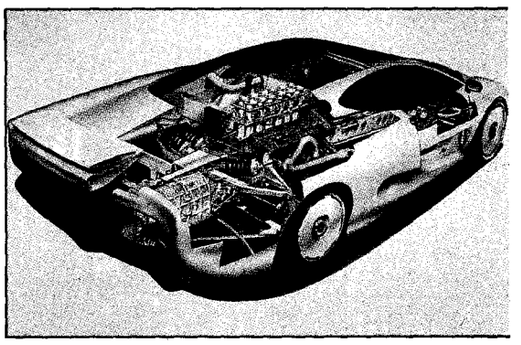
ELECTRONICS · TECHNOLOGY INNOVATION

APRIL 1989



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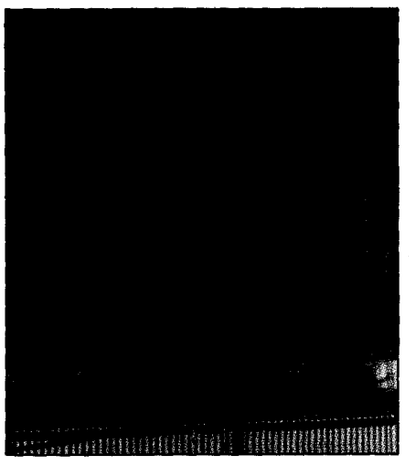

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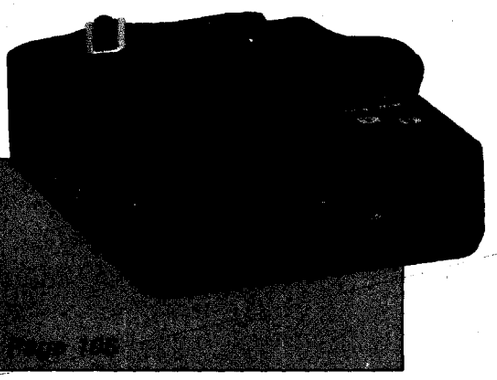

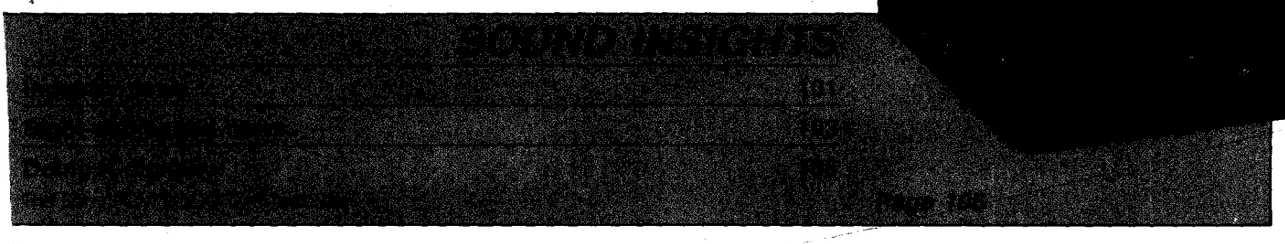

Something in the air . . .
Coming soon:
An up-to-date, comprehensive guide to Australian Astronomy. Find out about the people, the technology and the theories that fuel the exciting resurgence in sky watching.
Practical information on buying a telescope and finding your way around the heavens.
If you're into sky watching, watch out for
ON SALE IN MARCH

FREQUENCY

ROS BROMWICH

Starting a new job is always part exciting, part frightening, and assuming the editorship of Australia's best electronics and technology magazine is no exception.

Not the least part of the challenge is getting the mix of stories right. Enough projects of enough complexity to keep the most avid builders satisfied, together with those of sufficient simplicity to interest budding engineers; covering the instrument market in depth (which service is not offered by another magazine) with comprehensive reviews of products each month and features for all you technology-hungry readers out there.

Browsing through some old copies of ETI the other day I was struck by the fact that what were issues years ago are very much the issues of today. Plus ca change and all that. Notably, in the very first ETI there was a major article about pollution, specifically that from lead-producing internal combustion fuel and how it could be reduced and eventually brought to a halt in the future. We've gone some way down that road of course, and these days planetary pollution is very firmly on the political agenda instead of being the province merely of a few anxious scientists.

In the same week that I looked through the old ETIs I came across a long and depressing feature in *The Guardian Weekly* (an excellent digest of *The Guardian*, *The Washington Post* and *Le Monde*) on the enormous problem of waste from the USA's nuclear weapons program and how that country has failed to deal with it adequately. It made gloomy reading telling of procedures based on a dire lack of knowledge, sheer carelessness and official duplicity in denying the public full information on what was being done in the name of defence.

The waste includes not only plutonium but mercury and quantities of solvents, all lethal in minute amounts and remaining a threat for countless thousands of years. Soil, air and groundwater have been contaminated by billions of gallons of radioactive waste, and tanks containing concentrated waste are starting to leak, contaminating the public water supply. Explosive gases may rip the tanks open and spread radioactivity over a wide area. Mindbogglingly, several of the weapons plants and laboratories were constructed on land known to be prone to earthquakes.

The US Energy Department (DOE) must bear much of the blame for this fiasco. It seems that it connived at keeping secret what should have been public knowledge; for example, workers were prevented from forming health and safety committees and a leak at one plant was undetected for a year and not repaired for another! The DOE argued that it should be self-regulating in nuclear matters, rather than be controlled nationally from outside, and moves by Congress and the States affected by the problem to introduce stricter safety codes for the DOE were largely blocked by the Reagan administration.

Plans for cleaning up after the weapons program are now under way but at enormous cost and, some fear, too late to avoid further major damage. For every dollar now spent on producing bomb-grade material, 45 cents goes towards waste management.

The DOE has said that it will take up to $128b to 'clean up' disintegrating plant and research facilities in the next 20 years, much more than was spent to actually create the weapons material in the first place. Senator John Glenn, who requested the figures, says that they may underestimate the true cost of trying to fix all those years of neglect because the decommissioning of old nuclear facilities which are still operating and reprocessing spent fuel from ship and submarine reactors were not included.

Indeed, the cleaning up may be badly executed because of the DOE opting for cheap as the main criterion – for example, pouring radioactive waste into cement and letting it stay on site when the cement is already known to leak long-enduring radioactive material.

Although the outlook is pretty grim one cause for hope may come out, the writer concludes. The costs of fixing the mess may force the DOE and Congress to reconsider the need for obtaining more plutonium. Let's hope the weapons-making community as a whole gets its act together very soon in this regard.

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Industry News

Paul Williams

Webster Computer Corporation has appointed Paul Williams as networking sales manager.

This appointment follows Webster's emergence into the networking arena with the release of Multigate, a multi-functional product that allows up to four Apple Macintosh LocalTalk networks to communicate with each other and with other computer systems. Williams will be responsible for worldwide sales of Multigate and other Webster networking products yet to be announced.

Williams joined Webster in 1986 and until his new appointment, specialised in Government computing as well as handling general sales in the DEC environment.

Prior to Webster, Williams was Victorian sales manager for GEC

★ ★ ★

Laser technology group, Laserex Limited, has appointed Alan Mayne as general manager. Mayne, who is currently director of business development has been a director since November 1987.

The group's managing director, Robin Ferris, said Mayne had made an outstanding contribution to Laserex since its inception three years ago.

Telecom directory and service assistance operators at work.

Praxa system handles Telecom load

AUSTRALIAN software house PRAXA has designed and is supplying Telecom's new business performance analysers (BPAs) which monitor the more than 1,000 Directory Assistance (013) and Service Assistance (1100) calls per minute Telecom receives nationwide during peak periods.

The BPAs monitor the Ericsson ASDP 162 network automatic call distributor (NACD) switching systems which queue incoming telephone enquiry calls and distribute them to available operators located at Telecom's remote manual assistance centres around the States.

The BPAs record raw management statistics such as the number of calls received and answered, number of operators working and provide a computed estimate of the number of operators required for efficient service.

PRAXA is supplying Telecom with six systems using the MicroVAX 2000 or VAXstation 3200 hardware (depending on the system load requirement) plus the BPA's fully customised software to overcome the BPA system overloads which Telecom has experienced in the past.

Telecom's principal engineer, NACD National Support, Colin Lopes, explained the importance of the BPA.

"Our existing BPAs have been running on PDP 11/23 hardware which, while a good system, was designed for commerical use and not our immense loads.

"In 1987-88 Telecom answered approximately 129 million Directory Assistance and 20 million Service Assistance calls on the NACD across Australia.

"To efficiently manage these volumes of high priority calls requires accurate and reliable statistics."

PRAXA is supplying a BPA for each of Telecom's six Traffic Control Centres in Perth, Brisbane, Adelaide, Melbourne, Sydney and Hobart.

For more information contact Dene Elsegood, PRAXA Limited, ☎ (03) 690 3811.

Imagineering to distribute Webster's Multigate

WEBSTER Computer Corporation has appointed Imagineering as its exclusive Australasian distributor for Multigate, a networking product that connects up to four LocalTalk networks together and provides a gateway for Macintoshes to communicate with any other computer system running TCP/IP.

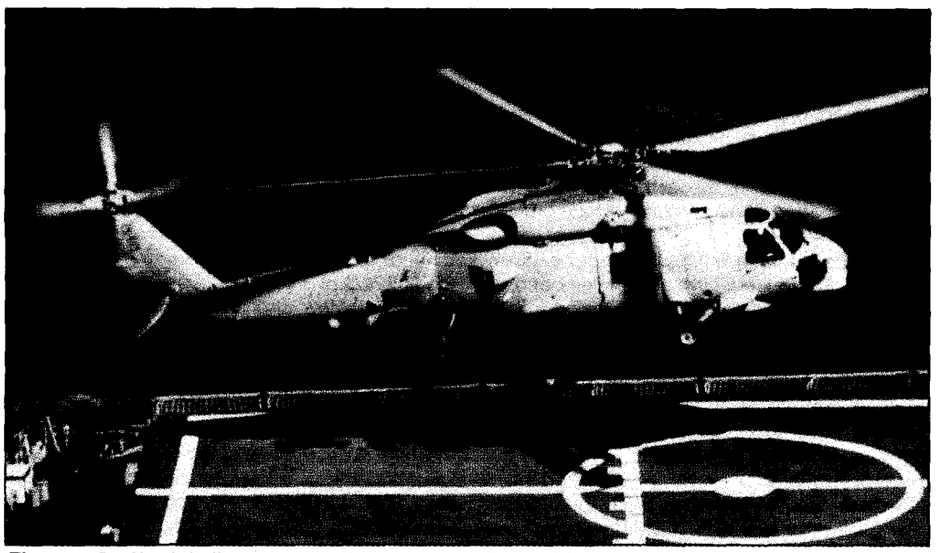
Under this agreement, which is worth approximately $3m in the first year, Imagineering will have sole distribution rights for Multigate in Australia, New Zealand, Hong Kong and Singapore, allowing Webster to concentrate its effort in the European and USA markets.

Paul Williams, Webster's networking product manager, said that Webster approached Imagineering, "because we were looking for a high profile distributor in the pc arena who had the combination of strong technical and distributor skills."

Williams added, "Imagineering will provide telephone 'hot-line' installation and application software support for Multigate. Backed by Webster's Melbourne-based support team, we can assure Multigate customers that both software and hardware will be professionally and efficiently maintained."

Webster will work closely with Imagineering, providing assistance with product training, promotional and marketing activities.

Local supplier for SeaHawk cockpit display screens



The new SeaHawk helicopter, soon to be used on Anzac frigates to provide powerful antisubmarine capability.

THOMAS Electronics has been chosen as the supplier of the cockpit display screens for the new SeaHawk helicopters.

The SeaHawks will primarily be used on the Navy's six FFG's and the proposed Anzac frigates to provide these ships with powerful anti-submarine capability. The SeaHawk has an advanced combat data system, integrating the information received from a number of sensors including radar and sonar buoys.

All tactical information is displayed on the two central cockpit displays which utilise 12" high brightness CRTs designed for viewability under all ambient light conditions.

For more information contact William Hutchinson on ☎ (02) 53 0721.

Industry News

Dr Ron Sandland

Dr Ron Sandland has been appointed chief of the CSIRO Division of Mathematics and Statistics. A statistician, Dr Sandland has worked for the division since 1969, acting as a consultant to the Divisions of Plant Industry, Tropical Crops and Pastures, and Fisheries and Oceanography.

Dr Sandland's research interests were initially in growth curve analysis, classification, allometry, recursive regression procedures, and capture-recapture experiments. More recently, he has been involved in data analysis problems related to ore reserve estimation in mining and in taking statistics and statistical thinking to Australian industry, especially in the area of quality improvement.

★ ★ ★

Robert MacPhail has been appointed southern region sales manager for computer peripherals group IPL Datron. He will be responsible for IPL's extensive range of printers, monitors, disc drives, memory devices and other electronic products throughout southern NSW, Victoria, Tasmania, South Australia and Western Australia.

Before joining IPL, MacPhail was national sales manager for Tech Pacific.

STUART CORNER

CCITT SPEEDS UP ITS PROCEDURES

Increasing pressure forces change

The CCITT must adapt to cope with the rapid pace of technological change — or face serious competition.

The International Telephone and Telegraph Consultative Committtee (CCITT), at its ninth Plenary Meeting in Melbourne in November, put in place new procedures aimed at greatly reducing the time taken to issue new standards recommendations. It will in future be possible for recommendations to be completed in less than nine months.

The CCITT is the main standards setting body for the world's telecommunications administrations and manufacturers of telecommunications equipment. For example, the Integrated Services Digital Network (ISDN) widely touted as the basis for all future public communications services, was developed and defined by the CCITT and its participating member organisations.

The CCITT has been under increasing pressure to adapt to cope with the rapid pace of technological change, the merging of computer and communications technologies and pressure from users who want services to meet their needs.

Leading industry figures believe any failure to change will undermine the pre-eminence of the CCITT and its parent body the International Telecommunications Union (ITU). CCITT is already facing competition from other regional and global international organisations producing standards applicable to communications. In some cases, the CCITT is co-operating with these organisations. For example, the CCITT X400 and X500 standards for electronic mail have been developed jointly with, and are identical to, the International Standards Organisation's Message Handling Systems standards, part of the seven layer Open Systems Interconnection (OSI) architecture.

CCITT standards recommendations are produced by study groups which work on the questions during a four year study period. At the end of this period the recommendations are voted on by members at a Plenary Meeting such as that held in Melbourne. A 100% vote in favour is required.

Because discussions take place continually during the study period, there is seldom any dissent over recommendations presented to the Plenary. Melbourne was no exception: all the recommendations were approved. These recommendations, essential for public telecommunications administrations and developers of telecommunications equipment will now be published as the CCITT Blue Book. This comprises 60 separate publications, totalling 22,000 pages.

Until CCITT recommendations are finalised by a Plenary Assembly, administrations or manufacturers are taking a gamble if they commit to developing products or services based on the draft recommendations. However, the pace of change is such that they cannot afford to wait years for a Plenary. Telecom Australia, for example, decided to base its ISDN network on the state of the CCITT recommendations in early 1987. Telecom committed to support these for a minimum of six years, and said it would support a second set of standards if the recommendations finalised at the Melbourne Plenary differed significantly. As things turned out, there were no major differences.

Under the new procedures adopted in Melbourne, a study group may vote to submit a recommendation for immediate approval by the CCITT membership. If no member of the study group votes against such a proposal, the recommendation will be distributed to all CCITT member organisations. If 70% of the members replying vote in favour, then the recommendations will be adopted. Plenary chairman, Mel Ward, said this procedure should allow new recommendations to be produced in nine months. Ward warned that other rival standards organisations would "fill the vacuum" left by the CCITT if it failed to expedite its procedures in the future.

Over the next four year study period, the CCITT will focus on a number of key areas: the asynchronous transfer mode (ATM) standards for broadband transmission, broadband ISDN and the problems associated with carrying high bandwidth video signals over the telecommunications network.

The changes to CCITT procedures and the new recommendations must be ratified by a plenipotentiary meeting of the ITU. This will be held in Nice in May this year.

ISDN goes on show

TELECOM Australia has staged its first public demonstration of the Integrated Services Digital Network, due to come into operation next year. ISDN will give subscribers access to two digital channels at 64 kilobits per second (B channels) and one 16 kilobit per second digital channel (D channel) over existing telephone lines. These channels can be used to carry two normal telephone conversations, or voice, and fax or high speed data traffic. The third channel can be used to provide a number of advanced network features, or as a low speed data channel for computer communications.

The initial ISDN services will only be to large organisations able to take at least 20 B and 2 D channels into their PABX. ISDN will be extended to smaller subscribers progressively over the next few years.

Equipment on show included Group IV fax machines (capable of sending an A4 page with laser printer resolution in only three seconds), combined multimode terminals incorporating the functions of PC, fax, laser printer, videotex and teletex terminal and scanner, picture vidoetex systems and slow scan TV systems.

All these devices will be able to operate via a suitable PABX system, over the public telephone network in major capital cities from the middle of next year.

LM Ericsson, whose AXE telephone exchanges are the heart of Telecom's ISDN, claims that the Australian network will be the most advanced in the world. It will be the first national network (ISDN access will be available in all major capital cities next May). It will also be the first to conform to the international CCITT standards. Ericsson developed ISDN for Telecom under a $25m contract awarded in 1987.

The other key component of the corporate ISDN network will be the ISDN PABX. Ericsson, NEC and Telecom all had ISDN PABX systems interconnected over the public telephone network at the demonstration. Telecom's ISDN PABX launched just the week before, is the result of a joint venture with Japanese electronics giant Fujitsu.

ISDN has been introduced without definite ideas as to what type of terminals and services users really want. Many manufacturers have produced a range of devices incorporating several possible services in a single unit. However, many of these are non-standard, so would only work with a similar identical device at the other end of the phone line. For example Fujitsu demonstrated an Imagephone capable of transmitting freehand drawings to an identical device at the other end of the line.

Only one wholly Australian company was represented. JTec is a small Sydney-based organisation which hopes to carve out an international niche for itself with some innovative products designed to work in the ISDN network.

JTec's J2000 Basic Rate Multiservice Terminal is aimed at the small business market which JTec hopes will open up early in the 90s with the introduction of Basic rate ISDN (ISDN services over single phone line) to small business subscribers.

The J2000 is an IBM compatible based unit which can connect to the ISDN telephone line to send and receive text messages under existing communications protocols as well as Group IV fax and Fiatel. It also includes voice store and forward facilities and call diversion capability. Another JTec product, the J2020, adds similar capability to an existing pc.

Mobile phone network

LESS than two years after its introduction, Telecom's cellular mobile telephone system, Mobilenet, is already suffering congestion. Sydney, where the service first started, is worst hit with up to 9% of calls reported to be dropping out.

Mobilenet uses a network of short range radio transmitters and receivers covering the service area and the same frequencies are reused many times by non adjacent cells. A computer control system manages the network so that when a mobile unit moves out of range of one transmitter (a cell) it is automatically handed over to another transmitter. If every available channel on that transmitter is in use, the cell will be disconnected. If the network is not carefully designed and the same frequencies are used by cells in close proximity, interference will occur.

Demand for the service has far outstripped original expectations. There are already 25,000 users in Sydney. By the end of next year all major cities in Australia will be covered and Telecom anticipates a total of almost 120,000 subscribers.

There are only two ways to increase capacity on the network – allocate more channels or install more base stations, so reducing the size of the cells. Telecom is increasing the number of cells, but is reported to be encountering opposition from residents and councils who object to having the 20 to 30 metre high towers in their locality.

Careful design of transmitters and selection of transmitter locations is essential to maximise capacity on the network. Telecom uses computer mapping techniques to select antenna sites, antenna designs and power levels, but says that unless additional radio frequency spectrum is allocated, unacceptable congestion will be inevitable in the high traffic area of the Sydney region by 1990/91.

Telecom has two 19 MHz channels available in Sydney and Melbourne. These correspond to 633 mobile telephone channels in each city. The Department of Transport and Communications is considering allocating two additional 22 MHz channels to the service. These would give an additional 832 channels and could be in use, if authorised, by November 1989.

Any further gain in capacity will come only with the introduction of the next generation of digital mobile telephone systems. Telecom says such a system could not be introduced before November 1991, at the earliest.

And elsewhere . . .

Softly, softly approach to HDTV

WHILE Europe, the USA and Japan are rushing to introduce high definition television services (HDTV) as fast as they can, Australia is taking a more leisured approach. An ad hoc working party has been established headed by the Department of Transport and Communications, and is monitoring the issues. It includes representatives from the ABC, The Federation of Australian Commercial Television Services (FACTS), media organisations, the Australian Electrical and Electronics Manufacturers Association and manufacturers Philips, Sony and Kodak. In fact, according to the chairman of the committee, Colin Knowles of the Department of Transport and Communications, Australia's caution was instrumental in preventing the Japanese system being adopted by the international standards body, the CCIR, at a meeting in Dubrovnik in 1985.

In the USA and Japan the issue of HDTV is becoming increasingly complex, in part because of its enormous market potential. A recent report produced for the US Electronics Industries Association has forecast that HDTV will be taken up by US consumers faster than either colour TBs or VCRs, reaching 10% of all households within four years of its introduction and 25% by the end of the century. The Association is pushing for the development of a uniquely American system to maximise opportunities for US manufacturers of transmission and delivery systems. There is only one manufacturer of TV receivers, Zenith, which is still US-owned.

Zenith is one of 16 US high technology companies discussing the formation of a consortium at giving US industry a large slice of the future HDTV market. Also involved are IBM, Hewlett Packard, DEC, Apple Computer, Texas Instruments and Motorola.

To complicate the US HDTV scene even further, the US Department of Defence is spending at least $30m on the development of HDTV technologies. The future market for HDTV in the military will be much larger than this. DoD uses TV technology in a wide range of applications including command and control systems, battle management and aircraft cockpits. DoD is now soliciting proposals from industry for HDTV development.

Over half of all US households receive TV over cables and the National Cable TV Association is concerned that cable TV remains competitive with other future video media. The Association is threatening to develop a separate standard to the broadcast HDTV standard if it believes the latter does not provide the picture quality required to compete with recorded media.

In Japan, manufacturers are adopting an interim solution to the demand for higher picture quality – extended definition TV (EDTV). EDTV receivers operate on the present network but use digital techniques to process the incoming analogue signal and generate a higher quality picture.

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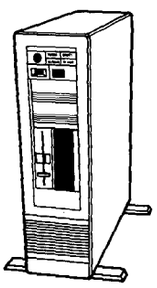

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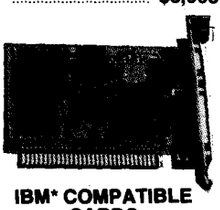

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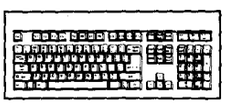

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X12022 ..... **ONLY $109**

IBM* XT* COMPATIBLE CASE

XT* size and styling. Features security key switch, 8 slots, and mounting accessories.
Size: 490(W) x 390(D) x 140(H)
Cat. X11090 .... **only $69**

IBM* XT* COMPATIBLE CASE WITH AT* STYLING

Now you can have AT* styling in a XT* size case. Features security key switch, 8 slots, and mounting accessories.
Size: 490(W) x 145(H) x 400(D)
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Compact foot space. Features security key switch, 8 slots, and mounting accessories.
Size: 360(W) x 175(H) x 405(D)
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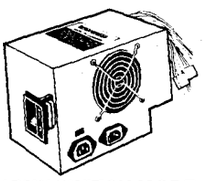


150W SWITCH MODE POWER SUPPLY FOR IBM* PC*/XT* & COMPATIBLES

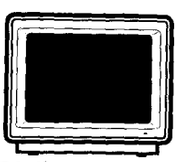
DC OUTPUT: +5/13A, -5V/0.5A +12V/4.5A -12V/0.5A
Cat. X11096 ..... **$129**

200W SWITCH MODE POWER SUPPLY FOR IBM* AT* & COMPATIBLE

DC OUTPUT: +5/16A, -5V/0.5A +12V/5A -12V/0.5A
Cat. X11097 ..... **$199**

180W SWITCH MODE POWER SUPPLY FOR BABY AT* COMPATIBLES

Cat. X11098 ..... **$169**



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Quality Auto VGA, EGA, CGA monitor without the high price tag!
Display Tube: 14 inch 90° deflection P22 Non-glare, tint. 0·31mm Dot pitch,
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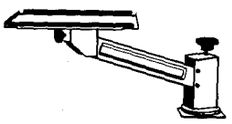
Resolution: 800 dots(H) x 600 lines(V)
Display Colour: TTL input TTL input: 8/16/64 colours Analog input: unlimited colours

X14528 ..... **only $945**



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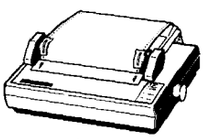

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- NLQ Mode
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- Tractor or friction feed
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- Convenient push button control panel
- Standard Parallel interface

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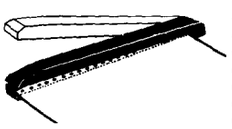
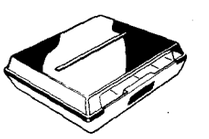


RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget.

C21085 ..... **$9.95**



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- Suitable for most printers

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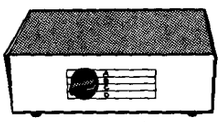

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- Switch comes standard with female connector

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4 WAY RS232 X19125 ..... **$79**
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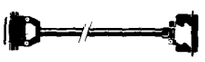

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- 25 pin "D" plug (computer end) to Centronics 36 pin plug

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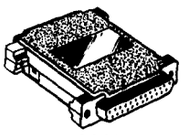

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat.X15650 **Male to Male**
Cat.X15651 **Male to Female**
Cat.X15652 **Female to Female**

Normally $14.95 each
Only $9.95ea

DB15 GENDER CHANGERS

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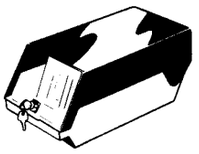

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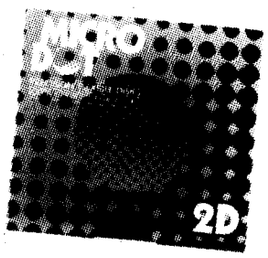

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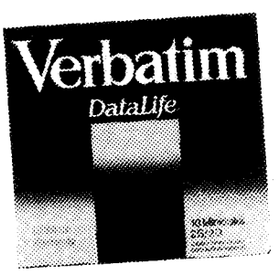

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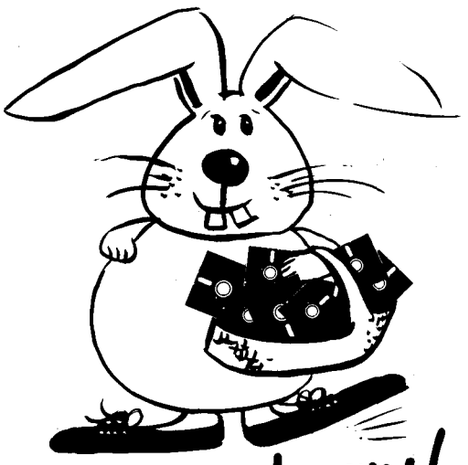

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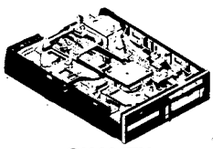

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Industry News

BIS Banking Systems Pty Limited has annouced the appointment of Allen Rosenberg as general manager, Australasia.

BIS Banking Systems is a member of The BIS Group, and markets banking and finance software through 12 branches throughout the world. The Australasian operation services the territories of Australia, New Zealand and the Immediate Pacific Islands.

Rosenberg's experience in the DP industry spans many years, including running his own software company, and seven years each with IBM and JBA before the latter was acquired by BIS Banking Systems. In 1985 Rosenberg received the IBM Golden Slipper Award for the marketing of products associated with the IBM mid-range computers.

MM Cables boosts police communications

AWA built, tested and installed the LAN, using a variety of MM Cables' products.

MOST of the cables used in the Sydney Police Centre's new communications control system were manufactured locally.

The system uses about 2km of LAN cables built by MM Cables at its Liverpool factory in Sydney.

MM cables supplied 25 pair indoor telephone cables, plus varying quantities of 10, five and two pair cables for miscellaneous wiring.

AWA built, tested and installed the LAN, which is expected to boost the efficiency of police communications in Sydney by about 50%.

The system is basically a high speed method of facilitating radio broadcasts from the SPC to vehicles and officers in the field.

According to AWA Project Engineer, Geoff Unsworth, the LAN will allow NSW police to communicate between the SPC at Surry Hills and suburban, regional and country stations, land, sea and air vehicles, as well as portable radios.

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READER INFO No. 4

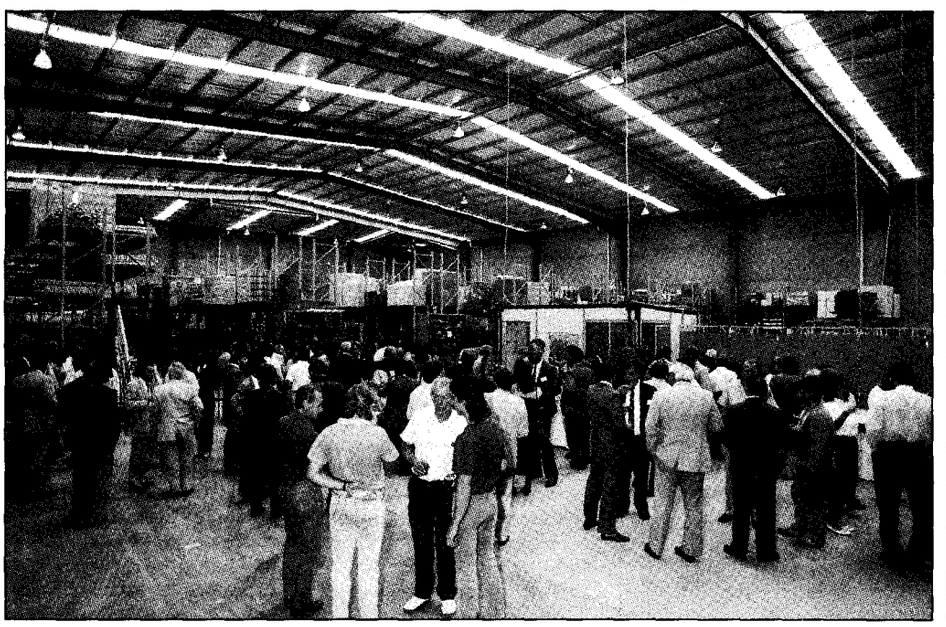
Exide offers news of battery-related technology

SUBMARINE batteries that gave power after 69 years underwater and a revolutionary inverter invented in Australia are just two features in the first issue of a new quarterly news sheet, *Ion Exchange*.

Published by Pacific Dunlop Batteries' industrial division, the makers of the Exide battery, range, *Ion Exchange* aims to keep industrial users abreast of battery and related technologies, including standby power and emergency lighting.

The full-colour A4 publication carries regular columns, on terminology, how to get more out of your industrial batteries and news of technical literature releases.

Ion Exchange is free to qualified industrial users. Write on company letterhead to Pacific Dunlop Batteries Industrial Division, 55 Bryant St, Padstow, 2211 or phone the Exide Hotline, (008) 02 3785.



The opening of Concord Lighting's new complex in Clarinda, Victoria.

Factory opening celebrates Concord's 15th year

CONCORD Lighting Pty Ltd, one of Australia's leading lighting companies, celebrated its 15th year of business with the formal opening of its new national head office, factory and warehouse complex at Clarinda, Victoria.

Concord's immediate past chairman, Alfred Paton, who is also deputy chairman of Australia Post, opened the complex, which is nearly 40,000 square feet of floor area.

In opening the complex, Paton paid tribute to the company's staff who had been responsible for innovative lighting design in Australia's commercial and domestic building markets as well as seeking export opportunities.

"In Concord's 15 year history, the company has grown from a three person operation in a small office in Richmond, to a national company with more than 50 direct employees – its owns sales offices in Melbourne, Sydney and Brisbane and agents/distributors in all remaining States and Territories throughout Australia." Paton said.

Paton paid special tribute to Concord's managing director, Ray Woodward, who has been associated with the company from its first day of operation.

Woodward told the 150 guests at the opening ceremony that when the company first started 15 years ago it had just one product line. "Today the diversity of the needs of our customer base is met with a product range of more than 3,500 items," he said.

Woodward told the guests that Concord was planning its activities to meet the needs of clients in the architectural, industrial and residential sectors of the building industry.

Industry News

CIMA Electronics has appointed Mike Osborne as technical director. Mike joined the Centre for Industrial Microelectronics Applications on secondment from the Department of Robotics and Digital Technology at Chisholm Institute where he was senior lecturer in Digital Design.

★ ★ ★

Australian Test & Measurement Pty Ltd has appointed Ron Koenig as hardware development engineer to expand the range of do-it-yourself electronic modules.

Ron has had extensive experience with instrumentation and development of data communications products, having just completed a two year stint at Netcomm in the research laboratory. Prior to that he was responsible for modem designs at Modem Technology.

DSP (digital signal processing) technology will soon be employed by AT&M for wave analysis equipment and Ron brings with him a wealth of experience in that challenging field.

★ ★ ★

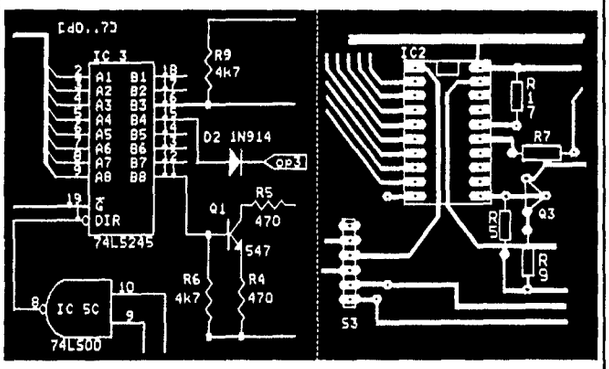
Following recent restructuring within Sony Australia, Charles Montesin has been appointed senior product manager with responsibilities for the Sony camera range of products.

Montesin has 15 years experience in the broadcast and business video camera market providing specialised camera support to customers. He has previously held both product management and product specialist positions within the industry.

The newly formed product management structure within the Communication Products Group of Sony is designed to provide a more direct information route between the local market requirements and engineering, R & D and product planning divisions of Sony in Japan.

OrCAD

Systems Corporation



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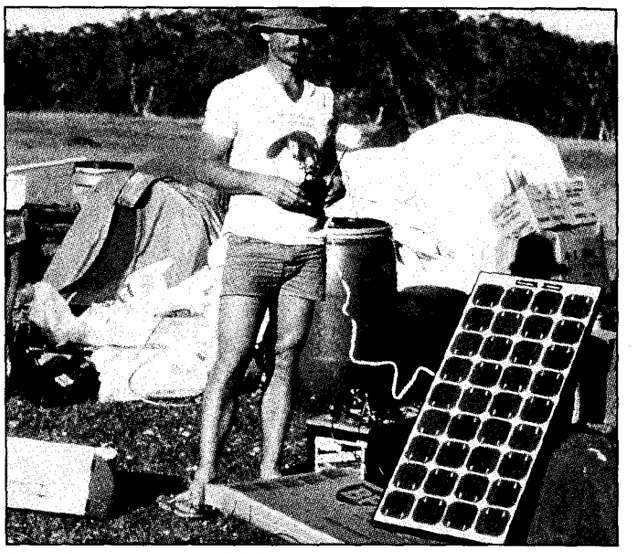


Mike Cusack with the BP Solar module.

BP Solar keeps wilderness couple in touch

AN Australian couple who recently completed a year-long experiment in wilderness living claimed the experiment would have failed without solar power.

Mike and Susan Cusack took part in the experiment in the remote Kimberley region of Western Australia for Dick Smith's Australian Geographic magazine.

They lived in the bush without additional supplies and without outside support in an attempt to gauge human reaction to such isolation.

The couple used a BP Solar power module to provide power for radio communications, lighting, a small electronic typewriter and video camera used to record and experiment.

The purpose of the experiment was to determine how a couple who normally lived in a city environment would cope with a year in isolation and a harsh environment, without the conveniences of home.

According to Mike Cusack the experience could not have been safely undertaken without solar power.

"Without a hook-up with the Royal Flying Doctor we could have perished and no one would have known for months," said Mike. "The Kimberley is a vast, inhospitable and unpopulated area, truly one of the world's last frontiers. As well as keeping us in touch in case of an emergency the solar power enabled us to record experiences on paper and video. Solar power was really the only practical way of providing power for such devices, especially in the Kimberley where solar power is a vast, untapped resource," he said.

The Cusacks used a BP Solar 45 watt solar module coupled to two six volt batteries. The solar module kept the batteries at full charge throughout the twelve month expedition.

The Cusacks, who normally live in an outer Melbourne suburb, spent the year in a primitive shelter 40km southwest of the Prince Regent River between Derby and Kalumbaru Mission.

They lived with temperatures as high as 45° celsius and through the Kimberley wet season where close to 1000 millimetres of rain falls in just three months. The couple have documented their experiences for Australian Geographic magazine.

New medical system to be installed Australia-wide

A PILOT system for tracking medical records and making doctors' appointments for approximately 30,000 people a year at the Commonwealth Medical Examination Centre in Melbourne has proved so successful that the Commonwealth Department of Community Services and Health has decided to install it in its medical examination centres throughout Australia.

The eight centres, which employ doctors, nursing sisters and administrative staff, provide medical examinations on behalf of all Federal Government departments and authorities.

People being examined include those applying to join the Public Service, migrants applying for permanent residence, workers' compensation cases and people applying for invalid pensions.

The Commonwealth Medical Officers System (CMOS) was developed in Canberra over the past eight months by a team made up of departmental staff and consultants from Computer Sciences of Australia, which also provided the team leader, and the Oracle Corporation.

It was built around the Oracle database and runs on a VAX 8810 processor. The computer communicates via landline with another VAX 8810 installed in the Department's office in Canberra.

The Melbourne centre employs a total of 16 doctors and five nursing sisters backed by administrative staff.

The system is accessed via 10 terminals located in the centre.

For more information contact Paul Taylor on ☎ (062) 89 7740, Peter Stebbings on ☎ (062) 53 1222 or Brian O'Shea on ☎ (02) 498 7179.

Sonobuoy contract for AWA MicroElectronics

AWA MicroElectronics has been awarded a contract from the Department of Defence to design advanced chipsets for a variety of sonobuoy applications.

"The contract is worth about $370,000 to us," said AWA MicroElectronics marketing manager Toby Cross.

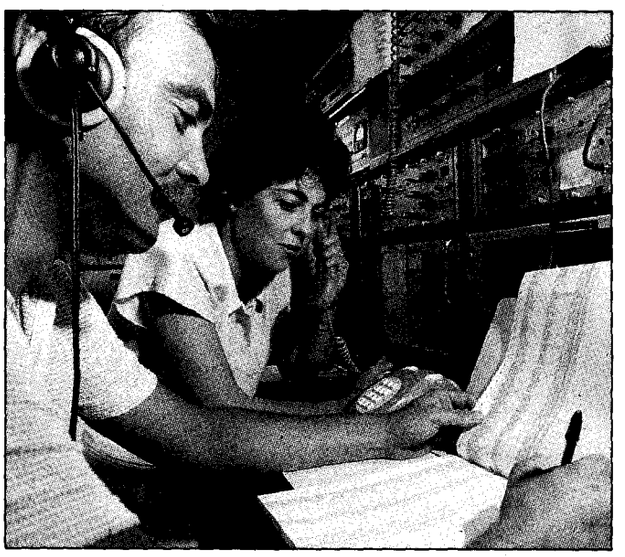
The Barra Sonobuoy is one of Australia's biggest export successes in the defence field Manufactured by Sonobuoys Australia, a joint venture of AWA and Plessey, Barra is able to detect quiet-running submarines even in shallow and turbulent waters.

One or more buoys are dropped from an aircraft. Once in the water, an array of hydrophones is deployed from each buoy to gather data and transmit it back to the aircraft for processing. The processed information can help the aircraft pinpoint the submarine and track it.

The challenge for AWA MicroElectronics has been to develop a chipset which can process more of the data within the buoy itself. "This will require advanced digital signal processing techniques for combining and filtering analogue information from the hydrophones.

"AWA MicroElectronics will implement these through advanced custom silicon design techniques using a combination of standard cells and hand crafted full custom cells. This approach has proved to be very effective; it results in a high performance device produced in half the time and hence at a very reasonable cost to the customer," said Toby Cross.

Because space within a buoy is extremely limited, and a buoy is non-recoverable, the chipsets have to be cost-effective, efficient, and precisely tailored to the task.



Staff at one of the OTC Maritime Communications stations.

OTC's safety net

THE crew of the Sydney to Hobart yacht race, in an ironic way, owe their security and modern communications systems to the 'unsinkable' Titanic.

More than any other shipping tragedy, the sinking of the Titanic brought the maritime nations of the world together to set up international rules and procedures to safeguard the lives of people at sea.

Communications is the most important aspect of those procedures. In a challenging and potentially hazardous race like the Sydney to Hobart, race crews rely on the communication network provided by Australia's worldwide telecommunications organisation OTC.

Wherever the yachts are along the coast, OTC operators are within reach, 24 hours a day, listening, monitoring and handling distress calls through conventional radio links or INMARSAT, the international maritime satellite organisation.

If there is a medical emergency on board, the crew can call OTC Radio Medical, a service that puts mariners in touch with a Commonwealth Medical Officer who will advise on how to handle the problem on board, or will mobilise a Medevac helicopter evacuation.

For personal communications, crew members can ring home, using OTC's Seaphone service – a direct VHF radiotelephone link that provides access to Australian national and international telephone networks.

Reporters covering the race for radio networks or newspapers can use either the telephone service OTC Seaphone, or OTC Seatex which gives them access to the worldwide telex system.

OTC is the Australian signatory to INMARSAT, which operates a system of eight satellites for global mobile communication.

OTC is planning two INMARSAT coast earth stations by the early 1990's, at its Perth International Telecommunications Centre. The earth stations, accessing satellites which cover the Indian and Pacific Oceans, will allow Australians to utilise the latest in highly compact and portable communications equipment. Already OTC Auto Seaphone allows callers to dial direct to almost anywhere in the world. For more information contact Jeff Bird ☎ (02) 287 4068.

Roger Delen (right) at the Adelaide printed circuit board manufacturing facility with Stephen Young.

Major electronics group acquires Teknis

THE pc board manufacturing operations of the Adelaide-based Teknis Group have been purchased as a going concern by Australian electronics company, Delen Corporation.

The Sydney-based company has purchased the business of Tekpro, the main manufacturing division of publicly-listed Teknis Limited which was placed in receivership in May 1988.

Adelaide chartered accountants, Messrs John Heard and Stephen Young of Allert, Heard & Co, were appointed joint receivers and managers of Teknis Limited and Teknis Consolidated Pty Ltd. The companies owed more than $8m at the time of the appointment.

Young said the sale to Delen Corporation, for an undisclosed amount, followed extensive national and international interest in Tekpro which had in recent years developed its Hendon (South Australia) pc board facility to worldwide competitive standards.

Roger Delen, Delen Corporation's founder and managing director, said the company planned to upgrade and expand the newly-acquired Tekpro operations.

He said the Tekpro acquisition provided Delen Corporation with the necessary tool to help meet its objective of supplying the Australian electronics industry with a total support service for pc boards – the heart of any electronic device.

Delen Corporation's other Australian activities include the development and supply of personal computer software for the design of pc boards and pc board design bureau services.

More information contact Stephen Young; ☎ (08) 212 6711 or Roger Delen ☎ (02) 684 4569.

Design study contract for ozone monitoring

IT was announced recently in the USA that Honeywell had been appointed major contractor for the global ozone monitoring radiometer (GOMR) system design study to develop a satellite instrument that will monitor the condition of the earth's atmosphere. Perkin-Elmer will also participate in the study.

Under the terms of a contract worth about US$515,000 Honeywell's Satellite Systems Division will lead an industry team that will determine the feasibility, impact, design and costs associated with producing the two components of GOMR:

- a GOMR nadir sounder (GNS) to determine global distributions of total ozone; and
- a GOMR limb sounder (GLS) for determining vertical distributions of geophysical parameters in the stratosphere.

The concentration and distribution of ozone in the upper atmosphere has been the subject of increasing concern, because depletion of the ozone layer allows more of the sun's ultraviolet rays to reach the earth's surface. Ultraviolet rays have been cited as a cause of skin cancer and cataracts.

The GOMR instrument, which would fly as part of the National Oceanic and Atmospheric Administration (NOAA) operational payload aboard the NASA space station's polar orbiting platform, would remotely measure ozone, temperature and other atmospheric constituents of the earth.

The design of the GNS will be based on that of the total ozone mapping spectrometer (TOMS) that flew on the Nimbus-7 research satellite in 1978, updated with current UV sensor technology. Data collected by TOMS are currently used by NASA to measure the ozone depletion in Antarctica, site of the so-called ozone 'hole' where, according to 1987 research, the layer has been reduced by 50%.

The experience gained in building another instrument that flew on Nimbus-7 – the limb infrared monitor of the stratosphere (LIMS) – will be important to the design of the GLS. LIMS was a limb scanning radiometer with six channels of infrared wavelength information. It operated flawlessly for seven months, the maximum planned lifetime of the IR detector's solid cryogenic cooler.

AT&T and Honeywell form new relationship

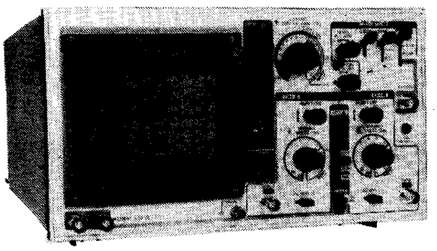
AT&T and Honeywell Limited have commenced a new business relationship for the sale and support of a range of AT&T communications equipment.

Honeywell will manufacture, sell and support AT&T's System 75 PABX in Australasia and will assume the ongoing support of AT&T's Dimension range of PABX equipment nationally. Honeywell will also sell and support AT&T's Premises Distribution System.

AT&T Australia's managing director, Lonnie Rush, welcomed the new association with Honeywell. "They have a fine reputation and capability in the automation and control business across all aspects of Australia's commercial, industrial, defence and government markets," he said.

Honeywell Limited's managing director, Phil Myles, coincidentally announced the formation of a new business group, Honeywell Communications.

"We are delighted to be associated with AT&T in these new business activities. AT&T is the worldwide leader in the supply of a full range of communication facilities and its Bell Laboratories is recognised as one of the leading research and development establishments in the world," he said.



HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

- **Wide bandwidth and high sensitivity**
- **Internal graticule rectangular bright CRT**
- **Built in component tester**
- **Front panel trace rotater**
- **TV video sync filter**
- **Z axis (intensity modulation)**
- **High sensitivity X-Y mode**
- **Very low power consumption**
- **Regulated power supply circuit**

COMPONENT TESTER is the special circuit with which a single component or components in circuit can be easily tested. The display shows faults of components, size of a component value, and characteristics of components. This feature is ideal to trouble shoot solid state circuits and components with no circuit power. Testing signal (AC Max 2 mA) is supplied from the COMPONENT TEST IN terminal and the result of the test is fed back to the scope through the same test lead wire at the same time.

CRT
CRT: 6" (150mm) Flat-faced high brightness CRT with Internal Graticule.
Effective display area: 8 x 10 div (1 div = 10 mm)
Acceleration potential: 2KV

VERTICAL
Operating Modes: CH-A, CH-B, DUAL, ADD (CH-B can be inverted.) Dual modes: Alter; 0.2ufs - 0.5ms/div. Chop; 1ms - 0.5s/div. CHOP frequency 200KHz approximately.
Deflection factor: 5mV/div 20V/div +/−3%, 12 ranges in 1-2-5 step with fine control.
Bandwidth: DC; DC - 20MHz (−3dB). AC; 10Hz - 20MHz −3dB).
Rise Time: Less than 17ns.
Overshoot: Less than 3%.
Input impedance: 1M ohm +/−5%, 20pF +/−3pF
Maximum Input Voltage: 600Vp-p or 300V (DC+AC Peak).
Channel Isolation: Better than 60 dB at 1KHz.

HORIZONTAL
Sweep Modes: NORMAL, and AUTO
Time Base: 0.2ufs - 0.5s/div +/−3%. 20 ranges in 1-2-5 step with fine control.
Sweep Magnifier: 5 times (5X MAG).
Linearity: 3%.

TRIGGERING
Sensitivity: INTERNAL: 1 div or better for 20Hz - 20MHz (Triggerable to more than 30MHz). EXTERNAL: 1Vp-p or better for DC - 20MHz (Triggerable to more than 30MHz).
Source: INT, CH-A, CH-B, LINE and EXT.
Slope: Positive and Negative, continuosly variable with level control PULL AUTO for free-run.
Coupling: AC, HF-REJ and TV. TV SYNC Vertical and Horizontal Sync Separator Circuitry allows any portion of complex TV video waveform to be synchronized and expanded for viewing TV-H (Line) and TV-V (Frame) are switched automatically by SWEEP TIME/DIV switch. TV-V:0.5s/div to 0.1ms/div. TV-H:50ufs/div to 0.2ufs/div.

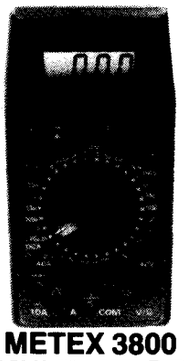
X-Y OPERATIONS
X-Y Operations: CH-A: Y axis. CH-B: X axis Highest Sensitivity: 5mV/div.

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

OTHER SPECIFICATIONS
Intensity Modulation: TTL LEVEL (3Vp-p); Positive ..... brighter. BANDWIDTH; DC-1MHz Maximum Input Voltage: 50V (DC+AC Peak)
Calibration Voltage: 0.5Vp-p +/−5%, 1KHz +/−5% Square wave.
Trace Rotation: Electrically adjustable on the front panel.
Power Requirements: AC; 100, 120, 220, 240V 20W
Weight: 7kg approximately.
Size: 162(H) x 294(W) x 352(D)mm.

Cat. Q12105 ..... **only $695**
(tax exempt only $630)

Bulk orders, schools, and tax exempt inquiries, please phone (03) 543 2166 for special low pricing.

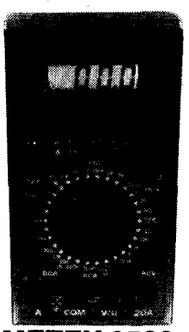


METEX 3800 MULTIMETER

Compact, rugged, battery operated, hand held 3½ digit multimeter.
Features...
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system.
Over-range Indication: "1" Figure only in the display.
Temperature Ranges: Operating 0◦C to +40◦C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat.Q91530 ..... **Normally $109**
SPECIAL $79



METEX 3530 MULTIMETER

Compact, rugged, battery operated, hand held 3½ digit multimeter.
Features...
- ½" high contrast LCD.
- Automatic over-range indication with the "1" displayed.
- Automatic polarity indication on DC ranges.
- Capacitance measurements to 20uF
- Diode testing with 1 mA fixed current.
- Audible Continuity Test.
- Transistor hFE Test.

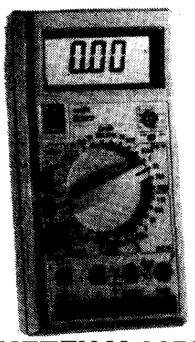
SPECIFICATIONS
Maximum Display: 1999 counts 3½ digit type with automatic polarity indication.
Indication Method: LCD display.
Measuring Method: Dual-slope in A-D converter system.
Over-range Indication: "1" Figure only in the display.
Temperature Ranges: Operating 0◦C to +40◦C
Power Supply: one 9 volt battery (006P or FC-1 type of equivalent)

Cat. Q91540 ..... **Normally $139**
SPECIAL $109

ECONOMY ANTISTATIC SOLDER SUCKER

- Light weight
- Sturdy construction
- Easy to remove tip
- Excellent value for money!

Cat. T11281 ..... **$13.95**



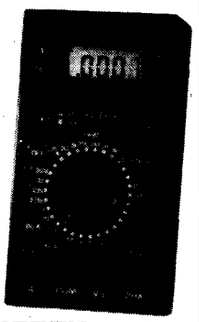
METEX M-3650 MULTIMETER

20A, 3½ digit frequency counter multimeter with capacitance meter and transistor tester.

Features include a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement.

CHECK THESE FEATURES....
- Audible continuity test
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD.
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

Q91550 ..... Normally $165
Special, only $129



METEX 4500H MULTIMETER

10A, 4½ digit multimeter with digital hold, transistor tester and audible continuity tester.

CHECK THESE FEATURES...
- Readout hold
- Transistor Tester
- 4½ digit x ½"(H) LCD
- Audible continuity tester
- Quality set of probes
- Digital readout hold
- Built in tilting bail
- Instruction manual
- hFE test
- Diode Tester
- Vinyl case

Q91560 ..... Normally $175
Special, only $159

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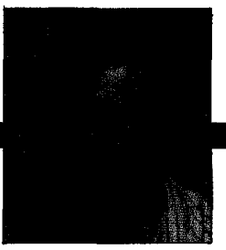
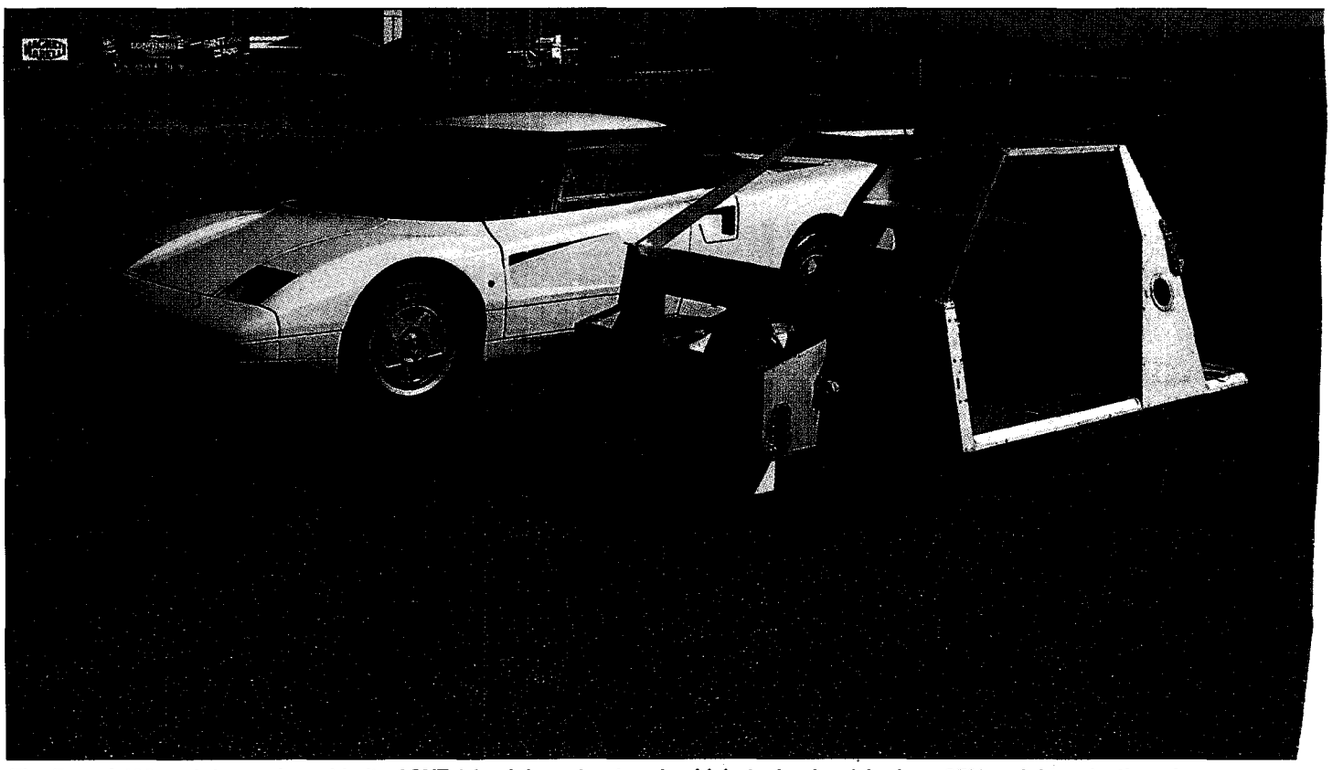


BRIAN WOODWARD



The Ferrari 408 prototype, alongside its ASVT (aluminium structured vehicle technology) body; a 27% weight reduction plus 22% more torsional stiffness.

LET THERE BE LIGHT

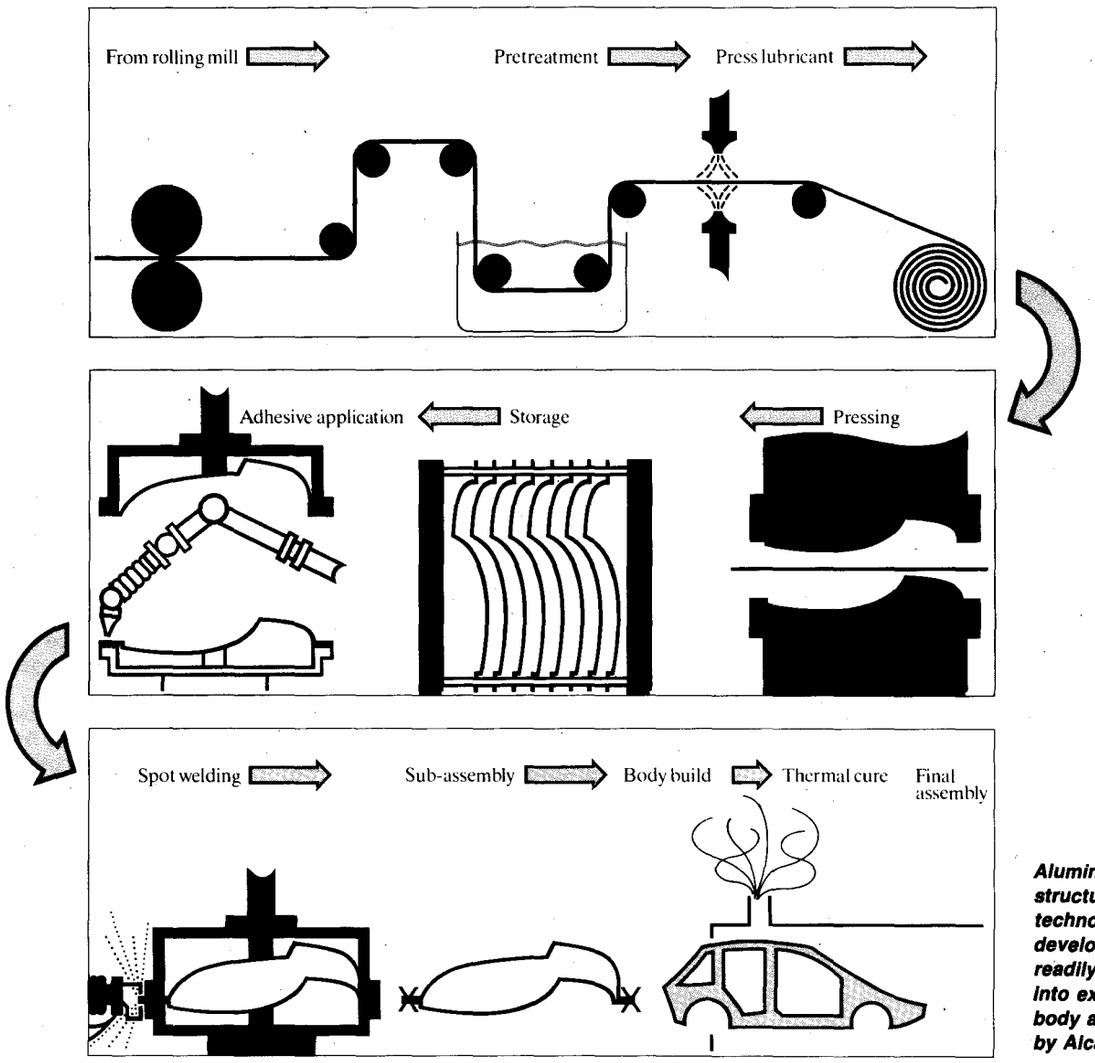
Ultralightweight on the road

Aluminium promises to provide lighter, more fuel-efficient cars. Brian Woodward reports.

