ELECTRONICS TODAY INTERNATIONAL

APRIL 1990

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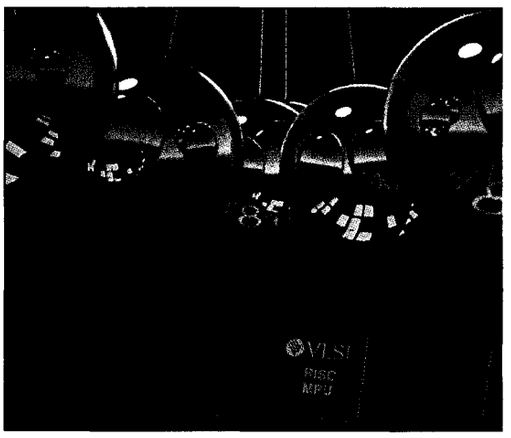

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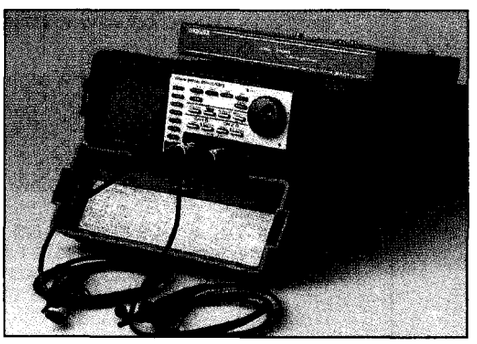

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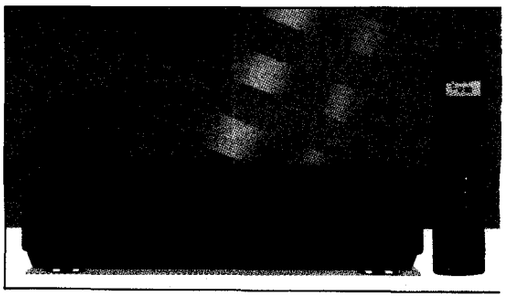

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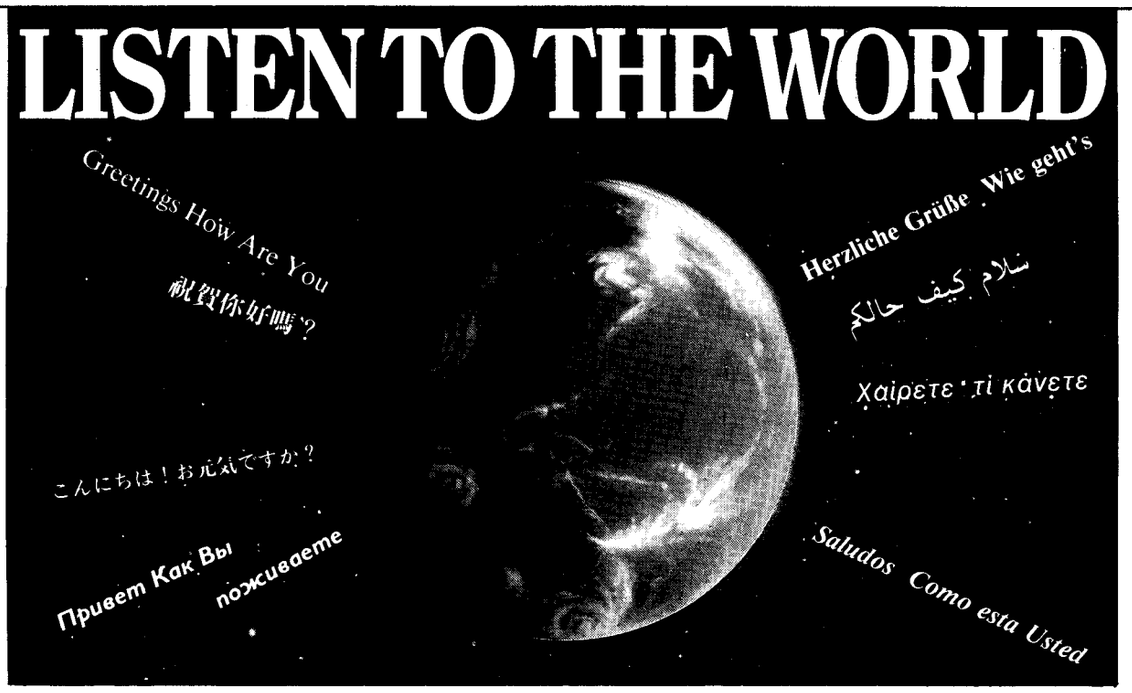
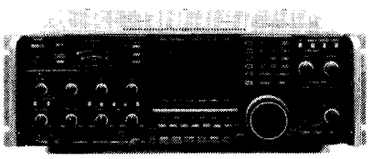
Cover showing Mobilesat (see page 6) courtesy of Aussat.

LISTEN TO THE WORLD



WITH ICOM RECEIVERS

There's a world full of information out there and more people are using ICOM's outstanding range of receivers to gain access. ICOM will expand your horizons to include new dimensions in transglobal communications both public and private. For local news, weather and emergency services transmissions or a wealth of international knowledge – listen to the world with ICOM receivers.



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The first receiver to give you all communications from 0.1MHz to 2GHz. That's space age technology applied to literally space communications.

Every receiver and scanner on the market is in this amazing unit.

FEATURES:

- AFC, for FM Modes.
- USB, LSB, CW, FSK, FM, FM-narrow, AM.
- 1000 Programmable Memories.
- 10 groups of Scan ranges.
- Multiple tuning steps.
- Direct Digital synthesizer.
- Dual clocks and timer functions.
- Super high frequency stability.
- Spectrum Scope included in Multifunctional, CRT display.
- Computer Controllable (optional CT17).

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Pick up long wave, medium wave and short wave bands around the world. Set your favourite frequencies and sit back with your remote control (optional) to enjoy amateur to national radio broadcasts.

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- USB, LSB, AM, FM, CW, R-TTY (FM Mode is optional)
- 32 Memory Channels.
- Infrared remote control (optional).
- Programmed memory and mode scans.
- Adjustable If Notch Filter.
- Noise Blanker.
- 12V DC Kit for portable operation (optional).
- Voice Synthesizer (optional).

IC-R7000

Every UHF/VHF message is within ear-shot. Listen in on weather, fire emergency services, TV and many more local communications with total convenience. Program your interests, scan for news, its all neatly packaged.

FEATURES:

- USB, LSB, FM, FM-narrow, AM.
- 99 Memory channels.
- Infrared remote control (optional).
- Variable scan speed and delay.
- Noise blanker.
- 12V DC Kit for portable operation (optional).
- Voice Synthesizer (optional).
- 6 scanning functions.

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NOTE: Handles optional on all models.

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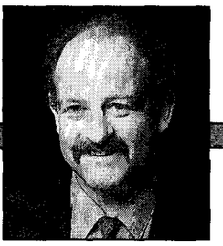
READER INFO No. 4



KIM BUCKNOLE

Why is greater use not made of the creativity of Australian scientists and designers?

"Why, indeed?" might be your response. By the time you read this, some answers will have been recorded. The question posed is the title of one of four sessions comprising the National Ideas Summit held in the Senate Chamber of the old Parliament House in Canberra on 26th February, two weeks from time of writing. Professor Donald "Lucky Country" Horne, as chairman of the Australia Council, came up with the concept of the Ideas Summit to involve many prominent Australian names and minds in a "think-fest".

Contributors to the sessions were to include Dr Peter Ellyard, of the Commission for the Future, historian Hugh Stretton, Noni Hazelhurst, and Professor Don Aitken of the Australian Research Council. Sessions were to embrace the contribution of the arts to the intellectual life of Australia, the role of the universities in developing ideas and the role of publishing and broadcasting in broadening the levels of intellectual debate in Australia.

At the time of writing, I have no idea what they came up with. But the fact that such a thing could happen in Australia is in itself a matter of some interest. I have an aged relative who, as recently as 1980, defined culture as something that grew between the toes of at least half the population. It would be much harder now to propose such a thesis. But... it remains true that as a nation we offer more respect, more approbation, more hero worship to the athlete (in the broadest sense) than to the intellectual, to the physical rather than the mental gymnast, to the corporeal rather than the cerebral. I doubt that we will ever offer a ticker tape parade to a Nobel Prize winner – but we will to an Ashes-winning or Commonwealth Games team.

Our sportsmen are often described as ambassadors of our nation, but so, too, are those who engage in intellectual rather than physical exercise. Our artists, actors, writers, broadcasters and scientists are often better known, and more highly respected, overseas. There is still an anti-intellectual atmosphere at large in the "Lucky Country".

There has been something of a furore in NSW of late because of the weighting of the HSC results. It is argued that the need to encourage students into the sciences at university level has led to an unsatisfactory situation for those wishing to follow a career path in the arts.

To me, all this is unsatisfactory. A healthy society should surely value equally all those endeavours of which man is capable.

Ideally, a society should provide a framework for the talents of individuals to be developed to the maximum benefit of that individual and society. Underfunding the arts and the sciences, whilst fawning on the sportsmen, creates a poor environment in which to foster the talents of our young artists and scientists. Tinkering with the exam results to secure a quota of science students is not a solution. Consider the reported response to the multi-function polis concept recently. If we could isolate the anti-Japanese element from the response, there would still be little sympathy for the concept of first class facilities for technologists, scientists and sunrise businesses. This might be a fault in PR. Indeed, the main media coverage has been unsatisfactory in explaining the concept. But the media reflects society. The society does not highly value scientists, artists, or academics.

There is no easy short-term answer. But if I had my "druthers", I would like to see the Ideas Summit come up with an idea which would induce our governors and our populace to value "renaissance" man, or at least to value the scientist, the artist and the athlete equally.

"'Tis a consummation devoutly to be wished" as a playwright with an interest in the totality of man's endeavours once said.

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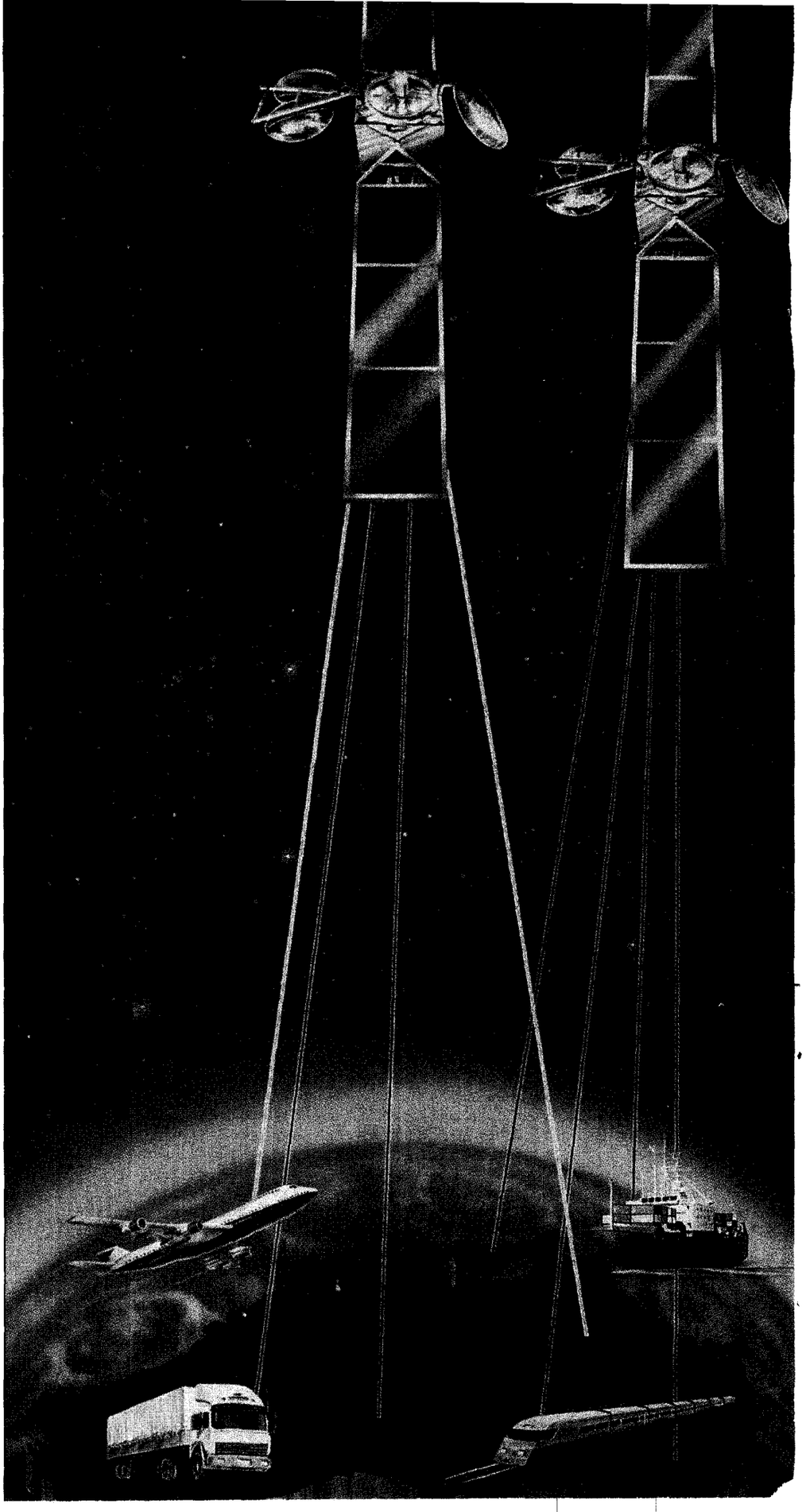


MOBILE COMMUNICATIONS, LOOKING UP

In 1992, Aussat will inaugurate the world's first domestic satellite communications service for mobile users around Australia — on the ground, in the air or at sea. The system offers a unique opportunity for the Australian electronics and communications industry. Roger Harrison reports.

Australia is a sparsely populated country, as readers well know. The main population centres are concentrated on the continent's coastal fringes. Mobile communications have, therefore, always been in high demand throughout Australia, experiencing phenomenal growth since the end of World War II. As emerging technologies permitted, Australian business and government services have exploited every new development in mobile communications. Witness the explosive growth of the cellular radiotelephone network since its introduction just three years ago.

However, the needs of businesses and services operating outside the urban population centres have never been satisfactorily met, due to problems of distance, coverage and cost. HF radio systems, used in the outback, are comparatively low in cost, but suffer from the well-known variabilities and problems with unreliable propagation of HF radio waves. It's used because there's nothing better on offer.

Communications now means more than just the telephone. Data communications (primarily computer data and facsimile) is an increasingly important component of business, and private life.

Proposals to exploit the facilities of the Aussat B series of satellites, due to be launched between mid-1991 and mid-1992, were put forward in 1986 part of a feasibility study at the planning stage. The potential for mobile satellite services was proposed to Aussat's existing customers, and subsequently investigated as a future Aussat business.

The investigation identified markets in road, rail, sea and air transport, exploration services, government and emergency services. The details of services required have been assessed and a mature system proposal developed in just a few years. Aussat has dubbed it Mobilesat. It will be the world's first such domestic satellite service.

L-Band coverage of Australia showing nominal signal strengths.

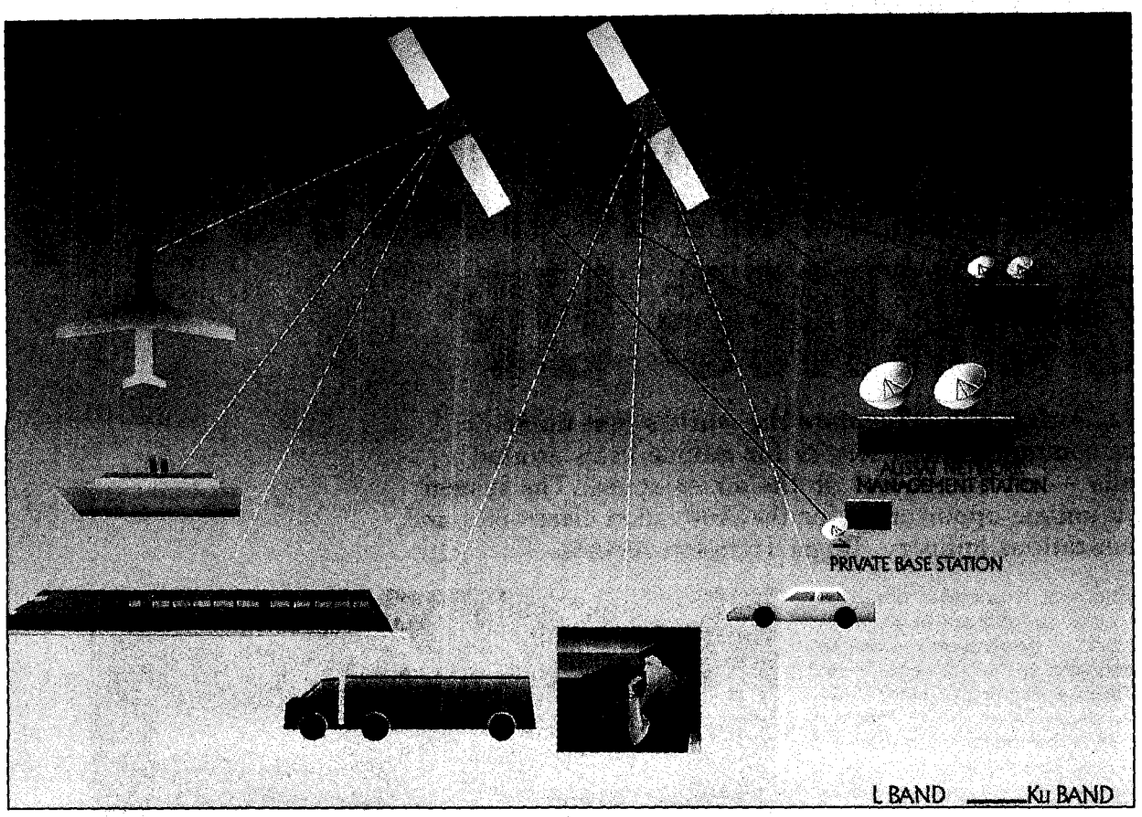
Features and benefits

Aussat says that Mobilesat will, for the first time, provide an instantaneous and reliable service Australia-wide for people and services needing telecommunications on the move. Five services will be available when the system is complete:

- High quality voice communications for linking into the public switched telephone network, or private networks.
- Voice band data services – e.g: fax, computer to computer communications.
- Data messaging between vehicles and between vehicles and bases (e.g: paging services).
- For remote monitoring, telemetry and control data communications.
- Relay of position determination and other data.

This covers a range of requirements for Australian users and services including:

- Mobile telephone services, linked to the



The MOBILESAT network.

Telecom network, from anywhere in the country.

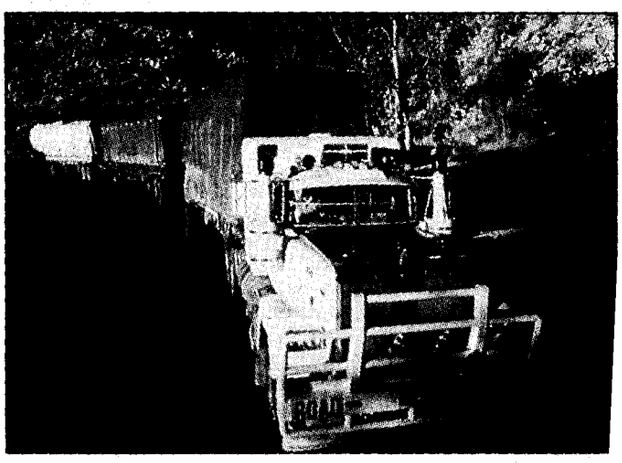
- Services for mining, surveying and geophysical exploration companies operating in remote and off-shore regions.
- Communications for the transport industry, trucking, shipping, airlines, railways and companies with vehicle fleets operating in widely dispersed areas.
- Service industry support for customer service personnel providing goods and services in rural and remote areas.
- Rapid and reliable communications for emergency services such as the police, ambulance, the Royal Flying Doctor Service, road maintenance crews, fire fighters, and others.
- 'School of the Air' for remote areas.
- Data collection and distribution, including remote data monitoring for scientific and environmental research.

Aussat research puts the potential market size for mobile satellite communications at around 50,000 users, the majority being land mobile applications.

Elements of the system

Mobilesat will operate in the UHF L-band, uplinking (transmitting) in the band between 1646.5 and 1160.5 MHz, and downlinking (receiving) in the band between 1545 and 1559 MHz. Fixed ground terminals ('hub'

Vehicles will have a 'frisbee' shaped roof-mounted antenna.



MOBILESAT will improve fleet management systems.

stations) will operate in the 14/12 GHz bands (uplink/downlink).

Mobile terminals for applications requiring low speed data services will feature a low-cost non-steerable antenna with a modest gain of 4-6 dBi with a high rejection below elevation angles of 5 degrees and smooth, uniform gain across elevation angles of 25 to 70 degrees. Practical models look rather like a large frisbee!

More expensive and complex antennae are required for fixed or transportable applications, while tracking antennae are required for some voice and medium speed data mobile applications.

Voice access via Mobilesat will use equipment rather like cellular telephones. Paging equipment is likely to be similar to current equipment in the field.

It is envisaged that power consumption of terminals to be used for remote applications will be geared to the use of low cost solar panels and battery systems.

Aussat has been conducting technical field trials and customer demonstrations for the past two years. In September 1989, Aussat issued a 'request for tender' to supply network control stations.

When?

The MODAC and MOPAGE packet data services will be the first commercial Mobilesat services to come on line – later this year. MODAC, the Mobilesat Data Acquisition and Control service, gathers data in real-time from remote and/or unattended monitoring stations, for example: monitoring of river data, pipeline station monitoring, security surveillance or fire alarm monitoring in buildings, monitoring applications in electricity supply and distribution facilities, unattended remote weather stations and seismic monitors. Aussat claims that Mobilesat is ideally placed to provide cost effective, high performance communications services for these users.

MOPAGE, Aussat says, will provide the ideal nationwide communications medium for the long distance transport industry. It features a two-way messaging service plus the facility to report data from an on-board electronic vehicle monitoring system and a position determination device.

These initial services will use INMARSAT's Standard-C system. Both MOPAGE and MODAC will be available for private networking. It is expected that some service providers will offer a bureau service for customers whose needs do not justify a private network in the initial years of operation. A range of value-added services are expected to be offered along with such

MOBILESAT environmental monitoring service

AUSTRALIA will soon be able to keep a closer eye on its valuable natural resources in remote areas, thanks to developments in satellite communications technology. One development is the STANDARD-C terminal, which allows for the collection via satellite of environmental data from remote sites using low cost L-band technology.

Aussat Pty Ltd has taken delivery of Australia's first STANDARD-C terminal and, after initial testing and demonstrations later this year, will introduce the remote monitoring service in early 1990. Called MODAC (Mobilesat Data Acquisition and Control), the service will allow for the development of various applications such as remote monitoring of ground water, river levels, seismographic activity and weather conditions.

At present, this type of monitoring involves the physical collection of data from the remote site. Through the STANDARD-C MODAC terminal, data can be transmitted via satellite to a customer's premises for real-time monitoring and analysis.

The Aussat MODAC service can also be used for the remote operation of irrigation systems, dam flood gates and pipeline control systems.

Aussat has contracted the CSIRO Division of Water Resources to develop a software interface to a range of analogue and digital sensors. Application-specific data management software will be developed to suit each customer's existing computer system.

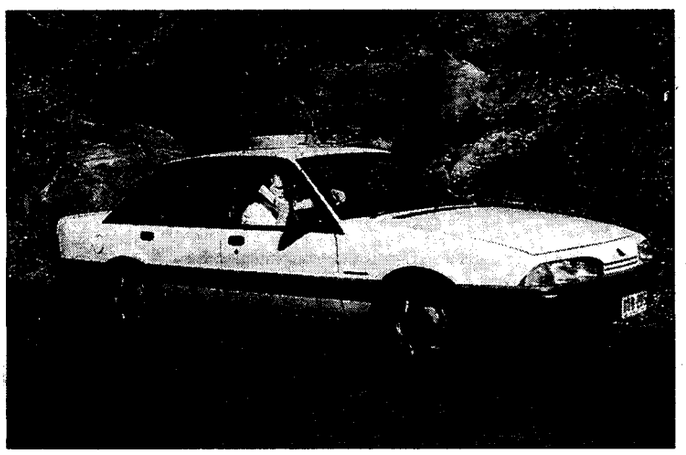
Equipment at the remote site will consist of an antenna, power supply and the STANDARD-C MODAC terminal. Data will be transmitted in three ways:

- sent automatically at regular intervals and stored at the customer's main computer facilities;
- automatically triggering an alarm if, for example, a river height rises dramatically;
- allowing an operator to request specific information and receive it almost instantaneously.

With this collection of up-to-the-minute data, environmental and resource management organisations will be able to make more precise and timely analysis at much lower cost.

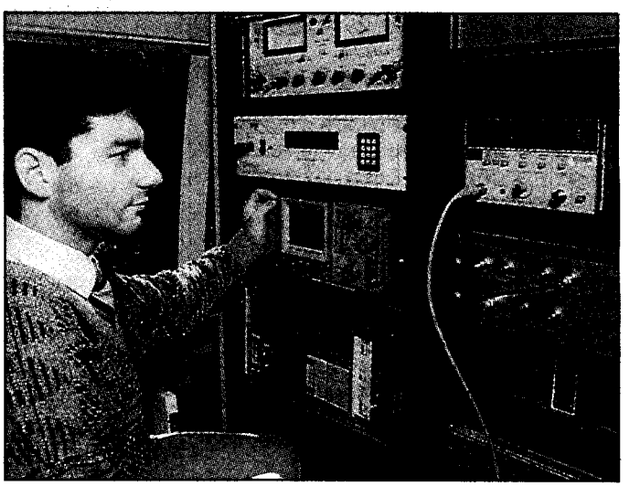
"Australia is a world leader in climatology, arid land and water management," said Dr Michael Wagg, executive manager of MOBILESAT. "The introduction of remote monitoring via satellite will only enhance this reputation. The software being developed here for use with the STANDARD-C MODAC terminal will also have applications around the world, because it can be used on the global Inmarsat satellite system," he said.

For further information contact: Dr Michael Wagg, executive manager, Mobile Communications Business, Aussat Pty Ltd, ☎ (02) 238 7823. Or: Mr Leighton Farrell, manager, Corporate Relations & Public Affairs, Aussat Pty Ltd, ☎ (02) 238 7892.



Reliable communications on the move.

Emergency service organisations will benefit.



MOBILESAT test van is used for experiments through the ETS-V satellite and 'Aussat House' hub station in Sydney.

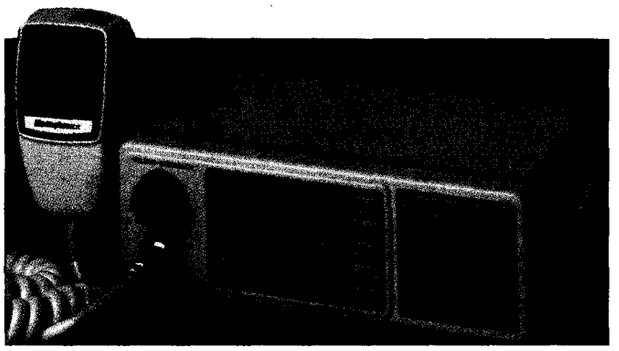
bureau facilities.

All data packets are passed from the field terminals directly to the satellite which retransmits them down to a hub station. These packets are then passed to customer 'base stations' for subsequent distribution and usage within the customer's system or premises.

The Standard-C digital transmission system allows for the use of very compact mobile earth station equipment comprising an antenna and a transceiver. These terminals cost around $5000 per unit. Standard-C is a two-way store-and-forward system, originally designed to provide a telex service for international shipping, which has been improved to suit land-based applications. Customer premises interfaces will be made progressively available through telex, X.25 and X.400 distribution links. Various versions are expected to come on the market to suit different applications, ranging from a low-cost power-efficient terminal optimised for a low duty cycle to a high power terminal capable of transmitting continuously.

That's just for starters. The full commercial service offering voice and data telecommunications will come into being following the commissioning of the Aussat B-series satellites in 1992.

Contributed by The Apogee Group



GX558 VHF marine transceiver

THE GX558 is designed and built in Australia, and features OTC's Auto-Seaphone system built-in, operated from a keypad on the front panel.

The GX558 is fitted with both international and Australian VHF channel sets, including AYF channel 87A. It has provision for extra channels if the VHF band expands, or fitting private channels used by charter and fishing fleet operations and emergency services.

The GX558 uses a simple keyboard which allows instant access to any channel with no more than two keystrokes, with both "dual-watch" and direct over-ride to distress ch.16. It can scan anywhere from two channels to the full band, easily programmed from the front panel.

It has a large 2 watt front-mounted speaker allowing the radio to be flush-mounted through any panel.

The casing is sealed against moisture and uses a combined die-cast aluminium and steel chassis. The radio makes extensive use of miniature "surface-mount" electronic components. Further information from Standard Communications ☎ (02) 816 4755.

READER INFO No. 229

Hands off

THE auto answer feature on the Philips MCR 30 cellular mobile phone takes safety a step further than conventional "hands-free" mobile phones by providing automatic phone answering.

Users can pre-determine the number of rings before the phone automatically answers the call, leaving the driver to just speak instead of having to fiddle with a key or button.

The MCR30 is also available as a transportable (which can be converted into a vehicle phone). Calls can be made for over four and a half hours without having to recharge the battery.

Both models feature a memory-redial facility.

Other facilities include automatic redial for a preset number of times and a repeat interval, both of which can be set by the user, and periodic pips to monitor cost. It can also be adjusted to remotely operate your answering machine by recalling the appropriate tones from the memory.

In all, there are 22 user programmable options. The MCR 30 mobile phone is available for around $1500. For further information contact Rob Haines, Radio Communications Products, Philips TDS, ☎ (03) 235 3666.

READER INFO No. 230

Radio data comms starter kit

THE MCS-300 developed by Sydney company Expertech allows radio communications users to implement and evaluate a simple data communications system, and then use this as the basis of a more comprehensive network suited to their own applications.

Using a standard IBM compatible PC/AT computer, the demonstration software provided with the kit allows transmission to, and reception from, a "mobile" which has an LCD display unit and a simple pushbutton status unit attached. This software also allows variations to the default timing/operating parameters and communications protocols can be used.

Supplied with the kit is the "Base" Data Communications Controller (DCC) which connects to the PC through a standard serial RS232 port. The DCC is initially "hard-wired" to a "Mobile" Radio Data Interface (RDI) module. Attached to the RDI are the LCD display module and status unit, that act as the mobile peripherals for the demonstrative software. Further information from Expertech on ☎ (02) 805 1989.

READER INFO No. 231

Handset range

VOCA has extended its range of telephone handsets with the recent introduction of a low-end unit, the ATX-10.

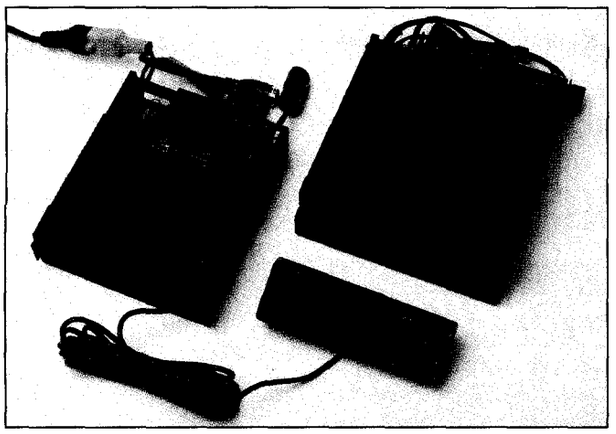
Purchasing the ATX-10, with a retail price of $109, generates a saving of $347 over a 10 year period compared with the cost of renting a basic unit at the rate of $3.80 per month.

The ATX-10 comes equipped with features such as on-hook dialling, memory storage for 10 one-touch and 10 speed-dialling numbers, and battery memory back-up.

The ATX-10 also has tone or pulse dialling, pause button, last number re-dial, and an earth/flash key for PABX compatibility.

For further information, contact Anna Favaro, Voca Communications, ☎ (03) 697 7000.

READER INFO No. 232



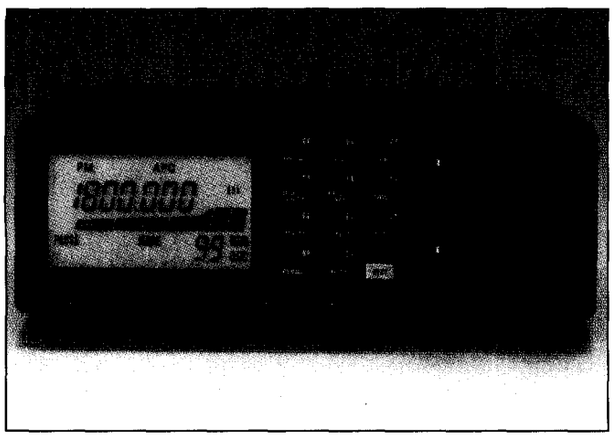
Mobile duo bander

THE IC-901A is a multi band, multi mode transceiver. Supplied with 2m FM/SSB/CW and 70cm (FM), it has the capability of handling every amateur band from 28 to 1200 MHz in FM.

Its front panel is detachable – enabling installation of the front panel on the dashboard and the "works" elsewhere (up to 3.5m away). Using optional optical fibre cables and interface units, the front panel and transceiver units can be separated by as much as 20m.

Features include an optional paging function and DTMF squelch 12 memory channels plus one programmable call channel for each band, with programmed scan, memory scan and skip functions.

READER INFO No. 234



IC-R100

THE IC-R100 is built to the size of the amateur band IC2400A dimensions and has a bandwidth of 100kHz to 1856Mhz, (specification is guaranteed from 500 kHz to 1.8 GHz.)

It operates from 13.8V DC, and has a built-in 15dB preamplifier to enhance weak signals above 50 MHz in the UHF band. A 20 dB attenuator is also built-in to prevent saturation and intermodulation caused by strong local signals.

The IC-R100 has 121 memory channels.

Multi-mode scanning can be set on clear, on signal or delayed. Other features include a built-in clock/timer, variable tuning steps (1, 5, 8, 9, 10, 12.5 or 25 kHz); AM, FM and wide-band FM coverage.

READER INFO No. 235

Advanced multi-band transceiver

THE IC-970, intended for "serious" VHF and UHF operators is a full duplex, multi band, multi mode transceiver covering 6M, 2M, 70cm & 23cm. As supplied, the IC-970 includes the band modules for two metres (144-148MHz) and 70cm (430-450MHz); optional 6m and 23cm modules are available.

The IC-970 is very suitable for satellite operation; tracking of uplink and downlink frequencies being automatically performed when tuning.

The addition of an optional receiver module UXR96 unit enables the IC-970 to receive a full 50 to 905MHz.

READER INFO No. 236

Icom's best

THE World Radio TV Handbook has awarded its "Best Communications Receiver of 1989' award to the Icom IC-R9000.

The IC-R9000 covers virtually the entire usable frequency spectrum with a coverage of 100kHz to 2 GHz. it has a built-in spectrum scope. It can receive TV signals by patching the output into the spectrum scope.

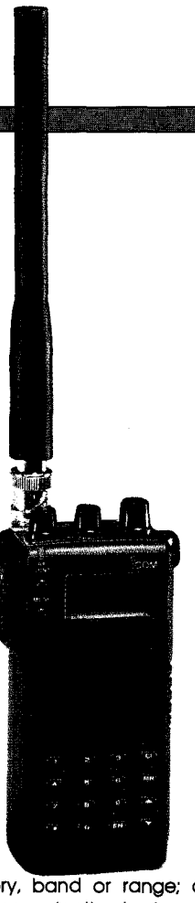
The IC-R9000 has 1000 memory channels, in 10 banks and offers ten different scan ranges.

READER INFO No. 237

Up to 1300 Megs in miniature

THE complete IC-R1 receiver measures 49mm wide, 103mm high and 35mm deep, and weighs just 280g.

It features triple conversion superhet circuitry; FM, AM and wide-band FM reception; high AM sensitivity of 0.79uV (2-905MHz, 10dB S/N); 100 memory channels; multiple scanning modes, including



memory, band or range; dual frequency selection-keyboard or rotary tuning; 11 selectable tuning steps; 24 hour clock and timer with auto power on/off; LCD display with "S" meter; built-in NiCad, or external DC supply (6 – 16V).

READER INFO No. 238

Upstairs transceiver

THE IC-275 features DDS (direct digital synthesiser) PLL circuitry, all mode, packet and ATV capability. It is suitable for OSCAR 13 or any other 1.2 GHz band satellite work.

Options include the TV-1275 ATV Adapter. The IC-1275 has an in built mains supply and can operate on 13.8V DC.

Features include 99 memory channels; 2 programmable scan edges; separate call channel; 1240-1300MHz coverage in A3, A1, or F3 modes, (A5 or A9 optional with TV-1275); inbuilt data switch for "instant" packet; and inbuilt SWR meter.

More information on Icom products can be obtained from authorised dealers or from Icom Australia on ☎ (03) 529 7582.

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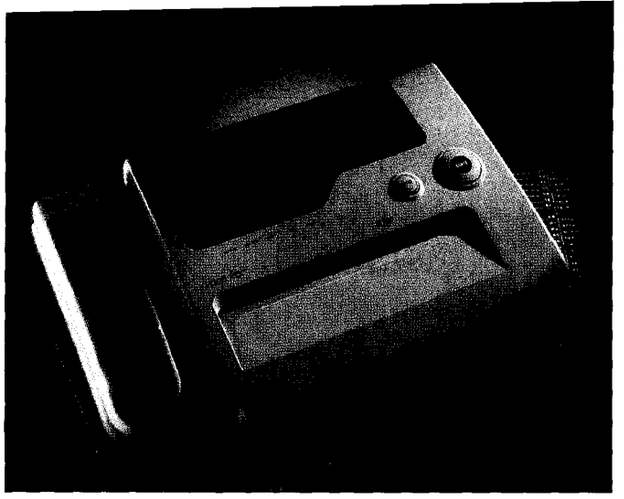

Budget fax

DESPITE its low pricing ($1299), the M900 comes fully equipped with an integral handset, copying function and many of the features available on more expensive machines.

There is no need to dedicate a telephone line to the M900 as the manual answer mode allows the unit to double as a telephone. In manual mode, the operator answers the telephone as normal and by simply pressing the start button, can begin to receive a facsimile if the fax tones are heard, while in automatic mode the M900 operates as an automatic facsimile receiving machine.

With its 'Voice Prompt' feature activated, incoming calls are greeted by a pre-recorded voice which informs them that they have contacted the M900, and that if they wish to do so they may begin their fax transmission.

The 'Switch-To-Fax' facility is available when the M900 is connected to a pulse telephone line, with a second handset connected via a mode 3 adaptor. Calls answered on the second telphone can be switched through to the fax machine if the fax tone is heard.

Professionals who are often on the move can use a cordless handset as the second telephone, retaining cordless telephone mobility as well as the 'Switch-To-Fax' capability from remote locations. Alternatively, a conventional telephone answering system may be connected to the M900 to record telephone messages when an office is unattended.

Facilities such as on-hook dialling, 20 number memory (for numbers of up to 21 digits) including three one touch numbers, last number re-dial and hold are included.

For further information, contact Anna Favaro, Voca Communications, ☎ (03) 697 7000.

READER INFO No. 240

ISDN express card design kit

THE MB89000B Express Card from Mitel is the latest version of the IBM PC based Design Kit for component evaluation and hardware/software development.

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The menu driven software provides a full size display window for each interface component. It allows direct on screen manipulation of device control and gives real time refresh of status information. A help facility covers all major system functions.

The MB89000B ISDN Express Card is compatible with all clock speeds of IBM ATs and most clones. It is also compatible with most 80386 based machines that have 8MHz I/O buses.

For more information talk to George Brown Group Direct Sales Line, ☎ (02) 638 1999.

READER INFO No. 241

Faxphone with a Blue Pencil

THE Faxphone HF2302 Siemens can censor "junk faxes" that arrive unsolicited but cost a business money when received and printed by a facsimile machine.

After an address has been recognised as a "junk fax sender", the number can be programmed into the Faxphone and all faxes from that address will be rejected. Up to 30 different numbers can be recognised.

For further details contact Advanced Business Products, Siemens ☎ (03) 420 7288.

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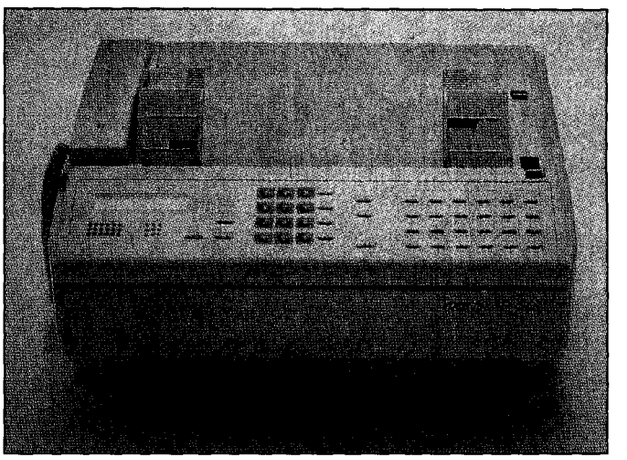

LANS to Voca-fax

THE Facsimile Interface Processor (FIP) is an internal upgrade for the F50 fax which operates with a customised PC Applications Software (PCAS) package. Together, they enable the user to access the Voca-fax F50 from the workstation, transmitting documents directly to any Group 2 or 3 fax worldwide.

All of the document types normally created on a workstation, such as letters, reports and spreadsheets, can be sent in this way. However, the FIP/F50 system now lets users transmit documents and diagrams in which text, graphics and photographs have been combined as well.

These documents can be created on the system by utilising the scanning and greyscale capabilities of the F50 to accurately reproduce graphic or photographic material, which is then merged with the required text during transmission using FIP and PCAS. As a result, visually effective business documents can be quickly put together and sent to multiple locations or call groups if necessary.

Thus reports can have line, bar and pie graphs, tables, flow charts, schematic or exploded diagrams, floor plans, letterheads, logos, maps, photographs or other graphics incorporated for maximum impact, without the extra expense of a separate scanner.

The applications software provided by Voca is menu-driven, the operator selecting functions from the PCAS Main and Maintenance menus via the function keys. During installation, PCAS creates its own sub-directory for the storage of images, text files, received faxes and delayed commands.

PCAS operates on IBM PC, XT, AT and PS/2 personal computers, or directly compatible machines operating under MS-DOS or PC-DOS version 2.0 or higher, and is capable of transmitting any ASCII file either from its own sub-directory or others on the network file server. FIP can also be used with mainframe or mini computers.

For further information, contact Anna Favaro, Voca Communications, ☎ (03) 697 7000.

READER INFO No. 243

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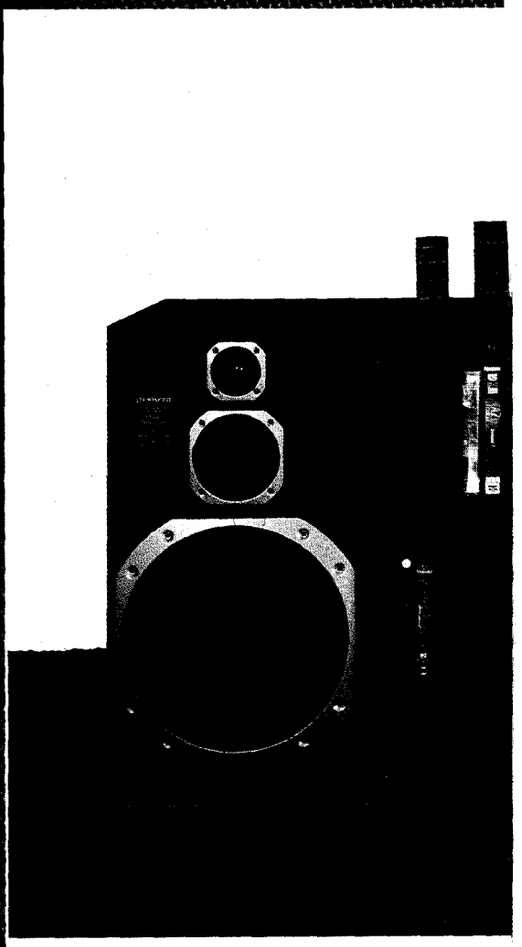

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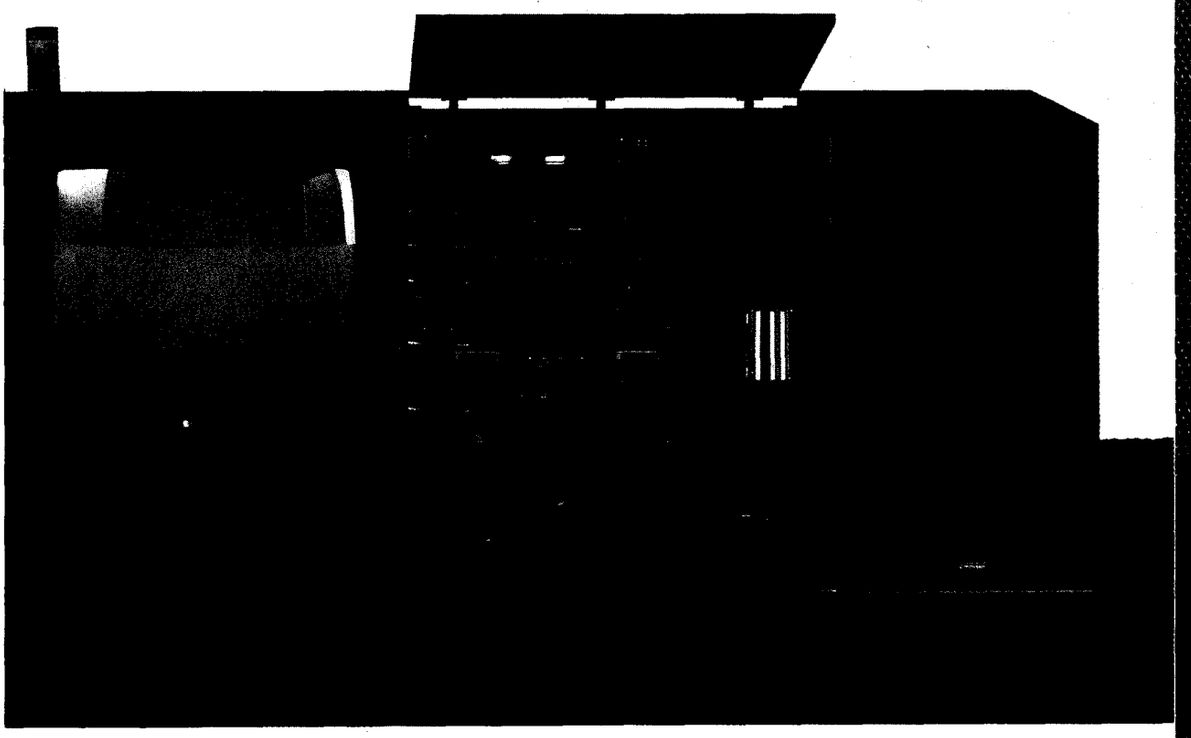

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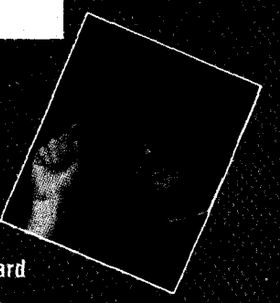

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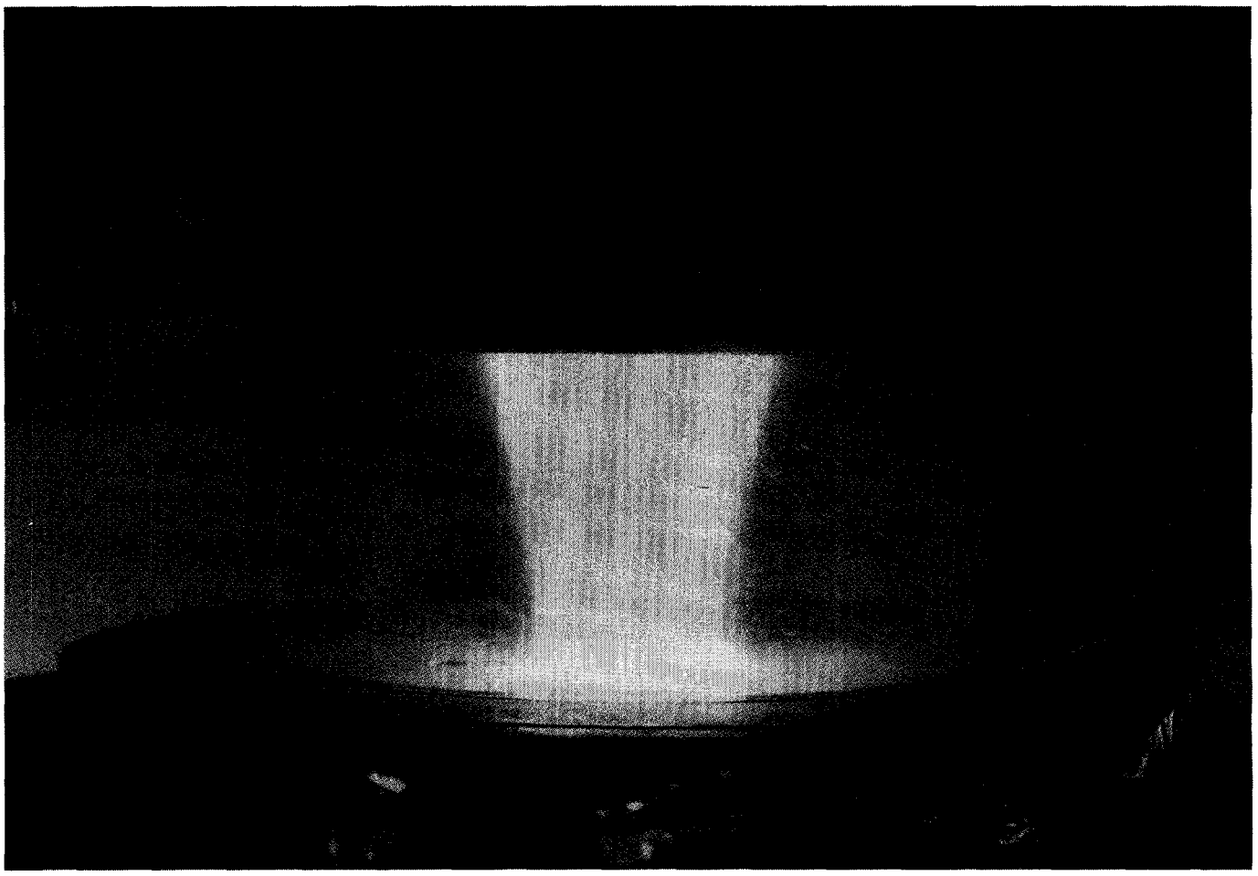
ECR TECHNIQUE FOR WAFER PROCESSING

Electron cyclotron resonance (ECR) is an effective wafer processing technique with etching rates greater than conventional plasma equipment. Developed in Britain, the technique is expected to become the preferred method for production plasma processing. By Brian Dance.



An ECR plasma.

TECHNOLOGY

This technique (ECR) was developed in Britain for semiconductor wafer processing. It enables patterns to be etched on wafers with the sub-micron dimensions required for VLSO device processing, but with etching rates greater than in conventional plasma equipment. This technology also has the advantage that there is less risk of wafer damage, since the energy of the bombarding ions is very low.

Etching speed is vitally important for the economical fabrication of semiconductor devices. It is now recognised that it is desirable to process each wafer separately rather than in large batches. One reason is that, a single 150 mm wafer may contain 10,000 to 20,000 devices, so the failure of a whole batch is expensive. An additional advantage is the greater degree of process control, which can be obtained by processing each wafer individually – apart from the fact that batch loading systems are complex, expensive and difficult to automate. However, it is not economical to

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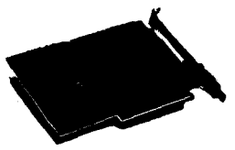

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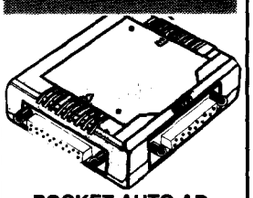

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process each wafer separately, unless the etching rate is high enough for the process to be carried out relatively quickly.

Conventional plasma processing does not develop adequately high concentrations of ions in the plasma to achieve the desired etching rates. This technique is, therefore, attractive for single wafer processing.

Thin film deposition

Another application for this process is the deposition of ultra-thin films of extreme purity on semiconductor substrates at low temperatures. This is one of the major problems encountered in semiconductor device production. Such thin films are conventionally deposited at relatively high temperatures (about 500°), at which some materials, such as gallium arsenide and other III-V compound semiconductors, suffer damage.

The alternative Plasma Enhanced Chemical Vapour Deposition (PECVD) process can deposit the films at about 200-300°C, but there is a risk of the relatively high energy ions from the plasma damaging the devices being produced.

ECR, on the other hand, enables high quality amorphous, crystalline and polycrystalline films to be deposited at low temperatures for device fabrication. The quality of the films is equivalent to those produced by high temperature processes, yet the growth rate can be over ten times the rates obtained by PECVD. There is virtually no risk of damage to the devices, since the energy of the bombarding ions is only a few electron volts.

Microwaves with magnetic field

The technique, developed by Plasma Technology of Yatton (near Bristol, England) employs a gas plasma excited by microwave power in conjunction with a very powerful magnetic field. The company claims to have been the first in the world to combine the use of microwave power excitation together with a magnetic field for the confinement of the plasma, although these methods have previously been used separately. The combined technique produces the very high ion fluxes which are required to achieve the desired high etching and deposition rates at very low substrate temperatures.

This work resulted from a three year British collaborative project under the Alvey scheme for achieving directional or anisotropic plasma etching at high rates. Plasma Technology investigated a number of techniques for plasma ion density enhancement to achieve the required etching rates; these techniques included magnetic confinement, microwave plasma generation, and pulse techniques.

100 μ m square GaAs via hole etched with a chlorine based ECR plasma.

The company came to the conclusion that the most promising method was Electron Cyclotron Resonance. Although primarily developed for Reactive Ion Etching (RIE), reports from Japan indicated that the technique is equally valuable for plasma deposition processes.

The microwave plasma technique was formerly known as Reactive Ion Stream Etching (RISE). However, this name has been replaced by Electron Cyclotron Resonance to cover both deposition and etching applications.

The ECR technique employs the 2.45 GHz industrial microwave frequency at a level of perhaps 200 W, whereas conventional plasma processing employs power at the industrial radio frequency of 13.56 MHz or, alternatively, at a frequency of a few hundred kHz.

The microwave power comes from a magnetron at the top of the ECR system. A 1 kW magnetron is employed in the Plasma Technology production equipment with a manual tuning system. A closed loop arrangement controls the power so that accurate reproducibility of the process parameters can be obtained from one run to another. The availability of relatively cheap magnetrons of the required power output and frequency was important for the development of the technique.

The high frequency produces very high ion densities for a given power input, some 50-90 per cent of the gas molecules being ionised. The lower power level required to produce this high degree of ionisation reduces the risk of thermal damage.

The ionisation efficiency increases with frequency, but Plasma Technology director, John Ball, explained that the use of an excessively high frequency will give rise to mode structures in the plasma, leading to nonuniformity points on the wafer surface. He added that Plasma Technology has investigated the mode structures formed at 2.45 GHz to ensure they do not interfere with the processing.

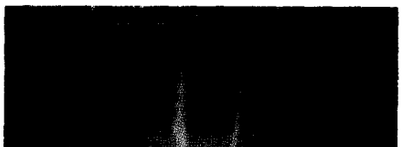
Magnetic field

The magnetic field must be adjusted to produce the cyclotron resonance in the selected gas mixture. This resonance condition is required to strip the electrons from the particular gas molecules used, so as to produce the required plasma density. The water cooled magnet in the Plasma Technology system requires a current of up to 250 A to 70 V.

It is necessary to steadily ramp up the magnetic field intensity rather than to apply the full field suddenly. The equipment is programmed so that the magnetic field achieves and maintains cyclotron resonant conditions.

The ECR technology requires magnetic field strengths approaching one Tesla (10,000 Gauss) which will necessitate the use of increasingly advanced magnet technology in the future. Plasma Technology is associated with Oxford Instruments Ltd whose high field magnet technology is a great asset in the development of ECR equipment.

Initially it was intended to employ the magnetic field merely for confining the plasma in the area of the wafer being processed. However, the directionality of the ion beam is improved by the field which is almost vertical at the surface of the wafer,

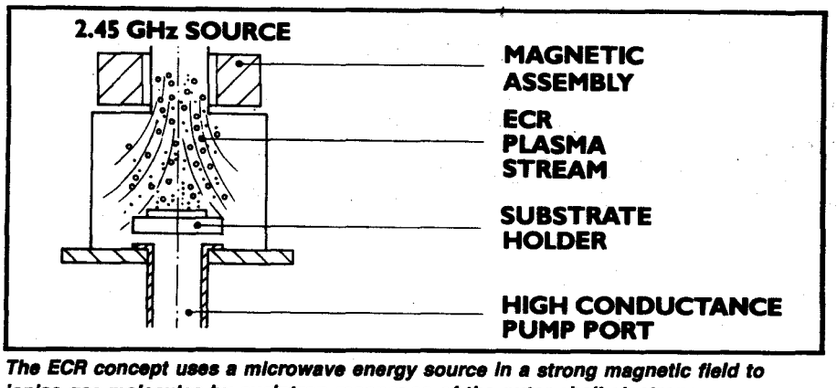


GaAs feature etched in a chlorine based ECR plasma using a 1.5 μ m positive resist mask.

thus producing structures with more vertical walls.

The whole range of gases employed in conventional plasma etching can be used in the new system. The positive ions have a relatively low energy, thus reducing the risk of damaging the wafer. The electrons stripped off the gas molecules form more ions by collision with molecules, thus producing an increased ion density.

The ECR system operates with low pressure gas plasmas (about 10^{-5} torr instead of the more typical 10^{-3} torr of conventional plasma processing), thus producing excellent film quality with very low contamination. Even a relatively small amount of gas can produce a reasonably high deposition rate.



The ECR concept uses a microwave energy source in a strong magnetic field to ionise gas molecules by cyclotron resonance of the outer shell electrons.

Ion energy

The ion energies in the ECR system are so low that they must be increased for some applications in order to remove non-volatile compounds from the wafer during etching. Materials such as aluminium, copper, silicon, etc need physical ion bombardment if they are to be removed from the surface.

The ion energy can be increased by applying a bias at the 13.56 MHz industrial radio frequency from a 500 W generator incorporated into the ECR2000 Plasma Technology etching equipment. The fast field reversal produced by the RF field causes electrons to accumulate on the substrate and biases it negatively by up to 300 V.

The positive ions are therefore pulled from the plasma towards the wafer, thus increasing the ion energy. The etching of some materials such as silicon dioxide requires no additional bias to achieve a satisfactory etching rate. However, a potential of about −10 V is built up on the substrate even if no bias is deliberately added.

The bias also makes the ion path more vertical and enables structures to be etched to a depth much greater than their width. Bias is therefore required to achieve the vertical walls required for sub-micron device features in VLSI product fabrication where the surface area of the etched structures must be reduced to the absolute minimum. Depth/width aspect ratios of 1:1 or less can be achieved without bias, but bias is needed for aspect ratios of 3:1 or 4:1 for VLSI fabrication.

In the deposition ECR3000R equipment developed by Plasma Technology, the applied bias can be used to improve the adhesion of the film or its surface mobility, as well as to enhance the deposition rates.

The low bias voltage of a few volts, attainable in the ECR equipment, may be compared with those in conventional reactive ion etching systems where 800-900V is not uncommon. It is not satisfactory to obtain the bias by the application of a constant or dc potential to the substrate table, because passing a dc current through an insulating wafer bias is more difficult to decouple than RF generated bias.

The ECR technique makes it possible, for the first time, to apply a selectable bias which is completely independent of the plasma source and of the exciting power.

Energy coupling

John Ball explained the importance of correctly coupling the microwave energy into the system. The plasma contains up to 10^{12} electrons cm^3. This is some orders of magnitude above that of a normal plasma, so it becomes a better conductor than pure copper.

This highly conducting plasma therefore reflects the microwaves, which will not enter the plasma. However, rotation of the plane of polarisation of the waves enables the plasma to absorb the microwave energy. This rotation is automatically created by the interaction of the plasma with the magnetic field.

Plasma Technology's first ECR etching system, the ECR 200R, was based on work done under the Alvey progam and designed for the R & D and process development markets, rather than for large scale production work. It incorporated flexible control with a substrate loading system, which allowed wafers of different sizes to be employed. It has been delivered in Europe. The ECR3000 machine is very similar to the etching equipment, but has been designed for thin film deposition.

Experience with the machines has already shown etch rates more than an order of magnitude higher than those of existing reactive ion etching systems. However, the incident ion energy levels are only a few electron volts in the ECR equipment, thus virtually eliminating risk of damage.

Silicon nitride layers deposited at less than 100°C by the ECR technique have shown film quality superior to silicon nitride films deposited by conventional plasma techniques at over 300°C. Other work has shown that device quality amorphous silicon for thin film transistors can be successfully deposited at ambient temperatures.

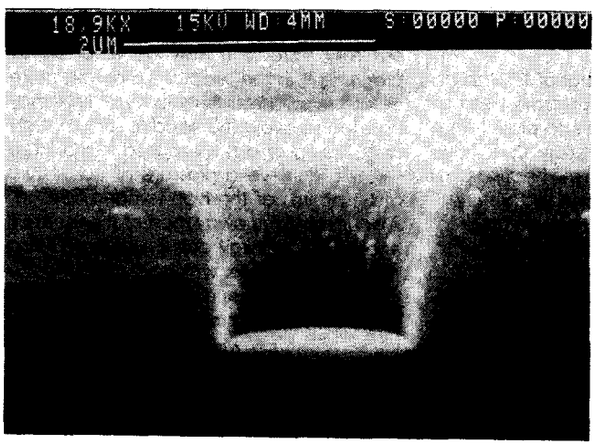
Plasma Technology believes that the ECR technique is capable of being extended for the deposition of polycrystalline and even epitaxial layers in silicon and compound semiconductor technology. However, these are predictions rather than proved results.

Research plans

A number of research projects, some of which are collaborative, have commenced at Plasma Technology, to investigate other apects of ECR techniques such as silicon nitride passivation, capping layers for III-V devices and the deposition of silicon dioxide layers.

It is planned to further develop ECR etch processing in silicon technology including etching of the dioxide, aluminium, silicon and copper and also multilayer etching processes. The program incorporates multilayer masks and metallisations. In III-V materials, Plasma Technology will be investigating damage-free etch processes for gallium arsenide and gallium aluminium arsenide, as well as dielectric and metallisation layers in FET device technology.

An experimental program has started on the application of ECR technology to the low temperature growth of gallium arsenide with a view to improving the film quality available using MOCVD techniques. Said a company spokesman: "It is probable that the efficiency of the ECR plasma source will open the door to low temperature processing for many applications previously carried out at much higher temperatures." He certainly expects ECR to become the preferred technique for production plasma processing.



Features etched in silicon dioxide by ECR method. Processes previously requiring side wall polymerisation can now be done under polymer free conditions, thus eliminating particle and residue problems.

THE EUROPEAN COLLABORATION

Europe is realising that if it is to compete with the big Japanese and American research projects it must pool its resources. Brian Dance brings us up to date on three of the largest international projects underway there.

The relatively small countries of Europe now realise, more than ever before, that they can compete with large Japanese and American research projects only if they pool their resources into collaborative programs. Much of this collaboration takes place through such pan-European schemes as Eureka (European Research Co-ordination Agency) and BRITE (Basic Research in Industrial Technologies for Europe) in which government-supported academic and national institutions work with industrial companies.

This article describes some recent progress in three of the largest international research projects in which many European countries are involved.

