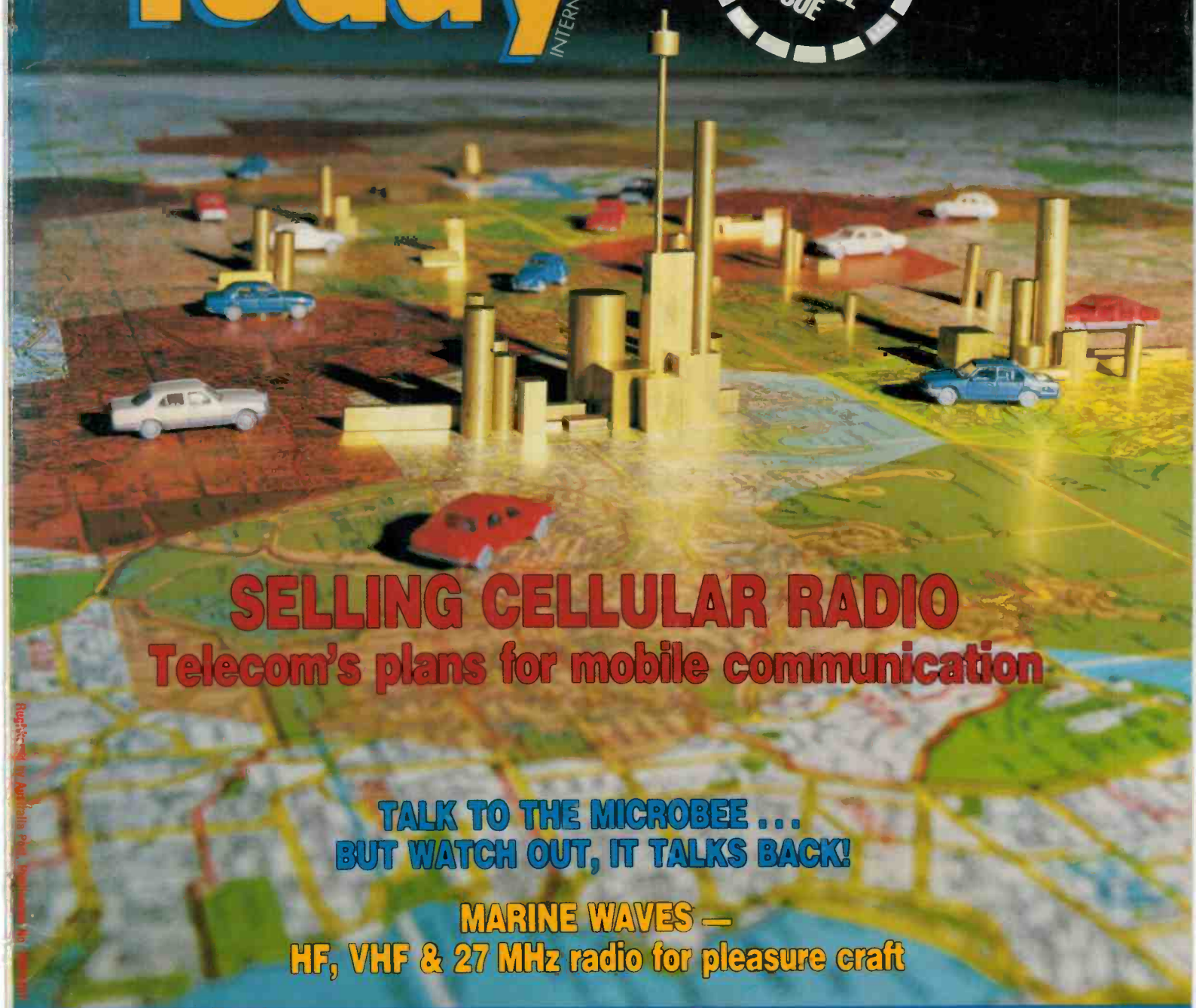
JANUARY 1986

SPECIAL: 1986 DATA REFERENCE ISSUE



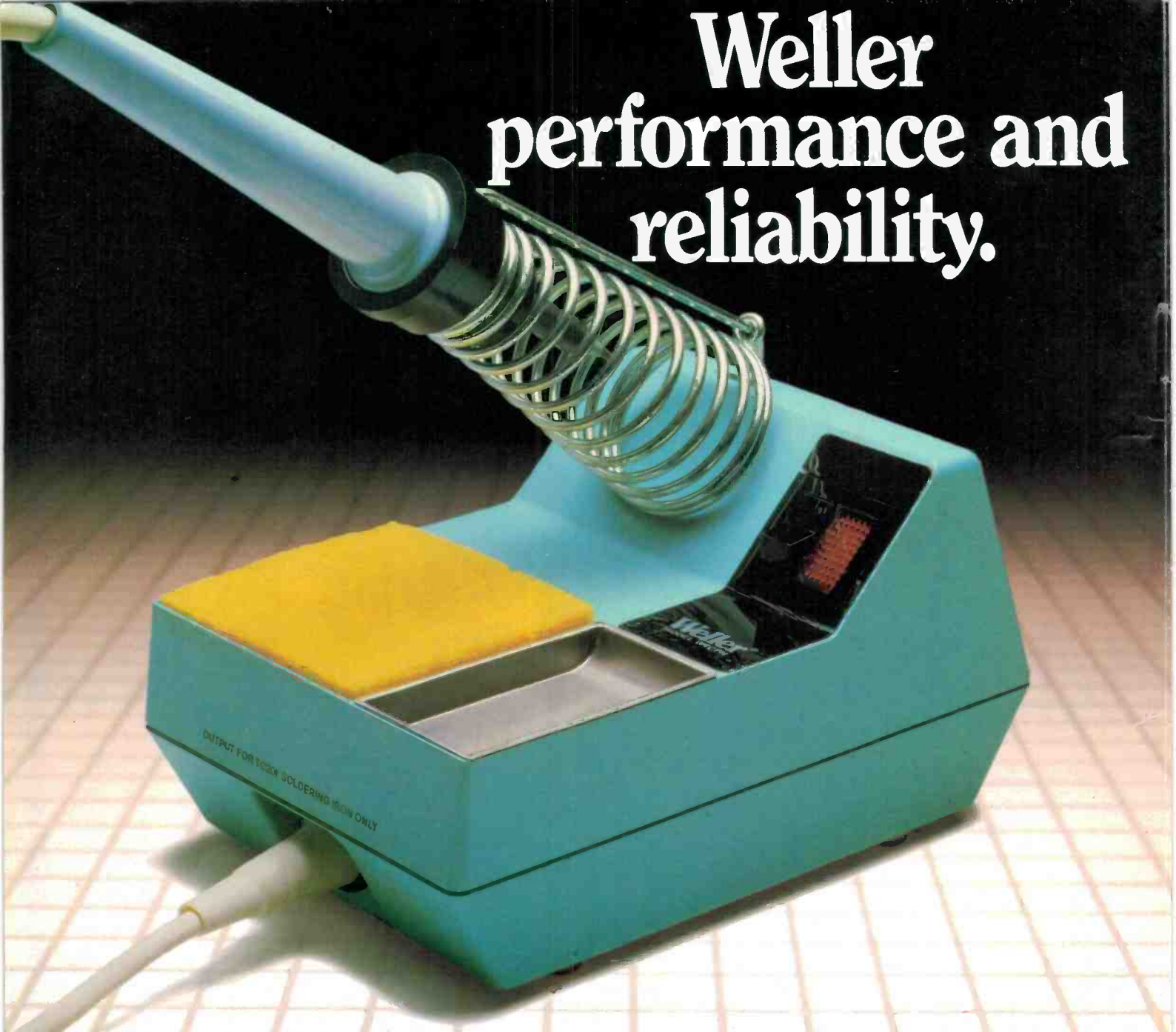
SELLING CELLULAR RADIO
Telecom's plans for mobile communication

TALK TO THE MICROBEE . . .
BUT WATCH OUT, IT TALKS BACK!

MARINE WAVES —
HF, VHF & 27 MHz radio for pleasure craft

GREAT PROJECTS: DIGITAL FREQUENCY DOUBLER
BUS SHARING FOR COMMODORE

Weller performance and reliability.



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You could buy a lower priced soldering station that looks very similar to the Weller WTCPN. But it wouldn't perform like it.

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Don't be fooled by look-alikes.

Check with your Electronics Distributor.

The Weller WTCPN

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Electronics Today INTERNATIONAL

JANUARY 1986

FEATURES

PROJECTS

REVIEWS

OFFERS

DEPARTMENTS

COVER: Photograph by Glen Cameron, devised by Vicki Jones.

LITTLE DICK'S SUMMER SIZZLERS

WIRELESS BURGLAR ALARM

Crime is on the increase! Your home, unit or office needs 'effective' security. And with DSE's Wireless Alarm System, you'll have total protection and enjoy peace of mind.

This is a complete package. Included with the sophisticated Central Processor are a **passive infrared sensor** for whole room monitoring, **remote reed switch** for guarding entry/exit points and **personal remote control**. You can even extend the system by adding on more of these affordable peripherals shown below.

And because it's wireless there are no expensive installation costs. Just plug the Central Processor into the power point, connect the peripherals and set the alarm. As simple as that! It's like having a personal security guard — but without the cost. Cat L-5120

Extend your system by adding 'more' of these. . .

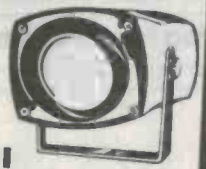
PERSONAL REMOTE CONTROL
Use to remotely turn the alarm on and off. Convient!
Cat L-5124
$39.95

PASSIVE INFRARED SENSOR
Monitors whole rooms (covers 64sq.m.). Any movement is instantly transmitted to the CPU.
Cat L-5122
$119

REMOTE REED SWITCH
Guards entry/exits. Any intrusion and the alarm sounds. Cat L-5126
$39.95

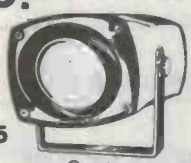
LOCAL AUDIO ALARMS

LARGE PIEZO ELECTRONIC



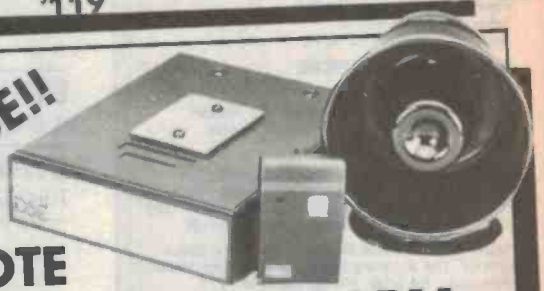
Compact but it delivers an earsplitting sound! Ideal for car, home or van alarms. Operates from 12V DC at 500mA; 110dB output at 1m. Cat L-7030
$24.95
REDUCED!

PIEZO ELECTRONIC ALARM



What a bargain! Amazing output for such a tiny unit! Suits most systems. Working voltage: 7.5-15 (200mA at 12V). Sound ouput: 110dB at 1 m. Frequency: 2800Hz.
~~$14.95~~
NOW $9.95
Cat L-7025

VALUE!!



REMOTE SWITCHED CAR ALARM

Stops thieves 'stealing off' with your valuable car! Hard to imagine that real protection could be so affordable — but DSE covers all the angles. Features boot and bonnet trigger, ignition cut-out, battery backup capability and more. Loud 110dB siren should scare off thieves instantly. Cat L-5096
$159

CAR COMMANDER

Tells you what's happening under the bonnet!

Incredible! Every family car can have the monitoring facilities of a Formula One racer with this inexpensive unit. An LCD displays the status of vital functions: oil pressure, RPM, voltage and water temp. Programmable RPM and water temp. alarm warns of impending problems. Built-in stopwatch too! Cat Y-3011
$84.95

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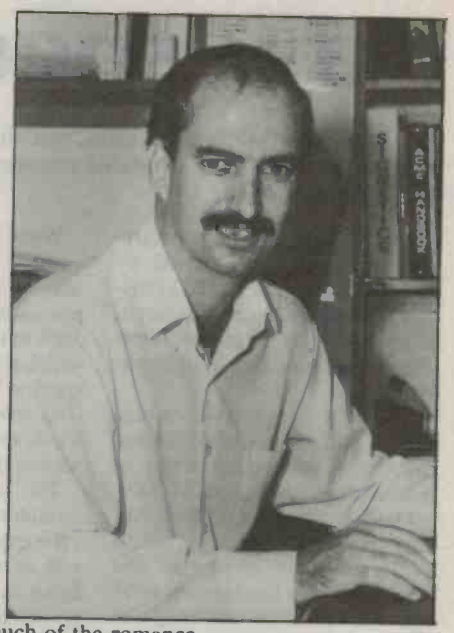


THINKING ABOUT THE past is not something I particularly want to promote — as you may have noticed. Certainly there are lessons to be learnt and some answers. But personally I think that if you dwell on the past that's precisely where you will stay.

That said, there is something that is soon (in the next half decade) to pass from the public eye. For all but a few dedicated souls the last remnants of the romantic era of radio are about to disappear. The local 'ham' with his impressive looking aerial and smoke filled room, the marine operator ('Sparks' to his familiars) with his room packed full of arcane electronics; such were the images of radio for 80 years.

To a degree it's all still there. There are special licences and intensive training courses, deep mysteries to be plumbed. The point is: why bother?

The continuing trend in which radio manufacturers pack more and more circuitry into smaller and smaller boxes has vastly increased the equipment's reliability, vastly decreased frustration and put paid to much of the romance.

Now we have cellular radio, the subject of one of our feature articles. The radio is reduced to a telephone. No mystery, no smoke filled rooms, no 'Sparks', just a dial and connection to anywhere on Earth.

Cellular radio technique solves the problem of limited radio spectrum so well that it threatens the very existence of commercial mobile radio in all but the smallest of population centres. It also increases reliability, range and security by integrating radio with the switched telephone network.

The new cellular radio technique fulfils a fundamental rule for success — it will become so useful it won't possibly fail.

David Kelly
Editor

NEXT MONTH

DISPLAY TECHNOLOGY

One feature of computers you might never have considered is the way they communicate with you. On the other hand, you might have frequently cursed an unclear LCD screen or a faulty indicator light. There are quite a few ways for computers to tell you something, so next month we take a look at display technology to work out what's happening and why, and what's likely to happen.

VZ200 16K EXPANSION MODULE FOR VZ300

Unfortunately for VZ200 owners who updated with the VZ300, the old expansion module won't give you the full 16K RAM. This project fixes that up; with a few minor hardware modifications it tells you how to remap the module to prevent overlap.

1200/75 BAUD MODEM

Part 2 of this project gets more technical. It deals with Telecom line interfacing, how to check different service tones, how to dial and how to recognise the telephone 'off-hook'.

HALLEY'S COMET

This time round, Halley's Comet isn't that bright heavenly body that awed our ancestors. It's a bit more like the pin point stars we see everyday. And if anything, that adds to its mystery. Resident ETI 'comet buster' is out to end all that, or as close as he can come with plain old facts of history, physics and hints on observation.

New spectral scanner

An Australian scanning system, which incorporates several features not presently available commercially, is to be marketed internationally.

The airborne, multispectral scanner, jointly developed by Carr Boyd and the CSIRO Division of Groundwater Research, is mounted as a set of interchangeable modules in light aircraft.

Scientists on board view a real-time colour display of geological and other surface resources of interest from an altitude of 2000-3000 m as the aircraft flies over the 'target' country.

The scanner measures and records energy levels in up to 15 spectral bands (in the range of 0.45 to 12.5 micrometres) reflected and emitted from the ground.

Not surprisingly, it is expected to have many uses in mineral exploration, forestry, fishing and environmental monitoring.

More specifically it is likely to be an invaluable asset in organisations concerned with crop monitoring, detection of salt encroachment and soil erosion, identification of sources of water pollution, fire fighting (the scanner 'sees' through smoke), and even with the spotting of marijuana crops in police surveillance.

When the plane is flying at an altitude of 2000 m, the device scans a swathe 4 km wide and processes data for each 10 m^2; at 3000 m it scans a strip 6 km wide with a resolution of 15 m^2. It has spectral bandpasses as narrow as 0.03 micrometres in the short-wave infrared, and 0.3 micrometres in the thermal infrared.

The scanner comprises nine modules which include the optical components of the scanner itself, detection and motion stabilising hardware, electronics and an image-processing system.

The latter, developed by Geoscan and based around a Motorola 68010 microprocessor, has four 8-bit, 512 x 512 image planes, besides a wide range of hardware and software options. The host computer is a Hewlett-Packard A900 system, with a 6-megabyte memory, and a disk storage of approximately 1 gigabyte.

Data from the system is recorded first on a Winchester disk before passing to 1600 bpi magnetic tapes which are computer compatible.

The multispectral scanner was conceived at the CSIRO Division of Groundwater Research (formerly known as the Division of Land Resources Management) by Dr Frank Honey when he was looking for a new technique to aid geological mapping and locate minerals of economic importance.

Prior to making the decision to commit funds for the manufacture of commercial units, Carr Boyd carried out final tests with an operational prototype scanner earlier this year in the eastern goldfields, WA.

The results were dramatic. Hitherto unknown faults and rock sites were readily identified. Earlier flight tests over farming areas located previously unsuspected areas of salt encroachment.

Data processing, a key factor in the successful application of the scanner, was an aspect that required much work in order to sort out bugs associated with scanner imagery. Raw scanner data suffered from two effects: changes in atmospheric backscatter which caused considerable variation in image contrast and brightness, and slight misregistration of the visible channels with the infrared channels which offset scanlines and varied the relative pixel positions along a scanline.

Geoscan developed software to correct the first effect and devised a correction and resampling routine to reduce pixel to pixel registration errors to less than 0.125 pixels.

The project, set up in 1982 as a Carr Boyd/CSIRO joint venture to develop a commercial prototype, has been funded by Carr Boyd. The company received an AIRDIB grant and technical and engineering assitance from the Defence Research Centre, Salisbury. Fairey Engineering of Adelaide carried out the detailed design and construction of the operational prototype.

The Carr Boyd group is confident that the expertise developed to date will lead to further improvements and substantial economic benefit to Australia particularly when the cost-effectiveness and remote-sensing practicality of multispectral scanners are fully recognised.

For more information contact **Carr Boyd Minerals Ltd, PO Box 6049, Hay St East, Perth, WA 6000. (09)325-9822.**

Backing for Stanilite Electronics

Hambro-Grantham has announced that First MIC has invested $1 million in Stanilite Pacific, a rapidly growing commercial and defence electronics group.

First MIC is a licensed investment company, sponsored and managed by Hambro-Grantham. Its major shareholders include the Commonwealth Bank of Australia, City Mutual Life, STC and Mutsui & Co (Aust).

In September, First MIC announced it had acquired a 17 per cent interest in Stanilite. John Grant, managing director of Hambro-Grantham says Stanilite is First MIC's biggest investment so far. He added that Stanilite is classic example of a potential Australian entrepreneurial business success.

Eight years ago Stanilite was a one man business operating from a garage. It now has an annual turnover in excess of $5 million and has competed successfully with limited financial resources against much stronger multi-national industrial groups.

It initially began producing emergency lighting systems for public buildings. Through technological innovation in design, it created the 'Quickfit' range of exit signs which won an Australian Design Award in 1982. The company now controls 20 per cent of the Australian emergency lighting market and has begun exporting overseas in competition with other major national groups such as Chloride.

Early in its development, Stanilite moved into the defence electronics sector by becoming a preferred contractor to the Department of Defence for the repair of communications and radar equipment alongside groups like AWA, Plessey and STC. Since then, the government has appointed Stanilite to develop, manufacture and market two innovative defence systems, the Patrol Ambush Light which is an infantry illumination support system, and the Secure Voice Naval Communications System for coded and plain speech transmission.

Stanilite has already sold these systems overseas. The company is also using its design and technical skills in the development of a range of stand-alone and integrated electronic security systems for the commercial market.

Programmes turn on VCR

If you've ever been cheated by the recording timer on your VCR and found half an hour of the mud wrestling had eaten into the time set precisely aside for the movie, this new VCR development could be for you.

According to a recent American report on things in West Berlin, two TV networks have introduced VPS (Video Programme Service) by which a code accompanying transmission will switch on a VCR when the desired programme begins rather when the VCR automatic programme recording device at home switching on at a specific time. The new service requires the user to enter recording times for a particular programme putting the VCR in the standby mode. The code, transmitted with the broadcast in the vertical blanking interval, consists of four bytes of data which specify the day, month and time the programme is scheduled. When the code's information matches that programmed into the VCR by the user (ie when the programme actually starts) the recording process is triggered despite possible changes in scheduled starting times.

The code also carries information to pause or halt recording if the programme is interrupted or in the case of a test pattern.

The VCR decoder consists of two ICs, a data-slicer IC and a decoder IC (supplied by Philips, Siemens and Plessey among others). The data-slicer bipolar chip separates the VPS code from the video signal while the decoder gate-array device processes the code. It reads the data into a buffer and feeds it over a digital bus to a microprocessor.

The scheme, which took eight years to implement in West Germany despite its simplicity, was developed at Blaupunkt-Werke GmbH, part of the Robert Bosch group.

IBM microscope

IBM scientists in Switzerland have made a new scanning tunnelling microscope with a scanning assembly small enough to be held in one hand. Because it is so small, it can be used with other microscopes to zoom in on atomic surface structures and make images of them.

A tunnelling microscope can show how individual atoms are arranged on a wide variety of surfaces. For example, the new microscope has produced images of gold, silicon and graphite atoms as they actually appear at the surface of those materials.

IBM is using the tunnelling microscope techniques to investigate the properties and behaviour of various materials at the atomic level, including surfaces and interfaces important for future computer circuitry.

It sees atoms by scanning a small probe back and forth a few atomic diameters above the material to be studied. An electric current flows between the probe and the surface atoms even though the atoms in the tip and surface do not actually touch. This current rises and falls dramatically as the tip approaches or recedes from the surface.

When the tip is scanned laterally across the surface, the vertical position is simultaneously adjusted to maintain a constant current. This means the distance to the surface is also kept constant, and the probe traces a profile of the surface under its path. In a few minutes the tip makes many such parallel profiles, producing a three-dimensional map of the surface atoms.

IBM scientists believe that the new smaller device will permit very advanced research into the nature of thin films, the atomic surface structure of materials such as silicon and gallium arsenide and of junctures between materials that make up semiconductor circuits.

Knowledge in these areas will be vital to the development of the very small and fast circuits required for future computers, the scientists belive.

In addition to its own research, IBM has worked with academic laboratories in the US and Europe, where research teams are using the technique in such widely varied fields as surface science, molecular biology, metallurgy, electronics, and low temperature physics.

BRIEFS

Profit hike for OTC

OTC has recorded a record profit of $93 million before tax, earned on a turnover of $412 million over 1984/85. Tax and dividend payouts totalled $65 million. Under its legislation, OTC is required to operate on a commercial basis to provide international communications to all Australians at the lowest possible charges. The commission is also required to make a dividend payment to the Commonwealth; this year's dividend of just on $20 million, together with tax provision of $45 million, brings total payments to the Commonwealth for the past five years to $238 million.

Progress at Culgoora

The earthworks for the compact array of the Australia Telescope have been completed, except for the service roads and diversion channel. The pedestals that support the antennas have been constructed at the first fourteen stations and the first section of track is about to be laid. The 6 km antenna is due in September 1987 and the antenna at Siding Spring in November 1987.

Optical fibres for the Bridge

The Department of Main Roads has selected AWA to supply 144 optical fibre lane change indicators for the Sydney Harbour Bridge which will replace the DMR tow truck crews, police escorts and rubber lane divider flaps. Costing a total of $350,000, the programmable indicators will be mounted on eight trusses above the traffic lanes. The Sydney Harbour Bridge is the first installation of optical fibre traffic indicators in Australia.

Philips' award

The Institution of Engineers' 'Engineering Excellence Award for Manufacturing Facilities' has been won by Philips for its Australian Defence Electronics Facility at Moorebank. The Philips Moorebank facility is currently manufacturing radar data processors as well as assembling and testing radar equipment for the RAAF's F/A-18 Hornet aircraft.

Industrial laser research funding

A Commonwealth sponsored research project at the University of NSW on the use of lasers in industrial chemical processes is to receive an additional $1.035 million in funding. The laser based reactions and processes being investigated include coatings, surface treatment, catalyst generation, printing, chemical synthesis and fine powder production.

Zip-rack

Autotron Australia has recently released a new 19-inch rack system called Zip-rack, which uses an aluminium extrusion design.

Zip-rack has the lightness of aluminium combined with the strength of square section extrusion with integrated mounting flanges.

Easy to assemble from a kit pack, the unit is self aligning on assembly with corner connectors that interlock each piece of aluminium extrusion with only the need for a small rubber mallet or similar tool. If required, this rigid rack frame can be futher strengthened with the use of pop rivets; in fact, the extrusion design facilitates the use of this fast, effective method of fixing in preference to screws, nuts, washers and spanners.

The extrusion is clear anodised to give an attractive and durable finish.

As the name suggests, Zip-rack is a fast, convenient and economical rack system, and is suitable both for the professional and the hobbyist.

For more information contact your local **Dick Smith** store.

Advanced gate-array design centre for Australia

Hardie Technologies has recently set up Australia's first semicustom chip design house at the headquarters of its subsidiary chip supplier, NSD.

The design centre is equipped with a 32-bit Domain computer and runs specially developed software which will allow Australian companies needing custom gate array designs to locally complete their specifications.

The highly advanced software and other technology associated with the centre is the result of an agreement between NSD and National Semiconductor of Santa Clara, California. Under the agreement NSD will use CMOS gate array designs as the basis for its semicustomising operation.

The centre applies design software to the last (metalisation) layer of a standard NSC gate to give specific functions for a design requirement.

Alain Legrand who was lured from RMIT to work for the new gate array design house sees the export market as the main beneficiary of the NSD approach. He believes Australia has many innovative, top line designs and electronics approaches which could establish a stronger export position by the use of applied specific integrated circuits (ASICs). The advantages he predicts are that Australian products would be more compact and reliable, cheaper to produce, and they would have design protection in that the only way an imitator could emulate their design would be to steal the film of the final layer wiring connections for the rest of the standard chip.

At the opening ceremony of the design centre at the NSD offices in Box Hill, Victoria, recently Legrand demonstrated the DN600 Domain computer and its sophisticated design tools, supplied by Mentor graphics and NSC.

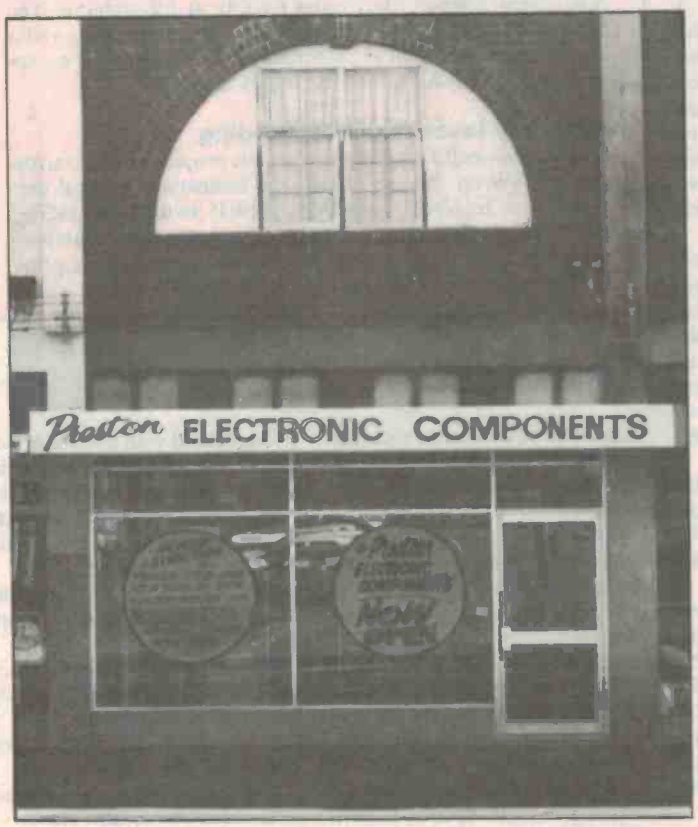
In front of the Domain workstation is a line up of services including circuit and concept evaluation, customer training for design, or turn key design facilities of gate chip arrays. Legrand stressed the important difference between this approach to gate array design and that carried out by competitors of Hardie Technology.

"Up to now gate design has consisted of design capture, sending the thing overseas for simulation and iterative improvement, and then finding out what went wrong. We offer full design verficiation, right here. The software enables us to simulate the gate array electrical performance before it is sent to the US for manufacture. This is one of the important attractions of the design centre approach."

As ASICs allow designers to integrate several standard chips in one single chip, the total chip count of a design, the board size and the production costs drop, making the technology perfect for servicing niche markets. Australia has been able to capture a number of these small markets and the step to the design centre approach is an obvious one.

NSD, which was formed in 1981, has, by setting up the centre, given local designers access to National Semiconductor's SCX6200 family of arrays, which range from 600 to 6000 gates. An extensive macrocell library is incorporated in packaging options ranging from conventional dual inline packaging (DIPs) to advanced high density plastic leading chip carriers and pin grid arrays up to 172 pins.

A second sourcing agreement was recently announced for the entire gate array family by NSC and International Micro-electronic Products. Both companies use the same CMOS process and their products are fully compatible at the mask level.



OVER THE COUNTER

A new electronics shop in Preston, Melbourne, has become something of a Mecca for local technical school students.

The shop, Preston Electronic Components, in High St, near Bell St, is owned and operated by 20-year-old Darren Candy. Darren has been an electronics fanatic for years; the local kids find he is a great chat and can offer some sound advice.

Darren is specialising in major brands of active and passive electronic components. He has a good range of kits including Altronics ones such as Musicolour IV, Frequency Meter, Capacitance Meter and Function Meter and he also has Talking Electronic kit sets, which he describes as "kid's kits".

Darren's mother, Jackie, who helps out with the growing business, says Darren has always wanted to go into a retail store. "He has always been interested in electronics, CBs and radios. He did electronics at the RMIT after he left school and worked for a couple of electronics businesses before going out on his own.

"Darren's major hobby was CB radio and now when the kids in the area come in because their CB is playing up he'll suggest different ways they might be able to fix it!"

Darren agrees he does have a lot of students in the shop but he says his major clients are mostly servicemen, technicians, schools and hobbyists. "I'm stocking National Semiconductor, SGS, Motorola and similar brands, as well as associated electronic goods, and I am very pleased to be an Altronics distributor," Darren explains and adds, "I am also specialising in hard to get parts. If we haven't got something we'll chase it. We are actually doing a lot of finding of hard to get parts which the bigger companies won't usually bother with."

Darren promises a wide range of resistors, cables, circuit boards, capacitors, sprays, pcb artwork, instrument cases, relays, kit sets, semiconductors (all types), trimpots, photosensitive, transformers, switches, products, etc. Enquiries are welcome in the shop as are mail orders and phone enquiries.

He says the business is going well and he gets a lot of customers off the street. "I'm a couple of kilometres down the road from Rod Irving Electronics in Northcote and we can send customers to each other," he adds. Darren's ambitions? "I want to expand to all areas but stay specialising in component parts."

BUILD YOUR OWN PROGRAMMABLE NAVIGATING ROBOT

This all-Australian designed do-it-yourself robot can be programmed to do countless navigating tasks. You can use it just for fun or teach it to do practical things like following you while you work, carrying tools or food. You can even send it around the house on its own, performing various tricks.

LOOK AT ALL THESE FEATURES!

★ Self contained — no extra computer or other equipment required (as with many others' robots).

★ High level programming language built-in. The language designed especially for this robot is similar to languages like C and LOGO and allows both simple programming for beginners and complex programming for experts.

★ Expandable — specifically designed for the hobbyist to experiment with. Not only is an expansion port provided, software designed to allow easy control of the expansion electronics is included in the Hobbybot language.

★ Ultrasonic sensor — no device is really a robot unless it has a sensor so that it can interact with its environment. (Some robots at $399 have no sensor!)

★ Designed by world's most prolific personal robot designer.

1979 Tasman Turtle
1981 Talking Turtle
1982 Turtle Tot
1983 Elami (Hong Kong), Chester (Commodore Bus. Mach. Texas)
1984 Blinker
1985 Hobbybot

★ Low cost — robots with built-in language, sensors and fully self-contained cost around $2000! Hobbybot costs not much more than you would pay for just the ultrasonic sensor kit if purchased separately.

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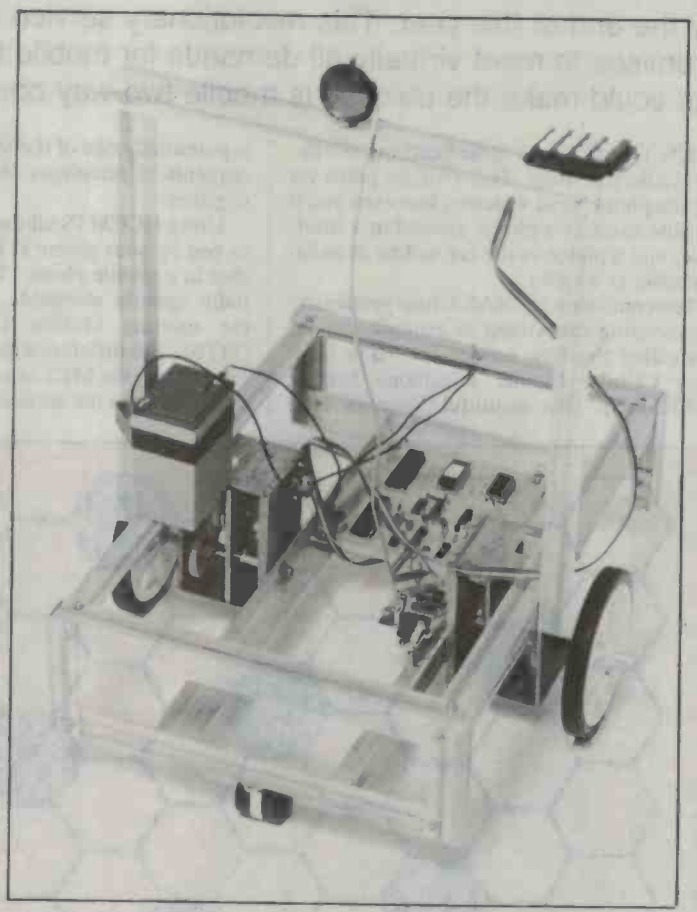

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FEATURE

CELLULAR RADIO

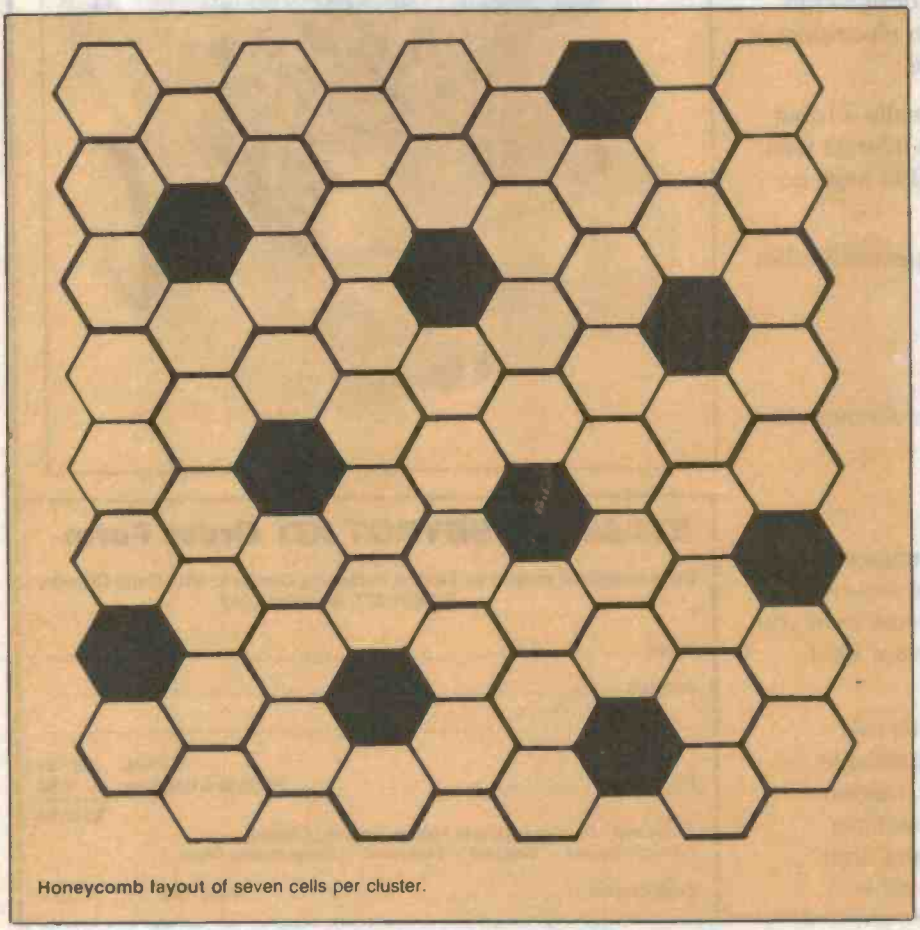
Jon Fairall

Telecom will launch its cellular radio mobile telephone service by the end of this year. This revolutionary service not only promises to meet virtually all demands for mobile telephones, but could make the ubiquitous mobile two-way obsolete.

DICK TRACY EAT your heart out; Cellular Radio is coming. There are no plans yet for telephone wrist watches, but soon you'll be able to carry a phone around in a briefcase, and a phone in the car will be as indispensable as a radio.

Telecom, with its NASA-like propensity for covering everything in esoteric jargon, has called the new service the High Capacity Cellular Mobile Telephone Service (HCCMTS). This mouthful disguises what is potentially one of the most exciting developments in telephony since Bell got it all together.

Using HCCMTS all the services available to you by your phone at home will be available in a mobile phone. The service will initially operate alongside, and then replace the existing Mobile Telephone Service (MTS). The difference between them is just one of size; the MTS can only cope with 180 subscribers on the air at one time. Using the new service, there will be space for virtually an unlimited number of channels.



Honeycomb layout of seven cells per cluster.

Telecom has every reason to suppose that cellular radio will be popular. In fact the reasons for its introduction is that MTS has been wildly successful, with space in the major city networks now at a premium. In fact, Sydney is completely full, only four years after the service started. Telecom is still developing the MTS network, and expects to have the service up and running in every major metropolitan centre in Australia by the end of the year.

Background

So, what is cellular radio? In an ordinary telephone service, the factor limiting the number of telephone channels is the num-

SYSTEM AT A GLANCE

Modulation: Narrowband FM
Specification: Modelled on the US AMPS system
Frequency: mobile transmit — 825-845 MHz
land transmit — 870-890 MHz
Bandwidth: 30 MHz
Number of channels: 666
Cell size: 2 km-10 km
Cluster size: 7 cells

ber of wires in the ground. When radio is used for propagation of the telephone signal the same role is played by the electromagnetic spectrum, ie, the amount of space allocated the service determines how many calls you can have going at one time.

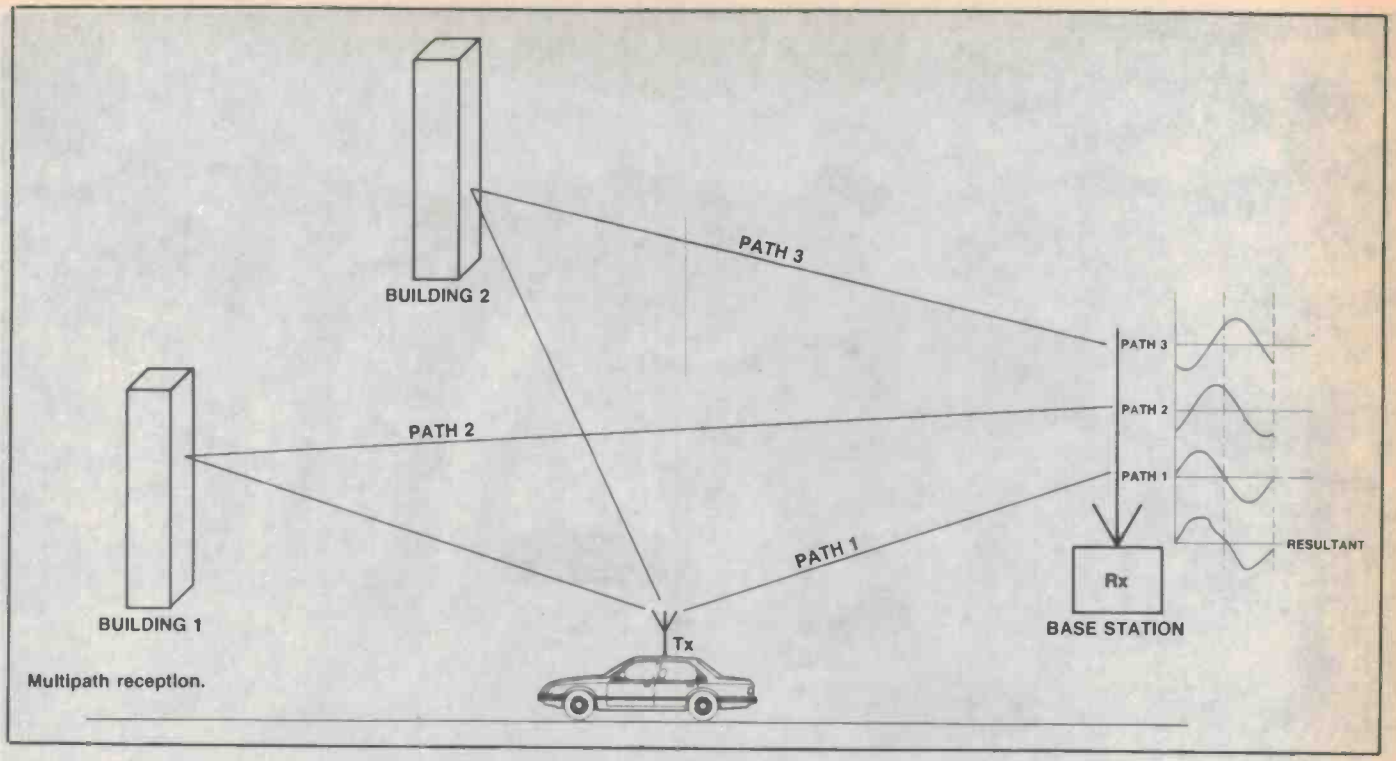
One way around this impasse is to use multiplexing. To cram more channels into one pair of wires we can divide the channels in time, or in frequency, or in some combination of both. The limiting factor in the amount of multiplexing is the bandwidth of the transmission medium. In wire communications this is set by technology, but this is true to a much lesser case in radio communications. Over the air, the limit is set by legislation.

An enormous number of potential users have some legitimate reason to use the radio spectrum. This finite range of frequencies is broken down into small regions and allocated to certain uses on the same basis that political decisions are always made. Whether those are good or bad reasons, the result is that around the world, only a small range of frequencies is available for consideration by telephone companies.

When the facts of scarce spectrum resources meet the needs of intelligible speech transmission for a certain minimum bandwidth, the result is a service like the MTS. It uses a single, or a few widely spaced transmitters. All the mobiles share the frequency space available on a first come first served basis.

Cellular radio goes down a different track, which we might call space multiplexing. The idea is that the same frequency is reused in different places across a large area like a city. The city is divided into zones called clusters, and each cluster into cells. At the centre of each cell is a radio transmitter which broadcasts over a small range of frequencies. It is surrounded by other cells all broadcasting on different frequencies. Together, all the cells in a cluster take up the entire bandwidth available to the service. So, within this cluster, all the frequencies available are separated in a specific spacial pattern. This pattern is then repeated in another cluster adjacent to it, and in another and another and so on. The result is that no two adjacent cells use the same small range of frequencies.

The number of cells in a cluster must be ▶



Multipath reception.

chosen such that the pattern forms in the way just described. On the assumption that all the cells are the same size and shape, there are only a certain number of cells per cluster that will work, for example: 4, 7, 9, 12, 13, 16, 19 and so on. Telecom has settled on 7 as its standard number.

The number of cells in a cluster is the result of a trade off. The advantage of going to higher numbers is that there is less danger of interference with another cell using the same frequency. In order to find the same frequencies being reused one must cross a greater number of other cells.

On the other hand the more cells there are in a cluster, the fewer channels are available in any given cell. So the trade off is between reception quality and efficient use of the spectrum.

One of the beauties of the system is that it is expandable in a way no other form of multiplexing is. Simply by making the size of the cells smaller, you can increase the number of subscribers ad infinitum. The primary check on this process is an economic one. The more cells, and thus transmitters there are the more the system costs.

History

The idea of cellular radio is not new. A history of cellular should probably start with the birth of mobile communications during the 1930s, including the revolutionary idea of putting a broadcasting receiver in motor cars. (In view of the amount of ambient noise in a typical car of the period, this must have seemed a singularly useless invention.)

Real work on cellular concepts began in the 1950s when engineers at Motorola and AT&T noted that the conventional radio phone system would soon be inadequate. However, there were some formidable technical obstacles in the way which have really only been satisfactorily solved within the last few years — with the help of cheap and high speed computing.

The Federal Communications Commission, the US regulatory agency, began licensing operators in 1982, and a number of these systems are now up and running. The first was in Chicago in 1984, and now services are available in the corridor between New York and Boston, as well as Washington and Baltimore.

In the UK the entire country has been divided up between two operators, Cellnet and Vodafone. Services started in the major cities in 1985 are now spreading out into the motorway countryside. Although two private operators were set up by the British government specially to stimulate competition, they have negotiated to divide the rest of the country up between them. The licences require both operators to provide coverages of 90% of the country by 1990, and for their services to be compatible.

Initial tenders for the Australian service were called in 1984 and a winner, the Swedish company Ericsson, was announced in July 1985. Things are due to kick-off in Sydney in December 1986. The service will be expanded rapidly into the top fifty market areas in Australia over the next few years. In fact, Telecom estimates that 150,000 mobile phones will be in service by 1994, by which time the service will be available in every centre in the country with a population over 20,000.

Handoff

Perhaps the most fundamental technical problem that needed to be solved before cellular radio could become a reality was 'handoff'. Cellular radio is intended as a mobile service. Thus it has to be accepted right from the start that during the course of a call the mobile transceiver might traverse a number of different cells. At each cell boundary the mobile must change base station and thus frequency. The smaller the cells the faster and more often this process must be done. It has only been made possible by the availability of large amounts of computing power, both in the radio and the base station.

While the unit is on the air the level of its signal is constantly monitored. When the signal reaches a certain low level the system commences to find a new frequency in a new cell that will achieve a significantly higher signal level.

To do this the system tries out a number of different adjacent cells, seaching for one on which the signal is better. When it finds one it assigns a new route through the switching centres for the call, and then orders the mobile to switch frequency. The whole process takes a few hundred microseconds to complete, so that users are completely unaware of what is happening.

This system, impressive though it may be, would be of little use without a rather complex interface into the conventional telephone network. Under normal conditions the mobile communicates with a base station, which turns the FM signal from the mobile into a two megabit pulse code modulated data stream. Each base station has associated with it a Mobile Services Switching Centre (MSC) which checks the level of the signals, initiates the handoff routine if necessary and passes the signal on to the exchange.

The MSC is also able to communicate di-

rectly with all the other adjacent MCS's so that during the handoff operation, proper switching can be achieved. The control sequence originates in the MSC which first accepts the call and which continues to control the fate of the call as long as the connection is maintained, even though it may no longer be directly involved.

When the MSC has determined the proper handoff sequence a parallel operation takes place between the exchanges. An exchange has to be one of the new generation of digitally controlled Ericsson AXE exchanges; they connect the mobile to the rest of the Telecom switched network, and re-route the signal path under the control of the MSC.

Multipath reception

Although this sounds fine in theory, in practice, getting it right has proven very hard indeed. The urban environment is not very kind to radio reception. The signal from the mobile, as seen from the base station, shows a jagged plot when signal strength is plotted against time. The level rockets up and down as the car moves around buildings, power lines, bridges and underpasses.

The primary cause of this type of fading is multipath reception. The signal is reflected off all sorts of objects so that, instead of a single signal, the base station actually receives a number of signals, with some sort of unpredictable phase relationship between them. If the signals are in phase they will add and reception will be good. If they are 180 degrees out of phase the signals will subtract and the result will be no reception at all.

Compounding this is the fact that the mobile is probably moving over a significant fraction of a wavelength in a very short period of time. At 900 MHz a wavelength is only 0.3 of a meter. A mobile travelling at 60 kph covers a complete wavelength every 18 milliseconds. To compound the problem even further, all these effects are very frequency sensitive.

As a result, it's not possible to set the system to handoff whenever signal strength drops below a certain critical value. It needs to know whether the low level is the result of temporary attenuation or distance from the centre of the cell.

One way of handling this problem is to take an average of readings over some critical time period. This method avoids switching due to sudden negative spikes. Of course the setting of this time period involves some fine judgment if the subscriber is to be left unaware of what is going on. Systems have been tried which ally such methods with a doppler sensor. This looks for minute frequency changes in the carrier from the mobile, and thus senses whether it is travelling towards or away from the base transmitter.

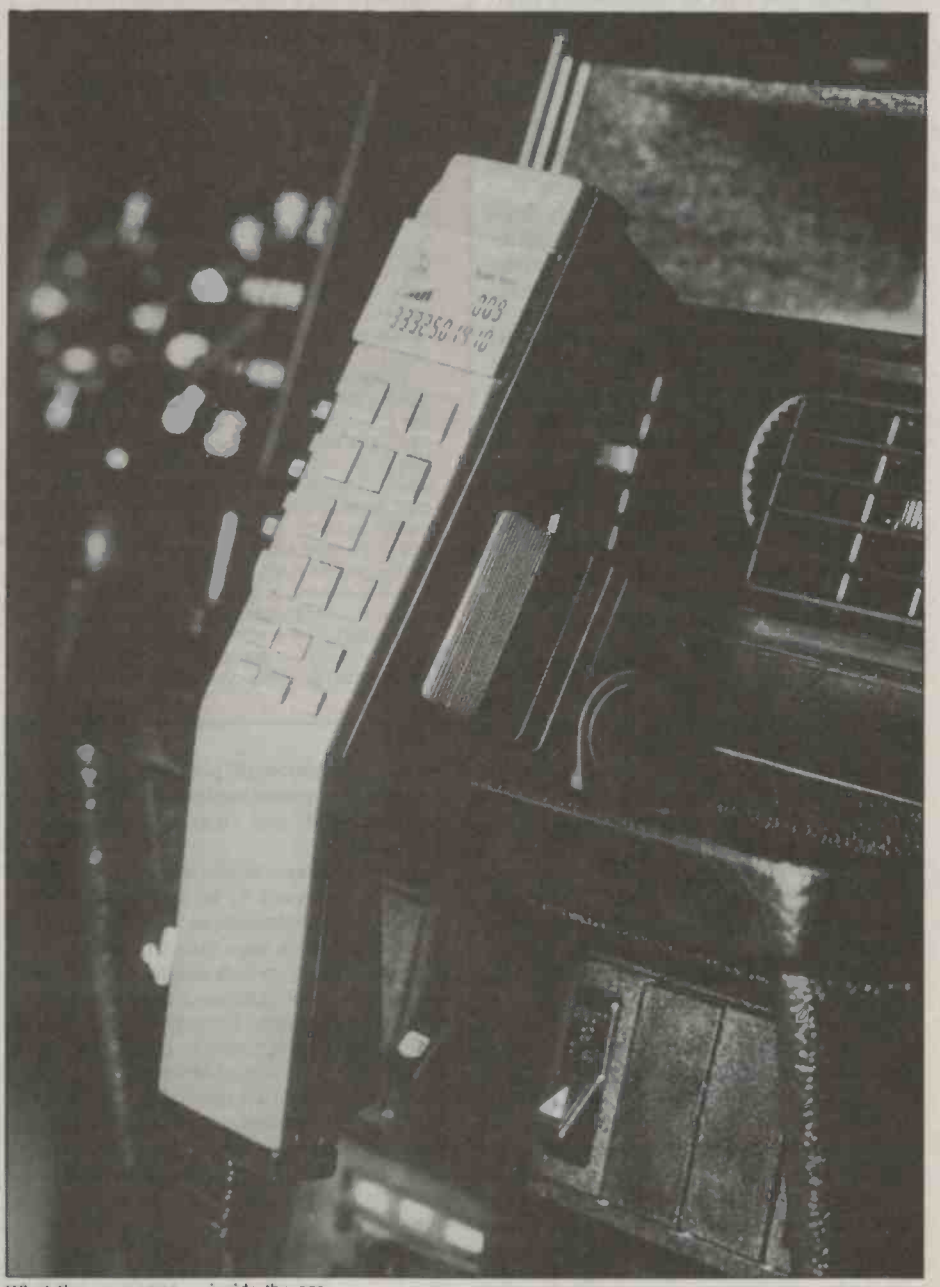
Using it

Currently Telecom is considering three different types of unit for use in the Australian system. One is a handheld unit about the size and weight of a traditional walkie-talkie. It will operate like a normal fixed phone and should give good reception from inside cars or buildings. Models under consideration have batteries that will allow about a half hour's operation.

