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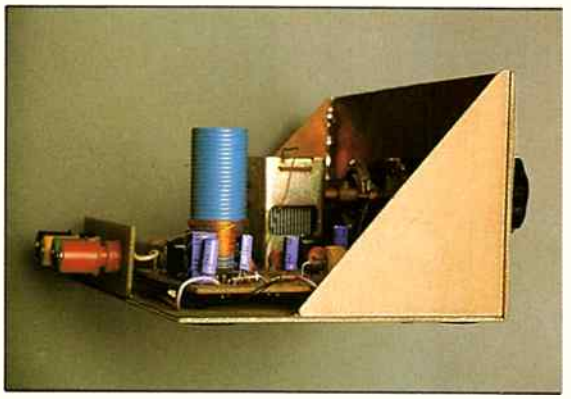

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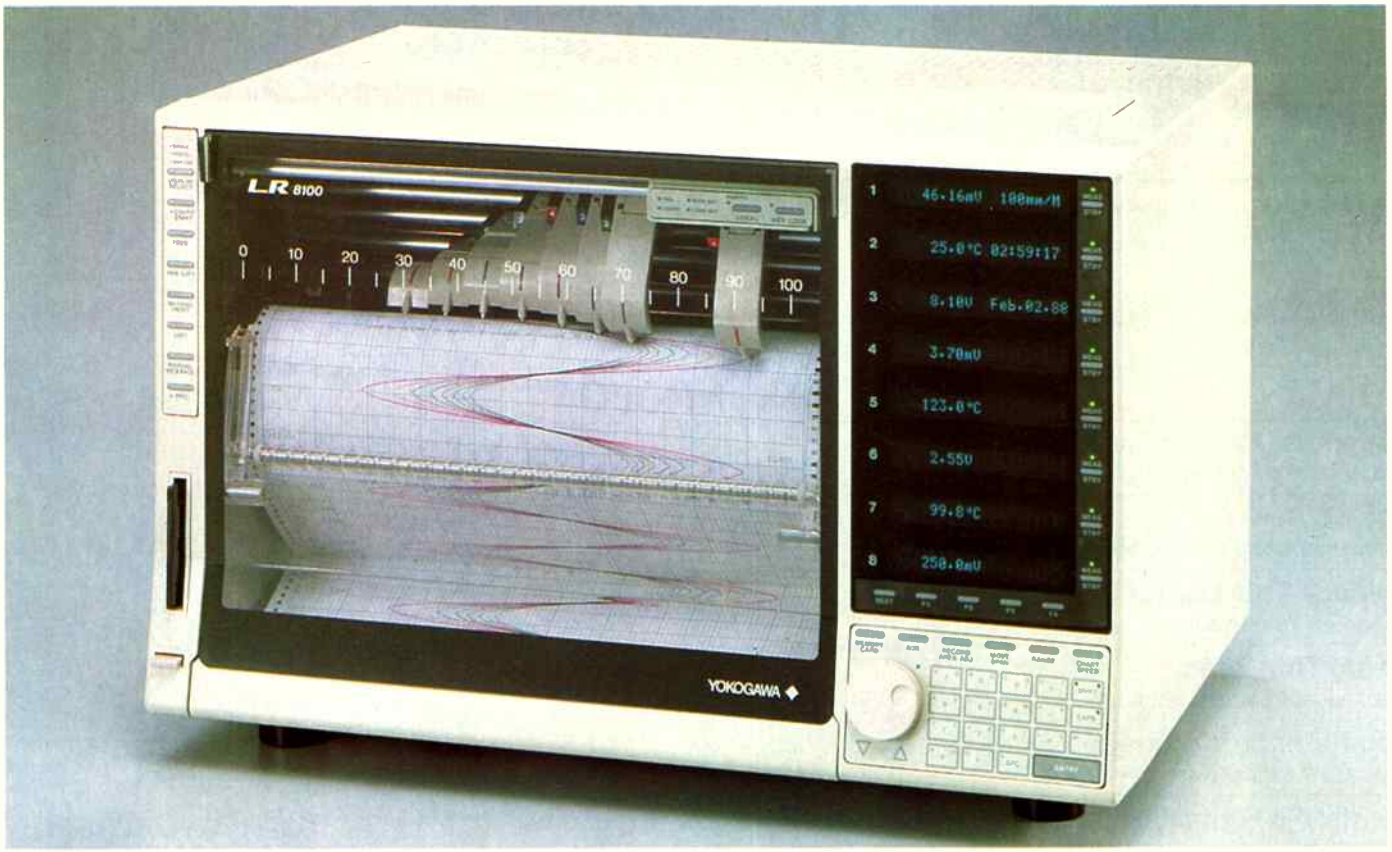

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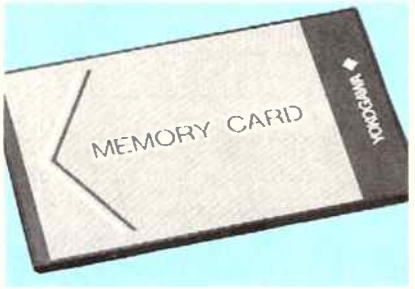

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FREQUENCY

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These days, science is seen more and more to be part of the productive economy of the country and less and less as the somewhat esoteric pursuit of a few unusual minds. In the eyes of those who govern us, at least. This connection of science, technology, R and D, however you view it, was amply demonstrated when the government's new science package was revealed as we went to press.

Extra funding of $1 billion to be given over six years was announced, with a science policy council (to be chaired by the PM himself), Barry Jones' new status as Minister assisting the PM for Science and Technology, $390 million going to equipment and research projects in government agencies such as the CSIRO and in universities and colleges. The tax deduction of 150 per cent on research undertaken by companies has been extended for two years to June 1993, with a further two years at 125 per cent.

'We took notice of what the scientific community was saying,' we were told. Almost inevitably, however, came the voices of protest. The cash, welcome though it was, could not repair the damage done by previous cutbacks at all levels.

While denying reports that 500 CSIRO jobs were threatened, the organisation's chief executive, Dr Keith Boardman, did admit that much more money would be required to cut job losses altogether, and declared that it would take about $60 million a year to restore CSIRO to its position of five years ago ($90 million has been allocated). The Opposition was even more forthright: 'A catastrophe would happen in CSIRO,' said Peter McGauran, science spokesman, unless money was spent on infrastructure and research projects which had been terminated because of lack of funds.

The fact is that Australia languishes pretty low on the international table of science funding. The comparison is based on support of science from direct government grants and from private industry, as a percentage of each country's gross national product. Unsurprisingly, Japan has far more business funding than government, USA has about equal coming from both, and so on down the table to Australia, with low overall spending but the majority coming from the government. Australian businesses are just not investing in science research to a level where a significant turnaround in performance is likely to result.

So while the education field cries out for support as basic science and teaching get a raw deal again — and we should ponder the announced closure before it even opened of Bond University's science faculty — it surely behoves our manufacturing sector to take a close look at its strategies for the future.

It seems strange that good science and technology aren't seen as profitable in Australia today. Indeed, Barry Jones actually stated that only when Australian industry is forced into being innovative by the high quality of foreign competition will it start being profitable (and therefore, one is forced to conclude, worthwhile). High tariffs on imports have kept the balance in favour of me-too technologies, with little that is really new, and we now have the situation in which only the removal of protection of manufacturing industry will stimulate the necessary growth in R and D to cope with all that extra competition in the marketplace.

The generous tax concessions for industrial research and development are said to have been a success, with an increase of industry's share from 20 to 35 per cent, but some sceptics credit creative tax manoeuvres for much of the apparent improvement. Also, how much of the tax advantages are going to foreign-owned companies cashing in on the government's generosity?

Perhaps it is time to ask that the private sponsors of R and D be as accountable as the public sector is required to be. But as the old warhorses of 'higher productivity' and 'reducing debt' raise their heads after another baleful balance of trade report, it seems that science and technology need all the help they can muster to make their proper contribution to the economic future.

EDITOR
Rosalind Bromwich

PRODUCTION EDITOR
Anne Lawton

DESIGNER
Clive Davis

ART STAFF
Ron Farrell

PRODUCTION
Mal Burgess

ADVERTISING PRODUCTION
Brett Baker

SECRETARY
Nina Stevens

ACOUSTICAL CONSULTANTS
Challis and Associates

ELECTRONICS EDITOR
Roger Harrison VK2ZTB

ELECTRONICS SECTION
Compiled by The Apogee Group

EDITORIAL ASSISTANTS
Adam Searle
Jamye Harrison

DRAFTING
Graeme Knight
Jamye Harrison

Enquiries to The Apogee Group on (02) 555 1646: fax (02) 818 2949.

EDITOR-IN-CHIEF
Brad Boxall

PUBLISHER
Michael Hannan

HEAD OFFICE
180 Bourke Road,
Alexandria, NSW 2015.
PO Box 227, Waterloo, NSW 2017.
Ph: (02) 693 6666.
Federal Facsimile: (02) 693 9935.

ADVERTISING
New South Wales: Kim Bucknole, NSW Advertising Manager, Jonathan Poynter, Sales Executive, The Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Ph: (02) 693 6666. Facsimile: (02) 693 9997.
Victoria and Tasmania: Valerie Newton, The Federal Publishing Company, 221a Bay Street, Port Melbourne, Vic 3207. Ph: (03) 646 3111. Facsimile: (03) 646 5494.
Queensland: Graeme Smith, The Federal Publishing Company, 26 Chermside Street, Newstead, Qld. Ph: (07) 854 1119. Facsimile: (07) 252 3692.
South Australia and Northern Territory: Michael Mullins, C/- Federal Publishing, 98 Jervois Street, Torrensville, SA 5031. Ph: (08) 352 8666. Facsimile: (08) 352 6033.
Western Australia: Des McDonald, 48 Clieveden Street, North Perth 6006 WA. Ph: (09) 444 4426.
New Zealand: Gordon Morr, Rugby Press, 3rd Floor, Communications House, 12 Heather Street, Parnell, Auckland. Ph: 796 648. Telex: NZ63112, "Sportby".
Britain: Peter Holloway, C/- John Fairfax & Sons, 12 Norwich Street, London EC4A 1BH. Ph: 353 9321.

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Industry News

John Winters

John Winters has left Apscore International to head the Venture Marketing Group, which offers management and marketing expertise to computer and high tech companies.

Winters was group general manager of Apscore for more than 12 months, presiding over a period of immense growth.

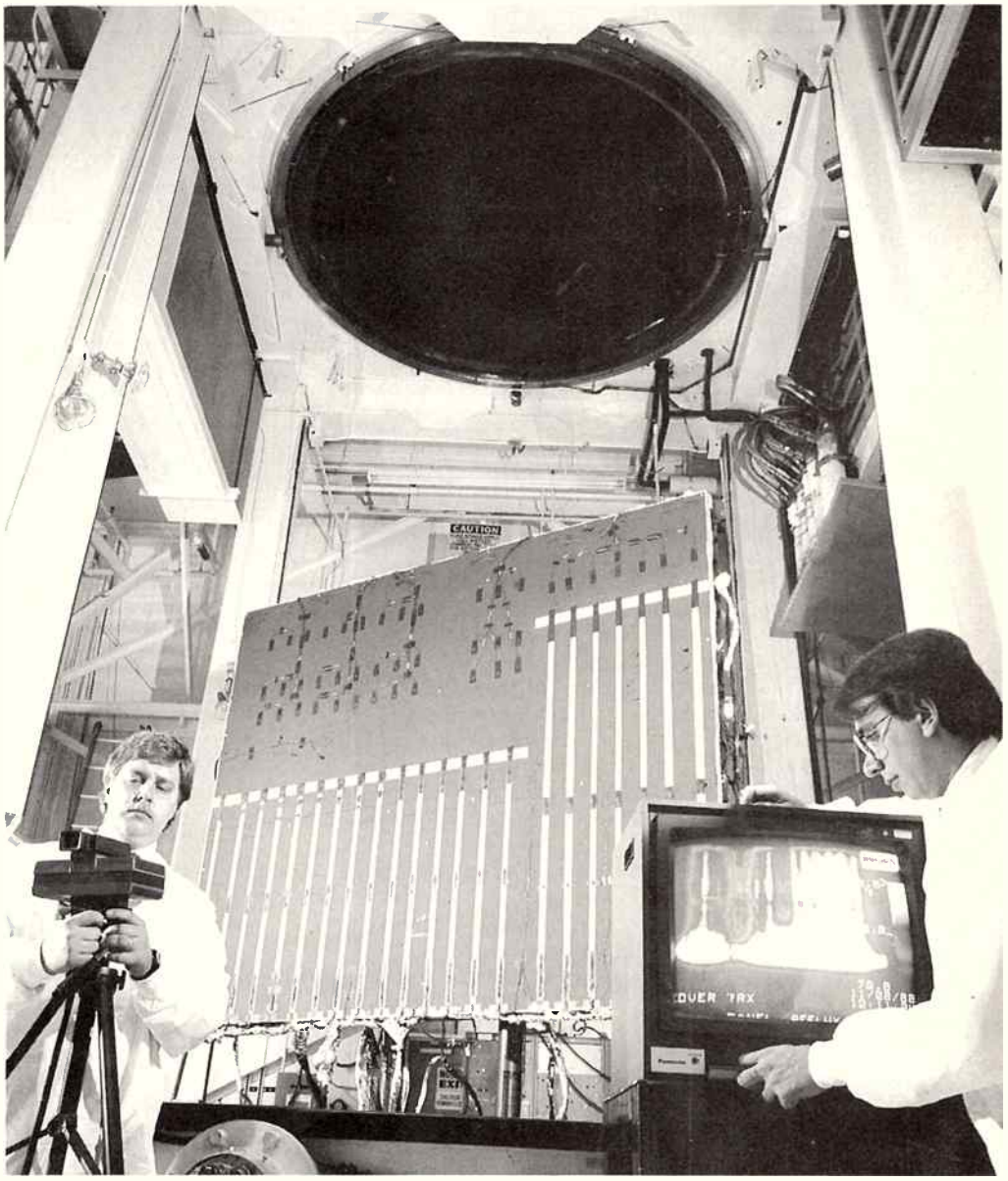
Winters said his experience with Apscore and previously with Attache Software as general manager had given him an insight into what was needed to get Australian high tech companies up and running.

He said the Venture Marketing Group offered a comprehensive range of services specially designed to complement existing skills and resources.

★ ★ ★

Hypertec Pty Ltd, Sydney-based PC enhancement boards builder, has appointed Colin Lillywhite as marketing representative in the United Kingdom.

Lillywhite, formerly senior account representative with B.S. Microcomp, took up his post on April 1. Hypertec is establising a UK office as part of its major UK export drive.



Seeing a satellite's hot spots

SATELLITE technicians at Hughes Aircraft Company use a Probeye infrared viewer (left) to "see" the sources of heat during development tests of the Aussat-B communications satellite.

Images of the satellite's heat exchange system (background) taken by the Hughes-invented Probeye viewer are displayed on a monitor for instant examination. The heat exchange system acts like a radiator to dispel heat generated by the satellite's communications electronics.

Two Aussat-B satellites, the first of which is scheduled for launch in 1991, are being built by Hughes Space and Communications Group in El Segundo, California. They are the first of the new Hughes HS 601 high-power spacecraft and will be owned and operated by Aussat Pty Ltd.

Comms networks remote monitoring

THE Perth-based technology company, Westronic Australia Ltd, claimably a world leader in the design and manufacture of remote monitoring and control systems for large-scale communication networks, has established a presence in Malaysia, Hong Kong and Taiwan.

As part of its push into the region, Westronic has appointed the City Service Company of Bangkok as a sales and service agent in Thailand. The arrangement provides for two Thai engineers to spend a month working and training with engineers at Westronic's HQ at Perth's Technology Park in Bentley.

The aim of the program was to give the engineers expertise in the assembly and testing of Westronic equipment exported to South-East Asia from Western Australia.

Thai engineer Winai Wiriyaprasitchai (left) with Westronic senior electronic technician Robert Barker.

Westronic's Vice-President (Engineering), Ray Datodi, said Bangkok's geographical position was central to the new markets the company was aiming at.

Prime users of Westronic systems are electricity and power utilities, oil and gas producers, refineries, water suppliers, telecommunications companies, complex industrial plants, railway systems and large buildings.

Fusion furore

PROFESSORS Pons and Fleischmann of Utah University claim to have used electricity to split heavy water. This contains a kind of hydrogen called deuterium which has one proton and one neutron in each of its nuclei rather than the single proton in standard hydrogen. It is found throughout the world's oceans.

They say they have spent five years trying to criticise their work, but reached the point where they could see no explanation other than that some nuclear fusion process was going on. Both professors announced in late March that they had successfully sustained a fusion reaction at room temperature for 100 hours using equipment found in school chemistry labs.

One experiment apparently burnt a 10 cm hole in laboratory floor. This heat could not have come from ordinary chemical electrolysis, but it could be generated within the atoms themselves, from the fusion of nuclei.

The scientists' suspicions deepened when they detected gamma radiation neutrons, and a third kind of hydrogen called tritium. These are evidence of deuterium fusion.

While the university has been criticised for making public this research, before it has been subjected to the normal peer review through scientific journal publications, it has been said this was done because information regarding this research was beginning to leak.

Since the announcement the university claims it has been swamped in calls from investors and representatives of industry interested in developing fusion power generators.

So far, despite the number of places attempting it, only two research centres have succeeded in repeating the experiment, one team from Brigham Young University, also in Utah, and the National Technological Institute in Hungary.

Dr Stephen Jones, head of the team at Brigham Young University, said there was a long way to go to demonstrate practical applications of the discovery. Reactions occurring at the rate of 200 fusions an hour were too slow to be a practical energy source, he claimed.

Industry News

Lance Beal

Lance Beal has been appointed managing director of Melbourne-based Trace Technology. Trace is the distributor of Barco Electronics, LTM, CMC and other products for the broadcast communications industry. In addition, the company will shortly be announcing distributorship acquisition for a whole new range of audio products.

Beal joined the company as general manager upon its formation last year. He has worked for several years in the broadcast communications industry, and has held management positions in such companies as Channel 9 in Victoria, the Greater Union Theatre Group in Sydney and Sony Corporation.

★ ★ ★

Dr R H Frater, director of the CSIRO Institute of Information and Communications Technologies, has announced the planned retirement on medical grounds of Dr Ken McCracken, the director of the CSIRO Office of Space Science and Applications (COSSA). Dr McCracken has temporarily transferred to other duties, on the basis of medical advice. He will commence leave on 31 May 1989, prior to retirement. New organisational arrangements for COSSA will be made.

STMs and AMFs

ADVANCES in microscope technology have culminated in the development of the scanning tunnelling microscope and its relative the atomic force microscope. They are able to distinguish individual atoms whose diameter is one angstrom – one ten-billionth of a metre.

The potential of the STM is so great it is only the fourth invention to win a Nobel Prize in Physics since the award was given in 1901. With it, scientists will be able to map the detailed atomic structure of a surface and explore the electronic properties of its atoms individually.

This application will be invaluable to microchip designers, electrochemists and molecular biologists among others. Co-inventors and recipients of half the 1986 prize were Heinrich Rohrer and Gerd Binnig of IBM's Zurich Research Laboratory in Switzerland.

The other half of the 1986 prize went to Ernst Ruska of the Fritz Haber Institute in West Berlin for his work in electron optics and for the design of the first electron microscope.

The STM depends upon the properties of electrons, like the electron microscope and for the same reason. It also relies upon the dual nature of electrons, using a quantum-mechanical phenomenon called tunnelling.

This is where electrons bore through barriers in ways which apparently defy classical physics. The STM utilises this principle in a manner that provides an elegantly simple instrument.

According to its co-inventor, Gerd Binnig, it operates along the lines of a needle tracking a record groove. The needle is sharp and made from tungsten with its tip ground or etched till it is just one atom wide.

This is lowered to within a billionth of a centimetre of the surface to be imaged, and a small voltage is applied. Electrons tunnel between the tip and surface, creating a measurable current.

Repeated scans build-up a minutely detailed picture of the atomic landscape. The precision of the device, able to sense differences in the vertical height of only 0.01 angstrom, said to be remarkable, stems from a unique property of the tunnelling current.

According to Heinrich Rohrer, "It is this exquisite sensitivity that gives you atomic resolution."

Since 1986, a large number of STMs have been built and are installed in about 100 labs worldwide. They are now commercially available, too. The devices have been key to developing applications in almost everything from computers to metallurgy and medicine.

But what the STM cannot do is work well with non-conducting materials. This is because it depends on electron tunnelling. This is where the AFM, or atomic force microscope comes in.

It was invented by IBM Zurich's Binnig and Gerber in collaboration with physicist Calvin Quate of Stanford University's E.L. Gintzon Laboratory. The AFM scans a surface by moving a tip along it one straight line at a time. But it is actually in contact with the material and senses the micro forces which exist between atoms.

It uses a diamond tip mounted on a tiny gold-foil cantilever spring which can ride up and down. A small force (roughly one-millionth of a gram) is used to keep the tip on the surface but it is not enough to cause any damage.

The inter-atomic forces sensed at the end of the tip cause the cantilever spring to deflect slightly, corresponding to the atomic structure. To measure these deflections, scientists at UCSB have sandwiched the diamond tip and gold spring between the sample and an STM tip.

As the metal cantilever rides over the sample, if it goes up, narrowing the gap between it and the tunnelling tip, more tunnelling current is seen. If it goes down, less current is seen.

The instrument thinks it's tunnelling, but it is actually measuring the deflections. This endows the AFM with atomic resolution.

The optical-lever AFM works by bouncing a laser off a small mirror mounted atop the diamond tip. Light reflected from the mirror is detected by a position sensor.

Very small deflections are amplified or "levered" by the system's geometry. This way the unit can detect a vertical change in a surface of only 0.1 angstrom. The future of both the STM and AFM are believed to be without limit.

History for sale

WAY back in 1980, ETI purchased the then 'state of the art' in microcomputers – an Industrial Micro Systems 8000. It was, and still is, a truly magnificent machine of vast weight and size. The dust cover alone outweighs several of today's complete PCs and the power supply just has to be seen to be believed!

Incredibly, for its age, the IMS supports multiple terminals with separate inbuilt microprocessors for each. Today, the machine is still in full working order. It has been upgraded, sporting a 25 Mbyte hard disk drive as well as the original 1.2M 8" floppy disk drive.

Architecture is the classic S100 bus, so the machine is infinitely adaptable. The operating system is the classic CPM-compatible TurboDOS; CPM is also available.

The machine, together with up to five Televideo 910, 925 and 950 terminals, is now offered for sale, complete with manufacturer's workshop manuals, full circuit diagrams and a vast range of software and disks.

This is a unique opportunity to purchase what was truly the Rolls-Royce Silver Ghost of microcomputers.

Despite its age, the IMS 8000 is totally reliable and astonishingly fast (it eats IBM PCs for breakfast and most of today's LANs seem like a bad joke).

The machine would make an ideal basis for bulletin board operations – or would operate for many years in routine computing operations. It is still in daily use and can be shown running. Service is still available! Also available is a second (back-up) machine with 1.2M floppy drive and a 10M hard disk.

Eventually, both machines will be worth a fortune as collectors' items.

The IMS 8000 and terminals will be sold separately if necessary.

For the past few years, the machines have been in the possession of ETI's Founding Editor. For further information, ring: Collyn Rivers on (02) 818-3559.

Optical disk breakthrough

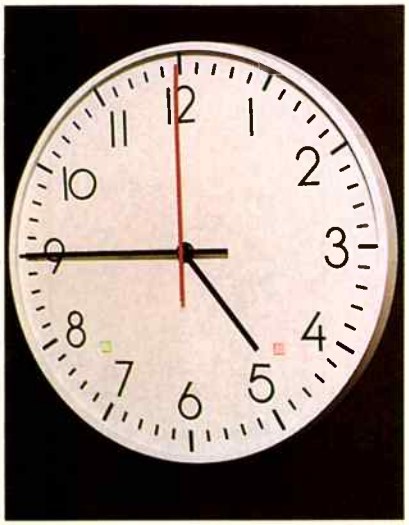
A 3.5 inch erasable optical disk holding 280 Mbytes of memory in the read/write/erase format from Energy Conservation Devices in the US is to be marketed by Matsushita Electric.

Access time is said to be around 42 milliseconds. This is as fast as a current, reasonable hard disk.

World's biggest clock system

AN extensive master clock system installed throughout the new Parliament House in Canberra is, according to suppliers, probably the biggest clock system in the world.

It includes approximately 2500 analogue, slimline walls connected by 50km of cable to a telesynchronised master clock with five satellites.



Both Houses are served by the system, and each clockface displays red and green which flash to indicate when MPs are being called into either House when a division is called on a vote.

A current of 120 amps is required to light up all 5000 division lights. The accuracy of the clocks is within 0.001 seconds a year.

Hertz Electronics Pty Ltd of Sydney, having initially designed the system, has supplied the Ascom-Favag brand Swiss-made clocks.

According to them it is probably the biggest clock system in the world.

It has cost several hundred thousand dollars, and is similar to, but bigger than, systems normally used in long-distance railway networks.

Promise to banish CFCs

SEVERAL of the world's largest electronics companies have promised to phase out the use of ozone layer-destroying CFCs. NEC and Matsushita from Japan, the world's largest and ninth largest IC manufacturers respectively, announced this in late March.

This follows from the agreement reached at the meeting of the American Electronics Association held in Silicon Valley, California, also in March.

The industry consumes huge amounts of CFCs in IC production, Matsushita this year will use 3800 tonnes. Its target for 1993 is 3000 tonnes, with all consumption ending at the turn of the century.

NEC said it would halve use by 1993, and also finish up by the year 2000. Seiuko Epson, too, said it would cease CFC use by 2000. These companies, and others, are responding to pressure from the Japanese Government.

It wants to repair the country's somewhat soiled environment image, and may offer tax concessions to this end. The question around the traps now, according to industry sources, is not if they get rid of CFCs, but how and when.

The sooner the better.

Training levy debated

THE concept of a training levy on companies, raised during the often heated discussion surrounding the development of the Graduate Tax (euphemistically named the Higher Education Charge), has again re-emerged.

The Australian Vice-Chancellors Committee (AVCC) has placed on record its opposition to any nationally collected and controlled levy of this kind. Instead, they support an internal levy system for companies, set at around 1% of payroll tax.