JET developments

The harnessing of thermonuclear reactions to produce useful power is one of the most challenging tasks ever investigated by man. The prize for successfully taming the hydrogen bomb is an almost unlimited source of energy. The Joint European Torus (JET) project located in Culham, Oxfordshire, UK, is a collaborative international project under the European Atomic Energy Community (Euratom) of the 14 EEC countries plus Sweden and Switzerland. It is aimed at determining whether or not thermonuclear fusion can offer a source of economical energy for electric power generation.

JET is the world's largest fusion reactor. The maximum values of plasma temperature, density, and confinement time achieved in JET in 1989 were adequate for the operation of a fusion reactor, but they have yet to be achieved simultaneously.

Dr Paul-Henry Rebut, director of JET, said at a recent press conference: "I firmly believe that fusion has a major role to play in the world energy source of the future. Up to now our main concern has been the heating and confinement of plasma; I consider these two problems as being solved. Now we have to concentrate on the problem of impurity control."

Fusion reactions may offer a vast new source of energy from plentiful fuels which do not themselves produce radioactive waste, but of which the reactor structure itself will become radioactive. The intermediate fuel, tritium, is radioactive with a short half life. A fusion reactor is inherently safe and has only sufficient fuel for about half a minute of operation. A malfunction will quickly stop the reaction.

Light nuclei must move together at high speeds to overcome their electrostatic repulsion if they are to undergo fusion. This means operating at temperatures of millions of degrees, at which no material is suitable for confining the reactants. In stars, gravity confines the reacting plasma, but is too weak for use in man-made equipment. Some groups hope to use inertial confinement in which the reaction occurs so rapidly that the intertia of the fuel keeps it together while it reacts.

JET is a 'Tokamak' machine using a magnetic field to confine the high temperature plasma. The field (up to 3.4 tesla in JET) keeps the plasma away from the walls of a torus or toroid. The JET magnet frame is 11.5 m high and weighs 2700 tonnes.

Fusion reactions occur fairly slowly in the sun, at some 15 million degrees celsius, but a fusion reactor on Earth must use temperatures of 100-200 million degrees celsius to produce a reasonable reaction rate. Mega-ampere currents pass through the plasma and heat it. Beams of energetic neutral atoms and RF waves (22-55 MHz range) supply more heat.

The most convenient reaction to use is the fusion of deuterium and tritium, two isotopes of hydrogen. Deuterium in the oceans is virtually inexhaustible, but tritium is not found naturally; instead, it may be obtained by breeding it in the reactor. Later, the more difficult reaction of deuterium with itself may be used to avoid the need for tritium. Only about 0.1 g of gas is required in the large torus to achieve a pressure of about two atmospheres at the high temperature.

Neutrons carry away most of the reaction energy. This energy can be given up in a blanket of material which will surround the fusion region in later experiments. Heat from the blanket will be able to raise steam for electricity generation. The neutrons also convert lithium in the blanket into tritium fuel.

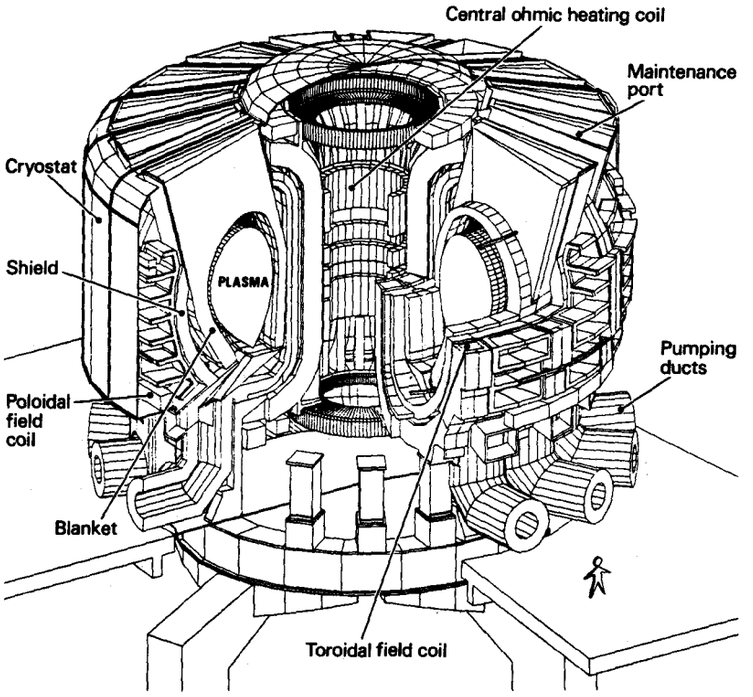
The remaining energy from the reaction is carried by π particles which stay in the plasma and raise its temperature. The first study of π particle heating will be made at JET. Ignition occurs when the energy is adequate to maintain a self-sustaining reaction, ie when the product of temperature, density, and confinement time reaches 5×10^{22} M°C, $m^{-3}s$. In 1989, JET attained over a tenth of this value, this being about 2,500 times better than the best world value in 1970 when JET was being planned. JET is not designed to achieve ignition.

Only deuterium plasmas have been used in JET, producing some 50 kW and giving data on plasmas without making the whole structure radioactive during the current experimental work. If a 50:50 mixture of deuterium and tritium were used at the present time, JET would generate over 10MW of fusion power for a short time. Frozen deuterium pellets can be shot deep into the plasma at up to1.5 km/s to raise the plasma density. Later, pellets of deuterium and tritium will be used at higher speeds.

In 1989, the areas of the torus walls previously covered with carbon were replaced by the extremely toxic beryllium because it has a lower atomic number. Material sputtered from the walls reaches the plasma, where impurities adversely affect plasma parameters. Most of the 1989 progress was achieved by this change of the material facing the plasma.

It is proposed to extend the JET research program until 1996 to enable an investigation to be made into impurity problems. Rebut stated that this should enable the conditions to be established for much longer times (10s to 1 m). It is planned to carry out the work on impurity control during 1992-1994, work with tritium following until 1996, when the equipment will become so radioactive that robot handling will be necessary.

Proposals are under discussion at Garching, West Germany for a successor to JET, known as the Next European Torus (NET). Europe, the USA, the USSR and Japan are also hoping to



combine their efforts to design an International Thermonuclear Experimental Reactor (ITER).

High energy research

CERN is the European Laboratory for Particle Physics based in Geneva, Switzerland. With a 1990 budget of 858 million Swiss Francs (about Australian $730m), it is supported by its 14 member countries from Western Europe, with Finland expected to join in 1991. The funding from member countries has enabled large and extremely costly particle accelerators to be constructed near Geneva – unnecesary and impractical for each individual country to duplicate. About half of the world's particle physicists are now involved in wide ranging reserach programs at CERN.

After five years of construction work, CERN's huge LEP (Large Electron Positron Collider) commenced operation last July under the Jura mountains on the French-Swiss border. It consists of a circular tunnel 27 km in circumference, so large that a train could be driven through it. Inside the tunnel is an evacuated tube through which electrons and positrons travel in opposite directions at nearly the speed of light. They are injected into the tube from special accelerators and controlled in their flight by suitable magnets located around the tunnel.

The object of the LEP work is to observe what happens when electrons collide with positrons at the highest possible speeds. Each colliding beam can currently have particle energies of up to 50 GeV, but it is planned to increase this energy to about 100 GeV per beam, the energy for which the LEP machine design was optimised.

Scientists are searching for the unusual particles which emerge from such energetic collisions. Such particles include the W and Z particles, which mediate the weak force found in radioactive decay, just as photons mediate the electromagnetic forces. They may also find quarks.

LEP was immediately successful. The particle beams were brought into collision for the first time in August, 1989, and the five-day pilot gave 58Z ° events. The first physics run, started in September, was completed in October, with the observation and measurement of some 11,000 neutral Z^0 particles.

The new LEP measurements on Z^0 production show there are only three known types of neutrino (electron, muon and tau). The chance of a fourth type of light neutrino is now less than one in a thousand. Previous work on the supernova 1987A – the abundance of light elements from the big bang – and accelerator experiments favoured only three types of neutrino, but, unlike the LEP work, it did not exclude the existence of four or even five types.

CERN planners are already discussing the possibility of putting a proton-proton collider with energies of up to 8 TeV (= 8,000 GeV) per particle in the LEP tunnel.

Microchip fabrication

Collaboration between Siemens of West Germany and Philips of the Netherlands, in the so-called "Mega project', led to the production of high density memory devices using 0.7 micron linewidths last year. Siemens produces a 4M bit DRAM (Dynamic RAM) and Philips a 1 Mbit SRAM (Static RAM) which are of comparable complexity. The Dutch and West German governments contributed some US$255m towards the research and development costs of US$770m. Philips alone is financing the 1 Mbit SRAM production to the extent of US$1200m.

Government grants or loans to the semiconductor industry, often combined with some tax concessions, are now seen as essential if the combined efforts of the relatively small countries of Europe are to produce devices that will be competitive with those from the USA and Japan. The aim is to minimise the influence of overseas equipment suppliers on European manufacturers.

Although memories are the specific products developed from the work of the Mega project, the main aim of the work was to master the technology and applications.

The chip makers of Western Europe are now poised to launch the most ambitious collaborative ULSI project yet. It is expected to achieve 64 Mbit memory chips using a 0.3 micron technology by 1995, but this goal will be reached through 0.7 micron and 0.5 micron steps. This JESSI (Joint European Submicron Silicon and Initiative) project aims at developing a silicon technology along with the related design procedures which will be able to keep the European manufacturers fully competitive through the mid-1990s. At present, Europe lags behind the world leaders by some two years.

JESSI initially arose through the initiatives of the West German and Dutch governments in 1986, in collaboration with Philips and Siemens. It was to be a Eureka project which would continue the Mega project. The estimated investment required is some US$4b.

JESSI planners hope this work will enable end users to be offered systems with up to 200 million transistors on a single 50 mm^2 memory chip and up to 10 million transistors on logic chips of a similar size. It has been extended to include ASICs (Application Specific ICs) fabricated with 0.3 micron technology.

Competitive production may be possible only by using increased wafer sizes of 200 or 250 mm diameter. Current production costs per function should be reduced by a factor of about twenty to achieve competitive production. Major emphasis will be placed on automated manufacture.

JESSI will be even more expensive than the Siemens-Philips Mega project, with more collaborating companies. Countries currently involved include the Federal Republic of Germany, Belgium, France, Italy, Britain and The Netherlands.

A major part of the work will be the development of suitable lithographic techniques (optics for the deep ultra-violet, X-ray, electron beam, defect inspection, and repair). Other areas where further work will be required in equipment design include advanced layer deposition techniques, dry etching, sputter processing, materials and backing and bonding technology.

BBC MONITORS LISTENING TO THE WORLD

Two important moves for the BBC recently saw the upgrading of its famous Monitoring Service and the modernisation of its record library. Arthur Cushen reports.

The BBC Monitoring Service recently celebrated 50 years of successful operation in the field of news coverage by radio.

BBC Monitoring was born just before World War II, when recordings were made on wax cylinders at an isolated listening post and brought to the BBC's staff at the monitoring centre. The cylinders contained recordings of broadcasts of German and Italian radio stations, picked up by aerials on top of a hill. The transcripts produced were a vital source of news.

By 1941, nearly 250 bulletins in 30 languages were being monitored daily. Two years later, the aerials were moved to a line of hills closer to London – the Chilterns – and the staff to nearby Caversham Park. At present, more than 500 people work there, including 130 monitors, some multi-linguists. Working in shifts around the clock, the monitors transcribe foreign radio and television broadcasts and news agency reports.

Forty editors knock the text into shape and daily summaries are printed and bound on the premises and dispatched to Caversham's customers. The monitors are not merely translators; they have to exercise a high degree of news judgement.

BBC Monitoring has lost count of the number of major news stories it has broken. Take the Cuban missile crisis of 1962, before the White House-Kremlin hotline existed. Caversham picked up Kruschev's offer of withdrawal on Radio Moscow and was able to bypass diplomatic channels by flashing an immediate message to Kennedy.

Caversham is funded by the Foreign Office, but its staff are understandably peeved when people describe them as "eavesdroppers". This is not the case; the broadcasts monitored are all in the public domain.

What BBC Monitoring provides are the facilities to collect, sift and disseminate information on a massive scale. The material is collected and passed on to customers, many of them paying subscribers, with no added comment.

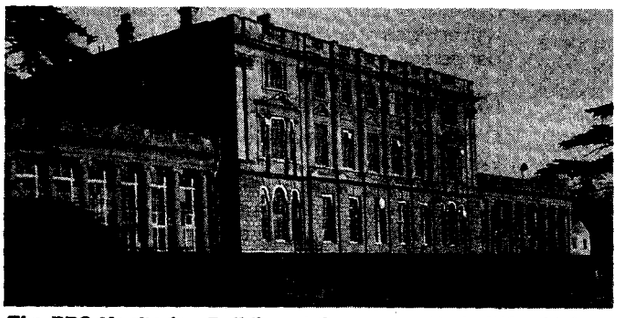
Customers include BBC newsrooms, especially that of the World Service, as well as newspapers and magazines, government departments, commercial companies, foreign embassies and universities.

BBC Monitoring concentrates on broadcasts from the Soviet Union, Eastern and Western Europe, North and East Africa, the Middle East and Afghanistan. It shares information, via satellite, with its US counterpart, the Foreign Broadcast Information Service, which covers other parts of the globe. Together, they monitor the output of 130 countries and transcribe more than half a million words a day. The combined material is edited and published daily in the 100,000 word summary of world broadcasts. There are also weekly economic reports on industrial, scientific and agricultural developments; a 24-hour teleprinter file of news and current affairs; and a weekly update on world broadcasting. Some of this material is used each month in this feature, as the writer is a subscriber to the BBC World Information Bulletin.

The impact of Glasnost in the Soviet Union and its satellites has increased the monitors' workload immensely. "Glasnost actually means more work than the Cold War," says general manager Barry Whitehall in an article in *London Calling*. "The greater the freedom of expression, the more broadcasts there are to monitor."

Now, the first fruits of an eight year, £18m modernisation program should help the Service to cope better with this awesome input. Included is more sophisticated signal receiving equipment and a new, computerised listening room.

Until now, transcripts have been typed, distributed manually and re-keyed for publication. The computerised editorial system does away with such duplication of effort. The final three year phase of the modernisation involves restoring the main building to its former glory before putting it back to work. Meanwhile, BBC Monitoring will go on doing what it does so well.



The BBC Monitoring Building at Caversham Park, UK, which has recently been completely remodelled.

Largest record library

AS well as upgrading its Monitoring Service, the BBC is modernising its record library – the world's largest. With some 1½ million entries – and growing rapidly each day now that compact discs are being added to the library – the time has come for the old card system to be disposed with, and all information is to be put onto compact disc. This special CD system will hold over 330,000 type written pages.

The card system has been broken down into 180 elements, making a greater diversity of information available. It will take about a year to complete the changeover and between 200-300 staff will be employed on this major project.

Broadcasting organisations throughout the world will be able to access the catalogue by telephone; another alternative is for the actual compact disc to be made available to various broadcasting organisations.

ARTHUR CUSHEN

NEW STATIONS FOR THE PACIFIC

Arthur Cushen brings us up to date on the latest shortwave developments in the Pacific region.

Two new stations, one in Western Samoa and the other in Tonga, will provide additional radio programming for listeners in these countries.

Radio Polynesia, a new FM broadcaster in Apia, is using 98.1MHz and broadcasts from 6.00am to midnight week days, and 10.00am to midnight Sunday local time using the callsign KWS.

Radio Polynesia joins the long established Government station 2AP which commenced operation in 1948. Australia has granted aid to Western Samoa, including two new 10kW transmitters which will be operated on 747kHz carrying the English service. Radio 2AP has moved its transmitter site from Afiamalu, on top of a mountain, to a site by the sea close to the radio station at Mulinuu. Depending on the effectiveness of the new transmitter site, it may be possible to close down one, two or all three of the 1kW repeater stations on 540, 1251 and 1359kHz. The new transmitters were planned to be in operation this year.

The United Christian Broadcasters Ltd is constructing a gospel radio station for Tonga and a 300-foot tower is being prefabricated in New Zealand to be installed near Nukualofa, the proposed site of the studio building. The United Christian Broadcasters has studios in Auckland, where many programs are being prepared in the languages of the South Pacific, and considerable research is underway to find gospel programs in the various language groups. The initial plan is to operate on 738kHz on mediumwave, with a 5kW Harris unit, but, later, shortwave and FM transmitters will be installed. United Christian Broadcasters is to share the studio facilities with the new TV station in Tonga. The station could start operation from the staff residency in Nukualofa if there is any delay in finalising the lease for studio premises.

As well as recording studios in Auckland, plans are underway to establish a production facility with Tonga's new TV licensee in Hawaii. Tonga already has a well established Government-operated broadcasting service on 1017kHz mediumwave, and, in recent months, on shortwave 5030kHz using 1kW. The transmissions are between 1755 and 1000UTC.

New Zealand has its second shortwave broadcaster in operation with Print Disabled Radio Levin carrying its programs in the 75 metre band on 3935kHz. This is a relay of 2XA on 1602kHz, operating from Levin, and is a service for visually impaired listeners, comprising readings from books and newspapers. The transmitter, of 1000 watts on 3935kHz, is operating Sunday, Monday, Thursday 0630-1000UTC, and, in the future, a gradual expansion of these transmissions up to 2100-1100UTC is expected.

As well, a relay of the 2XA program into Wellington on mediumwave is contemplated, while within New Zealand and overseas the shortwave frequency should provide interesting reception. The address of the station is Print Disabled Radio 2XA, PO Box 360, Levin, New Zealand.

Further RCI relays

ALONG with the recent announcement that Radio Canada International will use the facilities of Radio Korea to carry its Manderin program in a two-hour broadcast to China, comes news that Montreal will offer additional coverage of the Middle East.

Radio Canada will commence an hour-long broadcast in Arabic and has plans to use some of the transmitting facilities of Deutsche Welle at Cologne for shortwave coverage of the Middle East.

At present, this area is being covered through relays by Austrian Radio. Radio Canada is aware that medium-wave transmissions are more popular in the Middle East area and is negotiating with Radio Monte Carlo for time on its transmitter in Cyprus. Radio Monte Carlo's transmitter is at Cape Greco and operates on 1233kHz using 600kW.

The voice of America and the BBC both have strong mediumwave transmitters operating from Rhodes and Cyprus.

Higher power

RADIO France International has released details on its new relay base to be built in Jibuti in East Africa. The coverage will include West Africa, the Middle East, East Africa and parts of Asia. Three 500kW transmitters will be installed and, as well, a new FM station is to be built to enable French residents of Jibuti to have an improved service both locally and from Canal France. It is expected that the shortwave facilities will be in operation in the early part of 1991.

13 MHz changes

THERE is a growing number of shortwave stations moving to the 13MHz band 13600-13800kHz, and many international stations are gearing up for this new frequency range.

Radio Canada International, after being denied use of this new band by its Government body is now operating on some test frequencies, and 13670 has been heard at 1900-1930UTC to Europe and, again, 2130-2200UTC to Africa. According to one of the engineers at Sackville, the transmitting site of Radio Canada, extensive work is under way to provide suitable coverage of Europe, Africa and Latin America. Due to the fact that the transmitters are running almost continuously, there is a gap of only five hours between 0700-1200UTC when some alterations to the aerial system can be undertaken.

Canada, like most international broadcasters, is dismantling its 6MHz band antennas in place of 13MHz band, an indication that there is an increasing move towards higher frequency operation.

The fact that this new band is suitable for world wide transmission has resulted in some excellent reception in the Pacific area. eti

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This item was contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand. He would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

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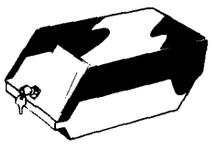

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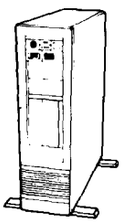

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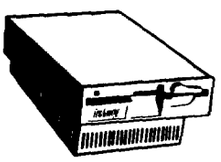

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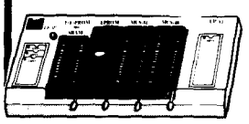

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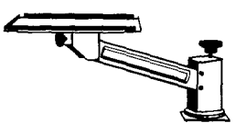

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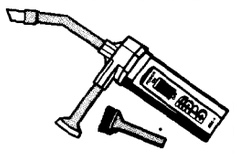

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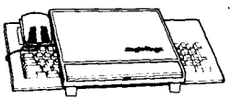

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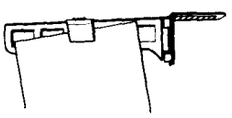

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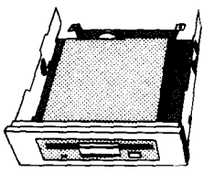

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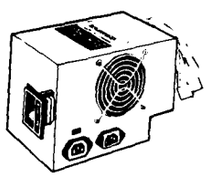

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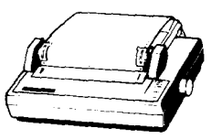

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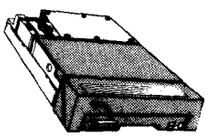

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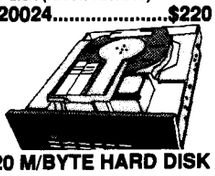

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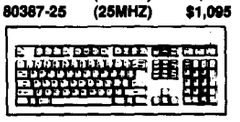

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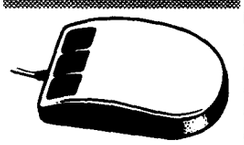

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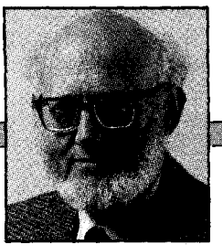

JOHN COULTER

WHAT'S WRONG WITH SCIENCE IN AUSTRALIA?

John Coulter, former research scientist turned senator, takes a critical look at the Government's present attitude towards science in Australia.

Very few practising scientists enter active politics: only three of the 224 House of Representatives and Senate members are former research scientists. The bulk of federal politicians have a background in commerce and business. Of that 224, 141 have higher academic qualifications. There are 61 BAs, 34 LLBs, 27 Dip. Eds, 16 BEcs, 10 B Comms, 10 BScs and 7 MB, BSs. Thus, although there is a bigger proportion of politicians with higher qualifications than in the general community, the ratio of science degrees to other degrees is much lower. Fifty three per cent of politicians come from five commercial backgrounds: law, accountancy, company director, primary producer or small business. In the bureaucracy which services these politicians one finds the same predominance of commercial orientation. This orientation reinforces and fails to question the prevailing economic thrust of Government and business.

As a former "hands on, laboratory bench research scientist turned Senator" I am deeply concerned at the direction taken by the Hawke Government with respect to science, science research and science eduation. The solution to the many problems in these areas is not to throw more money at them; the problems are much more serious than that, and more thoroughgoing changes will be needed to redirect science and research in ways which will attract and hold more of the public attention.

We find education, science and research looked upon by Government as input to the productive enterprise, to be shaped and directed to better serve the perceived needs of industry. There is an assumption that the future will be an extension of the recent past; that science is both the hand maiden and the master of an inevitable 'progress' towards more, faster and better – a progress to which the rest of us must adapt. Even Mr Barry Jones, the Minister for Science, seems to espouse this.

The Commission for the Future, when it was first created, was clearly designed to find out how to coerce Australians into this inevitable future. This contrasted markedly with the Swedish model created after the 1972 Stockholm Conference on the Human Environment, which helped the Swedish people explore the implications of the alternative futures which lie before them, and the methods by which each may be reached.

I understand both Mr Jones and Senator Button, the Ministers jointly responsible for the Australian Commission for the Future, expressed annoyance when the Commission first invited Professor David Suzuki to speak in this country. His was not a message they wanted heard here! This, more than any other occurrence illustrates what is wrong with the Government's attitude to education, science and research.

Informed choices

Just as the Swedish Commission for the Future helps the Swedish people make informed choices, so this is a model for academic institutions in Australia. Government sees our universities as training grounds for the technical servants of industry and as sources of technical help with manufacture. This gives greater status to the imperatives of present industry than to goals indicated by a more comprehensive and informed overview of options. This is wilfully blind. I am not so naive as to ignore the fact that many academics and university departments in the past have not played this socially involved responsible role, but, rather, have happily enjoyed academic freedom in the ivory tower. The quid without the pro quo. Indeed, one partial explanation of the ease with which this Government has successfully launched its vicious attack on the academic and research institutions lies in these institutions' failure to establish a sufficient constituency in the general public.

But the answer does not lie with the present Government policy.

The Robyn Williams, David Suzukis and Paul Ehrlichs of today have shown that the public have an enormous interest in understandable and relevant science.

Every recent survey of public opinion has indicated strong concern for the deterioration of the environment. While some may see the inadvertent application of science and technology as largely responsible, it is true that in the solving of these problems science will play a crucial role – not science serving the extension of industry on industry's terms, that will only exacerbate the problems – but science serving to find out, to understand, and to inform, so that society can make more intelligent judgements about which way it wants to go.

The Hawke Government, until quite recently, cut funds to environmental research. Its record of spending in the energy field also shows that very little has been spent in the area of alternative energy sources or on energy conservation. It is both ironic and instructive that these are the very areas in which some of the greatest advances have been made overseas – advances which are proving to be most profitable. While we have spent 85 per cent of our energy research grants on coal, and only 10 per cent on renewable energy, others have discovered ways of cutting the demand for electricity by 75 per cent and using renewable energy for the 25 per cent we cannot presently displace. Who will want our coal under these conditions, as greenhouse warming threatens to change the global climate? Depressingly, the Liberals would increase investments in an anachronistic coal industry.

The answer does partly lie with more money for education, science and research – but, more importantly, it lies with the way in which these crucial social activities are directed. These activities should serve society, but not the narrow model of society conceived by either the Hawke or a potential Peacock Government. They will best serve society in a free, interactive association in which Governments support, but not subsume, that interaction. eti

Senator John Coulter is the spokesman for the Australian Democrats on Science and Technology.

ETI PROJECTS

The projects presented in ETI are chosen to appeal to a wide variety of reader interests. They range from simple, fun but practical, low-cost entry level devices, through interesting, useful and often challenging projects for more experienced enthusiasts, to technology demonstration projects that introduce emerging, new and exciting technological developments for constructors at all levels. Often, ETI projects will present engineering solutions to real problems or market needs. Over a year, we aim to publish a balanced selection, to cater to readers' wide interests and levels of experience.

This month we include:

ETI-1431 Two-way Loudspeakers
ETI-1630 Blue Streak RISC Computer Card
ETI-1428 Audio Filter — Part 2

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Send orders to **Reader Services, ETI Magazine, 180 Bourke Rd., Alexandria, NSW 2015 Australia.** Please note that phone orders cannot be accepted.

Unfortunately we are also unable to handle technical enquiries on projects and articles on the telephone. We are happy, however, to handle such enquiries by mail. Please address such enquiries to: **Technical Enquiries, ETI Magazine, 180 Bourke Rd., Alexandria, NSW 2015 Australia.** We will endeavour to deal with them as promptly as possible.

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ELECTRONICS

ETI PROJECT BUYERS' GUIDE

ETI-1431 Budget two-way speakers

This project *will* require you to shop around. But the results will be worth it. For a start, you'll need to find a supplier of veneered particle board for the cabinet. The author used "Brimsboard", which is manufactured by DG Brims & Sons Pty Ltd in Brisbane. They have distributors in Sydney and Melbourne.

An 1800 x 1200 x 18 mm sheet of Tasmanian Oak veneered Brimsboard costs $41.95 a sheet. Here are the addresses where you can buy it:

Brims Distributors Pty Ltd, Station Rd, Yeerongpilly Qld 4105, ☎ (07) 848-1091.

Brims Distributors Pty Ltd, 22 Fairfield St, Fairfield NSW 2165, ☎ (02) 632-7583.

Cabinet Timbers Pty Ltd, 24-28 Kavanagh St, South Melbourne Vic 3205 ☎ (03) 62-4771.

Drivers can be found at Jaycar and Dick Smith stores. The woofer/mid-range used is a locally manufactured 200 mm (8 inch) driver sold by Jaycar, model JC-200. It features a polypropylene cone, and costs a reasonable $49.95. (Cat. no. CW-2112). Dick Smith Electronics stocks something similar, with what looks to be nearly identical characteristics, cat. no. C-2034. It has a traditional circular rim mount as opposed to the square frame mount on the JC-200.

You can choose between a couple of tweeters, too. Jaycar recommends a 25 mm (one inch) dome tweeter, cat. no. CT-2025, which costs $19.95. Another suitable type would be the Philips AD11610/T8 25 mm textile dome tweeter. But note that it's almost $10 more expensive.

For connector terminals, you've got a wide range to choose from. Probably the easiest to mount is the circular type, such as the one Rod Irving Electronics stocks, cat. no. P10246. They also have another that mounts in a square hole, cat. no. P10248.

ETI-1630 RISC board

Explore the world of RISC technology – at minimum cost and minimum risk. The system is based on the VL86C010 Acorn RISC Machine (ARM) processor from VLSI Technology, and its companion support chips. This project would have to be the doyen of 'technology demonstration' projects presented by Energy Control International. This is a concept devised by proprietor Ken Curry, which applies to projects designed to demonstrate the capabilities of emerging semiconductor technologies. As RISC technology is currently 'all the rage', this project is very timely.

Energy Control International will have the project available in both kit and built-up form at a cost ranging from $599 to around $750, depending mainly on the memory configuration. Fully built-up units will also be available, ranging from about $700 to $950 (ex-tax), again depending mainly on the memory configuration.

Further details can be obtained direct from:

Energy Control International, 26 Boron St, Sumner Park Qld 4074, ☎ (07) 376-2955.

NEXT MONTH

Heads & parkers reminder for your car

Ever been caught with a flat battery because you inadvertently left your headlights and/or parking lights on? Yes, we've all done it at one time or another. Install this simple project and you'll never be caught in the situation again.

If you leave your headlights or parking lights on, a buzzer sounds when you turn the ignition off. The project is remarkably simple, yet effective. It uses common off-the-shelf components and can be installed in a trice. An ideal 'beginners' project.

Automated test equipment feature

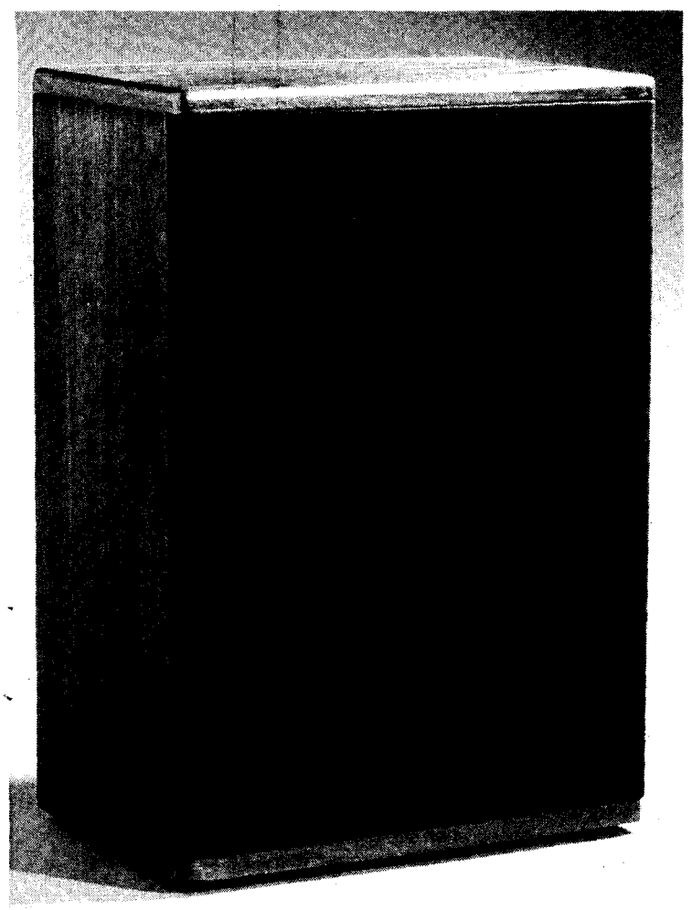
Automated test equipment — ATE — will come to dominate the test and measurement market in a few short years. ATE has already become an integral part of electronics manufacturing production lines.

Increasingly over the past few years, programmability has become a feature in most benchtop, and some portable, test equipment allowing test functions and procedures to be programmed using a personal computer. Thus, many test and measurement procedures using such equipment can be readily semi-automated, or entirely automated. In addition, add-on "boxes" and plug-in cards for PCs have been produced which turn the PC into a programmable test instrument.

This feature takes an overview of the field, looks at the sort of equipment on offer and what might be in store in the future.

BUILD YOUR OWN TWO-WAY SPEAKERS

'Build your own speakers and save $100s,' **screamed the advertisement. Build the cabinets too — it's easy — and save $100s more. Ken Curry Jr shows how.**



The finished product, a handsome two-way loudspeaker.

Wanting a pair of two-way speakers and having all the gear to build everything except the drivers, I figured I could save more by constructing the speaker boxes, too. Good power tools for woodworking are relatively cheap these days, and many home workshops boast an arsenal that would have been the envy of many a handyman a few years ago.

While ready-built kits take the hassle out of building speaker cabinets, they also take away some of the satisfaction, not to mention the punishment they inflict on your wallet. With a little delving, I found a supplier of good quality veneered particle board called Brimsboard. This is manufactured by DG Brims & Sons Pty Ltd in Brisbane, which has distributors in Sydney and Melbourne. An 1800 x 1200 x 18 mm sheet of Tasmanian Oak veneered Brimsboard costs $41.95. One sheet will make a pair of decent-sized cabinets.

The Yellow Pages lists plenty of places that sell veneered particle board, some of whom offer a cutting service. Drivers are freely available from electronics retailers.

I set about determining what size cabinet one sheet of Brimsboard makes and what bass driver suits it. I had to decide if it would be a sealed (air suspension) enclosure or a ported bass reflex box.

I consulted a good reference book: *The Loudspeaker Design Cookbook*, by Vance Dickason. The blurb on the front cover says – *Everything you need to build the loudspeaker system you wanted but could not afford. Easy ways to pick the exact box size, the ideal drivers, the most pleasing finish and the correct way to feed your music to your new, superb loudspeaker system.* It is a veritable *mine* of practical information.

Dickason says: "The closed-box is the simplest of all loudspeaker designs ... Because of its highly controllable response shape and transient characteristics, and because of the relative ease of achieving correct box parameters, the closed-box design is probably the best for home construction, especially if you are a beginner." That convinced me. I'd have a closed box.

My next step was to choose the bass driver. Dickason advises choosing a woofer with a Q_t of greater than 0.3. There are quite a few suitable drivers to choose from, though retailers don't often list such details in their catalogues. Dickason warns that woofers chosen for a closed-box design should be checked out for potential air leakage loss. The centre dust cap and the roll surround are the culprits here; neither should be porous.

After scanning the available catalogues and looking at prices

ELECTRONICS
ETI-1431

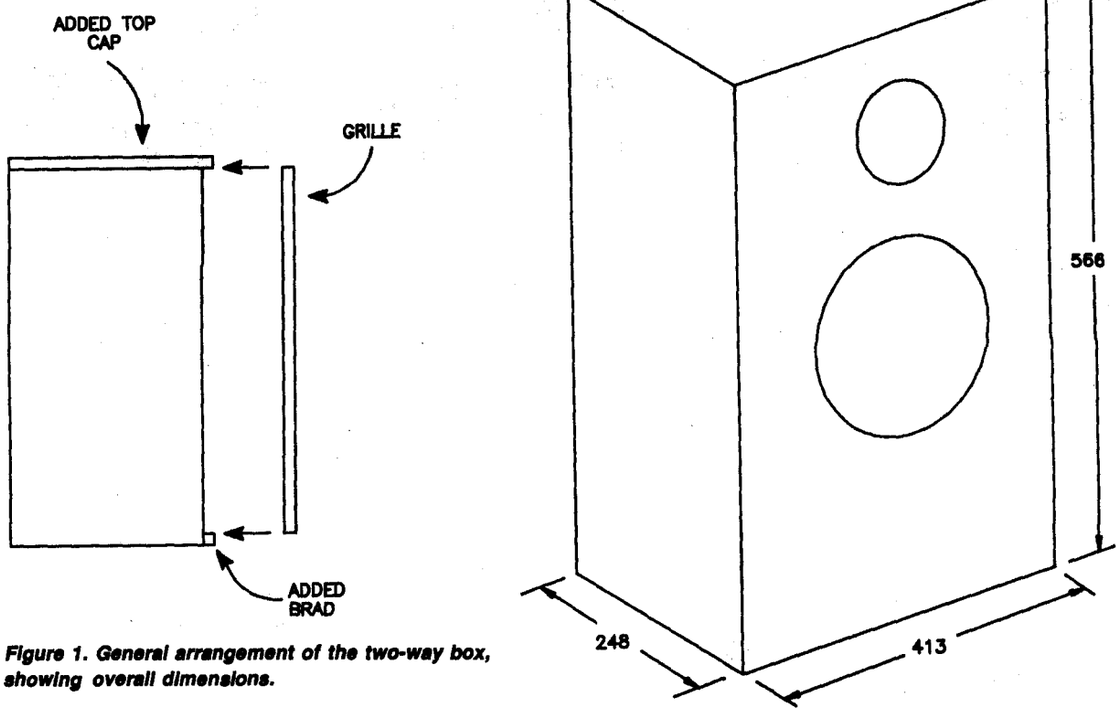


Figure 1. General arrangement of the two-way box, showing overall dimensions.

and characteristics, I settled on a locally manufactured 200 mm (8 inch) driver sold by Jaycar, the JC-200. It features a polypropylene cone, doesn't exhibit any of the failings Dickason warns against and costs a reasonable $49.95. (Cat. no. CW-2112). Dick Smith Electronics stocks something very similar (Cat. no. C-2034.) It has a traditional circular rim mount as opposed to the square frame mount on the JC-200.

The search for a tweeter revealed a couple of types that could be used in conjunction with this woofer. Jaycar recommends a 25 mm (one inch) dome tweeter (Cat. no. CT-2025), which costs $19.95. The Philips AD11610/T8 25 mm textile dome tweeter is also suitable, but costs almost $10 more.

Designing the box

I'll get into the crossover details a little later. The next stage of the exercise was to decide on the details of the box design. Guru Dickason says "... there are two criteria which will optimise the utility of your standard rectangular enclosure ... (they) involve minimising standing wave modes and locating the woofer on the front panel.

"Standing wave reflections back into a woofer cone, caused by the parallel walls of your enclosure, can have an adverse effect on your driver frequency response. The accepted convention is to use the H/W/D ratio of 2.3/1.6/1."

A single 1800 x 1200 mm sheet of 18 mm veneered particle board can be made up into two rectangular enclosures with a volume of around 40 litres, which happens to suit the chosen woofer pretty well. After lots of sketching on squared paper to get the required H/W/D ratio, I found all the required pieces for a box 570 mm high by 250 mm deep and 400 mm wide could be cut from the 1800 x 1200 mm particle board sheet, leaving a minimum of scrap.

You can see the end result in Figure 1. I added a top 'cap' of cedar, which overhangs the front. I ran a brad across the front panel. A frame carrying the grille cloth jams snugly between them. The cabinet stands 566 mm tall (without the cap), is 248 mm deep (about 270 with the grille in place) and 413 mm wide. Bracing on all internal corners was enough to damp resonances.

I located the woofer in the centre of the front panel. (Dickason says there is no *one perfect* location for the position of the woofer on the front baffle.) I didn't want to place it too low and have to use stands for the speakers to avoid floor reflection problems. The cabinets aren't all that tall to start with. I also needed to allow room for the tweeter and keep the woofer away from the top edge to avoid high frequency refraction problems. So, I ended up putting it in the middle.

Construction of the cabinets is quite straightforward. If you don't own a power saw, drill and router, they can be hired quite cheaply for a weekend.

First, cut up your veneered particle board. The cutting plan is shown in Figure 2, along with the order of cuts. The front panel has been dimensioned so that you can attach it on the outside of the front face, or inset it. To inset, the front panels need to be carefully routed to get a snug fit for best appearance. Mine were inset. The series of pictures here show how we proceeded.

When cutting, use a *sharp* saw blade; use a soft-lead pencil for marking out and don't press hard, because the marks are hard to get off the veneer; when doing multiple cuts of the same length, use a piece of scrap wood G-clamped to the bench as a cutting stop; prick or centre-punch hole centres.

When the panels are all cut, carefully sand all the rough edges. Now mark out and drill the front and rear panels as per Figure 3.

The hole in the rear panel will depend on which connector you choose. (There are quite a few – see the parts list.) I used a circular type and drilled its mounting hole using a hole saw in the electric drill. The holes for the drivers in the front panel were cut using a fly cutter. A tip here – in each case, drill a small pilot hole first.

As I planned to mount the drivers to the rear of the front panel, rather than on the front, I chamfered/rounded the edges of the driver holes. I did this to improve the appearance, and to reduce refraction effects for the tweeter. Some tweeters have an integral

mounting that requires them to be mounted on the face of the front panel, in which case dress your front panels accordingly.

Assembling the cabinet

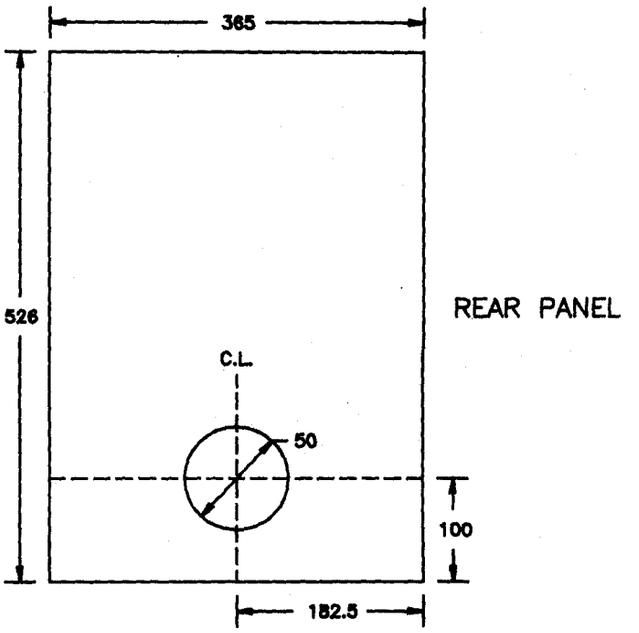
To put the cabinets together, you'll need to measure, mark out and cut bracing for all the panels. I used 50 mm dressed pine for this. Bracing goes on the top, bottom and side panels first. If you're recessing the front and/or rear panels, don't forget to make allowance. I nailed the bracing in place, first running copious quantities of PVA glue around the mating faces. To ease assembly of the top and bottom panels to the side panels, I drove nails in the mating braces, as seen in the accompanying photograph. Apply PVA glue to all mating surfaces.

When assembling the last panel which makes an open box (before adding front or rear panel), check the squareness of the assembly. Put your partly completed cabinets aside to dry for a while. Sand the exposed edges top and bottom to obtain a flush finish.

Now you can prepare and fit your front panel, which, for appearance's sake, has to be glued in place. Use enough glue to ensure the box is airtight. Mark out, prepare and drill the screw holes for the rear panel (which will be the last piece you attach).

The top cap was made from two short planks of cedar, glued together and then sanded to a smooth, seamless finish after cutting to size. The grille frame was made from square brad, sized so that, with the grille cloth fitted to it, it jammed in place.

Mount the drivers to the rear of the front panel, and carefully seal all round the edges using a flexible sealing strip or compound,



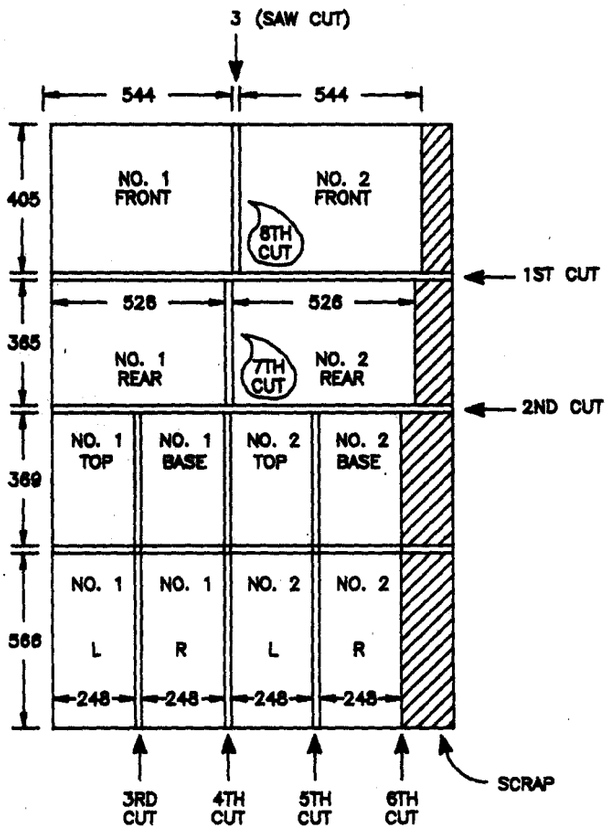


Figure 2. Cutting plan for the veneered particle board sheet.

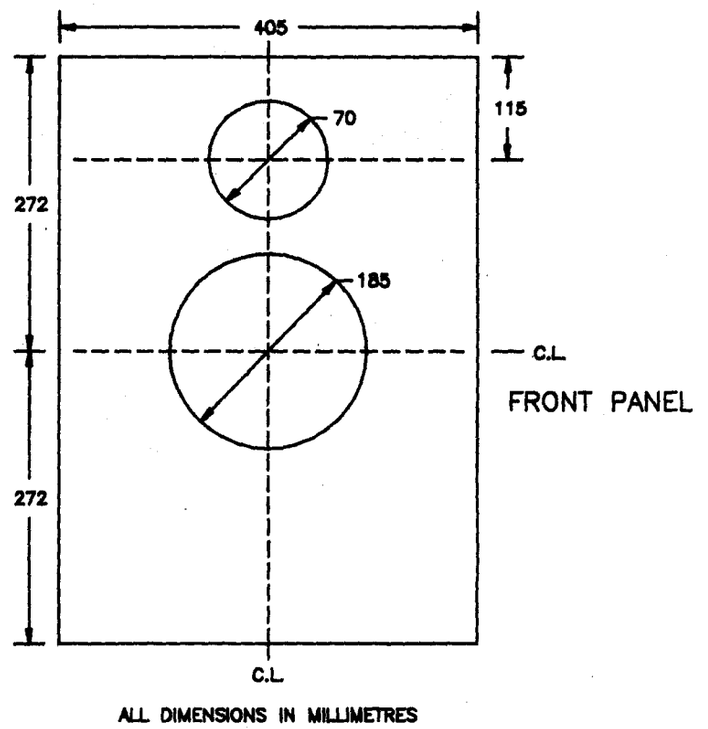
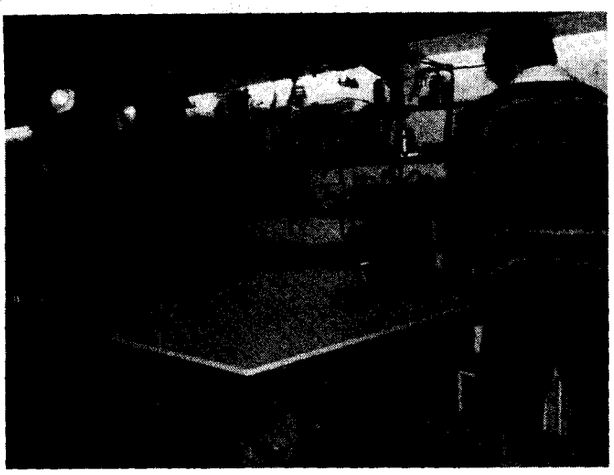
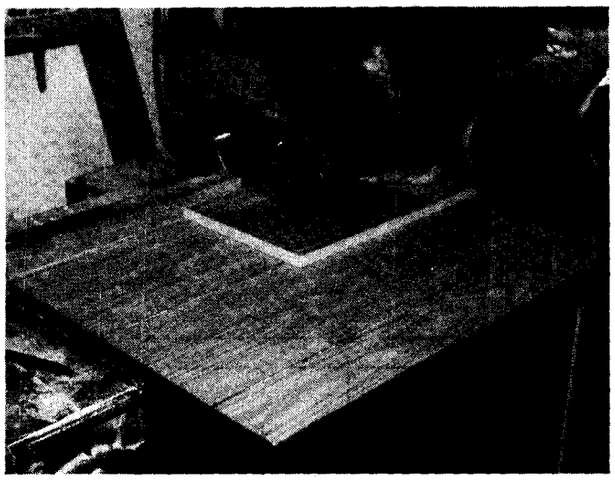


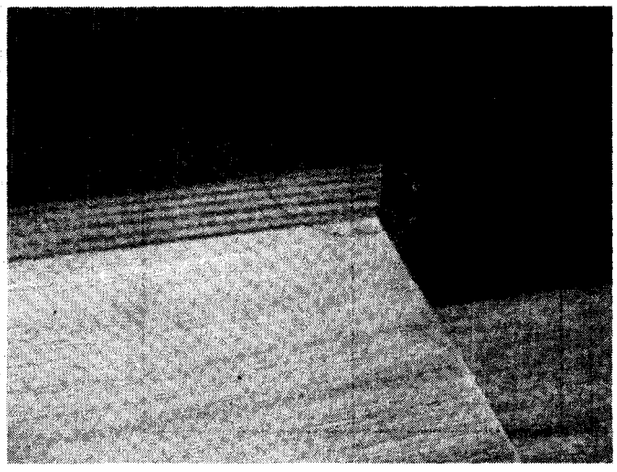
Figure 3. Showing the cutouts on the front and rear panels. The size of the rear panel hole will depend on the speaker terminal connector you get.



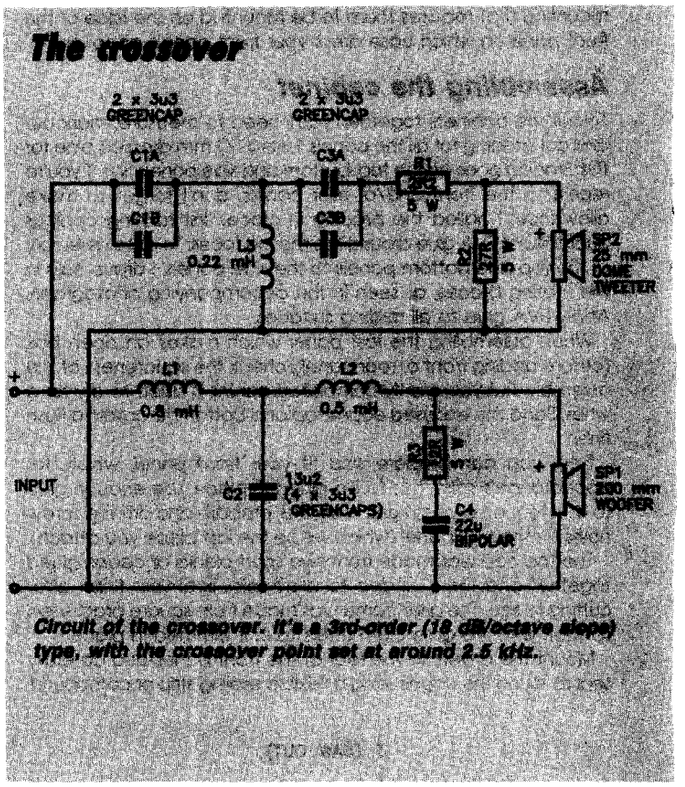
Cutting the main sheet.



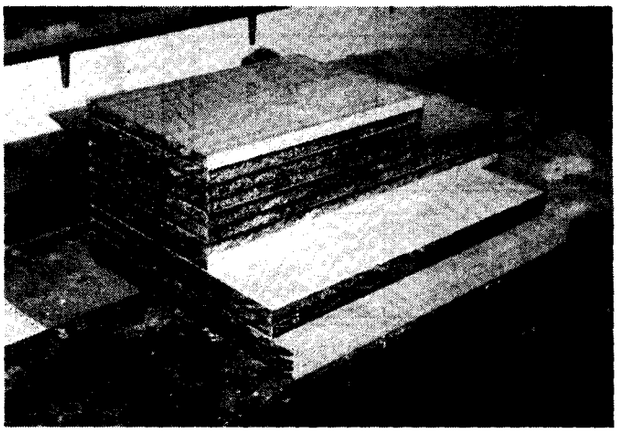
Cutting the panels.



Use a scrap of timber G-clamped to the bench as a cutting stop for multiple cuts of the same length.



Circuit of the crossover. It's a 3rd-order (18 dB/octave slope) type, with the crossover point set at around 2.5 kHz.



All the panels cut, ready to assemble into the cabinets.

such as Mastic. Don't get this stuff on the woofer's roll surround, or you'll spoil the sound. The terminal connector on the rear panel should be well-sealed in a similar fashion.

The inside panels of the box should be lined with a sound absorbent material, such as mattress overlay foam, available in 50 mm thick strips and in different densities. A medium density type is suitable; too dense a lining will reduce the volume. It can be secured in place with dabs of glue. Special speaker cabinet lining material is available, but is more expensive. Only the top, bottom, side and rear panels need lining.

Wiring and testing

Assemble the crossover (see panel) on a scrap of particle board

I thought to build a pair of ready-made two-way crossovers, of the simple 6 dB order (6 dB slope) I'd like to use (about $20 each). Roger Harrison, ETI's Electronics Editor, came up with the crossover circuit you see here. Vernon Dickerson also discussed crossovers in his book.

This is a 6dB order crossover, with the crossover point set at around 2.5 kHz, each rolling off at 6 dB per octave. This ensures good control of the output from the woofer above that point, where it begins to work outside its piston operating mode. The crossover frequency is a good octave below the driver's specified upper rolloff frequency.

The tweeter's resonant frequency should be a good octave below the crossover point. Both the Jaycar and the Philips tweeters mentioned above meet this requirement.

Good quality metallised polyester or polypropylene capacitors must be used for C1, C2 and C3. The RC network, R3-C4, provides impedance compensation for the woofer (see Reference 2). A standard bipolar capacitor is OK here.

The tweeter is somewhat more sensitive than the woofer, and this is 'padded back' with the attenuator formed by R1-R2. The values were chosen to provide a little 'brightness' to the sound. If you find you don't like this, change the value of R2 to 18 Ohms.

The inductors present a bit of a problem. Some values can be obtained 'off the shelf' if you shop around a bit. If you're winding your own, use 0.8 mm or 1.0 mm enamelled copper wire. Get hold of a digital inductance meter or RLC bridge. For formers, the bobbins on which many retailers sell enamelled or tinned copper wire can be used for the smaller values. Plastic transformer bobbins are ideal.

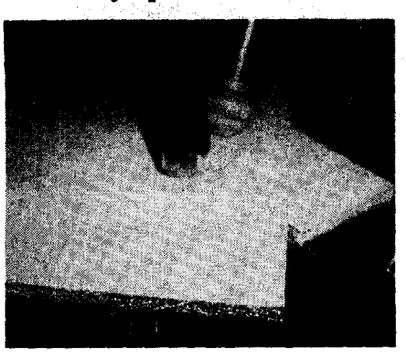
When mounting L1 and L2, orient their axes at right angles to minimise possible coupling. L3 should be mounted as far away from L1 and L2 as you can reasonably get it.

It's wise to wire it all up with extra heavy duty hookup wire. 'Monster'-type speaker cable is good if you're willing to pay for it. Make sure you connect the speakers correctly. Their + terminals will be marked in some way.

Drill pilot holes for centring the hole cutters when preparing the front and rear panels.

PARTS LIST — ETI-1431

1 x sheet of Brimsboard, 1800 x 1200 x 18 mm. Approx. five metres of 50 mm square pine. Timber for top cap (if required). Half metre of 18 mm dressed brad. Nails, screws. PVA woodworking glue. Sealant – Mastic or similar
2 x 200 mm woofers (see text)
2 x 25 mm dome tweeters (see text).
Speaker terminal connector e.g: Rod Irving Electronics, Cat. no. P10246 (circular), or P10248 (square).
Crossover components (see panel)
Approximate cost: $220-$240 to build a pair



Using a hole saw for the speaker terminal connector cutout in the rear panel.

For the larger cutouts in the front panel, I used a fly cutter.

Chamfer the driver cutouts with a router if you mount the drivers behind the front panel, as I did.

and mount on the front panel beneath the woofer. Wire up the drivers to the crossover and the crossover input to the rear panel terminals. You should test your wiring at this stage. Using a 1.5 V cell, momentarily connect it across the input terminals – positive to red, negative to black. The woofer cone should move out. If it does not, check your wiring. Listen to both drivers. You should hear a loud thump whenever the battery is connected and disconnected. Don't use a battery bigger than 1.5 V for this test, or you risk damaging the drivers.

When you're satisfied all's well, apply sealant around the inside edge of the rear panel and screw it in place. You're ready to rock and roll!

These loudspeakers are rated at around 60 watts and will deliver quite crushing sound levels in an average room. The bass end is smooth because of the air suspension system chosen. For the cost, they deliver very acceptable sound – certainly better than the boom boxes you get with many commercial 'hi-fi' systems.

REFERENCES

1. *The Loudspeaker Design Cookbook*, by Vance Dickason, published by the Marshall Jones Co., 1987. ISBN 0-8338-0194-5.
2. *Principles And Problems In Loudspeaker Design*, by David Tillbrook, ETI, December 1979 and January 1980.

Brimsboard veneered particle board is manufactured by DG Brims & Sons Pty Ltd, PO Box 80 Moorooka Qld 4105. You can buy sheets through the following outlets:

Brims Distributors Pty Ltd Station Rd Yeerongpilly Qld 4105 ☎ (07) 848-1091.
Brims Distributors Pty Ltd 22 Fairfield St Fairfield NSW 2165 ☎ (02) 632-7583.
Cabinet Timbers Pty Ltd 24-28 Kavanagh St South Melbourne Vic 3205 ☎ (03) 62-4771.

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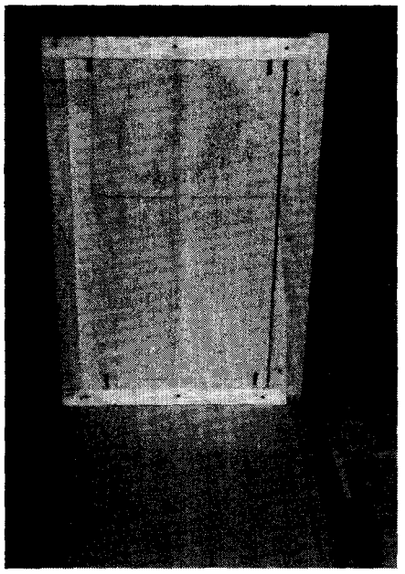
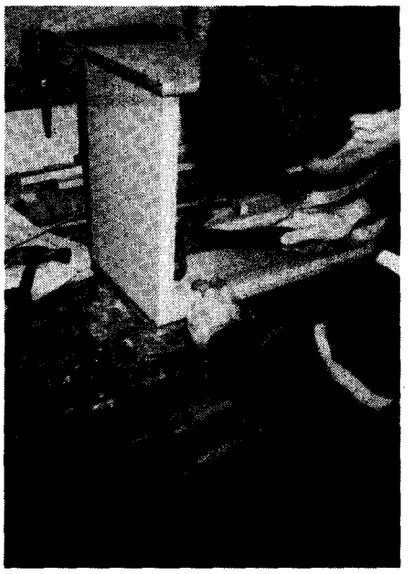
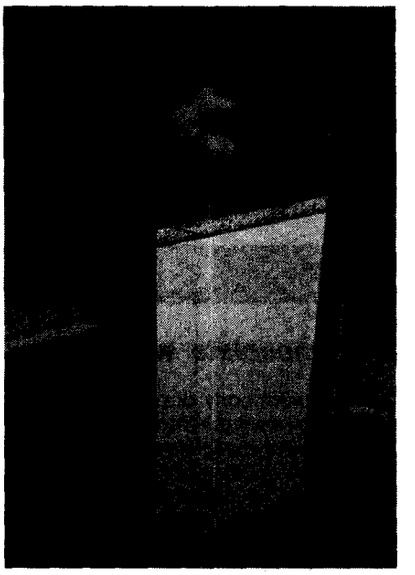


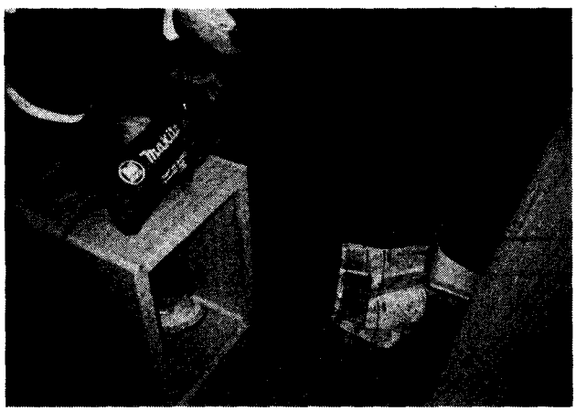
Bracing, gluing and nailing the panels. Note the 'pre-nailed' braces.



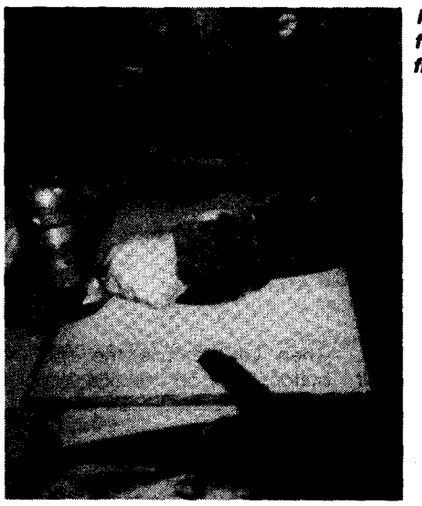
The top, bottom and side panels are assembled to make an 'open' box.



Checking that the box squares up.

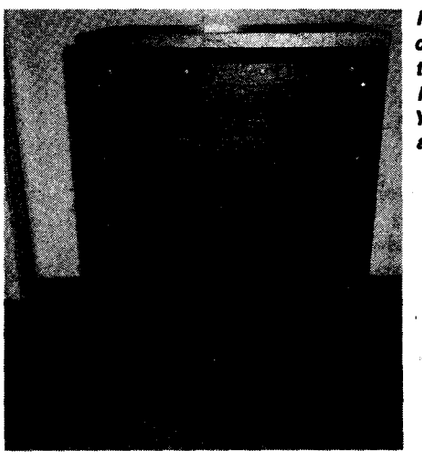


Once the box is assembled and the glue dried, sand the exposed edges to get a flush finish.



Routing the sides of the front panel to obtain a flush fit.

Gluing the two cedar planks together to make the top cap with an invisible seam.



Rear view of completed cabinet, showing how the rear panel is screwed in place. You must get an airtight seal.

INGENUITY

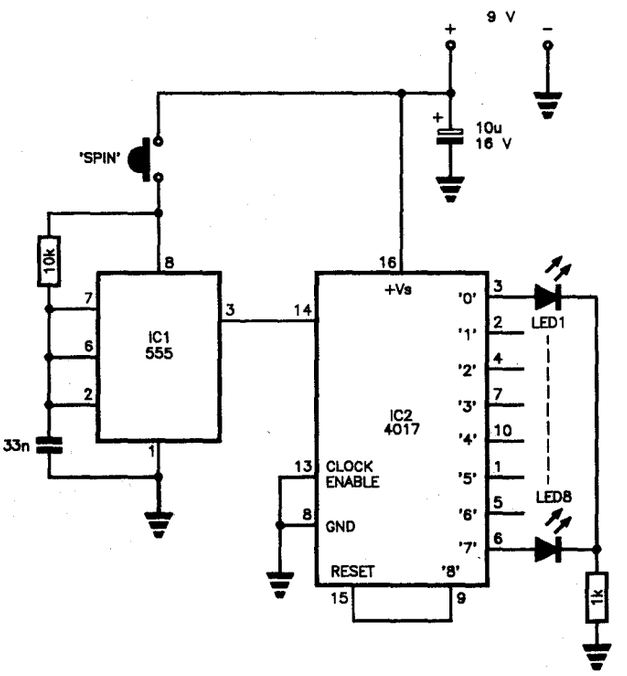
CIRCUITS

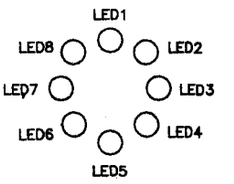
LED chocolate wheel

Here's a great party or games novelty – an electronic version of the old, familiar chocolate wheel. This circuit drives eight LEDs arranged in a circle for an "electronic chocolate wheel." It uses a 555 oscillator driving a 4017 decade counter.