The second type is bigger and more robust, and generally about the size of a briefcase or small suitcase. It features a proper power supply allowing operation from the mains or automotive dc. It also has rechargeable Nicads as standard equipment to permit lengthy portable operation.

The third type is a fixed telephone for operation in vehicles. It will perform exactly like an ordinary telephone except that it is tailored for the automobile environment in much the same say as the current generation of car phones. Features like hands-free operation and on-hook dialling are expected to be basic.

A considerable amount of uncertainty ▶



What the user sees — inside the car.

still surrounds the way in which these units will be supplied to the public. At one stage there was a considerable body of opinion within Telecom that suggested they should retain monopoly control over the sale and distribution of customer terminals. It now appears however that there will be an open house policy with manufacturers free to sell direct to the public.

Still to be resolved is the question of how much local content will be required. Some manufacturers, AWA for instance, are hoping the government will require large amounts of local content, thus giving manufacturing based operators the upper hand. Companies that tend to manufacture overseas and import into this country could find themselves left out in the cold.

The future

Cellular communications is very new, and naturally full of unresolved issues. One that looms large is the question of security, both of terminal equipment and the communication they carry. It is not difficult to make cellular phones very unattractive to thieves. Rather more difficult is the problem of making them unattractive to eavesdroppers.

As things stand with the MTS, it is quite possible to listen in on mobile calls with simple scanner technology. The argument against any form of encryption is that it's very difficult to eavesdrop in a purposeful fashion since there is no necessary or unbroken link between a particular subscriber and a particular frequency. Indeed, with the HCCMTS, where frequency might be changing every few seconds, the possibility of someone being able to bug a particular conversation is very remote.

Nevertheless, as the possibility still exists of casual eavesdroppers listening to conversations perhaps better kept quiet, a considerable amount of thought has been given to the question of encryption for mobile systems. Difficulties are caused by the fact that all the details of the encryption system, including equipment to defeat it, must of necessity be provided to everyone who wants to use the system. Several systems have been proposed overseas that use statistical methods of encoding the channel, usually requiring that both transmitter and receiver be synchronised in some way.

Another sort of problem is caused by the fact that there are technical changes looming with great implications for cellular systems. In fact, most studies of trends around the world seem to show that the current generation of cellular technology will not reign for long.

The most obvious of these trends is digital technology, which should begin to mature enough to support HCCMTS-type functions within the next 10 years. Digital is significant because it is in the alliance of the coming generation of portable small computers and communications that most analysts see the real market for cellular systems.

A digital service would allow a far greater number of services to be offered. Cellular computer communications would allow the introduction of a sophisticated paging service for instance, which would be a far better allocation of spectrum space and time than voice channels. Perhaps such a system could involve the transfer of files several kilobits long into pocket sized packages. Another common scenario has a computer accessing a printer or memory buffer mounted in a car. It would have tremendous implications for the way in which many jobs are organised in terms of data collection and transfer.

Another trend that is likely to have relevance to cellular radio concepts is exploration of high frequency techniques. One of the disadvantages of using high frequencies for broadcasting is their poor radiation properties. But this becomes a bonus when applied to cellular radio. In particular, the fact that super high frequency becomes increasingly line-of-sight as frequency goes up means that cell boundaries can be more and more accurately defined.

At the same time increasing bandwidth means that each cell will be able to support more channels. In fact, it's interesting to speculate how high frequency needs to go before the number of possible channels equals the possible number of subscribers in a typical urban cell. Because at that time it will become more economic to supply all services by radio rather than hard wire them. The introduction of cellular radio is probably more than just the introduction of another Telecom service. It may be the beginning of the end of the Telecom network as we know it.

SAVING THE BEAST

The threat of theft is one that we all have to come to terms with. Since the police seem unable to stop the orgy of looting that affects not only the cars themselves, but also their accessories, it's necessary to either accept that coming to the attention of thieves is one of the penalties of ownership, or to design in features from the ground up that make theft less attractive.

This second course has been chosen for cellular radio. In the first place, it is possible to make the system ignore certain numbers, or to log them as they occur. After a customer reports his equipment stolen it would be possible to make the equipment useless by simply refusing to recognise calls to or from the mobile, or by interfacing to the police in some way.

Neither is it possible for a thief, once he has stolen a unit, to simply acquire a new telephone number from Telecom. Each mobile has two numbers associated with it: an identification number, which is supplied by Telecom and corresponds to the telephone number, and a maker's serial number. The ID number is carried in system ROM, so replacing it is an easy matter: simply replacing one integrated package.

The second number, however, is required to be buried in the hardware of the system, and to self destruct when removed. Apparently the favoured means of accomplishing this is to put the information on a small CMOS IC which is secured directly into the case. It is assumed that any attempt to remove it will result in the IC destroying itself by overheating or static or both.

Anyway, given the existence of these two numbers it is then rather simple to request that a mobile send both numbers when setting up or receiving a call. Detecting theft is then simply a matter of comparing the numbers.

According to John Boland, who is leading the Telecom section charged with setting up Cellular Radio, this will not be done as normal practice, since it adds unnecessary overheads to the system. However, it can be done when customers require it, presumably after their units have been stolen.

CONTROLLING THE BEAST

At the centre of the frequency bands assigned to cellular radio, 21 channels are reserved for controlling the system. They are known as the 'paging and access' channels. As it transverses the cells, the mobile is constantly monitoring these channels. On-board circuitry allows the mobile to constantly select the channel with the strongest signal.

To initiate a call, a mobile transmits on one of these channels. When the call information (number to be called, calling subscriber identification) has been established the MCS sends information back to the mobile assigning it one of the voice communications channels. If all the channels in the cell are full the MCS can direct the mobile to try an adjacent cell. If any free channels exist and signal strength is sufficient the contact will be made that way.

The procedure of changing frequency when a roving mobile changes its base station is known as handoff. In the AMPS system, the received signal strength is constantly monitored at the MCS. When this signal strength reduces by a set amount a changeover search is initiated by the MCS.

Each MCS is connected to all the adjacent MCS's by landline. The MCS currently controlling the mobile asks all the adjacent MCS's to which it is connected to monitor the signal strength of the mobile. If one can be found that exceeds the level of the current MCS by a significant margin the system will handoff.

The signals that do this are sent over the voice channel to the mobile and over landline to the chosen MCS. A series of tones instructs the mobile to change its transmit and receive frequencies to those of the new cell. This entire sequence takes approximately 50 ms, and thus is far too short to be perceptible.

Reception of a call also starts with the mobile tuned in to one of the paging and access channels. The MCS sends out a paging signal by broadcasting the call sign of the desired mobile. When a call is received, the paging channel tells the mobile, and assigns it a frequency. After level checks are completed the call goes ahead.

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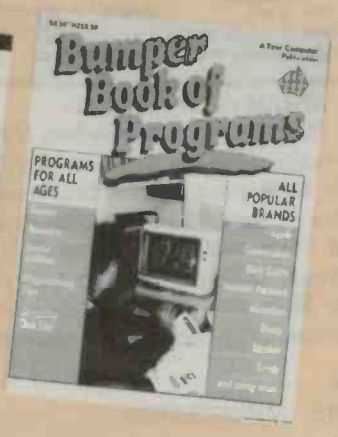

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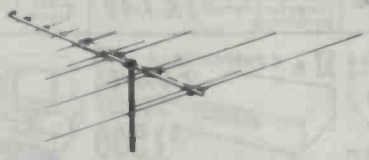

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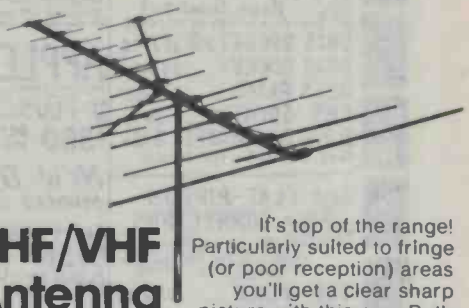

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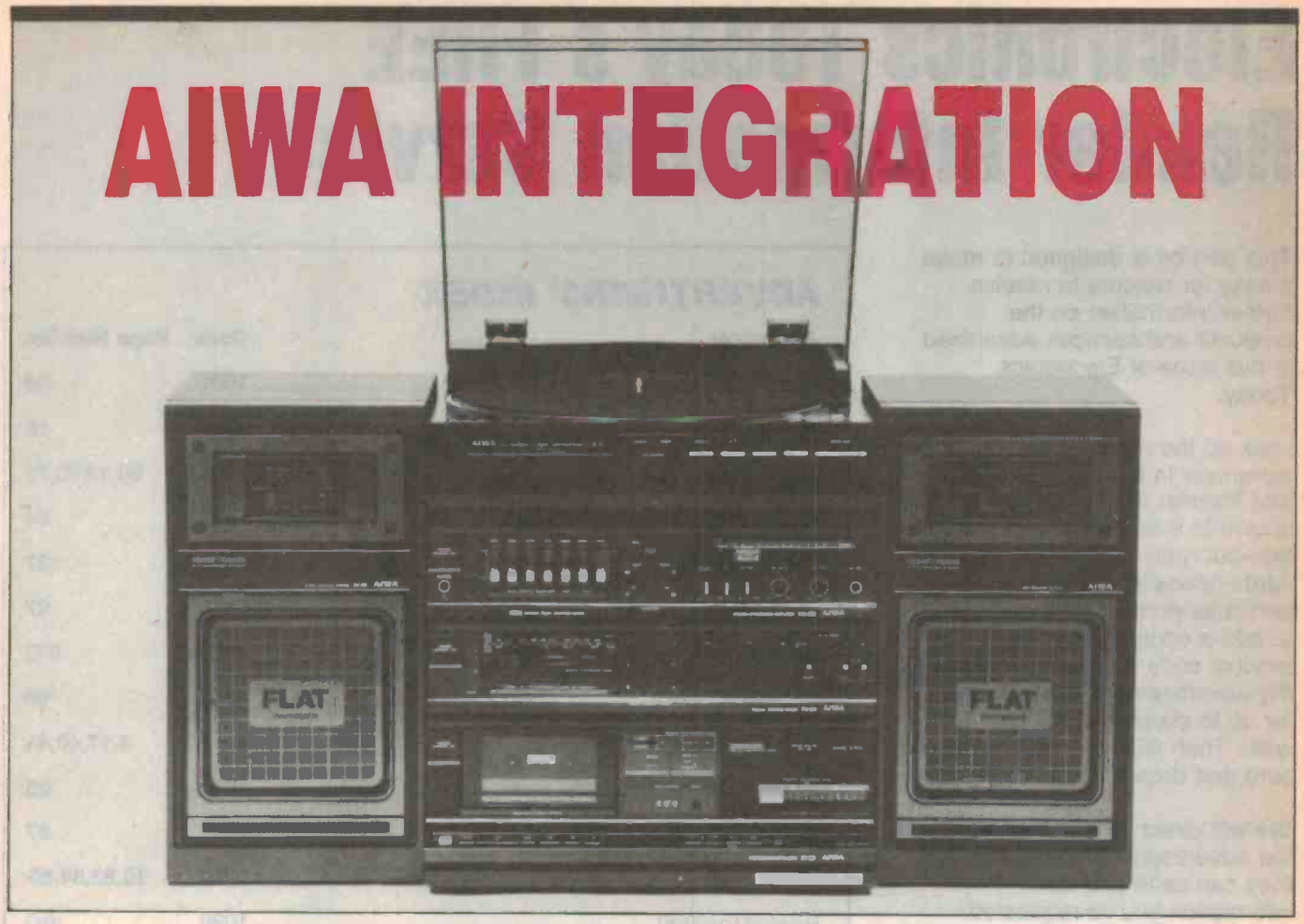


— V-800 series stereo system

There's no denying the attractiveness of buying an integrated stereo system instead of painstakingly matching the necessary single components. But, you take with one hand and give with the other . . .

Louis Challis

AIWA STEREO SYSTEM

Incorporated in an audio system rack RK-X80, including Stereo Cassette Deck FX-80, FM/AM Stereo Tuner TX-60, Stereo Integrated Amplifier MX-80 surmounted by linear tracking tone arm fully automatic LX-30 flanked by speakers SX-F6.

Dimensions:	
(with components in rack)	*380 mm (h) x 330 mm (w) x 385 mm (d)*
(with speakers at sides)	*380 mm (h) x 710 mm (w) x 385 mm (d)*
Manufacturer:	*Aiwa Co Ltd*
RRP:	*$1749*

OVER THE LAST 15 years, ETI has tended to shy away from reviewing integrated stereo systems in preference for individual components which allow you to 'mix and match' components to your taste. This is something of a compromise as more than 60% of all the equipment sold world-wide is integrated systems, but justified on the basis that even the people who buy those systems have more than just a passing interest in the more expensive and esoteric individual items which are available.

As you might have noticed, ETI is 'casting the net' a bit wider these days and thus the review of an integrated system.

Aiwa Co Ltd of Tokyo, Japan, is one of the smaller but more innovative Japanese manufacturers of hi-fidelity equipment, whose reputation and image have brightened each year. Although as a 'sister company' of the Sony Corporation, it has access to Sony technology, Aiwa has tended to limit its technological association to the purchase of speaker component and special integrated circuitry.

Aiwa's forte is undoubtedly the design of cassette recorders. I have held their products in high esteem for many years, and must acknowledge that we currently use two Aiwa cassette recorders in specialised signal processing roles.

The manufacture of cassette recorders can be rewarding and in that respect Aiwa has displayed considerable ingenuity in its lateral integration through the parallel production of many models. That approach however, does not necessarily ensure any manufacturer will have a reasonable share of the market. As a consequence, Aiwa has tended to aim for a vertical integration in its products through the production of the associated system components (amplifiers, tuners, turntables and speakers). It introduced the first of the 'mini-systems' which soon swept through the market place.

Since then, the Aiwa mini-systems have expanded in vertical integration with the release of more and less expensive mini-

systems. The V-800 series component system is one of the more modest systems, the size and ergonomic characteristics of which have been carefully designed to appeal to both young and old alike.

Design and appearance

The anchor of the V-800 system is a modular racking system which offers some new attributes. The three primary components (graphic equaliser/amplifier, tuner and cassette recorder) plug directly into special pre-wired sockets which form an integral part of the rack. These sockets provide both mains power and interlinkage for signal inputs and outputs for each of the three rack-mounted components. This arrangement simultaneously provides special functionality, as well as a front panel more attractive than most other rack systems.

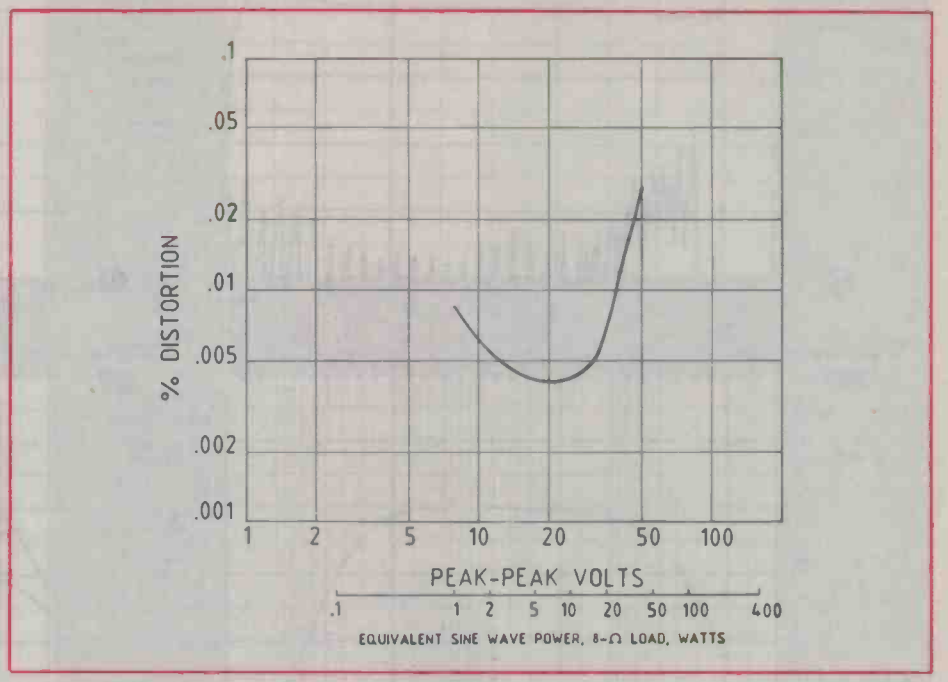
The top panel of the racking system incorporates two mechanical sockets at the rear, with buffered feet at the front which rest on top of the integrated amplifier, so that the linear tracking turntable can sit neatly on top of the system. The bottom component in the rack is the stereo cassette deck, the controls of which are stepped forward from the main front panel in much the same way as piano keys sit proud of the piano for greater convenience.

The stereo FM tuner (with only mono AM capability) is sandwiched neatly between the cassette player and the amplifier. The speakers can be placed either side of this system or preferably fixed to the adjacent wall using the hardware provided. Better still, they would sit further apart on a bookshelf or sideboard for optimum stereo imaging.

Colour emphasis is on black, highlighted by silver aluminium for volume controls and record player controls, and with small bands of red plastic below the power switches and synchro recording buttons on the front keyboard of the cassette recorder.

It is these individual red buttons on the cassette deck keyboard and the associated automatic switch-over from one input to another which are the most attractive and innovative feature of the system. This specific capability puts this system well in front of most conventional hi-fidelity rack systems, where you are forced by a lack of 'vertical design integration' to operate a number of separate controls (which may be more than four) to record or listen to one component in that system which has not been already selected or activated.

The Aiwa system works on the principle that you only need to touch a single button in order to switch either the recording chain or the monitoring chain from radio to tuner, or from cassette recorder to turntable. More significantly, it allows you to instantly record or replay from any one of those components.



Each of the components in the system offers a number of sensible ergonomic features, which most users will appreciate and which provide further flexibility, along with a deliberate simplification of controls. As an example, the cassette recorder does not require simultaneous activation of a PLAY and RECORD button. On the front projecting 'keyboard control panel', even without selecting PLAY, all you have to do is press one of the four buttons labelled TUNER, PHONO, AUXILIARY or CD. This automatically switches the cassette player into the recording mode with the appropriate input, and the recording process will start provided that the specified component is already correctly tuned in or operating (and of course connected).

Cassette

The level controls on both the cassette recorder and amplifier are slide controls. These visually indicate their functional settings much more directly than do rotary controls and as a consequence they look and work better. The supplementary functional controls on the cassette recorder are limited to two switches, one which selects Dolby and the other which selects Dolby B or C. The cassette recorder avoids many of the more prosaic controls through the use of automatic detectors to tell the machine whether a Type I or NORMAL (gamma ferric oxide), Type II CrO_2 (chromium oxide) or Type IV METAL tape has been inserted. The cassette recorder then automatically selects the bias and equalisation requirements to suit the tape inserted. If your tape is an old one, without the correct rear indents, it will be treated as being a Type I tape.

The level display features five sets of LEDs which respond to peak levels of −10, −5, 0, +3 and +6 dB. Many purists and faddists might find this limited but they work quite well and provide just adequate visual control information.

As well as the standard PLAY, FAST FORWARD, REWIND and STOP buttons, the keyboard also incorporates an illuminated PAUSE button, which you touch to activate and touch once more to deactivate, and a RECORD MUTE button. This control allows you to silence the specific sections of the recorded information such as advertisements on radio or TV, or provide gaps between musical items to suit your special requirements.

At the other end of the keyboard are the four red buttons, each with its own LED display for the SYNCHRO recording capability and a timer control switch which allows the unit to be used with an external timer for automatic recording or replay on demand.

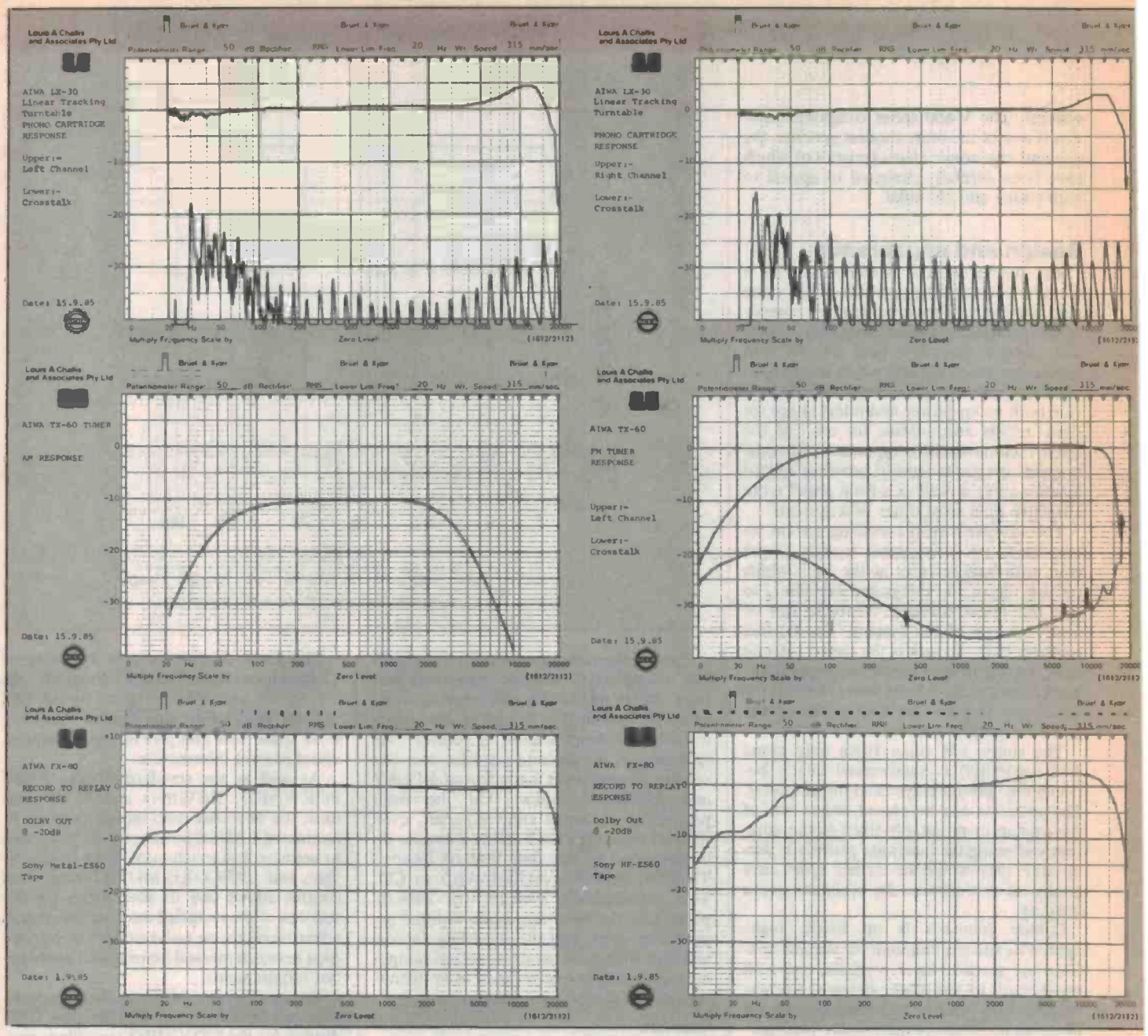
Tuner

The FM stereo tuner (with AM mono) is a rather neat component, which should endear itself to most users.

The LED display between the power switch and the main display incorporates five different levels of input signal sensitivity as a form of S meter.

The main display immediately to the right incorporates illuminated displays for FM, FM stereo, memory activation, AM input and AUTO/MUTING.

The station setting dial display features 15 double LEDs which only indicate the approximate position of the tuning dial, instead of precisely showing it as would a me- ▶



chanical system or the far more preferable digital frequency display. I found this system somewhat disconcerting when the display stepped from LED to LED and not from station to station as I searched up or down the dial for a wanted station. This was even more disconcerting where two stations were relatively close to one another and the display did not even move. This was one of the features in the FM stereo tuner to which I could not be reconciled.

The other controls on the front panel of the tuner are six pre-set FM, and six pre-set AM station channels, provided by means of three rocker bar switches located in the centre of the front panel. Two separate large buttons, which are labelled in small letters AM and FM, are located immediately to the right. At the extreme right hand side of the tuner's front panel are two large tuning buttons which allow you to search upwards or downwards for a station, provided you know what it sounds like, rather than where it is!

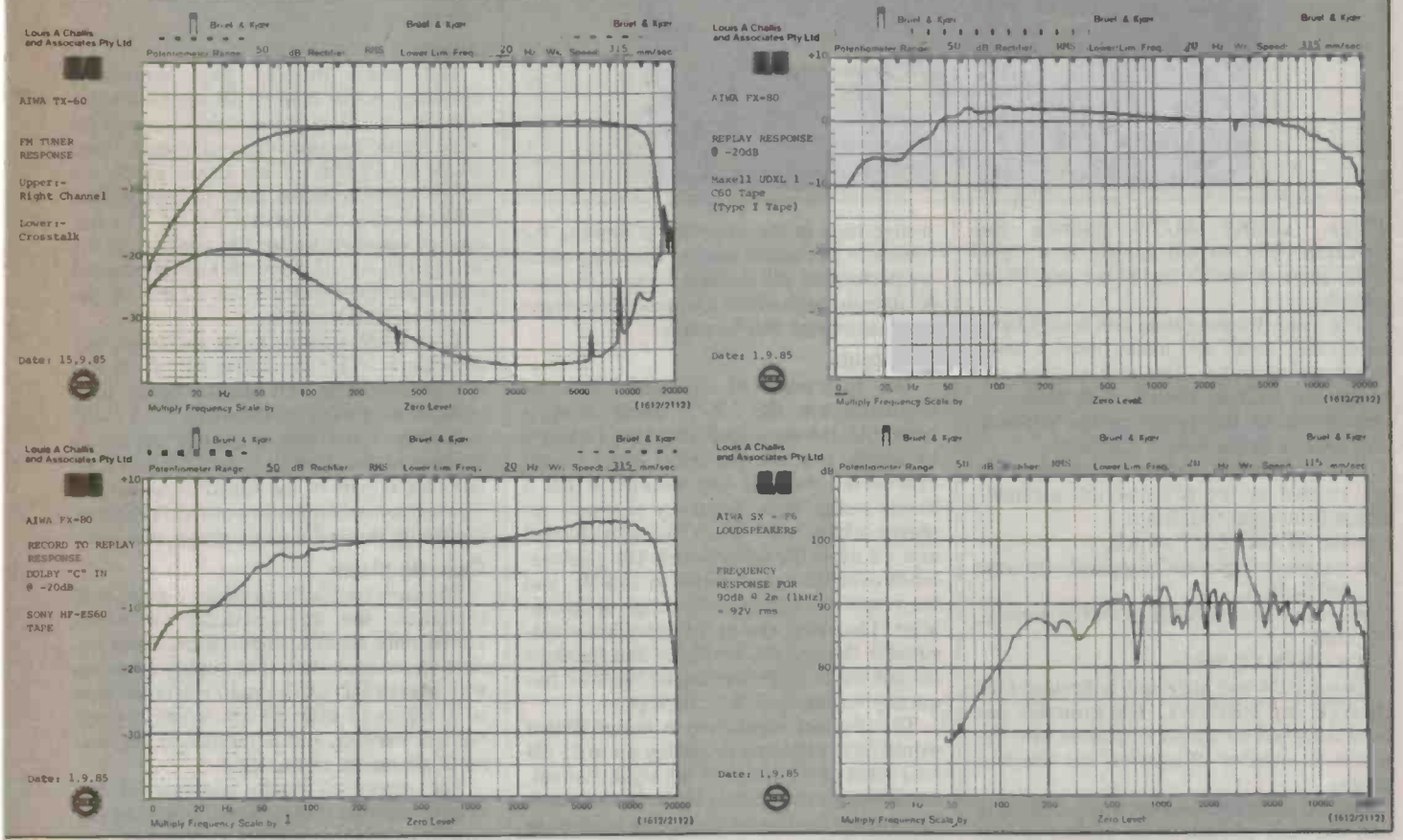
The remaining controls on the front panel are a small green MEMORY button, which is activated once you have found a station you want to store, a MANUAL tuning button, which allows you to incrementally step up or down for fine tuning, and a grey AUTO button, which allows the tuner to search for the precise carrier centre frequency.

At the rear of the tuner are five lever operated aerial input sockets which accept the 300 ohm dipole aerial lead supplied, as well as a cleverly designed AM loop antenna. The leads of this antenna are long enough to allow it to be optimally positioned for the best signal reception and for adequate separation from the other components in the system, which might otherwise cause interference problems in some low signal strength areas.

I found both antennas provided good sensitivity and excellent reception, although when searching for station carriers, it is sensible that both antennas be correctly aligned for reasonable signal strength.

Amplifier

The MX-80 stereo integrated amplifier which sits on top of the tuner features a headphone socket immediately below the power standby/ON switch on the left hand side of the front panel. Immediately to the right is a five level power indication display visually matching the signal strength display on the tuner below. The individual levels in the display operate at power levels of 0.1



watts, 0.2 watts, 1.5 watts, 20 watts and 80 watts peak power into 8 ohms. The display is located in a parallel position to the tuner's signal sensitivity display. These power levels are for both channels and not for just a single channel.

Immediately to the right of the power display is a seven band graphic equaliser providing ±10 dB boost or cut with centre frequencies of 40 Hz, 125 Hz, 330 Hz, 1 kHz, 2.5 kHz, 6.3 kHz and 16 kHz. Each of these controls covers one and a half octaves. Consequently they are reasonably broad but a trifle insensitive in terms of their frequency equalisation characteristic. This is all the more apparent when they are compared audibly with the performance of a more conventional third-octave, half-octave or even single octave graphic equaliser.

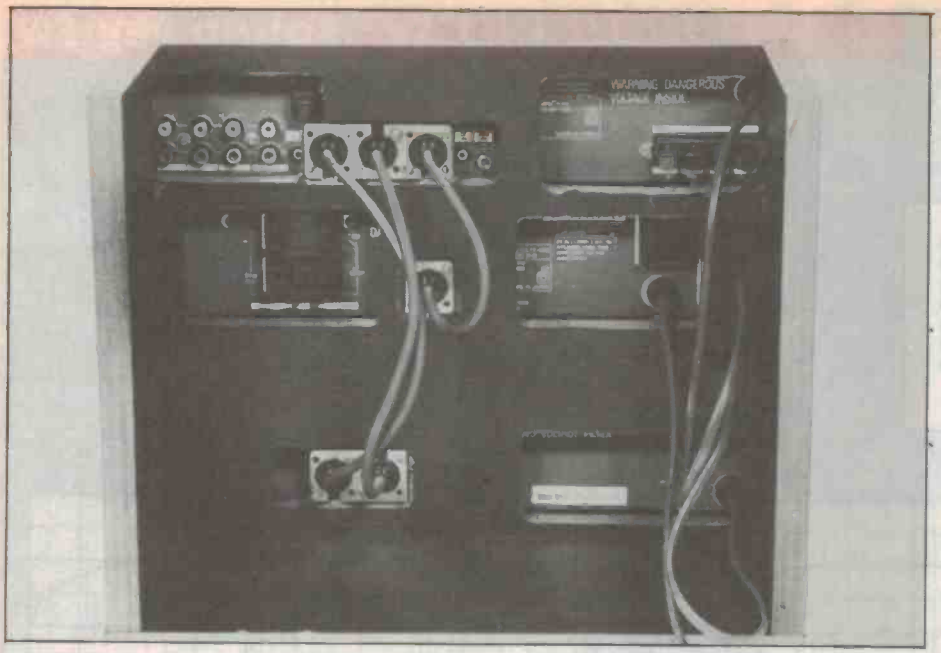
Although I acknowledge that I was initially critical, in practical usage there is more method in the designer's madness than might appear at first sight. The centre frequencies of the 40 Hz and 16 kHz equalisers should however, ideally be higher and lower in operating frequency respectively, even though they do provide functional performance.

In the centre of the integrated amplifier's front panel are five input control switches for the selection of the inputs to the amplifier. These are double width controls for the cassette recorder labelled TAPE at the top, a combined TUNER and PHONO input switch in the middle and CD player and AUXILIARY (input) switch on the bottom. On the right hand side of the panel is the large slider volume control. Below this are three small buttons, each separately illuminated by an LED. The first is for the graphic equaliser disabling switch, a DSL (dynamic super loudness) control and a MUTING control to provide 20 dB attenuation. Two small rotary controls are provided for BALANCE and MICROPHONE volume control and a 3.5 mm diameter ring and tip socket is provided for a low impedance microphone immediately adjacent.

Turntable

The top panel is provided with 12 mm ventilation clearance to allow the amplifier to breathe and the relatively simple linear tracking turntable sits on the top shelf.

This turntable features a well designed spring-loaded moulded clear acrylic cover and which is both neat and functional. Under the lid are two top panel controls. The first is a three position switch for ▶



45 rpm, central AUTO position and 33⅓ rpm. The second control is a DISC SIZE selector switch for 17 cm and 30 cm records.

The linear tracking tone arm is very light, moderately small and incorporates a small integrated cartridge. This arm and the cartridge are built to comply with space requirements as the prime design criterion and have to be viewed in that light.

Five long bright aluminium pushbuttons are located at the front of the turntable which from right to left are:

- the START/CUT switch;
- a traverse right and a separate traverse left button,
- a tone arm RAISE/LOWER button, and
- a REPEAT button.

Two LEDs are provided indicating OPERATE and REPEAT. The turntable has been designed for simple operation with the minimum number of controls for effective usage.

Special plugs and sockets connect directly into the back of each of the racked system components with the exception of the turntable. Its signal leads terminate in a pair of RCA colour coded coaxial sockets on the back of the amplifier together with a separate lead and plug to suit other types of amplifiers or radio receivers.

Speakers

The speakers, although neat in size and based on the current Japanese vogue of aluminium honeycomb flat speaker design, are one of the weaker links in the system. With cubic volumes of less than 13 litres, they are designed to provide useful frequency response from 120 Hz to 20 kHz. Such a frequency response limits a significant proportion of what you hear from many rock, pop and classical recordings.

Objective testing

I simplified the scope of many of the objective tests in the interests of limiting the review to a readable length. The tests which we performed still provide most of the useful data through which a comparative objective assessment can be made.

Turntable

The first piece of equipment that we evaluated was the LX-30 linear tracking turntable, the measured frequency response of which, not unexpectedly, looks almost exactly the way the unit sounds. It has a slowly rising high frequency resonant response which is +3 dB in the right channel and +5 dB in the left channel. This peak extends over the range 8 kHz to 16 kHz, and the response subsequently drops off thereafter. The lower end of the spectrum is reasonably flat and the amplifier and speakers do not make effective use of the low frequency response of the cartridge.

The channel separation is better than I would have expected providing up to 25 dB over most of the range in the right channel, and is significantly better in the left channel. The reason for this difference in separation between the two channels relates entirely to the 'anti-skating non-linearity' characteristics of the linear tracking tone arm.

The tone arm resonates at around 12 Hz and any frequency content around that region (which is typically produced by warped records) may result in a somewhat 'murky' sound. The tone arm mechanism is a trifle noisy when starting, stopping or traversing under manual control and this normally necessitates the closure of the lid for the quietest results.

Amplifier

The amplifier provides a peak output of 39 watts per channel into 8 ohms and exhibits moderately low distortion characteristics over most of the range until the onset of clipping. At signal input levels higher than 600 millivolts into either the auxiliary input and the CD input, the distortion level rises rapidly and the otherwise excellent distortion characteristics of the system fall down rather badly. This may be a minor oversight in the system design but which, consequently, makes the unit less suitable for use in conjunction with a CD player than might otherwise be the case. The amplifier does, however, function quite well with the other three input sources already provided. With CD (and auxiliary) input levels held down to 600 millivolts, the distortion characteristics of the CD and auxiliary input channels are excellent, right up to 'CD performance' criteria.

Tuner

The tuner provides good sensitivity, providing better than 30 dB signal-to-noise ratio for 10 dBf input signals, with an ultimate signal-to-noise ratio of greater than 70 dB at 65 dBf. In the mono mode the 30 dB signal-to-noise ratio is provided at 7 dBf which is also relatively good. The frequency response in the FM mode is 45 Hz to 13 kHz +1 −3 dB with a good channel separation of greater than 37 dB in the 1 kHz to 5 kHz region.

In the AM (mono) mode the frequency response is 50 Hz to 3.3 kHz +0 −6 dB and the bandwidth is only slightly better than your existing local telephone line. The AM sensitivity could not be readily measured because of the need to retain the AM loop antenna as part of the tuned input circuit. The subjective evaluation of the AM tuner sensitivity showed it to be above average.

Cassette player

The cassette player provides a good performance, the characteristics of which varied only slightly when Dolby noise reduction was selected. The replay response with Maxell UDXL-1 Type I reference tape is 40 Hz to 12 kHz ±3 dB, which is good but not exciting and is limited by the azimuth alignment of the heads.

The record to replay response of the casette recorder is determined in part by the type of tape being used. Thus, by way of example, with Sony ES60 metal tape the frequency response is extremely flat and smooth, extending from 45 Hz to 17 kHz +0 −3 dB, with Dolby out at −20 VU. With Sony HF-ES60 Type I tape and with Dolby out, the frequency response extends from 45 Hz to 17 kHz ±3 dB although with a not quite flat repsonse curve. Similarly with Dolby C selected, the frequency response extends from 57 Hz to 16 kHz 63 dB.

These record to replay frequency responses are particularly good considering the simplicity of the circuitry. I gained an impression that there is some similarity between the low frequency droop characteristics provided by a cassette player and the FM tuner which may have been intentional and may have been incorporated to protect the speakers from high level low frequency signals.

Speakers

The on-axis frequency response of the loudspeakers was measured in our anechoic room. This response is not particularly smooth, although it is generally within ±10 dB from 100 Hz to 20 kHz. The measured response exhibits one significant notch at 730 Hz and an unusual peak in the response at 2.2 kHz, neither of which are associated with cross-over frequency. Apart from those features, the response is acceptable and is also achieved with reasonable sensitivity at two metres (88 dB for one watt at one metre at 1 kHz).

Subjective testing

I left a number of critical evaluations to the subjective testing. This was performed using a wide range of test and demonstration material to reveal even more information than the objective assessment.

I started my evaluation of the turntable characteristics with the Shure TTR 115 trackability test record and determined that the cartridge is able to cope reasonably well with peak velocities up to 25cm/s with orchestral bells, flute and harp. This corresponds to the 4th level in a five level scale. The cartridge complains loudly and clearly when subjected to any significant warp or modulation components in the frequency range 10 to 14 Hz.

When evaluated with the Swedish Hi-Fi Institute LJUD test record, it coped particularly well with a track which contains unusually high levels of low frequency signal. This particular track has generally resulted in significant audible distress when testing other cartridges, quite apart from the associated amplifiers and speakers.

Two other records, Ultragroove UG-9001 "The Digital Fox — Volume One" by Virgil Fox (which was the first digital recording made in the United States and contains a repertoire of wide-ranging organ music) and CBS 86122 "Guilty" (a half speed mastered extended range recording) by Barbra Streisand and Barry Gibb, confirmed that the record player cartridge produces far too much emphasis of the speech sibilants and this necessitates the judicious use of the 16 kHz graphic equaliser to provide some degree of high frequency cut.

The low frequency performance of the amplifier and speakers is reasonable but by no means outstanding. These evaluations also confirmed that at least 5 dB of boost was required with the 40 Hz graphic equaliser to provide a more realistic and acceptable low frequency sound. Taken overall, the record player is fair but by no means exceptional.

I listened to a wide range of both FM stereo and AM programmes using the tuner and found that the subjective performance of the FM tuner is excellent, although I was concerned about both the tuning sequence and accuracy of tuning indication. Once a station is logged with the memory, this is no longer a problem, but until you have logged it, you don't necessarily know without station identification which station you are logging.

The cassette player is by far the most exciting of the components in the system, proving to be an absolute delight to use. It offers features that I wish my current rack of equipment could emulate. The ability to select any one of the other source inputs, and instantly switch into the record mode at the push of a single button, is a wonderful innovation and this will unquestionably endear this system to its future users.

Again the ability to switch from one system component to another on replay, just by activating one of the major controls on the tuner or cassette player, was equally attractive and this is the first system that I have seen that provides this unusual and extremely sensible capability. I evaluated the cassette player with both non-Dolby, Dolby B and Dolby C pre-recorded cassettes and found that the performance was excellent on the pre-recorded material and even better on record to replay.

Although the SX-F6 speakers are small, neat and theoretically 'high-tech', I would have been far happier, and much more at ease, with the total system if offered a better low frequency performance (ie down to 70 Hz instead of only 110 Hz). I believe that an extra two-thirds of an octave would make all the difference when listening to the latest generation of records, tapes and even FM stereo broadcasts, which do provide excellent performance (even if displaying too much compression on some of the best known stations near the top of the band).

If Aiwa is prepared to offer the V-800 series with an alternative (and larger) speaker, or if the dealer is prepared to sell you the system with better speakers, this would close off the one performance 'loophole' that worried me more than the rest.

The Aiwa V-800 series system almost provides 'true hi-fidelity' even though it does not contain the best of Aiwa's components, nor necessarily the best of this manufacturer's technology. It does, however, offer a degree of operational flexibility, convenience and ergonomic design features which are attractive enough to warrant a much closer inspection than this review might otherwise indicate from both my comments or my criticism.

With a few refinements in the speaker/cartridge characteristics, supplemented by the optional offer or purchase of larger speakers (and not forgetting the question of CD input sensitivity), this review would be much more favourable.

At a selling price of $1749, the V-800 series is, however, well suited for use as a 'second system' or as a 'first purchase' for a buyer on a very limited budget. ●

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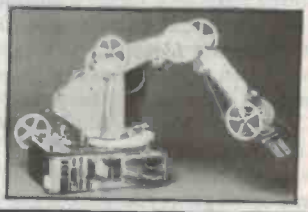

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Model: FP42
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Input	Line	Microphone	Output Mix Bus	Phones	Phones (Cue)
Low-Impedance microphone	90 dB	40 dB	25 dB	100 dB	100 dB
Line	40 dB	−10 dB	−25 dB	50 dB	50 dB
Mix Bus	55 dB	5 dB	–	62 dB	65 dB

Noise: Equivalent input noise: less than −129 dBV
Distortion: Under 0.4% THD from 30 to 20,000 Hz at +15 dBm ouput; under 0.5% IM distortion up to +15 dBm output level
Input Clipping Level: Microphone: −35 dBV to −5 dBV
Line: +15 dBV to +45 dBV
Mix Bus: 0 dBV
Output Clipping Level' Microphone: −33 dBV
Line: +17 dBV
Limiter: Threshold: +8 to +14 dBm, adjustable
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Recovery Time: 500 msec typical
Peak Indicator: Lights 7 dB below 5% THD clipping point or at limiter threshold. Separate indicator for each output
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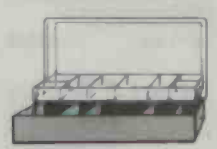

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X11020 Bare Case $95
X11022 Case & Pwr Supply $159
Dual 8" Slimline Drive Case
X11025 Bare Case $99
X11026 Case & Pwr Supply $275

ETI BOOKS

Scanner's World	$5.95
Computer Projects Vol.1	$5.95
Lab Notes and Data	$7.95
Electronics It's Easy Vol.1	$5.95
Electronics It's Easy Vol.2	$5.95
Test Gear Vol.1	$3.00
Test Gear Vol.2	$3.95
Test Gear Vol.3	$4.95
Top Projects Vol.5	$3.00
Top Projects Vol.6	$4.95
Top Projects Vol.7	$3.95
Top Projects Vol.8	$4.95
Top Projects Vol.9	$4.95
Top Projects Vol.10	$5.95
ETI Circuits Vol.1	$2.95
ETI Circuits Vol.2	$2.95
ETI Circuits Vol.3	$2.95
ETI Circuits Vol.4	$2.95
30 Audio Projects	$3.95
Audio Projects from ETI	$5.00
Simple Projects Vol.2	$2.95
Simple projects Vol.3	$5.95
Circuit Techniques Vol.1	$4.75
Circuit Techniques Vol.2	$4.75
Circuit Techniques Vol.3	$4.95
Circuit Techniques Vol.4	$5.95
How to Build Electronic Games	$3.95
Electronic Projects for Cars	$3.95
Project Electronics	$4.75
Radio Experimenters Handbook	$7.95
Electronics Projects for Young Scientists	$3.95
Computers and Computing Year Book	$4.95
Computers and Computing Vol.3	$4.95
Computers and Computing Vol.4	$5.95
How to Build Gold and Treasure Detectors	$3.95
Electronics and Music	$5.95

IBM* COMPATIBLES from $1,495!

Incredible deals to suit everyone including our special package deals!

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. only $1,495

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty only $2,100

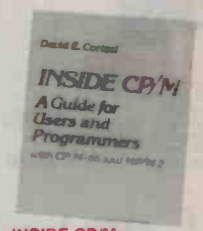
256K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer and a monochrome monitor and 3 months warranty! only $2,400

640K PACKAGE DEAL: Includes Colour Graphics Card, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports. A 120 C.P.S. printer, a monochrome monitor and 3 months warranty! only $2,500

*IBM is a registered trademark

CICADA 300
- 300 baud
- Provides full 12V bipolar output signal
- Direct connect modem
- Full duplex operation

(Phone not included)
Cat. X19101 NOW $179



INSIDE CP/M
A Guide for users and programmers with CP/M-86 and MP/M2, by David Cortesi.
This book is both a guide and a reference manual for CP/M, an operating system for small computers. The book has two sections. The Tutorial presents the basics of the management, use, and programming of a small computer and CP/M. In the Reference, CP/M information is organised for quick access by programmers and users.
$47.50

QUARTZ CRYSTAL CLOCK MOVEMENT
- Very compact and reliable.
- Self starting one second stepping.
- Stepping motor has stronge torque
- Powered by 1.5V AA battery that lasts approximately a year.
- Supplied with two sets of hands, one short and one long.
- +15 seconds/month accuracy.
- 56mm square, 15mm deep.

Complete with data sheet, instructions and wall hanger bracket
Cat. X90100 $14.95

MITSUBISHI DISK DRIVES
MF353 (3 1/2" DRIVE)
Double sided, double density, 1 M/Byte unformatted, 80 track per side.
Cat. C11953 $280
MF351
3 1/2" Standard size disk drive. Single sided, double density.
Cat. C11921 $225
M2896-63
Slimline 8" Disk Drive, Double sided Density No AC power required. 3ms track to track. 1.6 Mbytes unformatted, 77 track side 10s/su10 bit soft error rate.
Cat. C11916 $550
Case & Power Supply to suit
Cat. X11022 $159
M4854
Slimline 5 1/4" disk drive. Double sided, double density, 96 track/inch, 9621 bit/inch, 1.6Mbyte unformatted 3ms track to track access, 77 track/side.
Cat. C11904 $350
Case & Power Supply to suit
Cat. X11011 $109
M4853
Slimline 5 1/4" disk drive, Double sided, double density, 1 Mbyte unformatted, 3ms track to track, 80 track/side, 5922 bits/inch.
Cat. C11903 $260
M4851
Slimline 5 1/4" disk drive. Double sided, double density 500K unformatted, 40 track/side. Steel band drive system.
Cat. C11901 $199
Case & Power Supply to suit
Cat. X11011 $109
M4855
Slimline 5 1/4" disk drive, double sided, double density, 96 track/inch 2.0 Mbytes unformatted.
Cat. C11905 $385

Rod Irving TOP 40 Kits

EA AM STEREO DECODER

AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system.
(EA Oct '84) 84MS10
Cat. K84100 **$27.50**

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz 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) 82AO3A/B)
Cat. K82040
Cat. K82041 **$109**

CYLON VOICE

Have your voice transformed into that of the sinister sounding Cylons. Great fun and scary! (EA Jan '81)
Cat. K80012 **$19.95**

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 or headphones. (EA Nov '83) 83MA11
Cat. K83110 **$14.95**

EPROM PROGRAMMER

If you have ever wanted to rewrite or extend the operating system of your microcomputer or if you're interested in dedicated microprocessor applications then this EPROM Programmer is just the thing. It is an inexpensive unit that uses readily available IC's, interfaces directly to the expansion bus on the back of all the popular 8080/Z80 microcomputers and programs 2708's, 2716's, 2758's and 2732's. (EA July '80) 80PP71
Cat. **$79.50**
(Horwood case supplied)

EFFECTS UNIT

An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.
(EA June '83) 83GA6
Cat. K83060 **$75.00**

CUDLIPP CRICKET

A fascinating Electronic Cricket with just two ICs. The Cudlipp can be used to bug your home, office etc! Great fun! (EA Feb '82) 82EG2
Cat. K82022 **$12.00**

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) 83PS5
Cat. K83050 **$149**

1W AUDIO AMPLIFIER

A low-cost general-purpose 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov '84)
Cat. K84111 **$9.95**

30 V/1 A 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 volatage and current metering is provided. (ETI Dec '83) ETI 162
Cat. K41620 **$52.50**

TEMP PROBE

Can measure temperature from -50 to 150-c. It simply plugs into your multimeter - great for digital multimeters. Accuracy of 0.1 c resolution of 0.1-c
(ETI June 83) ETI 153
Cat. K41530 **$27.50**

VIDEO ENHANCER

100's SOLD

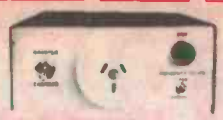
Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct '83) 83VE10
Cat. K83100 **$39.50**

VIDEO AMPLIFIER

Bothered by smeary colours, signal beats and RF interference on your computer display? Throw away that cheap and nasty RF modulator and use a direct video connection instead, it's much better! The Video Amplifier features adjustable gain and provides both normal and inverted outputs. Power is derived from a 12V DC plugback supply.
(EA Aug '83) 83VA8
Cat. K83081 **$17.95**

LOW OHMS METER

How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov '81) ETI 158
Cat. K41580 **$39.50**



40 W INVERTER

This 12 240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May '82) 82IV5
Cat. K82050 **$57.50**

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 **$89**

15V DUAL POWER SUPPLY

This simple project is suitable for most projects requiring a dual voltage. (ETI 581, June '76)
Cat. **$19.50**

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 **$27.50**

VOICE OPPERATED RELAY

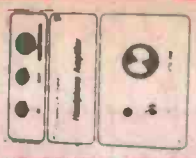
EA's great Voice Operated Relay can be used to control a tape recorder, as a VOX circuit for a transmitter or to control a slide projector. (EA Apr '82) 82VX4
Cat. K82043 **$17.95**

100W SUB-WOOFER AMPLIFIER

Capable of up to 120 watts RMS into 4 ohm loads and up to 80 watts RMS into 8 ohm loads, this power amplifier module has been specifically designed for use as a sub-woofer driver amplifier in a tri-amped hi-fi system. It uses four power Mosfets for rugged, reliable operation. (EA July '82) (82PA7)
Cat. K82075 **$97.50**

MICROBEE SERIAL-TO-PARALLEL INTERFACE

Most microcomputers worth owning have an 'RS232' connector, or port, through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel "Centronics" interface printers. Save money by building this interface. (ETI Jan '84) ETI 675
Cat. K46750 **$59.00**



HEADPHONE AMPLIFIER

PRACTICE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb '84) 83MA11
Cat. K83011 **$29.95**

300 BAUD DIRECT CONNECT MODEM

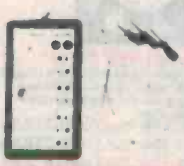
Modem? What do I want with a modem? Think of these advantages:

- Can't afford a floppy disc? Use your telephone to access one for the cost of a call.
- Bored with your old programs? Download hundreds of free programs.
- Want to get in touch with fellow computer enthusiasts? Use 'electronic mail'.
- Ever used a CP/M system? CP-DOS? UNIX? Well a modem will make a your computer a remote terminal on some of the most exciting systems around.