If it wasn't for oxygen, aluminium would be the ideal metal. It is ductile, light and second only to iron – making up 7% of the earth's crust. But its affair with oxygen has been passionate since the Big Bang.

Aluminium oxidises so well (and so quickly) that the ore from which the metal is extracted, bauxite, consists of aluminium oxide. The ore, by the way, was named after the town of Les Baux in France, where it was discovered in 1821. The white powder which forms in minutes on the surface of freshly polished aluminium is aluminium oxide, and it is this oxide which makes aluminium a difficult metal to weld.

It also has other problems. It loves reacting with other metals and it consumes so much power to smelt that it is often called "congealed electricity" and this raises its price in energy-poor countries. In fact, smelting aluminium proved so difficult for so long that aluminium was one of the luxury



Aluminium structured vehicle technology has been developed to be readily introduced into existing auto body assembly plant by Alcan.

metals until 1886 when an American, Charles M. Hall, and Frenchman, Paul Heroult, independently developed a method of releasing aluminium from its ore by electrolysis. Prior to that, variations of Hans Christian Oested's chemical method of converting the ore to metal had been used. Oested was first to isolate the metal, as recently as 1825.

The system used today is a continuing development of the final electrolysis process developed by the German chemist Karl Bayer in 1889 (yes, *that* Bayer) for extracting aluminium from bauxite.

The first success of the metal was being mixed in ratios between 7 and 13% with copper to form bronze – much loved by sculptors creating monuments to political leaders in squares and avenues the world over. But when Bayer's system made aluminium relatively cheap, it became an instant success as a very thin wrapper for perishable foods – chocolate being among the first to be wrapped in aluminium foil.

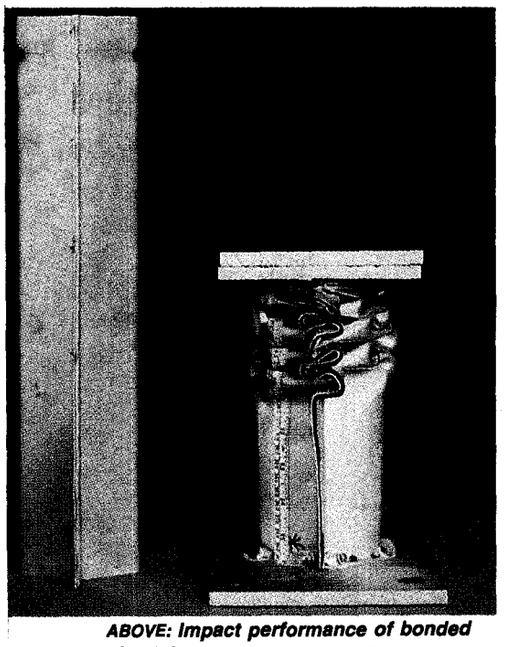
Aluminium is important to the world of the car designer and to Australia. Its importance to Australia is this country's vast reserves of the ore bauxite and the relatively cheap energy available to smelt it in Victoria – centre of Australia's aluminium smelting industry.

'One of the most well known vehicles to use an aluminium body is the Range Rover'

In thin, hand-formed sheets aluminium has long been used by car builders as a non-stressed body skin – mainly for sports and racing cars. Unlike the aerospace industry, in which aluminium's low weight has outweighed its raw materials cost and difficulty in assembly, the car industry must use more cost effective methods. On terra firma, aluminium must compete dollar for dollar with significantly cheaper (but less desirable) iron.

As cars made the change from separate chassis and body to an integrated form of construction, aluminium fell into the doldrums. As soon as aluminium had to form a chassis as well as a body skin, the problems of pressing it into shape and welding the whole vehicle together became far too expensive to compete with iron.

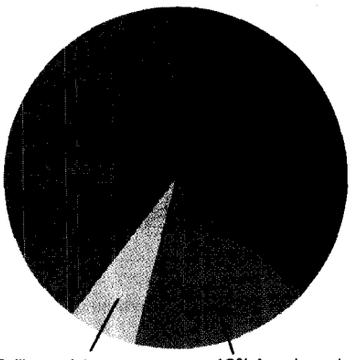
Many vehicles have used aluminium extensively. Few survived. One was the 1954 Panhard Dyna in France (where, as in many countries after World War 2, aluminium was used because steel was in short supply and recycled aluminium from warplanes was abundant). In Australia, the car which might have become the Holden, the Lloyd Hartnett,



ABOVE: Impact performance of bonded aluminium structures compares favourably to that of spot-welded steel structures of nearly twice the weight.

started its prototype life as a Gregoire and aluminium was used extensively as chassis rails. The rails were cast – and expensive.

One of the most well known vehicles to use an aluminium body is the Range Rover. Like so many 4WD vehicles, however, it retains its chassis. Although the body is very strong, it is not an integrated body/chassis design demanded by the conventional 2WD passenger car market. In fact, aluminium was chosen for the Range Rover because, having made a really stiff chassis (essential for effective wheel control and suspension) and noticing how heavy it was, designers decided to keep the vehicle's weight down by using aluminium. If the Range Rover's body was made from steel the entire vehicle would probably weigh as much as a house. As it is the Rover is close to 2 tonnes!

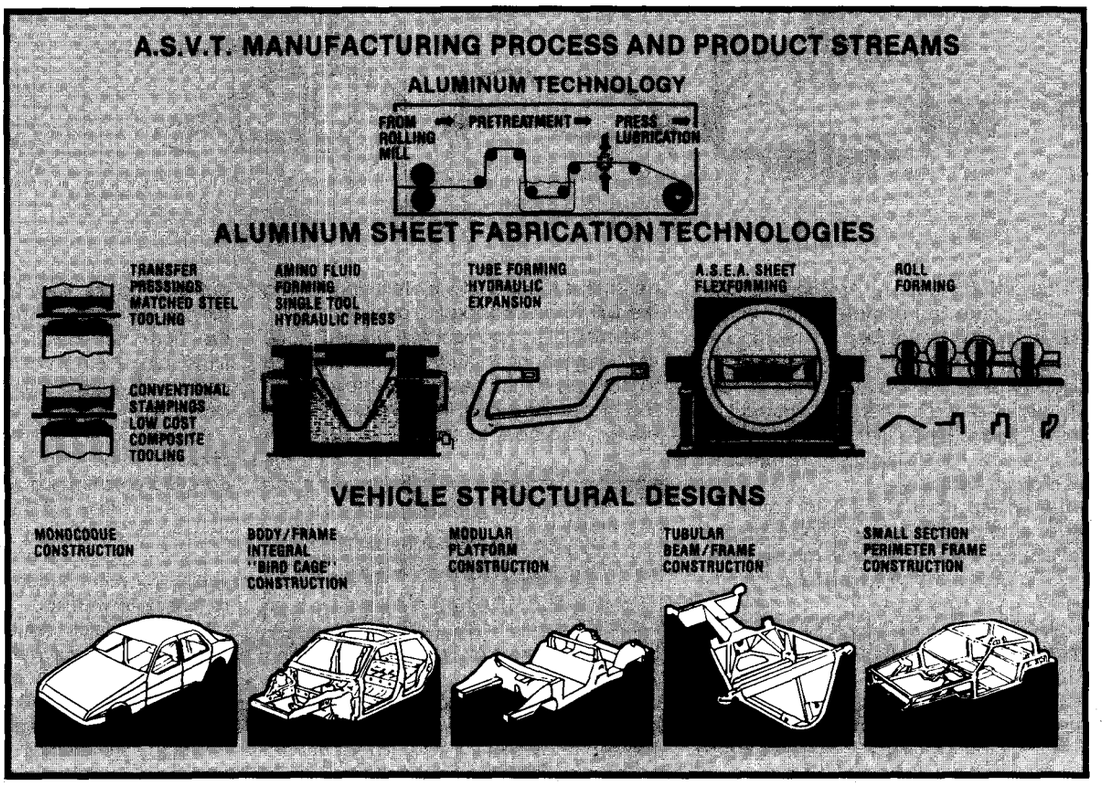


RIGHT: Weight reduction is the second most important factor in reducing fuel consumption.

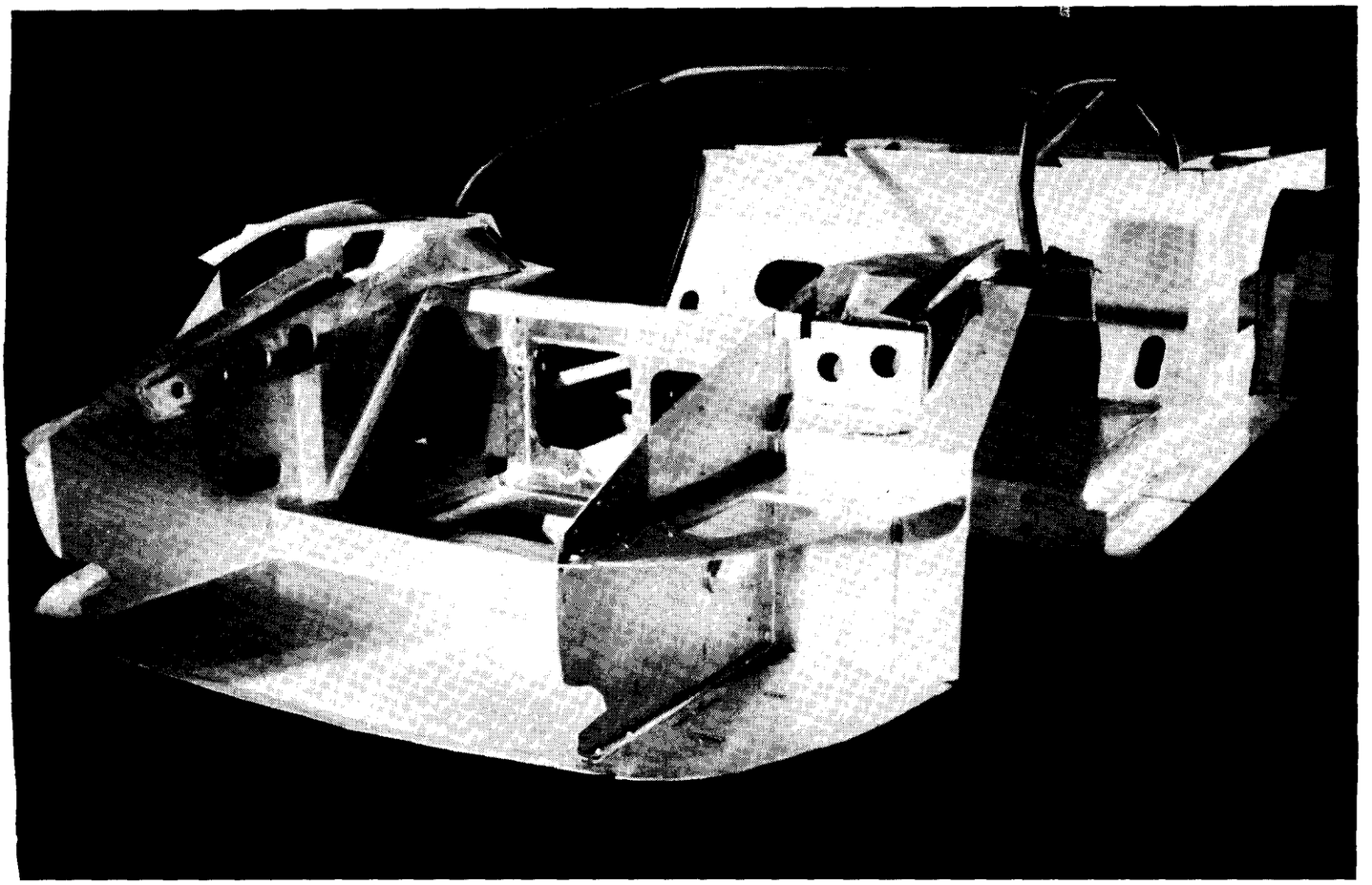
The man who was the moving force behind the development of the Range Rover was Spen King. As he moved from one project to another his affection for aluminium grew. Today he's a consultant assisting in the design of cars made entirely from aluminium. The breakthrough came with the development of heat-cured adhesives. These have so profoundly changed the way in which an all-aluminium car is designed and built that the race is on to make the process accessible to cars in the medium to low price bracket. Why?

Four factors contribute to a car's energy profile: 5% is rolling resistance, 18% aerodynamics, 40% to powertrain and 37% to vehicle mass. Mass reduction has the second largest potential for improving a vehicle's energy efficiency. It also holds the key to offering improved performance from smaller engines – further increasing the gains made by reducing weight.

Let's explain that. Few moments in motor sport will be remembered as well as the time when big V8s and hot sixes were demolished by the ubiquitous Mini Cooper at Bathurst. The all-powerful Mini achieved its huge success by virtue of two components –



ASVT is applicable to a wide range of structural design concepts.



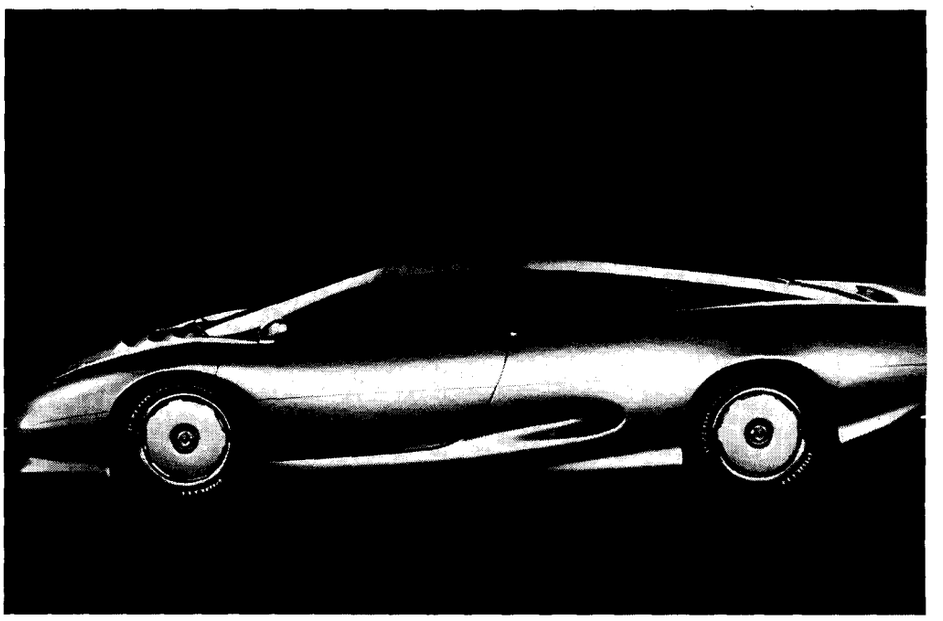
The Jaguar XJ220 prototype, designed as a roadgoing competition car, needing the highest levels of overall structural rigidity without incurring a concomitant weight gain. Its 48-valve, 6.2-litre aluminium block V12 is capable of 500 bhp and 200 mph.

handling and power-to-weight ratio. Its four-cylinder engine might have been only just over one litre in capacity, but the clever Issigonis-designed box body was very light.

Make a car lighter and you can either reduce the size or power of engine needed to push it. Of course, you can also use the same formula to say that any reduction in vehicle mass means an increase in performance from the same engine. And that's what is happening with the current line of research into lightweight aluminium cars – they're using their reduced weight to gain a performance edge.

The reasons are simple. High performance cars are expensive. The extra cost of using aluminium is of little concern to a driver seeking improved performance.

Alcan of Canada has been the guiding force in designing and developing aluminium prototypes. To date, more than 20 cars of seven or eight different designs have been built and tested. At the cheap car end of the market Alcan has built prototype Mini Metros (the car developed as a Mini replacement).



Realising that it would be many years before car makers in the cut-throat cheap end of the market could justify a switch to all-aluminium cars, Alcan changed its tack and started developing prototypes in the performance sector of the market. A Bertone Fiat X 1/9 was built, as was a Pontiac Fiero. The two most public aluminium cars are so charismatic that their aluminium content is often overshadowed by their performance potential. One is the Ferrari 400 and the other is the stunning Jaguar XJ220. A quick tour of the specifications of these vehicles show aluminium's advantages.

The Ferrari is a mid-engined two-seater coupe with a 4.0 litre aluminium V8 engine running four overhead camshafts, four valves per cylinder and electronically managed fuel injection and ignition. It develops 224kW and a massive 372Nm of torque for an all-up weight of 1137kg. This gives it a power-to-weight ratio of 5.08kg/kW (meaning that the engine has 5.08 kW of power to push each kilogram of the car along the road – better than almost any other sports car and almost as good as some motorcycles.

'Cars with vastly improved fuel efficiency and performance which don't corrode? Aluminium has moved the concept from being a pipe dream to a reality'

It is a rich irony that the body skin is made from Kevlar-reinforced fibre, not aluminium. But with a Cd of 0.274 the Ferrari is capable of reaching its top speed of 310km/h very quickly indeed.

The Jaguar is a far more outrageous looking car. It is also a technological leap into hyper-tech. The engine is a four valves per cylinder V12 of 6.3 litres capacity developing a staggering 373kW and 542Nm of torque. With a higher all-up weight than the Ferrari at 1560kg, the Jaguar still manages a power-to-weight ratio of 4.18kg/kW to give it a top speed in excess of 320km/h and acceleration of 3.5 seconds from zero to 100km/h. Stunning stuff.

In each case these cars use an aluminium 'frame' to support the engine and suspension (and offer exceptional passenger cell rigidity with surrounding deformable zones for

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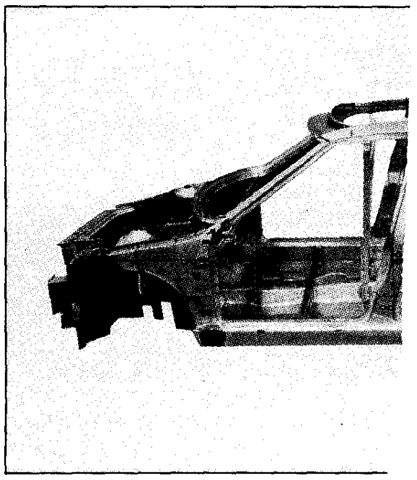
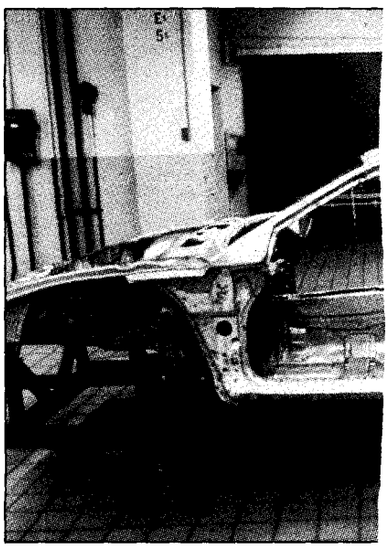




safety) that is constructed quite simply. In much the same manner as steel components are stamped and then assembled to make the frame of a conventional car, aluminium sheet is pressed and assembled with a minimum number of locating welds. As it is assembled the adhesive is placed between the mating parts. The frame is then placed in an oven and the adhesive bond cured.

The resultant joins are stronger than spot-welded steel and significantly stronger than welded aluminium. However, at present, the system is best suited to low volume production vehicles such as the Ferrari and Jaguar – both of which will cost a king's ransom when placed into the showrooms.

Cost effectiveness has finally arrived as a result of the new assembly techniques. Alcan gives the following breakdown:

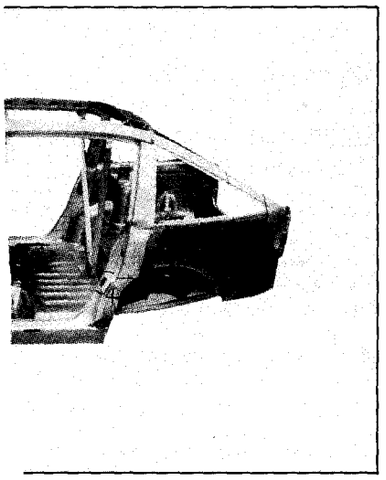
- less than half the weight of metal is needed to make a car from aluminium
- the recovered scrap is far more valuable (not only because it is aluminium, but also because it is less likely to have corroded
- weight reduction gives secondary savings in items such as suspension and braking components, as well as smaller engines
- no anti-corrosion treatment such as galvanising or thixotropic sprays are needed
- tooling costs are reduced because aluminium is cheaper to form (it needs less energy to press into shape)
- careful cost analyses show that, once the cost of a new factory is amortised, the cost differential could be as little as $US100 per car.

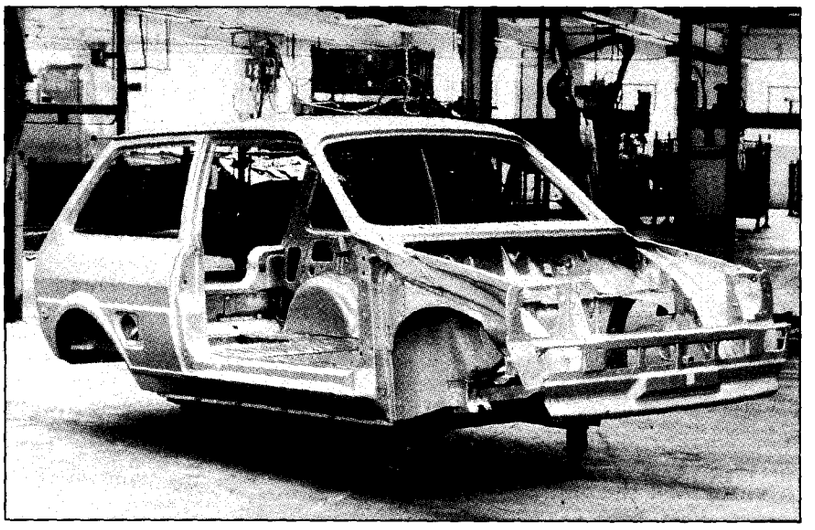
The reality is different. It's mainly based on that simple sentence: "Once the cost of the new factory has been amortised". It is not possible to switch from steel to aluminium without major capital investment in plant. This will restrict aluminium cars to the expensive, very high performance, low volume cars for the time being.

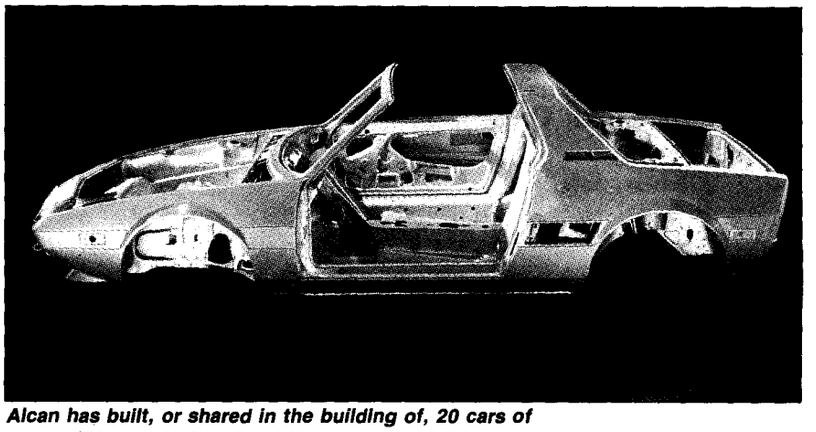
But news is breaking of one car using extensive bonded aluminium techniques that *will* be manufactured in larger numbers. The car is a yet-to-be-announced mid-engined Honda sports car using Honda's 3.0-litre V6 and tipping the scales at around 1100kg for sparkling performance. Indeed, early rumours say that it's a Porsche-beater. And the projected price is around $A100,000 – right in the heart of Porsche and Jaguar territory.

The race is on.

Cars with vastly improved fuel efficiency and performance which don't corrode? Aluminium has moved the concept from being a pipe dream to a reality. eti







Alcan has built, or shared in the building of, 20 cars of seven different designs including, from top left clockwise: the ECV3, the Austin Metro, the Bertone X1/9 and the Pontiac Fiero.

TECHNOLOGY

RECOGNISING SPEECH IN NOISE

Speech would be the most efficient form of man-machine interface. While some speech prototypes have been demonstrated in the laboratory, practical devices are still a long way off. Dr William Ainsworth, University of Keele, UK, writes.

Speech dominates human communication. If we want people to do something, or we need certain information from them, we simply speak to them. If they are far away we may write them a letter, but most people prefer to pick up a telephone, perhaps because reading and writing seem much more complicated than speaking and listening. That is hardly surprising, for it takes years of practice at school to become proficient in the skills needed to read and write.

When we want to communicate with a machine we have to learn new skills. We need to know how to poke at a keyboard with our fingers and to watch the effect it has on a screen. How much easier it would be if we could simply speak into a microphone to get the machine to do what we wanted!

This dream occurred to speech technologists many years ago, and for the last 20 years or so they have been trying to devise techniques for getting machines to respond effectively to speech signals.

Speech communication appears to be a simple process. It is learned by every healthy child with little or no effort. In reality it is not simple: it is a most complex process. An idea in the mind of the speaker must first be expressed as a sentence in a language understood by both him and the listener. It must then be articulated. We do it by modulating the airstream from the lungs by the vocal cords to produce a sequence of pulses whose frequency determines the intonation. The pulses excite the resonances of the vocal tract and then radiate from the lips as a sound wave. The meaning of the sentence is coded in this wave by subtle movements of the tongue, jaw and lips. These complex movements are known intuitively by everyone who has learned the language.

But this is only half the story. The sound wave passes through the outer ear of the listener and causes the eardrum to vibrate. These vibrations cause the ossicles, a series of small bones attached to the eardrum, to move and pump fluid in the cochlea, or inner ear. In the cochlea is the basilar membrane which oscillates at various places along it which depend upon the frequencies present in the input signal. So, the structure of the inner ear begins the process of decoding the speech wave. Attached to the basilar membrane are a large number of hair cells, some 30,000 of them, which activate nerve cells when they bend. These cells are the first stage in a complex system which leads up the brainstem and eventually to the auditory cortex.

Automatic recognition

So far, the processes by which the speech signals are decoded by the brain are not well understood, so programming a computer to recognise speech in the same way that the brain operates is obviously impossible. Nevertheless, for many practical purposes a machine which recognises just a few words can be very useful. For example, consider a program that displays the choices available to the user by means of numbered menus. If the machine can just recognise the spoken digits the user can complete his task by voice.

Most practical speech recognisers work by pattern matching. The user speaks all the words in the machine's vocabulary and the machine analyses them and stores the result. These stored patterns are often known as templates. When an unknown word is spoken, the machine compares this new utterance with each of the stored templates and chooses the one which gives the best match.

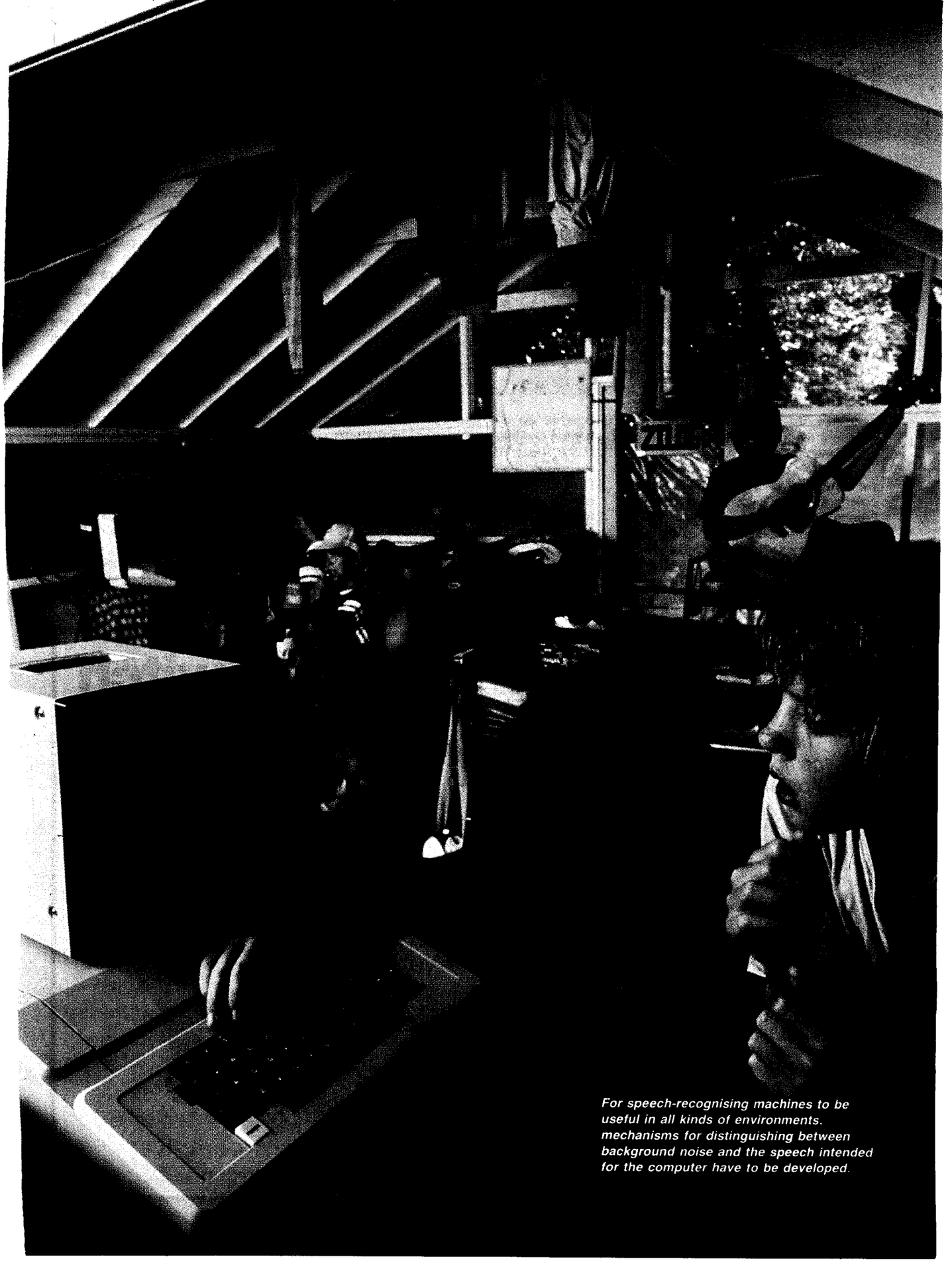
'When we want to communicate with a machine we have to learn new skills'

Several techniques have been employed to analyse speech signals. We know that speech is encoded in terms of frequencies and that the human auditory system begins its analysis of sounds by separating them into their component frequencies, so spectral analysis is a popular technique.

But speech recognisers built on these principles alone are not very successful, for three reasons:

(1) Every time we utter a word we speak at a different rate, so some patterns are spread out in time compared with others.

(2) Different people have different sized vocal tracts, so the formants occur at different frequencies when they say the same word.



For speech-recognising machines to be useful in all kinds of environments, mechanisms for distinguishing between background noise and the speech intended for the computer have to be developed.

(3) Most speech communication takes place not in isolation, but against a background of other noises.

Various techniques have been devised for dealing with these problems. The first problem can be dealt with by so-called dynamic time warping. This enables the stored templates to be expanded or compressed in such a way that the optimum match is obtained. Alternatively the problem can be dealt with by building statistical models of each word which incorporate the variability of the utterances.

Usually the multi-speaker problem has been circumvented by training the system with the voice of the user, but there have been some attempts to cope with it by building transformations for each new speaker that enable his voice to be transformed into one like that of the person who originally trained the system. Here, statistical modelling of the variability has again been used.

The problem of recognition in noise has not yet been solved. John Bridle and his colleagues at the UK Royal Signals and Radar Research Establishment in Malvern, western England, some years ago showed that a speech recogniser which worked well in the quiet recognised only about 50% of spoken digits correctly when the signal-to-noise ratio was +3 dB. This is far worse than human performance. It has been known for many years that spoken digits can be recognised with almost complete accuracy with a signal-to-noise ratio as poor as −6 dB, which means the intensity of the speech is much less than that of the noise.

Auditory modelling

The superior performance of people in recognising speech in noise had led to the suggestion that speech analysers which operate on the same principles as the human auditory system might work better than those based on conventional techniques. Preliminary experiments by Dr Ghitza at the Bell Laboratories in the USA and others elsewhere have shown promising results. Professor Ted Evans, the leader of a research group at Keele, has developed an electronic model of a single channel of the auditory system. It gives responses similar to those obtained by inserting micro-electrodes in the auditory systems of cats.

'The first problem can be dealt with by so-called dynamic time warping.'

Professor Evans's model consists of a filter with characteristics that simulate those of the inner ear, a half-wave rectifier and logarithmic compressor to represent the action of the hair cells, and what is called a probalistic spike generator to simulate the production of action potentials in nerve cells.

The first stage of the model consists of a bank of band-pass filters which simulate the signal processing as far as the auditory nerve. The characteristics of these filters are estimated by a process known as reverse correlation. A random noise signal is applied to the auditory system and responses are recorded from the auditory nerve by means of a microelectrode. The noise signal causing the nerve fibre to respond is also recorded. By a process similar to cross correlation between the noise input signal and the response of the nerve fibre, the impulse response (the response of a filter to a single impulse) of the auditory filter is found (in practice the impulse response is reversed in time; hence the term reverse correlation). Several experiments have to be done with a number of nerve cells, each tuned to respond to different frequencies, to develop the impulse responses of a bank of filters.

These impulse responses can be programmed on the computer and used to simulate the filtering characteristics of the auditory system. The other stages of auditory

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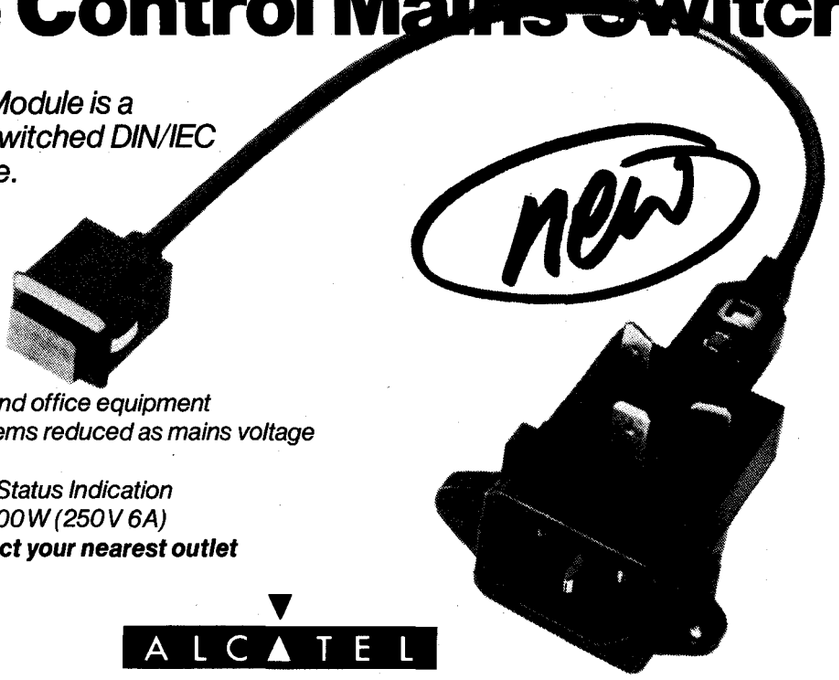

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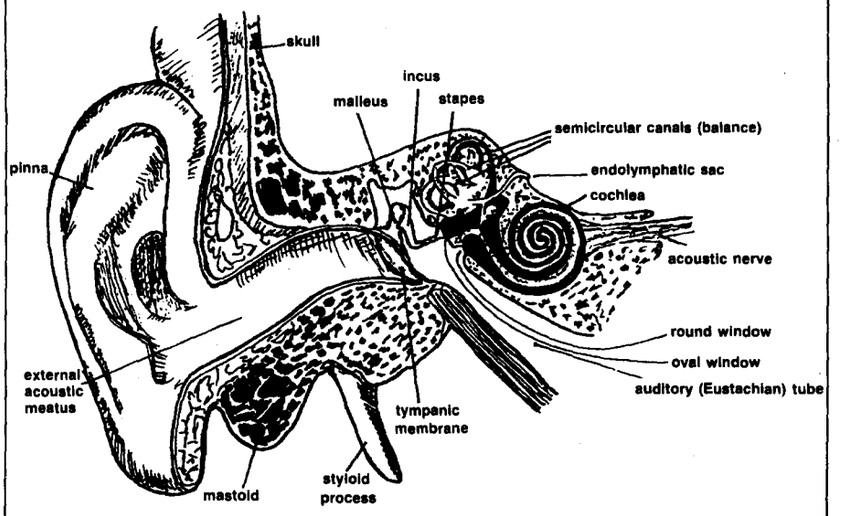


Sound waves pass through the outer ear and cause the eardrum to vibrate. These vibrations cause the ossicles, a series of small bones attached to the eardrum, to move and pump fluid into the cochlea, or inner ear. In the cochlea is the basilar membrane which oscillates at various places along it. Attached to the basilar membrane are some 30,000 hair cells which, when they bend, activate nerve cells. This is the first stage in a complex process which leads up the brainstem and eventually to the auditory nerve.

processing, logarithmic compression and rectification by the hair cells and the generation of spikes according to a probability function, can also be programmed. The result is a computational model which allows the signals generated at each level in response to speech sounds to be studied.

The auditory system is more complicated than I have already outlined. Recent physiological studies have shown that there are interactions between the channels: if there is activity in one channel, the activity in neighbouring channels is suppressed. This mechanism might be responsible for reducing the effects of noise while enabling speech signals to be transmitted to the higher regions of the auditory system. We intend to build lateral supression into our model and to investigate what effect it has on speech processing.

Speech synthesis

Techniques for speech synthesis were developed about 20 years ago. In a typical system a sentence is first translated into a sequence of phonetic units, which represent the way in which each sound is pronounced. This can be done by looking up each word in a phonetic dictionary or by applying a set of context-sensitive rules (for example *p* followed by *h* is pronounced *f*, otherwise *p*).

The phonetic units are then translated into acoustic parameters which represent the physical characteristics of the sounds. The acoustic parameters are the frequencies of the formants, their intensities, and their durations. They are used to control a speech synthesiser consisting of a set of resonators excited by a sequence of pulses.

Although such a system produces intelligible speech, the output sounds rather mechanical. Moreover, it has been found that when it is heard against a background of noise it is a great deal less intelligible than equally loud natural speech. We are

'Techniques for speech synthesis were developed about 20 years ago.'

collaborating with the IBM Scientific Centre in Winchester, southern England, to try to discover why this is so.

One possibility is that whereas this system faithfully models the resonances of the vocal tract it does not employ realistic excitation pulses. A technique known as inverse filtering is being used to measure the shapes of the excitation pulses in human speech. In this technique the characteristics of the vocal tract filter are estimated, and then the characteristic of the filter is inverted. If speech signals are passed through the 'inverted' filter, only the excitation pulses remain.

Using the technique we are able to study the variation in shape of the excitation pulses. This knowledge can be applied to speech synthesis. We expect that speech synthesised in this way will be more intelligible in the presence of background noise.

User interface

When the captain of a ship gives a compass course for the helmsman to steer, the helmsman repeats it back to confirm that he has heard it correctly. When a telephone operator is asked to obtain a number she repeats the number back. Communicating with a machine in a noisy environment is somewhat similar. The noise may corrupt the speech signal and cause an error in recognition. The user will be unaware of the mistake unless the words are displayed on a screen or the machine is equipped with a synthesiser to speak back to him. If the user is communicating over a telephone line, or if his eyes are busy with another task, the latter course may be the only one that is practicable.

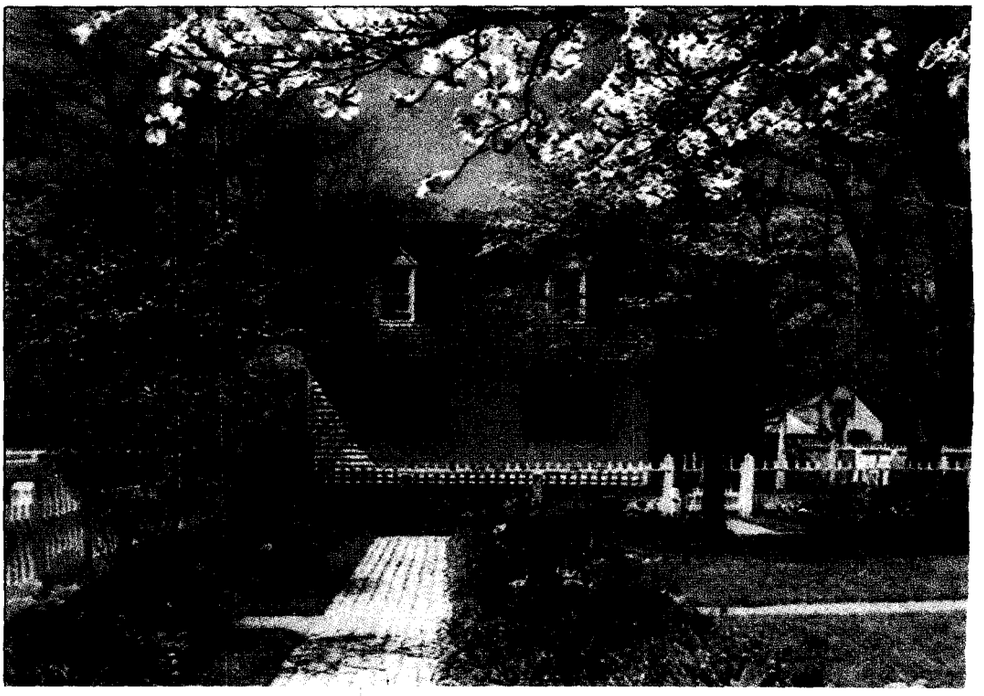
The question arises as to whether the response of the recogniser should be checked after each word has been spoken to it or whether it should be checked later, for example, at the end of each sentence. Compass courses always consist of three digits and they are repeated back as a group. Telephone numbers, on the other hand, vary quite widely in the number of digits they contain. They are often checked after three digits, but on a bad line digits may be checked one by one.

Here at Keele we are interested in communicating with computers in a noisy environment where it is likely, in spite of advances in recognition from auditory modelling and in synthesis from realistic excitation pulses, that occasional mistakes will be made. So we are interested in finding the most efficient ways of detecting and correcting errors.

We have developed a mathematical model of the user interface, which enables us to arrive at the optimum number of words which should be spoken before any checking is done. This model predicts, as might be expected, that as the noise level rises and the frequency of errors increases, the number of words spoken before a check is made should be reduced. Experiments have shown that the specific predictions of the model are borne out in practice. eti

Dr Ainsworth is at the Department of Communications and Neuroscience at the University of Keele, UK.

The quality available from VFS hardcopy printers is surprisingly good. These prints were made with the Kodak colour video printer which uses a thermal dye transfer process.



TECHNOLOGY

STILLS TO ORDER

Video still photography update

Less-than-perfect photos? Extra-fast image transmission required? Some manufacturers reckon that electronic still photography could be the answer. Derek Powell reports.

Although we are yet far from replacing chemically-based photographic film with magnetic image recording, the technology of electronic still photography has come further than is commonly realised.

Complete systems are now available with electronic still cameras, transmission links, retouching and manipulation devices, storage and retrieval systems and more. Printing, publishing, defence, law enforcement and education are among the diverse user groups of this infant technology.

"Still video" is based on the organisation and storage of pictures gathered from a range of sources by reducing them to a common standard – in this case a single frame of video. Images can be gathered from slides via a telecine chain; from hardcopy using a video copystand camera; from single video or motion picture still frames; from the graphics output of computer programs or from real life using a video still frame camera recorder.

Once the image is converted to video, a number of operations are possible that are difficult to accomplish with hardcopy images like slides or prints. Still video images can be manipulated and enhanced by computer graphics; they can be instantly copied and quickly transmitted by cable or telephone circuits anywhere in the world. Particular images can be easily filed, quickly random-accessed and presented to large or small audiences via monitors or video projectors.

It has been said that still video is an answer looking for a question but it is instructive to see the growing list of big name companies from both the photographic and video worlds queuing to provide that query.

The Eastman Kodak company has long realised that it is in the business of images, and that the images of today can be photographic, videographic and computer graphic. Canon has had a long and proud involvement with photojournalism and has set itself to providing a range of options which address the professional photographer's needs in the age of instant communications. Sony, from the video side of the fence, has seen the potential of the video techniques to bring a new flexibility to still imaging.

Kodak, Canon and Sony all offer a range of products based on the video floppy system (VES). This standard was established in April 1986 by the Electronic Still Camera Conference. At last count, nearly 50 manufacturers had agreed to support the system and most are already producing hardware.

It is true, however, that buyers have not been falling over each other to purchase product here in Australia. A major factor limiting its acceptance at present is that most equipment is based on frames of video conforming to the NTSC standard. While this can be tolerated for some applications, especially when the principal output requirement is for hardcopy, it does limit the input and display options for local users.

This is a rather curious situation as the usual course of events would see PAL versions of new equipment released six to eighteen months after the release of the NTSC machines in Japan or the USA. VFS product has been around for well over two years and PAL equipment is not even on the horizon. Sony, for one, does expect to release the VFS range in PAL although a firm date has not been announced. Certainly, overseas interest in and acceptance of the product would seem to make PAL units for the European and Australian markets a viable proposition.

'Once the image is converted to video, a number of operations which are difficult with slides or prints are possible'

The VFS system

The VFS recording medium, which looks like a similar version of the familiar 3½ inch floppy disc, has external dimensions of just 60mm by 54mm. Inside, a 47mm disc coated with magnetic powder rotates at 3600 rpm (NTSC). The recording system, despite the use of a computer-like floppy disc, is not

digital but analogue.

A magnetic recording head lays down tracks of 0.1mm pitch using an FM recording system broadly similar to that of conventional VCRs. Video signals are processed in component form with a separate luminance signal. Chrominance is laid down using R-Y, B-Y differential colour, line-sequential FM recording.

Each disc can hold up to 25 frame images or 50 field images. "Field" recordings have only half the vertical resolution of "frame" recordings; however, on playback of single field images a second field is interpolated to increase apparent resolution.

VFS also allows for audio recording so that a commentary may be added to the pictures. When selected, 9.6 seconds of time-compressed FM audio is added to each frame; with audio, only 16 frames will fit on a disc. In a field record mode, 25 pictures with audio can be accommodated or eight minutes of audio-only recording.

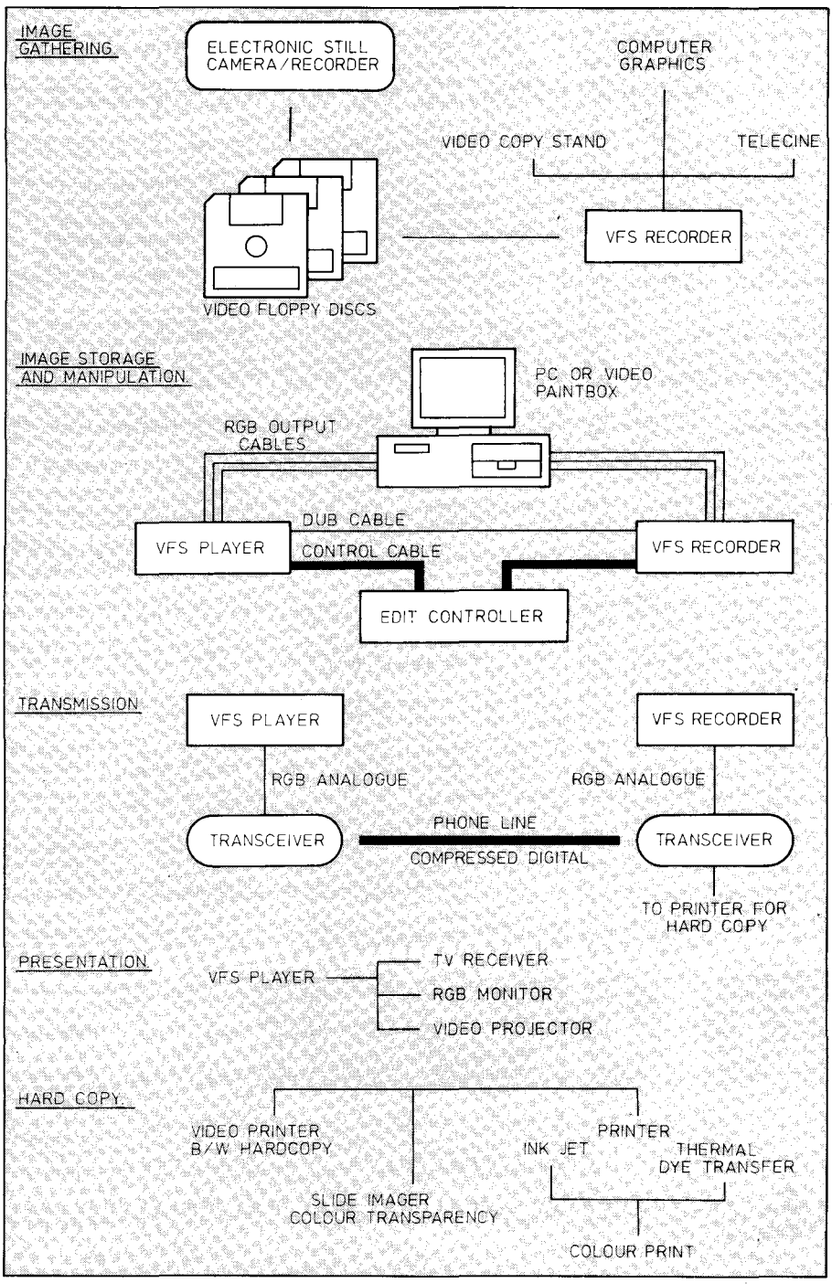


Diagram of VFS system configurations.

Image capture

Electronic photography has been limited by the characteristics of video pickup elements. Vidicon or Saticon camera tubes made life very difficult for a still video camera designer. Camera tubes are bulky, power hungry and need extensive deflection and registration circuitry.

The breakthrough in video still cameras came with the development of CCD sensors. Resolution and sensitivity are both high and the CCD can be electronically shuttered to provide the short exposure times needed to freeze action and provide a sharp, still image.

Still video camera recorders are built to operate (and look) like conventional still cameras. Canon's range features interchangeable lenses, high resolution and six modes of auto exposure.

The Sony MVC-A7AF, which resembles a medium format SLR, is more highly automated. The image sensor is a ⅔inch interline transfer CCD chip with a resolution of 380,000 picture elements. A six times zoom lens is standard with built in autofocus and self-adjusting automatic white balance adjustment.

'Fifty manufacturers agreed to support the system and most are producing hardware'

The automatic exposure system would be instantly familiar to a user accustomed to current 35mm SLR equipment. Exposure control can be set to program mode or shutter speed priority with manual exposure compensation for back-lit or difficult subjects. There is even an electronic flash unit for indoor or night shooting.

The sensitivity of the camera system is roughly equivalent to a film speed of ASA/ISO 160 (in the field recording mode). For low light situations a +6dB gain switch effectively increases the sensitivity to ISO 320.

The extra (non-film camera) functions have been made as user-friendly as possible. For example in auto audio mode, the built-in microphone is activated for 9.6 seconds as soon as the shutter is pressed. The recorded audio track is coded with information to link it to the proper video tracks, so later playback of audio with video is automatic.

Most electronic still cameras do not allow replay direct from the camera and do not have electronic viewfinders. Images can be checked by replaying the discs via a console VFS player and monitor. However, the electronic still camera is not the only source of still video images.

Just like a standard VCR, a benchtop VFS

recorder can be connected to a variety of input devices. For copying images from books, photographs or other printed material a standard video camera can be used, usually mounted on a specially lighted copy stand. The camera is usually connected in RGB mode, rather than composite, to the recorder. When the image is set up and correctly focused, the record button on the recorder is pressed and a single frame is laid down on the next floppy track.

Kodak offers a special slide scanner as part of its VFS lineup. This allows use of existing slide library material as part of a VFS presentation and gives access to the range of filing, transmission, display and manipulation options that the video system provides. The slide video transfer unit, as it is called, has adjustable zoom to crop the image or highlight detail, rotation to amend a crooked perspective and allows brightness, colour and sharpness to be adjusted before transfer.

A personal computer with a suitable RGB output can directly input graphical information to the VFS recorder. However, PC graphics and paint programs can do more than just originate charts and text. Even more interesting is the potential for image manipulation.

Manipulating images

Once VFS images have been gathered, an editing system consisting of a VFS player, recorder and controller is commonly used to duplicate the images and organise them for filing and presentation. Usually a "dub" output/input is provided for copying. This keeps the signal in component form to give least degradation when copied. Remember that this is an analogue recording system, not digital, and only about three generations of dubbing can be tolerated.

The potential of VFS images really hots up when the RGB outputs of the playback machine are used to feed the image capture board of a video paintbox or computer graphics system. Real life images can then be overlaid with text and charts or retouched using the paintbox tools. Very sophisticated presentation graphics can be created and stored as sequences on the recording VFS machine.

Still video recordings can be played back and displayed on any TV set or monitor although, like computer graphics, better resolution will be obtained using direct RGB inputs on a monitor or video projector. An appropriate amplifier and speaker system is also needed when the recordings have an audio component.

Transmission

One of the principal advantages of converting images to the electronic medium is the potential for swift transmission of pictures across the country or across the world. VFS transceivers are available in a number of transmission standards. One of the most technically interesting is the Kodak still video transceiver which is the fastest currently available.

The ProMavica MVC-A7AF still video camera recorder, the first from Sony, converts optical picture information into electronic signals and records them on a floppy disc.

The operation of this unit can be roughly compared to a colour facsimile machine. The still images from a camera or disc player are fed to the transceiver as composite or RGB analogue video. The transceiver converts the image into digital form and transmits it via standard telephone circuits to the remote receiver which then reconverts to analogue video.

> ***'USA Today had a finished colour print of a candidate just 20 minutes after he was photographed on the other side of the continent'***

The transmitter can operate at speeds of between 9600 and 2400 bps. The transmission rate is dependent on line quality. At the highest speed, a colour image can be transmitted in around one minute.

A special preview mode transmits a recognisable image in just 10 seconds. This allows a remote station to quickly preview a number of available pictures and select for full resolution transmission only those shots required. An RS-232 interface provides for computer control of batch transmission with autodial facilities. As a byproduct of the digitising for transmission, images in digital form can be stored off-line on computer floppy discs.

Transmission of images by wire is of course not a new idea. Wirephoto machines, which have been in use for many years, use an analogue transmission method. Other VFS transmitters conform to this standard, even though the resolution is less than the digital method, so that they may access the existing wirephoto networks.

The quality of the colour image transmission is suitable for newspaper reproduction and newspapers like *USA Today* (which publishes a colour front page) have used electronic photography and transmission to cover late-breaking stories.

Some sort of record must surely have been set during the last Presidential campaign when the paper had a finished colour print of a candidate delivering his speech just 20 minutes from when he was photographed on the other side of the continent.

The quality of video photographs is not yet good enough for magazine reproduction but there are areas where the colour transmission of the VFS system is used. *Time* magazine has used electronic proofs – VFS images taken from slide originals – transmitted to the editorial desk from overseas.

Hardcopy prints, produced from the electronic stills, are used to select photos and lay out the magazine format while the colour separations are being processed and delivered. This puts the production schedule a day or more ahead and allows coverage of news and sporting events closer to the magazine deadline without sacrificing reproduction quality or editorial flexibility.

Hardcopy

This leads us to the last link in the electronic photography system – hardcopy.