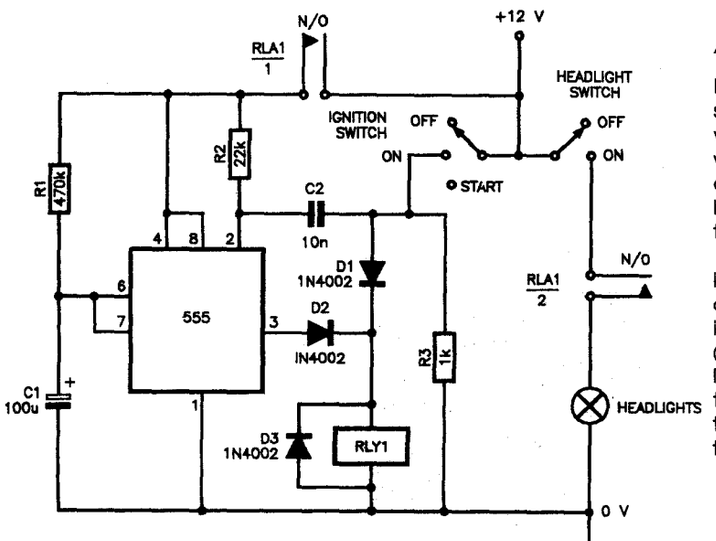
The 555 is connected as a simple astable oscillator by tying pins 2-6-7 together. The timing resistor and capacitor combinations chosen cause it to oscillate at a few kilohertz.

When you press the "spin" button, the 555 oscillates. Its output pulses clock the 4017's input, each output going high in turn. Output 8 of the 4017 is connected to the reset input (pin 15), so that it resets the 4017 after LED8 has turned on, then off again. The whole process repeats for each successive group of eight cycles from the 555 oscillator.





As the 555 oscillates so fast, you can't tell which LED will be lit when you release the spin button, stopping the 555. You can observe the action of the lights "going round and round" if you temporarily change the 555's 10k timing resistor to 1M.



A headlight delay timer

Ever parked your car in a dark spot and had no light to find your way? This headlight delay timer will keep your headlights on for around 40 seconds after you leave the car, and then turn them off.

When you turn your car's ignition on, diode D1 allows current to the relay coil, turning it on. This closes the N/O (normally open) relay contacts RLA1/1 and RLA1/2. When you turn on your headlights switch, the RLA1/2 contacts pass current to the headlights.

If you leave your headlight switch on, turn the ignition off and get out of the car, the 555 will be triggered because the charge on C2 now reverses the voltage on pin 2 of the 555 timer (the 'trigger' pin), thus triggering the 555 which then supplies current to the relay via pin 3 and diode D2, holding the relay on. Capacitor C2 discharges via the 1k resistor R3. When the 555's timing period is completed, some 40-50 seconds later, the relay lets go, opening the two contacts. The headlights go out and the 555 timer resets.

Solid state valve distortion

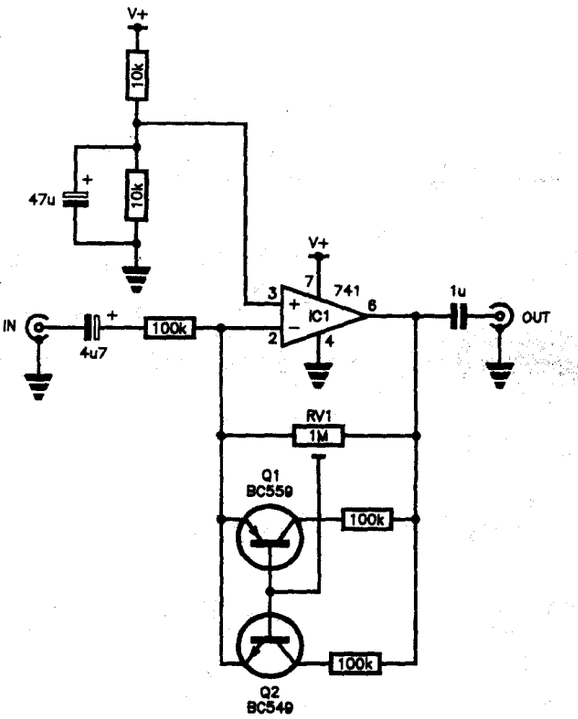
The "fuzz" sound beloved of guitarists was first produced on valve amplifiers by driving the amp into clipping. The valves' characteristics then develop that distinctive, rich harmonic sound. Solid state amps, when driven into clipping, produce a different sound because solid state devices have different characteristics in this mode of operation; solid state fuzz is much harsher because of the mix of harmonics produced. Valve amps are said to have a 'soft clipping' characteristic, while solid state amps are said to have a 'hard clipping' characteristic.

This circuit can provide the characteristic 'soft' clipping of valve amplifiers for a solid state amp system without the hassle and expense of installing a valve stage or stages. The circuit is added-in between the guitar amp system's pre-amp output and the power amp's input.

The circuit employs an op-amp with a symmetrical clipper in its feedback path consisting of a PNP-NPN pair of transistors.

At low signal levels, the output is a copy of the input, at the same level. That is, the stage has unity gain at low levels. The signal level increases to a point where the voltage between the wiper of RV1 and the output will be sufficient to turn on Q1 on negative peaks and Q2 on positive peaks of the waveform. When this happens, the feedback is increased because the 100k resistor in the collector of Q1 or Q2 (whichever is turned on) and the transistor's collector-emitter resistance shunts the 1M pot (RV1). The greater the amplitude of the peak, the lower the turned-on transistor's c-e resistance and the greater the feedback. In this way, feedback is progressively applied, 'softening' the clipping process.

Input sensitivity for the onset of clipping is adjustable between about 150 mV and 10 V.



The circuit requires a supply rail of between 10 and 20 volts. To avoid having to use split (+/−) supply rails, the non-inverting input of the 741 op-amp is biased at half the supply rail. If you have split supply rails available, simply ground the non-inverting input. The negative supply rail goes to pin 4, positive to pin 7.

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BUILDING BLOCKS OF ELECTRONICS

Phase splitters, power amps and the constant current source

The blocks described this month are among the most common you will encounter, particularly in audio equipment. By Jack Middlehurst.

Phase splitters produce two output signals that are equal in magnitude but have opposite phases so that they can drive push-pull stages. We will be discussing push-pull stages later, but phase splitters can be made using only one active device so we will describe them here.

Valve phase splitters

To keep costs down, the commonest valve phase splitter uses a single triode. It is a derivative of the valve current amplifier. The dc coupled circuit is shown in Figure 9.1. The voltage at the grid has to be about Vplus/3. In the ac coupled version shown in Figure 7.2 this voltage is set by the ratio of R to Rc and the characteristics of the valve. The output impedance at the anode (A) is Rl but that at the cathode (C) is low, similar to the output impedance of the cathode follower. The valve must have good insulation between the cathode and heater to prevent hum being injected into the circuit.

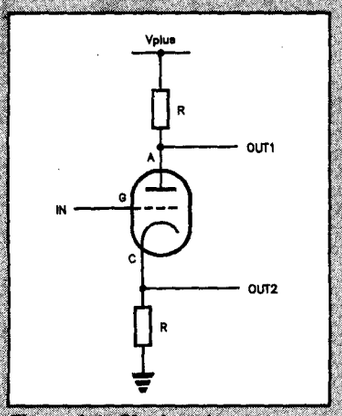
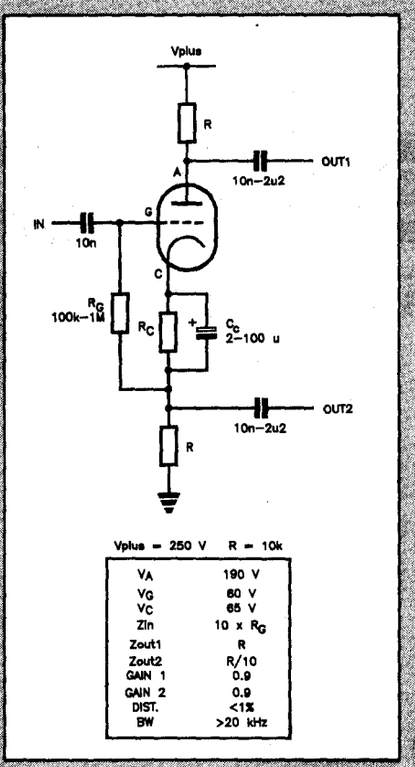


Figure 9.1. Single valve phase splitter.



Vplus = 250 V	R = 10k
VA	190 V
VG	80 V
VC	65 V
Zin	10 x RG
Zout1	R
Zout2	R/10
GAIN 1	0.9
GAIN 2	0.9
DIST.	<1%
BW	>20 kHz

Figure 9.2. An ac coupled phase splitter.

In the dc coupled case, Vc should be about Vplus/3 and Va should be about twice Vplus/3. If Va is high and Vc low, check that Vg is about Vplus/3. If it is not, the problem is in the previous stage. If Vg is correct, the valve is dead, so check the obvious things such as heater voltage and filament glow. If the dc voltages are correct, a signal of 1 V injected into the grid circuit should produce an output of about 0.9 V at each of the outputs.

Transistor and FET phase splitters

Similar circuits (Figure 9.3) are sometimes used in transistor equipment. High fidelity amplifiers use two- or three-transistor phase splitters which will be dealt with later. The dc voltages for transistor circuits are the same proportion of Vplus as for valve circuits. The bias in the ac coupled version is provided by the 100k and 47k resistors.

For FETs, there is a minimum source-to-drain voltage of about 8 to 12 V for the circuit to work properly, so FET circuits are only used with a Vplus above 12 V. Since most small signal FETs have an upper limit of 20 to 25 V, the FET circuits are only used at low signal levels and where high input impedance is essential. As shown in Figure 9.4, their biasing arrangements are similar to those for valves. The ac testing of these circuits is the same as that for valve circuits.

Power amplifiers

The major use of power amplifiers, in the frequency range in which we are interested (that is, audio), is to provide the drive for

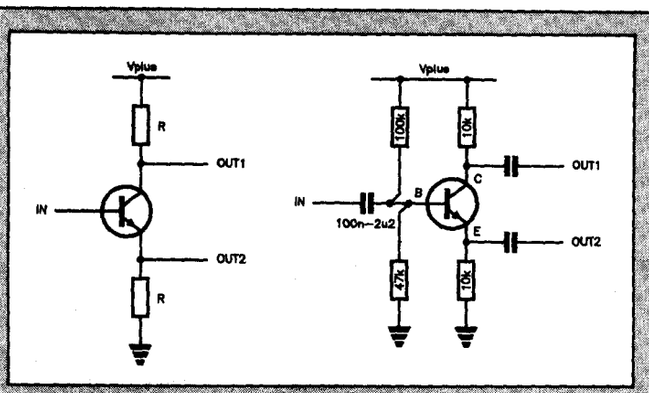


Figure 9.3. Single transistor dc and ac coupled phase splitters.

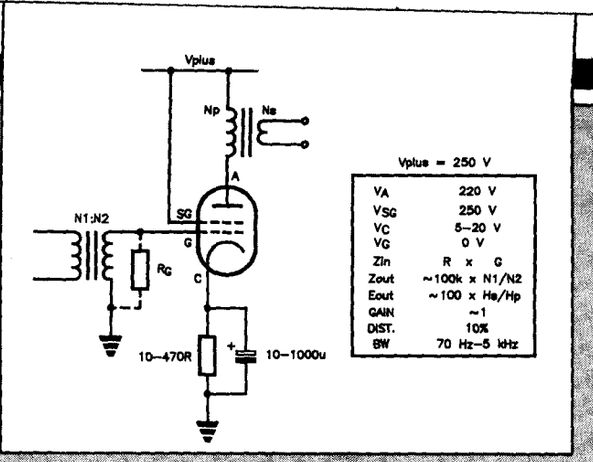


Figure 9.6. Single beam tetrode transformer coupled power amplifier.

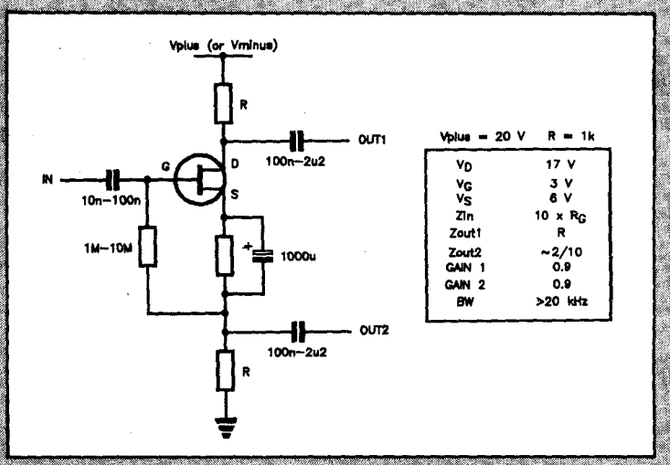


Figure 9.4. An ac coupled FET phase splitter.

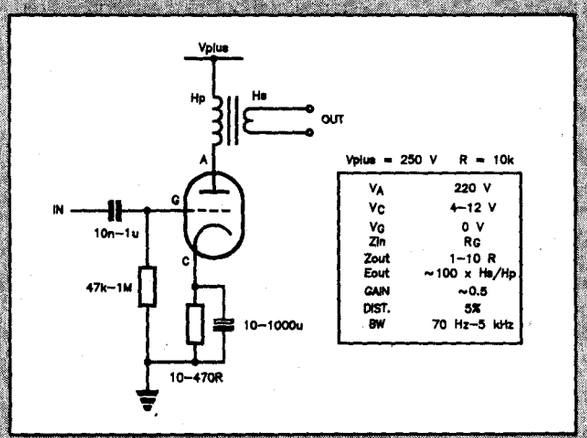


Figure 9.5. Single triode RC coupled AF power amplifier.

loudspeakers. Early power amplifiers using one valve could only produce a few milliwatts, enough to drive sensitive earphones.

These days the only limit on power is the budget. Since we are restricting ourselves to single active devices at the moment, we will deal with high powered push-pull amplifiers later.

Valve power amplifiers

Single-valve audio power amplifiers are invariably transformer coupled at their output and are transformer or RC coupled at their input. Figure 9.5 shows an RC coupled triode power amplifier and Figure 9.6 a transformer coupled beam tetrode power amp. Sometimes the input transformer will have a resistor – Rg – across the secondary to avoid resonant peaks in the frequency response.

The output transformer has the anode current flowing in its primary, so to prevent saturation of the iron there is an airgap in the laminations. Because this limits the available primary inductance, the low frequency response of this type of circuit is not particularly good. Figure 9.7 shows two different ways in which negative feedback is used in later circuits in an attempt to improve frequency response.

Because the dc resistance of the primary of the output transformer is only a few Ohms, Va will be a few volts less than Vplus. Typical power triodes are the 45 and the 2A3, although the KT66 and KT88 are sometimes found triode connected. The pentode, or more commonly beam tetrode, can range from the EL3NG through the 6V6, 6L6, KT66 and KT88 to small transmitting valves such as the 807. The screen voltage is almost always equal to Va, except for the 807.

There are many advantages to using these devices in a *push-pull* arrangement, and this will be dealt with later under 2-valve active blocks.

If the cathode voltage is correct, the circuit should function. A signal injected at the input should produce an output. If not, the input transformer or capacitor is to be suspected. Several things can contribute to maximum power not being achieved. The valve emission may be down, the cathode capacitor may have lost its capacitance, the input signal may be insufficient, or the input transformer may have a shorted turn. The first is easily checked by measuring Vc, the second by measurement or substitution, the third by measurement, and the fourth by isolating the transformer and testing it.

A power amplifier that is more commonly used at VHF and UHF, but one that we will need to know about later, is the *grounded grid amplifier*, shown schematically in Figure 9.8. Because the grid is earthed, there is excellent screening between the output and the input so it's a circuit which is inherently stable at VHF and UHF.

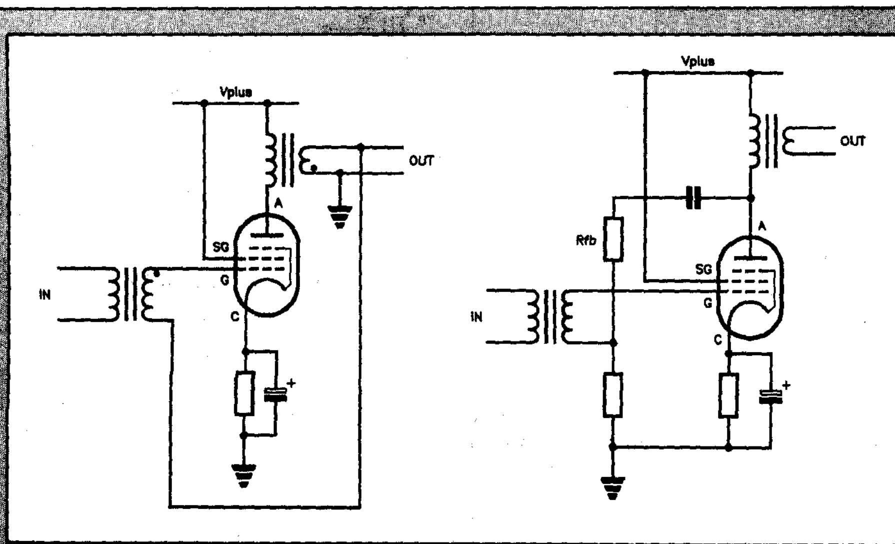
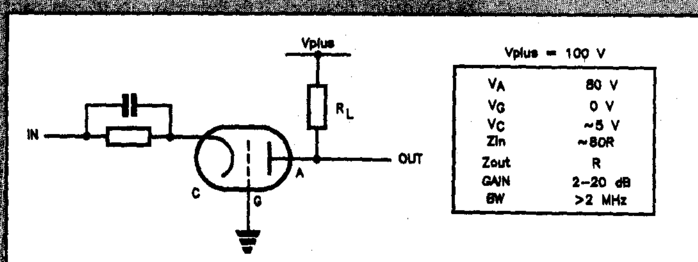


Figure 9.7. Two ways of applying [illegible] feedback to a power amplifier.



[illegible]

[illegible]

Single stage transistor power amplifiers

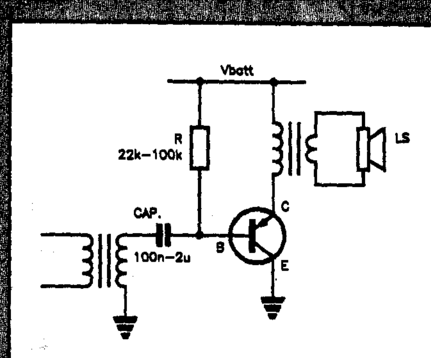
[illegible]

[illegible] transistor is cut off by either R being high [illegible] short circuited.

[illegible]

IC power amplifiers

[illegible]



[illegible]

in Figure 9.10.

Single IC power amps range from 250 mW output (LM2896) to 10 W output (LM383, TDA2003 and related types), and 2×4 W stereo output for the LM377 twin amplifier types. The input of each amplifier is usually fed from a volume control via a coupling capacitor and biasing resistor. In recent types, this biasing resistor is simply returned to earth.

The only dc testing you can do consists of establishing that the necessary power supply voltages are on the correct pins, that the output voltage is about Vplus/2, and that the bias voltage, if any, on the input is correct. [illegible] circuit inside, the output voltage will lock at the positive or negative supply voltage and blow the fuse. The dc voltage on the loudspeaker should be zero; otherwise the output capacitor is faulty.

If the dc conditions of the amplifier are correct, applying the [illegible] injector [illegible] to the input should produce some output [illegible] short circuit on the output.

The constant current source

[illegible]

Transistor constant current source

[illegible]

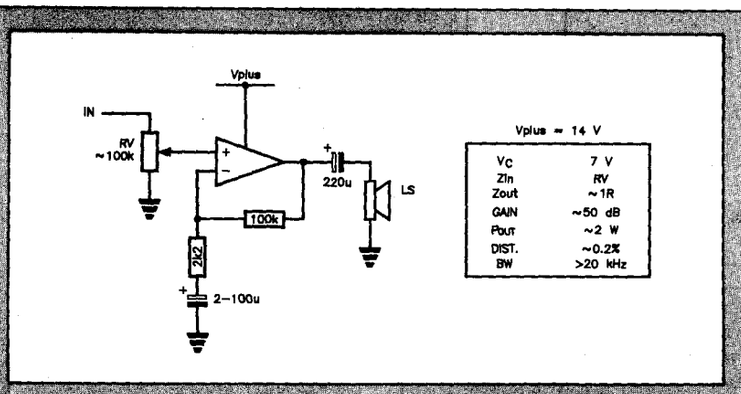


Figure 9.10. Single IC power amplifier. Not much to it!

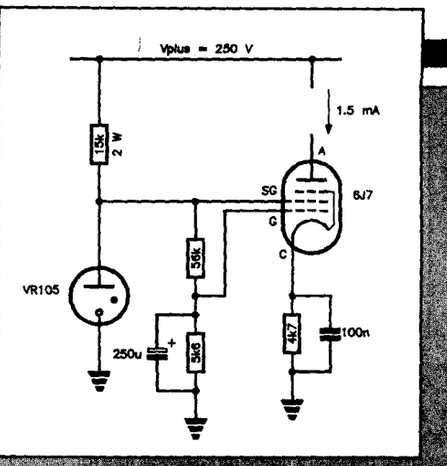


Figure 9.11. Valve current source, or constant current source.

Because of the little base current here, the collector current is not exactly equal to the emitter current, so high gain transistors are used in this circuit to keep the base current down.

FET constant current source

Since the gate current of an FET is negligible, FETs are often found as constant current sources where high accuracy is needed. The circuit in Figure 9.13 is similar to that of the transistor, except that the source has to be at 7.6 V to set the current at 5 mA.

Because depletion FETs such as the 2N3921 have a drain current of about 2.5 mA for zero gate-to-source voltage, the constant current source of Figure 9.14 is perhaps the simplest form of constant current device. The current is reasonably constant for any drain voltage above about 3 V. To set a given value of current, a resistor is inserted between source and ground.

Two-transistor constant current source

Where high stability is required, the two-transistor source of Figure 9.15 is used. This circuit occurs in many high fidelity power amplifiers. The 0.6 V base-emitter voltage needed to turn Q1 on is provided by the constant current times R4. The collector-base voltage of Q2 is held at 0.6 V by the base-emitter junction of Q1, so the operating conditions of Q2 are firmly fixed.

Transistor Q1 acts as an emitter follower in the closed, high gain negative feedback loop so the constant current through Q1 is firmly locked by the loop. The current can be altered by changing R4.

IC constant current source

Constant current sources are much used in integrated circuits. Because of the ease of adding an amplifier and transistor, the circuit of Figure 9.16 is used. The amplifier forces the voltage across R to be equal to Vref. Once Vref and R are known, the current through

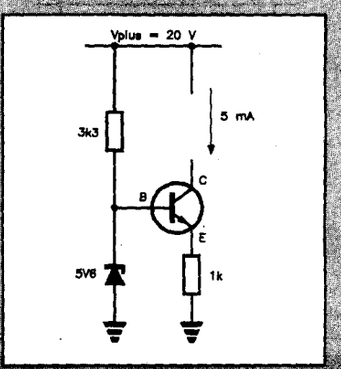


Figure 9.12. A transistor current source.

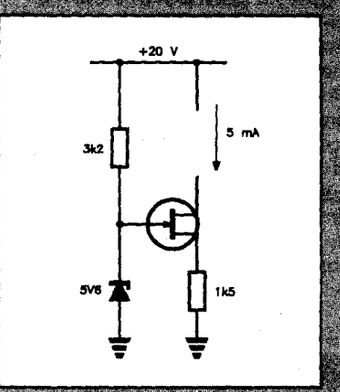
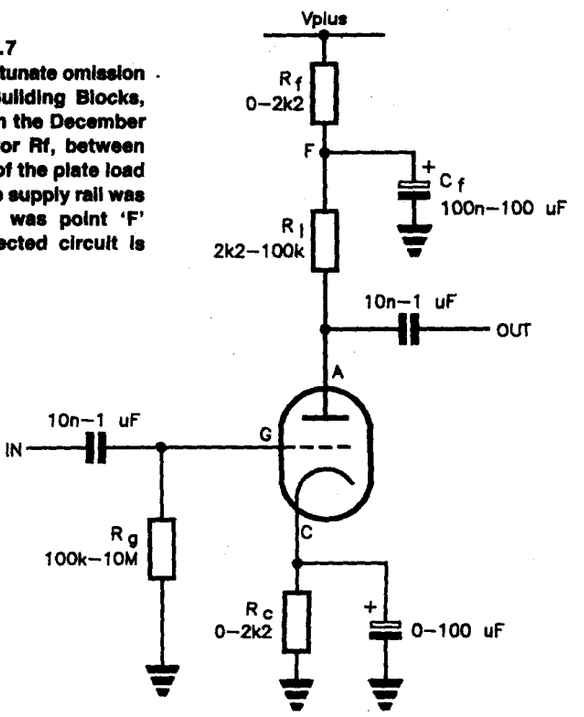


Figure 9.13. Current source using an FET.

ERRATUM,
PART 5, FIGURE 5.7

There was an unfortunate omission in Figure 5.7 in Building Blocks, Part 5, published in the December 1989 issue. Resistor Rf, between the bypassed end of the plate load resistor, Rl, and the supply rail was not included, nor was point 'F' marked. The corrected circuit is shown here.



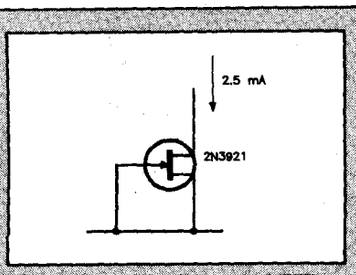


Figure 9.14. Simple form of FET current source.

R is simply Vref/R. Because a high gain transistor is used, the base current is small, so the output current is approximately equal to Vref/R.

To avoid the base current problem, the circuit of Figure 9.17 is sometimes used. This can provide very accurate currents. Its main limitation being the voltage restriction on the FET. Both these constant current generators can be built using discrete components.

One considerable advantage of the constant current source is that since the current does not depend on Vplus, the constant current source is *almost immune to any power supply ripple* on Vplus. This property is made use of in high fidelity amplifiers as we shall see later.

Contributed by The Apogee Group

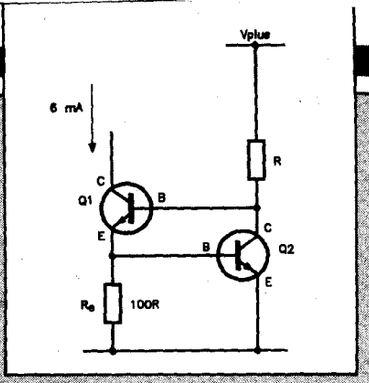


Figure 9.15. Two-transistor accurate constant current source. You'll see this widely used in many applications.

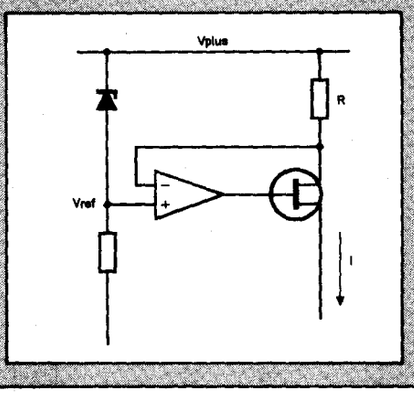


Figure 9.17. IC-FET constant current source.

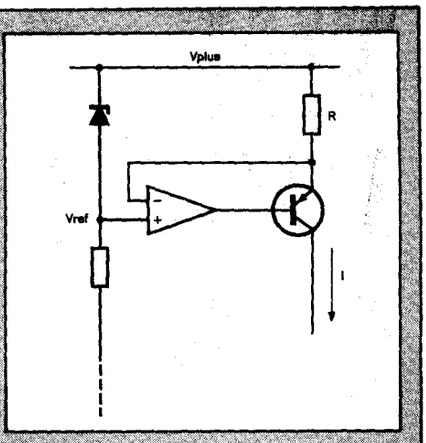


Figure 9.16. IC-transistor constant current source.

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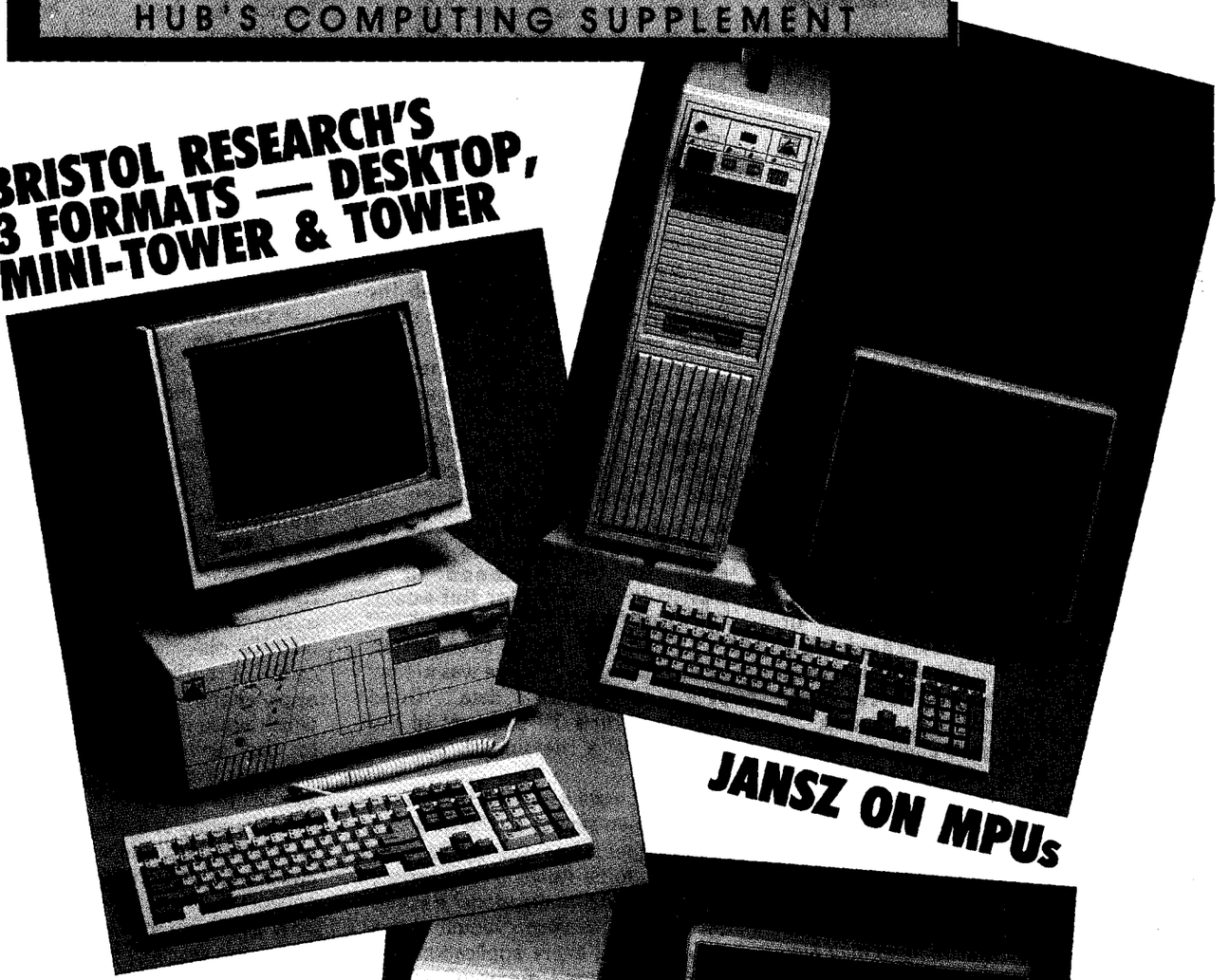

JANSZ ON MPUs

Cranswick on CAD Networking — Neat Solutions to Nutty Problems.

As costs come down, more and more companies will install networking systems and, gradually, standalone workstations will become a thing of the past.

CAD NETWORKING — THE PATH OF THE FUTURE

BY KESTER CRANSWICK

Computers have made a massive difference to the way engineers and architects go about their business. The power of modern software simplifies the initial drafting process allowing changes to drawings to take minutes, not days.

But even today, many workstations are still standalone devices. Files are exchanged on floppy disk and the fight over who is next to use the plotter is a feature of office life. Such an environment is a thing of the past in the Melbourne offices of CMPS, a firm of consulting engineers with 19 offices around Australia and the Asia-Pacific region. It has networked on a massive scale, and is reaping the benefits from the investment.

Most projects are done on Autocad software, though CMPS also has Micro CADAM and Microstation should customers request it. In Melbourne, the PC-based hardware is spread over three floors and has been installed progressively since 1986. Linking it all is a Novell network.

The hardware is about to receive a substantial upgrade, with 16-bit 386 PCs being assigned to general engineering applications and brand new 486 PCs coming in for the CAD work.

The engineering and CAD users share the same network, but have different disk drives to keep their files separate. There is nothing to stop users accessing files on either drive.

Two options

When it came to selecting a network, the options boiled down to a choice between Novell and 3Com. "At the time, we could not run Autocad on a non-dedicated file server, and we needed to have a file server that could be used for other tasks. So we chose Novell," said Peter Rebecchi, manager of CAD systems.

"We still run the server in non-dedicated mode because we do the housekeeping on it," said Rebecchi. This means that CAD users don't have to give up a workstation when the network administrator wants to make a few changes.

The Novell 2.1 network has thin Ethernet cabling pushing data around at 10Mbps over distances up to 300 metres. Each of the 15 workstations has a Western Digital Ethernet Plus card installed.

"Good management is 70 per cent of the success of a network," says Peter Rebecchi.

When the move to networks came, the biggest change was in how people treated their data. "Good management is 70 per cent of the success of a network," claimed Rebecchi.

There were a number of issues to decide when setting up the network. For instance, was the application, Autocad, to be stored on the server, or on individual workstations? If stored on the workstation, would users download the entire application into their workstation's memory? Where would the many temporary files generated by Autocad be stored?

In the end, Rebecchi decided to have the application resident and run from the server. There is an Autocad licence for each user and each workstation is equipped with the copyright protecting Autocad dongle.

All files are tagged as shareable. When a workstation boots up, it identifies itself to the server. The Autocad batch file changes to the appropriate directory, containing five files that must be resident on the workstation, loads an Autocad configuration file and calls Autocad from the server.

Only the code needed for the task at hand is in the workstation's memory. To the workstation, the server is just the drive where Autocad is stored.

Temporary files are paged to the local hard disk, and, according to Rebecchi, the network is fairly transparent to everybody.

Perhaps surprisingly, Rebecchi finds that Autocad on the network runs about 25 per cent faster than on a standalone machine, because of Novell's disk caching abilities. The only drawback comes with applications such as Autoshade, which reads and writes continuously to the server disk, slowing the network. Autoshade is run on a standalone PC.

A number of output devices, such as an electrostatic plotter, a pen plotter and sundry printers, are linked to the network. The electrostatic plotter has 33M RAM for spooling images that could be up to 5M in size. The network has eliminated switch boxes and doesn't frustrate users by making them wait until the printer has finished a job.

Storage is the other aspect of

networking in a CAD environment.

The server has 300M of storage in two separate drives amd a second processor board so both drives can be accessed concurrently. Rececchi is planning to introduce a disk subsystem allowing up to 1.2G of storage. But, he cautions, too much storage can be difficult to administer.

Backing up is vital. A day's work might be worth $1m to a client.

Backing up is vital. "A day's work might be worth $1m to a client," said Rebecchi. The CMPS network has two 40M tapes streamers, a 150M streamer and a rigorous backup procedure. Every day, for a fortnight, all changed files are backed up. Each week, a full disk backup is performed. At the start of the week three, the cycle starts again, using the oldest daily backup tapes.

Computer viruses

In a month, some 110M of files are generated. With the risk posed by computer viruses, Rebecchi is not chancing their loss; and backups help staff who want to go back to versions of files they did a few days previously.

"It is not infallible, as somebody might want the file they changed three weeks ago. But it is pretty good," claimed Rebecchi.

Additional complete backups are made at strategic points in the year, such as financial year end. Two sets of backups are archived, one in a fireproof safe that can resist 1000 degree temperatures for ten hours, without the plastic inside melting.

To keep track of files, Rebecchi has developed an on line database listing of every file in the archives. Built in a shareware database program, called PC-File, it records the number of copies of a drawing, their versions and where they are archived. "Some jobs are four to six years old and we may have 20 versions in the archives," said Rebecchi.

The CMPS network is state of the art as far as networking PCs is concerned. It is big, sophisticated and costly.

Networking is often put off because of the cost and hassle

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involved. Not only do networking cards and software have to be installed, but the workstation memory may need to be increased to cope with the networking software. Against this, the carrying of disks between workstations may not seem that inconvenient for a small company.

But a CAD network need not be that expensive or memory-hungry. According to Alan King, managing director of Systec, budget networking software can be as good as the costlier, better known names.

"The main advantage of dearer systems is performance," said King. "But most CAD environments are not disk intensive. They are CPU intensive."

Lantastic is the networking product he distributes. It can be run over twisted pair or Ethernet cabling at 2Mbps, or 10Mbps. And it needs minimal memory in the workstation and file server. On the PC, the networking overhead is just 12KB. On the server, it is just 40KB. A forthcoming hardware option will reduce the server overhead to nothing.

Cheap and efficient

Lantastic is not only memory efficient, it is also cheap, with the software/hardware costing under $600 per workstation. Systec also sells an accessory from J&L Information Systems that takes care of serial redirection and allows peripherals such as plotters to converse with workstations. This overcomes the only major limitation of the Lantastic networking system. King's view is endorsed by Martin Jones, general manager of ACADS, an independent body looking after the interests of the CAD community.

"High speed is not necessary," he said. "The main use of a network is to share peripherals and files."

ACADS holds regular seminars in most states on networking for the CAD environment. They feature independent consultants offering advice on the best means to network a CAD environment, with the emphasis on MS-DOS systems.

But there is more to CAD than MS-DOS. Many CAD environments use Unix workstations. Those who supply them believe they have many advantages when it comes to networking.

Jim White, marketing manager of Engineering Computer sales, has won many clients over to Unix on the strength of its networking features. ECS is also a good example of the scope of networking. In its Melbourne office it has a network of Apollo, Sun, Unisys and Hewlett-Packard Series 300 workstations, linked to IBM and compatible PCs. All work together, sharing files and information quite transparently.

"One of the key things is the elegance with which Unix operates,"

The CMPS network is state of the art as far as networking PCs is concerned.

said White. The major attraction is the ability to share the same files. A user might have five networked workstations working on the same project. "With a DOS-like network, all they can do is transfer files. With a Unix network, all workstations can be looking at a single copy of the file, stored on a reference workstation," White said.

"If it changes, it is immediately apparent to all workstation users. On PCs, it is up to a management procedure to make sure everyone has the same data."

Some might argue that workstations from companies such as Hewlett-Packard and Sun cost far more than PCs. White disagrees. An HP workstation comes with the networking card and licence included in the price. Though a base PC may be cheaper, by the time a screen and networking are added, it can cost just as much, if not more, he claims.

As yet, Australian users are not showing as much enthusiasm for linking their CAD networks into their office automation networks. Most prefer to keep them separate. But some users are splitting the CAD environments. For instance, Brook Crompton Betts, a Sydney-based manufacturer of electrical motors, has a network of HP workstations running HP's ME10 mechanical engineering package, linked to a PC network 200 metres away which handles the CAM side of the job.

"We call that distributed CAD/CAM. Networking allows us to distribute specialised activities," said White. "That wasn't possible a few years ago."

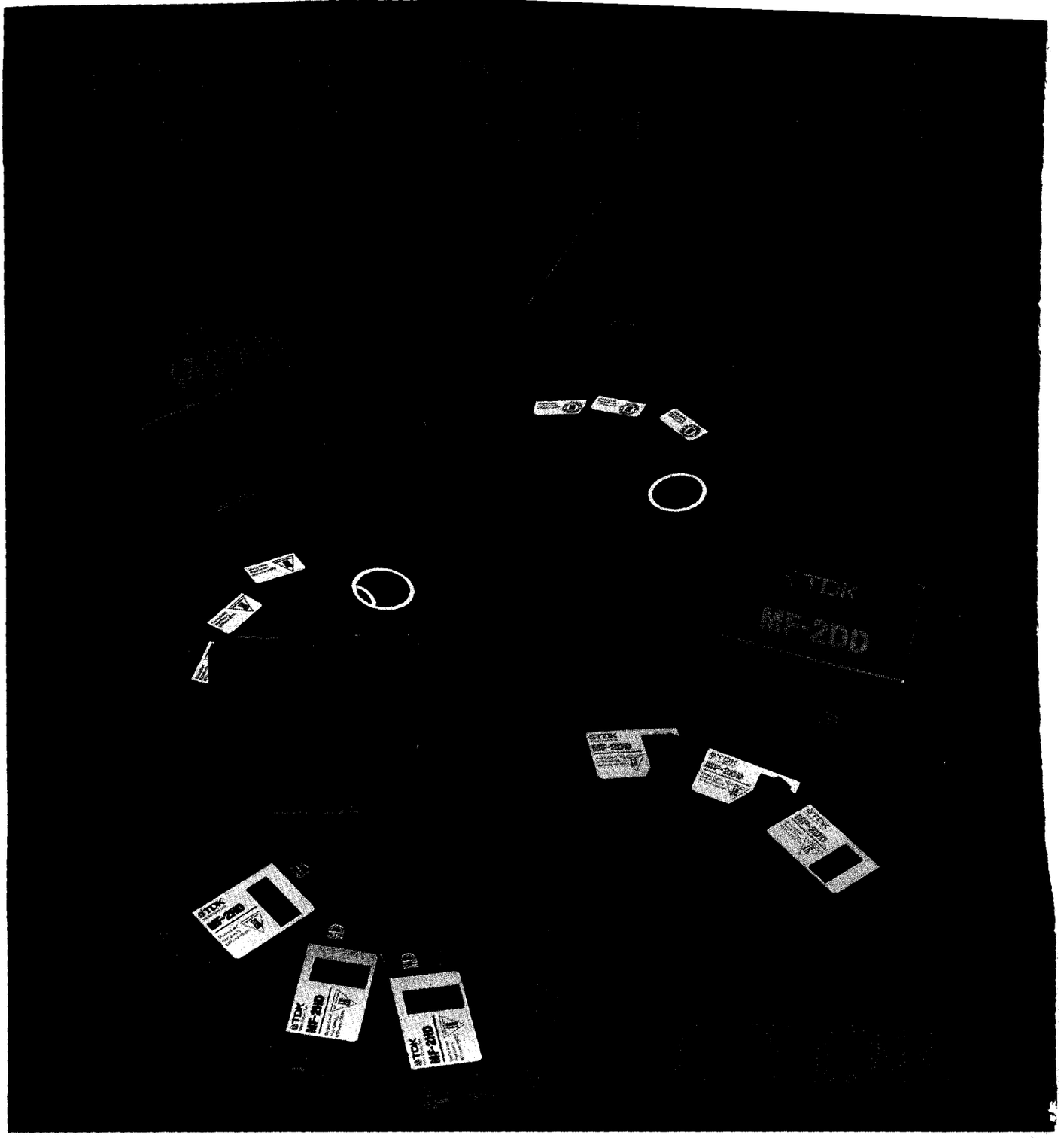
Another dimension to the networking problem is linking the old and the new. Many manufacturers have computerised over a decade or more and have many incompatible machines to link.

The solution is either the adoption of the file transfer standards, such as IGES, or the writing of bi-directional file translation packages. For example, Silcraft, a Melbourne automotive accessories firm, has GMS software running on a networked host and workstation. But it also needs to exchange data with a ten year old NC lathing system; and file transfer utility makes this possible.

Greater Integration

The future of networking in a CAD environment is one of greater integration and functionality. Wide area networking, where offices in different locations are linked, is still in its infancy. So, too, is the use of digital links to send files between offices in different states or countries.

There will always be those firms that are happy to work in a non-networked environment. But as costs come down, this number is going to dwindle. For users with more than one workstation, the truism that the network is the computer is well worth bearing in mind. eti



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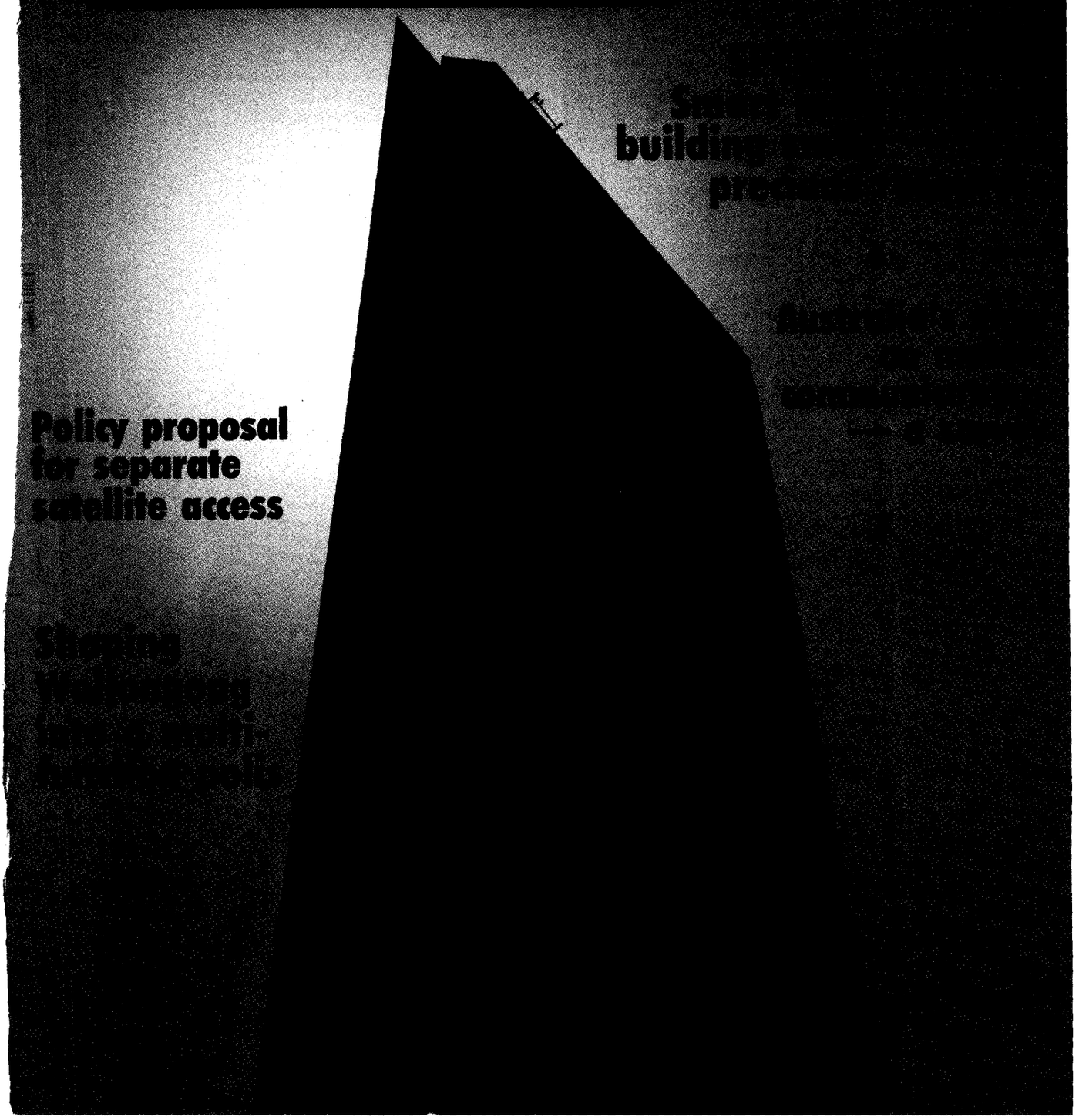

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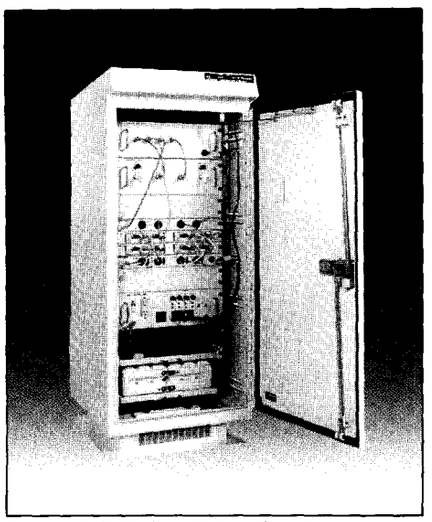

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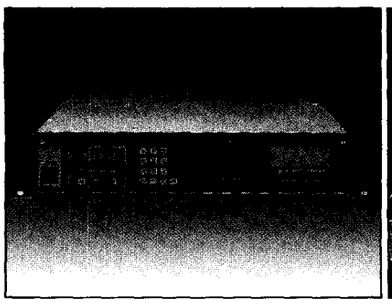

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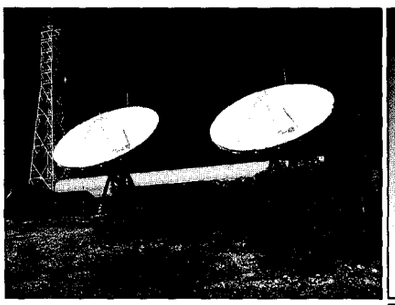

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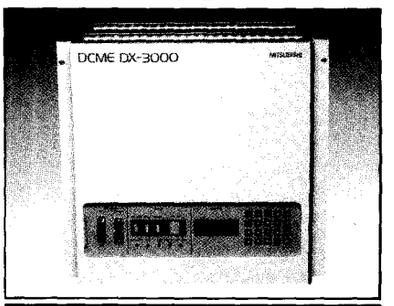

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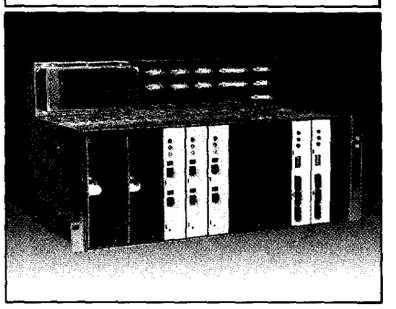

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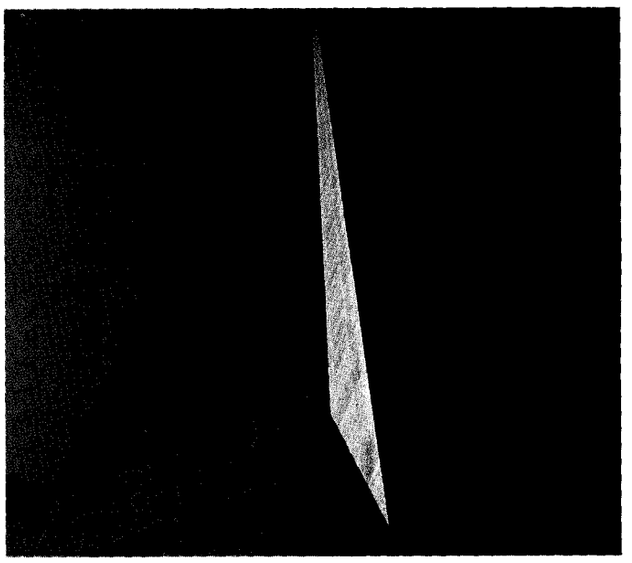


Australia's failure to convert technological innovations into entrepreneurial ventures is leading it to a forecast $10 million trade gap in the IT industry. **Trevor Barr**, director of the Australian Electronics Development Centre, reviews government policies designed to shrink the manufacturing cringe.

INDUSTRY POLICY STOCKTAKE

It's timely to review some policy achievements of recent years for Australia's information based industries.

The Hawke information industry era opened with Barry Jones touting his lost opportunities thesis. Our inadequacy was not, according to Jones, lack of scientific inventiveness, but failure to convert technological innovations into our own entrepreneurial ventures.

Much of our pioneering scientific work was great — in radio science, in microwave technology, in semi-conductors, and so on, but there were simply too many technological fish that got away.

A reborn Jones talked of the revitalisation of science, and devised his sunrise industries shopping list. Naive strategy perhaps, but invaluable in raising awareness about fundamental technological reform in Australia. Indelibly stamped on national consciousness will be the Hawke government's Minister for the Future's plea that Australians "must add value to what they do."

John Button, one of the longest serving federal industry ministers, presented a different policy perspective to the same broad problems. Button's Information Industry Strategy document of 1989 related IT to debt — a trade gap of $4 million, forecast to reach $10 million by the early 1990s, essentially due to the high level of imported computer hardware.

In this technological-client state Australia has the world's principal players in the computer and communicatios industry all operating here. At the heart of the Department of Industry, Technology and Commerce's (DITAC) much maligned Partnerships For Development program was Button's demand that the information transnationals do more for Australia, within Australia. Button called upon them to regard their Australian activities as integral to their overall corporate growth strategy and global operations — to deepen their roots in Australia. A trans-national who signed a Partnerships agreement committed to achieve, within seven years:

1. Expenditure on R & D activities in Australia equivalent to five per cent of industrial turnover annually,

2. Annual exports of goods or services equivalent to 50 per cent of the Partnerships imports into Australia.

3. An average across all exports by the seventh year of 70 per cent local value added content.

Twelve computer Partners signed in the Program's first year and gave

Trevor Barr: *Will all the dries who can find a level playing field in international information markets please stand up.*

undertakings to export $1054 per annum by 1994.

Clearly these policies were a result of government realisation of specific problems with the computer industry in Australia, and recognition that the Offsets Scheme of 1986 had not produced sufficient desirable change.

Meanwhile, the equipment side of Australian telecommunications industry had emerged with a complementary policy.

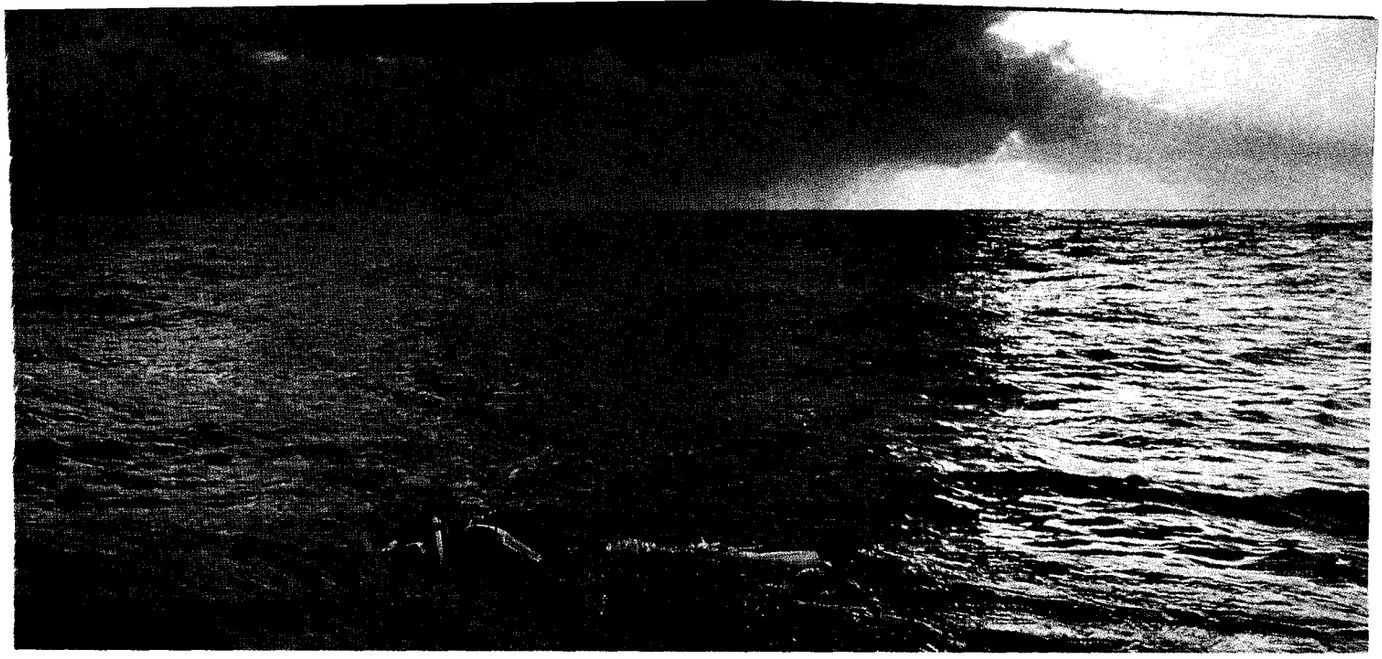
Button's Australian communication equipment industry plan of 1985 involved reduction in tariffs on most imported telecommunications products and components from 30 per cent to 20 per cent and the target achievement of $600 — $800 million in exports by 1996. This commendable action plan also had the right rhetoric — 'a more export oriented, internationally competitive and innovative communications equipment industry'. Never before had the industry been invited to propose feasible Australian export targets.

How then to assess Senator Button's DITAC as architects of national information industry policy? Plenty of critics, but generally little praise for a group who at the very least began to address major structural problems in this industry. These are slippery slope approaches, claim the critics, based on undesirable artificial stimulants. Will all the dries who can find a level playing field in international information markets please stand up?

The Partnerships plan must be judged not only in terms of R&D targets and export goals, but also in terms of the flow-on effects that will be generated. One of the major outcomes is already that the indigenous printed circuit board industry has received a major boost from computer companies wanting to meet their national targets. What might well emerge is a significant printed board subcontractor industry as a result of this initiative. Some 17 transnational companies are now working with about 90 local firms and institutions. Would these targets have been achieved without the Canberra initiative?

Given the structural problems in Australian industry, Button's DITAC really had to bite the bullet — and the proof may be in the pudding for us in the 1990s. If so, someone might just say that this mini MITI did a damn good job. ■

READER INFO No. 244



Communication with New Zealand is best done at the bottom of the Tasman.

The most efficient way to communicate between New Zealand and Australia is via a submarine communication link. But the job of making and laying an optical fibre cable of such length is a major challenge.

That's why tenders for the contract were sought from around the world.

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MOBILE COMMUNICATIONS
THE VIEW FROM THE CUSTOMER

BY PETER McBURNEY *

The last two years have been a period of rapid change in telecommunications policy and activity in Australia, and more change is likely to occur. In mobile communications high levels of interest have been generated by the Austel enquiries into cellular mobile communications and public access second generation cordless telephone (CT2) services.

Australia is not unique in this regard: mobile communications is a global industry, and the major players are seeking opportunities worldwide.

BIS Shrapnel undertook Australia's largest market research study of mobile communications in 1989, interviewing over 1500 business users and non-users of various mobile technologies. The survey was oriented towards user needs for communications and examined each of the major mobile technologies:

- **Private Mobile Radio**
- **Wide Area Paging**
- **Cellular Mobile Radio**
- **Second Generation Cordless Telephones (CT2)**
- **Land Mobile Satellite Communications**
- **Mobile Data Services**

Market demand

The demand for mobile communications in Australia has been generally under-estimated. A market study in 1981 indicated a demand for 5000 mobile terminals in both Sydney and Melbourne. In fact, demand for the automatic (non-cellular) mobile service far exceeded these forecasts. Within a year of commissioning, the service was being extended, and planning had commenced for a cellular replacement system. Market surveys indicated potential demand (nationally) to reach 300,000 by 1995.

Customers were first connected to the cellular MobileNet system in January 1987, and there were 21,000 subscribers by the end of March 1988. The Telecom forecast for 1990 had risen from 100,000 to 140,000 subscribers. By the end of October 1988, the number of subscribers had risen to 50,000, and it is believed that Telecom was predicting a total market size of 215,000 by 1993.

The number of MobileNet subscribers passed 100,000 in August 1989, and in September Telecom announced they now expected the 200,000th subscriber to be enrolled before mid 1990. Subscriptions are apparently now growing at a rate of eight per cent per month (150 per cent annually).

By the end of 1989, it is believed that MobileNet had more than 120 base stations nationally, with a coverage area reaching 72 per cent of the population.

It is understood that 1989 has seen MobileNet almost double the number of base stations in Sydney, from the 20 in operation at the end of 1988. To August 1989, Telecom had invested some A$200 million in the network, and another $700 million is planned over the next four years.

Graph 1 compares the penetration of cellular mobiles per head of the labour force in Australia with the same figure for other countries. Australia is well above the position we would expect for the length of time we have had the service.

One of the reasons for this exceptional growth is the high percentage of Australians who commute to work by car, compared to workers in European countries. Cellular phones make this commuting time more productive. However, this factor may result in lower per capita market potential for public access CT2 services in Australia relative to Europe.

Competition

The graph also casts some light on a key issue in the debate on cellular in Australia: should we allow a competitor to Telecom? Compare the cellular penetration rates achieved in France, West Germany and the UK. All have similar populations and industrial structures, and launched their cellular services at roughly the same time. But the UK, the only one with a competitive environment, has seen considerably greater penetration than either France or West Germany.

Whatever the views of Austel, Telecom or others regarding a competitive environment, our survey results show that cellular users certainly welcome it. Fifty-four per cent of 'Top 200' companies and Government organisations were in favour of a second cellular network, with only 25 per cent against. (The remainder were undecided or expressed no opinion.) For small and medium size business users of cellular phones, the support was even stronger, with 70 per cent in favour. Just 11 per cent were opposed to the idea.

We asked our sample of companies who they thought should operate a competing cellular network or networks. The results are instructive: 68 per cent of small and medium size companies thought that the second operator should be a private Australian-owned firm. Only four per cent thought that it should be a foreign firm.

We also asked who should *not* operate a second cellular network. Forty-four per cent said that it should not be Telecom Australia, and 42 per cent that it should not be a foreign owned firm. A common reason for this view was expressed by one major corporate MIS manager: "The telecommunications infrastructure is a national resource and should be

controlled by Australians". Clearly, the potential overseas players will have to deal with this negative perception if they are to undertake a successful entry to the Australian market.

Opinions of Telecom

From the strong support shown for a competing cellular service, one could gain the impression that cellular phone subscribers are 'anti-Telecom'. The survey findings reveal, however, that while there is a strong feeling, it is not as great as the figures would lead one to believe.

Twenty-four per cent of small and medium businesses are positive or very positive towards Telecom, while 35 per cent have a neutral opinion overall. Fifty-three per cent of 'Top 200' businesses were positive towards Telecom. Businesses in regional areas are more favourably disposed than those in capital cities.

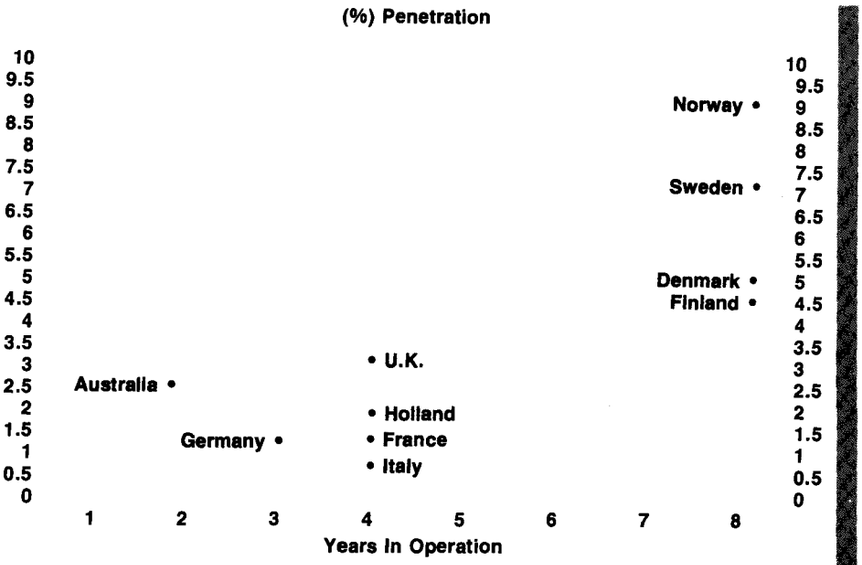
And opinion of Telecom's MobileNet service is more favourable than opinion of Telecom overall, especially among subscribers. Small cellular users are less happy than the medium-size users with MobileNet.