Save on ready built modems.
Cat. K97050 **$99**

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**



TRANSISTOR TESTER

1000's SOLD

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 **$17.95**

ELECTRONIC WATT METER

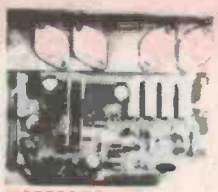
This unit will measure the power consumption of any mains appliance with a rating up to 3 kilowatts. It makes use of a special op amp called an 'output transconductance amp' or OTA, for short.
(EA Sept. 83) 83WM8
Cat. K83082 **$89.95**

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. **$19.95**

ZENER TESTER

A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.
(ETI May '83) ETI 164
Cat. K41640 **$9.95**



MOSFET POWER AMPLIFIER

Employing Hitachi Mosfets, this power amplifier features a 'no compromise' design, and is rated to deliver 150 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion.
ETI 477 (ETI Jan. '81)
(Single module only)
Cat. K44770 **$79.50**
Plus power supply (No trans) $49
Plus transformer PF4361/1 $49.50

PARALLEL PRINTER SWITCH

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 666, Feb. '85)
Cat. K46660 **$69.95**

BIPOLAR PROM PROGRAMMER

Every digital workshop should have one! Can be used to program the popular fusible-link PROMS like the 74S188/288, 82S23 & 82S123 etc
(ETI June '83) ETI 688
Cat. K46880 **$49.50**

ELECTRIC FENCE

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automative ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept. '82) 82EF9
Cat. K82092 **$19.50**

FAIR DINKUM RS232 FOR MICROBEE

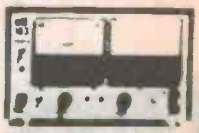
The Microbee, among other home computers, has a "sort of RS232 port in that it doesn't implement negative-going portion of its ouput signal (TxD). Most peripherals with an RS232 input can cope with that, but inevitably, there are those that can't. This project fixes that.
(ETI 676, ETI FEB '84)
Cat. K67680 **$34.95**

PHONE MINDER

Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. '84) 84TP2
Cat. K84021 **$27.50**

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 get 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.
(81AO10) (EA Oct '81)
Cat. K81101 **$47.50**



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. K41630 **$182.50**

300W "BRUTE" AMPLIFIER

The "Brute" develops 300W into 4 ohms, 200W into 8 ohms!
For many audio applications there's no substitue for sheer power - low efficiency speakers, outdoor sound systems, or maybe you like the full flavour of the dynamic range afforded by a high power amp. Whatever your requirement - this "super power" module should fill the bill. (ETI 466) (ETI Feb '80)
Cat. K44660 **$89.95**
(Heatsink not included)

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 your early warning of power failure, and makes a handy beginner's project.
(ETI 280, March '85)
Cat. K42800 **$7.95**

MOTORCYCLE INTERCOM

OVER 300 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 **$45.00**

LOW-COST BIPOLAR MODEL TRAIN CONTROLLER

Here is a simple model train control for those enthusiasts who desire something better than the usual rheostat control. It provides much improved low speed performance and is fully overload protected, yet contains relatively few components. Best of all, you don't need to be an electronic genius to construct it. (80TC12) (EA Dec '80)
Cat. K80120 **$39.95**

Rod Irving Electronics, No.1 for components!

QUALITY LEDS

Cat. No.	Description	Price
Z10140	3mm Red	$0.20
Z10141	3mm Green	$0.30
Z10143	3mm Yellow	$0.30
Z10145	3mm Orange	$0.30
Z10150	5mm Red	$0.15
Z10151	5mm Green	$0.30
Z10152	5mm Yellow	$0.30

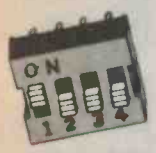
NEW!

12 WAY TERMINAL BLOCKS

P18050	240V 10AMP	$1.50
P18052	240V 15AMP	$1.75

CANON TYPE CONNECTORS

Cat. No.	Description	Price
P10960	3 pin line male	$3.90
P10962	3 pin chasis male	$3.00
P10964	3 pin line female	$4.20
P10966	3 pin chasis female	$4.50



DIP SWITCHES

Cat.No.	Description	Price
S13402	2 Way	$1.50
S13404	4 Way	$1.70
S13405	5 Way	$1.90
S13406	6 Way	$2.30
S13407	7 Way	$2.40
S13408	8 Way	$2.50
S13410	10 Way	$3.00

TOGGLE SWITCHES

Cat.No.	Description	Price
S11009	SPST mini	$1.20
S11010	SPDT econ mini	$1.25
S11020	DPDT econ mini	$1.50
S11025	C/Off econ mini	$1.50
S11030	DPDT C/Off econ	$1.95
S11034	4PDT mini	$6.95
S11036	SPST std 125V 3A	$1.30

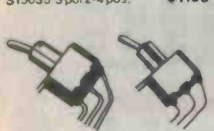
QUALITY MOMENTARY (RED BODY)

SPDT Cat. S11050

$1.50 $1.40

ECONOMY ROTARY SWITCHES

Cat.No.	Description	Price
S13021	1 pol 2-12 pos.	$1.95
S13022	2 pol 2-6 pos.	$1.95
S13033	4 pol 2-3 pos.	$1.95
S13035	3 pol 2-4 pos.	$1.95



QUALITY RIGHT ANGLE TOGGLE SWITCHES

S11040 S.P.D.T. RA PCB $1.50

S11042 D.P.D.T. RA PCB $1.60

10,000uF 75V ELECTROS

25% more microFarads! Ideal for those who want a more powerful amp!

	1-9	10+
Cat. R16587	$10.50	$9.00

IC SOCKETS (LOW PROFILE)

How cheap can they go?

	1+	10+	100+	1000+
8 Pin Cat.	15c	14c	12c	09c
14 Pin Cat.	16c	15c	14c	10c
16 Pin Cat.	17c	16c	15c	11c
18 Pin Cat.	18c	17c	16c	13c
20 Pin Cat.	29c	28c	27c	26c
24 Pin Cat.	35c	33c	32c	28c
40 Pin Cat.	45c	40c	35c	30c

ECONOMY TRANSFORMERS

	1-9	10+
2155 Cat. M12155	$6.75	$5.95
2156 Cat. M12156	$9.50	$8.95
2851 Cat. M12851	$4.50	$3.60
6672 Cat. M16672	$9.95	$9.30
2860 Cat. M12860	$3.95	$3.80

NEW TRANSFORMER!

240V to 15V C.T. at 250 mA

Cat No. M12860

1-9 $3.95 10+ $3.80

RCA GOLD PLATED PLUGS AND SOCKETS

For those who need the ultimate in connection. Essential for laser disc players to get that fantastic sound quality.

Plug Cat. P10151 $2.95

Socket Cat. P10150 $2.25

50% OFF THESE PRICES! THIS MONTH ONLY!

D CONNECTORS

Cat. No.	Description	Price
P12166	9 pin Plug Crimp	$ 9.50
P12167	9 pin Skt Crimp	$ 9.95
P12168	15 pin Plug Crimp	$10.95
P12169	15 pin Skt Crimp	$11.95
P12170	25 pin Plug Crimp	$12.95
P12171	25 pin Skt Crimp	$13.95

BREADBOARDS

Cat. No.	Description	Price
P11000	100 Holes	$ 2.75
P11005	640 Holes	$10.75
P11007	640+100 Holes	$13.00
P11009	640+200 Holes	$17.50
P11010	1280+100 Holes	$19.95
P11011	1280+300 Holes	$32.50
P11012	1280+400 Holes	$36.75
P11015	1920+500 Holes	$57.50
P11018	2560+700 Holes	$64.95

RS232 & 'D' TYPE CONNECTORS

PART	DESCRIPTION	CAT. No.	1-9	10+
DE 9P	9 Pin Female	P10880	$1.75	$1.60
DE 9S	9 Pin Male	P10881	$2.25	$2.45
DE 9C	9 Pin Cover	P10992	$2.55	$2.45
DA 15P	15 Pin Male	P10894	$2.10	$1.95
DA 15S	15 Pin Female	P10895	$2.25	$2.10
DA 15C	15 Pin Cover	P10892	$1.15	$1.05
DB 25P	25 Pin Male	P10900	$1.95	$1.80
DB 25S	25 Pin Female	P10901	$2.95	$2.70
DB 25C	25 Pin Cover	P10902	$1.20	$1.10

IC SPECIALS!

	1-9	10+	100+
4116	$1.80	$1.70	$1.80
4164	$1.95	$1.75	$1.70
2718	$5.90	$5.50	$5.50
2732	$5.25	$4.95	$4.50
2764	$6.25	$5.95	$5.00
27128	$7.00	$6.50	$6.25
6116	$2.50	$2.25	$1.95
41256	$7.00	$6.50	$6.00
6264	$7.00	$6.50	$6.00

MSM5832 BACK IN STOCK!

1-9 $12.50 10+ 11.50

NEW IC's

	1-9	10+
MCS2400	$ 4.90	$ 4.75
41256	$ 9.00	$ 8.00
27128	$ 7.00	$ 6.50
74LS169	$ 2.50	$ 2.40
AY-3-1050	$12.50	$11.95
WD2791	$69.00	$67.00
WD2793	$69.00	$67.00
WD2795	$69.00	$67.00
WD2797	$69.00	$67.00
LM11CN	$ 2.95	$ 2.75
LM1871	$ 5.95	$ 5.75
LM1872	$ 5.95	$ 5.75
Z80ADART	$13.50	$12.95
LM338K	$10.60	$ 9.50
AMI53530	$24.95	$23.95
AM7910 (World Modem Chip)	$49.50	$45.00
UPC1031 R.F. Module	$19.50	
57716	$64.95	$59.95
27256	$69.00	$59.00

WE'RE OVERSTOCKED!

IC SPECIALS! 8000 SERIES

	1-9	10+
8085	4.50	3.50
8212	1.50	1.40
8216	1.50	1.40
8226	1.70	1.50
8243	4.50	3.90
8251	3.90	3.50
8253	3.50	3.30
8255	2.90	2.50
8257	3.50	3.10
8259	3.50	3.10
8279	3.50	3.10
2532	7.50	6.90
2764	5.50	5.10
27128	7.50	6.90
1488	.55	.45
1489	.55	.45

CERAMICS 50V

In handy packets of 100.

Description	Price
1pF - 2.2nF	$2.20
3.3nF - 10nF	$2.50
22nF - 47nF	$2.90
100nF	$7.00
220nF	$9.50

Plus 30% sales tax

ROD IRVING ELECTRONICS

425 High Street, NORTHCOTE, 3070
VICTORIA, AUSTRALIA
Phone (03) 489 8866

48 A'Beckett St, MELBOURNE, 3000
VICTORIA, AUSTRALIA
Ph. (03) 663 6151

Mail Order and correspondance:
P.O. Box 620, CLAYTON 3168
TELEX: AA 151938

MAIL ORDER HOTLINE (03) 543 7877 (2 lines)

POSTAGE RATES

$1-$9.99	$2.00
$10-$24.99	$3.00
$25-$49.99	$4.00
$50-$99.99	$5.00
$100-199	$7.50
$200-$499	$10.00
$500 plus	$12.50

This is for basic postage only. Comet Road freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included "free"!

Registered Post for orders over $200 included "free"!

MasterCard VISA

Errors and Omissions Excepted.

SPECTROL 43P

Equiv (Bourns 3006)

Great for precision work.

R14200	10R	R14290	10K
R14210	20R	R14300	20K
R14220	50R	R14310	50K
R14230	100R	R14320	100K
R14240	200R	R14330	200K
R14250	500R	R14340	500K
R14260	1K	R14350	1M
R14270	2K	R14360	2M
R14280	5K		

1-9 $1.75 10+ $1.50

NEW JOINABLE PCB MOUNTING SCREW TERMINALS

Less than half the price of the old ones!

	1-9	10+
2 Way Cat. P10542	$0.50	$0.40
3 Way Cat. P10543	$0.75	$0.65

(please note these are the new blue ones)

XENON/STROBE TUBES

As used in projects or as replacements

Cat. M14050 $2.95

LOG SLIDES POTS

We ordered log instead of linear for the graphic equalizer, so take advantage of our mistake!

1-9	10+	100+
$0.65	$0.60	$0.50

TRIGGER TRANSFORMERS

Cat. M10104 $1.20

RELAY AND BASE

Can carry 10A at 28V DC or 5A at 240V AC. Supplies with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.

Normally $8.95

Cat. S14074 NOW $6.95

MINI JUMPERS

- Contact terminal: Phospor bronze
- Material: P.B.T. 94V-0
- Gold plated

Qty	Cat. No.	Price
10	P12053	$ 2.95
25	P12055	$ 4.95
100	P12057	$21.95

10 TURN WIRE WOUND POTENTIOMETER

Spectrol Model 534

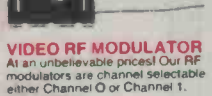
1/4" shaft.

Equiv (Bourns 3540S, Beckman 7256)

Dials to suit 16-1-11, 18-1-11, 21-1-11.

R14050	50R	R14100	5K
R14055	100R	R14110	10K
R14060	200R	R14120	20K
R14070	500R	R14130	50K
R14080	1K	R14140	100K
R14090	2K		

1-9 $9.50 10+ $8.50



VIDEO RF MODULATOR

At an unbelievable prices! Our RF modulators are channel selectable either Channel O or Channel 1.

Cat. S16040

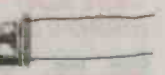
1-9 $4.95 10+ $3.95

Back in stock!!

TDK LINE FILTERS

240 V 3A

Cat $12.50



CRYSTALS SPECIALS

Prime Spec's. We just have too many in stock!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$7.50	$6.50
1.8432MHz	Y11003	$7.50	$6.50
4MHz	Y11020	$2.50	$2.00
4.194304MHz	Y11022	$2.50	$2.00
4.433618MHz	Y11023	$2.50	$2.00
4.75MHz	Y11025	$2.50	$2.00
4.915200MHz	Y11026	$2.50	$2.00
5MHz	Y11030	$2.50	$2.00
6MHz	Y11040	$2.50	$2.00
6.144MHz	Y11042	$2.50	$2.00
6.670MHz	Y11045	$2.50	$2.00
8MHz	Y11050	$2.50	$2.00
8.867238MHz	Y11055	$2.50	$2.00
10MHz	Y11060	$2.50	$2.00
12MHz	Y11070	$2.50	$2.00
14.31818MHz	Y11072	$2.50	$2.00
15MHz	Y11075	$2.50	$2.00
18MHz	Y11082	$2.50	$2.00
18.432MHz	Y11085	$2.50	$2.00
20MHz	Y11090	$2.50	$2.00

50% OFF THESE PRICES! THIS MONTH ONLY!

CENTRONICS

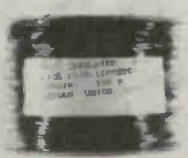
Cat. No.	Description	Price
P12200	36 way plug IDC	$12.50
P12201	36 way skt IDC	$13.50
P12203	50 way plug IDC	$14.50
P12204	50 way skt IDC	$15.50
P12207	24 way solder plug	$12.90
P12210	36 way solder plug	$ 9.50
P12211	36 way skdr line skt	$15.95
P12213	36 way skdr chss skt	$15.95

FUSE SPECIAL 3AG

Two values, 3 Amp and 1 Amp

1-99	100-999	1000+
8c each	6c each	5c each

STOCK UP NOW



HOOK UP WIRE

Cat. No.	Description
W11251	13/.12 TND BLK
W11252	13/.12 TLD BROWN
W11253	13/.12 TLD ORANGE
W11254	13/.12 TLD YELLOW
W11255	13/.12 TLD GREEN
W11256	13/.12 TLD BLUE
W11257	13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

1-9 $5.95 10+ $5.00

W11260 14/.20 RED
W11261 14/.20 BLACK
W11265 14/.20 BLUE
W11268 14/.20 WHITE

PRICES PER 100 METRE ROLL

1-9 $12.00 10+ $10.00

W11270 24/.20 RED
W11272 24/.20 BLACK
W11274 24/.20 GREEN

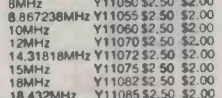
PRICES PER 100 METRE ROLL

1-9 $14.00 10+ $12.00

W11280 32/.2 BROWN
W11282 32/.2 BLUE

PRICES PER 100 METRE ROLL

1-9 $20.00 10+ $18.00



IDC SOCKETS

Cat. No.	Description	Price
P12100	10 pin IDC socket	$4.95
P12101	16 pin IDC socket	$5.50
P12102	20 pin IDC socket	$5.95
P12103	20 pin IDC socket	$6.95
P12104	34 pin IDC socket	$7.95
P12106	34 pin IDC socket	$7.95
P12108	40 pin IDC socket	$8.95
P12110	50 pin IDC socket	$9.95

ELECTRET MIC INSERTS

With pins for easy board insertion.

Cat. C10170

1+	10+	100+
$1.25	$1.10	$1.00

RELAYS

Massive 3A connectors

1-9	10+	100+
S.P.D.T. S14060		
$1.20	$1.10	$0.90
D.P.D.T. S14061		
$1.50	$1.40	$1.20

TRANSISTORS

Desc.	10-99	100+	Desc.	10-99	100+
2SJ49	4.50	4.30	2SK134	4.50	4.30
PN2222A	.10	.08	PN2907A	.10	.08
PN3463	.15	.13	PN3565	.12	.11
PN3566	.15	.13	PN3567	.10	.08
PN3569	.18	.16	PN3639	.18	.16
PN3640	.18	.16	PN3641	.10	.08
PN3642	.10	.08	PN3643	.10	.08
PN3644	.15	.13	PN3645	.15	.13
PN4250A	.15	.13	PN4355	.16	.14
PN4356	.16	.14	MPSA42	.23	.20
MPSA43	.23	.20	MPSA55	.15	.14
MPSA56	.15	.14	MPSA92	.22	.20
MPSA93	.22	.20	SC1410	.85	.75
BU126	1.50	1.25	BUX80	2.50	2.20
BU208	2.50	2.20	2SD350	2.75	2.40
BU326	1.95	1.70			

Plus 30% tax where applicable

RCA INSULATING SOCKETS

Cat No.	Desc.	1-99	100+
P10232	2 Way	0.25	0.21
P10234	4 Way	0.45	0.40
P10236	6 Way	0.75	0.60

Plus 30% tax where applicable

RCA CHASSIS MOUNT METAL

Cat No.	1-99	100+
P10231	0.16	0.13

Plus 30% tax where applicable

MINIATURE BUZZER

5-15V White or black.

Cat. A15062	10-99	100+
	0.90	0.80

Plus 20% tax where applicable

ADD ON DISK DRIVE FOR 6502 SYSTEM (APPLE* COMPATIBLE)

1-9	10-24	25+
$150	$140	$130

(*Apple is a registered trademark)

IBM ADD ON HARD DISK

- 10 Mbyte
- Seagate hard disk
- Hard disk controller by Xebec

Cat. X20010 $1295

Plus 20% tax where applicable

MITSUBISHI DISK DRIVES

		1-9	10+	25+
4851	5¼"	$160	$150	$140
4853	5¼"	$220	$205	$175
4854	5¼"	$250	$220	$195
2896	8"	$475	$430	$400

Plus 20% tax where applicable

AXIAL ELECTROLYTICS (DOUBLE ENDED)

Cat. No.	Description	10+	100+
R15705	0.47uF 63V	$0.12	$0.10
R15715	1uF 63V	$0.12	$0.10
R15725	2.2uF 63V	$0.12	$0.10
R15742	4.7uF 25V	$0.11	$0.09
R15745	4.7uF 63V	$0.11	$0.09
R15761	10uF 16V	$0.12	$0.10
R15762	10uF 25V	$0.13	$0.12
R15765	10uF 63V	$0.15	$0.14
R15792	22uF 25V	$0.13	$0.12
R15794	22uF 50V	$0.17	$0.15
R15812	25uF 25V	$0.13	$0.12
R15815	25uF 63V	$0.17	$0.15
R15831	47uF 16V	$0.16	$0.13
R15832	47uF 25V	$0.16	$0.13
R15835	47uF 63V	$0.22	$0.19
R15841	100uF 16V	$0.18	$0.16
R15842	100uF 25V	$0.18	$0.16
R15845	100uF 63V	$0.27	$0.24
R15851	220uF 16V	$0.17	$0.15
R15852	220uF 25V	$0.21	$0.18
R15855	220uF 63V	$0.50	$0.46
R15871	470uF 16V	$0.27	$0.24
R15872	470uF 25V	$0.29	$0.27
R15873	470uF 35V	$0.75	$0.70
R15875	470uF 63V	$0.75	$0.70
R15885	1000uF 63V	$0.60	$0.58
R15891	1000uF 16V	$0.39	$0.35
R15892	1000uF 25V	$0.45	$0.40
R15893	1000uF 35V	$0.70	$0.65
R15894	1000uF 50V	$0.00	$0.00
R15903	2200uF 35V	$1.20	$1.10
R15904	2500uF 50V	$1.30	$1.20
R15911	2500uF 16V	$0.59	$0.50
R15912	2500uF 25V	$0.95	$0.90
R15913	2500uF 35V	$1.10	$1.00
R15914	2500uF 50V	$1.30	$1.20
R15932	4700uF 25V	$1.90	$1.80
R15933	4700uF 35V	$2.40	$2.15

Plus 30% tax where applicable

RITRON II

Swivel base monitor in stylish case.

	1-9	10+	50+
Green Cat. X14506	$145	$135	$115
Amber Cat. X14508	$150	$140	$120

Plus 20% tax where applicable

MONITORS

Cat No.		1-3	4+
X14500	Ritron 1 Green	$130	$125
X14502	Ritron 1 Amber	$135	$130
	BACK IN STOCK		

Plus 20% tax where applicable

CERAMICS 50V PERIOD

	100+	500+
1pF - 2.2nF	$2.20	$2.00
3.3nF - 10nF	$2.50	$2.20
22nF - 47nF	$2.90	$2.70
100nF	$7.00	$6.50
220nF	$9.50	$8.50
330nF	$12.00	$11.00

Plus 10% tax where applicable

ELECTROLYTIC SINGLE ENDED PCB MOUNT

Cat. No.	Descr.	10+	100+
R15405	0.47uF 63V	$0.07	$0.06
R15415	1uF 63V	$0.07	$0.06
R15422	2.2uF 25V	$0.07	$0.06
R15424	2.2uF 50V	$0.06	$0.05
R15425	2.2uF 63V	$0.07	$0.06
R15432	3.3uF 25V	$0.07	$0.06
R15435	3.3uF 63V	$0.07	$0.06
R15442	4.7uF 25V	$0.07	$0.06
R15443	4.7uF 35V	$0.08	$0.07
R15445	4.7uF 63V	$0.07	$0.06
R15461	10uF 16V	$0.07	$0.06
R15462	10uF 25V	$0.07	$0.06
R15463	10uF 35V	$0.07	$0.06
R15465	10uF 63V	$0.07	$0.06
R15481	22uF 16V	$0.07	$0.06
R15482	22uF 25V	$0.30	$0.25
R15483	22uF 35V	$0.08	$0.07
R15484	22uF 50V	$0.09	$0.08
R15502	25uF 25V	$0.07	$0.06
R15505	25uF 63V	$0.10	$0.08
R15512	33uF 25V	$0.08	$0.07
R15521	47uF 16V	$0.09	$0.08
R15522	47uF 25V	$0.09	$0.08
R15525	47uF 63V	$0.10	$0.09
R15531	100uF 16V	$0.10	$0.09
R15532	100uF 25V	$0.08	$0.07
R15533	100uF 35V	$0.15	$0.12
R15535	100uF 63V	$0.24	$0.22
R15541	220uF 16V	$0.09	$0.08
R15542	220uF 25V	$0.14	$0.12
R15543	220uF 35V	$0.25	$0.23
R15545	220uF 63V	$0.26	$0.24
R15552	330uF 25V	$0.15	$0.13
R15555	330uF 63V	$0.34	$0.30
R15561	470uF 16V	$0.16	$0.13
R15562	470uF 25V	$0.23	$0.20
R15563	470uF 35V	$0.30	$0.28
R15564	470uF 50V	$0.00	$0.00
R15565	470uF 63V	$0.44	$0.39
R15581	1000uF 16V	$0.25	$0.22
R15582	1000uF 25V	$0.35	$0.30
R15583	1000uF 35V	$0.45	$0.40
R15591	2200uF 16V	$0.45	$0.40
R15592	2200uF 25V	$0.65	$0.60
R15593	2200uF 35V	$1.20	$0.91
R15601	2500uF 16V	$0.45	$0.40
R15602	2500uF 25V	$0.65	$0.60

Plus 10% tax where applicable

NOW AVAILABLE!
50 Page wholesale price list
Please call in or write to:
P.O. Box 620, CLAYTON 3168
and simply supply a business card!

UNPROTECTED STRIP HEADERS

Dual In Line 2.54mm

	1-9	10+
P12240 10 Way Unprot Header	1.25	1.10
P12246 16 Way Unprot Header	1.35	1.20
P12250 20 Way Unprot Header	1.45	1.25
P12256 26 Way Unprot Header	1.50	1.40
P12260 30 Way Unprot Header	1.75	1.65
P12264 34 Way Unprot Header	1.95	1.75
P12270 40 Way Unprot Header	2.25	1.95
P12275 50 Way Unprot Header	2.75	2.50
P12280 60 Way Unprot Header	2.95	2.75

Plus 20% Sales Tax where applicable

RESISTORS

¼ WATT E12 CARBON BULK
PACKED $5.25/1000
TAPED AND BOXED $5.25/1000
$5.00/1000 10K LOTS
¼ METAL FILM TAPED AND BOXED
$12.00/1000 $11.00/1000/10K LOT
SUPPLY E24 VALUE
Plus 30% tax where applicable

VERBATIM DATA LIFE DISKETTES

	10-99	100+	500+
SS/DD MD525-01	2.50	2.35	2.25
DS/DD MD550-01	3.20	2.50	2.40

XIDEX DISKETTES

SS/DD	2.50	2.50	2.25
DS/DD	3.40	3.05	2.85

Plus 20% tax where applicable

HORN SPEAKERS

Cat No.		1-99	100+
C12010	5" Plastic 8W Max	4.80	4.70
C12015	5" Metal 8W Max	4.70	4.60
C12012	12V Siren	8.50	8.00

Plus 20% tax where applicable

MONOLITHIC .1uF 50V

10+	100+	1000+
$0.09	$0.07	$0.06

Plus 20% tax where applicable

GREY FLAT RIBBON CABLE

			PER 100 FT ROLL			
Cat No.	Desc.	Per Mtr 1-3	4-9	10-99	100+	
W12614	14 Way	1.29	19.50	18.50	18.00	14.00
W12616	16 Way	1.90	21.50	19.50	19.00	16.00
W12620	20 Way	2.20	29.50	28.00	26.50	20.00
W12625	25 Way	2.50	32.50	29.00	28.50	25.00
W12626	26 Way	2.60	34.00	32.00	29.00	26.00
W12634	34 Way	2.80	44.00	42.00	39.00	34.00
W12636	36 Way	3.00	49.00	47.00	42.50	36.00
W12640	40 Way	3.20	55.00	52.50	49.50	40.00
W12650	50 Way	3.75	62.00	59.50	58.50	50.00

EX STOCK
LARGER QUANTITIES NEGOTIABLE
Plus 20% tax where applicable

CRYSTALS

Cat No.	Frequency	Can	10+	100+	500+	1000+
Y11000	1MHz	HC33	5.50	4.75	4.50	4.00
Y11005	2MHz	HC33	2.25	1.95	1.85	1.70
Y11008	2.4576MHz	HC18	2.25	1.95	1.85	1.70
Y11015	3.57954MHz	HC18	1.20	.90	.65	.60
Y11020	4.00MHz	HC18	1.30	.90	.75	.60
Y11022	4.194304MHz	HC18	1.40	.90	.75	.60
Y11025	4.75MHz	HC18	1.40	.90	.75	.60
Y11026	4.9152MHz	HC18	1.40	.90	.75	.60
Y11042	6.144MHz	HC18	1.40	.90	.75	.60
Y11050	8.00MHz	HC18	1.40	.90	.75	.60
Y11055	8.867238MHz	HC18	1.40	.90	.75	.60
Y11070	12.00MHz	HC18	1.40	.90	.75	.60
Y11072	14.318MHz	HC18	1.40	.90	.75	.60
Y11080	16.00MHz	HC18	1.40	.90	.75	.60
Y11085	18.432MHz	HC18	1.40	.90	.75	.60
Y11090	20.00MHz	HC18	1.40	.90	.75	.60

FULL RANGE OF CRYSTALS AVAILABLE ON INDENT
Plus 20% tax where applicable

POLYESTER 100V "GREENCAP" TYPE

Cat No.		1-99	100+	1000+
R15131	.001uF	0.06	0.04	.036
R15137	.0012uF	0.06	0.04	.036
R15138	.0015uF	0.06	0.04	.036
R15140	.0022uF	0.06	0.04	.036
R15142	.0033uF	0.06	0.04	.036
R15143	.0039uF	0.06	0.04	.036
R15145	.0047uF	0.06	0.04	.036
R15146	.0056uF	0.06	0.04	.036
R15147	.0082uF	0.06	0.04	.036
R15148	.01uF	0.07	0.05	.045
R15150	.015uF	0.07	0.05	.045
R15152	.022uF	0.07	0.05	.045
R15154	.033uF	0.07	0.05	.048
R15155	.039uF	0.07	0.05	.045
R15156	.047uF	0.08	0.06	.055
R15157	.056uF	0.08	0.06	.055
R15158	.068uF	0.08	0.06	.055
R15159	.082uF	0.08	0.07	.055
R15160	.1uF	0.09	0.08	.07
R15162	.15uF	0.11	0.10	.09
R15164	.22uF	0.15	0.14	.13
R15165	.27uF	0.16	0.15	.14
R15172	1uF	0.70	0.55	0.50
R15176	2.2u	1.20	1.10	1.00
R15178	3.3uF	1.50	1.20	

Plus 30% tax where applicable

COMPUTER CONNECTORS

Cat No.	Description	1-99	100+	1000+
P10900	DB25 Plug	1.30	1.20	1.00
P10901	DB25 Socket	1.40	1.30	1.20
P12210	Centronics Solder	3.50	3.15	2.50
P12200	Centronics Crimp	6.00	5.50	5.00
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Socket	1.40	1.30	1.00
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Socket	1.40	1.30	1.00
P10902	DB25 Cover	.80	.65	.55

Plus 20% tax where applicable

MEMORY

"Check for the latest memory prices!"

	10-99	100+	1000+	10K+
4164-15P	$2.00	$1.50	$1.30	$1.10
41256	$7.00	$6.00	$5.50	$5.00
6116P-3	$3.00	$2.90	$2.00	$1.80
2716	$4.90	$4.50	$4.25	$4.00
27128	$5.00	$4.50	$4.00	$3.50
2532	$7.50	$6.50	$6.40	$6.30
2732	$6.50	$6.10	$5.90	$5.50
27256	$29.00	$27.00	$22.00	19.00
6264	$5.50	$5.00	$4.50	$4.00

Plus 20% tax where applicable

IC's GALORE!

	1-9	10+	100+	250+
8035	3.90	3.70	3.50	3.00
8085	4.00	3.90	3.50	3.00
8088	19.00	18.00	15.00	14.00
8155	3.90	3.75	3.50	3.00
8156	3.50	3.30	2.90	2.50
8212	1.90	1.70	1.50	1.00
8224	2.40	2.00	1.90	1.50
8226	1.90	1.70	1.50	1.00
8237A	35.00	31.00		
8253	3.90	3.70	3.50	3.00
8255	4.00	3.50	2.90	2.00
8257	3.90	3.50	3.00	2.50
8259	3.90	3.50	3.30	2.70
8237A	35.00	31.00		
8279	3.90	3.50	3.30	2.70

Plus 20% tax where applicable

LOW PROFILE IC SOCKETS

How cheap can they go ??

	10+	100+	1000+	10K
8 Pin	.08	.07	.06	.05
14 Pin	.10	.09	.08	.07
16 Pin	.11	.10	.09	.08
18 Pin	.12	.11	.10	.09
20 Pin	.13	.12	.11	.10
22 Pin	.14	.13	.12	.11
24 Pin	.15	.14	.13	.12
28 Pin	.19	.17	.15	.14
40 Pin	.25	.24	.22	.20

Plus 20% tax where applicable

VOLTAGE REGULATORS

	10+	100+	1000+
7805uC	.45	.44	.43
7805KC	1.50	1.40	1.20
7812uC	.45	.44	.43
7815KC	1.50	1.40	1.20
7818uC	.50	.49	.48
7818KC	1.50	1.40	1.20
7905uC	.70	.60	.55
7912uC	.70	.60	.55
uA323KC	4.50	3.90	3.75
78H12	7.00	6.00	5.90
78HGKC	7.50	6.50	6.00
79HGKC	16.50	16.00	14.00
78P05	11.50	11.00	10.50
78P12	14.00	13.50	13.00

Plus 20% tax where applicable

BRIDGES

	10+	100+	1000+	10K+
6A 400V	1.00	0.80	0.75	0.69
W02	0.24	0.23	0.20	0.18
W04	0.25	0.24	0.21	0.19

NEW MDA3504 BRIDGE!

35A 400V	3.50	2.90	2.75	2.50

Plus 20% tax where applicable

IDC SOCKETS

	1-9	10+	100+
P12100 10 Pin Socket	1.95	1.75	1.25
P12101 16 Pin Socket	2.25	2.05	1.65
P12102 20 Pin Socket	2.45	2.25	1.90
P12104 26 Pin Socket	2.65	2.45	2.00
P12106 34 Pin Socket	2.75	2.55	2.15
P12108 40 Pin Socket	2.95	2.75	2.25
P12110 50 Pin Socket	3.50	2.95	2.50

Plus 20% Sales Tax where applicable

IDC CONNECTORS

		1-99	100+
P12114	14 Pin Dip Plug	0.60	0.50
P12116	16 Pin Dip Plug	0.65	0.55

Plus 20% tax where applicable

NEW SWITCHES

Right angle P.C.B. mounting

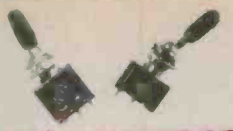
	10-99	100+
SPDT Cat. S11040	1.00	.95
DPDT Cat .S11042	1.20	1.00

Plus 20% Sales Tax where applicable

TANTALUM CAPACITORS

Cat. No.	Description	10+	100+
R16124	4.7uF 16V	$0.24	$0.18
R16125	10uF 16V	$0.25	$0.23
R16126	15uF 16V	$0.38	$0.36
R16128	22uF 16V	$0.42	$0.40
R16132	47uF 16V	$1.55	$1.20
R16134	68uF 16V	$1.80	$1.50
R16220	4.7uF 16V	$0.35	$0.33
R16224	10uF 16V	$0.38	$0.37
R16228	22uF 16V	$1.20	$1.00
R16300	0.1uF 16V	$0.13	$0.12
R16302	0.15uF 16V	$0.13	$0.12
R16304	0.22uF 16V	$0.15	$0.12
R16306	0.33uF 16V	$0.15	$0.14
R16308	0.47uF 16V	$0.15	$0.14
R16310	0.68uF 16V	$0.16	$0.15
R16311	0.82uF 16V	$0.18	$0.15
R16312	1uF 16V	$0.15	$0.12
R16314	1.5uF 16V	$0.24	$0.20
R16316	2.2uF 16V	$0.24	$0.23
R16318	3.3uF 16V	$0.29	$0.27
R16320	4.7uF 16V	$0.35	$0.33

30% Sales tax where applicable



ECONOMY TOGGLE SWITCHES

Unbelievable Value!

	10-99	100+
S11010 (SPDT)	0.70	0.60
S11020 (DPDT)	0.90	0.80

Plus 20% Sales Tax where applicable

QUALITY MOMENTARY (RED BODY)

	10-99	100+
SPDT Cat. S11050	1.00	.90

Plus 20% Sales Tax where applicable

19" RACK MOUNT CASE

Tremendous value! Vented.
Dimensions: 480(W) x 134(H) x 250(D)mm.

1-9	10+
$32.00	$29.50

DIP SWITCHES

	10+	100+	1000+
S13402 2 Way	.70	.65	.60
S13404 4 Way	.80	.75	.70
S13405 5 Way	.90	.85	.80
S13407 7 Way	1.10	1.00	.95
S13408 8 Way	1.20	1.10	1.00

20% Sales tax where applicable

TRANSFORMERS

Cat No.		1-99	100+	1000+
M12851	2851	2.50	2.25	1.90
240V 12-6V CT 150mA				
M12155	2155	4.80	4.10	3.70
240V 6-15V 1A tapped				
M12156	2156	6.35	6.15	5.95
240V 6-15V 2A tapped				
M16672	6672	6.35	6.15	5.95
240V 15-30V 1A tapped				

Plus 20% tax where applicable

NEW TRANSFORMER!

M12860	2860	3.00	2.50	2.20

240V to 15V C.T. at 250mA
Plus 20% tax where applicable

"BEAT THE DOLLAR DEVALUATION WITH RITRONICS WHOLESALE!"

DATA CASSETTES

Check our low prices on these quality tapes!

1-9	10-99	100+
$0.75	$0.70	$0.65

HOOK UP WIRE

Cat. No.	Description
W11251	13/.12 TND BLK
W11252	13/.12 TLD BROWN
W11253	13/.12 TLD ORANGE
W11254	13/.12 TLD YELLOW
W11255	13/.12 TLD GREEN
W11256	13/.12 TLD BLUE
W11257	13/.12 TLD WHITE

PRICES PER 100 METRE ROLL

1-9	10+
$3.50	$3.00

Plus 20% tax where applicable

W11260	14/.20 RED
W11261	14/.20 BLACK
W11265	14/.20 BLUE
W11268	14/.20 WHITE

PRICES PER 100 METRE ROLL

1-9	10+
$9.00	$7.00

Plus 20% tax where applicable

W11270	24/.20 RED
W11272	24/.20 BLACK
W11274	24/.20 GREEN

PRICES PER 100 METRE ROLL

1-9	10+
$11.00	$10.00

Plus 20% tax where applicable

W11280	32/.2 BROWN
W11282	32/.2 BLUE

PRICES PER 100 METRE ROLL

1-9	10+
$12.00	$11.00

Plus 20% tax where applicable

RAINBOW CABLE

Cat.No.	Description	1-29 mtr	30+ mtr
W12714	28AWG 14W per metre	$0.90	$0.70
W12716	28AWG 16W per metre	$0.90	$0.70
W12720	28AWG 20W per metre	$1.20	$1.10
W12726	28AWG 26W per metre	$1.80	$1.50
W12734	28AWG 34W per metre	$1.90	$1.80
W12740	28AWG 40W per metre	$2.20	$2.00

ENCLOSED ROTARY SWITCHES AT SPECIAL PRICES!!

		1-9	10+	100+
S13021	SW ROT 1P 12Pos	1.00	.80	.70
S13022	SW ROT 2P6Pos	1.00	.80	.70
S13033	SW ROT 4P 3Pos	1.00	.80	.70
S13035	SW ROT 3P 4Pos	1.00	.80	.70

Plus 20% Sales Tax where applicable

CANNON TYPE ADUIO CONNECTORS

We've sold 1000's because of their great value!

	1-9	10+
3 Pin Line male Cat. P10960	1.80	1.60
3 Pin Chas male Cat. P10962	1.90	1.70
3 Pin line female Cat. P10964	2.50	2.20
3 Pin Chas FMle Cat. P10966	2.90	2.50

Plus 20% Sales Tax where applicable

10W P.A. SPEAKERS TWIN CONE

1-9	10+	100+	300+
$5.00	$4.75	$4.50	$4.00

Plus 20% tax where applicable

YU-FONG YFE-1030C

Features:
- Large 3½ digit display. (½ inch high)
- Autopolarity, "-" display for Negative input.
- High over-load protection for all ranges.
- Over-load display highest figure "1" or "-1" alone glows.
- Power consumption 20mW approx.

Cat. Q126030

1-99	100+
43.95	34.00

Plus 20% Sales tax where applicable

CARD EDGE CONNECTORS

Edge Connectors to Disk Drives Etc.

	10-24	25-99	100+
P12060 10 Way Card Edge Con	2.95	2.50	2.10
P12062 20 Way Card Edge Con	3.25	2.75	1.95
P12064 26 Way Card Edge Con	3.55	2.95	2.20
P12066 34 Way Card Edge Con	3.95	3.50	2.30
P12068 40 Way Card Edge Con	4.50	3.90	3.50
P12070 50 Way Card Edge Con	5.50	4.50	3.90

Plus 20% Sales Tax where applicable

NICADS

Cat No.		1-99	100+	250+
S15020	AA	1.60	1.50	1.40
S15021	C 1.8AH	5.25	4.90	4.80
S15022	D 4.0AH	7.90	7.50	7.20

Plus 20% tax where applicable

SEALED LEAD ACID BATTERY 12V 1.2 AH

S15029	1-9	10-99	100+
	12.50	11.00	10.50

Plus 20% tax where applicable

FANS

		1-9	10+	100+
Cat. T12461	240V 4½"	10.50	10.00	8.00
Cat. T12465	240V 3½"	10.50	10.00	9.00
Cat. T12463	115V 4½"	10.50	10.00	8.00
Cat. T12467	115V 3½"	10.50	10.00	9.00

(Fan guards to suit also available)
Plus 20% tax where applicable

LEDS 5mm STANDARD

	10+	100+	1000+
Red	$0.10	$0.09	$0.08
Green	$0.15	$0.10	$0.09
Yellow	$0.15	$0.10	$0.09

Plus 20% tax where applicable

TELEPHONE CABLE (200 METRE ROLLS)

		1-9	10+
W11302	2 Pair	24.00	23.00
W11303	3 Pair	36.00	34.00
W11310	10 Pair	120.00	115.00

Per 200m Roll
20% Sales tax where applicable

75OHM COAX CABLE

Cat No.		100M	500M	1000M
W11222	3C2V	18.00	17.00	16.00
W11224	5C2V	27.00	25.00	24.00

(5C2V WHITE OR BLACK)
100M ROLLS
LINE LOSS PER 100' (33M 200MHz)
W11222 6.2dB (Approx)
W11224 3.9dB (Approx)
Plus 20% tax where applicable

PANEL METERS

		1-9	10+	100+
Q10500	MU45 0-1mA	6.95	6.75	6.50
Q10502	MU45 50-0-50uA	6.95	6.75	6.50
Q10504	MU45 0-100uA	6.95	6.75	6.50
Q10505	MU45 0-50uA	6.95	6.75	6.50
Q10510	MU45 0-5A	6.95	6.75	6.50
Q10518	MU45 0-1A	6.95	6.75	6.50
Q10520	MU45 0-20V	6.95	6.75	6.50
Q10535	MU45 VU	7.95	7.75	7.50
Q10530	MU52E 0-1mA	9.95	8.35	
Q10533	MU52E 0-5mA	9.95	8.35	
Q10538	MU65 0-50uA	9.35	8.95	8.75
Q10540	MU65 0-1mA	9.35	8.95	8.75
Q10550	MU65 0-100uA	9.35	8.95	8.75
Q10560	MU650 0-20v	9.35	8.95	8.75

Plus 20% tax where applicable

RITRONICS WHOLESALE

Incorporated in Victoria Pty. Ltd.

56 Renver Road, CLAYTON, 3168, VICTORIA, AUSTRALIA. Phone (03) 543 2166 (3 lines) Telex: AA151938

Minimum account order is $50, minimum cash sale is $25. Minimum post/pack $3.00. Minimum account post/pack $5.00. Comet Road Freight, bulky items and/or over 10Kg is extra.
Bankcard, Visa and Mastercard welcome.

Errors and Omissions Excepted.

High resolution Beta VCR

Sony Australia has released a new Betamax VCR which incorporates an improved picture recording method called 'Super Beta'. According to Sony this new high picture resolution technology is the first major improvement in home VCR picture quality since the company invented the Beta-format in 1975.

The Sony SL-HF950ES provides two recording modes for Super Beta. Super Beta PRO mode enables an over 10 per cent gain in picture resolution by enhancing the Beta-format's larger head drum for higher relative tape-to-head speed. With the use of highest grade tapes Super Beta PRO mode shifts the carrier frequency of the luminance signal 500 kHz higher, resulting in a wider luminance bandwidth which enhances picture sharpness and ensures reproduction of fine detail and texture even after repeated edits.

For Super Beta recording using a normal tape, the SL-HF950ES provides a Super Beta standard mode. This mode employs a newly developed DA (double azimuth) PRO 4 head structure to minimise crosstalk between adjacent video tracks, thus reducing noise.

Other features of the new Betamax include clean freeze frame, frame advance, two-speed slow motion (forward and reverse), double speed playback (forward and reverse), reverse playback and picture search with less bar noise. It also incorporates the Beta hi-fi system, giving quality audio with a frequency response of 20 Hz-20 kHz and a dynamic range of over 80 dB — a significant improvement in sound reproduction.

A useful on-screen display feature allows information such as tape counter, channel number, tape run mode and time recording mode to be displayed and checked on the CTV screen. In searching for a program, the Index Search enables random accessing of up to 15 programmes and Index Scan automatically plays back the beginning of each programme for about 10 seconds.

The SL-HF950ES sells for around $1600.

Cassette loading for better audio response

One of the oldest manufacturers of turntables, Dual of West Germany, has moved into cassette deck technology. Dual's products are distributed in Australia by Falk Electrosound and all feature the Dual DLL (direct-load-lock) system which offers several distinct advantages over conventional cassette decks.

The DLL's three point lock system ensures that the cassette is ideally located to eliminate wobbling and to provide optimum tape transport, full tape-to-head contact and quality playback through high azimuth alignment. A further feature of the DLL system is the accessibility of elements such as the heads, pinch roller and capstan enabling the owner to inspect, maintain and clean them easily.

Heading the new range of Dual cassette decks is the Dual C846, a three head, two motor, two speed unit with double capstan drive. It includes the DLL safety technology, double speed (9.5 cm/s) for extra frequency response, level stability, contrast and freedom from drop-out. The two motors prevent mutual interference between tape transport and tape winding, the double capstan ensures high precision tape guidance and the three heads enable simultaneous monitoring during recording.

As well, the C846 offers a computer controlled drive system, two in one M+X sound heads to ensure the best frequency response and avoids azimuth errors, professional VU metering and peak level display, and an electronic counter with double memory. It is finished in black anthracite metallic and costs about $799 RRP.

Portable multitrack mixer

The Vesta Fire MR-10 is the most recent newcomer to the audio multitrack market.

As with other similar equipment, the unit combines a four-track recorder with a mixer in a portable package and includes dc operation to allow recording of outdoor performances.

Some standard features of the MR-10 include overdubbing, punch in/punch out, mix down and ping-ponging to permit the combination of tracks. As well, there is a VU meter bridge, which allows both track and input levels to be monitored. The unit has dbx type 2 noise reduction which allows low noise recording on all four tracks.

The recorder in the MR-10 uses dc motors running at 4.75 cm/s, the pitch is variable by 15%, and the wow and flutter is 0.12%. Other claims are for a recorder frequency response of 40 Hz to 12.5 kHz.

The mixing section can be expanded to 6 channels with the MX-1 mixing expander and is connected to the MX-10 via a 5-pin DIN plug on the front panel.

The microphone/line input has an input impedance of 10 kilohms and can receive input signals between −50 and −10 dBV. The TRIM control provides this facility to allow a coarse adjustment of the input signal before the fader. The phono and line input impedances are 10 kilohms and take levels up to −10 dBV.

The MR-10 is 336 mm wide by 206 mm high and 65 mm deep, and weighs 3 kilograms with batteries. The unit uses 10 C cells or a 12-15 V plugpack for its power and drains 350 mA of current.

The MR-10 sells for about $600 RRP.

BRIEFS

Sanyo has budget CD
A new release from Sanyo is the CP-667 CD player which sells for around $429 RRP. Features include soft push controls and an auto search system that allows up to 16 selections to be programmed.

Pocket TV
Pocket TV has finally arrived in Australia with the release of Tandy Electronics' PocketVision unit selling for just under $300. It can be tuned to VHF and UHF. The liquid crystal screen is unaffected by direct sunlight and there's a detachable backlight for viewing in poor light conditions.

Onkyo quartz AM/FM receiver
High on the list of Onkyo gear being promoted by Rank Electronics is the TX-17 tuner amplifier which has output power of 25 watts rms per channel. Features include the ability to store frequently tuned FM and AM stations in memory, memory backup system, automatic search and 'direct tone control' circuitry.

Yamaha tuners
Yamaha has released two new AM/FM stereo tuners. The T-520 gives both digital synthesiser tuning and automated tuning, and features 8 AM/8 FM preset station tuning plus auto search and manual up/down tuning with improved tuning accuracy. The T-320 gives simple, straightforward analogue tuning.

Concord dual stereo amplifier
The new Concord HPA 54 from Sonic International is a 140 watt dual stereo amplifier. Features include 35 watts per channel output to drive four separate speakers, high and low line level inputs, soft start circuitry to prevent speaker 'pops', circuit protection to guard against overloading, and special speaker protection relays.

NAD's best cassette deck
NAD says its model 6155 cassette deck is the finest the company has ever made. It features NAD's new 'play trim' circuit which is claimed to correct the high frequency aberrations that limit the fidelity of cassette recordings. The circuit overcomes errors arising from tape saturation at high frequencies, from biasing that didn't match the tape when the recording was made.

Tandberg for hi-fi outlets
Rank Electronics has announced that it will promote and distribute the Tandberg range of audio equipment through a network of specialist audio dealers Australia-wide. With 50 years of operation behind it, Tandberg claims many 'firsts' in the area of high fidelity electronics including development of the first battery-powered radio in the 1930s. Leading the present range is the 3000A series of tuners and amplifiers.

New generation CMI
Fairlight Instruments now has a prototype of the Computer Musical Instrument Series III. It has a high-resolution X-Y graphics tablet built into the alpha-numeric keyboard, replacing the light-pen of its predecessors. The main advantages of the tablet over the light-pen are that it offers greater accuracy, the ability to draw on black areas of the screen, and ease of use. Electronically, the series remains much the same as it was. We are told that the Series III has been designed for maximum "musician friendliness"!

German products
German Hi-Fi International Pty Ltd in association with Atram Electronics is now retailing NAD, Dual, Telefunken Stereo TV, Uher, WHD, Visonik, David speakers and ASC recorders. The address is 6 Gurrigal St, Mosman, NSW 2088.

Stereo synthesiser for TV and video
GFS of Mitcham, Vic, is distributing the MFJ-1501 stereo synthesiser, designed to provide synthesised stereo from a TV or VCR. The unit simply connects between the auxiliary input of a stereo system and the audio output of a VCR or a TV speaker. It costs $305 RRP, including postage within Australia.

Design simplicity for VCR
JVC's latest model VCR, the HR-D140EA, is a low profile unit in the VHS format. Features include remote control, shuttle search of nine times normal speed, picture sharpness control, backspace editing and the capacity for up to four hours instant recording. RRP is $799.

Kef speakers for cars
Falk Electrosound has released two Kef car speaker systems. The 50 watt GT100 has two speakers, a pair of drive units and crossover. The GT200 features two 8-litre cavity-enclosures with a 200 mm (8 inch) driver and crossover designed to be mounted in the car's boot. Output into the car's interior is via flexible pipes through grilles mounted on top of the parcel shelf. These pipes are an integral part of the resonance control.

Nakamichi extends audio range

Nakamichi, through its Australian agent Convoy International, has introduced the PA-7 and PA-5 inherently stable/uniform impedance STASIS power amplifiers, CA-5 control amplifier and ST-7 AM/FM stereo tuner with Schotz noise reduction.

Nakamichi obtained the services of Nelson Pass of Threshold Corporation in designing the new power amplifiers and control amplifier, and also Larry Schotz of LS Research for the ST-7 AM/FM tuner which features his latest noise-reduction circuitry.

The PA-7 (rated at 200 watts/channel) and PA-5 (100 watts/channel) do not require global feedback to reduce distortion. As a result, both amplifiers are said to be inherently stable with any speaker and have uniform output impedance for optimum sound quality.

The CA-5 control amplifier is designed for the 'purist' and features level, balance and input selection control. The phono stage accommodates both moving-coil and moving-magnet pickups with selectable input impedance for the former and selectable capacitive loading for the latter.

The Schotz noise reduction system achieves 50 dB at 31 dBf without resorting to 'psuedo-stereo' reproduction.