Some diehard proponents of electronic imaging are predicting that film will shortly

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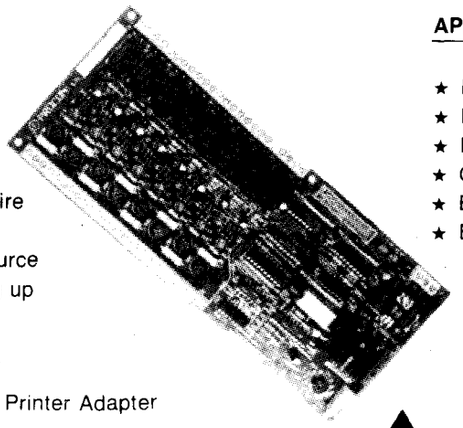

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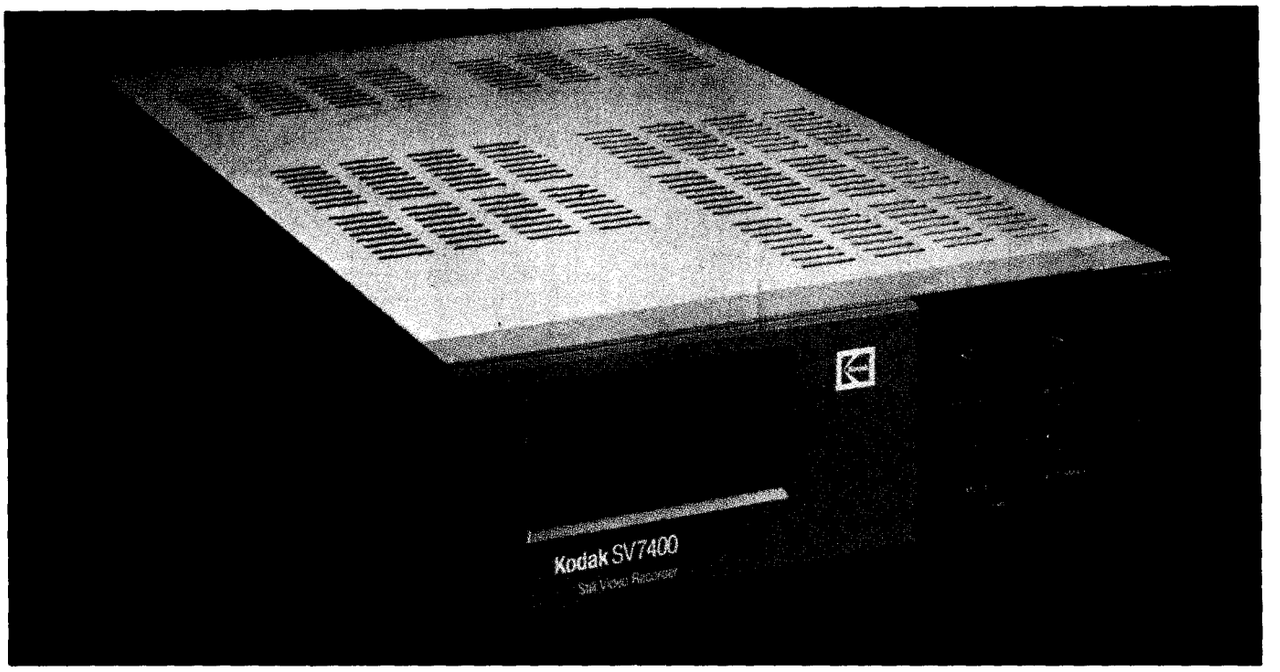
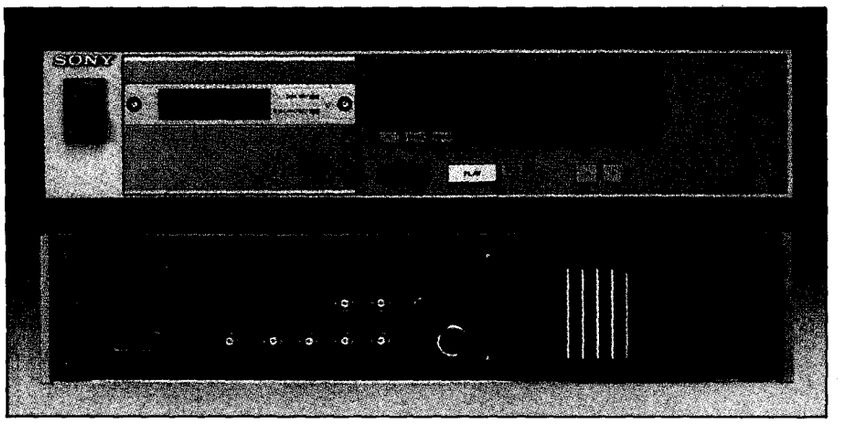
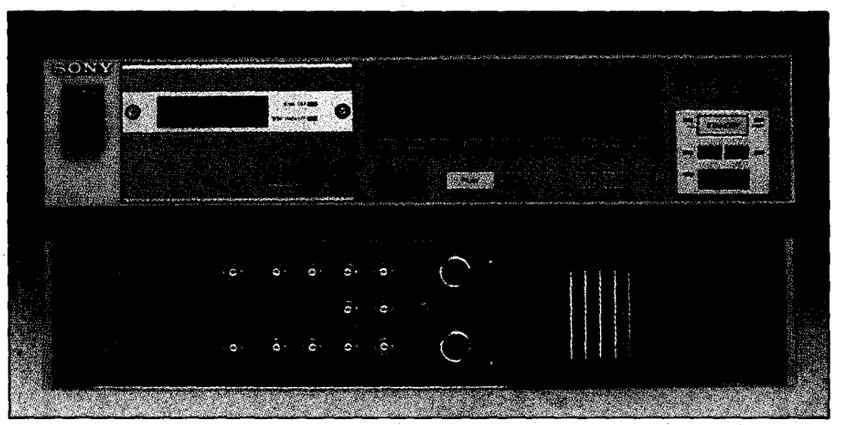


The Kodak SV7400 still video recorder.





The MVP-2500 still video player (top) and MVR-5500 still video recorder (bottom), part of the ProMavica series from Sony.

be obsolete. The general public are expecting to be lining up at video printing bars to have their happy snaps transformed from magnetic floppy to mantlepiece 8 x 10. While this technology is currently available, it does seem that widespread use of the format has some distance to go.

Hardcopy is produced by a range of machines using thermal printing (for black and white images on paper); ink jet printing (for low resolution colour output) or sophisticated thermal dye transfer techniques which yield high resolution, continuous tone photographic prints.

In Australia

A number of organisations have shown interest in the system for educational use. Still video with audio is a more flexible and easy-to-use alternative to the slide/tape and audiovisual for teaching. There is more flexibility in source material, copies can be made easily and cheaply and storage space for a number of programs is greatly reduced.

Another potential application is security. Stills from bank security cameras and the like can be in the hands of police officers on the beat or interstate within hours of a hold-up.

In mid 1988, the Electronic Still Camera Conference reconvened to approve a high band extension to the format which gives superior resolution. Perhaps the PAL implementation of VFS is being delayed until we can take full advantage of these new standards? When it does finally arrive, Australia's educators, corporate communicators, police and journalists will have a powerful new communications tool. eti

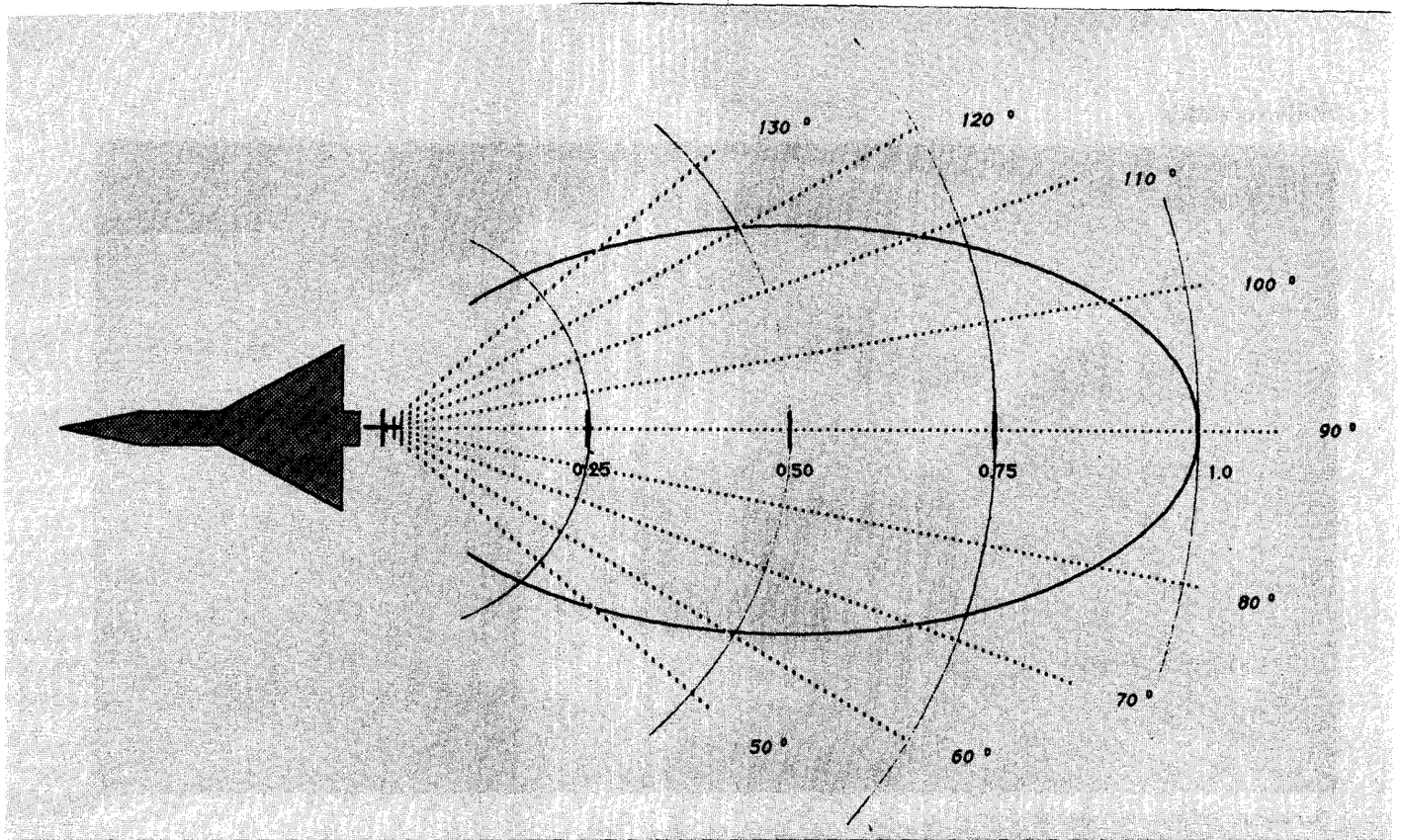


Figure 1: Infrared signature for a typical jet aircraft.

What can be done to avoid heat-seeking weapons launched from ground or air? Terry Moon and John Bell describe present and future methods in their second article.

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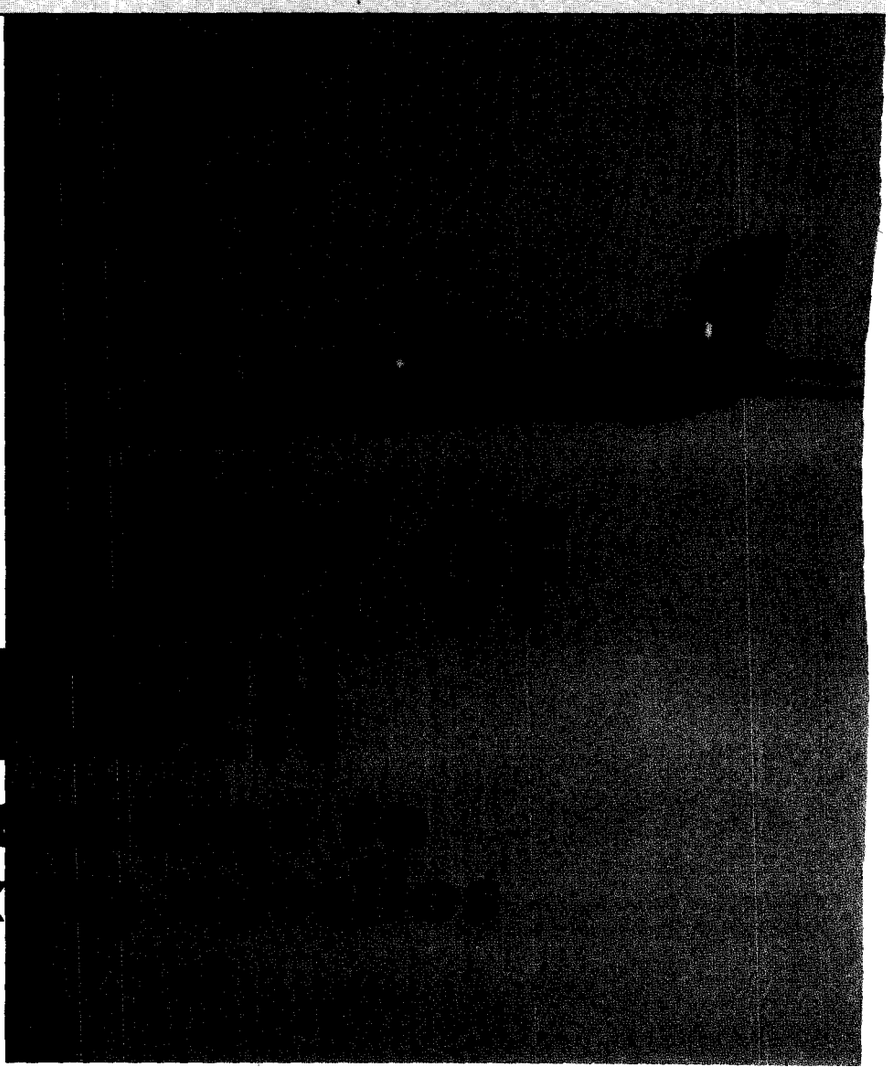
heat-seek



Every new weapons system generates a search for ways of reducing or negating its effectiveness. Often, simple tactical procedures can be used against such a new weapon. Bombers, for instance, may fly at heights above the range of surface-to-air missiles (SAMS) so sacrificing some bombing accuracy, and perhaps opening themselves to attack by air-to-air missiles (AAMs) launched from fighter aircraft. On the other hand, jet aircraft on a mission above an enemy territory may fly at very low altitudes in order to give the defences much less time to react; this, too, has its disadvantages as it makes it more difficult for the aircraft to locate their target and may bring them within range of localised anti-air artillery. In the case of unalerted aircraft, say civil airliners during peacetime, such manoeuvres are not part of their routine flight pattern which makes them easy prey for a terrorist attack.

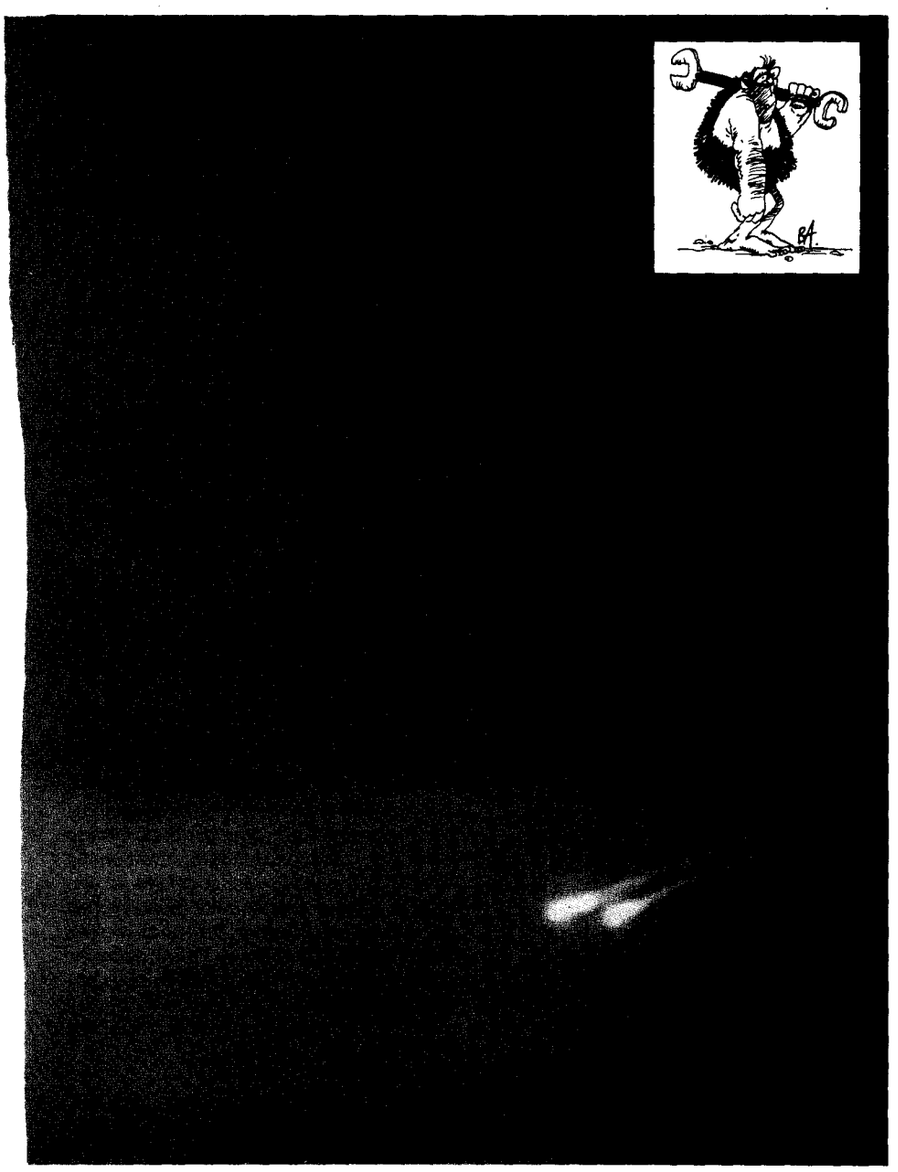
During the Yom Kippur war of 1973 the Israeli pilots adopted some simple measures to counter the Soviet-supplied SAM-7 missiles used by the Arab forces. It was reported that the Israeli pilots successfully degraded the tracking ability of the SAM-7s using a tactical manoeuvre that involved a sudden steep climb in their jet (going near to vertical) and then diving through their previous flight path. This manoeuvre, suited to alerted mobile fast-flying aircraft only, provided an area of intense heat on to which the SAM missiles could home – a manoeuvre definitely unsuitable for civil airliners.

However, such simple manoeuvres were soon countered by improvements in the agility of heat-seeking missiles and improvements to their tracking systems. Other countermeasures were clearly required which could be used by more vulnerable (say larger, slow-flying) aircraft against the more sophisticated and agile heat-seeking missiles.

Infrared countermeasures are those measures taken either to divert a heat-seeking missile from its intended target, deceive the missile as to the position of the target or to deny the missile adequate information to acquire or track the target. Most of the ways of realising this can be broadly categorised as either chemical or mechanical, though electronics plays a crucial role in detecting heat-seeking missiles and controlling the deployment of the appropriate infrared countermeasures. Because of the speed and complexity of modern combat aircraft pilots are relieved of as many simple or routine tasks as possible with, for instance, even the dispensing of the humble decoy flare being performed by an electronic controller.

Tactics alone are unlikely to succeed against the range of modern heat-seeking missiles deployed against aircraft. Even when fitted with appropriate flying gear the fighter pilot cannot sustain an acceleration of more than about 5*g*. Thus, once a supersonic heat-seeking missile, capable of pulling 20*g* say, is homing in on an aircraft, avoidance is almost impossible unless a manoeuvre is carried out with precise timing. Clearly, larger, slow-flying aircraft would be in a much worse predicament. Defence scientists are therefore working to increase the survivability of aircraft by providing on-board countermeasures against the deadly heat-seeking missiles.

The need for infrared countermeasures is probably best illustrated by the impressive performance of the Sidewinder AIM-9L air-intercept missiles used by the British against the Argentine Air Force during the Falklands war. The Argentine pilots did not attempt to evade these missiles and did not employ countermeasures; consequently they suffered grievous losses.



'Israeli pilots used a tactical manoeuvre that involved climbing almost vertically and diving through their previous flight path'

While active and semi-active radar homing missiles normally rely on the missile seeker sensing reflected radiation (emitted by an illuminating radar) from the target, infrared homing missiles detect the thermal radiation from the aircraft. More precisely, they do not require the target to be illuminated by an external source. The options available for countermeasures to infrared homing missiles are more limited than the countermeasures to radar-guided missiles. Infrared countermeasures can therefore be viewed as being based upon two fundamental concepts:
(1) generating a false target; or
(2) reducing the infrared radiation detected by the missile seeker.

Manoeuvres

Manoeuvring an aircraft that is being tracked by a heat-seeking missile can cause

Figure 2: F-111 aircraft dropping flares (photo courtesy Department of Defence).

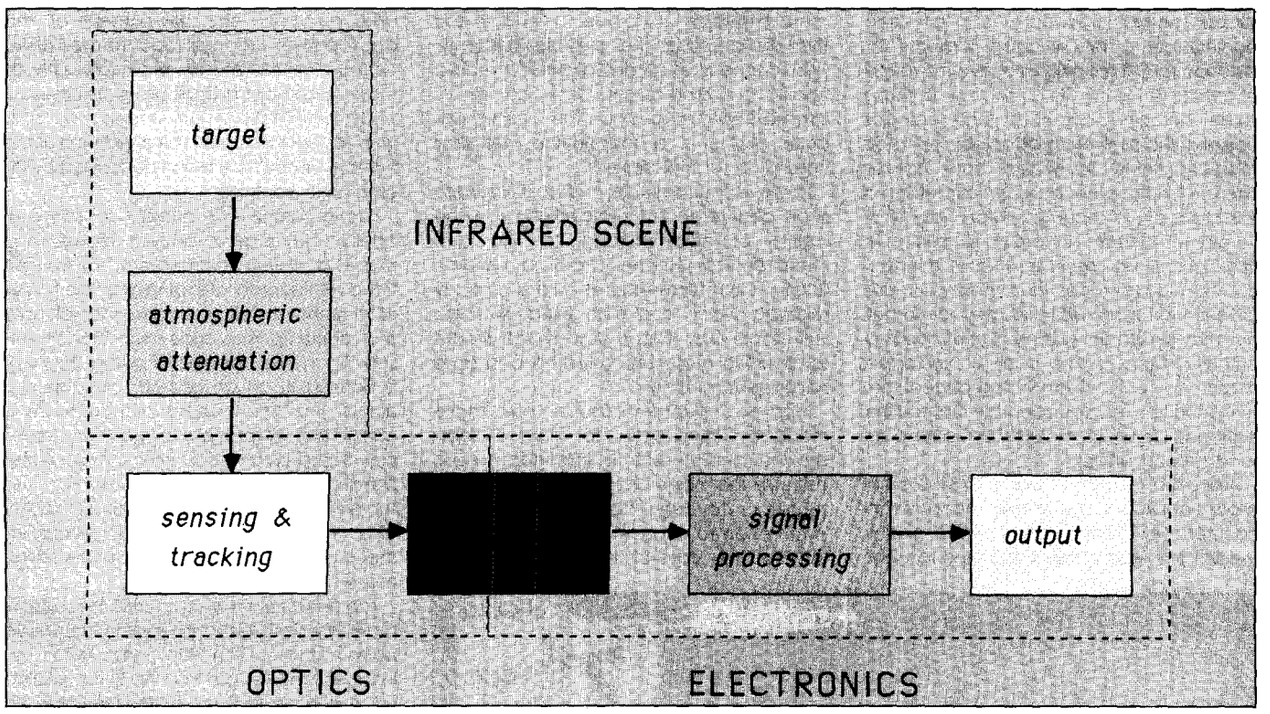


Figure 3: schematic diagram of an infrared warning receiver.

excessive demands on the changes to the missile flight path required to intercept the target. If the changes in direction are rapid enough, and occur at the right moment, they will cause the missile to miss the aircraft. The success of such a method is dependent upon the pilot knowing that he is being attacked by a heat-seeking missile and the agility of the aircraft relative to the missile. Manoeuvres may also be used along with other countermeasures.

Reduction of infrared signatures

The pattern and intensity of IR radiation emitted by an aircraft, ship or other platform is called an infrared signature. An example of the signature of a typical jet aircraft is given in Figure 1 where the relative intensity of the infrared radiation emitted by a typical jet aircraft is shown for various viewing angles, called the aspect of the aircraft.

Reducing or modifying this infrared signature can delay or prevent a heat-seeking missile from acquiring a target. Also, by reducing the infrared signature the effects of other infrared countermeasures will be enhanced. Some of the techniques used to modify or reduce infrared signatures are the shielding and cooling of the aircraft engine(s), use of smoke screens or aerosols to mask the target or the application of special paints which lower the intensity of infrared radiation emitted.

For example the Israelis fitted jet pipe extensions to several of their aircraft during the Yom Kippur war so that the enemy's heat-seeking missiles detonated their warheads away from vital aircraft structures.

Flares

Pyrotechnic flares are an intense source of heat and will act as a decoy luring a heat-seeking missile away from the hot tailpipe and exhaust gases of a jet aircraft. Flares are simple, cheap countermeasures that have proved effective against many types of heat-seeking missiles. The pyrotechnic decoy flare is similar to flares used for illumination or identification. Such flares consist of a fuel like powdered magnesium or aluminium, an oxidant like sodium nitrate and a small amount of binder. The chemical reaction for such a flare is:

$$5Mg + 2NaNO_3 = 5MgO + Na_2O + N_2$$

A 250g flare made from these materials burns for about 8 seconds. The main problem with flares is that the aircraft can carry only a limited supply. To use flares efficiently as decoys the modern aircraft uses a programmable electronic controller to dispense the flares at appropriate intervals. By connecting the controller to a warning device flares are ejected only when a heat-seeking missile is detected.

Infrared warning receivers

These devices detect the heat from the rocket engine of the infrared homing missile during its launch or subsequent powered flight. Spectral and spatial filtering can be used to differentiate between the rocket plume and heat from other sources such as chimneys, reflected sunlight or gun flashes. Infrared warning receivers rely heavily upon modern computing and signal processing techniques. They form the electronic brain of any smart countermeasure system, sensing the threats and providing warning so that appropriate countermeasures can be applied in the correct manner at the correct time. There could be no second chance! The schematic functions of an infrared warning receiver are shown in Figure 3.

Jammers

Unlike expendable decoy flares infrared jammers are active devices that can provide continuous protection for aircraft. They are installed on the wings or fuselage of aircraft from which they are able to draw their electrical power.

An early idea for jamming heat-seeking missiles was the blinker countermeasure. This concept would use two or three intense infrared sources spaced as far apart on the aircraft as possible – for example, at the wingtips. If these sources were then switched on and off sequentially the heat-seeking missile would seek to home on to one blinker and then the other(s). With two sources, say one at each wingtip, the missile seeker would cross from one side to the other; with three

sources, appropriately arranged, the missile could be induced to fly a spiral trajectory. Problems with this system are:
(1) Each blinker must be sufficiently intense to capture the homing and guidance system of the heat-seeking missile.
(2) The optimum blinker rate will vary from one missile type to another.
(3) IR missiles have a small field of view (typically less than 3°) and so, especially at close range, they might receive only one blinker signal which may then act as a beacon assisting the heat-seeking missile to track the target during the final stages of the engagement.

The great advantage of this concept, and indeed infrared jammers in general, is that blinker jammers may be left on during a given mission; that is, their operation need not be cued by a signal from an infrared warning receiver.

A more suitable type of infrared jammer is described in some detail by Jim Carey in his article in .the eighth edition of The International Countermeasures Handbook. Dr Kenneth Drellishak also discusses IR jammers in a later edition of this handbook. Such jammers modulate the infrared radiation they emit so as to deceive a heat-seeking missile as to the correct position of its intended target. They may use mechanical means, like shutters or filters placed in front of an infrared lamp, to modulate the infrared signal emitted or they may use an electronically-controlled flashlamp that can be rapidly switched on and off. Provided that the jammer installed on the aircraft to be protected emits a correctly coded infrared signal, tracking capability of the heat-seeking missile will be negated as it attempts to home onto the aircraft engines or fuselage. Hence the heat-seeking missile will be diverted from flying the correct trajectory needed to intercept the aircraft.

Because the jammer is located on the aircraft, usually near the engine(s), its effectiveness is independent of range. For example, if the infrared jammer is four times more intense than the heat emitted from the aircraft engine(s), and if it emits infrared radiation in the same angular pattern as the engines, it will be four times more intense than the aircraft engines at all ranges and aspect angles. (The aspect angle is the angle at which the aircraft is viewed as measured from the axis of the fuselage.)

Infrared jammers are designed to negate the tracking capability of a heat-seeking missile, causing the missile to miss its target by a safe margin. This acceptable miss distance will depend upon the type of heat-seeking missile being countered, particularly the explosive charge it is carrying and the type of aircraft being protected. An infrared jammer may degrade or negate the tracking capability of a heat-seeking missile in one of three ways:
(1) The jamming signal from the infrared jammer prevents the heat-seeking missile from acquiring the target during the prelaunch phase.
(2) The jamming signal causes a large pointing error in the seeker of the missile so that the target is no longer in the field of view of the seeker. This is called optical break-lock. After optical break-lock has occurred a heat-seeking missile receives no information as to the target's position and consequently it will fly a purely ballistic trajectory. This usually produces a very large miss distance.
(3) The jamming signal does not cause optical break-lock but reduces the tracking capability of the seeker to a point where the heat-seeking missile is unable to track a target accurately. This results in small, but acceptable, miss distances.

Such infrared jammers modulate the radiation emitted from an in-built infrared

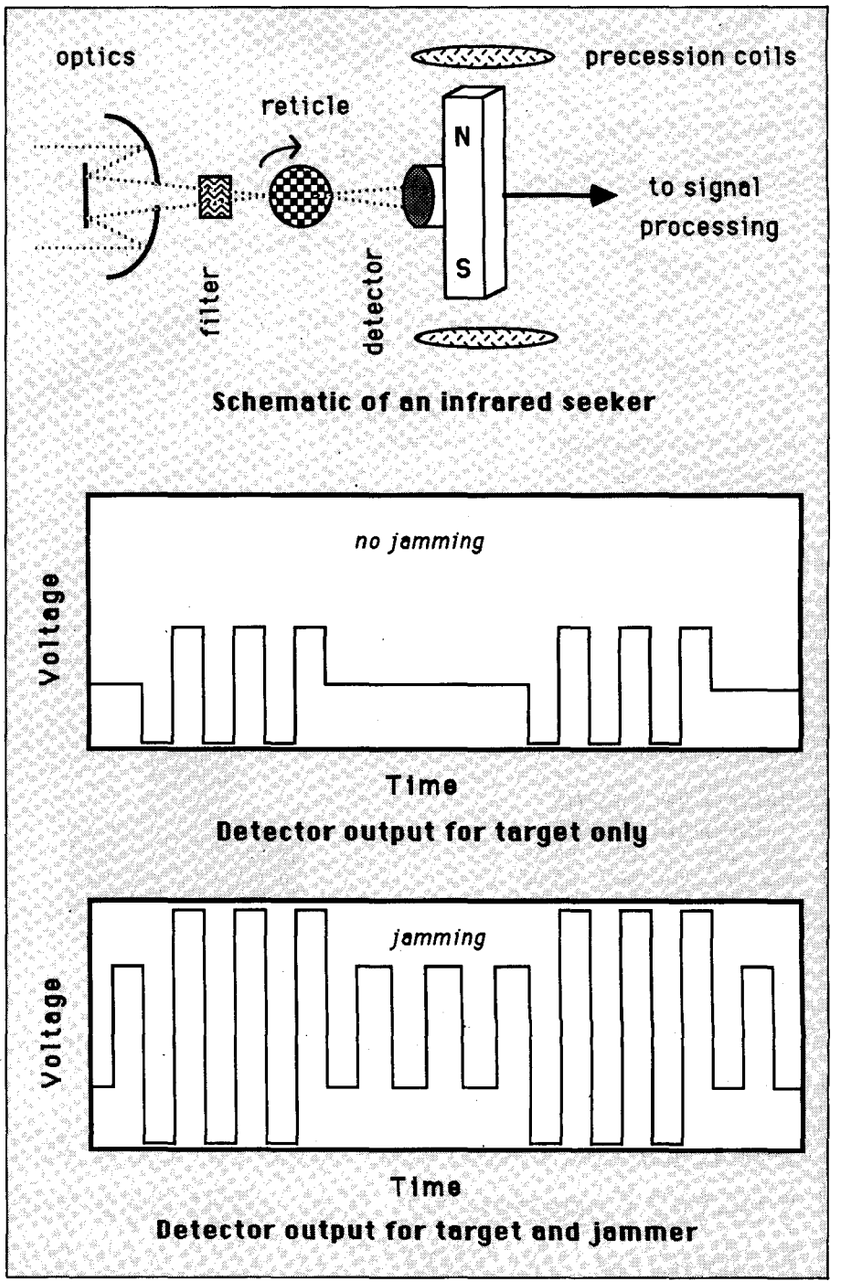


Figure 4: effect of jamming on the detected infrared signal.

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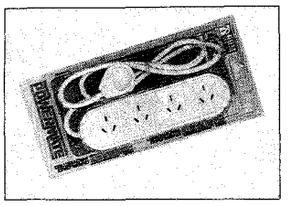

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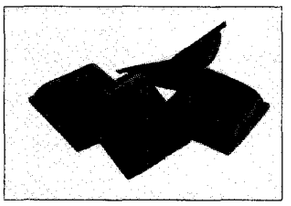

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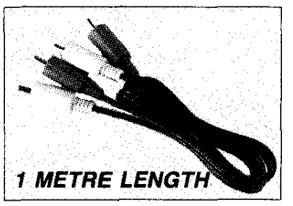

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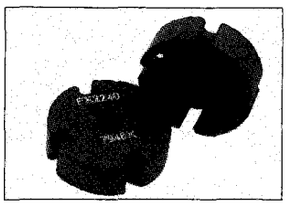

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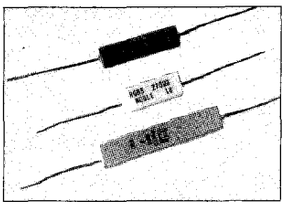

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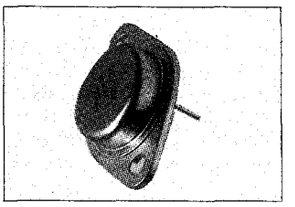

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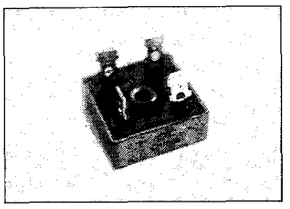

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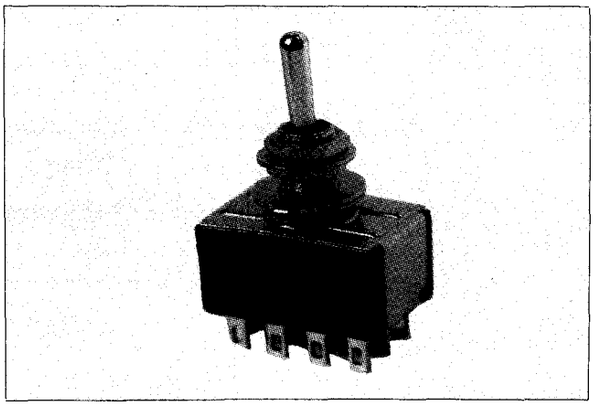

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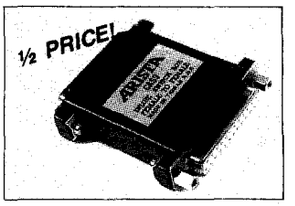

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source, producing jamming pulses that will combine with the signal from the target (encoded by the seeker optics and reticle) to produce an incorrect error signal at the output of the missile guidance electronics. As the heat-seeking missile now has incorrect information as to the location of the target, it will be deceived as to the correct position of the target and diverted from flying the required path to intercept the target. The effect of a jammer on the encoded signal produced by the tracking and guidance system of a heat-seeking missile is illustrated in Figure 4.

Infrared jammers enjoy several advantages over decoy flares. Jammers can provide continuous protection for an aircraft. In contrast, flares must be dispensed judiciously as an aircraft can only carry a limited supply. Pyrotechnic flares consist of potentially hazardous materials. The need for frequent reloading further complicates the storage, handling and carriage of decoy flares. Jammers can operate covertly, ie, the radiation emitted at optical wavelengths can be filtered so that the emitted signal is not visible to the naked eye.

Future systems

As the heat-seeking missile evolves into newer and deadlier models, there will be a need to develop more sophisticated infrared countermeasures. Because aircraft have severe limitations on the size, weight and power that can be made available for countermeasure systems, there will be a need for smaller, lighter and more power-efficient systems. Such systems are likely to use narrow field-of-view jammers (to enhance the usable power output) steered by high precision threat location and missile approach warning devices. The greater sophistication involved will necessitate the increased use of electronic and associated software to control and operate the system. To protect aircraft against the new generations of heat-seeking missiles future countermeasure systems will have to become more sophisticated, detecting, tracking then successfully deploying appropriate countermeasures with minimal reaction time.

'Infrared warning receivers detect the heat from the rocket engine of the infrared homing missile durings its launch or powered flight'

There are many challenges to tax the designers of the weapons and countermeasures systems. As indicated earlier we have focussed on the threat against aircraft and possible countermeausres to that threat. Much of what has been said applies equally to ships, tanks, motor vehicles and even oil platforms – anything in fact that emits recognisable infrared radiation above the level of the background infrared radiation. Protecting these high value targets against heat-seeking missiles is a major challenge to defence scientists. eti

Further reading

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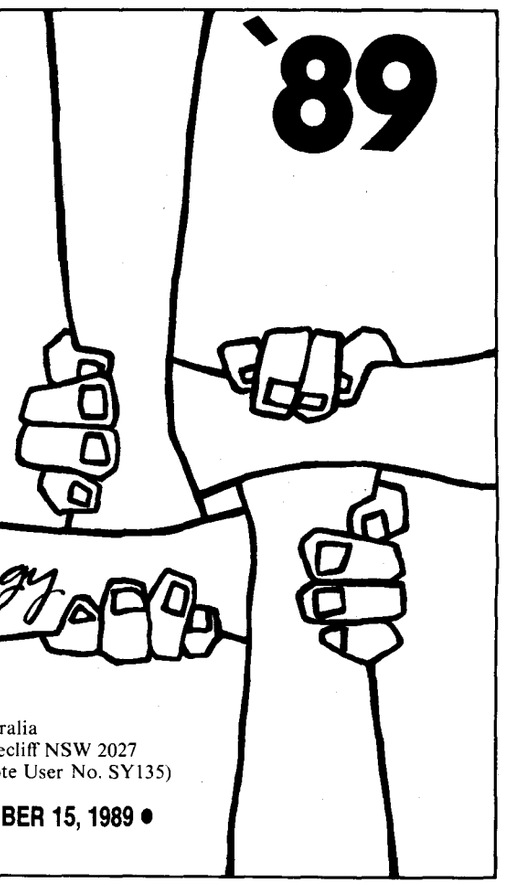

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• MONDAY, SEPTEMBER 11 – FRIDAY, SEPTEMBER 15, 1989 •

READER INFO No. 26

INNOVATION

JOHN LOGIE BAIRD

The man who invented television

Angie Testa discovers Baird, who made Neighbours possible.

There aren't very many people who give their middle names to things. Of course Mozart did it, albeit posthumously, but John Logie Baird's name has been immortalised by the annual awards – the Logies – presented by commercial television. It was Baird who gave us television as we know it today but, apart from these awards, not many people have heard of him.

He was born at Helensburgh, Dunbarton in Scotland in 1888. He suffered from bad health and although he did not do well at school he did show great promise in science; he supplied his father's house with electricity and worked on flying machines and telephones.

Later on he studied electrical engineering at the University of Glasgow and, after being turned down by the army on account of his faulty vision, obtained work with the Clyde Valley Electric Power Company. Various careers followed and in 1923 Baird found himself at Hastings on the South Coast. It was here that he began work on a "television" system, a means of sending pictures through the ether. By the following year he had produced televised objects in the outline and the next year transmitted recognisable human faces. At the Royal Institution, London, in 1926 Baird demonstrated the televising of moving objects. It is said that he actually had transmitted the first pictures near Glasgow in 1915. This was only across a room.

As early as 1908 A.A. Campbell-Swinton had pointed out that the only way to produce satisfactory pictures would be using a cathode-ray tube. It was with such a tube that high-definition pictures were broadcast in 1936 but Baird was unwilling to wait for the development of this high-definition system. He produced instead his own crude, stamp-sized pink-and-black pictures which stunned the world, and proceeded to bring out a colour system the next year. Baird also made fibre optics, the first facsimile system (demonstrated in 1944), the first video recorder and infrared television – not bad for a man who is almost unknown today! He is also credited with radar.

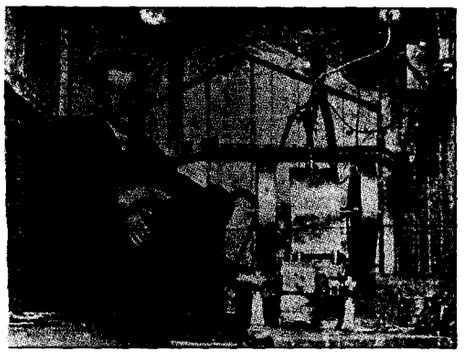
Almost as well known as his inventions were his eccentricities, so much so that even his domestic arrangements attracted publicity. Perhaps to obscure this, or perhaps because he did not like being in the limelight, much of the credit due to him in the realm of his work with television went to others. For him invention was perhaps, its own reward. We only know that he collected an amazing 178 patents.

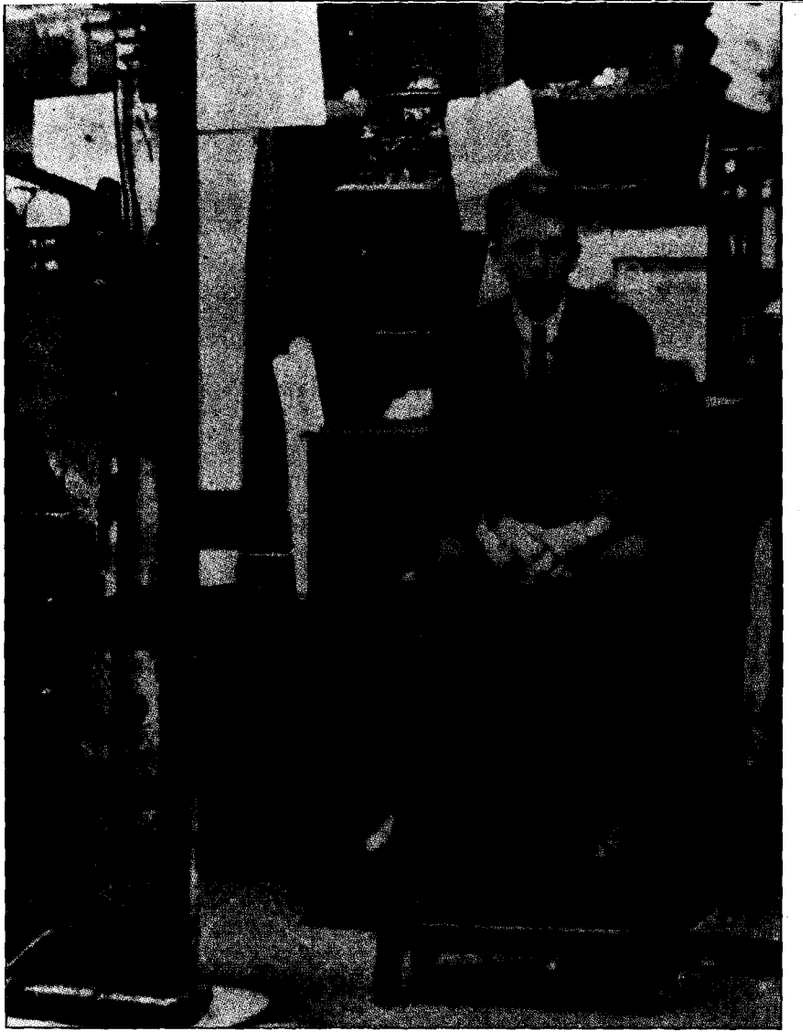
His work in the British Intelligence department during World War 2 is equally obscure. Even as recently as 1984 Baird's wartime role was still regarded as "classified". It was maybe to keep foreign powers in the dark that he claimed to be working only on television at this time. He was, it was true, but he was also working from 1923 onwards with radar detection. However, the burning down of the Crystal Palace set his radar work back and damaged the prospects of getting his television system accepted during the pre-war years.

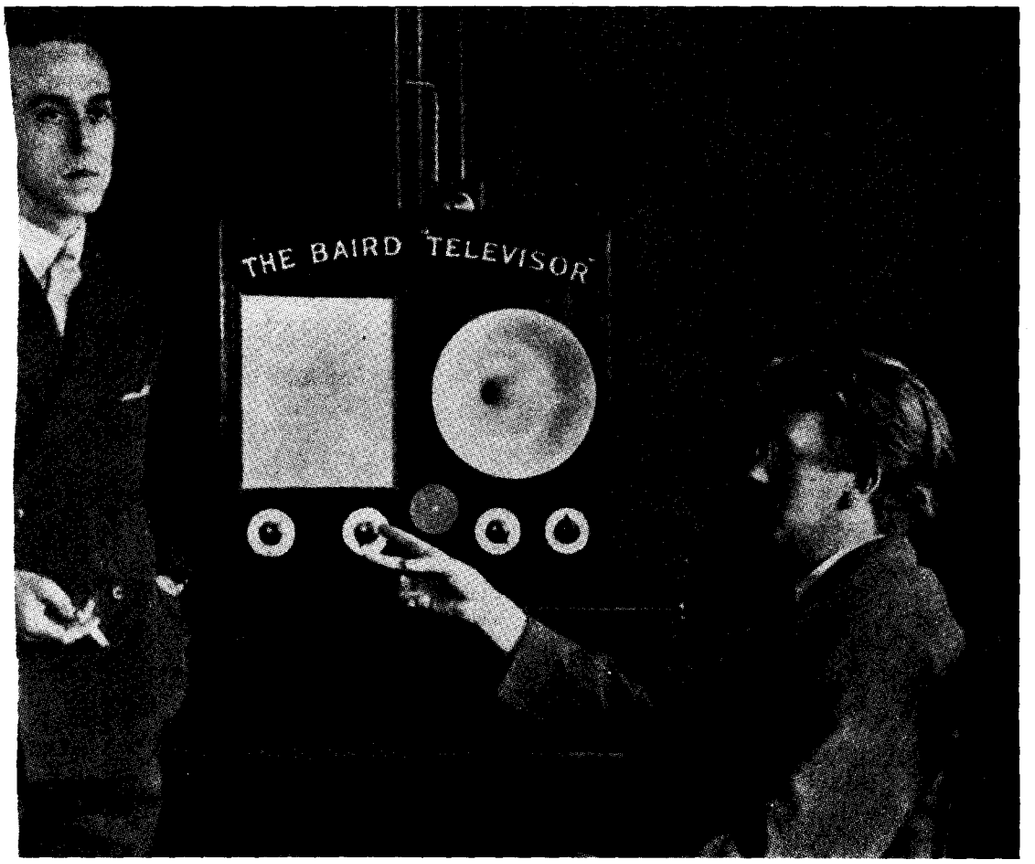
With his original 30-line system he was in direct competition with one promoted by Marconi Electrical and Musical instruments when the British Broadcasting Corporation

service began in 1936. The BBC selected the Marconi EMI system. During World War 2 there was talk of a British 1000-line colour three-dimensional TV system for after the war and by 1945 Baird had patents covering the processes that were required. The plans were not adopted, however, because they were too ambitious, so Baird is remembered only for his 30-line system. He died the following year.

Quite different from his other inventions was one which was of real benefit to humanity. Had he not been immortalised by the Gold Logie Baird should be remembered for the Baird undersock, a borax-treated undersock to be worn by soliders during World War 1 to prevent them getting trench foot. This useful invention did not make him famous either so he seems to have been unlucky all round. He rests with many other unsung geniuses of the day but should be remembered now and again as the man who gave us television. eti







Above: Baird as superintendent engineer at the Clyde Valley Electric Power Company in 1915.

Above left: his homemade electric light plant.

Left: Baird (seated) with writer Ronald Tiltman in Baird's laboratory, 1927, with an early 'televisor', designed to receive both signals and sounds.

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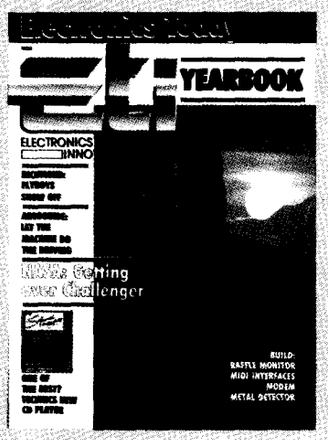

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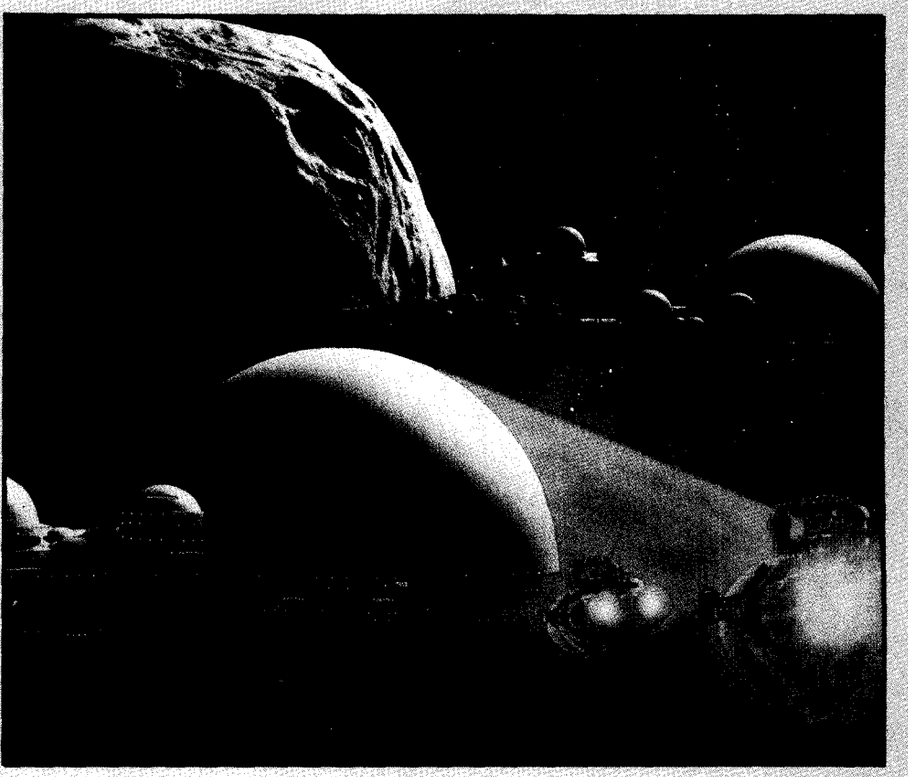

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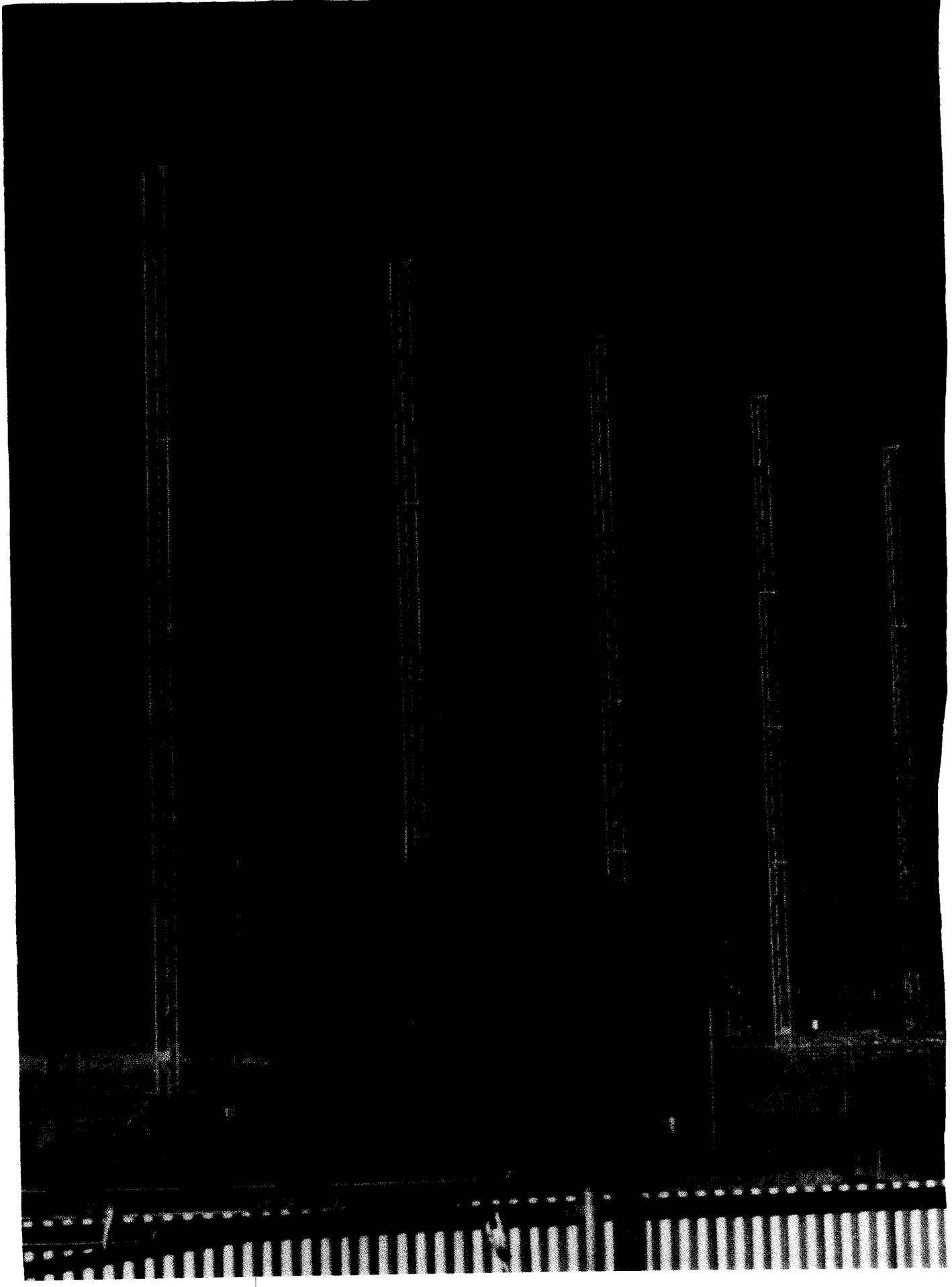


ANNA GRUTZNER

RADAR LOVE

Somewhere, over the horizon

Jindalee, Australia's over-the-horizon radar, has surmounted considerable odds to succeed. Anna Grutzner reports.

A delightful tale about the erection of antennas for the Jindalee receiver station well illustrates what a remarkable achievement Australia's experimentation with over-the-horizon radar has proved to be. Subcontracted by Hills, the clothes-hoist crowd, a rigger and his wife were hired in 1980 to assemble the vertical antenna array at the remote Mt Everard site near Alice Springs.

The couple, camped in a caravan with their two small children and the household's sundry pets, worked day and night in 30° heat for a month to erect the 980 antennas. When told that each of the securing guy-rope pegs was centimetres too shallow, they laboured on through the night to hammer them down and finish the task by the following day.

Their diligence, and that of a dedicated research team from the Defence Science and Technology Organisation (which had battled with the concept for more than three decades, through periods when the USA had all but abandoned its own experiments), saw Australia take the lead in the development of over-the-horizon radar technology.

Jindalee will permit Australia, for the first time, to track ship and aircraft movements in the region to our northwest. In tandem with the airborne early warning (AEW) radar capability, it will permit the defence forces to make pre-emptive airstrikes to the hitherto inaccessible north and west. Jindalee is capable of electronically roving the ocean and airspace for several thousand kilometres beyond the continent, unhindered by the curvature of the earth's surface. Its range is likely to be in the order of 1000-40000 km with a target resolution of 20-40 km. The radar has a sequential scanning beam of about 60 degrees.

The Long Range Weapons Establishment in Salisbury, South Australia, (now the DSTO,) began experimenting with OTHR in the 1950s. It had been discovered that radar transmissions, as well as conventional radar signals, could be bounced off the electrically-charged E-layer of the earth's atmosphere, known as the ionosphere. (Conventional radar relied on increasing its height to extend its vision over the horizon, a solution which had obvious limitations when looking at long-range surveillance.)

In the right ionospheric climate, however, a signal contacting the E-layer at a shallow angle will skip around the world, very much like a pebble causing ripples on a calm pond. Radio transmissions from the northern hemisphere can therefore be heard by a radar-receiving station in Australia. The radar beam must be powerful enough to illuminate a distant target and powerful enough to receive faint return signals.

With OTHR, instead of having to rely on whatever we can glean from Indonesian radio waves on a particular military manoeuvre, defence experts will be in a position to monitor the manouevres themselves. In a more general context, OTHR will be useful to foreign affairs specialists in keeping tabs on the internal activities of our neighbours; monitoring drug-smuggling and illegal migration activities in the northern sea and airlanes could be an important side-benefit. So, too, OTHR can detect ocean currents and the formation of cyclones.

As a broad-area real-time surveillance system, Jindalee is expected to be among the best developed in the world. However, the radar does not have a foolproof means of differentiating ships from aircraft. The defence forces must also rely on the more sophisticated AEW aircraft to identify foreign vessels. OTHR will, therefore, be more a planning system than an operational tool. It will assist greatly in monitoring the strategic environment at any given time, but AEW would be essential to plan a military response. The FA-18 aircraft then would be deployed to take over the surveillance operation.

The system operates with two separate stations – one for transmission, the other for reception – spaced several hundred kilometres apart.