This is not to say that users have had no problems with the MobileNet service. Just over half of small and medium business users of cellular phones indicated that they had experienced a problem; the most common were congestion, call drop out, call quality and fade-out. Clearly, however, users were not laying all the blame at the door of Telecom.

The survey findings indicate that a second cellular operator will not harvest fruit already ripe in taking market share from Telecom. The support shown for Telecom and MobileNet should lead one to conclude that the battle — if permitted — will be an interesting one and that Telecom Mobile will have a strong base of marketplace loyalty upon which to defend itself.

The longer term

Because of the rapid pace of technological development in the mobile communications field, there is no doubt that the marketplace is, to a large extent, technologically driven. This has resulted in a tendency to view



Graph 1: Cellular radio labour force penetration, 1989, in selected countries.

the market for mobile communications products and services as a collection of separate market places — one for Private Mobile Radio (PMR), one for cellular radio, and so on.

These technologies do have the capacity to serve different user needs — PMR, for example, permits broadcasts to all mobiles; and cellular radio provides automatic interconnection to the Public Switched Telephone Network (PSTN). Insofar as the technologies service different needs, and insofar as the needs are ranked differently by different users, we can speak of separate market places for each technology.

For some users, it may not matter which technology is adopted, as their needs may be satisfied by more than one solution. The same may soon be true for other users as technological developments expand and enhance the functionalities of each service. For instance, we take two examples — the future may enable automatic interconnection from PMR terminals to the PSTN; and virtual closed user groups (with, for example, broadcasting abilities, and priority overrides) on cellular radio networks.

Developments such as these blur, the distinctions between the different technologies, and, in the language of economics, make each a partial substitute for the others. This trend has been recognised by the UK Government, which, in calling for tenders for the new Private Communications Network (PCN) services, did not permit either of the two existing cellular operators to tender, but indicated that they would be allowed to offer 'virtual PCN' services on their cellular networks.

In short, the separate markets for the different mobile communications technologies may be on their way to becoming one market.

This development has important and far-reaching implications, both for existing product and network providers and for those planning entry to the market place. The implications include increasing user sophistication, and market growth.

With technological development proceeding at great speed and markets for existing technologies maturing, users gain experience and knowledge of possible and potential applications and become more technically sophisticated.

Along with technological development and user sophistication comes growth in the market, as more users find their needs satisfied by a particular technology, and as users

find new applications for existing services. The interconnection of the PSTN provided by cellular radio satisfied business needs for whole categories of customers who had not previously utilised PMR services. These needs were sufficiently important to Australian cellular subscribers to make them relatively price insensitive, at least by world standards.

As markets grow and mature, and as users increase in sophistication, providers of equipment and network services must respond to user needs and requirements. If they do not, they risk being overtaken by competitors who will do so. The race is thus between the 'Quick and the Dead'.

Two key characteristics of the winners will be:

- an ability to ensure that new product and service offerings match user needs, and thereby find a niche in the market place. As markets mature, the rate of failure of new products typically increases.
- dominance of particular vertical or horizontal market segments, achieved by adding value to standard product or service offerings and tailoring them to specific user segments.

* *Peter McBurney is Manager, Information and Communications Technology Unit, BIS Shrapnel Pty Ltd.*

MOBILEBITS

Potential in South-East Asia

Research by CIT Research, the international communications analysts, released in a report entitled Mobile Communications Analysts estimates the total value of the 1989 mobile communications market in just four countries — Australia, New Zealand, Hong Kong and Singapore — at US$ 750m (equipment and services). With a population of only 28m, this is the highest per capita take-up of mobile communications equipment and services anywhere in the world.

By the end of the 1990s, CIT projects 1.8m cellular and/or PCN users in the four countries, creating annual revenue of US$1.75b. CIT says the market potential for mobile communications is almost "limitless" in South-East Asia and the Pacific.

Mobile communications to service remote rural areas

Telecom Australia is currently testing a sophisticated new fixed cellular phone for people that live in difficult access areas.

The service operates through Telecom's MobileNet which now covers more than 75 per cent of Australia's population.

Telecom has already installed one service in a timber mill at Putty, 150 kilometres north-west of Newcastle.

Another unit is being installed on an isolated farm in an area known as South Jerry Plains near Singleton, also in New South Wales.

The recipients of the latest service, Ian and Susan Johnson, have two children aged four and two and live more than 33 kilometres from the nearest phone service.

The Johnsons have the added problem of no mains electricity — Telecom technicians are currently testing solar panels that have a battery backup to power the system.

The fixed cellular phone uses an interface to allow a mobile transceiver to link with the standard telephone network at the nearest Telecom telephone exchange.

Less pep per POP

According to a new 193-page research report on the US market from consulting firm International Resource Development Inc, cellular revenues will continue to grow throughout the 1990s, although not at the spectacular rate of the past five years. Cellular markets (including sales of equipment and revenue from subscribers) are likely to reach $16b at the end of the century, about four times the current figure.

The IRD report also predicts strong growth in paging services, and in the sales of conventional two-way radios (used by law-enforcement agencies, taxi fleets, etc.), but sees the strongest growth in various specialised mobile data communications systems and services. The U.S. market for all types of non-cellular mobile radio services and equipment is expected to account for an additional $16b by the year 2000. Then, as now, Motorola is expected to be the dominant U.S. supplier to most segments of the non-cellular equipment markets.

Several organisations plan new satellites to provide mobile telephony and vehicle-positioning services, says the report, which estimates user spending on satellite-based mobile equipment and services as $50m for the U.S. in 1989, excluding maritime use.

Bouncing of meteor trails

One trucking company, Midwest Coast Transport (Sioux Falls, SD) is currently testing a tracking system on ten of its 600-truck fleet, using signals bounced off the reflective trails which meteors leave as they disintegrate. (Radio waves of about 30MHz to 100MHz are reflected back the best). And unlike satellites, which can cost $100 million each by the time they are in orbit, the meteor trails are free. However, the report explains that meteor-burst works better for data communications than for voice.

UK PCN licenses

Mercury Communications, British Aerospace and STC have been granted licenses to provide mass market mobile communications systems or personal communications networks (PCNs).

Each network is expected to require an investment of around $2b, and be in place by 1992. They would support cheap, lightweight phones that could be used to make and receive calls from virtually anywhere. The systems are initially expected to compete with the current cellular networks run by Vodaphone, part of Racal Telecom; and Cellnet, a BT subsidiary. They could also pose a threat to BT's monopoly of the ordinary phone service because customers would be free to exchange their fixed phones for mobile phones.

Inmarsat improves land mobile coverage

Inmarsat will increase its number of satellite coverage zones from three to four, replacing the existing single Atlantic Ocean coverage with two regions. Implementation is expected by the end of 1990.

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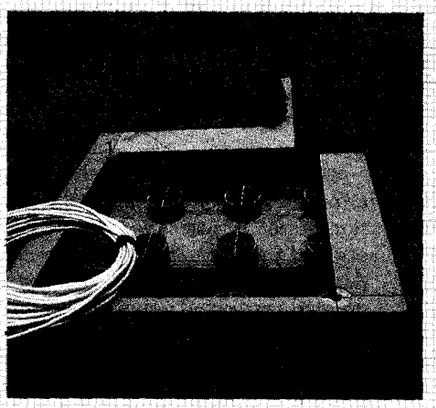

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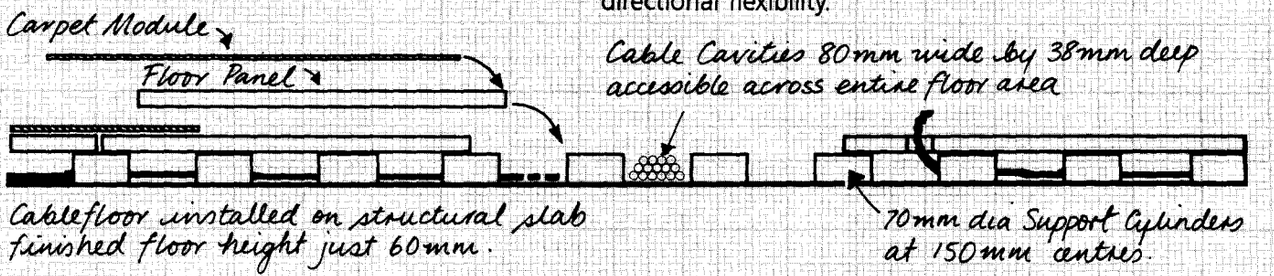

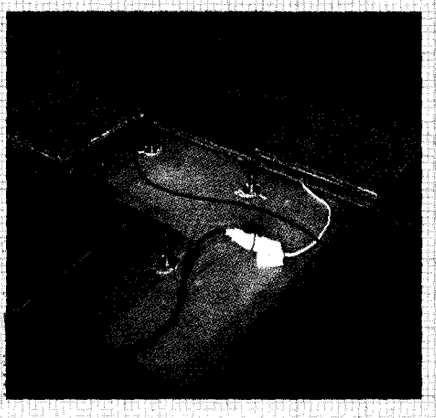

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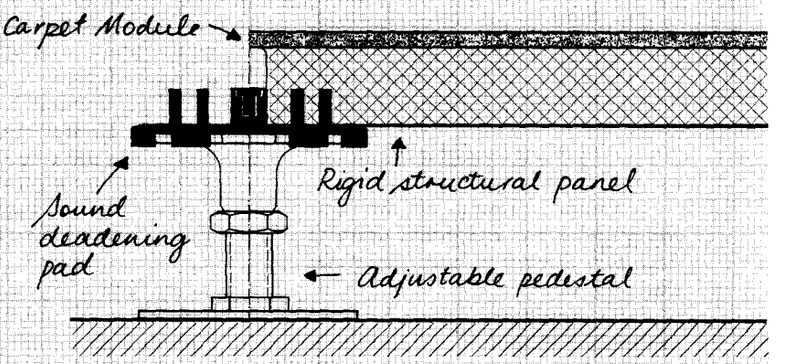

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A new Labour government initiative to liberalise access to international satellite systems has left some members of the industry both in Australia and overseas somewhat bemused.

AUSTRALIA — ONE BIG DISH FARM?

BY LIZ FELL

Announced in December by Mrs Ros Kelly, the junior minister in charge of telecommunications support, the policy initiative is intended to benefit private users of international satellite facilities.

In effect, the Minister has used a loop-hole in the Telecommunications Act to introduce competition and break OTC's virtual monopoly over international space facilities and over the provision of reserved services, including private network services.

In future, corporate users including foreign carriers, will be able to establish their own private satellite earth stations to receive and send private data, voice and video services to spacecraft owned by Intelsat, the international satellite cooperative.

The government plans to allow direct technical access to Intelsat by providing licences under the Radio-communications Act, administered by the Department of Communications.

Additionally, private network users will be free to establish their own satellite dishes to gain direct technical access to other spacecraft beaming into Australia such as Indonesia's Palapa or Statsionar (also known as Gorizont), one of the INTERSPUTNIK satellites controlled by the Soviet Union.

Another element of the new policy will allow corporate users to deal with carriers in other countries who are signatories to the Intelsat operating agreement "where Australia has reciprocal access".

For instance, users would be able to approach Telecom Corp of NZ or British Telecom when leasing their space capacity, to see whether they could get a better deal than the one offered by OTC Limited, Australia's Intelsat signatory.

Reciprocal access

The success of this new policy hinges on the Australian Government securing "reciprocal access" with other countries. At this stage, probably no other country allows a foreign signatory to establish Intelsat facilities on their territory, let alone sign up its own business customers.

It is understood that the Minister for Trade, Michael Duffy, intervened at the last moment during Cabinet deliberations, to insert the clause requiring "reciprocal" access.

Duffy is in charge of the negotiations over trade in telecommunications services at the Uraguay Round of the General Agreement on Tariffs and Trade (GATT). He is probably not eager to see Australia give away its services leverage without something in return.

In her December 13 statement, Kelly said that the new policy would give corporate users potential cost savings and technical flexibility, and encourage them to develop existing and new international services.

She subsequently sent a letter outlining the policy to overseas carriers such as AT&T of the US and British Telecom. The letter elaborated on her December statement:

"The government's new policy will promote the growth of enhanced services in Australia by:

- facilitating customers' access to international satellite systems;
- encouraging competitive tariffs and greater customer orientation by OTC in the provision of services;
- attracting overseas customers to locate their private network centres in Australia as a consequence of a more liberal regulatory regime;
- confirming the government's commitment to on-going policy development."

In this letter, Kelly also announced that foreign Intelsat signatories would be allowed to operate private earth stations within Australia where "Australia had been granted reciprocal rights of access to foreign markets."

Commenting on this initiative, a spokesman for Comsat, the US Intelsat signatory, said: "We have a lot more to lose if OTC enters the US and sets up its own earth stations or offers cheap access to Intelsat than if we entered the tiny Australian market."

TV companies to benefit

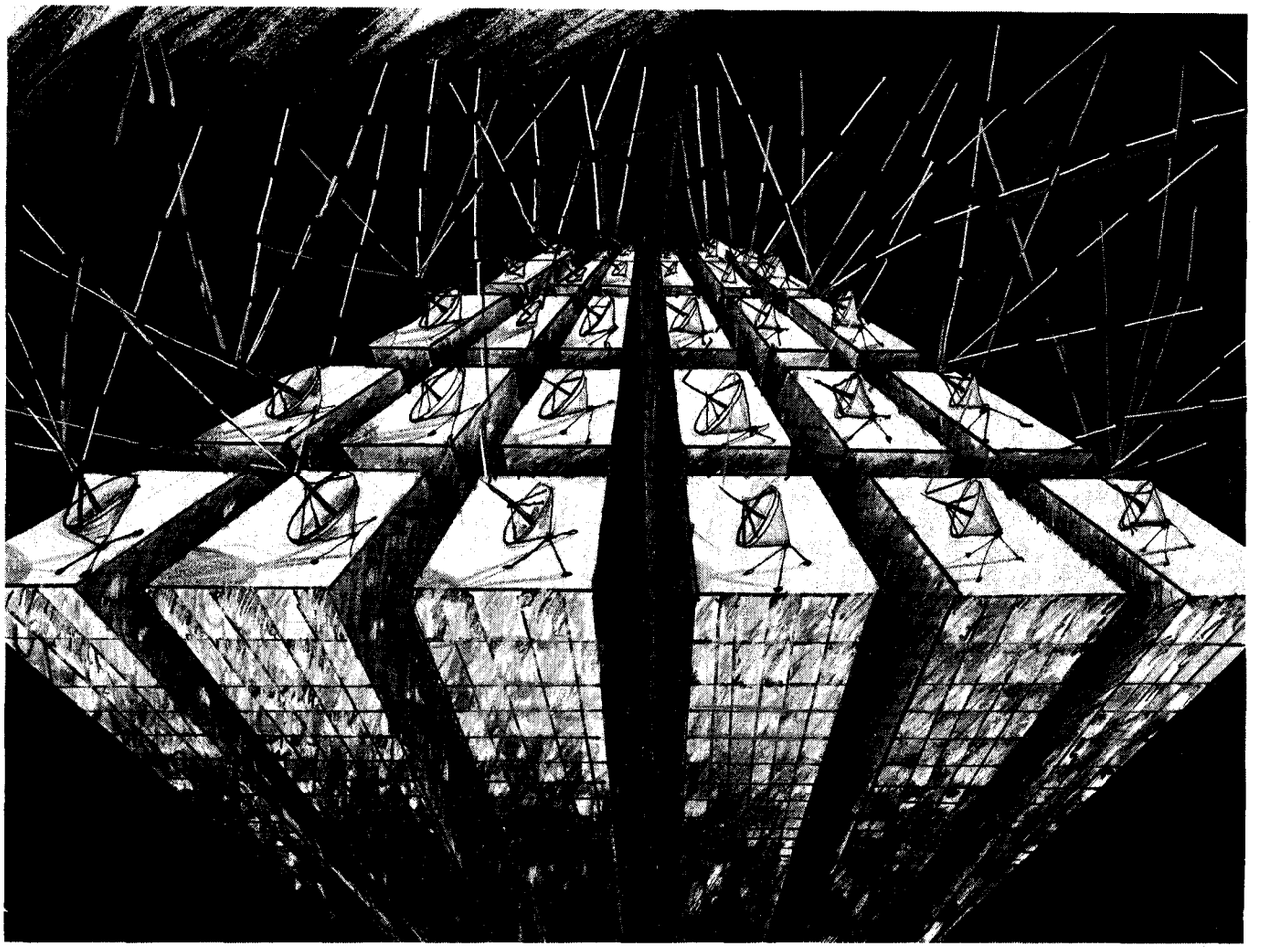
TV companies will be among the major Australian benefaciaries of this new policy. Last year, Intelsat relaxed the arrangements for billing space capacity for high bandwidth services such as TV.

An Intelsat spokesman said this allowed signatories such as Comsat to deliver global TV events free to poorer countries in South America, for example, without these countries having to pay for half of the space segment, as is the case usually.

The Australian Government has turned this billing arrangement on its head and said customers can now choose to pay only one signatory, either OTC or a foreign signatory, for their space segment.

This, of course, will have implications for OTC's capital investment in Intelsat which is based on usage. Kelly's letter touches on this by saying her Department will administer the new scheme on a "basis which provides for the financial commitment by OTC to Intelsat and for Australia's international obligations". It is understood this part of the scheme has not yet been fully worked out.

Networks Seven and Nine have the most to gain from the change in private earth station policy. These



networks established their own Intelsat earth stations in Sydney under the Fraser government and were allowed to receive international TV and radio only.

Under this new policy, they will also be able to send TV programs to the US or other countries who allow it, bypassing OTC's earth station facilities.

In addition, SBS TV can now use its own INTERSPUTNIK satellite dish located at its studio premises to pick up a daily Russian news feed directly.

Reuters, which has its regional headquarters in Hong Kong, may also choose to arrange for its news service to be received directly in Australia off the Intelsat Indian Ocean satellite, by establishing privately-owned satellite dishes.

Another beneficiary could be a new Indonesian-based satellite network, which plans to establish as many as 4000 Very Small Aperture Terminals (VSATs) making use of the Palapa satellite whose footprint covers all the Asian countries, parts of north Australia, the People's Republic of China, and the Southeast Asian peninsula.

Established by the Indonesian firm, PT Citra Sari Makmur, in cooperation with the telecoms authority, Perumtel, and Scientific Atlanta Inc of the US, this network is offering digital voice, data and direct video services to customers.

Indeed, Scientific Atlanta, one of the leading manufacturers of the small satellite dish market, is now marketing a Flyaway earth station which works to Intelsat and can carry one or two voice circuits.

So long as the Australian Government prohibits shared use of earth station facilities and resale of excess space capacity, few companies will want to establish their own large, expensive Intelsat dishes let alone embark on the construction of private teleports housing a group of dishes.

OTC's Business Manager, Brian Sue San, issued a press statement in December pointing out that the trend overseas was away from private customer premise earth stations in favour of centrally located installations such as those currently operated by OTC.

However, the powerful new Intelsat VII satellites may change this. Positioned over the Pacific by 1992-3 with powerful spot beams, they may make it attractive for multinational corporations such as General Motors or Ford to establish their own private international satellite facilities. ■

Wollongong's University is attracting millions of information technology research dollars — a large proportion from overseas — that may, in the long run, change the face of the city.

WOLLONGONG — BRAVELY FACING NEW FUTURE

The name Wollongong is synonymous with the steel works; it brings to mind pictures of smoke stacks, GTHO Phase III's and Aunty Jack. The reality, we are led to believe, is a far cry from the 'Wollongong the Brave' image of the 1970s — in fact it is diametrically opposite.

One blurb for the University describes it as '. . . 80 kilometres from Sydney within sight of the beautiful Illawarra coastline . . . It is a modern cosmopolitan centre with a diverse economic base which includes manufacturing, mining, farming and tourism.' And now high technology.

The University and the vision of its Vice Chancellor, Ken McKinnon, are central to the new direction being offered the region. McKinnon has the drive to change Wollongong from a steel based town to an information technology based town. In public forums, McKinnon never lets an opportunity slip. He continually harangues Telecom to lay fibre optic cable and make the area a trial site for fibre in the local telephone loop; his barely veiled agenda is to have it included as the essential node in a NSW multi-function polis.

And the town is supportive. In effect it has a few options. The steel making is successful but less and less labour intensive. In the decade from the early 1980s there will have been a reduction in the steelmaking workforce from 25,000 to about 5000 producing more steel with better prices. It doesn't require enormous foresight to recognise that other major industries must be introduced.

McKinnon's view is that because the University is there, it is sensible for any new industry to be knowledge-based — and telecommunications and information technology are knowledge-based by definition.

His vision is not academic; it is a commercial barrow he is pushing and with notable success. In recent months the University's commercial arm has attracted millions of research dollars, moving it into the big league in terms of specialist tertiary institutions.

The foundation of the University's twin push to information-based industry and commercialisation was laid with the corporatisation and subsequent majority sell-off of NEIS (National Engineering Information Services), a leader in electronic data interchange. NEIS, still based at the University, is 80 per cent owned by the State Bank.

From research to profit

The path from research and consultancy centres within the University to profitable enterprises is no accident. Each centre operates on a commercial basis from the outset. Each is given a line of credit from the University which they are expected to pay back. There are no subsidies — either for rent, salaries or shared

Vice Chancellor Ken McKinnon:

facilities — encouraging the centres to look for commercial opportunities.

The commercial operations come under the umbrella company, UNIADVICE, which provides centralised accounting services and contractual advice. Within that, however, all the centres are independently managed with separate accounting facilities and boards of management.

Although they operate at arms length to the University, there is substantial cross-fertilisation between the academic curriculum and the centres.

The Centre for Information Technology Research (CITR) is one such centre. Launched formally in April 1989, it grew out of converging interests in the University. One was the technical side through the electrical and computer engineering departments and the other, the regulatory and policy aspects from the information technology area.

CITR is headed by Dr Ian Reinecke, on secondment from his role as director of the four-year Information Technology degree program.

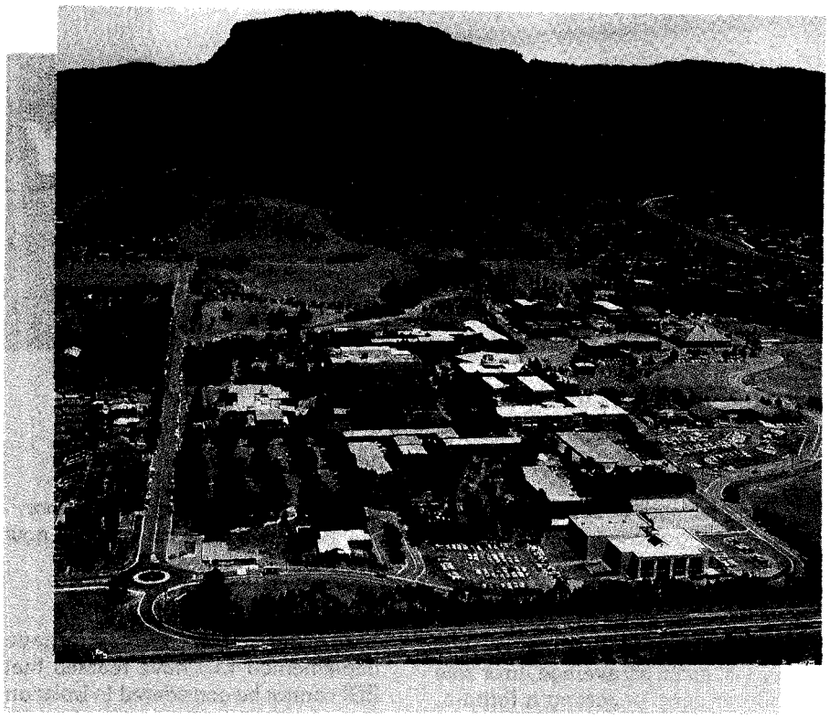
Lecturers involved in CITR's management training program come from Wollongong University and the University of Technology; and it is expected that the Centre will employ post-graduate students during vacation in the R&D areas.

The focus on information technology through the CITR and graduate and undergraduate courses, coupled with success in establishing commercially viable research centres, are the ingredients that attracted substantial funds and R&D facilities from such giants as Nortel (Canada's Northern Telecom), Telecom Australia, OTC and Telepower (the aggressive offspring of Computer Power and OTC).

According to Reinecke, CITR is looking for opportunities in four key areas; contract research, primarily in telecommunications; consulting activities in the regulatory and policy area; higher management training; and R&D management.

"All four of these are happening at different speeds but they are all happening," he said.

Currently CITR has research contracts with OTC; is negotiating with Telecom to establish a centre of expertise in the network area in the first half of this year; and in the next



The University of Wollongong

two to three months will sign research agreements with at least two other high technology companies.

In the regulatory and policy area, work on the international regulatory regimes for mobile cellular was carried out for Telecom. Reinecke is quick to point out the Centre is not a 'Think Tank' and that all research will be carried out on a contract basis. He says that is a decision dictated by commercial pressures — "We do not have the luxury of funding from external bodies as other University Centres do".

Higher management training is undertaken for Telecom only. For senior to middle managers the course is typically over three months, mainly external, and covers accountancy, marketing, industrial relations, public relations and deregulation. Although designed for Telecom, the program has also served as a bridging course for the 1991 introduction of a Masters program in Telecommunications Policy and Management.

Collaborating with competitors

CITR is managing collaborative, pre-competitive R&D projects between members of the Telepower consortium (of which CITR is one of 17 members). It is, says Reinecke, an area nobody has handled well. It involves companies, who in some circumstances would be competitors, agreeing to engage in collaborative research resulting in a competitive product. The challenge is to aggregate expertise and resources in the early stages before you get to product development.

The Centre is also talking to a number of companies about managing a substantial part of R&D activity where that company doesn't have the expertise and may have difficulty in recruiting top level staff.

In addition, Nortel has located its own Asia Pacific R&D facility at the University and will be involved with CITR in the areas of contract research and collaborative R&D ventures. The Nortel laboratory will be directed by Professor Hugh Bradlow, the University's professor of computer engineering.

Over the next six months, Nortel has committed to spend $36million which translates to substantial technology transfer and, with the advent of up to 50 software engineers in that facility alone, a considerable draw card for attracting post graduate students to the University.

Telecom Research Laboratories has elected to establish a branch at the University. Called the Software Solutions Centre, it will focus on intelligent networks and is expected to employ around 30 software engineers within two years.

This is big business. If Reinecke's calculations prove correct, CITR will have a turnover of about $1 million within the first few years of operation. The target is $5million "because that is the point at which it becomes interesting. If we are not there by the mid-90s I will be disappointed."

Profits will be reinvested in the Centre — in strategic alliances or collaborative relations with companies, in joint ventures in the R&D area, or to fund research programs.

Given the town's early stereotype, it begs the question 'Why Wollongong?'

"It is no great mystery when you look at the objective criteria," says Reinecke.

"Any company wasting money on CBD rental for research hasn't done its sums seriously. Wollongong is accessible to Australia's major city and its airport but you don't pay high rents.

"The environment with ocean, mountains and bush is much more pleasing than a CBD, and for employees of the R&D centres the medium price of housing is 30 per cent less than Sydney.

"The proximity to the University is something that can't be underestimated. The major problem for R&D organisations is nothing more complicated than getting the right people — they are going to have to come out of universities and there is going to be fierce competition for them."

Wollongong also has Vice Chancellor Ken McKinnon, with his respect for technically based knowledge, and his understanding of the commercial realities and the way in which universities can contribute to national economic development.

Says McKinnon: "While Wollongong is still short hand in some minds for steel and coal, to an increasing proportion it is becoming short hand for high quality research and development in the key technologies of the future.

"The decisions [by companies] to locate R&D centres at the University is validation of this new vision of Wollongong."

Shelley Spriggs

EDI IN THE GLOBAL ECONOMY

The impact of electronic data interchange (EDI) on the global economy should not be underestimated. To realise its potential it is essential that user, service provider and government undertake their roles in a responsible and effective manner.

BY MARK SELBY *

EDI (electronic data interchange) is now recognised by enlightened corporations as a pre-requisite for effective trading in the global economy. EDI is enabling corportions to enter new and distant geographical markets quickly and at dramatically lower costs than were possible before. EDI is also providing these corporations with an opportunity to source new materials/finished goods quickly and effectively from geographically distant suppliers.

The impact of these opportunities on global distribution is clear. The opportunities now emerging for low cost suppliers wishing to actively participate in the global economy is also becoming clear.

These opportunities can only be realised if potential participants have access to the global electronic communications infrastructure that is emerging. Clearly there are also major opportunities for telecom service providers in meeting the needs of the fast-changing global economy.

The provision of services and the support and promotion of these services by national governments cannot be understated. Some countries have discovered, for example, that national legislation may require amendment due to the impact of EDI on contract law.

What is EDI?

EDI involves the exchange of structured data between an application operating in one company and another application operating on a trading partner's site. There are many reasons for undertaking this linkage.

Most activity is being driven by customers who wish to improve their efficiency through EDI. The benefits include inventory reduction and the reduction of manual rekeying errors. Research has shown that manual data entry will incur an average error rate of 30 per cent — costing a fortune.

A good example of this cost helped ensure a large electronics company implemented EDI. The company in question was advised by a customer who manufactured washing machines that a special chip was required for a new front-loading washing machine. The order for the chip was placed and had a multiple digit product code.

Where overseas trading relationships do not exist, EDI provides opportunities for corporations to penetrate overseas markets by linking to new trading partners.

The order was entered into the supplier's system manually and the chips were duly supplied on time. Unfortunately the order processing clerk made a minor error entering the product code. The chips however, passed the customer's incoming quality check and the launch of the machines went ahead with great success.

The chips supplied did not have the tolerance of the desired chips and could not operate at high temperature or humidity levels.

The following summer a problem developed. If it was a hot day, the chip was inclined to malfunction. Rather than stop the wash, it caused the door to open resulting in scalding water and clothes being shot across the floor.

Both companies in question now use EDI.

Implementation lessons

Organisations that have implemented EDI have realised that EDI cannot be considered in isolation as a communications technology. It fundamentally affects the way that companies do business.

Each MIS department needs to understand what data will be exchanged and which internal applications will send and receive data. As this work commences, companies invariably discover significant inefficiencies and realise that now is a good time to make some changes, resulting in significant changes in information technology strategy; applications are being replaced and the need for networked applications being realised.

The changes in trading relationships are also becoming very apparent. In some cases a very bullish approach is being adopted with companies telling suppliers that they must trade via EDI. One major retail organisation in the US, for instance, has advised all suppliers that a $ US 2.50 penalty will be applied for each paper invoice submitted by suppliers.

It is clear that when implementing EDI, technical issues account for only 20 per cent of the problem; management issues for 80 per cent. If "technology' is simply thrown at the problem (ie the lack of EDI) then the potential benefits of EDI will not be realised. In fact the inefficiencies that existed before will simply be compounded.

There is considerable material relating to the experience of organisations implementing EDI; there is less information concerning the experiences of EDI value-added network (VANS) operators. Lessons learnt by VANS inlcude:

Cost

Considerable investment is required to build a VAN. The actual cost will depend upon the time scale and nature of the service. Having built the service, further significant costs will be incurred educating potential clients as to the benefits of EDI and of your service differentiation.

As competition has mounted in some countries so VANS have often resorted to uneconomical price-cutting. In some cases this strategy has devalued the services and impaired the range of services made available to the market.

Returns

Do not anticipate achieving break-even point for five years. The exact time will depend upon local market maturity, quality of service, competition and management effectiveness.

Initial revenue streams will result from customer joining fees, consulting services and software links to the VANS. Revenue from EDI traffic across the VANS will take several years to exceed the revenue from joining fees.

VANS operators must pay particular attention to the management and targetting of their sales — to focus on getting companies to join VANS is fine but must not be undertaken to the exclusion of building traffic volumes. There are examples of companies that have not sent one real (ie 'live') EDI message two years after joining.

Openness

The heady days of building proprietory VANS or using proprietory connection methods have gone. It was a superb strategy 10 years ago but the world has moved on. Internationally recognised standards administered by independent standards bodies should be used where possible.

International trends

EDI implementation is growing at different rates in Asia, Europe and the USA.

In Japan there is extensive use of EDI but a proliferation of corporate-specific standards. Elsewhere in Asia, growth in activity has been slower but international standards are being adopted.

In the USA there is a very high level of activity, driven initially by distribution, retail and automotive industries. National standards are migrating, slowly, to international standards but this migration is causing some pain to smaller organisations that have invested in US standards implementations to date.

Europe is seeing considerable growth due, in many cases, to the requirements/opportunities presented by the 1992 single market initiatives.

Revenue from EDI traffic across VANS will take some years to exceed joining fees; some companies have not sent on 'live' EDI messages for two years.

Most EDI activity in Europe is currently taking place in the UK (approximately 2500 companies) due largely to government policy.

The UK government did two significant things to create the right environment for EDI — deregulation and promotion.

By deregulating telecoms and establishing a relatively straight forward process for organisations to obtain VANS operating licences the market was opened for competition. Today there are over 30 VANS licence-holders in the UK.

To encourage the use of EDI and these services a large promotion and education program was launched, called VANGUARD.

At present we are seeing a varity of legislative and regulatory moves across Europe by member states. Germany, Denmark, and The Netherlands have been particularly active in creating an open environment. The European Commission is very keen to establish the liberalisation of VANS throughout the community in order to facilitate ease of cross-border trading. At present, however, the emphasis of member states on national environments and facilities is far greater than that on the pan-European environment.

This has caused concern in the European Commission and the resulting recommendations have, in turn, generated some considerable debate regarding the encroachment of national sovereignty in liberalisation policies. Article 90 of the Treaty of Rome which allows the Commission to curb public monopolies without the permission of individual governments is now figuring in this debate.

Rather than limiting themselves to the regulatory process, the Commission is also extremely active in understanding the needs of European companies and providing financial support to several EDI activities within the Community.

Most of the major manufacturing companies in Europe have major plants and key trading partners spread across several countries. It is essential that this multi-national structure continue, taking advantage of local skills and capabilities in an efficient and cost-effective manner. EDI provides an important tool to facilitate this improved efficiency.

While some VANS already offer a pan-European service today there is a growing demand from European companies for more service providers and greater OSI compliance.

The global economy

The emergence of global EDI has resulted in many organisations recognising the opportunities for greater remote sourcing. To date there have been many complications in trading with a supplier in another country or continent.

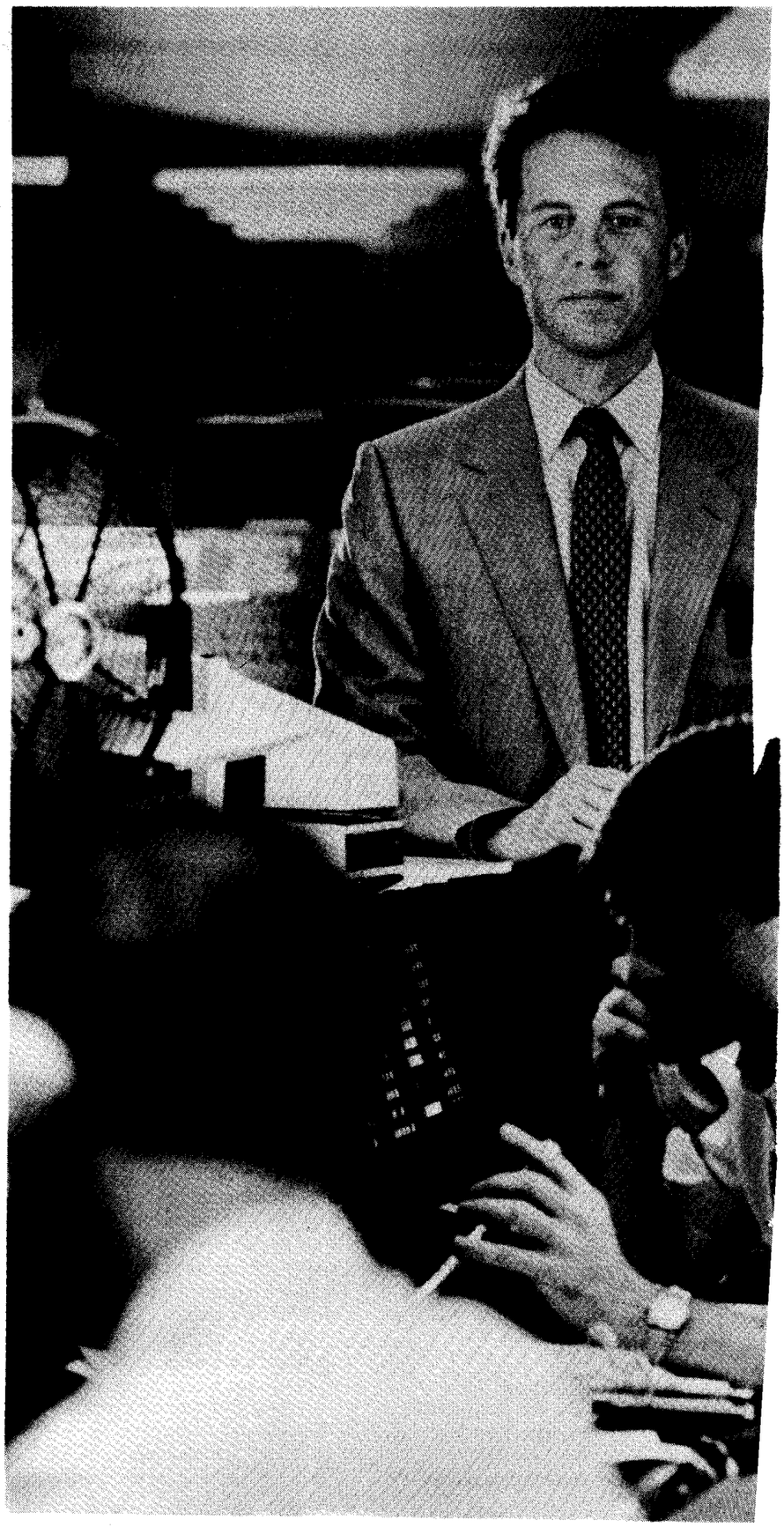
With EDI, companies are realising that the location or trading partners becomes less relevant. By building delivery times into production schedules the human skills in distant geographies can utilise global electronic communications to work "alongside' trading partners. Time to market for new products can be reduced, better responses to local market needs can be achieved and better utilisation of technological advances can be achieved.

Where overseas trading relationships do not exist, EDI provides opportunities for corporations to penetrate overseas markets by linking to new trading partners.

None of the above can happen, however, if a country or company does not have access to the global EDI communications infrastructure. Any country that is currently dependent on manufactured export trade risks being

Continued on page 18

WITH ONE U.S. DEAL THEY CAN MAKE $2,000,000.



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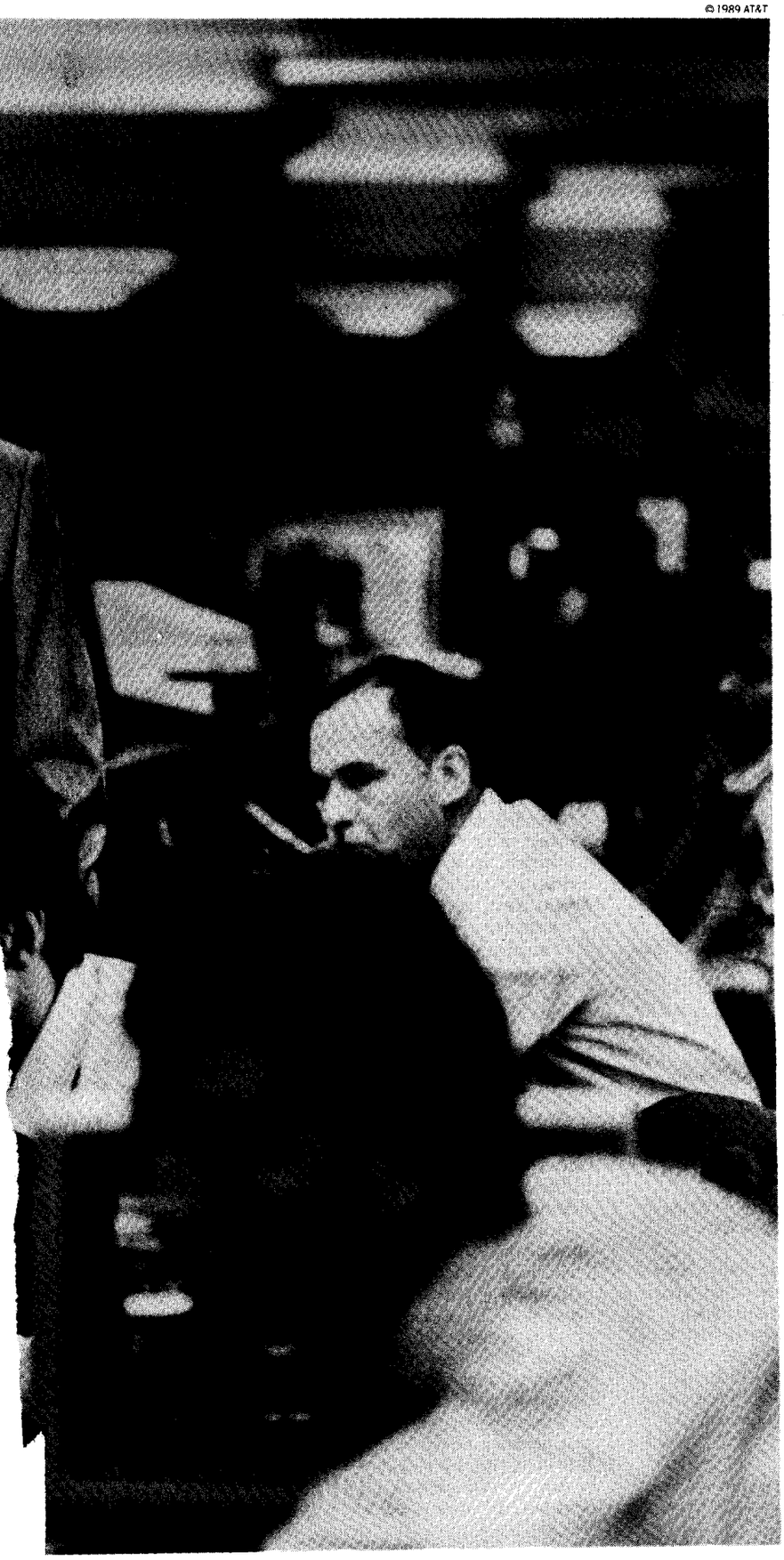

BUT I WILL PAY IF NEW YORK DOESN'T RECEIVE THE DATA.

I don't believe these guys. They make, or lose, millions every day.

I can't afford risks. Because when markets move, New York relies on me for up-to-the-minute data.

It would cost the company a fortune if my department mucked up. If systems went down, I'd pay for it.

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Continued from page 15

bypassed in the future if it cannot communicate with large overseas customers via EDI.

The role of governments

As the UK Government has shown through VANGUARD an administration can have a profound impact upon the growth of EDI. The European Commission is now playing a very proactive role on a pan-European basis. Meanwhile the French Government has made some significant legislative changes to help facilitate EDI and the West German Government has undertaken a profound liberalisation of its national communications infrastructure.

To help a country take advantage of EDI a national government may take one of the following routes:

i) ignore it and risk the gradual demise of its trade balance with time

ii) make companies aware of this trend as part of an educational program

iii) actively sponsor EDI initiatives (eg industry EDI associations)

iv) stimulate EDI usage through government department EDI acquisition policies.

It is contended that the significance of EDI on global trading is such that no government should simply ignore it. Rather, the most appropriate policy for facilitating EDI activity should be considered and implemented with the support of standards and industry associations.

*** Mark Selby is Digital Equipment Corporation's EDI manager. He delivered this paper at the recent Pacific Telecommunications Conference (PTC'90) in Hawaii.**

EDIBITS

Motor manufacturers and finance industry to link

Motor manufacturers and the finance industry are planning to link up to transmit the 500,000 wholesale vehicle invoices sent every year by motor manufacturers to finance companies.

The invoices are essentially orders for stock — dealers don't pay for stock, they finance it, and once the vehicle has been sold the finance is repaid.

The electronic invoice has been mapped into ANSI X.12 but, in keeping with the need for international standards, the EDIFACT invoice structure will be used for the industry.

EDIFACT Board members named

Twelve members have been appointed to the Australia/New Zealand EDIFACT Board, which was formed last year.

The Australian Board members are: Garry Campbell, Coles Myer; Colin Hill, Mitsubishi Motors; Les Jones, Australian Customs; Philip Constable, DITAC; Stewart Horwood, Standards Australia; Jonathon Knight, Standards Australia.

The New Zealand members are: Murdoch Taylor (Chairman), NZ Customs; Tony Mort, NZ Customs; Dennis Ferrier, Standards Assoc. of New Zealand; Barry Houston, NZ Product Number Association; Tony Cranston, Ministry of Commerce; Neil Wilson, NZ Trade Development Board.

WA Govt. to implement Supplynet

The WA Government last year chose Telecom's Supplynet to enable government and its suppliers, such as stationery or clothing manufacturers and distributors, to access up-to-date information on government tenders and contracts.

Supplynet combines a database service with electronic trading facilities to improve the purchasing process.

Subscribers, both suppliers and government, can access a vast amount of detailed purchasing information. It will add to the efficiency and fairness of the tendering process through better notice of tenders. Supplynet also provides messaging facilities through EDI to enable fast, efficient ordering of tender specifications, quote-calling and electronic trading.

Looking to improve freight network with EDI

Railways of Australia (RoA) is piloting the use of EDI to help coordinate its nationwide network of freight and passenger railway systems.

Nine million tonnes of freight was moved around Australia last year, and this load is expected to increase by 15 per cent a year.

The fleet of around 12,000 wagons is reaching its capacity. RoA hopes to extend capacity by using EDI to improve monitoring and control procedures.

Currently V-Line, Australian national, Westrail and the SRA are piloting the use of EDI to transmit freight rail information.

Two pilots have been set up: RoA is trialling Telecom's Tradelink in Victoria, SA and WA; and a Paxus Comnet network will be piloted between Sydney and Melbourne for three months.

The railways may have to set up two or more networks. As transport organisations, the railways have joined Tradegate and will probably be a part of the network. Most will also have to put in Tradelink because many suppliers, especially in WA, are on Tradelink. Telecom's Supplynet government supply and tendering system is being installed in WA and closely considered in other states.

Mincom and OTC join

Computer software house Mincom Pty Ltd and OTC Ltd are joining forces to provide EDI facilities for the mining and large capital intensive industries — users of Mincom's proprietary MIMS software.

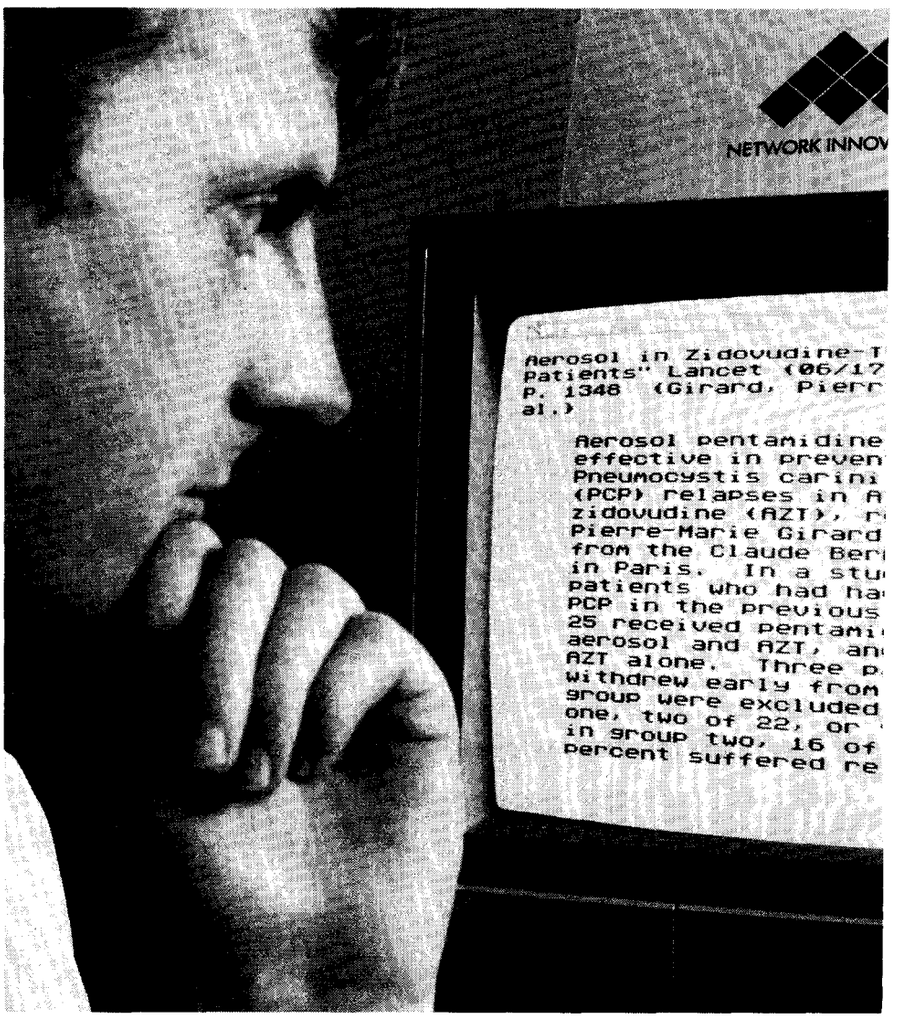
Mincom will build EDI functionality into its supply software system. At the same time there is a marketing agreement that Mincom will become onsellers of OTC's EDI EDGE software, the vehicle by which Mincom supply transactions (eg orders) will be translated and transmitted via OTC's EDI network.

The timing of this major upgrade announcement for the Mincom packaged software is made more significant by the fact that the Australian Defence Department will soon decide on a software supplier for its huge Supply Systems Redevelopment Project (SSRP).

It was, I think, TS Eliot who wrote:
"Where is the life we have lost in living?
Where is the living we have lost in knowledge?
And where is the knowledge we have lost in information?"

WHERE IS THE KNOWLEDGE LOST IN INFORMATION?

BY STUART CORNER



The difference between knowledge and information is very clear. The *Concise Oxford Dictionary* defines knowledge in terms of human understanding. Only people can have knowledge, but information can be stored in books, on magnetic discs or tablets of stone.

That definition may now be dated. Computer people talk about artificial intelligence and knowledge based on expert systems, though philosophically it is still reasonable to say that the only real knowledge is what people know.

It is said that the total of human knowledge is expanding at an almost exponential rate. If you accept that only people can have knowledge, this is clearly not the case. While there may be more of us than a few hundred years ago, there is little indication that our brains are any better at containing knowledge. What has increased is the amount of information we have amassed as the result of our own creativity and our attempts to understand the world around us.

Thanks to technology, that information is now more accessible. You could put the entire Encyclopaedia Britannica on a single CD Rom, put it in your personal computer and get information on anything from Aardvark to Zymotic in an instant. Massive databases on mainframe computers can be accessed from almost any point in the globe and information extracted on just about any topic.

However, commercial database services are not necessarily knowledge oriented. One information source might be on one database, but another related source of information might be on another. And the searching system is quite dumb. You have to communicate with it via complex command languages. If your interest is local area networks and you search on 'bridges' it will happily find information on bridges from Sydney Harbour to Ethernet.

Administratively, things are complex; you have to enter into agreements with individual database operators, often pay an upfront subscription fee, and learn different and complex sets of commands for each. This itself is a skill requiring knowledge which in many organisations is vested in a librarian

who extracts information on request. The librarian, however, has only limited knowledge of the discipline in which they are searching, and so has only limited ability to judge the value of any piece of information.

Attempts have been made to solve these problems with technology; to embody in computer software a skilled librarian's knowledge of information retrieval systems, so that people can extract information to enhance knowledge of their own disciplines.

At least two such technologies have been developed into fully operational commercial systems: Intelnet (from Telebase Systems in the US) and I-Net (from Bell Canada). Both provide an intelligent front end to a number of different database systems. Users do not need to learn different command structures or to subscribe to the different systems. They are not yet smart enough to distinguish between Bridges — Sydney Harbour and Bridges — Ethernet, but that will probably come.

Both Intelnet and I-Link are operated in Australia, Intelnet by OTC Ltd (which has a 21 per cent shareholding in Telebase) and I-Net, as I-link, by Telecom. However the two organisations have taken different approaches in using these technologies to help users turn information into knowledge.

Intelnet attempts to be all things to all people: to help philosophers and physiologists. The other intelligent database gateway, I-net is used in the same way in Canada by Bell Canada which developed the system. But it is not only used for accessing academic or commercial information. Public information booths house terminals into which you tap your request for information on news events, products or whatever.

Anyone can use Intelnet, by registering on OTC's international packet switched data service, Data Access, and paying a regular subscription fee plus connect time and search charges. Search charges for commercial databases are variable, so with the exception of some of the more costly systems, OTC has set a common tariff of about $20 per successful search. Over 850 databases are accessible via Intelnet.

OTC is also making access to Intelnet available through its Dialcom electronic mail service, on a different tariff structure, and to users of Transcom, a packaging of various online services aimed primarily at customers for its electronic data interchange (EDI) services.

Telecom has adopted a very different approach to using the I-Link technology. Telecom Plus, Telecom's value added service division responsible for I-Link, sees it as just another tool in providing value added information services tailored to specific customers.

Telecom Plus' philosophy, according to national manager business development, Phil Madden, is to understand the client's needs and to develop information systems that meet those needs. Telecom staff with knowledge of how the technology works, aim to configure it to bridge the gap between knowledge and information for that particular customer. This would mean that instead of 850 databases accessible by I-link there might be only eight, but eight of particular relevance to that client. The way users gained access to that information would reflect the way they used the information.

The first, and so far only, example of its use in this manner is Link, a system set up in conjunction with the Law Institute of Victoria. Madden said Telecom Plus had held discussions with both accounting bodies in Australia with a view to setting up a similar system.

Link (Lawyers Information Network), set up in mid 1988, uses I-Link to provide lawyers with an easy to use common interface to a number of databases of specific interest to them. It also provides electronic messaging services, and information dissemination facilities for legal bodies such as the Institute.

It provides access to a limited number of databases operated by the Ausinet service, for example the Financial Review Online. Land Titles data of Victoria has recently been added. ■

DRIFT BETWEEN DATABASES

Suffering from two-terminal syndrome? If swivelling from one terminal to another to access information from different mainframes (or from different databases on the same host) which must then be manually massaged and re-entered to update the mainframe is a routine task, then you could do with DRIFT.

A world first, DRIFT is a new expert system designed by Telecom Australia for in-house use. It front-ends a PC, LAN or mini and allows a user to access disparate systems (on up to nine mainframes) concurrently.

It allows the user to overcome the differences in protocols, database design, process design and process presentation.

The software can be tailored to suit specific organisational needs so the information sought from each database is integrated seamlessly and displayed on one screen. Effectively 'DRIFT is an intelligent go-between that can perform all the tasks that might have, until now, been performed by a human go-between'.

DRIFT was designed by Andrew Sheppard and Leon Mar, engineers at

Telecom's system development branch in Brisbane, and was subsequently trialled at Telecom's Perth South region. It has been enhanced and refined and is now being marketed throughout Australia by Telecom and Memorex Telex, and internationally through Memorex Telex.

Says Sheppard: "DRIFT is a means of integrating all the different databases from proprietory systems without changing the systems. It is possible to create a virtual database made of all others connected through software. It is an expert system which sits on top of a communications tool."

One application trialled in Perth was in the maintenance area. When a customer reports a problem with their phone service, details are stored on Telecom's fault recording system which runs on a mainframe on the east coast of Australia.

Before a problem can be fixed, the customer line must be tested to see whether the problem lies in the switch, the cable or the instrument itself. Testing is done by a minicomputer on the west coast.

DRIFT allows the tester to access both computers concurrently and the results are shown simultaneously on the one screen.

Under its agreement with Telecom, Memorex Telex will provide the global marketing and sales infrastructure, while Telecom supplies the intellectual property and technical skill for DRIFT.

Memorex's Geoff Burgess, program manager, DRIFT, can see applications for the software in almost every industry. For instance it has special application in the airline industry where two or more mainframes are frequently accessed for the one task. Caterers must access the reservations database to ascertain how many people are travelling on a particular flight; and the general data processing mainframe for orders, budgets and so on. Traditionally that requires two screens and re-entering of data to update each. With DRIFT it can be done on one screen and both mainframes are automatically updated.

Similarly, in the insurance industry, data line utilisation can be reduced and customer service improved by employing DRIFT to retain screens of information on one client. DRIFT requests the screens of information from the host and presents the data on one display. If the address needs to be changed then DRIFT prints an appropriate authority that the customer can sign. Details correct, DRIFT then places the data into the respective databases and closes the transaction.

This potential application would replace a system of multiple enquiries to different databases, and delays and errors in transcribing handwritten forms from the client.

DRIFT will be particularly useful where two companies with vendor specific mainframes have merged operations. ■ **Shelley Spriggs**

Buildings that can think for themselves — analyse data they have collected about their own systems, learn from that, self-diagnose and then correct — promise a 10 per cent saving per year. Dumb buildings cannot compete; developers simply must keep up with technology.

I THINK, THEREFORE

BY REBECCA SCOTT

Microchips embedded in jacket lapels to activate employee security mechanisms; solar-sensitive computers operating exterior sunscreens which open and close according to the weather; and lifts which are sensitive to body heat — these are just some of the signs of an intelligent building.

Sci fi? Not at all. These computerised control functions are available in today's intelligent buildings, and they are about to be overtaken by even more sophisticated artifical intelligence technologies being incorporated in the latest plans for Australian commercial buildings.

Once upon a time, not so long ago, every office building had a caretaker — somebody who made sure the lifts were working, adjusted the air conditioning, kept an eye on people coming and going, and generally looked after the place.

Today, fewer and fewer big office blocks have a caretaker on site. Building managers in head offices can now look after as many as 20 company buildings from a distance, with the help of increasingly sophisticated computer monitoring.

It is indeed the era of the intelligent building. Not only are they beginning to think for themselves, but an increasing number now have the artificial intelligence to analyse malfunctions and either correct them on their own (pre-preogrammed) initiative, or call in the experts. They can even dial up the building manager at home and give him or her a message identifying the fault.

This is the difference between an intelligent building and a dumb one. And the critical factor is computer technology incorporated in the design. It means that malfunctions with heating, air conditioning, lifts, power, security or communications systems are identified by the computer running the building — often long before the human tenants would have discovered anything was amiss.

The advantages are obvious. Tenants are kept happier, and costs — particularly energy and maintenance costs — are kept down. For example, by building intelligence into a lighting system, making it sensitive to body heat, cleaners working at night no longer need to have whole floors lit up as they work.

If lifts have an inbuilt heat sensor they will stop on floors only where the sensor tells them somebody is waiting.

Developers will be forced to build intelligent buildings within the next decade or they won't be able to lease their floorspace.

If somebody has pressed the button and then taken the stairs, the lift won't stop. On the basis of experience, intelligent lifts can also recognise peak times for journeys up, and journeys down, and be there waiting, even before the body heat sensor gives them the message.

Microchip technology — replacing the plastic staff identity cards — can ensure company security is maintained. The microchips — attached to an individual's jacket or blouse and bearing a personal signature — can be tracked by the central computer so that a record of each employee's movements is logged. It will allow after-hours access. In the case of any security breach, the records of the previous month, or even the previous year, can be checked to see who was in that high security room and at what time.

If an employee without the proper security clearance tries to enter a restricted zone, the microchip alerts central control. In the case of a fire or an earthquake the system can respond by opening all exterior doors to provide escape routes. In the case of a security breach, it can seal the building off from the outside.

It might sound like big brother, but industrial espionage and theft (of ideas in particular) can be costly. Effective security systems can save a firm losing valuable research to a competitor. Microchip-based systems can also discourage security breaches because people know they are being electronically tracked. Individual microchips can be barred via the central control point at any time, thus denying access to employees who have quit or been sacked, but who have retained their security chip.

It is expected that within five years, phones and faxes will be routinely linked to video systems — as with video conferencing. Dependent on ISDN (integrated services digital network) it will mean that voice, image, data and text can come down the same line and people will be able to see who they are talking to. When that sort of technology comes about there will be video screens wherever there is a phone — so flexibility of cabling within buildings will become even more important.

The technology to build these sorts of facilities into new buildings is already available. Some have incorporated certain aspects of intelligence. But few yet have fully integrated systems.

Raymond Fairs, of Digital D-Sign and a member of the intelligent Building Forum, believes developers will be forced to build intelligent buildings within the next decade, or they won't be able to lease their floorspace.

As business technology advances, he stresses the need for buildings which are able to cope with change. For example, they must have flexible partitioning, the facility to be able to plug phones, faxes and personal computers in anywhere, the ability to control air flow on a personal level and to modify the lighting to suit individuals. He also says there will need to be shared PABX facilities based in the building, so tenants can simply plug their phones in and unplug them — rather than having to drill holes in the floor to install their own PABX and then rip it out when they leave.

I AM . . . A BUILDING

Michael McMahon, special projects manager for Concrete Constructions, says Canberra's Parliament House is one of the most intelligent buildings in Australia.

It has more services in it than any other building you can think of, from standard things like air conditioning and lifts, through to document movement systems, waste removal, internal communications and data communications.

It has self-diagnostic lifts which seek help even before the passengers, or those waiting, know anything is wrong.

It has centralised shutes for waste collection. Unwanted documents are channelled down these shutes into the basement where they are automatically shredded, sucked into a hopper and onto a conveyor belt which runs into a baling machine. The waste paper is baled up and carted away — untouched by human hands from the time it goes into the shute to the time it is loaded onto the truck.

And it has sun-detector blind systems which open and close to shade according to the level of sunlight.

But, he says, for all that, Parliament House is still a relatively dumb building. "An intelligent building is one that can think for itself. That is, analyse the data fed into it about its own systems and, in analysing, learn from that and move into the self diagnostic mode to correct faults.

"It should keep an historical record so that it can do value management of the various components and learn by the experience."

According to Kevin Laurence-Bade, managing director of Midac Technologies, buildings such as Sydney's Grosvenor Place, the Coopers and Lybrand tower, the new IBM building at Pennant Hills and Canberra's Parliament House, are the most sophisticated we have built to date. Grosvenor Place, for example, has an energy management system which makes sophisticated use of solar power to save on energy bills.

"It will try and predict the energy usage using a set program to do that. It will ask itself what time of the year it is and make a prediction on that basis about the amount of cooling energy needed for the following day.

"When it has to use electricity, it uses off-peak power. And it has a special solar powered ice storage system.

"The computer in that building decides whether or not the outside air should be used for cooling. It will therefore feed outside air in, rather than use heaps of power to feed in cool air. It will also work out when is the coolest time of the night to flush the building out with cool air."

But Laurence-Bade says today's architects and planners are looking at a higher level of smart buildings than those so far constructed. Until now, intelligence systems have been working within set parameters and have been limited by the need to alert an operator.

"True artifical intelligence will highlight new areas where change is taking place, and where the parameters themselves should be altered, so the building operates more efficiently in energy consumption and in detecting malfunction," he says.

Intelligent buildings, naturally, cost more than dumb ones. But the initial outlay can save millions of dollars over the life of the building in maintenance and energy costs. Those in the industry believe that a good energy management system should be able to achieve a 10 per cent saving on a five year old building.