The ST-7 has a 16-preset electronically synthesised 'front end', with manual and 'seek' tuning. Front-panel pushbuttons allow the user to switch seek thresholds from 20 dBf to 40 dBf, separately activate the mute and mono modes, disable the noise reduction if desired, and convert the signal-strength display into a multipath indicator.

Suggested retail prices for the new units are: PA-7 200 watt/channel power amplifier, $3500; PA-5 100 watt/channel power amplifier, $2000; CA-5 control amplifier, $1500 and ST-7 AM/FM stereo tuner $1250.

THE SHURE THING

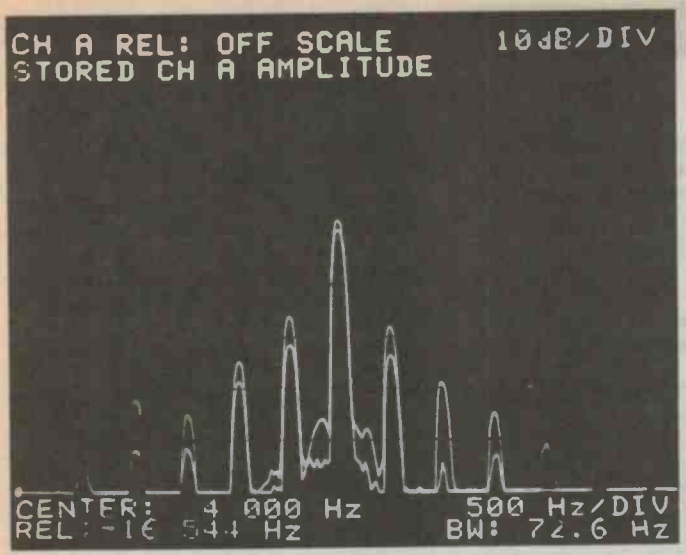
Make no mistake, Shure's Ultra 500 cartridge is about the best thing around in phono cartridges. The figures speak for themselves — but Louis Challis has a bit more to say on design and importantly, the end sound.

Louis Challis

OF ALL THE cartridge manufacturers in the world, Shure Brothers of Illinois is undoubtedly the best known. With an annual production of OEM and replacement cartridges and styli running into millions, for a long time they have held a large share of the world-wide market. (That market is now compressing as a result of both the in-roads of other manufacturers, quite apart from the effect that CD players, cassette players and hi-fi video have had.)

The Shure V15 Mark II, III, IV and V has each in its time constituted the bench mark for cartridge excellence against which virtually every other cartridge has been designed. Shure Brothers was the first to introduce the concept of 'trackability' as a marketing concept for its top of the range cartridges. The Shure TTR 101 and subsequent test records have become standard with reviewers and the trackability test records in particular have provided every audiophile with the opportunity to properly assess the performance of his/her cartridge and turntable, be it of Shure origin or otherwise.

The Shure V15 V was released some two years ago, before the advent of CD players and I must admit that I had come to the conclusion that Shure would not release a V15 VI. As it transpires, I was right but for the wrong reason. Shure looked at what its competitors were doing (in much the same way that its competitors had been looking at Shure for close to two decades). What was painfully evident was that 'you can't mass produce' a perfect cartridge because that type of item involves such a degree of precision assembly that gifted fingers, a steady hand and a microscope become the limiting factors.



Shure Ultra 500 tested with TRR103 Test Record with 1000 and 1500 Hz twin tone at 31.5 and 40 cm/s maximum velocities.

Shure's approach to the problem was to take its best production people to create a brand new group aptly called the "Ultra" group. The next step was to take the tried and proven V15 V as a basis for design, compare its attributes and liabilities with the best cartridges from Signet (Audio Technica), Grado (which is big in the States but not here), Ortophone and another Japanese manufacturer to determine the changes in performance and construction that were most likely to achieve the degree of perfection that they were seeking.

The first and one of the most significant changes Shure introduced was to move from the bi-radial stylus tip to a 'micro-ridge' profile embodying many of the attributes of the original Shibata stylus but redesigned on the basis of a computer optimised polishing sequence.

Then Shure took the stylus and inserted in the end a micro-thin beryllium stylus shank with an 18 mil diameter and a microscopic 0.5 mil wall. The wall thickness is less than the average human hair, so that was no mean feat. This shank was then telescoped into a larger diameter element which was itself inserted into a magnet structure; this structure was supported by a brand new elastomer bearing (with vastly improved characteristics compared with those previously used). The next step was to build a brand new folded pole piece structure with humbucking coils and precise control of flux leakage, so that the transfer of mechanical energy would be matched by an impeccable uniformity of electrical output.

The last and by no means least feature was the refinement of the dynamic stabiliser and brush assembly which sits in front of the stylus and more or less provides the characteristics of a shock absorber for the cartridge and tone arm assembly when riding over warped and irregular records, as well as tracking records with extremely high lateral excursions.

The appearance and physical characteristics of the Ultra 500 cartridge are very different from any other Shure cartridge. For a start, it is extremely heavy. The cartridge comes in a large wooden box with neat velvet trimming into which the stylus cleaning fluid, brush, screws, screw-driver, cartridge and dummy stylus are neatly inserted. The dummy stylus in particular is very sensible as this provides a safe means of aligning the cartridge on a tone arm and aligning the tone arm on a turntable without the risk of inadvertently damaging your expensive 'new baby'.

Objective testing

I mounted the cartridge on a Linn Basik LXV tone arm which was itself mounted on a Thorens TFD321 belt driven turntable.

We subjected the cartridge to a series of critical and demanding laboratory evaluations. The first of these was to determine the frequency response over the range 20 Hz to 20 kHz and subsequently over the range 1 kHz to 50 kHz. The results were less than ±0.5 dB variation from 20 Hz to 20 kHz and less than 0.2 dB variation over the range 1 kHz to 20 kHz. In the range 20 kHz to 35 kHz, the cartridge exhibits a rising response with the peak response occurring between 28 and 29 kHz, a 7.5 dB rise in the right channel and a 6.5 dB rise in the left channel. The response is back to zero at 35 kHz and drops rapidly to −13 dB at 50 kHz.

While the frequency performance is outstanding, the channel separation is better, providing the highest levels of separation I have yet seen from any cartridge. At 1 kHz, the left channel provides a genuine 35 dB separation while the right channel provides not less than 36 dB separation. If that were not enough, the trackability measured using the TTR 103 trackability test record was the best we have yet seen from any cartridge we have tested. The cartridge coped quite happily with velocity levels exceeding 37.7 cm/s. We tried a number of other test records from other well-known and respected cartridge manufacturers and found their test records presented no hurdles and no perceived limitations in performance.

SHURE ULTRA 500 CARTRIDGE

Weight:	*9.3 grams*
Manufacturer:	*Shure Bros, Illinois, USA*
RRP:	*$1212*

Subjective testing

The system I used for the subjective evaluation involved (for convenience) the same turntable and tone arm as we had used in the laboratory with a Yamaha C2A preamplifier, Yamaha M80 amplifier and B&W 801F monitor speakers.

The manufacturer's literature claims that the cartridge would perfectly track all of the cannon shots on Telarc's digitally recorded "1812 Overture" by Tchaikovsky, which is a pretty tall order. (During a similar demonstration four years ago in Japan, I had witnessed the failure of another manufacturer's new cartridge to satisfactorily achieve that goal.)

Now, as it happens, I don't have a copy of this record (the Telarc DGQR-10041 with Eric Kunzel conducting the Cincinnati Symphony Orchestra). None of my friends had one either, so I enquired of the importers, PC Stereo in Brisbane. The managing director offered to lend me his own personal copy provided I promised to play it "only once and only after I had assured myself that the cartridge was tracking perfectly and the stylus had not been damaged". With some trepidation I agreed. Much to my surprise, the record that he sent was one of the limited edition Super-Cut 'UHQR pressings' (serial no 676) which uses a much thicker vinyl blank than normal and which was specially pressed by JVC in Japan.

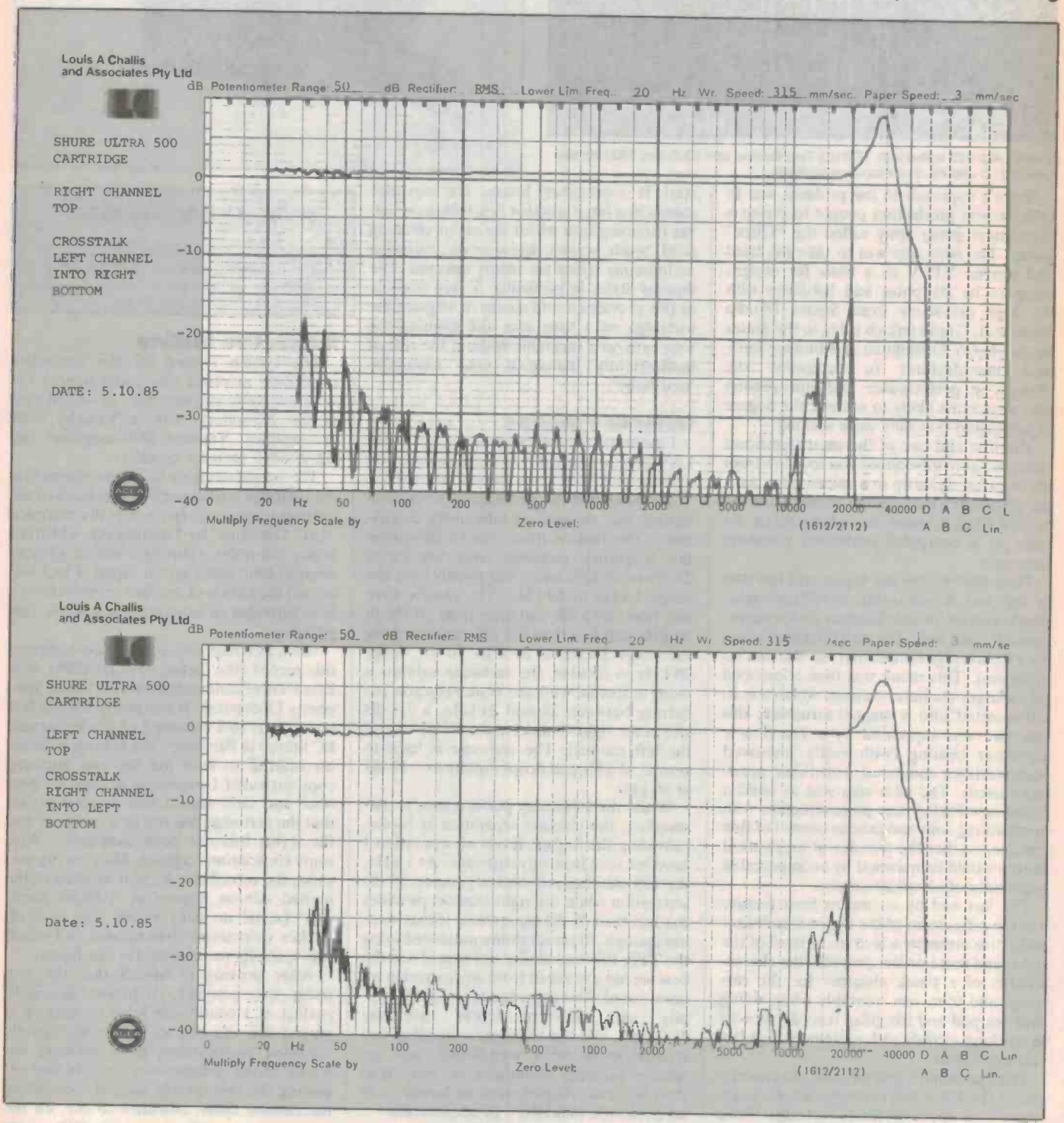
After proving to myself that the cartridge, tone arm and system were as near to perfect as I could ever hope to achieve, I played the CD disc of the same digitally recorded performance twice through the whole of the Tchaikovsky 1812 before replaying the two specific sections containing the cannon shots. Needless to say, on the ▶

CD disc the cannons were truly 'explosive'. More importantly, they were just as explosive on the record, with just the merest suggestion of a reduced low frequency performance when compared with the CD disc.

Shure's claim was fully substantiated and an unquestionable credit to its designers.

I then proceeded to play a series of other records including the Sheffield track record (Lab 20) which contains a series of rock and roll instrumental tracks for audio component testing and evaluation, which was loud and clear; "Beethoven's 9th Symphony" by Solte, (MFSLK-2-516) was aurally superb. Grieg's "Peer Gynt" (Telarc 10048) provided rapturous music and superb listening; Mobile Fidelity Sound Lab's recording of Respighi's "Feste Romane" (The Pines of Rome) (MFSL 1-507) provided the same: a superb orchestral feast.

At a selling price of $1000 plus, the Shure Ultra 500 is obviously not everybody's cartridge. Those people who are, however, seeking the ultimate in trackability, frequency response, channel separation, or musicality, are unlikely to find a better cartridge irrespective of price. ●



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Fantastic! Our Hornet is a real high-flyer with full 27MHz (expandable) marine band, local AM plus SSB for extra range. And it's so versatile — doubles as a PA with optional horn. Features noise limiter and blanker, LED display. Cat D-1716

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WOW! Just the trick for in-shore boating — with access to all CB frequencies. Plus a host of features. Squelch control, RF gain, channel selection control, CB/WX switch, RF Power/"S" Meter and more! Excellent value and safety. Cat D-1407

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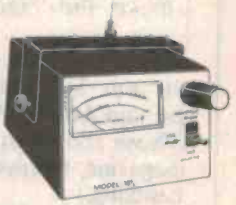
SWR/POWER METER

Suitable for 27MHz Marine

Built-in strength field facility indicates precise antenna radiation, other RF energy measurement. SO-239 sockets for permanent antenna line placement. Cat Q-1350



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It's got the lot! More features than even the most critical enthusiast could demand. Tune into AM/FM or any of the 12 SW bands by either direct frequency key-in, auto or manual scanning ... FIVE tuning functions in all. Adjust audio with treble and bass controls to suit personal tastes. Features sleep button, RF gain control and much more. Cat D-2831

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B.094/CW

DIGITAL FREQUENCY DOUBLER

Neale Hancock

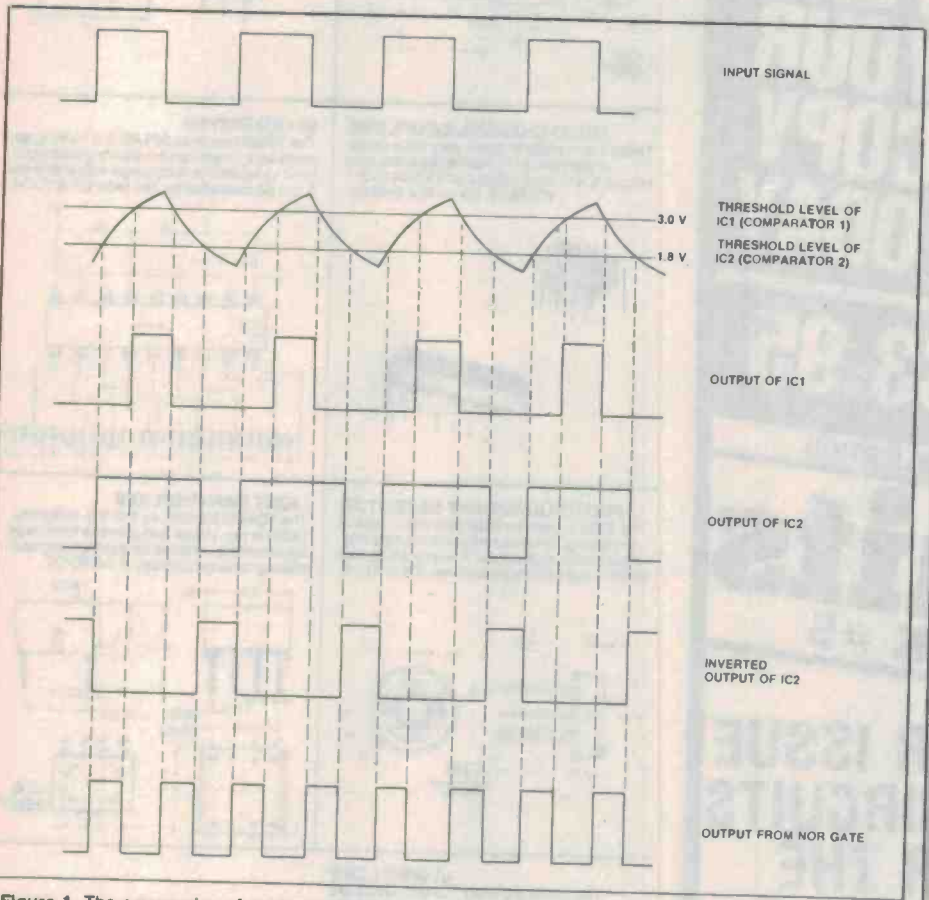


Figure 1. The progression of the input signal through the circuit, showing how its double is derived.

This project allows you to easily double clock frquencies or have a TTL signal and its double without dividing down.

DOUBLING A CLOCK frequency can be very convenient in digital circuits when synchronising two parts or two system components particularly when it is not feasible to divide the clock down. Simply doubling the

PARTS LIST — ETI-1513

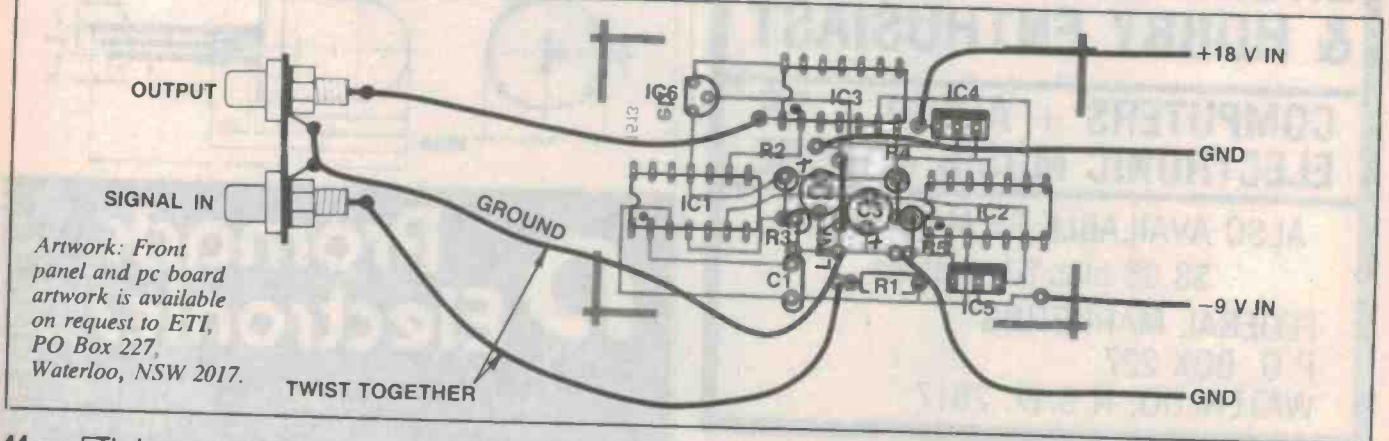
Resistors
- R1 ..... 680R
- R2 ..... 3k6
- R3 ..... 1k2
- R4 ..... 4k7
- R5 ..... 820R

Capacitors
- C1 ..... 22p ceramic
- C2, 3 ..... 47µ 16 V electro

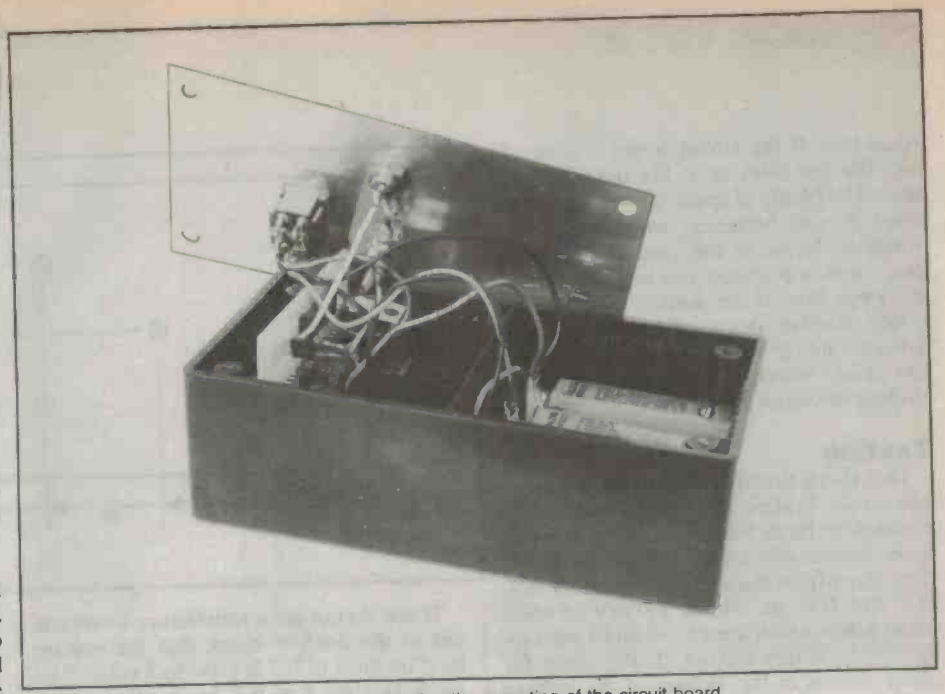
Semiconductors
- IC1, 2 ..... 710 comparator
- IC3 ..... 74LS02 hex NOR gate
- IC4 ..... 7812 +12 volt regulator
- IC5 ..... 7905 −5 volt regulator
- IC6 ..... 7805 +5 volt 100 mA regulator

Miscellaneous
ETI-1513 pc board; 3 x 9 volt battery clips; hookup wire; zippy box, 2 x RCA sockets; DPDT switch; Scotchcal front panel.

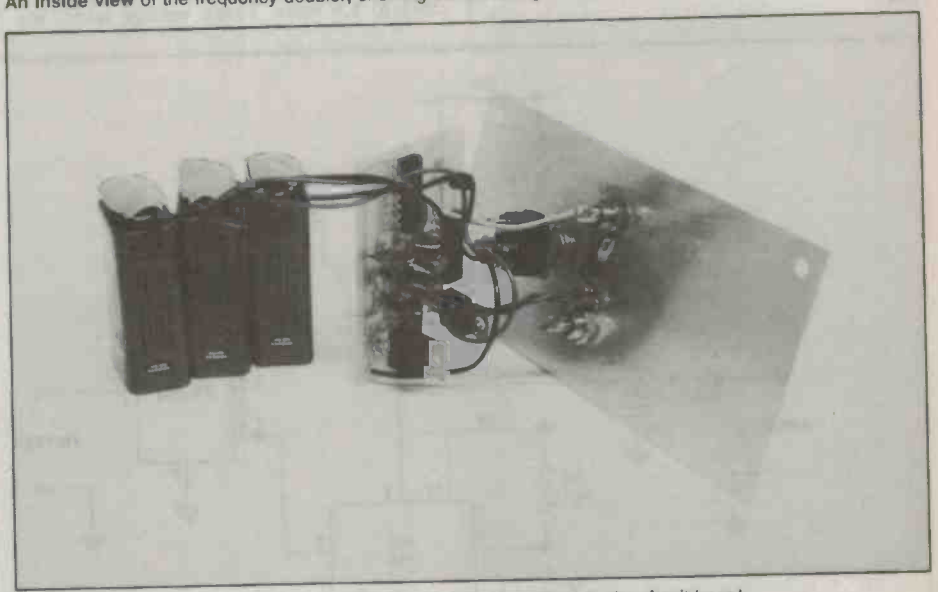
PRICE ESTIMATE: $17
(not including batteries)



Artwork: Front panel and pc board artwork is available on request to ETI, PO Box 227, Waterloo, NSW 2017.



An inside view of the frequency doubler, showing the mounting of the circuit board.



The frequency doubler out of its case, showing wiring connections to the circuit board.

frequency of your clock can save the hassle of redesigning. So, for applications where a high clock frequency or multiples of a frequency are required, this project is ideal.

A maximum output frequency of 10 MHz is possible when the input is a 5 MHz TTL level signal with a 50% duty cycle. To achieve this frequency range high speed comparators (TL710s) are triggered by the rising and falling edges of the input waveform, when they pass the threshold levels.

The level of the thresholds not only determines the mark-to-space ratio of the output waveform (see Figure 1), but also ensures even spacing of pulses. Therefore, if the incoming signal does not comply to TTL constraints (that is between around 0 volts and 5 volts) the waveform will not pass the threshold levels at points for which they were set. The resulting output pulses will have irregular width and spacing.

At high frequencies the frequency doubler can actually improve the quality of TTL pulses by virtue of the resistor and capacitor combination on the input. This combination not only slews the leading and trailing edges of the incoming signal, but also filters out any spikes and ringing on it. Therefore the comparators cannot be inadvertently triggered by such nasties.

The output from the comparators is fed directly into a TTL gate and providing that there is no mismatch with the load, the output pulses from the TTL gate will be clean of ringing and spikes.

Construction

Start the printed circuit board by soldering in the wire link which is located near the middle of the board. Next solder in the capacitors and resistors, check the polarity of the electrolytic capacitors C2 and C3 when you put them in. When you mount the resistors try not to use too much solder to prevent bridging between pads. Also avoid excessively heating R2, R3, R4 and R5 when you are soldering them in, as this may cause their values to drift.

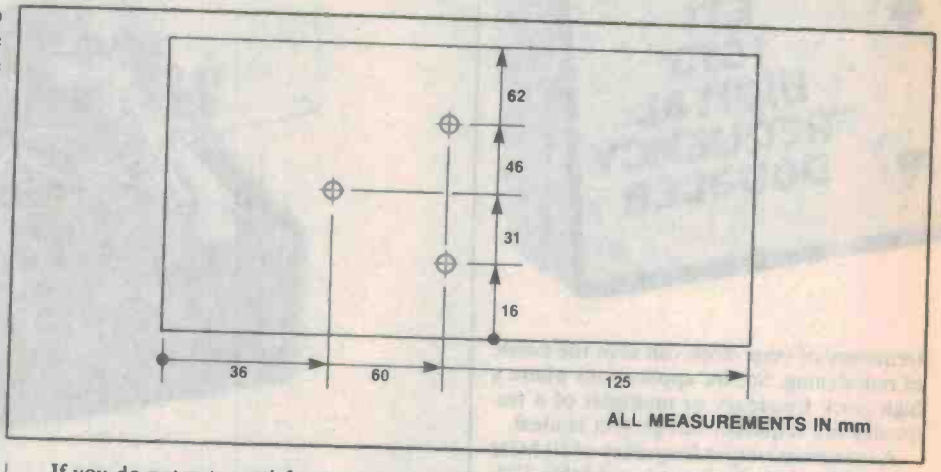
The voltage regulators IC4, IC5 and IC6 can now be soldered in. Be sure to check their orientation with the component overlay first. The rest of the ICs can then go in, but as with the others make sure they are orientated correctly. When soldering their pins be careful not to get solder bridges between them.

Begin the wiring connections with the three battery clips. The black lead which connects the single 9 volt battery is soldered to one of the middle poles of the switch. The end pole is connected to the −9 volt input on the printed circuit board. The red lead is soldered into the ground point next to R5. Take the remaining two battery clips and solder the red lead from one of the clips to the black lead of the other. Be sure to insulate the solder joint connecting the two wires to prevent unwanted short circuits. The unconnected red lead is then soldered on to the other middle pole of the switch, and the end pole to the 18 volt input of the circuit board. The black lead from this pair of clips is connected to the ground point next to IC3.

The wires connecting the RCA sockets to the printed circuit board can now be soldered in. First connect the input socket and the signal ground lead to their respective pads on the circuit board, making these leads as short as possible. These wires should also be twisted together to reduce the chance of undesirable effects at high frequencies such as losses and crosstalk. The output RCA socket has its central terminal connected to the output pad on the circuit board with a short length of wire. The ground terminal of the output socket is connected to the ground terminal of the input socket by a short length of wire.

If you want the frequency doubler to mount in a case, use a zippy box because the circuit board was designed to be mounted vertically in one. The printed circuit board should slide into the slots in the ▶

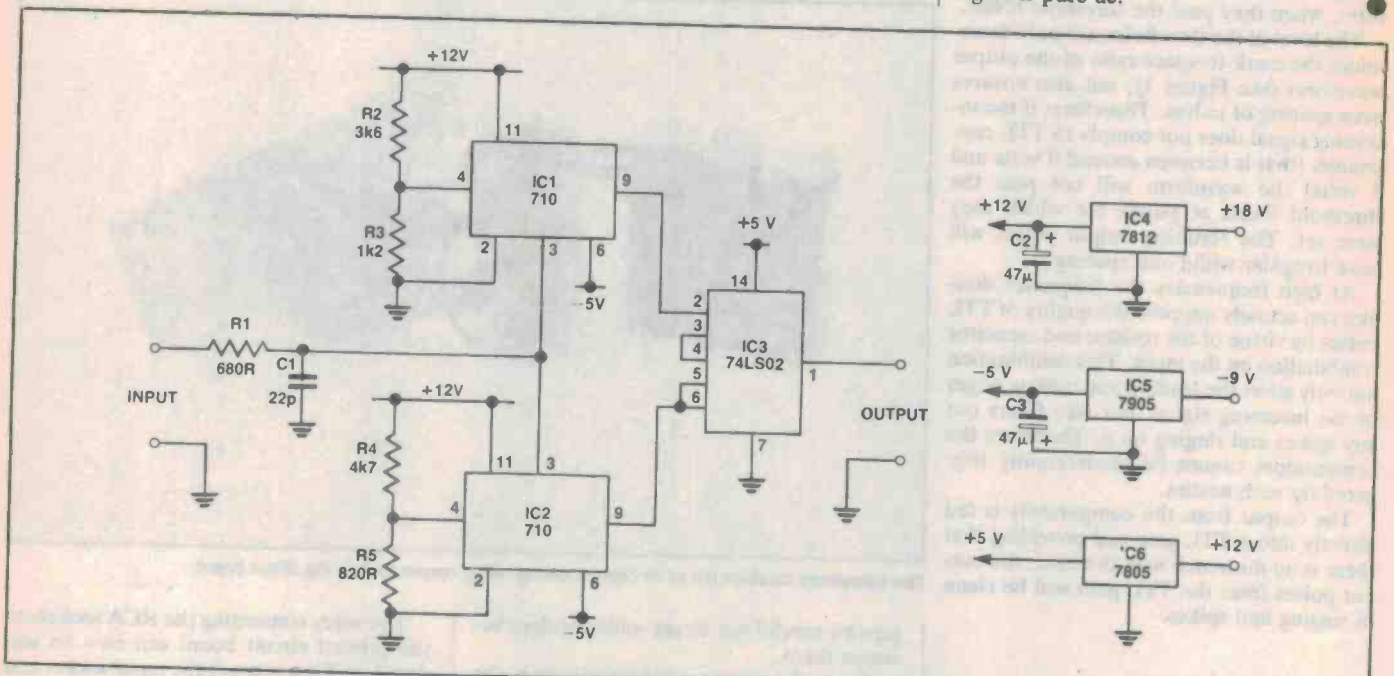
zippy box. If the circuit board is a bit too big, file the sides so it fits tightly. There should be plenty of space in the case for the three 9 volt batteries; to prevent them wreaking havoc in the case hold them in place with a partition slid into the slots of the zippy box. If the doubler is to be used inside another piece of equipment, drill holes to suit the mounting arrangement you are using. Watch out for the tracks when drilling the screw holds.



Testing

First check the circuit board for dry joints and solder bridges. If it looks satisfactory connect the three 9 volt batteries and switch it on. Before you connect it up, check that the output from the voltage regulators IC4, IC5 and IC6 are within 100 mV of their rated values which are 12, −5 and 5 volts respectively. If they are not, double check for short circuits in the vicinity of the voltage rails.

If you do not get a satisfactory waveform out of the doubler check that the voltage level on pin 4 of IC1 is close to 3 volts. Also check that pin 4 of IC2 has a voltage level close to 1.8 volts. These voltage levels are critical because they set the threshold level of the comparators. The comparator limits can also be affected by dc offset of the incoming signal, so check that the incoming signal is pure ac. ●



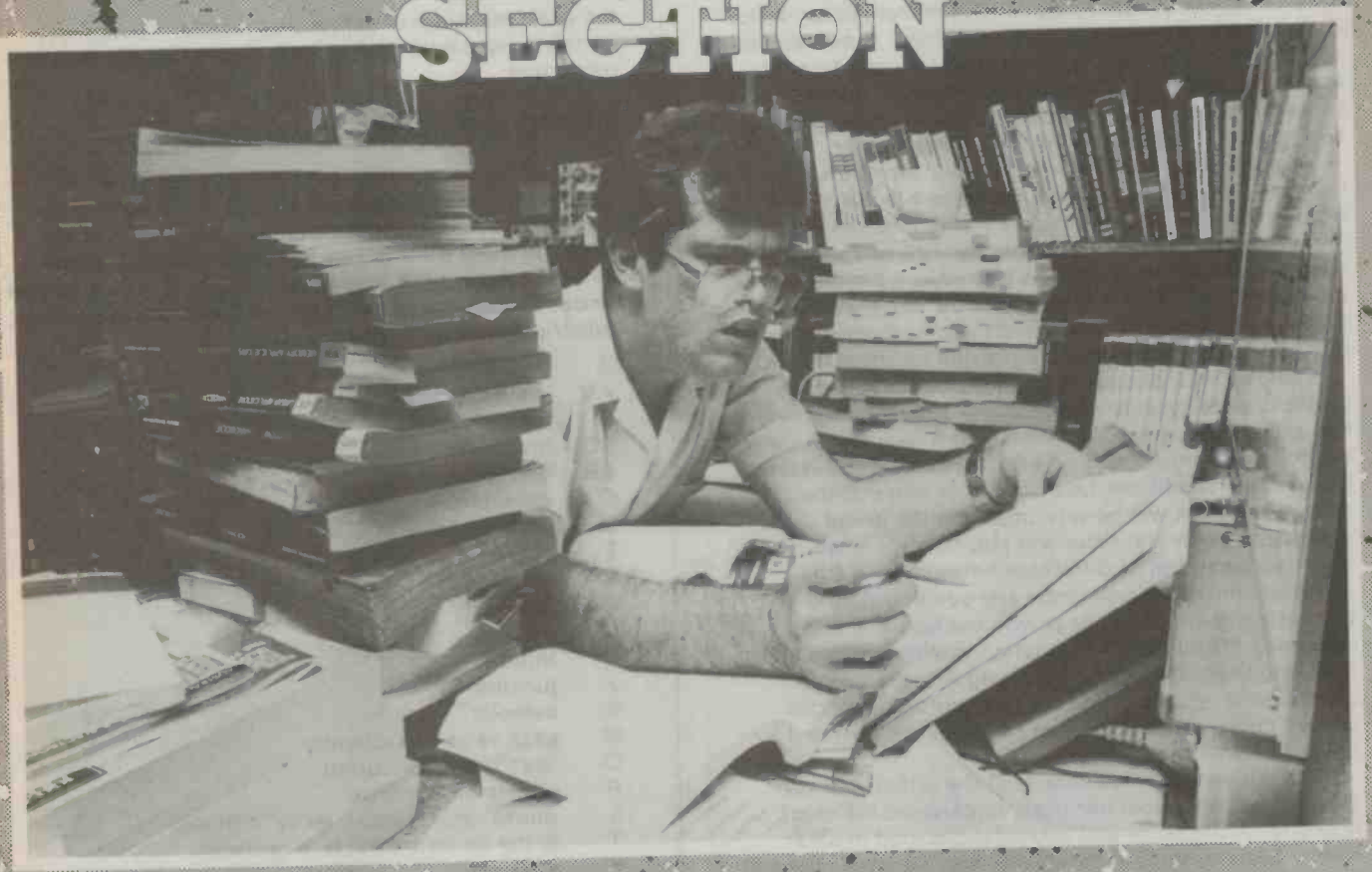
HOW IT WORKS — ETI-1513

The combination of R1 and C1 is used to slew the leading and trailing edge of the incoming square wave, making the rise and fall times longer. The resulting waveform goes to the non-inverting inputs of the differential comparators IC1 and IC2. R2 and R3 are connected to the inverting input of IC1 and set the upper threshold. The lower threshold is set by the combination of R4 and R5 connected to the inverting input of IC2. The output from IC2 is then inverted to make the mark-to-space ratio compatible with the output of IC1. Figure 1 shows the relationship between the threshold settings and the resulting output waveforms from the comparators.

To combine the outputs from the two comparators, the waveforms are put through IC3 which is a quad NOR gate, thus giving twice the input frequency. The upper input frequency limit of this circuit is 5 MHz; this frequency gives a mark-to-space ratio of close to 1:1. As the input frequency decreases, so too does the mark-to-space ratio. This is because the pulse width is set by the risetime of the waveform going into the comparators. Since the risetime is dependent on the value of C1, the mark-to-space ratio at lower frequencies can be increased by increasing the value of C1. However, this will limit the bandwidth of the doubler as high frequencies will be filtered out.

IC4 and IC5 are the 12 volt and −5 volt regulators respectively. These regulators provide accurate voltage levels, which are critical for setting the comparator thresholds. Capacitors C2 and C3 are used to decouple the voltage supply lines and thus remove any noise on the waveforms. IC6 is a 5 volt regulator and provides the voltage supply to IC3.

ETI 1986 REFERENCE SECTION



Contents:

DATA SHEETS EXPLAINED

The data sheets which we publish regularly are very popular, but from time to time we receive requests for a fairly simple explanation of the terms and abbreviations which one finds in semiconductor device data sheets. This article has been prepared to satisfy your requests.

by Brian Dance

THE INFORMATION contained in semiconductor device data sheets is often grossly misunderstood. Great care must be taken to ensure that the exact meaning of a term or abbreviation is clear. As an example, we can quote the following conversation which actually occurred between two people who should both have known better.

A representative of a semiconductor distributor was showing data on a new power device to a lecturer. The lecturer said that the device data was wrong, since the maximum collector current was quoted as 12A and the maximum collector-emitter voltage (V_{CEO}) as 80V; this is a power level of 12 x 80 = 960W, but the maximum permissible dissipation quoted in the data sheet is only 90W. The representative could provide no answer!

The data was, of course, perfectly correct. The problem arose because neither of the people concerned had appreciated the exact meaning of V_{CEO} which signifies the collector-emitter voltage *with the base open circuited*. Under these conditions (with zero base current) the collector current will be very small and the power dissipation in the transistor will also be quite small. Thus there is a great deal of difference between V_{CE} (the collector-emitter voltage under any conditions) and V_{CEO} (the collector-emitter voltage with the base open circuited). If still more information is required, one must look into the SOAR (Safe Operating ARea) graph to ascertain the regions of the collector voltage/collector current curve where the device can be safely operated for limited or unlimited times.

This is a very simple example of the pitfalls one can encounter if ones does not really understand the *exact* meanings of the terms and abbreviations used in data sheets. Such misunderstandings are very common, but not (we hope!) amongst the devices covered in our data sheets, since it is equally important that our readers understand the exact meanings of abbreviations used in data sheets on relatively simple devices such as ordinary diodes and transistors.

LETTER SYMBOLS

Three of the most important symbols used in semiconductor device data sheets are V, I and P for voltage, current and power respectively. Various subscripts are added to these three letters to indicate the electrode(s) to which the symbol is being applied and possibly certain circuit conditions. Some of the most commonly used subscripts are listed below.

A	anode
AV	average
B	base
BO	breakover
BR	breakdown
C	collector
D	drain or delay
E	emitter
F	forward
G	gate
H	holding
I	input
J	junction
K	cathode
M	peak value of a quantity
O	open circuit or output
R	reverse or repetitive
S	source, short circuit, series or shield
T	in the on state (that is, triggered)
W	working
X	specified circuit
Z	regulator impedance

CAPITALS AND LOWER CASE Both the quantity being shown and the subscript may appear as a capital or lower case letter in order to differentiate between instantaneous and rms values. The basic rules are given in the following table:

	MEANING
Capital quantity symbol plus capital subscript [V,I,P] + [C,E,B]	The steady current (no signal) value. The subscript (AV) may be added to indicate the total average value with signal or (M) for the total peak value.
Capital quantity symbol plus lower case subscript [V,I,P] + [c,e,b]	The rms value of the alternating signal component. The subscript (av) may be added to indicate the average value of the varying signal component or (m) to indicate the peak value of this component.
Lower case quantity symbol plus capital subscript [v,i,p] + [C,E,B]	The instantaneous total value of the quantity concerned.
Lower case quantity symbol plus lower case subscript [v,i,p] + [c,e,b]	The instantaneous value of the varying signal component.

Thus i_E is the instantaneous value of the total emitter current, i_e the instantaneous value of the alternating component of the emitter current, and $I_{E(AV)}$ the average (dc) value of the total emitter current. Other subscripts can be used in a similar way, I_F being the forward dc current with no signal, i_F the instantaneous forward current and I_{FM} the peak forward current.

ORDER OF SUBSCRIPTS

In most cases more than one subscript is needed; the subscripts are usually placed in a definite order governed by the following rules:

The first subscript indicates the electrode at which the current or voltage is measured.

The second subscript denotes the reference terminal or circuit mode. (This subscript is often omitted if it is felt no ambiguity will arise.)

The letter O may be used as a third subscript to show that the electrode not indicated by any previous subscript is open circuited. Similarly the letter S can be used as a third subscript to show the third electrode is shorted to the reference electrode of the second subscript, whilst the letter R as a third subscript indicates that a specified resistance is connected between the third electrode and the reference electrode.

The supply voltage to a collector is indicated as V_{CC}, the second suffix being a repetition of the first in the case of supply voltages. Similarly, one often meets the symbol V_{DD} for the positive supply to a CMOS (or COS/MOS) device, this being the supply to the drain. The negative supply to CMOS devices is normally represented by the symbol V_{SS}.

It should now be clear why V_{CEO} is the steady collector-emitter voltage with the base open circuited. Similarly I_{CER} is the collector cut off current with a specified resistance between the base and emitter. It is current with the base and emitter joined, since either the base or emitter can be used as the reference electrode without any change when they are joined.

The parameters of individual devices vary from one device to another of the same type number. The typical value of a parameter such as transistor current gain is often quoted in data sheets by the abbreviation 'typ' after the quantity, but minimum and maximum values are also often quoted. In economical devices no maximum and minimum values may be quoted. In the case of breakdown voltages, the minimum value applicable to any device of that type number is usually quoted so that the circuit designer knows that he can apply that value of voltage without danger of the device junction breaking down.

The above discussion gives the general principles of the way in which the symbols for various parameters are chosen. It is not complete, since we have not yet covered such items as current gain of a transistor or thermal characteristics of a device. However, these and other quantities will be covered in the following tables.

THERMAL CHARACTERISTICS

The symbols used for the following thermal quantities apply to all types of semiconductor device.

P_{tot}	total power dissipated within the device
T_{amb}	ambient temperature
T_c	temperature of the case of the device
T_j	temperature of the junction in the semiconductor material
T_{mb}	temperature of the mounting base of the device (= T_c)
T_{stg}	storage temperature
θ_h	thermal resistance of heat sink. (Units. $^oC/W$)
θ_i	contact thermal resistance between the case of the device and the heat sink
$\theta_{j\text{-amb}}$	junction to ambient thermal resistance
$\theta_{j\text{-c}}$	junction to case thermal resistance

SYMBOLS USED MAINLY WITH DIODES

C_d	diode capacitance with reverse bias
C_f	diode capacitance with forward bias
C_j	capacitance of the junction itself
C_{min}	minimum capacitance (which occurs at the rated breakdown voltage)
C_o	diode capacitance at zero bias
f_{co}	cut off frequency of a varactor diode
I_F	total dc forward current
i_F	instantaneous forward current
$I_{F(AV)}$	average forward current
I_{FM}	peak forward current
I_{FRM}	repetitive peak forward current
I_{FSM}	non-repetitive peak forward current occurring under surge conditions
I_R	continuous reverse leakage current
i_R	instantaneous reverse leakage current
I_{RRM}	repetitive peak reverse current
I_{RSM}	non-repetitive peak reverse current
I_Z	zener diode continuous operating current
I_{ZM}	zener diode peak current
t_{on}	turn on time
t_{off}	turn off time
t_r	rise time
t_{rr}	reverse recovery time
t_s	storage time
V_F	steady forward voltage
v_F	instantaneous forward voltage
V_R	steady reverse voltage
v_R	instantaneous value of the reverse voltage
V_{RM}	peak reverse voltage
V_{RRM}	repetitive peak reverse voltage
V_{RSM}	non-repetitive peak reverse voltage (on surges)
V_Z	zener diode working voltage

SYMBOLS USED MAINLY WITH TRANSISTORS

C_{ob}	transistor output capacitance in the grounded base circuit
C_{oe}	transistor output capacitance in the grounded emitter circuit
f_T	transition frequency or gain-bandwidth product in common emitter circuit
h_{FE} (h_{FB}, h_{FC})	current gain in the grounded emitter circuit (or in the grounded base or grounded collector circuit)
h_{fe}	the increase in collector current divided by the small increase in the base current which produces it. (Small signal current gain.)

I_B, I_C or I_E the steady base, collector or emitter current

$I_{B(AV)}$, $I_{C(AV)}$ or $I_{E(AV)}$ the average value of the base, collector or emitter current

I_{CEX} collector cut off current in a specified circuit

I_{CM}, I_{BM} or I_{EM} peak value of collector, base or emitter current

I_b, I_c or I_e rms value of the alternating component of the current

I_{bm}, I_{cm} or I_{em} peak value of the alternating component of the current

i_C, i_B or i_E instantaneous value of the total current

i_c, i_b or i_e instantaneous value of the alternating component of the current

I_{CBO} collector cut off current with the emitter open circuited

I_{CBS} or I_{CES} collector cut off current with emitter shorted to the base

I_{CEO} collector cut off current with the base open circuited

I_{CER} collector cut off current with a specified value of resistance between the base and the emitter

I_{EBO} emitter cut off current with the collector open circuited

$V_{BE(SAT)}$ base-emitter saturation voltage

$V_{(BR)}$ breakdown voltage

$V_{(BR)CBO}$ collector to base breakdown voltage with emitter open circuited

$V_{(BR)CEO}$ collector to emitter breakdown voltage with base open circuited

V_{CB} collector-base voltage

V_{CBO} collector to base voltage with emitter open circuited

V_{CC} collector supply voltage

V_{CE} collector to emitter voltage

V_{CEO} collector to emitter voltage with base open circuited

V_{ce} collector to emitter rms voltage

$V_{CE(SAT)}$ collector to emitter saturation voltage

V_{EB} emitter-base voltage

V_{EBO} emitter-base voltage with collector open circuited

V_{eb} emitter-base rms voltage

SYMBOLS USED MAINLY WITH FETS

I_D steady value of the drain current

I_{DSS} steady value of the drain current with the gate connected to the source

I_{DM} peak drain current

I_G steady gate current

I_S steady source current

r_{DS} drain to source (or channel) resistance

V_{DS} steady drain to source voltage

V_{GS} steady gate to source voltage

SYMBOLS USED MAINLY WITH THYRISTORS

I_{FRM} repetitive peak forward current

I_{FSM} non-repetitive peak (surge) current

I_{GD} gate current which does not trigger the device

I_{GT} gate trigger current

I_{GQ} gate turn off current

I_H holding current required to maintain conduction

I_R steady reverse leakage current

I_{RG} reverse gate current

I_{RRM} repetitive peak reverse current

I_{RSM} non-repetitive peak reverse current (in surge conditions)

I_T steady anode-cathode 'ON' state current

P_G gate power

t_{gt} gate controlled turn-on time

t_{gq} gate controlled turn-off time

$V_{(BO)}$ breakover voltage

V_D continuous off state voltage

V_{FG} forward gate voltage

V_{GT} gate trigger voltage

V_R steady reverse voltage

OPERATIONAL AMPLIFIER TERMS

Bandwidth, Δf. The frequency at which the gain falls by a factor of 0.7 relative to the gain at low frequencies.

Common mode rejection ratio, CMMR. The gain when a signal is applied to one of the inputs of the amplifier divided by the gain when the signal is applied to both the inverting and non-inverting inputs. It is usually expressed in dB.

Frequency compensation. An operational amplifier requires a capacitor to enable it to be used in circuits which are stable over a wide frequency range. Internally compensated operational amplifiers have this capacitor fabricated on the silicon chip, but an external capacitor must be used with other types of operational amplifier which do not contain an internal capacitor.

Input bias current, I_{bias}. The mean value of the currents at the two inputs of an operational amplifier.

Input offset current, I_{OS}. The difference in the two currents to the inputs of an operational amplifier. Normally much smaller than the input bias current.

Input offset voltage, V_{OS}. The voltage which must be applied between the two input terminals through equal resistors to obtain zero voltage at the output.

Open loop voltage gain, A_{VOL}. The amplifier gain with no feedback applied.

Output resistance, R_O. The small signal resistance seen at the output when the output voltage is near zero.

VOLTAGE REGULATOR TERMS

Dropout voltage, V_{DO}. When the difference between the input and output voltages falls down below the dropout voltage, the device ceases to provide regulation.

Foldback current limiting. In regulators with foldback current limiting, the current will 'fold back' to a fairly small value when the output is shorted.

Line regulation. The change in the output voltage for a specified change in the input voltage.

Load regulation. The change in output voltage for a change in the load current at a constant chip temperature.

Quiescent current, I_Q. The current taken by the regulator device when it is not delivering any output current.

Ripple rejection. The ratio of the peak-to-peak ripple at the input of the regulator to that at the output. Normally expressed in dB.

MONOLITHIC TIMER TERMS

Comparator input current. The mean current flowing in the comparator input connection during a timing cycle.
Timing capacitor, C_t. This capacitor is normally connected between the comparator input and ground. The time taken for it to charge controls the delay time.
Timing resistor, R_t. This is the resistor through which the timing capacitor charges.
Trigger current. The current flowing in the trigger input connection, at the specified trigger voltage.
Trigger voltage. The voltage required at the trigger pin to initiate a timing cycle.

Conclusions

Data sheets must be used intelligently and with much thought. Information on the conditions under which an entry in the data sheet is applicable is often stated in small print, but is of great importance. Data should always be thoroughly studied before a device is used for the first time; only then will you be able to fully understand the potential applications of the device.

Care with mains wiring

In general, the fuse should come before the switch on the active line. If possible, a double pole switch should be used to disconnect both the active and neutral. When using a double-throw switch, the mains should be brought in on the 'throw' terminals and not the pole. This is done so that when the switch is off, the unconnected 'throw' terminals will not be live.

The earth wire from the mains should be firmly connected to the chassis of the instrument housing and all exposed parts should have a good electrical connection back to this earth point. It should also be arranged that, if the mains cord is accidentally pulled out from the case, the earth wire will be the last to break.