Given the 320 kilowattt energy of the transmitter, the functions must be isolated to

Radar love

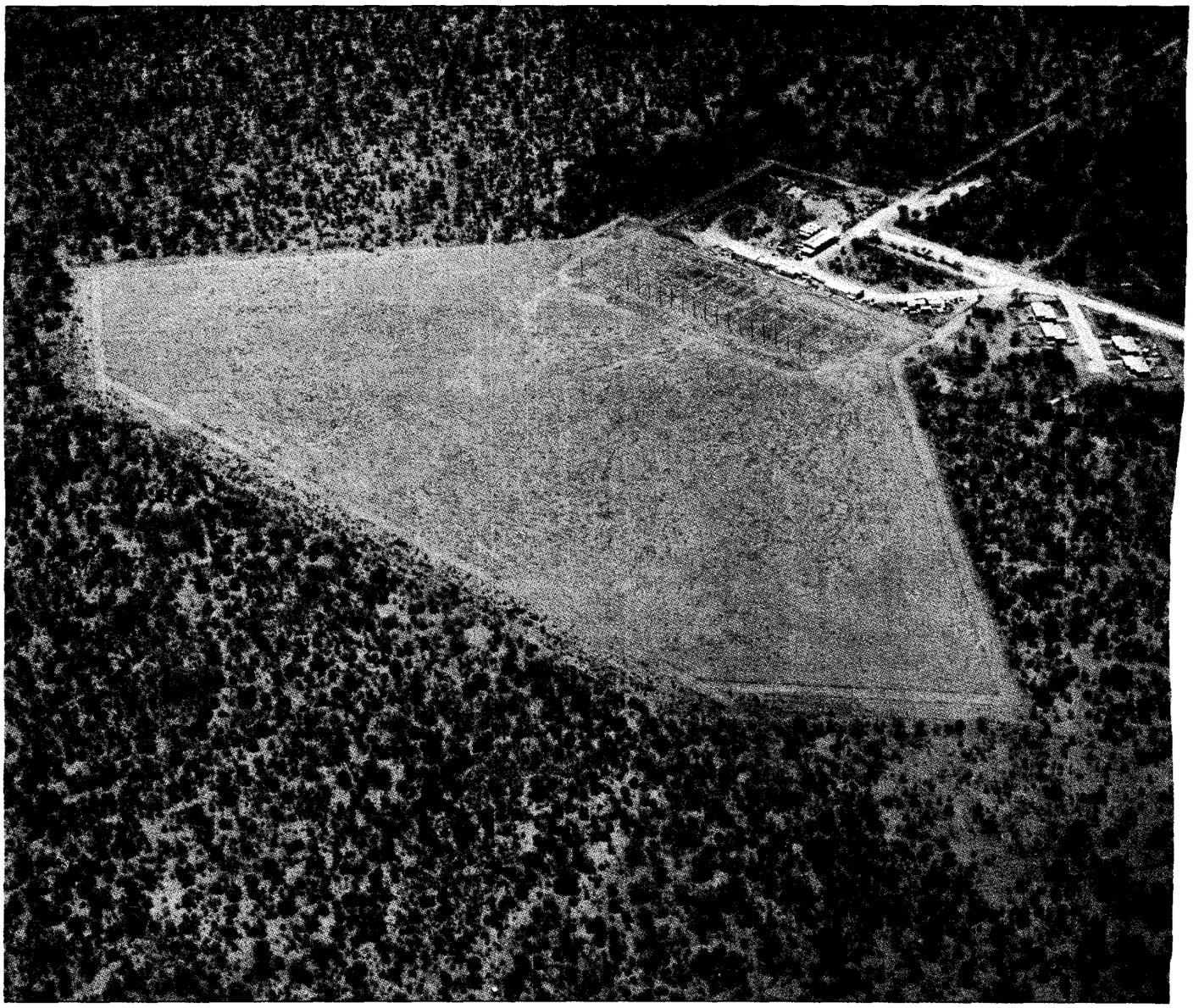
avoid interference. This was one of the early hitches with OTHR; signal sources were so unstable that their effects were lost in the random drift and fluctuations between the signals from two sources.

The transmission aerials, each sending at 40 kilowatts, will emit and focus a powerful beam that will be scanned through an arc. This technique is known as phasing, and involves the beam being steered by the interaction of individual beams from the aerials through the fixed array. Its receiver station has reception aerials which pick up the faint signals, which are then amplified and analysed by a computer which sorts useful data from electronic junk.

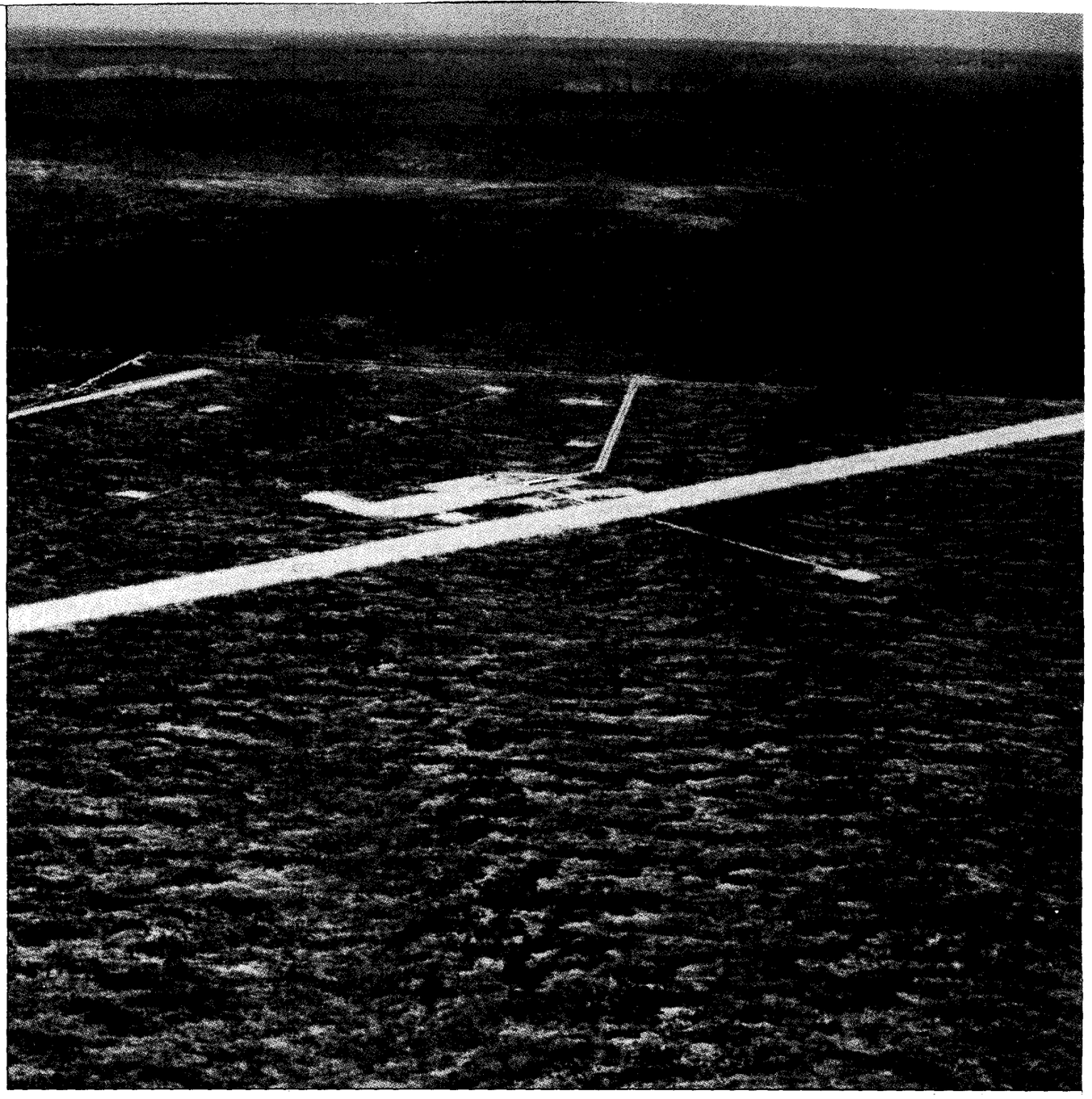
The aerial arrays or "curtains" make an arresting sight as one stumbles upon them in the remote centre of Australia. About 2.8 km in length, the Jindalee main array is the longest known OTHR. Each aerial is strung up between 40-metre high masts, made of corrosion-proof galvanised steel. The transmission elements are copper. Testing of each component is fastidious. No wire is batch-tested, as it must be guaranteed to withstand harsh extremes of temperature and wind.

One of the big question marks hanging over Jindalee is its likely vulnerability to the vagaries of the short wave band. The E-layer can change significantly over the period of a day, a week or a month. Random solar variations, the 11-year solar cycle and the time of day will affect the system. Jindalee compensates for such variations by sending up a reference beam from which the range of error is adjusted. Yet within a small area of the ionosphere its reflectivity can vary to such an extent that only a multitude of such reference beams could cover all the variations.

Australia has, nevertheless, proved a more stable radar environment than the USA. The USA had considered supplementing its OTHR capability with a northward-gazing chain, but wide irregularities in the ionosphere have hindered the scheme. OTHR also causes



Transmitting site, Harts Range.



havoc in the HR bands. The Soviet OTHR, an ionospheric backscatter radar similar to the US CONUS OTH-B system, has been nicknamed "The Woodpecker" because it jams most of the listening band with its tapping sound. The rapid clicking noise is made by the radar's 10.8 pps pulses.

The Soviets are believed to have four OTHRs. One, built during 1988 at Nakhodka in the coastal region of the Sea of Japan, faces the Pacific Ocean to watch the movement of ships, aircraft and missiles between the Chinese coast and Guam Island. But the Soviet OTHR is another victim of the burgeoning industrial problem that faces the Russian economy as a whole. Because of quality control problems facing Soviet manufacturers, their computer technology is so unsophisticated that processing of OTHR data is less than perfect.

'The couple, camped in a caravan with their two small children and the household's sundry pets, worked day and night to erect the 980 antennas'

Early US research undertaken by the Naval Research Laboratory was made available to Australian scientists in the late 1960s. Enthusiasm for OTHR was revived in the USA in the 1980s because progress in the technology made the system a more realistic proposition. However, it heralded a change in strategic doctrine. Earlier defence planners believed OTHR could be used to trace the trajectory of ballistic missiles launched from

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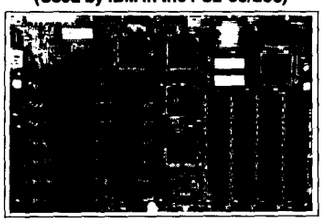

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Radar love

submarines. With advances in the Soviets' nuclear capability, the USA began to see an attack from a Soviet cruise missile, particularly over the vulnerable north pole region, as a distinct and uncomfortable scenario. It also conceded that even the most powerful microwave radar was incapable of detecting a missile launch at this silo.

Australia's original one-radar facility 160 km from Alice Springs is to be replaced by three, spread across the continent. This will overcome the technical limitations of a single radar system and explore the scope for linking the systems to enhance tracking. The initial facility will be close to the experimental site; the second and third sites have not yet been chosen. However, speculation abounds that the north Queensland town of Hughenden, 400 km west of Townsville, will be home to one and that the third will be situated somewhere in southern Western Australia.

While reports have suggested that Derby in the northwest of WA, may be used, this is unlikely given its proximity to the coast. Radar ideally needs to be inland, so that the signal can be bounced off the ionosphere to its destination and back to the receiver base. A radar "dead zone" of some 200 km exists from the coast inland. The construction timetable is for a network of operational radars begun next year and completed in 1994-96.

The Soviet OTHR has been nicknamed "The Woodpecker" because it jams most of the listening band with its tapping sound'

Cost is one of the most attractive aspects of the Australian venture. The Government estimates it will have the three-radar system up and running by 1996 for about $500m. Jindalee is far cheaper than equipping the Royal Australian Air Force with a comparable capability in AEW. Given that we would need nine extra (to have six in service at any time) at a cost of $200m per aircraft, the price differential speaks for itself. But for a long time, the three defence services, particularly the airforce, were most resistant to OTHR. It required a degree of operational cooperation they had not been willing to concede, and the RAAF feared the system would become a cheap substitute for its much-yearned AEW.

Options for improving the range accuracy of Jindalee have been seriously considered but ultimately not pursued. The Defence Department toyed with the idea of fine-tuning the radar through the recognition of proximate ground features. Specially-designed beacons placed at a number of forward locations would have the effect of sharpening the radar's focus. In his research into the strategic use of Australia's island territories, defence analyst at the Australian National University's Centre for Strategic and Defence Studies, Dr Ross Babbage, also argued that the Cocos Islands could provide such a forward beacon site.

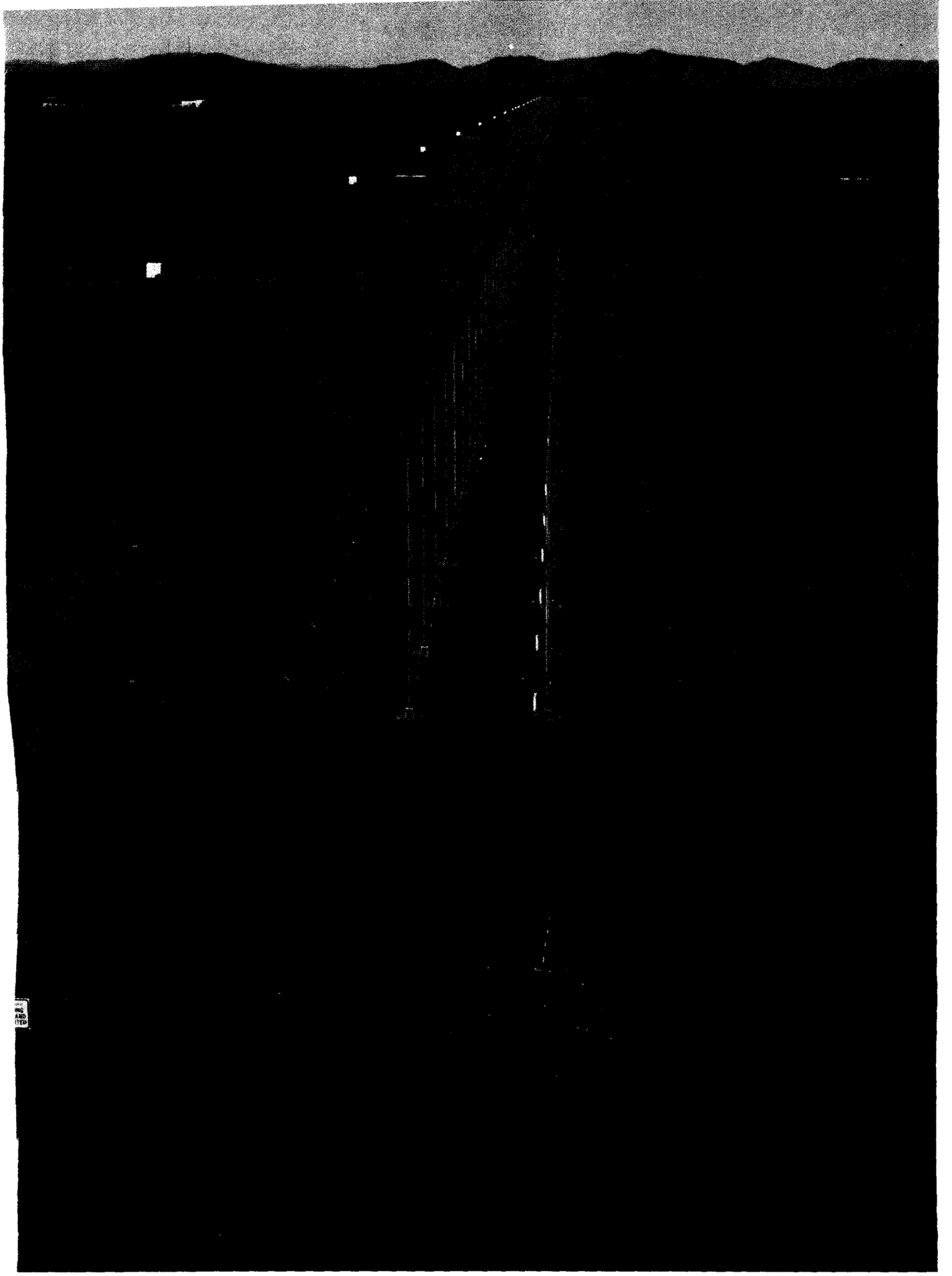
The spinoffs for Australian industry from Jindalee are likely to be substantial. Three local companies, AWA, BHP and Telecom have been nominated by the Government as prime contractors for the initial stages of the system. The transmitter aerial was designed by AWA, but the DSTO has awarded Radio Frequency Systems, an Australian subsidiary of the West German Kabelmetal Electro, a contract to construct and install the first array of eight. As the principal contractor, AWA is also in charge of the Alice Springs site and its operations by a staff of 20.

Involvement in these "project definition studies" will place the companies in a strong position to tender for the operational radar contract early next year. TNT is also believed to be showing keen interest in the project. The DSTO's electronics research laboratory will continue to pursue certain areas of research at Alice Springs to improve the system's performance, but it will also transfer much of the organisation's technology to the private sector.

Early attempts at establishing a local technology base from the project saw the waveform generator developed, the signal processor (which originally was part of the sonar program that led to the Barra system) and the transmitter array. Despite the headaches it caused, Jindalee's in-house computerised signal processor was also ahead of its time when developed a decade ago.

Regrettably, industry showed a distinct lack of foresight about the project even when it was beyond the purely experimental stage. According to the chief of DSTO's microwave radar division, Dr Don Sinnott, who wrote a bicentennial tribute to Jindalee: The Development of Over-the-Horizon Radar in Australia, there was little commitment of the companies involved to do more than say, in effect 'Give us the money and tell us what you want us to do.' "Missing was any entrepreneurial flair to foresee the possibility of OTHR becoming big business and warranting a company commitment to embrace the technology, or at least part of it, and use the opportunity provided to learn from the experience of DSTO," he said. eti

Anna Grutzner is the Canberra-based defence correspondent of The Australian.



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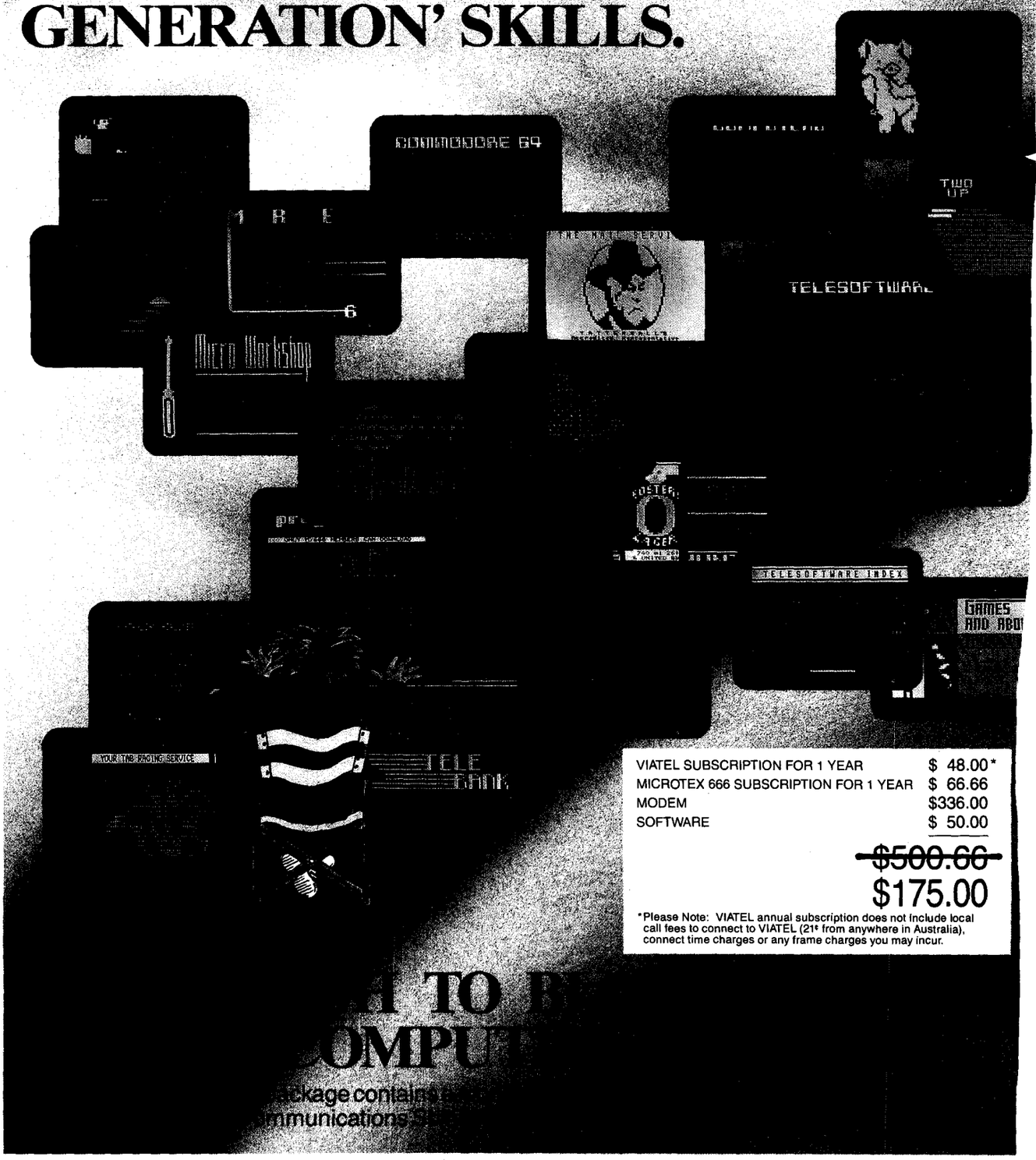

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PAUL BUDDE

Insect collection on-line

The Queensland Department of Primary Industries (DPI) has the biggest insect collection in Australia. This wealth of information is available to any farmer in Queensland on a new statewide link-up computer.

INSECOLL, a new computer-based data storage system, has been established in the DPI's insect collection in Indooroopilly. It stores information on distribution, seasonality and host associations of important agricultural and horticultural pests. It is part of DPI's effort to provide cost-effective, environmentally sound insect control in Queensland crops.

VAS report — Kuwait

Access to value added services (VAS) provided by the Ministry of Communications in Kuwait is currently effected via public switched telephone network utilising leased and dial-up lines of voice grade quality. Access to foreign databases and VAS is effected via subscription to a third party carrier (DRADO), which can arrange links to international databases through packet switched links and international trunk lines of voice grade quality.

Videotex in Kuwait is still very much at the experimental stage and is based on the French Telecom system conforming to European CEPT standards and providing access to 168 simultaneous users through the public switched telephone network. It is envisaged that these lines will support a subscriber base of approximately 1,000 before expansion is necessary.

The provision of X25 packet switched services by the Ministry of Communications will make links to external services offered by international videotex operators utilising the French Teletel protocols a feasible proposition and will of course facilitate access to the Kuwait videotex system via international access points in local networks.

The Kuwait public videotex system was launched in September 1988. It is envisaged that the products offered to videotex subscribers will be centered on interactive services providing news from KUNA (Kuwait News Agency) and Reuters, financial information from the Kuwait Stock Exchange and subscriber messaging systems together with electronic mail. Traditional videotex consultation services providing information on banks, airlines, hotels, news, weather and sports will also be included in the videotex database.

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Intelprop is an independent on-line information research bureau developed by a group of professional lawyers, scientists and engineers. The company has been established to offer a comprehensive information retrieval service to a wide variety of businesses and professions. The researchers are qualified and are skilled in on-line data search techniques and the use of algorithms for fast and efficient searches.

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Radio New Zealand on Myriad

Until now, the best way to keep up with the news during the day in New Zealand was radio. Telecom Myriad goes one better, with constantly updated reports assembled from stories gathered by the journalists of the country's leading radio news network, Radio New Zealand. It means instant access to the news when it happens, without having to wait for the next edition of the bulletin.

The Times and Sunday Times available via computer

The Times, Britain's oldest and best-known quality newspaper, and The Sunday Times, are now available in Australia through an online computer service. Subscribers to AUSINET, the computerised information retrieval system operated by ACI Computer Services, are able to have instant access to news and feature articles dating back to July 1985. In their computerised form, both newspapers will be combined in one file which will be updated daily. AUSINET users will be able to search the file very quickly for the articles that interest them, and then call up on their terminal just the items they need.

EDI: profiting from the new electronic market place

Within two years, over 50% of all company documents will be exchanged electronically. These are predictions being raised by the proponents of Electronic Data Interchanged (EDI).

The trend toward automated trading will be a boon for users of the system but only modest money-makers for network and translation software vendors because of a price war. In an assessment of the Australian and New Zealand opportunities for EDI to be presented at a conference in October, speakers are citing the conclusion from a USA report undertaken by Forrester Research, of Cambridge, Mass., in which EDI activity and trends of some Fortune 1000 companies were plotted. The report was released in July.

Forrester is estimating that half of the Fortune 1000 already transmit documents electronically with their trading partners. "The firms that will benefit most dramatically from the use of EDI are those who drive the market by persuading their suppliers to use it," the report notes.

Because of the nature of EDI

and the extensive benefits it can provide in both time and direct bottom line profits, it is coming to the point where if you do not use the system, you will simply not be traded with. The Voluntary Inter-Industry Communications Standard Commission (VICS) has commissioned the first industry study on the extent to which EDI is changing the way business is done. The report is compiled by Arthur Andersen & Co of Southern California.

Both reports suggest that EDI is becoming more and more accessible to business, small and large. Because of extensive competition between vendors and network providers, prices have been kept to a bare minimum. Not only will profits to network providers be modest, but the Forrester Report warns vendors against looking to EDI to sell hardware. Interviews with Fortune 1000 users indicated that they did not buy specific systems on EDI capabilities alone.

In the first detailed examination of Australian and New Zealand EDI prospects and applications, the EDI Council of Australia in association with IIR Pty Ltd, is presenting a two day analysis in Sydney on October 19 and 20 of the issues through a forum of users, consultants and vendors.

Teleaction successful

The USA interactive homeshopping service, Teleaction, had a very successful start to its hybrid Pay-TV-videotex service. In the first three months, 45% of the 4,000 connected households used the service. 38% asked for passwords to keep using the service after the three test months. Teleaction now wants to expand its service to 40,000 Pay-TV subscribers.

Data services on Portuguese aeroplanes

USA airlines are already providing telephone services for their passengers when flying above the North American continent. British Airways and the Belgium airline, Sabena, are undertaking trials with plane phones. The Portugese Airline, TAP, will be the first airline to also provide telex and data transmission services on their aeroplanes. The Portugese services are based on a French/British product using satellite technology. European and Brazilian airlines are now also queuing up for this equipment.

Hyptertex and hypermedia

Hypertext was described in 1967 as "a combination of text with the computer's capacity for interactive branching, or dynamic display... of nonlinear text...". Since that description, it has come into the common usage that hypertext is "non-linear text", a phrase which grows more puzzling the closer you look at it.

Indeed, the contents of hypertext are linear; to some extent words follow words just as they always have done. The secret to the non-linearity of hypertext is its capability to string together ideas and concepts – and the words that transport them – in networks, permitting presentation of a single body of information in multiple and varied ways.

Whereas traditional publishing has always linked semantic components together implicitly, through the order of their presentation, or through high level organisation structures like tables of contents and back-of-the-book indices, hypertext relies on explicit links, outside the flow of the original order of presentation.

Given recent advances in commercial processes to digitise just about any kind of information format – including computer graphics and animation, sound of all levels and qualities and, soon, full-motion video – the same principle of explicit linking can be applied to many media, leading to the latest extension of the concept – hypermedia.

But it goes further. Hypertext was conceived on a much grander scale, with a wide array of capabilities and features. Premier among those features was the interactive authoring nature of hypertext. The inventor, Ted Nelson, had a vision of a global system into which everyone could look, and from which anyone could extract anything in the system, reforming it into a document of his/her own. All of this was supervised by a massive accounting system that would track royalties, copyrights and so forth. But the kicker is that the user could create his own document, using excerpts where appropriate, and adding his/her own words as desired. All this would be aggregated into a new document, which then becomes further grist for everyone else's mill.

Consumers have gotten wind of these marvellous capabilities, and electronic publishers are rightfully concerned about their response to expected demand. Online systems are, in many cases, already pushed to their limits in terms of performance and delivery capability. Certainly, CD-ROM offers some potential to exploit complex software systems of this nature, but no one has yet done anything very impressive in that medium with hypertext as yet.

French expertise for Eire

France has signed an agreement with the Irish consortium Eolas to sell its Minitel know-how. Eolas encompasses Irish Telecom and two banks. There will be a six-month trial at four Irish test cities, starting in 1989. The initial installation will be 5,000 to 10,000 Minitel terminals. If all goes well this number will grow to 100,000 terminals.

Clirs now Info-One

The embattled Australian legal database, Clirs, recently went into its third phase. After its early, independent start, Computer Power and Westpac had to come to the rescue to secure its further existence. This step has now been followed by a name change and an aggressive marketing approach.

The "new" organisation is aiming for world leader position in information services by the early 1990s. At the moment, however, the company is still in court regarding the control of six other international databases. Info-One also diversified its services by announcing the introduction of two legal databases on CD-ROM.

No electronic yellow pages for Canada

Bell Canada began its ALEX videotex trial in Montreal as scheduled on December 5, but the service does not include electronic yellow pages, which were to have been a core feature. The Canadian Radio-television and Telecommunications Commission's (CRTC) authorisation for the limited ALEX rollout also includes strict provisions to assure that Bell Canada does not cross-subsidise the videotex project, including distribution of low-cost terminals. CRTC's warnings echo issues raised by the USA's FCC and District Court in their efforts to restrain RBOC's activities.

Network for Europe

Digital Equipment Corp (DEC) and the CAP Group are to market jointly the European service providers' network management and operational support systems, comprising DEC's hardware and CAP's application software. Their agreement includes CAP's Communications Administration and Billing System for advanced network management, which can be used to control services such as cellular radio, packet switching, trunked mobile radio and cable television. eti

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Paul Budde specialises in the marketing and management of electronic services and commmunications networks.

TECHNOLOGY

SEMICONDUCTOR WATCH

ETI engineer Terry Kee takes a look at the latest available in semiconductors.

Micro-power comparator with voltage follower

THE flexibility of this device allows it to function with voltage inputs ranging from 3.5 to 14 volts. Acceptable temperature operating ranges span from -30 to 70°C. The quiescent current is rated at 10 microamperes at room temperature. This factor allows an extended battery life for applications using batteries as either the main source or as back-up power.

Also included on this new chip are four enhancement-mode MOS field effect transistors (MOSFETs). These FETs are capable of being externally configured as either open-drain or totem-pole outputs. As an added safety feature, the drains have static-protecting diodes located on-chip. Another feature is the electrostatic discharge (ESD) protection circuitry present on all input pins.

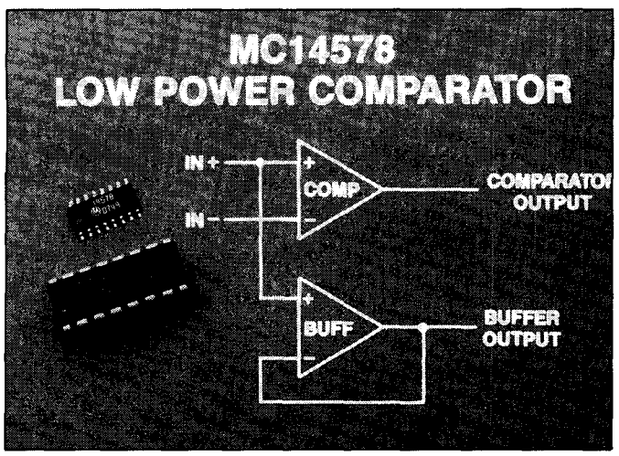
In a system design application, only one additional component is required for proper comparator operation. A 3.9 megohm resistor rated at +/– 10% needs to be installed between the reference bias pin and V+.

Ideal applications for this device include the following:

- Signal pulse shapers
- Threshold detectors
- Low-battery detectors
- Line-powered smoke detectors (plastic DIP meets UL217 specification)
- Liquid/moisture sensors

For further details contact Motorola on (02) 438 1955.

READER INFO No. 169



The cleanest room in Australia

THE $3m cleanroom just commissioned at AWA MicroElectronics' new Homebush Bay plant is so efficient that it keeps out anything larger than a virus.

The high-efficiency filters, which make up the entire cleanroom ceiling, were supplied, installed and commissioned by Gelman Sciences Australia of Lane Cove. The work forms part of AWA MicroElectronics' $65m program to establish Australia's only facility for the design and manufacture of state-of-the-art Application Specific Integrated Circuits (ASICs).

"We introduced cleanroom technology to Australia in 1967," said Tony Kelly, managing director of Gelman Sciences, "and this one is up there with the most advanced in the world."

The air in the cleanroom is changed every six seconds and is automatically monitored for air purity and to ensure the maintenance of the constant temperature necessary for chip manufacture.

Tony Kelly presented a Certificate of Compliance to AWA MicroElectronics' general manager Bob McCluskey at the cleanroom's hand-over. The certificate states that no more than ten particles of 0.5 micrometres in diameter are to be found per cubic foot of air within the rooms. The outside air contains more than 300,000 particles of this size per cubic foot.

This level of performance qualifies the cleanroom for a Class 10 rating under a stringent set of USA federal standards: only a Class 1 rating is higher.

"In fact the new cleanroom has exceeded specifications and certainly approaches Class 1," said Bob McCluskey. "There are no instruments sensitive enough to measure this level of air purity."

For further information contact Toby Cross at AWA MicroElectronics on (02) 763 4105 or Ian Parkin at Gelman Sciences on (02) 428 2333.

READER INFO No. 170

Intel 80386DX/ Errata 21

MUCH publicity has been given to a 'bug' in the Intel 80386 microprocessor known as Errata 21. The problem would cause a system to hang when executing a floating-point operation in protected-mode with paging enabled. Simply put, an 80386 system with an 80387 maths coprocessor running either UNIX or XENIX was known to exhibit this problem.

This errata has been subsequently fixed with the introduction of the 80386DX component (referred to as the D-step). The previous fix was to use an additional scrambler socket with the 386 chip.

The introduction of the D-step part coincides with the announced name change of the 386 to the 386DX (full 32-bit) to distinguish it from the newer 386SX (32/16-bit) device.

The 80386DX is available in 16, 20 and 25MHz speeds.

Intel's sole Australian distributor, Email Electronics (formally Total Electronics) now has local stock of all three versions of the A80386DX.

For more information contact Email Electronics, Ph: (03) 544 8244.

READER INFO No. 171

World's first quantum effect transistor

RESEARCH physicists at Texas Instruments in Dallas have fabricated the world's first quantum effect transistor. With critical dimensions 100 times smaller and transit speeds more than 1000 times faster than conventional transistors, the device operates on fundamentally different principles, known as quantum mechanical effects, which dominate the behaviour of matter and energy at dimensions of 0.02 micron (20 billionths of a metre) and below.

Called a "bipolar resonant tunneling transistor", it becomes the first device to directly contact and control a "quantum well" base, an ultra-thin layer of the device which allows only electrons with certain discrete energies to pass.

"Although quantum devices are strictly a laboratory development at this time, future chips incorporating quantum effect transistors might contain 100 times more functions in the same space and consume far less power than today's devices," notes Dr George Heilmeier, senior vice president and chief technical officer at TI. "Practical applications are about a decade away, but one day we might see a laptop supercomputer that runs on flashlight batteries."

The quantum effect transistor was developed by Drs Mark Reed, William Frensley, Alan Seabaugh and other device physicists in TI's Central Research Laboratories and is described in a paper being presented at the IEEE International Electron Devices Meeting (IEDM) in San Francisco. The bipolar device, a precursor to even smaller and faster unipolar quantum transistors that could revolutionise solid-state electronics, has active regions measuring only 10 to 20 nanometers (billionths of a metre wide, about 10,000 times smaller than a human hair and 100 times smaller than the corresponding functional components in today's semiconductors. At these ultra-small dimensions, quantum mechanical effects, in which electrons act more like waves than particles, dominate the behaviour of matter and energy.

The resonant tunneling transistor, Dr Reed explains, is only an intermediary laboratory development on the road to a unipolar quantum transistor in which electrons will be confined to quantum proportions in all three dimensions. Nevertheless, the bipolar device, fabricated in gallium arsenide, aluminium gallium arsenide, and indium gallium arsenide, exhibits promising performance. Robert Bate, Manager of Advanced Concepts in the Systems Component Laboratory of TI's Central Research Laboratories, notes that current gains at room temperature typically measure about 50, and that gains as high as 450 have been observed. Transit speeds, the speeds at which electrons tunnel from emitter to collector, are so fast that they're difficult to measure with today's technology, but are estimated to be on the order of femtoseconds (quadrillionths of a second).

Researchers in TI's Central Research Laboratories have worked with quantum effect devices and architectures since 1982. Early work on resonant tunneling was supported by the Office of Naval Research and the US Army Research Office. The first quantum effect transistor was realised under a contract awarded to TI by the Air Force Wright Aeronautical Laboratories. Similar work is continuing under a contract funded by the Defence Advanced Research Projects Agency (DARPA), a branch of the US Department of Defence.

For more information contact David Cartwright on (02) 887 1122.

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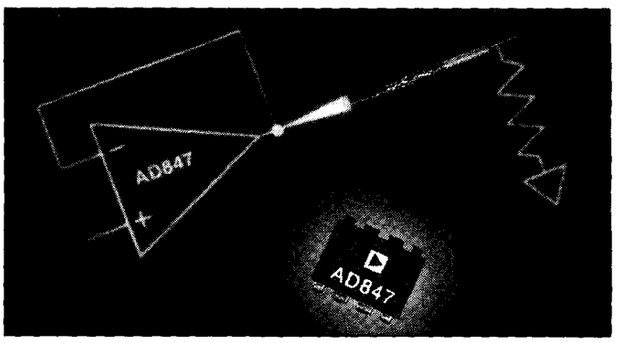


50MHz low-power op amp

DESIGNED for a variety of buffer, driver, and video applications, the AD847 op amp features 50MHz unity-gain bandwidth with 300 VμS slew rate while requiring less than 5mA of quiescent current. This general purpose, high-speed amplifier uses a standard 8-pin pinout and is stable driving any capacitive load. Higher speed, lower power applications benefit from the $\pm$5 V operational specifications in addition to the usual $\pm$15 V specs.

Applications include input buffering for flash analogue-to-digital converters, driving video cables, and converting high-speed digital-to-analogue converter outputs from current to voltage. For video systems, the AD847 provides differential gain and phase of 0.1dB and 0.1°, respectively. Full-power bandwidth measures 45MHz for a 2 V p-p signal with $\pm$15 V supplies and 30MHz with $\pm$5 V supplies; unity-gain bandwidths are 50MHz and 35MHz using $\pm$15 V and $\pm$5 V power, respectively. For data acquisition, a 10 V step settles in 120ns to 0.1–, equivalent to 10-bit accuracy.

With $\pm$5 V supplies, the AD847 yields maximum offset voltage of 1mV and open-loop gain of 3.5 V/mV (500 load) gains remains at 1.6 V/mV even into loads as low as 150ohms. With $\pm$15 V supplies, input offset voltage is 4.5mV maximum; open-loop gain increases to 5.5 V/mV (1k load). Minimum output current drive exceeds 20mA with either supply.

Packages include 8-pin plastic DIP and cerdip, as well as small outline (SO). Operating temperature ranges are 0 to +70°C, -40 to +85°C, and -55 to +125°C.

For further information contact Parameters on (02) 888 8777.

READER INFO No. 173

ARTHUR CUSHEN

BOOST FOR RADIO NEW ZEALAND

Powerful new transmitter for Radio NZ

The new Radio New Zealand International, operating from a new site and with a 100,000W transmitter, hopes to be up and running in 1990, coinciding with New Zealand's 150-year celebrations. Arthur Cushen reports.

After operating for more than 41 years with the power of 7500 W, next year Radio New Zealand International will operate from a new site and with a new 100,000 W transmitter.

In the past, Radio New Zealand (as it was known until taken over by our domestic network and the name changed to Radio New Zealand International), has been a relay of the internal non-commercial programs. Since May 1982, the Shortwave Service has been part of Radio New Zealand's contribution to broadcasting and costs have been met by the Public Broadcasting Fee.

External Affairs assistant secretary, Hugo Judd, said the new station aims to be on air in 1990 to coincide with New Zealand's 150-year celebrations. He said the Service would initially broadcast 11 hours a day, morning and evening, using a 100kW transmitter, located south east of Taupo. The signal would be strong enough to cover all South Pacific Forum countries. Judd said the programs would be in English with limited use of Pacific languages and there would be strong emphasis on news and sport. He said the operation of the Shortwave Service would be contracted out to Radio New Zealand, or to a private operator, The setting-up cost would be about $3m and the annual budget about $1m. He said 10 staff would be employed and many programs would be contracted out or made by Pacific Island groups in this country. Judd said the Government is committed to the Shortwave Service – its need has been highlighted by the Fiji Coup and the troubles in Vanuatu and New Caledonia.

'Since May 1982, the Shortwave Service has been part of Radio New Zealand's contribution to broadcasting and costs have been met by the Public Broadcasting fee'

In the official announcement there was no promise that Radio New Zealand Limited, (which is now a state-owned enterprise) would continue to operate the Shortwave Service on behalf of the Ministry of Foreign Affairs, but it is presumed that this is the most qualified group to broadcast on shortwave. The Government's present privatisation is leaving open the option as to the operation of the station which shows little gratitude on the part of the New Zealand Government as Radio New Zealand has kept the service in operation for these 41 years.

Seemingly, paid monitors who contribute background information as to reception of the signals in Australia have had their services terminated on economic grounds. It is hoped that when the high powered transmitter, the first of two, comes into operation, they will be reinstated so that Radio New Zealand has an accurate picture of reception in Australia and the South Pacific.

The present schedule of Radio New Zealand Interational is: 1730-2115UTC on 11780, 15150kHz; 2345-0145 15150, 17705; 0330-0730 on 15150 and 17705; 1000-1215 9850 and 11780kHz. During Saturday and Sunday transmission between 0145-0330 is continuous.

New Zealand has largest gospel network

WHAT is understood to be the largest non-commercial, privately owned, broadcasting network, Radio Rhema, has been established in New Zealand and will extend to 11 stations this year.

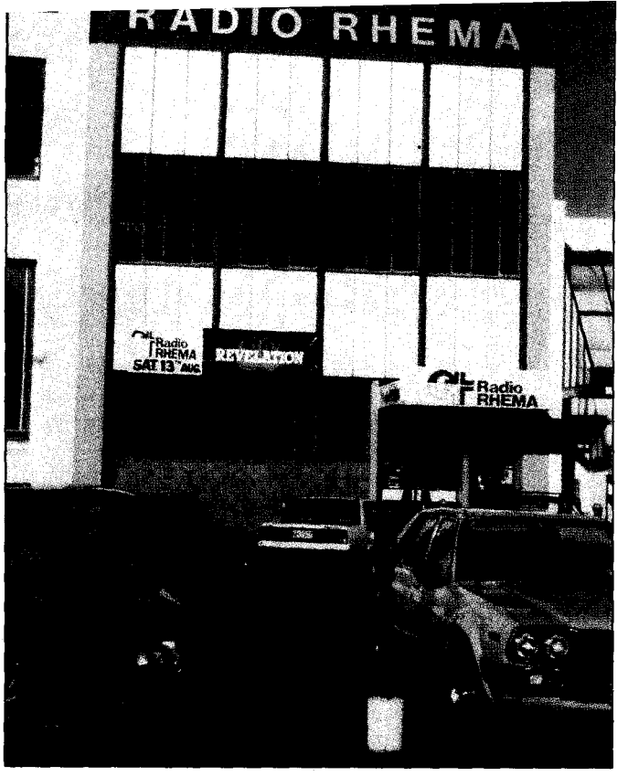
Six stations are already in operation – Christchurch, Wellington, Nelson, Hamilton, Tauranga and Taupo and another two have been granted a licence in Timaru and Invercargill. There are also applications before the Broadcasting Tribunal for stations in Auckland, Gisborne and Dunedin.

Radio Rhema has requested these frequencies for the new stations – 594 for Timaru, 1404kHz for Invercargill, while the Taupo station is on FM.

It was on 23 November, 1974 that Radio Rhema was granted a one-day licence to broadcast in Christchurch and this was the start of the Radio Rhema network as we know it today. On 11 November, 1978, Radio Rhema began operation in Christchurch as a permanent station and last year celebrated its 10th birthday. Within a few years Wellington (March 7, 1982) and Nelson (May 28, 1983) had also come on air. Hamilton opened 31 July 1988 and Tauranga and Taupo on December 18, 1988.

Radio Rhema operates from 1800-1200UTC with the key station in Christchurch synchronised with Wellington on 1503kHz, but plans have been announced for a 24-hour day operation. The station, as well as broadcasting gospel has a considerable amount of easy listening music and features the author's Radio World every Friday at 1100UTC.

Rhema is also planning to broadcast from Tonga. An agreement has been signed with the King of Tonga and a studio building and transmitter site are under construction, with mediumwave on 738kHz using 5kW. The Tonga station will use medium, short-wave and FM and will provide shorwave listeners in the Pacific with the chance to hear another new country. Radio Rhema also has operations in Australia and on the Isle of Man,



Radio Rhema's studios in Invercargill, from which their latest station 4XI will operate.

where programs are carried to cover listening audiences both in Great Britain and Ireland.

In New Zealand, the programs originate from the Christchurch studios and are fed to the network, but there are facilities for local breakouts so that individual stations can carry broadcasts from their own centres.

The Invercargill operation, using a callsign 4XI, is expected to use 1404kHz with 5kW from its new studios in The Crescent, Invercargill. The deregulation of control of broadcasting in New Zealand has resulted in radio frequencies being tendered for, and this of course will have some control over the expansion of Radio Rhema in the other centres, when the channels required will have to be purchased from the Broadcasting Commission.

And elsewhere

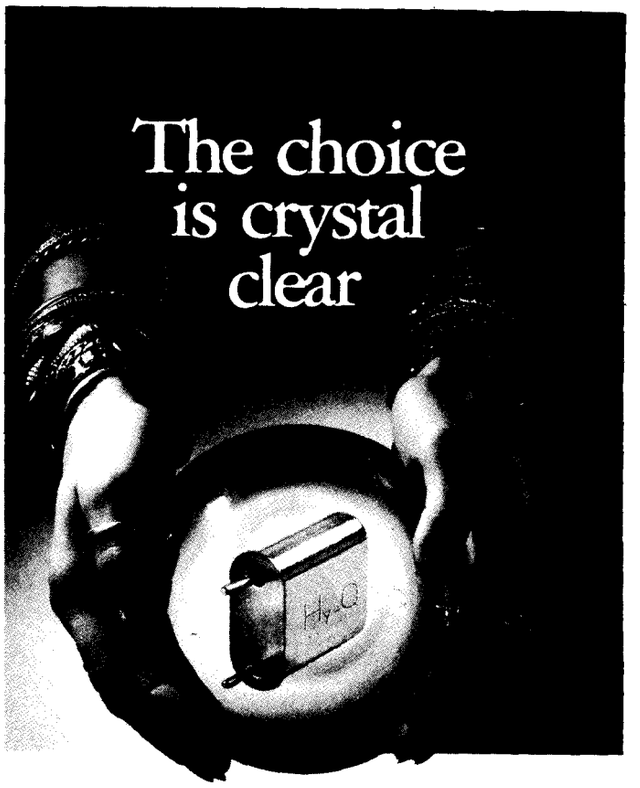
BELGIUM: Brussels uses two frequencies to Australia for an English transmission, Monday to Friday, 0800-0825UTC. The frequencies are 11695 and 21815kHz and on Monday the program includes a mailbag session followed by the Radio World feature for shortwave listeners.

GUAM: KSDA Adventist World Radio is using the new 21 metre band frequency of 1372jkHz for its transmission 1000-1700UTC. The first hour of the broadcast is in English and this is followed by other Asian languages. English is heard on Saturday and Sunday on 17865kHz 0200-0300 and daily 0000-0200 on 15125kHz.

PHILIPPINES: Rado Veritas Asia is using the new channel of 15460kHz in English 1500-1530UTC. Another frequency 15220 carries the gospel program which includes a news bulletin at 1520UTC.

RUMANIA: Bucharest is making use of the 13 metre band with the English broadcast 0645-0715UTC and 21550kHz is the channel in operation. The broadcast is also available 11940, 15250, 15335, 17730 and 17805kHz. eti

This item was contributed by Arthur Cushen, 212 Earn Street, 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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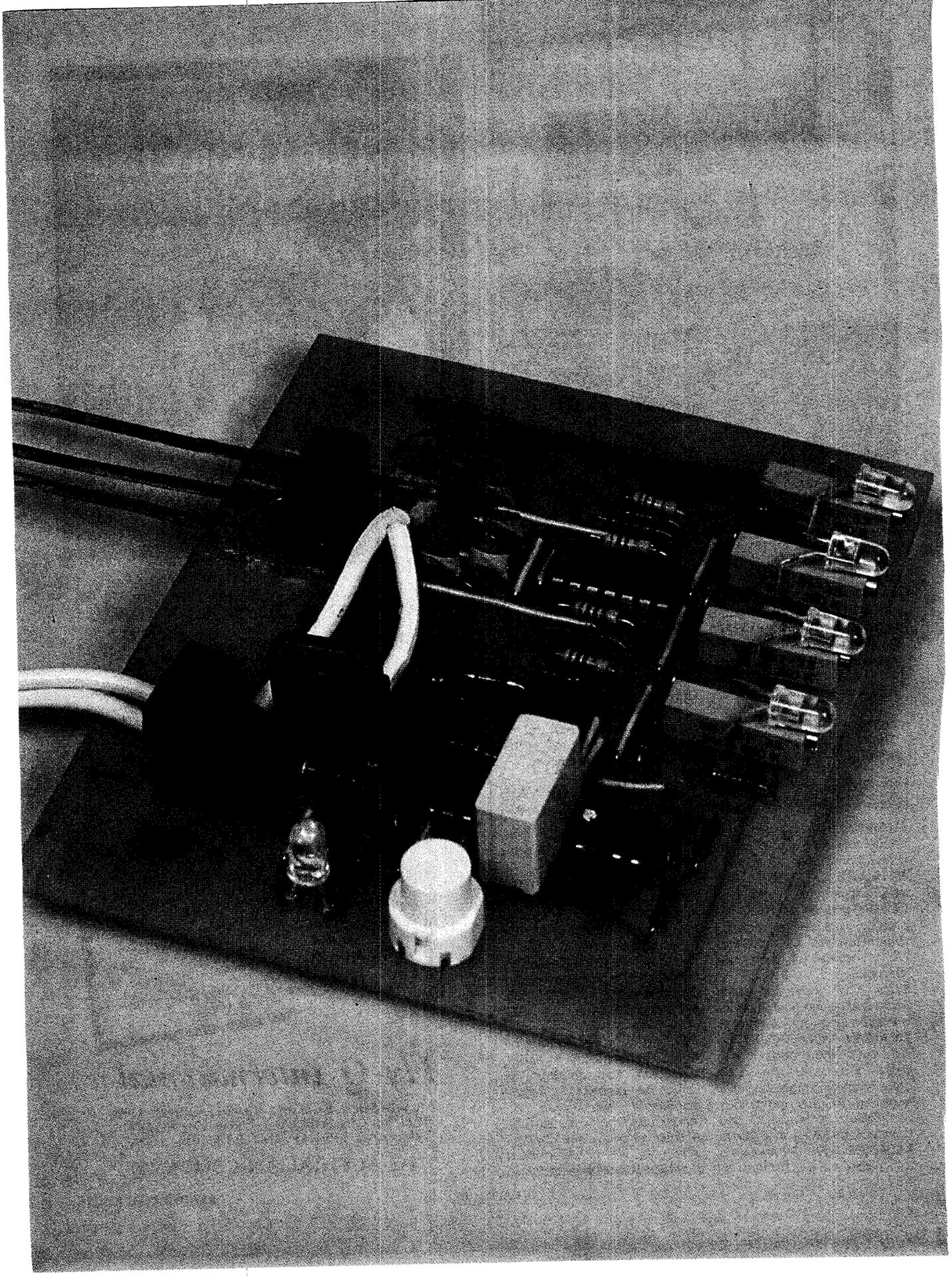


ELECTRONICS

HEAT PULSE UNIT

A device from the CSIRO that uses heat pulses to measure water flow.

The rate at which a tree uses water is a critical bit of information for anyone involved in managing trees, particularly in environments where water is scarce. Achieving maximum growth rates and yields may depend, in large part, on managing water correctly. Thus, an understanding of how trees use water is vital.

To this end, the CSIRO division of natural resources and environment has been developing a simple device that monitors the rate of sap flow up the trunk of a tree. The rate at which the sap is flowing is a sensitive indicator of the rate of water uptake.

The device described here is intended for routine use in orchards or similar situations where comparative day to day information on sap flow rates may provide an understanding of the access of trees to water and their possible need for additional water.

It is intended as a diagnostic tool to supplement observation of the weather conditions and the state of foliage and soil, and knowledge of the recent history of water need. As such, it is not recommended for quantitative measurement, but rather, for comparison of manual measurements made at a consistent time of the day over many days.

It is cheap to construct and commission, providing access to good quality measurement for users who cannot afford, or do not desire, more expensive commercial devices, and the ancillary computing equipment, to calculate flow rates from the raw data generated by these units.

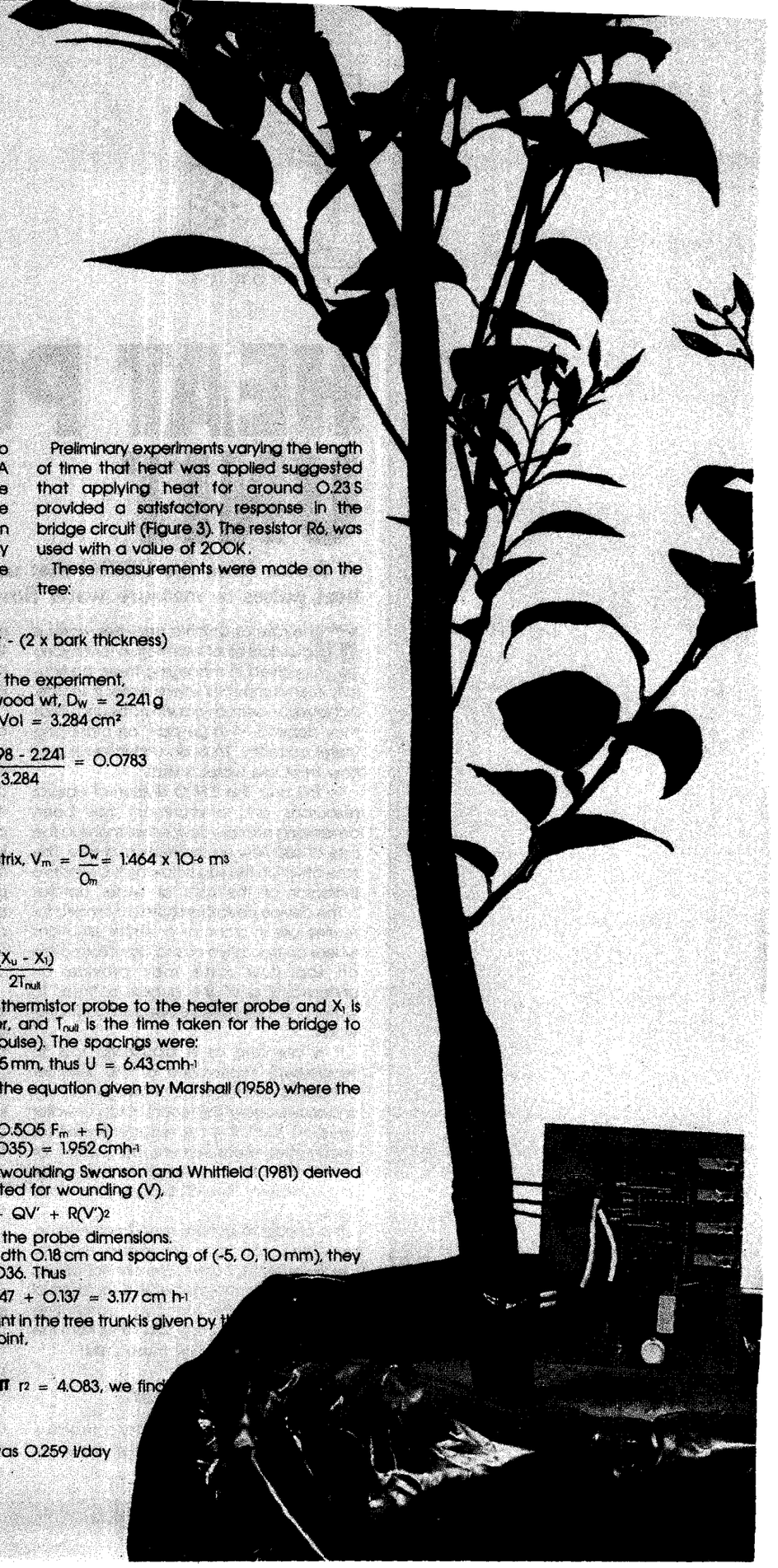
Theory of operation

The sapwood of a tree is a highly convective environment, with sap velocities of several metres per hour quite common. The use of the movement of heat in the sap wood to measure sap flow rate was first described by Huber et. al. in 1937.

Sensors are implanted in the sapwood above, and a shorter distance below, a heater element (Figure 1). The sensors are electrical resistors that are sensitive to heat, called thermistors. They are appropriate for this application because of their small size and sensitivity to small temperature changes. However they are delicate because of their fine leads. For many temperature sensing applications, including this one, they must be embedded in a protecting medium that will conduct temperature changes to the thermistor, while protecting it from physical damage.

The heat pulse technique involves the injection of a rapid burst of heat into the tree and then the measurement of the time it takes the heat to move vertically between two points (Figure 2). As the heat disperses from the heater source in the tree it moves in all directions at once, but it is specifically carried upward by sap flow. Hence if the time taken for the heat pulse to travel a known distance can be measured, the heat pulse velocity can be easily calculated. This must then be converted to sap velocity using known characteristics of the wood.

To calculate the rate of water flow, measurements must be made at several depths, as well as of the conducting sapwood area. Measurements are made at up to four depths through the use of eight thermistors incorporated into a pair of probes, i.e. four in each probe. Using the four pairs of thermistors one can calculate the heat pulse velocity at each depth. By making a few other simple measurements such as the tree diameter, the bark depth and the



A practical example

A prototype heat pulse unit was made to test these ideas under field conditions. A Valencia Orange tree was used with a single thermistor pair version of the device described above. The tree was growing in a pot and weighed and watered periodically to estimate water use independent of the heat pulse.

Preliminary experiments varying the length of time that heat was applied suggested that applying heat for around 0.23 S provided a satisfactory response in the bridge circuit (Figure 3). The resistor R6, was used with a value of 200K.