Professor Susan Serjeantson, who holds the chair of human genetics at the John Curtin School of Medical Research in Canberra, has said an industry training levy is urgently needed to redress the disaffection among people for a science career.

She said a 1% levy would increase the money spent on R and D to around two whole per cent of GDP, an increase from the present level of 1.18%. This is not a figure which compares well to other OECD nations.

However, Alex McLachlan, president of the Institution of Engineers, has called on the Federal Government to abandon thoughts of such a levy. He is not convinced existing training resources are spent to the best effect.

He said the Institution opposed the levy as "unproductive". Existing resources weren't being used to maximum benefit because Australia's current training system is craft-based instead of industry-based.

"Our award structures are too inflexible for a modern industrial-based nation," said McLachlan. "Consequently many training skills taught are irrelevant to the needs of industry – growth industries in particular."

Any decision on a levy should be deferred until existing programs have been "re-oriented to meet actual needs" and the effects of award restructuring assessed.

But the president of the Australian Society for Medical Research, Dr Nick Hunt, said financial and personnel problems in medical research have reached the stage where people talk openly of a 'crisis'.

He observed that science was now the easiest course for tertiary students to get into. Professor Serjeantson blamed the Federal Government for funding cuts which had driven our scientists overseas in search of better conditions and facilities.

She referred to the Australian wool industry which introduced a training levy in the late 1950s in response to the threat from synthetic fibres. Non-farm industries should now follow the lead, she said.

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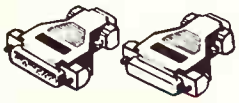

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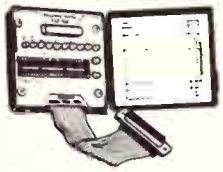

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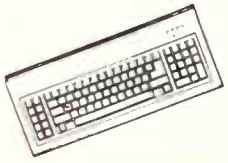
KEYBOARDS



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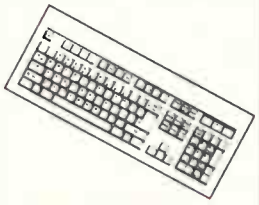

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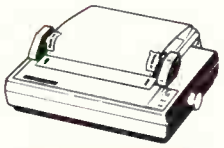

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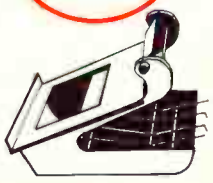

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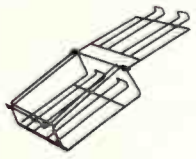

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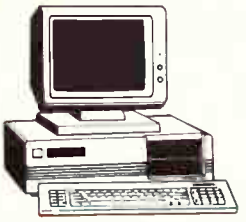

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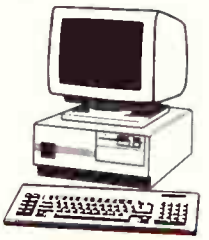

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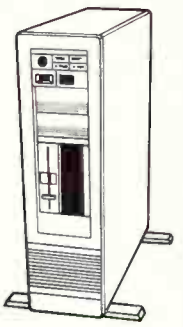

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FEATURES:

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- Four 16-bit I/O slot. Three 8-bit I/O slot, and one 32-bit memory slot
- 8042 keyboard controller interface for AT* compatible keyboard
- Seven direct memory access (DMA) channels
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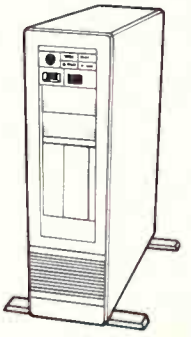

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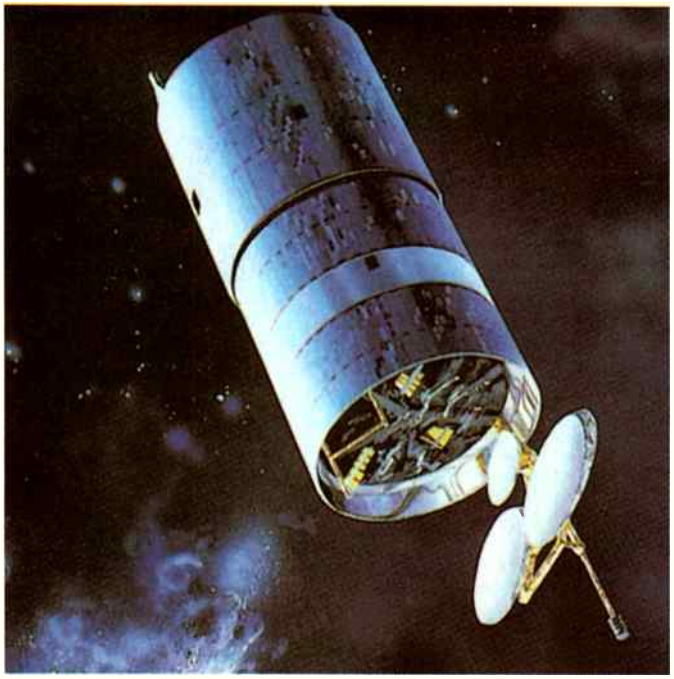


Aussat is just one of the several big names being supplied with earth station equipment by Codan.

Codan spins off satellite division

AUSTRALIA'S largest manufacturer of high frequency radio systems, the Adelaide-based Codan Pty Ltd, formed a separate division in December 1988, headed by Allan Gobolos, formerly engineering director for the Codan Group.

Since entering the field of satellite communications in 1980, the Codan Satellite Division was now generating revenue of around $5m a year, according to Gobolos.

Formed in 1959 to design and manufacture high frequency communications equipment, Codan now controls a significant share of this market in Australia and the Pacific Basin, and is Australia's sole designer and manufacturer of satellite earth stations.

Steady growth has seen the privately-owned group achieve an annual turnover of $25m, with over $5m derived from exports to more than 100 countries, including many developing ones.

The basic product in Codan's successful push into satellite communications is a telephony earth terminal (the ST9000 series) suited for thin route telephony and data private network applications in remote and rural areas. The satellite earth station operates through the Aussat satellite, in fixed orbit 35,000 km above Australia. Typical users are the emergency services, mining companies, government utilities and statutory authorities.

Companies currently supplied with earth station equipment include Aussat, OTC, regional and national television networks and AWA. Other products in commercial production include microwave component assemblies and digital satellite modems for business applications.

A key element in Codan's success, according to Gobolos, was its commitment to research and development and its associated involvement in OTC R&D programs. Codan employs around 350 people, with over 10% engaged in R&D, which accounts for 6 percent of gross revenue. Thirty-eight employees work in the Satellite Communications Division.

Death of the book?

IN an opening address to a publishing trade symposium entitled 'Towards the year 2000', staged by the US Aspen Institute, Jerome Rubin, vice-president of Times Mirror, claimed technology could render the book obsolete.

Expansion of computerised databases and electronic books would reduce the need for printed books, he said. Electronic books are easily revised, which is especially useful in areas like finance, science and legal data.

He went on to suggest that modern paperback, readers would, in the year 2000, insert a card-sized piece of plastic into a compact, high-resolution, flat screen holder, select the size, font and colour of the type and push buttons to turn the page.

It was conceivable that text would be dispensed with altogether, with readers looking at pictures instead and hearing the words read aloud.

However, some of Rubin's colleagues took issue with this scenario. Arthur Rosenthal, director of Harvard University Press, said such technology threatened to disenfranchise those who could not pay for information.

Others said computers could never substitute for taking a book to bed or reading in the bath. As the Mayor of Jerusalem, Teddy Kollek, said at the recent Jerusalem International Book Fair which displayed 100,000 books and drew publishers from 42 nations, "The book is still the expression of the spirit of mankind."

Commercialisation in Soviet space program

IN a recent decision, the Soviet space agency, Glavkosmos, announced a deal with a Japanese television company to send a journalist into space in 1991. The company, the Tokyo Broadcasting System (TBS) has said it may throw the field open for anyone to take part in the mission, not just a Japanese or a journalist.

Glavkosmos has also announced a deal with a Swiss company to sell advertising space on cosmonaut spacesuits and the Mir space station. Such moves derive from the pressure on the Soviet space program.

It has been squeezed from the international commercial launch market. Many in the USSR are now apparently questioning the program's value.

Soviet newspapers have reacted with indignation at these attempts to put the Soviet space program on a firmer financial footing. Space administration has been accused of "trampling prestige underfoot" to get hold of hard currency.

The Communist youth daily, Komsomolskaya Pravda, has said the Chemical Industry Minister, My Yuri Bespalov, had offered to pay for the flight from ministerial funds for the sake of "national prestige".

Many Soviet citizens have been annoyed at the cost of their space program. Maverick former chief of the Moscow Communist Party, Boris Yeltsin, campaigned for the new national parliament partially on a platform of a seven year moratorium on new space programs. He secured 89% of the vote in the Moscow constituency.

Soviet attempts to launch foreign payloods have also been hurt by a US ban on allowing the launch of satellites with US parts to be launched by Soviet rockets, despite the low rates being charged. Only India has signed for two commercial satellite launches.

For only one million Swiss francs ($620,000), the Swiss ad agency Punto SA has announced a deal with Glavkosmos to advertise on Soviet spaceships, launch pads and cosmonaut uniforms.

According to Andrea Capra, owner of Punto, the main exposure will be at launches, where the Soviets have indicated they wish to increasingly open to Western TV crews. A billboard able to display two company or product logos will also be constructed for the Mir space station.

There will be an opportunity for clients to have a three-minute commercial filmed by cosmonauts on the Mir. They will also be permitted to take 1kg of cargo into space. The idea here is that having been in space will increase their value.

Tass, the official Soviet news agency, has reported plans for a joint Soviet-Austrian space flight. Last year, Alexander Dunayev, head of Glavkosmos, said he would demand the Austrians foot the bill. Previously, both governments would co-sponsor such efforts.

Crawford quits AWA

AFTER barely 18 months in the job, Dr Peter Crawford (who was proclaimed AWA's saviour when appointed managing director in mid-1987) has walked out following a bitter dispute with AWA chairman Peter Mason over the speed and extent of the company's investment program.

Peter Crawford, a self-described "tough operator" with a "strong determination to get his way" was said to take a long-term view on how best to secure AWA's future following three successive years of upheaval which culminated in losses of $50m. This embarrassment was put down to a breakdown in internal management.

His strategy, aimed at reconstructing AWA into an internationally competitive company, consisted of an aggressive program of selling peripheral assets, focussing the company's energy on its hi-tech and electrical businesses.

A number of traditional businesses and properties were jettisoned, with the proceeds used to acquire new operations and expertise. This led to high start-up costs which reined in profits and ate heavily into earnings in the December half year.

A major problem was that Crawford was prepared to suffer the significant costs and what he saw as short-term impact on profits while AWA's major shareholders were not. He walked out because he believed he no longer had the support of a big investor in AWA, Pacific Assets.

PA paid top dollar for its shares, having leapt to AWA's defence in 1987 during the attempted rape by Christopher Skase. It is now bleeding and wants a quick fix, and its wishes are carefully noted. Pacific Assets chairman Peter Mason is also chairman of AWA.

AWA's largest shareholder, Capita, whose chief David Greatorex is deputy chairman of AWA, has supported Mason. Capita also paid a hefty price for its slice of AWA. It bought Skase's holding. When it did so, it was Capita's largest single equity holding. Greatorex has made it clear he wants a high return.

AWAFOCS terminal — part of AWA's Defence and Aerospace battlefield communications system. AWA's three successive years of upheaval have resulted in losses of $50m. Now, the aim is to 'stabilise' the company.

So does PA, having announced an extraordinary $10m loss on its AWA investment. Both Mason and Greatorex want AWA's share price to rise from its four-year-low of $1.05 a share.

Perhaps Crawford ran into trouble by taking a longer-term view which was incompatible with PA's, and perhaps Capita's shorter-term needs.

It is ironic that his departure coincided with a big improvement in net half-year profit to $30.46m on last year's $6.4m loss.

When unusual items and tax-benefits are discounted, it apparently shows a halving in operational profit to $3.8m from $7.9m. This is said to be a result of a heavy investment program on top of a 27.7% sales revenue reduction to $210.85m.

Delays on radio

PROBLEMS in filling positions in the Department of Transport and Communications have delayed implementing planned changes in the amateur operator certificate examinations, the DOTC has told the WIA (Wireless Institute of Australia).

The changes follow forums held by the DOTC early last year about the devolution of the examinations, and where the department expected to follow new procedures late last year. Nor has the department been able to advise applicants of details of the accreditation process.

The DOTC told the WIA it would set up the new procedures as soon as possible, but added that final implementation would depend on the resources it had available to finish outstanding tasks.

Mac April Fool!

IT was too good to be true. A Macintosh with a colour screen, 4 Mbytes of RAM, 60 Mbytes of hard disk storage and a mouse, running at twice the speed of any other Apple Macs with a price tag of under $10,000. Best of all, it was to be made by IBM.

According to the April issue of the US MacWorld magazine the release of this machine was imminent, causing much interest in the Macintosh fraternity. The story blazed through bulletin boards and even hit the business page headlines in some cities.

However, because the April edition came out in mid-March, no one made the April Fool's Day connection for which the story was intended. MacWorld was apparently surprised at its fabrication's acceptance. The IBM angle should have given the game away, they thought.

According to sources in the industry, the successful hoax reflects a widespread belief that a low-priced Mac is inevitable, that Apple Computer can no longer sustain its high prices while those in the rival MS-DOS market keep falling.

Astronomers discover active stellar corpse

A GROUP of American scientists, operating at Palomar, Kitt Peak, and the Steward Observatories, and using NASA's International Ultraviolet Explorer satellite, have discovered evidence of vigorous activity in a white dwarf star about 1500 light years from Earth – previously thought to be a "corpse". They think this finding may help them understand how stars are born, evolve and die.

When stars exhaust their nuclear fuel, they become compact white dwarfs, commonly thought incapable of any stellar activity other than a gradual cooling off. However, the object, catalogued as 0950+139, is surrounded by a glowing cloud of gas approximately the size of our solar system.

A number of explanations have been put forward. The white dwarf may be continually losing mass through some unknown process, according to Howard Bond of the Space Telescope Science Institute in Baltimore. This is unexpected because of the tremendous gravitational force on the surface of a white dwarf.

Another possibility is that nuclear-fusion re-ignited below the exhausted star's surface causing it to briefly balloon back into its red-giant phase, then re-collapse back into the white dwarf seen today, while the outer layers escaped to form the second shell of material observed around the star. This process may have lasted only a few years and "could well have gone unnoticed by astronomers," says Bond.

A third explanation, advanced by I. Iben and J. MacDonald at the University of Illinois is that hydrogen may diffuse below the star's surface to mix with carbon rising from its interior, leading to a re-ignition of nuclear fusion. As the process is very slow, they say, a star could have existed as a white dwarf for some time until the re-kindling of nuclear fusion.

Uni leads in superconductors

AT NSW University, the Advanced Electronic Materials Research Group has apparently perfected the manufacture of textured superconducting materials as well as superconducting quantum interface devices (SQUIDs).

They were one of the first groups in the world to manufacture textured superconductors. Its methods have only been reproduced at other laboratories in the last three to four months.

The 20-member uni group was established in mid-1987 with a three-year grant of $480,000 from the Department of Industry, Technology and Commerce under the Grants for Industry Research and Development (GIRD) scheme.

By the middle of next year, the money will run out.

Professor Graeme Russell, a team member, expects the first thin-film superconducting products to be on the market later this year. "The US and Japan are always telling people how far ahead they are – this will be a bit of a shock for them," he said.

One of the difficulties the group faced was that the needed equipment was not readily available. They had to search it out, and convince people to let them use it. This made the process more challenging than just the research.

Fairly soon, the details of a commercial agreement between Unisearch, the university's research arm, and AWA should be completed. The first commercial applications should appear later in the year.

A SQUID comprises two pieces of superconducting material separated by a small gap. Electrons approach the gap in pairs, which in quantum physics acts like a wave. Part of the wave tunnels across the gap to establish the charge on the other side.

They are very sensitive to changes in magnetic fields, current and temperature. This has led to their application in mapping brain-waves and prospecting for minerals by detecting changes in the ground's magnetic field.

They can also be used with pacemakers and magnetic storage devices like discs, by warning of the presence of strong magnetic fields. In contrast to the old SQUIDs which require liquid helium at $30 a litre to work, the new ones operate on liquid nitrogen which costs only 20c a litre.

Professor Russell said it was pointless trying to patent this development until the superconductor market stabilised in 10 or 15 years.

"We are not in a position to take out worldwide patents and battle multi-billion-dollar companies in court. The only way you can get ahead is to quickly follow up any breakthrough with commercial products," he said.

He also said he was confident Australian industry could exploit this discovery adequately.

Alcatel-STC to supply Telecom

ALCATEL-STC has won a $3 million contract from Telecom for equipment which allows telephone services to be rapidly connected to rural areas or urban developments such as new housing estates.

Adapted from the Versatile Multiplexer (VMUX) being manufactured as part of a three-year $50m contract for New Zealand's telephone system, the Remote Customer Multiplexers (RCM) will eliminate the need for telephone exchanges in areas where they would not be economical.

When fully equipped in their roadside cabinets, the RCMs will be able to handle a total of 240 telephone services within a 5km radius. Being a pair gain arrangement, it can apparently provide 30 phone links for each pair currently in that area of the Telecom network.

For more details contact Alcatel-STC, PO Box 488, 5 Blue St, North Sydney NSW 2060. ☎ (02) 925-7272.

Short list for communications contract

A joint venture between AWA and Telecom Australia has been shortlisted by the NSW State Government for its $88m-a-year statewide communications program.

The opportunity comes at a good time for AWA which is presently targeting service oriented opportunities. This comes hard on the heels of last year's restructuring, when AWA established a Project Services Unit with specialist skills in project management and systems integration.

Telecom's National Business Manager for the NSW Government, Brian Penhall, explained the basis of the joint venture. "AWA Project Services will provide management services while Telecom will ensure the optimum use of State Government purchasing expenditure, as an industry and export stimulus."

The partners say they believe this split of responsibilities will ensure the optimisation of Telecom's public networks, that due consideration is given to alternatives like Aussat, and that competition is maintained between all interested suppliers for other services.

Three other shortlisted groups are OTC/Computer Power, Bond Media/British Telecom, and L M Ericsson.

What the State Government is apparently after is a communications service covering voice, data, facsimile, text, video and mobile communications.

Whoever secures the contract will face a stiff challenge meeting the diverse needs of the NSW Government, with its presence in most towns throughout the state.

SUNSPOTS, THE EARTH AND EVERYTHING

The Sun has been getting all knotted and spotty of late. But that's normal, because it's rapidly approaching one of its regular highs (sunspot maximum) which it does roughly every 11 years, the last being in 1979. And the solar activity associated with this is having some spectacular effects here on Earth with aurorae being seen over Ipswich in Queensland, for example, Australian CBers regularly making contact with CBers on other continents and, more spectacularly, West Australian radio amateurs making contact on 50 mHz with amateurs in Finland, half-way round the world! When Old Sol goes on a high, so do radio propagation conditions. By Roger Harrison, VK2ZTB.

TECHNOLOGY

Sunspots are small, dark patches that appear on the visible surface (the "photosphere") of the Sun. They appear dark because they are cooler than their surroundings. The earliest known historical recordings of sunspots date back to the first century BC, when the Chinese observed them. The invention of the telescope brought the first systematic observations of sunspots in 1610, made by Galileo. The publication of his observations caused great consternation at the time; the Sun, blemished? Heresy! So much for telling the truth.

While sunspot observations on some sort of scientific basis date from Galileo's time (thankfully, Galileo's punishments did not deter others), reliable systematic observations only commenced in the mid-nineteenth century. Henry Schwabe, a German amateur astronomer, noted in 1834 what appeared to be a 10-year cycle in the number of sunspots based on observations he'd made over the previous seventeen years. No-one else had noticed any periodicity to that time, despite some 200 years of astronomers looking at the Sun through telescopes **(NOTE:** this is a very dangerous practice! You should *never* look directly at the Sun either unaided or through binoculars or telescopes as you will damage your eyes, permanently. To view the Sun with a telescope, project the image onto a sheet of white paper that is shielded from direct and reflected light.)

Not long after this, Rudolf Wolf of the Zurich observatory organised a world-wide program of regular solar observations among professional astronomers. A similar program continues to this day. From a search through earlier solar data, Wolf concluded that the average solar cycle was around 11 years. It was also Wolf who devised a method of counting sunspots and sunspot groups, to come up with a term known as the "sunspot number".

The Wolf sunspot number, R, counts the individual spots and the number of spot groups, making one sunspot group as important as 10 individual spots. The sunspot number is expressed as a weighted sum, like this:

R = 10 x No. of spot groups
+ No. of individual spots

It might seem like something out of a numerology text (think of a number, multiply it by your age and add the number you first thought of!), but it has stood the test of time. The sunspot number will be zero when no spots are apparent, 11 with one sunspot visible (which is also regarded as one group) or more. Sunspot numbers over 250 have been recorded. The sunspot number doesn't mean much in itself. Rather, it is a useful indicator of solar activity.

Each month, a mean of sunspot observations is take to produce a Monthly Observed Sunspot Number. As you'd perhaps expect, this fluctuates substantially from month to month. The monthly sunspot number is statisically "smoothed" to produce a Yearly Smoothed Sunspot Number which is used to chart the progress of the solar cycles.

The solar cycles are numbered – arbitrarily, but it helps to identify the individual cycles since regular scientific records have been kept. The current solar cycle, denoted as number 22, began in September 1986 when the yearly smoothed sunspot number reached a minimum value of 12.4. Since then, the sunspot number has risen rapidly, in fact more rapidly than any of the previous 21 cycles. Figure 1 shows a comparison with the previous three cycles.

In December 1987, the yearly-smoothed sunspot number was 51.4. The December 1988 value is estimated to be in the vicinity of 130. In that time, we've virtually gone from solar minimum conditions to conditions close to those usually experienced at solar maximum. The monthly sunspot value has exceeded 100 every month since June last year. The average amplitude of solar cycles (measured by yearly smoothed sunspot number) is about 110, so this cycle is already stronger than average. Figure 2 shows what's been happening. Daily numbers during this cycle have ranged from 150 to 250 since 1988.

The strongest cycle on record was cycle 19, which peaked in 1957 (see Figure 3) with a yearly smoothed sunspot number of 201. The last cycle (21) peaked at 165 in 1979. It seems likely that this cycle will exceed cycle 21 in amplitude to become the second largest cycle observed since records were systematically kept. Some observers are saying that it is still possible that this cycle may even exceed cycle 19, to become the largest on record!

The peak of a solar cycle brings with it a number of things that affect things here on Earth, both benefits and problems. Ultraviolet radiation from the Sun ionises the upper

layers of the atmosphere, from around 60-100 km upwards, creating that complex, electrified layer known as the ionosphere.

As you may well know, the ionosphere is used to reflect high frequency radio transmissions, between about 2 and 30 MHz, for long-distance communications and shortwave broadcasting. The higher levels of ultraviolet radiation from the Sun during the peak of a cycle produces greater ionisation in the Earth's ionosphere. This allows a wider spectrum of the high frequency (HF) bands to be reflected by the ionosphere, benefitting HF communicators and broadcasters.

The effects of solar activity on HF communications are well known to anyone who has spent any time involved in communications where HF circuits are employed – professional communicator and enthusiast (amateur or shortwave listener) alike. The solar cycle peaks, particularly large ones, bring problems, too, not just for HF communicators, but for a host of other terrestrial and space-borne systems. Two important events more common during large solar cycles are energetic solar flares and large geomagnetic disturbances.

Light my fire

A solar flare is a large "explosion" on the Sun, caused by a sudden release of magnetic energy when the magnetic field at some position on the Sun gets so contorted that it takes less energy to blow out the offending material and settle back to a non-contorted state than it does to stay contorted.

With the current solar cycle now rising rapidly towards a maximum, and with the Sun becoming increasingly "active", the effects on the ionosphere and HF communications can be quite dramatic. The Australian IPS Radio & Space Services has a daily recorded solar and geophysical report available simply by making a phone call. Here's how to "read" the solar-geophysical "weather" report you'll hear.

A solar flare can be seen by any of the techniques to observe the Sun, but a flare must be exceedingly large and bright before it can be seen in white light. Regular photographs of the Sun are taken using a filter that selects light emitted by hydrogen called H-alpha emission, which has a wavelength of 6563 Angstrom or 65.63 millionths of a metre. At this wavelength, we cannot see as far into the Sun as we do in white light. That is, we're looking at higher layers in the Sun's "atmosphere" (called the chromosphere because we're looking at a single wavelength, or colour. "Chromos" is the Greek word for colour.)

The chromosphere shows a wide range of very detailed structures; it's a beautiful sight when viewed through a telescope at a solar observatory. These structures are variously called plages, prominences, sunspots and fibrils.

Two solar observatories operate in Australia, one near Narrabri, NSW and the other in West Australia, at Learmonth near Exmouth. The US has large solar observatories at Kitt Peak in New Mexico and at Palehua in Hawaii. The early US space station Skylab, flown in the mid-1970s, was used for an extensive program of solar observations. Ironically, the rise of cycle 21 expanded the Earth's atmosphere, increasing drag on the satellite causing its orbit to decay more rapidly than originally expected. It broke up and plunged to Earth over south West Australia in 1979.

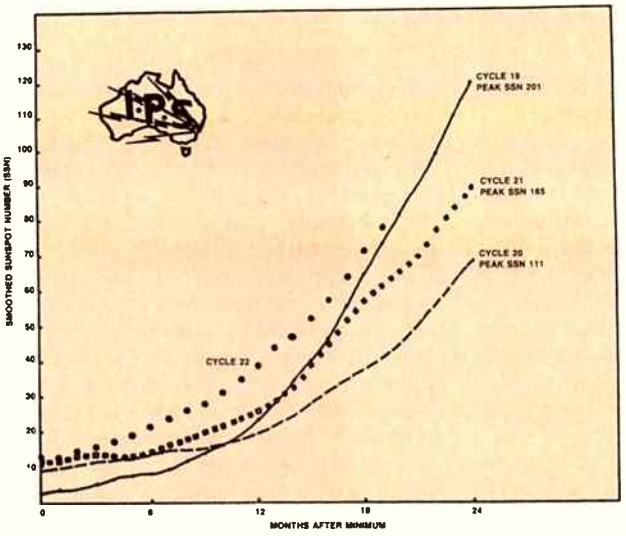


Figure 1. The rapid rise of solar cycle 22. This shows how quickly the sunspot number has risen for the current cycle, compared to the previous three cycles. (Courtesy IPS Radio and Space Services).