According to those working to encourage the use of intelligence in buildings, Australia is ahead of the United States in its acceptance of the technology. "The incidence of computerised buildings in Australia on a per capita basis is much higher than in America. For buildings of ten storeys and more it is common here to have computerised control," said Laurence-Bade. "But in the USA such technology is built into a minority of buildings, even high rise."

And according to Raymond Fairs, the acceptance of intelligent buildings is something developers will resist at their peril. If they don't keep up with the technology they won't sell the floorspace. Dumb buildings, he says, won't compete. ■

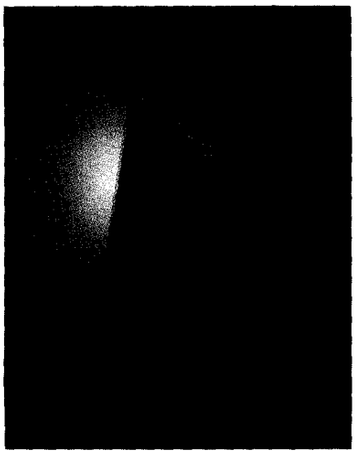
The high cost of generating power, and pressures to spread consumer demand more evenly, are forcing electric utilities to examine alternative technologies to monitor and control use. One way is over the phone.

ELECTRICITY . . . PHONE HOME

Death and taxes aside, the most enduring certainties of our lives are telephone and power bills. To date, telecommunications bills are the only element of the quartet consumers have any degree of control over — you can choose to call off-peak and get more value for money.

But perhaps not for long. Some power utilities in Australia and in other parts of the world are looking to introduce that degree of choice into electricity usage. Consumer choice may not be their prime motivation in introducing so-called time of use (TOU) tariffs, but it is a welcome by-product.

What is more, the technology



essential to that service will provide other spin-offs. It may even prove to be the first push to widespread acceptance of the 'smart house' — an electronic house that does everything but wash its own windows.

As the *Home Automation Technology Directory* puts it "These revolutionary new homes represent the most dramatic change in housing since the advent of indoor plumbing . . . In the 1990s, semiconductors will enter the wiring of homes . . . devices and appliances will contain semiconductors that will enable them to communicate with the network, with each other and with the outside world."

The motivation is load control and remote meter reading. The means is two-way communication between the home power meter and the utility's control room.

Peaks and troughs

Energy usage is cyclic, with peaks and troughs. Peak demand determines the energy authority's maximum capacity; the whole power generation and transmission structure is based on meeting that peak. If demand is considerably lower for a large proportion of the time, resources are wasted.

The challenge facing utilities is to efficiently reposition the growing peak-hour demand so the expense of additional power stations can be deferred. An obvious solution is to encourage consumers to use electricity during off-peak periods — hence TOU tariffs.

Real-time feedback from the consumers' premises back to the control room will also supply information on energy consumption and status. That data is important for surveys of energy use and instant recognition of power failures, but will also reap huge savings through remote meter reading. Data can be fed back to the central computer on request and fed directly into the utility's billing system. Customers can be billed more frequently, thus increasing cash flow and reducing debt.

A new system recently trialled in Australia and being evaluated in the US will provide this level of control over existing telephone lines. Called EMTEL, it grew out of a security system originally purchased from the US but refined in Australia by Alcatel STC and Telecom.

Its developers maintain that the telephone line, as opposed to the power line, is the natural link since it

Intelligent building technology — the social implications

BY RAYMOND W FAIRS*

Man once lived and worked on hill sides because a cave was considered the most environmentally appropriate place to dwell. We could have then, as now, each lived and worked in our individual caves — but we are by nature social beings and drawn to group activities.

Reasons for choosing where we live and work today have become far more complex, but the underlying issues are the same — the most fundamental issue being the need to communicate.

The twentieth century has seen the realisation of technology that, when implemented in the twenty-first century, will free people of the constraints of distance. The final result will be person to person, as distinct from point to point, communications — data, voice and visual, irrespective of relative geographical location.

We build structures to house groups of people who have some essential reason for gathering together over a period of time. And we prefer to build near those with whom we have some common affiliation.

Gravity would infer that we build outwards (horizontally) at or below ground level, but, to date, we have built upwards (vertically). Hence the hub — the CBD (Created Before Decentralisation).

Each CBD, as does a sun, soon generates a planetary system of residential dependencies, with arteries daily delivering and devolving the populace to the centre of the solar system to talk to one another.

The greatest component of intelligence being designed into our building structures today relates directly to communications — be it person to person, person to device or device to device.

These communications infrastructures have the capacity to remotely distribute the interacting people and/or devices and break the constraints that historically realised the CBD. Place each integral working group of corporate decision makers in appropriate geographical locations and leave the individual/group interaction to technology.

Place the senior executive corporate decision makers in appropriate executive suites, where their kind demand face to face interaction with their corporate colleagues, allies or opposition. The company's commercial processing staff and/or manufacturing employees may well be located together or separately, depending on corporate decisions.

Technology today can contribute significantly towards decentralising our workforce; what is now required is the desire of the social decision makers to collectively undertake forward planning to achieve decentralisation.

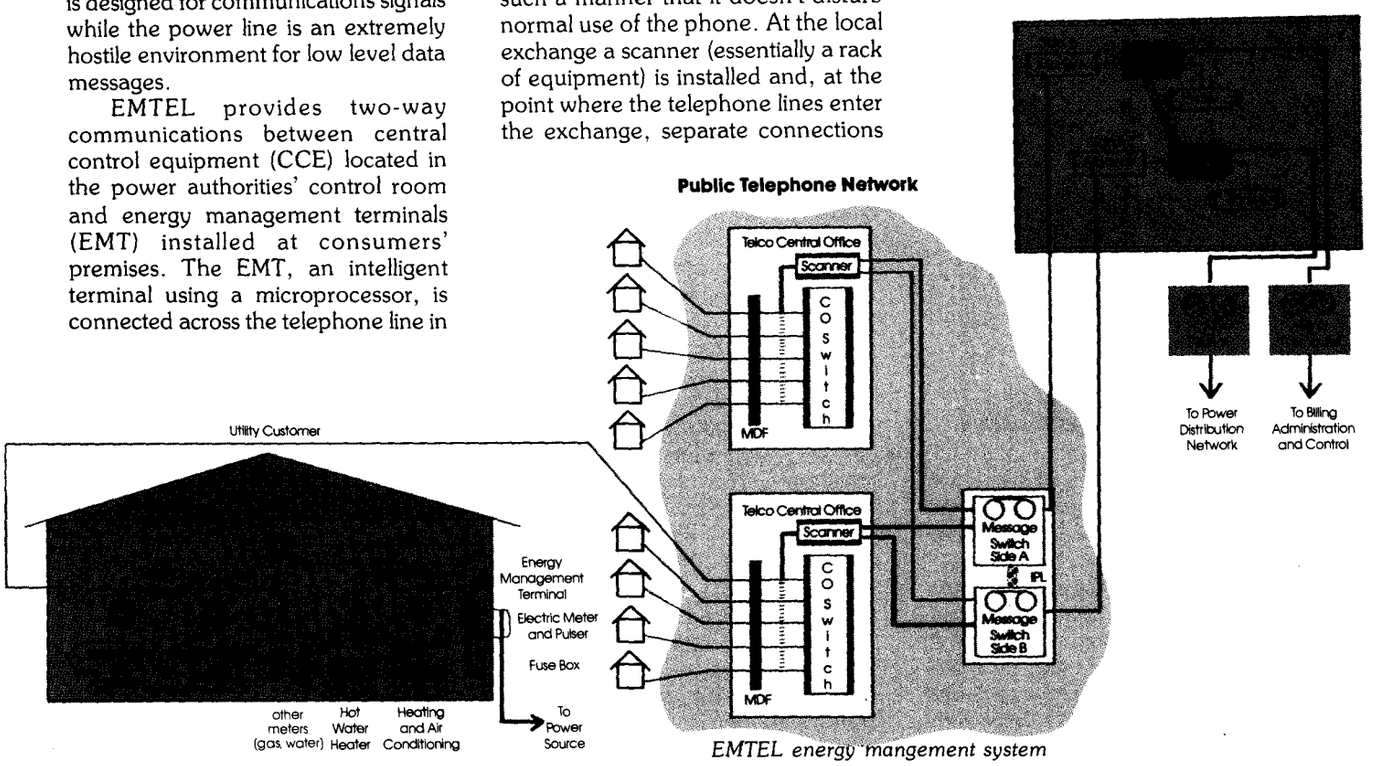
Our telecommunication carriers must be seen as essential players in successfully and cost effectively linking a distributed network of intelligent building structures together.

The technology is coming on-line, but at what annual unit cost and what unit cost increase?

The responsibility for intelligent building technology of a given building is that of the building owners, and, as

is designed for communications signals while the power line is an extremely hostile environment for low level data messages.

EMTEL provides two-way communications between central control equipment (CCE) located in the power authorities' control room and energy management terminals (EMT) installed at consumers' premises. The EMT, an intelligent terminal using a microprocessor, is connected across the telephone line in such a manner that it doesn't disturb normal use of the phone. At the local exchange a scanner (essentially a rack of equipment) is installed and, at the point where the telephone lines enter the exchange, separate connections are made to the scanner from every telephone line.



EMTEL energy mangement system

At the other end of the system, the CCE is connected directly to a host computer, in reality a message switch. The host computer continually communicates with each scanner and regularly transfers messages to and from the scanners and the CCE.

The next generation of exchange equipment, ISDN, will see the functionality performed by the scanners built into exchange software. Until then, however, installation of scanners at the telephone exchanges is the main expense which, in Australia, would be borne by Telecom and recouped via an ongoing service charge to the utilities and, ultimately, the consumers. Therein lies the rub.

The system has been well received by consumers in the trial area in Queensland, and there is no apparent dissatisfaction with the system from SEQEB, the local utility. However, the ongoing cost of this system, compared to one-off initial investment in a power line or radio system, appears to be daunting utilities.

According to Telecom's Gerard Johnston, the ongoing service charge will be offset by more efficient consumption, reduced costs and, perhaps, increased revenue.

such, commercial competition will ensure competitive pricing structures will prevail re the discrete technology components. This in turn will tend to guarantee the proliferation of such technologies.

There is no such guarantee related to the price structuring of the public carriers of information.

The enormous benefits to be gained by flexible geographic distribution of our work force should be obvious to all. Governments must structure our public information carriers towards facilitating community needs from a service and cost perspective.

As buildings are where we gather, the ramifications as to how we, as a community, plan, design, construct, regulate and interconnect such structures will have immense consequences for urban planning, building zoning, infrastructure services, transport and our lifestyle in general.

To achieve an integrated result will require the interaction of both public utilities and private companies of a diverse background in setting guidelines, standards and courses of action.

The task is long term, but sooner rather than later is the appropriate timeframe for action if we are to plan for a successful integration of intelligent building technology in the broadest sense.

A growing number of companies with a direct interest in intelligent building technologies and related social impact have convened a working group to evaluate these issues.

The Intelligent Building Forum was established in July, 1989, with the intention of bringing together building designers, computing and communication companies, building owners and tenants, statutory authorities, and government instrumentalities to investigate the task of integrating the specialist efforts of each player into a unified direction. ■

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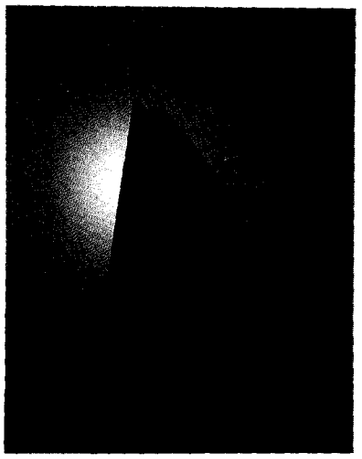
* Raymond Fairs is chairman of The Intelligent Building Forum and managing director of Digital D-Sign. Further information on the Intelligent Building Forum can be obtained by writing c/- of Level 1, 9 Deane St, Burwood, NSW 2134.



(Johnston quotes Telecom's experience of increasing off-peak rates where revenue increased as people made more calls at the cheaper rate.)

SEC Victoria recently called for tenders for a trial system. Rumour has it that the only systems to make the short list were power line or radio based, despite glowing reports from participants in the EMTEL pilot with SEQEB. Consumer responses were gauged through an AGB McNair survey; and, although somewhat guarded in his assessment of EMTEL, SEQEB general manager Keith Hoffman showed no confidence that alternative systems will be able to deliver the same calibre of enhancements in the future.

"The SEQEB trial [using EMTEL] clearly demonstrated the willingness of customers to take advantage of TOU tariffs, and successful cooperation between the manufacturer [Alcatel STC], Telecom and the electric utility and the technical viability of the design," wrote Hoffman in a paper on the subject.

Hoffman, wearing a dual hat as both head of SEQEB and a member of the Australian smart house association, New Expanding Shelter Technology (NEST) believes that getting it right at this stage will pave the way for the development of, and easy transition to, the smart houses of the future.

He wrote: "Manufacturers and utility engineers, with a background only in metering and control, are unlikely to develop the customer-oriented concepts necessary for the future. A much more multi-disciplinary approach is needed, embracing flexible tariffs; microprocessor-based hardware and software; new switchboard concepts; new home wiring concepts; home-owner preset or automated appliance controls; home communications busses for audio, data and perhaps video signals; control signalling internal and external to the home; customers' needs and customers' acceptance of those new concepts."

Telecom's Johnston also sees the power utilities' new systems as the vital step to make the smart house concept a reality.

"It is a strategic direction we see ourselves moving in. Once you have a two-way channel operating, the next step is to provide a terminal in the home, tie in water and gas, and link to the banks' computer. People will be able to read their bills in dollars and cents, not merely units of energy, and authorise payment through electronic funds transfer.

"If they [utilities] invest in technology that is not based on telecommunications there will be limitations."

Shelley Spriggs

OFFICE PLANNING USING AI

On trial in Japan now, and expected to be released in Australia in 1991, is an expert system which will calculate the office space required for any organisation, based on input data on personnel and their requirements. Fujitsu's OFFICE EXPERT will eliminate rule-of-thumb and calculated guesses about whether you can fit into that new building.

Designed to run on PCs, the software package combines artificial intelligence (AI) and computer aided design (CAD) to automatically generate a floor layout based on furniture, equipment, and the number of employees; and a telecommunications equipment and cabling layout checking duct capacity and power consumption.

It has four steps:

Space planning and management which will check the specified floor space and provide a graphic display, including the number of employees and space change for each year.

Zoning planning and management to ensure each organisation leasing space in a building is assigned the appropriate floor based on communications connections.

Layout planning and management providing several layouts for furniture and equipment — back-to-back, all facing the same direction and hexagonal. The layout is arranged using AI and can be added to or modified using CAD. The system generates and displays a colour perspective drawing using CAD.

Building facilities planning and management which checks whether the building has adequate power capacity and displays the heat dissipation and floor load distribution. The system automatically generates a cabling layout and checks the duct capacity.

The OFFICE EXPERT then gets down to the nitty gritty of power and telecommunications requirements by:

Simulating cabling routes for power and telecommunications lines, based on the equipment layout, keeping cabling as short as possible with no exposed cables. For telecommunications lines the cable type (power, coaxial, or optical fibre cable) can be selected.

CAD provides a diagram where floor plan, layout of furniture and terminals, power supply and telecommunications cabling are included. They are stored in individual CAD layers and the desired data can be displayed alone by selecting a layer.

Checking available duct space for telecommunications and power lines. Cables for each line are wired in individual ducts so the system calculates the percentage of duct space in use and, based on the calculated percentage, outputs a message to indicate whether a duct has available space. The information can also be displayed on screen by selecting the appropriate CAD layer.

Checking power capacity to determine power facilities for each floor are adequate by comparing the power supplied to each floor to the total power consumed by all the office equipment on that floor. This enables the user to know the power supply conditions even for offices in which the floor layout is frequently changed, and allows the user to modify the building's power distribution board after a floor layout change.

Displaying dissipated heat distribution from the equipment installed, taking the possibility of equipment layout change into consideration, and thus helping planners to design the appropriate individual or overall air conditioning and ventilation systems.

Future upgrades to the system are planned and will include lighting layout to eliminate display reflection, printer noise consideration, and telecommunications system design.

VERBATIM

NetWare 386 forum

Novell Inc., has announced the introduction of NetWare Remote Management Facility software and NetWare Name Service.

NetWare Remote Management Facility will give network managers full control of remote NetWare 386 servers from a centralised location. NetWare Name Service allows users a single point of access to multiple NetWare servers while offering network managers simplified and centralised administration.

Novell's Remote Management Facility allows customers to install, upgrade, maintain and backup distributed NetWare 386 servers from remote workstations. The product includes distributed server console software which enables desktop PCs to execute console commands through the NetWare internet facility or through asynchronous connections.

Novell's NetWare Name Service enables users to access network services transparently, while administrators view distributed resources on a collection of servers as a single system, providing them with a more responsive, manageable networking environment. NetWare Name Service runs under NetWare 386, SFT NetWare and Advanced NetWare v2.15.

Novell's Remote Management Facility and NetWare Name Service will be available through Novell distributors and resellers in the second quarter, 1990.

READER INFO No. 245

Aldus PageMaker 4.0

Aldus Corporation has announced a new version of its desktop publishing program, Aldus PageMaker 4.0 for the Macintosh. More than 75 features and enhancements have been added to the program.

With Aldus PageMaker 4.0, users gain superior control over writing and editing functions through a new Story Editor, an alternative text-only window for significantly faster word-processing speeds. This new version also offers more control for typography, including an expanded type-specification dialog box, as well as inline graphics, a feature that automatically links graphics to their corresponding text as editing and layout changes occur.

PageMaker 4.0 also includes a new links management feature to accommodate the growing number of desktop publishers working within interdependent production workgroups. Links management lets users keep track of changes made to text or graphics files placed in a PageMaker layout. It then offers the option of automatically updating the layout with the most recent version of those files whenever changes are made to them at their sources.

Aldus PrePrint supports Aldus PageMaker 4.0

Aldus Corporation's Aldus PrePrint, will support the 4.0 version of Aldus PageMaker.

Aldus PrePrint is designed to work specifically with files from Aldus PageMaker 4.0 and PageMaker Colour Extension, and with individual TIFF (tag image file format) files. With PrePrint, customers can save time and money by producing quality separations of entire PageMaker publications and colour TIFF images from the desktop.

READER INFO No. 246

New combat radios

The Australian Defence Force (ADF) has accepted delivery of the first Australian-made RAVEN combat radio from Plessey Australia.

The RAVEN combat studio system was developed in conjunction with the major sub-contractor, Plessey Defence Systems of the UK. Several thousand state-of-the-art RAVEN combat radios are being produced by Plessey Australia following the transfer from Plessey Defence Systems of manufacturing technology.

The Australian Army, as the main user of the equipment, is procuring RAVEN at a cost of approximately $400m for itself and on behalf of the Royal Australian Navy and the Royal Australian Air Force. It will replace a number of different radios currently being used by the ADF which are difficult and expensive to maintain.

RAVEN is a fully supported and integrated lightweight single channel radio system designed to provide a communication *security and* electronic counter counter-measures capability on the modern battlefield.

READER INFO No. 247

Communication solutions

Gilat Communication Systems Ltd is Israel's premier satellite communications company and is rapidly becoming a major vendor of satellite network systems to international providers of satellite network services. Five of Gilat's state-of-the-art products are now available here in Australia through Satellite Data Systems (SDS) of Melbourne.

The five Gilat products now marketed by SDS include the U-CORD, DATnet, ACEnet, USAT & *Audio Broadcasting*.

U-CORD

The U-CORD (Ultra-Compact Receiving Demodulator) is a proprietary receive-only earth station.

The U-CORD's typical applications include:

- Distribution of financial information (brokerage house/bankers)
- News reports to newspapers and radio stations
- Specialised pricing network communication
- Weather information distribution
- Database updates.

The U-CORD is ideally suited to networks with between 100 and 1500 remote sites communicating with one central hub.

USAT

USATs (Ultra Small Aperture Terminal) are an ideal solution for large corporations which maintain

VERBATIM

interactive data communications with 150-5000 remote sites.

USAT applications include credit card verification, electronic funds transfer, automatic teller machine transactions, travel industry reservations and ticketing, electronic mail, remote order entries, database enquiries and point-of-sale information.

DATnet

DATnet stands for Data Acquisition Terminal network. DATnet is used for applications where information has to be gathered to one central point from hundreds or even thousands of scattered points.

Typical applications include gas pipeline flow control information, oil production, pollution data, weather reports, water installations and geological survey information.

ACEnet

ACEnet stands for Asynchronous Data Communications System for Small Networks. The ACEnet network is based on Gilat's U-CORD product line and has been developed for use with small networks (dozens of remote terminals) with relatively low data traffic.

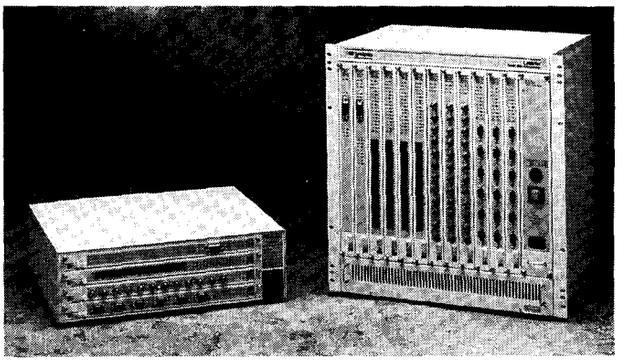
Applications include:

- SCADA Systems (Supervisory Control and Data Acquisition)
- Oil Pipes/Gas Pipes/Water Systems
- Remote Control Systems
- Data Collection (Industrial/Environmental/Weather)
- Message Switching
- Fax Networks

READER INFO No. 248

LattisNet System 3000

SynOptics Communications, Inc. (NASDAQ-SNPX) has announced a new line of connectivity products designed to meet the demands of widespread networking environments. The new LattisNet System 300 complements the existing LattisNet family of connectivity



products and provides a sophisticated backplane designed to support multiple access methods such as Token Ring and Ethernet.

The System 3000 product family includes concentrators and a variety of host and retiming modules. It is targeted at customers with complex networking requirements. The system's expanding networking capabilities include higher port and module density, integrated bridging and network management functions to provide value-added solutions for these complex networking environments. In addition, the System 3000 provides a standards-based foundation to support the increasing demands for additional network functionality in the future.

Working with unshielded twisted pair, shielded twisted pair and fiber optic host modules, LattisNet Model 300 Premises and Model 3030 Department Concentrators offer IEEE 802.3-compatible Ethernet at 10 Megabits per second (Mb/s) in a star topology. In the future, the System 300 will be capable of supporting both Token Ring and FDDI implementations for maximum access method versatility.

READER INFO No. 249

Aussat and TWO Australia sign new service

Aussat Pty Ltd today launched a new audio and data broadcast service with the signing of a major contract with TWO Australia Ltd.

TWO Australia, formerly Corporate Data Services Ltd (CDS), was formed in December through the merger of The Wheatley Organisation and CDS. It holds Multipoint Distribution (MDS) licences through which it provides a tourist information service.

The new Aussat service, known as OMNICAST, has been designed to provide a high quality multi-location distribution service for foreground music, in store audio promotions and advertising, electronic moving message displays and can also be used for computer data traffic.

TWO Australia, the first company in Australia to use this service, has an agreement with the Venture Stores Group to provide foreground music and will use the satellite to broadcast to 37 of its 78 stores throughout Australia. The remaining stores will receive the service through the narrowcast area service broadcasts (NAS) provided by TWO.

READER INFO No. 250

Affordable brouting

Network Solutions has announced the release of a new 3Com brouter, an internetwork product that provides concurrent network protocol routing and bridging.

The manufacturer claims that the BR/2000 can operate in a number of modes including: as a protocol-transparent bridge; as a router supporting Transmission Control Protocol/Internet Protocol (TCP/IP). Open Systems Interconnect (OSI) and Xerox Network Systems (XNS) protocols; or as a brouter for routing these protocols and concurrently bridging all others.

READER INFO No. 251

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21	46	71	96	121	146	171	196	221	246	271	296	321	346
22	47	72	97	122	147	172	197	222	247	272	297	322	347
23	48	73	98	123	148	173	198	223	248	273	298	323	348
24	49	74	99	124	149	174	199	224	249	274	299	324	349
25	50	75	100	125	150	175	200	225	250	275	300	325	350

WS/HUB APR' 1990

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CONTRACTS AND AGREEMENTS

AMEX implements XCOM6.2

American Express has implemented Spectrum Concepts' XCOM6.2 information transfer software throughout its Asian operations as part of an overall drive to further improve its service to its customers.

A critical aspect of the American Express operation is the need to move large files quickly and efficiently between different systems which include MVS and VM mainframes, AS/400s, S/38s and Stratus computers. XCOM6.2 allows the exchange of information between the organisation's many different types of computer systems in a way that was not previously possible.

READER INFO No. 252

Unisys network an airline first

Australian Airlines has become the first airline in this country, and one of the few in the world, to begin replacing its network of terminals with intelligent workstations that support distributed processing.

The airline plans to progressively replace its existing network of 2000 VDUs with a new network based on Personal Workstation^2 (PW^2) systems from Unisys. The ultimate value of the order is expected to be in the region of $5 million.

Local area networks of PW^{2}s will be installed at Australian city offices and airport terminals around the country. They will access the IBM and Unisys host mainframes via communications servers running SNA or UDLC protocols.

The new workstations will give staff access to any of the airline's systems — no matter on which host it runs — from a single desktop unit. The PW^2 will also let them run PC applications such as word processing and spreadsheets.

READER INFO No. 253

Siemens and IBM develop 64-million bit memory chips

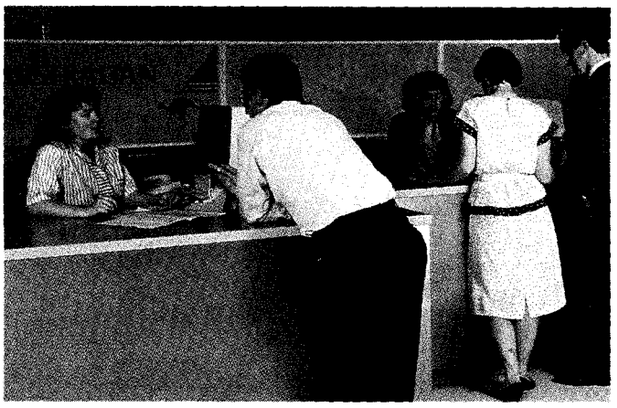
Siemens AG, Berlin and Munich West Germany, and IBM, Armonk, N.Y. (USA) have signed an agreement to jointly develop 64-million-bit memory chips.

Joint development of the 64-million-bit DRAM (Dynamic Random Access Memory) will begin immediately at Siemens and IBM. The common activities will be concentrated at IBM's new advanced Semiconductor Technology Centre in East Fishkill/New York and use the resources of both the Munich facility of Siemens and the Essex Junction/ Vermont facility of IBM. Production of the chips will take place in manufacturing facilities of the respective companies.

Each company will share equally in the development costs of the multi-year project and be responsible for its own personnel.

The goal of the project is to have a world standard 64-million-bit DRAM ready for commercial introduction in the mid-1990s. Work will concentrate on the chip design and the process technology, using the most sophisticated tools and materials available.

READER INFO No. 254



Innovative communications system

Daihatsu Australia has installed a communications system developed by Network Solutions which will allow 200 dealers nationwide to run off Ethernet, which is leaps and bounds ahead of the traditional ordering system which involved numerous telephone calls and paper documents.

The new system will link all Daihatsu state offices and dealers onto its central computer system so that they can place their orders and make enquiries directly through our main computer.

Operating on KERMIT software, the Daihatsu system comprises a high-powered TRW lanloader 2000 controlling unit, coupled with 3COM pair-tamer terminal servers.

READER INFO No. 255

Commonwealth Banks on Cablefloor

International communication between banks won't stop for housekeeping. So business went on as usual when the Commonwealth Bank in Adelaide installed Cablefloor in the telex and cables area of its King William Street headquarters earlier this year.

Cablefloor is an access flooring product supplied by CoDesign.

There were two options for cable management in the project.

Cables could have been run through the false ceiling of the ground floor main banking chamber to below where stand alone workstations in the section were to be relocated, or an access floor could be installed on the first floor.

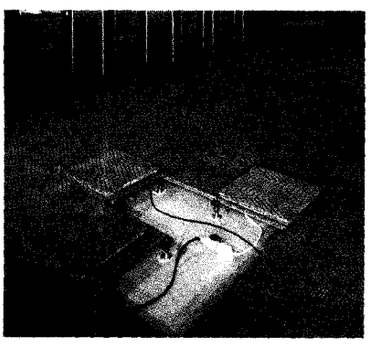
But that would have necessitated drilling through the slab, causing great disruption in the chamber below as workmen using high ladders installed the cables.

It would also have damaged the building structure, and provided a far less flexible solution to the problem of cable management.

They opted for 140 square metres of Cablefloor on the first floor because, with a large volume of electronic equipment on the floor, it was continually being affected by change.

Mero's superior acoustics

Office interiors supplier, CoDesign, has won a major contract to install anhydrite access flooring throughout the Australian Broadcasting



Corporation's new premises at Ultimo.

The seven-storey building will house the ABC's new radio and orchestra recording studios.

More than 5000 square metres of Mero anhydrite access flooring panels will be installed by CoDesign.

An access floor was incorporated in the building design to accommodate the masses of cables and services necessary to operate a modern building and recording complex.

The patented Mero Type IV panel to be supplied in the project consists of a sendzimire zinc-coated, die formed steel pan filled with non-combustible anhydrite.

The sub structure consists of pedestals and panels with a load bearing capacity of 2300 daN per square metre.

READER INFO No. 256

WITHOUT A SAFETY NET, THEY'D BE ALL AT SEA.

For almost as long as we can remember men have gone down to the sea in ships.

With over two thirds of the earth's surface covered by the great oceans. the sea provides a vital link between countries. It provides also a stage for one of the world's most competitive sporting activities, blue water racing.

Each year for the last 43 years on Boxing Day the world's finest and fastest ocean racers assemble in Sydney Harbour for the start of the Sydney to Hobart Yacht Race.

The eyes of the world are upon us, for this is a true blue water event. A test of skill and endurance for crews and boats alike, contested more often than not in treacherous off-shore conditions. Constant communications between organisers and competitors is essential for both race reporting and the pin-point plotting of yacht positions.

Fast, reliable transmission of information between the fleet and Race Control Centre in Hobart ensures not only availability of race statistics for the national and global media, but also provides a "safety network" of communications for the boats and their crews.

A network known as "SAFETY NET". A communication network transmitting vital data that enables organisers to plot accurately any yacht's position should it fail to report on schedule.

Working in conjunction with the Cruising Yacht Club of Australia and AWA Computers, the developers of SAFETY NET, one Australian communications company is ensuring the fast, accurate transmission of this vital information.

Scitec Communication Systems.

Because of the absolute reliability it has shown in previous blue water classics, multiplexing equipment from Scitec was chosen to network the AWA computers in Sydney and Hobart. Indeed, the Scitec communications technology used in this epic race is similar to that chosen by NASA to transmit information from the Voyager and Galileo deep space missions to the Goddard Space Centre in the United States.

For race organisers, Scitec equipment provides an essential link with the competitors.

For the crews transmitting their positions from pitching ocean racers somewhere off the coast of Australia, it provides peace of mind.

For they know only too well that without SAFETY NET, they could literally be all at sea.

Uptown Girl Sydney to Hobart 1986

SCITEC

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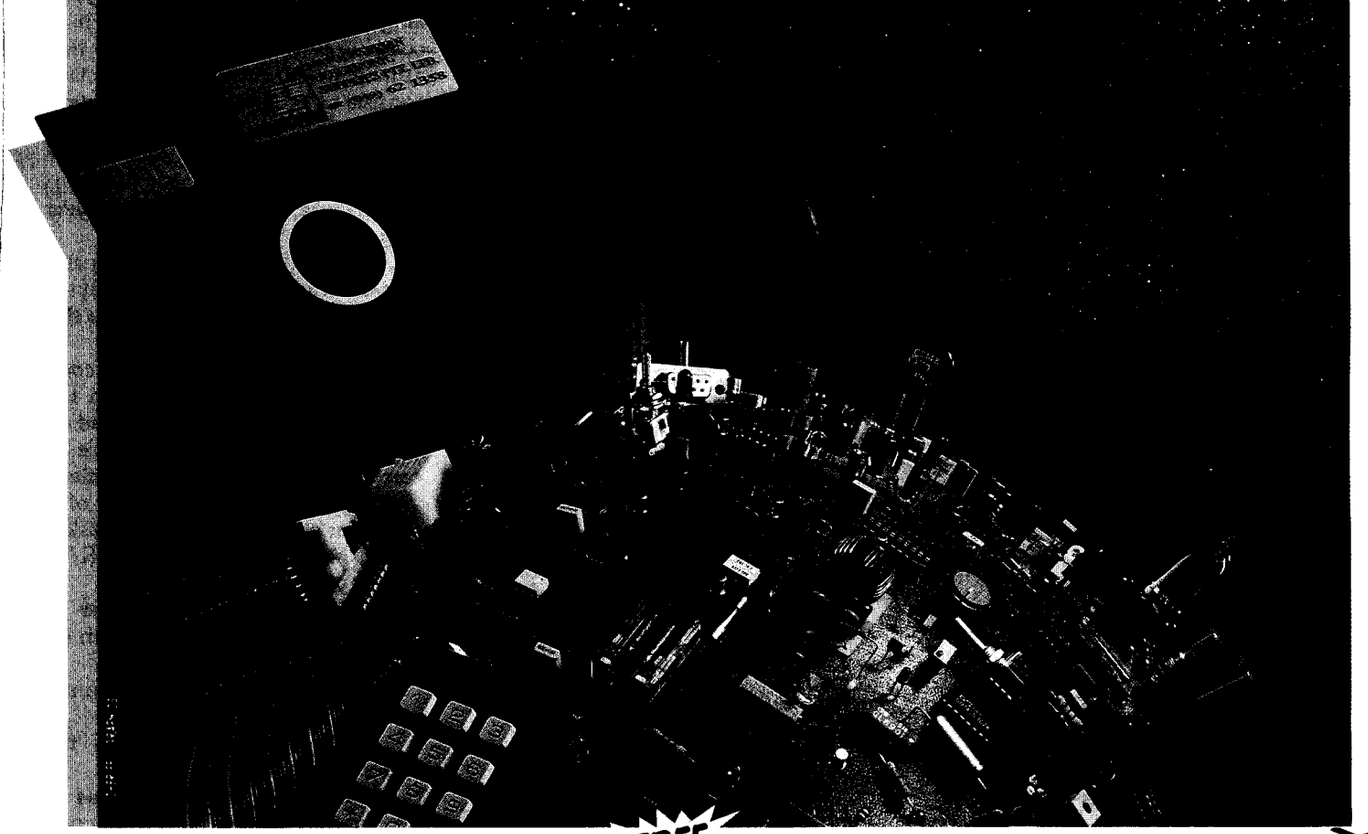

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THE BASICS OF MICROPROCESSORS

BASICS OF MICROPROCESSORS PART 2

Elmo V Jansz is Head of Electrical Engineering at Hobart Technical College, Tasmania. He is a professional electronics engineer with over 15 years experience in Electronics and Communications Engineering.

The 6502 contains a number of internal registers, to enable arithmetic, logic and control functions to be performed. Figure 1 shows a simplified version. This figure is referred to as a programmer's model, as the registers shown are the ones a programmer normally deals with.

All the registers shown are 8 bits wide storage locations, with the exception of the program counter which is 16 bits wide. Let's examine each of these registers in detail.

Accumulator

The accumulator is used for transferring data to and from memory. All arithmetic and logic operations involve the accumulator, in that one of the numbers involved is held in the accumulator.

Index registers X and Y

These are similar to the accumulator and can be used for data transfer. They can provide an index, which can be added onto a base address to form a complete address. This technique is used in reading information from tables. The index registers can be incremented and decremented by one unit, making them ideal counters in a program loop.

Program counter

This is a 16-bit register, the only 16-bit one present. The program counter points to the address which contains the next byte of the program to be executed.

The program counter counts sequentially, unless required to carry out a branch or a jump.

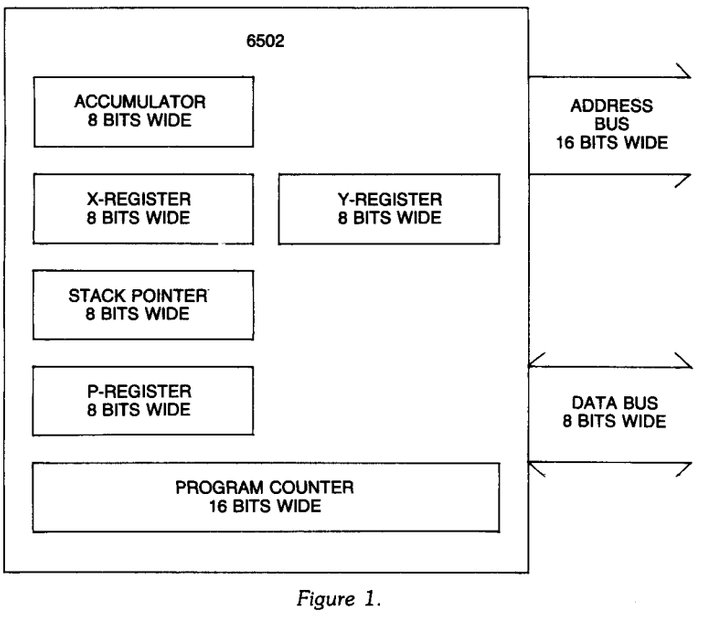

Figure 1.

Processor status register

This register is not one in the usual sense of being a data storage device. Each bit is a 'flag' or a 'status' symbol giving information such as overflow, carry-out, negative number and so on. It is primarily used in branch type operations.

We are now in a position to understand how the MPU deals with the machine code programs. The langugage used by MPUs is machine code — consisting of groups of hex numbers. A complete instruction consists of two parts — an operation code, called an op-code, and an operand, or the portion being worked upon. The op-code is one byte long, and the operand is one or two bytes long.

Machine code prgoramming can be carried out in one of two ways.

a. Using the resident monitor in the computer

The monitor is a machine code program stored in ROM which the computer executes when switched on or reset. The monitor is capable of carrying out the following activities:

1. Displaying the contents of a particular address location or register.
2. Modifying information in R/W memory via the keyboard.
3. Listing a certain number of lines of a machine code program on the VDU.
4. Saving to and loading from a storage device.
5. Transferring control to the user's program.

Using a monitor requires a programmer to look up an op-code chart for the MPU and hand assemble the program. This can turn into a complicated task with a long program.

b. Using an assembler

The use of an assembler is a more convenient method of carrying out machine language programming.

An assembler allows the programmer to use letter groups or mnemonics, which are more meaningful to humans than raw hex

INSTRUCTIONS		IMMEDIATE			ABSOLUTE			ZERO PAGE			ACCUM			IMPLIED			(IND, X)			(IND), Y			Z PAGE, X			ABS, X			ABS, Y			RELATIVE			INDIRECT			Z. PAGE, Y			PROCESSOR STATUS CODES	
MNEMONIC	OPERATION	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	OP	n	#	7 6 5 4 3 2 1 0 N V - B D I Z C	MNEMONIC
ADC	A + M + C → A (4) (1)	69	2	2	6D	4	3	65	3	2							61	6	2	71	5	2	75	4	2	7D	4	3	79	4	3										N V • • • • Z C	ADC
AND	A∧M → A (1)	29	2	2	2D	4	3	25	3	2							21	6	2	31	5	2	35	4	2	3D	4	3	39	4	3										N • • • • • Z •	AND
ASL	C ← 7 6 5 4 3 2 1 0 ← 0				0E	6	3	06	5	2	0A	2	1										16	6	2	1E	7	3													N • • • • • Z C	ASL
BCC	BRANCH ON C = 0 (2)																															90	2	2								• • • • • • • •	BCC
BCS	BRANCH ON C = 1 (2)																															B0	2	2								• • • • • • • •	BCS
BEQ	BRANCH ON Z = 1 (2)																															F0	2	2								• • • • • • • •	BEQ
BIT	A∧M				2C	4	3	24	3	2																																M_7 M_6 • • • • Z •	BIT
BMI	BRANCH ON N = 1 (2)																															30	2	2								• • • • • • • •	BMI
BNE	BRANCH ON Z = 0 (2)																															D0	2	2								• • • • • • • •	BNE
BPL	BRANCH ON N = 0 (2)																															10	2	2								• • • • • • • •	BPL
BRK	BREAK													00	7	1																									• • • 1 • 1 • •	BRK
BVC	BRANCH ON V = 0 (2)																															50	2	2								• • • • • • • •	BVC
BVS	BRANCH ON V = 1 (2)																															70	2	2								• • • • • • • •	BVS
CLC	0 → C													18	2	1																									• • • • • • • 0	CLC
CLD	0 → D													D8	2	1																									• • • • 0 • • •	CLD
CLI	0 → I													58	2	1																									• • • • • 0 • •	CLI
CLV	0 → V													B8	2	1																									• 0 • • • • •	CLV
CMP	A - M	C9	2	2	CD	4	3	C5	3	2							C1	6	2	D1	5	2	D5	4	2	DD	4	3	D9	4	3										N • • • • • Z C	CMP
CPX	X - M	E0	2	2	EC	4	3	E4	3	2																															N • • • • • Z C	CPX
CPY	Y - M	C0	2	2	CC	4	3	C4	3	2																															N • • • • • Z C	CPY
DEC	M - 1 → M				CE	6	3	C6	5	2													D6	6	2	DE	7	3													N • • • • • Z •	DEC
DEX	X - 1 → X													CA	2	1																									N • • • • • Z •	DEX
DEY	Y - 1 → Y													88	2	1																									N • • • • • Z •	DEY
EOR	A ∨ M → A (1)	49	2	2	4D	4	3	45	3	2							41	6	2	51	5	2	55	4	2	5D	4	3	59	4	3										N • • • • • Z •	EOR
INC	M + 1 → M				EE	6	3	E6	5	2													F6	6	2	FE	7	3													N • • • • • Z •	INC
INX	X + 1 → X													E8	2	1																									N • • • • • Z •	INX
INY	Y + 1 → Y													C8	2	1																									N • • • • • Z •	INY
JMP	JUMP TO NEW LOC				4C	3	3																												6C	5	3				• • • • • • • •	JMP
JSR	JUMP SUB				20	6	3																																			• • • • • • • •	JSR
LDA	M → A (1)	A9	2	2	AD	4	3	A5	3	2							A1	6	2	B1	5	2	B5	4	2	BD	4	3	B9	4	3										N • • • • • Z •	LDA
LDX	M → X (1)	A2	2	2	AE	4	3	A6	3	2																			BE	4	3							B6	4	2	N • • • • • Z •	LDX
LDY	M → Y (1)	A0	2	2	AC	4	3	A4	3	2													B4	4	2	BC	4	3													N • • • • • Z •	LDY
LSR	0 → 7 6 5 4 3 2 1 0 → C				4E	6	3	46	5	2	4A	2	1										56	6	2	5E	7	3													0 • • • • • Z C	LSR
NOP	NO OPERATION													EA	2	1																									• • • • • • • •	NOP
ORA	A ∨ M → A	09	2	2	0D	4	3	05	3	2							01	6	2	11	5	2	15	4	2	1D	4	3	19	4	3										N • • • • • Z •	ORA
PHA	A → Ms S - 1 → S													48	3	1																									• • • • • • • •	PHA
PHP	P → Ms S - 1 → S													08	3	1																									• • • • • • • •	PHP
PLA	S + 1 → S Ms → A													68	4	1																									N • • • • • Z •	PLA
PLP	S + 1 → S Ms → P													28	4	1																									(RESTORED)	PLP
ROL	7 6 5 4 3 2 1 0 ← C				2E	6	3	26	5	2	2A	2	1										36	6	2	3E	7	3													N • • • • • Z C	ROL
ROR	C → 7 6 5 4 3 2 1 0				6E	6	3	66	5	2	6A	2	1										76	6	2	7E	7	3													N • • • • • Z C	ROR
RTI	RTRN INT													40	6	1																									(RESTORED)	RTI
RTS	RTRN SUB													60	6	1																									• • • • • • • •	RTS
SBC	A - M - C̄ → A (1)	E9	2	2	ED	4	3	E5	3	2							E1	6	2	F1	5	2	F5	4	2	FD	4	3	F9	4	3										N V • • • • Z (3)	SBC
SEC	1 → C													38	2	1																									• • • • • • • 1	SEC
SED	1 → D													F8	2	1																									• • • • 1 • • •	SED
SEI	1 → I													78	2	1																									• • • • • 1 • •	SEI
STA	A → M				8D	4	3	85	3	2							81	6	2	91	6	2	95	4	2	9D	5	3	99	5	3										• • • • • • • •	STA
STX	X → M				8E	4	3	86	3	2																													96	4	2	• • • • • • • •	STX
STY	Y → M				8C	4	3	84	3	2													94	4	2																	• • • • • • • •	STY
TAX	A → X													AA	2	1																									N • • • • • Z •	TAX
TAY	A → Y													A8	2	1																									N • • • • • Z •	TAY
TSX	S → X													BA	2	1																									N • • • • • Z •	TSX
TXA	X → A													8A	2	1																									N • • • • • Z •	TXA
TXS	X → S													9A	2	1																									• • • • • • • •	TXS
TYA	Y → A													98	2	1																									N • • • • • Z •	TYA

(1) ADD 1 to "N" IF PAGE BOUNDARY IS CROSSED
(2) ADD 1 TO "N" IF BRANCH OCCURS TO SAME PAGE
ADD 2 TO "N" IF BRANCH OCCURS TO DIFFERENT PAGE
(3) CARRY NOT = BORROW
(4) IF IN DECIMAL MODE, Z FLAG IS INVALID
ACCUMULATOR MUST BE CHECKED FOR ZERO RESULT

X INDEX X
Y INDEX Y
A ACCUMULATOR
M MEMORY PER EFFECTIVE ADDRESS
Ms MEMORY PER STACK POINTER
+ ADD
- SUBTRACT
∧ AND
∨ OR
∨ EXCLUSIVE OR
M_7 MEMORY BIT 7
M_6 MEMORY BIT 6
n NO. CYCLES
NO. BYTES

6502 Instruction Set Summary

numbers.

An assembler permits the use of LDA for load accumulator or INX for increment X-Register, far more agreeable than straight hex numbers. Assemblers also permit the use of labels to define machine addresses and branch destinations.

In spite of all these features, assemblers merely make the assembly process less error prone and easier to de-bug. The efficiency and ability to carry out the object task still lies with the skill of the programmer.

On the negative side, assemblers have the disadvantage of occupying a large amount of memory space — with a small machine with limited memory this could be a problem.

Assemblers can be permanently stored in ROM or stored on disc and loaded into the computer when required.

Let us now look at how simple assembly language programs are constructed. Let us commence by examining the instruction set summary for the 6502.

The first column gives the instruction mnemonic, and column two gives the logical expression. These are followed by 13 additional columns that give the op-codes and the various addressing modes. In very basic terms the addressing mode gives information about where the operand is to be found and how it is to be dealt with by the MPU. The addressing modes are labelled Immediate, Absolute, Zero-Page etc. This is one of the most difficult concepts to grasp

in learning about MPUs. Hopefully, we shall overcome the problem by taking each one in turn and assembling small programs to understand how they operate.

We will now write a simple assembly language program and examine it in detail. We shall also learn how the immediate addressing mode functions.

Suppose it is required to load the accumulator with $FF and store the contents of the accumulator at address location $03DO. A typical assembly language program should look like Table 1.

An assembly language program normally consists of four fields. The first field is the label field which is like an address in memory into which the first byte of the instruction is placed. The assembler will replace this label with a hex address when producing the final object program. In this program the first byte of the LDA instruction will go into the address bearing the label START.

	Label Field	Op-Code Field	Operand Field	Comments Field
1.	START	LDA	#$FF	Load accumulator immediately with $FF
2.		STA	$03D0	Store accumulator at address location $03D0
3.	END	BRK	—	End program

Table 1.

The op-code field contains the mnemonic of the source program instruction. This is the most important of the four fields and is the one that must always have some information in it. The assembler will translate the mnemonics into binary numbers, i.e. the '0' and '1' language of the MPU. If the program is being hand assembled, then hex digits obtained from the 6502 instruction chart must be manually substituted for the mnemonics.

The next field is the operand field. This either contains data or the address from which data is to be obtained. It also contains information to the MPU about what addressing mode is to be used.

The comments field gives information about each line of program. The assembler ignores information in the comments field in the assembly process.

Let us now examine the complete program. Starting at line 1, we have LDA in the op-code field for load accumulator. The operand field tells us that loading is to be carried out in the immediate mode with hex FF. Immediate mode is indicated by the # sign and hex by the $ sign. The comments field gives a description of the operation being executed.

The STA in the op-code field of line 2 indicates that the information in the accumulator $FF is to be stored in hex address 03D0. Again, the comments column gives a description of the activity involved.

Line 3 ends the program with a BRK, i.e. a break instruction.

It should be clear by now that in the immediate mode, information is loaded directly into a register — in this case the accumulator. In other words, the hex number FF goes directly into the accumulator.

The same program could have been written using the X or Y Registers. You should try to write such a program yourself. The solution using the X-Register is as follows.

```
START  LDX    #$FF
       STX    $03D0
       BRK
```

Those who have an assembler for the 6502 should run these programs and ensure that they work.

Let us now hand assemble the above two programs using the 6502 instruction chart. We first locate the mnemonic LDA. Moving towards the RHS along the same line, we find under immediate mode the hex number A9. This is the machine code for "load accumulator immediately".

Proceeding along the same line, we find information in the columns labelled n and #. The n column tells us that two clock cycles are involved for this instruction and the # column indicates that two bytes are involved — one for the op-code, i.e. A9 and the other for the data FF.

Let us assume that our program is to commence at memory address $8000. The complete machine code program is as shown below.

```
8000   A9    FF
8002   D0    03
8004   00
```

The address of the first byte, i.e. A9 is $8000, the second byte, i.e. FF is $8001, the third and fourth bytes having addresses $8002 and $8003 respectively. This makes the address of 00 $8004. Notice that the address at which the information is to be stored, i.e. 03DO has been reversed in order. This is the way in which the 6502 is designed. The machine code program is loaded and runs as follows:

- Switch on the computer. If you have a disc connected to the machine, it will be activated and continue to rotate.
- Press Open Apple — Control — Reset to stop the disc drive. That is, holding down the Open Apple and Control, press Reset.
- Then release Reset, followed by the other two keys.
- Next, you must enter the monitor program. Type CALL-151. You should see the * delimiter indicating that you are in the monitor.
- Now type

```
8000:   A9    FF    (R)
8002:   DO    03    (R)
8004:   00
(R) = Return
```

To run the program, type 8000G. You should see some information at the bottom of the screen displaying the contents of the accumulator, the X-Register, the P-Register and stack pointer. Note the accumulator holds FF, the number we loaded into it at the beginning of the program.

If our program has run correctly, we should find FF in address location 03D0. Type 03D0 R. The screen should show 03D0: FF, indicating that address location 03D0 contains FF and that the program has run as expected.

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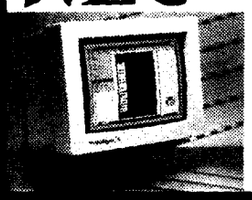

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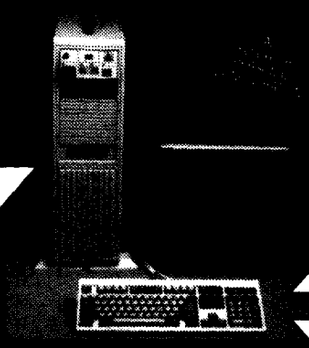

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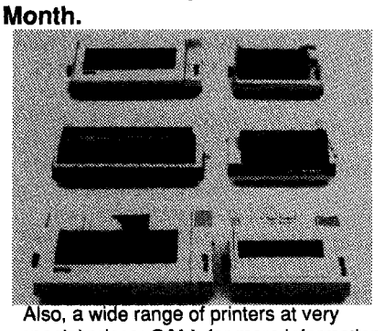

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PRODUCTS AND NEWS

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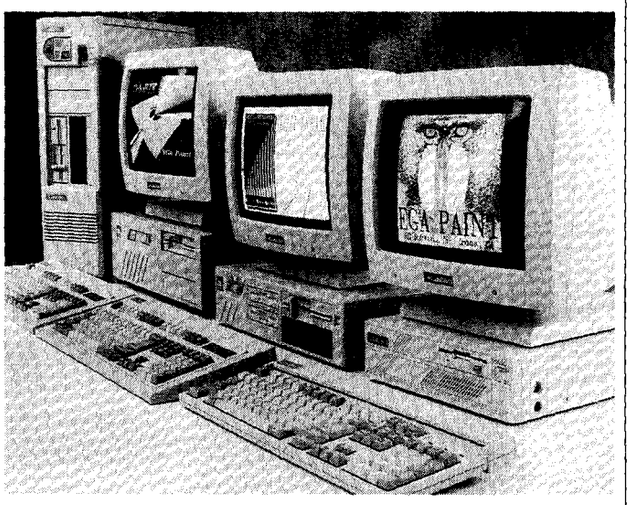

Labtam Delta II (model 3000)

The Delta II 3000 is a high performance, multi-user, multi-tasking information system featuring an Intel 80386 32-bit central processing unit, on-board cache, up to 32 Mbyte RAM, floating point co-processor options, LAN and WAN networks, printer interfaces, and up to 64 asynchronous RS-232-C channels.

Labtam is currently developing a version of the Delta II 3000 featuring Intel's new 80486 32-bit central processing unit. Labtam's research and development team, headed by technical manager Mr. Michael Podhorodecki, will be focussing on the Delta II 3000's total system architecture to optimise disk I/O, character I/O, network throughput, and similar factors. This version of the Delta II 3000 is expected to be released in 1990.

The Delta II 3000 can be fitted with up to 6 full height internal data storage devices. A multiple of hard disks, each up to 1000 Mbytes is easily able to accommodate large databases, spreadsheets, and other storage-hungry applications. Labtam's integral 150 Mbyte streaming tape drives or 2.3 Gbyte 8mm cartridge tape drives facilitate back up and archiving. For more information, ☎ (03) 587 1444, fax (03) 580 5581 Labtram, 41-43 Malcolm Rd., Braeside Vic 3195.

READER INFO No. 212

Trackman Stationary Mouse

Logitech's TrackMan features a new, comfortable shape; small, thumb-operated ball for controlling cursor motion; three buttons for selections; and a hardware default resolution of 300 dots per inch.

Serial and bus versions for IBM PC, XT, AT, PS/2 and compatible systems are available through dealers at a suggested retail price of $250 for the serial version and $265 for bus.

TrackMan is packaged with Logitech's MouseWare utilities. These utilities include software for creating menus for keyboard-based applications, more than 30 pre-created mouse menus for most of the popular applications, and Mouse-2-3, a mouse shell for increased Lotus 1-2-3 productivity. For information contact BJE Enterprises, 12/124 Rowe Street, Eastwood, NSW 2122. ☎ (02) 858 5611, Fax 858 5610.

READER INFO No. 207

Verbatim diskette duplicator

Verbatim Australia has launched a diskette duplicator, the US-sourced Mountain SmartCopier.

Based on autoloader technology, the SmartCopier has a built-in computer and 30Mb hard disk drive enabling automatic duplication of 3.5-inch and 5.25-inch diskettes.

Designed for standalone applications, it is more compact than the previous generation of duplicators and less expensive. The Smart-Copier is expected to retail for less than $10,000.

In principle, the SmartCopier works in much the same way as an office photocopier. Blank disks, like blank paper, are loaded into the hopper, the disk to be copied set at the bottom.

Unlike a photocopier, the Mountain duplicator can read the difference between a good copy and a defective disk, and will automatically sort them into Accept and Reject bins. It also verifies

previously made copies and quickly formats blank diskettes. The internal 30Mb hard disk drive stores master images for both 3.5-inch and 5.25-inch applications.

Throughput at 360Kb for a full copy of a completely full disk with verification is 0.46 sec, 30 sec in fast format, 24 sec in verification only and 46 sec in format with verifications. Further information from Verbatim Australia ☎(02) 437 6477.

READER INFO No. 213

Teco's TX Series

The TX200 series comes in three models: the TX200, utilising a 12MHz processor, the TZ200i with processor speed of 16MHz, and the top of the range TX210i, which features a 16MHz processor and on-board VGA.

The design of the Teco-manufactured motherboard, includes a floppy disc controller, video controller, real time clock, two serial ports and a parallel port.

The design also allows the user to run two half-height 5.25" devices and two 3.5" devices. Thus, a unit could be configured to include a 84Mb hard disk, a 3.5" 1.4Mb floppy disk, a 1.2Mb 5.25" disk and a tape back-up unit.

Memory expansion capabilities are supported with EMS LIM 4.0 built onto the mother board. The TX200 series (all supplied with 1Mb minimum RAM) will expand up to 8Mb on the motherboard, and to a maximum of 16Mb.

Six expansion slots are provided in the TX200 series, comprising four 16 bit and two 8 bit slots. Because the common add-ins are included on the motherboard, most users will only utilise one slot for a hard disk controller to have a fully functioning system.

The TX200 series, like all Teco products, is covered by a 12 month warranty, provided nationally by Bell & Howell.

The retail price of the new TX200 series ranges from $2395 for a single floppy TX200 to $7539 for a TX210i with 84Mb hard disk, tape back-up unit and Teco Multiscan monitor. (Prices include sales tax). For further information contact Trevor Taylor, Teco Australia Pty Ltd, 335-337 Woodpark Road, Smithfield, NSW, 2164, ☎ (02) 725 1233, Fax (02) 604 9330.

READER INFO No. 214

Ramtron's Dram

In New York on November 8, 1989, Ramtron Australia Limited announced that its majority-owned subsidiary Ramtron Corporation, had completed the design of two high speed 4-megabit 50 nanosecond Dynamic Random Access Memory (DRAM) chips jointly developed by Ramtron and NMB Semiconductor Company, a subsidiary of Japan's Minebea Company and one of the world's largest suppliers of DRAMs.

Commenting on the announcement, Ross Lyndon-James, Deputy Chairman of Ramtron Australia, said, "Ramtron has designed the world's fastest DRAM with an access time of 50 billionths of a second. These are the first commercial products resulting from the alliance formed in 1988 between Ramtron and NMB to address the US$9.6b DRAM market. Assuming a continuation of NMB DRAM sales at current market penetration levels, Ramtron will receive in excess of US$50m in royalty income over the four-to-six year life if its 4-megabit DRAM products."

The 4-megabit DRAMS, as well as other DRAMs currently under development, will be manufactured at NMB Semiconductor's plant in Tateyama, Japan, and sold through NMB's existing sales channels worldwide.

The company also announced that Ramtron Corporation had been awarded US Patent +4,873,664 titled "Self-Restoring Ferroelectric Memory", bringing to a total of sixteen the number of international patents covering ferroelectric technology owned by Ramtron.

According to Richard Horton, President of Ramtron Corporation, "This patent is particularly important to Ramtron since it comprehensively describes the application of one or more ferroelectric storage devices to a DRAM-based memory architecture. In combination with Ramtron's other issued patents, Ramtron literally has patent coverage of all significant methods of applying a ferroelectric storage device to a semiconductor-based memory product." For further information contact Ramtron Australia Ltd., Sydney ☎ (02) 252 4055.

READER INFO No. 215

AST's Premium 486/25 with Cupid-32

The Premium 486/25 comes standard with 2Mb of zero-wait-state memory, expandable to 4Mb on the processor board and a total of 36Mb maximum system expansion.

It offers seven expansion slots, five storage bays, controller support for three floppy drive devices, one parallel and two serial ports.

Its Cupid-32 (Completely Universal Processor, I/O Design) modular architecture separates the processor and memory (components likely to change as technology progresses) from the I/O and BIOS located on the system board.

The Premium 486/25 uses a 25MHz processor with 8Kb of cache and an 80387-compatible numeric co-processor integrated onto the chip.

Three configurations will be available, the Model 5, with a 5.25in. floppy drive and 2Mb of memory, the Model 115, with a 5.25in. drive, 2Mb of memory and a 110Mb AT-embedded hard disk and the Model 325 which offers a 5.25in. floppy drive, 2Mb of memory and a 320Mb hard disk with ESDI controller. Other options are also available. For information contact Merelyn Kelly, AST Research ANZ, Level 3, 178 Pacific Highway, St Leondards NSW 2065 ☎ (02) 906 2200.

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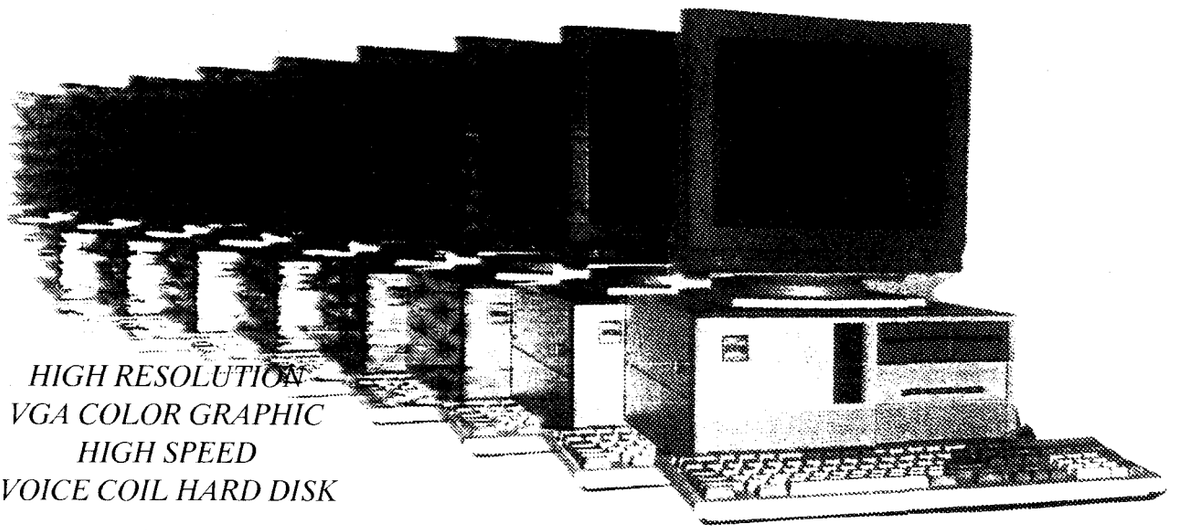

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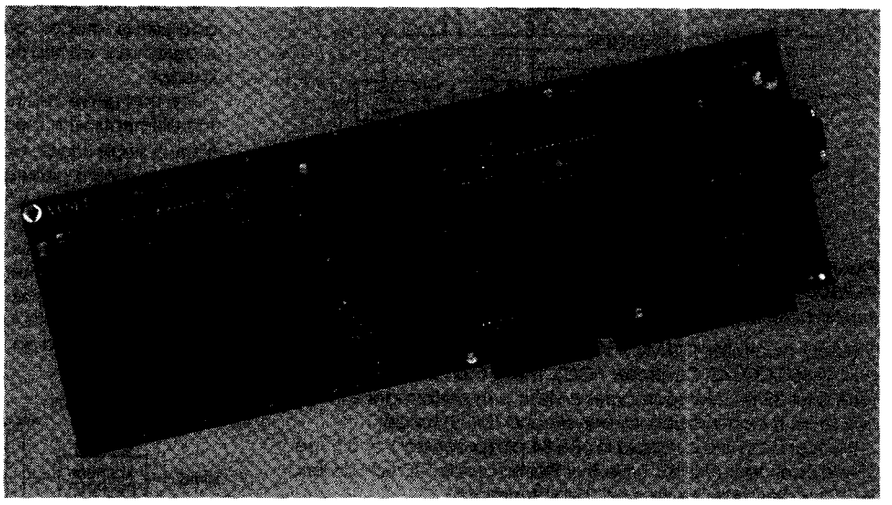
READER INFO No. 22

THE 'BLUE STREAK' RISC COMPUTER CARD

ELECTRONICS
ETI-1630



The "Blue Streak" RISC computer card. It uses the low-cost VL86C010 from VLSI Technology, plus memory controller (MEMC) and I/O controller (IOC) devices with memory ranging from 1M up to 4M on-board. All you require is an IBM PC/AT or close compatible for a terminal. The card plugs in. Software support includes ANSI C, Fortran and assembler. A board-resident assembly debugger permits debugging of programs on the RISC itself with download capability on the target system.