These measurements were made on the tree:

Height: 1.2 m

Sapwood diameter = trunk diameter - (2 x bark thickness)
= 22.8 mm

On a subsample taken at the end of the experiment,
Fresh wood wt. F_w = 2.498 g dry wood wt, D_W = 2.241 g
Immersed wood wt, I_W = 3.284 g, i.e: Vol = 3.284 cm^3

$$\text{Fraction of water, } F_1 = \frac{F_3 - D_w}{Vol} = \frac{2.498 - 2.241}{3.284} = 0.0783$$

$$\text{Fraction of matrix, } F_m = \frac{V_m}{Vol}$$

where V_m is the volume of the wood matrix, $V_m = \frac{D_w}{O_m} = 1.464 \times 10^{-6}\ m^3$

$$\text{Thus, } F_m = \frac{1.464}{3.284} = 0.446$$

The heat pulse velocity is given by $U = \frac{(X_u - X_l)}{2T_{null}}$

where X_u is the distance from the upper thermistor probe to the heater probe and X_l is that from the lower probe to the heater, and T_{null} is the time taken for the bridge to become rebalanced (Fig. 5, 0.23 S heat pulse). The spacings were:

X_u = 10 mm X_l = 5 mm, thus U = 6.43 cmh^{-1}

The sap velocity can be calculated using the equation given by Marshall (1958) where the sap velocity

$$V' = U(0.505\ F_m + F_1)$$
$$= 6.43\ (0.3035) = 1.952\ cmh^{-1}$$

To correct for effects to sap flow due to wounding Swanson and Whitfield (1981) derived the equation, where the sap flow corrected for wounding (V),

$$V = P + QV' + R(V')^2$$

where P, Q, R are coefficients relative to the probe dimensions.
For probe dimensions of length 3.0 cm, width 0.18 cm and spacing of (-5, 0, 10 mm), they give P = 0.3924, Q = 1.356 and R = 0.036. Thus

$$V = 0.3924 + 2.647 + 0.137 = 3.177\ cm\ h^{-1}$$

The amount of water passing a certain point in the tree trunk is given by t
area multiplied by the velocity at that point,

i.e. $Q = VA$

Since measurement gives the area, $A = \pi r^2 = 4.083$, we find

$Q = 3.177 \times 4.083$
$= 0.311$ l/day

The measured water use, by weighing, was 0.259 l/day

dimensions of the internal wood structure, one can use a series of simple equations to calculate the rate of water use by the tree.

The organisation of the heater and sensors as used in the device we describe was popularised by Closs (1958) and the numerical analysis of Swanson and Whitfield (1981). This organisation provides a greatly simplified interpretation of sap flow rate from heat flow measurements.

Operation

To install the heat pulse probes into the tree, three 1.8 mm holes must be drilled. This is done with the use of a drilling jig that enables the holes to be drilled both parallel and at the correct spacing. The user should construct such a jig of a suitable metal and ensure its correct geometry, and have a stable means of clamping it to the side of a tree. The correct spacing for the probes is that the lower thermistor probe is at a distance of 5 mm below the heater probe and the upper thermistor probe is at a distance of 10 mm above the heater probe. Once the holes have been drilled three blanks are inserted into the holes, and a piece of cardboard is held against them. A scalpel blade is then run along each blank so that a mark is left on the cardboard. Doing this enables an accurate measurement of the probe spacings to be performed. To allow both easy installation and removal of the probes, and to delay the effect of the tree's reaction to the damage caused in this process, wound grease is applied to the probes. The wound grease decreases the chance of infection. The probes are then carefully installed.

Each probe is driven by a Wheatstone bridge. Before injecting a heat pulse into the tree each bridge must be balanced. This is done with the potentiometers placed into each bridge and the LED's response to the comparator. After the initial injection of the heat pulse into the tree, heat begins to spread out vertically and horizontally. Since the lower thermistor is closest to the heater probe, it is heated before the upper thermistor, thus changing its resistance and modifying the voltage sensed across the Wheatstone bridge. As the lower thermistor continues to be heated, the bridge voltage difference increases, goes through a maximum and declines to provide a reference time for the rate of upward movement of the hottest region of the heat

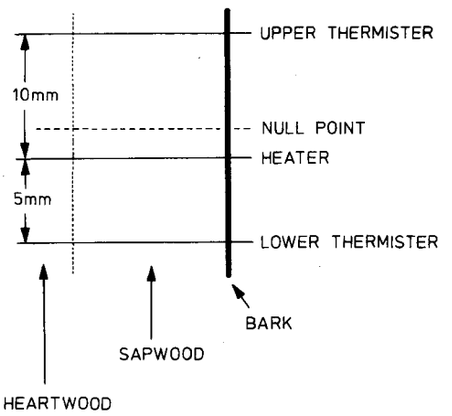


Figure 1. Organisation of heater and sensor in sapwood in order to use the heat pulse technique to measure sap flow rates.

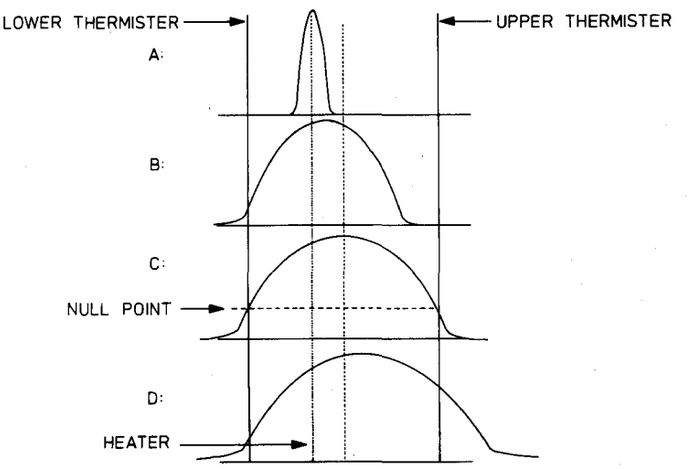


Figure 2.A. Initially the two thermistors are at the same temperature when a heat pulse is injected into the tree.

B. Since the lower thermistor is closer to the heat source than the upper thermistor, it begins to be heated as the heat pulse spreads out.

C. The heat pulse continues to spread out and move upwards until the temperature of the thermistors once again becomes equal.

D. As the heat pulse continues moving upwards the lower thermistor begins to cool whilst the upper thermistor is heated. Eventually as the heat pulse moves away from the thermistors their temperature once again becomes equal. The time taken from when the two thermistors are at equal temperatures initially, until after the injection of a heat pulse and then once again become equal, is known as T_{null}.

Disclaimer:

This device contains electrical circuits and a heating element that may become dangerously hot if mis-used. The Commonwealth Government, CSIRO and employees of CSIRO and ETI are in no way responsible for events relating to the use or construction of the device described.

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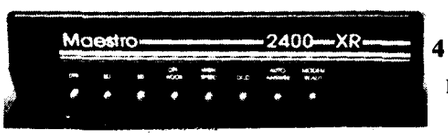

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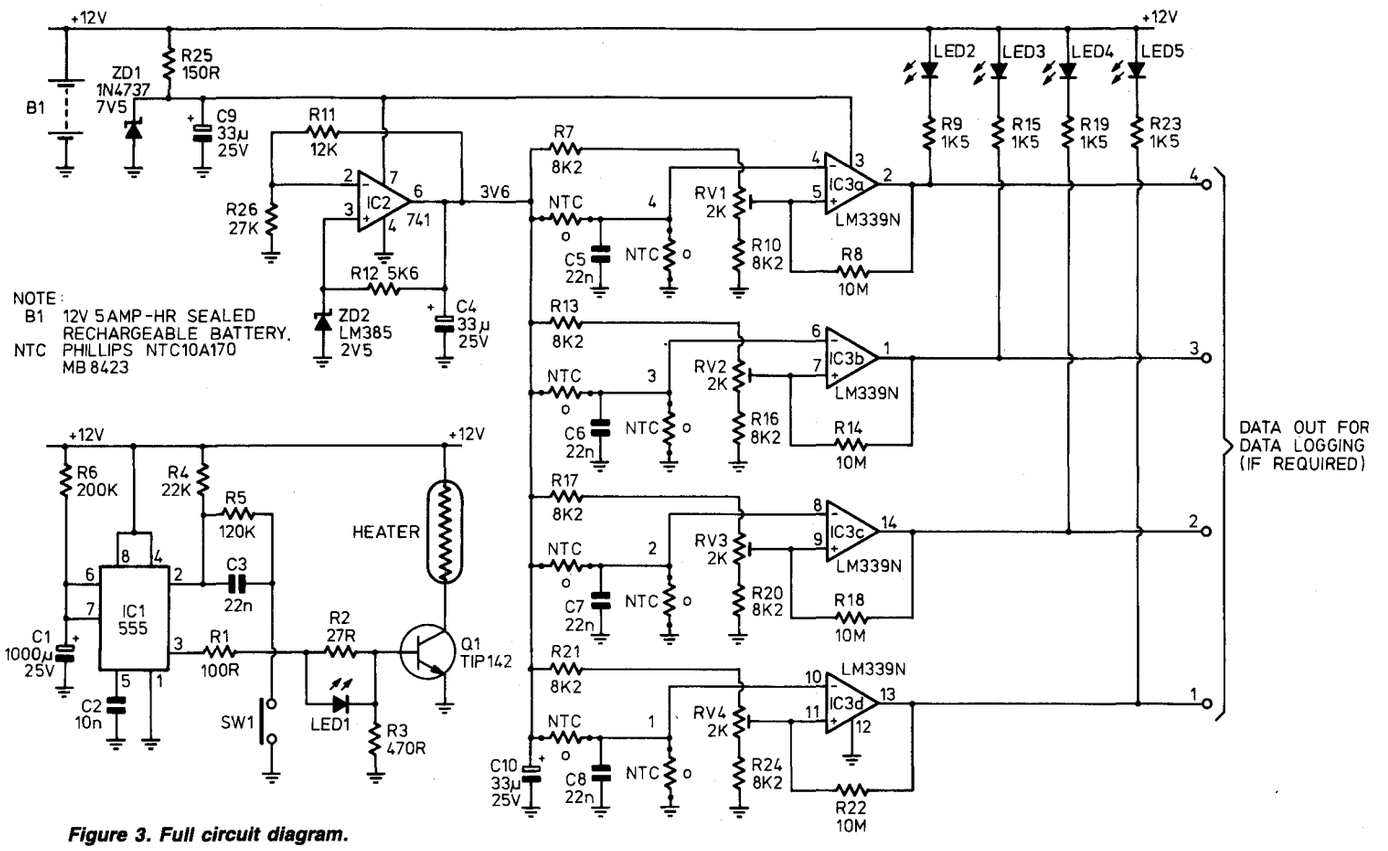


Figure 3. Full circuit diagram.

pulse when the circuit comes back into voltage balance (Figure 2). This is observed as a change of the LED by the operator, who should observe and record the elapsed time from when the heat pulse was injected to the change of LED state for all four bridges.

The notation of Edwards and Booker (1984) has been employed in the following description of the calculations involved in the estimation of sap flow rate from the timing measurements. A sample of the sapwood of the tree must also be taken and weighed so that the fraction of water, matrix and air in the wood can be determined. On taking the sample its fresh weight must be found. The sample weight immersed in water is then measured, and it is oven dried to determine its dry weight. The immersed weight in grams gives us the volume of the sample in mls, using Archimede's principle.

To calculate the fraction of water of the sample (F_w), we find the difference between the fresh and dry weights and then divide by the volume, i.e.

$$F_w = (FW - DW)/Vol$$

To find the fraction of the matrix we must first determine the volume of the matrix (V_M), which is the dry weight divided by the density of the matrix (P_M = 1530 kg m^{-3}), i.e:

$$V_M = DW/P_M$$

Thus the fraction of matrix (F_M) is the volume of the matrix divided by the volume of the sample, i.e:

$$F_M = V_M/Vol$$

The remaining fraction may be assumed to be air, i.e:

$$F_A = 1 - (F_M + F_W)$$

The heat pulse velocity is estimated from the equation:

$$U = (X_U - X_L)/2T_{null}$$

where X_U is the distance from the upper thermistor to the heater and X_L is the distance from the lower thermistor to the heater. The sap velocity is calculated using the equation:

$$V' = U(0.505 F_M + F_W)$$

where U is the heat pulse velocity, F_M is the fraction of matrix of the tree and F_W is the fraction of liquid (water) of the tree.

To correct for effects due to wounding on sap flow, Swanson and Whitfield (1981) derived the equation:

$$V = P + QV' + R(V')^2$$

where P, Q and R are coefficients relative to the probe dimensions, and V is the corrected sap velocity.

Construction

Nichrome wire is used to construct the heater coils. This nichrome wire is 0.404 mm in diameter, with a resistance of 8.14 ohm/m. The heaters should be approximately 4 cm long, have a maximum width of 1.7 mm, and a resistance of less than 1 ohm.

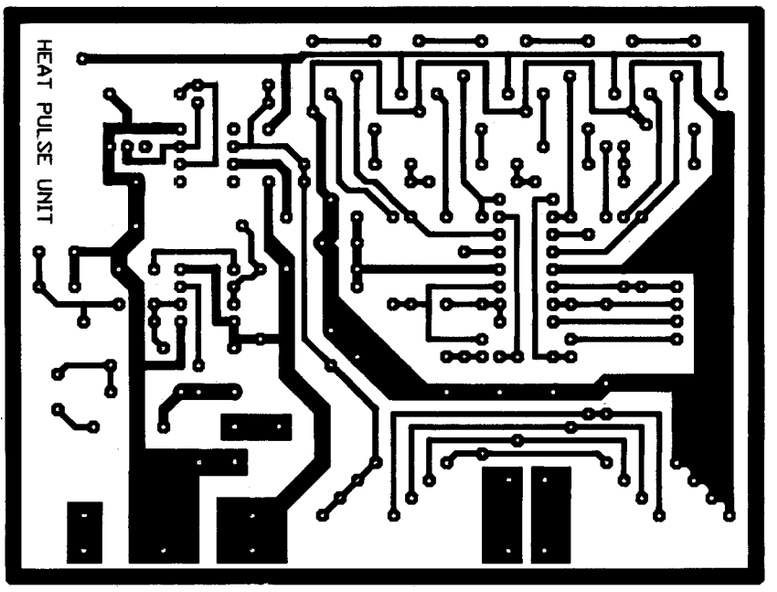
The method used to create these heater coils is to bend a length of nichrome wire into a hairpin and then to place the bent end into a vice. A piece of polythene plastic is then placed between the two pieces of wire which are then twisted around each other, creating a heater coil of the appropriate dimensions. Once the coil has been constructed the plastic is removed, leaving a coil within its dimensions and with no shorts. The heater coils may be kept apart using small droplets of Superglue, applied before being potted into Araldite.

Thermistor probes

To detect the heat pulse, NTC thermistors are used, that are 1 mm in diameter and have a resistance of 10 K ± 20%. It is advantageous to measure the resistance of each thermistor at a constant temperature to enable them to be paired up with similar resistances. The pairs of thermistors will then be used as two arms of a Wheatstone bridge that will require a minimal amount of balancing.

To construct the thermistor probes, wires must be joined to the thermistors. These joining wires need to be insulated to prevent shorting, and we have found that enamelled motor winding wire, 0.2 mm diameter or

similar, is suitable. The board is designed to provide up to four bridge circuits, since it was found that up to four thermistors and associated wires may be embedded in one probe. Five pieces of wire 10 cm in length are cut and then straightened out. The insulation is then removed from both ends of the wire for about 0.5 cm. The wires are then bundled using Superglue and taped to a microscope slide with the cleaned ends offset by 1 cm. Using a microscope or a hand lens and a scale background, the four thermistors are then attached in the correct position, depending on the diameter of tree stem anticipated. In the case of a 6 cm diameter trunk, the beads are placed at 5, 13, 19, and 22 mm from the end of the probe. The four thermistors are joined to four separate wires and all are joined to a common wire using a conductive glue. We used a silver dag, commonly used for mounting electron microscope specimens, but a number of similar products are available. A multimeter is used to check that there are no shorts or open circuits.



Probes

The completed probe or heater is then potted in Araldite, a two part epoxy resin supplied by Ciba Geigy. One must ensure that the thermistor beads in the two probes are placed at the same distance from the end of the probe. This will ensure that, when the probes are placed into the tree, the thermistor beads will be at the same depth from the tree centre.

A mould of two microscope slides filled with wax is used. The two microscope slides are held apart by small pieces of perspex that are glued in place. This is then filled with molten wax and rods of 1.7 mm diameter are

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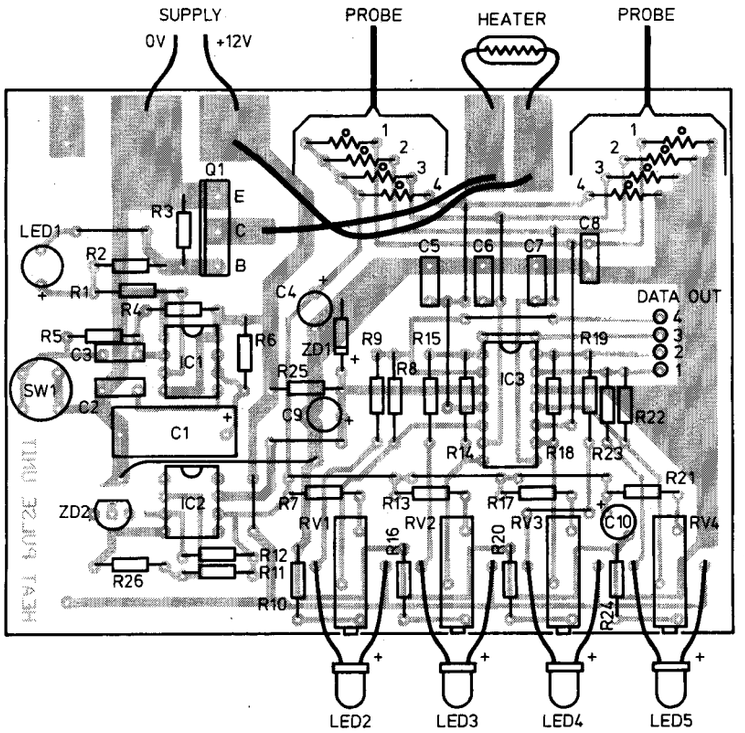

then placed in this molten wax to form the mould. Once the wax has hardened the rods are removed leaving holes of 1.7 mm diameter. A syringe and thin tubing is used to fill the mould with Araldite. The heater coils and thermistors are then carefully pushed into the moulds. These can then easily be checked for air bubbles by holding the mould up to a bright light source. The recovered probes may be lightly polished with an emery paper once they have set, to remove irregularities and adjust size, if necessary. eti

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Edwards, W.R.N., and Booker, N.W.M. (1984). Transpiration from a kiwifruit vine as estimated by the heat pulse technique and the Penman-Monteith equation. *NZ J Agric Res* 27, 537-543.
Huber, B., and Schmidt, E. (1937). Eine kompensations methode zur thermo elecktrishen messung langsamer safstrome. *Ber Deutsh Bot Ges* 55, 514-529.
Marshall, D.C. (1958). A heat balance method for measuring water flow in the stem of intact plant. *Plant Physiol* 33, 385-396.
Swanson, R.H., and Whitfield, D.W.A. (1981). A numerical analysis of heat pulse velocity theory and practise. *J Exp Botany* 32, 221-239.

The authors are C.D. Walker and P. Bikaunieks at the Division of Water Resources and C Gurr, Division of Soils, Adelaide Laboratory. Colin Walker can be contacted on (08) 274 9393.

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6	31	56	81	106	131	156	181	206	231	256	281	306	331
7	32	57	82	107	132	157	182	207	232	257	282	307	332
8	33	58	83	108	133	158	183	208	233	258	283	308	333
9	34	59	84	109	134	159	184	209	234	259	284	309	334
10	35	60	85	110	135	160	185	210	235	260	285	310	335
11	36	61	86	111	136	161	186	211	236	261	286	311	336
12	37	62	87	112	137	162	187	212	237	262	287	312	337
13	38	63	88	113	138	163	188	213	238	263	288	313	338
14	39	64	89	114	139	164	189	214	239	264	289	314	339
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17	42	67	92	117	142	167	192	217	242	267	292	317	342
18	43	68	93	118	143	168	193	218	243	268	293	318	343
19	44	69	94	119	144	169	194	219	244	269	294	319	344
20	45	70	95	120	145	170	195	220	245	270	295	320	345
21	46	71	96	121	146	171	196	221	246	171	296	321	346
22	47	72	97	122	147	172	197	222	247	172	297	322	347
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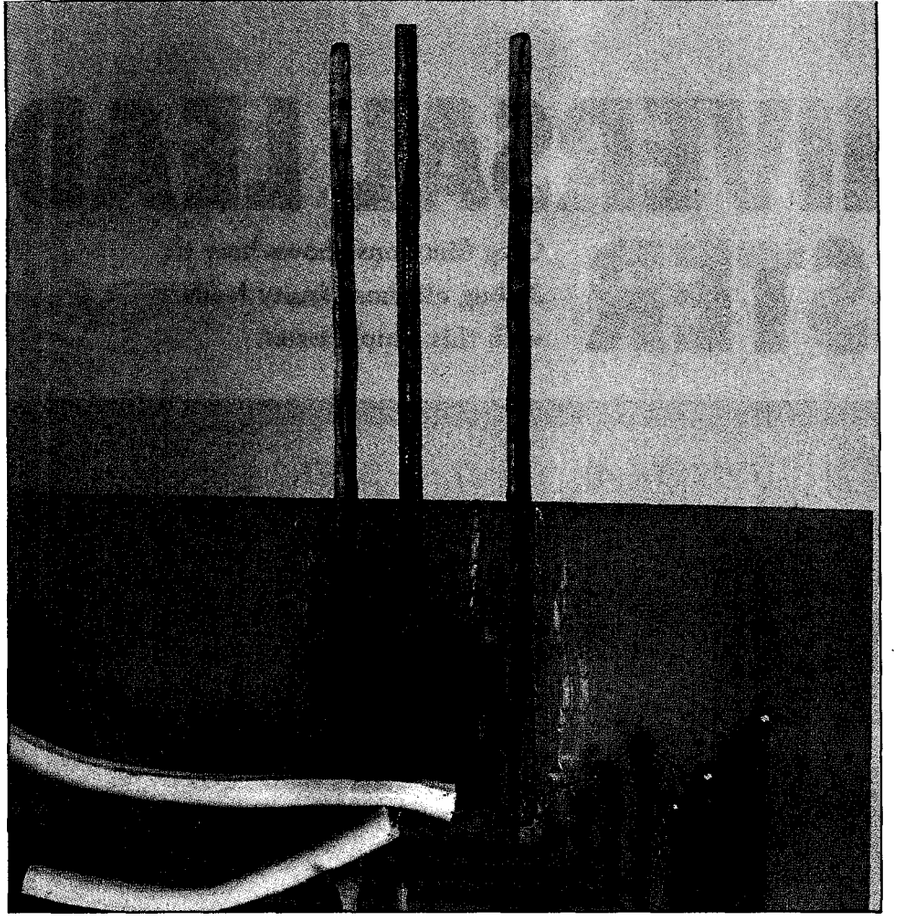

Heat pulse probe.

PARTS LIST

RESISTORS

R1	100R
R2	27R
R3	470R
R4	22k
R5	120k
R6	200k
R7, 10, 13, 16, 17, 20	8k2
R21, R24	
R8, 14, 18, 22	10M
R9, 15, 19, 23	1k5
R26	27k
R11	12k
R12	5k6
R25	150R
RV1, 2, 3, 4	2k trim

CAPACITORS

C1	1000µ/25 V electro)
C2	10n greencap
C3, 5, 6, 7, 8	22n greencap
C4, 9, 10	33µ/25 V electro

SEMICONDUCTORS

Q1	TIP142
ZD2	LM385.2 V5 voltage reference diode
ZD1	IN4737 7 V5 zener
IC1	555
IC2	741
IC3	LM339N
LED1, 2, 3, 4, 5	Red LEDs

MISCELLANEOUS

Switch, heater, 8 x Philips NTC 10 A170 M88423 or equivalent, 12 V battery.

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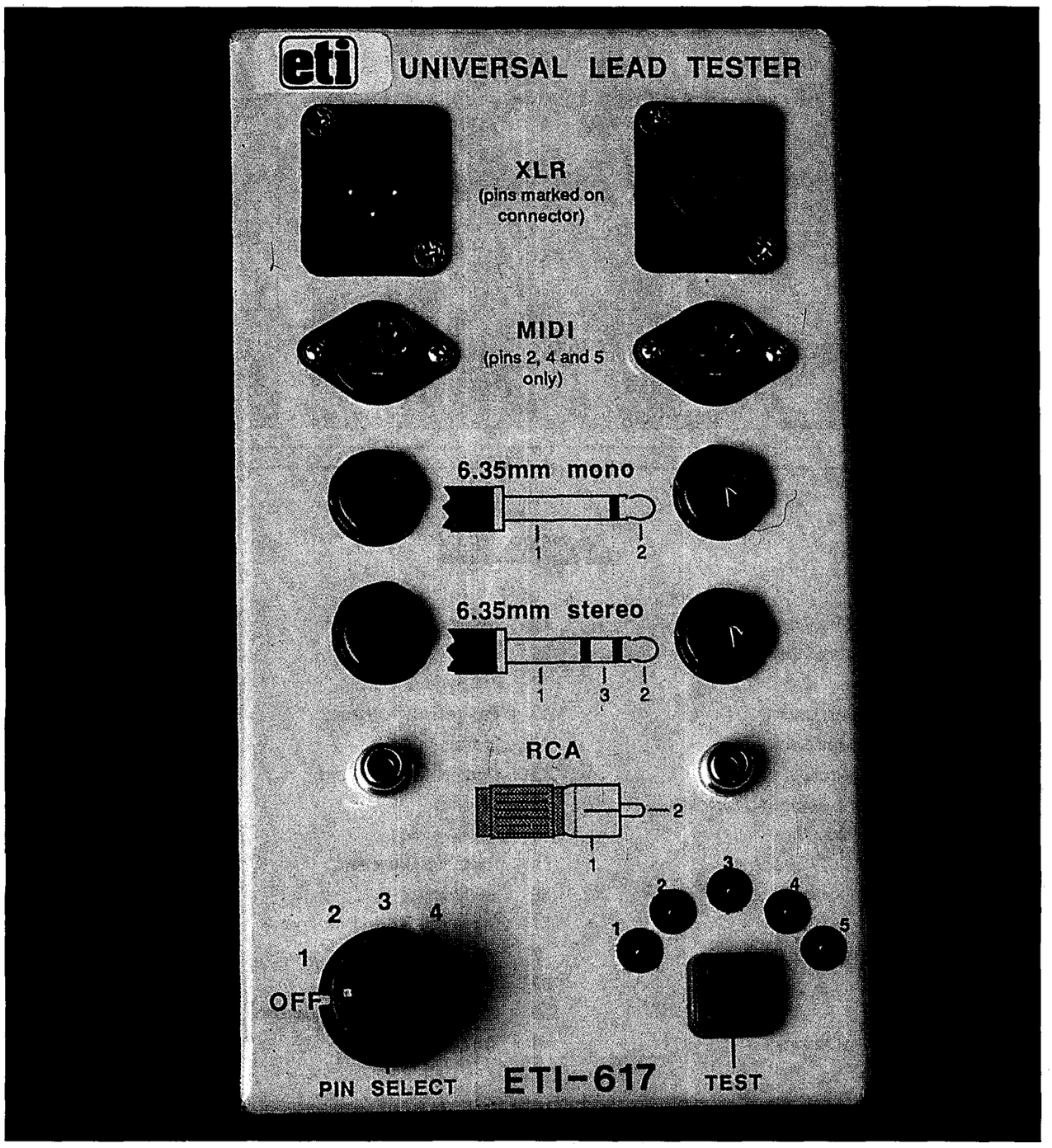
UNIVERSAL LEAD TESTER

Greg Simmons shows how to de-bug all those faulty leads with this simple tester.



This lead tester is a simple device that tests virtually every kind of lead you'll come across in a home recording or live performance situation, including MIDI leads. Apart from testing the leads for continuity, it also shows the pin-to-pin wiring of them.

This is a very useful feature for checking the wiring of leads with different connectors on each end, such as XLR to 6.35 mm plugs (often used for connecting balanced and unbalanced equipment together). These leads usually have two of the XLR pins soldered to the sleeve of the 6.35 mm plug (either pins 1 and 2, or pins 1 and 3), and the remaining pin soldered to the tip. Using the lead tester, it is possible to see which pins are connected where, preventing potential phase inversion and short circuit problems.

Construction

The prototype was built in a plastic 'zippy box', measuring approximately 20 cm × 11 cm × 6 cm. If the lead tester is to be taken on the road, it may be a good idea to build it into a sturdier metal box (make sure every socket is electrically insulated from the box, or else you will get false readings).

All sockets and terminals in the prototype were mounted on the bottom of the box, as this is much more rigid than the lid. Start by marking out and drilling all the holes. The template provided in this article will make the job easier, and also serves as a front panel. Just photocopy it, cut it out and fix it to the box with a thin smear of glue (I used a 'UHU' glue stick). Make sure the entire template is glued down, not just the edges, or else the holes will not be accurate. Drill small pilot holes first, and don't push the drill too hard or else it will damage the edges of the holes when it comes through the other side, and may also tear the template (you *did* use a photocopy, didn't you?). After the holes are drilled, clean up the edges and put a layer of clear self-adhesive contact onto the front panel. This will protect the template and provide a durable finish. Use a scalpel or blade to cut the appropriate holes in the contact for the sockets and terminals to go through.

Carefully solder the resistors to the anodes of the LEDs. See Figure 4 for determining which lead is the anode. The wiring to the sockets and switches comes next, and finally the battery connections. Be sure to use insulated hook-up wire, or tinned copper wire with insulation.

The prototype uses stereo 6.35 mm sockets for the mono and stereo 6.35 mm plug inputs. Being plastic, they can be used in metal boxes with no insulation problems.

If you are using these sockets, be sure to make connections to the correct set of pins. The socket has 6 pins, in two rows of three. One row of pins connects to the long contacts that go across the top of the socket, the other row is for switching only – don't use the switching contacts, since these open circuit when the plug is inserted. Figure 3 shows one of these sockets from underneath, and the correct set of pins.

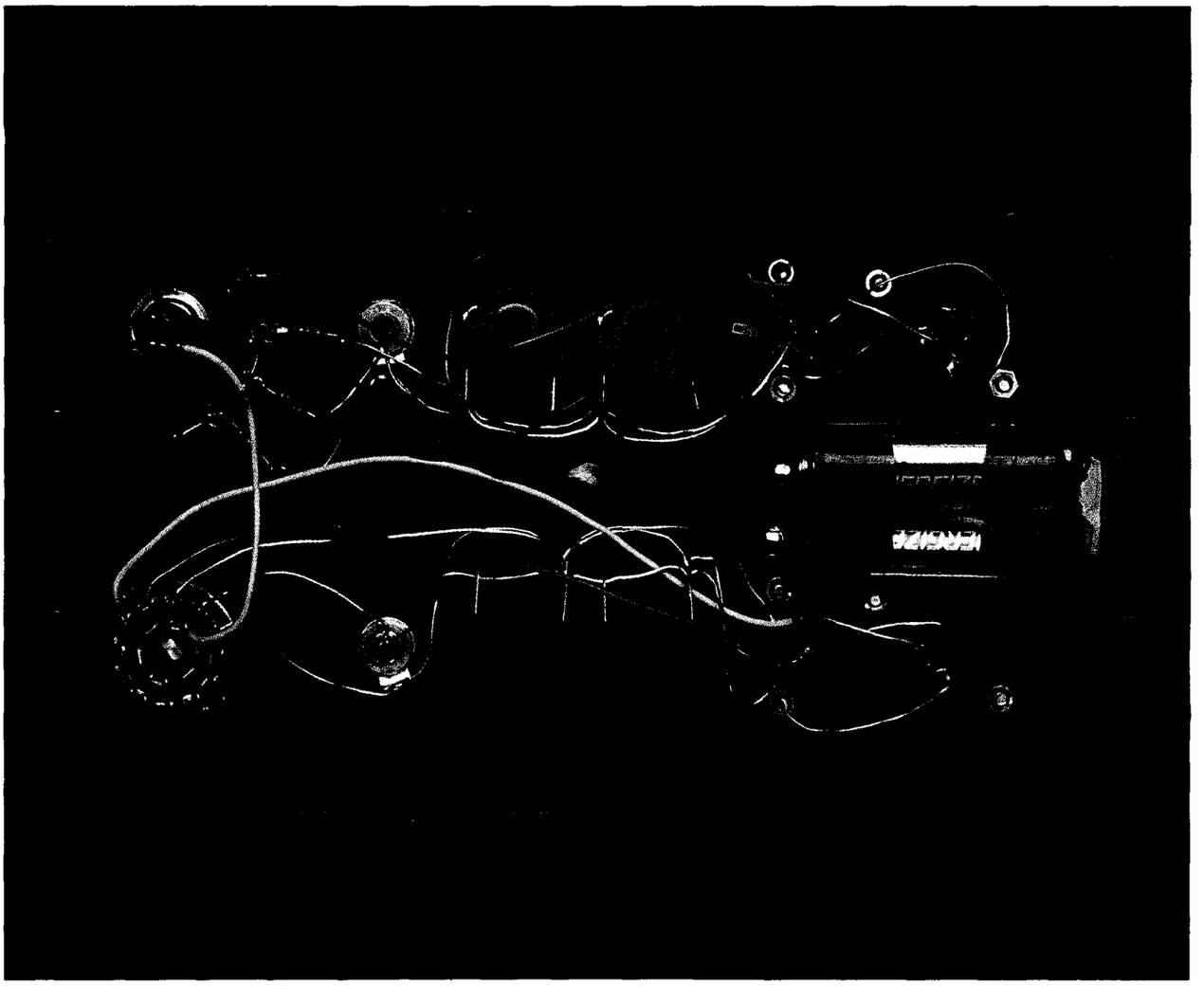
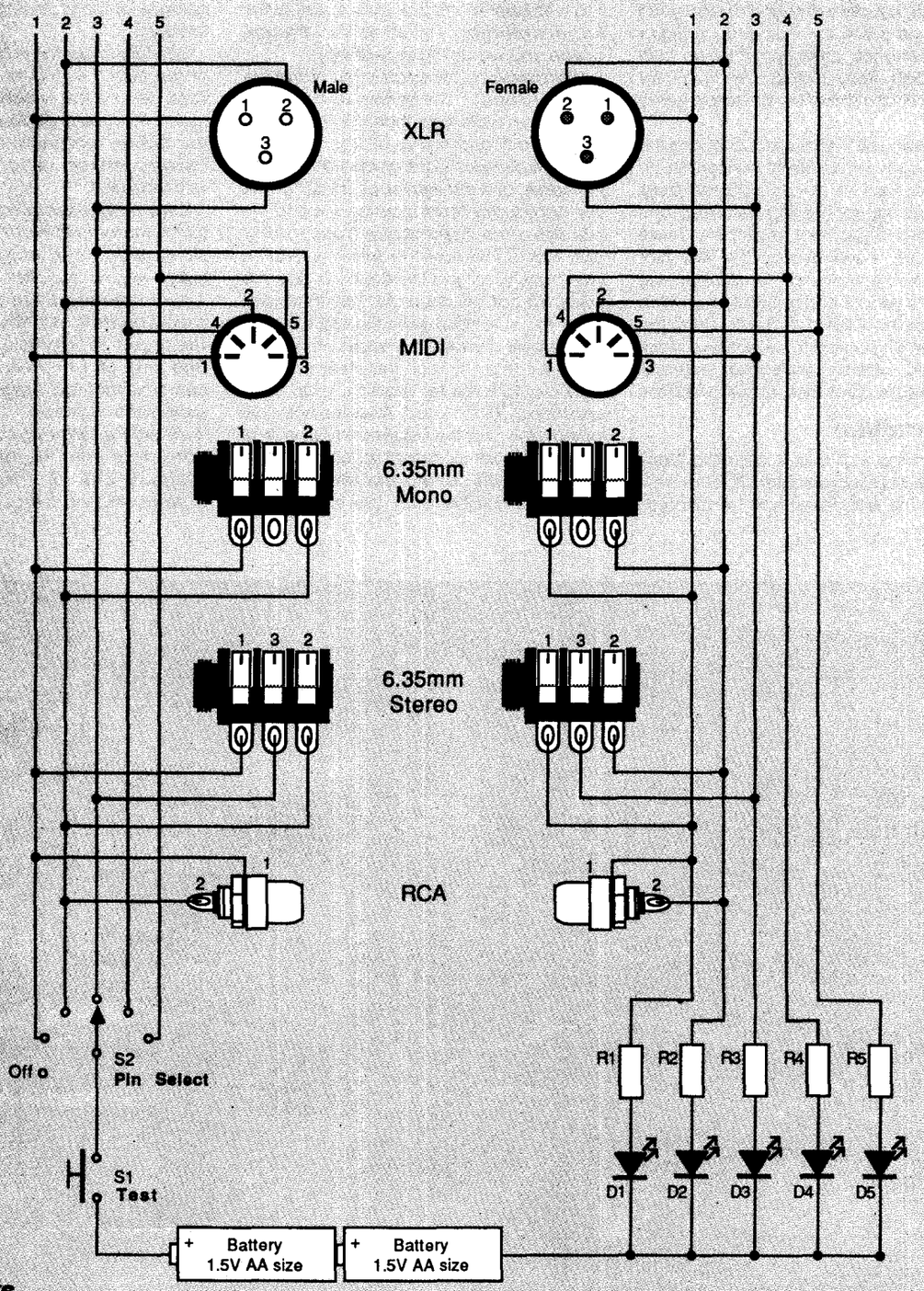


Figure 1



How it works

The circuit diagram is given in Figure 1, and closely corresponds to the front panel layout shown in Figure 2. All sockets are shown pictorially, in order to simplify construction.

The circuit is nothing more than an elaborate light switch, wired to light one of five LEDs (Light Emitting Diodes) at the push of a switch. Resistors R1 to R5 enable LEDs D1 to D5 to operate safely from the 3 volt power supply formed by the series connection of the two 1.5 volt batteries. The prototype uses two AA cells in a battery clip that electrically connects them in series, with the output voltage available on the terminals of a pp3 battery clip (these clips are available from most electronic component suppliers).

Switch S1 is a momentary contact pushbutton that connects power to the circuit. Switch S2 routes that power to the pins of the sockets on the left side of the box. When a healthy lead is being tested it will complete the circuit, lighting one (or more) of the five LEDs. The numbers around the 'Pin Select' switch (S2) on the front panel show which pin has power applied to it, while the LEDs around the 'Test' switch (S1) show that pins are receiving that power on the other end of the lead, thereby showing the pin to pin connections.

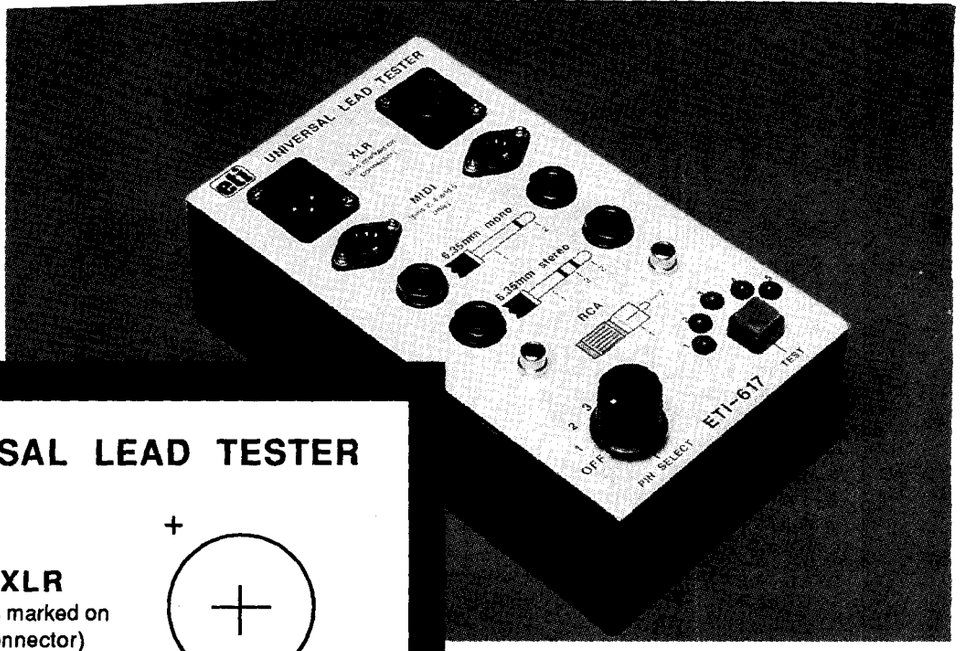
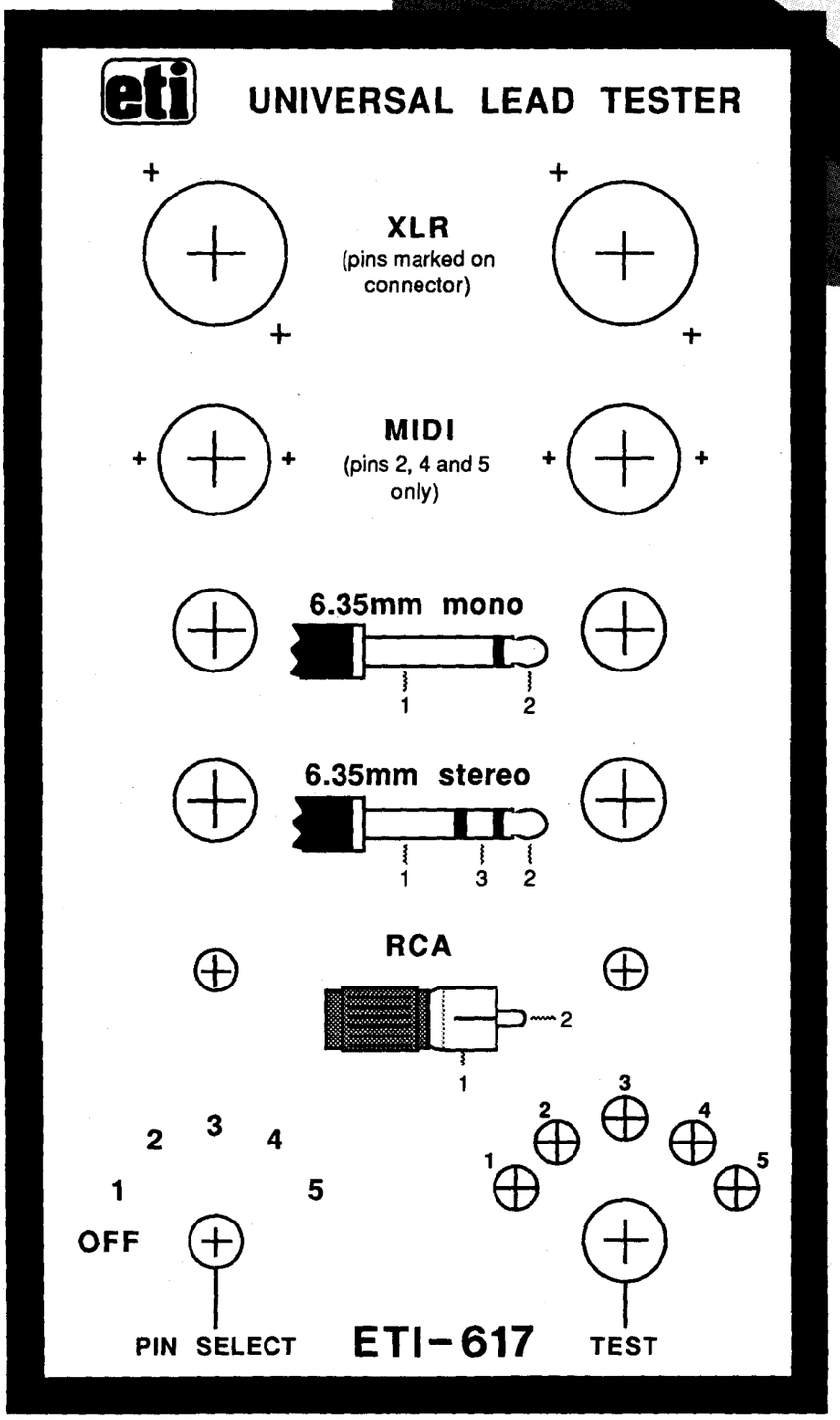


Figure 2



Note the connections for the MIDI sockets. The pins on these sockets have an unusual numbering scheme, as shown in the circuit diagram (Figure 1). The pins should be numbered on the back of the socket. Be sure to connect them as shown in the circuit diagram.

Rotary switches usually have the central pin (the 'pole') mounted in the centre, with the switched outputs in a ring around the outside. Put the 'Pin Select' switch (S2) at its most anti-clockwise position, mount it to the box and align the knob to select the number 1 position on the template. Now establish which switched output is the correct one for this position by using a multimeter or continuity tester.

You could use the batteries, one of the resistors and one of the LEDs for this purpose – connect one end of the resistor to the positive terminal of the batteries, the other end to the anode of the LED. Now connect the negative terminal of the batteries to the central pin on the switch, and move the cathode of the LED from pin to pin until it lights.

The same procedure can be used to find the other switched outputs. Fortunately, once you have found the first two the rest should be easier to locate, since they will usually appear one after the other.

Using the lead tester

Using the lead tester is simplicity itself. It works by applying voltage to a pin on one end of the lead, causing any LEDs electrically connected to that pin on the other end of the lead to glow. Plug one end of the suspect lead into the appropriate socket on the left side of the unit, and the other end into the appropriate socket on the right side. Select '1' on the Pin Select switch, and press the Test button. If pin1 on the left side is connected to pin 1 on the right side, LED 1 should light, showing electrical contact. Now select '2' on

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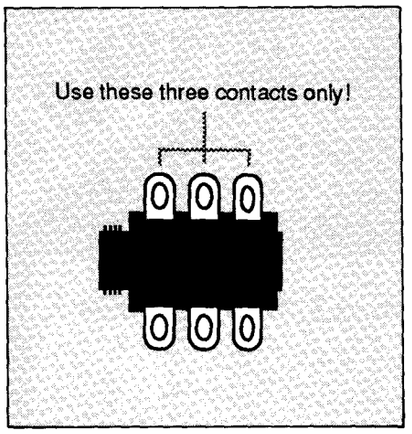


Figure 3

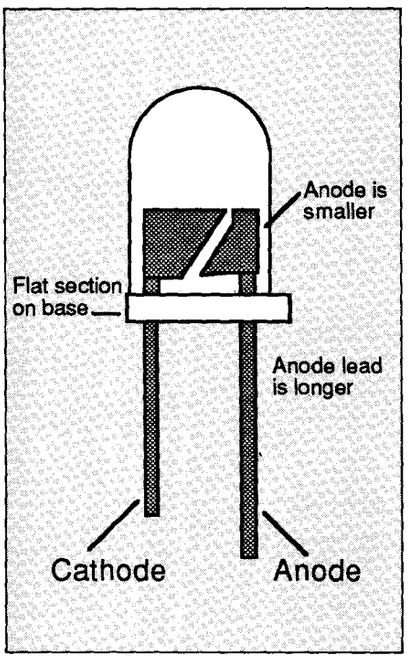


Figure 4

the rotary switch, and test pin 2. Do the same for pins 3, 4 etc. Of course, most leads don't have five pins.

Although MIDI uses a 5-pin connector, only three of these pins are actually connected (pins 2, 4 and 5). Keep this in mind when using the tester.

If a pin on one end of the lead is connected to more than one pin on the other end, you will see more than one LED light. Using the XLR to 6.35 mm lead mentioned earlier, two pins of the XLR would be connected to the shield of the 6.35 mm plug, causing two of the LEDs to light. No matter what sort of wiring exists within the lead, the tester will show you what pins are connected, and where.

The left side of the lead tester can also be used as a crude lead adaptor when the Pin Select switch is in the 'OFF' position. All the sockets on the left side of the box are electrically connected together, and there are no other components in the circuit (use Figure 1 for the actual connections).

It is possible to convert a female XLR to a stereo 6.35 mm by plugging the female XLR plug into the male XLR socket (this should be on the left side of the box) and plugging a stereo 6.35 mm plug into the stereo 6.35 mm socket on the left side. The same connections will also convert a balanced XLR to an unbalanced 6.35 mm, simply by plugging a mono 6.35 mm plug into the stereo 6.35 mm socket. The sleeve of the mono plug will connect pins 1 and 3 together, leaving pin 2 of the balanced lead as the signal. This, however, will cause a phase inversion in balanced systems that use pin 3 as the positive signal.

It is also a simple matter to convert a 6.35 mm mono plug to an RCA plug – very handy indeed!

The front panel in Figure 2 shows the pin numbering scheme used in the tester (some connectors, notably XLR and MIDI sockets, have the pins numbered on them). Use this as a guide, especially for 6.35 mm and RCA sockets. Happy lead testing! eti

Parts List — ETI-617

RESISTORS	
R1 to R5	56R, ¼ W, 10%
SEMICONDUCTORS	
D1 to D5	5×red leds
SWITCHES	
S1	SPST momentary contact switch
S2	6-position rotary switch, single pole
SOCKETS	1×male XLR panel-mount socket
	1×female XLR panel-mount socket
	2×5-pin 180 degree DIN socket (MIDI)
	4×stereo 6.35 mm sockets
	2×RCA sockets
MISCELLANEOUS	2×1.5 V AA size batteries and clip
	1×zippy box (20×11×6 cm)
	1×knob for rotary switch

ELECTRONICS
E T I - 1 9 1

SIMPLE LOGIC PROBE

When things go wrong, build this extremely simple logic probe for only a few dollars. By Rashid Adat.

One of the more difficult aspects of electronics is dealing with an errant circuit. What to do when things go wrong? Some test gear is essential when diagnosing faults. For analogue circuits a simple multimeter is the bare minimum. For digital projects, the equivalant of a multimeter is the logic probe.

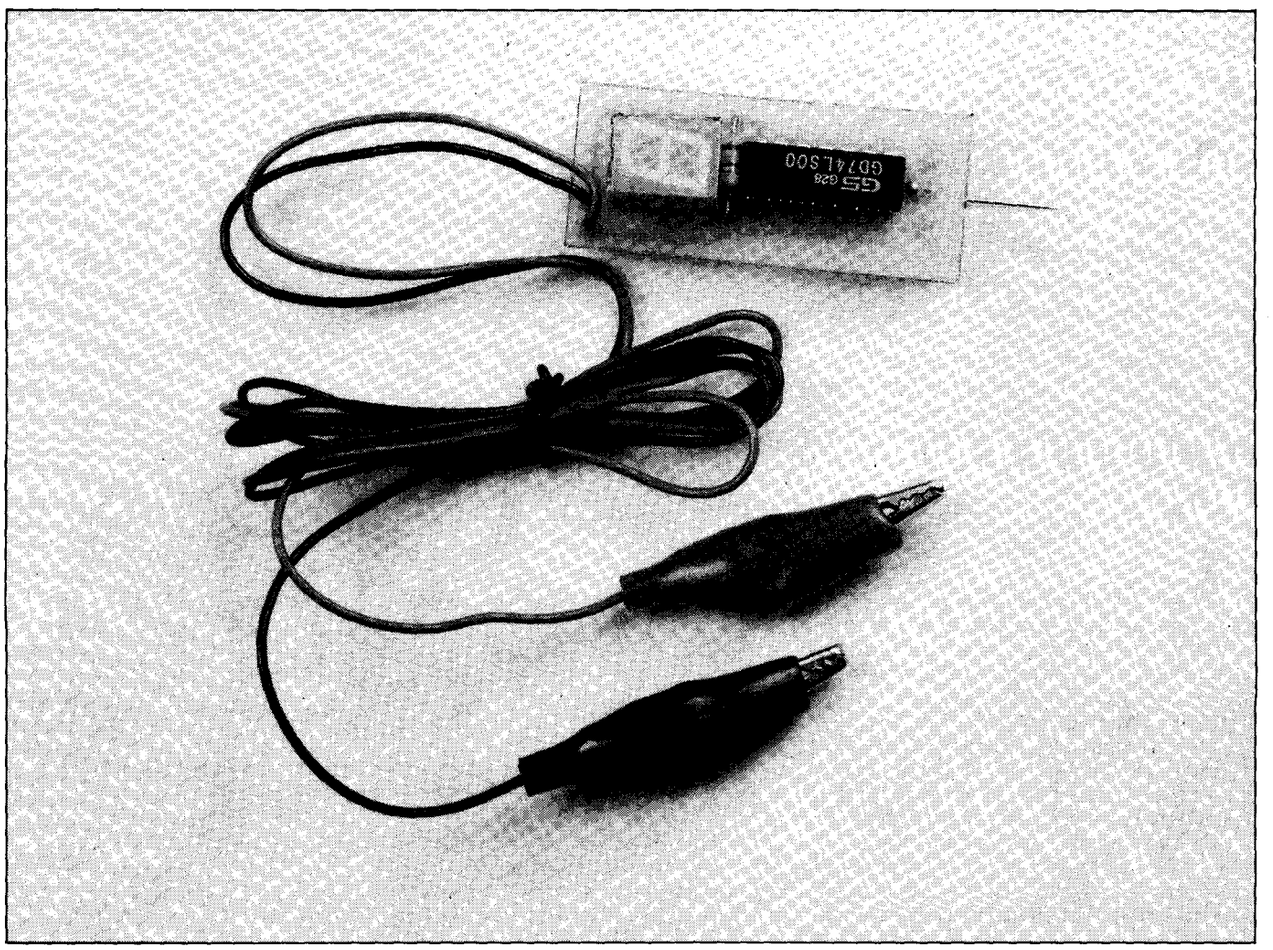
Impressive sounding though it is, a logic probe is in fact less complex than a multimeter – a simple version like this one can be built for just a few dollars.

A logic probe is a voltmeter which acts only digitally. It tells you if a part of the circuit under test is at a high or low logic level. This probe is designed to work with TTL circuits only (CMOS circuits usually use too high a supply voltage); levels it will detect are 2-5 V for a high level and 0 to 800 mV for a low level.

The probe uses a 7-segment LED display to show the results (Figure 1) and gives a 0 display when a low level is detected and a 1 when a high level is detected. If the test point is oscillating between the two, the two displays combine to form a P for pulse.

Construction

There are very few components for this project and so the order of assembly hardly matters at all. Leave soldering the LED display until last as this is the most easily damaged component and the most expensive. Go easy with the soldering iron when you come



to it and leave it to cool a little after soldering each pin.

There is no need to use an IC socket for IC1 as these chips are so cheap that you would have to damage a couple before recovering the cost of the socket.

Probing stuff

The most difficult aspects of assembling this project are the mechanical ones – what to use for the probe tip itself and what to house the complete board in.

A large darning needle was used for the prototype probe. This serves quite well but is a little vicious. A few inches from the pointed end of a metal knitting needle would perhaps be the ideal.

Whatever is used for the probe tip, be sure to solder it firmly into position as all the strain of stabbing at the errant circuit is taken at this solder joint.

Any convenient small case can be used to house the probe. After some searching, the prototype was finally dressed in the wide and colourful plastic body of a highlighter felt tip pen with the probe projecting where the nib once was and the two flying leads protruding from the pen top.

In use

Of course we hope you never have to use this project! However, assuming the worst happens, simply attach the red crocodile clip to a part of the circuit connected to the positive supply (5 V) and the black clip to the earth (O V). Touching the probe tip to any part of the circuit will now display O for a low logic level, 1 for a high level and P for a pulsing voltage.

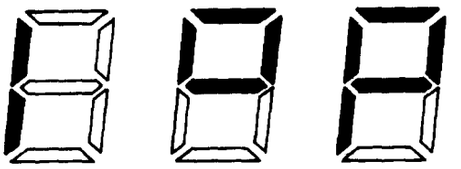
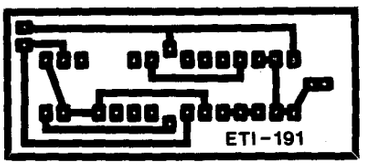


Figure 1: the logic probe's display.



Parts list

RESISTORS (5% ¼W)
R1 470R
SEMICONDUCTORS
IC1 7400
LED1 Common anode 7-segment display
MISCELLANEOUS
Probe tip, red and black crocodile clips. Connecting wire. Suitable case.

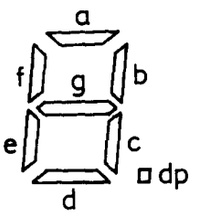


Figure 3: the standard labelling of a 7-segment display.

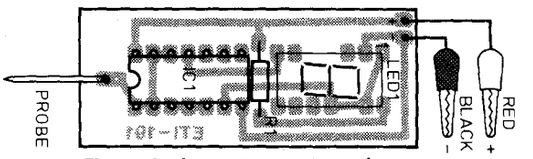


Figure 2: the component overlay for the pc board probe.

How it works

The circuit diagram of the logic probe is simple in the extreme and is given in Fig. 4. The one IC is a quad NAND gate IC containing four NAND gates of which only three are used. All of these have their two inputs connected together to be used as inverters. Whatever logic level is presented at the input is reversed at the output – a high level (1) input gives a low level (O) output and vice versa.

If the probe (connected to point A) is touched to a high level voltage then NAND gate IC1a inverts this to give a low at point B which allows current to flow from the supply, through current limiting resistor R1 and LED segment e (lighting it).

When the probe is low, point B is high and at the same potential as the supply, so no current can flow through segment e.

The gates b and c invert the probe signal again and so when the probe is high, point C is low and point D high, extinguishing segments a, b and g. When the probe is low these three segments light.

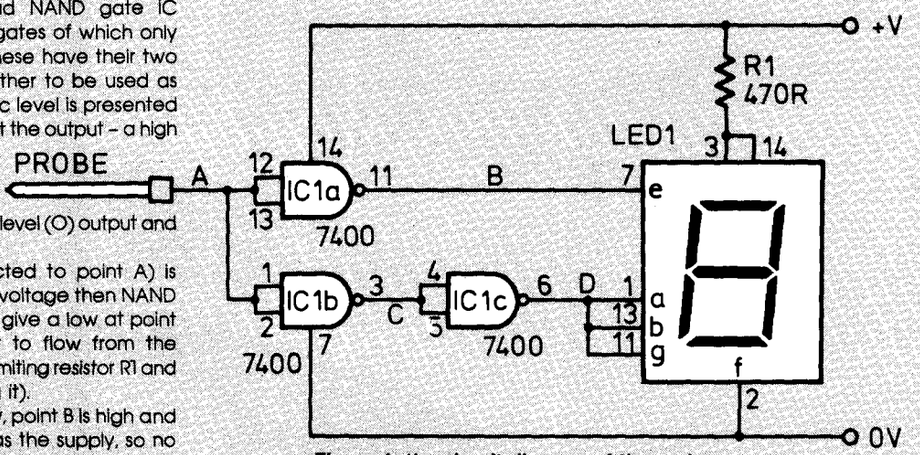


Figure 4: the circuit diagram of the probe.

Segment f is always lit and segments c, d and the decimal point are not used. The three possible segment patterns depend on the voltage at the probe tip (see Fig 1).

Errata

Errata to ETI – 1426 (Quarter wave loading speaker), published in December, 1988.

Some dimensions were missing from Figure 7. The bass driver should be 3 ¾ in above the base of the baffle panel. The notches in the side of the tweeter cut-out are ½ in wide. The top plate is missing from the cut-out diagram (Figure 6). This is 7 x 4 5/8 in.