Sunspots do not show up well in H-alpha light as they are lower in the Sun's atmosphere and are often hidden by overlying chromosphere; those that do show up are usually the larger ones. Plages, from the French for beach, are large, irregular bright areas often (but not always) associated with sunspots. Plages emit copious amounts of extreme ultraviolet (very short wavelength) radiation and thus play a role in the formation of the ionosphere and its variations. Regions containing plages and sunspots are known as active regions as they are continually changing.

Prominences and filaments are the same thing seen from different perspectives. A prominence is a large cloud of relatively cool gas which is suspended above the Sun's surface by magnetic fields which prevent its collapse back into the surface. When such a cloud is seen on the edge (or limb) of the Sun, against the dark background of space, it appears quite bright and is called a prominence. When seen against the face of the Sun it appears relatively dark as it is

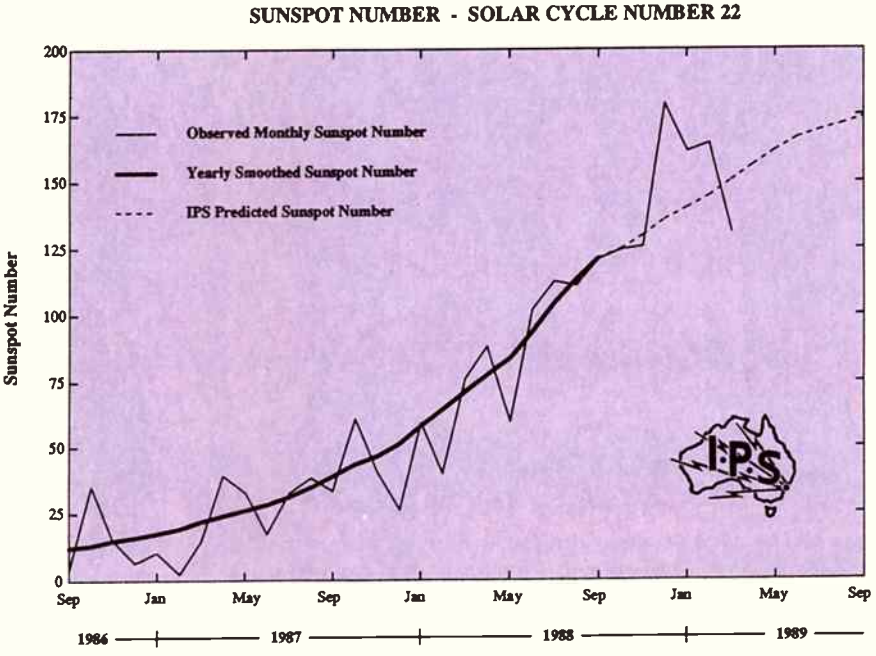


Figure 2. The variation of observed monthly sunspot number (thin solid line) and 12-month smoothed sunspot number (thick solid line) since solar minimum in September 1986. The dashed line is the IPS predicted trend to September 1989. (Courtesy IPS Radio and Space Services).

cooler than the chromosphere it is viewed against and is known as a filament.

Filaments and prominences can be up to 300 million kilometres in length and can reach heights of 100,000 kilometres above the Sun's photosphere. They can be very stable, lasting for months, moving across the face of the Sun as it rotates from "east" to "west" (left to right as you face it), disappearing over the west limb and reappearing over the east limb 13 or 14 days later. (The Sun has an average rotation period of 27 days; it's faster than the equator and slower towards the poles).

A filament may suddenly erupt in a flare and send a cloud of solar particles out into space. If this cloud strikes the Earth it causes changes to the Earth's magnetic field and the ionosphere, affecting HF communications. Particles are "captured" by the Earth's magnetic field and spiral down the field lines to plunge into the ionosphere in an oval-shaped arc on the night side of the Earth, near the north and south magnetic poles.

Colliding with the thin atmosphere, these particles cause such intense ionisation that the gases fluoresce, that is, they emit light – the "northern and southern lights", or aurorae borealis and aurorae australis. The more intense and energetic the shower of particles the greater the effect in the magnetic field and the greater the expansion of the auroral oval in length and breadth.

The "background" chromosphere between the various features just mentioned shows a great deal of fine detail called the fibril structure because of its fibrous appearance. Near and around active regions, this is often ordered into large swirling patterns by the associated magnetic fields.

Flares range considerably in size, a big one occupying as much as one-thousandth of the Sun's disc, and they can last for several hours. They can occur alone or be grouped closely together in time originating from a single active region. An active region comprised of some 75 to 100 sunspots came round the east limb of the Sun on March 6th this year. A massive flare appeared on the 9th, followed by another on the 10th, the first one said to be the strongest ever recorded. On the 10th, the region was facing the Earth directly; it ejected particles that reached

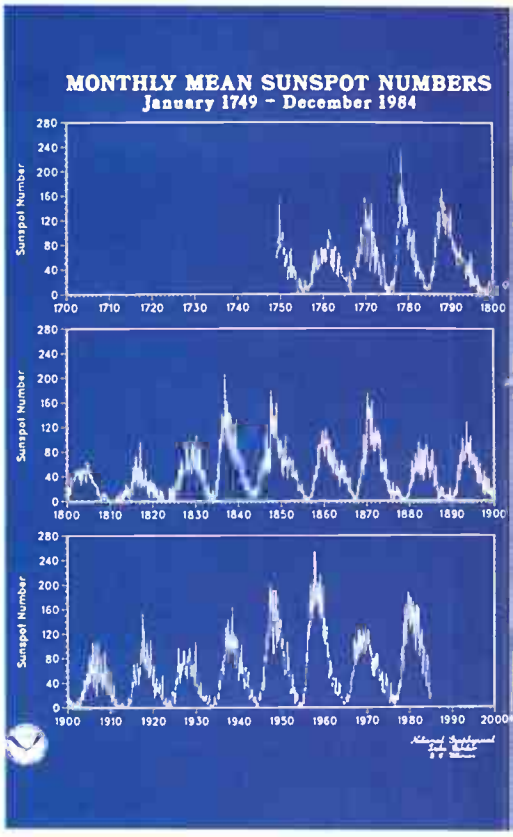


Figure 3. The solar cycles from monthly mean sunspot number, from 1749 to 1984. (Graph from NOAA, USA, supplied by IPS Radio and Space Services).

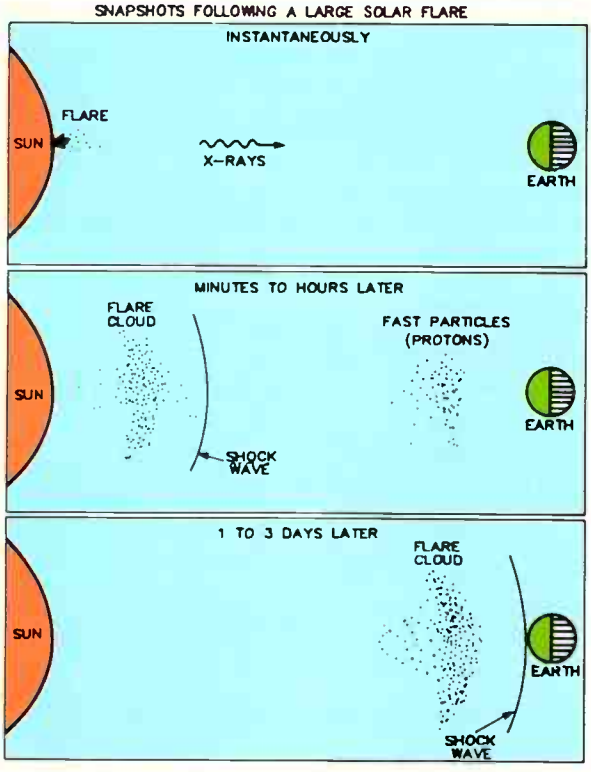


Figure 4. The three events which follow a large solar flare. At top, X-rays are emitted. They travel in straight lines and take around eight minutes to hit the Earth. In the middle, fast protons are emitted which reach the Earth after a delay of only minutes to hours. Then follows the flare cloud (plasma — a cloud of positive and negative ions). This follows days later, preceded by a shock wave where the cloud meets the quiet solar wind.

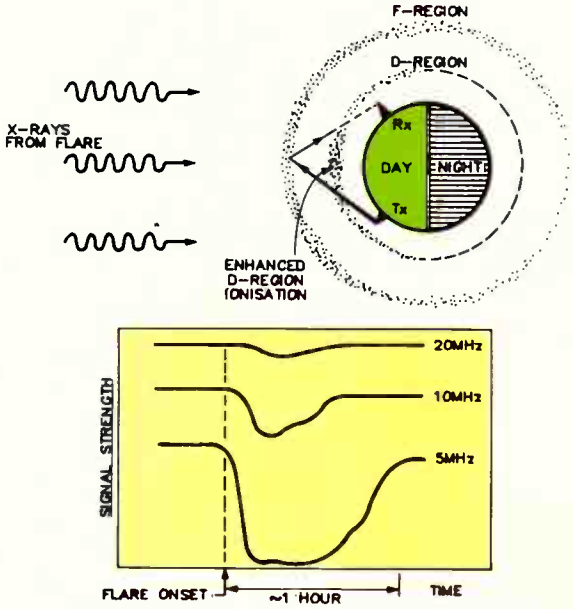


Figure 5. How X-rays from a flare affect HF signals, causing a shortwave fadeout on the dayside ionosphere. Note how the lower frequencies are affected most. The X-rays cause a sudden, large increase in ionisation in the ionosphere's D-layer, which increases absorption of the signals.

here on the 13th and 14th giving rise to a severe magnetic storm and creating enormous auroral activity seen as far north as the Tropic of Capricorn in Australia and as far south as Texas in the US.

Flares, fadeouts and storms

Flares have three major effects on high frequency communications, each brought about by the different things emitted or ejected from the flare site: X-rays, protons and a plasma cloud. X-rays travel in straight lines and travel at the speed of light, reaching the Earth in about eight minutes. Protons emitted by a flare can travel at tremendous speeds, reaching the Earth in as short a time as ten minutes. These are followed by a more slowly moving plasma cloud, or flare cloud, which is preceded by a shock front where the cloud hits the quiet solar wind. The flare cloud reaches the Earth any time from a few days to a week after being ejected from the flare. The sequence of events is illustrated in Figure 4.

Providing a flare has sufficient energy, some of the X-rays emitted will hit the Earth's atmosphere and increase ionisation. That might sound like what you want to improve HF propagation, but it increases ionisation in the D-layer of the ionosphere at 50-90 km, which increases the absorption of radio waves passing through it. It affects the lower frequencies most and can be so severe as to cause complete absorption. This is known as a shortwave fadeout or SWF. It can last as long as the flare causing it, that is, up to an hour or so. A small flare will only have a small effect; the effect of a large flare will be felt across the whole shortwave spectrum, with a general lowering in signal strengths.

As X-rays travel in straight lines, a shortwave fadeout will only be felt on that side of the Earth facing the Sun. For this reason, the effect is also known as a daylight fadeout. A shortwave fadeout is felt the most during the middle of the day and where signals from a distant transmitter travel through low or equatorial latitudes. Figure 5 illustrates the general features.

Very energetic flares also eject a stream of protons – the core particles from hydrogen atoms, the Sun's "fuel". This stream of protons can hit the Earth if they are ejected in the right direction; they can travel at velocities up to about 80% of the speed of light! They may take ten mintues to a few days to reach the Earth depending on the size and site of the flare. On their way here, they can cause severe damage to unshielded satellites or astronauts.

When they arrive in the vicinity of the Earth, they encounter its magnetic field and, being a charged particle (positive), they cannot travel across a field line, but swing around it. As the field lines are horizontal near the equator and vertical near the poles, the protons don't reach the equatorial ionosphere, but readily penetrate the ionosphere at the magnetic poles. Once they penetrate into the D-layer, they cause a massive increase in ionisation and hence a massive increase in absorption of radio signals passing through the polar regions. The effect is known as a polar cap absorption event (shortened to PCA) or a polar blackout.

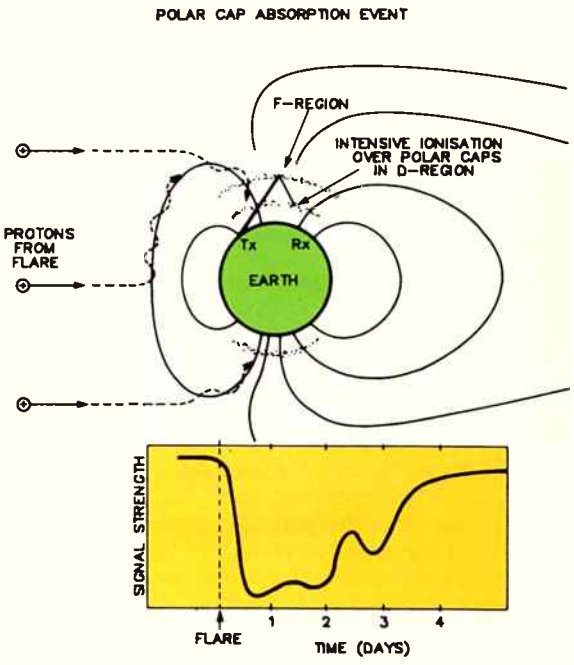


Figure 6. High energy protons shot out from a flare will be "captured" by the Earth's magnetic field and spiral down the field lines to penetrate the lower regions of the atmosphere over the magnetic poles. This increases ionisation in the ionosphere's D-layer causing massive absorption of signals which pass through the region. This causes a polar cap absorption event, or PCA. Signals may be non-existent or very weak, with some slight recovery during hours of darkness.

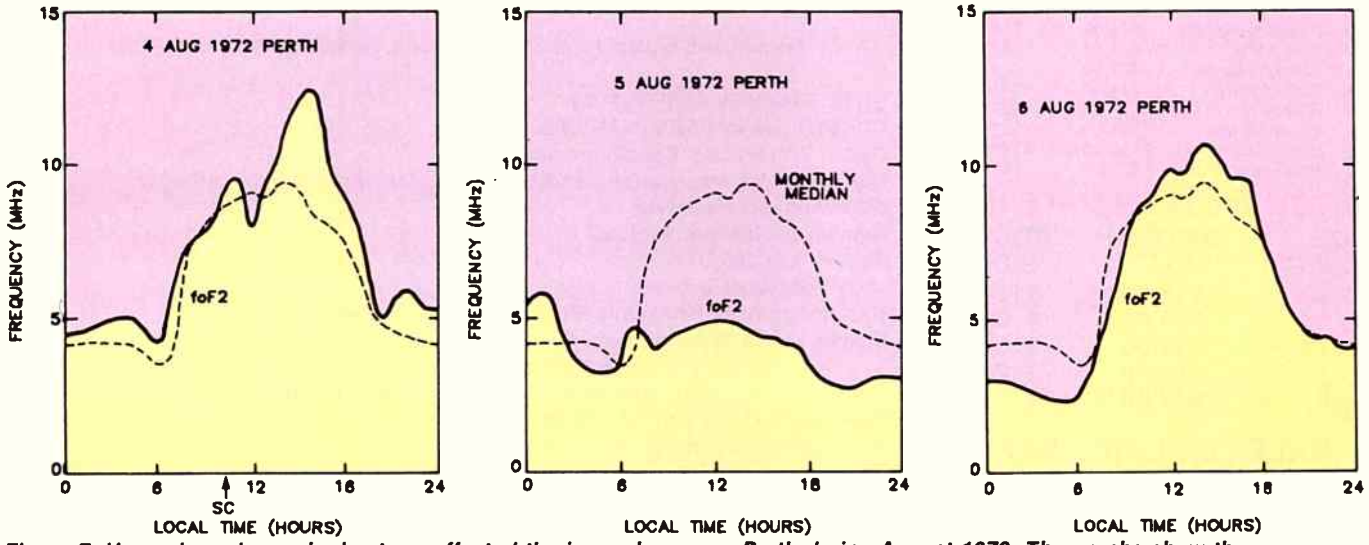


Figure 7. How a large ionospheric storm affected the ionosphere over Perth during August 1972. The graphs show the variation of foF2 versus local time; foF2 is the critical frequency of the F-layer, the frequency at which a radio wave directed upward penetrates the layer and is a measure of the maximum frequency which the ionosphere will support when a transmission is reflected from this point. The dashed line shows the monthly median values, the solid line the measured values. The flare's shock front hit the Earth at about 1100 local time on 4th August (marked SC which means "sudden commencement"), the plasma cloud following a few hours later. That day, the critical frequency rose by 50%. The ionosphere completely recovered on the 6th.

A PCA can last for several days to a week, depending on the size of the flare and will usually completely destroy HF communications within and to the polar regions, and on any communications circuits which pass through there. Fortunately, PCAs are relatively rare, occurring about half a dozen times or so a year, but they are more frequent around the peak of a sunspot cycle – which means now! Figure 6 illustrates what happens.

The third effect from a large flare is a plasma cloud, a mixture of positive and negative ions. A plasma cloud travels very much slower than protons emitted from a flare, and for the plasma cloud to reach the Earth, the flare must be in the right (or wrong!) location on the Sun. Generally, this means it much be on the side facing the Earth.

When a plasma cloud hits the Earth, a number of complex interactions takes place. It changes the electric field in which the ionosphere is embedded and alters the chemistry and large-scale motion of the ionosphere's F-region (which lies between 200 and 600 km above the ground). These complex interactions generally bring wide-scale disturbances, particularly to the radio frequencies which the ionosphere supports. The overall effect is called an ionospheric storm. Radio "conditions" during an ionospheric storm may improve, but they will also deteriorate. In other words, change is to be expected – hence the analogue with the weather we experience on the ground. Figure 7 illustrates the sort of effects on the ionosphere experienced during a large ionospheric storm.

Solar prominences, or filaments when seen face-on to the Sun, are often seen to disappear within a few hours after being apparent for perhaps weeks. It seems all or part of the matter contained in the filament is blown out into space in a fashion similar to solar flares. These sudden disappearing filaments, (SDFs for short) can effect the Earth's magnetic field, the ionosphere and HF communications, although the effects are much less than that of solar flares.

When the Earth's magnetic field is affected by particles ejected by solar flares and SDFs, we experience a geomagnetic storm. The shock front that precedes the cloud of ionised particles compresses the Earth's magnetic field on the side facing the Sun and gives rise to a sudden commencement. The field increases slightly initially, called the "initial phase", which is followed by a large decrease, called the "main phase". The initial phase may last some hours, while the main phase will persist for up to 3-4 days. Geomagnetic storms caused by other solar features commence gradually and are generally shorter-lived. During a geomagnetic storm, the magnetic field doesn't change all that much, actually, usually less than 1% of the undisturbed value.

Continuous recordings of the Earth's magnetic field are made at various locations around the world from which an index of magnetic activity is derived for intervals of three hours, called the K index. The K indices from all over the world are assembled and collated at Fredericksberg in the USA, which calculates an index of overall planetary magnetic activity for each day, known as the A index.

Magnetic disturbances occur much more often in the equinoctial months of March-April and September-October because the Earth's magnetic field is more nearly at right angles to the direction of flow of the solar wind and more susceptible to disturbances. A small flare that occurs during an equinox may cause a larger disturbance than a larger flare that occurs during a solstice (June, December).

Forecasts and how to read them

From Figure 4, you can see that from monitoring the Sun at solar observatories, it is possible to predict or forecast when solar flares, etc, will affect the Earth's ionosphere and magnetic field and what those effects might be. This is, naturally, of interest to anyone involved in HF communications, professional or enthusiast alike. Such forecasts of ionospheric and geomagnetic "weather" are provided by various scientific agencies around the world.

Flares occur more often around the peak of a solar cycle, hence the current interest! There were only two significant flares obeserved in December 1987, but more than 49 significant flares noted in December 1988!

In Australia, the IPS Radio & Space Services has operated a dial-up pre-recorded daily solar geophysical report service since the 1970s. If you need to follow or determine the

PANEL 1
Format and typical form of the IPS DAILY PROPOGATION REPORT

DATE: Thursday April 06 1989
CONDITIONS IN PAST 24 HOURS
Global Propagation Conditions: fair to poor
Comments on Propagation Conditions: poor conditions at high latitudes
Solar Activity: moderate
Number of Sunspot Regions: 8
Flares: M1 0950 UT
M4 1158 UT
Description of Geomagnetic Field: active to minor storm
Indices for Yesterday: 10 cm flux: 193 (147.9)
Estimated A index: 30
Observed Sydney Regional Ionospheric Index: 131
FORECAST FOR NEXT 24 HOURS
Solar Activity Forecast: low to moderate
Geomagnetic Activity: Forecast active
Predicted Sydney Regional Ionospheric Index: 160

The Daily Propagation Report gives detailed information on ionospheric propagation and geomagnetic field conditions, and a forecast for the next day. Radio Australia compiles the information for regular broadcasts to shortwave listeners on the HF bands — check with Radio Australia programs for details and monitor the appropriate frequencies. This Report is useful for following day-to-day changes in solar activity and HF propogation conditions. The forecast can be very useful when conditions are changing rapidly for better or worse.

PANEL 2
Format and typical form of the IPS PRE-RECORDED SOLAR AND GEOPHYSICAL TELEPHONE REPORT ON (02) 269-8614

(Spoken)
"This solar and Geophysical Report is issued by IPS Radio and Space Services at 0000 UT on the 16th March.
IPS Warning Number 09 was issued on March 15th and is still current.
Solar activity has been moderate with a total of five M class flares being observed in the past 24 hours. The largest flares were an M 5.5 — 1 Bright Flare at 1154 UT and an M 6.5 — 1 Bright flare at 1619 UT. Solar activity should continue at moderate levels for the coming day.
The geomagnetic field at Sydney was at active to minor storm levels early on March 15th but the disturbance had declined to generally unsettled levels by the end of the day. The field is expected to be mostly active for the next day.
Ionospheric maximum usable frequencies for Sydney have been 15 to 20 percent higher than IPS predicted values from 0600 to 1600 UT and around the IPS predicted values outside these times. Frequencies should return to predicted values in the forecast period.
The Ottowa 10.7 cm flux on March 15th was 119.
The observed Fredericksberg A index on March 14th was 14, and the estimated value for March 15th is 17.
End of message."
This report contains a condensed version of the Daily Propagation Report, plus details on critical frequencies and their progress, and effects on the ionosphere and geomagnetic field. The Report is issued daily at 0000 UT (10 am EAST), except for weekends, and updated more frequently if there are significant changes in conditions. Hence it can provide more immediate information during disturbed periods than the Daily Propagation Report.

ionospheric or geophysical "conditions" likely to prevail on a short term basis, then this service is a valuable aid; particularly as the Sun is now quite active and as the solar cycle advances.

Radio Australia is also providing a spoken "Daily Propagation Report" in a similar format to the IPS's telephone report.

The accompanying two panels give the text of a "typical" report. Panel 1 shows the sort of thing you might hear on (02) 269 8614. It is generally of one to two minutes duration.

The text of a typical Daily Propagation Report on Radio Australia is shown in panel 2.

I will go through the items highlighted in these texts one by one, giving a brief explanation.

The reports used to be updated on a daily basis, seven days a week, but since 1st February 1988 have not been updated on weekends.

TIME
Most of IPS time measurements are in UT (Universal Time) which is the same as Zulu (Z-time) or GMT (Greenwich Mean Time).

SOLAR ACTIVITY
A measure of the number of solar flares and their strength. Solar activity is classified as being Low (the usual, no problems expected), Moderate (disturbances likely), or High (fadeouts, and magnetic field disruption very likely).

OTTOWA 10.7 cm FLUX
A measure of the radio output of the sun at 2800 mHz (10.7 cm wavelength). This value is often a better indicator of solar activity than sunspot number.

The values are measured by the Ottowa radio observatory. Unlike the sunspot number, the ten centimetre flux never drops to zero during solar minimum. With no sunspots visible on the solar disc, the ten centimetre flux will still have a value of around 67. Table A gives a statistical comparison between the ten centimetre flux and sunspot number.

TABLE A

SUNSPOT NUMBER	10 CM FLUX
0	67
20	78
40	93
60	110
100	147
150	195
200	243

CRITICAL FREQUENCY
The highest radio frequency that can be reflected vertically from an ionospheric layer. Higher critical frequencies usually mean higher maximum usable frequencies for radio propagation.

Ionospheric disturbances refer to measurements made at Sydney, but are generally applicable to mid-latitude southern hemisphere conditions.

FLARE
An explosion on the Sun, likely to produce "shortwave fadeouts" in HF radio propagation, and may be associated with disturbances to the Earth's magnetic field.
Flare Classification Flares are classified in terms of X-ray production and also by apparent optical brightness.

X-ray flare classification is on scales M (1 to 9) and X (10 upward) as these are the ones most likely to produce effects on the ionosphere.

M-class flares, particularly the less energetic ones, are likely to cause a fadeout on only the lowest frequencies.

X-class flares are stronger, and produce more noticeable effects than M-class flares. They can cause fadeouts that affect the entire HF spectrum.

It should be noted that a fadeout will only occur on those circuits having a reflection point in the daylight hemisphere of the Earth. Circuits having reflection points only in the night hemisphere will not be affected, no matter what the energy of the solar flares happens to be.

Optical classification includes an area measurement (sub, 1,2, 3), and a brightness indication (faint, normal, bright: F, N, B, respectively). Large, bright flares are more energetic, although optical brightness and the effect on the Earth are not directly linked.

MAGNETIC ACTIVITY
Magnetic activity (of the Earth's magnetic field) is classified as (one of) quiet, unsettled, active, minor storm, major storm. Activity in the Earth's magnetic field can have a considerable effect on HF radio propagation, and is also important in planning geomagnetic surveys.

FREDERICKSBERG A INDEX
The Fredericksberg A index is calculated from the three-hourly K index values and represents an overall magnetic activity index for a particular day. Fredericksberg, a mid-latitude observatory, is located in the USA and this A index value is used as a worldwide standard. The values reported are generally applicable to mid-latitude areas.

Large values for the A index correspond to disturbed conditions. Levels of magnetic disturbance are described in the following terms:

A INDEX VALUE	DESCRIPTION
0 up to 7	quiet
8 up to 15	unsettled
16 up to 24	active
25 up to 35	minor storm
36 and above	major storm

Geomagnetic K Indices: K indices are a measure of disturbance to the Earth's magnetic field. Values are determined for three-hourly intervals. Typical figures are 0 to 1 (quiet), to 5 and above (major storm).