Sound reference level terminology

dB	6 milliwatts, 1.73 volts, 500 ohms
dBa	noise measurement (dB adjusted)
dBj	1000-microvolts reference
dBk	1 kilowatt reference
dBm	1 milliwatt, 0.773 volt, 600 ohms
dBμ	1 microvolt reference
dBV	1 volt reference
dBW	1 watt reference
dBx	crosstalk measurements
dBrap	decibels above the reference acoustical power, 10^{-16} watts
dBrn	relationship of noise to a reference level
dBrnc	crosstalk measurements
dBVg	decibels of voltage gain
VU	1 milliwatt; complex waveforms varying in both amplitude and frequency

TTL to CMOS. Functionally equivalent types

TTL	CMOS	
7400	4011	
7401	40107	
7402	4001	
7404	4009	4049
7406	4009	4049
7407	4010	4050
7408	4081	
7410	4023	
7411	4073	
7420	4012	
7425	4002	
7427	4025	
7428	4001	
7430	4068	
7432	4071	
7437	4011	
7440	4012	
7442	4028	
7445	4028	
7446	4511	4055
7447	4511	4055
7448	4511	4055
7449	4511	4055
7450	4085	
7453	4086	
7454	4086	
7470	4096	
7472	4095	
7473	4027	
7474	4013	
7475	4042	
7476	4027	
7477	4042	
7478	4027	
7483	4008	
7485	4063	
7486	4030	4070
7490	4518	
7491	4015	4094
7493	4520	
7494	4035	
7495	40104	40194
7499	40104	40194
74100	4034	
74104	4095	
74105	4095	
74107	4027	
74110	4095	
74111	4027	
74121	4047	4098
74122	4047	4098
74123	4098	
74125	4502	
74126	4502	
74132	4093	
74136	4030	4070
74141	4028	
74145	4028	
74148	4532	
74150	4067	
74151	4051	4097
74152	4051	4097
74153	4052	
74154	4514	4515
74155	4555	4556
74156	4555	4556
74157	4019	
74164	4015	
74165	4021	
74166	4014	
74167	4527	
74173	4076	
74178	4035	
74179	4035	
74180	40101	
74181	40181	
74182	40182	
74190	4510	
74191	4516	
74194	40104	40194
74195	4035	
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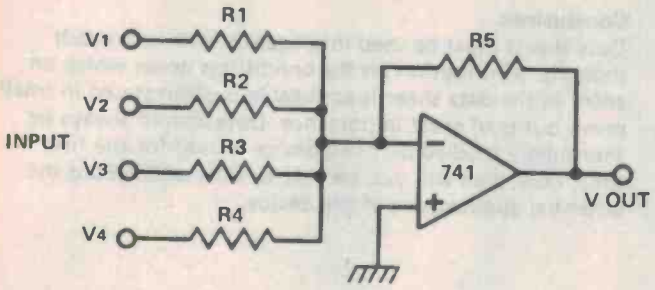
74251	4051	4097
74279	4044	
74283	4008	
74290	4518	
74293	4520	



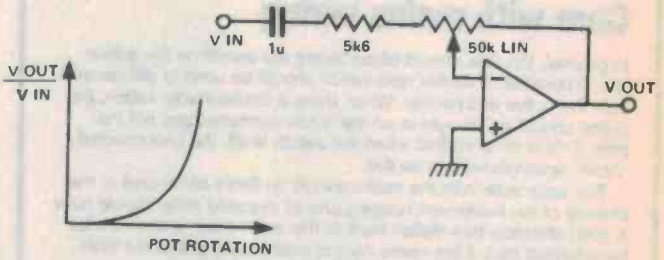
$$V\ OUT = -R5\left(\frac{V1}{R1} + \frac{V2}{R2} + \frac{V3}{R3} + \frac{V4}{R4}\right)$$

Basic summing circuit (mixer)

A virtual earth amplifier can be used to mix several signals together. The output voltage is a mixture of all the inputs. The amount of an input that appears at the output is inversly proportional to the input resistor. If the input voltages are fed into potentiometers before being fed to the mixer, then their individual levels can be manually adjusted. This is the basis of most audio mixers, although the cheaper units use op-amps. Most op-amp mixers will degrade the signal to noise ratio of the signals by more than a good discrete component amplifier.

Turning a linear pot into a log pot

By using the virtual earth characteristic of an op amp, a linear pot can be made to have the characteristics of a log pot. It seems to be fair to say that low cost linear pots are far more linear than log pots are logarithmic. Thus the linear pot can be turned into a better log pot than the actual log pot itself. By varying the resistor ratio 5k6 to 50 k, other laws can be produced, such as something in between log and linear or maybe a law that is even more extreme than log.



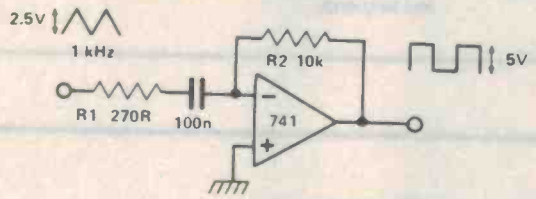


Fig. 11. Simple differentiator.

Simple differentiator

Mathematically, differentiation is the reverse process to integration. Thus, in the differentiator circuit the C and the R are reversed with respect to the integrator circuit.

The input waveform is a triangle with a constant rise and fall slope. This constant slope, when presented to a capacitor will generate a constant current. When the slope direction reverses, then so will the current flow. This current when passed through a resistor (R1), will then generate a square wave.

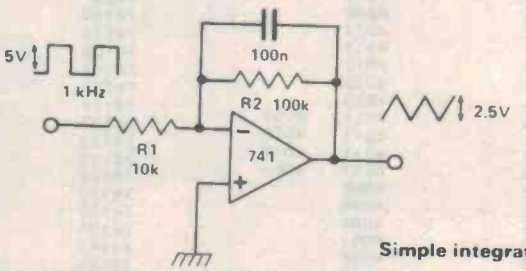
Simple integrator

An opamp and a capacitor can be used to implement, to a high degree of accuracy, the mathematical process of integration. In this case, current is summed over a period of time and the resultant voltage generated is the integral of that current as a function of time. What this means is that if a constant voltage is inputted to the circuit, a ramp with a constant slope is generated at the output. When the input is positive, the output of the opamp ramps negative.

In doing so it pulls the inverting terminal negative so as to maintain a 'virtual earth' condition. In fact the input current (Vin/R1) is being equalled by the current flowing through the capacitor, thus equilibrium is maintained. The equation governing the behaviour of a capacitor is C x dV/dt = I, where dV/dt is the rate of change of voltage across the capacitor.

Therefore $\frac{dV}{dt} = \frac{I}{C}$ Thus $\frac{dV}{dt} = \frac{Vin}{R1C}$

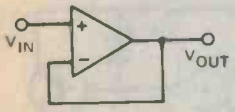
So, when a square wave is applied to the circuit below, triangle waveforms are generated. R2 was added to provide dc stability. Its inclusion does slightly corrupt the mathematical processes,



Simple integrator.

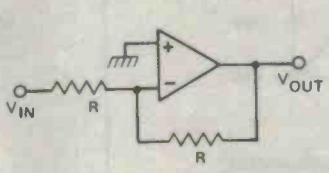
but not enormously. A good point about this integrator design is that it has a very low output impedance. You can put a load on the output and the opamp will still generate the same waveform — that's what is so nice about negative feedback.

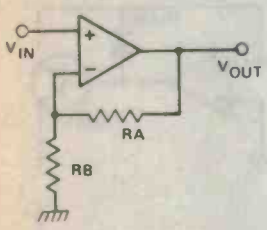
Basic opamp building blocks



Voltage follower/buffer input must have a dc path to ground

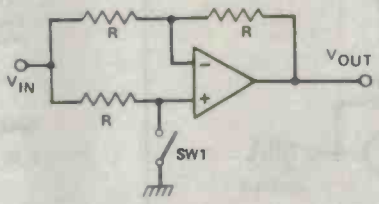
Inverter
Voltage gain = −1
input impedance = R

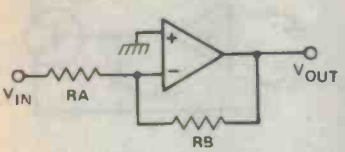




Non-inverting amplifier input must have a dc path to ground
Voltage gain = (RA + RB)/RP

Inverter/non-inverter amplifier
Voltage gain = +1 with SW1 open
Voltage gain = −1 with SW1 closed

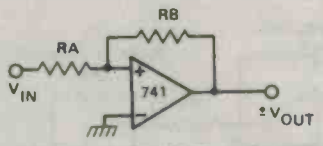




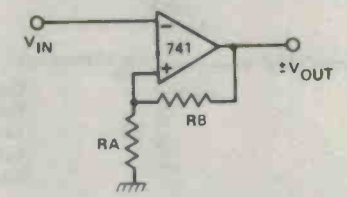
Inverting Amplifier
Voltage gain = −RB/RA
Input impedance = RA

The power supply and compensation are omitted from these diagrams. If internally compensated devices are used no additional compensation is necessary, i.e: 741, TL071, TL072, TL074, etc. If additional compensation is required consult the data sheets on the particular device used.

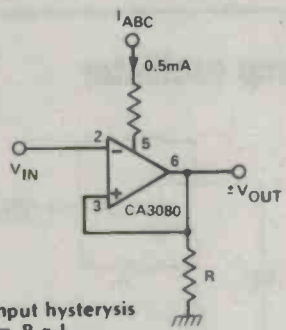
Schmitt triggers



Non-inverting; input hysterysis levels = ±(RA/RB)) x V_{OUT}



Inverting; input hysterysis levels = ±(RA/(RA + RB)) x V_{OUT}
Note that V_{OUT} depends on the supply voltage and the individual op-amp

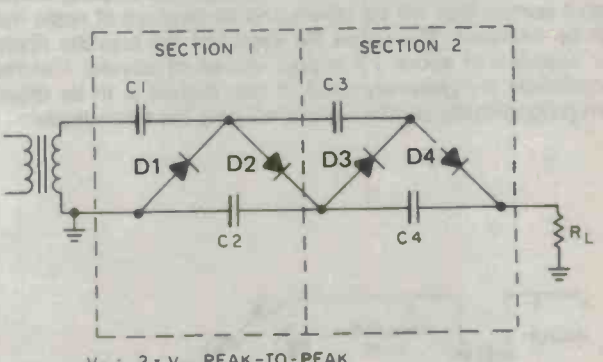


Transconductance type; input hysterysis levels = ±V_{OUT}; V_{OUT} = R x I_{ABC}
R can be replaced by two 1N4148 diodes back-to-back

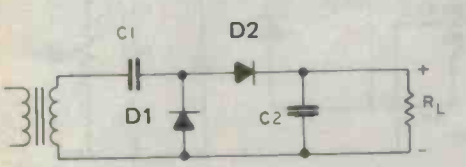
When trying to convert a slowly changing voltage into a step function with a well-defined leading edge a good Schmitt trigger is invaluable. This is a simple but effective trigger capable of good results in the audio passband. Once again, for higher frequency use substitute a faster op-amp for the 741. The Schmitt trigger works by using positive feedback to establish a 'deadband', a range of input voltages within which the output state will not change. The input voltage must exceed the higher limit in order to force the output high. Similarly, the input voltage must be taken below the lower limit to force the output low. The extent of this deadband is given in the equations.

Voltage multiplier

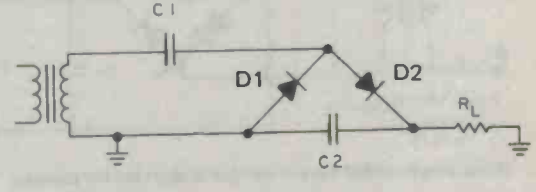
The basic voltage multiplier section shown below effectively doubles the dc voltage that can be obtained by cascading a series of multiplier stages. For instance, if 10 stages were cascaded the dc output would be 10 times that of original voltage. Due to the high output impedance of the circuit only relatively small currents can be drawn.



V_O = 2 x V_{IN} PEAK-TO-PEAK

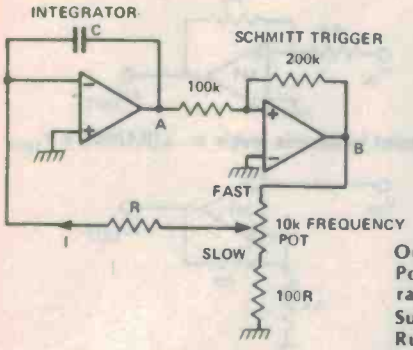


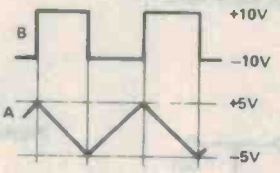
OR SHOWN AS →



$V_O = V_{IN}$ POSITIVE pk + V_{IN} NEGATIVE pk $R_L \rightarrow \infty$

Triangle/square wave generator

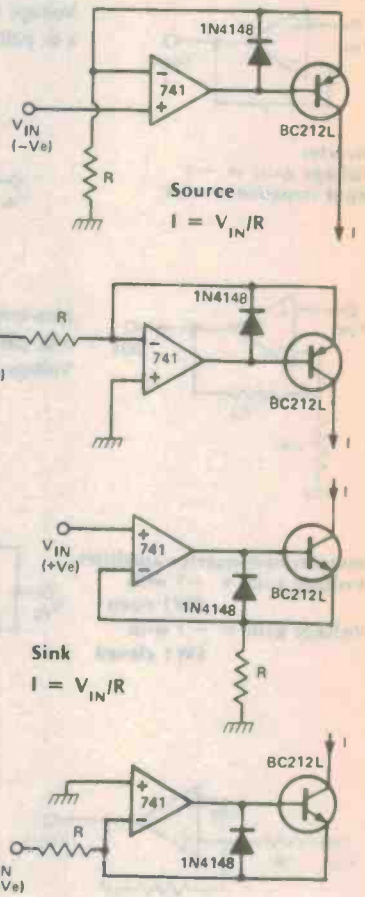




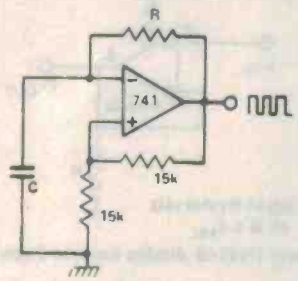
Output frequency F = (pot fraction)/2RC
Pot fraction can be 1/1 to 1/100, giving a 100 to 1 range from the pot
Suitable frequency range = 0.01 Hz to 50 kHz
Run op-amps from ± 12 V

This oscillator provides both triangle and square wave outputs at a frequency that can be varied over a range set by the 10k pot. A dual op-amp such as the TL072 is suitable and would provide frequencies to beyond 50 kHz.

Voltage-to-current converter

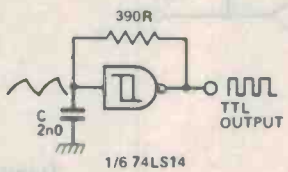


Opamp oscillator



$F \sim \frac{1}{RC}$ (rule of thumb)

TTL oscillator

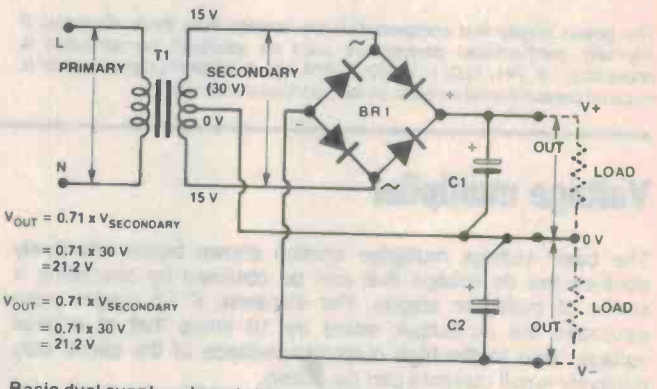


Vary C to change frequency
Do not increase the size of the 390R resistor

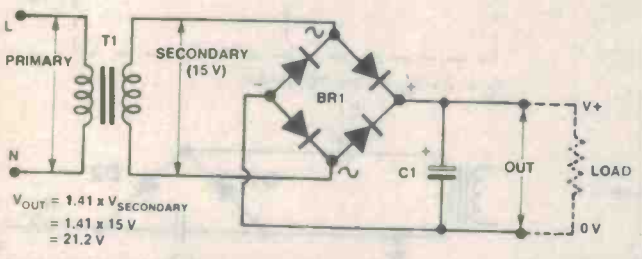
Frequency range = 1 Hz to 1 MHz

Basic power supply

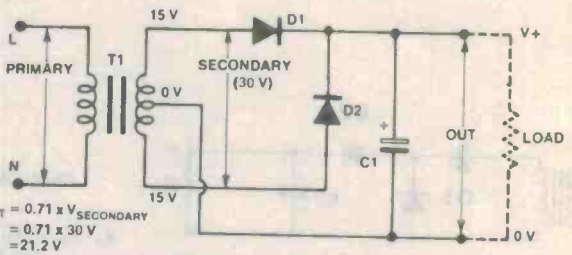
These circuits can provide the basis for a dc supply derived from the mains. The value of the capacitor will depend on the output current that will be drawn and the amount of ripple that can be tolerated. The larger the capacitor the less the ripple. For supplies of about 1 A output values of several hundred microfarads are generally used. If less current is to be drawn then proportionally smaller values will give the same ripple.



Basic dual supply using a bridge rectifier module.

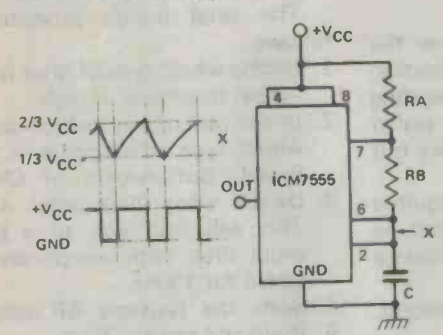


Basic single-ended supply using a bridge rectifier module.



Basic single-ended supply using a centre-tapped transformer.

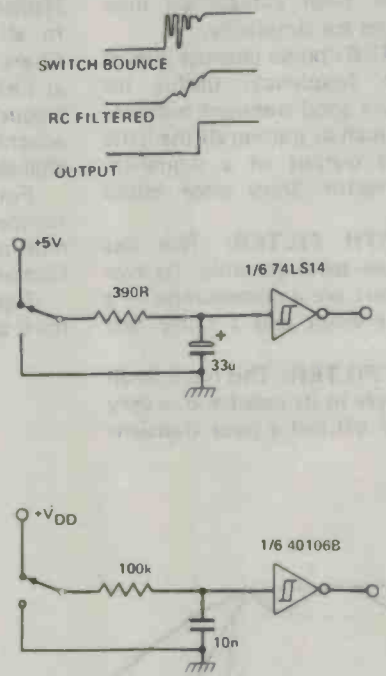
CMOS 555 oscillator



Output frequency F = 1.46/C(RA + RB)
C in farads, R in ohms
Quiescent current ~ 120 uA
Input current ~ 50 pA (this allows the use of resistors up to 10M in value)
Frequency range 0.001 Hz to 500 kHz
Supply range 2 to 18 V
Rise and fall time (pin 3) = 40 ns

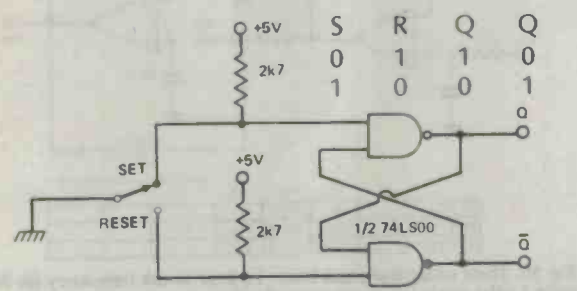
RA,RB	C	F
10M	10u TANT	7.3 mHz
1M0	1u0	0.73 Hz
100k	100n	73 Hz
10k	10n	7.3 kHz
10k	1n0	73 kHz

Debouncing with a Schmitt

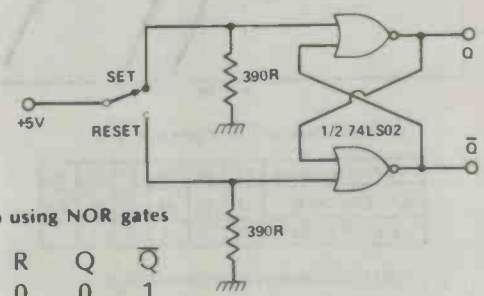


Debouncing with a flip-flop

Flip-flop using NAND gates



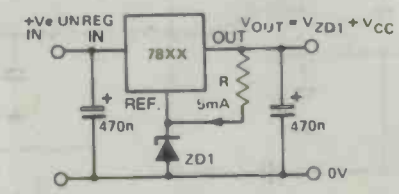
S	R	Q	Q̄
0	1	1	0
1	0	0	1



Flip-flop using NOR gates

S	R	Q	Q̄
1	0	0	1
0	1	1	1

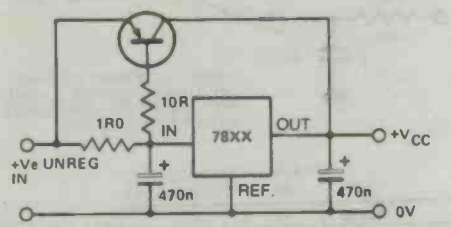
Increasing regulator voltages



Increasing the output voltage using a zener diode.

The output voltage of three-terminal voltage regulators can be increased by increasing the voltage on the reference or common lead on the regulator. This can be done as shown in the circuit diagram with the use of a zener diode. The resistor R should be selected to ensure sufficient current through the zener for a stable voltage reference.

Increasing regulator current



Using a bypass transistor to increase the output current drive. The first 600 mA flows through the regulator, the rest via the external transistor.

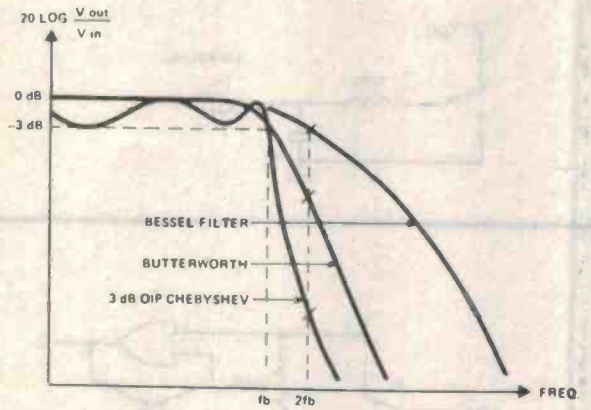
Active Filters

Filters have been categorised into three basic types for simplicity.

BESSEL FILTER: phase changes almost linearly with frequency, useful for systems where a good transient response is required – such as joining all the little pulses on the output of a digital-to-analogue convertor. Very poor initial roll off.

BUTTERWORTH FILTER: This has the flattest pass band possible. Its two other parameters are a compromise – a reasonable overshoot and a fairly fast initial roll-off.

CHEBYSHEV FILTER: This has a small amount of ripple in its pass band, a very fast initial roll off but a poor transient response.

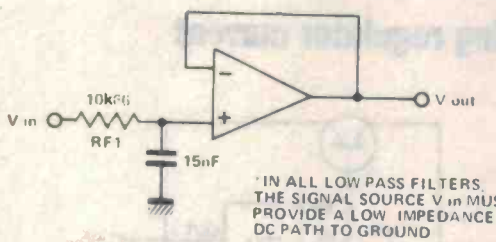


ATTENUATION AT FIRST OCTAVE (2 fb)

*3 dB CHEBYSHEV	17	28	39	51	62	75
BUTTERWORTH	12	18	24	30	36	42
6/FILTER ORDER	2	3	4	5	6	7

*NOTE THE IMPROVED ATTENUATION

Fig 1. Response of all three types of filter discussed, with table showing variation in attenuation between them.



*IN ALL LOW PASS FILTERS THE SIGNAL SOURCE V in MUST PROVIDE A LOW IMPEDANCE DC PATH TO GROUND

	RF	GAIN IN dB	COMPONENT TOLERANCES
BESSEL	10k66	0	10%
BUTTERWORTH	10k66	0	10%
CHEBYSHEV	10k66	0	10%

ALL THE RESPONSES ARE THE SAME FOR A FIRST ORDER FILTER

Fig 2. A general circuit for a first order low-pass filter.

Rolling your own

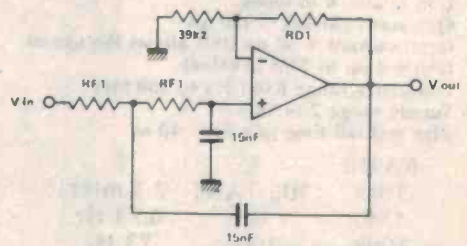
In all the examples which follow the filters have been designed for operation at 1 kHz. To change the operating frequency resistor/s RF must be scaled accordingly (note: resistors RD are not changed).

For example if the filter is required to operate at 250 Hz then RF must be multiplied by $\frac{1000}{250}$. Figure 7 shows a first order low pass filter.

Figure 8a, b, and c shows second, third and fourth order filters.

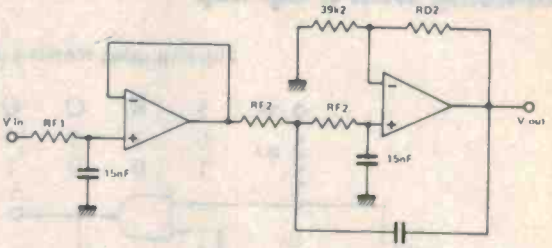
The total design procedure is as follows:

1. Decide which type of filter is required – low, band-pass or high.
2. In the case of low or high-pass decide which type of response is required, Bessel, Butterworth of Chebyshev.
3. Decide what filter order is needed. This will lead you to a particular order filter with components shown scaled for 1 kHz.
4. Scale the resistors RF accordingly.
5. Build and test the filter.



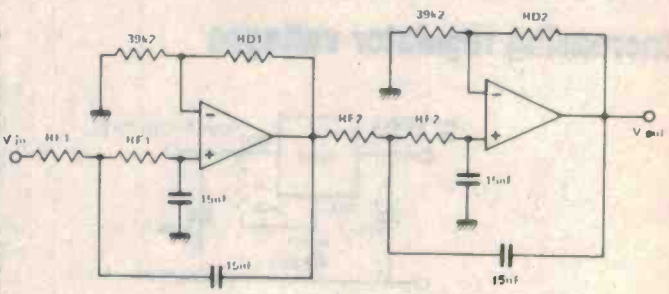
	RF1	RD1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	8k39	10k5	2.3	10%
BUTTERWORTH	10k66	23k6	4.1	10%
CHEBYSHEV	12k6	48k7	6.8	5%

Fig 3a. Second-order low-pass filter design, break frequency = 1 kHz.



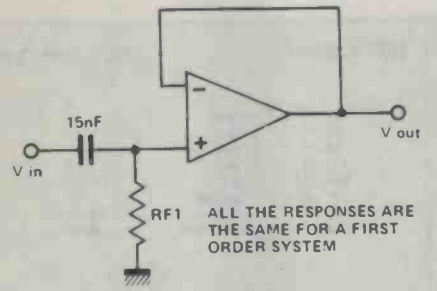
	RF1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	8k	7k26	21k5	4.1	10
BUTTERWORTH	10k66	10k66	39k2	6.0	10
CHEBYSHEV	35k41	11k73	66k5	6.6	2

Fig 3b. Third order low-pass filter. To alter break frequency (in this case 1 kHz) scale resistors accordingly.

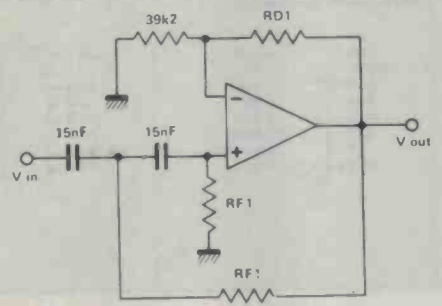


	RF1	RD1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	7k41	3k24	6k60	29k4	5.6	10
BUTTERWORTH	10k66	5k9	10k66	48k7	8.3	5
CHEBYSHEV	24k11	42k2	11k20	71k5	15	1

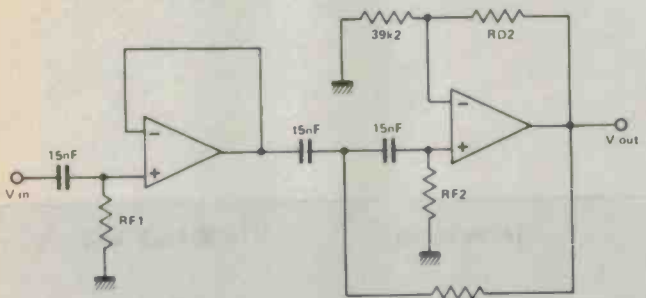
Fig 3c. Fourth order low-pass filter.



	RF1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	10k66	0	10%
BUTTERWORTH	10k66	0	10%
CHEBYSHEV	10k66	0	10%



	RF1	RD1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	13k35	10k5	1.3	10%
BUTTERWORTH	10k66	22k6	1.6	10%
CHEBYSHEV	9k01	48k7	2.2	5%



	RF1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	14k19	15k68	21k5	4.1	10%
BUTTERWORTH	10k66	10k60	39k2	6.0	10%
CHEBYSHEV	3k21	9k70	66k5	8.6	2%

Fig 4. From the top: first, second and third order high-pass filters, break point 1 kHz. Final roll-off is 6, 12, and 18 dB/octave respectively.

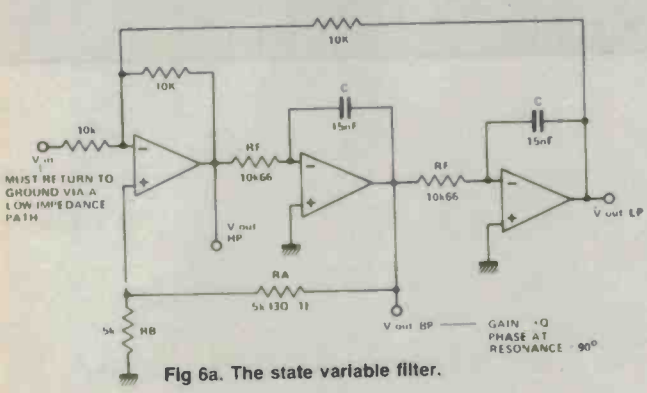
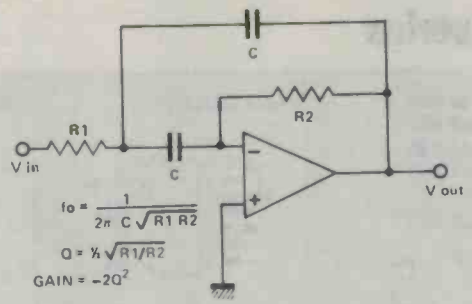
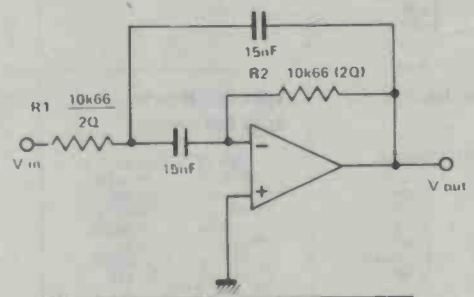


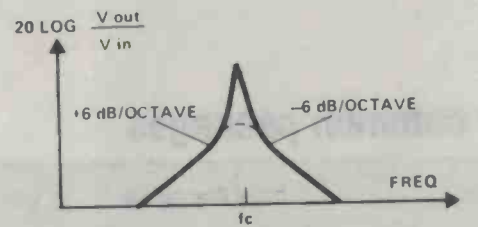
Fig 6a. The state variable filter.

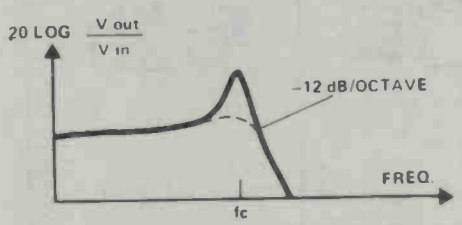




Q	R1	R2	GAIN IN dB
1	5k33	21k32	6 dB
2	2k66	42k66	18.1dB
3	1k77	60k40	25.1 dB
4	1k33	85k33	30.1 dB
5	1k06	106k66	34.0 dB

Fig 5. A multiple feedback bandpass filter. The centre circuit is normalised for 1 kHz. The table is the design table for this circuit. To change the design frequency change R1 and R2 by an equal factor.





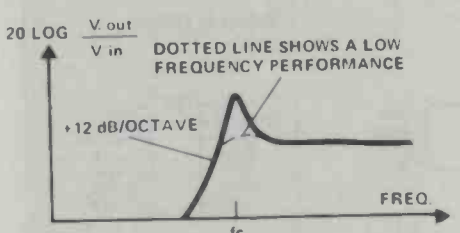
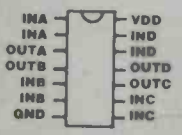


Fig 6b. The state variable filter is called a universal filter because it can give band-, low- and high-pass outputs — as shown above. Note that all these responses are second order.

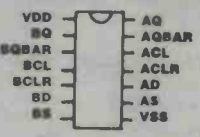
SEMICONDUCTOR PACKAGES

4000 series

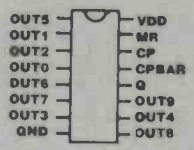
4001 Quad NOR
4011 Quad NAND
4030 Quad XOR
4070 Quad XOR
4071 Quad OR
4081 Quad AND



4013 Dual F/F

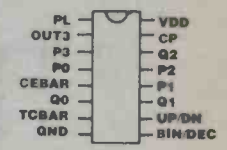


4017 Decade Counter

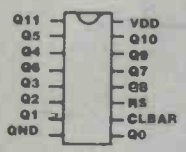


4021 Register

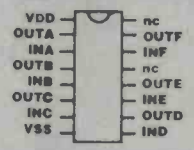
4029 Sync Counter



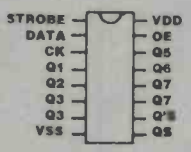
4040 Binary Counter



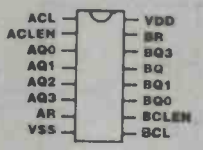
4049 Hex Inverter
4050 Hex Buffer



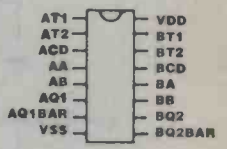
4094 Register



4520 Dual Counter
4518 Dual Counter



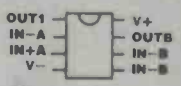
4528 Dual Mono



Other common packages

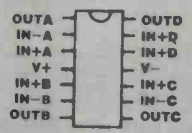
741 Opamp

TL072 Dual Opamp

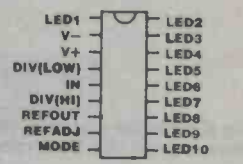


CA 3130 Opamp

LM324 Opamp

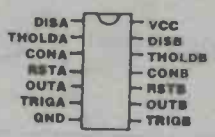


LM3914 LED Bar Driver



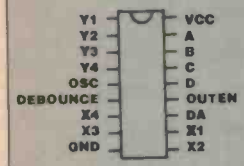
555 Timer

556 Dual Timer

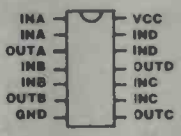


7400 series

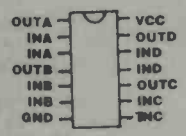
74C922 16 Key Encoder



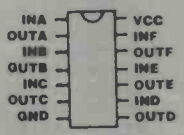
7400 Quad NAND
7408 Quad AND
7432 Quad OR
7437 Quad NAND
7486 Quad XOR
74132 Quad NAND Schmitt



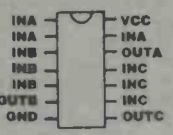
7402 Quad NOR



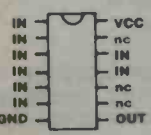
7404 Hex Inverter
7405 Hex Inverter
7414 Hex Schmitt
4069 Hex Inverter
40106 Hex Schmitt



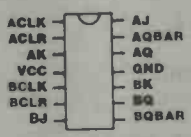
7410 Triple NAND
7411 Triple AND
7427 Triple NOR



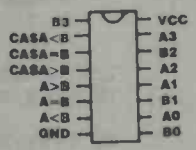
7430 NAND



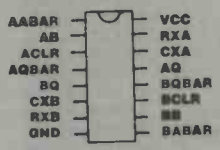
7473 Dual JK



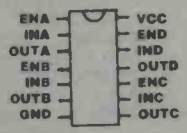
7485 Comparator



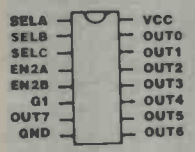
74123 Dual Mono



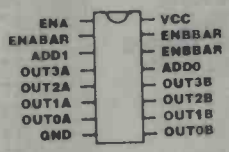
74HC125 Quad Buffer



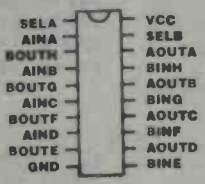
74138 1 of 8



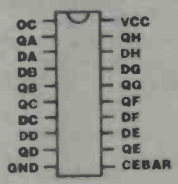
74156 Dual 1 of 4



74244 Octal Buffer



74373 Octal Latch



Regulators

7805, 7812 7815

7905 7912 7915

LM317 LM338

LM340

Transistors

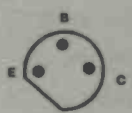
BC548,549,558,559,327,337

TO92

BD140, 139, 138, 137

TO126

2N 3641, 2N 3645



TO105

TIP31, TIP32

TOP66

Australian Frequency Allocations
(9 KHz-235 GHz)

A = AERONAUTICAL
AM = AMATEUR
AS = AMATEUR SATELLITE
B = BROADCASTING
BS = BROADCASTING -SATELLITE
C = CITIZEN BAND RADIO SERVICE
E = EARTH EXPLORATION SATELLITE
F = FIXED
FS = FIXED-SATELLITE
IS = INTER SATELLITE
L = LAND
M = MOBILE
ME = METEOROLOGICAL
MEA = METEOROLOGICAL AIDS
MES = METEOROLOGICAL SATELLITE
MOS = MOBILE-SATELLITE
MT = MARITIME
R = RADIONAVIGATION
RA = ASTRONOMY
RL = RADIOLOCATION
RS = RADIONAVIGATION -SATELLITE
S = STANDARD FREQUENCY AND TIME SIGNAL
SO = SPACE OPERATION
SR = SPACE RESEARCH
SS = STANDARD FREQUENCY & TIME SIGNAL-SATELLITE

Below 9K00	NOT ALLOCATED
9K00-14K00	R
14K00-19K95	F MT M
19K95-20K05	S
20K05-70K00	F MT M
70K00-72K00	R
72K00-84K00	F MT M R
84K00-86K00	R
86K00-90K00	F MT M R
90K00-110K0	R
110K0-112K0	F MT M R
112K00-117K60	R
117K6-126K0	F MT M R
126K0-129K0	R
129K0-130K0	F MT M R
130K0-160K0	F MT M R
160K0-190K0	A R
190K0-200K0	A R
200K0-285K0	A R
285K0-315K0	MT R A R
315K0-325K0	A R MT R
325K0-405K0	A R
405K0-415K0	R
415K0-495K0	MT M A R
495K0-505K0	M
505K00-526K50	MT M A R
526K50-535K00	B
535K00-1606K50	B
1606K50-1705K00	F M RL R
1705K-1800K	F M RL R
1800K-1825K	AM
1825K-1875K	R
1875K-1925K	F M
1925K-1975K	R
1975K-2000K	F M
2000K-2065K	F M
2065K-2107K	MT M
2107K-2170K	F M
2170K00-2173K50	MT M
2173K50-2190K50	MT M
2190K50-2194K00	MT M
2194K-2300K	F M
2300K-2495K	F M B
2495K-2501K	S
2501K-2502K	S
2502K-2505K	S
2505K-2850K	F
2850K-3025K	A M
3025K-3155K	A M
3155K-3200K	F M
3200K-3230K	F M B
3230K-3400K	F M B
3400K-3500K	A M
3500K-3700K	AM
3700K-3900K	F M
3900K-3950K	A M
3950K-4000K	F B
4000K-4063K	F MT M
4063K-4438K	MT M
4438K-4650K	F M
4650K-4700K	A M
4700K-4750K	A M
4750K-4850K	F B
4850K-4995K	F L M B
4995K-5003K	S
5003K-5005K	S
5005K-5060K	F B
5060K-5250K	F
5250K-5450K	F M
5450K-5480K	F A M L
5480K-5680K	A M
5680K-5730K	A M
5730K-5950K	F
5950K-6200K	B
6200K-6525K	MT M
6525K-5685K	A M
6685K-6765K	A M
6765K-7000K	F
7000K-7100K	AM AS
7100K-7300K	B
7300K-8100K	F
8100K-8195K	F MT M
8195K-8815K	MT M
8815K-8965K	A M
8965K-9040K	A M
9040K-9500K	F
9500K-9900K	B
9900K-9995K	F
9995K-10 003K	S
10 003K-10 005K	S
10 005K-10 100K	A M
10 100K-10 150K	F
10 150K-11 175K	F
11 175K-11 275K	A M
11 275K-11 400K	A M
11 400K-11 650K	F
11 650K-12 050K	B
12 050K-12 230K	F
12 230K-13 200K	MT M
13 200K-13 260K	A M
13 260K-13 360K	A M
13 360K-13 410K	F RA
13 410K-13 600K	F
13 600K-13 800K	B
13 800K-14 000K	F
14 000K-14 250K	AM AS
14 250K-14 350K	AM
14 350K-14 990K	F
14 990K-15 005K	S
15 005K-15 010K	S
15 010K-15 100K	A M
15 100K-15 600K	B
15 600K-16 360K	F
16 360K-17 410K	MT M
17 410K-17 550K	F
17 550K-17 900K	B
17 900K-17 970K	A M
17 970K-18 030K	A M
18 030K-18 052K	F
18 052K-18 068K	F
18 068K-18 168K	AM AS
18 168K-18 780K	F
18 780K-18 900K	MT M
18 900K-19 680K	F
19 680K-19 800K	MT M
19 800K-19 990K	F
19 990K-19 995K	S
19 995K-20 010K	S
20 010K-21 000K	F
21 000K-21 450K	AM AS
21 450K-21 850K	B
21 850K-21 870K	B
21 870K-21 924K	A F
21 924K-22 000K	A M
22000K-22 855K	MT M
22 855K-23 000K	F
23 000K-23 200K	F
23 200K-23 350K	A F A M
23 350K-24 000K	F M
24 000K-24 890K	F L M
24 890K-24 990K	AM AS
24 990K-25 005K	S
25 005K-25 010K	S
25 020K-25 070K	F M
25 070K-25 210K	MT M
25 210K-25 550K	F M
25 550K-25 670K	RA
25 670K-26-100K	B

15M AMATEUR BAND
(NOVICE/FULL LIC.)

21 000K-21 150K MORSE
21 150K-21 450K VOICE
21 100K-21 200K US NOVICE

80M AMATEUR BAND
(FULL/LIMITED LIC.)

3500K-3550K MORSE
3525K-3625K NOVICE
3550K-3700K VOICE
3700K-3750K US NOVICE
3794K-3800K FULL LIC.

40M AMATEUR BAND
(FULL LICENCE)

7000K-7035K MORSE
7035K-7300K VOICE
7100K-7150K US NOVICE

30M AMATEUR BAND
(FULL LICENCE)
10 100K-10 150K

160M AMATEUR BAND
(FULL LICENCE)

1800K-1815K MORSE
1815K-1860K VOICE
1825K CALL
1829K CRYSTAL

12M AMATEUR BAND
(FULL LICENCE)
24 890K-24 990K

HF CB CHANNELS

26 965K	1	27 215K	21
26 975K	2	27 225K	22
26 985K	3	27 255K	23
27 005K	4	27 235K	24
27 015K	5	27 245K	25
27 025K	6	27 265K	26
27 035K	7	27 275K	27
27 055K	8	27 285K	28
27 065K	9	27 295K	29
27 975K	10	27 305K	30
27 085K	11	27 315K	31
27 105K	12	27 325K	32
27 115K	13	27 335K	33
27 125K	14	27 345K	34
27 135K	15	27 355K	35
27 155K	16	27 365K	36
27 165K	17	27 375K	37
27 175K	18	27 385K	38
27 185K	19	27 395K	39
27 205K	20	27 405K	40

20M AMATEUR BAND
(FULL LICENCE)

14 000K-14 100K MORSE
14 100K-14 350K VOICE

26 100K-	
26 175K	MT M
26 175K-	
27 500K	F M C
27M50-28M00	MEA F M
28M00-29M70	AM AS
29M700-	
30M005	F M
30M005-	
30M010	SO
30M01-37M50	F M
37M50-38M25	F M
38M25-44M00	F M
44M00-45M00	F M
45M00-50M00	B
50M00-52M00	B
52M00-54M00	AM
54M00-56M00	F M
56M00-70M00	B
70M00-74M00	F M
74M00-74M80	F M
74M80-75M20	A R
75M20-75M40	F M
75M40-85M00	F M
85M00-88M00	B
88M00-	
108M00	B
108M000-	
117M975	A R
117M975-	
136M000	A M

10M AMATEUR BAND
(NOVICE/FULL LIC.)

28 100K-28 600K NOVICE
28 100K-28 200K US NOVICE
28 000K-28 500K US MORSE
28 500K-29 700K VOICE
28 600K DX LISTEN
29 600K FM CALL

27MHZ MARINE

27M680 COMMERCIAL/SHIP-SHORE-SHIP
27M720 FISHING/SHIP-SHORE-SHIP
27M820 FISHING/SHIP-SHIP
27M860 AMATEUR/DISTRESS ALT.
27M880 DISTRESS ONLY
27M900 AMATEUR/SHIP-SHORE-SHIP
27M910 AMATEUR/SHIP-SHORE-SHIP
27M940 AMATEUR/SHIP-SHORE-SHIP
27M960 AMATEUR/SHIP-SHIP
27M980 SURF RESCUE

UHF CB CHANNELS

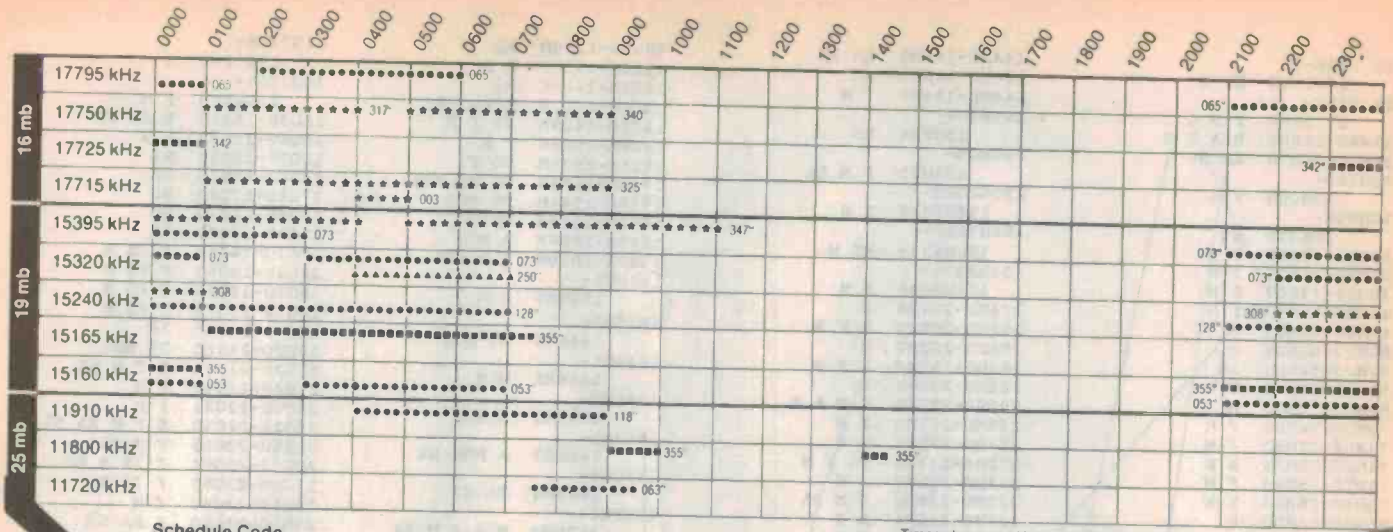
476M425	1	476M925	21
476M450	2	476M950	22
476M475	3	476M975	23
476M500	4	477M000	24
476M525	5	477M025	25
476M550	6	477M050	26
476M575	7	477M075	27
476M600	8	477M100	28
476M625	9	477M125	29
476M650	10	477M150	30
476M675	11	477M175	31
476M700	12	477M200	32
476M725	13	477M225	33
476M750	14	477M250	34
476M775	15	477M275	35
476M800	16	477M300	36
476M825	17	477M325	37
476M850	18	477M350	38
476M875	19	477M375	39
476M900	20	477M400	40

136M0-137M0	A M
137M0-138M0	B SO MES SR
138M0-	
143M6	B F M SR
143M60-	
143M65	B F M SR
143M65-	
144M00	B F M
144M0-146M0	AM AS
146M0-148M0	AM
148M0-149M9	F M
149M90-	
150M05	RS
150M05-	
153M000	F M RA
153M0000-	
156M7625	F M
156M7625-	
156M8375	MT M
156M8375-	
174M0000	F M
174M0-204M0	B
204M0-208M0	A R B
208M0-222M0	B
222M0-225M0	A R B
225M0-230M0	B
230M0-235M0	F M A R
235M0-267M0	F M
267M0-272M0	F M
272M0-273M0	SO F M
273M0-322M0	F M
322M0-328M6	F M RA
328M6-335M4	A R
335M4-399M9	F M
399M90-	
400M05	RS
400M05-	
400M15	SS
400M15-	

VHF TV CHANNELS
(CARRIER/LIMITS)

46M25/ 45M-52M	0
57M25/ 56M-63M	1
64M25/ 63M-70M	2
86M25/ 85M-92M	3
95M25/ 94M-101M	4
102M25/101M-108M	5
138M25/137M-144M	5A
175M25/174M-181M	6
182M25/181M-188M	7
189M25/188M-195M	8
196M25/195M-202M	9
209M25/208M-215M	10
216M25/215M-222M	11

401M00	MEA MES SR
401M0-402M0	MEA SO
402M0-403M0	MEA
403M0-406M0	F M
406M0-406M1	MOS
406M1-410M0	F M RA
410M0-420M0	F M
420M0-450M0	RL
450M0-460M0	F M
460M0-470M0	F M
470M0-520M0	F M C
520M0-585M0	B
585M0-610M0	B R
610M0-820M0	B
820M0-850M0	F M
850M0-890M0	F M
890M0-902M0	F M
902M0-928M0	RL
928M0-942M0	F M
942M0-960M0	F M
960M0-	
1215M0	A R
1215M-1240M	RL RS
1240M-1260M	RL RS
1260M-1300M	RL
1300M-1350M	A R
1350M-1400M	RL
1400M-1427M	E RA SR
1427M-1429M	SO F M
1429M-1525M	F M
1525M-1530M	SO F
1530M-1535M	SO MT MOS
1535M-1544M	MT MOS
1544M-1545M	MOS
1545M-1559M	A MOS
1559M-1610M	A R RS
1610M0-	
1626M5	A R
1626M5-	
1645M5	MT MOS
1645M5-	
1646M5	MOS
1646M5-	
1660M0	A MOS
1660M0-	
1660M5	A MOS RA
1660M5-	
1668M4	RA SR
1668M4-	
1670M0	MEA F M RA
1670M-1690M	MEA F MES M
1690M-1700M	MEA MES
1700M-1710M	F MES
1710M-2290M	F M
2290M-2300M	F M SR
2300M-2450M	F M RL
2450M-2500M	F M RL
2500M-2353M	F FS M BS
2535M-2655M	F M BS
2655M-2690M	F FS M BS
2690M-2700M	E RA SR
2700M-2900M	A R
2900M-3100M	R
3100M-3300M	RL
3300M-3400M	RL
3400M-3600M	RL
3600M-4200M	F FS M
4200M-4400M	A R
4400M-4500M	F M
4500M-4800M	F FS M
4800M-4990M	F M
4990M-5000M	F M RA
5000M-5250M	A R
5250M-5255M	RL
5255M-5350M	RL
5350M-5460M	A R
5460M-5650M	MT N
5650M-5725M	RL
5725M-5850M	RL
5850M-5925M	F FS M
5925M-7075M	F FS M
7075M-7250M	F M
7250M-7375M	FS MOS
7375M-7450M	F FS
7450M-7550M	F FS MES
7550M-7750M	F FS
7750M-7900M	F M
7900M-7975M	FS MOS F
7975M-8025M	FS MOS
8025M-8175M	F FS M
8175M-8215M	F FS MES M
8215M-8400M	F FS M
8400M-8500M	F M SR
8500M-8750M	RL
8750M-9200M	RL MT R
9200M-9300M	RL MT R
9300M-9500M	R
9500M-9800M	RL R
9800M-	
10 000M	RL
10G00-10G45	RL
10G45-10G50	RL
10G50-10G55	F M RL
10G55-10G60	F M
10G60-10G68	E F M RA SR
10G68-10G70	E RA SR
10G70-11G70	F FS M
11G70-12G20	F M B BS
12G20-12G50	FS
12G50-12G75	FS BS
12G75-13G25	F FS M
13G25-13G40	A R
13G40-14G00	RL
14G00-14G30	FS R
14G30-14G40	FS
14G40-14G47	FS
14G47-14G50	FS
14G5000-	
14G7145	F M
14G7145-	
15G1365	M
15G1365-	
15G3500	F M
15G35-15G40	E SR RA
15G40-15G70	A R
15G70-16G60	RL
16G60-17G10	RL
17G10-17G20	RL
17G20-17G30	RL
17G30-17G70	FS
17G70-18G10	F FS M
18G10-18G60	F FS M
18G60-18G80	F FS M
18G80-19G70	F FS M
19G70-20G20	FS
20G20-21G20	FS MOS
21G20-21G40	E F M SR
21G40-22G00	F M
22G00-22G21	F M
22G21-22G50	E F M RA SR
22G50-22G55	F M BS
22G55-23G00	F IS M BS
23G00-23G55	F IS M
23G55-23G60	F M
23G60-24G00	E RA SR
24G00-24G05	AM AS
24G05-24G25	RL
24G25-25G25	F M
25G25-27G00	F M
27G00-27G50	F FS M
27G50-29G50	F FS M
29G50-30G00	FS
30G00-31G00	FS MOS
31G00-31G30	F M
31G30-31G50	E RA SR
31G50-31G80	E RA SR
31G80-32G00	R SR
32G00-32G30	IS R SR
32G30-33G00	IS R
33G00-33G40	R
33G40-34G20	RL
34G20-34G70	RL SR
34G70-35G20	RL
35G20-36G00	MEA RL
36G00-37G00	E F M SR
37G00-37G50	F M
37G50-39G50	F FS M
39G50-40G50	F FS M MOS
40G50-42G50	BS B
42G50-43G50	F FS M RA
43G50-47G00	M MOS R RS
47G00-47G20	AM AS
47G20-50G20	F FS M
50G20-50G40	E F M SR
50G40-51G40	F FS M
51G40-54G25	E SR RA
54G25-58G20	E F IS M SR
58G20-59G00	E SR RA
50G00-64G00	F IS M RL
64G00-65G00	E SR RA
65G00-66G00	E SR
66G00-71G00	M MOS R RS
71G00-74G00	F FS M MOS
74G00-75G50	F FS M
75G50-76G00	AM AS
76G00-81G00	RL
81G00-84G00	F FS M MOS
84G00-86G00	F M B BS
86G00-92G00	E RA SR
92G00-95G00	F FS M RL
95G00-	
100G00	M MOS R RS
100G0-102G0	E R M SR
102G0-105G0	F FS M
105G0-116G0	E RA SR
116G0-126G0	E F IS M SR
126G0-134G0	F IS M RL
134G0-142G0	M MOS R RS
142G0-144G0	AM AS
144G0-149G0	RL
149G0-150G0	F FS M
150G0-151G0	E F FS M SR
151G0-164G0	F FS M
164G0-168G0	E RA SR
168G0-170G0	F M
170G0-174G5	F IS M
174G5-176G5	E F IS M SR
176G5-182G0	F IS M
182G0-185G0	E RA SR
185G0-190G0	F IS M
190G0-200G0	M MOS R RS
200G0-202G0	E F M SR
202G0-217G0	F FS M
217G0-231G0	E RA SR
231G0-235G0	F FS M



Sunday

News, information, entertainment and features presented by Brian Hadden, Warren Moulton, Paul Konik, Michael Cole, Brian Bogle and others from the ABC's Melbourne announcing staff.
Times shown are Universal Time Coordinated.