Here is an erratum for the Printer Buffer project, Part 1, ETI February 1989. In the 'How It Works' section (page 110), third column, second paragraph, a line was omitted from the text. The paragraph should read:

The eight input data bits from the input port are latched on the rising edge of the STROBE signal from that port in a 74LS374 latch. The output enable for this latch is taken from the active low enable signal from the port selection section. The output lines of the latch go to the input lines of the dynamic RAMs. As only one of the enable signals is active at any time, this means that the dynamic RAMs always have the current data from the active port on their data in pins.

Also, according to Andrew Conway, the author of the article, the indentation of the pseudocode (page 112) is ambiguous. Anyone who wishes to have the correct indentation may write to him for a photocopy. We apologise for any confusion which may have arisen from these errors.

Write to: Andrew Conway, 10 Gilmore Rd, Doncaster, VIC 3108.

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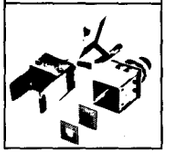

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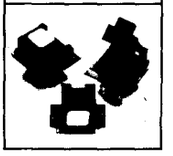
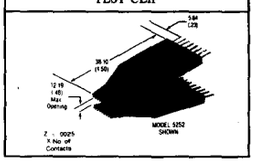


ADAPT-A-SOCKET

SMALL OUTLINE TEST CLIP



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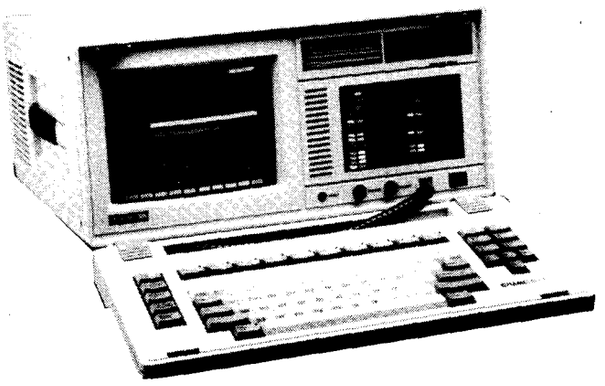

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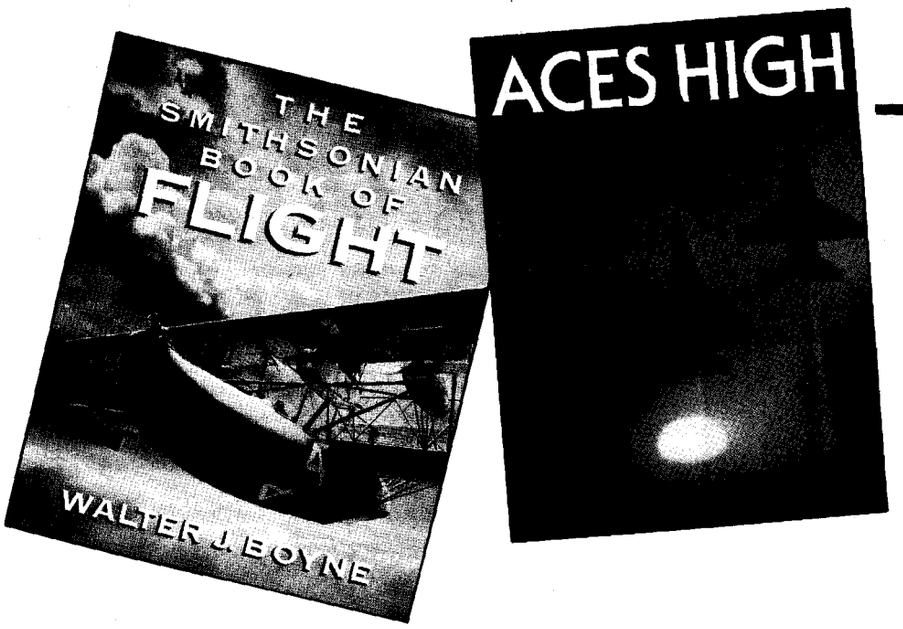

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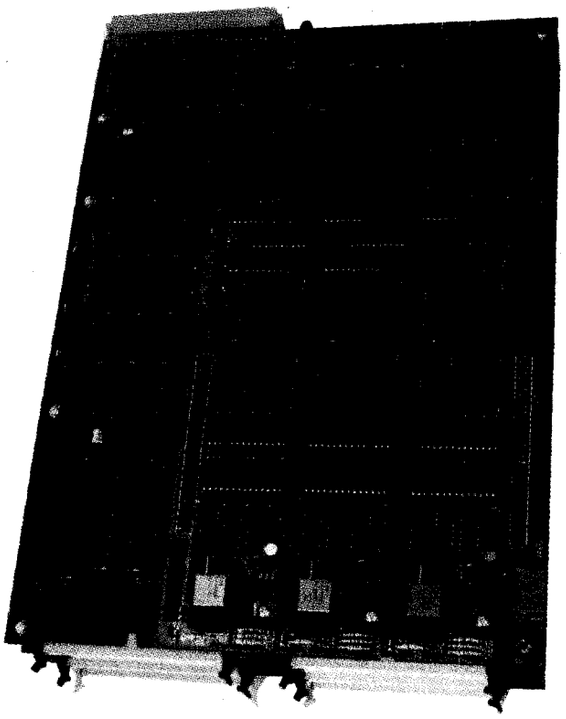

IPD image processing and display sub-system ▲

THE Arlunya manufacturing division of The Dindima Group Pty Ltd has released its IPD image processing and display sub-system.

The IPD is a flexible VMEbus compatible digital image processing and display sub-system designed for use in image processing systems or work-stations. It operates in conjunction with the main system computer to perform complex display funcitons on stored digital data.

The IPD facilitates "view-porting", i.e. multiple overlapping "views" to be displayed, and permits the fast separate processing of each view. Each view is assembled in an image memory plane from the data on the system mass memory.

Four image planes with analogue RGB output is the minimum configuration for this VMEbus compatible board set. One card provides timing and control circuits and the other, memory. A 'piggy back' module to the main board carries the look-up tables and high speed digital/analogue converters. Additional memory cards can be added, each providing four image planes.

The illustration shows an eight image plane version of the IPD with main board which carries an output board piggy-back and two image memory cards. The cards are mounted together with screws and spacers to form a three VME slot assembly.

Each image plane has a resolution of 512 x 512 pixels by 8 bits of intensity (256 grey levels) and an associated 256 byte memory mapped transfer function table. Individual transfer function tables (look-up tables) provide a unique mapping function specific to an image plane. Each image memory is dual-ported memory-mapped DRAM enabling rapid pixel access without on-screen disturbance.

For more information contact The Dindima Group, P.O. Box 104, Vermont, Vic, 3133.

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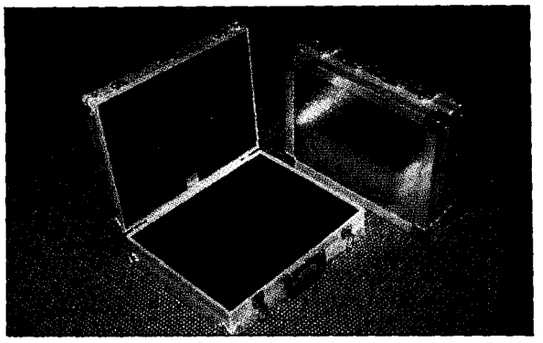

Technician's tools case ▲

A NEW full flight case from Meiko in the light weight Maxima series comes in an attache size 450 x 350 x 125mm and is available in a black ABS or aluminium top and bottom. Deeper units can be pre-ordered. The unit comes with 2 key latches, a nylon handle and heavy duty metal corners. Meiko uses a stayed hinge on each side, joined by a galvanised piano hinge for ultimate strength and longevity. The inside is upholstered with black vinyl and the tools pallet provides flexibility with both multiple pockets and elastic stays. Papers and documents can be stored behind the tools pallet. The unit sells for $199.00 including sales tax.

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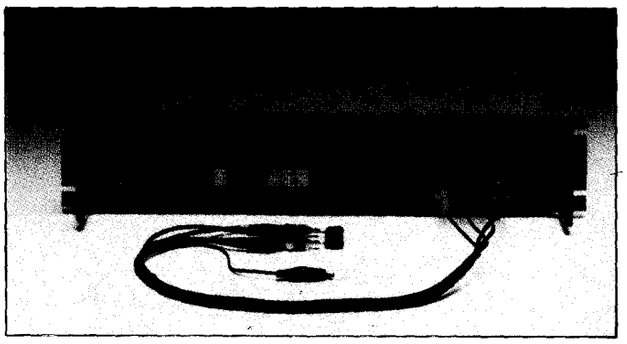

New rack mounting LCR bridge ▲

PRISM Electronics has annouced the addition of a rack mounting LCR bridge to its existing range of bench top instruments. The new 6458 is oriented to OEM and systems applications, occupies a 2U high slot in a 19 inch rack and is available with front or rear panel test connections.

The 6458 offers 0.1% measurement accuracy of L,C,R,D & Q at three test frequencies of 100Hz, 1kHz and 10kHz. Primarily intended for remote operation the instrument has full talk/listen facilities via both IEEE-488 and RS232 interfaces. For local operation all functions are controllable from the front panel and a full 5 digit high brightness display is included.

Standard features include 4 terminal measurements, 2 V dc bias for electrolytic capacitors and a ZERO C facility to offset stray capacitance in external test fixtures.

A wide range of accessories is available including component test leads with Kelvin clips or SMD tweezer style probes and menu driven software for logging and analysis of results on a PC.

More information contact Paramaters Pty Ltd on ☎ (02) 888 8777.

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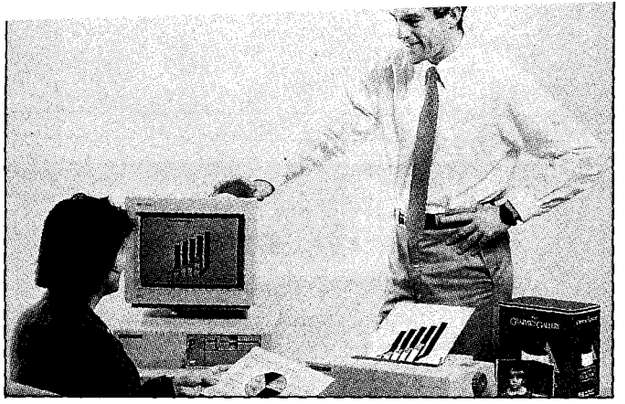

HP Paintjet colour-graphics printer ▲

HEWLETT-Packard's PaintJet colour-graphics printer now runs with AutoShade software from AutoDesk, Inc., says the company. AutoShade(tm) allows users to generate 3D shaded images when used with AutoCAD(tm), another AutoDesk PC-CAD software program.

"AutoCAD is the most extensively used PC-CAD software, and its support for the HP PaintJet colour-graphics printer makes the printer even more useful for mechanical and architectural design," says Robert Miles, PC marketing manager for HP Australia.

Mechanical engineers, architects and designers using AutoCAD software and the HP PaintJet colour-graphics printer now can produce low-cost, colour printing with lifelike, shaded images.

AutoDesk Inc. designed AutoCAD software to replace manual drafting and design for creating, editing, storing and exchanging drawings. Architectural and engineering firms, and other companies, use the software on a range of PCs, including the HP Vectra PC, IBM PC/XT/At and other compatibles.

The HP PaintJet colour-graphics printer produces vivid full colour text and graphics with 180 x 180 dots-per-inch resolution. The HP PaintJet printer uses thermal-inkjet technology to create near-letter-quality text at a speed of 167 characters per second.

For more information contact Gordon Williams on ☎ (03) 895 2644.

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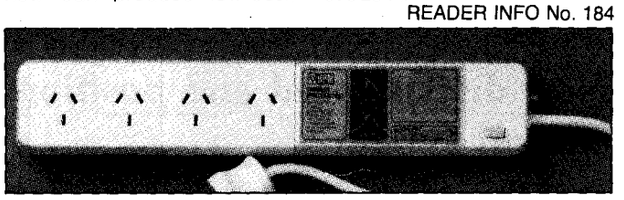

Power protector from HPM ▲

HPM'S NEW Power Protector (Cat. 105/PP/4) provides sophisticated defence against power surges and other damaging electrical disturbances, says the company.

Disturbances such as power surges, interference and overload come unexpectedly and are potentially destructive, but the Power Protector, which retails around $80.00, has a range of protection which assures clean power.

Power surges are frequently called transient surge spikes – "transient" because of their short duration, and "spikes" because of their appearance on an oscilloscope screen. The Power Protector clips these surge spikes, and consequently protects even microprocessors and other delicate circuitry.

The Power Protector also offers an in-built filter which reduces interference, and ensures the best performance possible for expensive appliances, and an overload switch which activates once an overload is detected.

For more information contact Anthony Pal, Marketing Services, HPM. ☎ (02) 361 9999.

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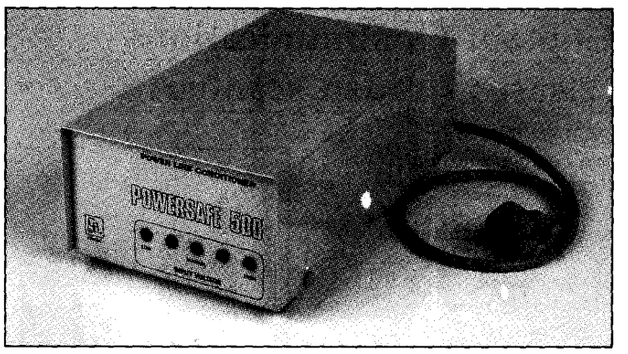


Safe power — Powersafe 500 ▲

THE humble 240 volt power outlet in some locations often carries as much as 280 volts and as little as 190 volts – seldom tolerated by much of today's electronic equipment which requires a clean well-regulated 240 V mains power supply to ensure operations reliability.

Component Resources has added the Powersafe 500 to its existing Powersafe 1000 and 2500 range, all of which include a built-in power line filter for protection against line transients.

The Powersafe 500 guarantees to maintain output voltage at 240 V ±5% over an input voltage range of 189-283 VAC.

READER INFO No. 186

DPX-222 full duplex modem ▲

THE DPX-222 is a multi-speed modem designed to provide a cost effective solution for high volume corporate applications such as point of sale data collection or credit verification.

Capable of operating at 300 bps, 1200 bps and 2400 bps, it supports the Hayes "AT" command set and is suitable for both local and international calling with Bell and CCITT compatability. Incorporated in the modem is anti-tinkle circuitry and tone dialing specific to New Zealand PSTN requirements.

Although primarily designed as a dial network modem, the DPX-222 can also be deployed in lease line mode. In this mode, should the lease line fail for any reason the DPX-222 will re-establish the data circuit by automatically dialing a pre-programmed number, minimising outage time.

An on line "help" facility, together with a comprehensive operating manual have been included to aid both the first time and experienced user to quickly become familiar with the modem.

Housed in a rugged metal case to provide electrical screening and noise immunity, the DPX-222 is approved by Telecom Australia for connection to its network. A rack mount version of the modem is available.

Fo more information contact Derek Whitehead on ☎ (03) 735 3333.

READER INFO No. 187

Captain Communications releases Uniden scanner ▼

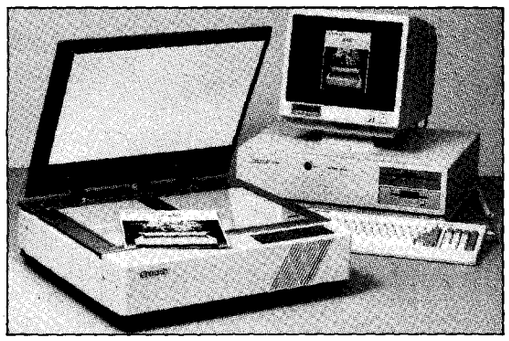
CAPTAIN Communications has released the latest in scanning technology from Uniden. The model UBC2OOXLT has 2OO channels and covers a wide range of frequencies, from 66MHz up to 956MHz, a first for a handheld scanner.

The scanner offers 1O priority channels, channel lockout, delay and search. The 2OO memory channels are split into 1O 2O-channel banks. All channels are programmed through the numeric keypad.

The UBC2OOXLT is supplied complete with a rechargeable ni-cad battery pack and charger. It provides up to 5 hours of dependable use. The scanner can also be run via the ac adaptor/charger, or from external 12 volt power where available. The frequencies stored in memory are protected from loss by a built-in capacitor which protects the memory for up to 3O minutes when replacing batteries.

For more information contact Captain Communications ☎ (O2) 633 4333.

READER INFO No. 188



Sharp gets a headstart with new colour scanners ▲

SHARP has released two desktop colour scanners for personal computers, allowing pc users to be able to freely manipulate and alter the colour or shape of photographics, designs, drawings, slides, or transparencies on the computer screen.

In addition, full colour images can be transmitted to other computers anywhere in the world via a modem.

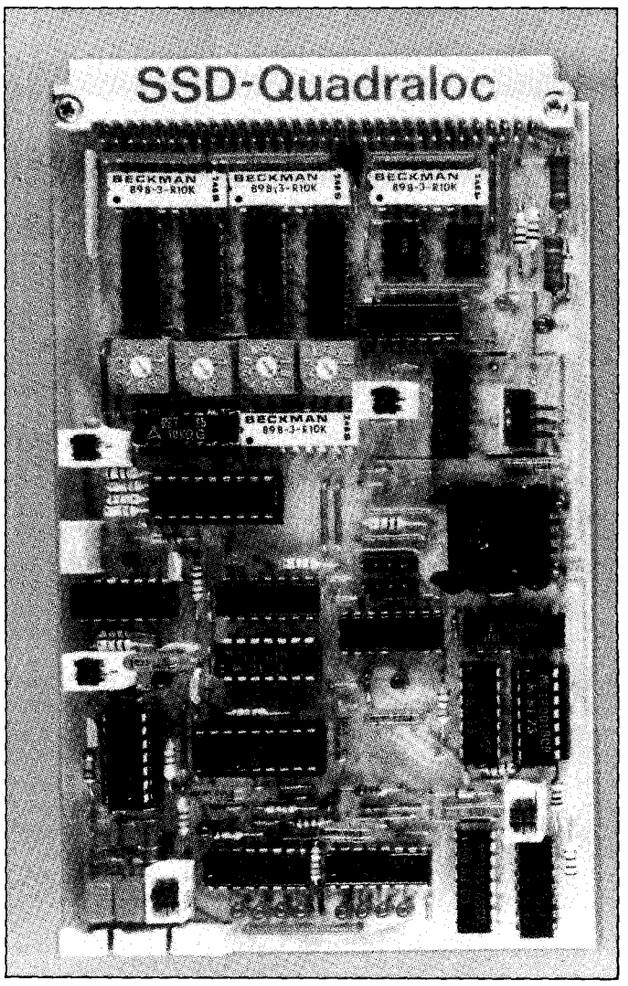
Sharp colour scanners provide colour resolution up to 3OO dots per inch with alternative resolutions adjustable to match a wide variety of applications. A colourpalette of over 26O,OOO tones will capture every nuance of colour.

There are two scanners available. The JX45O scans up to A3 size (17"x 11.5/8"); and the smaller, more economical JX3OO scans up to A4 size (8.5" x 11")

Both colour scanners are fully compatible with IBM PC and PS/2 and compatibles, plus many other systems.

More information from Tony Prince on ☎ 831 9111.

READER INFO No. 189



New digital speed and position control system ▲

THE SSD-Quadraloc 6OOOS digital speed and position control system has been released by Eurotherm International. The unit provides the electronic equivalent of an infinitely variable mechanical gearbox, which is able to maintain precisely the speed or position ratio or two driven shafts over a range of 1.9999:1 to O.OOO1:1.

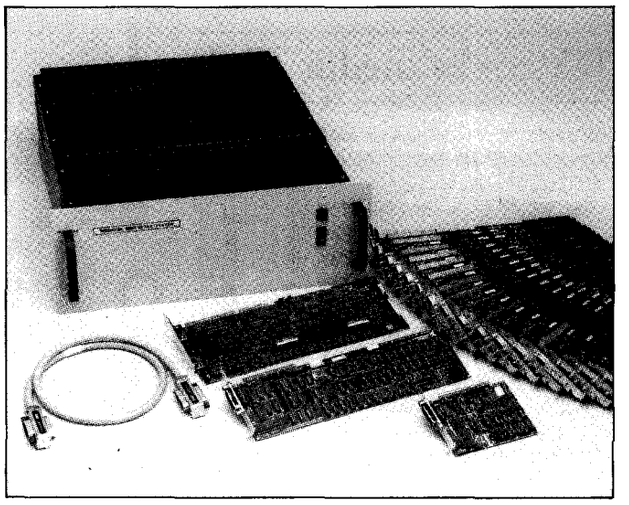
Long term speed holding is, for all intents and purposes, absolute. Traditionally, long term speed holding of variable speed drives has been attempted by means of analogue techniques. Such solutions tend to be susceptible to changes in temperature and voltage so that precise speed control is all but impossible to achieve – especially for any length of time. SSD-Quadraloc systems use pulse generators and high accuracy counting techniques to eliminate the effects of these parameters.

The 6OOOS control system is versatile enough to be specified for use in new equipment or to upgrade, substantially, existing drive systems. Used with the SSD range of DC drives, available with ratings to 3OO kW, the 6OOOS control can be supplied with serial interface unit allowing multi-shaft digital control from a host computer.

For more information contact Joe Mather on ☎ (O2) 477 7O22.

READER INFO No. 190

Camera system digitises 512 analogue waveforms simultaneously ▶



MUXO4 AND MUX16 multiplexers control up to 256 digitising camera systems for analogue waveform acquisition and storage.

Tektronix has a waveform and retrieval system that enables users to store up to 512 digitised waveforms from 256 digitising camera systems at once.

Tektronix's MUXO4 and MUX16 multiplexing systems, when used with Tektronix' digitising camera systems, provide low-cost, multiple-channel storage, especially for users who already own analogue oscilloscopes.

These systems store high-speed, single-shot waveforms up to 1 GHz, depending on the oscilloscope used. They can be used for testing in such applications as lasers, X-rays and high energy physics.

READER INFO No. 191

Data I/O multi programmer ▲

TECH-Rentals now has the Data I/O 288 multi programmer available for rental. This versatile programmer is capable of handling in excess of 500 different devices, including EPROMS, EEPROMS, PLCCs and microcontrollers from 16K to 1 megabit capacity.

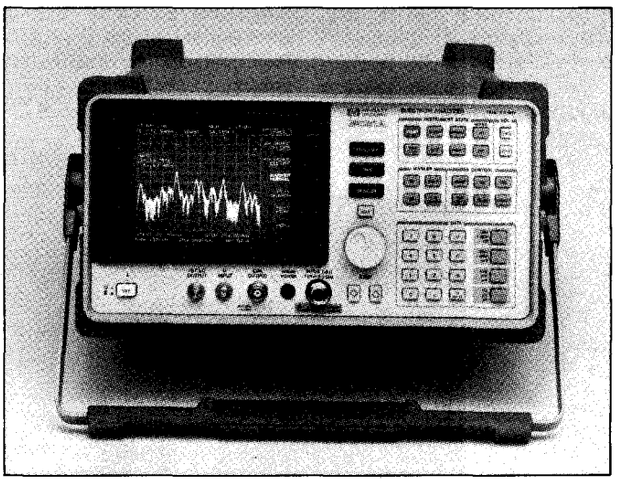
The 288 is of modular construction comprising a mainframe, containing all the necessary voltages and control functions, and a variety of plug-in modules to program differing devices. The MOD 32 module will program most 24 to 30 pin EPROMS and EEPROMS of NMOS and CMOS construction. Other modules are available to program 40 and 44 pin packaged microcontrollers, EPROMS and PLCCs. With 512K RAM as standard (optional 2 megabytes) and 288 can download virtually any size of file from a computer connected to the RS232 interface.

Local programming is achieved through the use of a 16 key pad and all commands are easily selected from menus displayed on the 32 character LCD display. The 288 can be used to simultaneously program up to 8 devices either as a gang or a set and features intelligent algorithms and electronic identifiers to speed selection and programming.

The 288 can be programmed remotely by either a personal computer or a terminal using the RS232 port and can translate up to 8 data formats at speeds from 100 to 19200 bps. The unit also performs a number of self diagnostics on both itself and the device under test to ensure programmability.

Further information, contact your nearest Tech-Rentals office.

READER INFO No. 192



HP 6.5GHz spectrum analyser ▲

THE new HP 8561A spectrum analyser from Hewlett-Packard extends high performance in its portable spectrum-analyser series.

By using solid-state electronic switching, the HP 8561A spectrum analyser is the first rf analyser to provide continuous sweep capability from 1 kHz to 6.5 GHz. Tracking preselection extends from 2.75 to 6.5 GHz, eliminating concerns about multiple responses or images when analysing high-frequency signals.

The HP 8561A is lightweight, easy-to-use and portable. In addition, it meets MIL-T-28800C requirements for temperature, pulse shock, and transit drop. The series, with a mean-time-between-failures rate of 10 years has proven to be extremely reliable.

Because several high-level functions have been included, the HP 8561A facilitates field-mission applications. One function measures occupied power bandwidth of a signal. A fast Fourier transform function measures amplitude modulation and distortion, as well as amplitude modulation in the presence of incidental phase-angle modulation.

For more information contact Gordon Williams on ☎(03) 895 2644.

READER INFO No. 193

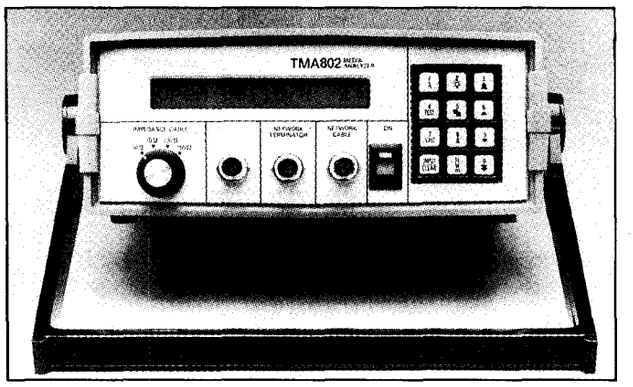
Tektronix media analyser

THE Tektronix TMA802A media analyser is available for rental from Tech-Rentals.

The TMA802A is designed for use with Local Area Networks (LANs) and provides the service engineer with information on shorts and open circuits along with the ability to monitor traffic levels and map networks. The instrument is non intrusive, battery operated and of rugged and lightweight construction.

In the Standalone mode the TMA802A provides information on the distance to short and open circuits on the network, using the built-in TDR circuitry. Status is displayed in plain English on the 16 character LCD readout.

The monitor mode gives a readout of the network's utilisation as a percentage of its maximum capacity and is independent of the vendor or Protocol used. The readings are averaged over intervals of 2 and 20 seconds or since last RESET.

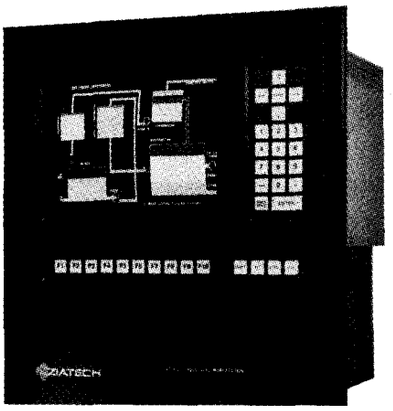


In the scope mode the TMA802 is operated in conjunction with a dual beam oscilloscope to provide detailed graphic information on fault conditions or in network mapping. Whilst designed for optimum performance with a TEKTRONIX 2225 oscilloscope it will function well with any unit with a minimum of 50MHz bandwidth.

The TMA802S is capable of testing co-ax or twisted pair LANs (impedance being selected by a four position switch) and is compatible with the entire family of IEEE 802 networks. Interfaces are currently available for Ethernet/Cheapernet and Map Broadband with Starlan and Token ring to follow shortly. All other functions and instructions are entered by the front panel 12 key keypad.

For further information on the TMA802A please contact your nearest Tech-Rentals office.

READER INFO No. 194



QA-50 computer projection panel from Sharp

SHARP has released the QA-50 computer projection panel offering high contrast display, versatility and reliability. The system is lightweight, portable and user-friendly.

Features include:

- Advanced DST (double super twisted) LCD as well as full 640 x 480 dot display,
- Compatibility with the VGA (Video Graphics Array) and MCGA (MultiColour Graphics Array) in IBM's PS/2 family of computers, as well as the CGA (Colour Graphics Adaptor) and EGA (Enhanced Graphics Adaptor) in IBM PC/XT/AT computers and compatibles,
- Eight-level shading function,
- Wireless remote control unit (optional).

Built-in EEPROM holds all important set-up adjustments in memory even when the power is turned off.

More information from Tony Prince on ☎ 831 9111.

READER INFO No. 195

NEMA interface DOS workstation

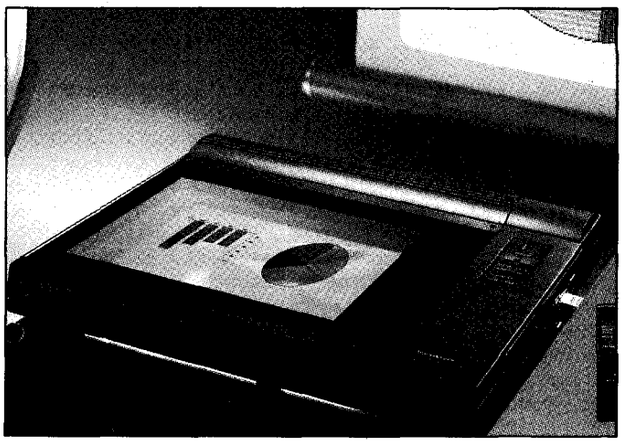
THE ZT1000, from Current Solutions, is designed for computerised machine and process control, and features watertight seals and PC/XT/AT compatibility.

The front panel is constructed from half-inch aluminium with numeric and function keypads. A choice of monochrome or EGA monitors is available together with floppy and hard disks if required.

The ZT1000 is designed to run PC DOS 3.3 plus users' application programs out of EPROM or NOVRAM should the environment be unsuitable for rotating disk media. Space is provisioned for I/O boards.

Software packages such as The Fix can be supplied with the industrial workstation for applications requiring a turn-key solution. For further information, contact Current Solutions on (03) 720 3298.

READER INFO No. 196



IWATSU

NEW

500MHz SS-6521
PORTABLE ANALOGUE OSCILLOSCOPE

3-input, 3-trace
DC to 500 MHz

GP-IB

Iwatsu's new SS-6521 portable oscilloscope features the wide bandwidth of DC to 500 MHz. Operations are driven by guide menus, while setups – CH1/CH2 deflection factors, A/B sweep rates, etc. – and the results of cursor measurements – time and voltage differences and ratios, etc. – are displayed digitally on the screen together with comments. Up to ten setups can be held in memory. Double-Speed-Control keys allow fast or slow adjustment of the cursors, trigger level, delay time, etc. While pressing their centers resets to the standard values and full remote control is possible using GP-IB or RS232C connection, the SS-6521 will progress your measurement.

- **CRT readout with user defined comment mode**
- **Cursor simultaneous measurement**
- **Recall or save 10 front panel setup**
- **Easy-to-use *guide* menu system**
- **Fully programable over GP-IB or RS232C interfaces**
- **700 MHz triggerable bandwidth**
- **Auto trig level triggering**
- **Dual-speed-control keys**
- **Dual delay function**
- **Bright CRT using box lens technology**

IWATSU

NILSEN INSTRUMENTS

NILSEN INSTRUMENTS PTY. LTD.
200 Berkeley Street, Carlton, Vic. 3053.
Ph (03) 347 9166 Fax (03) 347 3919

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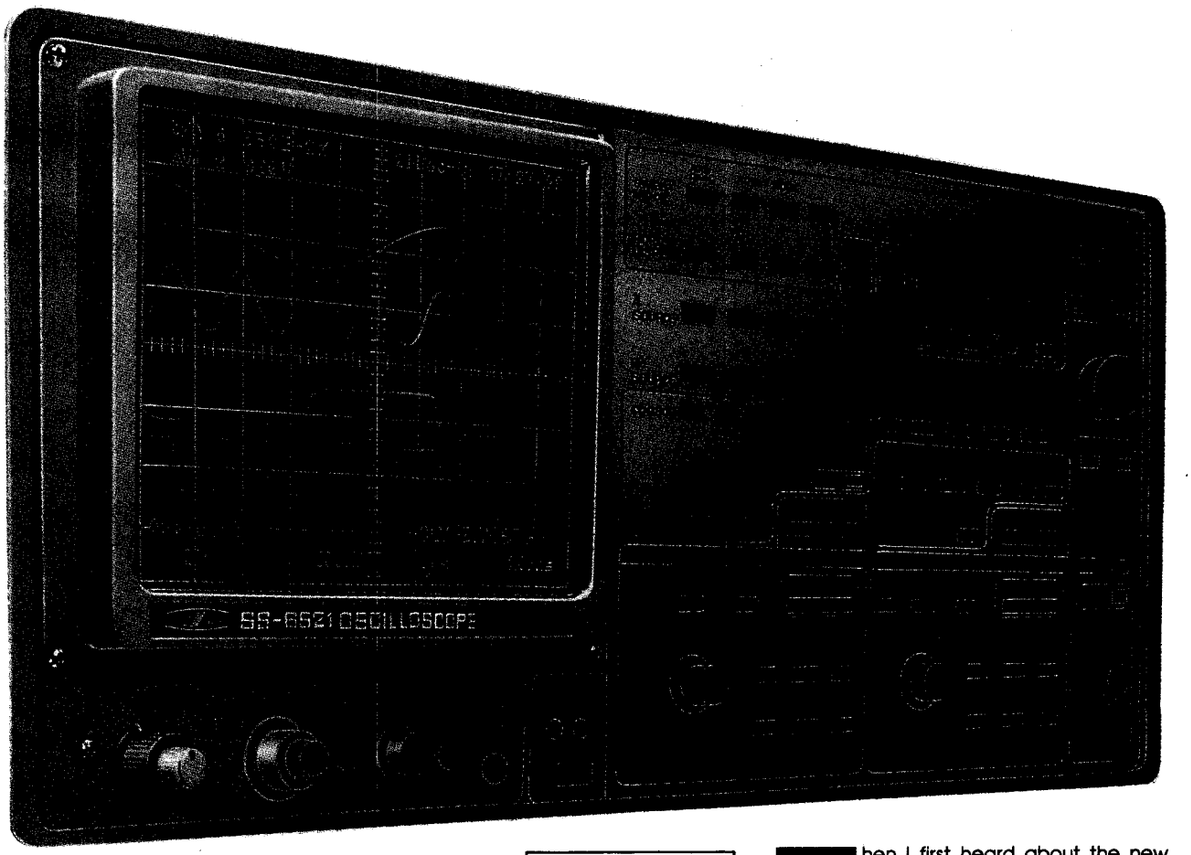


INSTRUMENTATION

IWATSU HAS A WINNER

But shh, don't tell the Russians!

Jon Fairall looks at a new 500 MHz analogue oscilloscope from Iwatsu.

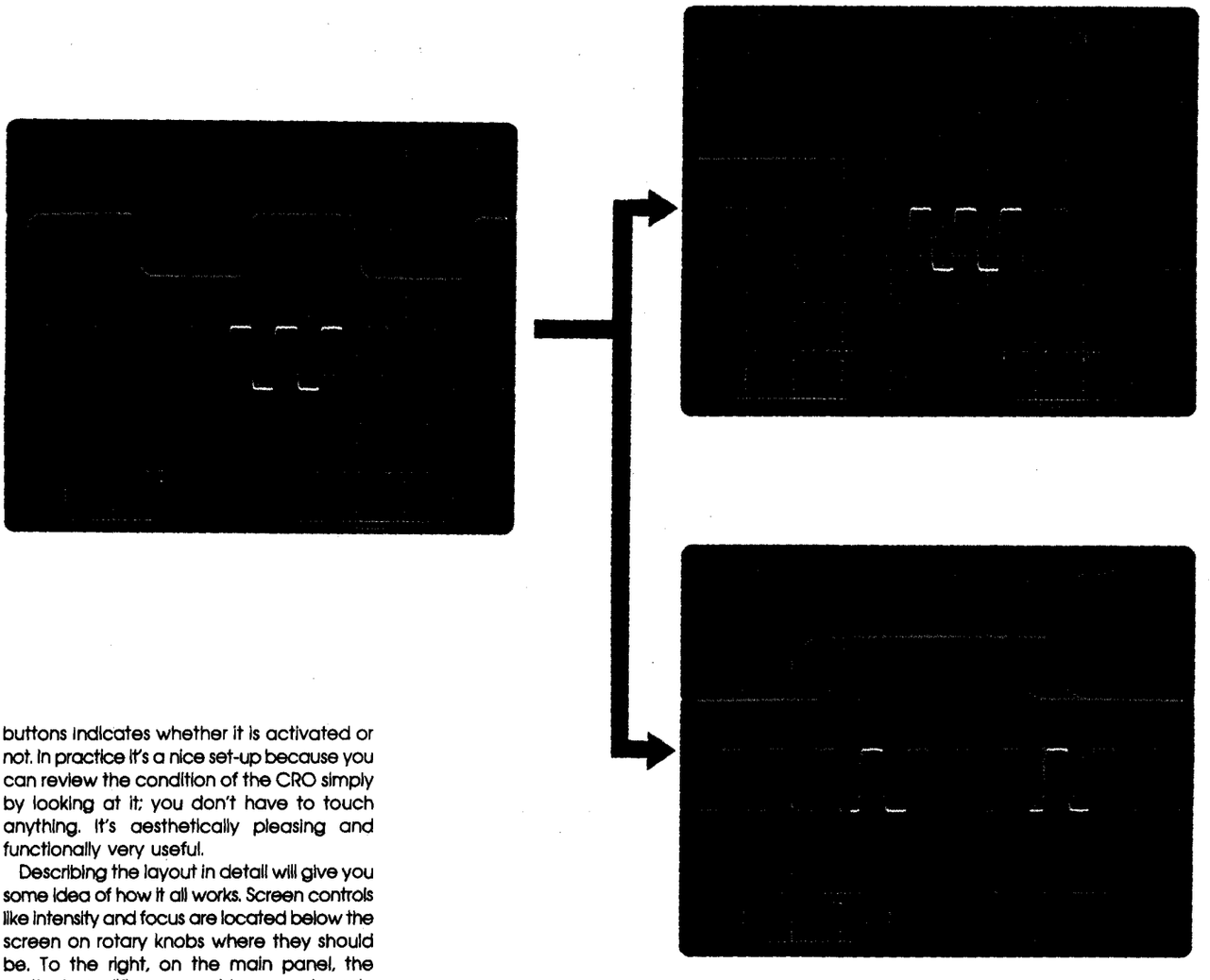
When I first heard about the new Iwatsu product, the SS6521, I was intrigued, not only by the specifications, which are impressive given the size of the product and its price, but also by a solemn warning from the distributors that the product is covered by CoCom rules, and would I please not tell the Russians about it. So, any ETI readers of a vaguely pinkish hue, please stop reading now.

For the rest of you, right-wingers all, I can report that the new Iwatsu really is quite a machine. It has some remarkably sophisticated functions, with outstanding performance married to extreme operational simplicity. Without reading the manual, it's quite possible to take control of most of the standard functions, which operate in a conventional way.

The front panel

The first thing one notices about the SS6521, is that it has a lot of buttons. Not for Iwatsu the impassive, blank, front panel common on many contemporary US-designed CROs. Here, every function is clearly marked with its own button. This could make for horrible confusion, but they are grouped together in a simple, colour-coded, logical fashion to make sorting it all out quite straightforward.

There are two types of switches: the rockers, which are used in place of rotary knobs, and push buttons. The position of the rockers is spelt out in alphanumerics on the CRT. A small light above each of the push



buttons indicates whether it is activated or not. In practice it's a nice set-up because you can review the condition of the CRO simply by looking at it; you don't have to touch anything. It's aesthetically pleasing and functionally very useful.

Describing the layout in detail will give you some idea of how it all works. Screen controls like intensity and focus are located below the screen on rotary knobs where they should be. To the right, on the main panel, the vertical amplifier, cursor, trigger and mode controls are all divided into separate boxes

'The first thing one notices about the SS6521 is that it has a lot of buttons'

picked out in pastel shades.

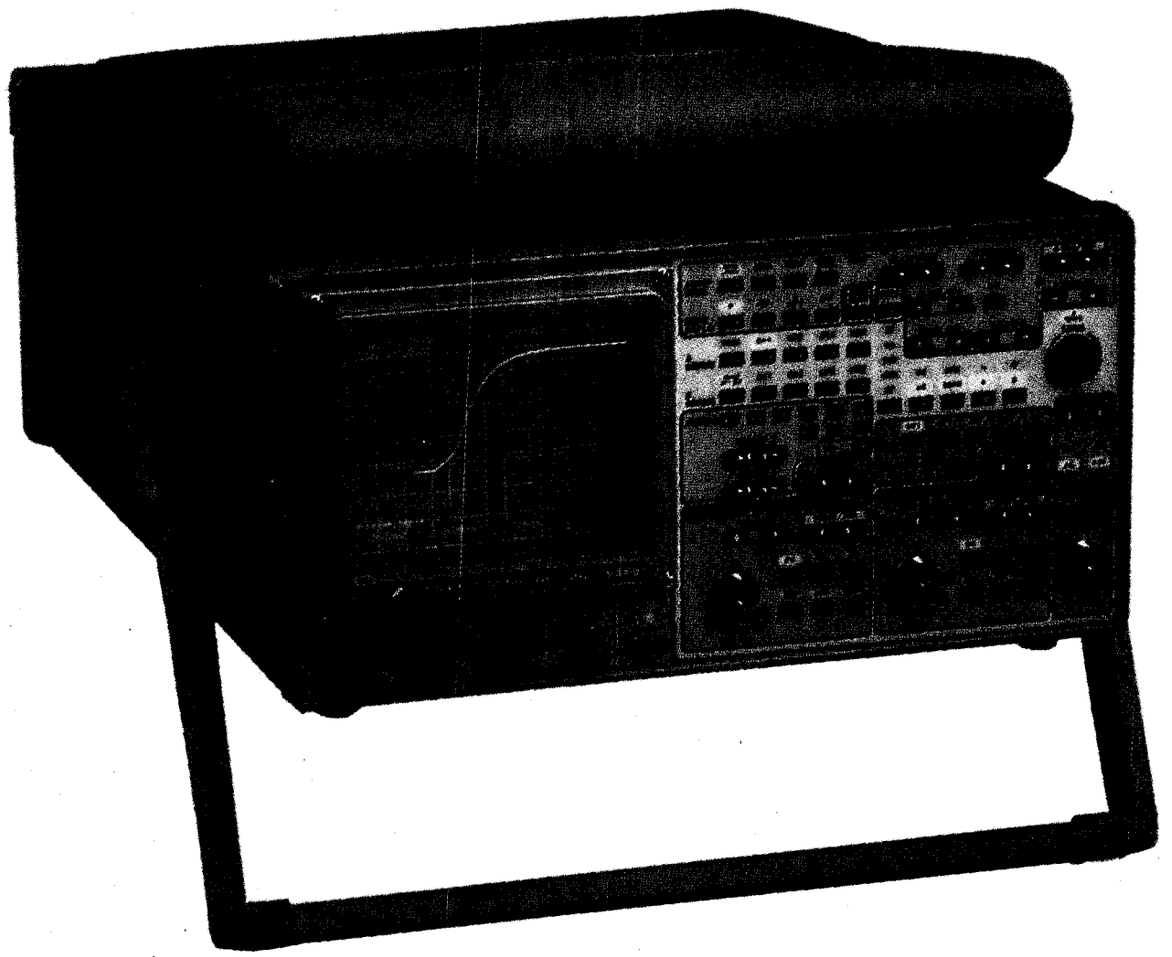
The two vertical amplifiers are boxed together around the BNC connectors for the leads. Attenuation is controlled by a rocker switch, and the setting, from the usual 5 mV to 5 V/div, read on the screen.

There is a third vertical amplifier next to these two. At first, I thought this was the usual Z axis input, but on closer inspection it turns out to be an extra channel. However, the amplifier only has a choice of 1 Mohm input, and thus a 350 MHz bandwidth. The other two are switchable from 50 ohm to 1 M, and have a 500 MHz bandwidth in the 50 ohm position.

Above the Channel 1 box, all the cursor controls are grouped together. Cursors can be used to measure delta V, V, dB (i.e.: logarithmic), delta t, t, and frequency. The type of cursor is selected by a button and the position adjusted on a rocker switch. Personally, I find cursors an overrated facility, with the exception of being able to do frequency measurements without recourse to a calculator – but if you need them, you will be impressed by the ease with which the Iwatsu makes it work.

To the right, there is a small panel to set up the vertical mode. It is absolutely standard, and includes a bandwidth limiter to cut bandwidth to 20 M. The trigger controls are above this, and are also pleasing in their normality. The only exception is a multi level HF reject capability, which allows you to choose 10 k, 20 M, 100 M or hf (presumably 500 M). The trig level is set on

Functions such as delay sweep magnification (top right) and dual delay (lower right) have been added to the ordinary delay function (left) for greater convenience in waveform observation and analysis.



'It's easy to forget, when going over the 6521, just how advanced a device it is'

a rotary pot which seems a little out of place.

At the top of the panel, a group of functions allow the creation of delayed and expanded sections of the main sweep. When the expanded sweep is in use, the portion of the main trace being examined is brightened, so you know where you are at all times. There are also facilities for single shot, normal and automatic sweep modes.

Finally, there are two buttons in the centre. One allows control from either the front panel, or from a remote site via RS232 or GPIB. The second allows access to a succession of 'guide menus', that allow you to alter the machine in certain ways. For instance, you can set up a default setting that can be summoned at will, put comments on a screen, which would be extremely useful if you were into screen photography, or adjust the time delay on Channel 2 in 5 pico second steps, so that it exactly coincides with Channel 1 on the screen.

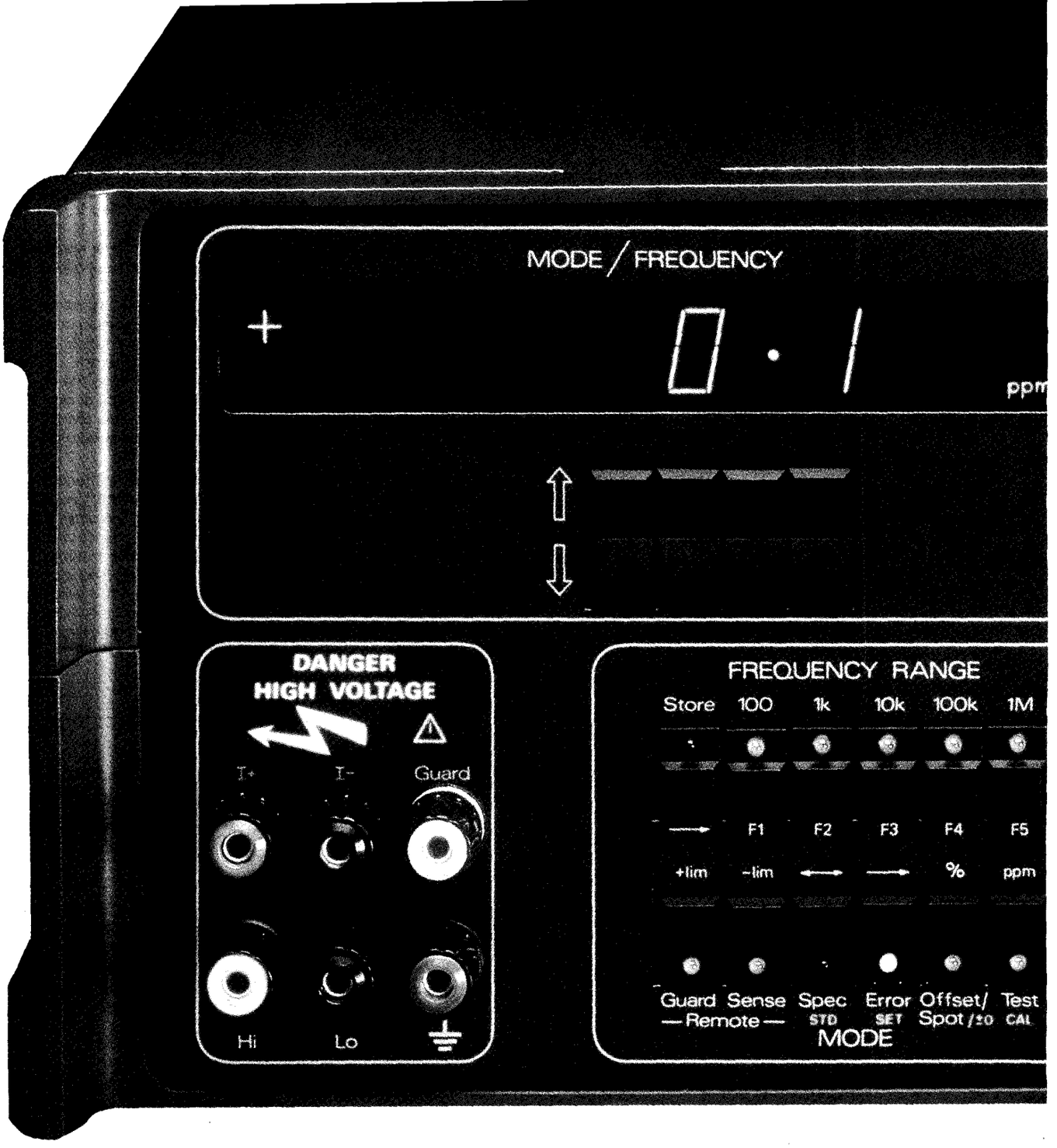
The technology

It's easy to forget, when going over the 6521, just how advanced a device it is, but the ability to do such small yet significant time adjustments puts it back into focus. Although much the same size, weight and appearance as most other CROs, its bandwidth is exceeded by perhaps only three or four. Iwatsu is not keen to discuss its techniques too closely, but the vertical amplifiers use thin film hybrids with tantalum nitride resistive elements and GaAs FETs mounted on glass substrates, to do the donkey work. The trigger circuits, a major problem at this speed, are controlled from a custom IC using Emitter Coupled Logic.

Much of the performance is due to the tube. It has a 150 mm front end and uses an accelerating voltage of 20 kV. Although this is reasonably high, it is not enough to deal with the very fast writing speeds required here. Iwatsu has developed a new meshless lens with a claimed electron beam transmittance of 100%. This gives something like a 50% increase in efficiency over conventional tubes. It also has a new phosphor coating on the front of the screen to cope with the phosphor burning that would otherwise result from such high transmittance.

The SS6521 is good value at $23,887, excluding sales tax. For more information, contact Nilsen Instruments on (02) 649 3222.

eti



INSTRUMENTATION

DATRON'S 4708 CALIBRATOR

Les Cardilini checks it out.

FUNCTION	RANGE	FREQUENCY (Hz)	UNCERTAINTY ±(ppm Output + Floor)		
			24 Hour Relative to Cal Standards 23°C±1°C [1]	1 Year Total Uncertainty 23°C±5°C [2]	1 Year Spot Calibrated Total Uncertainty 23°C±5°C [2]
DC VOLTAGE [3]	100.00µV to 100.00000mV		2 + 0.4µV	12 + 0.5µV	
	1.0000000V		1 + 0.8µV	8 + 1µV	
	10.000000V		0.5 + 3µV	4.5 + 3µV	
	100.00000V		1 + 50µV	8 + 50µV	
	1000.0000V		1 + 500µV	10 + 500µV	
AC VOLTAGE [6]	1.0000mV to 100.0000mV	10-31	90 + 5µV	140 + 6µV	120 + 6µV
		32-330	50 + 5µV	100 + 6µV	80 + 6µV
		300-10K	40 + 5µV	90 + 6µV	70 + 6µV
		10k-33k	50 + 5µV	240 + 6µV	220 + 6µV
		30k-100k	200 + 5µV	750 + 6µV	530 + 6µV
		100k-330k	550 + 10µV [4]	1450 + 11µV [4]	800 + 6µV
		300k-1M	1250 + 22µV [5]	2450 + 23µV [5]	1450 + 6µV
	1.000000V	10-31	60 + 30µV	110 + 30µV	100
		32-330	30 + 20µV	70 + 20µV	50
		300-33k	20 + 10µV	60 + 10µV	40
		30k-100k	50 + 20µV	130 + 20µV	100
		100k-330k	150 + 100µV	350 + 100µV	250
		300k-1M	900 + 400µV	1800 + 400µV	1300
	10.00000V	10-31	60 + 300µV	110 + 300µV	100
		32-330	30 + 200µV	70 + 200µV	50
		300-33k	20 + 100µV	60 + 100µV	50
		30k-100k	50 + 200µV	130 + 200µV	100
		100k-330k	150 + 1mV	350 + 1mV	250
		300k-1M	900 + 4mV	1800 + 4mV	1300
	100.0000V	10-31	70 + 3mV	120 + 3mV	100
		32-330	40 + 2mV	80 + 2mV	60
		300-10k	30 + 1mV	70 + 1mV	60
		10k-33k	40 + 2mV	80 + 2mV	60
		30k-100k	70 + 3mV	170 + 3mV	130
		100k-200k	250 + 10mV	600 + 10mV	400
	1000.000V	45-330	110 + 20mV	170 + 20mV	160
		300-10k	70 + 20mV	130 + 20mV	120
		10k-33k	110 + 20mV	190 + 20mV	170
		30k-100k [7]	650 + 40mV	1050 + 40mV	250
RESISTANCE	10Ω		4	35	
	100Ω & 1kΩ		1.5	14	
	10kΩ		1.5	13	
	100kΩ		1.5	22	
	1MΩ		4	42	
	10MΩ		10	67	
	100MΩ		15	270	
DC CURRENT [9]	100.0000µA		10 + 2nA	109 + 2nA	
	1.000000mA		5 + 10nA	49 + 10nA	
	10.00000mA		5 + 100nA	49 + 100nA	
	100.0000mA		5 + 1µA	49 + 1µA	
	1.000000A		10 + 20µA	121 + 20µA	
	10.00000A [8]		30 + 500µA	150 + 500µA	
AC CURRENT [9]	100.0000µA	10-1k	160 + 6nA	700 + 16nA	450
		1k-5k	200 + 10nA	1150 + 20nA	800
	1.000000mA	10-1k	100 + 60nA	450 + 160nA	320
		1k-5k	150 + 60nA	550 + 160nA	320
	10.00000mA	10-1k	100 + 0.6µA	450 + 1.6µA	320
		1k-5k	150 + 0.6µA	550 + 1.6µA	320
	100.0000mA	10-1k	100 + 6µA	450 + 16µA	320
		1k-5k	150 + 6µA	550 + 16µA	320
	1.000000A	10-1k	400 + 60µA	600 + 160µA	350
		1k-5k	550 + 100µA	850 + 200µA	500
	10.00000A [8]	10-1k	220 + 1.4mA	520 + 1.5mA	480
		1k-5k	670 + 1.5mA	1100 + 1.7mA	770
		5k-20k	5000 + 25mA	8000 + 30mA	5000

▲
Specifications ▶

The least significant digits (LSDs) in the displays on digital multimeters (DMMs) might not seem important in magnitude of volts, amperes and ohms but they certainly can appear large in terms of dollars, to the purchaser.

Generally, if you need better resolution in test and measuring gear you have to pay for it.

But perhaps more importantly, instruments and systems that have, say, seven-and-a-half and eight-and-a-half digit resolution, can only be as reliably accurate as their calibration permits them to be. There is little to be gained by having eight or nine digits in an instrument display if the reading can only be guaranteed to be accurate to the third or fourth digit.

For example, it is frequently necessary to follow closely the adjustment procedures outlined in technical data, in order to confidently optimise the performance and safety of electrical and electronic systems. Unless the resolution of instruments used to observe critical test and measurement parameters in the field and in the laboratory is accurate to the required degree, however, then it would be reasonable to question the results obtained using them.

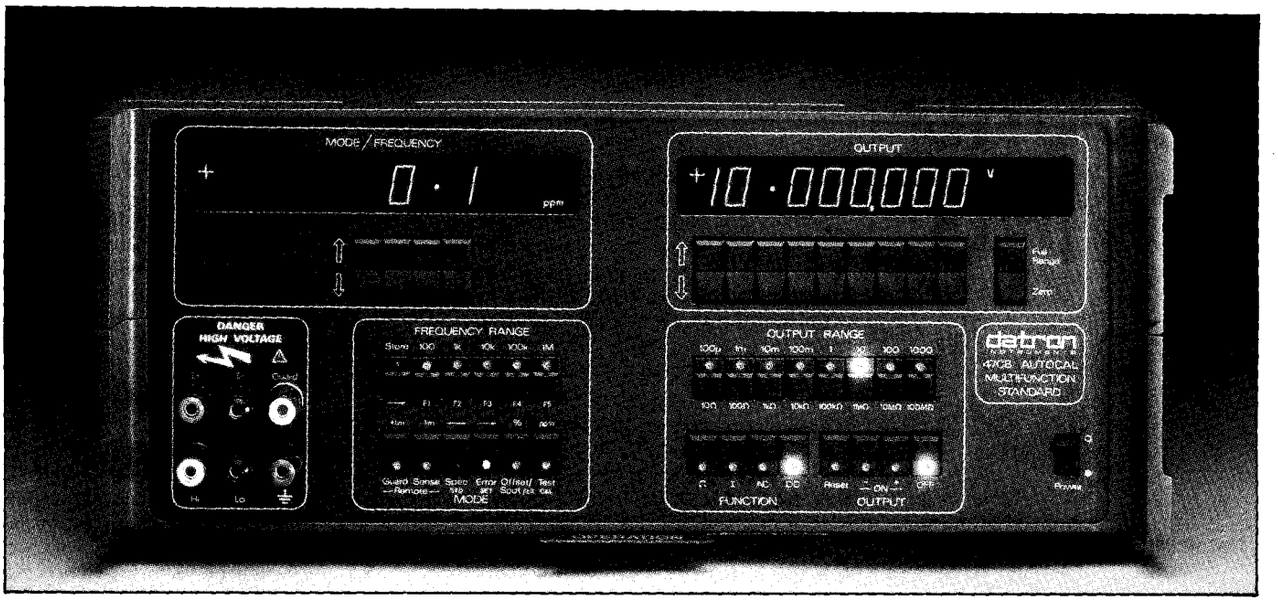
"Generally, if you need better resolution you have to pay for it"

In repeated use an instrument such as a multimeter might have to be checked or re-calibrated quite regularly, depending on the demands of an application.