TECHNOLOGY

The RS-232C serial interface standard for computers has had a contentious life since personal computers arrived over a decade ago. The new EIA standard should settle matters once and for all. Roger Harrison explains.

THE EIA-232D SERIAL INTERFACE STANDARD

Peace at last?

Introduced in 1962 in a document titled *Interface Between Data Terminal Equipment and Data Communications Equipment Employing Serial Binary Data Interchange* (phew!) from the US Electronics Industry Association (EIA), the serial interface 'standard' was later updated in 1969 and the "RS-232" term adopted (Document S.9012OEIA, just in case you really want to know). This was updated in 1972 and has remained untouched since. It was originally intended to set down an interconnection standard between computer terminal machinery and data modems, but necessity (I guess) and practice developed it into a general serial interface link between any two devices having serial communications ports.

Background

Early computer terminals were adapted teletype machines which had a typewriter style keyboard and printout on paper. These were a serial communications machine developed to replace Morse keys on telegraph lines. They were supplanted by video display units in computer applications which were also serial devices. These evolved with ever-advancing features and functions and the signalling requirements of such equipment were incorporated into the RS-232 standard.

The personal computer boom brought desktop computing to the world, and with it a demand for peripherals – printers, plotters, telephone modems etc. Manufacturers, not wishing to re-invent the wheel, adopted and adapted the RS-232 interface to suit their products' needs. That's when, and where, the serial interface "standard" began to run off the rails.

The early standard did not specify a connector, but merely the use of 25 lines and pin numbers. The 25-pin "D" connector (DB25) became an erstwhile "standard", but not with everybody. Apple used a DIN socket on its IIc, IBM a 9-pin D-socket on the AT, for example. The DB25 connector is quite frequently found on computing equipment used as a general input/output (I/O) port and even for parallel printer ports.

No "handshaking" was provided in the original standard, nor any form of "loopback" self-testing, essential where modems are used. In addition, confusion arose as to exactly what was data *terminal* equipment (DE) and what was data *communications* equipment (DCE). In many instances, it's clear that the assignment of equipment as to sex – that is, whether it's DTE or DCE – is rather arbitrary.

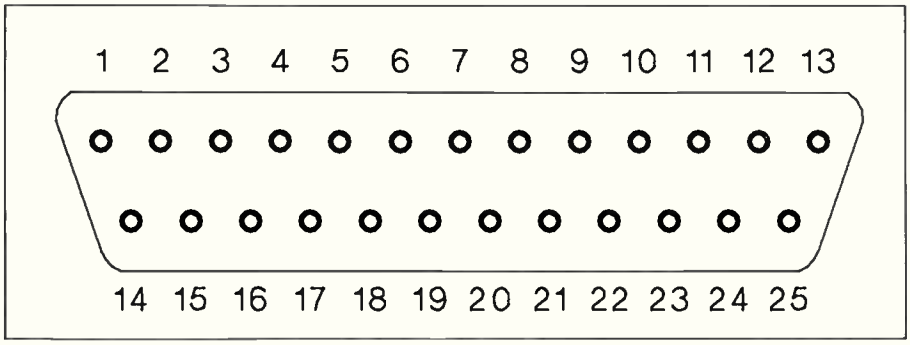
When the teletype was king, the 'on' and 'off' parts of the signal stream were known as 'mark' and 'space' bits. The convention was to have a low voltage for the mark and a high voltage for the space. When the serial data interface standard was developed, there were no TTL or CMOS ICs around and analogue circuit techniques were adapted for the task of data signalling. To gain immunity from induced noise and hum in lines and cables, the mark and space bits were represented by voltages swinging between +3 to 25 volts and −3 to 25 volts; the mark being the negative swing, the space being the positive swing, while the area between +3 and −3 volts is a "dead band".

The RS-232 standard specified that a 'line input' have a dc resistance of between 3000 and 7000 Ohms, with a parallel capacitance of no more than 2500 pF. Further, the line input was not to be inductive and the open circuit voltage could not exceed +/− 2 V. A line output was required to deliver between 5 V and 15 V (line input at 0.9 V), no more than 25 V open-circuit and no more than half an amp when shortened to any other line (including ground); the source impedance and capacitance of a line output was not specified.

The RS-232 standard provided for four interchange circuits, as they were called, categorised as follows:

Category A	Ground
Category B	Data
Category C	Control
Category D	Timing

There were only two Category A circuits – AA, the frame or protective ground, and AB, the signal ground. Likewise, in Category B, BA was "transmitted data", BB "received data". Other categories comprised more signals and circuits. For example, in Category C, CA



The 25-pin D connector arrangement, looking at the pins of a plug or the connections (rear) of a socket.

is "request to send", CB is "clear to send", CE is "ring indicator", and so on. Secondary circuits were also provided, thus SCA was "secondary request to send", for example.

The new standard

Last year, the EIA set down the new serial interface standard, which has been dubbed "EIA-232D". The question of a "standard" connector has been settled in favour of the 25-pin D type, equipment sex defined, fully interlocked handshaking provided and loopback testing. Now, there might be peace at last! The primary electrical specifications are summarised in the table here.

Three new signals have been created for the EIA-232D standard by redefining existing signal lines and assigning a use to pins 18 and 25 which were previously unassigned. Pin 11 remains unassigned. Some line/pin Circuit Categories have been redefined, too.

Equipment sex is now easy to sort out: if it transmits on *pin 2*, it's a *DTE*; if it transmits on *pin 3*, it's a *DCE*. Thus, DTE gear should have a male DB-25 connector (plug), DCE gear a female DB-25 connector (socket). Serial terminals and your personal computer, for example, are DTE devices. Printers, plotters and modems are generally regarded as DCE devices, although strictly, it applied to modems in the first place.

So, connecting a DTE to a DCE is a simple matter of a "straight through" cable, plug on one end, socket on the other. Where you need to connect two DTE machines, like one computer to another, for example, then pin 2 of one connects to pin 3 of the other. The handshake and other lines (if necessary) may also have to be swapped, depending on the particular equipment.

Pin 1 now, rather than being the frame or protective ground, is for the cable shield, should your cable have one. It's usually found as a length of hookup wire with a lug on the end, left dangling beside the connector. In practice, you would connect it to the chassis connection of your terminal equipment (DTE)

PRIMARY SPECIFICATIONS EIA-232D

Parameter	Specification
Connector for DTE	DB-25P (male)
Connector for DCE	DB-25S (female)
No of drivers on line	one
No of receivers on line	one
Maximum cable length	Limited by 2500 pF capacitance
Receiver input range	+/– 30 volts
Receiver input threshold	+/– 3 volts
Receiver input resistance	3000 to 7000 Ohms
Driver output swing	+/– 5 V min., +/– 15 V max.
Driver load	3000 to 7000 Ohms
Driver slew rate	30 V/us maximum
Maximum data rate	20,000 bits/second

Comparison between RS-232 and EIA-232

RS-232C				EIA-232D	
Circuit	Description	Name	Pin	Circuit	Description
AA	Frame ground	FG	1	—	Shield
BA	Transmitted data	TXD	2	BA	Transmitted data
BB	Received data	RXD	3	BB	Received data
CA	Request to send	RTS	4	CA	Request to send
CB	Clear to send	CTS	5	CB	Clear to send
CC	Data set ready	DSR	6	CC	DCE ready
AB	Signal ground	SG	7	AB	Signal ground
CF	Data carrier detect	DCD	8	CF	Received line
—	Reserved for testing		9	—	Reserved for testing
—	Reserved for testing		10	—	Reserved for testing
—	Unassigned		11	—	Unassigned
SCF	Sec. data carr. det.	SDCD	12	SCF/CI	Sec. data carr. det./ Data signal rate detec
SCB	Sec. clear to send	SCTS	13	SCB	Sec. clear to send
SBA	Sec. transmit data	STD	14	SBA	Sec. transmit data
DB	Transmit sig. timing	TC	15	DB	Transmit sign. timing
SBB	Sec. received data	SRD	16	SBB	Sec. received data
DD	Receive sig. timing	RC	17	DD	Received sig. timing
—	Unassigned		18	LL	Local loopback
SCA	Sec. request to send	SRTS	19	SCA	Sec. request to send
CD	Data terminal ready	DTR	20	CD	Data terminal ready
CG	Signal quality detect	SQ	21	RL/CG	Remote loopback/ Signal quality detect
CE	Ring indicator	RI	22	CE	Ring indicator
CH	Data rate selector	—	23	CH	Data signal rate
CI	Data rate selector	—	23	CI	Data signal rate
DA	External Tx timing	(TC)	24	DA	Tx sig. element timing
—	Unassigned		25		Test mode (TM)

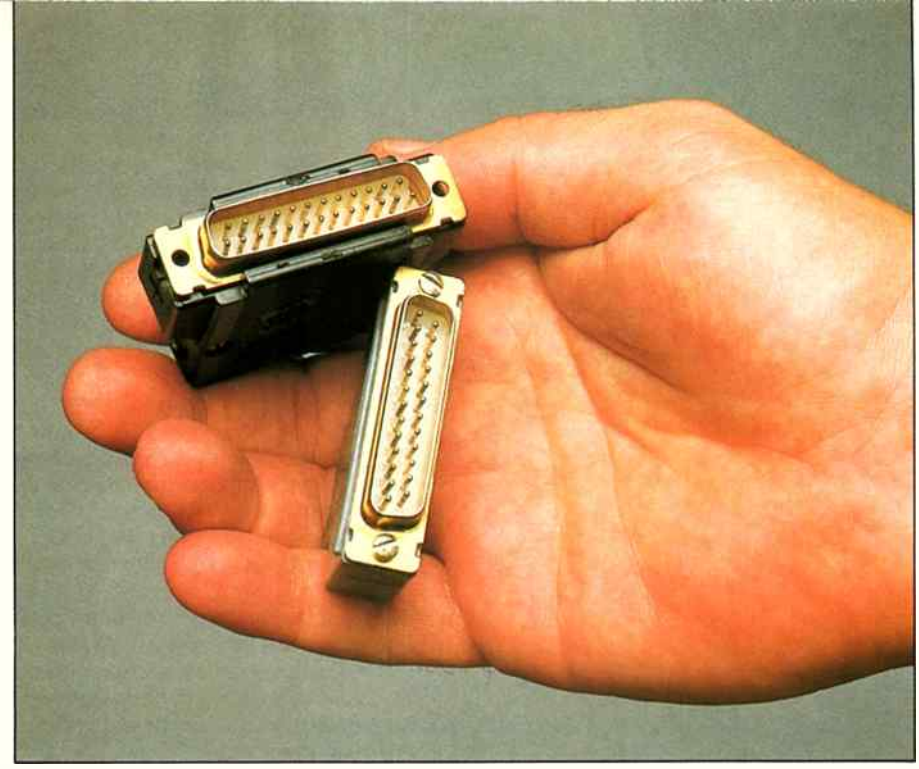
and leave the other end unconnected; this prevents "earth loops" which have a nasty habit of acting like an "antenna", picking up all sorts of stray signals.

Pin 6, previously the Data Set Ready (DSR) line, is now *DCE Ready* which, frankly, makes a little more sense. Pin 12, which rather languished as the Secondary Data Carrier Detect line over the years, now has either of two purposes: as the Secondary Received Line Signal Detect or the Data Signal Rate Select. The latter acknowledges developments in modem technology.

Pins 18 and 21 are now assigned to loopback test functions, again acknowledging developments in modem technology. Pin 18, previously unassigned, is used in local loopback testing. This may simply involve signalling to modem hardware to connect the output to its own input and run a test routine. This checks out the modem and terminal at your end.

Pin 21 now has a dual function, either for Remote Loopback or Signal Quality Detector. This endows compatibility with its previous use and provides for remote loopback testing facilities. In the latter application, a modem sends test signals over the line to another modem, and this, or the terminal to which it's connected, echoes the test signals back to the originating modem. Thus, you can check the whole connection, from one end to the other. Loopback test facilities are found on higher-cost, more complex, multi-featured modems.

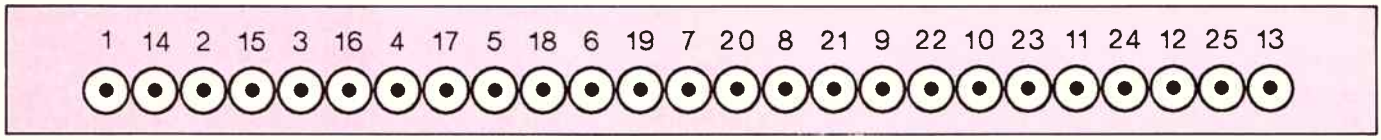
The previously unassigned pin 25 is now involved as a handshake signal in the loopback testing. It is used by a DCE device to signal a DTE device that it has received an RL or LL signal.



The EIA-232D serial interface standard should, hopefully, settle matters once and for all!

Peace at last?

Well, that should settle matters with serial interfaces, except that, in Europe, the CCITT V.24 serial interface standard is aligned with the RS-232C standard, with some minor differences. e.g. pin 11 may carry a "printer busy" signal. No doubt, in time, some congruence between the EIA-232D and V.24 pin assignments will come about, or maybe not. In the mean time, it's up to equipment manufacturers to help out all us consumers by providing serial interfaces that comply with the standard. eti



Now that "ribbon cable" abounds and 25-pin D insulation-displacement connectors, or IDC plugs and sockets, have become relatively cheap and widely available, you often see them used in serial interface applications, particularly between computers and their peripherals, like modems, printers and plotters. Where such connectors are used, the pins connect to alternate lines in the cable, as shown here. A trap for the unwary or uninitiated!

TECHNOLOGY

HENRY FORD'S HOMAGE TO A GENIUS

Museums can be dull and lifeless places, but the Henry Ford Museum and Greenfield Village near Detroit in the USA, offer excitement and wonder to any person interested in the history of technology.
By Brian Woodward.

At the age of 21, Thomas Alva Edison worked as a newspaper boy on a train. Realising he had a captive audience, he decided to take a piece of the action and installed a small printing press on the train. He then wrote and printed his own newspaper, for sale on the train.

It was a 'first' – one of many from the man who must rank with the leaders of the modern day Renaissance. While this is not a history of Edison, some understanding of the man is necessary to explain the philosophy which led to the Henry Ford Museum.

From humble beginnings, Edison showed talent and intelligence, but above all, immense enthusiasm, for anything technological. Not long after his success, at age 12, as a newspaper journalist, printer and publisher, Edison became a telegraph operator using the newfangled Morse code to communicate faster between railway stations than had even been possible.

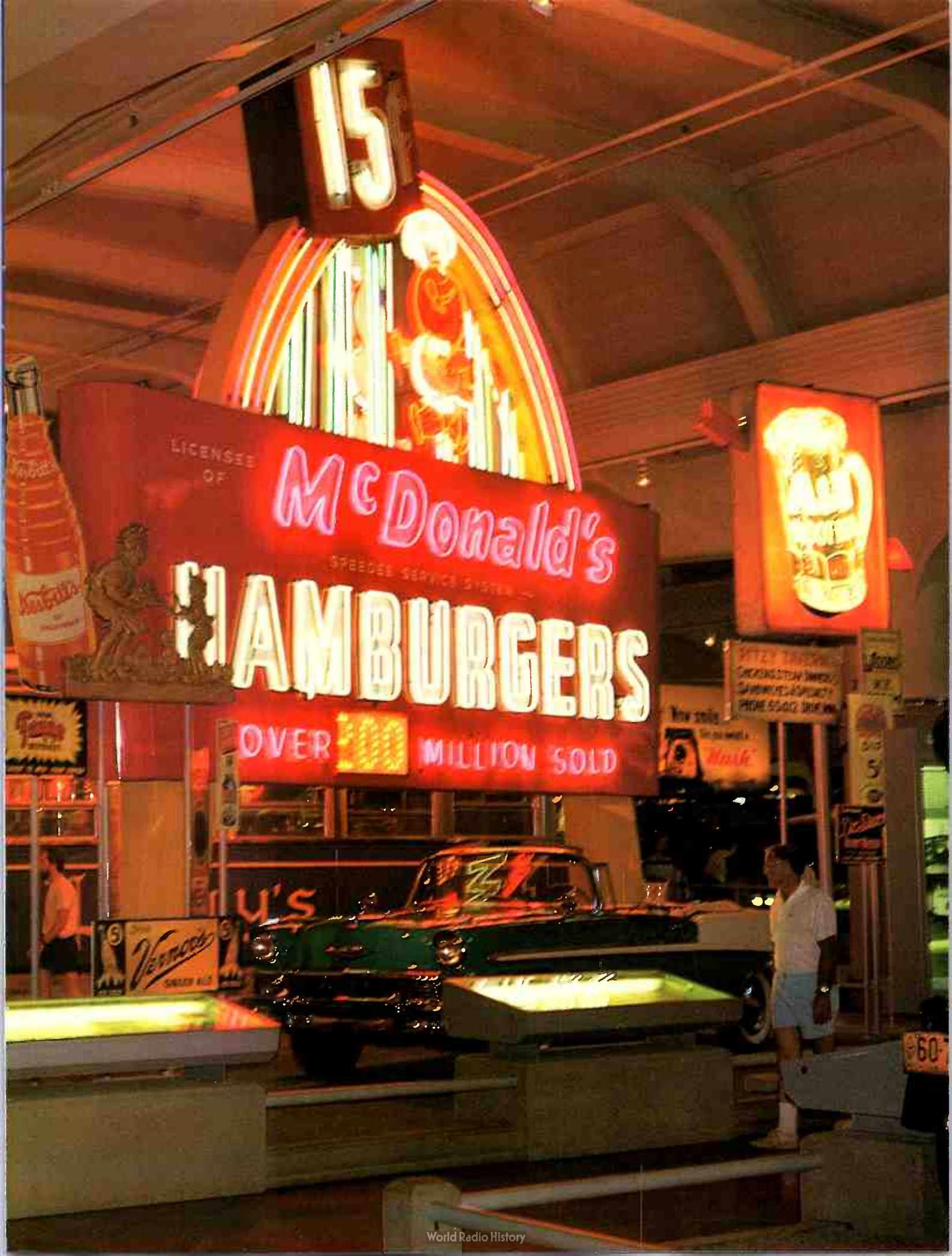
Working with electronics sparked (pun intended) an interest that was to consume him until his death in 1931.

Edison realised, however, that kitchen table inventors were seldom regarded as more than eccentrics. He knew that research must be systematic, continuous and well-funded if it was to bear fruit.

As a telegraph operator he watched other industries take on the technology of telegraphy. One which he knew would benefit by a better approach was the burgeoning stock market. At 24, he developed a much-improved ticker-tape machine, enabling stock brokers to be in touch with the exchange in a matter of seconds. The invention was a huge success and it gave him the money to commence what was probably the world's first Industrial Research laboratory at Newark, New Jersey.

In his lifetime, Edison accumulated more than 1000 patents. He invented or improved (and patented his contribution) telegraphy in 1874, telephones and the phonograph in 1877, incandescent light in 1879, cinematography in 1891 (his was the 35mm sprocketed film we use in conventional cameras today), electric generating equipment and storage batteries in the

The changing automotive landscape is represented by such familiar road sights as this 1960 McDonald's Speedee sign. It keeps track of the number of hamburgers sold around the world. The car parked below is a 1956 Chevrolet BelAir.



Homage to a genius

TOP: The car in which J.F. Kennedy was shot. FAR RIGHT: The Douglas Auto Drive-In Theatre sign from Kalamazoo, MI, invites viewers to see Car Culture, a film designed for the Automobile in American Life section.
ABOVE and RIGHT: From old bikes to roller-skating robots, exhibits cover the gamut of working technology.

period of 1900 - 1910.

His friends and work companions were, similarly, leaders in their fields; William Boroughs, who patented the first commercially available mechanical adding machine and Firestone, who developed new methods of making tyres for the infant auto industry.

Into Edison's life at his Menlo Park research laboratory came a young engineer, Henry Ford. Like so many who had worked with Edison he was fired with a determination to realise his dreams. While working days for Edison, the young Ford at night constructed a motor car in a shed at the bottom of his garden.

Ford called it the quadricycle and it first saw the light of day in 1896. It was the start of a dream for Ford. At the time, cars were the playthings of the rich. Ford could see that in a country isolated by the tyranny of distance, cheap motor cars would mobilise the masses better than railways or bicycles. His idea of making a four-wheeled bicycle powered by a stuttering gasoline engine was visionary.

But, unlike his mentor and hero, Edison, Ford didn't manage to raise the capital to realise his invention until 1909. During the intervening years, he worked as a design engineer for a number of car companies (some bearing his name, others not) and split with financiers each time he attempted to introduce a cheap car. But he progressively raised capital by promoting his name in sport (a Ford car, the 999, held many records in 1904) and industry, with progressively more successful designs.

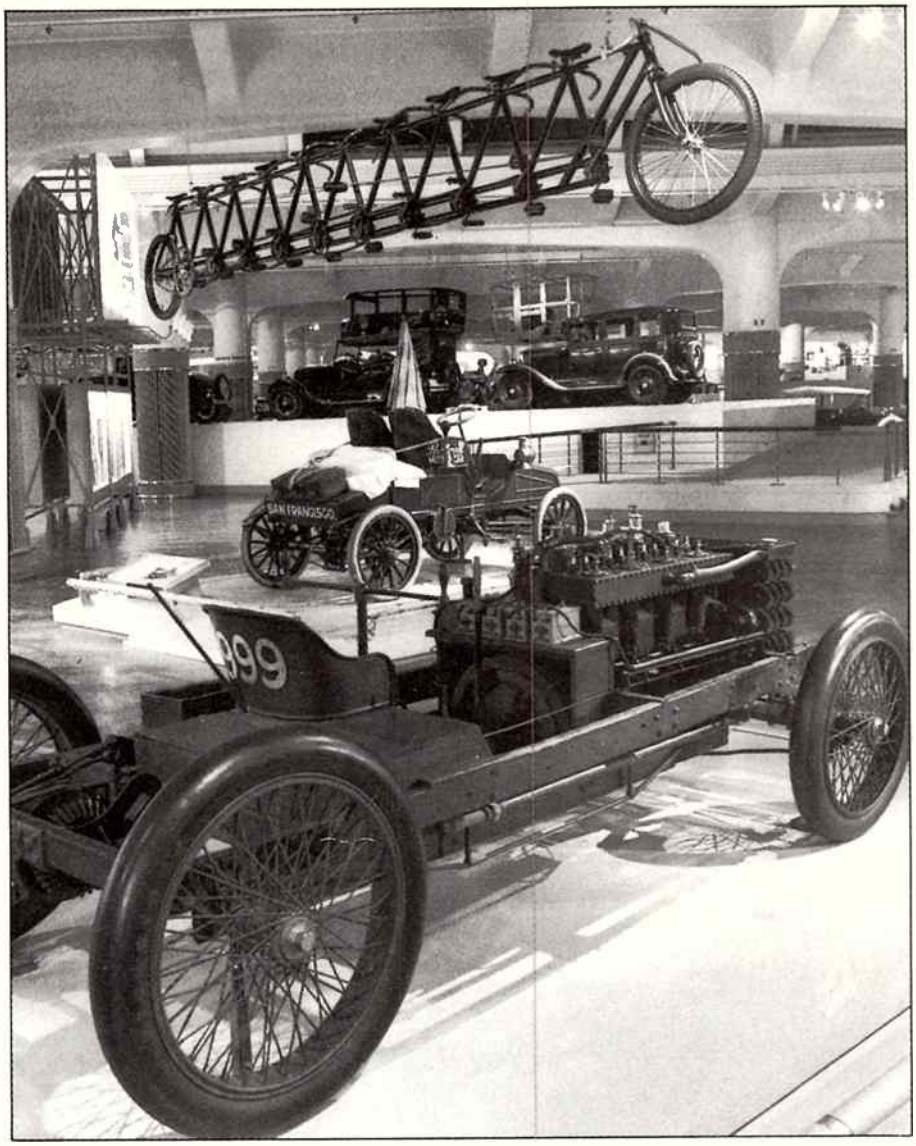
The struggle Ford experienced led to the cementing of his lifetime affection for Edison – he understood the battles Edison waged to earn enough to keep his industrial laboratory working productively.

So great was Ford's affection for Edison he asked him to open his museum in 1929. Ford was, by this stage, fabulously rich and his method of repaying his nation a debt of gratitude was to create a museum dedicated to displaying exhibits which showed how far and how fast technology had changed the American way of life.

Edison took a shovel, (not just any shovel, but that which had once belonged to the noted botanist Luther Burbank,) and plunged it into a wet concrete block. The place was originally known as the Edison Institute, incorporating the Henry Ford Museum and Greenfield Village. The buildings in the village, and the exhibits in the main museum building, depict American life from the time of the first fleet until the present time.

Americans have always honoured new ideas and the museum and village stand as an ever-changing testament to that attitude and to the people who have made the country great.

One exhibit verges on idolisation, if we can believe its authenticity. Deep within the main museum building, on an out-of-the-way shelf, is a small vial. It is corked and stands on a small, wooden support with a short, typed inscription alongside. It contains, says the card, the last, dying breath of Thomas Edison!



The use of gimmicks, stunts, races and endurance contests to sell more cars is described in the Advertising and Promoting the Automobile section; pictured are the 1902 999 Racer, the 1903 Packard Old Pacific and an 1896 Orlten 10-seater bicycle.

> ***'Edison then wrote and printed his own newspaper, for sale on the train'***

The entire museum and village is too much for a single day's visit. It would take a week of diligent strolling and observation to do the place justice. This month I would like to take you on a word-of-mouth tour of some exhibits within the museum – next month, the village. Hopefully these words will whet the appetite of those who have an interest in the history of technology (American, at least) and encourage a visit.

The museum is open 9-5 daily, closing only on Thanksgiving and Christmas days. It's also worth noting that the interiors of the buildings in the village are not accessible from January 1 until mid-March so that maintenance can be carried out.

Immediately inside the main entrance is the ticket office. Admission to the museum is $US9.50 for adults and $US4.75 for children. There is ample parking outside with special parking for the disabled. The same price will be charged before you enter the village. If hard-pressed for time, take a day for the museum and a day for the village.

Opposite the ticket counter is an information bureau, where a fair supply of

They're getting away with murder.