INFORMATION

World News
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Report From Asia:
Asian events from an Australian perspective. RA's news division presents background reports from our correspondents based in Asia. 0110 UTC.
Business World:
Money, trade and new technology. Economic analysis of Australian and world business developments. 0310 0510 1110 1310 UTC

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
Some Musical Memories:
Dick Williams dips into his collection of favourite records from over the years. 0030 1530 UTC.
Australian Top Hits:
Two hours of the most popular sounds around Australia. 0910 UTC.
Australian Country Style:
A roundup of the Country and Western music scene in Australia presented by Eric Scott. 1930 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
The Week in Science:
Brendon Telfer reports on the latest research in scientific advances in Australia. 1410 1910 UTC.
You Asked For It:
Denis Gibbons and Desley Blanch answer listeners' questions about Australia and its people. 0010 UTC.
Talkback:
Barry Seeber presents a program for DXers and shortwave listeners everywhere. 0210 0530 0810 1210 2110 UTC.
Books and Publishing:
Geraldine Coutts looks at contemporary Australian publishing. 0330 UTC.
Short Story:
A series presenting various Australian short stories. 0730 1710 2230 UTC.
Sports Magazine:
A roundup of events in sports, from Australia and around the world. 0610 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 1130 1640 2130 UTC.

Monday

News, information, entertainment and features presented by Rick Dowling (1900-2300 UTC), Barry Clarke (2330-0400 UTC), Rob Hoskin (0400-0900 UTC), Suzanne Dowling (0910-1100 UTC), Barry Seeber (1100-1500 UTC) and Peter Cavanagh (1500-1900 UTC).
Times shown are Universal Time Coordinated.

INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Four Corners:
In-depth analysis of international issues. The how and why of current world events and trends. 0010 0210 1210 1810 2010 2210 UTC.
Australian Insight:
The issues and attitudes behind Australian news events. How Australians see themselves and the world. 1110 1310 1510 1710 1910 2310 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
Australian Country Style:
A roundup of the Country and Western music scene in Australia presented by Eric Scott. 0030 0530 UTC.
Soundabout:
Two hours of young, contemporary music from Australia and around the world presented by Suzanne Dowling. 0910 UTC.
Jazz Australia:
Ralphe Rickman presents the finest of Australian jazz. 1530 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
The Week in Science:
Brendon Telfer reports on the latest research in scientific advances in Australia. 0110 0730 UTC.
Short Story:
A series presenting various Australian short stories. 0330 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0810 1128 1410 1610 2110 UTC.
Adams at Large:
A look at Australian life through the eyes of writer, film maker and patron of the arts, Phillip Adams. 1130 UTC.
Arts News:
Events and happenings in the Australian Art arena, presented by Trevor Robertson. 1412 2112 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 0310 0845 1150 2130 UTC.

Tuesday

News, information, entertainment and features presented by Rick Dowling (1900-2300 UTC), Barry Clarke (2330-0400 UTC), Rob Hoskin (0400-0900 UTC), Suzanne Dowling (0910-1100 UTC), Barry Seeber (1100-1500 UTC) and Peter Cavanagh (1500-1900 UTC).
Times shown are Universal Time Coordinated.

INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Four Corners:
In-depth analysis of international issues. The how and why of current world events and trends. 0010 0210 1210 1810 2010 2210 UTC.
Australian Insight:
The issues and attitudes behind Australian news events. How Australians see themselves and the world. 1110 1310 1510 1710 1910 2310 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
Jazz Australia:
Ralphe Rickman presents the finest of Australian jazz. 0030 0530 UTC.
Soundabout:
Two hours of young, contemporary music from Australia and around the world presented by Suzanne Dowling. 0910 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
Arts News:
Events and happenings in the Australian Art arena, presented by Trevor Robertson. 0330 0730 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0110 0810 1128 1410 1610 2110 UTC.
Australian Inventor:
Keith Smith reports on new Australian inventions. 1412 2112 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 0310 0845 1150 2130 UTC.

Wednesday

News, information, entertainment and features presented by Rick Dowling (1900-2300 UTC), Barry Clarke (2330-0400 UTC), Rob Hoskin (0400-0900 UTC), Suzanne Dowling (0910-1100 UTC), Barry Seeber (1100-1500 UTC) and Peter Cavanagh (1500-1900 UTC).
Times shown are Universal Time Coordinated.

INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
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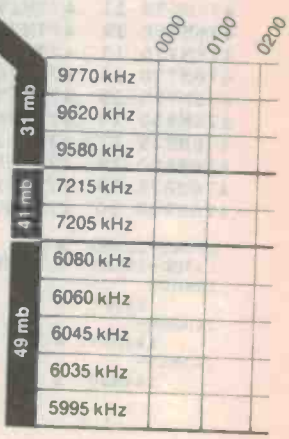
Four Corners:
In-depth analysis of international issues. The how and why of current world events and trends. 0010 0210 1210 1810 2010 2210 UTC.
Australian Insight:
The issues and attitudes behind Australian news events. How Australians see themselves and the world. 1110 1310 1510 1710 1910 2310 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
Some Musical Memories:
Dick Williams dips into his collection of favourite records from over the years. 0530 UTC.
Soundabout:
Two hours of young, contemporary music from Australia and around the world presented by Suzanne Dowling. 0910 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
Australian Inventor:
Keith Smith reports on new Australian inventions. 0330 0730 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0110 0810 1128 1410 1610 2110 UTC.
You Asked For It:
Denis Gibbons and Desley Blanch answer listeners' questions about Australia and its people. 1412 2112 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 0310 0845 1150 2130 UTC.



RADIO AUSTRALIA

Thursday

News, information, entertainment and features presented by Rick Dowling (1900-2300 UTC), Barry Clarke (2330-0400 UTC), Rob Hoskin (0400-0900 UTC), Suzanne Dowling (0910-1100 UTC), Barry Seeber (1100-1500 UTC) and Peter Cavanagh (1500-1900 UTC).
Times shown are Universal Time Coordinated.

INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Four Corners:
In depth analysis of international issues. The how and why of current world events and trends. 0010 0210 1210 1810 2010 2210 UTC.
Australian Insight:
The issues and attitudes behind Australian news events. How Australians see themselves and the world. 1110 1310 1510 1710 1910 2310 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature program is
Soundabout:
Two hours of young, contemporary music from Australia and around the world presented by Suzanne Dowling. 0910 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
You Asked For It:
Denis Gibbons and Dooley Blanch answers listeners' questions about Australia and its people. 0330 0730 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0110 0810 1128 1410 1610 2110 UTC.
Letters to the Editor:
A selection of the more interesting or amusing letters that have appeared in the Australian press. 1412 2112 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 0310 0845 1150 2130 UTC.

Friday

News, information, entertainment and features presented by Rick Dowling (1900-2300 UTC), Barry Clarke (2330-0400 UTC), Rob Hoskin (0400-0900 UTC), Suzanne Dowling (0910-1100 UTC), Barry Seeber (1100-1500 UTC) and Peter Cavanagh (1500-1900 UTC).
Times shown are Universal Time Coordinated.

INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Four Corners:
In-depth analysis of international issues. The how and why of current world events and trends. 0010 0210 1210 1810 2010 2210 UTC.
Australian Insight:
The issues and attitudes behind Australian news events. How Australians see themselves and the world. 1110 1310 1510 1710 1910 2310 UTC.
The Week in Canberra:
A review of events in the national capital. RA's news division reporting what Australia's political leaders are saying and doing. 1410 1810 2010 2210 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
Australian Concert Hall:
A program of fine music featuring Australian musicians and composers, arranged and presented by Don Taylor. 0530 1430 UTC.
Soundabout:
Two hours of young, contemporary music from Australia and around the world presented by Suzanne Dowling. 0910 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
Australia Fair:
Tim Cousens talks to people about Australian exports to the world. 0112 0730 UTC.
Letters to the Editor:
A selection of the more interesting or amusing letters that have appeared in the Australian press. 0330 0610 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0110 0810 1128 1610 2110 UTC.
Calling Antarctica:
Mary Adams presents a weekly program for Australians based in the Antarctic. 0200 UTC (15410 and 11885 kHz) 0400 UTC (15240 and 15410 kHz) 0915 UTC (6045 kHz).
Bill Belcher's Band Bazaar:
The best of band music from around the world. 2230 UTC.
Sports Magazine:
A roundup of events in sport, from Australia and around the world. 1612 UTC.
Sports Scoreboard:
A roundup of Australian and international sporting results. 0310 0845 1150 2130 UTC.
This Australia:
Series about life, culture and industry in Australia. 2112 UTC.

Saturday

News, information, entertainment and features presented by Brian Hadden, Warren Moulton, Paul Konik, Michael Cole, Brian Bogle and others from the ABC's Melbourne announcing staff.
Times shown are Universal Time Coordinated.

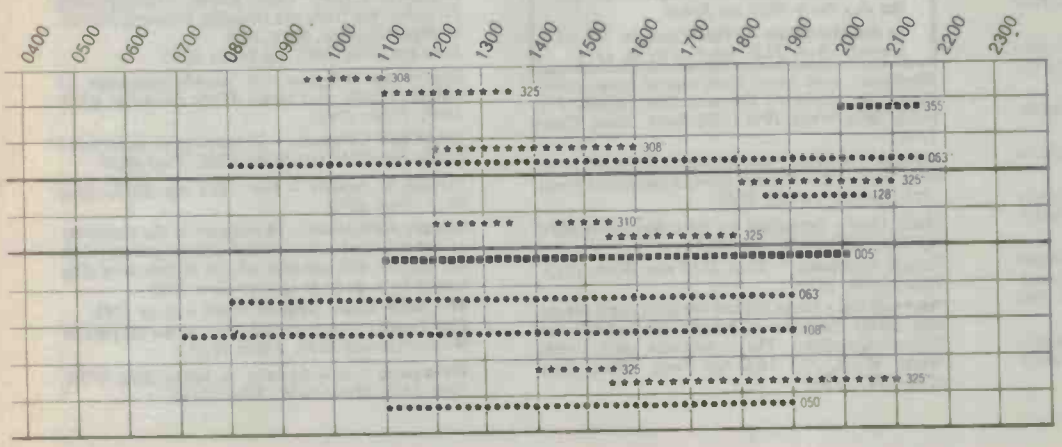
INFORMATION

World News:
Ten minute bulletins every hour on the hour.
World and Pacific News:
Ten minute bulletins at 0900 1000 1800 1900 2000 UTC on frequencies directed to the Pacific.
Australian News:
Ten minute bulletins at 0130 0430 0830 1230 1630 1830 2030 2330 UTC.
Australian Editorial Opinion:
The opinions of the opinion-moulders: what Australia's major newspapers are saying about world and national events. 0210 0410 1110 1310 UTC.
Report from Asia:
Asian events from an Australian perspective. RA's news division presents background reports from our correspondents based in Asia. 1410 1710 2010 2310 UTC.
The Week in Canberra:
A review of events in the national capital. RA's news division reporting what Australia's political leaders are saying and doing. 0010 0310 UTC.

ENTERTAINMENT

Radio Australia plays popular music from Australia and around the world. Today's feature programs are:
International Top Hits:
Two hours of the most popular hits around the world presented by Paul Konik. 0910 UTC.
Australian Concert Hall:
A program of fine music featuring Australian musicians and composers, arranged and presented by Don Taylor. 2230 UTC.
Bill Belcher's Band Bazaar:
The best of band music from around the world. 0530 1530 UTC.

Topical interviews and selected feature programs are presented in all sessions. Today's special listening:
This Australia:
Series about life, culture and industry in Australia. 0330 0610 1810 UTC.
Adams at Large:
A look at Australian life through the eyes of writer, film-maker and patron of the arts, Phillip Adams. 0510 1510 1910 UTC.
Books and Publishing:
Geraldine Coutts looks at contemporary Australian publishing. 0730 1430 1730 UTC.
Australia Fair:
Tim Cousens talks to people about Australian exports to the world. 1210 UTC.
Stock Exchange Report:
Latest prices from the Melbourne Stock Exchange. 0110 UTC.
Sports Magazine:
A roundup of events in sport, from Australia and around the world. 0112 2110 UTC.
Saturday Sports:
Reports and commentaries from major sporting events around Australia today. 0200 0730 UTC on 17750, 17715 and 15240 kHz. (One hour earlier January and February 1985.)
Sports Scoreboard:
A roundup of Australian and international sporting results. 0840 UTC (17750, 17715 15240 6045 kHz) and 1130 UTC.
Talkback:
Barry Seeber presents a program for DXers and shortwave listeners everywhere. 1610 UTC.



Radio Australia is the international shortwave service of the Australian Broadcasting Corporation.
The station operates around the clock from modern studios in Melbourne, broadcasting to tens of millions of listeners all over the world in nine languages: English, Indonesian, Standard Chinese, Cantonese, Neo Melanesian, French, Thai, Japanese and Vietnamese. The present daily output is 50 hours of programs.
Programs in all services range through a broad spectrum of information, education and entertainment, presented in an informal style which has become Radio Australia's much-praised hallmark. The news service and public affairs programs have an unrivalled reputation for accuracy and reliability. Feature programs reflect many facets of Australia, its people and their lives, and the music is drawn from all over the world. The station ranks amongst the most popular and respected of shortwave broadcasters.
Frequencies and transmission times for all services are published separately in the Radio Australia transmission schedule. Occasionally a frequency or program is changed. These changes are announced regularly on air prior to commencement.
Write to Radio Australia for free transmission schedules, program guides for all services and publicity material. Aerial booklets, which explain how to erect an outside aerial to improve shortwave reception, are also available. We like to hear your comments about our programs. Our address is Radio Australia, 699 Highbury Road, Burwood East, Vic 3151. Post: G.P.O. Box 428G, Melbourne 3001 Australia. Telephone: +61 3 235 2222. Telex: RADAUS 30470

BBC World Service

WORLD NEWS – broadcast daily in the World Service. *0000, 0200, 0300, 0500, 0700, 0800, 0900, 1100, 1300, 1600, 1700, 2000, 2200, 2300;* **NEWSDESK** – a half-hour programme including World News and despatches from overseas and UK correspondents. *Daily 0400, 0600, 1800;* **News Summary** – *0100, 1000, 1200, 1400, 1900, 2100*

All times GMT

TWENTY-FOUR HOURS – analysis of the main news of the day *daily 0509, 0709, 1309, 2009*

THE WORLD TODAY – examines thoroughly one topical aspect of the international scene *Mons to Fris 1645 rep 2209, Tues to Fris 0145 (South Asia), Tues to Sats 0315, 0545, 0915*

COMMENTARY – background to the news from a wide range of specialists *daily 1609, 2309*

RADIO NEWSREEL – news of events as they happen and despatches from BBC correspondents all over the world *daily 0015, 0215 (South Asia) 1200 (ex Suns), 1500*

NEWS ABOUT BRITAIN *daily 0009, 0309, 1109*

OUTLOOK – an up-to-the-minute look at people, events and opinions together with the latest UK news, sport and weather *Mons to Fris 1400, 1900, Tues to Sats 0100*

BRITISH PRESS REVIEW – survey of editorial opinion in the Press *daily 0209, 0909*

FINANCIAL NEWS – including news of commodity prices and significant moves in currency and stock markets *Mons to Fris 2230 rep Tues to Sats 0445, Mons to Sats 0930*

FINANCIAL REVIEW – a look back at the financial week *Suns 0445, rep 2230*

STOCK MARKET REPORT *Mons to Fris 1939*

Australia New Zealand

MHz	00	01	02	03	04	05	06	07	08	09	10	11	GMT	13	14	15	16	17	18	19	20	21	22	23	24	MHz	Metres
21.550	►	►	►	►	►	►	E	E	E	E	E	E	E	►	►	G	G	G	G	►	►	►	►	►	►	21.550	13.92
15.310	►	►	►	►	►	►	►	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	►	15.310	19.60
15.280	►	►	►	►	►	►	►	►	►	F	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	15.280	19.63
15.070	►	►	►	►	►	►	►	►	►	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	15.070	19.91
11.955	►	►	►	►	►	►	►	G	G	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	11.955	25.09
11.775	►	►	►	►	►	►	►	►	►	►	►	►	U	U	U	U	U	U	U	►	►	►	►	►	►	11.775	25.48
11.750	►	►	►	►	►	►	►	►	►	F	F	F	F	F	F	F	F	►	►	►	►	►	►	►	►	11.750	25.53
9.915	►	►	►	►	►	►	G	G	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	9.915	30.26
9.640	►	►	►	►	►	►	►	G	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	►	9.640	31.12
9.570	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	9.570	31.35
9.510	►	►	►	►	►	U	U	U	U	U	U	U	U	U	U	U	U	U	U	►	F	F	F	F	►	9.510	31.55
9.410	►	►	►	►	G	G	G	G	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	►	9.410	31.88
7.150	►	►	►	►	►	►	►	G	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	►	7.150	41.96
7.145	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	►	7.145	41.99
6.175	►	►	►	►	►	U	U	U	U	U	U	U	►	►	►	►	►	►	►	►	F	F	F	F	►	6.175	48.58
5.975	►	►	►	►	►	►	►	G	G	G	G	G	G	►	►	►	►	►	►	►	►	►	►	►	►	5.975	50.21

About Britain – looks back on some of the week's events *Fris 1945 rep Sats 0030, 0530, 1115*

Anything Goes – a variety of music and much more. Write to Bob Holness at World Service *Sats 1215 rep Mons 0330, 0830*

Assignment – a major weekly examination of subjects of importance *Weds 2030 rep Thurs 0230, 1130, 1615*

Book Choice – four editions each week: *Sun 2225 rep Mon 1709; Wed 0440; Mon 2225 rep Tues 0540; Tues 2110 rep Thurs 0140; Wed 1740 rep Thurs 2100; Fri 0145*

Business Matters – a weekly survey of commercial and financial news *Thurs 2030 rep Fris 0330, 1030*

Classical Record Review – Edward Greenfield reviews new releases *Suns 1015 rep Suns 1900, Weds 0815, Thurs 0430*

Development '85 – *Mons 1115 rep 1545, Tues 0815, Fris 0215*

The Farming World – *Tues 1840 rep Weds 1225 Thurs 0640, Thurs 2340*

From Our Own Correspondent – BBC correspondents comment on the background to the news. *Sats 2209 rep Suns 0315, 0730, 1115*

From the Weeklies – a review of the British weekly press *Fris 2315 rep Sats 0730*

Good Books – recommendation of a book to read *Mon 0315 rep 0915, Wed 1945, 2315*

Jazz for the Asking – Peter Clayton plays listeners' jazz requests *Sats 2030 rep Suns 0630, Fris 1215*

John Peel – selects tracks from newly released albums and singles from the progressive rock scene in Britain *Tues 0330 rep Thurs 0830, Fris 1330*

A Jolly Good Show – Dave Lee Travis presents pop news, interviews and your requests *Sats 0815 rep Tues 1515, Thurs 2115*

Regular Sports Programmes

Saturday Special – Sats 1515, 1615
Sports Round Up *daily 1245 (ex Suns) 1745, 2245; Suns 1330*
Sports International *Mons 2030 rep Tues 0230, 1130*

Letterbox – listeners' opinions on World Service programmes *Fris 1445 rep Sats 0145, 2315, Mons 0530*

A Letter from.... – explores a theme arising from the week's events in Scotland, Wales, England and Northern Ireland in turn. *Tues-Fris 1125 rep 1709, 2225*

Letter from America – *Sats 1015 rep Suns 0545, 1645, 2315*

Merchant Navy Programme *Thurs 2315 rep Fris 0745, 1015*

Look Ahead previews programmes for the day *daily 0939 (ex Suns)*

In the Meantime – What's new on World Service *Thurs 2105 rep Fris 0150, 1115*

Meridian – each week, three topical programmes about the world of the arts *Sats, Weds, Fris 0630; Sats, Weds, Fris 1130; Suns, Tues, Thurs 1715*

Monitor – a weekly survey and analysis of comment from radio stations around the world *Weds 1715 rep Thurs 0145, 0945*

Music Now – presented by John Amis *Fris 0030 rep Fris 0830, 2115, Sat 1400*

Nature Notebook – *Tues 1830 rep Weds 1215, Thurs 0630, 2330*

Network UK – looks behind the issues and events that affect the lives of people throughout the United Kingdom. Three editions each week *Mons, Weds, Fris 2100 rep Tues, Thurs, Sats 0215, 0745, 1330*

Omnibus – each week a half hour programme on practically any topic under the sun. *Tues 1615 rep 2030, Wed 0030, 1000*

People and Polics – background to the British political scene with reports on Parliament. *Sats 0230 rep 1030, 2130*

The Pleasure's Yours – write to Gordon Clyde for your classical requests *Suns 0815 rep 2115, Thurs 1515*

Recording of the Week – a personal choice from the new releases *Sats 0045 rep Mons 0545, Tues 1345, Weds 2145*

Reflections – a daily consideration of the meeting point between religion and life *daily 0455 rep 0809, 2240, Suns 1709*

Religious Services – Church of the Holy Spirit, Hubberston, Milford Haven, South Wales (Rev Bill Lewis) *3rd;* Remembrance Service from Sidwell Street Methodist Church, Exeter (Rev Ron Dale) *11th;* Bangor Abbey, County Down, Northern Ireland (Rev David Chillingworth) *17th;* Service from the Ursuline Convent School, Westgate-on-Sea, Kent *24th*
Suns (ex 10th) 1030 rep Mons 0030

Report on Religion – a weekly magazine of religious news and views *Weds 0130 rep 0730, 1445, Thurs 1945*

Sarah and Company – 30 minutes of guests and music *Fris 1715 rep Mons 0730, Tues 0030*

Science in Action – *Fris 1615 rep 2030, Suns 0915, Mon 0230*

Sunday Half-Hour – 30 minutes in the company of schools and local church congregations with the history and message of the hymns they sing traced by a guest presenter *Suns 2030*

The Sandi Jones Request Show – *Suns 1345*

Top Twenty – records and news of the hit parade *Weds 1830 rep 2330, Thurs 1215.*

Waveguide – how to hear us better *Suns 0750, Tues 1115, Weds 0430, Thurs 0130*

Voice of America

(GMT) FREQUENCY Asterisk (*) Indicates medium wave

ENGLISH PROGRAMS

SOUTH ASIA

SUNDAY	MONDAY-FRIDAY	SATURDAY
(0100-0300) 7205; (0100-0400) 7115, 11710, 15160, 15215, 15250, 17735, 21540; (0300-0400) 7200.		
0100 News 0110 Sunday Morning 0130 News Summary/Sunday Morning 0200 News 0210 Sunday Morning 0230 News Summary/Sunday Morning 0300 News 0310 VOA Morning 0330 News Summary/VOA Morning 0357 News Summary	0100 News 0110 Morning Newsline 0130 VOA Morning 0200 News 0210 Morning Newsline 0230 VOA Morning 0300 News 0310 Morning Newsline 0330 VOA Morning 0357 News Summary	0100 News 0110 VOA Morning 0130 News Summary/Sunday Morning 0200 News 0210 VOA Morning 0230 News Summary/Sunday Morning 0300 News 0310 VOA Morning 0330 News Summary/VOA Morning 0357 News Summary
(1300-1500) 7125; (1300-1700) 9760, 15205; (1300-1900) 9645, 9700, 15395; (1400-1900) 6110; (1500-1900) 7105; (1530-1600) 1575.		
1300 News 1310 International Viewpoints 1330 Studio One 1400 News & Editorial 1415 The Concert Hall 1500 News 1510 New Horizons and New Products 1530 Music USA Standards 1600 News 1610 International Viewpoints 1630 Special English News & Features 1700 News 1710 Critic's Choice 1730 Issues in the News 1800 News 1810 Focus 1830 Special English News & Features	1300 News 1310 Newsline America 1330 Magazine Show 1400 News & Editorial 1415 Music USA Jazz 1500 News 1510 Newsline 1530 Music USA 1600 News 1610 Focus 1630 Special English News & Features 1700 News 1710 Newsline 1730 Magazine Show 1800 News 1810 Focus 1830 Special English News & Features	1300 News 1310 Weekend 1400 News & Editorial 1415 Music USA Jazz 1500 News 1510 This Week 1530 Press Conference U.S.A. 1600 News 1610 American Viewpoints 1630 Special English News & Features 1700 News 1710 Weekend 1800 News 1810 Closeup 1830 Special English News & Features

EAST ASIA

SUNDAY	MONDAY-FRIDAY	SATURDAY
Northeast Asia (2200-0100) 17820, 17740, 15290, (2200-2400) 15305; 1st Sun. (1700-1800) 6110, 9545, 11920; *Southeast Asia* (2200-0100) 7275, 9770, 15185; (2300-0100) 1575; *Indonesia* (2200-0100) 11760; *Oceania* (2200-2400) 11760, 15303, 17740.		
2200 News 2210 VOA Morning 2230 Special English News & Features 2245 VOA Morning 2300 News 2310 VOA Morning 2330 Special English News/VOA Morning 0000 News 0010 VOA Morning 0030 Special English News & Features 0045 VOA Morning	2200 News 2210 Morning Newsline 2230 Special English News & Features 2245 VOA Morning 2300 News 2310 Newsline 2330 Special English News/VOA Morning 0000 News 0010 Morning Newsline 0030 Special English News & Features 0045 VOA Morning 0057 News Summary	2200 News 2210 VOA Morning 2230 Special English News & Features 2245 VOA Morning 2300 News 2310 VOA Morning 2330 Special English News/VOA Morning 0000 News 0010 VOA Morning 0030 Special English News & Features 0045 VOA Morning
Northeast Asia (1100-1330) 11715; (1100-1500) 9760, 15425; *Southeast Asia* (1100-1500) 7230, 9760, 15160; (1100-1200) 1575; (1100-1230 and 1400-1500) 1143; 1st Sun. (1700-1800) 1143, 1575, 6110, 9545; *Indonesia* (1100-1400) 6110; (1100-1500) 15160; (1700-1800) 7260, 9545, 9575; *Oceania* (1100-1330) 11715; (1100-1400) 6110, 15160; 1st Sun. (1700-1800) 6110, 7260, 9545, 9575.		
1100 News 1110 New Horizons and New Products 1130 Issues in the News 1200 News 1210 Critic's Choice 1230 Special English News & Features 1300 News 1310 International Viewpoints 1330 Studio One 1400 News & Editorial 1415 The Concert Hall	1100 News 1110 Newsline 1130 Music USA 1200 News 1210 Focus 1230 Special English News & Features 1300 News 1310 Newsline America 1330 Magazine Show 1400 News & Editorial 1415 Music USA Jazz	1100 News 1110 This Week 1130 Press Conference USA 1200 News 1210 American Viewpoints 1230 Special English News & Features 1300 News 1310 Weekend 1400 News & Editorial 1415 Music USA Jazz

(GMT) FREQUENCY Asterisk (*) Indicates medium wave

OTHER LANGUAGE BROADCASTS

FAR EAST, SOUTHEAST ASIA, OCEANIA

BURMESE (1200-1300) 11895, 15210, 17740.
CHINESE (2200-0100) 6130, 7200, 9545, 11925, 15395; (1000-1200) 17740; (1000-1600) 6185, 7285, 9555, 9660, 11965, 15410.
INDONESIAN (2200-2330) 9620, 11805, 15155; (1100-1200) 9630, 11895, 15210; (1400-1500) 6030, 9730, 15105.
KHMER (2200-2230) 1575*, 6015, 6100, 7225, 9630, 11775; (1400-1500) 1575*, 7240, 9620, 11930.
KOREAN (2130-2200) 6110, 9545, 15215, 11925, 17780; (2330-2400) 11805, 15155, 17780; (1330-1400) 6030, 9725, 15250.
LAO (1130-1230) 1575*, 9620, 11930, 15250.
THAI (2330-2400) 11775, 15215, 17810.
VIETNAMESE (2230-2330) 7225, 9630, 11775; (1230-1330) 15250; (1230-1330 and 1530-1630) 1143*, 7230, 9620, 11930; (1500-1600) 6120.

SOUTH ASIA

BENGALI (0130-0230) 15185, 17785, 21630, (1600-1700) 1575*, 7230, 9545, 11965, 15185.
DARI (0145-0230) 7105, 9540, 9705, 11780, 15225; (1515-1600) 9680, 11845, 15435, 17845; (2300-2330) 1260*, 6160, 7265, 9530, 11865.
HINDI (0030-0100) 5985, 7105, 7210, 11780, 15225; (0100-0130) 15185, 17785, 21630; (1600-1700) 9680, 11835, 15435, 17810.
PASHTO (0000-0030) 1260*, 6015, 7105, 9635, 11780, 15225; (0100-0145) 6015, 7105, 9540, 11780, 15225; (1430-1515) 11845, 15435, 17845, 21610.
URDU (0230-0300) 9540, 9705, 11780, 15225, 17830; (1330-1430) 11845, 15435, 17810, 21610.

RADIO MOSCOW BROADCASTS TO AUSTRALIA AND NEW ZEALAND

Daily Features	
NEWS	Every hour on the hour
NEWS IN BRIEF	Every hour on the half-hour
NEWS & VIEWS	04.10; 07.10; 10.10; 14.10; 18.10; 21.00; 00.10
NEWSREEL (week-days)	02.10; 06.10; 09.10; 12.10; 16.10; 19.10; 23.10
SOVIET WAY OF LIFE	01.10; 05.10; 13.10; 15.10; 22.10
THE WAY WE SEE IT	03.10; 08.10; 11.10; 17.10; 20.10
FOCUS ON ASIA	01.30; 15.30; 23.30

Weekly Features		
MAILBAG	MON, FRI	02.30; 06.30; 12.30; 19.30
SCIENCE & ENGINEERING	MON	04.30; 09.30; 16.30; 22.30
	WED	02.30; 06.30; 12.30; 19.30
ROUND ABOUT THE USSR	TUE	02.30; 06.30; 12.30; 19.30
	THU	04.30; 09.30; 16.30; 22.30
CULTURE AND THE ARTS	TUE	04.30; 09.30; 16.30; 22.30
	THU	02.30; 06.30; 12.30; 19.30
SPOTLIGHT ON SPORTS	FRI	04.30; 09.30; 16.30; 22.30
DISARMAMENT — THE ISSUE OF THE DAY	SAT	19.10
	SUN	02.10; 09.10; 16.10; 23.10
	MON	02.10; 06.10; 09.10; 12.10
RUSSIAN BY RADIO	SAT	19.30; 00.30
	SUN	03.30; 09.30; 16.30
AUDIO BOOK CLUB	SAT	06.30; 17.30; 22.30
	SUN	13.30; 20.30
	MON	03.30; 11.30
MARXISM TODAY	SAT	04.30; 09.30; 16.30
	SUN	02.30; 06.30; 12.30; 19.30; 22.30
27th PARTY CONGRESS	SUN	17.10; 20.10
	MON	03.10; 08.10; 11.10
YOUTH PARADE	SAT	15.10; 22.10
	SUN	01.10; 05.10; 13.10
	WED	19.30
	THU	04.30; 09.30; 16.30; 22.30
PROGRAMME GUIDE	SAT	17.10
	SUN	03.10; 08.10; 11.10
LISTENERS' FORUM	SAT	16.10; 23.10
	SUN	06.10; 12.10; 19.10
DX PROGRAMME	SAT	16.20; 23.20
	SUN	06.20; 12.20; 19.20
JAZZ SHOW	TUE	07.30; 14.30; 18.30; 21.30
	SAT	07.30
	SUN	21.30
MUSIC AT YOUR REQUEST	WED	07.30; 14.30; 18.30; 21.30
LISTENERS' REQUEST CLUB (bi-weekly)	SAT	18.30
	SUN	10.30
FOLK BOX	THU	07.30; 14.30; 18.30; 21.30
	SAT	14.30
	SUN	07.30
MUSIC & MUSICIANS	FRI	07.30; 14.30; 18.30; 21.30
	SAT	10.30
	SUN	18.30
YOUR TOP TUNE	SAT	02.40; 12.40; 15.40; 20.40
	SUN	01.40; 04.40; 11.40; 17.40
	MON	13.40
MUSICAL QUIZ "WHAT? WHERE? WHEN?"	SAT	04.40; 09.40; 16.40
	SUN	02.40; 06.40; 12.40; 19.40; 22.40

TIME in UTC	FREQ in MHz
00.00-01.00	17.73; 17.85; 12.01; 9.70
01.00-02.00	21.53; 17.73; 17.85; 15.22; 12.01
02.00-05.00	21.53; 17.73; 17.85; 15.22; 15.51
05.00-08.00	21.64; 17.64; 17.73; 17.85; 15.22
08.00-09.00	21.67; 17.75; 17.85; 15.22; 15.28
09.00-10.00	21.67; 17.75; 15.22; 15.28; 15.49; 15.51; 9.79
10.00-11.00	21.58; 21.67; 17.75; 15.28; 15.49; 15.51; 9.79
11.00-12.00	21.67; 15.28; 15.49; 15.57; 9.79
12.00-13.00	17.67; 15.28; 15.57; 9.79
20.00-21.00	7.29
21.00-22.00	17.85; 11.86; 7.29
22.00-23.00	17.85; 13.71; 11.86; 9.70; 7.29
23.00-24.00	17.73; 17.85; 11.85; 12.01; 9.70; 7.29

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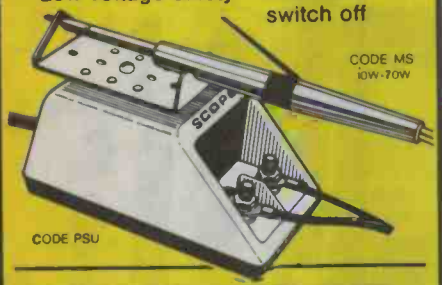

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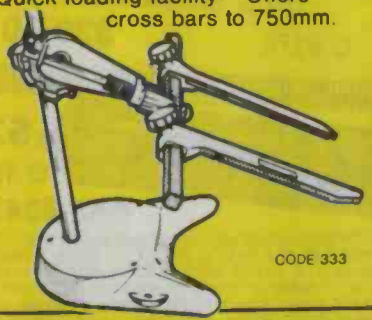
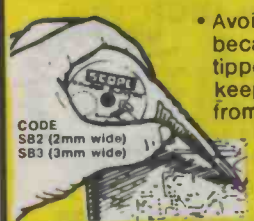


SOLDER BLOTTER

2 M IN WIND BACK DISPENSER



- Avoid burnt fingers because metal tipped container keeps fingers away from iron tip
- Dispenser locates tape positively

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R65C24P1	6.61
R65C24P2	7.71
R65C51P1	12.27
R65C51P2	13.53
R65C52P1	22.03
R65C52P2	24.86

HIGH LEVEL LANGUAGE CIRCUITS	
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R65F11AP	35.72
R65F12Q	42.33
R65F12AQ	46.58
R65FR1P	97.25
R65RT2P	97.25
R65FR3P	97.25
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Page: 256 Year: 1984

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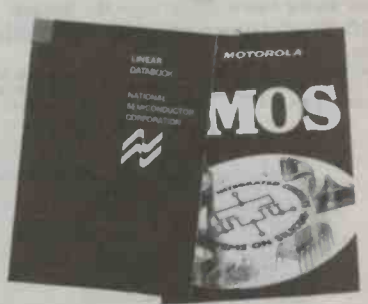

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M 3075	40V + 40V	160W	45.50	43.50
M 3080	45V + 45V	160W	45.50	43.50
M 3085	12V + 12V	300W	55.00	52.50
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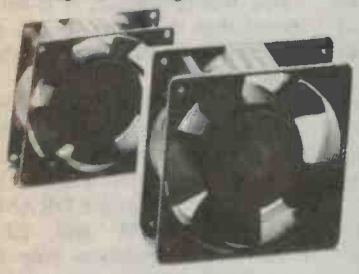

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If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.
TECHNICAL INFORMATION Illumination: 22W Fluorescent **Weight:** 8.16kg **Lateral Extension:** 254mm **Vertical Extension:** 254mm **Fixing:** Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

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Introducing FRAM

At a recent symposium held in Sydney, Ross Lynden-James, chairman of Newtech Developments, announced the creation of the world's first 1K ferro electric random access memory (FRAM).

Newtech is heavily funded by North Queensland sugar farmers. It is the parent company of a grab bag of high and low tech companies both in Australia and the United States. Flagship of the US branch is Amtec Securities, which directly controls Ramtron Inc, of Colorado Springs.

Ramtron was set up in 1984 to develop FRAM into a commercial technology. Its attributes look like a wish-list from a computer memory designer. It is non-volatile, uses a single 5 volt rail, has symmetrical read and write speeds in the vicinity of 100 nanoseconds and should cost no more to fabricate than conventional DRAM.

The path that took Newtech to FRAM weaves a bit, but illustrates the part luck can play in business. In the 1960s Norm Shubring was working at the General Motors Research labs when he discovered some rather interesting properties in the substance potassium nitrate (KN03). For various chemical reasons he discovered that if he created a very thin film of the stuff he could get a memory-like effect. It was the early 1960s, however; silicon was the rage, and Shubring found himself working on other things.

It was left to George Rohrer and his company called Technovation to develop the material further all through the 1960s and 70s. He made the product stable (Schubring's product only lasted for a few days), and he reduced the working voltage down to TTL levels. He also built 1024-bit arrays.

In fact, by the early 1980s Rohrer was able to demonstrate a memory cell with some pretty interesting characteristics. Of particular interest was its non-volatility. It didn't need battery power to retain information.

He succeeded in getting General Motors interested again in the technology. GM, as an auto maker, has special interests in non-volatile memory. The new generation of car will depend heavily on electronics for all sorts of functions, so the idea that the contents of memories could be made independent of the state of the batteries was especially attractive.

However, GM is a big company and slow to act. Newtech's US advisors had heard of the deal between GM and the tiny Ramtron company, and decided to move in. The result was the purchase of some of the most exciting memory technology in sight. GM's interest hasn't slackened either, so Newtech could be sitting on rather a large goldmine.

Rohrer's work used shadow mask technology and achieved switching speeds in the order of microseconds. To make practical memory circuits, speeds in the order of nanoseconds are required so during the last year efforts have been made to apply new technologies to the process. This is the technology of integrated ferro electrics, in which the ferroelectric thin film is used only as a storage medium, and a silicon substrate is used for the logic and decoding circuits. Using this technique, it is estimated that switching speeds as fast as 10 picoseconds can be achieved.

The technology owned by Newtech is thought to be worth millions in the world's marketplace, since it would effectively take all the market for DRAM, SRAM, EPROM and EEPROM. The question now is how long before commercial products start to flow out of Colorado Springs. Directors of the company are naturally coy about specific dates, but informally suggested that the next few years could be very interesting.

AWA optical fibre modem

AWA's FIE8 optical fibre RS232 modem is totally powered by receive and transmit data signals.

The user simply plugs the FIE8 modem to the back of an RS232 outlet or computer peripheral and connects the fibre cable for the system to be fully operational.

The first of the FIE8's has been successfully installed in South Australia's Queen Elizabeth Hospital. The FIE8 provides the hospital with communications bandwidth adequate for the hospital's present needs, while allowing for future extension to higher speed communications links and possible local area network application over optical fibre links.

Additional applications for the FIE8 modem include its use in offices, by the military and in the petro-chemical and mining industries. Harsh electrical environments such as factories, processing plants and power stations are also potential users.

AWA is looking at the export potential of the FIE8 modem, with interest being shown by major overseas users in the USA, UK, Japan and Canada.

3½-inch Winchester for Mac

Apple Computer has announced the new Hard Disk 20, an external 3½-inch 20 megabyte Winchester disk drive for connection to the standard disk drive port of the Macintosh.

The Hard Disk 20 is three inches high and stores as much information as 50 Macintosh floppy disks. The unit has the same footprint as the Macintosh and is designed to fit under the computer. An expansion port on the back of the hard disk allows a second Hard Disk 20, a back-up tape device or an external floppy disk drive to be connected to the system.

The disk comes with a hierarchical filing system that manages thousands of files without complex partitioning schemes. This new Macintosh finder and file system enables any number of files and folders to be stored on the hard disk.

For further information contact **Apple Australia, 37 Waterloo Rd, North Ryde, NSW 2113. (02)888-5888.**

AUSGRAPH 86

Ausgraph 86, the fourth Australasian computer graphics conference and exhibition, is to be held in Sydney from 7-11 July 1986.

Ausgraph 85, held in Brisbane in August, attracted over 500 delegates, more than double the figure expected by the organisers, with delegates coming from all around Australia as well as New Zealand, South-East Asia, US, UK and Europe.

"We were all delighted by the success of the Brisbane conference," said conference chairman, Harry Hvistendahl, "and because next year's venue is Sydney, we expect an even bigger turnout and are prepared to cater for double the number of exhibitors and visitors. The amazing thing about Ausgraph is the feeling of excitement generated by both the conference and the exhibition," he said. "Computer graphics is still a comparatively new field in Australia, and the visual impact and effects which can be generated by the technology open up all sorts of possibilities for professionals from many different fields."

The Ausgraph 86 conference is being held in the Sydney Hilton hotel, with the exhibition taking place in the nearby Sydney Town Hall.

A call for papers for Ausgraph is already being distributed worldwide. The conference will cover the areas of introduction to computer graphics, graphics standards and interfaces, graphics in mapping and exploration, computer graphics in publishing, CAD with microcomputers, input-output devices, graphics workstations, image processing, video and animation techniques, CAD with interactive graphics, business graphics, and expert systems.

For further information, contact Ausgraph 86 Conference Secretariat, PO Box 29, Parkville, Vic 3052. (03)387-9955.

CLUB CALL

TISHUG (Texas Instruments Sydney Homecomputer Users' Group) will have reached its 5th birthday as of May 1986. It has catered for users of the Texas Instruments 99/4(a) Home Computer and clones, and now provides assistance to owners of the TI Professional.

The Texpac Electronic Magazine (BBS) operates between the hours of 7 pm and 6.30 am Monday and Tuesday, then non-stop from Wednesday 7 pm through to Monday morning 6.30 am. Access is available to any member of Australia's TI user groups who fills a registration form and pays an annual fee of $5.

Membership to TISHUG is $8 joining fee and $22 pa. For all club enquiries, readers can contact PO Box 149, Pennant Hills, NSW 2120 or phone ah (02)848-0965.

The **Sydney Microbee User Group** (SMUG) advises that its former editor and president Colin Tringham has resigned and the new president is David Butler. The club's mailing address is PO Box, C233 Clarence St, Sydney, NSW 2000. Telephone numbers are: David Butler (02)638-2993 (7.30 pm to 9 pm, Mon to Fri except Wed) and W. Saillard (02)810-4758 (7.30 pm to 9.30 pm Mon to Fri). The group meets 3rd Saturday monthly at Strathfield Girls' High School hall 1 pm to 5 pm.

BRIEFS

LAN file server

Lancore's PC-Core frees the host computer from storage management and networking overhead tasks by providing a mass storage and tape backup system driven by a processor. It features a high performance 75 Mbyte Winchester drive and a 60 Mbyte streaming tape drive and is housed in an attractive desktop or tower mount cabinet. Off-peak backup routines may be programmed in via an inbuilt timer which also manages the system during the activity. For further information contact Daneva Australia, 47 Falcon St, Crows Nest, NSW 2065. (02)957-2464.

18-channel fibre optic multiplexer

The IFS S18000 fibre optic multiplexer is a high performance alternative to conventional multi-channel RS232C transmission media such as twisted pair line drivers, statistical multiplexers and modems. It can simultaneously transmit and receive up to 18 RS232C data signals over two optical fibres. Each input is sampled at a rate of 500 kilosamples/s so that data can be transmitted at rates up to 100 kbps. For more information contact Integral Fibre Systems, 2 Thomas St, Chatswood, NSW 2067.

TOC gets aggressive

Time Office Computers, maker of the Kookaburra portable computer, has embarked on an aggressive marketing program that has seen the cost of the 80186 based computer drop to $795. This makes it the cheapest portable on the market in Australia, as well as one of the most powerful. TOC also has plans to equip new generation Kookaburras with a 1M RAM disk in the near future.

Series line filter

The Tycor power line filter is designed to remove the decaying oscillatory transients and spikes as well as common mode noise which together constitute about 98% of the microprocessor problems attributable to interference through the mains power supply. For further information contact Electromark Pty Ltd, PO Box 184, Mortdale, NSW 2223. (02)570-7287.

MAKING YOUR MICROBEE TALK

Imagine how much better your games would be if your computer actually spoke to you! Well it's possible to make your 'Bee speak in your own voice! How? Using digital recording techniques. Best of all this requires no extra hardware!

Jon McCormack

SPEECH SYNTHESISERS HAVE been around for a while, yet still they have a few faults to be ironed out. Nine times out of 10 you can't understand a thing they say. And the worst part is they have American accents. Some of the more expensive units produce acceptable speech (listen to the new TI computer and you'll see what I mean), but alas the price!

One alternative to buying a speech synthesiser is to digitally record your own voice (or someone else's) and then have the computer play it back at your leisure. This method also has some disadvantages. The worst is that analogue-to-digital (and vice versa) converters are expensive and chew up huge amounts of memory. For example, suppose we have 8-bit resolution and we wish to record the human voice over a bandwidth of, say, 300-3300 Hz. It can be shown mathematically (honest) that if the incoming signal is limited so that its highest frequency is f Hz, a pulse train of 2f pulses/s will allow the waveform to be reconstructed. Therefore, for our maximum frequency of 3300 Hz, we require 6600 samples per second.

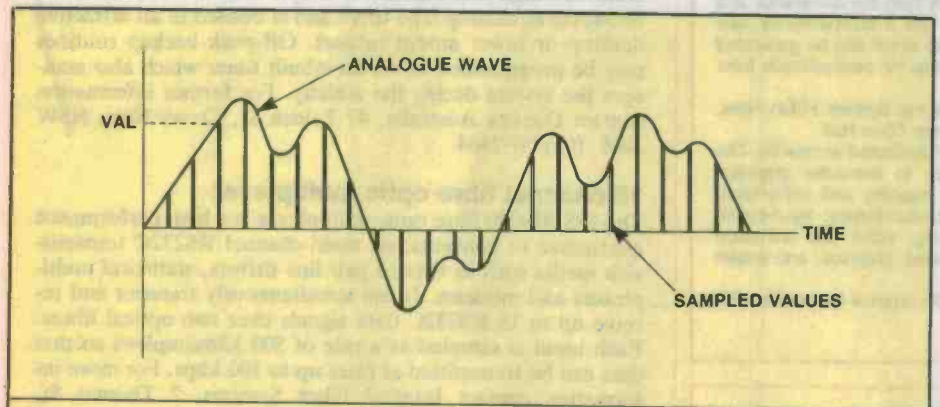


Figure 1. Sampling analogue waves. Each line shows the value of the waves' amplitude when sampled. These sampled values are converted to binary (quantising) and can then be stored in a computer.

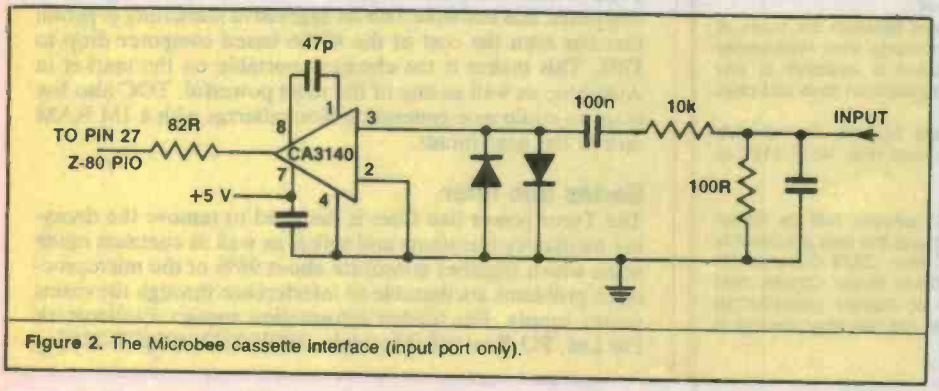


Figure 2. The Microbee cassette interface (input port only).

Each time an analogue waveform is 'sampled' the value of its amplitude is taken and the number rounded to the closest integral value from the chosen resolution. In the case of 8-bit resolution this would be a value between 0 and 255. Now each of these binary values represents the analogue waveform in digital form. The part where the wave is sampled is called 'sampling' (funny about that!), the part where the waveform is approximated is called 'quantising' and the final step when the value is converted to computer readable form is called 'encoding'.

These three steps make up what is the commonest form of digital recording — pulse coded modulation (PCM), as used in compact discs, the American telephone system, etc. Figure 1 shows the outline of this process.

Back to the problem of memory — if we have 8-bit resolution (1 byte), and sample at 6600 samples per second, we use up about 6K of memory per second! This means that a 32K computer could hold a little less than 5 seconds of speech!

Speech on the Microbee

The program described here is a very simple type of PCM — its resolution is 1 bit! Despite this resolution the results are still acceptable; the quality is about the same as over the telephone (sometimes slightly better). Before describing the program, let's look at two parts of input/output on the Microbee.

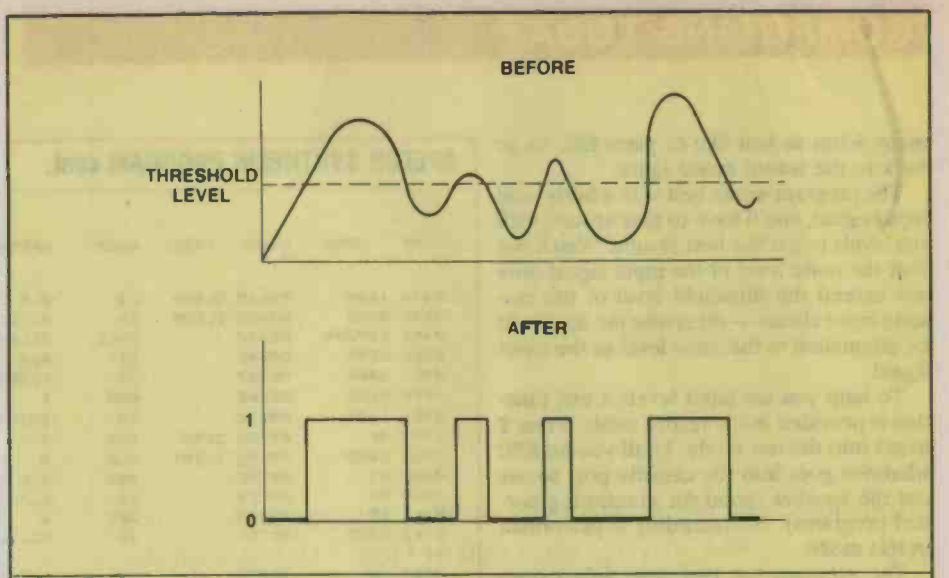


Figure 3. An input wave after input from the cassette interface. As can be seen, the amplitude is lost, only the frequency remains. The output is 1 if the value of the wave is above the threshold level, 0 if not.