But who calibrates the calibrator? In the case of the Datron Model 4708 Autocal Multifunction Standard the instrument calibrates itself.

The 4708 comes in its basic form as a mainframe unit to which dc voltage, ac voltage, resistance and current options may be configured in various combinations. For example,

GENERAL	
POWER	100/120/220/240V±10%, 50Hz or 60Hz, 370VA (660VA Max).
OPERATING TEMPERATURE	0°C to +50°C.
STORAGE TEMPERATURE	−40°C to +70°C.
DIMENSIONS (H × W × D)	178mm × 455mm × 563mm (7" × 17.9" × 22.2").
WEIGHT	36kg (80lbs).
SAFETY	Designed to UL1244, IEC348, BS4743.
WARRANTY	1 year.



The Datron 4708 Autocal Multifunction Standard calibrator — it calibrates itself.

the mainframe might be set up initially with either the dc voltage option, the ac voltage option or both. The 4708 can also be rack mounted using the kit from the range of options and accessories available and the unit is made fully multifunctional by adding the ohms and current (to 2 amperes) calibrating option.

The options can be retrofitted at a later time if needed, thus affording the opportunity to update, rather than have to replace the equipment as requirements demand or if budget constraints are a major consideration at the time of initial ordering.

An IEEE-488 interface, a standard feature on every 4708, transforms the unit from a bench top calibrator into a computer-controllable systems instrument. Together with this facility, the ability of the 4708 to operate in an uncontrolled temperature environment and the fact that the convenient single set of analogue output terminals is totally isolated when the set is in the OFF state, means that the 4708 can be put to work in many different automated areas, without having to worry about reduced performance or the need to compromise test specification requirements.

The master reference in the Model 4708 is established by an array of zener diodes which is claimed to be three times as stable as a single zener, in the short-to-medium term. Having a near zero temperature coefficient is a major criterion in the selection of resistors and diodes for the master reference, and zener current in the reference circuit is further adjusted individually for zero temperature coefficient at the time of manufacture.

In the 4708 calibrator, dc voltages with exceptionally low noise and linear to within 0.1 parts per million (1 part in 10 million) of full scale for the life of the instrument are generated from the basic reference voltage, using pulse width modulation techniques. The six dc output voltage ranges extend from 100.00 microvolts to 1000.0000 volts.

The voltage calibrator outputs are controlled by a totally electronic, true RMS

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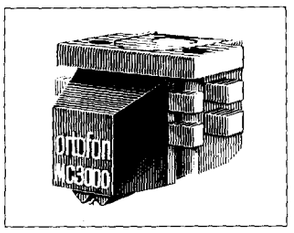

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ac/dc transfer process which has a wider dynamic range and a faster and totally predictable settling time, compared with traditional thermal transfer methods. Datron Instruments points out that this feature not only facilitates faster manual measurements but also greatly simplifies the generation of software when the 4708 is used in a computer controlled system.

The 4700 or voltage calibrator option has five output voltage ranges between 1.0000 millivolt and 1000.000 volts and the frequency is continuously variable from 10 Hz to 1 MHz, depending on the voltage range selected. The 1000 volts output range in the ac voltage option means that the instrument is able to supply high voltages without having to use an external booster amplifier, even at high frequencies.

In the resistance and current standards option a voltage to current converter which is driven from the dc voltage and ac voltage sections of instrument is used to generate fully floating, direct currents and RMS alternating currents, up to 2 amperes. The current output can be extended to effectively provide the calibrator with an 11 amperes dc, or RMS ac capability, using the Datron Autocal Transconductance Amplifier Model 4600, with which the 4708 Autocal Multifunction Standard is "slave mode compatible".

"Offset and gain errors may be introduced"

Five current range settings in each mode of operation, dc and ac, in the 4708, extend from 100.0000 microamperes to 1.00000 ampere. The sixth range to 10.00000 amperes is provided by the 4600.

The ohms option offers resistance from 10 ohms to 100 megaohms, in seven ranges.

Automatic calibration is effected by adjusting for analogue errors measured at the time the particular instrument is calibrated. The method uses only front panel operations or the equivalent IEEE-488 interface commands if under software control. The technique called Autocal was pioneered by Datron and stores digital corrections which are continually applied when the instrument is in use.

Confidence in the integrity of a calibration of different parameters at whatever level, of course, depends on the user being able to trace or verify the string of external standards by which equipment is calibrated. Tracing back to their source the external standards by which calibration is verified might be likened to tracing a pedigree or a person's lineage. Traceability for the 4708 Autocal Multifunction Standard extends back to the National Physical Laboratory in the United Kingdom.

The front panel on the 4708 Autocal Multifunction Standard is tidy and easy to read. Frequency and output are displayed, each in a panel, above a dual row of UP-DOWN keys which rapidly roll the respective digits to the required value. Alternatively, two further keys may be used for immediate selection of ZERO and FULL RANGE (for example 0.1, 1, 10 and so on), two points commonly used in the calibration of DMMs. Clearly labelled range and function keys also illuminate when the respective range or function is activated.

Offset and gain errors may be introduced in order to check the offset gain and linearity of DMMs and makes the job simple and straightforward, according to Datron.

The need for lengthy calculations on likely uncertainties in readings on the calibrator are eliminated by Datron's patented spec readout function in the 4708. A ROM-based lookup table stores the specification for every range of every function in the instrument and under microprocessor control the relevant uncertainty in the output is automatically calculated and displayed. Datron literature quotes total 1 year, plus/minus 5 degrees Celsius uncertainties to better than 4.7 ppm (dc volts) and 40 ppm (ac volts).

Output terminals on the 4708 Autocal Multifunction Standard are grouped together and safety terminals guard against accidental contact with "hot" parts. In fact, safety is taken even further in that to obtain an output of any potentially hazardous voltage requires a predetermined sequence of keystrokes. As well, an audible alarm sounds to remind the user of potential danger from high voltage. The warning alarm continues to sound whenever high voltages are present at the output.

Further information about the Datron 4708 Autocal Multifunction Standard and associated options and accessories may be obtained from the Australian Distributors, Scientific Devices Australia, with offices in Victoria, New South Wales and South Australia. eti

Les Cardilini is a lecturer at RMIT and a regular contributor to magazines and journals.

Accuracy, Modularity, Price...
spec by spec the 4708 is right on target!

The World's Most Accurate Multi-Function Calibrator

datron INSTRUMENTS
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With total 1 year ±5° accuracies to 4.7ppm DCV and 40ppm ACV, the 4708 Multifunction Standard from Datron Instruments is the world's most advanced programmable calibrator.

As instrument manufacturers push calibration requirements ever higher, the unrivalled levels of performance and capability the 4708 provides, ensures that your calibration investment today will be viable in the future.

If your current requirements do not include all functions, the 4708 can be supplied in DCV only, ACV only, or DCV and ACV configurations; the addition of the Resistance and Current option makes the unit fully multifunctional. IEEE-488 is fitted as standard and, of course, any option can be retrofited as required.

The 4708 features a cost effective built-in wide bandwidth 1000V amplifier with a capability of supplying 1000V at 33kHz or 750V at 100kHz. This enables the wide range of hand held, bench or systems DMMs requiring calibration at high voltage and high frequency to be handled without extra equipment cost. Full compatibility with Datron's high current calibration products and calibration software gives the 4708 even greater flexibility.

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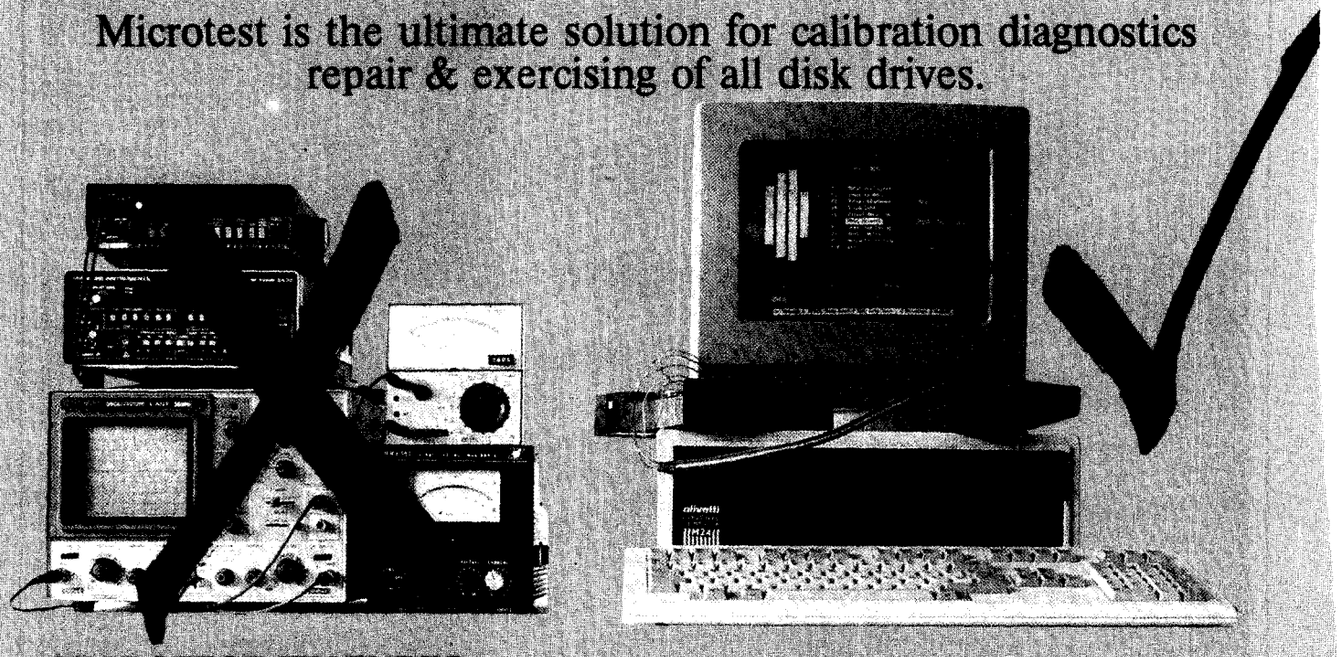

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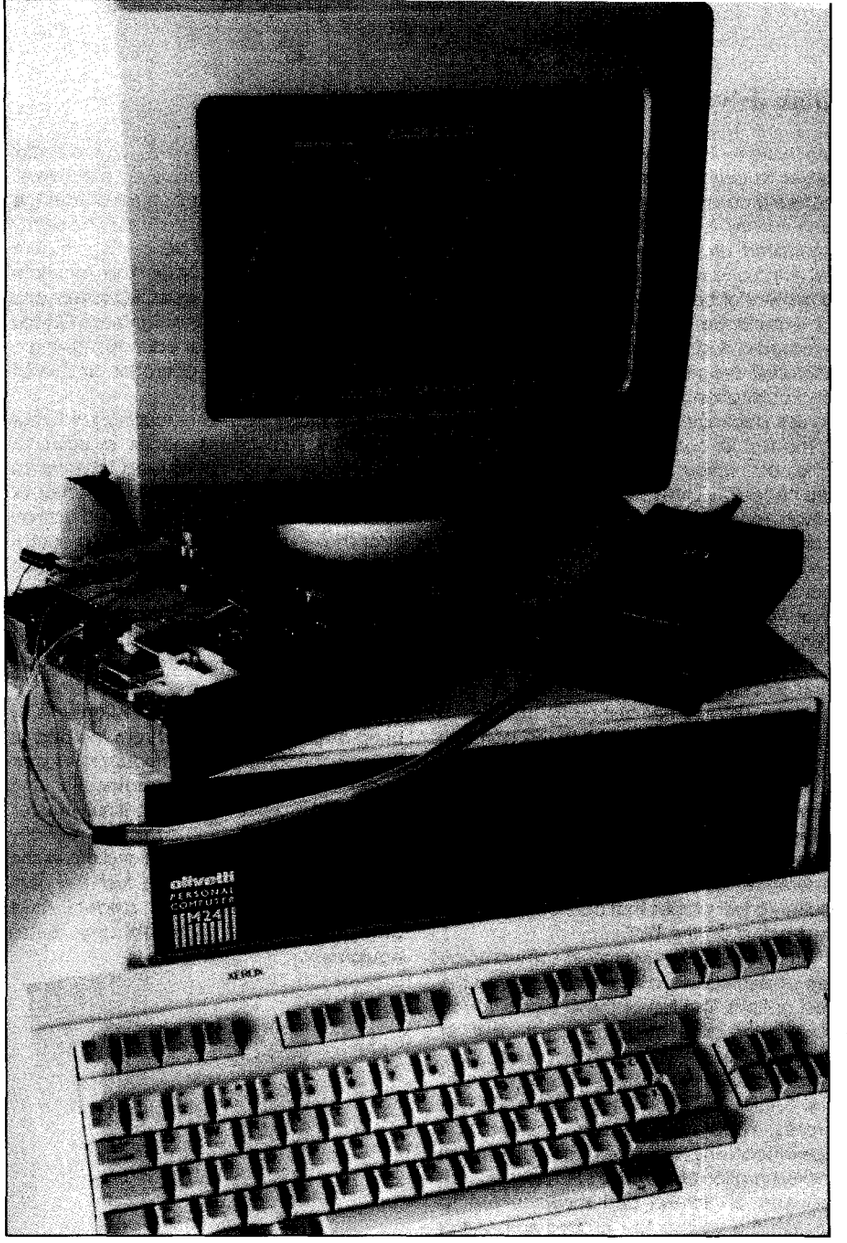
INSTRUMENTATION



MICROTEST DISK DRIVE TESTER

ETI's Jonathan Powers checks it out.

The use of PCs in offices and industry is becoming more widespread by the day. Word processing, data acquisition, automated testing, accounting and many more areas rely heavily on PCs and are areas where being able to store and retrieve data reliably is of the utmost importance.

Integral to achieving this reliability is the correct operation and alignment of the PC's disk drives. Floppy disks are the most popular and widespread way of storing data in non-mainframe systems. Even where hard disks provide the primary storage, floppies serve an invaluable role as backup and portable storage as well as being, in most cases, the only means of transferring new programs to

the system. The failure of the floppy disk drives to perform their read/write function correctly can mean inconvenience, lost time and money and, worst of all, lost data or corrupted programs. The setting up and servicing of drives has traditionally required a battery of benchtop test gear and a lot of experience but Westinghouse has just released in Australia a portable test kit called Microtest designed to provide full diagnostic and calibration facilities in one small easy-to-use package.

The test kit comprises a small box called "the pod", various test leads and probes and the necessary software on floppy disk, all of which is housed in a compact lunchbox-sized carry case. All that's needed to complete the system is a standard test disk and host computer in the form of an IBM PC or clone that has at least one working floppy drive, 256K of memory and an RS-232 port.

The host PC is the controller for Microtest and acts as the interface between the pod and the drive under test (DUT). The pod is connected to the PC via the RS-232 port with the standard cable provided. The pod derives its power from the port so no external power supply is needed. The hardware interface in the pod contains an A to D converter, analogue multiplexer, band-gap reference, demodulator and a set of fully buffered test probes that connect to various test points on the DUT.

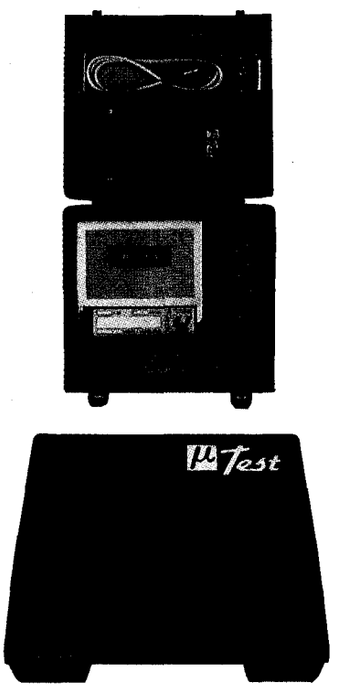
After loading the Microtest software you are presented with a simple menu giving the test options. The first of these allows you to specify the drive type you wish to test. At present the software details almost 300 different drives and more will be added in the future. For each listed drive Microtest stores the necessary calibration specifications as well as graphical representation of the drive's PC board which appears on screen and shows where to attach the various test probes emanating from the pod. Once the probes have been clipped on to the test points of the specified DUT you can then enter the "Align" mode listed on the menu. A selection of eight crucial tests can be done either automatically or under the direction of the operator.

These tests include rotational speed of the disk, index-to-burst timing, head radial alignment, head signal amplitude, track zero detect, azimuth alignment, head load timing and read/write test. For each test the operator is presented with an on-screen display giving details of the status of the test (head and track number), a digital readout of the relevant results and also an analogue-type meter display of the result showing where it lies in relation to the calibration range for that particular drive. This is very useful for showing up marginal results that may just creep into the pass range.

Where relevant, an oscilloscope type display may also be shown. On the radial alignment test, for instance, a "cat's eyes" pattern (or double hump) is read from the test disk and displayed on screen. A healthy drive will give humps of equal magnitude. If not, adjustment is in order. The real-time dynamic display simulates a CRO screen and instantly shows up any misalignment. On-line help is also available for each test giving a brief description of its operation and what the result means.

To show up intermittent faults or just to put the drive through its paces a powerful "Exercise" program can be used. This enables the drive to be put through a set series of operations which can be repeated until an error shows up. The operator may program in any sequence of head movement, read or write instructions and allows a comprehensive study of the reliability of the drive to store and retrieve information in any situation.

Also available is what they call "Repair" mode which turns the system into a simulated set of ordinary test instruments. By using one of the test leads from the pod as a probe the screen simultaneously mimics an analogue and digital voltmeter, TTL and CMOS logic probes and a continuity tester. This allows testing of the drive, or in fact any circuit, at a component level and allows the experienced serviceman to test the non-mechanical aspects of a suspect drive comprehensively without any extra equipment.



Lunchbox-size test kit, handy to carry around.

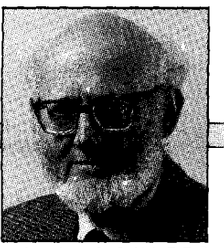
I put Microtest through its paces on an old IBM PC with Tandon TM100-2A drives. Not having much experience with the insides of disk drives I had a few reservations about using Microtest but these quickly disappeared. The software was loaded on the A drive and the drive type easily found on the menu. After selecting the drive type a basic layout schematic of the circuit board appeared on screen with details of where to connect the test leads. With the cover off the PC the drive B board was easily accessible and the probes attached. The Dysan 224/2A test disk was selected (not included in the Microtest package) and inserted in the B drive. I then went into the "Align" mode and selected an automatic run of all tests available. Within about half a minute the drive had been put through its paces as I watched and a complete summary of results presented on screen. Thankfully the drive got a clean bill of health. A printout of the results could be obtained if you wish.

I then proceeded to the "Exercise" mode and programmed in a random sequence of read and write actions. With a blank disk in the drive I let the sequence run for a few minutes without logging any errors. Clearly this drive was behaving itself.

I then borrowed a drive (coincidentally of the same model) which was known to have a radial alignment problem. The onboard B drive was disconnected and the new drive connected in its place with the extender cables provided. This time, in the radial alignment test, the drive could clearly be seen to be out of spec. I decided not to try to correct the problem myself even though the Microtest instruction book gave general hints as to how this could be done. Without a service manual or experience to guide me it may have been the ruin of a good friendship!

Even after a brief play with the Microtest system I was impressed at how easy it was to drive. The instruction manual was well set out and, although on the brief side, contained all the necessary information. I've seen several "software only" disk service packages in the past but these won't allow the full range of tests that a hardware interface will. For those involved in disk drive set up or servicing, Microtest would seem to offer a great deal as a self-contained, fully portable package that eliminates the need for any other benchtop equipment. The retail price, subject to confirmation, will be in the $2000 range but considering the cost of the discrete components that it replaces and its ability to be conveniently taken "on-site", Microtest deserves a worthwhile examination. A demonstration disk with a full simulation of the system will be made available to interested parties.

Contact Westinghouse on (03) 397 1033; fax (03) 397 1861. eti

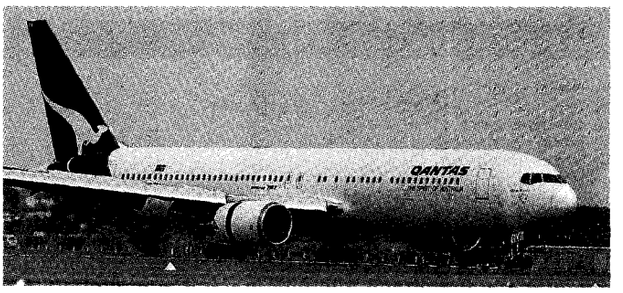


JOHN COULTER

PLANE SABOTAGE AND THE SECOND LAW

Choosing the right path

John Coulter addresses the problem of airline sabotage and concludes that increased security may not be the right, or only, solution to what is essentially a social and political issue.



One serious slip in security and this plane could be prey to sabotage. How do we prevent it?

It was the German philosopher Hegel who reminded us that 'Freedom is the recognition of necessity'. If we wish to journey to distant celestial bodies it's necessary that we conform with Newtonian mechanics. If it's freedom to transmit words and pictures by electronic means then we must understand the laws which control electric circuits and electromagnetic propagation. If we seek the freedom to do certain things we must understand and conform with the relevant laws of nature.

One of the most fundamental laws is the second law of thermodynamics. It tells us that the entropy, or degree of degradation or disorganisation in the universe, continually increases. Order is, naturally, far less likely than disorder and to maintain order against this tendency requires that energy be expended – or, more strictly, that available energy be degraded to unavailable energy. Thus the maintenance of order or a reduction in local entropy requires an increase in entropy elsewhere. As low grade mineral resources are scavenged, brought together and smelted to make pure metals a great deal of high grade chemical or physical energy is degraded to unavailable ambient heat. The metals then begin to rust and decay and can only be maintained against the inexorable working of the second law by more inputs of energy.

As human populations have become larger and technical civilisation more complex it is clear that greater effort must be put into maintaining these increasingly unlikely structures. This effort finds expression in an upside and a downside. The upside is the maintenance of order and complexity. The downside is the increase in entropy or disorder somewhere else in the total system. Material progress, looked at from this perspective, becomes a progression towards a greater degree of improbability precariously maintained and extended at greater and greater cost. Working against the second law is not a linear process; it is one of diminishing returns. The further you go the harder you have to work just to stand still.

> ***'Every piece of baggage could go through a 3D X-ray device'***

It is not my purpose now to argue the stupidity of replacing with human-engineered substitutes those processes which nature provides free, although that would be a useful path to follow. It is to remark on the precariousness of much that is complex and how better to protect it.

It now seems certain that a bomb brought down the jet over Scotland, killing all on board. Consider, for a moment, the enormous complexity in designing, building and flying a 747. Add to that the complexity of running a large airline with airports, complicated computer programs keeping track of passengers and baggage, the meticulous attention of thousands of ground staff to, among other things, security. One serious slip and a large airliner crashes. Where do we invest our diminishing stocks of available energy to make the most impact on this situation?

Broadly, we can go either of two ways. We could seek more sophisticated surveillance and security systems. Every piece of baggage could go through a 3D X-ray device – a CAT scanner connected to a shape-identifying computer. Every piece could be sniffed by a sensitive GC-MS also connected to an advanced substance-recognising computer.

Alternatively, we could begin to address the social and equity issues that cause people to put bombs on planes. I have a strong feeling that, for too long now, we have sought technical solutions to what are basically social and political problems. We have probably made most of the easy improvements that lie on that path. But, in the process, we have failed to appropriately address these social and political problems.

In the last half century powerful and potentially very disruptive and destructive technologies have been developed. Control and access is in the hands of the few. Relatively, inequity has increased. The second law tells us that pursuing ever more complex and powerful technology makes a system more insecure. It is now urgent that greater attention be paid to equity, justice and access. Otherwise, airliner bombing may be come a portent of loss of freedom as we attempt to protect ever more vulnerable technologies from the assaults of the disadvantaged. eti

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

ELECTRONICS

Programs

C64

```
20 GOSUB 1000
30 D=D+1:PRINT"■IS YOUR AGE ";B;:INPUTA$
40 B$=MID$(A$,1,1)
50 IFB$="Y"THEN250
60 IFB$="N"THEN80
70 GOTO30
80 INPUT"■■■IS YOUR AGE HIGHER THEN";A$
90 B$=MID$(A$,1,1)
100 IFB$="Y"THEN130
110 IFB$="N"THEN190
120 GOTO 80
130 A=A+1:C=INT(A/2):A=C
140 IFA<1THENA=1
150 B=B+A
160 IFB<1THENB=1
170 IFB>100THENB=100
180 GOTO30
190 A=A+1:C=INT(A/2):A=C
200 IFA<1THENA=1
210 B=B-A
220 IFB<1THENB=1
230 IFB>100THENB=100
240 GOTO30
250 PRINT"■IT TOOK ME ";D;" GUESSES TO GUESS YOUR     AGE."
260 INPUT"■■■IS THERE ANYONE ELSE WHO WANTS A GO";A$
270 B$=MID$(A$,1,1)
280 IFB$="Y"THENRUN
290 IFB$="N"THENEND
300 GOTO 260
999 END
1000 REM **********
1010 A=50:B=50
1020 POKE53280,1:POKE53281,1:POKE646,14
1021 INPUT"■DO YOU WANT INSTRUCTIONS";A$
1022 B$=MID$(A$,1,1)
1023 IFB$="Y"THEN1030
1024 IFB$="N"THENRETURN
1025 GOTO1021
1030 PRINT"■I AM TRYING TO GUESS YOUR AGE."
1040 PRINT"THE ONLY HINT YOU CAN GIVE ME IS A YES'
1050 PRINT"OR NO.  THESE CAN BE SHORTENED TO Y AND"
1060 PRINT"N.  FIRST OF ALL I WILL ASK YOU"
1070 PRINT"IS YOUR AGE 50?"
1080 PRINT"YOU THEN TELL ME YES OR NO.  IF YOU "
1090 PRINT"TYPE IN NO ( OR N ) I THEN WILL ASK,"
1100 PRINT"IS YOUR AGE HIGHER THEN?"
1110 PRINT"YOU THEN TELL ME YES OR NO, SAME AS "
1120 PRINT"ABOVE.  THE NEXT TIME I ASK YOU AN AGE"
1130 PRINT"IT WILL BE HIGHER OR LOWER, AND YOU"
1140 PRINT"KEEP ON REPEATING THIS TILL I HAVE"
1150 PRINT"GUESSED YOUR AGE.":PRINT"■PRESS SPACE TO START"
1160 GETA$
1170 IFA$=" "THENRETURN
1180 GOTO 1160
2000 RETURN
```

Age guesser

This program will guess the age of any person. The program works by continually taking a number and halving it, and either adding or subtracting it from the age put on the screen, depending on the input given to the computer. The instructions to the program will be displayed when the program is run. The way this program works enables it to guess the age of the person in seven or less guesses.

S. Williams,
Wendowee,
VIC.

Vic20

```
00001 REM  ** VIC BINGO **
00002 REM   by G.R.Laming
00003 REM  1/3a Falcon Ave
00004 REM Mile End  SA 5031
00010 DIM P(90): POKE 649,1: POKE 36879,8: POKE 36869,PEEK (36869) OR 2
00020 S=4*(PEEK (36866) AND 128+64*PEEK (36869) AND 112)
00030 C=37888+4*(PEEK (36866) AND 128)
00040 PRINT "[clear][3xdown][5xright][yellow]VIC-20 BINGO": PRINT "[5xright]----
------"
00050 PRINT "[14xdown][right]Copyright   May 1987": PRINT "[down][4xright]by  G.
R.Laming[white]"
00060 PRINT" [home][9xdown][right]selecting random nos.": PRINT "[5xright]please
  wait"
00070 FOR N=1 TO 90
00080 R=INT (RND(1)*90)+1
00090 IF P(R)<>0 THEN 80
00100 P(R)=N
00110 PRINT "[home][13xdown][9xright]";: IF N<10 THEN PRINT "[right]";
00120 PRINTN: NEXT: N=1
00130 PRINT" [home][9xdown][right]                          ": PRINT "[5xright] EYES
 DOWN"
00140 PRINT "[down][10xright] "
00150 GET D$: IF D$<> CHR$(136) THEN 125
00160 PRINT "[clear]": POKE 36864,8: POKE 36865,45
00170 POKE 36867,PEEK (36867) AND 129 OR 38: POKE 36866,PEEK (36866) AND 128 OR
26: GOTO 190
00180 GET D$: IF D$<> CHR(136) THEN 180
00190 IF N<1 THEN N=1
00200 IF N>90 THEN N=90
00210 T=INT(P(N)/10): U=P(N)-T*10: IF U=0 THEN U=10: T=T-1
00220 SC=S+T*3+U*52-52: CO=C+T*3+U*52-52: IF U=10 THEN U=0: T=T+1
00230 IF T=0 THEN T=-16
00240 POKE SC,T+48: POKE CO,1: POKE SC+1,U+48: POKE CO+1,1: GET A$: IF A$=CHR$(1
36) THEN N=N+1: GOTO 190
00250 IF A$=CHR$(135) THEN POKE SC,32: POKE SC+1,32: N=N-1: GOTO 190
00260 IF A$=CHR$(138) THEN 280
00270 FOR X=1TO100: NEXT: POKE SC,32: POKE SC+1,32: FOR X=1 TO 100: NEXT: GOTO 1
90
00280 PRINT "[clear]: POKE 36866,PEEK (36866) AND 128 OR 22: POKE 36867,PEEK (36
867) AND 129 OR 46
00290 POKE 36864,12: POKE 36865,38: RUN
```

Vic bingo

This program will enable those persons with a Vic-20 to use it at their club/social club etc. to call bingo games. After the Vic has selected the random numbers the function keys are used as such: pressing f7 will select the next number and that number will flash on the screen to indicate that it was the last number selected. F7 is then used again and again until a person calls "bingo" whereupon the numbers on his card are checked against the grid. F4 is used to re-run the program for the next game. Note that if the caller is calling at such a rate that he happens to select an additional number after the bingo call he may step back to the "bingo number" by pressing f5. To re-run the program f4 is used instead of f3 to avoid accidental contact with this key ruining a game. Note that I have used spaces for clarity. They are not necessary unless surrounded by quotation marks and cursor controls are explained in square brackets.

G.R. Laming,
Mile End,
SA.

C64

```
10 GOSUB50000:POKE53280,0:POKE53281,0
100 PRINT"■■■■ 64 PHONEBOOK ■"
110 PRINT,"■■■■L■■OAD FILE"
120 PRINT,"■■■N■■EW FILE"
130 PRINT,"■■■F1■■ END"
200 GETK$:IFK$=""THEN200
210 IFK$="L"THENGOSUB10000:GOSUB1000:GOTO100
220 IFK$="N"THENGOSUB11000:GOSUB1000:GOTO100
230 IFK$<>"■"THEN200
240 PRINT"■":END
900 IFEX=1THENRETURN
1000 GOSUB22000
1010 PRINT,"■■■E■■NTER NEW DATA"
1020 PRINT,"■■F■■IND ITEM"
1030 PRINT,"■■L■■IST ALL ITEMS"
1040 PRINT,"■■S■■AVE FILE TO DISK"
1045 PRINT,"■■A■■LPHABETICAL ORDER"
1050 PRINT,"■■F1■■ RETURN TO FIRST MENU"
1100 GETK$:IFK$=""THEN1100
1110 IFK$="E"THENGOSUB2000:GOTO1000
1120 IFK$="F"THENGOSUB3000:GOTO1000
1130 IFK$="L"THENGOSUB4000:GOTO1000
1140 IFK$="S"THENEX=0:GOSUB5000:GOTO900
```

```
1145 IFK$="A"THENGOSUB7000:GOTO1000
1150 IFK$<>"■"THEN1100
1200 GOSUB22000
1210 PRINT"■■  ■DO YOU WANT TO SAVE THE FILE?■"
1220 PRINT,"■■■■■ ■■ES"
1225 PRINT,"■■■■N■■■"
1230 GETK$:IFK$=""THEN1230
1240 IFK$="Y"THENGOSUB5000:GOTO1000
1250 IFK$<>"N"THEN1230
1260 RETURN
2000 IFP<ELTHEN2100
2010 PRINT"■";"■■■■■ INDEX FULL ■■"
2020 W=3:GOSUB30000
2030 RETURN
2100 GOSUB22000
2110 PRINT"■■ ENTER DATA■"
2120 FORI=0TOFLDS
2130 PRINTF$(I);:INPUTA$(P,I)
2140 NEXTI
2150 P=P+1
2200 GOSUB22000
2210 ID=P-1
2220 GOSUB20000
2230 PRINT"■■  PRESS ■■RETURN■■ TO ACCEPT THIS ITEM"
2240 PRINT"  OR ■■DEL■■ TO DELETE IT"
2250 GETK$:IFK$=""THEN2250
2260 IFK$=RET$THENRETURN
2270 IFK$<>DEL$THEN2250
2280 GOSUB21000
2300 RETURN
3000 GOSUB22000
3010 IFF=0THEN3700
3020 INPUT"■FIND";FI$
3030 PRINT"■IN:"
3040 FORI=0TOFLDS
3050 PRINT,"■";I+1,"■";F$(I):NEXTI
3100 GETK$:IFK$=""THEN3100
3110 IFASC(K$)<49ORASC(K$)>49+FLDSTHEN3100
3120 F=ASC(K$)-49
3130 PRINT"■■■ SEARCHING..."
3200 FORI=0TOP:FP(I)=-1:NEXT:FF=0:FORI=0TOP
3310 IFLEFT$(A$(I,F),LEN(FI$))=FI$THENFP(FF)=I:FF=FF+1
3320 NEXTI
3400 PRINT"■■■■  "FF" ITEMS FOUND";W=2:GOSUB30000
3410 IFFF=0THENW=3:GOSUB30000:RETURN
3500 FORI=0TOFF-1
3510 ID=FP(I)
3520 GOSUB20000
3530 PRINT"■ PRESS ■■N■■ FOR NEXT ITEM"
3532 PRINT"■ PRESS ■■P■■ TO PRINT ITEM"
3535 PRINT"■ OR ■■DEL■■ TO DELETE THIS ONE"
3540 GETK$:IFK$=""THEN3540
3550 IFK$="N"THEN3610
3555 IFK$="P"THENGOSUB6000
3560 IFK$<>DEL$THEN3540
3570 GOSUB21000
3580 FORII=0TOFF-1
3590 FP(II)=FP(II)-1
3600 NEXTII
3610 NEXTI
3620 RETURN
3700 PRINT"■■■■■■■■ THERE ARE NO ITEMS TO FIND! ■■"
3710 W=3:GOSUB30000
3720 RETURN
4000 GOSUB22000
4010 PRINT"■■ LIST":W=2:GOSUB30000
4020 IFP=0THEN4300
4100 ID=0
4110 GOSUB20000
4120 PRINT"■■ PRESS ■■N■■ FOR NEXT ITEM,"
4125 PRINT"■ ■■P■■ TO PRINT ITEM,"
4130 PRINT"■ ■■DEL■■ TO DELETE THIS ONE"
4140 PRINT"■OR ■■F1■■ TO END"
4150 GETK$:IFK$=""THEN4150
4160 IFK$=DEL$THENGOSUB21000:GOTO4180
4165 IFK$="P"THENGOSUB6000:GOTO4180
4170 ID=ID+1
4180 IFK$<>"■"ANDID<PTHEN4110
4200 RETURN
4300 PRINT"■■■■■■■■ THERE IS NOTHING TO LIST ■■"
4310 W=3:GOSUB30000
4320 RETURN
5000 GOSUB22000
5010 PRINT"■■ SAVE FILE"
5020 INPUT"■■ FILE NAME";FL$
5030 PRINT"■■PREPARE DISK THEN PRESS ■RETURN■"
5035 GETK$:IFK$<>RET$THEN5035
5040 OPEN1,8,1,FL$
5050 FORII=0TOP-1
5060 FORJJ=0TOFLDS
5070 PRINT#1,A$(II,JJ)
5080 NEXTJJ,II
5090 OPEN2,8,15:INPUT#2,A,A$,B,C:PRINTA;A$;B;C:CLOSE1:CLOSE2
5092 IFA<>0THENPRINT"■■ -UNABLE TO SAVE FILE-■":GOSUB30000:RETURN
5100 PRINT"■ PRESS ■■C■■ TO CONTINUE"
5110 PRINT"■ OR ■■F1■■ TO END"
5120 GETK$:IFK$=""THEN5120
5130 IFK$="C"THENRETURN
5140 IFK$<>"■"THEN5120
5150 EX=1:RETURN
6000 OPEN4,4,0
6010 PRINT#4,F$(0),CHR$(14)A$(ID,0)CHR$(15)
6020 FORII=1TOFLDS
6030 PRINT#4,F$(II)"    "A$(ID,II)
6040 NEXTII:CLOSE4
6050 RETURN
7000 PRINT"PLEASE WAIT..."
7005 S=0:FORB=0TOP-2:IFA$(B+1,0)>=A$(B,0)THEN7030
7010 FORC=0TOFL:B$(C)=A$(B+1,C):A$(B+1,C)=A$(B,C):A$(B,C)=B$(C):NEXTC
7020 S=S+1
7030 NEXTB
7040 IFSTHEN7005
7050 PRINT"IN ORDER.":W=2:GOSUB30000:RETURN
10000 PRINT"■■ ■ 64 PHONEBOOK ■"
10010 PRINT"■■■ LOAD FILE"
10020 FL$=""
10030 INPUT"■■ FILE NAME";FL$
10040 PRINT"■■ SET UP DISK THEN PRESS ■RETURN■"
10050 GETK$:IFK$<>RET$THEN10050
10060 OPEN1,8,0,FL$
10065 OPEN2,8,15:INPUT#2,A,A$,B,C:PRINTA;A$;B;C:W=2:GOSUB30000
10068 IFA<>0THENPRINT"■■ -UNABLE TO LOAD FILE-■":W=3:GOSUB30000:RETURN
10070 P=0
10080 FORJJ=0TOFLDS
10090 INPUT#1,A$(P,JJ)
10110 NEXTJJ
10120 P=P+1
10130 IFP<ELANDST<>64THEN10080
10131 CLOSE2
10140 OPEN2,8,15:INPUT#2,A,A$,B,C:PRINTA;A$;B;C:CLOSE1:
      CLOSE2:W=2:GOSUB30000
10145 IFA<>0THENPRINT"■■ -UNABLE TO LOAD FILE-■":W=3:GOSUB30000
10200 RETURN
11000 PRINT"■■ ■ 64 PHONEBOOK ■"
11010 PRINT"■■ NEW FILE"
11020 FORII=0TOEL:FORJJ=0TOFLDS:A$(II,JJ)="":NEXTJJ,II:P=0:RETURN
20000 GOSUB22000
20010 PRINT"■■"F$(0),"■"A$(ID,0)"■"
20020 FORII=1TOFLDS
20030 PRINT"■■"F$(II)"■■■"A$(ID,II)
20040 NEXTII
20050 RETURN
21000 PRINT"■■DELETING THIS ITEM■"
21010 FORII=IDTOP-1
21020 FORJJ=0TOFLDS
21030 A$(II,JJ)=A$(II+1,JJ)
21040 NEXTJJ,II
21050 P=P-1
21060 PRINT"■ITEM DELETED":W=2:GOSUB30000
21070 RETURN
22000 PRINT"■■ ■ 64 PHONEBOOK ■"TAB(26)P" ENTRIES"
22010 RETURN
30000 TI$="000000"
30010 IFTI<W*60THEN30010
30020 RETURN
50000 EL=100
50010 FLDS=4
50020 F$(0)="     SURNAME:"
50030 F$(1)="  FIRST NAME:"
50035 F$(2)="     ADDRESS:"
50040 F$(3)="        TOWN:"
50070 F$(4)="PHONE NUMBER:"
50100 DIMA$(EL,FLDS),FP(EL):RET$=CHR$(13):DEL$=CHR$(20):RETURN

READY.
```

C64 phone book

This computer phone book is based on a simple database program. Instructions to use it are contained in the program. A printout option appears in a subroutine at line 6000, a wild-search at line 3310 and an alphabetical sorter occurs in a subroutine at line 7000. To change the limit of entries per file change EL in line 50000. If the number of fields of F$() are altered then FLDS in 50010 should become the number of the highest F$() element.

O. Anderson,
Williamstown,
VIC.

```
00100 REM ********************
00110 REM * KEYBOARD  DRAW *
00120 REM ********************
00130 REM BY CORY SELIGMAN
00140 REM NOTE THIS PROGRAM CAN ONLY RUN ON DISK BASED MICROBEES
00150 REM          R   T   Y
00160 REM            F   G
00170 REM          C   V   B
00180 REM USE THE ABOVE LAYOUT TO MOVE THE CURSOR
00190 REM NUMBERS 1 TO 9 CHANGE DISTANCE IN EACH MOVE
00200 REM S=SAVE   L=LOAD   P=PRINT SCREEN   E=ERASE SCREEN
00210 REM Q=QUIT   Z=ENTER X,Y COORDINATES
00220 REM ESC=ENTER TEXT. NOTE YOU CAN'T GO OVER TEXT WITH THE CURSOR OR YOU WIL
L GET AN ERROR
00230 REM USE SHIFT AND ONE OF THE DIRECTION KEYS TO ERASE WHILE MOVING
00240 POKE162,30:POKE 163,128
00250 OUTL#1
00260 PRMT( )
00270 POKE 257,2
00280 INPUT"ENTER FILENAME TO SAVE SCREEN TO ";B1$
00290 HIRES
00300 X=255:Y=110
00310 SET X,Y
00320 PLT 0,0 TO 511,0 TO 511,221 TO 0,221 TO 0,0
00330 A1$=KEY$
00340 CURS 1,1: PRINT"PCG USED ";(14 USED)
00350 CURS 15,1:PRINT"; FILE ";B1$
00360 CURS 32,1:PRINT"; DISTANCE ";D
00370 CURS 45,1:PRINT"; X= ";(14 X)
00380 CURS 54,1:PRINT"; Y= ";(14 Y)
00390 CURS 1,2:PRINT"T=UP V=DOWN F=LEFT G=RIGHT SHIFT=ERASE S=SAVE E=ERASOR L=LO
AD"
00400 F=X: G=Y
00410 IF A1$(>"" THEN LET A=INT(VAL(A1$))
00420 IF A<0 THEN LET D=A
00430 IF A1$ ="T" OR A1$="t" THEN LET Y=Y-D
00440 IF A1$ ="B"OR A1$="b" THEN LET Y=Y-D:X=X+D
00450 IF A1$ ="C"OR A1$="c" THEN LET Y=Y-D:X=X-D
00460 IF A1$ ="R"OR A1$="r" THEN LET Y=Y+D:X=X-D
00470 IF A1$ ="Y"OR A1$="y" THEN LET Y=Y+D:X=X+D
00480 IF A1$ ="V" OR A1$="v"THEN LET Y=Y-D
00490 IF A1$="F" OR A1$="f" THEN LET X=X-D
00500 IF A1$="G" OR A1$="g"THEN LET X=X+D
00510 IF X>510 THEN LET X=510
00520 IF X<1 THEN LET X=1
00530 IF Y>220 THEN LET Y=220
00540 IF Y<1 THEN LET Y=1
00550 SET X,Y
00560 IF ASC(A1$)<90 THEN PLOT F,G TO X,Y ELSE PLOTP F,G TO X,Y
00570 RESET X,Y
00580 IF A1$="S" THEN GOTO 600
00590 IF A1$="E" THEN GOTO 290
00600 IF A1$="L" THEN  720
00610 IF A1$="P" THEN 880
00620 IF A1$="Q" THEN GOTO 830
00630 IF A1$="Z" THEN 1150
00640 IF A1$="" THEN CURS X/8,16-(Y/16):INPUT T1$:CURS X/8,16-(Y/16):PRINT" ";Y=
-16          (PRESS  ESC HERE  IN BETWEEN  THE  INVERTED COMMAS
00650 GOTO 330
00660 CURS 1,1:PRINT"   63  SPACES
      "
00670 CURS 1,2:PRINT"   63  SPACES
      "
00680 CLOSE 6: OPEN"A",6,B1$
00690 GRSAVE 6
00700 CLOSE 6
00710 GOTO 330
00720 CLOSE 6: ON ERROR GOTO 820
00730 INPUT"ENTER FILENAME TO LOAD ";L1$
00740 OPEN "I",6,L1$
00750 CLS
00760 ON ERROR GOTO 820
00770 GRLOAD 6
00780 A2$=KEY$
00790 IF A2$="" THEN 790
00800 IF A2$="A" THEN 330
00810 GOTO 750
00820 CLOSE 6:RUN
00830 CURS1,1:PRINT"DO YOU REALLY WANT TO QUIT Y/N "
00840 A3$=KEY$
00850 IF A3$="" THEN 840
00860 IF A3$="Y" THEN POKE 257,0:END
00870 CURS1,1:PRINT"      ABOUT  35  SPACES          ";:GOTO 330
00880 CURS 1,1:PRINT"PRESS "S" TO STOP PRINT  ";:IF KEY$=""THEN 880
00890 CURS 1,1:PRINT"   63  SPACES
      "
00900 CURS 1,2:PRINT"   63  SPACES
      "
00910 DATA 62,01,211,11
00920 DATA 96,105,14,128,229,6,8,8,203,34,125,181
00930 DATA 40,2,203,194,35,16,245,122,205,69,128
00940 DATA 225,203,87,48,231
00950 DATA 62,0,211,11
00960 DATA 201,-1
```

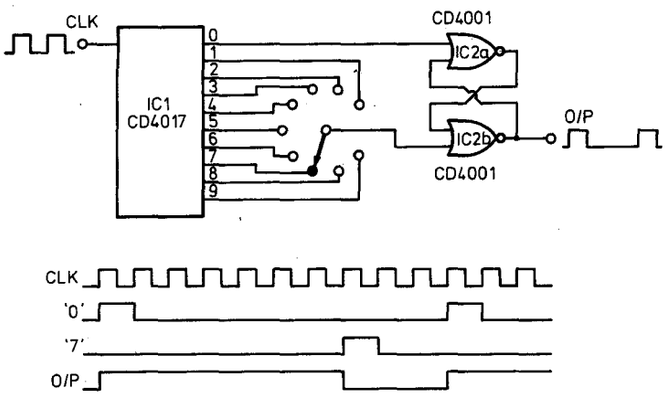
```
00970 J=336:RESTORE 270
00980 READ K
00990 IF K=-1 THEN 1010
01000 POKE J,K:J=J+1:GOTO 980
01010 LPRINT CHR(27);"A";CHR(8)
01020 FOR K=0 TO 15
01030 FOR U=0 TO 8 STEP 8
01040 A$=KEY$
01050 IF A$="" THEN 1070
01060 IF A$="S" THEN 320
01070 LPRINT CHR(27);"K";CHR(0);CHR(2);
01080 FOR J=0 TO 63: C=USR(336,61440+U+16*PEEK(61440+K*64+J))
01090 NEXT J
01100 LPRINT CHR(10);
01110 NEXT U
01120 NEXT K
01130 LPRINT CHR(27);"2";CHR(7)
01140 GOTO 330
01150 CURS1,1:PRINT"          ABOUT 25 SPACES
01160 CURS 1,1:INPUT"ENTER X VALUE ";X
01170 IF X>510 THEN 1160
01180 CURS 1,2:PRINT"     ABOUT 25 SPACES
01190 CURS 1,2:INPUT"ENTER Y VALUE ";Y
01200 IF Y>220 THEN 1190
01210 GOTO 330
```

Keyboard draw

This program is the result of my need for a simple drawing program with easy to remember commands and the ability to save and load screens. When loading screens any key will go to the next screen in the file and the letter "A" will let you add to the screen displayed at that moment.

C. Seligman,
Essendon,
VIC.

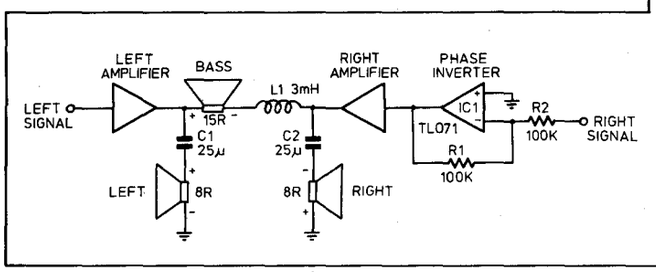
Circuits



Variable mark-to-space generator

This circuit produces a square wave output with a variable mark-to-space ratio selected by means of a rotary switch. The ratio can be adjusted between 9:1 and 1:9 in nine precise steps.

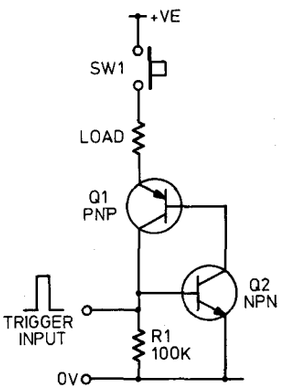
The O output of the 4017 decade counter is used to reset the NOR gate latch. One of the remaining nine outputs then sets the latch after the selected period. With the number 7 output selected as shown, the latch is reset after seven clock pulses have been received at the clock input, giving a mark:space ratio of 7:3.

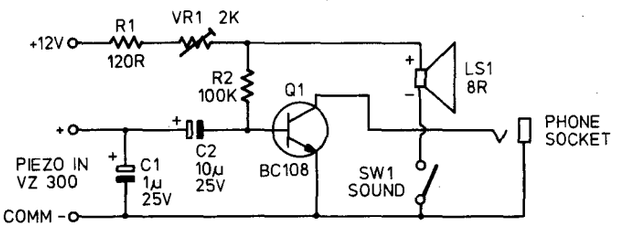


Two transistor latch

This circuit operates in a similar way to an SCR. When the trigger input is held high Q2 is turned on and, in turn, this turns on Q1. The collector current of Q1 provides the base current of Q2, developing a voltage drop of 0.7 V across R1.

When the trigger voltage is removed the transistors will remain on because of this base current. The only way to reset the circuit is by removing the supply momentarily by means of the RESET pushbutton switch.





Better VZ amp

Anyone who tried to build the VZ published in the May 1988 edition of this magazine may have had a few problems with it. Here are some modifications.

Shorting out the speaker is not very healthy for the computer as it either causes the computer to crash or the program to go haywire. The remedy is to put the switch inline with the speaker.

The volume is not very loud so I reduced the 1K2 resistor to 120R. The volume control acted more like a tone control so I re-connected it (see circuit diagram).

An on/off switch is not needed if you take the positive power supply from the internal switch.

I didn't use a 6.5mm plug and socket to connect up the amp and computer, mainly because I had a 3.5mm plug and socket but also I didn't want to remove the monitor socket, so I put the socket on the top left hand side of the computer near the vent.

Ben Hobson,
Quirindi,
NSW 2343.

Super woofer

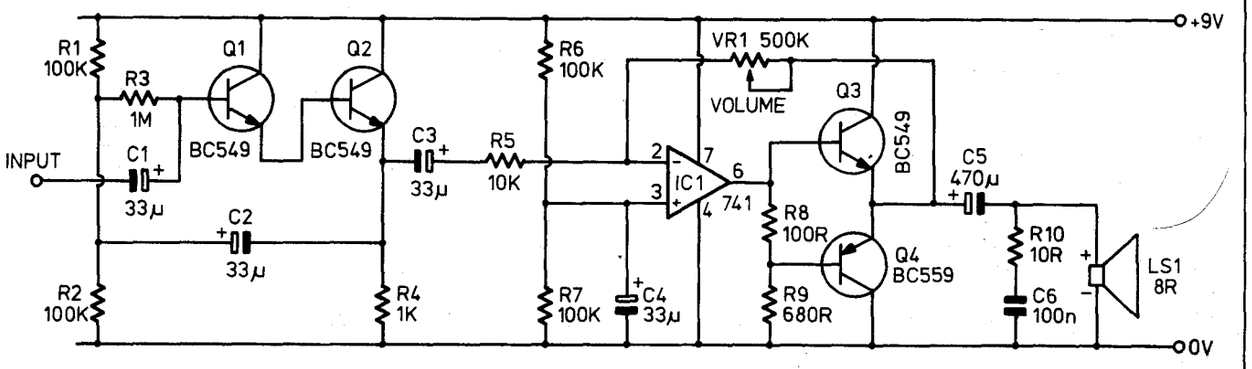
This circuit enables a single centrally placed woofer to be added to a stereo system. This gives a cost effective bass enhancer which still preserves the stereo picture via the original speakers.

The right channel is driven in antiphase and the right hand speaker is reverse connected to restore the phase.

C1 and C2 as shown give a crossover at about 800 Hz – other values could be tried.

The single bass speaker is bridge connected across the antiphase outputs via inductor L1. This has the incidental advantage of cancelling out in-phase hum and vertical turntable rumble.

Note that for a system playing records only, the inverting IC circuit could be removed by reversing one half of the stereo cartridge.



Very high-impedance audio amplifier

This simple circuit will produce approximately one watt of power when connected to a 9-volt power source. The advantage of this circuit is that it uses a bootstrapped Darlington pair to boost the input impedance to about 20 megaohms. A volume control is provided on the main section of the amplifier by way of the inverting op-amp and VR1. Unlike many designs, this allows the input impedance to remain over 20 megaohms no matter where the volume is set.

The main elements of the circuit are cheap, easy-to-find parts and shouldn't cost more than about $4 (excluding speaker). The output transistors are only BC549 types because as the volume is increased, the distortion becomes too great so current consumption is reduced to a safe level by reducing the volume.

The output section has a Zobel-network consisting of R1 and C1. This reduces oscillation at high gain. The output section itself is quite simple consisting of an op-amp driving a complementary pair.

D. Yates,
French's Forest,
NSW 2086.

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ETI, Federal Publishing,
PO Box 227,
Waterloo, NSW 2017

Contributors can look forward to $20 for each published idea/program which should be submitted with the declaration coupon below.

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

'Idea of the month' contest

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

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

RULES

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

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

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

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

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Cut and send to: **Scope-ETI 'Idea of the Month' Contest/ Computing Column, ETI Magazine, PO Box 227, Waterloo NSW 2017.**

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* Breach of copyright is now a criminal offence.

Title of Idea/program .....

Signature ..... **Date** .....

Name .....

Address .....

..... **Postcode** .....

BUFFOONERY

IN THE HEAT OF THE FLIGHT

The terrible threat presented by heat-seeking missiles is not one that should be taken lightly. At any moment these deadly emissaries might hurtle helter-skelter from the heavens to rain general nastiness upon our collective heads. Or even upon your head, alone. With luck, I won't be standing next to you at the time. That does sound rather callous, I know, but I'm sure you'd be thinking much the same when it comes to the possibility of any such device setting its sights on the back of your own noggin. And frankly, I don't blame you – the price of dry-cleaning these days is scandalous.

Fortunately for us, there are people who apply themselves to inventing counter-measures to this class of thing, namely defence scientists. As you will have read by now in the second part of Messrs Moon and Bell's article on heat-seeking missiles which appears in this very issue of *ETI*.

Scientists have come up with all manner of means to defend unsuspecting – and even suspecting – aircraft from warhead devices designed to home in on targets of specific heat profiles. And this is the thrust of the abovementioned article (which you should have read by now): that although defence scientists are finding ways to counter these nasty implements, those at the other end of the process – that is, the scientists inventing heat-seeking missiles – are coming up with devices of ever-increasing sophistication and nastiness.

All of this is well and good, but these scientists are concerned only with protecting aircraft from these organs of obliteration. "What," I asked myself in a rare moment of compassion, "about the average person in the street? How could he or she avoid the inevitable headache that would follow a blow to the back of the cranium from a bloody great ballistic missile?"

I have been pondering this very question and I now proffer the result of my deliberations, which were long and deep and lasted well into my lunch hour last Thursday.

Through some amazing coincidence, many of the countermeasures I have devised for the innocent member of the public to use to evade heat-seeking missiles as he/she strolls down the street, does the shopping and goes about his/her business are remarkably similar to those of defence scientists with university degrees, letters after their names and keys to the executive bathroom at the Scientists' Club.

There are two basic principles upon which infra-red countermeasures are based: (a) the generation of a false target (diversion); and (b) the reduction of infra-red radiation detected by the missile (denial). Let us first have a closer look at

(a) DIVERSION The easiest and arguably most effective method of diverting a heat-seeking missile is based on the same principle as that employed to avoid shark attacks by locals at Australian beaches. In order to reduce by 50% your chance of being attacked, you simply make sure you take a friend when you go swimming. To further increase your chances of survival, take two friends.

The reason for the success of this principle in the evasion of heat-seeking devices is obvious: if you have another source of infra-red radiation walking beside you, there is now a one in two chance of you being hit. Much better odds. Take this principle to its conclusion and you arrive at the following dictum: when possible, hang around in a crowd when you are out in the open and the forecast is for light showers with occasional heat-seeking missiles. (It should also be noted here that a dog on a leash may be substituted if human accompaniment cannot be arranged. Long-haired breeds such as Samoyeds and Border Collies are to be preferred because of their greater emission of heat than, say, a Corgi.

Another handy method by which to evade heat-seeking missiles is to carry a watch at all times – however, it mush be a watch with fluorescent digits and hands because of the radiation-emitting properties of this substance. The watch can be used in two ways: (1) wear the timepiece on your wrist and then when you hear a missile whooshing through the air, stretch out your arm and hope that the missile is distracted by the proximity of another radiation source and heads for it, instead. Sure, the chances are that you'll lose a hand, but that's better than copping it in the neck (2) As you hear the missile approach, hand the watch to your companion as you mutter something about having forgotten his/her birthday. With some luck, the infinitesimal amount of radiation given off by the watch will tip the balance of chance against you being the one hit.