They test bombs in your Pacific. They dump chemicals and nuclear waste into oceans all around the world.
They kill whales and baby seals.
And if people get in their way, they kill them too. They're getting away with murder and they know it.
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Or contact Cheryl McEgan for any further information. (08) 223 7665.

Homage to a genius

printed information and maps are available, free of charge. A map is essential, otherwise you'll get lost. The museum is very, very large! Also, eight or nine areas within the museum are given to ever-changing special exhibits.

As you pass through a corridor and enter the main building, you'll be impressed by its massive size. As a matter of interest, the pillars which support the vast door are part of the central heating system, which maintains a constant temperature year round to protect the exhibits. To your right as you enter is a small cinema showing films which highlight the museum and its special exhibits.

Basically, the museum is divided into two major areas. To the right is transport – cars, motorcycles, bicycles; trucks, planes and even a pair of motorised roller skates and a 600 tonne coal burning locomotive.

To the left (and possibly more interesting to all but car buffs), is a bewildering range of exhibits which trace the early development of technology in fields as

> *'Tucked away in another corner is the chair in which Abraham Lincoln was assassinated in 1865'*

diverse as the kitchen, farming, the camera and jewellery, to name but a few. Exhibits show the development of ceramics and glass, silverware, pewter, clocks. One section shows how heating the American home has developed from the simple hearth through to modern, reverse cycle airconditioning.

The agricultural exhibits are particularly interesting because America, along with Australia, led the world in mechanising primary produce during the last century. Early tractors and harvesters are on display.

Of all the exhibits in the left side of the museum, though, the Howard Bros Circus captivates the imagination. Opened in 1987, the Circus was billed as the "biggest little show on earth." A replica of a 1930s circus, and consisting of thousands of small figures – circus crowds, performers, trainers and animals with their vehicles, tents (and even a sideshow alley) – the exhibit will hold you fascinated for an hour at least.

Further into the museum you can follow the development of engines, steam onwards, with one of the crowning glories of the museum, the 1857 Gothic steam engine.

Tucked away in another corner of the museum is the chair in which Abraham Lincoln was relaxing (in the aptly named Ford's Theatre) when he was assassinated in 1865.

Similarly macabre, in the transport section of the museum, is a collection of Presidential vehicles, including the car John F. Kennedy was riding in when he was shot. For those with an interest in the technology of the automobile, an entire section has been devoted to various stages in the car's development – techniques used to design a car from the first sketches to the finished product.

Also on display in the transport section is the all metal Ford tri-motor aircraft which was used by Admiral Richard E Byrd for his first flight over the South Pole in 1929. There are many other planes on display, some of great historical significance.

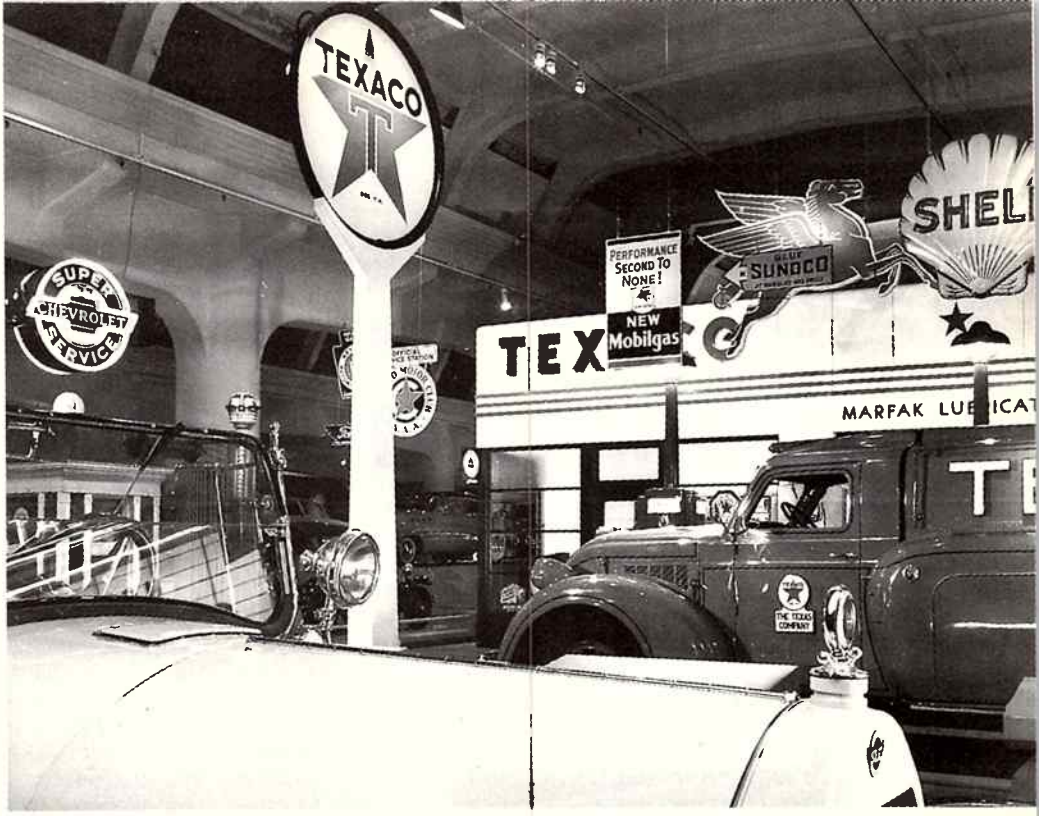
In the typically understated manner of the museum is a section devoted to caravans and campers. One was Edison's own holiday camper and, nearby, is one which belonged to the Lindburg family.

Throughout the automotive section there are video screens with loop tapes showing footage from the early days – priceless films which add life to the displays.

Last but not least is a section devoted to lighting and communication. Here is a collection of equipment which must be unparalleled in the world of electrics and electronics. The exhibit outlines the very birth of both industries and there is an early electricity generating station which is still in working order.

No trip to the USA would be complete without a visit to the Henry Ford Museum in Dearborn. A short drive from Detroit, Dearborn is a more pleasant place to stay than the industrial and lacklustre Detroit.

Next month, Greenfield Village – a hands on experience with the greats of American technology. eti



ABOVE: This 1940 Texaco service station was designed to convey an image of cleanliness, efficiency and modernity and soon became one of the most common highway building styles.

LEFT: The evolution of the automobile is illustrated by a procession, starting with early bikes and carriages and ending with a 1981 Ford Escort and a 1983 Honda Accord.

ARTHUR CUSHEN

BAND EXPANSION NOW LEGAL

Expansion of shortwave bands will allow many more stations. Arthur Cushen writes.

At a recent World Administrative Radio Conference most shortwave bands were extended in their coverage and many broadcasters moved to those out of band frequencies before the extensions were implemented.

The expansion of the bands will allow many more shortwave stations to be fitted into the various frequency ranges and this will mean a lesser degree of interference from broadcasters operating on adjacent channels. The move has already been noted on all the shortwave bands, while the new 13 mhz band, which is supposed to come into operation in July, is almost utilised to the full.

The first shortwave bands were assigned at a Mexico City conference in 1948 and at a Conference in Geneva in 1979; the shortwave bands were expanded and the eight bands allocated for use for international broadcasting are generally referred to by their frequency coverage or in some cases, the wave length, eg. the 31 metre band.

The new band allocations mean that the 49 metre band covers from 5950-6200 kHz. The 41 metre band covers from 7100-7300 kHz (not used for broadcasting in the Americas as it is assigned to amateur radio use only;) the 31 metre band covers 9500-9775 and will be extended up to 9900 in 1994. The 25 metre band covers from 11700-11975 and will also be extended in 1994 to eventually cover 11650-12050 kHz. The 22 metre band is a new band covering 13600-13800 kHz. The 19 metre band covers from 15100-15450, expanded from 15045-15600 kHz. This extension is now official. The 16 metre band, which was 17700-17900, is down to 17550 this year. There is little change in the two high frequency bands, 13 metres covering 21450-21750 and the 11 metre band covering from 25600-26100 kHz.

Further congestion

DESPITE the expansion of the shortwave bands, deregulation in many countries has meant further congestion. There have been critical examinations of this aspect of modern broadcasting brought about by greater interest by new stations, following the end of jamming. Well-known American writer Roger Legge recently commented that it was time for the world's international broadcasting stations and the International Frequency Registration Bureau, Geneva, to start paying more attention to the quality of programs and reception, rather than quantity.

It should be obvious that the two biggest users of the shortwave broadcast spectrum are already using far more than their fair share of the world's high frequency broadcasting space. These are the USSR and the USA and include Government and expanding non-government broadcasters (mainly religious) from the USA and from many overseas locations.

Now that jamming is off Radio Liberty and Radio Free Europe, it should be possible for these stations to reduce the number of frequencies per program and make some of the twenty five 250 kW transmitters in Portugal and Spain available to VOA,

13 mHz BAND ACTIVITY

Already there are many stations using the new band 13600-13800 kHz. In all cases the broadcasts are in English.

kHz	UTC	Location
13610	0600	East Germany, Berlin
13625	0400	Israel, Jerusalem
13635	1030	Switzerland, Berne
13650	0600	North Korea, Pyongyang
13655	0700	Jordan, Amman
13660	1215	Iceland, Reykjavik
13665	0500	USSR, Moscow
13670	0800	Korea, Seoul
13680	1800	Canada, Montreal
13685	0830	Switzerland, Berne
13690	1250	East Germany, Berlin
13695	0100	USA, KVOH Los Angeles
13700	0430	Holland, Hilversum
13700	2030	Holland, Hilversum
13715	1700	Czechoslovakia, Prague
13720	0100	Canada, Montreal
13720	1000	Guam, KSDA
13720	2100	USA, WRNO New Orleans
13730	0000	USA, WSHB Cypress Creek
13760	1400	USA, WCSN Boston
13760	1600	USA, WHRI South Bend
13770	1855	Iceland, Reykjavik
13770	1430	Holland, Hilversum
13780	2100	West Germany, Cologne
13780	1030	Switzerland, Berne
13790	1900	West Germany, Cologne

Arne Skoog, founder of Sweden Calling Dxers, in the studios of Radio Australia, Melbourne, during a recent visit to Australia

rather than VOA's having to spend over $100m and several years to replace the low power World War II vintage transmitters at Tangier. Since the USA and USSR have already agreed on reduction in some fields, it is to be hoped that they may be able to agree to a mutual reduction of high frequency broadcasting usage, so that other, particularly small, countries without relay stations will have a better opportunity of broadcasting satisfactorily.

Nordic interests

THE broadcasting stations in Northern Europe, Iceland, Sweden, Norway, Finland and Denmark co-operate in promoting their own news and activities. Norway, Sweden and Finland are all well received here in the South Pacific.

Promotion of Radio Sweden was one of the aims of Arne Skoog, who visited Australia and New Zealand recently. Arne founded "Sweden Calling DXers" in February, 1948 – the longest running continuous session for the shortwave listener. He retired in 1978, to be replaced by George Wood who continues to compere the session. Last year, Radio Sweden celebrated two anniversaries; 50 years of broadcasting and 40 years of "Sweden Calling DXers".

Radio Sweden broadcasts from facilities located in Horby (with two 500 kW transmitters) and Karlsborg (one 500 kW). All installations are owned and operated by Swedish Telecom Radio Broadcasting.

The External Service of the Swedish Broadcasting Corporation, Radio Sweden, broadcasts in English, French, German, Spanish, Portuguese, Russian and of course Swedish, to cover an audience in all continents of the globe. All programs begin with news and comments regarding Sweden and the Nordic countries. The second part of the 30 minute program covers Nordic music on Monday and Friday; mailbag, stamps corner and Swedish Spectrum (an art magazine), on Sunday, a review of major events of the week on Saturday, a science magazine "Horizon" on Thursday and finally "Sweden Calling DXers", an electronic media magazine, on Tuesday.

Radio Sweden broadcasts in English to Australia 1230-1300UTC on 17705 and 21610 kHz. Other transmissions received are at 0300-0330 on 9695, 11705 and at 2100-2130 on 9655, 11705 kHz. Program schedules are available by request from Radio Sweden s-105 10 Stockholm, Sweden.

And elsewhere

AUSTRIA Austrian Radio is now relaying Radio Canada International. Transmissions in English received in this area are 0300UTC on 11730 kHz and 0400 on 15275. The shortwave Listeners Digest is broadcast on Saturday at 0330 and on Wednesday at 0405UTC.

BELGIUM: Brussels has retimed its English transmission to Australia, now broadcast 0700-0725 Monday to Friday on 11695 and 21815 kHz. Brussels has also been heard in the 11 metre band on 26050 kHz at 0900 in English and on 25645 kHz at 1000 in French.

FINLAND: Helsinki broadcasts in English to Australia and South East Asia 0800-0825 on 17795 and 21550 kHz, 0830-0855 on 15245 and 17795 kHz.

ISRAEL: Israel is broadcasting to North America at 0100 and 0200 in English on frequencies 11605, 12077 and 15615 kHz.

SWITZERLAND: International Red Cross in Geneva will continue its monthly tests using the transmitters of Swiss Radio from 0740-0757UTC on 9560, 13685, 17870 and 21695 kHz. Tests are scheduled for Mondays July 31 and August 28, and Thursdays August 3 and 29.

UNITED KINGDOM: The BBC announced recently that it would drop 18080 kHz as it was outside the 16 metre band. This has been replaced by 17640 kHz which is operating with the World Service 0900-1800UTC.

USA: The schedule announced by WSHB Cypress Creek, South Carolina, operated by Christian Science Monitor shows broadcasts are to Central and South America and the Caribbean. The complete schedule is 0000-0600 13760; 0600-0800 11980; 0800-1200 9495; 1200-1400 11930; 1400-1600, 2000-2400 17555 kHz. Power is 500 kW and reports should be sent to the Boston address: PO Box 860, Boston MA 02123.

A new gospel station, KJES, has been heard with test transmissions on 9665 kHz at 1030UTC. This broadcaster uses only 7 kW and the mailing address is Radio Station KJES, 3720 Greenwich Dr. El Paso Texas 79902. eti

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

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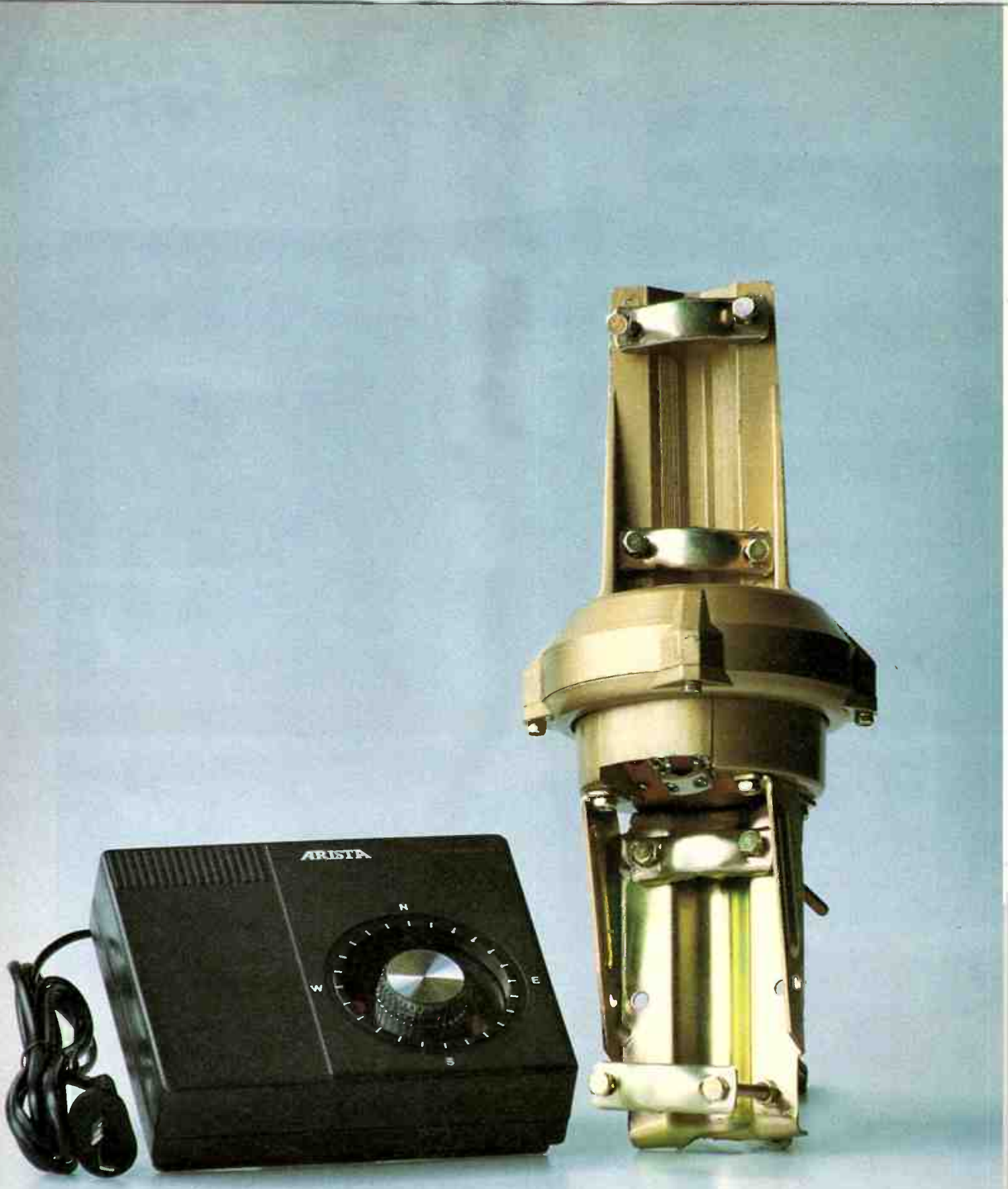
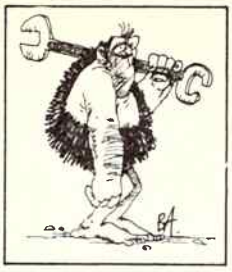


Arista's AAR2 rotator. This is a low-cost, lightweight unit suitable for TV antennas or lightweight VHF or UHF amateur antennas.



TECHNOLOGY

SWING THAT BEAM

The rounds and abouts of antenna rotators

Radio amateur, satellite chaser, CBer or TV "DXer", if you have a beam antenna, you need to swing it. By Roger Harrison VK2ZTB.

The first rotatable beam antenna I built employed an "Armstrong rotator". The pole supporting the beam was loosely held at a suitable height and I simply twisted it by hand until the beam pointed in the desired direction. Hence the term, Armstrong! In the face of a stiff breeze, to keep the antenna pointed where I wanted it, I wrapped a few turns of hemp (that's rope, not the other stuff) around the mast and tied it off to a few nails nearby. Crude, but temporarily effective.

I say, temporarily, because with a slightly stiffer breeze, the beam resisted its hemp "brake" and behaved like a weathercock. I learned a lot about the mysteries of "wind loading" and braking this way. I also learned that the electro-mechanical contraptions known as antenna rotators are by far a more elegant and practical solution to the problem of rotating a beam and knowing where it's pointed.

Antenna rotators come in a variety of shapes, sizes and styles and with differing specifications. Choosing one for the job means you first have to consider the job you want the rotator to do – yeah, yeah, swing the antenna and hold it in place – but how big an antenna, what weight and wind area, where will you mount it, etc?

In days gone by, and occasionally still, antenna rotators were fashioned from such things as windscreen wiper motors, washing machine motors and so on. For the electro-mechanically adept, such solutions to swinging an antenna provide something of a challenge.

Considerations

The antenna or antenna system settled on will determine the sort of characteristics or specifications you will require of the antenna rotator. Three things are of primary importance: turning torque, braking torque and vertical loading. After that you need to consider the mounting arrangements, the control and direction indicator system, then perhaps the rotation speed.

But first, think ahead. Plan for later "expansion". Is the antenna system you're considering now going to be the same in two or three years' time? You may only wish, or can afford, to put up one particular antenna at this time, but want to "stack" another one with it later. If you're a VHF/UHF enthusiast, you may only want to fly one or two fair-sized Yagis right now, but stack a pair or more later.

The force, or torque, required to swing an antenna is related to its weight and boom length, and to some extent the force that a wind will exert on it. Braking torque, too, is dependent on these factors. Different antennas have different characteristics and will affect your choice; even with antennas of the same weight, larger turning and braking torques are required for antennas with a long boom length. Tolerance on braking torque can be increased significantly if the rotator is operated at reduced speed. Many rotators have only a fixed speed, but some types incorporate a variable speed facility. If you change antennas, or perhaps add one to the stack, then running the rotator at reduced speed lowers the braking torque requirement, reducing operating stress on the rotator.

Fortunately, although rotators come in a limited range of sizes and styles, they have generally been designed to cope with common types of antennas and antenna system designs.

Types and styles

Rotators range from small, "light duty" models designed to turn comparatively small and lightweight TV or FM antennas, right through to *monster* machines capable of turning huge beams and stacks weighing up to 1000 kg and having 10-12 metre booms. Some types are versatile enough to be used for "standard" horizontal rotation or as elevation rotators for aiming antennas at satellites.

A "light duty" rotator may have a turning torque rating ranging from 150-250 kilogram-centimetres (kg cm) and be able to carry a weight of perhaps 50-100 kilograms. A "medium duty" rotator may have a turning torque of around 400-600 kg cm and a vertical load (weight) rating of around 200 kg. "Heavy duty" rotators may have a turning torque rating ranging from around 1000 kg cm to 2000 kg cm or more and be rated to carry vertical loads in the 500-1000 kg range.

The braking torque rating of a rotator is related to its construction and speed of rotation. In some models, the braking torque may be four or five times the turning torque rating (in kg cm, again), but may be up to ten times or more the turning torque.

The light duty TV-type antenna rotator, such as the Arista AAR2 Automatic Antenna Rotator, are the lowest in cost and are quite adequate for antennas of modest dimensions and weight. The AAR2, for example, will take an antenna, or antenna system, up to 50 kg in weight. So, it will

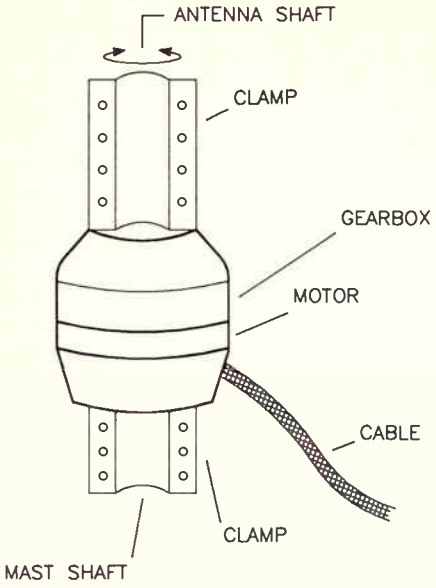


Figure 1: the shaft-mount or coaxial style of antenna rotator. Light duty "TV-type" rotators are like this.

handle, for example, quite a sizable VHF/UHF TV antenna, or a goodly sized FM antenna, perhaps a four or five element six metre amateur band beam or, say, a 10-15 element two-metre band Yagi. It could handle a single, small and light two or three element 10 metre amateur band Yagi or a quad, or 27 mHz CB beam. It *won't* swing your tri-band amateur beam! The AAR2 sells for around $170 and is the only model of its type with energy authority approval, according to Arista's managing director, Mike Dean.

Stockist of probably the widest range of antenna rotators on the market in Australia, Emtronics carries some ten models, from Create Design, Kenpro and Daiwa. The Kenpro range is the most popular, with five models to choose from ranging from the light duty KR-250 through the KR-2000RC heavy duty rotator, and including the KR-500 elevation rotator for satellite work.

The model numbers give a clue to the rotators' turning torque rating in kilogram-centimetres. So, the light duty Kenpro KR-250 has a turning torque rating of 250 kg cm and is suitable for much the same applications as the Arista AAR2. The KR-250 costs $199.

The KR400 is a medium duty rotator, available in several models, capable of carrying a vertical load of 200 kg and a turning torque rating of 400-700 kg cm, depending on the model. The KR-400 will rotate the average three element tri-band amateur yagi or a goodly sized stack of VHF/UHF arrays. Cost is $369, or $429 for the RC model; the control units are different.

Top of the line is the KR-2000, rated at 2000 kg cm turning torque. It will handle a 250 kg vertical load and boasts a 10,000 kg cm braking torque. This rotator will certainly handle antennas the size of a six element, four-band amateur Yagi or a four element, multi-band quad, for example, or a substantial VHF/UHF array. It's listed at $1325. The KR-800 lies between the KR-400 and KR-2000. While it is only rated to carry a 200 kg vertical load, it has an 800 kg cm turning torque and 4000 kg cm braking torque. List price is $659.

The Daiwa MR-750 is an interesting unit. You can have it configured with from one to four motors to provide increasing ratings in turning and braking torque. In other words, you can *upgrade* the rotator! With one motor, it is rated to deliver a turning torque of 700 kg cm with a braking torque of 6000 kg cm. Which makes it a medium duty rotator in this configuration. Add another motor and double the figures, taking it into the heavy duty rotator range. Four rotators takes the turning and braking torque ratings to 2800 and 21,000 kg cm, respectively. So, your rotator can "grow" as your antenna system grows. Basic cost is $575, with each motor costing $190. You could swing a truly monstrous array with a four-motor MR-750.

Emtronics also offers two azimuth-elevation rotator systems for satellite work, each comprising a pair of Kenpro rotators. The KR-5400A uses a KR-500 elevation rotator "married" to an upturned KR-400. The KR-5600A employs a slightly uprated KR-400 with the KR-500 mounted to it in the same way. The former costs $759, the latter $959. The KR-500 can swing the antenna through 180 degrees.

There are five models in the Create Design RC5 range of rotators with turning torque ratings ranging from 600 to 2200 kg cm. Two have vertical load ratings of 400 kg, the other three, 700 kg. Their construction results

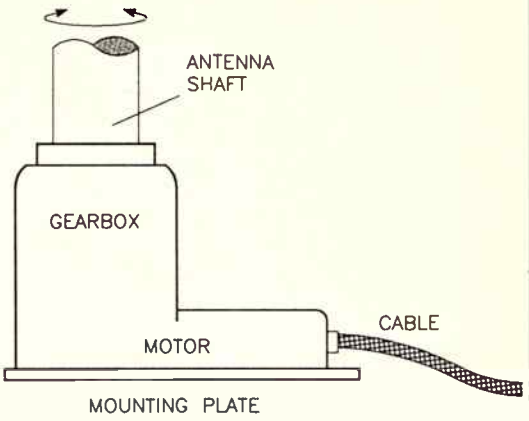


Figure 2: this type of rotator is designed for mounting on a plate and incorporates a thrust bearing and motor in the base. Medium and heavy duty rotators are of this type and may incorporate an antenna shaft mounting arrangement rather like the coaxial type shown in Figure 1.

in a braking torque rating of around ten times turning torque rating. They all feature variable rotation speed, ranging from a "fast" 75 seconds for 360 degrees, to a "slow" 180 seconds (three minutes).