This project enables you to explore the world of RISC technology at minimum cost — and minimum risk. The system is based on the VL86C010 Acorn RISC Machine (ARM) processor from VLSI Technology, and its companion support chips. This project would have to be the doyen of 'technology demonstration' projects presented by Energy Control International. Part 1, by Roger Harrison.

I believe this is the first build-it-yourself general RISC computer project to be described in a popular electronics magazine anywhere in the world. It has been made available courtesy of Brisbane-based semiconductor importer/distributor Energy Control International, which represents VLSI Technology Inc in Australia. As mentioned in the introduction, it is another of their 'technology demonstration projects', a concept devised by proprietor Ken Curry, which applies to projects designed to demonstrate the capabilities of emerging semiconductor technologies. As RISC technology is currently all the rage, this project is very timely.

Energy Control International will have the project available in both kit and built-up form at a cost ranging from $599 to around $750, depending mainly on the memory configuration. Fully built-up units will also be available, ranging from about $700 to $950 (ex-tax), again depending mainly on the memory configuration.

But before we get down to the nitty-gritty, let us take a look at the VL86C010 RISC processor and how a system is implemented using the support chips designed to work together with it. Knowing more about the critical devices of the system is the only way you'll gain an appreciation of how a RISC system is devised and how the project itself functions.

The VLSI Technology RISC Computer System

VLSI Technology has a full system solution to the design of a cost-effective, small computer. This system was designed by Acorn Computers Ltd of Cambridge, United Kingdom, using the VLSI Technology Inc CAD system.

What makes this system different is its unique method of partitioning the four circuits. Instead of designing the circuits around self-contained functions, this system is partitioned around basic computer fundamentals such as memory bandwidth, die size of all four components, and low-cost packaging available today. Careful attention to these fundamentals has yielded a small computer system that can bring excellent performance to the user at low cost.

An examination of the system and its alternate form of partitioning will highlight the advantages of a top-down design approach to the entire problem, not just CPU optimisation.

The computer shown in Figure 1 is partitioned into four circuits: the VL86C010 Acorn RISC Machine (ARM) processor, VL86C110

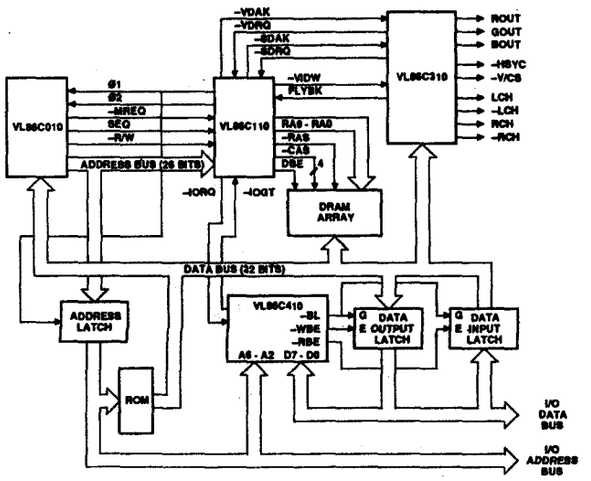


Figure 1. Block diagram of a RISC system based on the VL86C010 Acorn RISC Machine (ARM) and its companion support chips.

Memory Controller (MEMC), VL86C310 Video Controller (VIDC) and VL86C410 I/O Controller (IOC). These four circuits together form a full 32-bit microcomputer system with performance in the five to six million-instructions-per-second (MIPS) range.

The four parts are available in one 84-pin (processor), and three 68-pin packages (JEDEC Type-B or Plastic-Leaded-Chip-Carriers, PLCC) while implementing full 32-bit functions.

Partitioning the system

Traditionally, component designers viewed a computer system as "centred" on the CPU. The processor was designed in a vacuum, without concern for other elements in the system. The CPU was optimised to be high-performance and then the system designers found that in order to exploit the performance, they had to resort to expensive memory systems or cache sub-systems, increasing the cost dramatically. The CPU made such high demands on the memory that I/O transactions were not sufficiently served. This forced the systems designer to implement ever more complex I/O sub-systems, yet another addition to cost, complexity, and decreased reliability. Even today's most popular personal computers use plug in cards with on-board memory sub-systems for video and data communications.

The requirements for a small computer today are very much different than even a few years ago. Now users expect a small computer to have capabilities that were only available in minicomputers. Full colour displays at resolutions up to 640 by 480, real memory of 1 Mbyte, and networking support are common features demanded by end-users.

The VLSI Technology Inc system is "centred" on the memory, with each element designed to use the bandwidth efficiently without making large demands that require premium memory components. Video display is integrated into the system to use the main memory for display area, eliminating the need for expensive add-on video cards.

The system operates with a 24 MHz clock that yields a basic processor cycle of 8 MHz (125 ns). Even at this speed, the memory system uses inexpensive 120 ns access time page-mode DRAMs.

Memory controller functions

Since the system is designed around the memory, it is logical that the VL86C110 Memory Controller (MEMC) should be discussed first. Understanding how this part functions provides insight into the other elements and how they are co-ordinated together.

As the name would indicate, the MEMC generates the timing and control signals required by DRAM. In addition, MEMC acts as the main interface between the other three components by providing the critical timing signals for all elements from a single clock input. Figure 2 shows a block diagram and Figure 3 the functional pinout of the memory controller. It should be noted that MEMC does not have a data bus connection allowing it to be placed in a 68-pin package.

To program the internal registers of MEMC, the data is encoded on the address bus during a processor write to the part. While at first this may seem a large overhead, using the simple/fast addressing modes and barrel shifter in the processor, the programmer will find that the address encoding causes very little impact.

The part generates all the timing signals required for interfacing the elements with the memory. High speed timing is generated from a single clock, usually 24 MHz for an 8 MHz processor. All system timing is generated on the MEMC with minimal buffering on the other devices. This scheme minimises clock skew in the system allowing slower access time memory devices to be used.

Figure 4 shows an example of how clock skew occurs in timing paths. Having all buffers on a single chip allows delays to track more closely than the total process variation. As shown by the example, fewer buffs in the path lower the amount of time that data must be valid on the bus, minimising setup and hold times.

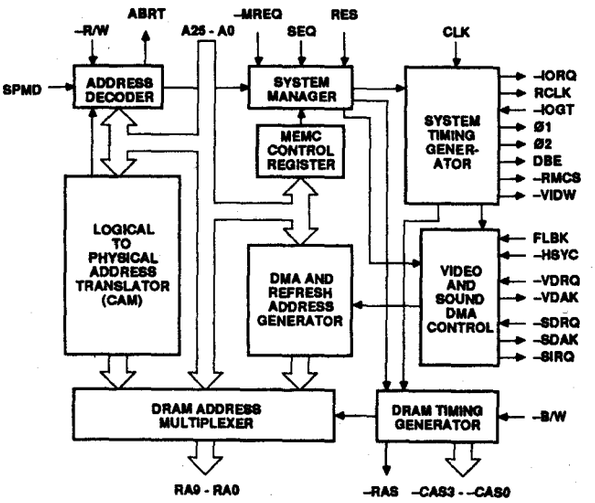


Figure 2. Organisation of the VL86C110 memory controller (MEMC).

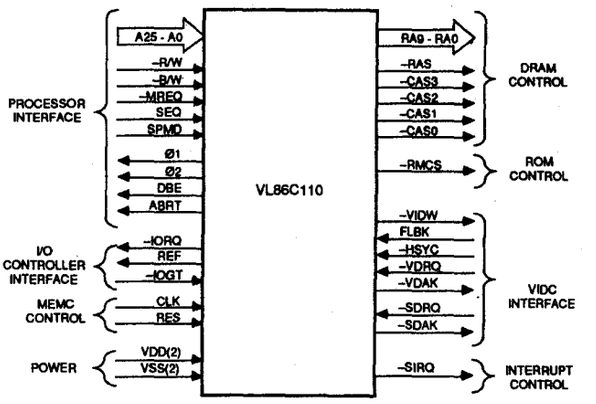
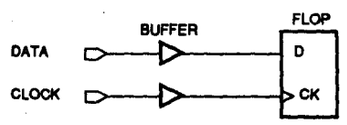


Figure 3. Pin diagram of the VL86C110 MEMC chip.



Minimim Setup Time = Flop Setup Time + Data Buffer Maximum - Clock Buffer Minimum

Minimum Hold Time = Flop Hold Time + Clock Buffer Maximum - Data Buffer Minimum

Figure 4. Clock slew timing example.

Removing the clock buffer will eliminate the difference between the clock buffer delay minimum and maximum times.

The clock is divided by three and used to generate the processor and main system bus reference clocks. The MEMC drives up to 32 memory parts directly in several different configurations. Various configurations provide for up to 4 Mbytes of real memory in the system. The bandwidth of the low-cost DRAM memory is increased through extensive use of page-mode transfers because many memory references in computer systems are sequential in nature. MEMC also provides memory map decoding for I/O and ROM in the system.

In order to optimise bandwidth, MEMC will take the ROM chip select active at the beginning of every non-sequential access and remove it if the cycle is not a ROM access, making slower ROM accesses more efficient and once again allowing lower-cost ROMs to be used.

MEMC supports several key functions in the system that usually have a tendency to impact performance or require faster components, so that this is not the case in this system. If a small computer is to support networking it must provide for multi-tasking and process isolation. MEMC provides full virtual memory support with a Logical-to-Physical Address Translator implemented as a 128 entry content addressable memory (CAM).

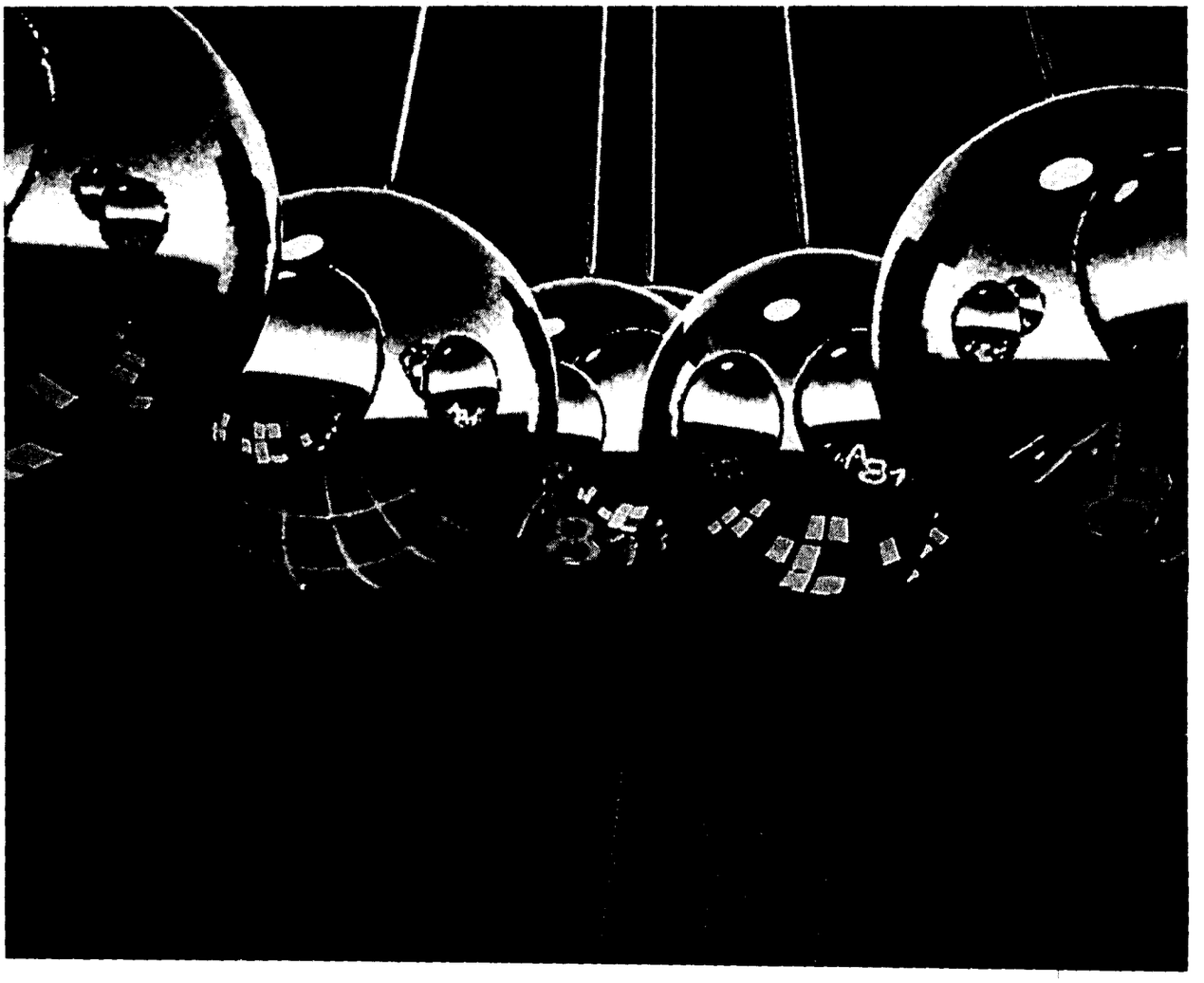
Logical pages can be 4K, 8K, 16K, or 32K bytes each. RAM memory is always treated as 128 physical pages, meaning that MEMC contains a CAM entry (descriptor) for each physical page in memory. Having a CAM location for every physical page of memory eliminates descriptor thrashing, thus improving system performance.

Thrashing occurs when the MMU system has fewer descriptors than physical pages of memory, which introduces another source of address translation misses – the data is resident in memory but a descriptor to translate to that page is not available. A descriptor must be taken from another page to point to the requested page.

Many current memory management units contain only a small sub-set of the page tables and must retranslate the logical address whenever a new logical page is referenced (descriptor miss). Translation can take up to several microseconds depending on how many memory cycles must be performed.

In this example system, the address translation is not in the critical path and does not require faster memory than a system that uses physical addresses. No translation takes place on the row address values which are required early in the memory cycle. The mapped address bits are placed into the column address field and are therefore not needed until much later in the cycle.

This approach can be taken because the memory is usually configured as a single bank, meaning all memories are active when the RAS becomes active regardless. Systems that have more



than one bank of DRAM and use this approach would be required to select (bring RAS active) all memory devices on every cycle. Multi-bank memory systems designed in this manner would have much higher power consumption and lose much of the advantage of DRAM technology.

The simple CAM contained in MEMC can support demand paging with some software assistance and it provides a full virtual memory implementation with three levels of access protection efficiently. The goal of virtual memory support in this system was to let programs be written independent of real memory size rather than for multi-user support. Today's most popular PC has suffered recently due to the artificial real memory limitation placed on it by the machine designers.

MEMC contains all the address generators to support DMA activity related to video, cursor, and sound generation. These were placed on this circuit for two reasons. First, it eliminates the need to have the full address bus placed on the video interface circuit. This allows the VIDC to have the full 32-bit data bus and still be packaged in a 68-pin package. Second, this arrangement uses the memory bandwidth more efficiently by reducing synchronisation and buffer delays on the memory bus while improving DMA latency.

Table 1. VL86C010 instructions

FUNCTIONS	MNENOMIC	OPERATION	PROCESSOR CYCLES
Data Processing			
Add with Carry	ADC	Rd: = Rn + Shift(Rm) + C	1S
Add	ADD	Rd: = Rn + Shift(Rm)	1S
And	AND	Rd: = Rn • Shift(Rm)	1S
Bit Clear	BIC	Rd: = Rn • Not Shift(Rm)	1S
Compare Negative	CMN	Shift(Rm) + Rn	1S
Compare	CMP	Rn - Shift(Rm)	1S
Exclusive - OR	EOR	Rd: = Rn XOR Shift(Rm)	1S
Multiply with Accumulate	MLA	Rn: = Rm * Rs + Rd	16S max
Move	MOV	Rn: = Shift(Rm)	1S
Multiply	MUL	Rn: = Rm * Rs/	16S max
Move Negative	MVN	Rd: = NOT Shift(Rm)	1S
Inclusive - OR	ORR	Rd: = Rn OR Shift (Rm)	1S
Reverse Subtract	RSB	Rd: = Shift(Rm) - Rn	1S
Reverse Subtract with Carry	RSC	Rd: = Shift(Rm) - Rn - 1 + C	1S
Subtract with Carry	SBC	Rd: = Rn - Shift(Rm) - 1 + C	1S
Subtract	SUB	Rd: = Rn - Shift(Rm)	1S
Test for Equality	TEQ	Rn XOR Shift(Rm)	1S
Test Masked	TST	Rn • Shift(Rm)	1S
Data Transfer			
Load Register	LDR	Rd: = Effective address	2S + 1N
Store Register	STR	Effective address: = Rd	2N
Multiple Data Transfer			
Load Multiple	LDM	Rlist: = Effective Address	(n** + 1) S + 1N
Store Multiple	STM	Effective Address: = Rlist	(n** + 1)S + 2N
Jump			
Branch	B	PC: = PC + Offset	2S + 1N
Branch and Link	BL	R14: = PC, PC: = PC + Offset	2S + 1N
Software Interrupt	SWI	R14: = PC, PC: = Vector #	2S + 1N

***Shift() denotes the output of the 32-bit barrel-shifter. One operand can be shifted in several manners on every data processing instruction without requiring any additional cycles.**
**** - n is the number of registers in the transfer list.**
N denotes a non-sequential memory cycle and S a sequential cycle.

In most systems, a DMA operation proceeds as follows: (1) the DMA device requests a transfer, (2) the memory controller synchronises to the system clock and recognises the request, (3) processor is signalled to relinquish the bus, (4) processor synchronises and recognises the request, (5) processor issues grant to memory controller, (6) memory controller synchronises and recognises grant, (7) memory controller issues DMA grant, (8) DMA synchronises and recognises grant, (9) DMA device enables address bus drivers, (10) memory controller receives address and multiplexes address to memory devices, (11) memory controller issues data acknowledge, (12) DMA device synchronises and recognises acknowledge, and (13) DMA device removes request to end cycle.

MEMC provides the memory arbitration and all address sources in a single device within the system. This eliminates several levels of pulse synchronisers and buffering delays. When the VIDC signals a DMA request, MEMC only has to recognise the request, disable the processor when appropriate, and enable the address from the internal source.

The DMA device has a simple interface to latch the data when the acknowledge signal goes inactive. This interface provides a very efficient DMA capability for read-only devices like video and sound generators. In order to optimise bandwidth usage, MEMC performs four memory cycles per DMA request, one full access taking 250 ns and three sequential page-mode accesses of 125 ns each.

Four cycle bursts were chosen for all devices to increase bandwidth but keep bus latency to a reasonable value. Long latency introduces other costly problems that are usually solved with expensive FIFO buffers or other interface hardware that is duplicated in every device that connects to the bus.

RISC processor functions

The VL86C010 RISC processor provides the computational element in the system. The processor has a radically reduced instruction set containing a total of only 46 different operations. Unlike most others, all instructions occupy one 32-bit word of memory. In keeping with the tradition of RISC methodology, the processor is implemented as with a single-cycle execution unit and a load/store architecture.

The basic addressing mode supported is indexed from a base register, with several different methods of index specification. The index can be a 12-bit immediate value contained within the instruction, or another register (optionally shifted in some manner). The index can be used in a pre or post-indexed fashion for any method of specification.

Table 1 shows the instructions supported by the processor. These instructions operate only on the CPU internal registers. Only the multiply instruction requires more than one cycle to execute (32 x 32 multiply in 16 clocks worst case) and it is not the limiting factor in interrupt response time.

All instructions have conditional execution implementing a type of skip architecture. Unexecuted instructions require a single processor cycle and keep the three-stage pipeline intact. This approach was taken as opposed to the delayed branch approach to simplify the virtual memory page fault recovery process. When the branch and delayed instruction are contained on separate physical pages and a fault occurs on the fetch after the taken branch, the recovery process can be extremely expensive in both software and hardware complexity.

Studies have shown that compiled code generated on the VAX averaged three instruction executions between every taken branch. While instruction set differences may cause the number of instructions between branches to vary, the conditional execution helps the processor keep its pipeline intact for forward reference branches of short length.

The VL86C010 supports two types of branch instructions, branch and branch-with-link for subroutine calls. Again, both branch types

offer conditional execution. For subroutine calls, the current value of the machine state contained in register 15, program counter and status register, is copied into register 14.

Linking subroutine calls through the registers instead of the more traditional memory stack reduces the call/return overhead. For a single-level linkage, the state is saved within the machine in a single clock and can be restored also in a single clock. For multi-level call sequences, full machine state is contained in a single word, requiring only a single memory reference for stacking.

Two types of data transfer instructions are supported for memory references. A single register can be read or written to memory in two clock cycles. In order to exploit sequential memory access modes, the processor also performs load and store multiple operations. For these instructions more than one register is transferred, taking two clocks for the first register and one clock for each additional one.

This instruction greatly enhances the processor's ability to move large blocks of memory and context switches that save the entire machine state. A block transfer instruction of all 16 registers is the longest instruction and therefore is the limiting factor in interrupt response time.

Figure 5 shows a block diagram of the processor. Several hardware features are worthy of note. First, by streamlining the instruction set, more silicon area can be dedicated to hardware functions that enhance performance. The VL86C010 contains a full 32-bit barrel shifter that can be used to pre-shift one operand on every processor cycle without additional delay.

The barrel shifter increases the performance of shift intensive applications like graphics manipulations significantly. Second, the addition of a memory interface signal (SEQ) to alert the VL86C110 that the next memory address is sequential to the current address. This extra status allows the processor and memory controller to exploit the page-mode capability of DRAMs and obtain higher bandwidth without requiring faster memory devices.

The third major hardware feature is the partially overlapped register file containing 27 locations, although only 16 are visible to the program at any one time. Unlike some other RISC processors, the registers in the VL86C010 overlap across processor modes instead of procedure calls.

The processor supports four modes of operation: User, System, Fast Interrupt Request (FIRQ), and Normal Interrupt Request (IRQ). In the User mode the program has 16 (R0 to R15) registers. R15 contains the program counter and status register and R14 is used

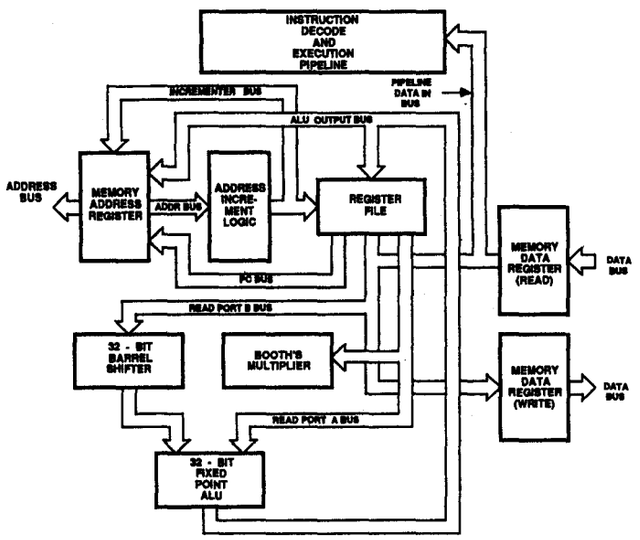


Figure 5. Internal block diagram of the VL86C010 RISC processor.

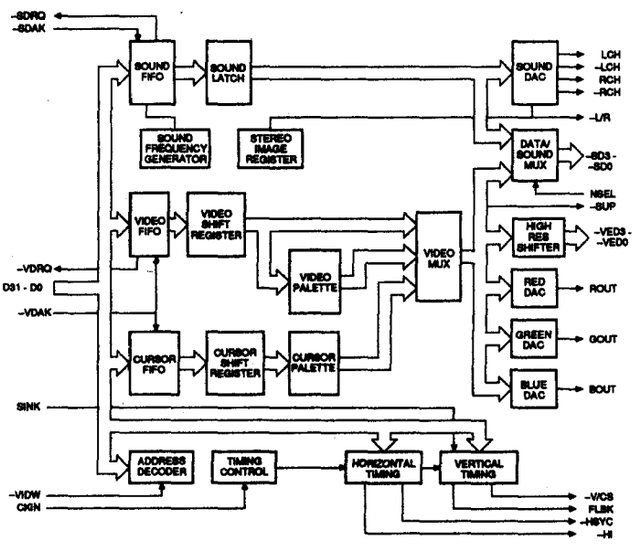


Figure 6. VL86C310 video controller (VIDC) block diagram.

for subroutine linkage. The other 14 registers are general purpose, as is R14 when it is not needed for linkage.

Whenever a mode change is performed, new registers are mapped into the visible space. Two new registers (R13 and R14) are available to the System and IRQ modes respectively. Seven additional registers are available in the FIRQ mode which lowers the processor's interrupt latency. The FIRQ mode has a worst case interrupt latency of 22.5 clocks and can be as little as 2.5 clocks.

The extra registers can hold DMA pointers and word counts allowing the processor to implement high speed DMA transfers without external controllers, further reducing system cost without significant overhead.

Most other RISC processors overlap the registers across procedure calls, implementing a register stack that is used for local variables and parameter passing. This scheme works well with the C language because C does not allow nested scopes like other languages such as Modula2 and PASCAL.

These languages require the program to access variables of all levels that are active at the same time. In addition, the processor must handle the case where the register stack overflows. Both these problems complicate the processor design and can slow context switching across processor modes.

It was determined that the overlap across modes was a more efficient use of chip area for supporting all high-level languages and making the processor more responsive to the asynchronous environment posed by network support. Besides, the large register bank is expensive and can extend processor cycles with extra levels of decode internally.

Video support

Video support is integrated into the design of the processor system to eliminate add-on video sub-systems and dedicated display memory buffers. The VL86C310 Video Controller (VIDC) provides a highly flexible choice of display formats in both colour and high resolution monochrome. Horizontal timing is controlled in units of two pixel times and vertical in units of raster times. Besides performing video operations, the VIDC also can generate high quality stereo sound with up to eight channels of separate stereo position.

Figure 6 shows a block diagram of the video controller. The part accepts video data in a packed pixel format from the memory, serialises the data into pixel information, and presents the data

to the colour-mapping RAM (video palette) where it is converted to analog values suitable for driving an RGB monitor. The VIDC is not used in the project to be described.

Supporting I/O transactions

Input/output control is very important in computer systems. Most component vendors concentrate all their design effort and analysis on the CPU, striving to achieve the highest performance. I/O is left as an after-thought at best, or the I/O sub-system is designed as a special-purpose CPU trying to maximise its performance without regard to the other elements in the system.

Interfaces grow complex and establish bottlenecks to system performance or even worse, sub-systems become isolated and difficult to control. For example, many graphics processors proposed in the past few years did not allow the host processor access to the display memory.

Software engineers proclaimed this as an unmanageable solution and, as a result, many component designers reworked their interfaces to provide more control.

Addressing I/O and CPU designs at the same time is important because many of today's high performance systems are totally I/O bound, forcing the CPU into idle states, and causing the users to pay for performance they cannot obtain in the execution environment.

The last element in the system is the VL86C410 Input/Output Controller (IOC). The circuit provides a unified environment for I/O related activities such as interrupts and peripheral controllers. This environment simplifies system software and allows the processor to interface easily with existing low-cost peripheral controllers such as VL16C450 Asynchronous Communications Element and VL1772 Floppy Disk Controller.

A block diagram of IOC is shown in Figure 7. The part provides the system with several general I/O support functions. The VL86C410 contains four 16-bit counter/timer circuits, two configured as general-purpose timers and two as baud rate generators. One baud rate generator is dedicated to the Keyboard Asynchronous Receiver/Transmitter (KART) and the other controls the BAUD output pin of the device. Timing of external events becomes more important in systems that must support networking and multi-tasking. Most network protocols require nodes to respond within a certain time (three seconds is common) and the initiator mode must detect a timeout and invoke error recovery procedures.

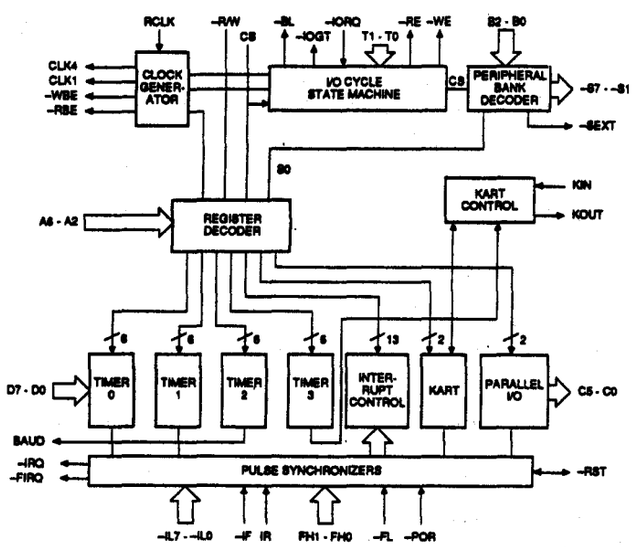


Figure 7. Block diagram of the VL86C410 I/O controller (IOC).

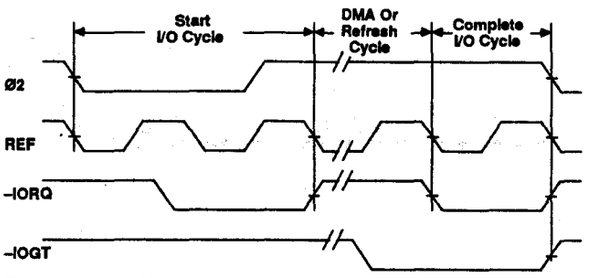


Figure 8. VL86C410 interruptible cycle example.

Multi-tasking operating systems usually require some type of timing interrupt for task control.

The KART section is a simple fixed-format asynchronous bidirectional serial communications link designed basically for keyboard input. The format is fixed with an eight-bit character, one start bit, and two stop bits. The clock rate is a standard 16 times the data rate and the transmit and receive clocks are at the same rate and controlled by Timer 3 within IOC. To improve noise immunity, false start bits of less than one-half bit duration are ignored. The KART is ideal for interfacing to the low speed character rate (up to 31K characters/second) from a keyboard but it can be used for other purposes if the format is suitable.

The major task of IOC is the implementation of an efficient interface between the high speed system and the lower speed I/O peripheral controller buses. The system exploits the low-cost peripheral controllers but should not be severely impacted with performance/latency penalties for using them.

The part contains six programmable bi-directional I/O pins for implementing special processor control. Interrupts are supported with control for both normal (IRQ) and fast (FIRQ) interrupts through mask, request, and status registers. Sixteen interrupt sources are supported, fourteen level and two edge-triggered, meaning the IOC should have the total interrupt status for most system configurations.

Centralising the interrupts in this manner reduces polling, improves efficiency, and reduces latency within the system. Fast response time allows the processor to replace expensive dedicated logic with software, lowering the system cost accordingly.

The peripheral controller cycles are supported with four different lengths for access times. This allows peripheral controllers from various vendors with different bus clocking schemes to be interfaced easily and cheaply without extra logic.

Each VL86C410 supports seven peripheral select lines which are independently selectable from the four access cycle times. If more than seven peripheral controllers are needed, multiple IOCs can be used in the system or the select lines can be decoded further externally because the system provides sufficient address set-up time.

In order to maintain low latency on the high speed system bus, the IOC is designed to allow an I/O cycle to be interrupted by a DMA access on the system bus. Figure 8 shows a timing diagram of this operation. The IORQ is generated by MEMC whenever an I/O access address is detected. The IOC will respond with an IOGT signal when the access is complete.

If the MEMC detects a pending DMA request, it removes IORQ and performs the transfer. IOC turns off the buffers that isolate the two buses and continues with the I/O cycle until the MEMC returns the IORQ. Then, the cycle is completed when both the master and slave devices parameters have been met.

This interruptible I/O cycle eliminates the slower peripheral devices from the system bus latency calculations, improves efficiency, and lowers system cost.

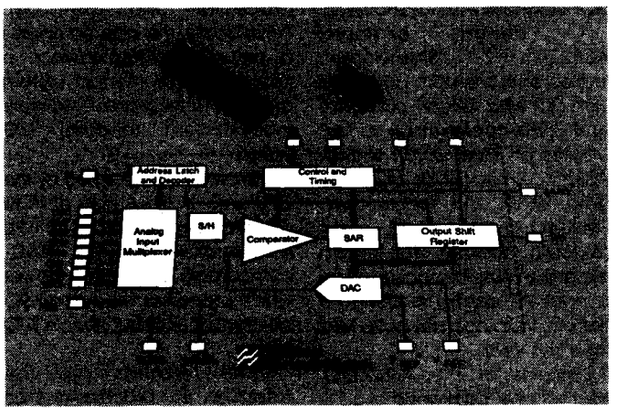
Next month, we cover the design of the project and full assembly details.

Contributed by The Apogee Group

TECHNOLOGY

SEMICONDUCTOR WATCH

Roger Harrison reports on what's happening in the world of semiconductors.



New 10-bit serial ADCs

NATIONAL SEMICONDUCTOR has released three new 10-bit serial I/O analog-to-digital converters (ADCs). They feature on-board multiplexer and track-and-hold capabilities.

National says they are ideally suited for engine monitoring and control applications, instrumentation and automatic-test equipment, and process-control systems.

The ADC1031, ADC1034, and ADC1038 have one, four and eight analog input channels respectively. Separate serial I/O and conversion clock inputs help to interface the devices with a variety of microprocessors and National's Microwire interface.

The three converters are guaranteed over industrial and military temperature ranges, and tested for missing codes and ½ LSB or 1 LSB total unadjusted error.

They feature power consumption of 20 milliwatts at 5 V and a conversion time of 13.7 microseconds, according to National Semiconductor.

The ADC1031 series employs a successive-approximation conversion technique. An input track-and-hold capability, which allows the analog input to vary during the conversion, is implemented by a capacitive reference ladder and sampled-data comparator. Analog input voltage range for all three devices is zero to +5 V supply and a +5 V external reference.

The fast and flexible serial interface of the ADC1031 series offers user-programmable left- or right-justified output data with a serial data-exchange rate of ten microseconds. Digital I/O lines are TTL- and CMOS-compatible. More information from the distributors, VSI.

READER INFO No. 224

Latched address SRAM

A NEW 16K SRAM that provides additional memory capacity and latched addressing for fully integrated microcontroller/embedded controller solutions has been announced by Micron Technology.

The MT5C1627 CMOS SRAM, a member of Micron's expanding family of application specific standard memory products, is organised as 2K×8 and features an on-chip address latch and access speed of 100 nanoseconds.

The device's on-chip address latch eliminates the need for external address latches, which makes it ideal for multiplexed address/data bus applications typical in today's microcontroller-based systems.

Such applications include automotive, disc drive, industrial control, portable instrumentation, telecommunications, portable medical equipment, robotics, keyboards, and printers.

The MT5C1627 is functionally compatible with, but not limited to, Intel's MCS-51 8-bit and 16-bit families of microcontrollers. It also complements Intel's 87C257 latched 32K×8 EPROM and 87C75PF Port Expander.

The MT5C1627 requires a single 5 V (10 per cent) power supply and all inputs and outputs are fully TTL compatible. Micron will also offer industrial and automotive temperature grades for the device.

Micron Technology Inc, a world-wide supplier of memory products, manufactures and markets dynamic RAMs, fast static RAMs, cache data RAMs, and memory-intensive and other enhancement products for workstations and personal computers. They are represented in Australia by Reptechnic, 3/36 Bydown St, Neutral Bay NSW 2089. ☎ (02) 953-9844.

READER INFO No. 225

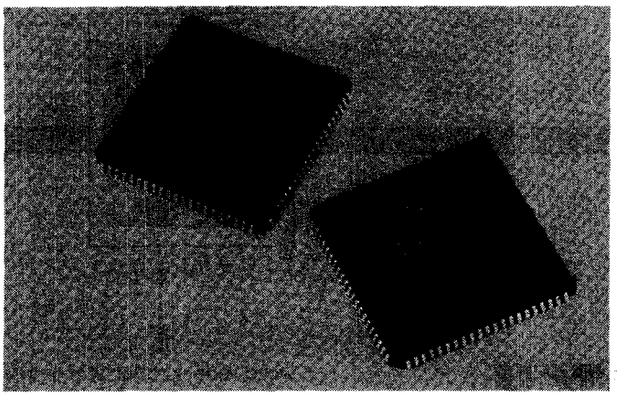
85 MHz RAMDAC supports 1024×768

BROOKTREE Corporation extends its support of high-resolution, high-performance colour graphics systems with the introduction of the Bt474, an 85 MHz monolithic CMOS RAMDAC for 8514A and TIGA industry standard 1024×768 resolution systems.

Featuring a 256×24 colour palette RAM and 15-colour overlay, the Bt474 employs four byte-wide pixel input ports that are multiplexed 4:1 to handle the 32-bit input from a 1024×768 high-resolution system.

The Bt474 also uses three 8-bit video D/A converters, configurable for either 6-bit or 8-bit operation, as well as four overlay input ports (also multiplexed 4:1) to support overlay/cursor information.

Brooktree's new RAMDAC can also be configured for VGA-compatible operation – a feature unique to the Bt474, according to Brooktree - at a resolution of 640×480. In the VGA mode, two of the overlay input ports are used to channel the 8-bit VGA pixel data from the system's VGA controller to the



colour palette.

"Tremendous momentum has developed around the adoption of the higher resolution colour graphics standard of 1024 x 768 pixels," said Dale Roark, product line architect for Brooktree, "fuelled to a large extent by the demands of graphical interface software programs such as Presentation Manager and Microsoft Windows."

According to Mr Roark, the Bt474 will support both architectures, as well as the VGA standard, simplifying the transition to the higher resolution standards without sacrificing VGA compatibility.

The Bt474 also incorporates a power-management capability for high-resolution lap top systems featuring an auxiliary monitor port. This allows the system to shut down the D/A converters and the colour palette, but maintains palette data and access to the command registers.

In this mode, the palette may be written to or read by the MPU, automatically powering up during MPU read/write cycles and then shutting down when the MPU access is completed. In the power-down mode, the Bt474 requires less than 1mA.

Additional features include an on-chip voltage reference, analog output comparators for monitor connection and identification, and support for interleaved frame buffers to allow faster frame buffer updates. A unique anti-sparkle circuit permits reading and writing to the Bt474's colour palette during active video.

The Bt474 is packaged in an 84-pin PLCC, and comes in both 75 MHz and 85 MHz versions. The Bt474KPJ75 supports screen refresh rates up to 66 MHz while the 85 MHz version is for higher refresh rates or resolutions. Brooktree products are available from Energy Control International, 26 Boron St, Sumner Park Qld 4074. ☎(07) 376-2955.

READER INFO No. 226

New cache controller for x86 uP

AUSTEK MICROSYSTEMS has added another member to its Microcache family of integrated cache memory controllers for the x86 range of microprocessors.

The A38202SX Microcache for Intel's i386SX microprocessor has begun sampling, and production is set for the second quarter of 1990, according to Dr Rob Potter, Austek's manager of corporate marketing programs. "Cache memory is now the preferred technique for obtaining the maximum performance from personal computers and workstations operating above 20 MHz," he said.

"Many PC manufacturers using the i386SX have assumed that cache memory is too expensive. However, at operating frequencies of 20 MHz and above, the A38202SX allows designers to obtain zero wait-state performance from systems using the cheapest available versions of dynamic memory (DRAM) combined with cache memory configured from industry standard 8k x 8 or 16 x 4 static RAM."

The A38202SX is a second generation cache controller, incorporating features derived from Austek's A38152 and A38202 cache controllers for the i386. The A38202SX has optimised interfaces for the i386SX microprocessor, the i387SX mathematics coprocessor, industry standard SRAMs and system chipsets.

The A38202SX gives the designer choice of a two-way set associative or direct mapped cache of 16, 32 or 64 kilobytes. Performance may be improved by optional use of a burst-mode fill feature, in which eight bytes of data are fetched in a cache miss cycle, resulting in higher hit rates and overall reduced filling time.

Other A38202SX features include: caching of BIOS ROM, three on-chip non-cached region descriptors to minimise compatibility problems, write buffer control for zero-wait state write operations, and on-chip asynchronous I/O bus snooping.

A design example, A38202SXDE-1 'Sidewinder', implements a system complete with 20 MHz i386SX processor and i387SX coprocessor, up to 8 Mbytes of RAM, i387SX socket, A38202SX and 32 Kb of cache data SRAM, Via Technologies FlexSet chipset, and eight (6x16bit, 2x8bit) full-length expansion slots, all packaged on a baby-AT card. The design is expected to operate at 25 MHz later this year.

Samples of the A38202SX Microcache, packaged in a 132 lead plastic quad flatpak, are available immediately. Volume shipments are to begin in the second quarter of this year.

READER INFO No. 227

New design 16-bit microcontroller — one for all

SIEMENS claims to be the only European manufacturer to present a 16-bit microcontroller of its own development which sets standards with its combination of performance and flexibility.

For the SAB 80C166, implemented in megatechnology, the processor, interrupt controller and I/O system are of an entirely new design.

Comparable to a 32-bit controller with respect to computing power, the SAB 80C166 is intended for a wide range of applications requiring embedded control, according to Siemens.

Microcontrollers are becoming important for the control of complex processes; the applications known as embedded control, e.g. in automobile engineering, and control tasks in industry and in data processing, all of which make very special demands.

Of primary significance are the arithmetic computing power, high language oriented data handling and short interrupt reaction times with priority assignment facility.

Since previous controllers were only partly able to meet these requirements, Siemens developed a 16-bit computer as a new type of symbiosis of processor and controller. Functionally, the chip comprises a powerful microprocessor, a programmable interrupt system and an integrated, largely independent modular I/O system.

The processor is formed by the CPU core, 1k of RAM, 8k of ROM and a clock generator. The CPU is characterised by RISC-comparable computing power which processes more than 90 per cent of all instructions in 100 nsec.

Other features are the extensive bit processing high level language-oriented addressing modes and the arithmetic capability. Almost any number of general purpose registers, with a maximum of 16 x 2 bytes, can be defined by means of register banking in the internal RAM.

With the interrupt system of the SAB 80C166, the heart of event management, one of 16 priority levels can be assigned to each interrupt source. The interrupt reaction time is no more than 400 nsec, Siemens claims.

The peripheral event controller also contributes to the rapid reaction capability of the system, because it off-loads the CPU from the interrupt-driven data transport tasks (DMA principle).

READER INFO No. 228

For further details, contact Edgar Sandy, Communications Equipment Department, Siemens Ltd 544 Church St Richmond Vic 3121 ☎ *(03) 420-7314.*

PROGRAMMABLE ACTIVE LOW PASS AUDIO FILTER

ELECTRONICS
E T I - 1 4 2 8

Part 2 of a technology demonstration project from Energy Control International by Craig Wiley and Richard D Davis.

Toggle switches

Switches S1 to S10: Register state operators
Position of each switch (up or down) determines the logic state of the corresponding input register upon loading. The switches will directly affect the internal logic states when the device is in the Direct Program Mode as described below. Each switch is disconnected in the centre position which allows programming though jack J1.

Type: Double Pole, Single Throw, 3 Position
Positions;
UP: Loads Logic 1 State
CENTRE: Disconnects switch, allows programming though jack J1
DOWN: Loads Logic 0 State

S1: Decimator Sample Rate Bit D4
S2: Decimator Sample Rate Bit D3
S3: Clock to SCF Bandedge Divide Down Ratio Bit D2
S4: Clock to SCF Bandedge Divide Down Ratio Bit D1
S5: Clock to SCF Bandedge Divide Down Ratio Bit D0
S6: RC Filter Bandedge Bit D7
S7: RC Filter Bandedge Bit D6
S6: RC Filter Bandedge Bit D5
S9: DC Gain Bit G2
S10: DC Gain Bit G1

Switch S11: "XTAL OSC CONTROL", Crystal oscillator control switch
This switch enables and disables the HSCF24040 crystal oscillator function. It is directly connected to device pin CLKIN and jack J3. When it is down in the "OFF" position it allows a clock input into jack J3 to serve as the HSCF24040 time base. When it is in the up "ON" position pin CLKIN is tied low to −5V which selects the internal crystal oscillator to serve as the time base.

Type: Single Pole, Single Throw
Positions;
UP: "ON" which enables the internal clock
DOWN: "OFF" which disables the internal clock and allows operation by the external clock

Switch S12: Direct program switch
Direct program mode causes the data registers for D0-D7, G1 and G2 to act transparent. When switch S12 is up in the "DIRECT PROGRAM" position, CS is pulled to VSS (-5V) by R6. This disables the A0, AS, WR, and DS inputs and places the HSCF24040 in the direct program mode. When switch S12 is down in the "MANUAL LATCH" position, input register loading is controlled by switch S15; switch S13 must be in the "BW" or "GAIN" position. Note that data latch control inputs CS, A0, AS, WR, and DS can be driven from jack J1 when S12 is in the "DP" position and S13 is in the open (centre) position.

Type: Single Pole, Double Throw
Positions:
UP: "DIRECT PROGRAM" mode, D0-D7, G1 G2 latches transparent (switch open)
DOWN: "MANUAL LATCH" mode, loading controlled by S15 (switch closed)

Switch S13: Register select switch
This switch, which is tied directly to pin A0, selects either the D0-D7 registers of the G1, G2 registers during manual loading. It is not used in the Direct Program Mode. When in the "GAIN" (down) position, it sets pin A0 to logic 0 which allows access to register bits G1 and G2. When in the "BW" (up) position, it sets pin A0 to logic 1 which allows access to register D0 through D7. With switch S13 in the centre position, it is disconnected and allows control of pin A0 though jack J1. The purpose of the A0 pin is to allow use of an 8-bit bus to write all ten registers. The data into pin A0 can be latched by a 1 to 0 logic transition on pin AS; pin AS is pulled high by resistor R9 and can be pulled low by pin AS of jack J1.

Type: Double Pole, Single Throw, 3 Position
Positions:
UP: "BW", Bits D0-D7 Latch Access
CENTRE: Switch Open (Control enabled by jack J1)

BNC connectors

Jack J2: "CONVERT \", External A/D converter control output pin
This active low output signal indicates when the Sc OUT output is valid (ie, when the decimator output has settled. It is used to trigger an external A/D converter or sample/hold amplifier. This jack is directly connected to the CNVRT \ pin of the HSCF24040.

Jack J3: "CLK IN", External clock input
This input jack is used to drive the HSCF24040 with an external clock. Switch S11 must be in the OFF position for this input to function. This jack is connected directly to the CLKIN pin of the HSCF24040.

Jack J4: "CLK OUT", Device clock output
This output jack provides a buffered version of either CLKIN or the internally generated crystal oscillator output. It is connected directly to pin CLKOUT of the HSCF24040.

Jack J5: "SYNC", Decimator sampling sync input
This active low input jack resets the internal logic and counters, and can be used to synchronise the output of several devices. This jack is connected directly to pin SYNC\ of the HSCF24040.

Jack J7: "Sc OUT", Switched-capacitor filter output
This jack is the analogue output of the switched-capacitor filter after passing through the decimator. It is directly connected to the pin SCOUT of the HSCF24040. Optional load resistor R13 can be added on the EBICS board.

Jack J8: "Rc OUT", RC filter output
This jack is the analogue of the RC filter and is connected directly to pin RCOUT of the HSCF24040. Optional load resistor R14 can be added on the EBICS board.

Jack J9: "Rc IN", RC filter input
This jack is the analogue input to the RC filter and is connected directly to pin RCIN of the HSCF24040.

Jack J10: "Sc IN", Switched-capacitor filter input
This jack is the analogue input to the switched-capacitor filter and is directly connected to pin SCIN of the HSCF24040. This pin is internally enabled only when switch S14, "CONFIG SELECT" is up in the "SM" position.

Parameters	Test Conditions	Test Level	HSCF24040 MIN	TYP	MAX	Units
AC ELECTRICAL CHARACTERISTICS (CONTINUED)						
Digital Inputs (Pins D0 - D7, G1, G2, SYNC, CLKIN, PD, AA/SM, A0, AS, DS, CS, WR)						
VIH (Input Voltage High)		I	2.0			V
VIL (Input Voltage Low)		I			0.8	V
IIN (Input Current)		I			1.0	µA
CIN (Input Capacitance)		II			10	pF
Digital Outputs (Pins CLKOUT, CNVRT)						
VOL (Output Voltage Low)	Driving Standard TTL Load	I			0.4	V
VOH (Output Voltage High)	Driving Standard TTL Load	I	2.4			V
Clock Frequency						
Internal Oscillator Frequency		I	1		4	MHz
Input Clock Frequency		II	(1)		4	MHz
Microprocessor Interface Timing						
Non-Multiplexed Address/Data bus:						nsec
Tas (Address Setup Time)		I	100			nsec
Tah (Address Hold Time)		I	10			nsec
Multiplexed Address/Data bus:						nsec
Tasm (Address Setup Time)		I	20			nsec
Tahm (Address Hold Time)		I	10			nsec
Tds (Data Setup Time)		I	100			nsec
Tdh (Data Hold Time)		I	10			nsec
Tdpw (Data Latch Pulse width, DS or WR)		I	100			nsec
Taps (Address Latch Pulse Width)		I	50			nsec
Tcsh (Chip Select Hold, CS or WR)		I	10			nsec
SCOUT Synchronization Timing						
T1 (CLKIN to CLKOUT Delay)		I			50	nsec
T2 (SYNC Delay Time)		I	100			nsec
T3 (SYNC Setup Time)		I	75			nsec
T4 (SYNC Pulse Width)		I	75		(2)	nsec
T5 (CLKIN to CNVRT Delay)		I			75	nsec

Notes: (1) The minimum input clock frequency is constrained only by the SC filter bandwidth. SC bandwidths below 78 Hz may degrade at high temperatures due to leakage currents.

(2) It is required that the external SYNC input return to a logic high at least 1 CLKIN clock cycle prior to the falling edge of the next CNVRT output.

ABSOLUTE MAXIMUM RATINGS (Beyond Which Damage May Occur) (1)

Supply Voltages
VDD to GND ..... 0 to +7 V
VSS to GND ..... 0 to -7 V

Input Voltages
Digital Input Voltages
All except CLKIN, CS.....-0.3 V to (VDD + 0.3 V)
CLKIN, CS ..... (VSS - 0.3 V) to (VDD + 0.3 V)
Analog Input Voltages
SCIN, RCIN.....(VSS - 0.3 V) to (VDD + 0.3 V)

Output Voltages
Analog Output Voltages
SCOUT, RCOUT..... Momentary Short to VDD

Temperature
Temperature, case ..... -60 to + 140°C
junction ..... + 150°C
Lead Temperature (soldering 10 seconds) .. + 300°C
Storage Temperature ..... -65 to + 150°C

Note (1): Operation at any Absolute Maximum Rating is not implied. See Electrical Specifications for proper nominal applied conditions in typical applications.

RECOMMENDED OPERATING CONDITIONS

Supply Voltages
VDD ..... +4.75 to 5.25 V
VSS ..... - 5.25 to -4.75 V

Temperature
Temperature, Ambient ..... 0 to +70°C

ELECTRICAL SPECIFICATIONS

Test Conditions: VDD = +5V, VSS = -5V, T_A = 0 to 70°C for HSCF24040ACJ, T_A = -55 to +125°C for HSCF24040AMJ, unless otherwise specified. All typical specifications are for T_A = 25°C only.
For explanation of Test Level, refer to Test Level Codes following timing diagrams.

Parameters	Test Conditions	Test Level	HSCF24040 MIN	TYP	MAX	Units
DC ELECTRICAL CHARACTERISTICS						
DC Gain of Combined RCF and SCF						
HSCF24040ACJ (0 to 70°C):						
SCF Gain Setting = 1.0	SCBW = 5 kHz RCBW = 7 kHz	I	0.999	1.0	1.001	V/V
SCF Gain Setting = 2.0		I	1.99	2.0	2.01	V/V
SCF Gain Setting = 4.0		I	3.97	4.0	4.03	V/V
SCF Gain Setting = 8.0		I	7.92	8.0	8.08	V/V
HSCF24040AMJ (-55 to +125°C):						
SCF Gain Setting = 1.0		I	0.998	1.0	1.002	V/V
SCF Gain Setting = 2.0		I	1.98	2.0	2.02	V/V
SCF Gain Setting = 4.0		I	3.96	4.0	4.04	V/V
SCF Gain Setting = 8.0		I	7.90	8.0	8.10	V/V
DC Gain of RCF Only		I	0.95		1.05	V/V
DC Gain of SCF Only	SCF Gain Setting = 1.0	I	0.95		1.05	V/V
DC Offset Voltage, Output Referred						
RCOUT		I	-10		+10	mV
SCOUT	SCF Gain Setting = 1.0	I		±10		mV

Parameters	Test Conditions	Test Level	HSCF24040 MIN	TYP	MAX	Units
AC ELECTICAL CHARACTERISTICS						
RC Filter (RL = 5 kΩ, CL = 50 pF)						
Programmable Bandwidth (Fo, -3dB)		I	7		80	kHz
Bandedge Tolerance, Referenced to Fo		I	-0		+5	%
Passband Response, DC to 0.25Fo Referenced to RCF DC Gain		I	-0.1		+0.1	dB
Stopband Loss, Referenced to RCF DC Gain						
0.25Fo		I			0.1	dB
Fo		I	2	3	4	dB
17.25Fo		I	72			dB
Harmonic Distortion, ±3V Sinusoidal Input at RCIN						
Magnitude of Harmonics		II		-80		dB
THD (HSCF24040ACJ)		I		0.01	0.02	%
THD (HSCF24040AMJ)		I		0.01	0.1	%
Dynamic Range		I	85	90		dB
Integrated Noise Voltage, 0.01Fo to 2.0Fo		I		50	70	µV rms
SC Filter (RL = 5 kΩ, CL = 50 pF)						
Programmable Bandwidth (Fc)		I	78		20,000	Hz
Bandedge Tolerance, Referenced to Fc		I	-0.5		+0.5	%
Passband Response, DC to Fc Referenced to SCF DC Gain		I	-0.1		+0.1	dB
Stopband Loss, Referenced to SCF DC Gain						
1.5Fc		I	30			dB
2.0Fc		I	50			dB
2.5Fc		I	66			dB
3.0Fc		I	76			dB
Harmonic Distortion, ±3V Sinusoidal Input at SCIN						
Magnitude of Harmonics		I		-72		dB
THD (HSCF24040ACJ)		I		0.05	0.075	%
THD (HSCF24040AMJ)		I		0.05	0.2	%
Dynamic Range		I	85	90		dB
Integrated Noise Voltage, 0.01Fc to 2.0Fc		I		70	100	µV rms

Parameters	Test Conditions	Test Level	HSCF24040 MIN	TYP	MAX	Units
DC ELECTRICAL CHARACTERISTICS (CONTINUED)						
Output Drive Capability, RCOUT and SCOUT						
Maximum Voltage Swing	RL = 5 kΩ	I	+3.0			V
Minimum Voltage Swing	RL = 5 kΩ	I			-3.0	V
Maximum Sink/Source Current	RL = 5 kΩ	I	600			µA
Analog Input Voltage Range (1)						
RCIN		I	-3.0		+3.0	V
SCIN; SCF Gain Setting = 1.0		I	-3.0		+3.0	V
SCIN; SCF Gain Setting = 2.0		I	-1.5		+1.5	V
SCIN; SCF Gain Setting = 3.0		I	-0.75		+0.75	V
SCIN; SCF Gain Setting = 4.0		I	-0.375		+0.375	V
Analog Input Impedance						
RCIN Resistance		I	100			kΩ
RCIN Capacitance		I			25	pF
SCIN Resistance		I	50			kΩ
RCIN Capacitance		I			25	pF
Power Supplies						
Operating Current						
IDD; Normal Mode	XTAL Oscillator Active	I		15	20	mA
IDD; Power Down Mode	XTAL Oscillator Active	I		2	4	mA
ISS; Normal Mode	XTAL Oscillator Active	I		15	18	mA
ISS; Power Down Mode	XTAL Oscillator Active	I		1	3	mA
Power Dissipation						
Normal Mode	XTAL Oscillator Active	I		150		mW
Power Down Mode	XTAL Oscillator Active	I		15		mW

Note (1): Input voltage outside these ranges will degrade harmonic distortion performance.

DOWN: "GAIN", Bits G1, G2 Latch Access

Switch S14, "CONFIG SELECT", Filter configuration selection
This switch controls the logic state of HSCF24040 pin AA/SM which internally determines the analogue input to the switched-capacitor filter. In the down "AA" position logic state 1 is forced which establishes the RC filter output as the SCF input. In the up "SM" position logic state 0 is forced which establishes the ScIN analogue input as the input to the SCF. This switch does not have a corresponding function on jack J1.

Type: Single Pole, Single Throw
Positions;
UP: "SM", Analogue Input ScIN is SCF Input (Logic 0)
DOWN: "AA", RC filter output is SCF Input (Logic 1)

Switch S15, "LATCH DATA" Data strobe control switch
During manual loading, pushing this momentary-contact switch up into the "L" (Latch) position loads the input registers by pulling the DS input to ground. Concurrently, switch S12 must be in the "MAN" (DOWN) position or pins WR and CS must be pulled low at jack J1. This switch is not used in the Direct Program Mode.

Type: Single Pole, Single Throw, Momentary Contact
Positions;
UP: "L", Latches register data (DS = logic 0),
Momentary Contact
DOWN: (DS = logic 1)

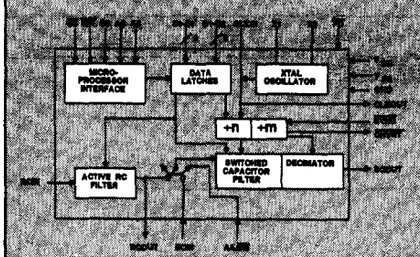
Switch 16: Power down switch
This switch is used to disable the analogue circuitry of the HSCF24040 thus conserving power. Along with pullup resistor R12, it controls the logic state of pin PD.

Type: Single Pole, Single Throw
Positions;
UP: "POWER DOWN", Analogue Portion Disabled (PD = logic 1)
DOWN: "POWER ON", Device Fully Functional (PD = logic 0)

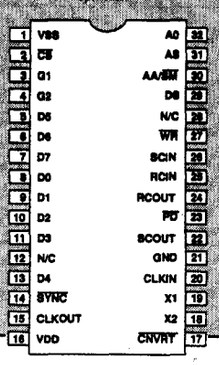
ABBREVIATED DATA SHEET HSCF24040 PROGRAMMABLE 7TH ORDER LOW PASS ACTIVE FILTER

Features:
- 85 dB Dynamic Range
- Cut Off Frequency (fc) up to 20 KHz
- On-Chip Anti-Aliasing Protection
- Programmable Bandedge Frequency for both RC and Switched Capacitor Filter
- S/H Output
- Microprocessor Compatible
- 7th Order Ladder Filter with Cosine Prefiltering Stage
- Stopband Attenuation 76dB at 3 fc
- On-Chip Oscillator (External Crystal)

Applications:
- 12-Bit Signal Processing Systems
- Pre-Sample Anti-Alias Filter
- Reconstruction Smoothing Filter
- Test Equipment/Instrumentation
- Spectrum Analysers
- Medical Telemetry/Filtering
- Speech Analysis and Synthesis
- Data Acquisition Systems
- Computer Controlled Test Systems



PIN ASSIGNMENT HSCF24040
TOP VIEW



PIN FUNCTIONS HSCF24040

NAME	FUNCTION
VSS	Negative supply voltage
CS	Chip select, active low
G1 - G2	The digital inputs that control the DC gain of the SC filter
D0 - D7	The digital inputs that control the RC filter bandedge, SC filter bandedge, and SC filter decimation rate
SYNC	This digital input controls the sampling instant for the SC filter decimated output; active low
CLKOUT	Master clock output capable of driving 1 standard TTL load. It is buffered version of either CLKIN or the internally generated crystal oscillator output.
VDD	Positive supply voltage
CNVRT	This digital output indicates that the SCOUT output has settled and can now be converted or sampled (drive capability is 1 standard TTL load); active low
X1-X2	An external crystal is connected between these pins to generate an accurate clock by chip (optional)
CLKIN	The master clock input. Forcing CLKIN to VSS enables the on-chip oscillator (external crystal)
GND	Ground
SCOUT	SC filter output
PD	This digital input is used to power down the analog circuitry; active low
RCOUT	RC filter output
RCIN	RC filter input
SCIN	SC filter input only valid when AA/SM is forced low
WR	Write strobe; active low
D8	Data window
AA/SM	This digital input controls whether the input to the SC filter comes from RCOUT or SCIN
A0	Address strobe
A1	Register address select

General Description
The HSCF24040 is a monolithic 7th order low pass active filter system. It offers 76 dB of stopband attenuation and 85 dB of dynamic range, which makes it suitable for 12-bit systems. Because of the internal 3rd order RC anti-aliasing filter, no external components are required for device operation. Both the RC filter and switched-capacitor filter have digitally programmable cutoff frequencies.

The last stage of the SC filter contains a programmable decimator which provides a sample/hold output function that reduces the sample rate at SCOUT. This ensures that the hold period of the sampled and held output is long enough to perform an A-D conversion or be resampled by an external sample-and-hold.

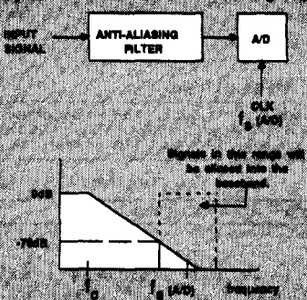
The HSCF24040 is manufactured using Honeywell's state-of-the-art BEMOS process which allows the fabrication of low power CMOS logic, linear CMOS circuits, bipolar linear circuitry and thin film resistors on a single chip. The HSCF24040 is packaged in a 32-pin DIP, operates on a +/-5 V supply voltage and is offered in commercial and military temperature ranges.

SC filter
SC filters are sampled data filters that provide extremely accurate and stable responses. This is because their internal "time constants" depend only upon the switching frequency and the ratios of monolithic capacitors.

The switching frequency is normally derived from a crystal controlled oscillator and is thus extremely precise. On-chip capacitor ratios are accurate to within approximately 0.1%. Therefore, high order sharp roll-off filters can be manufactured that require no post production trimming.

Since the filter bandedge can be programmed by varying the frequency of the clock that controls the filter's switches, the filter bandedge can be made to track the sample rate of an external A-D converter.

The filter in the HSCF24040 has seven poles (Chebyshev approximation) to ensure a minimum loss of 76 dB at three times the bandedge so that the system A-D can sample as low as four times the bandedge (see Figure 1). The SC filter has a differential signal path to



Since the filter loss is greater than 76 dB, any aliased signals will be below the 12 bit level.

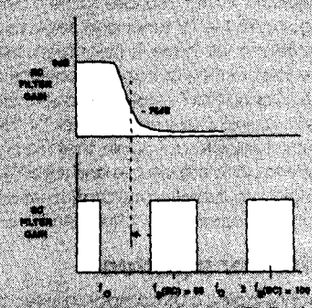
Figure 1. Requirements for an anti-aliasing filter prior to A/D conversion.

improve its PSRR, distortion, and dynamic range. Through digital programming, bandedges of up to 20 KHz and dc gains of 1,2,4 or 8 can be achieved.

Active RC filter
Although the SC filter is programmable and offers

excellent performance, it does have one major drawback. Because it is a sampled data filter, it can fold or 'alias' out-of-band energy into the desired passband in much the same way as the external A-D. Therefore, a continuous time filter is required in front of the SC filter to provide aliasing protection. We are, however, aided by the fact that the filter sampling rate is many times greater than the bandedge frequency (50 times in this case).