Port B of the Z80 PIO chip on the 'Bee handles the common forms of input/output. The eight bits of this port are used for the cassette interface, the RS232 port, network interrupting and for the Microbee speaker. We are interested in the speaker bit and the cassette input bit.

First the cassette input. Figure 2 shows the circuit diagram of the input port. Its effect is to attenuate the input signal and square up the input waveform. The diodes protect the computer from overloads. Figure 3 shows how an input wave form looks after this process. Amplitude information (whether the wave is on or off) and wave shape are lost. Only the frequency of the input wave is left. Thus the stored digital waveform has no dynamic range (all sounds are the same volume) made up entirely of square waves.

The speaker output situation is similar. If an 'on' (1) bit is output to the speaker the cone moves forward, and 'off' (0) means the speaker moves backwards.

Despite these shortfalls it's still possible to record speech. (Recording other sounds like complex music is pushing it a bit far.)

The program

For what it does the program is very simple. Type the program in as it appears (there's no need to use Edasm — you can use the monitor or BASIC poke statements and enter the 'CODE' column). Before your run it, save it especially if you use Edasm, as the recorded signal will overwrite the source program.

To run just JUMP to address 400 hex. The screen will clear and an introductory message will be displayed. Now you'll need to connect the cassette input plug to the output of an amplifier of some kind which has a microphone input. Once your microphone and amplifier are connected up press any key to start recording. As soon as you press a key the 'Bee will digitally record whatever is being input.

When available memory has been used up a new message will be displayed on the screen. Press any key to play the recorded information. With some luck you should hear what you said into the mic while recording. You can play the message as ▶

SPEECH SYNTHESIS PROGRAM

```
ADDR   CODE     LINE   LABEL    MNEM     OPERAND

                00100 ;        Digital speach recorder
                00110 ;-----------------------------------------
                00120 ;        by Jon McCormack, August 1984.
                00130 ; Input from cassette interface, output to mbee speaker
                00140 ;
0001            00150 TIME     EQU      1              ;Delay between samples
0600            00160 BLOCK    EQU      600H           ;Start of storage area
3000            00170 SIZE     EQU      3000H          ;Size of storage block.
                00180 ;
0006            00190 WTKEY    EQU      0006H          ; Get key in A reg.
001B            00200 ESC      EQU      27             ; Esc key.
000C            00210 DISP     EQU      000CH          ; Display B reg. on VDU
0009            00220 INKEY    EQU      0009H          ;Test if key down
                00230 ;
0400            00235          ORG      400H
0400 119704     00240 BEGIN    LD       DE,RECMES      ;Address of message
0403 CD2204     00250          CALL     PRINT          ;Show message
0406 CD0600     00260          CALL     WTKEY          ;Wait for key press
0409 FE54       00270          CP       'T'            ;Check if test mode
040B 281F       00280          JR       Z,TEST
040D CD4704     00290          CALL     RECORD         ;Record
0410 111505     00300 REPT     LD       DE,PLYMES      ;Print play message
0413 CD2204     00310          CALL     PRINT
0416 CD0600     00320          CALL     WTKEY          ;Wait for key press
0419 FE1B       00330          CP       ESC            ;Quit yet ?
041B 28E3       00340          JR       Z,BEGIN        ;Yes - goto start
041D CD6D04     00350          CALL     PLAY           ;else play message
0420 18EE       00360          JR       REPT           ;Ask to play again
                00370 ;
0422 1A         00380 PRINT    LD       A,(DE)         ;Print message on screen
0423 B7         00390          OR       A              ;Test if zero
0424 C8         00400          RET      Z              ; if so return
0425 47         00410          LD       B,A
0426 CD0C00     00420          CALL     DISP           ;Disp char on screen
0429 13         00430          INC      DE
042A 18F6       00440          JR       PRINT          ;Print next char
                00450 ;
042C 11F304     00460 TEST     LD       DE,TSTMES      ;Print test message
042F CD2204     00470          CALL     PRINT
0432 DB02       00480 TLOOP    IN       A,(2)          ;Get port data
0434 CB47       00490          BIT      0,A            ;Is bit set ?
0436 3E00       00500          LD       A,0            ;Zero A,don't change flag
0438 2802       00510          JR       Z,NOSET
043A 3E40       00520          LD       A,40H          ;Set speaker bit
043C D302       00530 NOSET    OUT      (2),A          ;Output bit to speaker
043E CD0900     00540          CALL     INKEY          ;Chech if key presed
0441 FE1B       00550          CP       ESC            ;Exit yet?
0443 28FB       00560          JR       Z,BEGIN
0445 18EB       00570          JR       TLOOP          ;Back for more
                00580 ;
0447 210006     00590 RECORD   LD       HL,BLOCK       ;Start Address for store
044A 010030     00600          LD       BC,SIZE        ;# of bytes to save ▶
```

many times as you like or press ESC to go back to the record mode again.

The program works best with a fairly loud input signal, you'll have to play around with the levels to get the best results. Watch out that the noise level of the input signal does not exceed the threshold level of the cassette input circuit — otherwise the noise will be attenuated to the same level as the input signal.

To help you set input levels a test function is provided in the record mode. Press T to get into the test mode. Until you hit ESC whatever goes into the cassette port comes out the speaker (good for monitoring normal programs). No recording is performed in this mode.

The program has two main subroutines — RECORD and PLAY. The rest of the programme just handles printing messages on the screen.

RECORD gets a bit from the cassette port and stores it in the C register. Each time a new bit is sampled from the port, all the other bits are shifted across one to accommodate the new bit. Once the register is full, the whole byte is saved in memory. This process is repeated until the given amount of memory has been used up.

PLAY is the exact opposite of RECORD. The bits are retrieved in the same order in which they were recorded and output to the Microbee speaker. The subroutine TFIX makes the time between output bits the same as when they were recorded (the PLAY routine plays faster than RECORD records!).

The DELAY subroutine controls the delay between samples (ie controls sample rate). The higher the time value the less resolution you can have. I've tried values up to about 10 and can still understand the speech. This means with a 32K 'Bee you can get about 1 minute of speech. Play round with the value of TIME (line 150) and you will see the difference it makes. The value of BLOCK (line 160) controls the start address from where the recorded signal is to be recorded. SIZE (line 170) is the size of the block of memory to be used for the recording. If you have a 32K 'Bee then the value can be higher (up to 7000 hex).

With a bit of playing around it's easy to see how to use these routines in your own programs. Don't forget that you can't use all memory for recording; you still need some for the program itself. It is even possible to make your 'Bee recognise certain commands by comparing the incoming signal with a recorded one: with speech recognition, however, timing is a bit of a problem.

By the way, if you want a tape copy of the program (Edasm version and machine code as well) send $9 (includes postage) to the author at PO Box 247, Bentleigh, Vic 3204.

SPEECH SYNTHESIS PROGRAM cont.

```
ADDR   CODE     LINE   LABEL    MNEM    OPERAND

044D 1608      00610 OLOOP    LD      D,8             ;Bits per byte
044F DB02      00620 ILOOP    IN      A,(2)           ;Get port data
0451 CD9204    00630          CALL    DELAY
0454 CB47      00640          BIT     0,A             ;Is cassette in bit set?
0456 2804      00650          JR      Z,ZERO          ;No.
0458 E601      00660          AND     1               ;Clear other bits
045A 1801      00670          JR      SHIFT
045C AF        00680 ZERO     XOR     A               ;Zero A
045D CB23      00690 SHIFT    SLA     E               ;Shift E to left
045F 83        00700          ADD     A,E             ;Save bit
0460 5F        00710          LD      E,A             ;Store in E
0461 15        00720          DEC     D               ;Dec bit count
0462 20EB      00730          JR      NZ,ILOOP        ;Get next bit if byte not fu
11
0464 78        00740          LD      A,E
0465 77        00750          LD      (HL),A          ;Save byte
0466 23        00760          INC     HL              ;Advance mem pointer
0467 0B        00770          DEC     BC
0468 78        00780          LD      A,B             ;End of record
0469 B1        00790          OR      C               ; yet?
046A C8        00800          RET     Z
046B 18E0      00810          JR      OLOOP           ;Next byte
               00820 ;
046D 210006    00830 PLAY     LD      HL,BLOCK        ;Play block of mem.
0470 013030    00840          LD      BC,SIZE
0473 1608      00850 PLOOP    LD      D,8             ;8 bits per byte
0475 5E        00860          LD      E,(HL)
0476 CB23      00870 SLOOP    SLA     E               ;Shift bit out of E
0478 3005      00880          JR      NC,NOUGH        ;Not set
047A AF        00890          XOR     A               ;Clear A
047B CBF7      00900          SET     6,A             ;Set bit 6
047D 1801      00910          JR      SPEAK
047F AF        00920 NOUGH    XOR     A
0480 D302      00930 SPEAK    OUT     (2),A           ;Output bit to speaker
0482 B7        00940          OR      A               ;DELAY
0483 B7        00950          OR      A
0484 CD9204    00960          CALL    DELAY
0487 00        00970          NOP
0488 15        00980          DEC     D               ;Lower bit count
0489 20EB      00990          JR      NZ,SLOOP
048B 23        01000          INC     HL              ;Next byte
048C 0B        01010          DEC     BC
048D 78        01020          LD      A,B             ;Check if
048E B1        01030          OR      C               ;end of block
048F 20E2      01040          JR      NZ,PLOOP        ;yet
0491 C9        01050          RET
               01060 ;
0492 C5        01070 DELAY    PUSH    BC              ;Short dela, twix samples
0493 0601      01080          LD      B,TIME
0495 10FE      01090 DEL      DJNZ    DEL
0497 C1        01100          POP     BC
0498 C9        01110          RET
               01120 ;
0499 0C        01130 RECMES   DB      0CH             ;CLS
049A 4D        01140          DEFM    'Microbee digital voice recorder.'
04BA 0D0A      01150          DW      0A0DH           ;Car. Ret.
04BC 0D0A      01160          DW      0A0DH
04BE 50        01170          DEFM    'Press "T" to test, any other key to begin r
ecording.'
04F2 00        01180          DB      0
04F3 0D0A      01190 TSTMES   DW      0A0DH
04F5 54        01200          DEFM    'Test mode. Press "ESC" to exit.'
0514 00        01210          DB      0
0515 0D0A      01220 PLYMES   DW      0A0DH
0517 50        01230          DEFM    'Play mode : press "ESC" to record again, an
y other key to play.'
0556 00        01240          DB      0
0000           01250          END
00000 Total errors

DEL     0495    SPEAK   0480    NOUGH   047F    SLOOP   0476
PLOOP   0473    SHIFT   045D    ZERO    045C    DELAY   0492
ILOOP   044F    OLOOP   044D    NOSET   043C    TLOOP   0432
TSTMES  04F3    PLAY    046D    PLYMES  0515    REPT    0410
RECORD  0447    TEST    042C    PRINT   0422    RECMES  0499
BEGIN   0400    INKEY   8009    DISP    800C    ESC     001B
WTKEY   8006    SIZE    3000    BLOCK   0600    TIME    0001
```

BUS SHARING
for Commodore 64 & VIC 20

Mark Hopkins

This adapter allows up to eight Commodore computers to share a single disk drive and printer. Just the thing for the classroom situation or at computer club meetings. It is easy to use and works with either the C64 or the VIC 20.

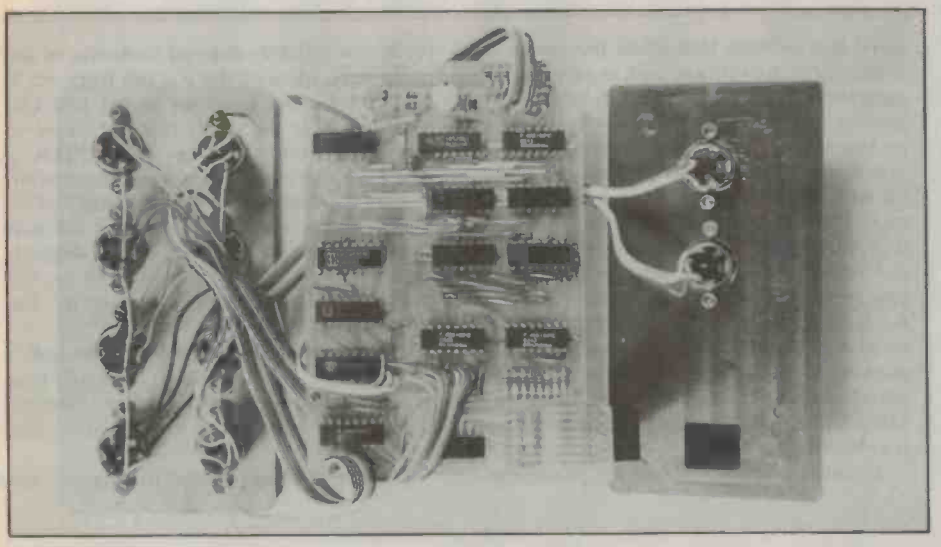
THIS PROJECT was born out of a request by a local computer club which wanted to document a large amount of VIC 20 public domain software. As anyone who has been involved in home computing will know it is difficult to appreciate whether a program is good or bad from its name alone. So it was decided to get interested members together one day to load and run these programs and write small descriptions of each. But there was one small stumbling block. All the programs were on disk and very few members had disk drives at that time. (They were around $700 in late 1983.)

The apparent solution was to connect several computers up to one disk drive. Each member could be given a mutually exclusive set of programs to try from the same disk, then they would set off at their own pace, loading, running and describing each program.

The concept demanded simply a three pole eight position rotary switch which each operator could manually switch to his/her computer when needed. Then the idea of doing it electronically (with automatic switching) was hit upon. This would save operators having to climb over one another to reach the switch or having someone operate the switch right in the middle of a save or load. Hence this bus sharing device was born, and has served the purpose well.

Such a unit would also be very useful in a classroom situation, in which each student could download a program into his/her own computer and work on it. The program loaded might be one written by the teacher in preparation for the lesson, or it could be the student's own work which can be saved, in up-dated form, at any time during the lesson.

Another very useful application for the switch is to allow all computers access to a single printer, much as a line printer on a main frame computer. While this ties up the bus for a considerable amount of time (unless the printer has a buffer), it is a lot cheaper than buying and maintaining eight printers.



The bus sharing device is housed in a small plastic box. It derives power via a 12-pin 0.156" double-sided edge connector conveniently plugged into the user port of any computer. There are a number of 6-pin DIN sockets on the back of the unit, allowing up to eight computers, either VIC or C64, to be attached. The front panel has a 6-pin DIN socket for connection to peripherals, such as disk drive and printer, a 3-pin DIN socket for power entry, and a 7-segment LED display to indicate which computer, if any, is using the bus.

When the bus is free the display is blank; when it is in use a number (0 to 7) designating the computer using it is displayed. If a computer requests the bus and it is busy it is made to wait till the bus is free. For example, if a file is to be loaded the computer will display SEARCHING and then appear to freeze until its turn, upon which it will begin LOADING.

The computers are queued on a priority basis, that is, computer seven will be serviced before any other. (This, for example, might be the teacher.) That is to say, when the current user releases the bus if several requests are pending, the highest number device gets it. To do it on a first-come first-served basis would require too much logic, and is not warranted considering the small ▶

PARTS LIST — ETI-689

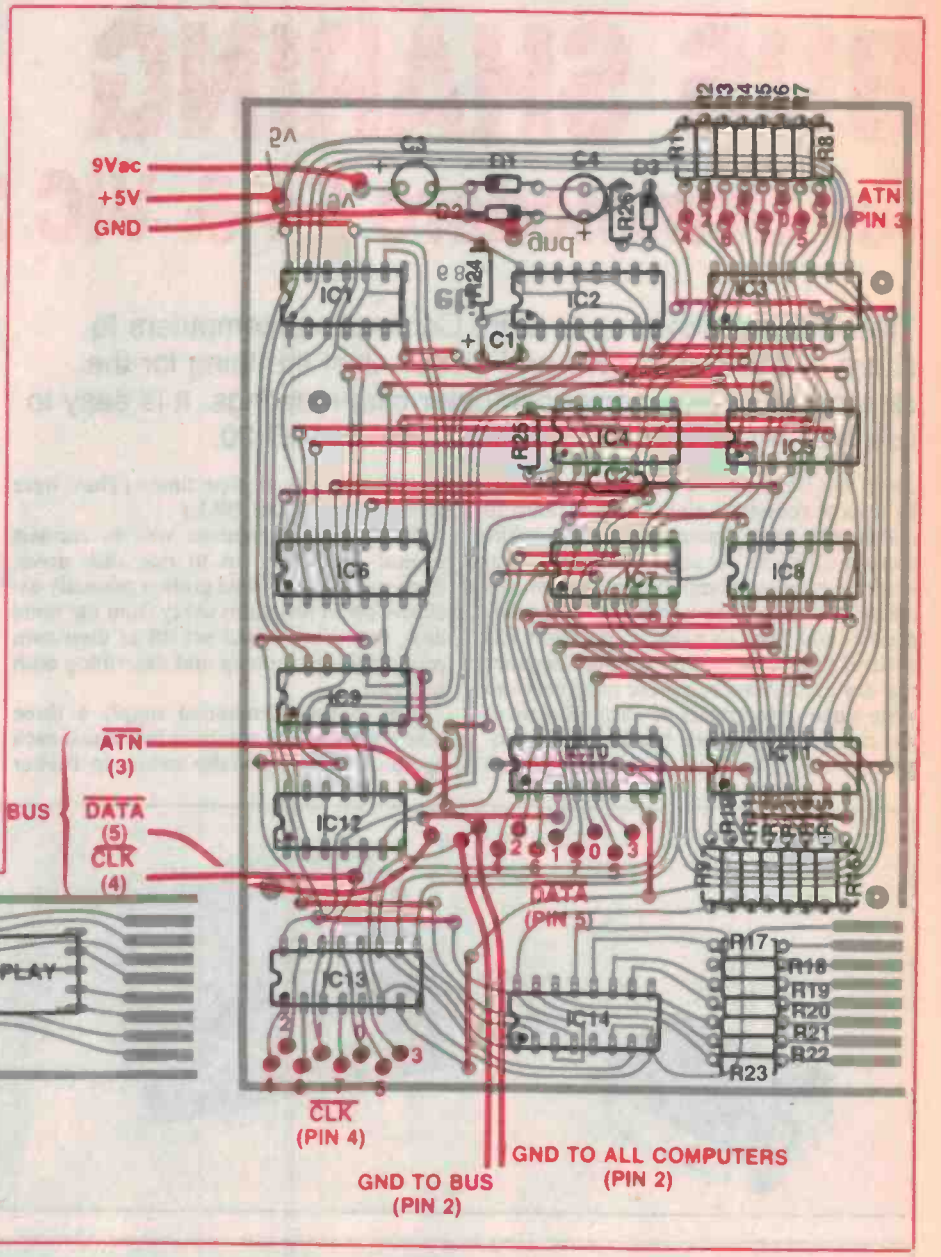
Resistors.....all ¼ W, 5%
R1-R16.....10k
R17-R23.....330R
R24,25.....100k
R26.....1k2

Capacitors
C1.....47µ 6 V tantalum
C2.....10µ 16 V tantalum
C3,4.....47µ 25 V electrolytic single-ended

Semiconductors
IC1,9.....4013
IC2.....4528
IC3,10,11,13.....4051
IC4,5.....74C14 or 40106
IC6.....4532
IC7,8.....7403
IC12.....4011
IC14.....4511
D1,2.....1N4002
ZD1.....1N4739 9V1 zener

Miscellaneous:
ETI-689 pc board; FND 500 or similar display; 16 x 6-pin DIN plugs (or as required); 1 x 3-pin DIN plug; 9 x 6-pin panel mount DIN sockets; 1 x 3-pin panel mount DIN socket; 12-way double sided 0.156" edge connector; 9 metres of 4-core screened cable; case, Arlec PC1 or similar; hook-up wire; small 'zippy' box 80 x 50 x 25 mm; 4 x small rubber feet; piece of polarised red plastic (see text for size); 500 mm of 12-way rainbow cable.

Price estimate: $45
(not including DIN plugs and cables)



amount of time that the bus would actually be in use.

Design considerations

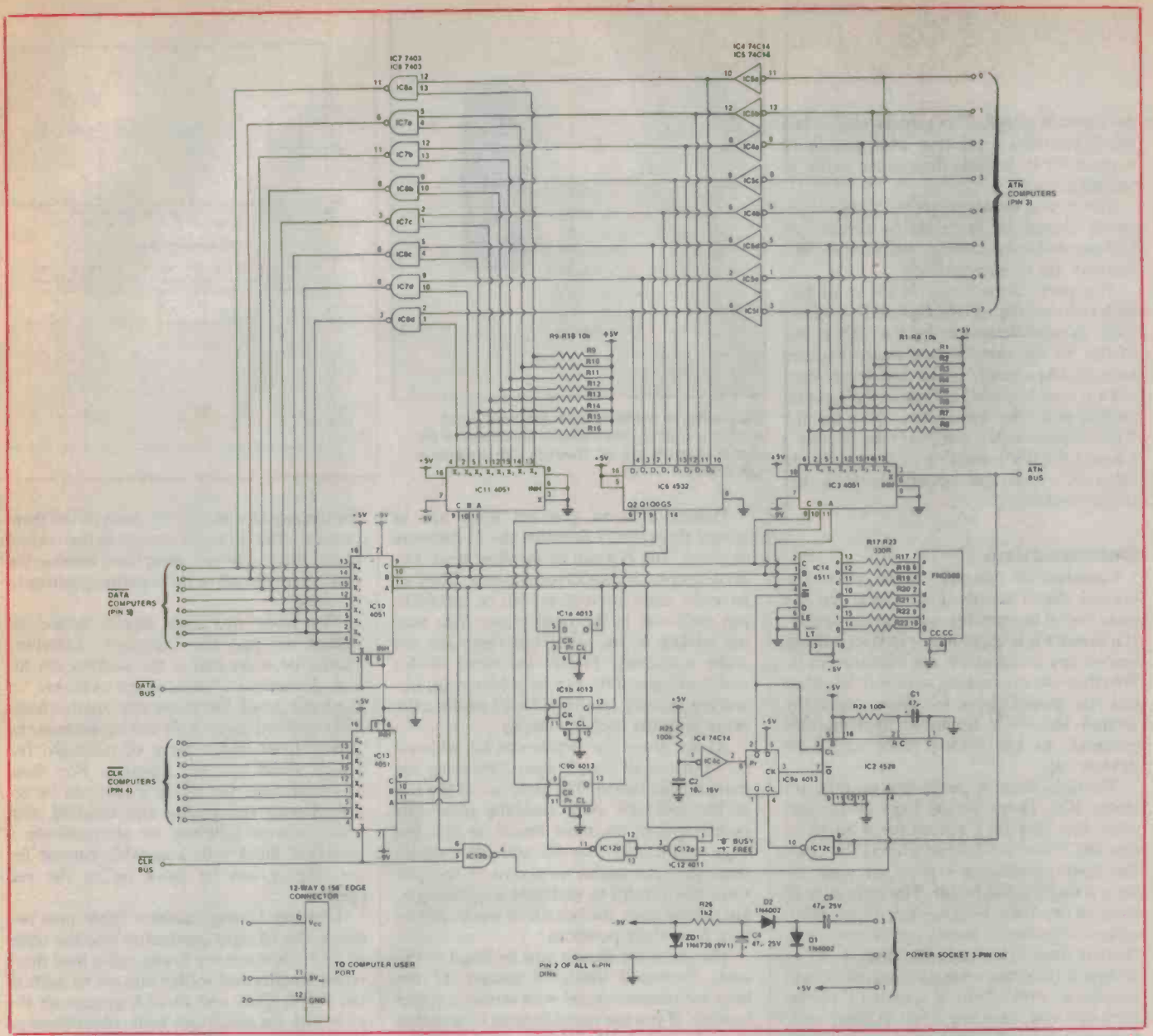
The design is quite straightforward and uses a mixture of CMOS and TTL logic. There are no compromises with logic level interfaces however, as the CMOS is driven by open-collector TTL, and the TTL is driven by analogue switches which preserve the logic level on their inputs. CMOS was chosen both for its unique bidirectional analogue switches and its low power consumption, while the TTL was used to achieve the open collector capability.

The most interesting aspect of the design is the way in which the computers are queued. Specifications of the Commodore serial bus indicate that when the computer wishes to communicate with a peripheral it pulls the ATN line low and watches the data line for a response. If the data line doesn't go low within 1 ms, the computer assumes that the peripheral is not present and comes up with the device not present message. If the DATA line goes low within this time the computer will be happy to wait for as long as necessary before the DATA line goes high again, indicating that the device is ready to send or receive information. The serial bus switch tricks each computer into thinking it has a peripheral connected by gating each ATN line back on to its own DATA line until such time as that computer is selected.

To save on space and cost the power supply is conveniently derived from one of the computers. Most of the ICs run from +5 V and ground, but in order to get low ON resistances for the 4051s it is necessary to run them from a higher supply. This is achieved by a charge pump on the ac available on the user port, which develops −9 V. The actual power consumption of the unit varies between 10 mA and 50 mA, depending on how many segments are lit on the display. This is easily supplied by the computer.

In order to make the unit easy to build, an enclosure with removable front and rear panels was considered necessary. This allows ready access for construction and servicing.

The edge connector used to plug into the ▶



HOW IT WORKS — ETI-689

There are five wires provided on the serial bus: ATN, CLK, DATA, RESET and GND. The reset is not used here because if someone turns a computer on you don't want them all to reset. The ground lines of all computers are joined to provide a reference for the logic circuits. The other three signals are each fed through a 4051 eight channel analogue multiplexer. This can best be thought of as a three pole eight position switch.

When a computer requires the bus it brings its ATN line low. The 4532 priority encoder produces a 3-bit code, unique to that computer, which is latched by the three D-type flip-flops when clocked by the GS output of the encoder. This only occurs if the bus is not 'busy'. The result is that the ATN, CLK and DATA lines of the requesting computer are selected on to the bus via ICs, 3,13, and 10 respectively. Once the ATN line is connected, being low, it clears IC9a setting the bus to busy. This prevents other computers from selecting the bus.

When activity occurs on the DATA and CLK lines this causes IC2, a retriggerable monostable, to begin timing. When no activity has occurred for 500 ms on either of these lines it is assumed that the bus is no longer required and IC2 times out and clears IC9a, setting the bus 'free', ready for another computer to use it.

IC11 serves to queue the computers which are waiting to use the bus. It connects the ATN line of each computer back to its own DATA line, except for the selected computer. This has the effect of acknowledging each computer's request so that it waits until the bus is free instead of thinking that the device is not present.

The select lines from IC1 and IC9b also feed a 4511 decoder and 7-segment display to indicate which computer is using the bus. The blanking input is employed to turn the display off if the bus is free.

In order to get sufficiently low switch impedance for reliable operation, ICs 3, 10, 11 and 13 are fed with +5 V, and −9 V, derived from a charge pump on the 9 Vac available on the user port of one computer. As the 4051s have three supply pins the 0 to 5 V logic levels are preserved. All other ICs run off 5 V and ground.

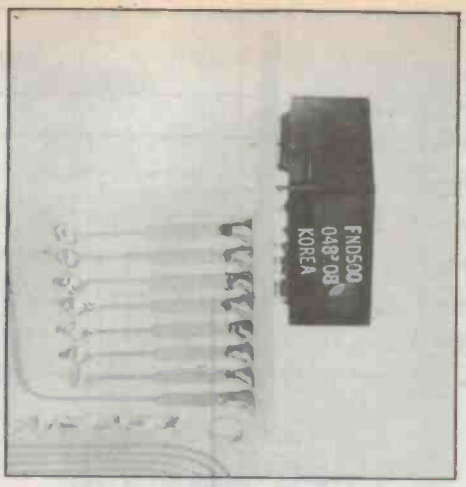
Pull-up resistors are used on the ATN lines to ensure a logic high is maintained on any inputs which do not have a computer plugged into them so that they do not give false bus request signals. R25, C2 and IC4 provide a reset pulse to IC9a, ensuring that the bus is free at power-on.

Should several computers be requesting the bus at the same time the priority encoder (4532) selects the one with the highest number when the bus next becomes free.

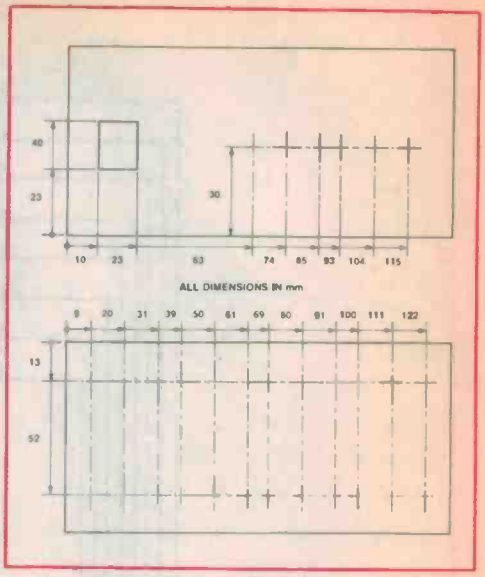
user port is attached to a small plastic box which provides protection and mechanical support for it. A cable then connects this to the main unit.

The timing capacitor on the 4528 monostable should be tantalum to ensure low leakage and stable timing. Aluminium electrolytics are unsuitable here.

The parts chosen are readily available, with two exceptions: the 6-pin DIN and the 4532. A possible source for the DIN is one of the TV or video repair places you see around. (At a pinch, 5-pin, 240 degree connectors could be used as these are plug compatible with the 6-pin ones, save for the RESET pin which is not used here anyway.) I found the 4532 wasn't as common as the other ICs, but still obtainable from the larger stockists.



The display is soldered on to the small board which is placed against the main board so that the edge connectors line up. They are fillet soldered at right angles.



Construction

Construction should begin with the printed circuit boards. First check that the main board fits into the enclosure properly. If it doesn't it is much better to trim it down before any components are soldered to it. Whether you are making your own board or not you should check for flaws, especially around the −9 V tracks as applying this potential to the wrong place could be devastating.

The links must be put in first as some are under ICs. There are 39 links in all, and while this may be a record for a board of this size it was considered preferable, from the home-constructor's point of view, to have a single sided board. The proximity of some of the links, both to each other and to other components, means it is necessary to insulate them. The best and simplest way to do this is to obtain a length of single-strand telephone wire. Strip a length of plastic from one end, then use a pair of sharp end-cutters to cut and push a piece of insulation of correct length along the wire. Cut the wire and use the insulation as a template for your pliers to bend the link.

Having ensured that all links are in (count them) you can solder the 25 resistors in place. The ICs can be installed next, observing normal CMOS precautions. They all have the same orientation, but be careful to put each one in the right place. You may use sockets if you wish, but these are not really necessary. Finally the three diodes and four capacitors can be soldered in, observing polarity carefully. Don't confuse the zener with the rectifier diodes.

At this stage the display can be soldered on to the small board, again observing the correct orientation. The slots are at the top of the FND500. Now carefully place this board against the main board so that the edge connectors line up and fillet solder them at right angles as shown in the pictures. Be careful to maintain a right angle, but do not force the boards or tracks will be torn from their positions.

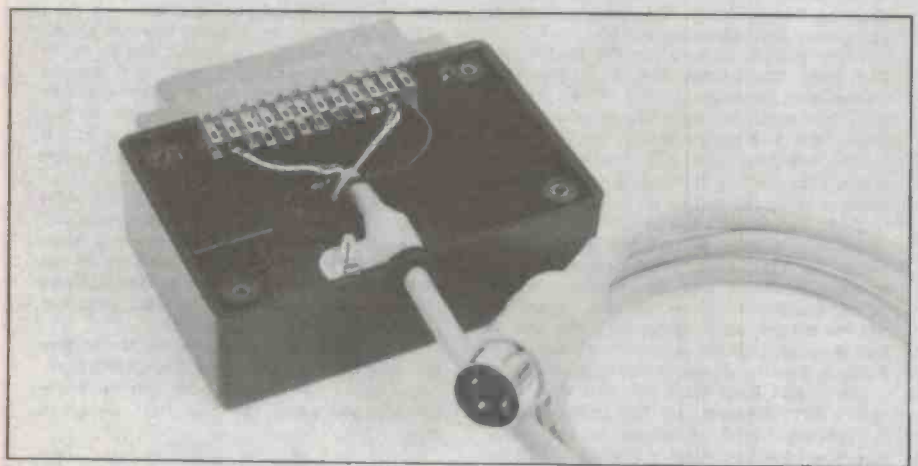
The pc board should now be fitted to the case. Threaded insulated spacers 12 mm long are recommended with screws top and bottom. If you use metal spacers ensure that they do not short out any tracks on the board. The location of the board should be such that the display is as close as possible to the front panel, without fouling it. Mark the display location on the back of the front panel so that it can be cut out in the correct place. When fitting is completed remove the board again to allow the remaining wiring to be done.

The front and back panels should be drilled as per the diagrams. Labelling should be done before the sockets are fitted. A number of choices are available for the front panel. For those who are mechanically inclined a neat hole can be made in the plastic front and a piece of polarised red plastic glued into the opening. For those less confident, the whole panel can be replaced with red plastic and labelled with white rub-on lettering or alternatively a Scotchcal label with a suitable cut-out for the display can be stuck on to the red plastic.

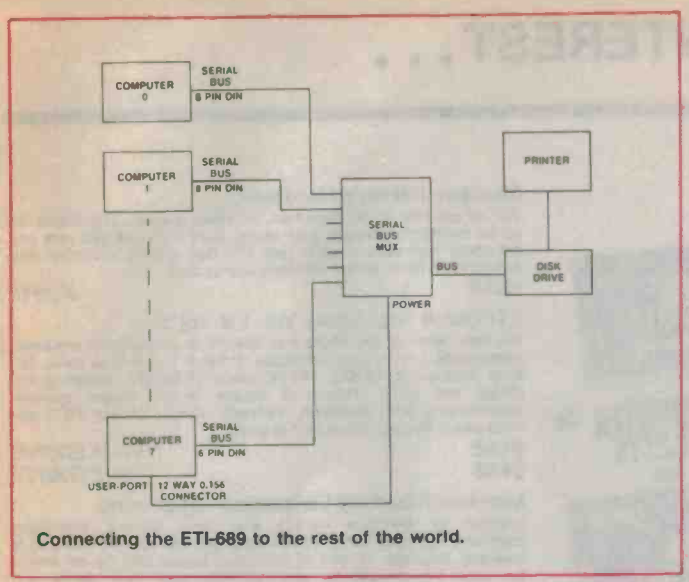
Tear the 12-way rainbow cable into two strips, one of eight conductors and the other of four. Now cut the 8-way cable into three equal lengths and solder one set to each of the ATN, CLK and DATA groups on the pc board. Be consistent with colour/channel association for each group. Now solder the other ends to the appropriate pins of the DINs on the rear panel. Note: *the pin-outs of the pc board are not consecutive, so take care.*

Cut the 4-wire ribbon in half and connect one piece between the ATN, CLK, DATA and GND pins near IC12 and the 6-pin DIN on the front panel. Strip one conductor from the other cable and use it to connect the rear panel socket pin 2s together and to earth on the board. The three remaining wires are for the power supply from the 3-pin DIN to the pc board.

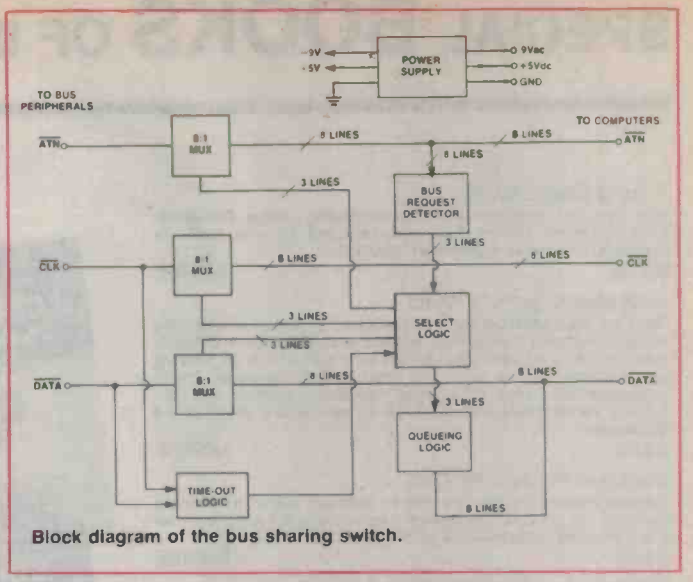
Now mount the 12-way edge connector on the small enclosure as shown, and connect a length of cable from it to the 3-pin DIN plug. All three connections should be to the top row of pins, pin 1 being on the top left when viewed from the rear. The rubber feet are held on by the lid screws, and the box is turned upside down. The positioning of the edge connector should be such that its height matches that of the connector on the



Mounting of 12-way edge connector.



Connecting the ETI-689 to the rest of the world.



Block diagram of the bus sharing switch.

computer so that the feet will correctly support the enclosure. This method of mounting also ensures that the connector cannot be plugged in upside-down.

Make up as many 6-pin to 6-pin cables as you require, using the 4-core shielded cable. Twist the shields together and solder to pin 2 (GND) on the plugs. Be careful not to melt the insulation on the inner conductors when heating the braid. On assembly the cables should be checked for continuity and shorts with an ohm-meter. This completes the construction phase, so all that remains is to check it carefully and then try it out.

Testing and using it

There are no adjustments to be made to the bus switch, except if a printer is to be used. (This will be discussed later.) You will need at least one computer and a disk drive for testing. Make sure everything is turned off, then connect the power lead from the computer user port to the 3-pin DIN socket. Don't make any other connections at this stage.

Turn the computer on while watching the channel display. If all is well it should *not* come on at all. Now carefully measure the +5 volt and −9 volt somewhere on the board. Be careful not to let the meter probes slip especially on the −9 V. A good place to measure this is on pin 7 of one of the 4051s. The 5 V rail should be between 4.8 V and 5.2 V, while the negative supply should lie between −8 V and −10 V.

If all is well turn the computer off and connect a cable from the drive to the front panel DIN and one from the computer to one of the rear panel connectors. Turn the computer and drive on. This time the display should come on momentarily with the number of the channel used.

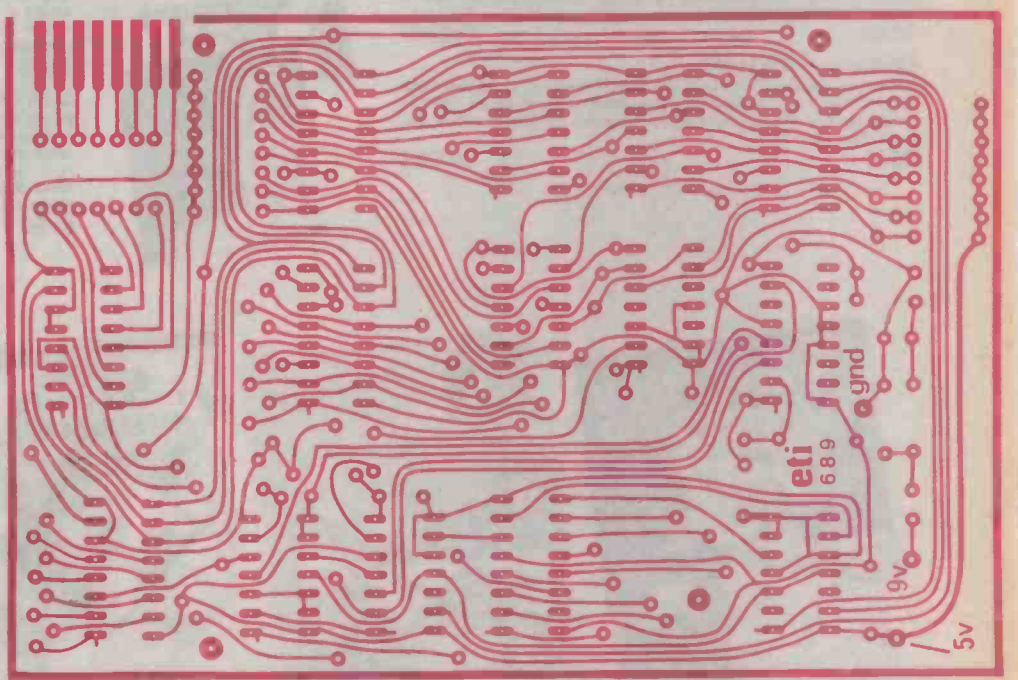
Try loading a directory, and watch the channel number display. It should come on for about the same time as the red LED on the drive. If everything is OK, try connecting the computer to each of the other channels to ensure that they all work. *Note: while it is probably all right to plug and unplug with the power on, I recommend that you turn it off before removing or inserting connectors.*

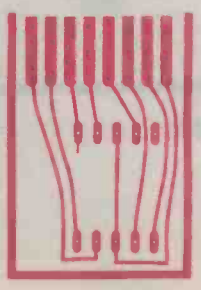
The final test is to connect a second computer to another channel. Load a long program on one computer, and while it is proceeding attempt to load another program with the second computer. The first should go to completion, while the second waits. When the bus is free the channel number will change and the second computer will commence loading its file from the drive.

If you intend using a printer via the bus switch you may have to adjust C1 to suit your printer. Since no activity takes place for some time during carriage returns, C1 may need to be increased to stop the bus from timing out.

You can check if this is necessary by printing something and if the channel number display turns off while printing is in progress the capacitor will have to be increased. R24 could be increased instead, but a maximum of 500k is recommended.

Well that about wraps it up. You should by now have a very useful addition to your Commodore system — either that or eight ruined computers! ●





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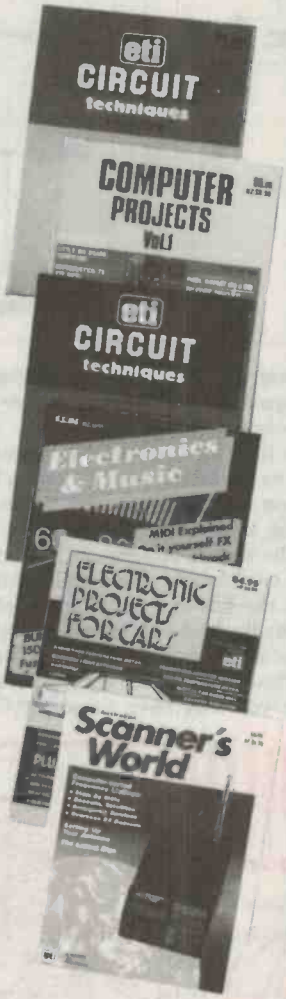

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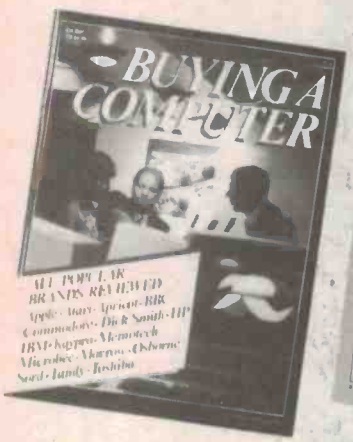

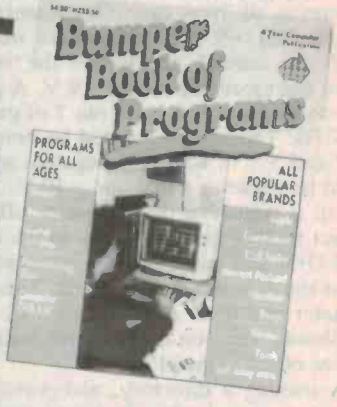

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PO Box 227, Waterloo 2017, NSW

Test Pattern Generator

K. Sharkey,
Albion Park Rail, NSW 2527

The listing is for a utility for the VIC-20 computer. Used in conjunction with an oscilloscope it assists in setting up or repairing any television set.

This program supplies a set of test patterns which are a reasonable facsimile of the signal given by a conventional test pattern generator. There are six different patterns, namely:

1 Colour bars for setting colours, greyscale, and general trouble-shooting.
2 Crosshatch to set linearity and convergence.
3 Dots mainly used to set static convergence.
4 Checker pattern also used to set convergence, and gives some indication of frequency response.
5 Purity checks the alignment of the scanning of the electron guns.
6 Tone provides a sound source to enable tracking the signal through the system.

Even without an oscilloscope the program enables you to set the colours and greyscale correctly. Caution should be exercised if you are not sure how to do this however, as there are quite a few controls on the average television receiver and you may never get back to normal. So read up on the subject or get a friend with the necessary knowledge to do it for you. Apart from this you should note that the high voltage section of the receiver can give you a mighty BOOT if you get too close.

```
100 IF PEEK(56)=24 THEN 280
110 POKE 56,24:POKE 55,0:CS=6144:PRINT"[CLEAR]LOADING DOUBLE SIZE":PRINT
    :PRINT"CHARACTERS"
120 FOR I=CS TO 7678 STEP 2:Z=PEEK(33792+(I-CS)/2)
130 POKE I,Z:POKE I+1,Z:NEXT
140 GOSUB 280
150 GOSUB 770:POKE 36879,8:POKE 36865,16
160 CO=24:I=38403:A=1:B=1:C$="7"
170 POKE I,VAL(C$):POKE I-30720,32
180 I=I+CO:A=A+1
190 IF A=21 THEN B=B+1:I=I-479:A=1
200 IF C$="0"AND B=4 THEN 270
210 IF B<>4 THEN 170
220 A$="354260"
230 C$=MID$(A$,N,1)
240 B=1:N=N+1
250 POKE 36864,10
260 GOTO 170
270 GET A$:IF A$=""THEN 270
280 POKE 36869,240:POKE 36867,174:POKE 36866,150:POKE 36865,38
    :PRINT"[CLEAR,SPACE2,RVS,YELLOW,SPACE]TV TEST PATTERNS
285 PRINT"[DOWN,CYAN,SPACE3]BY K.R.SHARKEY."
290 PRINT CHR$(14):POKE 36879,8:PRINT "[GREEN,DOWN]"SPC(2)"1   COLOUR BARS
300 PRINT "[DOWN]"SPC(2)"2   CROSSHATCH"
310 PRINT "[DOWN]"SPC(2)"3   DOTS"
320 PRINT "[DOWN]"SPC(2)"4   CHECKER PATTERN"
330 PRINT "[DOWN]"SPC(2)"5   PURITY"
340 PRINT "[DOWN]"SPC(2)"6   TONE"
350 PRINT "[DOWN]"SPC(2)"7   END"
360 INPUT"[DOWN,YELLOW]SELECT FUNCTION";A
370 IF A>7 OR A<1 THEN 360
380 ON A GOTO 150,390,530,590,700,730,760
390 GOSUB 770:POKE 36879,0:POKE 36865,16
400 FOR X=0 TO 23:POKE SL+X,64:NEXT
410 C=C+1:IF C=10 THEN 430
420 SL=SL+48:GOTO 400
430 SL=7681:C=1
440 FOR X=SL TO SL+484 STEP 24:POKE X,93:NEXT
450 C=C+1:IF C=9 THEN 470
460 SL=SL+3:GOTO 440
470 SL=7681:C=1
480 FOR X=0 TO 23 STEP 3:POKE SL+X,91:NEXT
490 C=C+1:IF C=10 THEN 510
500 SL=SL+48:GOTO 480
510 GET A$:IF A$=""THEN 510
520 GOTO 280
530 GOSUB 770:POKE 36879,0
540 FOR X=1 TO 23 STEP 3:POKE SL+X,46:NEXT
550 C=C+1:IF C=9 THEN 570
560 SL=SL+48:GOTO 540
570 GET A$:IF A$=""THEN 570
580 GOTO 280
590 GOSUB 770:POKE 36879,8:K=0:POKE 36865,16
600 FOR SL=SL TO SL+64 STEP 8:FOR X=0 TO 3:POKE SL+X,32:POKE SL+X+30720,0
    :NEXT X:NEXT SL
610 IF C=2 THEN C=1:GOTO 630
620 C=C+1:SL=SL+4:GOTO 600
630 IF K=1 THEN 660
640 IF K=2 THEN 670
650 SL=7680+(6*24):K=K+1:C=1:GOTO 600
660 SL=7680+(12*24):K=K+1:C=1:GOTO 600
670 GET A$:IF A$=""THEN 670
680 GOTO 280
690 END
700 GOSUB 770:POKE 36879,42-8
710 GET A$:IF A$=""THEN 710
720 GOTO 280
730 POKE 36878,15:POKE 36876,220
740 GET A$:IF A$=""THEN 740
750 POKE 36878,0:POKE 36876,0:GOTO 280
760 END
770 N=1:PRINT"[CLEAR]":POKE 36866,152:POKE 36864,10
780 POKE 36867,PEEK(36867)OR 23:POKE 36865,34
790 POKE 36869,254:POKE 36881,24:SL=7680:PRINT"[CLEAR]":C=1
800 RETURN
1000 STOP
10000 SAVE"TEST PAT. GEN.":GOTO 10000
```

Tape Tip

I. G. Zampech,
Toogoolawah, Qld 4313

Much of the erratic behaviour of the Commodore 1541 disk drive can be attributed to overheating. Because the drive doesn't have legs the surface on which it sits rapidly becomes warm, which then pre-heats the air before it passes through the internal mechanism. By raising the drives of the table by 30 mm or so it is possible to overcome this problem.

Auto Screen Off

J. Arnold,
Rooty Hill, NSW 2766

The purpose of this program is to protect monitors from being damaged. If the same display image is left on the screen for long periods of time, the phosphor coating on the tube can be burnt. The program simulates a Digital VT220 terminal by 'turning off' the screen display if keyboard input is not detected during a preset delay period. On detection of keyboard input the display re-appears including the key pressed.