Mountings

Rotator mountings are of two general types: plate mounting, or shaft mounting. Some models can be mounted by either method, having a removable shaft mounting on the bottom. The shaft mounting type is meant

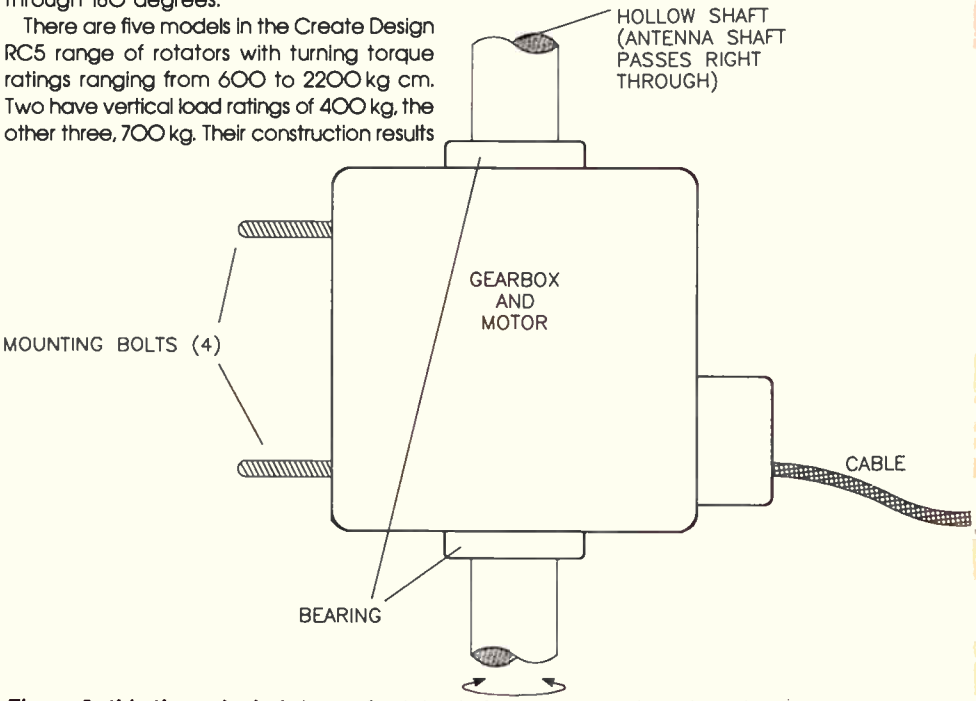


Figure 3: this through-shaft type of rotator is less common than the other two, more often seen as an elevation rotator, for satellite antenna systems. The antenna shaft passes right through the gearbox and motor housing, with shaft clamping arrangements adjacent to the bearings at each end.

for mounting atop a pipe mast. Light duty (TV-type), and some medium duty, rotators are of the shaft-mount type. They are sometimes referred to as "coaxial" type rotators, for obvious reasons (See Figure 1). Shaft-type rotators can accommodate a limited range of mast and antenna shaft diameters. This is something to check when selecting one you might want to buy.

The plate mounting type of rotator (Figure 2) is meant for mounting to a plate which is welded to the top of a tower, or inside the tower, with a shaft running up, through a thrust bearing at the tower's top, then to the antenna system's boom. This latter arrangement is a desirable one for several reasons. Firstly, the thrust bearing will take the dead weight of the antenna system and the shaft running from the rotator to the boom will absorb a lot of the torsion developed by the antenna system in high winds, as well as during starting and stopping. This reduces the stress on the rotator and will add greatly to the life of the system. A shaft of say three to five metres or so, between the rotator and boom, is often recommended.

You can install a plate mounted rotator at the base of your tower if you wish, running a shaft right up the tower. While this has certain advantages in installation and servicing, there are other disadvantages, such as twist in the shaft causing some wobble during starting and stopping, additional cost and tower weight.

Rotators which allow the shaft to pass right through are also found, making them suitable for either azimuth or elevation rotation (Figure 3), as mentioned earlier.

Arista's AAR2 and the Kenpro KR-250 are both shaft mounting types. The AAR2 may be attached to masts ranging from 22 mm in diameter to 40 mm diameter. The Daiwa MR-750 is a plate mounting type and can accommodate shafts ranging from 38 mm to 63 mm in diameter.

Control/indicator units

You'll find three general types of control/indicator units. Rotator motors are for the most part low voltage (usually 24-28 V) ac-operated, reversible types. The motor has two windings connected so that one or the other is fed through a capacitor to provide a 90 degree phase shift, which determines the direction of rotation of the motor shaft, and thus the antenna. The control unit determines which direction the motor rotates by means of a switch or relay contacts. The indicator mechanism varies from type to type.

The simplest, lowest-cost control/indicator unit is found with light duty TV-type antenna rotators. The "workings", simplified for the sake of clarity, are shown in Figure 4. A ratchet-and-solenoid escapement arrangement is used. A toothed wheel (36 teeth) and ratchet mechanism driven by a front panel knob operates a set of spring-loaded switch contacts. You set the pointer to where you want the antenna aimed. If you move it clockwise, the "CW" contact closes applying ac directly to the uppermost motor winding and ac via the capacitor to the lower motor winding. This drives the motor clockwise. A 36-toothed wheel and a set of contacts in the rotator housing cause the solenoid in the control unit to drive the actuator wheel back round so that the spring-loaded contacts open once again, stopping the motor at the required position.

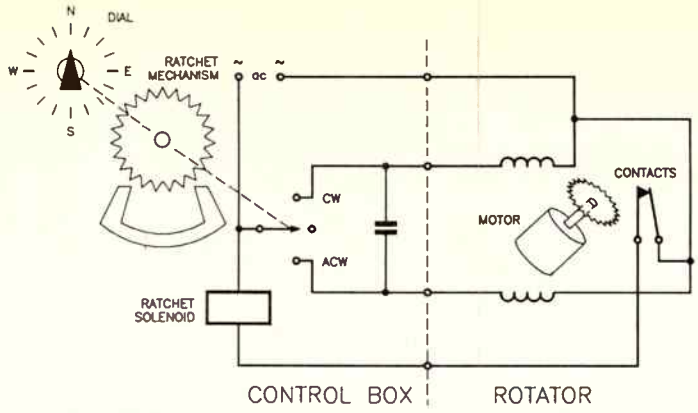


Figure 4: simplified schematic of the simplest, lowest-cost style of control/indicator unit, employing a ratchet-and-solenoid escapement mechanism. Light duty " TV-type" antenna rotators have control/indicator units of this type.

The 36-toothed ratchet wheel means you have only a 10 degree aiming accuracy, but as you can only accommodate relatively small antennas with comparatively wide beamwidths, this is no disadvantage. The control unit operates with a distinct "clunky" sound, which is the solenoid doing its job. The Arista AAR2 and Kenpro KR-250 have control units of this first type.

The second type of control box, Figure 5, involves a simple spring-loaded, three-position, centre-off key switch, or perhaps a pair of spring-loaded, two-position key switches, to operate the motor. The indicator circuit employs a panel meter (connected as a voltmeter), fed from a regulated dc supply, connected to a potentiometer mounted in the rotator and driven by gears from the main drive. With this pot's wiper at mid-travel, the voltage between one side of the supply and the wiper is halved and the metre will read half-scale. This may be arranged to read SOUTH on the meter scale.

When the wiper is driven fully to the left in Figure 5, there will be no current through the meter and its needle will rest on zero, marked NORTH on the meter scale. The pot's wiper is driven fully to the right when the rotator has swung through 360 degrees, and the meter will read full-scale, marked NORTH, as you'd expect.

The variable series resistor provides for zero-setting of the meter circuit. The accuracy of the meter scale limits the antenna pointing accuracy here; typically, it would be within five-six degrees (best at the right hand end of the scale, worst at the left hand end).

Some medium duty rotators have control units of this type, such as the Kenpro KR-400 and KR-800. The Kenpro KR-500 elevation rotator also comes with a control unit of this type.

The third, and more sophisticated, type of control box is illustrated in Figure 6, known generally as a "balance-type" circuit. This employs two potentiometers, a pair of dc amplifiers and two relays, the relay contacts operating the motor circuit. The pot in the control box has a 360 degree drive arrangement, operated by a pointer knob. When pointed at the NORTH position, and

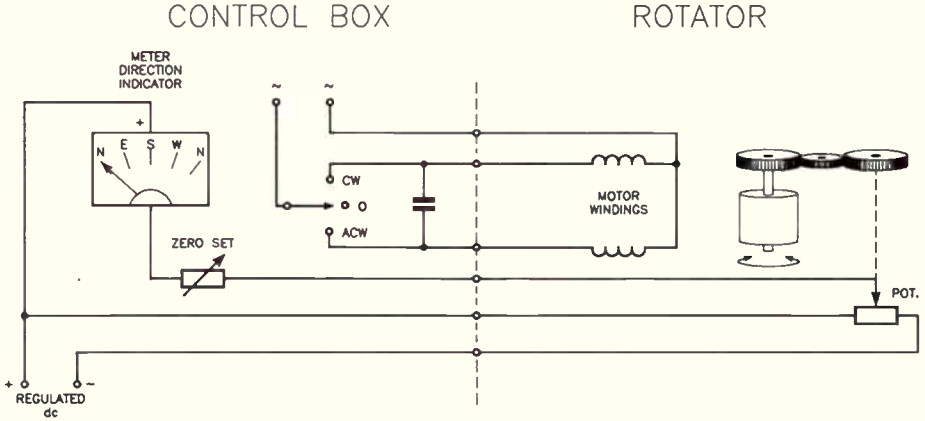


Figure 5: this style of control indicator/unit is popular, found on mid-priced medium duty rotators. A panel meter serves as the indicator.

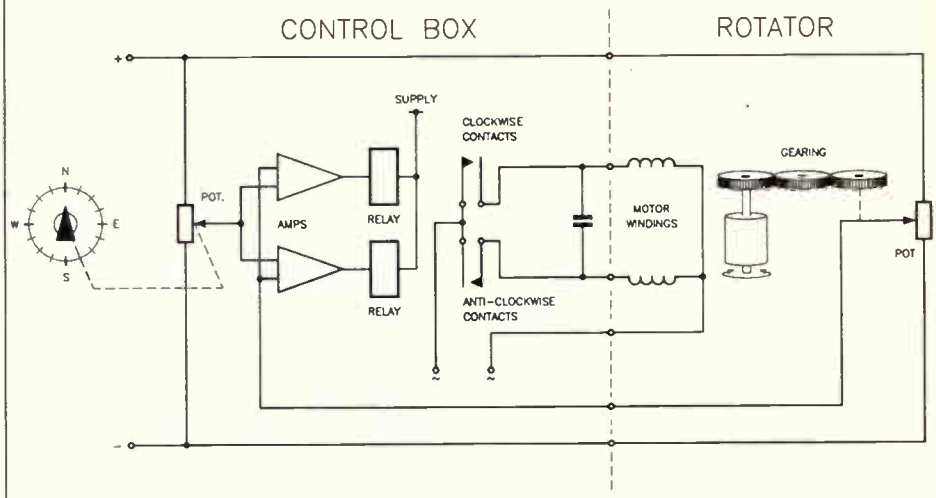


Figure 6: the more sophisticated style of control/indicator unit has a schematic rather like this, known as a balance-type circuit. Heavy duty and some medium duty rotators sport control/indicator units of this type.

with the antenna aimed north, the dc amps show no difference between their inputs and neither relay is operated.

If the control knob is then turned to EAST, for example, there is a difference between the voltages on the wipers of the control unit and rotator pots, the circuit is unbalanced and the top amp will operate its relay, closing the clockwise contacts. This applies power to the motor and the antenna shaft turns, also turning the rotator pot. When it reaches east, there will once again be no difference between the voltages at the two pot wipers, the circuit is balanced again and the clockwise relay drops out, removing power from the motor.

A variation on this has a motor-powered potentiometer and large pointer revolving over a substantial circular scale on the control box. Control circuitry permits presetting the direction on the dial and then actuating the rotator with a switch, when required. Readout accuracy can be within two degrees or so.

Slippage and other mechanical inaccuracies can affect pointing accuracy in practice.

Some control units of the latter type are simply calibrated in degrees around the compass, while some include a great circuit map of the world centred on a suitable area – great for HF DX enthusiasts! Create Design has a control unit with this feature.

Some medium duty and the heavy duty type of rotators generally have control units of the third type, some being more sophisticated, with extra features.

Other matters

When choosing an antenna rotator, you might consider such additional matters as, rotation speed (or time taken to swing full-circle), the interconnecting cable specifications and the availability of spare parts.

The "fastest" rotators take around 50 seconds to complete 360 degrees, the slowest 180 seconds; a "median" speed is 75-80 seconds. The Arista AAR2 takes 75 seconds, while the Kenpro KR-400 takes 50 seconds. The Daiwa MR-750 takes 70 seconds, while the top-line Kenpro KR-2000 takes 80 seconds. The Kenpro KR-500 elevation rotator takes a little more than 70 seconds to go from zero to 180 degrees.

Note that, while all rotators have a stop that prevents them continuing around and around, some rotators will swing *more* than 360 degrees, perhaps 375 up to 420 degrees.

The cable between the control unit and the motor will comprise maybe up to eight wires and may have to run a considerable distance if the control point is located well away from where the antenna's mounted. Three of the wires will have to carry the motor current and any voltage drop here will affect rotator performance. The cable must be well-rated to carry the required current with a minimum of loss.

Some rotator types are repairable, should you be so unfortunate as to suffer stripped gears or such. And it is a point to consider asking your chosen stockist.

Summary

So, there's a bit more to it than first meets the eye, eh? Perhaps I've been able to give you a little more insight into antenna rotator technology to help you choose one to suit your application. Swing it! eti

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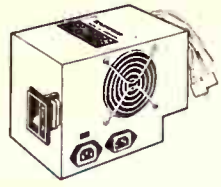

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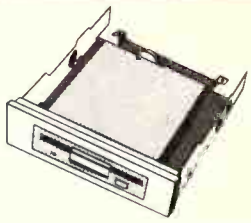

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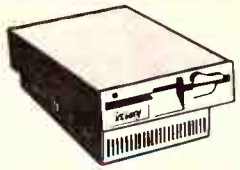

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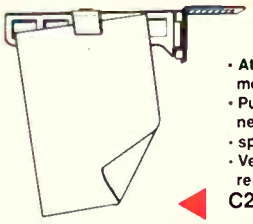

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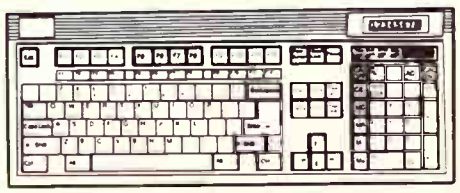

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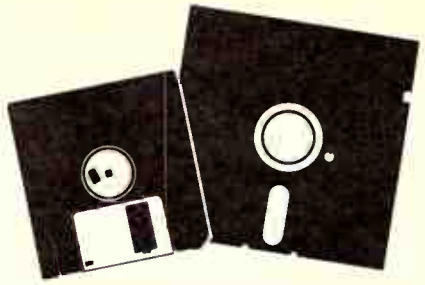

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- High impact plastic lid and base

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ROD IRVING ELECTRONICS

ANNA GRUTZNER

Australia's defence against mines — one of the military's oldest weapons — could leave some waters vulnerable, reports Anna Grutzner.

The old cliche that "those who do not learn from history are condemned to repeat it" was driven home to Western powers during the Gulf War when their much-neglected countermine capabilities proved no match for World War 1 vintage mines.

One of the cheapest, oldest and most versatile tools of military conflict – the seamine – seriously threatened commercial shipping along a major international trade route. The USA failed to anticipate the havoc a few Iranian mines could cause and was embarrassed by the disproportionate response they elicited from US forces. Five vessels, including the fast-guided frigate, USS Samuel B. Roberts, and an American tanker, the 275,000-tonne Bridgeton, fell victims to the ancient moored contact mines. While a multinational mine clearance force of specialist vessels managed to clear the waters, the lesson was learnt and the major powers reappraised their capabilities.

The seamine has emerged not merely as a tool of limited conflict, but as a new tactic in maritime terrorism, and it is an enticing weapon for weak countries and terrorist groups.

Australia's defence forces are much weakened by the yawning gap in its countermine warfare forces. The Royal Australian Navy's sole minehunter, the HMAS Curlew, long ago reached geriatric status. The oldest ship in the navy, it has a sonar and shallow wire sweeping gear of limited effectiveness. The navy is understood to be negotiating with the British to borrow a vessel so that HMAS Curlew can be taken out of the water before the long-awaited inshore minehunter (MHI) is ready for service.

The threat of a mine attack being made against Australia is extremely slight, but the Germans proved during WW2 how rapidly and covertly a mine-planting operation can be staged in major and strategic shipping lanes. German ships laid some 230 moored contact mines off the coast near Sydney, Newcastle, Hobart, Albany and in the Bass Strait to the detriment of half a dozen ships.

The potential harm to commercial shipping, to say nothing of military operations, is well illustrated by a few trade statistics. Thirty-eight ports, spread along a 20,000 km coastline, are used to transport more than 95 per cent of the country's exports and imports. These ports are also critical to coastal domestic shipping, which accounts for nearly 40 per cent of all internal cargo movement. In 1986-87 the ports moved in excess of 309 million tonnes of cargo worth $75 billion.

Australia's shallow coastal waters and ports are ideal for mine-laying, and countermeasures are severely hampered by the sea conditions and geographic scale of hunting operations. While the laying of moored mines in shallow waters cannot be dismissed (especially as neighbouring countries stockpile them) the most likely threat is from ground mines. Typically, ground mines are laid on the seabed to about 30 metres to attack surface vessels, though with a large enough explosives payload, they can destroy a vessel from 90 metres depth. New rising and homing mines have been developed to overcome the limitations of ground mines in deep water but the sophist-

Department of Defence

COUNTERMI

HMAS Rushcutter, one of the navy's prototype minehunters.

NE WARFARE

icated technology remains in the hands of the major powers, thus giving most countries no reason to develop countermeasures. The Soviet Union, 12 of whose Natya class ocean-faring minesweepers were recently acquired by the Indian Navy, has the single greatest mine-laying capability in the world.

A countermine warfare fleet is on the RAN's agenda. Minehunting in protected or low sea state conditions will be performed by the six Australian-made Bay class minehunters (MHIs) while another 10 civilian craft will be fitted with minesweeping capabilities. A mine warfare system headquarters will be established next year and teams of clearance divers will be based on both east and west coasts with support units to coordinate logistical, maintenance and repair functions on the vessels.

However, the charge of "too little, too late" has been levelled with some justification at naval planners. The Dibb report on Australia's defence capabilities bluntly described the urgent situation as the result of "poor planning and procrastination". Ignorance of the credibility gap and the navy's profound obsession with the "big guns" of warfare have exacerbated the problem. The gap will remain until the mid-1990s at the earliest and even then the need for an ocean-going minehunter won't be met.

The 120-tonne Bay-class MHI represents a dramatic deviation from any countermine vessel ever built. The 31-metre hull is of catamaran design and is constructed of glass-reinforced plastic with a foam centre. The material, now being used by the Royal Navy to build Britain's Sandown class minehunters, is tougher and more explosion-proof than steel and does not produce a magnetic signature capable of detonating a magnetic mine. Essential to any good minehunting/sweeping vessel is high resistance to underwater shock, as some new ground mines have fuses which are activated by the vessel merely sailing on the surface above. Vessels must also be safeguarded against magnetic and acoustic-activated mines, requiring the hull and engines to be purpose-built.

The MHI survived rigorous shock testing and the sandwich composition has proved to be a very strong supporting structure. The broad twin-hull vessel is stable enough to carry the ship's propulsion and power-generation gear

Countermine warfare

Department of Defence

HMAS Shoalwater, now fitted with bilge keels, has put hull problems behind it, says the navy.

at a higher level, thereby reducing the acoustic signature and protecting the machinery from underwater shock. The large span between the two propellers (Dutch Schottel system powered by two Poyaud 200 kW turbo-charged diesel engines) provides good manoeuvrability. The hull has caused its designers headaches, however. Degaussing problems occurred with the GRP material and its transparency to electro-magnetic radiation forced the navy to combat any electrical interference emissions which could affect non-related control circuits. It has actually devised an innovative degaussing system that produces low residual magnetic signature in the water. While conventional solutions rely on the installation into purpose-built vessels of sophisticated electro-magnetic degaussing coils, Australian designers have come up with permanent magnets that achieve similar results in non-specialised vessels. The navy insists the hull problems are three years behind it. Moreover, one of the two MHI prototypes, HMAS Shoolwater, was fitted last year with new bilge keels and has showed a marked improvement in performance over HMAS Rushcutter.

The most recent problem to jeopardise the project is the hull-mounted sonar. The West German Krupp Atlas Electronik DSQS-11H sonar has failed to adapt to the catamaran platform in trials and may be abandoned altogether. The navy admits it was overoptimistic about the sonar but says it is not alone in making a huge technology leap. The British, for instance, are having trouble with their variable depth sonar. Conversely, the DSQS-11H installed in the Royal Thai Navy's German-built Type 48 class minehunter/sweeper is said to be performing well.

Krupp was given until mid-year to iron out the problems or to provide an alternative sonar. Failing that, the Government was likely to opt for a French sonar – probably one of the Thomson CSF range. The navy has done an exploratory trip overseas and will be looking closely at the experiences of other regional powers which have purchased sonars in recent times. Both the Royal Malaysian Navy's Mahamiru class minehunter/sweepers (four modified versions of the Italian Lerici) and the Indonesian Navy's new Pulau Rengat class vessels (modified Dutch-built Tripartites) use the Thomson Sintra TSM 2022 IBIS V sonar and mechanical sweeps.

The Krupp sonar under trial with the RAN is part of the MWS80 system, which can independently detect and classify suspected mines through 360 degrees and simultaneously through 90 degrees. Suitable for hunting moored and bottom mines, it employs three sub-systems. The Atlas DSQS-11H mine countermeasures sonar looks for and locates mines, the Atlas Mini-Ranger MRS3 tactical navigation and command equipment identifies and records their presence with precision navigational sensors, and two ECA PAP 104 mine-disposal submersibles carried on deck destroy the mines. While the vehicles will not be fitted with Krupp's high definition sonar to identify objects at close range underwater, the PAP 104s will lay charges to blow up mines by remote control.

Because of the design and construction delays, the MHI may have missed the opening that existed a decade ago in the export market. Shipbuilder Carrington Slipways, at whose Tomago yards near Newcastle, NSW the prototypes have been developed since 1976, is caught in a bind. They cannot hope to clinch deals with overseas customers until the RAN puts its final stamp of approval on the MHI and its mine-

hunting systems. Yet the RAN is holding back until the project is a certain success.

It had been accused of letting slip several commercial opportunities, including one to sell eight MHIs to Saudi Arabia and to build 15 for a Gulf states bloc with common minehunting requirements. The former contract was won by the new British Sandown class. Naval officials here argue the MHI was never in the running because the Saudis need the deeper-water capability of a variable depth sonar (to below the 90 metre MHI capacity) for use in the Red Sea.

Despite strong competition from the French and the USA (whose older minehunters were being upgraded), Saudi Arabia ordered the six Sandowns. The British have even adjusted the construction timetable for the Royal Navy's vessels to accommodate their Saudi customers with the second vessel off the production line.

Hopes remain high, however, that Third World nations and those with modest defence budgets will find the MHI an attractive proposition. Most major western shipyards now produce a minehunter design for the export market and the interest in buying countermine vessels also has increased as many navies upgrade their surface fleets and the vulnerability versus costs stakes are raised. Several RAN promotion missions to south east Asia and to the Middle East have raised encouraging interest.

Cost will be a key factor in the MHI's saleability. It is no longer the cheap alternative conceived in the early 1970s. The navy puts the cost currently at $86 million, though the indirect costs far exceed that figure. Nor is the project yet completed; the sonar delays will further increase the indirect costs. Ironically, the decision to build rather than buy off-the-shelf was largely based on the belief that the catamaran design would minimise costs. At less than $100 million sailaway price, the MHI remains a competitive domestic purchase, although its export potential is limited by price-competitive rivals on the market.

The spinoffs for local industry from the project appear few. While valuable experience has been gained, it was at the financial and manpower expense of other naval projects. Other naval training programs were disrupted by the dedication of so many resources to the MHI venture. Moreover, some aspects are so specialised that the know-how will be of limited further application. For instance, Carrington's fibreglass facilities produce a much higher standard of shock-resistant material than that required for normal commercial work. Only export sales of the MHI will justify its staying operational.

In the debate over single versus multifunction vessels, Australia took an early decision to concentrate its efforts on minehunting. The navy's thinking was predicated on three interrelated factors: geography, risk and cost. The country's isolation and vast distances between ports make it vulnerable to widely-dispersed mine attack. The number of vessels in the minecounterforce is, thus, critical to its capability. It seemed better to spread the budget to the acquisition of extra vessels than to upgrade their functions. It was also felt that with limited recurrent funds, the costs of repairing and battling on without one of a few complex multifunction vessels in the event of damage would be too great a risk.

Besides, when the RAN opted for the MHI in 1976 there was nothing else on the market suitable or affordable. The British Hunt class hunter/sweeper was too costly and the French CIRCE class was no improvement on the navy's existing TON class fleet. The Royal Navy has, in fact, reverted back to single-function vessels in its new Sandowns. In a £120 million project being undertaken by the Vosper Thornycroft dockyards, it is using the same glass-reinforced plastic material for the 500 tonne hull as the MHI.