Thus, a low order, active RC filter with a bandedge accuracy of only 5% will suffice. This concept is illustrated in Figure 2.



Note: The RC filter should provide > 76 dB of loss for several different SC filter sample rates f_s (SC).

Figure 2. RC filter provides anti-aliasing for SC filter.

The bandedge for the RC filter must be programmable to ensure efficient rejection of the SC filter images located at multiples of the SC filter rate. Eight different RC filter bandedges spanning a 12-to-1 range are available on the HSCF24040.

The programmability is achieved by switching different resistor and capacitor values into the filter. A single RC filter bandwidth setting (3 dB) of f_0 (RCF) will provide 76 dB of anti-aliasing protection for SC filter bandwidths ranging from f_0 (RCF)/5.71 to f_0 (RCF)/4.

The topology of the RC filter has been chosen so that the dc gain and the pole Qs rely on ratio matching of the on-chip resistors and capacitors. The RC filter bandedge is laser trimmed for high accuracy during the manufacturing process.

Decimator

The decimator block samples the differential output of the SC filter and converts it to a single ended signal. The decimator also provides a sample-and-hold output (SCOUT) at a programmable sample rate of 25/fc, 12.5/fc, 6.25/fc, or 4.167/fc, where fc is the SC filter bandwidth.

By choosing the proper decimation rate, the hold time at SCOUT will be sufficiently long to allow an A-D conversion to take place. (An external sample and hold may be required for hold times longer than 100 µ sec to prevent more than ½ LSB of droop for a 12-bit A-D converter).

The CNVRT\ output is an active low digital output that indicates when the SCOUT\ output is valid. Applying a falling edge to the SYNC\ input initiates the CNVRT\ pulse on the next rising edge of CLKOUT.

The use of the decimator block with SYNC\ and CNVRT\ ensures a proper converter or sample and hold and eliminates the need for a smoothing filter at the SCOUT\ output.

Programmability

The chip contains an 8-bit and 2-bit data register. Data in the 8-bit register controls the SC filter bandedge, RC filter bandedge, and the decimation rate. (A programmable divide down chain generates the SC filter clocks from the master clock. A similar divide down the chain determines the decimation rate from the SC filter clocks).

RCF BANDEDGE				DC GAIN		
RCF 3dB BW	D7	D6	D5	DC GAIN	G1	G2
80KHz	0	0	0	1	1	1
56KHz	0	0	1	2	1	0
40KHz	0	1	0	4	0	1
28KHz	0	1	1	8	0	0
20KHz	1	0	0			
14KHz	1	0	1			
10KHz	1	1	0			
7KHz	1	1	1			
CLOCK TO SCF BANDEDGE DIVIDE DOWN RATIO				**DECIMATOR SAMPLE RATE**		
fCLK/fC	D0	D1	D2	fS/H/fC	D3	D4
200	0	0	0	25.000	0	0
400	0	0	1	12.500	0	1
800	0	1	0	6.250	1	0
1,600	0	1	1	4.167	1	1
3,200	1	0	0			
6,400	1	0	1			
12,800	1	1	X			

fC = 0.1db Bandwidth of the SC filter.
fCLK = Master clock frequency at CLKOUT.
fS/H = Sample rate at SCOUT output.

Table 1. Programmable features.

HSCF24040	INTEL (MPX'ED) 8088, 8085, 8051	MOTOROLA (MPX'ED) 6801, 6803	MOTOROLA (NON-MPX'ED) 680D, 6801, 6802, 6809
$\overline{CS}$	Generated from A8-A15	Generated from A8-A15	Generated from A0-A15
DS	VDD Supply	E	E
$\overline{WR}$	$\overline{WR}$	R/$\overline{WR}$	R/$\overline{WR}$
A0	ADI	ADI	AI
AS	ALE	AS	VDD Supply
D0-D7	AD0-AD7	AD0-AD7	D0-D7
G1-G2	ADI	ADI	DI

Note: Tying $\overline{CS}$ to the VSS supply disables the microprocessor interface and allows D0-D7, G1-G2 to be programmed directly without the need for a latch signal.

Table 2. Microprocessor interface connections.

Data in the 2-bit register controls the programmable dc gain on the SC filter. The truth tables for both registers are shown in Table 1.

The SC filter's bandedge is programmed by selecting one of the divide down ratios shown in Table 1. This ratio is divided into the master clock frequency to arrive at the filter cutoff frequency.

As an example, assuming typical master clock frequency of 4 MHz and a divide down ratio of 400 (D0, D1, D2 = 001), the filter's bandedge would be 10 kHz. Alternately, selecting a divide down ratio of 3200 (D0, D1, D2 = 100) would provide a filter bandedge of 1250Hz. With a constant master clock frequency, up to seven different discrete SC filter bandedges can be obtained.

An infinite number of different bandedges can be derived by varying both the divide down ratios and the master clock frequency. This provides the ultimate level in programming flexibility.

The five control signals A0, AS, WR\, CS\, and DS allow the user to directly interface to 8-bit microprocessors without additional glue logic. Both Motorola's MPXed and non-MPXed bus formats as well as Intel's MPXed bus format are supported.

Interface connections for both the Intel and Motorola 8-bit microprocessors are shown in Table 2. In addition to the data-latch format, the D0-D7 and G1-G2 inputs can be hardwired for direct programming without the need for a latch signal by tying the CS\ inputs to VSS. A0 = 1 selects the BW registers D0-D7 and A0 = 0 selects the gain registers G1, G2.

Oscillator

The HSCF24040 provides an on-chip oscillator (external crystal) for applications where a system clock is not available. The user has a choice of either the clock-driven or the oscillator mode.

The oscillator mode is enabled by tying the CLKIN input to VSS.

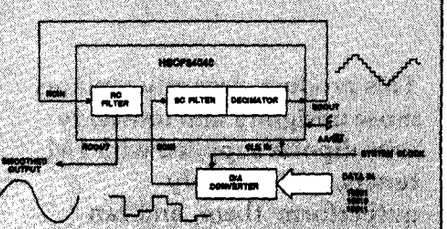
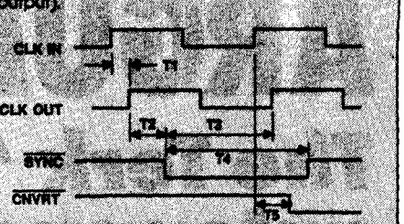


Figure 3. The HSCF24040 as a smoothing filter for a D/A converter.

Typical application circuit

Figure 3 illustrates how the HSCF24040 might be used for smoothing the output from a D/A converter. In this case, the D/A output is fed into the SCIN input of the device.

The SCIN input is enabled by tying AA/SM\ to ground. The SCOUT output is fed externally into the RCIN input. The smoother output is finally brought off-chip via the RCOUT pin. (Note that the smoothed output will not correct for the inherent sin (X)/(X) droop of the original D-A converter output).



Scout synchronization timing.

TECHNOLOGY

This product elegantly replaces those unsightly and unwieldy wire dipoles supplied with FM tuners, will certainly outperform them, and can obviate the necessity of having an outdoor antenna.
By Roger Harrison.

A CIRCULAR ARGUMENT

The Terk 'pi' indoor FM antenna reviewed

With all the attention paid to the proper setting up of source equipment in a hi-fi system – record player, CD and tape machine – the FM tuner often becomes the Cinderella of the game. More for the sake of form than for practical reasons, I suspect, when you buy an FM tuner it comes supplied with a wire dipole. You're meant to tape the ends and the centre termination on the wall in the vicinity of your sound system, the lead-in from the dipole's centre being connected to the FM tuner's antenna input. This isn't always practical; I've never actually done it myself, and never seen anyone else's setup with the wire dipole strung up like that. It's unsightly, and probably for this very reason, most people just chuck the contraption down behind the equipment rack or run it out of sight along the rear of the equipment shelf. I don't blame them.

Problem is, FM reception with such an arrangement is a hit-or-miss affair. It may well be quite acceptable on most of the major stations, but, inevitably, some stations suffer from noisy reception or varying signal strength as people walk around the room and so on. And if you're keen on listening to some of the 'community' FM stations, which transmit on much lower powers and consequently have much lower signal strengths, the result is really a bit of a lottery.

Some people solve these difficulties by discarding the wire dipole and installing an external FM antenna. They're rather like a large TV antenna, but perhaps not so complicated, with fewer elements. That's OK if you're living in your own home. If you're renting, or living in a unit, putting up an external FM antenna presents a whole host of hurdles. You need approval from the landlord or the body corporate, maybe even the local council.

Even if you live in your own home on the standard Australian quarter-acre block, where do you mount the outdoor FM antenna – on the same mast as your TV antenna? Generally, there won't be enough length in the mounting mast for you to do that, so you have to mount it separately.

An outdoor FM antenna is generally a beam of some sort, with all its collecting power focused broadly in one direction – a quadrant really. But the FM stations you want to listen to aren't always so obliging as to be located in one general direction from your home, or even within one quadrant. So, an external FM antenna isn't always the solution, either.

You can avoid installing an outdoor FM antenna by taking a 'split' from your TV antenna – but while this solution may work better than the wire dipole, it has a number of drawbacks. Firstly, you lose some of the signal going to the TV tuner and, secondly, a TV antenna will have a poor response (even a loss) in the FM band because it is tuned to pick up the TV station frequencies, not the FM band. There are outdoor TV/FM antennas available, but again, that means you have to go to the trouble and expense of changing your existing installation which probably performs quite satisfactorily.

The indoor solution

Terk Technologies, a US company based in New York State, saw this problem some years ago and set about designing an indoor FM antenna. The goal was to not only replace the unsightly and poorly performing wire dipole you get with FM tuners, but to also obviate the necessity of having to install an outdoor antenna.

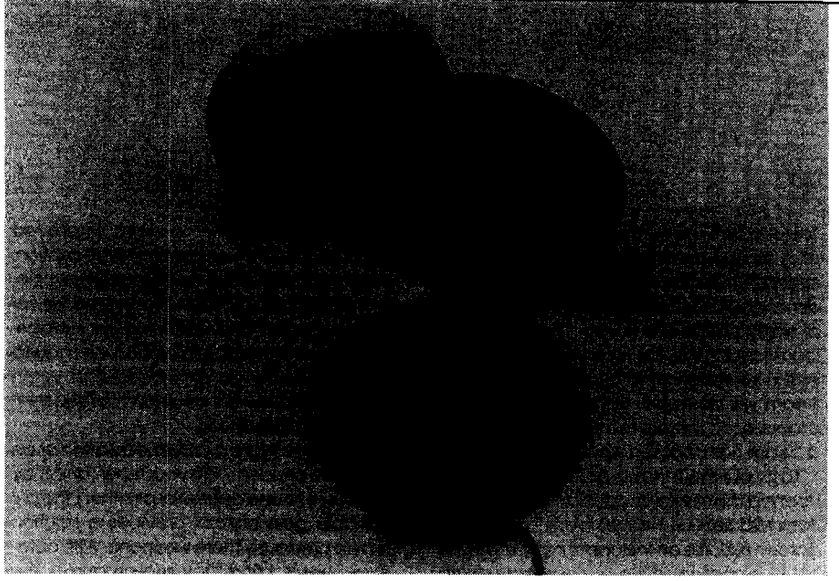
Terk's first antenna was a slender, not too tall, pyramid-shaped device, designed to stand atop a hi-fi equipment rack, on a shelf or whatever. It was basically a tuned vertical whip with an integral solid-state amplifier – known in the communications trade as an 'active antenna'. It sold rather well in the USA, and still does, having gone through one or two revisions.

Market feedback suggested that a more compact shape would be more adaptable and so Terk engaged renowned US electronics designer, Larry Shotz, to design something. This collaboration was a good strategy. The man behind Terk Technologies, Neil Terk, is an award-winning industrial and graphic designer turned manufacturer. What they came up with was a small circular active antenna, about the diameter of a compact disc. It was duly dubbed the 'pi'.

Terk Technologies is represented exclusively in Australia by the Sydney-based Communications Power Inc, renowned as the distributor of the Allsop range of audio and video care and cleaning products.

Let's take a look at it

The pi antenna measures 130 mm in diameter and is 28 mm thick. The smooth, all-



The Terk 'pi' indoor FM antenna is about the size of a compact disc, but 28 mm thick. It is available in white, black and grey. It can be stood vertically or laid flat. It is an 'active' antenna, having a low noise amplifier as an integral part of the loop antenna inside. It is powered from a 12 Vdc plugpack.

plastic casing has a rubber encased 'foot' at the bottom which allows the antenna to be stood vertically. A rubber button on the rear face at the top allows the pi to be laid flat (it also has a second purpose, which I'll get to shortly). Thus, you can stand it either vertically or horizontally atop your hi-fi equipment rack or cabinet, lay it flat on a nearby shelf, or even atop the equipment inside the rack or cabinet.

Inside is a pc board with a specially configured loop track that forms the antenna, and an integral low noise, tuned RF amplifier. This can provide some 38 dB of gain, which can be varied by means of the rubber button on the top rear of the case. You can adjust the received signal level between full gain (38 dB) right down to a loss of 20 dB. This allows you to get good reception on a station when the FM tuner or receiver may be "overloaded" by another, very strong, signal creating crossmodulation interference within the receiver.

Its size means it is unobtrusive, and its styling does not jar with room decor. But the technology employed means it will outperform the usual wire dipole supplied with FM tuners. Wire dipoles are meant to be taped to a wall, forming a 'T' about one and a third metres across. Not, as I mentioned earlier, that many people seem to do that. Even when properly installed in a T-shape, wire dipoles give poor reception on stations located more or less along the line of the wire, which means finding a position for the dipole which gives good results on all stations can be next to impossible.

Indoor FM antennas other than the wire dipole are not new; there are a number of 'rabbit's ears' styles of set-top TV/FM antennas available. However, these have similar disadvantages to wire dipoles, if not worse, because they are not tuned to the FM band. And, let's face it, most of these contraptions are downright ugly. The Terk 'pi' indoor FM antenna overcomes all these problems and has an acceptable, if not stylish, appearance to boot.

A thin (3 mm diameter) coaxial cable about two metres long exits from one side of the pi's foot. On the free end is a small plastic box about half the size of a cigarette lighter, with a coax plug protruding from the top end – which goes to your tuner's antenna input – and a 3 mm jack socket adjacent to where the coax enters. A standard 12 Vdc plug pack plugs in here to power the antenna. The coax plug on this little box is an 'F-type' connector; this type is widely used in the USA, whereas 'PAL type' connectors are the most commonly encountered on tuners imported into Australia. A simple push-on adaptor, F-to-PAL, was supplied with the review unit. A small 75-to-300 Ohm 'balun' adaptor was also supplied.

On the front face of the pi, just above the foot, is a small LED which lights up when the pi is powered up. The button on the rear, which serves as the gain control knob and a second foot when the pi is laid flat, is marked with +38 dB at maximum, −20 dB at minimum and 0 dB about one-third of the way around. There's no marker on the knob though, which would have been useful.

When standing vertically, the pi predominantly picks up vertically polarised signals, and when laid flat, it predominantly picks up horizontally polarised signals. FM stations transmit their signal one of three ways: vertically polarised, horizontally polarised, or combined vertical and horizontal. Vertical polarisation favours FM reception in cars because vehicle 'whip' antennas are installed more or less vertical and are thus most sensitive to vertically polarised transmissions. FM antennas in the home may be – well – anything!

The major FM stations transmit both vertical and horizontal. Community stations may transmit vertical or horizontal, depending on a number of factors – like what sort of antenna can be afforded out of their comparatively miniscule budget, or what they have managed to scrounge (beg, borrow...) from a benevolent supplier. In any event, by the time the signal reaches your antenna, it will be a mixture of polarisations due to multiple reflections from the ground, buildings and other structures in the path between the transmitter and you.

Here's where the versatility of the Terk pi shines. You can orient the antenna for best reception on the station you want to listen to at the moment. When used standing vertically, the pi shows a small amount of directionality, allowing it to be rotated for best reception on weak stations. It does not have the sort of directionality exhibited by a wire dipole. Placed horizontally, it is omnidirectional. And the adjustable gain allows you to set the signal level to get the best signal-to-noise ratio possible.

On weak, low-powered, stations the pi is claimed to reduce electrical noise pickup, which is a problem with wire dipoles, rabbit's ears and even outdoor antennas, making reception either much clearer or entirely banishing the noise.

On test

To review the Terk pi, I was fortunate enough to have on hand a variety of equipment. Firstly, I had an Icom R9000 general coverage scanning receiver, which provides coverage from 10 kHz to 2 GHz and features a spectrum analyser type display (see review in the February issue). I also had Akai's top-line AT-93B stereo tuner (see review, Nov. '89) and a Harman/Kardon hk550Vxi stereo receiver (reviewed December '89). In addition, Akai kindly loaned me an AM-73B integrated amplifier, which matches the AT-93B tuner. In essence, this gave me two complete hi-fi systems – one of moderate cost (the Harman/Kardon) and one top end system (the Akai components), plus a calibrated communications receiver.

I purchased a locally manufactured three-element FM antenna and constructed a 'reference' antenna, the gain of which can be calculated. I installed the reference antenna on the roof at our offices in Balmain here in Sydney. The three-element FM antenna I rigged up as a portable antenna so I could try it in various situations.

The Akai tuner has a singular advantage – two antenna inputs. You can select either antenna, or have the tuner automatically select the antenna which gives the best reception. It also has a signal strength meter.

I set up a wire dipole (supplied with one of the tuners), taping it to the wall behind the equipment. This happened to be an internal wall. With the Icom receiver, I could compare any antenna against results recorded on the reference antenna on the roof and get a reasonably repeatable

measure of the difference between one antenna and another, and between one antenna located in different positions.

Our offices are located high on a ridge, within a few kilometres of the major Sydney FM and TV stations. It's a veritable 'RF hotspot'. Many FM stations, including the lower-powered community FM stations scattered around Sydney, can be received here. But, that situation is both a boon and a bane because the very strong commercial FM stations can, and do, cause problems in a tuner, making reception difficult on weaker stations because of crossmodulation from the stronger ones. In addition, the TV Channel 2 mast is a few kilometres away. Frequency-wise, it's just below the FM band and it causes all sorts of crossmodulation problems with any tuner I've tried, from the bedside clock radio to the $1100 Akai.

I compared the performance of the Terk with the wire dipole taped to the wall and with the dipole hung down in a random fashion behind the equipment. With the pi's gain set at maximum, as you'd expect, the Terk leaves the wire dipole for dead. I tried setting the gain of the pi to give the same signal strength on one station as the wire dipole, and then compared their performance on signals across the band. At worst, the pi performed much the same as the wire dipole. However, on some weak signals from community FM stations, the pi delivered a signal with a better signal-to-noise ratio. I guess this is a result of its tuned design, which limits out-of-band noise. The loop design itself may simply be less prone to noise pickup, too.

Comparing the pi, inside, against the omnidirectional reference antenna on the roof was interesting. The pi has sufficient gain to deliver signal strengths around 10-18 dB higher than the reference antenna, despite a seven metre height difference and two intervening walls, a ceiling and metal roof! On some weaker stations, the reference antenna delivered better signal to noise ratios than the pi, but on others, the opposite was true. Radio propagation is a complex thing!

Comparing the pi and the three-element FM beam also proved illuminating. From Balmain, a number of FM station transmitting masts are to the east, and a number are to the north. Community stations are scattered in all directions. Now here is one of the problems with a beam antenna. Which way do I point it? Aim north, and stations east and west, and to a lesser extent from the south, are severely reduced in strength, or cannot be heard at all. Solution – use a rotator. Expensive and a nuisance.

Compared to the beam in a "typical" outside position, the pi showed its form as an "all rounder". The pi could 'pull in' most signals at a similar, and sometimes better, signal strength than the beam from its favoured direction. For stations in other directions, the pi easily outdid the beam. If your home is located such that the majority of stations are in the direction of one quadrant, then a beam will do its job admirably. The pi will probably do the job, too. But in my situation, a beam has decided disadvantages.

To try out the Terk pi in a different situation, I loaned the review model to my colleague Jack Middlehurst. He lives in one of Sydney's garden suburbs on the upper north shore. His house is located on the side of a ridge which screens signals from the TV and FM stations located largely around the city some 20 km distant. To get decent TV reception, he had to install a TV antenna away from the house so that it could 'look over' the ridge. A masthead amp is located at the antenna.

"With the pi's gain set at maximum, the Terk leaves the wire dipole for dead."

For FM reception, Jack installed a split on the TV feeder. Not ideal, as it affects TV reception, but a wire dipole indoors gave very poor results on the FM tuner.

Well, he reported the Terk pi worked quite satisfactorily. At full gain, some stations would show distortion, which was easily corrected by backing off the gain control. Jack said that the pi would permit reception of some stations that were impossible to receive on an indoor dipole, but that beyond a certain gain setting, the signal-to-noise ratio could not be improved. This is because, there's little you can do to change the "raw" signal-to-noise ratio of weak signals if the signal-to-noise ratio is already poor or marginal, such that it is below the ability of the FM receiver's limiter and detector to improve it.

Back at the office I tried experimenting with different positionings for the pi. It showed limited directionality when stood in the vertical position. I measured the variation to be about 6 dB. On marginal signals, this can mean the difference between reception with some background noise and, oriented for best reception, full quieting of the background noise. It is the "capture effect" of FM receivers that brings this about. A variation of as little as 2 dB can bring the capture effect into play in an FM receiver. Once you've acquired a signal at good strength, twisting and turning the antenna will make little difference.

When operated in the horizontal position, reception on some stations improved compared to the vertical position reception, while reception of other stations was worse. In the horizontal position, I found the Terk pi is best placed on a non-metallic surface. Laid flat on the top plate of the tuner, I found its overall performance was less than when it was positioned flat on a non-metallic shelf a little distance away.

When you have a crossmodulation or an overload problem with your tuner (and they all suffer it to one degree or another), the pi's variable gain control provides a solution where previously there was none. With auto-scan tuners, I find they search across the band and stop on every spurious signal, delivering a distorted cacophony at regular intervals across the band. But, wind back gain control on the pi and it all disappears as if by magic!

Some of the weaker signals are affected by crossmodulation, I find. Again, I found that backing off the gain on the pi permitted crossmod-free reception of these stations.

Appearance wise, it's very attractive. The pi can be obtained in all-black, white or grey. The rubber foot, in each case, is black. A No 12 Vdc plugpack was supplied with the review model, and the proprietor of Communications Power, Laurence Rodny, informs me that plugpacks will be supplied with stocks shipped to retailers.

Summary

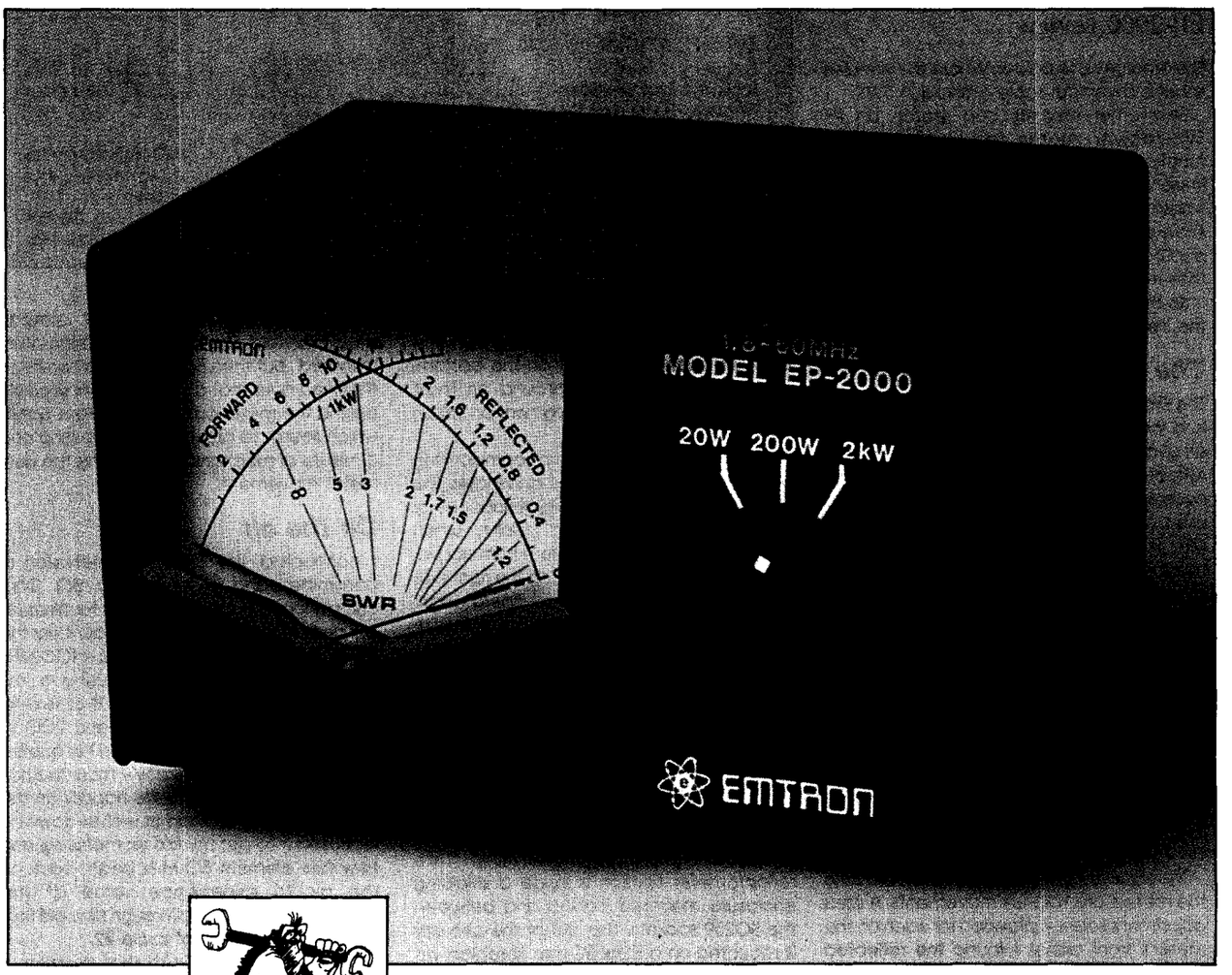
The Terk pi indoor antenna is a stylish and very effective indoor FM antenna. It has distinct advantages to both conventional indoor and outdoor FM antennas, particularly in 'problem' reception cases. While it may not solve problems in all situations, because every situation is different and has individual characteristics, I would recommend it's at least worth a try. Compared to the trouble and expense of installing an external FM antenna, the Terk pi has all the advantages.

If you want and enjoy good sound, why compromise your system with indifferent or poor results on FM reception? If you've paid out good money for a quality FM tuner or receiver, don't skimp on the antenna. You wouldn't put a $10 cartridge on your $600 tone arm or use $1 tapes in your cassette deck, would you?

The Terk pi costs $199, rrp.

Contributed by The Apogee Group

Review unit kindly supplied by Communications Power Inc, PO Box 246 Double Bay NSW 2028. ☎ (02)357-2022. Thanks also to Akai for the loan of the AT-93B tuner and AM-73B amplifier, and to Convoy International for the loan of the Harman/Kardon hk550VxI receiver.



Emtronics' EP-2000 SWR & RF power meter is a robust unit featuring a cross needle type display that simultaneously indicates forward and reflected power and SWR.

INSTRUMENTATION

Roger Harrison reviews the locally manufactured Emtron EP-2000 "cross needle" SWR and RF power meter.

REFLECTIONS ON A REFLECTOMETER

I've said it before. Next to a good multimeter, the basic test instrument every radio amateur's shack should have is an SWR meter, or reflectometer. Having RF power measurement incorporated is a good thing, too.

A reflectometer is indispensable for testing and setting up antenna systems, for tuning an in-line antenna tuner or matching system, and adjusting matching systems on an antenna. An RF power meter is an essential tool for checking and testing any transmitter.

Background

Reflectometers come in three basic forms: single meter types where the meter is switched between a 'forward' reading and a 'reflected' reading; twin meter types where one meter shows forward reading and the other shows reflected; and the cross needle types, which have a dual meter movement, the meters positioned side by side in the same housing with the scales facing each other and the needles crossing in the area between. One meter displays forward power,

the other reverse power. Where the needles cross is a vertical scale marked in SWR.

Few other devices can match an RF SWR/power meter for simplicity and functionality, as it delivers direct readout of important performance parameters in any transmitting system. And it can be used to show actual system performance under the applicable operating conditions. No wonder they're ubiquitous!

So much for the justification. What about the instrument under review?

The EP-2000

The Emtron EP-2000 SWR and power meter is a cross needle type instrument, giving simultaneous display of forward power, reflected power and SWR – no adjustments necessary! The specifications claim it can be used across the frequency range from 1.8 MHz to 60 MHz and is designed for use in nominal 50 Ohm systems. The maximum forward/reflected power ratio it can display is given as 5:1. It features three selectable forward power ranges: 20 watts, 200 watts and 2 kW. The corresponding maximum reflected power ranges are 4, 40 and 400 watts. Accuracy is quoted as better than +/– 10 per cent, which is certainly quite adequate for the majority of amateur radio applications and circumstances. It would suit many other applications too, such as HF marine and HF land mobile and base station installations.

The sheet supplied with the EP-2000 says the meters are 100 uA movements. A zero adjustment screw is provided for each on the meter's front panel. I found the reflected power movement would not zero properly. From a little inspection, I found the screw securing the movement's front panel, removed it, adjusted the offending movement's swinging arm which sets the needle position, replaced the front panel, and had no further problem.

The EP-2000 is housed in a sturdy and attractive all-metal case measuring 125 mm wide by 80 mm high by 110 mm deep. The case is painted two-tone 'jungle' green and has four small rubber feet on the bottom, which prevent it sliding around on most surfaces or scratching equipment on which it may be standing.

As you can see from the accompanying photograph, the meter unit dominates the left side of the front panel, which slopes back a few degrees, improving visibility when typically viewing the instrument from above. The power selector switch is on the right side of the panel. It is a rotary type, operated by a 20 mm diameter black plastic knob with white indicator. The panel lettering is white and very visible, even under poor lighting conditions. The input and output connectors are standard SO239 sockets, mounted 45 mm apart on the horizontal centre line of the rear panel.

The meter scales are quite easy to read from arm's length distance, but should not be read from much further than that for practical purposes. Internally, the reflectometer section is inside a shielding enclosure mounted behind and between the SO239 sockets. The rest of the circuitry is mounted on a 50 x 60 mm fibreglass pc board which is soldered directly onto the rotary switch terminals. Six preset trimpots are on this board, for calibration of each of the forward and reflected power ranges. These are preset at the factory when each unit is calibrated before shipping. Shielded twin-wire cable is used for wiring between the reflectometer section, the pc board and from the pc board to the meter.

The construction appears simple, straightforward and robust. It's not 'laboratory standard', but then Emtron doesn't pretend that it is. I note that a shield plate is secured behind the meter cutout in the front panel, which seems to provide both shielding and a means of mechanically securing the dual meter movement.

SPECIFICATIONS EP-2000

Frequency Range	1.8 — 60 MHz
Input/Output Impedance	50 Ohms
Forward/Reflected Power Ratio (max.)	5:1
Power Ranges:	
Forward	20/200/2000 watts
Reflected	4/40/400 watts
Accuracy	better than +/– 10%
Input/Output Connectors	SO239
Dimensions	125 x 80 x 110 mm

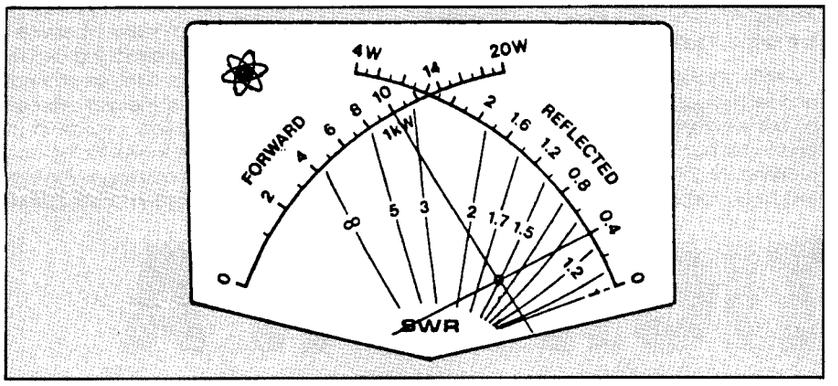
On the air

I connected the EP-2000 between a transmitter and a calibrated 50 Ohm dummy load which had a facility to measure the peak RF volts developed across it. For the sake of verification, I connected a 100 MHz 'scope across the load too, using a low capacitance probe. I checked it at several power levels using the 20 W and 200 W scales. It proved to be well within the quoted +/– 10 per cent accuracy – more like half that. And, yes, it works quite happily on the six metre (50 MHz) band as well as down on HF. I used it to get my old six metre rig and new four element 50 MHz beam back on the air to experience some of the spectacular DX coming through now old Sol's running at the peak of cycle 22.

I also tried it on a load that presents a known SWR and, again, results were well within the quoted accuracy. Accuracy proved to be unaffected by the "standard drop test" – from bench to floor – proving just how robust it is.

The power ranges are sensible, the 20 W range being ideal for Novice licensees, for use with lower power rigs, or for tuning-up and adjustment of antenna systems when low power should be used for courtesy's sake. The 200 W scale caters for the popular transceivers which, in general, run around 100 watts output. If you're running something around the 'legal limit' (400 W PEP on SSB), the 2 kW scale caters for you, but don't expect to be able to accurately know whether you're putting out 380 W or 420 W; the '4' on the scale for this range is only about 40 per cent of full-scale.

Priced at $110, this instrument is well worth the investment. I can heartily recommend it if you're in the market for a good quality, robust SWR & RF power meter.



How the cross needle display works. The dual meter movement indicates forward power on the left hand scale and reflected power on the right hand scale. Where the meter needles cross shows the SWR according to the vertical line markings (they're arcs, actually).

Review unit kindly supplied by Emtronics, PO Box K21, Haymarket, NSW 2000. ☎ (02) 211-0988.

Contributed by The Apogee Group

INSTRUMENTATION

Kikusui has established a considerable reputation in the test and measurement world with its range of high quality, high performance, value-for-money instruments. The newly released COM3000 series is set to further enhance that reputation, judging from the performance evaluation of this one, writes Roger Harrison.

Portable oscilloscopes have long been in demand by those involved in field service. Until very recently, portable oscilloscopes have employed traditional analog technology. However, the constraints of size, weight and power consumption have always impinged on performance, restrictions being placed on instruments at the design stage. Truly portable, as opposed to 'luggable', analog oscilloscopes, offering 100 MHz bandwidth, two channels and maybe two timebases are still a rarity. You can only 'shrink' the technology so much.

Digital oscilloscopes offer advantages by way of unique functions and features that have particular virtues in field servicing of today's electronics and computer technology. But digital storage oscilloscopes, or DSOs, are more complicated than analog types and 'shrinking' them to portable size was a challenge not taken up by instrument manufacturers until a few years ago.

It was the development of several critical technologies that fuelled the design of portable DSOs. Among these were very large scale integration of digital, offering multiple functions in a single device, or a small set of related devices, the marriage of both analog and digital in VLSI devices, and the development of highly sophisticated, programmable microcontrollers. Fabrication in CMOS allowed dramatic reductions in power consumption. Display technology surged ahead too, with refinement of the traditional cathode ray tube (CRT) and development of liquid crystal displays (LCDs).

All this activity fuelled the development of a rash of portable DSOs in recent years by most instrument manufacturers – and we've reviewed some representative examples in ETI.

Kikusui is a Japanese manufacturer which established a reputation for quality and performance in the analog oscilloscope market in the mid-1980s, offering a serious challenge to the dominance of Tektronix and Philips in this market. They have managed to carve for themselves a comfortably-sized niche. Kikusui is represented in Australia by Emona Instruments of Camperdown in Sydney.

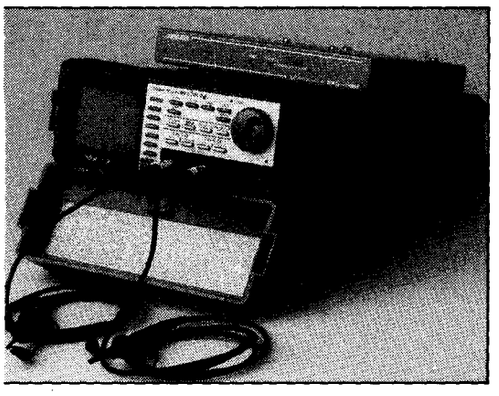
The DSO advantage

In a digital storage oscilloscope, the waveform to be viewed is first amplified in the same manner as in an analog oscilloscope. It is then applied to an analog-to-digital converter (ADC). This samples the waveform amplitude at given intervals, the digital result then being stored in a random access memory (just as you find in a personal computer). From here it can be recalled as required. The values of either all the points measured or only some of them may be recalled. Particular values may be sought out – such as peak amplitude – and recalled for purposes of analysis or display. Digitising the signal and storing it in RAM offers a versatility not available in analog CROs.

To display the waveform that has been sampled and stored, the digital information is recalled from the memory and applied to

KIKUSUI'S COM3101 PORTABLE DSO

Kikusui's COM3101



a digital-to-analog converter (DAC), the output of which then drives the vertical deflection amplifier for the cathode ray tube (CRT). The timebase controls not only the sweep, but the ADC, memory and DAC. The original signal is reconstructed point-by-point and displayed.

The display is actually made up of a series of dots. To improve the visual appearance of the display, electronic interpolation is used to literally 'join the dots'. Various interpolation methods may be used.

Where the display of high speed repetitive signals is called for, a technique called *sequential sampling* is included. This "reconstructs" the signal by sampling it at different points over a number of cycles. The display is progressively built-up with each sweep across the CRT, many cycles of the input waveform being used in succession to build up a single cycle of the display. While this technique can only be employed with repetitive waveforms, and not transient events, note that the input need not necessarily be a sine wave.

A problem unique to digital storage oscilloscopes is the phenomenon called aliasing. The ADC is 'clocked' at a pre-determined rate to sample the incoming waveform. Where a high speed signal of complex form is being viewed and the ADC clock rate happens to be lower than the input signal frequency, the signal displayed on the screen will have completely different timing. This phenomenon is called 'aliasing'.

A good example to illustrate the problem is in trying to display an amplitude modulated RF signal. This is a composite signal made up of a high frequency carrier and a much lower frequency modulating signal. The object is to view the overall signal, showing the amplitude variations caused by the modulating signal. However, the ADC sampling rate has to be much lower than the RF carrier frequency and all you're likely to see – because of aliasing – is some representation of the low frequency modulating signal. Not terribly satisfactory.

To overcome the problem, the better instruments employ an analog signal peak detector circuit which senses the peak voltage of the input. This is used to ensure retention of the signal peak from the ADC in order to get a proper display of the composite waveform.

Another problem is jitter. When viewing repetitive signals, there will be some difference between the sampling rate and the sweep trigger signal. This causes an uncertainty of plus- or-minus half the interval between samples. Thus, the trace will jitter due to the uncertain triggering. Jitter cancelling circuits are employed to correct the problem. It is especially important when looking at an enlarged view of the input waveform.

High frequency noise on a waveform can mask details that may be important. Good DSOs offer an averaging mode which strips away the noise to reveal the wanted signal.

A particular advantage offered by digital storage oscilloscopes is the ability to get a close-up view of a portion of a waveform. Because the samples of the input signal are sequentially stored in memory, you can electronically 'take out' a segment of the stored waveform and display it. Once you've captured the signal, readout from the memory is readily controllable. Thus, you can 'zoom in' on a glitch or transient for closer examination. You can also 'compress' slowly varying events, effectively 'zooming out' for a view of events that occur over a lengthy time interval.

The real power of digital storage oscilloscopes lies in their facility to store a signal without specific regard to the detailed signal parameters or display mode. The processes of acquiring the signal and then displaying it are largely divorced, which does not happen in the analog oscilloscope. Being able to manipulate the signal once it's captured gave designers considerable flexibility and they have taken imaginative advantage of this.

When examining transients, you often need to view events preceding and/or succeeding it. This can be a great advantage in analysing cause-and-effect situations in a circuit. For this reason, digital storage oscilloscopes provide pre- and post-trigger viewing of transient or 'one- shot' waveforms. This feature is particularly useful in tracking down glitches and transients in both digital and analog circuitry.

Many DSOs include a roll or chart recorder mode, which allows viewing of slowly varying signals that may have periods of seconds, minutes or longer. In this mode, sequentially successive 'bites' of the signal are stored and then displayed, moving across the screen from right to left at a suitably slow rate. A complete waveform is seen to march steadily across the screen. This mode is often used to pick out transient signals that would otherwise go entirely unnoticed.

Kikusui's COM3000 series oscilloscopes comprise four models, two DSOs and two analog models. All are portable types, featuring a 3.5 inch (89 mm) bright, rectangular CRT display, dual Y channels, an *auto* set function, pushbutton function selection and on-screen menu, four setup memories, a frequency counter function, a DVM function, plus delta-V and delta-T measuring functions. Each of the analog, and each of the digital, models is available in either 50 MHz or 100 MH operating bandwidth.

The COM3101

The two DSO models feature maximum 20 megasamples/second sampling in storage mode and simultaneous measurement on both channels. Effective storage frequency for single-shot is 8 MHz; 100 MHz repetitive on the COM3101 (50 MHz on the COM3051).

The COM3101 is a remarkably compact instrument considering the features and functions that are packed in its case. It measures 215 mm wide by 75 mm high by 343 mm deep overall, and weighs just 4.5 kg. It can be powered from the ac mains, 90 to 250 V, 50-60 Hz, consuming around 60 watts. It can also be powered from an external dc supply, 11-16 V, consuming around 48 watts. An optional battery pack is available (BA01-COM), which attaches to the top of the instrument's case. This provides nominally 50 minutes operation from full charge, according to Kikusui. It measures 214 mm wide by 30 mm high by 174 mm deep and weighs 1.9 kg. One of these was supplied with the review instrument.

Digital functions of the COM3101 include signal averaging and arithmetic function modes, four reference memories, four viewing modes (envelope, pretrigger, view time and roll), sine and pulse interpolation.

The vertical channels feature a deflection factor range of 5 mV to 5 V per division in the usual 1-2-5 sequence (10 ranges). Nominal input impedance is 1M//28 pF. You can have separate signals on each channel, add the two channels or operate in alternate and chopped mode – all familiar analog instrument facilities.

The COM3101 sports two timebases. As is typical with analog CROs, you can run the timebases in normal mode, single shot or auto. They can be triggered from either input channel or an external input, and the triggering boasts the usual ac, dc, HF-reject and TV horizontal coupling modes. The display can be driven by timebase A alone, A intensified by B, or B separately triggered. Sweep time range for the A timebase is 20 ns to 100 ms per division in the usual 1-2-5 sequence, yielding 21 ranges. The B timebase range extends from 20 ns/div. to only 50 ns/div. (20 ranges only). Delay jitter is quoted as 1/10,000.

Vertical axis resolution is quoted as eight bits, 25 dots per division, while horizontal axis resolution is 10 bits, 100 dots per division. This

results in a very clear, unambiguous trace. There are two display memories of 1024 words/channel.

Probably *the* outstanding feature of the COM3101 is the automatic search-and-set function. There is a pushbutton on the instrument's front panel prominently marked 'AUTO'. When you've hooked up the DSO to a circuit, pushing this button causes the instrument to select automatically the optimal vertical deflection and timebase ranges, and even the input signal channel, so that you can view the signal without having to waste time running through the various Y input sensitivity and timebase settings to get a sensible display. It's a ripper feature!

The single-key auto setup facility for oscilloscopes was pioneered in the marketplace by Philips a few years ago. It first appeared on their top-line instruments, then was gradually featured in models down the range. I didn't think it would be long before other manufacturers emulated such an effective facility.

The front panel design of the COM3101 (and the others in the series) is quite unlike both conventional analog CROs and other DSOs. As you can see from the accompanying photograph, there is an array of pushbuttons or keys, and a large rotary knob. Kikusui refers to it as an interactive setting system.

When setting it up, a menu is selected and displayed on the CRT. The desired mode and function are selected with keys for the X and Y sections, and the range, variables and other parameters are varied using the rotary knob. It's actually easier to do than it is to read about! If you're used to operating a conventional oscilloscope, this takes a little getting used to, but it turns out to be quite efficient, particularly if you use the AUTO search-and-set key first up.

Four set-up memories are provided for storing panel settings you may find you use frequently. These settings can be recalled at the touch of a button, as they say. If you install the optional GPIB interface (IF03-COM), up to 100 steps can be stored.

The CRT trace is quite bright, even when viewing high speed waveforms. It should be – 12 kV is applied to the accelerator. The graticule is an internal type and is clear, with good contrast. The display shows, apart from the signal waveform(s), all the setting parameters, measured values at cursor set points, values measured by the DVM (which, incidentally, works on channel 1 only) and frequency counter values (in real mode).

Like all good DSOs, the COM3101 provides an *envelope* mode, allowing the display (and measurement) of AM modulation envelopes. In addition, aliasing caused by input signals greater than half the sampling frequency can also be detected. Noisy signals can be averaged, the number of sweep cycles for averaging being selectable from 2, 4, 8, 16, 32, 64, 128 or 256.

In digital storage mode, the CRT display is continuously updated. However, using the *view time* function, you can change this so that the display is updated once per second or once every two seconds. A *roll mode* is provided for viewing very low speed waveforms (as explained in my preamble). The incoming waveform is digitised and stored in memory. It is then written on the display continuously, new data being displayed on the right of the CRT while the old data is shifted off-screen to the left. You can freeze the display at any time using the trigger and pause functions.

The COM3101's pretrigger function permits you to select the trigger point at zero, 1.3, 5.1 or 9 divisions of the CRT display. This is extremely handy for viewing what happens *before* and *after* the trigger point of the waveform or event being viewed.

The instrument's arithmetic function allows you to take the signals in channel 1 and channel 2 and add, subtract or multiply them.

"The COM3101 is a sturdily built, well thought out and designed instrument."

The add or subtract function is used, for example, in singling out crossover distortion in audio amplifiers. The multiply function can display a power waveform by operating on a voltage waveform in channel 1 and the circuit's corresponding current waveform in channel 2.

Construction of the COM3101 is very sturdy. The front panel is covered by a nattily designed fold-down 'protector' that props up the front of the instrument and also serves to house probes. These go behind a panel which details the menu table, right where you need it – no need to continually refer to a manual! This front panel protector sports an integral carry handle.

Ergonomically, the COM3101 is a delight to use, despite its compact dimensions. I tried it out on a variety of digital and analog circuits to put it through its paces. Because I found it quite unlike other DSOs, I looked through the manual before turning it on. Satisfied I could make sense of it, I plugged it into the mains and switched on. Nothing. Not a squeak, not a light. A blank screen and no sign of life. Must have done something wrong, I thought I checked everything. The power cord, the fuse (the manual told me where to find it), switch and all. Still nothing. Back to the manual. Aha! There are two switches to operate when powering it from the mains: one on the front panel (which I was using) and one hidden in a recess on the rear panel. It still pays to read manuals – but more closely.

The AUTO search-and-set function is a *dream*. It just saves so much time and bother. I connected the COM3101 to a circuit that develops a rather complex waveform across an inductive load, containing high speed spikes, damped oscillations, exponential ramps and all. I tried getting a sensible display the conventional way, trying various combinations of X and Y settings, and trigger modes. Such a waveform makes trigger setting, in particular, a nightmare. It took me some 20 minutes to obtain a sensible display. The auto function took all of a few seconds. Smart.

With a sensible display, I could then get into pretrigger viewing, expand the trace to view selected sections, scroll it backwards and forwards across the screen, measure amplitudes and periods, etc. It's great to be able to measure a multitude of parameters from a signal, connecting just one instrument.

Once acquired, the display was rock steady, with no evidence of jitter. I tried viewing the same signal using a VHF analog oscilloscope from another manufacturer which features excellent trigger facilities and specifications and an auto set facility. The COM3101 was decidedly better at the job.

The pushbuttons have a good tactile 'feel' and positive response. The rotary selector knob is an excellent idea that works well. The two Y channel inputs are located on the front panel, which some portable 'scopes don't manage – to their detriment. The external X input is located on the right hand side apron, just behind the front panel. This input is not used as often as the Y inputs, and I found this to be a sensible, easily accessed location.

The battery pack screws neatly on the top plate and connects via a D-sub connector arrangement. Rechargeable Nicads are used. I did not get the opportunity to try the unit in battery operation.

Summary

The COM3101 is a sturdily built, well thought out and designed instrument that offers the power, features and functions of many benchtop DSOs in a portable form. I think it offers very good value for money.

The COM3101 is the top unit in the COM3000 range. It is priced at $6348 ex-tax for the 100 MHz version and $5665 ex-tax for the 50 MHz version. The battery pack option costs $594 ex-tax and the GPIB (IEEE-488) interface, $996 ex-tax.

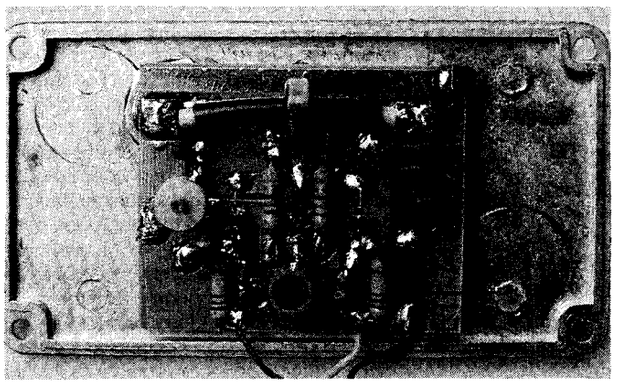
Contributed by The Apogee Group

The COM3101 reviewed was supplied by Emona Instruments, 86 Parramatta Rd, Camperdown, NSW 2050. ☎ (02) 519-3133. Fax: (02) 550-1378.

ROGER HARRISON

ANSWERS & ARGUMENTS

This column is intended as a forum for exchange between you, the readers, and the magazine. Via this column I'll answer queries on projects, general questions on electronics and related subjects that may puzzle or concern you, engage in a little argument on topics of interest, or discuss subjects you might like raised. It's up to you! Short letters will be appreciated, long ones may be edited; if asking questions, confine your letter to one or two topics please. Send your letters to: Locked Bag 888, Rozelle NSW 2039.

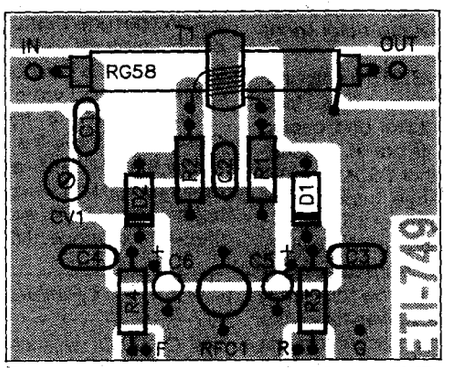


Showing the construction of the ETI-749 SWR Meter — the picture missing from the article in January's issue.

The picture, please!

I have a puzzle regarding the project ETI-749 SWR Meter, published in the January issue. On page 123, in the first paragraph under the heading *Construction*, you say that the components are mounted on the copper, or track, side of the printed circuit board "...as can be clearly seen from the accompanying picture." But, search through the article as much as I could, nowhere could I see such a picture. It looks as if it could have been right there on the page, just above the artwork for the edge meter scales. Was there ever such a picture, and if so, could you please show it in the magazine? It would help me, and no doubt other readers, to build it. The component overlay, on page 124, seems to have had the track pattern (in red) transposed left to right.

I.B., Coburg, Vic.



The component overlay for the ETI-749 SWR Meter. This was shown incorrectly in the January issue, on page 124.

Yes, you're quite right, the picture is missing and the overlay has the track pattern transposed. Unfortunately, the production system currently used for the magazine prevents checking this at the absolute final stage before printing, and if something goes completely missing, or (as in the case of the overlay), the pattern is transposed ('flopped', as they say in the trade), such errors get through.

The missing picture and the correct component overlay for the ETI-749 SWR Meter are reproduced herewith (with prayers offered for safe passage).

Prices, please!

All advertisements and news should include prices. ETI is a great magazine – even my wife reads it. The projects are great and it's good to see technical and general articles. The magazine has good balance and good presentation overall.

J. S., Port Arlington, Vic.

Good. Thanks. (By the way, what do you mean "...even my wife...?")

ETI-1623 I/O Card Kit

After contacting several suggested retail stores, both locally and interstate, I was unable to locate a 24-line input/output card (ETI-1623) kit, as featured in ETI, June 1989.

It would be greatly appreciated if you could please let me know a source of supply.

G. M. H., Gosnells, WA.

Well, kits as such are not available. However, you can obtain a pc board from the author, Graham Dicker, as detailed in the caption beneath the component overlay on page 49 of the June '89 issue. The five components required for this project are all items commonly stocked by many electronics retailers. For the pc board, contact:

Graham Dicker *PC Computers*, 36 Regent St, KENSINGTON S.A. 5068, ☎ (08)332-6513

Advice on the ETI-459 Transmission Line Speakers

Some time ago I built the Transmission Line Speakers designed by Richard Timmins and published in ETI in August 1977 (Project 495).

I believe their performance is still pretty good, especially since I substituted SEAS metal dome tweeters for the original KEF T27s. But I wonder if I might achieve even further improvement in detail at the top end by

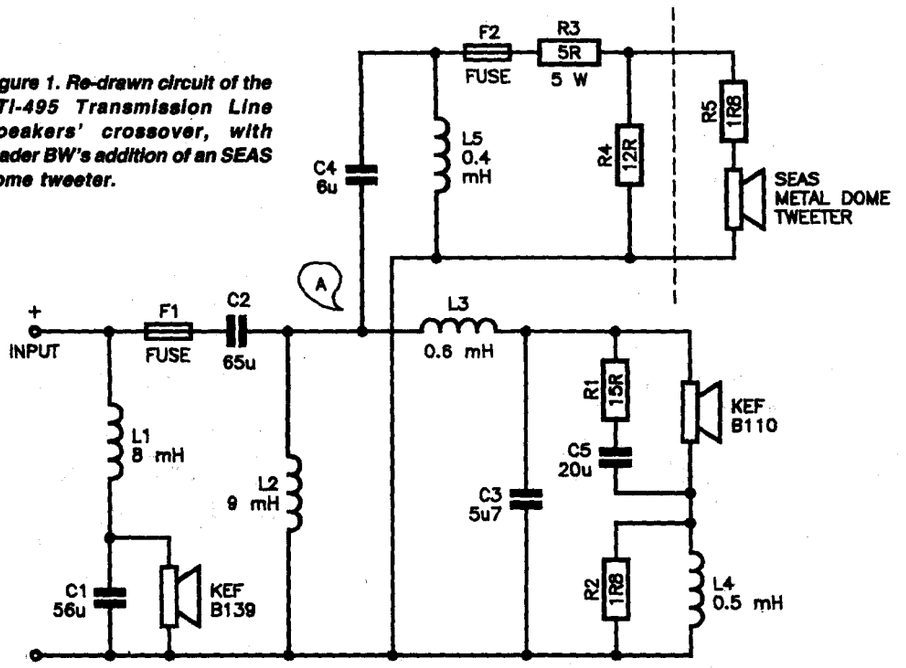


Figure 1. Re-drawn circuit of the ETI-495 Transmission Line Speakers' crossover, with reader BW's addition of an SEAS dome tweeter.

alteration to the crossovers.

I notice that most more recently designed crossovers separately feed each drive unit directly from the input through only its own part of a crossover network. Whereas, in the ETI-495 design all units are fed in series so that, for example, the high frequencies are all first passed through a 65 uF capacitor.

It is a straightforward matter to alter the design to a "parallel" setup (especially for the tweeter) using mostly the same components. Or does this really require a complete redesign of the crossover? I do realise that this article was published a long time ago, but I imagine there may be other readers interested in your comments. I think there may still be a few of these speakers around as they were well known and popular among hi-fi buffs.

B. W., Bulleen, Vic.

I've redrawn the ETI-495 crossover circuit here (Figure 1), with your modification of the SEAS dome tweeter added. I've arranged it so you can clearly see that the three sections are not really "in series."

The 65u capacitor (C2) and inductor L2 (9 mH), form a simple high pass filter that attenuates the extreme bass, so that energy from this part of the audio spectrum, which is often at high levels, is not applied to the midrange and high frequency drivers. While the response of these drivers is attenuated down at the bottom end of the spectrum, it is finite. Speakers such as these, because of their extreme bass performance, are often called on to reproduce material with lots of bass at extremely high levels. This energy can affect the performance of the mid and top end drivers.

It is not often appreciated why active loudspeakers, where the drivers are individually driven from carefully designed electronic crossovers that virtually delete out-of-band signals before amplification, sound that much better than speakers of the same configuration with conventional passive crossovers.

Try switching the line at 'A' from its current connection to the input and do some listening tests with material containing lots of deep bass at high energy levels (Toccata and Fugue, or Japanese folk drums – six metre diameter monsters!). I'd be surprised if the top end reproduction was better over all. Moral of the story here is – an active system would be even better. But your cash position would be even worse!

I don't see why you've put a 1R8 resistor in series with the SEAS tweeter. You'd be better off re-jigging the values of R3 and R4 to better match the sensitivity of the SEAS tweeter to the KEF B110 mid-range driver. For a reference on how to go about this, see: "Principles and Problems in Loudspeaker Design", Part 2, by David Tillbrook, ETI February 1980. pp 136-142.

Project identification

I have a dual tracking power supply which I believe is an ETI design as the PCB is identified with ETO14 and the front panel is lettered with "E/T Dual Power Supply".

If this information is adequate to confirm that the power supply is indeed an ETI design, would you please advise if it would be possible to obtain a circuit for same from your magazine or perhaps a copy of the original article.

D. W. C., Fraser, ACT.

The project you have is no. ETI-105, published in November 1971. Copies of the article are available from our Reader Services department at a cost of $4.

For readers wanting copies of articles for past projects, contact: Reader Services, ETI Magazine 180 Bourke Rd, ALEXANDRIA NSW 2015

Battery monitor circuit

I have an item of battery-backed equipment and would like to install some simple circuit that flashes an LED, or whatever, when the battery voltage falls below a pre-determined value (preset via potentiometer).

N.B., Goulburn, NSW.

I think we can oblige. The accompanying circuit, Figure 2, originally appeared in the Ideas for Experimenters column in 1983, and subsequently in "Circuits Cookbook #5", page 63.

Submitted by reader CW Catherwood of Lismore NSW, it is quite a simple circuit. The transistor and 10k trimpot form an adjustable voltage divider. The collector of Q1 provides bias for the gate of the C106 SCR. The voltage on the transistor's collector depends on the base current – which is determined by the battery voltage – and the value of the 10k preset.

When the battery voltage is high enough, the transistor's collector voltage is below the SCR's gate threshold. When the battery voltage falls sufficiently, the transistor's collector voltage rises and the SCR turns on. The SCR will then conduct, providing supply to the flashing LED.

The 5V1 zener maintains the voltage required by the flashing LED, while the 470R resistor and 10u capacitor determines its flash rate.

You can take it from here!

Contributed by The Apogee Group

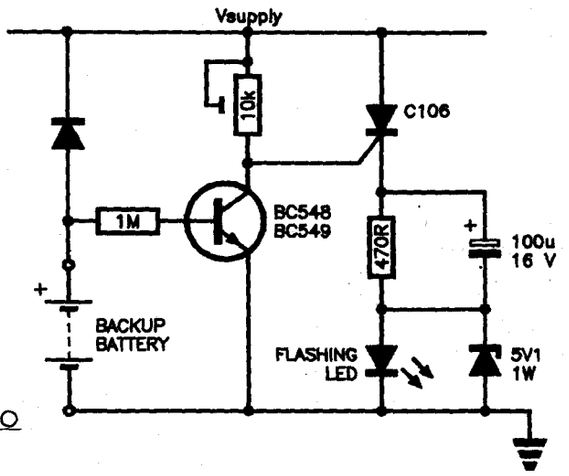


Figure 2. Battery monitor circuit. The Flashing LED warns you when the backup battery level falls below a preset voltage.

BUFFOONERY

HISTORY, PHILOSOPHY AND THE LAST LAUGH

The 1960s were in full swing. Harold Holt was PM, Andrew Peacock was but a colt. The Rolling Stones were in their twenties, jazz and folk music were top of the pops in Australia. The Vietnam war was escalating by the week and conscription was a four-letter word among tertiary students of the nation. History was in the making ... it's just that some weeks are more historic than others.

The immediate years after World War II, educationally, had concentrated on vocational training, suiting the needs of the time, national reconstruction and all that. Then the 1960s baby boomers swamped the tertiary institutes, seeking an education more than a strict vocation.

Educationalists of the period hurriedly put together educational/vocational courses to suit the demand. So science and engineering courses included compulsory units of history and philosophy, history and philosophy courses included compulsory units of science and mathematics, and courses in computing ignored the trend and got on with teaching FORTRAN, COBOL and ALGOL – BASIC was yet to be "invented."

Between Vietnam moratorium protests and exercises in draft-card burning, science and engineering students sat through lectures and tutorials on the History of the World's Great Religions, The Ideas of the Great Philosophers and similar uplifting, mind-broadening subjects.

Ideas learned here were immediately applied to such practical pursuits as The Collision of Inelastic Spheres on Horizontal Surfaces, Getting Out of Lab. Work, Minimising Essays & Getting Away With It, Convincing the Faculty Head that Institute Rules Permitted Proxies to Attend Lectures On Your Behalf, etc.

A colleague of mine was pursuing the same course as myself during that period, encumbered with a draft card and student's exemption from call-up while he continued his course (subject to satisfactory performance). In order to prolong his exemption for as long as possible, he was very much "into" Creative Course Reconstruction; which meant passing the minimum number of subjects per year and accruing extensions for completion of other subjects.

But one year came the day of reckoning. Following the half-yearly exams, my acquaintance was summoned before the Head of the Liberal Arts Faculty to explain his poor (read non-existent) progress in a subject euphemistically described as History of Ideas. The first half-year had covered the great philosophers, which time my acquaintance had spent getting acquainted with the great philosophers of The Student Prince, a hotel of apt name and appropriate location (or is that loquacion.)

"My boy," said the Head of Faculty, addressing my friend in a condescending manner despite the age of the addressee. "Your progress in this course has been jeopardised by your persistence in other activities.

"I must warn you that failure is inevitable, unless you embark upon another course of action," he said, menacingly.

"And what course would that be?" questioned my friend.

And the Head of Faculty boomed, "You must put Descartes before the sauce, my boy!"

Girls cheaper and more flexible than pc boards?

LIKE many simple ideas that have revolutionised our world, printed circuit boards met with a difficult birth.

Paul Eisler, the man who invented the printed circuit, recounts a true anecdote about one "false start" on the way to their birth in his autobiography, My Life with the Printed Circuit.

In 1936, Eisler approached the British Plessey Company, seeking to demonstrate a printed circuit radio, the practical realisation of his technique that "printed" the wiring connections between components using copper laminate on a phenolic board.

Eisler claimed that his printed circuit manufacturing technique would improve reliability, simplify production, enable the miniaturisation of circuits and create new products and markets. The directors of Plessey couldn't see it, telling Eisler that his printed circuit would replace the work carried out by "girls" and that "girls are cheaper and more flexible!"

Discouraged, Eisler turned to other things.

The sagacity of Plessey's directors almost literally blew up in their faces. The first non-laboratory application of printed circuits was in radio proximity fuses (ironically, an American invention) fitted to anti-aircraft shells, used so successfully against the German V1 "Doodle Bug" flying bombs, just five years later in 1944.

Today, the electronics and computing industries depend on the humble printed circuit board. Paul Eisler, the last laugh is yours.

Contributed by The Apogee Group

SOUND INSIGHTS

ETI'S AUDIO & HI-FI SUPPLEMENT

CHALLIS IN WONDERLAND

Louis' report from the USA

BITSTREAM'S THE GO!