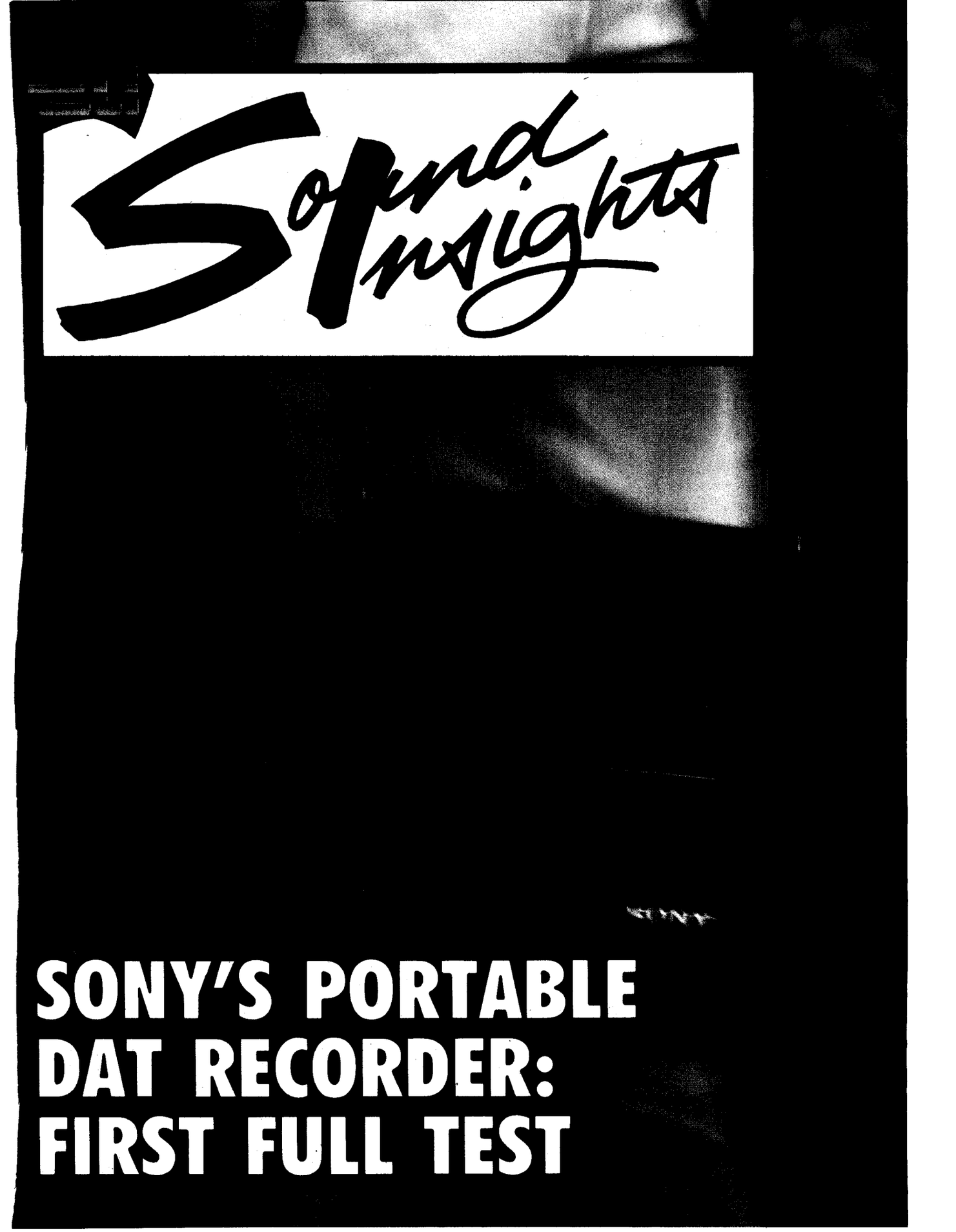
The third method to come under the "diversion" heading is based on the decoy tactic – flares, to be more specific. By employing a flare or similar device upon the approach of a missile, its flightpath can be altered. For the average person without access to armed forces issue flares, some types of fireworks will do just as well. Best of all is the Roman Candle which gives off a healthy heat and will divert the most determined missile. Sparklers and skyrockets are also useful, although it must be mentioned that the latter can cause clothing to catch alight and provide a heat-seeking device with an even larger target.

(b) DENIAL A more obvious method of heat-seeking missile evasion is to deny the warhead a heat source; in the case of the individual on the street, this means body heat. The proof of the efficacy of this method is everywhere: just think how many times you have been at a shopping centre when a bunch of heat-seekers has come raining down – did you notice that it was the shoppers who had just emerged from air-conditioned shops who were ignored by the missiles and who therefore survived?

Another countermeasure which comes under "denial" is to diffuse the source of heat coming from a person, thereby denying the warhead an accurately definable target. This can be done by means of smoke screens, aerosol sprays and reflective paints. Recent highly complex and dangerous scientific experiments conducted in my backyard have shown that the application of special reflective paints can not only reduce the level of radiation emitted by the human body, but can also divert heat from the painted subject towards other objects, thereby making them potential targets for the homing missile – like next door's cat. (Sorry Mrs Winthrop.)

Reflective paint applied to the body can also, I discovered towards the conclusion of my experiments, stain the furniture rather severely and cause serious domestic altercations. eti

Sound Insights



SONY'S PORTABLE DAT RECORDER: FIRST FULL TEST

BOSE®

The Bose® 601™ Series III Direct/Reflecting® Loudspeaker System

Bose engineers have invested more than 25 years of ongoing research seeking one goal—re-creating the realism of a live performance.

The next best thing to hearing music live is hearing it through a Bose® Direct/Reflecting® speaker.

Drawing on the heritage of the internationally acclaimed Bose 901® speaker, the 601™ speaker gives you the best seat in the house—wherever you sit or stand.

The research: three dimensional sound.

Through our extensive acoustical research into live sound, we learned that focusing on only one musical parameter such as frequency response and expecting realistic sound is like trying to create a lifelike painting by concentrating solely on colour. As with visual images, live sound has perspective, clarity and proportion.

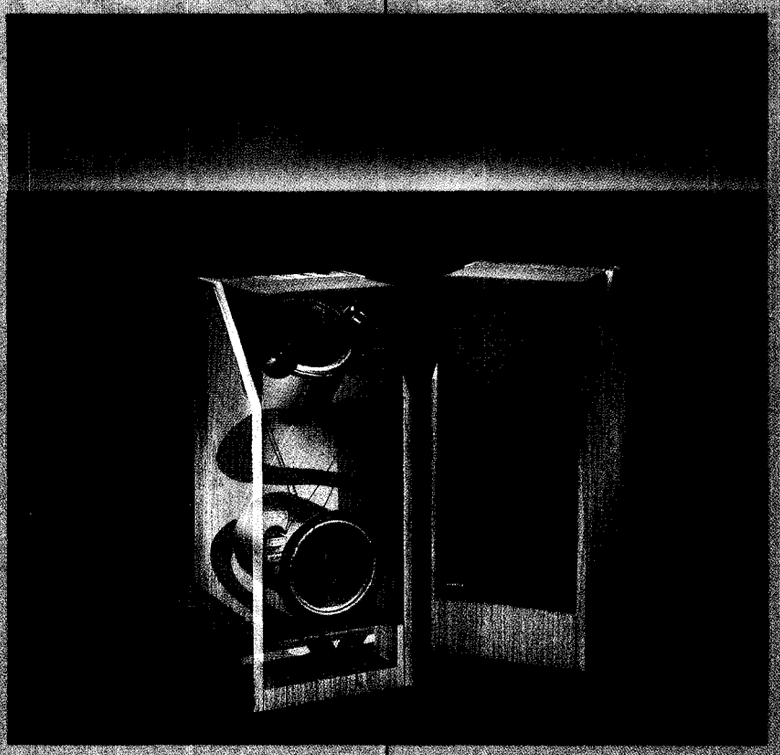
We designed our speakers based on the natural combination of direct and reflected sound. The difference between listening to conventional speakers and Bose Direct/Reflecting® speakers is like the difference between viewing a movie on a television versus experiencing it in a theatre.

The 601 system brings a three dimensional sensation to music—giving the sound depth, height and width. In short, it seems to come alive!

In a live performance, the majority of sound reaches your ears after being reflected off the walls, floors and ceiling. With conventional speakers, you mainly hear only direct sound. Bose Direct/Reflecting® speakers add the missing elements of music by bringing you the natural combination of direct and reflected sound (see diagrams at right). The result is a lifelike soundstage that's practically like being there.

The performance: ideal for audio, video and digital.

With most conventional speakers, you hear stereo in one or two parts of the room. Everywhere else, you hear primarily one speaker. The 601 system allows you to hear true stereo



everywhere in the room—even when you are directly in front of one of the speakers.

The 601 system is the ideal cornerstone for a complete home entertainment system. It unleashes the full potential of your sound system, efficiently produces excellent sound and easily handles high power. This rare performance combination allows you to enjoy today's power-demanding sound sources such as digital audio at true-to-life volume levels.

The Bose 601 system also makes it possible to use your stereo system in a new way: as part of a total audio/video system. It is designed to produce greater realism with all video sound sources—especially stereo televisions, hi-fi VCRs and video disc players.

Bose 601 Direct/Reflecting® system.

Conventional speaker system.

Bose Australia Inc., 11 Muriel Avenue, Rydalmere, NSW 2116 Telephone: (02) 684 1022, 684 1255

Bose Distributors:
NSW and VIC: Bose Australia (Reverse charge (02) 684 1022); QLD: Stereo Supplies (07) 229 7930; WA: Prosound (09) 325 1066; SA: Blackwood Sound (08) 278 1281; TAS: Chessman Distributors (003) 26 4622.

Bose®

READER INFO No. 10

MARY RENNIE

NO BUSINESS LIKE SHOW BUSINESS

But is it big business?

Mary Rennie looks at the efficacy of trade shows in the hi-fi industry and asks, do we need them in Australia? The answer, apparently, is a mighty yes.

Reading any overseas hi-fi magazine you could be forgiven for thinking the hi-fi world is one big show: the Japan Audio Fair; the Summer and Winter CES in the USA; the Audio/Video Show in West Germany; Son et Video in France – reports about hi-fi shows abound. The prominence they are given in the press would suggest that they are important events, and they are, particularly to the industry.

Trade and consumer-oriented shows are appropriate platforms for manufacturers to launch new products, display current models and address a large number of people interested in their technologies and arts – people drawn there by the promise of a number of manufacturers under the one roof. They are where manufacturers can win prestige with their peers and the press for being the best, the first or the strangest, and where the same manufacturers can also woo their markets at a consumer level.

Three of the most important hi-fi shows worldwide are the annual Japan Audio Fair, where the big audio-video manufacturers parade their wares for their own domestic market, and the Winter and Summer Consumer Electronics Shows in Chicago and Las Vegas respectively, where much of what's new is launched onto the world outside Japan. The USA is the most important market to exporters because of its sheer size; such a large homogenous market with uniform laws and standards, duties and other trade restrictions can accept or reject a product, that is, make or break it (witness DAT), and set trends for the rest of the world.

Shows in other countries are important events too, not least because the world is divided by its adoption of different broadcasting standards. The launch of a PAL video system is not of much interest to NTSC American buyers, except as an indication of alternatives, but of great interest to Europe and Australia. The 1988 Son et Video, held in Paris, was, apparently, a success with 125 exhibitors from 20 countries including 54 exhibitors from Japan.

Surprisingly for such an influential and widely reported show, the American CES (which has a huge number of exhibitors showing most consumer electronics goods) has a comparatively small attendance. The last Winter CES in Chicago showed a downturn for the first time in four years when attendance fell below 100,000 to 98,651 people. Compare that with the 63,000 figure for attendance at last year's Perth Electronics Show!

The Perth figure suggests shows should be booming in Australia. However, while the Perth Show with its large hi-fi element flourishes, other hi-fi shows have not been so lucky. Rather, they have taken Kamikaze courses. Last year saw an almost laughable situation when two groups, Australian Hi-Fi Publications and Barnes Exhibition Services, mounted separate hi-fi shows on the same weekend in Melbourne. It was a curious time when both outfits declared themselves committed, blamed each other and went ahead, splitting the industry – which could not afford to exhibit at both – and confusing and dividing the public which was unlikely to attend both. The intransigence and economics of the schedule seem laughable except for their results: out of pocket entrepreneurs and a pathetic showing of the industry.

It might be timely then to ask whether Australia needs a dedicated hi-fi show at all. After all, most products have already been displayed at an overseas show and orders taken by the Australian retailers. And, while a show brings a wide range of products together under the one roof, it may be that the consumer is better off viewing/listening to the equipment on the shop floor with fewer people, less jostling, preferably a listening room, and possibly more patient staff.

'The Perth figure suggests shows should be booming in Australia, but other hi-fi shows have taken Kamikaze courses'

The answer to that question, according to Bose's David Adams, is an unequivocal yes; in fact, the more the better. "Shows are worth 5-10% of turnover, just through sales and follow-through," he says. Apart from tangible sales, Adams sees them as valuable advertising and communication events. Indeed, Bose is trying every avenue and exhibits now at home decorating shows, seeing itself as part of the leisure industry.

Adams' sentiments on the valuable communicative nature of shows are echoed by our own native manufacturers. The members of the Australian manufacturers' guild Oz-Fi who exhibited at the Audio-Video Show last year reported that the show gave them the opportunity to talk design and operation with members of the public (something they love to do). It also pitted them against their overseas rivals, even if it wasn't a success on the sales side. On the plus side for the public, hi-fi shows have also given us a taste of things to come, one-off samples of equipment released overseas, and have offered seminars and lines of discussion for those earnestly interested in the subject.

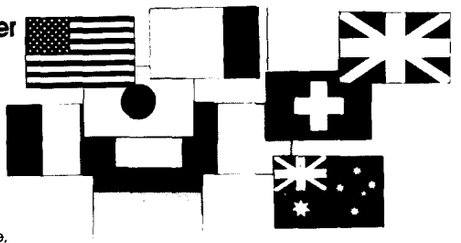
Those of the industry who haven't been soured by last year's fiascos are now signing up for another hi-fi show, this time in Brisbane. The FM104 Queensland Electronics Show running from 23 to 25 June will be held at the R&A Showgrounds and will feature hi-fi, video, car stereo and computers.

Dead or alive?

A recent press release from Akai declaring DAT dead and promoting a standard Akai cassette deck has received

BRAVO ULTRA 500!

Rarely, if ever have critics been so unanimous in their praise



AUSTRALIA
"Make no mistake, Shure Ultra 500 cartridge is about the best thing around in phono cartridges... Shure's claims were fully substantiated and an unquestionable credit to the designers."
Electronics Today

BELGIUM
"The sound blows your mind: clarity, presence, long and rounded bass, warm and crisp non-aggressive highs and, what the others lack: a distinct separation of music levels."
Panaudio-Video

FRANCE
"It shows... exceptional cleanness of sounds, total absence of distortion, amazing ease with which the most complex messages are played back... We rediscover numerous records."
La Nouvelle Revue du Son

GERMANY
"Compared to the reference MC-systems of the highest top category a juror even took with "absolute certainty" the Shure system for a MC-system —which means that this exclusive group now has to admit an MM representative to its elite ranks."
Stereoplay

ITALY
"Overall the most prestigious among Shure pickups... It seems that Shure want to cater to the most demanding audiophiles."
Audio Review

JAPAN
"Recently there have been strong hints that MM (Moving Magnet) cartridges are surrendering to MC (Moving Coil) products. However, as is typical of a manufacturer as famous as Shure, they have arrested the trend by developing the new ULTRA series."
Stereo's Best Choice Stereo

"Amazing, a truly wonderful cartridge. I was shocked rather than merely surprised ...Indeed, in whatever environment the recording is performed the reproduction is very penetrating."
Swing Journal

SWITZERLAND
"Absolutely top class. In terms of sound neutrality, this system is in a class of its own."
Electronic Sound

UNITED KINGDOM
"I have praised Shure cartridges in the past, but this ULTRA 500 model is far the best performer to come from that stable."
Gramophone

UNITED STATES OF AMERICA
"...it is my feeling that it (ULTRA 500) has no real competition... Moving-coil cartridges tend to be pretty mediocre in some respects... their major failing are in spurious coloration, where the ULTRA 500 excels... Its sound is gorgeously smooth and effortlessly clean, even at the highest recorded levels, and its low-end performance is as good as anything I've heard."
Stereophile

"...unquestionably... among the best ever made... These cartridges create the illusion that one is hearing the master tape at the studio... at least as good as some cartridges costing upward of $1,000."
New York Times

"For sheer accuracy of reproduction, it has little real competition."
High Fidelity

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Ph: (02) 29-6731

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51 Scarborough Beach Rd,
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AE04

READER INFO No. 21

Sony's non-portable PCM-2500 digital audio recorder.

some support from other members of the hi-fi press. The statement comes at a time when the first DAT players have been released onto the Australian market by Casio, Tascam and Sony.

With the exception of Casio DA1 these players are professional products retailing at very expensive ($3000 plus) prices. So far the Casio model has been the only consumer product. The hold-up, as ever, is the war over copyright in the USA.

According to Glen Stanford at Akai everyone is holding off to see what the US market will accept or reject. While Akai Japan had a shipment of DAT players ready to sail for Australia 12 months ago in a bid to be the first here with a player, the company held off as the wrangle over copyright and copycode systems dragged on. The strategy behind the wait is that one could only lose by bringing out a DAT player early to the market outside the USA.

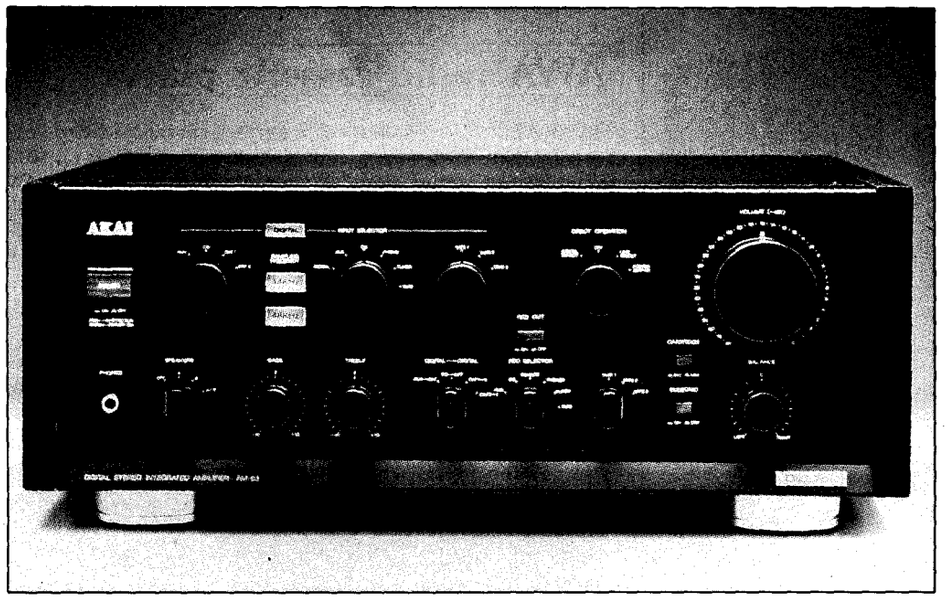
Better to wait, see the outcome and bring out a fourth generation player than to court the wrath of the recording industry which has been actively promoting the tape levy both in Australia and in the USA.

Stanford, however, does not so much describe DAT as dead, as being very sick. "Look back to CD players which took 11 to 12 years to get where they are now. That's how long DAT is going to take, except that people already have digital technology on CD. On top of that, car and portable CD players are becoming cheaper, and while a DAT player will cost $1500 minimum, a CD player for each of your environments wouldn't add up to $1500."

Nevertheless, the professional product has been selling even if demand is not large. Sony has sold about 10 units in NSW of its PCM-2500 (non-portable) model, mostly to corporate buyers who use them for voice or sound recording. (BHP was a customer, as was Clive Robertson, who reportedly bought two.) Casio too has had some success with its players, selling out its first shipment of DA1 players. But despite this, according to a Casio spokesman, the company, like Akai, has decided to hold off the next shipment until the US embargo/copying fracas has been resolved. Sony and Tascam have not admitted such problems.

Meanwhile, *Sonics* magazine has published a comparison of the defunct Casio DA1, the Sony PCM2500 and the Tascam DA50 in its Jan/Feb issue.

Note: We incorrectly reported in *ETI*, January 1989, that Akai has a professional DAT player on sale in Australia. eti



Digital amp

THE new Akai AM-93 integrated amplifier has been designed with the "digital technologies" in mind, incorporating a digital-to-analogue converter so that it can accept direct digital signals from CD, and, in the future, satellite TV transmission and DAT.

The amp has four digital inputs, eight analogue inputs, offers 120 watts per channel with Source Direct switching and switchable subsonic filter. It also uses a "super active servo-driven power supply in a floating transformer design with zero impedance". This last mouthful is said, by Akai, to aid bass reproduction by maintaining an effective output impedance of zero and to be better than class A design.

In an effort to reduce extraneous noise, Akai claims to have developed a new phase-locked loop circuit intended to hold synchronisation and suppress digital radiation. The amp uses dual DACs with linear 18-bit, 8 times oversampling filter.

Specs are frequency response of 20 Hz to 20 kHz, less than 0.05% thd. RRP is $2995 with a two year warranty.

READER INFO No. 175

Car speakers muted for phone

A BRITISH company has released an adaptor for mobile cellular telephones which automatically shuts down the radio or stereo for the duration of a call.

The MR range of audio mute adaptors from ACC-CELL senses the increase in current when a telephone is in use and mutes the car's loudspeakers. The adaptor is activated by the ring of an incoming call or on pressing the send button for an outgoing call. Three seconds after the end of the call it switches the loudspeakers back on.

According to the company the adaptors can be used safely with all cellular telephones and most medium-power audio systems, and can switch four loudspeakers at up to 100 W per channel.

It comes with full cable harness, plugs and instructions taking about 40 minutes to fit. Four versions are available: audio mute; audio mute with call alert output; audio mute with cigar socket for portables; and audio mute plus call alert output for portables.

For more information contact Mr Baber, ACC = CELL, Apex House, Kingsfield Lane, Longwell Green, Bristol, England BS15 6DL. ☎ 44 272 352261; fax 44 272 352271.

READER INFO No. 174

Bass machine

ANOTHER speaker system incorporating sound processing is the Australian designed and manufactured EHT bass machine from Etone. This is a powered sub-woofer system for use with an existing PA speaker system.

With the increased popularity of various electronic rhythm synthesisers the performing musician needs a sound system capable of considerable bass output. The EHT bass machine is a self-contained unit consisting of a 38 cm bass speaker in an integral power amplifier via an electronic crossover with extensive signal processing functions used to extract maximum performances and to operate everything to peak efficiency.

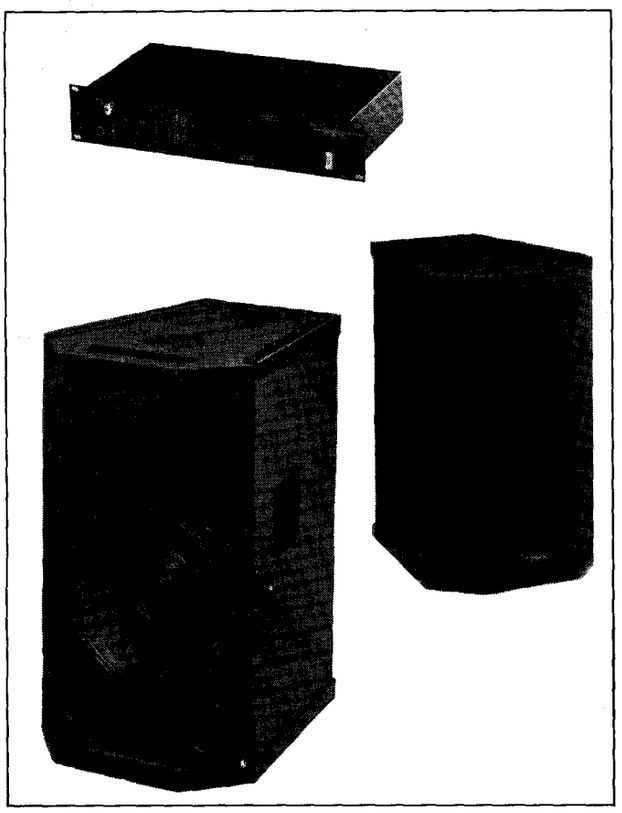
The main system speakers should also operate more efficiently because the crossover section of the EHT bass machine removes the frequencies below 120 Hz from the main system signal. Since the main speakers are no longer being overloaded by lower bass they should deliver clearer mid and high frequency output.

The bass machine speaker only works below 120 Hz. The signal processor section equalises the frequency response, eliminates unwanted sub-sonics, prevents distortion through input overload and prevents speaker damage from either excessive cone movement or voice call overheating.

The bass machine is available from Etone, 6-12 Stanley St, Peakhurst 2210. ☎ (02) 534 3569.

READER INFO No. 176

This month's Sound Insights cover shows Sony's new PCM-2000, the portable DAT recorder, in motion. Reviewed on page 106 by Louis Challis.



Signal processed speaker system

SIGNAL processing, with its promise of loudspeaker protection and signal optimisation is a technology which is likely to be increasingly available in hi-fi products, especially in powered speakers.

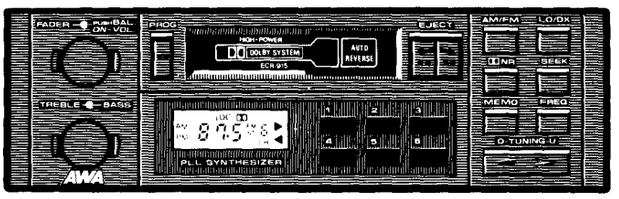
New from America's Apogee Sound are the AE-5 loudspeaker and A-5 dual channel signal processor providing a two-way, two-amplifier electronically-coupled speaker system.

The loudspeaker consists of a 12" high power cone driver and a one inch "throat composite diaphragm compression" driver coupled to a moulded uralite 90° high frequency horn. The high frequency driver is fluid cooled.

The signal processor provides crossover, time domain alignment, fixed corrective equalisation points and a positive amplifier feedback driver protection system. The amplifier's output signal is continually monitored; when safe operating levels are exceeded, a limiter circuit acts to protect the drivers from damage. An internal switch selects between the operation of the processor for use with the AE-5 speaker or others connected. This switch optimises the upper low frequency response to compensate for the different enclosure shapes, eliminating the need for two different models of enclosure.

The claimed loudspeaker frequency response is 53 Hz to 17 kHz ±4 dB and the maximum sound pressure level is 124.5 dB continuous and 130 dB peak. Power handling is 400 W continuous and 1200 W peak. Distributed by Entertainment Services of Australia, ☎ (03) 547 7578.

READER INFO No. 180



AWA radio cassette player

THE AWA ECR915 is the latest car product from AWA.

Features include 15 watts per channel sound, Dolby noise reduction and electronic memory tuning, and separate treble, bass, balance and fader.

The auto reverse cassette deck comes with locking fast forward and rewind, tape program and eject switch.

READER INFO No. 179

Multi-play CD

PIONEER Electronics has released the PD-M900, a six disc CD player for the home. The unit has an eight-times oversampling digital filter and a twin "glitchless" linear envelope D/A converter. The player has been constructed with a copper-plated honeycomb chassis and large insulators to protect against resonance. Four separate power supplies are provided to eliminate any fluctuation of the power supply.

The unit enables time fading editing, digital level control with memory and has a remote control unit with multi-cartridge programming capability.

The PD-M900 is the flagship model of the Pioneer multi-play CD players and retails at $1099.

READER INFO No. 178

Projectors for Super VHS

HOT on the tail of Super VHS come two compatible projectors for large screen presentations, seminars, and teleconferencing.

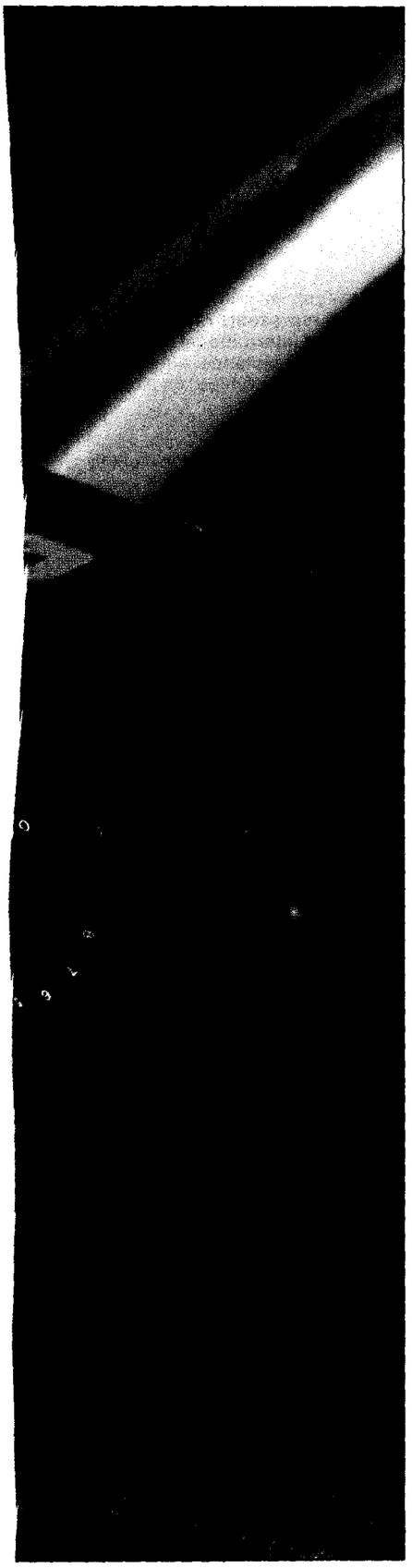
The Barcovision 600S and higher output 1500S accept inputs from NTSC/PAL/SECAM composite video sources including VCR, Super VHS recorders, video disc, satellite receivers and video cameras. It's available from Trace Technology on ☎ (03) 646 5833.

READER INFO No. 177

Indulge your senses.

JAMO Concert.

READER INFO No. 24



DOING IT DIGITALLY

The Sony PCM-2000 DAT recorder

Louis Challis takes an early look at the latest in digital recording technology.

Over the past two years professional sound recordists in Australia have been gleefully waiting for the release of the first professional R-DAT (digital audio tape) recorders which have been on sale in Japan, but under wraps in most other places.

For almost two years professional and amateur musicians in Japan were able to purchase the consumer versions of the DAT recorders and, more recently, the professional versions as well. In Europe the consumer versions were on sale in Dusseldorf and in London and I could have bought a portable R-DAT in either of those two cities had I wished to. In the USA a couple of innovative marketing groups are sending people to Japan to buy machines at the Akihabra in Tokyo; these machines are then offered at astronomical prices to less intrepid Americans who don't seem to have the time or the inclination to make the trip themselves.

After what feels almost like a lifetime of waiting, Sony has brought in a consignment of its first portable, professional PCM recorders, the small and exciting PCM-2000 digital audio recorders. After many promises and many months, I was honoured that they offered me one of the very first units to be made available for review purposes.

Although first appearances may be deceiving, this machine has not been designed to deceive nor to pull any punches when it comes to ergonomic design, functional performance and the important conveniences of small size and light weight. This recorder doesn't look like any previous Sony, Nagra, Stellavox or multi-unit PCM recorder with which you may be familiar. Its external appearance is both friendly (because of the well labelled and colour-coded controls) and, I felt, business-like (because of the rubber buffered edges and corners which have been designed to "soften the blows of professional usage").

The primary functional controls are ergonomically and sensibly arranged in two groupings. The primary recording controls, which include the large recessed and well protected red record switch, and the pause control, are sensibly positioned at the right-hand side of the front panel adjacent to the coaxial level controls and large LCD display. The less frequently required control functions, and those that are specifically required for studio playback or special monitoring purposes, are recessed separately on the top of the recorder body.

On the left-hand side of the recorder a large LED display dominates your attention and on its right is a small push button which

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The 1616 is available fully assembled or in "kit" form; the 1616 can be tailored to your level of computing needs.
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- Motorola 68000 or 68010 processor.
- 512K bytes RAM as standard.
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- Optional disk/co-processor card.
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- Dual serial ports.
- Centronics compatible parallel printer port.
- General purpose digital to analogue I/O port.
- Analogue two-button joystick port.
- Graphics: 320H × 200V 16 colours, 640H × 200V any four of 16 colours.
- Standard RGBI interface or composite video.

THE OPERATING SYSTEM

1616/OS is a programmer's delight
- ROM resident.
- Inbuilt screen editor.
- File & Directory management.
- I/O redirection.
- Over 100 documented internal system calls.
- Monitor functions.
- Installable drivers.
- Unprecedented Hardware accessibility.
- Windows and graphics and more . . .

The flexibility and power of 1616/OS make it a pleasure to use. Complicated tasks are simple.

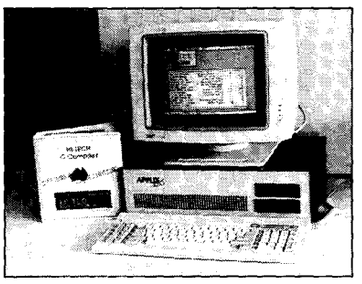
"C" DEVELOPMENT SYSTEM

All Australian. The Hi-Tech "C" Compiler running under 1616/OS comes with macro assembler, linker and librarian. The special Applix Library utilises the power of the 1616 system calls. A cross-compiler running under MS-DOS and producing code for the 68000 is also available.

DISK/CO-PROCESSOR CARD

Truly a computer in its own right, the 1616 Disk Controller Card adds another dimension to the 1616 system.
SSDCC Technical Features:
- On board Z80H CPU (running at 8Mhz).
- 8K to 32K of ROM.
- 8K to 64K of static RAM.
- WD17722 disk controller chip.
- Supports both 3.5" ad 5.25" DS 80 track floppy drives.

Options:
- SCSI hard disk interface using the NCR5380.
- Two additional serial ports (under Z80 control) using the Z8530 SCC.
- CP/M support



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Mini kits start at $239, basic kits from $599, keyboard $139, power supplies from $89, disk controller kit from $249. Fully built ready to run systems $1800.
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68000 macro assembler free,
32 bit forth including source $89
SS Basic $69 Hi-Tech "C" $275
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READER INFO No. 17

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BKP88/129A

READER INFO NO. 20

activates the back-lit display for approximately 10 seconds to conserve battery voltage. Adjacent is a similar switch which displays the battery voltage and thus the battery condition on an extended LCD bar graph-type display using the same LCD elements as in the input level display.

To the right of the LCD display is a large concentric rotary volume control, with left channel on the outside and the right channel operating concentrically unless it is depressed to release it to facilitate separate control. When depressed the right channel knob pops out and, hey presto, you can exercise separate control over each.

I initially felt that with a dynamic range approaching 100dB there would be many situations in which it is questionable whether the volume controls would ever really need to be optimised in the field if correctly adjusted at the start of a recording session.

However, feedback from other professional users dispelled this view as there are many professional microphones which are not optimally suited to the input sensitivity range of the PCM-2000. Therefore, level adjustment and more critical settings would dominate the use of this recorder and, specifically, its level settings.

The liquid crystal display combines multiple functions as do many similar displays on video recorders and some of the other more recent professional equipment to be released on the market. It provides a wide range of critical and important display functions to confirm the activation of specific controls, to confirm the settings which are not otherwise clearly displayed and, most particularly, to alert the recordist to problems, eg, potential loss of battery capacity and other operational alerts which require urgent action.

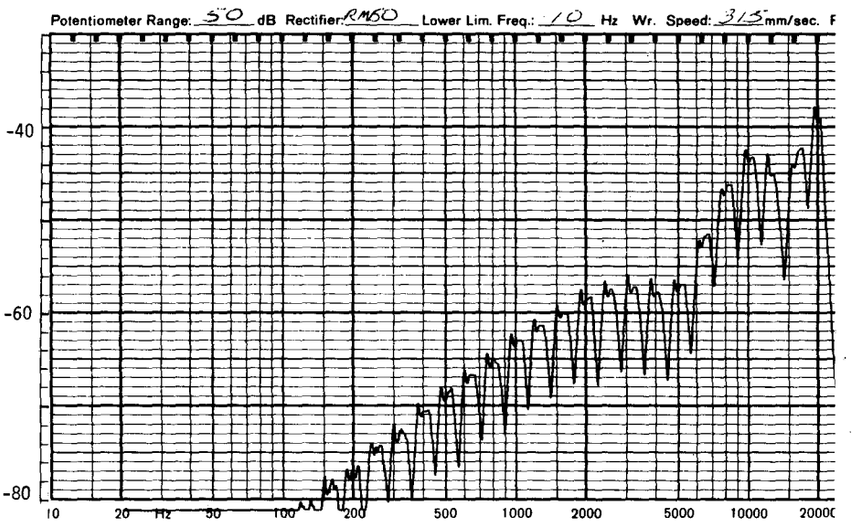
The lower part of the display contains an LCD bar graph peak reading level meter covering the range -60 to 0dB for both left and right channels. At the right-hand edge of the display, if the signal input exceeds 0dB, a very clear "OVER" modulation display appears and, simultaneously, "CAUTION" on the central part of the display. The incremental number of bars on the display do not follow a conventional dB relationship in terms of the numbers per 10dB, but the display is clear enough and adequate, remembering that there is approximately 35dB of additional recording range below the 60dB setting.

In a manner analogous to the latest CD players, the display provides either a direct tape counter in hours, minutes and seconds or surprisingly, the option of remaining time on the tape, which I believe is a decidedly convenient feature.

The sampling frequency selected from the three available is displayed at the top right-hand corner of the LCD display. The PCM-2000 gives you the option of the normal 48kHz, as well as 44.1 or 44.056kHz.

The display also advises when the automatic tracking frequency (ATF) is operating or, alternatively, when the external control frequency from separate equipment has taken control of that function.

Additional displays show when the identification signals have been written or are skipped or whether separate time code information is recorded on the sub-carrier channel. Sony is about to release a supplementary unit, the BBG-200, which will sit across the top and back of the recorder providing an additional NPI battery pack to extend the limited battery life of the single NiCad battery pack up to approximately 3 hours. This unit will incorporate a time code generator which will lock the recorder tape transport on to a separate external film recording or video recording time code for precise synchronisation. Professional video and film recordists will find this most attractive as it will offer considerable benefits with transfers and recording of 16mm filming which currently use Nagra IVs with their 50Hz crystal-controlled synchronisation signals.



Crosstalk, both gains at 6; 270 ohms across undriven channel.

Immediately below the main display window is a large recessed power ON-OFF switch, a RESET button which resets the primary digital counter, a MEMORY key which stores the point where the counter is reset in the memory, the ATC/CTL selector which selects the way the control of tape tracking is played back. For most field recording the ATF switch would be utilised, but when the CTL (control) switch has been selected the tape is played back under the external control circuit. This function is required when the PCM-2000 replays tapes prerecorded on another Sony PCM-2000 recorder.

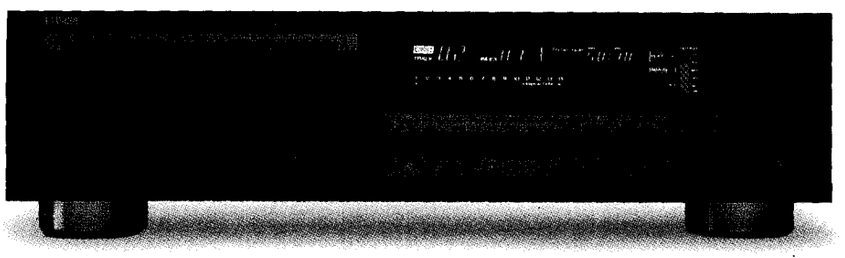
The next switch is the TRACKING key which, when pressed, indicates the output level of both heads (A and B) during playback and when pressed again, returns to the original audio signal level meter setting. Adjacent to this is the MODE key which selects the display information in terms of either a direct counter position, total time remaining on the tape or a program number as encoded during recording. Each time the key is pressed the indication changes in the preset sequence.

Two minor controls set below the recording switch are the ID RIGHT key which encodes the tape with the START identification and SKIP identification when pressed, while to the right of this is the ID ERASE key, which initiates the erasure of the start ID and the skip ID indications.

These functions may be altered by resetting the SKIP control switch, which is under the cassette loading well cover. On the large exposed face of the recorder adjacent to the cassette well are five indented and clearly identifiable push buttons. These are a PLAY button, a STOP button, which is offset in position to make it identifiable in the dark, a pair of push buttons for REVERSE and FAST FORWARD and a

Dimensions	**212mm wide x 77mm high x 268mm deep**
Weight (with NPI NiCad)	**4.2kg**
Price	**$6500 plus tax (NB: there are now 2 scales, of 20% and 30%)**

YAMAHA'S NEW CDX 1110 CD PLAYER OWES ITS BRILLIANCE TO A PIECE OF TWO-BIT TECHNOLOGY.



Until now, CD players were limited to 44.1 kHZ and 16 bit technology. Now Yamaha has, as Audio Magazine states, "found a way to improve on perfection". Introducing the world's finest CD player that features 18 shifting bits and 8 times oversampling digital filters. A technological progression that quadruples both sampling frequency and density to produce exquisite wave-form resolution.

The result is unsurpassed sound quality. We could mention its 44 key wireless remote control, its new 3 beam laser pick-up, its 24 track direct access and random access programmable playback. Or we could compare it to our previous model, the CDX 1100. Of which Audio Magazine said "As to how a CD player is ideally supposed to sound, we do not hesitate to say that it should sound like the CDX 1100". All of which proves that the new CDX 1110 won't sound one bit better than any other CD player. It'll sound two-bits better. Starting at $399, our entire CD player range is there for the picking in your local Yamaha Hi-Fi store.

YMH

5 YEAR WARRANTY.

READER INFO No. 22

Saatchi YAM044

12 month warranty on laser heads.

SEARCH button, which is used to detect the start of identification or ID signals once the FAST FORWARD or REWIND buttons have been activated. With this control you can find a previous section of recording, provided the ID Button has been pressed during recording or that a new start has been made at that point on the tape.

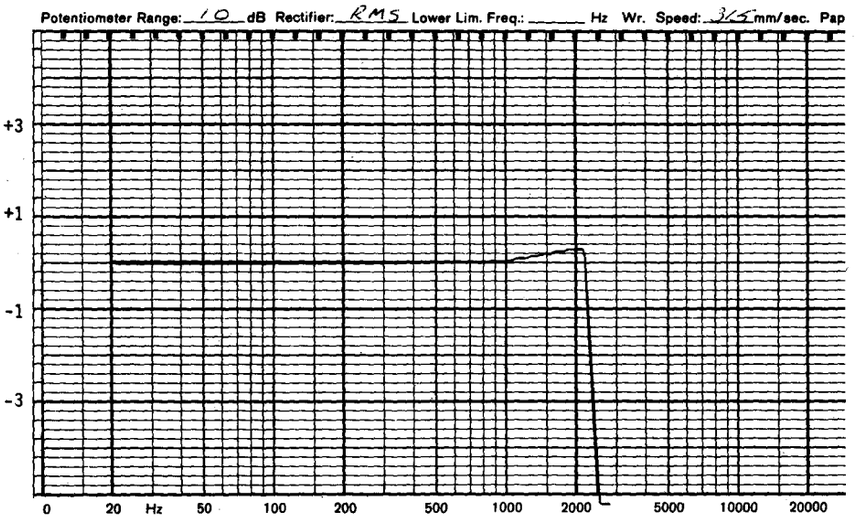
Under the cassette well cover is a series of minor controls including the longitudinal time code record button and lamp, which facilitates the selection of a time code from an external generator. The inputs to this circuitry are via a large 60-pin side connector on the left-hand panel. This push button can be activated or deactivated at will and is illuminated to ensure that the correct function has been selected.

Below this is the INPUT SELECTOR switch which selects either ANAlogue or DIGital input and adjacent to this is the SKIP switch which allows the ID function to be written during playback and selects whether or not the skip functions are activated or deactivated by the appropriate switch on the front panel. Below this is the emphasis ON-OFF switch which allows a pre-emphasised high frequency signal to be recorded, as and when required during field recording, to improve the record signal noise ratio characteristics. The use of this pre-emphasis may well be a refinement that most users would not require, but many professional musicians have adopted this approach with conventional tape recorders and I guess old habits die hard.

Below this is the switch for word synchronisation which selects either the internal word-synchronised signal generated in the recorder or an external word-synchronised word signal connected to its BNC connector. Below this is the switch for selecting the three sampling frequencies.

Two other controls are located on the front panel in front of the cassette loading well. The first of these is a LOAD-UNLOAD push button which flashes on and off when pushed to warn you that you have to wait for the tape to be withdrawn from the video head before the cassette can be removed. This switch can only be activated with the power on. Once the tape is withdrawn from the heads, the EJECT button can be manually activated to remove a DAT cassette from the well.

On the right-hand side of the recorder is another deeply recessed panel with a large number of sockets and controls for the major input and output connections. These include a pair of balance microphone sockets utilising standard Canon female type XLR sockets. These are configured for either microphone or line levels, although a number of users have complained that the normal line level settings do not strictly conform to the +4VU or 4dBm settings for which other recorders have been optimised. This problem



Frequency response at 10dB POT; 200Hz-200kHz.

is apparently being examined by Sony, which is likely to revise the mike level and line level relationships in the next version of this recorder. The microphone sockets are internally wired to provide for different phantom power feeds which are controlled by a separate switch above.

Immediately above the left-hand socket is a mike attenuator switch which provides three steps which are respectively OFF, or 20dB or 40dB of attenuation. Above that is a mike input filter switch, which in the OFF position provides a 3Hz to 22kHz + 3dB band width, in the M position, which is the preferred music position, provides a 6dB per octave high pass filter above 100Hz and which in the V or voice position, provides a 12dB per octave high pass filter above 200Hz.

> ***'Under the cassette well cover is a series of minor controls'***

To the left of this is a microphone power supply switch selector which provides a 48 V 2mA phantom supply, or a 12 V, 10mA phantom supply, or a 12 V, 10mA A/B feed powering, to suit the wide range of professional microphones that might well be connected to the mike sockets. Some users are concerned that the common powering configurations for both microphones is limited, but this can be overcome by utilising a separate SQN mixer to facilitate two different types of power systems simultaneously.

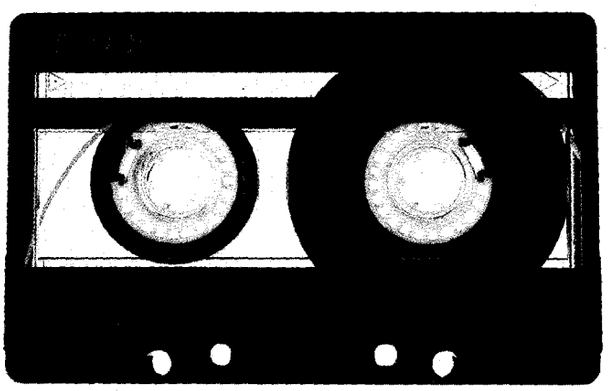
In the centre of the recessed panel are a pair of unbalanced RCA line output sockets colour coded, red for right, and white for left. At OVU output these provide a full 2 V RMS signal, which may prove to be disconcerting for some professional users. Above and to the left of these sockets is a standard tip ring and sleeve headphone socket fed from the common output line amplifier. This provides 15 mW of maximum output signal with an output impedance of 32 ohms. To the right of this is a separate headphone volume control. At the top of the recessed panel are a pair of XLR sockets, one female for DIGital IN and the other XLR three-pin male for DIGital OUT.

On the left-hand side of the recorder are four more sockets, one being a four-pin XLR male socket, which provides for external connection of +12 to +15 V, the second being a BNC socket for connecting the WRD SYNC input connector. This allows synchronisation of this recorder with other equipment. Next is the LTC OUT longitudinal time code output connector, which outputs the time code recorded on the tape and the last is the LTC IN or longitudinal time code input connector, which allows the unit to record its time code from an external generator. To the right of these behind a slide up recessed cover is a 60-pin multi connector, which provides the ability for the user to further expand the functions of the PCM-2000 recorder in the future. Of the 60 pins in the socket, 29 are allocated for specific functions including data transmission and error flags.

After I had familiarised myself with the control functions, it didn't take very long to learn how to use the PCM-2000. Its major and minor controls are both simple and straightforward.

As I soon found, they are peculiarly well set up for serious recording of music or outdoor sound signals. Most of my recording was devoted to recording test signals for

Real to real.



DENON HD-8 100 MINUTE DIGITAL LEVEL, METAL PARTICLE TAPE.
LIFETIME GUARANTEED. THE FINEST TYPE II TAPE MONEY CAN BUY,
CAPACITY OF UP TO TWO AVERAGE COMPACT DISCS.

You are looking at an audio cassette tape which has the ability to make a recording sound as real as the original.

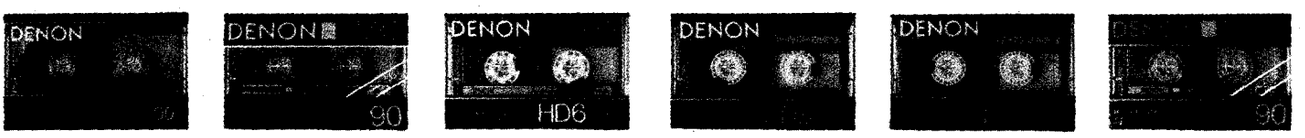
This superior tape has been developed, through 75 years of experience in the art and science of high fidelity recording, to match every requirement of a modern tape. With features like high-density tape coating particles to enable higher output, lower noise, and enhanced magnetic performance. For perfect sound and reproduction. Or dynamic balanced (DB) cassette hubs. For smoother tape rotation and tape wrap reliability. And a new magnetic pigment binding technology for heat resistance in automotive or portable tape.

Denon audio cassette tape is available in a range to suit every recording purpose, from compact disc to actual live recording. And it may surprise you to find that Denon tape is not expensive. Quite to the contrary, every Denon tape is affordable. And because Denon cassettes are built to the highest standards of quality, they're guaranteed for the most extended term imaginable. A lifetime.

So remember to look for Denon tapes. And discover just how real your originals can sound.

For further information contact TEAC Australia on (03) 646 1733.

DENON AS GOOD AS THE ORIGINAL



READER INFO No. 35

Unauthorised recordings may infringe the Copyright Act 1968.

Measured performance of Sony PCM-2000 digital audio recorder

Serial No: 500332

Record to replay response at -20VU:

Tape	Lower -3 dB Point	Max. Point and Frequency	Upper -3 dB Point
TDK	25 Hz	NIL	NA

Speed accuracy: Better than 1:10^5

Wow and flutter

	Wow	Average	Immeasurable
	Flutter	Unweighted	Immeasurable

Harmonic distortion

		1kHz	
OVU	2nd	-82.5	dB
	3rd	-85.6	dB
	4th	-	dB
	5th	-	dB
	T.H.D.	0.01%	
-40VU	2nd	-64.6	dB
	3rd	-	dB
	4th	-70.5	dB
	5th	-69.8	dB
	T.H.D.	.05%	
-60VU	2nd	-45.5	dB
	3rd	-	dB
	4th	-52.5	dB
	5th	-	dB
	T.H.D.	.055%	
-80VU	2nd	-30.8	dB
	3rd	-33.9	dB
	4th	-	dB
	5th	-	dB
	T.H.D.	2.5%	

Dynamic range

Tape		
TDK	103dB(A)	99dB (Flat)

Erasure ratio

(for 333Hz signal recorded at OVU) 100dB

assessing the objective performance characteristics of this recorder, although I did avail myself the opportunity to record some live music as well.

The handbook claims that the PCM-2000 has a frequency response from 20Hz to 20kHz ± 0.5dB, recording with balanced inputs. I soon confirmed that the recorder has a somewhat better performance than would appear from that simple statement as the 3dB frequency extends from 2.5Hz at the bottom end up to the upper limit frequency of 22kHz, at which point it is in fact + 0.5dB high.

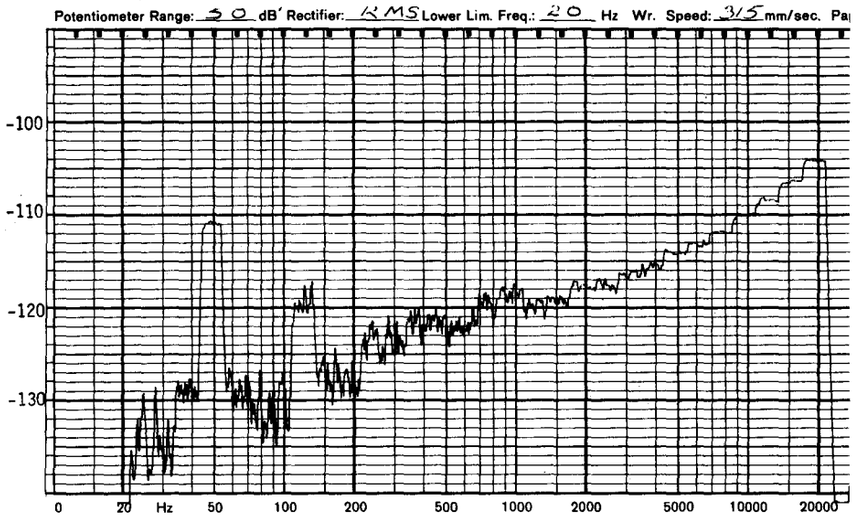
The drop in signal level above 22kHz is extremely fast as you will note on the level recording.

As you will also see the frequency response is ruler flat from 30Hz to 15kHz, and by ruler flat I mean within 0.1dB. Because the frequency response is determined by a digital encoded signal there is no reason to expect that, provided the Reed Solomon codes are functioning correctly, this response would not be maintained between this recorder and any other recorder of similar characterisitcs. The signal-to-noise ratio of the recorder relative to 0dB, is an outstanding 103dB(A) weighted and 99dB linear unweighted. These figures are dominated by the high frequency noise, surprisingly enough, which might well be slightly reduced by the application of emphasis when recording music. However, once you've achieved a signal-to-noise ratio of this magnitude, and particularly with the mid-band signal-to-noise figures, which are of the order of 120dB re 0dB, there is little chance of futher improvements. With signal-to-noise values of 100dB plus, you have, I fear, reached the limits of current digital recording technology.

'You will get the finest portable battery-operated recorder that money can buy'

Although the level recordings of the signal to noise performance of this recorder displays significant hum components with levels conforming to -111dB at 50Hz and -120dB at 150Hz, these components are primarily the result of hum leakage from the regulated power supply which we used instead of the normal NPI battery pack for our laboratory testing.

In normal use with a battery supply, these components would never appear. As a result the unweighted and A-weighted performance of the recorder would be even better than that indicated by our graphs.



Signal-to-noise ratio of microphone input, 5 mV IN, emphasis off.

The crosstalk between channels is good, but not as outstanding as the other performance figures, and the slowly rising level of crosstalk signal from a low of -80db at approximately 100Hz, through to -40dB at 20kHz, is indicative of an apparent signal leakage between the analogue input channels at the front end of the recorder.

As I soon found, the wow and flutter figure is immeasurable, and as hard as we tried we couldn't record anything that indicated any sign of wow and/or flutter.

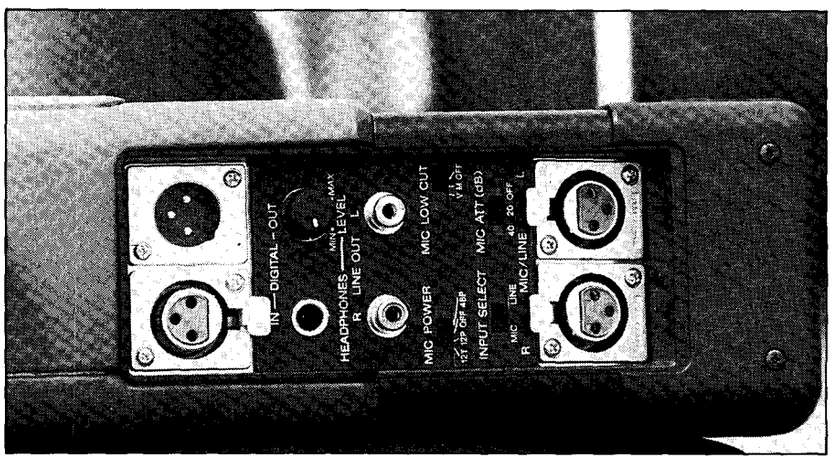
When it came to assessing the distortion characteristics of this machine I was not surprised to find that the distortion figures were slightly better than the handbook claims at OVU, and depending on whether the line output or the record monitor headphone output is used, you get slightly different figures. As the attached table shows, distortion does not become readily measurable until the output signal levels drop to about -60dB. This level, as you will soon realise, is below the normal recording level range when the input signals are monitored by the inbuilt liquid crystal display. At -60dB the distortion is just a little higher than 0.5% at the line output socket and a shade less at the record monitor headphone jack. When the output drops to -80dB the distortion is just on 3% at the line output socket but slightly below the internal noise threshold of the headphone output amplifier.

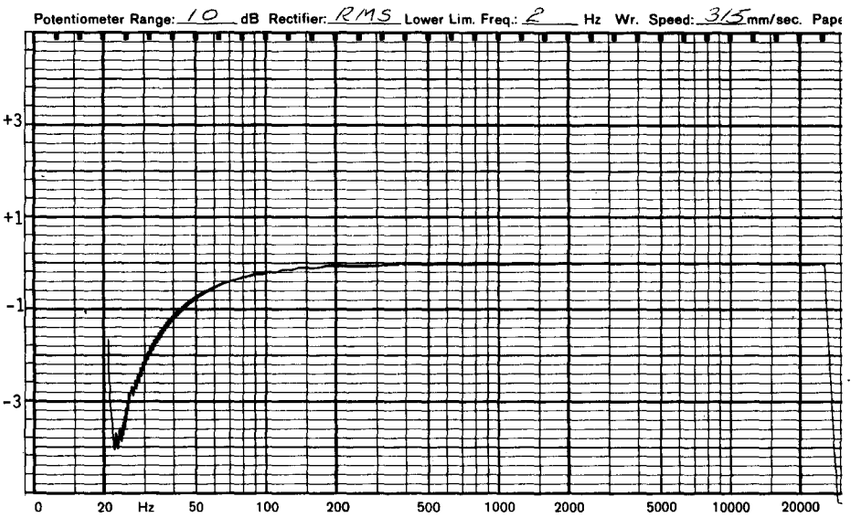
In checking the accuracy of the recording level indicator, I confirmed that it was very accurate, provided the mike input or line input does not overload in front of the recording level amplifier stage. If there is any trace of overload in the front end, a post compression of the signal leads to erroneous indication on the level meter.

I tried my hand at live recording and found that this recorder is far easier to use than any other professional recorder that I currently own (and I have quite a few); ergonomically, however, this recorder leaves the rest for dead.

I listened (very carefully) to the only pre-recorded DAT tape which I own, which was a gift from Onkyo in Osaka, more than a year ago. The 6 minutes of prerecorded material on that cassette convinced me that this machine offers every professional and, I suspect, quite a few semi professional musicians a recording system which is second to none in terms of its technical performance, functional flexibility and, most particularly, its size and convenience.

You may not have the $6500 plus tax that you will need to purchase this recorder, but if you have, rest assured, you will undoubtedly get the finest portable battery-operated recorder that money can buy. eti





Frequency response at 10dB POT; 2-2000Hz.