The catamaran design for the MHI was a unique solution to the unique Australian sea conditions. However, the solution itself limits the vessel's operations to shallow waters and low sea states. Its critics argue the minehunter has made itself a luxury item rather than an essential one. It cannot operate in sea states higher than 3-4, which constituted the conditions during the America's Cup racing off Fremantle in 1987. The seas off northwest Western Australia are sea state 5-6 50 per cent of the time, thus severely curtailing the MHI's usefulness. Essentially, it will be confined to harbours, harbour approaches, estuaries and other shallow waterways. The vast majority of shipping traffic to and from Australia transits through waters of less than 90 metres, that is, within the sonar's capability. Yet the one area where deeper seas are encountered is the strategically critical coastline off Newcastle-Sydney-Port Kembla. Many of the country's oil and gas rigs also lie in the 90-200 metre depth range and are in the strategically important northwest.

Clearly, a deeper water capability is required. The navy admits as much, but will not be looking at options until the mid-1990s at the earliest. Perhaps a specially-equipped civilian vessel or one similar to the British River class would fulfil the role. As for the minesweeping requirement, the RAN proposes to adapt suitable commercial vessels, such as fishing trawlers, to create a "craft of opportunity" fleet. Civilian craft could be fitted with sweeping gear at short notice and little cost. A 10-vessel force of variously sized vessels would cover the range of sea states from protected to open waters. The threat of shallow moored mines could be countered by the acquisition of inexpensive mechanical sweep systems (about $30,000).

Naval experts have attacked the craft of opportunity program (COOP) as a stop-gap measure. Lieutenant Commander Alan Hinge told a parliamentary inquiry into countermine measures in February that the US-devised COOP was intended to augment, not replace, permanent naval forces. A force structure of 10 minesweeper COOPs, including 88 personnel and costing $47 million, is being planned for peacetime conditions, escalating to a 20-vessel fleet with 176 personnel at a cost of $94 million for conflict. The entire countermine proposal is awaited with much interest and a great deal more scepticism. eti

In its bid to acquire a minehunting capability, the navy has somewhat neglected its minesweeping requirements. The two functions, though often incorporated into a single vessel, are quite distinct. Minehunting involves using sonar to locate and identify mines with the complementary use of disposal systems or divers to destroy them. Sweeping involves a mechanical or influence array being towed behind the vessel. The mechanical array cuts the mooring cables of buoyant mines to enable their disposal; the influence stimulates the towing ship's magnetic and acoustic signature to explode mines. Sweeping is preferable to hunting for buoyant mines when environmental conditions might hinder a sonar's performance or when the water is likely to be riddled with undetectable mines.

While the MHI clearly cannot fulfil the function of a minesweeper, local technological innovation has come to the rescue with a cheap sweeping proposition. The Defence Science and Technology Organisation (DSTO) and Plessey Australia have developed radical towed magnetic and acoustic sweeps which do not rely on electrical power down the towing cable from the vessel. Conventional influence sweeps depend on a very high power current through a large cable, which means navies must use large ships with big generators aboard. Moreover, in the Australian concept, permanent magnetic materials in the magnetic sweep and water-propulsion in the acoustic sweep overcome the need for purpose-built magnetically and acoustically clean minesweeping hulls.

STUART CORNER

GETTING MOBILE ALL OVER

The recent Asia Telecom '89 conference in Singapore focussed on the communications problems facing nations in the Asian region. Stuart Corner reports.

Australians are taking to mobile telephones at a staggering rate. Sydney's cellular mobile telephone network is fast approaching saturation point; and when Aussat's second generation satellites go into orbit in a couple of years time, they will usher in nationwide mobile telephone services for farmers, miners and roaming executives.

In spite of its popularity, the handheld portable telephone, or communicating brick as it is unkindly called, is still seen as a toy for yuppies, an image which those who use handheld phones ostentatiously in public places do nothing to dispel.

In Australia, these new-fangled devices are something of a luxury. We have a very good nationwide telephone network which reaches almost every dwelling on our sparsely populated continent. Other nations are not so fortunate. In 18 of the nations of Asia, there is less than one telephone for every 100 people. In fact, 85% of the world's population has virtually no access to a telephone. And the investment needed to provide these facilities would be many billions of dollars.

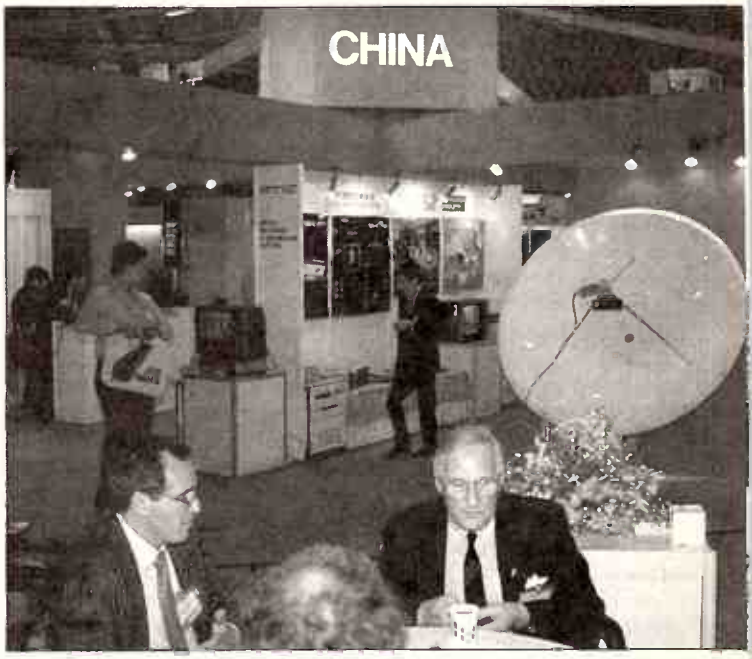
However, alternatives to the traditional terrestrial telephone network now offer more economical means of providing at least some form of telecommunications for countries without a well developed telephone service. Satellite and radio communications could form the basis of the future telecommunications networks in the developing countries of Asia and Africa. They offer opportunities for such countries to make great leaps forward into the late 20th century world of instantaneous nationwide communications.

Asia Telecom '89, held in Singapore in February, was an exhibition and conference which focussed on the communications issues facing nations in the Asian region. Not surprisingly, satellite and radio communications featured prominently on exhibitor's stands and in papers presented to the conference.

One of the most exciting developments discussed at Asia Telecom was the Geostar Radio Determination Satellite System (RDSS). This is claimed to provide a two-way message service, and precise position location – all from a pocket-sized unit with an antenna the size of a postage stamp! These services are already operating in the USA using larger terminals which can be carried on a vehicle. The pocket-sized terminals will not come into operation until satellites with sufficient power are in orbit.

> *'Satellites are expensive and few Asian nations can afford their own'*

Australia will get these facilities with the launching of Aussat's B1 and B2 satellites in 1991 and 92. Tony Staley, chairman of Geostar Pacific Pty Ltd headquarters in Melbourne, told the conference that the Australian system would support up to 1.8 million users per hour. He said that cost of the handheld units should be about $500 by the mid 1990s. The larger units, now operating in the USA, cost $US3000 each and $US45 per month to run, Staley said.



The China stand at the Asia Telecom exhibition in Singapore in February.

The Geostar messaging service permits exchange of short alphanumeric messages in 106 character bursts. Where longer messages are required several of these short messages can be scrolled together.

"In countries with less developed telecommunications systems, RDSS offers the opportunity to spread basic two-way communications capability into any part of the country or the seas around it without the need for any of the traditional multimillion dollar infrastructure," Staley said.

Olof Lundberg, director general of Inmarsat, also stressed the benefits satellite communications could bring to developing nations. "Because the (network) infrastructure is inadequate or non-existent in many areas of developing countries, mobile satellite communications may be a very low-cost way to meet thin needs in rural and remote areas," he told the conference.

Lundberg estimated that 75% of Inmarsat's mobile land communications business would come from "less developed areas of the world" by the year 2005.

Inmarsat is the international satellite operator set up to provide communications for ships at sea. It is expanding its operations into mobile land communications and providing communications for aircraft in

flight.

Malaysia is a pioneer in the use of mobile telephony for a rural and developing economy. The network was described to the Asia Telecom conference in a paper by Dr Mohd Khir Bin Harun, chairman of Syarikat Telekom Malaysia. In 1985, with the launch of its Automatic Telephone User Radio (ATUR) service, Malaysia became the first country in Asia to have a fully automatic mobile telephone service with nationwide roaming. There are now 23,000 subscribers on the service. Although mainly designed to provide communications for vehicles on the move, the network has brought telephone services to many small communities. Dr Harun described a payphone developed in Malaysia for use on the cellular mobile network. About 260 have already been installed.

Cellular radio was identified by a recent London conference as a means of bringing telecommunications to rural communities at an economical cost. But, according to Dr Harun, the sophisticated electronics needed in mobile phones makes them very expensive and unlikely to find their way into rural communications except as payphones. Malaysia has also developed and is testing a system which links the cellular telephone to a PABX so that the cost can be shared among a number of users.

Some Asian nations comprise many separate islands and for these, radio and satellite communications represent the only viable means of widespread communications.

Indonesia, which comprises of islands spread over 10 million square kilometres of ocean, pioneered the use of satellites for basic communications services in 1976 with the launch of its Palapa satellite. With Palapa, Indonesia became only the fourth country in the world to have its own satellites in orbit. Palapa provided the first ever direct dial telephone links between Indonesia's major cities. Indonesia's experiences were described by Krishnahadi Pribadi, technical director of Indonesia's PT Elektrindo Nusantara.

Indonesia makes extensive use of what is known as full mesh demand assigned multiple access (DAMA) single channel per carrier technology. This permits any earth station on the network to communicate with any other under control of a central hub station. Indonesia has at present 200 earth stations on the network, the maximum possible under the original DAMA technology. A new DAMA technology recently introduced will permit up to 800 additional earth stations needed to provide adequate coverage of the country. Further enhancements, including new voice coding techniques which permit acceptable voice signals to be carried in a digital data stream of only 2.4 kilobits per second, will reduce the power requirements for earth stations by a factor of between five and ten, allowing them to be reduced in size to less than 2 metres diameter.

> ***'Malaysia is a pioneer in the use of mobile telephony for a rural and developing economy'***

Similar DAMA technologies will be used in the Pacific Area Co-operative Telecommunications (PACT) network being set up by Australia's Overseas Telecommunications Commission (OTC) for 18 Pacific region island nations. The Pact network will provide telephone, telex and fax links within and between the nations of the region as well as extending international communication links to more remote areas of many Pacific nations.

Satellites are expensive and although satellite communications could benefit many Asian nations, few can afford their own domestic satellite. To take advantage of this opportunity, a consortium of Cable and Wireless (UK), The China International Trust and Investment Corporation and Hutchinson Wampoa of Hong Kong has been formed to launch and operate a satellite for use by Asian nations. Asiasat was originally named Westar VI (it was recovered from orbit by the space shuttle Discovery in 1984). It will be launched in 1990 and will have beams covering China, Korea, Hong Kong, Taiwan, Nepal, Vietnam, Burma, Afghanistan, Iran and India. It will provide public television services and public and private telecommunications.

Ron Elias, managing director of the Post and Telegraph Corporation of Papua New Guinea, saw the new generation of cordless telephone systems now being introduced in the UK and other nations as being particularly appropriate for his country. This system, known as CT2, comprises radio base stations located at strategic public places and linked into the public telephone network. They provide telephone services from small pocket phones by radio within a few hundred metres radius of the base station. Users cannot receive calls on their CT2 phones, only make them. Many designs incorporate a pager to alert the user when someone wants to make contact. Qantas is installing a CT2 system in Australia's major airports, to allow executives to keep in touch with head office.

In Papua New Guinea, no town except Port Moresby has a population in excess of 10,000 and 87% of the population lives in rural areas. It is mainly the populations of the regional urban centres that need modern telecommunications according to Elias. Many of the rural population did not even know what a telephone was and therefore would have no need of one, he said. The urban 13% "would appreciate the standard of telecommunication services in other countries and therefore would demand the same standard."

Recently introduced paging services were proving very popular in these regional centres, and Elias anticipated a high demand for cordless telephones in regional centres which were too small to justify setting up full mobile telephone services. These are present only in the capital, Port Moresby, and there are no plans for expansion to other centres, Elias said.

Could interference kill ISDN?

ONE of the major purported benefits of the Integrated Services Digital Network (ISDN) may turn out to be a false promise. Proponents of ISDN claim that it will allow the existing subscriber network to carry two voice channels or voice and high speed data simultaneously. But tests in Europe have indicated that this may not be the case. Wiring in customer premises consists of unshielded twisted wire pairs. These do not radiate significant interference when carrying a 3.4 kilohertz analogue signal, as used in the links to individual subscribers in the telephone network at present.

However, with ISDN these wires will carry digital signals at a bandwidth of 160 kilobits per second. They will both interfere with other electronic equipment, particularly radio receivers, and be themselves subject to interference from electrical equipment such as motors and fluorescent lights. They will also present a security risk. Researchers in Switzerland reported to a conference in Boston, USA, last year that it was possible to eavesdrop on a conversation carried as an ISDN signal by using a small dish antenna and some associated electronics.

Australia is already experiencing problems with the electromagnetic radiation from present day digital pabx systems and has called for greater protection to be built into electronic equipment such as radios, so that it does not suffer from interference (ETI Dec 89 page 13). ETI

Stuart Corner is a former editor of C in C news, and a regular writer on computers and communications.

TECHNOLOGY

SYDNEY'S MEDICAL CYCLOTRON

By 1991, Australia's first medical cyclotron and PET facility should be operational at the Royal Prince Alfred Hospital, Sydney. It will have enormous impact. Adam Searle reports.

On August 1986 the Federal Government approved a submission from the Department of Resources and Energy for the Australian Nuclear Science & Technology Organisation (ANSTO) to build and operate a cyclotron to produce radionuclides for medical use.

The proposal includes the establishment of a national positron emission tomography (PET) facility to be operated in conjunction with the Royal Prince Alfred Hospital's Nuclear Medicine Department headed by Dr John Morris. The cyclotron will be located at the RPA.

Construction arrangements for the project are underway, having gained funding last February, and the cyclotron and PET service should become operational during 1990-91. It will be Australia's first such installation.

Medical cyclotrons represent a major advance in understanding and diagnosing a wide range of clinical problems.

Cyclotron-produced radioisotopes can reveal the pathophysiology of many of the major causes of premature death and disability in our community – strokes, heart attacks, cancer, schizophrenia and epilepsy.

A cyclotron is a device which accelerates electrically charged atomic particles in an ever-increasing spiral path, finally deflecting the particle beam onto a "target" with such force they make the material of the target become radioactive. The radioactive material can then be processed for use as a medical "tracer".

Radioactive substances spontaneously emit radiation which can be measured with great sensitivity by electronic means and can be used to keep track of minute or trace quantities of radioactive substances in the body.

This process provides a safe non-invasive means to see how organs are functioning within the body. It displays their biochemistry and physiology. The capacity to watch chemical changes as they occur within the body enables medicine to detect disease before structural or anatomical changes occur.

As X-rays, ultrasound and magnetic resonance imaging give information on structure and anatomy, they often do not detect a disorder before it is anotomically apparent, by which time, as in the case of, say, cancer, it may be too late to do much.

Cyclotron-produced isotopes are different to reactor-produced isotopes because they emit positrons (which are the opposite to electrons, only positively charged). Very short-lived cyclotron isotopes of oxygen, nitrogen, carbon and fluorine all emit positron radiation. Their distribution in the body is measured with a new technique called positron emission tomography, PET for short.

Because cyclotron isotopes tell us about chemistry, bloodflow and function they tell us more, and can reveal a problem at an earlier stage. than other anatomically-based techniques such as X-rays, ultrasound and nuclear magnetic resonance.

Cross sectional images

A PET camera produces a series of cross-sectional images of the part of the body within its ring of radiation detectors. It is called a tomograph. (See accompanying illustrations.)

The patient receives an injection or inhales a small amount of radioactive 'positron-emitting' tracer. Then a scan is made, during which radioactive counts are collected for later analysis.

A computer is programmed to reconstruct the data into a series of cross-sectional maps of the tracer distribution inside the patient. Maps of tracer distribution indicate the chemistry and therefore the function of the body part being studied.

The tracer loses its radioactivity quickly, and the radiation dose to the patient is usually much less than from many X-ray scans. PET centres are being installed around the world as the availability of positron isotopes and the sophistication of PET cameras improves.

Their impact on clinical research is expected to be profound. Two main areas for their intended usage are in the fields of clinical research and medical therapy (pharmacology).

Current research is concentrated particularly in the areas of neurology and cardiology. In neurology, studies with fluorine-labelled glucose and the amino acid methionie, labelled with carbon-11, have been useful in evaluating cerebral tumour metabolism and grading the severity of brain tumours.

Other tracers are proving valuable In the study of acute strokes, epilepsy, Parkinson's disease, transient ischaemic attacks and cancer metabolism.

The major cyclotron tracer used for brain diagnosis is fluorine-18. With a half-line of 110 minutes, it can be distributed to other capital cities by air when PET cameras become available in Melbourne or Perth for example.

PET also has great potential in cardiology. It is used in the assessment and treatment monitoring of ischaemic heart disease and cardiac insufficiency, providing regional studies of metabolic bloodflow and heart muscle metabolism.

Professor Langstrom in Uppsala has produced recipes for labelling 80% of drugs in the current pharmacopoiea, with enormous implications for pharmacology.

Domestic needs

With these capacities operating at RPAH and the Austin Hospital in Melbourne, not only will Australia's leadership in nuclear medicine in this region increase but domestic needs will be more readily met and the overall ability to treat many illnesses will be greatly enhanced.

Considering that the first cyclotron was created in 1931, and that the quest for an Australian cyclotron has been waged since 1962, it is perhaps not before time. It took Magellan three and a half years to cross the Pacific – the medical cyclotron will take 60!

Its long-term implications for health care in this country are significant, and its potential for Australia's medical profile in its region are considerable.

While we are generally regarded as being

How PET works. A substance, such as glucose, is "tagged" with a radioisotope and injected into the body (tagged gases may be inhaled). Cyclotron radioisotopes emit positrons which collide with electrons and the two annihilate one another. This releases a burst of two gamma rays that shoot off in opposite directions. (1) They strike crystals in the detector ring around the patient, causing a flash of light. (2) The flashes are recorded by photomultipliers. A computer constructs an image from the array of flash location (3).

at the cutting edge of medical research and diagnostic techniques, and have pioneered many diagnostic uses for reactor produced isotopes, Australia has not led in the provision of medical cyclotrons and diagnostic PET cameras. There are over 100 worldwide. The USA has 40, Europe 21, Japan 11, South Korea 1, Indonesia 1, Africa 3, and the Middle East 2. Australia and New Zealand are the only developed countries without at least one medical cyclotron.

Many cyclotron radioisotopes are too short-lived for importation. Demand can therefore be met only by domestic production; and despite the availability of the necessary expertise and instrumentation, many Australian patients are denied a range of important clinical investigations because of a lack of suitable radioisotopes, such as iodine-123 and krypton-81m.

Australia's geographical remoteness and the escalating costs of importing isotopes also add to the need for an Australian cyclotron.

Current costs of importing required isotopes, including iodine-123, thallium-01 and indium-111, are in excess of $1m each year. This is expected to more than double within five years, adding to our already cumbersome trade deficit.

More than 20 years of debate and indecision in both the medical and political communities of Australia have passed since Dr James McRae of Sydney University first stated the need for a cyclotron in 1962.

In 1969, Dr McRae had recommended that the then Australian Atomic Energy Commission (AAEC) install a cyclotron at Lucas Heights. St George Hospital offered a site to the AAEC, and the following year, 1970, the AAEC had approved $850,000 in principle to acquire one.

When the AINSE-AAEC joint submission suggesting provision of hospital facilities at the proposed Lucas Heights cyclotron site was made in 1974, a furore over the site began. And by 1978, the AAEC concluded that the redundant ANU "physics" cyclotron was unsuitable for Australia's medial needs.

Modified proposal

The struggle only regained momentum after 1983. In 1984, ANSTO, in conjunction with RPAH, submitted a modified proposal for a national cyclotron to be sited in the Royal Prince Alfred Hospital in Sydney.

The Health Minister referred it to the NHTAP which invited the Austin Hospital in Melbourne to submit a similar proposal. Since the late 1970s they had been requesting a small cyclotron for PET in patients with epilepsy.

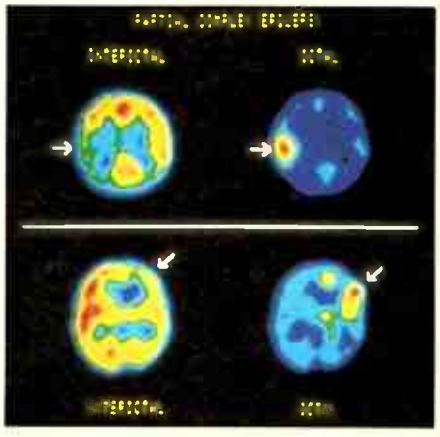
When the final decision was made in 1986, Austin Hospital was the main competitor to RPA. The key reason for the choice of RPA was the fact that it was at the centre of a large, five-hospital complex, close to the Sydney University medical school, the physics and engineering faculties, the airport and Lucas Heights. All of the Lucas Heights packaging and transport facilities will be used.

RPA is a large teaching hospital and has remained at the forefront of development of nuclear medicine in Australia. It was the first hospital to introduce radioisotope scanning in Australia with positrons, with the acquisition of a brain scanner in 1962.

It has been the first to use many new radionuclides and instruments, and has pioneered the use of computerised data analysis. Almost half the physicians in nuclear medicine in Australia have been trained at RPAH. From this perspective, it is hard to imagine where else the cyclotron would be better located.

The Austin Hospital in Melbourne, which will eventually obtain a cyclotron as well, will run its PET Program in parallel to RPAH. A joint organisation, AUST PAC (Austin and RPAH Cyclotron Group) was formally created in 1986.

Much of the software development in computer imaging of scanner data in this area has been done in Australia. Research on enhancing it is continuing. eti



PET images of the brain showing localisation of epilepsy sites. There was no anatomical abnormality present in this patient and CT X-ray was normal.

ELECTRONICS
ETI - 789

The lure of foreign lands and exotic climes, and the fascination of faraway radio broadcasts — it's all there on the shortwave bands. By Brian Hammill.

It has been a long time since a shortwave receiver project was described in *ETI* – 11 years, when the last solar cycle was coming to peak, just like the current one is now. Shortwave stations are readily received from all round the world at present because shortwave "conditions" are at their best. It's fun and fascinating to pick up foreign broadcasting stations on a simple homemade receiver. And it's often eye-opening to hear how foreign broadcasters view world news events – quite different from versions you get on the local stations!

This project is quite simple to build, performs remarkably well and should give you a taste of the "lure of the shortwaves". It's an ideal school science or electronics club project, or as an amateur radio club beginners' course group project.

Details

The circuit employs a single radio frequency (RF) stage which also acts as a detector, providing audio output which is then amplified by an op-amp single-stage amplifier having very high gain to bring the signals up to headphone level. The RF stage uses a dual-gate MOSFET and incorporates regeneration, or controlled positive feedback (called "reaction") which considerably improves its amplification, sensitivity and selectivity. The circuit is powered from a 9 V transistor radio battery.

The circuit is assembled on a spacious printed circuit board and the project is housed in a cabinet made from pieces of blank single-sided pc board soldered together. This makes for a low-cost housing that has particular advantages in reducing the influence of "hand capacitance" when tuning the circuit. The material is also easier to work with than aluminium or steel ready-built cabinets.

The components, for the most part, are widely stocked by electronics retailers of differing persuasion. The exception would be

Front view of the completed project. The cabinet is made from pieces of blank board soldered together and measures 168 mm x wide 80 mm high x 108 mm deep.

SIMPLE SHORTWAVE RECEIVER

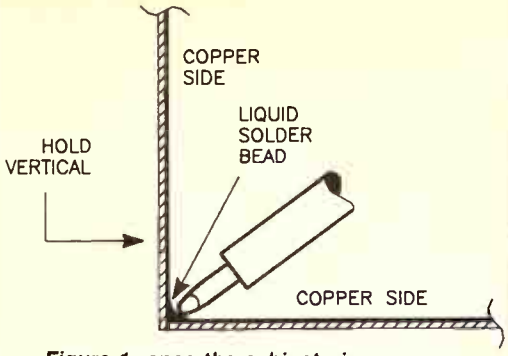
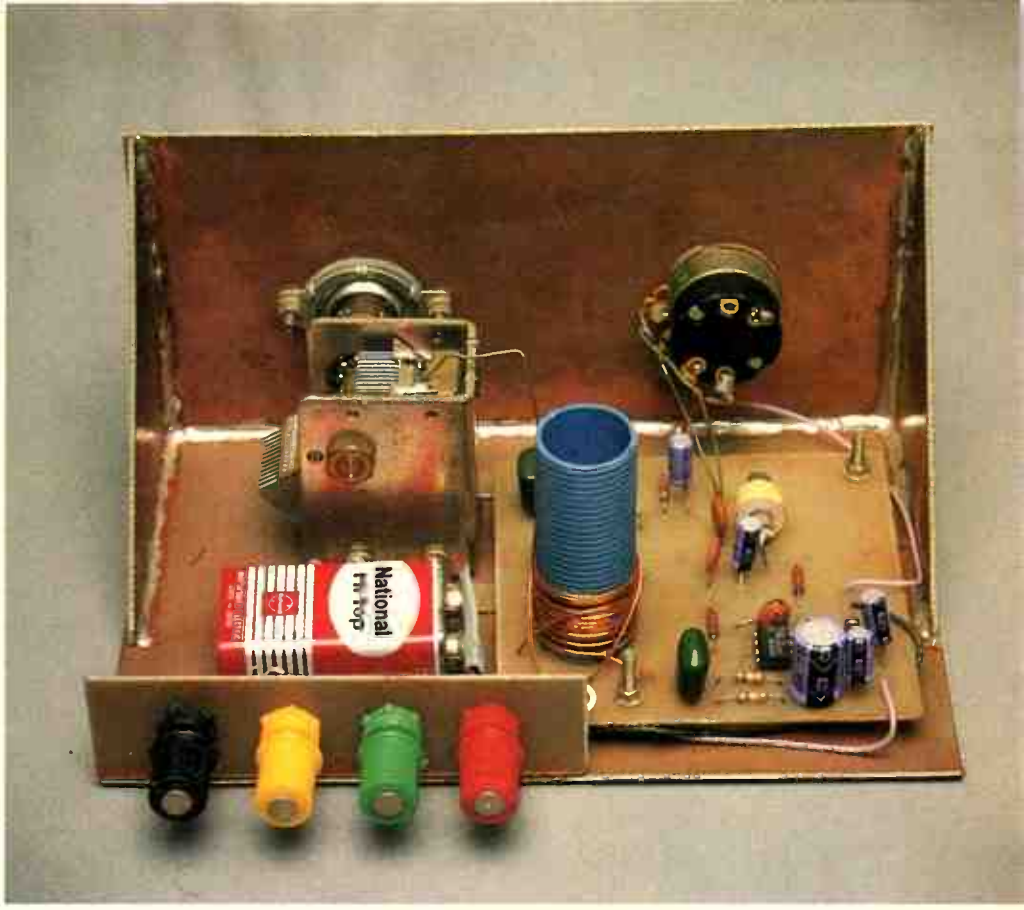


Figure 1: once the cabinet pieces are tacked together, a fillet of solder is run along each of the mating edges as shown here, making sure the iron tip heats both edges such that the tinning you put on initially liquifies. Touch the solder to the iron tip where it meets the two faces so that a liquid solder bead forms, then slowly run the iron along the joint.