Philips has won a major battle in the marketing war between rival CD player manufacturers. Roger Harrison explains how the company has leapfrogged the DA converter debate with 'Bitstream' which, they claim, overcomes inherent non-linearities in conventional converters.

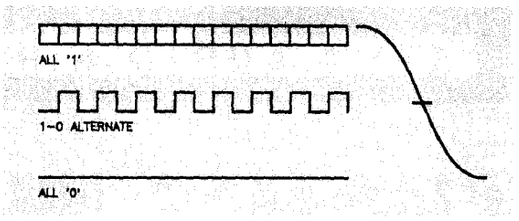


Figure 2. How the 1-bit continuous conversion process works.

The technology that converts digital data on a CD into sound is good, but not perfect. The digital-to-analog conversion process has inherent limitations which different manufacturers mask in different ways.

A conventional D-A converter uses the binary weighted current divider method. A series of currents is generated, one for each bit of the incoming stream of 16-bit binary words. These currents must vary in precise steps, each a factor of two. In a good 16-bit D-A converter, the current value for the most significant bit (MSB) must be generated with an accuracy of 1/65,536 (about 15 parts per million) of the least significant bit (LSB). This problem becomes more severe for D-A converters using a greater number of bits.

The accuracy with which bit currents can be generated is normally limited by inherent inaccuracies in the values of analog components inside the D-A chips, such as resistors. Other effects, like temperature changes and long-term drift in component behaviour, also impact on accuracy. Such effects can be corrected by using an averaging technique in the D-A's current divider, as Philips feature in some of their chips.

The new 'Bitstream' conversion technique is claimed to eliminate non-linearity problems at the source, rather than attempting to correct them at a later stage. Developed by Philips, it operates almost entirely in the digital domain, avoiding the potential inaccuracies of the analog voltage-adding operations performed in multi-bit D-A converters. The actual conversion to an analog signal is performed only at the very last stage in the process. A flow diagram of how it works is shown in Figure 1.

Since in theory any converter operating at more than 1-bit resolution is subject to non-linearities, the new technique operates on a high-speed 1-bit data stream. Which is where the name 'Bitstream D-A conversion' came from. With this technology there is no longer any need for the multiple bit current adders, with their dependency on the accuracies of analog components.

The 1-bit high-speed bit stream operates at a frequency of 11.2896 MHz. It is obtained from the stream of 16-bit digital words coming from the CD by a code conversion process. Quantisation noise is said to be eliminated by a 'noise shaping' process, which enhances resolution in the audio frequency band.

At the same time, an 'upsampling' process is performed on the digital bit stream, so that the original 16-bit data stream with four-times oversampling is converted into a 1-bit data stream with an effective oversampling rate of 256 times. This oversampling rate corresponds to a frequency of 11.2896 MHz, which is 64 times higher than the original four-times oversampling rate.

The conversion of the resulting 1-bit high-speed data stream into an analog signal is performed by a switched capacitor network. In this network, the switching of the capacitors is controlled by two signals representing the logic '0' and '1' levels of the incoming bit stream, together with a continuous clock signal. The 1-bit data stream is converted into an analog signal using a 1-bit D-A converter (see Figure 2).

The potential non-linearities of the 16-bit system, which can result in weighting errors on the individual bits of the 16-bit binary words, are thereby completely avoided, according to Philips.

The Bitstream D-A conversion technique has another advantage over multi-bit systems. It is well known that such systems are subject to cross-over distortions caused by the switching of the most significant bit around the zero level, and glitches at each bit transition. Since these processes are not required in the Bitstream system, an additional source of non-linearities is eliminated.

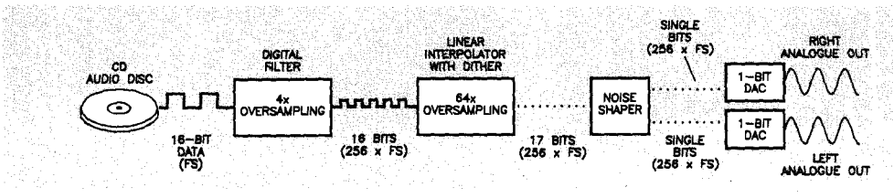


Figure 1. Flow diagram of the Bitstream D-A conversion process.

New check tape

GERMAN tape manufacturer BASF has collaborated in the production of a new test cassette tape. The prestigious German hi-fi magazine *Audio* has released the new test cassette under the name *Soundcheck*.

There has always been a close relationship between test cassettes and BASF. At the beginning of the eighties, the magazine *Hifi Stereophonie* produced the official DHFI test cassette for the German High-Fidelity Institute. BASF Chromdioxid Super 11 was used exclusively as tape material.

Since the DHFI test cassette has been unavailable for years, BASF decided it was time to offer dedicated hi-fi fanatics something comparable again. However, since *Hifi Stereophonie* had long ceased to appear as a publication, another producer had to be found.

Wolfgang Feld, *Audio's* CD reviewer, met the idea of bringing out a new test cassette with enthusiasm, especially as he

COVER STORY

This month's cover shows the Marantz CD-60 compact disc player. Its features include dual 16-bit D/A converter; 4 times oversampling; FTS (favourite track selection) programming with auto-start; 20-track random programming; extended track programming modes; repeat and edit modes; 33-key remote control; CDM-4 laser mechanism; and Marantz DBus I/O. Further information from Kym Biddell, Marantz (Australia) on ☎ (02) 742 8440.

Also on the cover is Philips' CD Autocleaner. This has an internal motor and gear train controlled by an electronic circuit for automatic, one-touch cleaning. In a radial action it moves a moistened chamois from the centre of the compact disc to the outer edge in 20 seconds from start to finish.

It is powered by battery, or an optional AC adapter, comes complete with cleaning fluid and an extra chamois, and retails at $49.95. For further information contact Philips' Accessories ☎ (02) 742 8311 or (03) 790 0777.

ASC voice logging systems

THE System AS400 is designed for simultaneous recording of up to 64 channels on a 24-hour master tape. Because of the automatic self-checking device of all important sub-units utmost security of recorded information is guaranteed.

The cassette recorder ASN 200 D is particularly suited for short-term documentation on one or two tracks, e.g. as an electronic memo-book. The automatic record level control combined with the voice actuated switch (VOX) ensures continuous recording without operator intervention.

Due to the autoreverse facility, the cassette recorder AN2 has a recording capacity of up to 16 hours. The 4-channel version of the AN2 allows recording of up to 4 different calls simultaneously.

System DS 4 is for applications where recorded data have to be read back in an extremely short period of time.

Any recorded call can be selected immediately without unending rewinding of a cassette. The DS 4 has no mechanical parts. ASC's voice logging systems are distributed in Australia by Trace Technology ☎ (03) 646 5833.

READER INFO No. 217

Classy Class A

THE Series 500 features a power output of 25 watts Class A operation per channel, and thermionic valves with superior linearity, stability and load tolerance.

According to distributor Audio Products, the unit also offers value in terms of sonic quality/cost, without sacrificing power out. It has been given its unique look by means of situating the thermionic valves in a semi-circle on the top of the unit.

For further information contact Doug Osmond, Audio Products ☎ (02) 997 466.

READER INFO No. 218

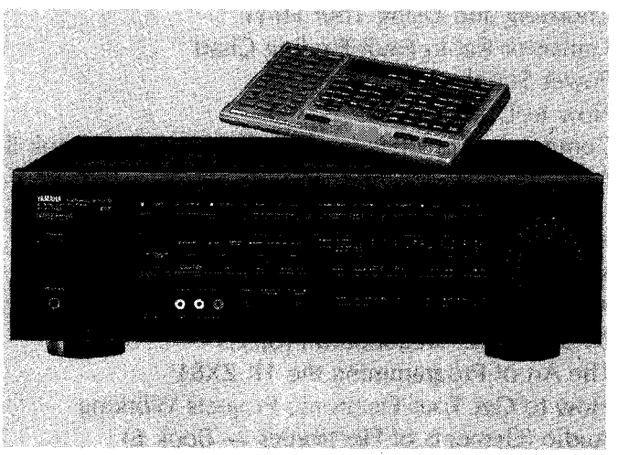
New Yamaha AVX amp

REPLACING the AVX100 AV Amp but retailing for $100 less, the AVX 700 offers five channel amplification: 65 w/ch for main speakers; 14x2 w/ch for rear processing of surround sound; and 14 w (mono) centre channel drive for faithful reproduction of Dolby encoded video tapes and laserdisc.

It has Dolby Pro Logic built in, which will decode Dolby encoded videos, Yamaha's Simulated Surround, Live Surround and Hall Surround; Yamaha Active Servo processing or conventional amplification for the main speakers; 9 audio inputs and 4 video inputs; S-VHS capability; test tone generator for correct volume setting of each channel and a learning capable remote control.

The AVX 700 retails at $1199. For further information, contact Yamaha Music Australia, ☎ (03) 669 2388.

READER INFO No. 219



and his colleague Peter Bengel had praised the quality of the new BASF Chrome Maxima II. A special series of the Chrome Maxima II was produced with a white housing and playing time of 50 minutes.

While the Digital DAT master was produced with test signals at the *Audio* test laboratory, the mixing and filtering of the sample music were entrusted to the sophisticated electronics of the Stuttgart Sonomaster Studios. Each cassette was copied at the original speed of 1:1 from the DAT master tape.

The master machine used for this was the Pioneer D-1000 DAT recorder, from which the signals were played directly onto 10 works-selected Revox recorders adjusted with the BASF Calibration Mechanism Cassette.

To bring out the very best from these recorders, each one was readjusted by the calibration computer after each recording. As *Audio* puts it "There is no better way to copy cassettes."

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Audio (Elements of Electronics — Book 6)	BP-111	**$16.00**

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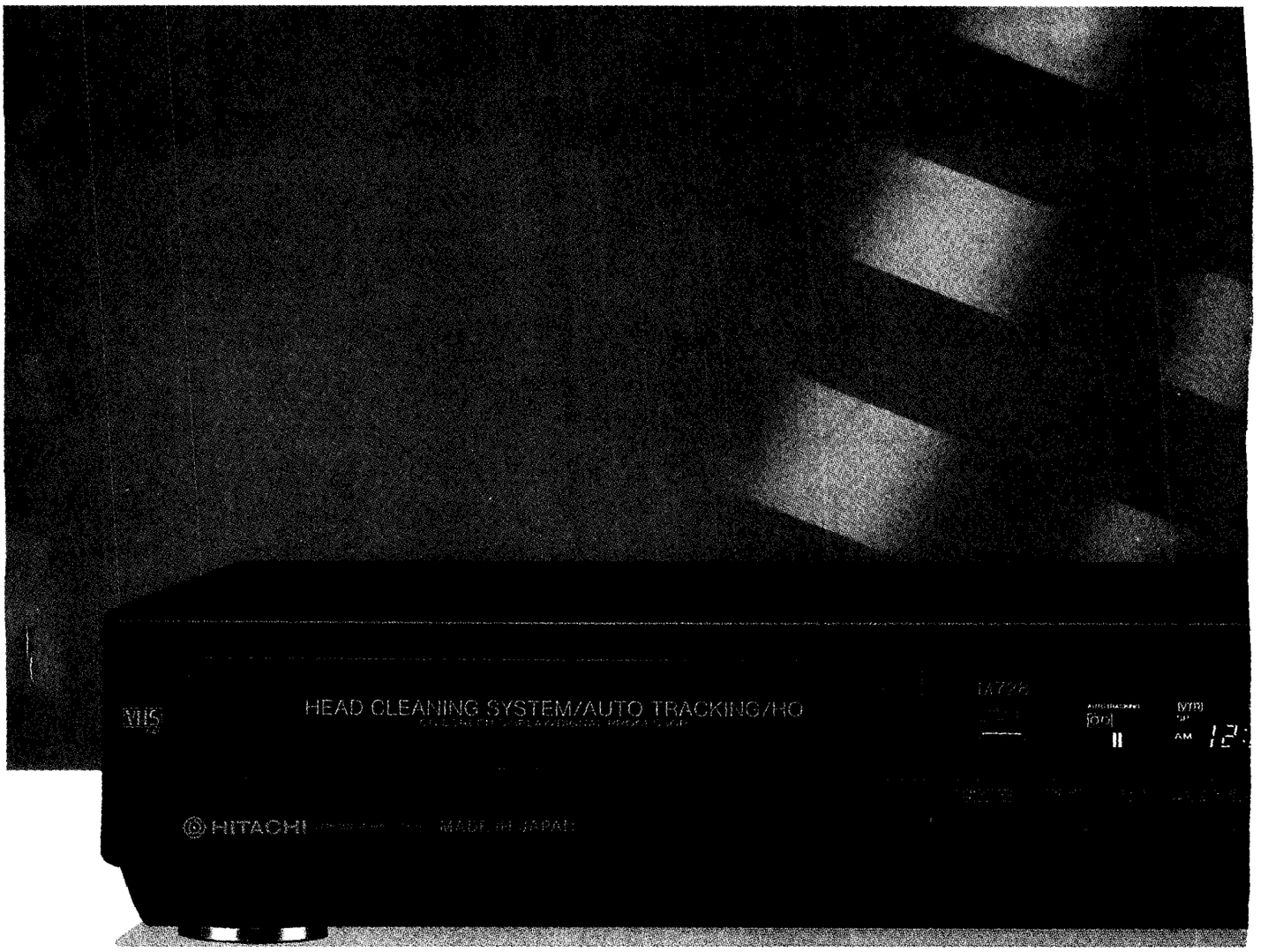


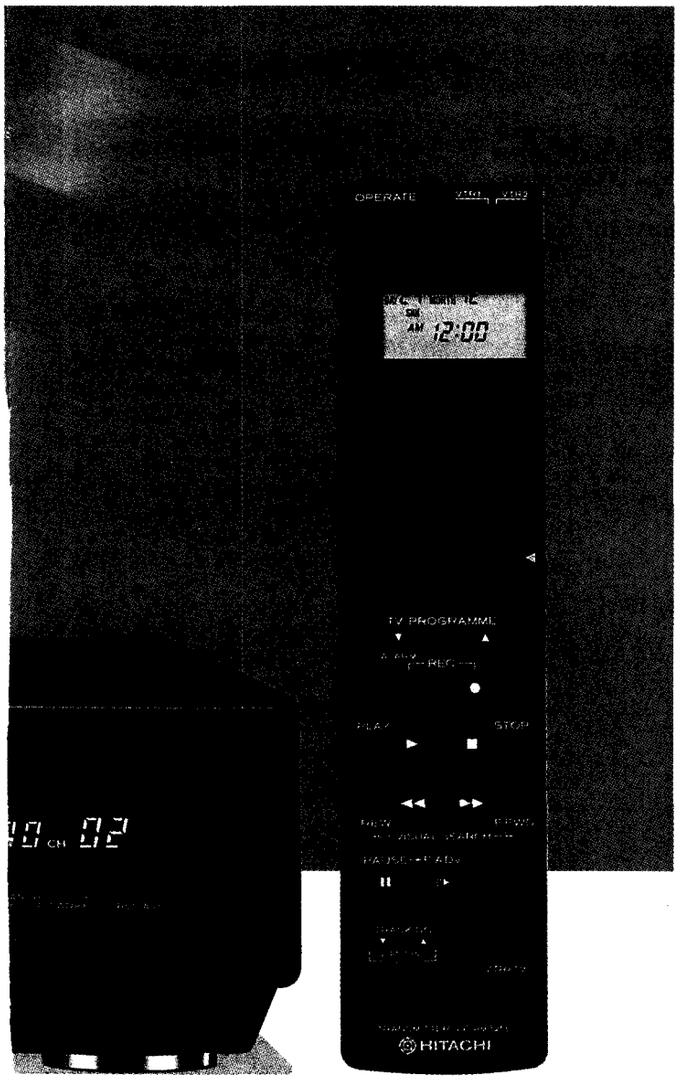
NO MORE DIRTY VIDEOS?

Hitachi has launched a new VCR that cleans video heads automatically. Les Cardilini looks at the Hitachi Video Deck Model VT-M728E (AU), and at the dangers of cleaning video heads that it may circumvent.

How often should the heads in a VCR be cleaned? Perhaps more importantly how do you know when the video heads need cleaning and how should you clean them?

Dirty video heads ordinarily make the picture appear snowy or streaky. Applying a head cleaning tape can help; but first test that the problem is with the VCR and not the TV set or the antenna, by playing a prerecorded video cassette.

If the quality of the video picture is normal,



then the video heads are probably doing their job satisfactorily, in which case cleaning them would be a waste of time. In fact, depending on the type of cleaning device you use, you could inadvertently be doing more harm than good.

One trap for the unwary when cleaning the heads in a VCR is that unlike the relatively large and robust metal heads on audio cassette decks, the metal core of a video head in a VCR is made from wafer-thin ferrite, normally protected in the head drum assembly (the bright, shiny, cylinder-like part visible through the loading compartment door on many VCRs).

These brittle ferrite tips are likely to snap under abnormal stress – for example if a thread from a cleaning cloth is caught on the head and pulled, or if too much pressure is applied. Not only does this render the head

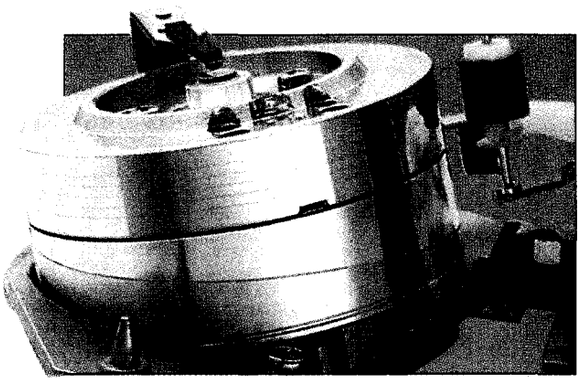
useless, but the knife-sharp edge that is characteristic of a broken video head might also permanently damage videotapes subsequently played in the VCR before the broken head is replaced.

Head cleaning devices and fabrics typically have a chamois texture. If they do not, threads may catch on the video heads or the cloth may leave behind lint. This can then foul parts of the VCR mechanism or adhere to the videotape and cause picture dropouts if it gets between the tape and the head while the tape is playing or recording. Minor dropouts in a VCR usually show up as random, bullet-like streaks on the screen. Severe dropouts might wipe out large areas of picture, momentarily.

Head cleaners fall into one of two categories, wet or dry. Both require care in their application. A wet cleaner uses a solvent to remove contamination from the heads. They tend not to abrade the video heads, but several minutes should be allowed for the solvent to dry out before playing a tape in the VCR, to ensure that the solvent does not adversely affect regular tapes.

Dry video head cleaners are typically abrasive and work by scraping contamination from the head. They can also grind down the ferrite tips of the heads with careless or excessive use.

Cleaning the heads might be better left to an experienced technician, especially when the oxide has packed tightly onto the heads and requires a little elbow grease to remove it. Other parts of the machine, such as the drum, belts and pulleys might also be in need of attention if the machine has had a lot of use.



How do heads get dirty?

A video head has a microscopic slit or gap in its ferrite core which must remain "open" to the tape for the head to operate efficiently. In practice, the gap can become clogged with magnetic powder stripped from the tape as it rubs against the head while it is playing. The clogging is what we are referring to when we say the heads are dirty.

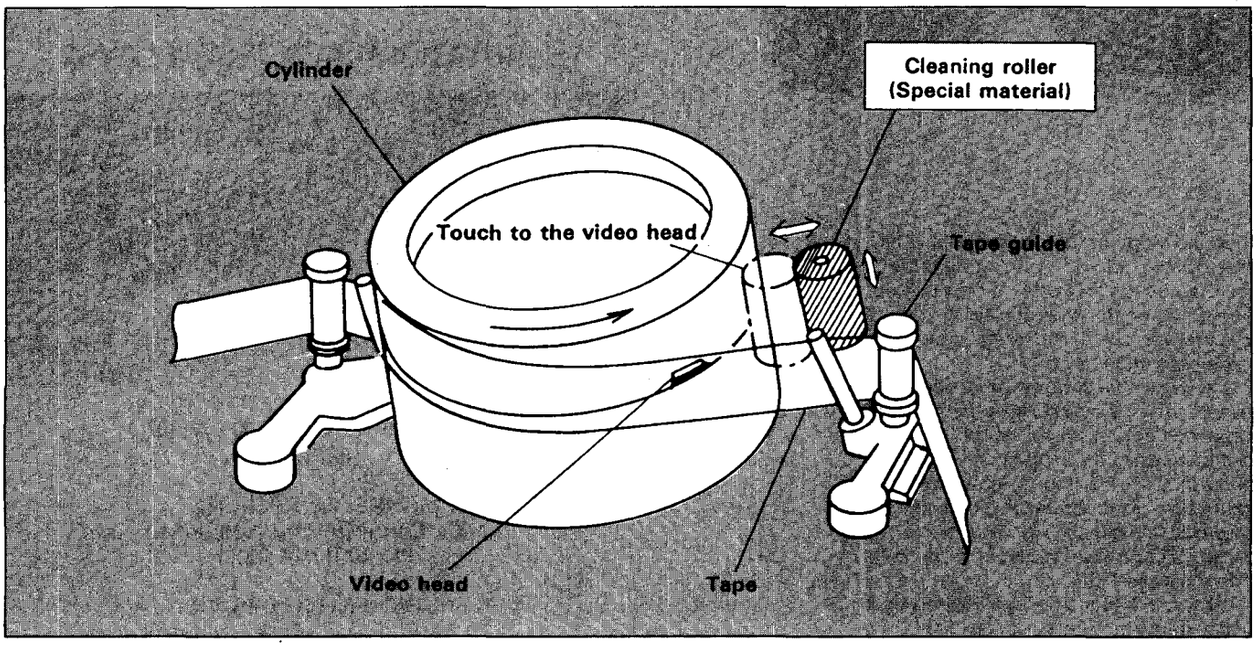
The picture from a VCR that has dirty heads typically becomes streaky and snowy – or may disappear altogether, depending on how much oxide sticks to the tip of the head and how tightly it is packed together.

The heads themselves are not large, and oxide deposits which are invisible to the naked eye can affect their performance. The problem can arise suddenly to build up over a long period. It can happen to all VCRs, new or old. It may never happen to some video enthusiasts.

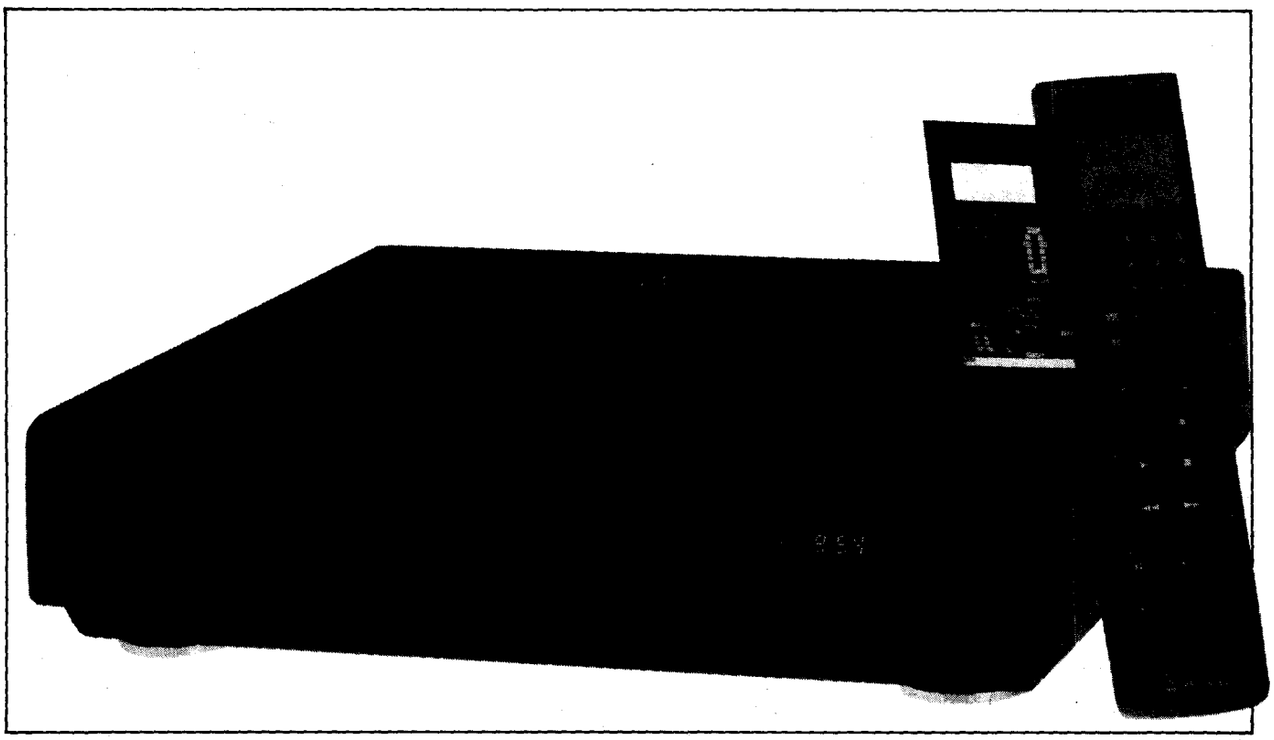
A VCR that has dirty heads is not necessarily faulty. So don't worry if your new VCR or a set that has just been repaired has dirty heads. The problem might even reappear immediately after the heads have been cleaned – though if this happens regularly, it might be grounds for changing the brand of tape or at least having the VCR serviced.

Hitachi's new approach

A new approach to cleaning the video heads in VCRs is adopted in Hitachi's VHS Video Deck Model VT – M728E (AU). Recently



The auto head cleaning system cleans the video heads automatically when recording or playback starts and finishes, to prevent dirt from accumulating on the heads.



released for sale in Australia, the new Hitachi VCR features, perhaps for the first time here, an automatic, head cleaning system that is located *inside* the VCR.

The mechanism comes on automatically for approximately one second each time the PLAY button is pressed, and again for one second as the videotape is being unloaded. The video heads are therefore cleaned before each tape begins and after it has finished playing. The soft, dry, lint-free head roller cleans the heads and presses against the spinning head drum as it cleans. It should therefore help to prevent the tape picking up grime left on the drum by, say, another videocassette.

One of the main difficulties with having dirty heads in VCRs (or tape decks generally) is that grime begets grime. Oxide deposited on the heads tends to increase friction between the head and the tape. More oxide then comes off the tape and so the process continues, packing the oxide tightly onto the head. Removing the potential oxide build-up before and after each playing, with a non-abrasive cleaner should therefore reduce the likelihood of heavier contamination.

The new Hitachi VCR also has a HEAD CLEANING push-button on the front panel in case the heads become dirty despite the preventative cleaning. Pressing this button activates the head cleaner system which performs six cycles of head-cleaning action.

The front-loading Hitachi VHS Video Deck Model VT-M728E(AU) is diminutive – only 370 millimetres wide and 89 millimetres high, to match the dimensions of midi hi-fi systems. It has a strikingly simple front panel as most (if not all) functions including programming, clock and TV program selection are handled on the infrared remote control.

A hinged front cover on the remote control neatly hides all but the regularly required buttons for TV channel selection and operating the VCR. The time of day and the date are conveniently shown on a liquid crystal display (LCD).

"One of the main difficulties with having dirty heads is that grime begets grime."

Aids to programming the VT-M728E(AU) include on-screen displays and menus for presetting TV channels and setting a variety of functions, including normal, daily and weekly programming options and the time and date in the system clock and calendar.

During program viewing, the on screen display (OSD) shows the current status of the system: which channel is selected, VCR mode, time and date, and more. The system can be preset to highlight these program details briefly on the TV screen whenever the TV channel or the VCR mode is changed or, alternatively, the display feature can be disabled from the remote control.

A built-in timer caters for preset recording of up to eight programs for a one-year period and the details of up to four regularly recorded TV program spots can be stored in the remote memory as the need arises, and transmitted via the infrared remote control to reprogram the VCR as often as required. Should you wish to confirm that an important recording gets away to a good start, an audible alarm in the remote control can be set to sound when the preset recording is to commence. The remote control can also be used to control functions on a second, compatible, Hitachi VCR in the same video system.

Digital Automatic Tracking is used in the VT-M728E(AU) to ensure that the heads pick up the best signal from the tape to optimise picture quality. If preferred, the tracking system can be adjusted manually at the remote control to cater for tapes recorded in other VCRs, and to eliminate vertical jitter in "still frames" when the VCR is in the PAUSE mode.

So the next time you see a bird preening itself before it absconds after feasting in your favourite fruit tree, don't get mad – think of the Hitachi self-cleaning VCR "smoothing its feathers" as it prepares to play its next videomovie!

Recommended retail price for the Hitachi Video Deck Model VT-M278E(AU) is $649 and the set carries a 12 month warranty on all parts, including the video heads. Further information: Hitachi Sales Australia Pty. Ltd 153 Keys Road, Moorabbin, Victoria 3189, ☎(03) 555 8722.

BUFFOONERY

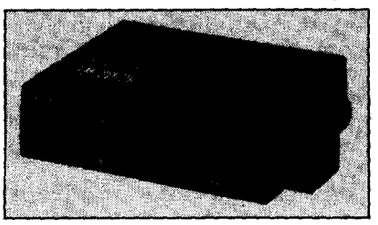
REVOLUTIONS, REVELATIONS

Strange news from Sound Insights

In the necessary course of research into new audio and video products for Sight & Sound News we newshounds are often faced with a quandary. Since Australia is not the be-all and end-all of international markets, many worthwhile products are, unfortunately, not available here. Do we publish or not? Usually, we wait until they become available before telling you about them.

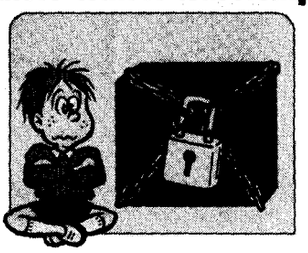
However, there is another category of overseas products, news of which you are missing altogether. The products are generally so weird and wonderful that no-one seems to want to stock them here. Now lately, we've been feeling guilty about this, because somewhere among these strange gadgets the germ of the next microbiological revolution might lie. We wouldn't be able to sleep at night if we thought that one of our competitors was going to break the news about the next big thing, so editorial judgement is now suspended and here are some of those gems we've been keeping from you.

The absentee parent



The IM 20/20 Eye Guardian from the Imax Corporation of Japan effectively monitors television viewing distances. Parents can monitor their children's TV viewing distance without being present. The Eye Guardian creates an adjustable infrared zone that senses the presence of a viewer. When in the non-viewing zone, the sensor is activated and a yellow warning light flashes. If the viewer remains within this zone for more than the adjustable pre-set time, the Eye Guardian automatically removes all signals to the TV set. It is easy to install and to operate.

Remote control censorship



Protection from rampaging TVs is big business in Japan. The Master Command 11 from the Victor Company of Japan, (JVC), allows you to place those more *sensitive* channels under lock and key. (You know the type we mean.) Viewing access to any of these channels requires the previously set 3-digit number to be entered.

Voices in your head

Development of the inner ear headphone is progressing in leaps and bounds. Sony has one, Aiwa released five in one month. Here are some exclusive pictures of what one hopes isn't as painful as it sounds. They come in white, black, pink and blue.

Simply the best

While the world is understandably concerned with the depletion of the ozone layer, Sharp Corporation may have inadvertently stumbled upon the solution. The OZ-201 RS is an ozone generator located in the fridge. It is marketed as a deodoriser but the true significance of this serendipitous gesture has not gone unnoticed.

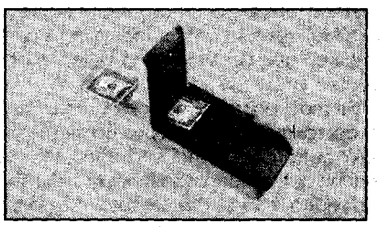
Life in the fast shower

The model TP-10000 handsfree shower-phone with the AM/FM radio, from Tele Peak (Far East) Ltd of Hong Kong, allows you to not only receive but also place phone calls whilst in the shower. We are unsure whether lack of Telecom approval or the fact that it doesn't have FM stereo has stymied Australian distribution.

Watch out for falling TVs

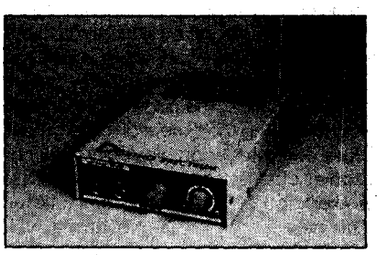
Many of you have wanted to suspend your TV from the ceiling. (Haven't you?) Now, Kyoei Shoji of Japan has released ceiling brackets in a variety of models for different sized TVs. The model TH-A2 will also accommodate side speakers. We trust that the threat of suspension from the ceiling will improve the quality of the programs?

Check your change



The PASCAL 101 is a U.S. currency validator – which automatically checks the validity of the currency at a rate of up to 60 notes per minute. Just the thing for when those counterfeits are coming at you thick and fast.

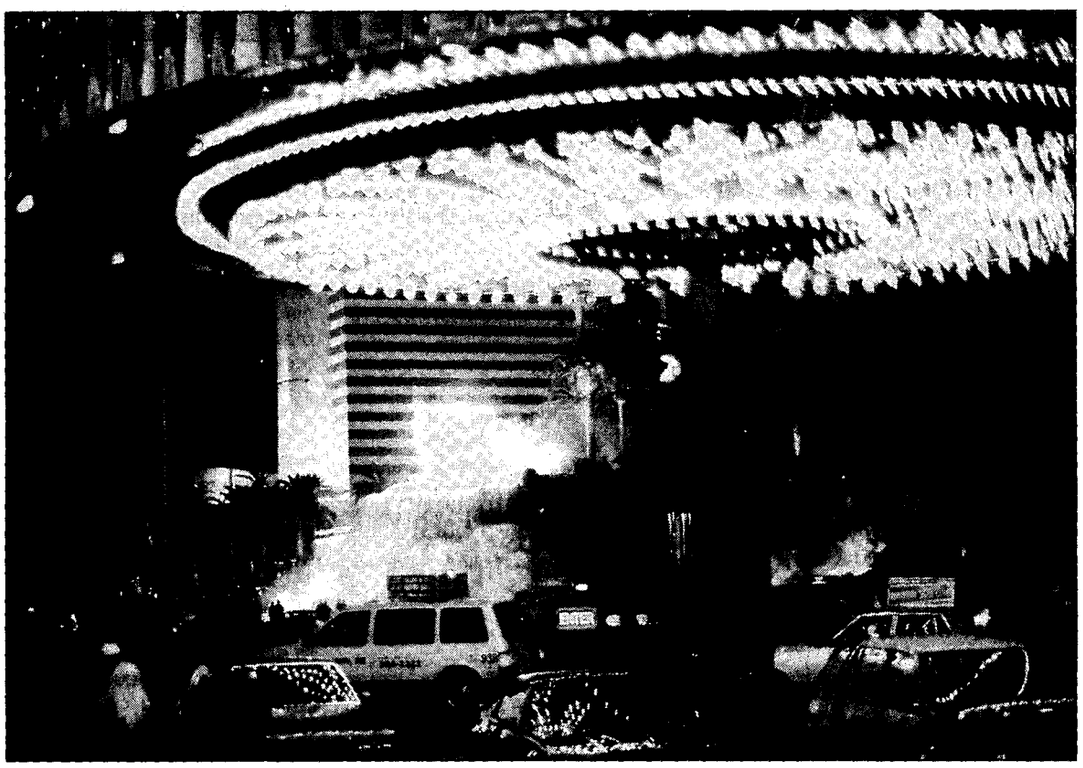
Amaze and amuse your friends



The Infra Noise voice shifter's usefulness is not immediately obvious. It lets an actor play two roles in a duet, male and female, and also transforms an old voice into a crisp and youthful one. Or it can be used as an intercom to discourage overly aggressive salespeople!

By Mary Rennie

CHALLIS IN WONDERLAND



Louis Challis follows the white rabbit and lands on his feet at the 1990 Winter CES in Las Vegas.

The summer Consumer Electronics Show (CES) in Chicago and the winter CES in Las Vegas are the two largest consumer products shows in the world, each attracting in excess of 80,000 visitors from more than 100 countries to what have now become legends in their own time.

Even though many manufacturers tend to wait till the Chicago summer CES for their most important releases, the winter CES continues to attract crowds of marketing and public relations personnel, international buyers galore, and hordes of journalists, all of whom are just itching to describe the new goodies.

This year's winter CES offered the same sort of razzamatazz that one would expect from an American presidential election convention, with Hustler Bunnies signing their autographs on photographs and lots more colour than you might otherwise have expected. As you might guess, with more than 80,000 visitors in town, every hotel and motel in Las Vegas was filled to capacity.

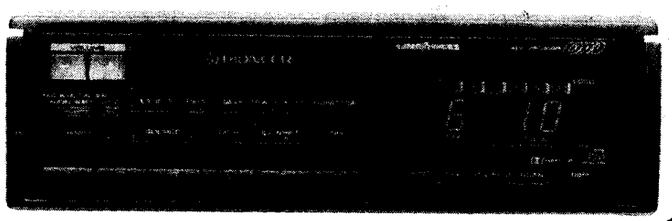
Each year, I detect subtle changes in the pulse of the consumer electronic market, and this year is no exception. Underlying pressures have built up and surfaced in a number of areas which are of vital importance, not only to the American market, but quite significantly to our readers in Australia and New Zealand.

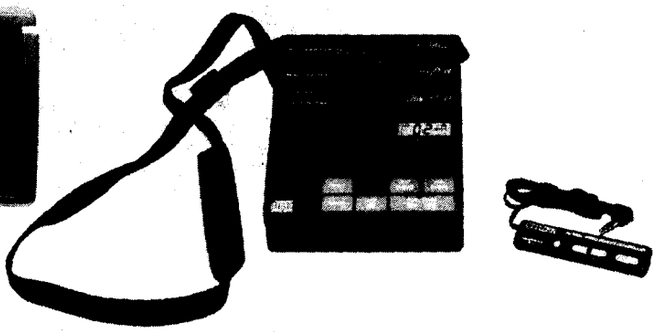
Growing secure

Over the last two years I have noted (with more than a little concern) the extent to which the security sector has been growing at the CES, with almost a whole pavilion (which would cover more than five hectares) devoted to that disturbing, and increasingly important market.

Almost every manufacturer of car audio equipment now offers a removable, draw out or security rated car audio or car CD system, with the emphasis in America tending away from the more esoteric motion detectors, key codes, and fancy alarms (some of which utilise amplifiers and speakers to shout out: *Please call the police – this car is being stolen!*). The main thrust has been to adopt a simpler and less expensive design approach, which tends to discourage theft by hiding the main electronic units in the boot of the car. The control functions are then provided by either hard wired, pluggable or wireless remote controls, most of which now use small 'pocketable' consoles. As you would expect, most of these employ supplementary dashboard brackets, placed so that you can readily see the LCD and LED displays and the simple push button controls, which require a panel about half the width of the normal car AM/FM cassette player console.

At last year's CES, there were just two stands openly displaying 'electronic





protection equipment' in the form of high voltage crowd controllers. To the uninitiated, these devices generate between 40,000 and 150,000 volts at a widely spaced pair of terminals. These may be at the end of a night stick (if you like to keep your assailant at a distance), or at the end of a little module slightly bigger than a cigarette pack (if you're prepared to let them get that close). This year, there were at least seven stands displaying these wares, with lots of orders from Asian, European and American buyers who obviously have a market that is ready and willing to accept them.

Another security product which caught my eye was the crime stopper EP3000 Electroplate which provides moving messages on a license plate frame. It lets you program up to eight messages, each of up to 115 characters, and 'readable' from up to 25 metres. Once programmed, you can switch on from your dashboard control panel. What I couldn't find out was what sort of messages other than ads or emergency signals you might wish to display.

The other clearly observable growing trend, was the provision of 'car finder' facilities – for people like you and me who experience difficulty finding the proverbial 'needle in the haystack' in a large, open air or underground parking station. These devices variously flash the car's headlights, sound a short strident blast and can, on demand, leave the car's headlights on for 20 seconds or so – helpful when you are trying to find a door lock in the dark.

Another obvious trend was the 'added features' now offered for 'low end' remote control vehicle security systems. As well as switching on and off your alarm, these now provide attractions such as 'last door arming', 'starter kill', an output to 'flash for parking lights', 'panic', and 'intrusion memory', complete with two stylish transmitters, all for US $ 165.00.

Sirens and strobes

Not to be outdone, a burgeoning range of home burglar alarm systems was on offer. These afforded all sorts of new capabilities, including sirens which were claimed to be audible almost from the ends of the earth, fancy displays, super-powerful strobe lights and supplementary systems for either restraining or disabling intruders or for protecting, restraining or disabling your home computer equipment – which, not surprisingly, has become a fruitful market for the ne'er do wells of US society (and ours as well I suspect).

One natty little security device which caught my eye was the Carl Cardkey which 'gives a sense of security' for cyclists (and their bikes), skiers (and their ski gear), and closes off front gates (to keep in tiny tots and Fido!). The main attribute of the Cardkey system is obviously convenience: it fits into pockets and wallets and avoids the perennial problem of finding keyholes in the dark.

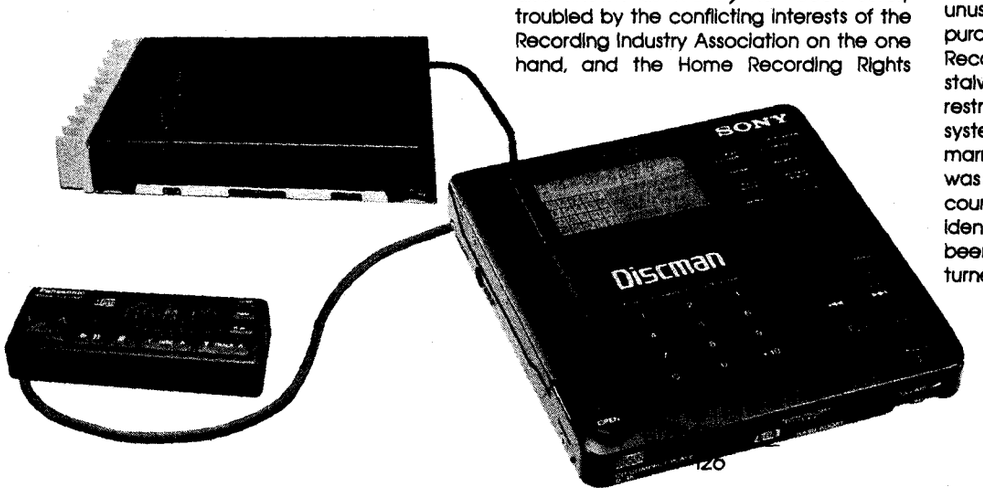
Since 1986, when DAT first made its debut at the Harumi Fairground in Tokyo, amateurs and professionals have been waiting with bated breath for this new technology to reach the stores. The path of DAT (sometimes also known as R-DAT) has been sorely troubled by the conflicting interests of the Recording Industry Association on the one hand, and the Home Recording Rights Association on the other, which says, "Yes! We have the right to tape pre-recorded material!"

Caught in the middle are the electronics manufacturers, who have developed one of the most powerful and exciting technological electronic developments of the last decade, which rivals the CD by providing a comparable quality of recorded signal with a parallel degree of user convenience.

Whilst the marketplace has been champing at the bit, we have been provided with a rare insight into the unusual powers and pressures of the competing American lobbyists working behind the scenes in Washington DC. In one corner of the ring were the lobbyists for the Recording Industry Association, and in the other, those belonging to the Home Recordng Rights Association. We are now aware of the extent to which the various forces and intrigues have kept this product off the American market, and, as a consequence, off the Australasian market as well.

DAT recorders did appear in Japan and West Germany in 1987, and prototypes were available for reviewers in mid-1987. I was fortunate enough to be able to fully evaluate an example in my laboratory and subsequently in the field, but although I had a 'mouth watering' review ready to roll, I faced the excruciating situation of having an embargo on that test material until the political issues were appropriately resolved.

In the last six months we have observed an unusual situation, with Sony Corporation purchasing the prestigious and powerful CBS Records Company. CBS was one of the stalwarts behind the lobbyists seeking restrictions on the marketing of the DAT system so, in effect, the 'good guy' was marrying the 'bad girl'. (I'm not saying which was the guy and which was the girl). Of course, the progeny faced something of an identity crisis in that what had previously been black and white had now suddenly turned into an unusual shade of grey.



It was obviously imperative for Sony to develop the fantastic potential of CBS Records to its fullest extent, without cutting the ground from under it as it might have done if everybody could have bought a DAT recorder and taken home somebody else's CD (or even pre-recorded DAT) to make an illicit or illegal home copy.

Enter Serial Copy Management System, with the memorable acronym SCMS. For the last three years, the brains and brawn (which in this case means money) of the electronics and recording industries have been devoted to the development of a system which would provide adequate, simple, cost effective and foolproof protection for all that wonderful software which you nasty people out there are just waiting to copy, irrespective of the scruples involved or even the legality, or illegality, of such action.

Approximately three to four years ago CBS Records was pushing an alternative system, with a narrow band of frequencies being notched out of the original recorded material so that a system could detect the absence of signal in that band of frequencies. There were so many antagonists, with strong and valid reasons knocking that system, that it died a rapid and fortuitous death, because it just did not work.

Now, after a hiatus of more than three years, you are about to get a crack at digital recording. The electronics and music industries have finally agreed on a technological solution that addresses the fear of rampant music pirating. The Sony and National (Matsushita) Corporations were proclaiming the arrival of DAT recorders incorporating SCMS in the USA in the fall (September/October) of this year.

The technological solution is essentially a copy-limiting scheme which is embodied in an IC (integrated circuit) chip to be installed in every home DAT deck. It will permit you to copy a CD (or a pre-recorded DAT) digitally onto a blank DAT cassette, as many times as you wish. But you will not be able to make a second DAT copy of the first copy. In effect, what SCMS does is to put a code on the first copy that triggers a "don't record signal" in all DAT decks. Ironically, of course, you can make a copy of a DAT copy of analog recorded software (such as an LP, cassette or live microphone recording), because these analog sources do not incorporate the digital 'anti-copy' code which will be incorporated on all CDs and pre-recorded DATs.

All the new DAT recorders on display at the CES now incorporate the SCMS chips, and the software is starting to incorporate the appropriate matching 'fingerprint data' which will trigger those chips.

For all that, the SCMS does not guarantee that the DAT recorders will soon arrive in Australia or New Zealand. For one thing, the agreement between the hardware and software groups appears to be based on the principle that each country will have to adopt legislation which requires the incorporation of SCMS. Whilst the appropriate legislation is being presented to the US Congress, it has not yet been introduced to either the Australian or New Zealand Parliaments. Of course, the companies are free to introduce DAT hardware or software without legislation, and are equally free to withhold them even if the legislation is passed. Some companies will not issue DAT software until they feel that they are adequately protected by law, whilst others are reluctant to issue DAT software, irrespective of whether there is legal protection or SCMS chips inside the DAT recorders.

Pulling out the stops

Not surprisingly, the first breakthrough was evident on the Sony stand, where they were handing out free Sony Classical pre-recorded DATs with matching Sony Classical pre-recorded CDs. I didn't get a chance to play my sample until I got home, and was not surprised to find that most of the superlative

material on both the CD and the DAT was digitally recorded, and already available on the CBS label in Australia. Without any fanfare, Sony has decided to pull out the stops, with a special presentation, including a display of more than $2M worth of digital recording equipment designed to simulate the total digital recording experience by taking show visitors through the entire process – from recording in a digital multitrack studio, through the various stages of digital mixing, editing and mastering, right up to and including the DAT duplication facility. To cap it off, they provided listening rooms where you could hear the music recorded in the simulated studio by students of the renowned Julliard School of Music in New York.

Yes! Sony has finally bitten the bullet, and decided, with other manufacturers I'm sure, to finally cut the 'Gordian knot' and go for broke on this issue. It was intriguing that they were being fully supported by Matsushita which is otherwise an arch rival in such matters. Of course, both companies stand to lose countless billions of Yen if consumer DAT doesn't soon get off the ground..

Nakamichi was displaying its Hi-End model 1000 Digital Audio Recorder, which is destined to do the same sorts of things in the DAT field that the Nakamichi 1000 compact cassette recorder did back in 1973. Apart from costing the equivalent of A$10,000, the Nakamichi 1000P Digital Audio Processor incorpates eight times oversampling digital filters, individually calibrated 20-bit digital-to-analog converters and truly establishes a new reference standard for consumer DAT recorders.

Each D-to-A converter IC has a matching ROM chip programmed at the factory with individual bit error compensation data to provide D-to-A converters that match the theoretical limits of 20-bit performance. Intriguingly, the system design has been based on accommodating new technologies and further advances in system control, through the adoption of replaceable plug-in modules which the company intends to upgrade as time progresses. I have been promised the opportunity to review the Nakamichi 1000 Digital Audio Recorder as soon as the first unit arrives in Australia.

Other intriguing developments in the DAT field were AIWA's portable DAT player which is neat, small and really exciting – if you have pre-recorded DAT material, and the adoption of the DAT format for storing and accessing the same sort of material and capabilities which are currently being offered by CD ROM and CDV. The displays that I attended convinced me that with appropriate computer hardware, you could either develop your own in-house software, or extract information from other commercial sources to provide capacities comparable with the largest commercial or computer hard disc systems as either a primary data source or as a backup system.

If DAT developments were exciting, the CD field was even more so.

The first news I received after walking through the doors at the CES was from Len Feldman, whose vehicle number plate boldly proclaims Mr Hi-Fi, and who holds a prestigious position in the US consumer electronics field.

Len proudly advised me that there are now CD players in more than 20 per cent of US homes, and the penetration rate is now galloping along at a percentage increase of the order of four per cent of households per year. Obviously, many households have more than one CD player, and, consequently, conventional record players and even compact cassette players are feeling the competition.

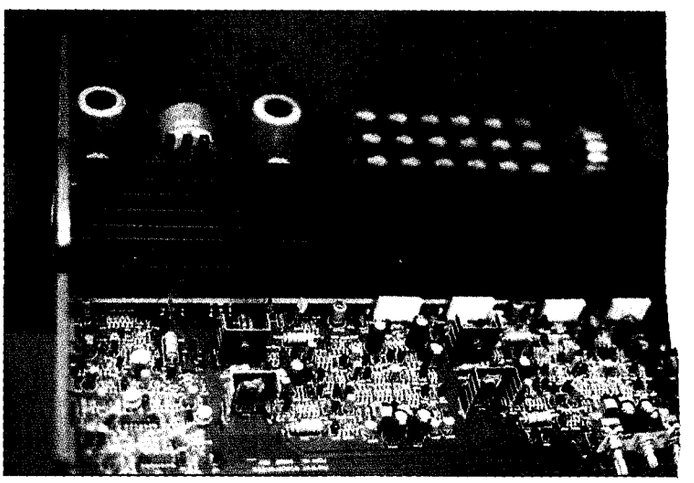
If I had mistakenly believed that the Japanese, Europeans and Americans had already achieved perfection in their CD players, based on the blurbs, hype and publicity on the individual stands, then I was obviously sorely misguided. Almost every manufacturer was claiming state-of-the-art advancements in the quality not only of their product, but of their sound. A closer look at the sales statistics for CD players in the United States was intriguing in that Sony sales were well in advance of their nearest competitor, with a whopping 17.48 per cent market share. Sony is selling almost twice as many CD players as the next ranking company, Pioneer (source of data: Audio Week, January 1990). What I could not find out was whether the sales lead is due to the quality of their product, better advertising, superior marketing or better pricing.

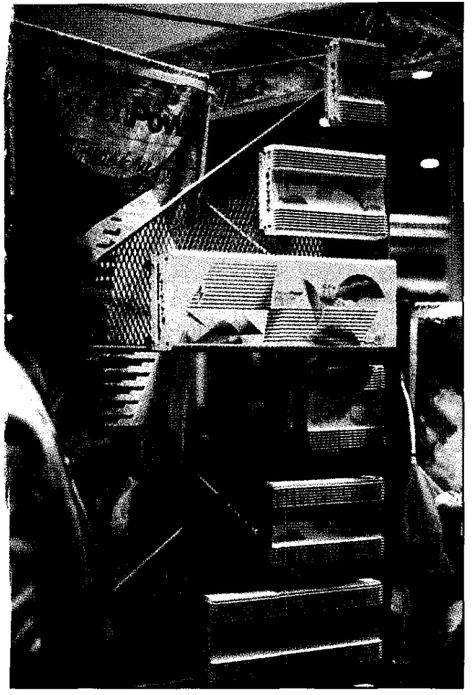
As you may guess, all eyes were on the Sony stand and there was plenty to see. Sony's well known ES line of CD decks was complemented by its first "high density linear converter system" led by the CDP-X77ES with a selling price of US $ 1,700. I listened briefly to this new offering and was impressed with what I heard, although the listening conditions were far from perfect. In fact, I found only one listening room out of the hundreds at the CES where they had taken the trouble to acoustically correct the room through the appropriate use of insulation and acoustical foams on walls, ceiling and parts of the floor.

Not to be outdone, almost every other manufacturer of electronics equipment whose name comes to mind was offering a range of either home, automotive, or 'Discman' style CD players. Sony's D-35 fourth generation portable CD player featured a range of firsts that were astounding.

It incorporated a 10-key control pad to facilitate 'one-touch' programming and direct access to any selected track and a 'program/time edit' function which makes it easier to record onto any cassette deck.

Thus, for example, if a C90 tape is being recorded, then the D35 will search the CD to find the combination of tracks that will





best conform to the recording time of the selected cassette. The playback sequence that the D-35 has determined is then displayed on its liquid crystal display. The 'Time Fade' facility is something that I find desirable on my Nakamichi Dragon compact cassette recorder, but did not imagine would be adopted for a portable CD player. Nevertheless, it is a real winner. It is supplemented by the 'Auto Spacing' facility, so that the two-second time break can be pre-recorded onto your tape in order to provide more effective track search functions on your CD player. The adoption of a 'Sleep/Wake-Up Timer' provides an added degree of flexibility, converting the unit into a fully functional bedside alarm clock with music, when used with the portable active speaker system. With a whole host of other features, including rechargeable battery, weight of just over 1 lb and suggested RRP of less than $400 Sony has another winner in the wings.

Sony was not the only company to offer Discman style players. Among the more prestigious, yet unexpected, firms was Casio, with its attractive MS419 and MS450 players.

The Koreans were there in force, with both Samsung and Goldstar displaying conventional single and multi-disc players as ME-TOOs, following the revolution that Pioneer started five years ago. Not surprisingly, Sony, Hitachi, Mitsubishi, National Panasonic and a large number of other manufacturers including Philips, Magnavox and Marantz were also displaying multi-disc or carousel type CD players.

The automotive CD player scene has burgeoned in a way that I would not have imagined, with Sony displaying its fourth generation CDX-A100 'DiscJockey' with relatively sophisticated technology at a suggested RRP of under $900.

Sony has sensibly maintained a compatibility between its first generation car CD hardware and subsequent units, but has provided significant enhancements in dust exclusion, condensation control and compatibility, with a wide range of Disc Jockey remote commanders and cassette control head units. Removable car CD receiver players were being displayed by Alpine Electronics, with its attractive Model 5903 (which I noted, with interest, will fit into the cradle of my dashboard), as well as CD Shuttle Controller and boot Disc Jockey modules, which offer many of the features provided by the Sony Disc Jockey system. Most of these units feature 16-bit eight times oversampling capabilities and dual digital to analog converters coupled with disc sensors which will play 3-inch discs without an adaptor.

Panasonic was displaying its 12 disc car changer (two more than the Sony model) with four times oversampling, two x DACs as well as two different styles of removable CD changer controllers and matching two x 25 watt amplifiers to blast you and your passengers with higher power levels.

As exciting as the DAT and CD developments were, there were even more exciting developments in the compact cassette field, where the most obvious and insidious change was in the development of 'special length' cassettes. The ubiquitous C90 cassette has suddenly been partially supplanted by the C100, after loads of people complained about the inability to record a complete CD on one side of a tape. Now every major tape manufacturer has jumped on the band wagon and is producing C100 tapes.

There were other major developments in the tape field, with significant emphasis being placed on reducing tape cassette physical modulation. I saw some impressive demonstrations of the extent to which the new shell designs were able to minimise low level intermodulation noise. There were also some exciting developments in the miniaturisation of pocket cassette recorders with weight reductions of up to 45 per cent being achieved by some manufacturers in their quest for the subminiature grail.

The section of the CES that I found most disturbing this year was the outdoor car audio exhibition, which sounds, for all the world, like a jet engine test cell as you approach it along the pathway which runs from the convention centre to the Hilton Hotel.

Disturbing noises

The parking lot (and associated tent city) where the members of the 'International Sound Challenge Association' had hung up their shingles was attractive to the eye, but disturbing to the ear. As I recall it, last year's record was 152 decibels of sound pressure level at the driver's seat; this year's record was a staggering (and frightening) 155 decibels, proudly proclaimed by a rosette stuck on one of the vehicles.

Lest you should have any false images, I have spent much of the last two years designing state-of-the-art acoustical treatment to reduce the peak noise levels produced by our new F18 jet fighters, from levels which are less than 155dB down to levels where our RAAF maintenance crews will be adequately protected.

When faced with the naivety of imbeciles seeking to outdo 'jet engines with after burners', and who are aiming to produce amplified sound levels approaching those of intercontinental missiles (right at the aft end where all the fire, brimstone and acoustical action is taking place), the hairs at the back of my neck start to stand up, and you can undoubtedly see the fear in my eyes as I look for an escape route.

All is not lost, however, for even whilst I was at the CES, the American press was announcing that the mobile stereo boom would face restrictions imposed by US legislators.

As I strolled along Waikiki Beach the day after the CES closed in Las Vegas, I heard a car approaching from at least half a kilometre away. By the time it reached me I had my fingers firmly in my ears. One does not normally expect (nor gird one's loins against) such attacks on city streets, or in taxis as you leave for the airport – another unwelcome incident I experienced the next day.

Fortunately, we have appropriate environmental protection laws in almost

every state in Australia, and though I note that many of our car audio suppliers are offering more powerful amplifiers and more efficient and powerful speakers we have, thank goodness, not yet reached the diabolical sound levels that this crazy new American religion is seeking.

One other major display item at the CES was high definition television, which I had previously viewed in Japan and which Philips expertly displayed (their own PAL version), at the Opera House in November, 1989.

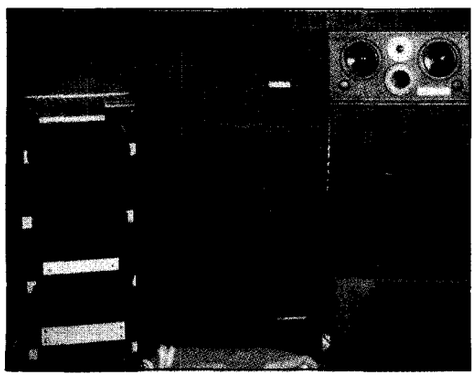
The American FCC has currently rejected the concept of a new American Television Standard to replace the current NTSC 525 line system, and, as good as HDTV is, if it can't offer appropriate compatibility with the existing transmission and/or receiving equipment, it will not be able to make progress in a market that is so strongly entrenched. The displays that I saw were exciting, but lacked credibility for any application other than 'home theatres' and 'private video cinemas'.

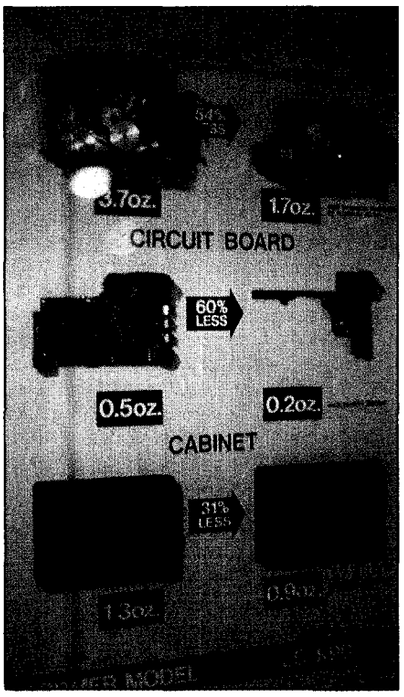
I suspect that this is not the first time that Philips has correctly gauged market requirements and users' real needs, at a time when the Japanese have chosen to sit on Cloud Nine and view the situation through rose-coloured glasses. My bet is that the Philips system will be more readily acceptable than the Japanese HDTV in Australia, and will gain slow acceptance if for no other reason than that their system offers a more practical set of answers to a plethora of very thorny issues.

Irrespective of what happens, I am ready to make a small wager that at least one large Australian statutory authority will have an HDTV system in use by the end of 1991.

The other 'home cinema' development that caught my eye was Sharp's LCD Sharp Vision projection TV system, which is capable of producing pictures ranging between 500mm and 2.5m, with quality of definition which will unquestionably have a tremendous market penetration in the USA.

By contrast, the stereo-video system displayed by Toshiba in the form of its VHS Camcorder model SK-3D7, with two high resolution CCD sensors and two separate lenses, is more likely to prove something of a seven day wonder, even for general home use. I saw practical demonstrations of the system, which although innovative, does not really offer attributes which are likely to threaten conventional two dimensional systems.





The last, but by no means the least, of my worthwhile experiences at the CES was Dolby Laboratories' release of the 'Dolby S' system. While most readers are familiar with Dolby A, Dolby B, Dolby C and some of the professional Dolby Noise Reduction systems, few are aware of some insidious problems that the use of these systems create. Nobody has been more aware of these problems than the people at Dolby Laboratories who have devoted hundreds of man years of research to finding not only a technical solution to those problems, but, more significantly, finding a cost effective solution.

The problem is that when you encode a pre-recorded signal with either Dolby B or Dolby C and perform an A-B test between the encoded material and the original material, whilst the encoded material may be quieter, it also sounds different, because you have not only reduced the noise, but have also added audible components of sound which have modified the quality of that sound – generally to an unacceptable degree. Dolby Laboratories has finally produced a cost effective noise reduction system capable of providing 10 dB of noise reduction at low frequencies (which previous Doby systems just did not do), and a more than commendable 24 dB of noise reduction at higher frequencies, where most cassette noise lies.

The system reduces distortion, improves head room and, unlike the Dolby B and Dolby C systems, is much more resistant to the insidious decoding problems, which result from differences in individual cassette players and which do not track the original encoded signal in precisely the way they should.

I had the good fortune to be invited to the release with a select band of journalists and marketing personnel, and was able to hear the quality of Dolby S encoding system when fitted to a specially modified Pioneer cassette deck into which special ICs were incorporated. The music was played through a set of B & W 801M Series II monitors, with which I am familiar, and which provided as faithful a signal as one could reasonably hope for in a demonstration of that type.

The quality of the signal was far superior to 'Dolby B' or 'Dolby C', and, when and if the 'Dolby S' system is accepted, I forecast a further extension in the life of the compact cassette.

Yes – the 1990 CES was most certainly an eye opener, and although I have probably written enough now, I have so many more stories to tell that I feel duty bound to write a sequel for a future issue of ETI.

HDTV news

Philips Components (USA) say they are to build a $120 million factory to produce colour television picture tubes and future products for High Definition Television (HDTV) applications. Initially, more than 300 new jobs will be created.

The new plant is expected to be built in two phases. Phase One, which is projected to be completed 18 months from ground breaking, will have a capacity to produce one million 27V (29-inch) standard and high-grade picture tubes. Phase Two will produce tubes to be used in Philips' upscale HDTV television sets. The specific time frame for Phase Two has yet to be determined.

Sites under consideration for the new plant are in Tennessee, Kentucky, Ohio and Michigan. A decision is expected to be announced soon.

A letter of intent, signed in January by Philips, will see the introduction of D2MAC to the Xinjiang Uygur Autonomous Region of the People's Republic of China by the end of this year.

Also covered were the purchase of D2MAC equipment and co-operation on manufacturing and sales in China.

The letter of intent was signed at a ceremony in the Netherlands by Professor Zhang Zhijian, on behalf of China's Ministry of Radio, Film and Television, and Mr P Groenenboom, managing director of Philips Consumer Electronics division.