The program occupies the top of RAM memory and is protected from BASIC programs overwriting it. There is a machine code source listing and BASIC source listings for both 16K and 32K Microbees attached.

```
00100 REM       ****** VDU SAVER ******
00120 REM       This version for 16K Microbees
00130 FOR X=16144 TO 16252
00140  READ A
00150  POKE X,A
00160 NEXT X
00170 A=USR(16144)
00180 END
00190 DATA 33, 47, 63, 34, 194, 04, 33, 16, 63, 64, 160, 0, 34
00200 DATA 162, 0, 33, 0, 244, 1, 255, 3, 17, 1, 244, 64, 32, 23
00210 DATA 176, 195, 33, 128, 205, 233, 163, 245, 58, 125, 63
00220 DATA 40, 37, 254, 4, 40, 63, 42, 127, 63, 35, 34, 127, 63
00230 DATA 124, 254, 0, 32, 51, 189, 32, 48, 58, 126, 63, 60, 50
00240 DATA 126, 63, 254
00250 DATA 1
00260 REM AMEND VALUE AT LINE 250 FOR DELAYS IN 22 SECOND (APPROX) INCREMENTS
00270 DATA 32, 37, 62, 4, 50, 125, 63, 24, 22
00280 DATA 33, 0, 0, 34, 127, 63, 245, 62, 0, 50, 126, 63, 241
00290 DATA 254, 0, 40, 13, 62, 0, 50, 125, 63, 245, 62, 12, 211
00300 DATA 12, 241, 211, 13, 241, 201
```

```
00100 REM       ****** VDU SAVER ******
00120 REM       This version for 32K Microbees
00130 FOR X=32528 TO 32686
00140  READ A
00150  POKE X,A
00160 NEXT X
00170 A=USR(32528)
00180 END
00190 DATA 33, 47, 127, 34, 194, 0, 33, 16, 127, 34, 160, 0, 34
00200 DATA 162, 0, 33, 0, 244, 1, 255, 3, 17, 1, 244, 64, 32, 23
00210 DATA 176, 195, 33, 128, 205, 233, 163, 245, 58, 125, 63
00220 DATA 40, 37, 254, 4, 40, 63, 42, 127, 63, 35, 34, 127, 63
00230 DATA 124, 254, 0, 32, 51, 189, 32, 48, 58, 126, 63, 60, 50
00240 DATA 126, 63, 254
00250 DATA 1
00260 REM AMEND VALUE AT LINE 250 FOR DELAYS IN 22 SECOND APPRO - INCREMENTS
00270 DATA 32, 37, 62, 4, 50, 125, 63, 24, 22
00280 DATA 33, 0, 0, 34, 127, 63, 245, 62, 0, 50, 126, 63, 241
00290 DATA 254, 0, 40, 13, 62, 0, 50, 125, 63, 245, 62, 1 , 211
00300 DATA 12, 241, 211, 13, 241, 201
```

```
ADDR   CODE    LINE   LABEL   MNEM    OPERAND

                00100 ;************ VDU SAVER ****************
                00110 ;       Author  -  J.G. Arnold
                00120 ;       Date    -  13-Feb-85
                00130
00C2            00140 VECTOR  EQU     00C2H           ;Input vector
00A0            00150 MEMTOP  EQU     00A0H           ;Top of memory pointer
00A2            00160 WARMST  EQU     00A2H           ;Warm start pointer
0000            00170 SCRON   EQU     00H
0004            00180 SCROFF  EQU     04H
                00190
3F10            00200         ORG     3F10H           ;7F10H FOR 32K
                00210
3F10 213F3F     00220 START   LD      HL,KEYIN
3F13 22C200     00230         LD      (VECTOR),HL     ;New input vector
3F16 2103F      00240         LD      HL,START
3F19 22A000     00250         LD      (MEMTOP),HL     ;Top of memory pointer
3F1C 22A200      0260         LD      (WARMST),HL     ;Warm start jump address
3F1F 210004     00270         LD      HL,0F400H       ;Fill second VDU RAM
3F22 01FF03     00280         LD      BC,03FFH        ;area with spaces
3F25 110F4      00290         LD      DE,0F401H
3F28 3620       00300         LD      (HL),20H
3F2A EDB0       00310         LDIR
3F2C C32180     00320         JP      8021H           ;Return to Basic
                00330
3F2F CDE3E9     00340 KEYIN   CALL    0A3E9H          ;Look for KB input
3F32 F5         00350         PUSH    AF
3F33 3A703F     00360         LD      A,(FLAG)
3F36 2825       00370         JR      Z,INPUT         ;Input detected
                00380
3F38 FE04       00390 NOINP   CP      SCROFF
3F3A 283F       00400         JR      Z,FIN           ;Screen already off
3F3C 2A7F3F     00410         LD      HL,(COUNT)
3F3F 23         00420         INC     HL
3F40 227F3F     00430         LD      (COUNT),HL
3F43 7C         00440         LD      A,H
3F44 FE00       00450         CP      0
3F46 2033       00460         JR      NZ,FIN
3F48 7D         00470         CP      L
3F49 2030       00480         JR      NZ,FIN
3F4B 3A7E3F     00490         LD      A,(MSB)
3F4E 3C         00500         INC     A
3F4F 327E3F     00510         LD      (MSB),A
3F52 FE01       00520         CP      1               ;Multiples of 22 seconds
3F54 2025       00530         JR      NZ,FIN
3F56 3E04       00540         LD      A,SCROFF        ;Set to turn off
3F58 327D3F     00550         LD      (FLAG),A
3F5B 1816       00560         JR      SCREEN
                00570
3F5D 210000     00580 INPUT   LD      HL,0
3F60 227F3F     00590         LD      (COUNT),HL
3F63 F5         00600         PUSH    AF
3F64 3E00       00610         LD      A,0
3F66 327E3F     00620         LD      (MSB),A
3F69 F1         00630         POP     AF
3F6A FE00       00640         CP      SCRON
3F6C 2806       00650         JR      Z,FIN           ;Screen already on
3F6E 3E00       00660         LD      A,SCRON
3F70 327D3F     00670         LD      (FLAG),A        ;Set flag on
                00680
3F73 F5         00690 SCREEN  PUSH    AF
3F74 3E0C       00700         LD      A,0CH
3F76 D30C       00710         OUT     (0CH),A
3F78 F1         00720         POP     AF
3F79 D30D       00730         OUT     (0DH),A         ;Set/Reset screen
                00740
3F7B F1         00750 FIN     POP     AF
3F7C C9         00760         RET
                00770
3F7D 00         00780 FLAG    DEFB    SCRON           ;PRESET TO ON
3F7E 00         00790 MSB     DEFB    0
3F7F 0000       00800 COUNT   DEFW    0
0000            00810         END
00000 Total errors

SCREEN  3F73    MSB     3F7E    COUNT   3F7F    FIN     3F7B
INCHAR  3F38    INPUT   3F5D    FLAG    3F7D    KEYIN   3F2F
START   3F10    SCROFF  0004    SCRON   0000    WARMST  00A2
MEMTOP  00A0    VECTOR  00C2    .
```

CONTRIBUTORS PLEASE NOTE

All contributions to this column should be accompanied by a listing of the program from a printer. Hand written or typed listings are not acceptable.

There are two reasons for this. The first is that a listing from your computer gives us some guarantee that *you* have the listing correct.

Secondly, if you present us with a neat final copy of your program we can use photographic techniques to reproduce it in the magazine, without risk of errors.

Contributors will be paid $20 for each item published in this column. Submissions must be original programs which have not been previously published. You may send as many programs as you wish with the accompanying declaration.

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Tariff reductions for communications equipment industry

The Federal Government has announced a two stage plan to revitalise Australia's communications equipment industry for growth into the 1990s and beyond.

Under the first stage of the plan the Government has accepted a recommendation by the Industries Assistance Commission (IAC) to reduce tariffs on most imported telecommunications products and components from 30 per cent to 20 per cent. These reductions are to be phased in over a four year period, though the IAC's report on the industry had recommended a two year period for most products.

In agreeing to the tariff reductions the Government has sought the co-operation of the local industry in developing a comprehensive strategy to address the industry's long term problems. This strategy is expected to be announced by the middle of 1986.

The Minister for Industry, Technology and Commerce, Senator Button, said that despite relatively high tariff protection and a largely protected market via Telecom purchasing, the Australian communications equipment industry has not grown significantly either in output or exports. The Government was particularly concerned that this relatively poor performance had occurred at a time when there was a world-wide explosion in communications services, with good development prospects available through growing world markets and opportunities created by new technology.

"The Government has also been concerned that continuing high levels of protection for this industry would disadvantage users of communications services, and delay necessary changes to the industry," Senator Button said. "The only way for the industry to meet these challenges is to achieve international competitiveness in pricing, and adopt positive strategies which will involve, among other things, increased research and development and greater penetration of export markets."

Industry has begun to make substantial commitments to research, development and export. However, important issues still need to be addressed including the relatively small size of Australian companies, fragmented market efforts, and restrictive regulatory procedures which act as a disincentive to growth.

Acknowledging signs that the industry is moving to become more aggressive in its market approach, Senator Button warned that unless the pressure to adapt is maintained there is a real danger that the rate of change will be so slow that it will not be enough to reverse the relative decline of the industry.

An important consideration in seeking a more competitive communications sector was the fact that information industries were having an impact on all facets of industry and the economy, well beyond their own immediate boundaries, and that there were good growth prospects.

The Minister noted that the Governmnent had accepted the IAC's recommendation for a 25 per cent value-added production bounty to be paid on modems and multiplexers generally used with computers, but that it intended to defer implementation of this decision until 1 July 1986. This was necessary to allow for the establishment of appropriate administrative and legislative arrangements. He also announced that preforms used in the manufacture of optical fibre would be subject to a tariff of 20 per cent from 1 July 1986.

Aust-NZ telecommunications

A key point made by STC's corporate affairs director, in his address to the conference of the Australia-New Zealand Businessmen's Councils in Canberra recently was that closer economic relations between Australia and New Zealand depended on the availability and easy access to an integrated communications system connecting both countries.

Mr Selby-Adams recommended that the Australian and New Zealand domestic telecommunications networks be interconnected to form a wider area trans-Tasman STD dialling network. His thesis was that information was a commodity of critical importance in international relations as well as in planning and development of internal resources. It could facilitate better use of resources and better complex societal decisions, but it needed to be 'packaged' for decision-makers and treated as the important national resource it is.

"The introduction of an easier access and more efficient technology into the trans-Tasman communications system will effect widespread improvements in economic performance and planning at national and international levels," he said.

"The conclusion one draws from macro-economic research is that telecommunications and overall economic development go hand-in-hand.

"Washington's Brookings Institute reports that almost one-half of the increase in US labour productivity during the past 25 years is attributable to technological innovation resulting from large-scale capital investments in research and engineering."

Mr Selby-Adams also criticised the high charges for trans-Tasman calls. The Australia to New Zealand international rate was $1.30 per minute, over a distance of approximately 2000 km. Land rate charges for Sydney to Perth (3500 km) were 64 cents a minute, day rate. In New Zealand, Auckland to Dunedin (1670 km), the day rate charge was 95 NZ cents.

"The Australian and New Zealand domestic telecommunications networks should now be interconnected to form a wider area STD dialling network as opposed to the present international subscriber dialling system with the complexity and 'psychological' pressures attendant with international calling," he said.

The conclusion: that the technology was available and a government commitment to implement such a change was required.

BRIEFS

Fine for CB repeater offence

A South Australian man who made the Adelaide CB radio repeater useless for operation by hundreds of other licensees last March has been fined the maximum of $40 in the SA Magistrate's Court and forfeited a $300 transceiver to the DOC. Michael Ptasznyk, of Mile End, SA, was prosecuted under Regulation 12(1) of the Wireless Telegraphy Regulations for breach of the conditions of his CB radio station licence. He was also ordered to pay $17 court costs and $150 towards the cost of the DOC's investigation.

US will extend MF broadcast band

In the US the problem of accommodating 4685 AM radio stations on the broadcast band, which uses only 106 channels, has forced the Federal Cummunications Commission to extend its range up to 1705 kHz. Stations are not expected to commence using this extended part of the band until the early 1990s. A further 4505 US stations operate on the FM band.

RTTY/CW computer interface

A US-manufactured Model MFJ-1224 computer interface designed to connect to a radio transceiver or receiver and allow computerised RTTY/ASCII/AMTOR/ARQ/FEC/CW operation is available from GFS Electronic Imports. Its I/O circuitry enables it to be used on a wide range of computers including the VIC-20, C-64, Apple and TRS-80C. For details contact GFS, 17 McKeon Rd, Mitcham, Vic 3132.

Versatile HF antenna tuner

GFS Electronic Imports of Mitcham, Vic, has released a continuous frequency coverage antenna tuner for use over the 1.8 to 30 MHz frequency range. Manufactured by MFJ Enterprises in the USA, the Model MFJ-900 Econo Tuner is designed to match virtually any HF transmitter to any antenna. Its small size (135 mm x 60 mm x 190 mm) makes it adaptable for marine and land mobile use.

Esperanto — the universal language

Among the 100 or so languages broadcast over shortwave radio is the universal language of Esperanto.

Esperanto was created by Dr L.L. Zamenhof, a Polish oculist, and published by him in Warsaw in 1887. It has an alphabet of 28 letters, all of which are pronounced.

The language has followers in almost every country, though their numbers have never been great. However, among radio amateurs, communication in Esperanto is not uncommon — testimony to Zamenhof's belief in the need for a universal language.

The first Esperanto broadcasts were in 1922 when a station in Newark, USA, began experimental programmes in the language. Similar experiments also took place in London.

In 1924, at a technical conference which had been called to prepare for an international agreement on the allocation of wavelengths, a resolution was passed favouring the use of Esperanto for international broadcasting. Indeed, about half of the proceedings of the conference was conducted in Esperanto.

From then until the mid 1930s was a period of growth for broadcasting in Esperanto. The leading country in the field before World War II was Czechoslovakia.

After the war, broadcasts in Esperanto were resumed, although in the countries of Eastern Europe there was a break of some eight years because of the Cold War. In 1959 the Polish Radio Polonia reintroduced Esperanto into its foreign service. Today the Esperanto broadcasts of this station lead the world, both in numbers of programmes and in size of audience.

The following broadcasts in Esperanto can be heard in Australia.

Time and Day	Station	Kilohertz
0530-0600	Radio Polonia	5995, 6135, 7270
0545-0557 (Sun)	Austrian Radio	6000, 6155
0600-0615 (Thurs)	Vatican Radio	6250, 7250, 9645
1100-1125	Radio Polonia	7145, 9525
1100-1130	Radio Beijing	9880, 15100
1300-1330	Radio Beijing	11685, 15165
1530-1555	Radio Polonia	7285, 9675
1630-1655	Radio Polonia	6095, 7285
1800-1810 (Mon, Thurs, Sat)	SRI Switzerland	3985, 6165, 9535
1930-2000	Radio Polonia	6095, 7285
2000-2010 (Sun)	Vatican Radio	6250, 7250, 9645
2000-2020 (Sat)	RAI Italy	7275, 9710, 11800
2000-2030	Radio Beijing	7470, 9965, 11445
2030-2040 (Mon, Thurs, Sat)	SRI Switzerland	3985, 6165
2130-2155	Radio Polonia	5995, 6095, 7285
2230-2300	Radio Beijing	11515, 15600

All broadcasts are daily, unless otherwise stated, and times given are in UTC.

— Arthur Cushen

CLUB CALL

Amateur radio operators, their families, friends and others interested in ham radio are invited to the **Central Coast Amateur Radio Club's** 29th annual field day on Sunday, 23 February 1986, at the Gosford Showground, north of Sydney.

The day's events will include pedestrian direction finding foxhunts on 144.3 MHz AM (junior) and 146.55 MHz FM (open), a pedestrian talk-in foxhunt on 146.5 MHz FM, quizzes and an open scramble. Non-radio activities will include children's games, a ladies' stall and an afternoon bus trip visiting the Australian Reptile Park.

For further details write enclosing a stamped SAE to the CCARC, PO Box 238, Gosford, NSW 2250.

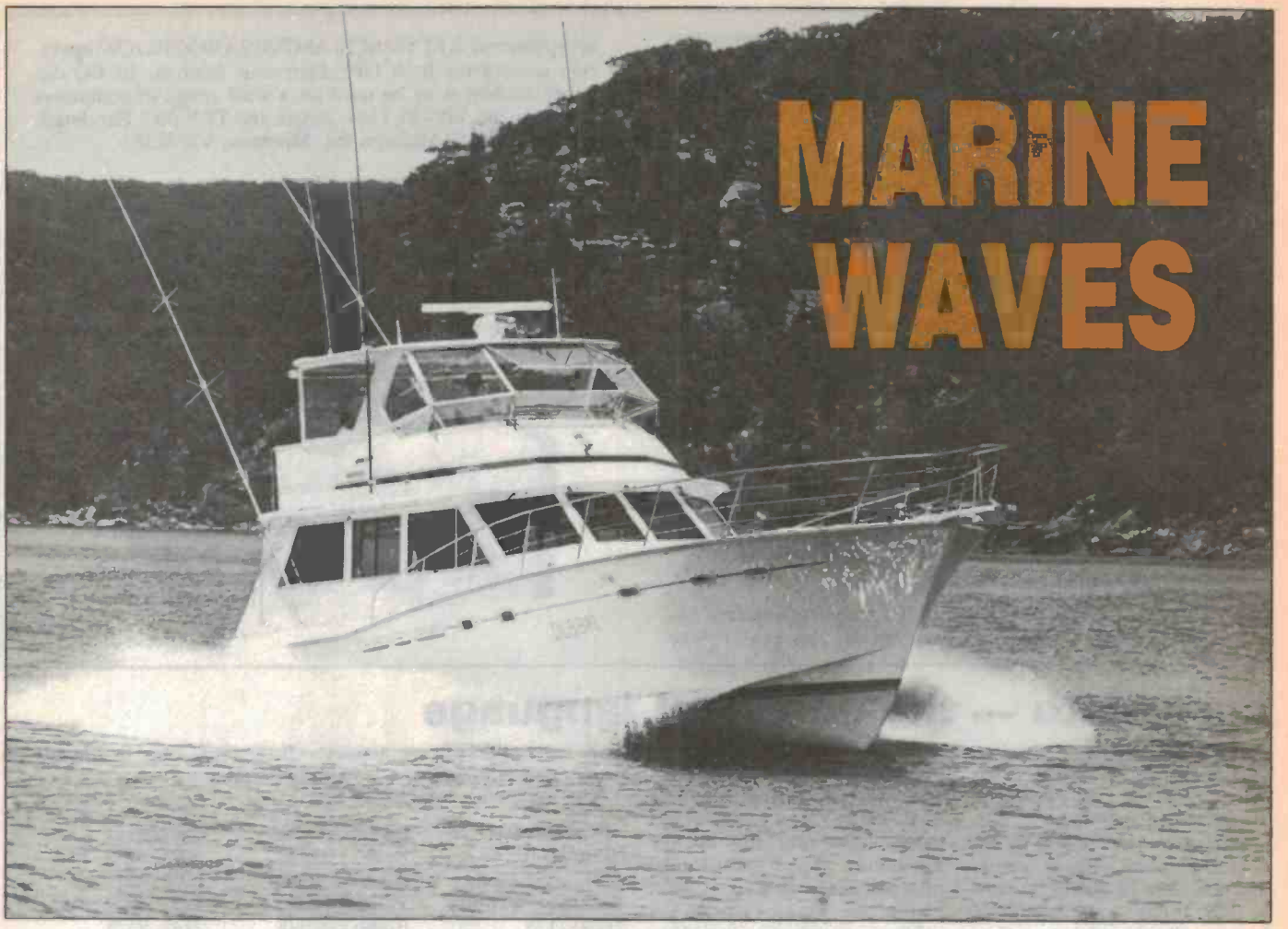
The Sydney Amateur Digital Communications Group is developing an Australian-designed amateur packet radio system. Centrepiece is a modem that will interface via RS232/V.24 to a TNC or computer and can be easily connected to amateur transceivers.

For more information contact the SADCG, PO Box 231, Frenchs Forest, NSW 2086.

A **live-in Novice Amateur Radio Course** for young people aged 12-17 years is being planned for the May school holidays by a group of Sydney amateur radio operators.

Subjects covered will include both theory and practical electronics, radio regulations and Morse code. It is also anticipated a full amateur station will be set up covering AMTOR, packet radio and satellites. Non-radio activities at the camp will probably include swimming, bushwalking and sports.

For further information contact Peter O'Connell, VK2JJJ, 3A Algernon St, Oatley, NSW 2223, enclosing a stamped SAE.



MARINE WAVES

Few boats go to sea without some means of radio communication, but a surprising number of small craft are inadequately equipped for the type of journey undertaken. ETI gives an overview of the marine radio services available and discusses their different applications.

Helen Grasswill

A FEW YEARS ago a friend of mine took off from Sydney harbour aboard an old wooden schooner. It was the start of what was intended to be the trip of a lifetime, sailing up the east coast of Australia to Cairns and then through the islands of south-east Asia. On board was an experienced ham radio operator, complete with his own equipment, who had been engaged to take charge of the yacht's communications needs.

A pretty good arrangement you might think . . . but it soon became apparent that the radio ham's only interest in the journey was to see how many shortwave buddies around the world he could contact from the boat. He knew nothing about marine radio links and, worse still, he didn't want to know. When asked for weather reports and the like, he gave 'no worries' answers and never bothered to check with a coast station closer than Buenos Aires.

Off the Queensland coast, near the southern extremity of the Great Barrier Reef, the yacht sailed straight into a cyclone. For five days the crew battled incredible winds and fierce seas; my friend was sure he'd seen his last days. Finally the yacht broke up on a treacherous reef and by some miracle, and a lot of help from a local lighthouse keeper, the crew managed to battle their way ashore on one of the few inhabited islands in the area, much the worse for wear but nevertheless alive.

The moral of the story is, of course, that had correct marine radio procedures been adhered to, the boat would probably still be sailing today. Cyclone warnings had been issued to all craft for at least two days prior to the boat encountering strong winds. Furthermore, although the radio operator managed to get out a Mayday message it was transmitted on a non-marine frequency; by sheer luck it was picked up by some chap in Whoop-whoop, but it took a critical amount of time to be relayed back to the coastal rescue authorities.

Now I'm not saying that it's impossible to sail safely without a marine radio. Christopher Columbus and hundreds of others did it that way centuries ago, and even today there are adventurers whose philosophy is to tackle nature without the aid of mod cons. Fair enough. But for the rest of us, wanting to enjoy the cruising life, it's just plain stupid not to take advantage of at least some of the equipment, facilities and knowledge the late twentieth century has to offer!

Marine frequencies

Australia participates in an international marine radio network, which is essentially the same for small craft as for commercial shipping. This network comprises two separate services, one on HF for SSB equipment and long distance or ocean travel, the other a relatively new service using VHF gear for offshore boating. As well, a string of services for local boating in Australia and Papua New Guinea, run by private and voluntary organisations and clubs, operates

on the 27 MHz band using SSB and AM modes.

The HF and VHF services are controlled by the Overseas Telecommunications Commission (OTC). This body maintains 13 coast radio stations (CRSs), located approximately 400 km apart to provide a comprehensive link-up along the entire coast. All stations operate on HF, but at present only six — Sydney, Melbourne, Adelaide, Perth, Brisbane and Townsville — monitor VHF (though it should be extended to the rest within a couple of years and relay aerials already enable considerable coverage).

Specified areas of the HF and VHF bands have been designated as **SOLAS (safety of life at sea) distress and safety frequencies,** or channels, and are kept under 24 hours a day surveillance. Because of this constant monitoring, the distress channels also double as **calling and reply frequencies** via which vessels make initial contact with CRSs and are then directed to move up to **working frequencies** to conduct their business. Radiotelephone services are conducted on both systems — **Radfone** on HF and **Seaphone** on VHF. A radiotelegram service is also available on HF.

The 27 MHz service operates in a similar manner, but does not offer radiotelephone or radiotelegram facilities. Also, it operates almost exclusively on simplex frequencies whereas both the HF and VHF marine services cater for a combination of simplex, duplex and semi-duplex systems.

All three services allocate scheduled times on specified frequencies for broadcasting weather bulletins, navigation warnings and other maritime information. Details of these announcements are published in 'skeds' available from all CRSs and most of the private organisations.

In the case of emergency, CRSs and other surveillance stations work in co-operation with marine search and rescue authorities headquartered in Canberra.

As with all radio communications in Australia, the marine waves are regulated by the Department of Communications (DOC), not simply to burden us with yet another bit of bureaucratic hoo-ha but also to ensure that transmissions can be made without interference, especially in emergencies.

Of the three types of equipment approved by the DOC for small craft — HF, VHF and 27 MHz — it may be desirable to have one, two or perhaps all three types on board, depending on where you plan to travel. All equipment must be licensed (as a 'ship station') by the DOC, costing about $30 a year per vessel, and for both HF and VHF the operator must also have a Restricted Radio Operator's Certificate of Proficiency (RROCP), which involves a written, oral and practical examination covering radio theory, procedures and minor repairs. (Both the DOC and OTC publish booklets outlining licensing and procedural requirements, and technical colleges run short courses in preparation for the RROCP exam for those who don't want to attempt it 'cold'.)

HF (high frequency) marine radio

The international HF marine radio service is designed for long-range communications and is the only effective radio for ocean passages beyond about 50-100 km from the coast or out of range of a coastal radio station. Up to 400 watt power on SSB is authorised, enabling communications over thousands of kilometres, however sets should be operated on low power wherever possible.

Although the term HF in general covers the 3-30 MHz bands of the radio frequency spectrum, HF marine radio operates between 2 and 8 MHz and therefore includes some medium frequencies — occasionally you will see equipment labelled MF/HF.

The most important frequencies are 2182, 4125 and 6215.5 kHz — the SOLAS distress and calling numbers. For effective communication it is essential to understand how the radio waves are propagated and to be aware of the different characteristics of the 2, 4 and 6 MHz bands.

The signals in these bands are predominantly 'skywaves', which travel upwards until they reach a reflecting layer in the ionosphere and are then reflected back over a wide area. Under ideal and identical transmission conditions a wave at 2 MHz ▶

Inside and outside Sydney Radio.

bends and returns to Earth sooner and closer to the transmitter than one at 4 MHz, and a 6 MHz wave travels further than both of them. Thus the higher frequencies in the HF marine bands give the greatest ranges of communication.

However, a more important consideration when using an HF marine radio is the changing state of the ionosphere in any 24-hour period; this results in significantly greater ranges of communication (or larger 'skip' distances) being possible during the night than during daylight hours.

In simplified terms, the main reflecting layer of the ionosphere (the F layer, some 320 km above the Earth) is more or less permanently ionised but during daylight hours energy from the sun causes intervening ionised layers (the E and D layers) to form between it and the Earth's surface. The distance covered by a signal reflected from these lower layers is significantly less than it would be had the signal passed through to the F layer. Further, radio frequencies less than 3 MHz tend to be absorbed by the D layer, eliminating skywave propagation. For this reason, frequencies in the 2 MHz band are not favoured for long-distance communication during the daytime, although shorter distances of 100 km or so can be covered due to a 'ground wave' component.

At sunset the ionisation in the lower layers decreases and the D layer disappears almost immediately. So, in effect, the reflecting layer of the ionosphere 'rises' at night enabling skywave signals in the 2 MHz band to be sent back to Earth and also increasing the possible range of signals in the 4 and 6 MHz bands.

Thus at dusk communications can suddenly be made over thousands of kilometres on the 2 MHz band, whereas only a few minutes earlier the range was severely limited. A great advantage of using frequencies in this band is that they are not subject to as much interference as on the higher bands, and wherever possible it is worth waiting until nightfall to make long-distance connections. Static, though, can be a problem in tropical areas.

Interference, largely from foreign traffic, is most pronounced in signals on the 6 MHz band, which travel the furthest — even in the daytime these frequencies can cover distances of 1500 km or more. But therein lies another problem — the increased distances travelled at night are usually so great that even if the signal is picked up it will be weak, possibly garbled, and may not be heard clearly. Consequently, the 6 MHz band is usually used only when communication on lower frequencies is unsatisfactory.

For ocean passages the 4 MHz band provides the most useful marine frequencies, being able to transmit over distances of around 300 km during the day and over thousands of kilometres at night, without the static problems of the 2 MHz band or as much interference as the 6 MHz band.

For short range communications the very small ground wave component present in the HF marine frequencies is worth considering. Propagation of these waves is as a straight line transmission and its effectiveness is governed by the terrain over which it travels; on land, the wave is severely reduced (attenuated) by hills and cliffs, but over water there is comparatively little attenuation. Signals on 2182 kHz, for example, may be carried as far as 250 km or more over water, but perhaps less than a third of that distance over land. It follows, then, that signals transmitted on this frequency in open waters might be picked up, subject to appropriate aerial heights and other factors, whereas in enclosed waters surrounded by high ground or along a cliff-lined coast they may not always be suitable.

OTC's recommended procedure for vessels within 100 km of a coast station, wishing to call on HF during daylight hours, is to first attempt to call on 2182 kHz then, if unsuccessful, try 4125 kHz.

As we have already seen, the quality of HF marine communications is not constant for a number of reasons, not least of which are interference and the continually changing electrical state of ionospheric layers. In addition, the 11-year sun spot cycle causes the clarity of reception to be generally better in peak years of activity and somewhat patchy at other times. (We are presently moving into a low level of sun spot activity.) The fact that the vessel is always changing its position in relation to the coast station does not help, either.

More than with any other of the marine radio systems, the HF transceiver must be carefully and expertly installed. A strong and appropriately fitted antenna is essential, preferably located as high above sea level as safely possible, and because of the wide range of frequencies incorporated in the HF marine bands an antenna tuning unit is also necessary.

Prices of HF marine equipment vary considerably according to the features required, but you're up for at least $2000 for a good basic outfit.

VHF (very high frequency) marine radio

VHF marine radio has been used by port authorities in Australia for some years but was introduced for small craft communication only in the late 1970s. It is the normal local communications system for vessels operating in various parts of the world including the USA and Europe.

The VHF service is ideal for vessels operating within about 50 km of the coast or nearest coast station, and communication over greater distances is possible in good conditions. It can also be useful for ship-to-ship communication in open waters.

At present the Australian service operates only along the east and south-east coasts of the mainland and along a section of the west coast controlled from Perth. Further antennas and equipment are being progressively installed and within a few years VHF surveillance will be maintained along the entire coastline.

The term VHF covers the 30-300 MHz bands of the radio frequency spectrum, but for marine purposes it refers to frequencies between 156 and 162 MHz. These frequencies are always referred to as channels and are pre-set in the transceiver. There are 55 'international' channels at intervals of 25 kHz, and some transceivers can also be fitted with private channels. The international VHF SOLAS distress and calling frequency is Channel 16 (156.8 MHz), and Channel 67 (156.375 MHz) is designated as a supplementary safety channel.

The signals transmitted in the VHF band are mostly 'direct wave', though there is a small skywave component. Direct wave is simply a 'line of sight' communication and hence it is limited by the curvature of the Earth and subject to 'blind spots' by blocking from high landmasses and the like. However, the signals are very strong (about ten times greater than normal mediumwave broadcasts) and will travel 50-100 km, perhaps up to 150 km in ideal conditions. Also, a temperature inversion caused by a warm layer of air overlying a cold layer in the troposphere (air closest to the Earth's surface) can sometimes produce a 'ducting' effect, causing a VHF signal to slightly follow the curvature of the Earth and achieve radio contact far beyond the normal range.

A great advantage of VHF is that the range does not vary between day and night, nor is it affected by the 11-year sun spot cycle.

As VHF uses FM, voice reproduction is superior to both HF and 27 MHz. It is not affected by atmospheric or other noise and provides interference-free reception of almost telephone quality. Indeed, as far as I'm concerned, it's worth having a VHF set for the Seaphone facility alone — calls are cheaper and more reliable than on the HF Radfone service and provided you're in range of a coast station OTC can connect you with anywhere on the Australian telephone network and overseas. (On costs: a 4-minute call to anywhere in Australia is about $5.20 on Seaphone, $12 on Radfone.)

The power of the VHF transceiver is limited by law to 25 watts and all sets must have a 1 watt low power facility for close working. However, because the system operates on 'line of sight' it is advantageous to have the antenna mounted as high as possible. Installation is simpler than for the HF unit and an antenna tuning unit is not required.

Reliable VHF marine radios with a large range of channels are available from about $500 with simplex and semi-duplex set-ups, and from around $2500-$3000 if you want to be very flash and have full duplex.

27 MHz marine radio

The privately-run 27 MHz marine radio system (colloquially known as '27 Meg') operates in Australia and Papua New Guinea where it grew like Topsy in the absence of an official government service for inshore boating communication. Understandably, it is looked upon with great affection by many mariners, though in the long-term the introduction of the international VHF service to Australia is likely to cause a decline in its popularity.

Although not part of the OTC marine communications service, the 27 MHz system is recognised by the DOC and is monitored by numerous private and volunteer organisations all along the coast. It can be particularly useful in areas such as the Australian east coast where dedicated 27 Meg buffs abound.

For marine purposes 27 MHz refers to frequencies between 27.68 and 27.96 MHz at the upper end of the HF band. The individual frequencies are designated as channels according to their exact location on the band. The distress and calling frequency of 27.88 MHz, for example, is called Channel 88 and the supplementary safety frequency of 27.86 MHz is Channel 86. Channel 98 (27.98 MHz) is also allocated to recognised rescue organisations, while other parts of the band are used as working channels and for club activities such as racing.

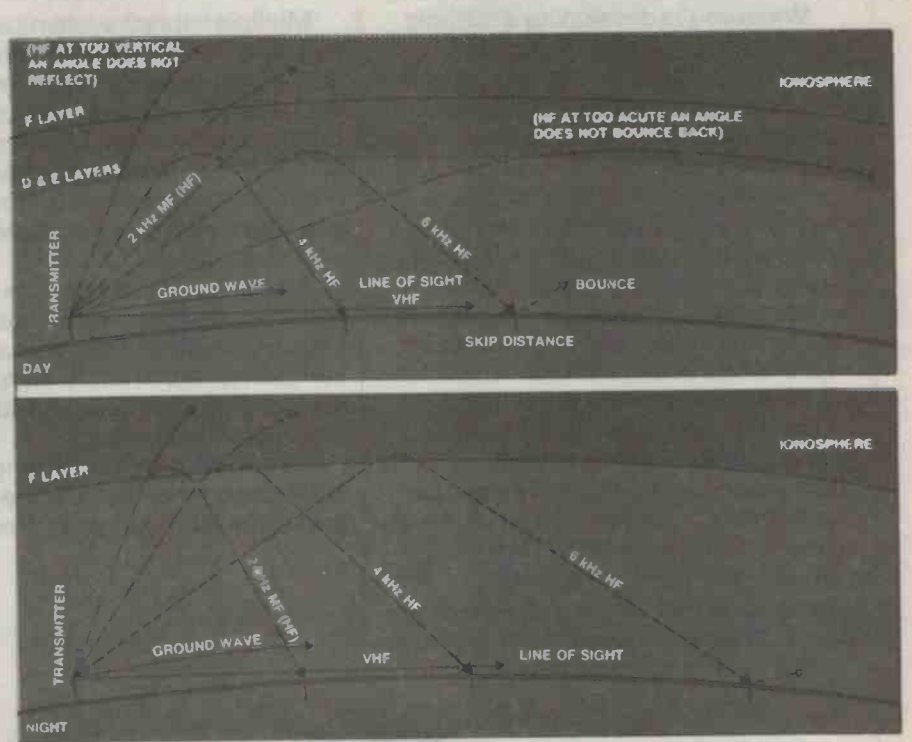
A few years ago all 27 MHz transceivers had AM only and power output was restricted to 4 watts, but SSB has now been added to some sets increasing the effective power output to a legal 12 watts. Only smallish antennas are allowed, however, so communication is limited to virtually line of sight, with a reliable transmission range of only a few kilometres. Under ideal atmospheric conditions this could increase to as much as 100 km.

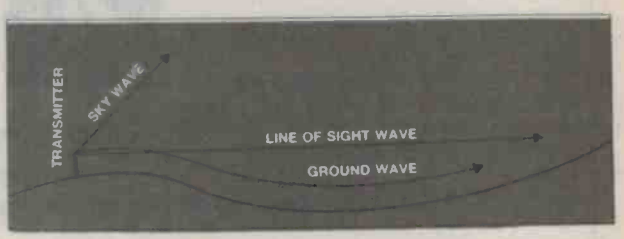
Because 27 MHz is high on the HF band, transmissions can suffer from atmospheric and noise degradation. But there is another type of 'interference' to be aware of: signals transmitted on SSB are not received very clearly on AM sets, and conversely signals transmitted on AM sound weaker when received on SSB than they would if picked up on AM. So, if you're using an AM/SSB set, a little juggling of the dials may be called for; if you have AM alone, there's nothing you can do — but take heart, AM is favoured by most mariners.

A wide range of 27 MHz transceivers is available, ranging in price from about $100 to $300, and they're dead easy to install. For my money, it's well worth having one as a back-up for the VHF and for use as a walkie-talkie when crew members go ashore in remote places.

Over to you

Choosing equipment to suit your needs is very much an individual matter. To help you, in a future issue of ETI we'll survey marine radios and discuss the various features and options available. ●

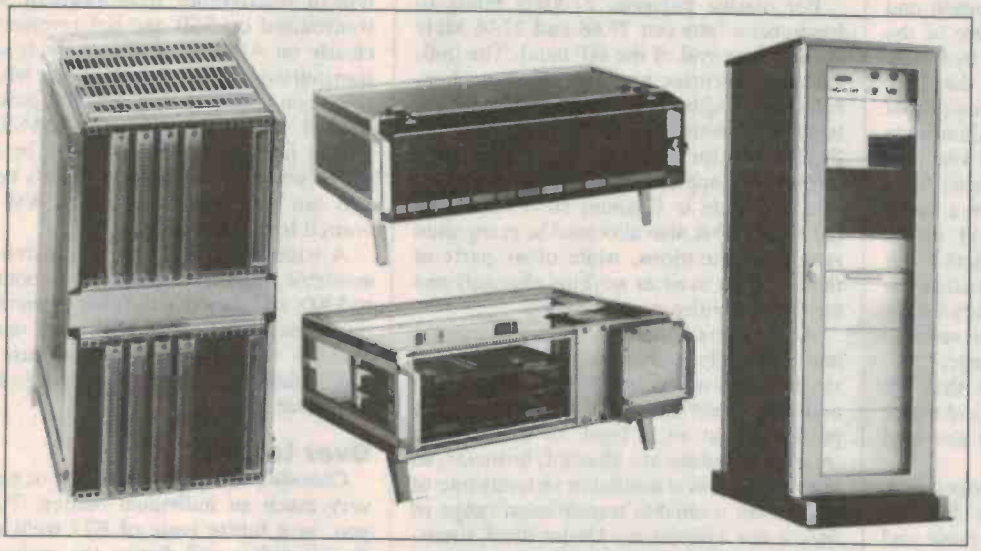




Above: Reflecting characteristics of ionosphere between day and night.

Right: Transmission characteristics of ground waves, line of sight and sky waves.

Excellence in design deserves excellence in packaging



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Gil Hardwick,
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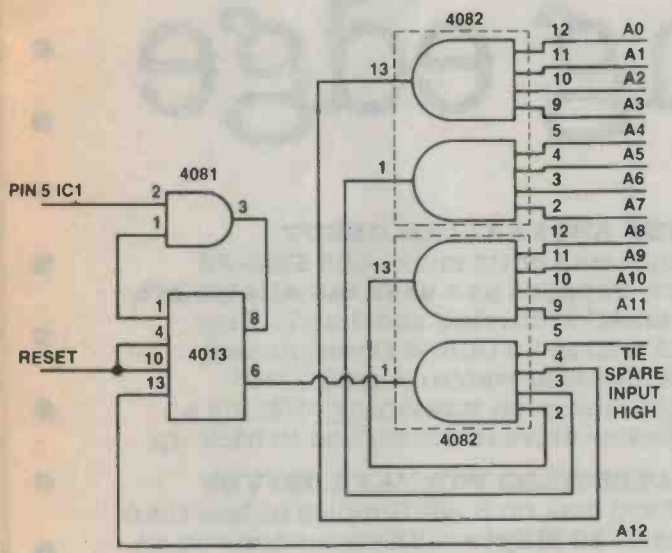

This circuit is a modification for the ETI-668 Microbee EPROM Burner by Tom Moffat and Geoff Nicholls. It saves manually switching between two 'halves' of a 2764.

Attached is a block diagram of the circuit, which can be built on its own board and piggybacked onto the original ETI-668 board.

To synchronise the action between addresses 0FFF and 1000, a 4013a flip-flop is set in direct mode through four 4082 AND gates when all the R0-R11 address lines are high, to wait for the counter transition to 000. Its Q output is connected to one input of a 4081a AND gate and is sent high by the FFF count. The other gate input is connected to pin 5 of IC1, and it in turn is sent high by the next programming pulse after 0FFF, just before the falling edge of the clock pulse for 1000.

The 4013b flip-flop is set by the output of the 2091a going high, and its Q output is the new A12.

The propagation delay through the IC3a/IC2 circuit is equal to that through the 4081a/4013b circuit (±10 ns according to my data books), so as the A0-A11 address lines fall after programming at 0FFF is completed the new A12 address line goes high enabling the 1000 address.

The respective Q outputs of the 4013 go high during and just after programming at 0FFF, and stay high until they are reset again. They are both reset by the existing SW1 at the start of programing.

While the set input of 4013a is high at 0FFF and 1FFF, and that of 4013b is high at every programing pulse after 0FFF, no disallowed state will occur unless the burner is reset during programming. That will blow the program anyway.

'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 60 W Portable Cordless Soldering Iron, a 240 Volt Charging Adaptor together with a Holder Bracket. The prize is worth approx. $100.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each person will be paid $20 for an item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

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

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

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

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

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

at the leading edge

100 MBYTE OPTICAL DISK DRIVE MAKES AUSTRALIAN DEBUT
US manufacturer, **ISI**, has commenced shipments of its model **525 IBM-PC** compatible **Write-Once/Read-Mostly** drive. Supplied as a **user installable kit,** the 525 is designed as a rapid access **(100 msec)** archiving and distribution medium for backing up hard disk drives as well as an Online Direct-Access storage for local and distributed databases. The removable cartridge will withstand electromagnetic fields, heat, light and even scratching offering a data integrity exceeding that of the Winchester drive it is designed to back up.

SOFTWARE BACKUP UTILITY ELIMINATES NEED FOR TAPE DRIVES
FASTBACK can back up a full **10 MByte** hard disk on 5.25" floppies in less than 8 minutes on an IBM-PC, XT or compatibles or **20 MByte** in the same time on an **IBM-AT.**
FASTBACK can make either partial or incremental backups or restores with full disk management, sequencing, dating and overwrite protection.

PRIAM RELAUNCHES ITS 14 inch DRIVE SERIES
Following an upsurge in demand for their **6650-10** Winchesters, with **SMART, SMD** or **Priam** interface, predictions indicate a record year for the line. Users are citing years of reliable service for the pioneer design a feat some users are claiming is not matched by more recent introductions. Daneva is preparing to restock the old trouper and would like to hear from Australian vendors needing support.

PRIAM CLUSTER TOWER SERVES UP TO 8 IBM PC COMPATIBLES
Designed as a starter for those nearly at the stage of purchasing a local area network, but confused by the array of options, the **Cluster Tower** provides immediate shared storage up to **292 MEyte** and dual, concurrent **printer support.** At the same time it is designed to suit any **DOS compatible LAN** purchased in the future.

IBM-PC XT is the registered trade mark of International Business Machines.

daneva

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Adelaide: DC Electronics (08) 223-6946
Brisbane: Baltec (07) 369-5900

DAN004

MINIMART

FOR SALE: TI99/4A SOFTWARE. Seven games including Snake Attack, Blackjack, Concentration, Stanley for $15. Send to T. Smith, 7 McMenamin Pl, Kelso, NSW 2795.

FOR SALE: CHALLENGE CDS-1 speakers, transmission line — as new, cost $1700 sell $900. D. Dixon, 17 Rowes Lane, Cardiff, NSW 2285. (049) 54-8746.

FOR SALE: SANSUI Z-7000 AM/FM receiver 90 Wrms per channel, built-in timer unit, as new, cost $1000 sell $650. D. Dixon, 17 Rowes Lane, Cardiff, NSW 2285. (049)54-8746.

FOR SALE: VZ200 COLOUR COMPUTER, datasette, 16K memory module, joysticks and 6 cassettes $275 ono. L. Brill, PO Box 42, Ganmain, NSW 2702. (069)27-6406.

WANTED: VIC-20 COMPUTER. Can pay up to $100 for one with datasette, $75 without. Must include power supply etc. Phone Craig on (03)720-3619.

FOR SALE: S100 Boards; MW6AO VDU $100. Micropolis FDC 10086-52-9B suit system 80; C/W system disk $150. D. Squirrell, 13 Cardinia St, Berwick, Vic (03)707-3281 ah.

FOR SALE: Z200/300 PROGRAM COPIER. Copies all m/c games etc. Also transfer from tape to disk — $12 tape of $15 disk. N. Sarafoudis, PO Box 31, Huntingdale, Vic 3166. (03)551-6381 ah.

FOR SALE: VIC-20 programme library. High quality games, utilities, educational and misc programmes available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson, ACT 2602 for list.

FOR SALE: GULBRANSEN PREMIERE organ; needs attention; $500. (02)638-6804 after 5 pm.

SHOPAROUND

ETI 169: Audio Oscillator

Geoff Wood Electronics has advised us that it is doing this project (Oct-Nov 1985) as a kit. Price will be about $150.

ETI 689: Commodore Bus Sharer

The only problem you might have with this project is in the plugs and sockets that connect the unit to the outside world. We have specified the standard parts, but you could cut costs and corners by buying less expensive components (eg 3-pin DIN plugs instead of 6-pin where appropriate). We strongly suggest that you make up your own cables as the ones sold as standard by Commodore seem a trifle overpriced. Also, note that you don't need to buy all the sockets if you have no need for them. Tailor it to suit yourself.

ETI 1530: Vibration Detector

This is a really simple rainy Saturday type project for those of you with an overflowing junk box. Why not select resistors at random and see if it will still work! Dick Smith Electronics is doing it as a kit for an absurdly small amount of money. Have fun.

ETI 1513: Frequency Doubler

All standard components, no problems.

Artwork

For those constructors willing and able to make their own pc boards and/or front panels, we can supply same-size film transparencies of the artwork, positives or negatives as you require. From the list given below, select what you want and address your request/order to:

'ETI-xxx Artwork'
ETI Magazine
PO Box 227,
Waterloo, NSW 2017

When ordering, make sure you specify positives or negatives, according to the process you use. Your cheque or money order should be payable to 'ETI Artwork Sales'. Prices for the artwork for this month's projects are as follows:

ETI-689	front panel	$4.87
	rear panel	$4.87
	pc board	$6.40
ETI-1530	front panel	$3.50
	pc board	$2.00
ETI-1513	front panel	$2.37
	pc board	$4.87

Fuzzy Logic

THE LATEST TREND out of the USA, hard on the heels of cocaine, AIDs and Madonna, is Fuzzy Logic. Fuzzy logic? A tautology you think? Not so, says the father of fuzzy logic, Lofti Zadeh. Lofti, who was even tall when his parents named him, began it all by talking about fuzzy sets almost twenty years ago.

A fuzzy set is a set with fuzzy boundaries, what else? Consider, for instance, the set of good electronics magazines. At the centre is ETI, while further out are various other rags, all with less and less claim to belong to the set. At some stage we could, in fact, pick up such a rag and deny it claim to the set at all. You can quantify this by giving ETI 1.0, various competitors 0.9-0.1 and the gutter press the big nil.

The beauty of this, says Lofti, is that it is pretty much how human beings think about things. The world is divided into certainties and long shots.

From fuzzy sets develops fuzzy logic. Standard logic says, if A and B then C, Fuzzy logic says C maybe, depending on how true A and B turn out to be. Fuzzy logic computers are on the drawing board, and they will use current to signify how true a particular statement is. Plans are in existence for a CMOS chip with nine circuits that have grades of current from 0 to 1. Thus if a gate goes high with half the full current potential it means the gate is just like a nervous groom at a wedding; only half sure it should be there.

Of course, the reason for all this fuzzy stuff is the creation of expert systems, ie, making the computer more like the operator who pounds the keyboard. How do we reason? For even the most rational of us, decision making consists of a little bit of this, a little bit of that, and a whole swag of prejudices thrown in. It's the little bits of this and that that make humans so unpredictable. Does it comfort you to know they are trying to make computers the same?

Bring out your dead

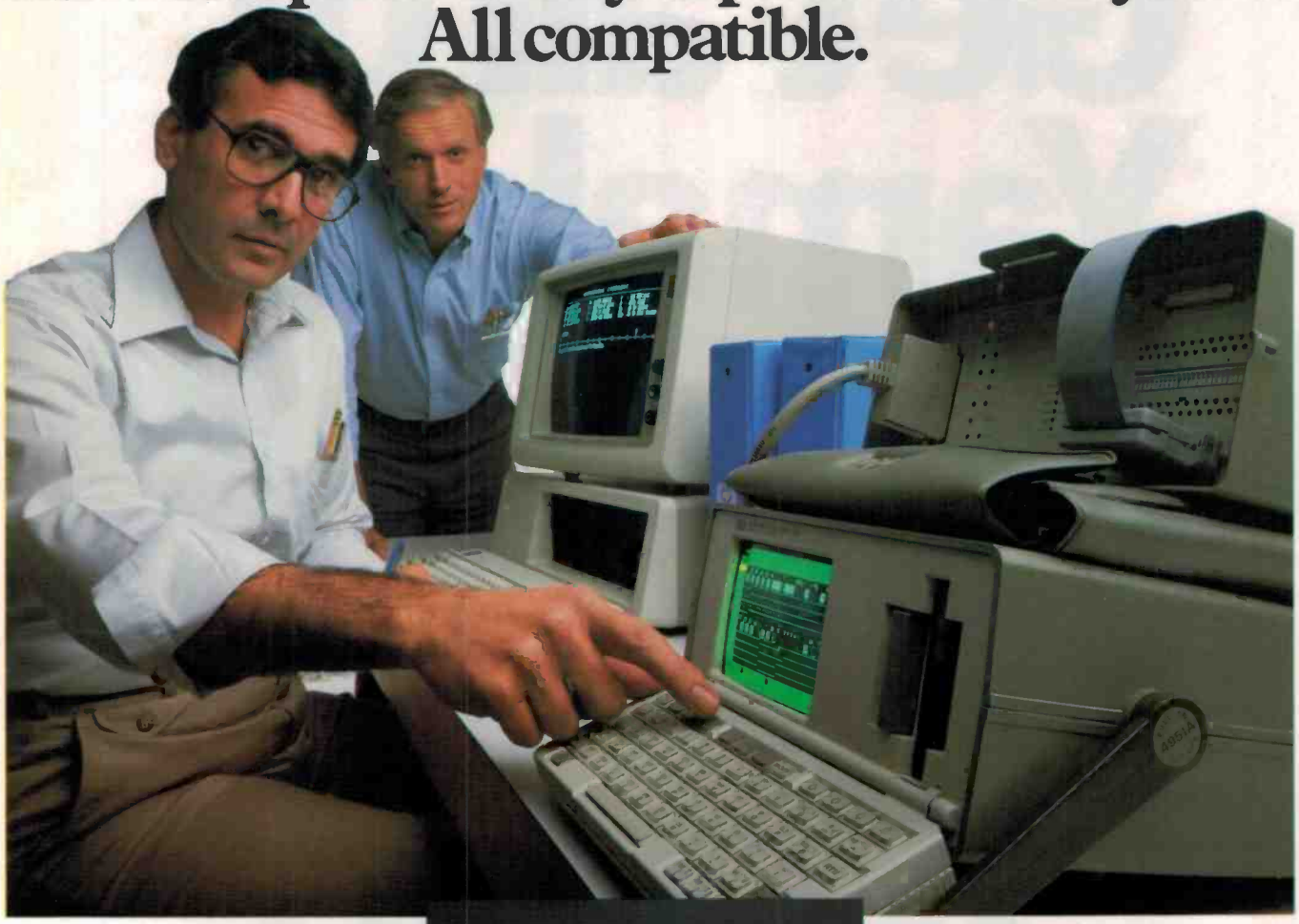
In the event that the computers get so fuzzy they take over the world and start WWIII, an enterprising US gent, one Rafael Ross, is now offering you a new choice in interment. Forget burial, forget cremation, get cremained.

When the Actor called on US business to commercialise space, he especially praised Ross for his imaginative scheme to launch the highly cremated remains of people into space. Ross offers three orbits for eternity: a 1900 mile polar orbit, see the whole world once every few orbits; a geosync orbit for people who only want to see one side of it; and a de luxe trajectory into deep space, for those who can't wait to get out of it.

In the Ross scenario, the ashes of the dear departed are burned a couple of times to make sure there is no foreign material present, sterilised with gamma rays then hermetically sealed into an ultra light, ultra strong, Torlon container. "You can paint anything on the outside you want," says Ross.

Apparently, demand for the $15,000 service is quite high. Dr Ross already has the first load in his office: an Italian lady and her cat. However, reaction from other undertakers has been less enthusiastic. Said one of these gentlemen: "You offer the bereaved a space shot and you might quite possibly get punched in the mouth". Another undertaker said he would consider offering it to someone "pre-need", but he felt it would be inappropriate in the "at-need situation".

Eliminate hot sites faster. HP's complete family of protocol analyzers. All compatible.



HP is the first company to offer you a complete family of protocol analyzers that are all data-compatible. Now, you can quickly identify and solve network problems – without having to recreate them for analysis at each organizational level.

Clear lines of communication with remote capability

For the first time, you can have a clear line of communication from the customer's hot site to your district or regional service center – even to R&D if necessary.

All HP protocol analyzers permit remote transfer of data and test programs, so you have high-powered analysis wherever you need it. Captured data and test programs written on one HP analyzer can be transferred to any other remote unit.

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Software extends flexibility

With three HP protocol analyzers to choose from, you don't have to buy any more performance than you need. You are also assured continuing software support – a comprehensive package for X.25 certification and testing as well as powerful decode and simulation packages for SNA, X.21, CCITT #7, and the other protocols you need.

Quick and easy measurements

All HP protocol analyzers feature a common human interface – menus, decoded displays, ASCII keyboards, and softkeys that quickly and easily guide you through your measurements. Learn how to use one HP protocol analyzer and you can use them all.

For details about the HP family of data-compatible protocol analyzers, call Hewlett-Packard.

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