Inside view of the shortwave receiver, showing the general assembly details.

the tuning capacitor. It is not necessary to obtain one to match that shown in the pictures of my prototype exactly. Tuning capacitors come in a variety of shapes, sizes and values. In a circuit such as this, the value – or capacitance range – is of no great concern, by and large. A tuning gang having a range of 10 to 414 pF will work just as well as one having a range of 5 to 160 pF, but the frequency range covered will be different for each.

You may salvage a suitable tuning gang from an old valve radio, preferably a mantel-style set of the 1950s or early 1960s – the gangs are more compact. A search amongst the surplus or "distressed' stock bargain bins that some retailers feature will often turn up tuning gangs of this sort. Some firms, such as Sheridan Electronics or Pre-Pak in Sydney, specialise in surplus stock of older vintage and may be able to source a suitable gang.

Single section tuning capacitors, as used in my prototype, are not as common as two-section gangs, as shown. With a two-section gang, only one section is used. The section with the larger set of moving plates will provide a wider tuning range. For a lesser tuning range (which makes tuning in stations a little easier), use the other section. You could also experiment by connecting the two sections together!

With a 10 to 415 pF capacitor as used on the prototype, the frequency range covered extends from about 6 mHz through 25 mHz. This covers the major shortwave broadcast bands known as the 49, 31, 25, 19, 16 and 13 metre bands. A capacitor with 160 pF

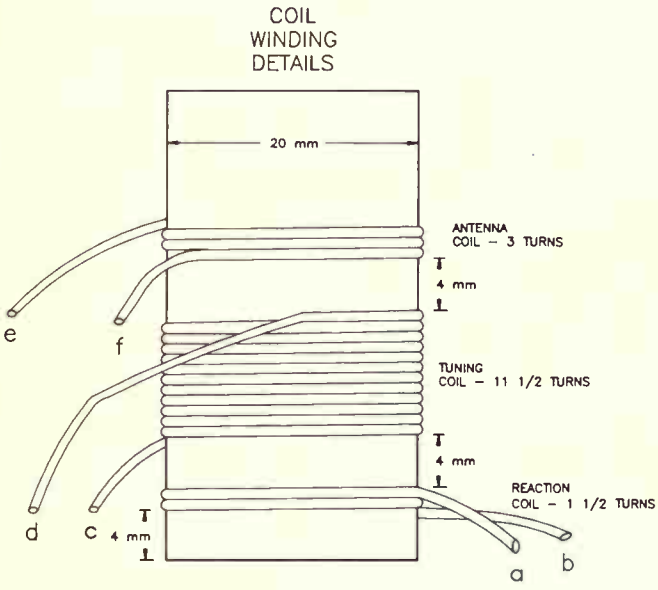
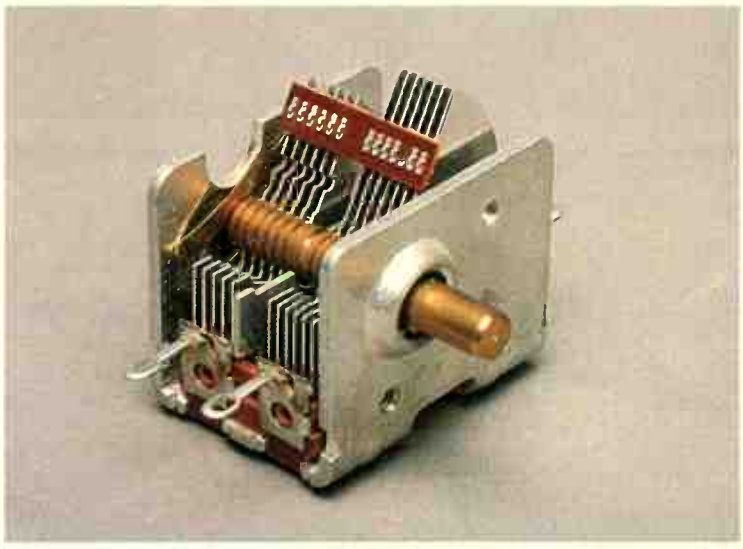
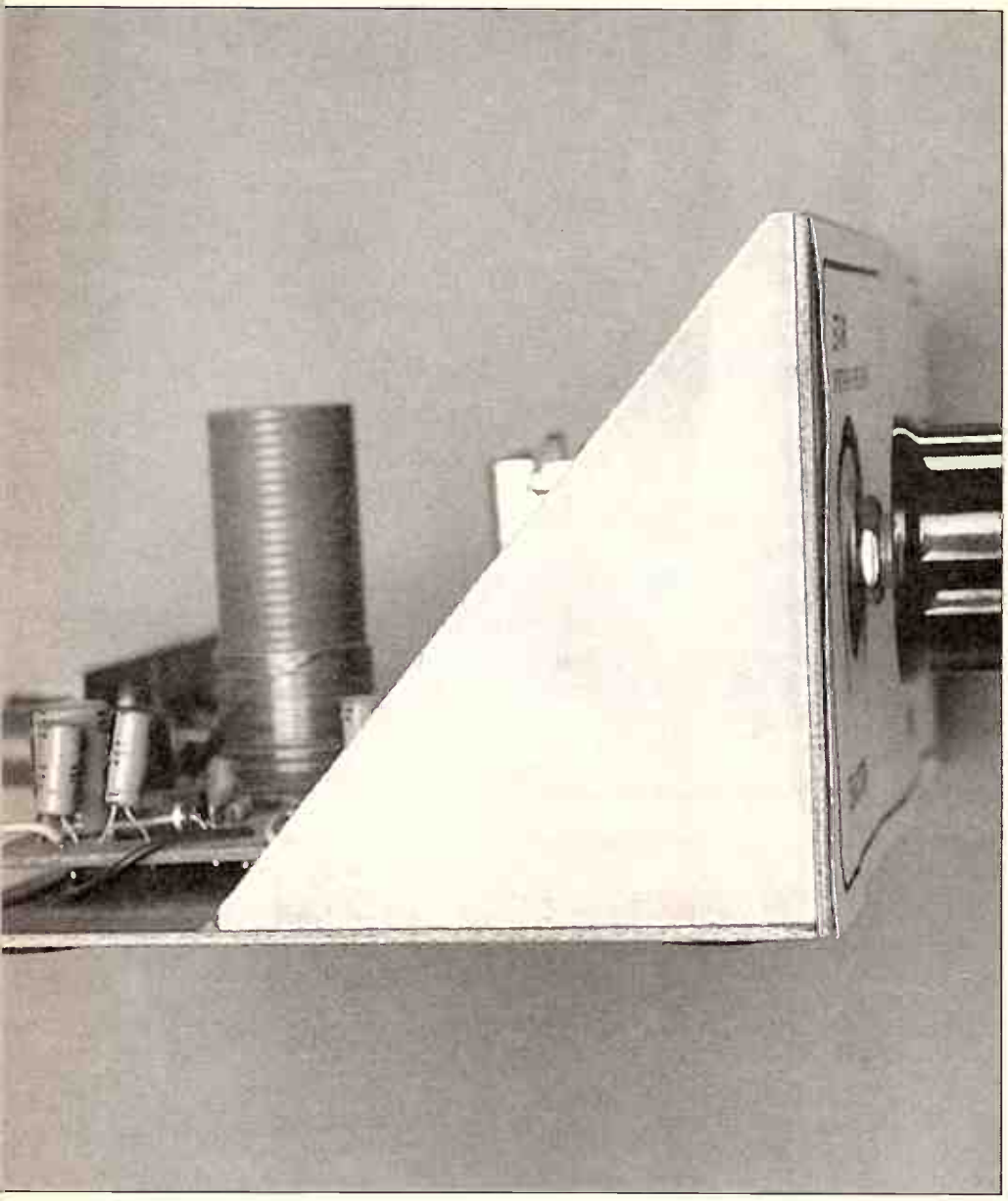


Figure 2: coil winding details. Use 20 gauge enamelled copper wire. All turns are wound next to one another (closewound).



Picture of a two-section tuning gang of the type that can be commonly salvaged from an old radio or found in some suppliers' stocks. Only one section is used, the one with the larger set of moving plates. This provides a wider tuning range. Use the other section if you want a lesser tuning range.



Side-on view of the cabinet, showing how the cabinet pieces mate together.

maximum capacitance will put the lowest received frequency around 9 mHz.

I have specified a potentiometer with an integral switch (the "reaction" control) as this is cheaper and more convenient than having a separate toggle switch. Dick Smith Electronics stocks a pot that's ideal for this project. Described as a miniature rotary, it's listed as catalogue number R-1974. If you can't get a suitable 5k switch pot, then one having a vlaue of 10k may be readily substituted.

Construction

Start with the cabinet. Mark out and cut the pieces of blank pc board. If purchased as a complete kit, these may be already pre-cut. Mark out and drill the base board using your tuning gang and unloaded ETI-789 pc board as templates to mark the hole positions. Carefully measure the height and position of the tuning gang shaft and work out where the holes for the tuning dial will be on the front panel. The dimensions given in the mechanical drawings here refer to the prototype; your one may be different.

Also mark out a suitable position where the shaft hole for the reaction pot should go. Centre-punch all holes before drilling, to prevent the drill bit wandering. Mark out and drill the rear bracket.

With the cabinet pieces prepared, scrub down the copper sides with steel wool (non-soapy variety) and lightly tin the mating edges with a good hot iron. Hold one of the side panels in place and tack it in position with a small spot of solder near, but not at, each end. Make sure it's held vertical. Rope a friend or family member into helping you with this. All the copper sides face inwards. The photograph shows how the side panel is aligned with the base and how the front panel mates to them.

With both side panels in place, lay the front panel flat on the bench or table and place

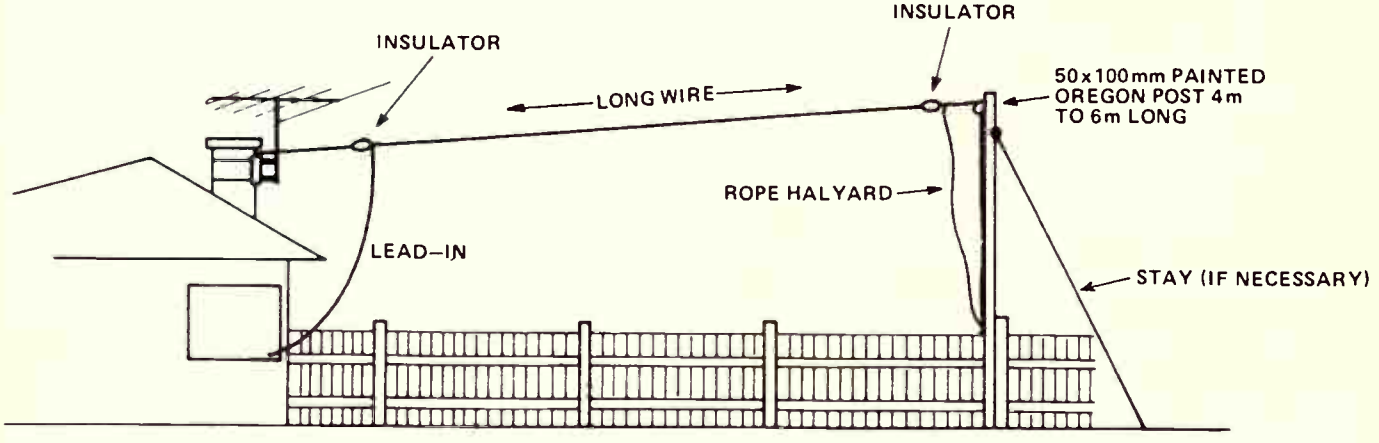
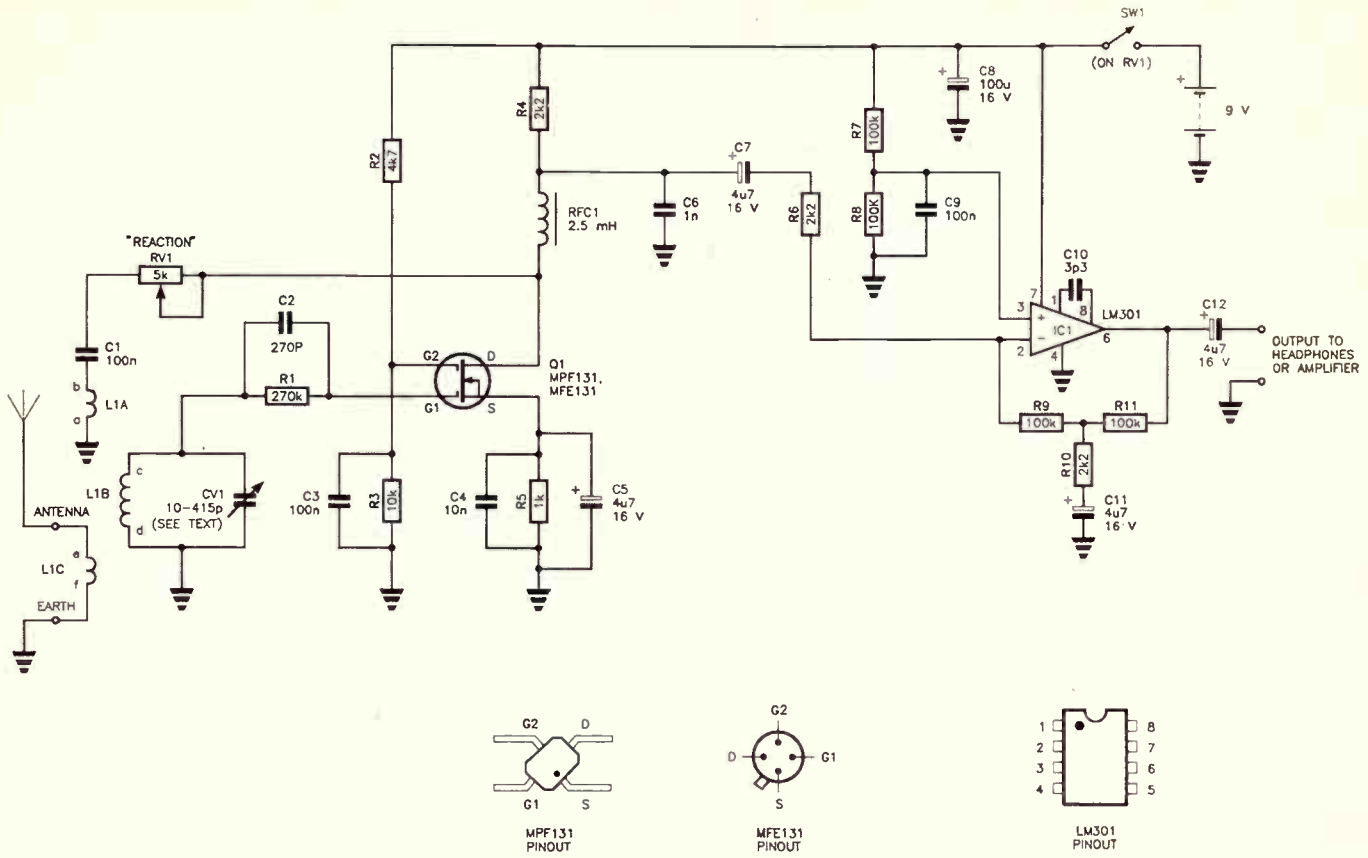


Figure 3: a useful long wire antenna for your shortwave receiver. You can use hookup wire, for economy. The insulators can be egg insulators obtainable at electronics stores.



How it works

The circuit has two stages: the radio frequency (RF) stage which selects (tunes in), amplifies and detects the signals, followed by a high gain audio amplifier stage to bring the audio up to good headphone level. For cost, simplicity and safety the receiver is powered from a single 9 V battery.

Just one tuned circuit is used to select the signals, comprising coil L1B and the tuning gang, CV1. Signals from the antenna are coupled into the tuned circuit by means of the small adjacent coil, L1C. At the selected frequency of the tuned circuit, signals are boosted by the resonant action of the tuned circuit, while signals away from this frequency are attenuated.

The signal selected by the tuned circuit is coupled to gate 1 of the dual gate MOSFET, Q1. Resistor R1 provides gate bias and capacitor C2 lets the RF bypass this resistor which would otherwise spoil the good work of the tuned circuit by attenuating the signal.

Gate 2 of Q1 is biased at about 6 V by the voltage divider formed by R2 and R3. This gate is bypassed for RF by C3. The incoming RF signal is amplified by Q1, the amplified signal appearing at the drain. Rectification of the (AM) modulated signal occurs in the drain circuit of Q1; RFC1 and C6 filter out the RF to leave just the audio across R4 to pass on to the audio amplifier stage. Source bias for Q1 is provided by R5 which is bypassed for RF by C4 and for audio by C5.

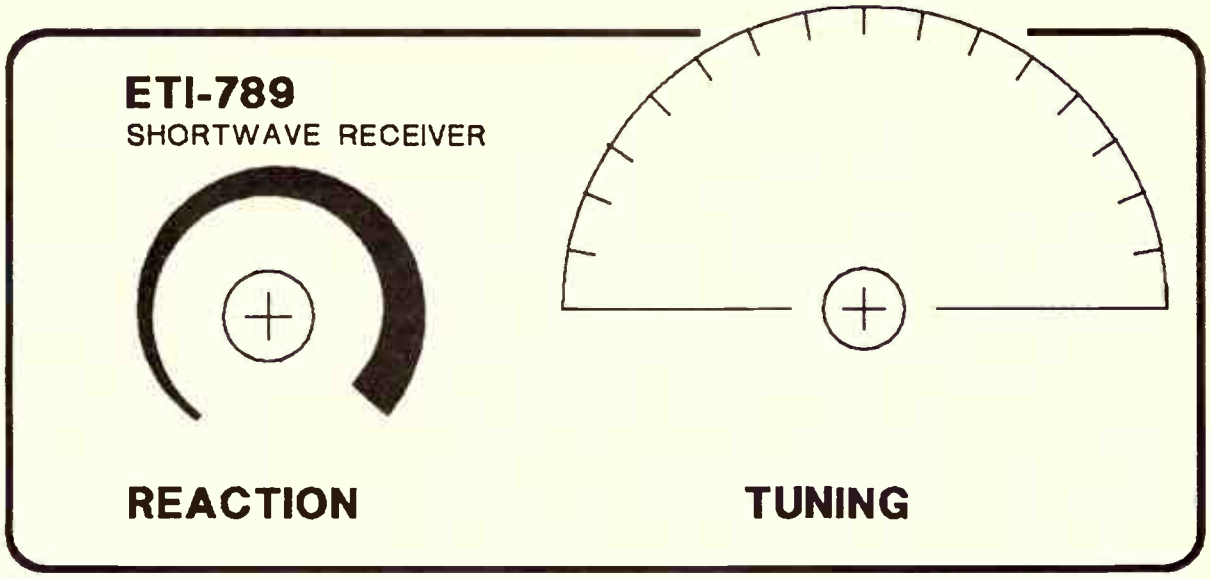
The amplified original RF signal present at the drain of Q1 is coupled back into the tuning coil, L1B, via RV1 and C1. This capacitor simply blocks the dc drain voltage which would otherwise be shorted to ground by L1A. The amount of signal fed back via L1A is selected by RV1. The connections to L1A are arranged so that the signal portion fed back is returned in phase with the incoming signal. The signal phase at the drain of Q1 is opposite to that at gate 1 (the incoming signal) so L1A is connected so as to reverse the phase of the fed back signal portion.

This provides positive feedback, which means the extra portion adds to the incoming signal and is amplified again, and so on, greatly increasing the gain and sensitivity of the stage. With sufficient feedback, the stage will oscillate. With RV1 (reaction) set so that the stage is just below oscillation, you obtain maximum gain and therefore maximum audio output, as well as best sensitivity and selectivity.

The audio signal on the drain side of R4 is coupled to the following audio stage via C7. This stage used an operational amplifier (op-amp), type LM301 or similar, working at very high gain. Usually, an op-amp stage such as this requires split supply rails, that is, positive and negative above and below ground, as they say. But as we're restricted to a single 9 V battery supply, other arrangements had to be made. So, the non-inverting input (pin 3) is biased to half the supply rail voltage by the voltage divider, R7-R8. Capacitor C9 bypasses this point for ac.

The audio from Q1 is coupled to IC1's inverting input, pin 2. Feedback from IC1's output is coupled to the inverting input via R9-R10-R11-C11. This provides negative feedback for IC1. The gain at dc and low frequencies is about 100, determined by the ratio of R9-R11 to R6, because at dc and low frequencies C11 acts like an open circuit. At audio frequencies, however, the feedback is largely bypassed to ground via R10-C11 and the op-amp operates at near its full open loop gain.

Capacitor C12 blocks any dc from passing to the headphones as the output of IC1 has a dc level on it of half the supply rail voltage because of the voltage applied to its non-inverting input. Capacitor C10 limits the overall bandwidth of IC1, ensuring it doesn't oscillate at high frequencies. Capacitor C8 provides bypassing for the supply rail, ensuring it has a low ac impedance, which batteries do not!



Full size reproduction of the front panel used on our prototype.

the just assembled unit in position, ensuring you haven't got the panel positioned upside down with respect to the base! Now, tack the side panels to the front panel as you did before.

The next step is to run a fillet of solder along all the mating edges, as illustrated in Figure 1. Tack the rear bracket in place with a solder bead at each end, then run a fillet the length of the mating faces.

Now tackle the coil winding. Figure 2 shows the details. I used a length of 20 mm outside diameter plastic tubing. It was grooved, which proved more of a hindrance than a help. Smooth is best. A piece of perspex or polycarbonate tubing about 50 mm long is ideal. You don't need all that length, but the extra bit gives you something to hold on to while winding on the wire.

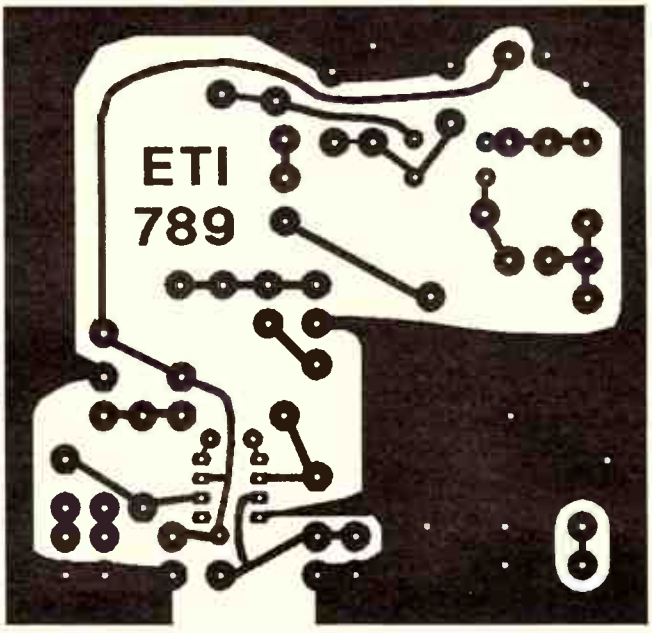
The reaction coil, L1A, goes on first. Cut a 200 mm length of the enamelled copper wire and lay one end over the former about 4 mm from one end (the bottom). Glue it in place with a quick-setting adhesive such as Superglue. Then wind on one-and-a-half turns, going clockwise up the former, keeping the turns close together. Superglue the end of the last turn in place, or the whole turn-and-a-half, for that matter.

Then, another 4 mm further up the former, commence L1B by fixing the start in place with Superglue, then winding clockwise up the former to complete 11.5 turns, glueing the end in place as you did the start. You'll need about a metre of wire for this one.

Finally, 4 mm from the end of L1B, wind on three turns for the antenna coil, L1C, in the same manner. You'll need about 300 mm of wire. Always make sure you leave plenty of trailing wire on the coils' ends. Put the coil aside for now.

The pc board can be assembled next. First check your board, whether homemade or store-bought, looking for undrilled holes and whiskers between closely-spaced pads. The component overlay shows where everything goes. It's quite straightforward. Solder all the resistors and capacitors in place first, taking care you get the electrolytic capacitors the right way round. Solder the RF choke, RFC1, in place.

Then solder IC1 in place – or solder an 8-pin DIL socket in place instead. The RF stage MOSFET can now be soldered in position. These devices are static sensitive and are supplied with either a piece of wire wrapped around all the pins, or inserted in foil or conductive foam. Handle the device carefully, ground yourself first as a precaution by touching a grounded object for a few seconds. Take it from its foil and insert it in the board, seeing you get it the right way



The printed circuit artwork, full size.

round, then solder it in place. If it comes with wire wrapped around the pins, leave this on until the device is soldered in place, then carefully unwrap it.

Now cut and solder in place suitable lengths of hookup wire to run from the pc board to the on/off switch, the audio output terminal, to the ground and antenna terminals. Tinned copper wire (20 gauge) is used to connect the reaction pot terminals (RV1) and to the tuning gang (CV1) fixed plates connection. The battery snap connector has its red lead soldered to one contact of the on/off switch and the black lead soldered to the pc board as indicated on the overlay.

If you wish, for the sake of convenience, pc pins can be soldered into the pads for the off-board connections so you can attach leads after the board has been mounted to the base of the cabinet.

The coil can now be glued in place on the board. If the end is cut square and smooth, Superglue will do the job. Otherwise, use a silicone rubber glue, on the inside of the former. Determine the ends of the coils as

Parts list — ETI-789

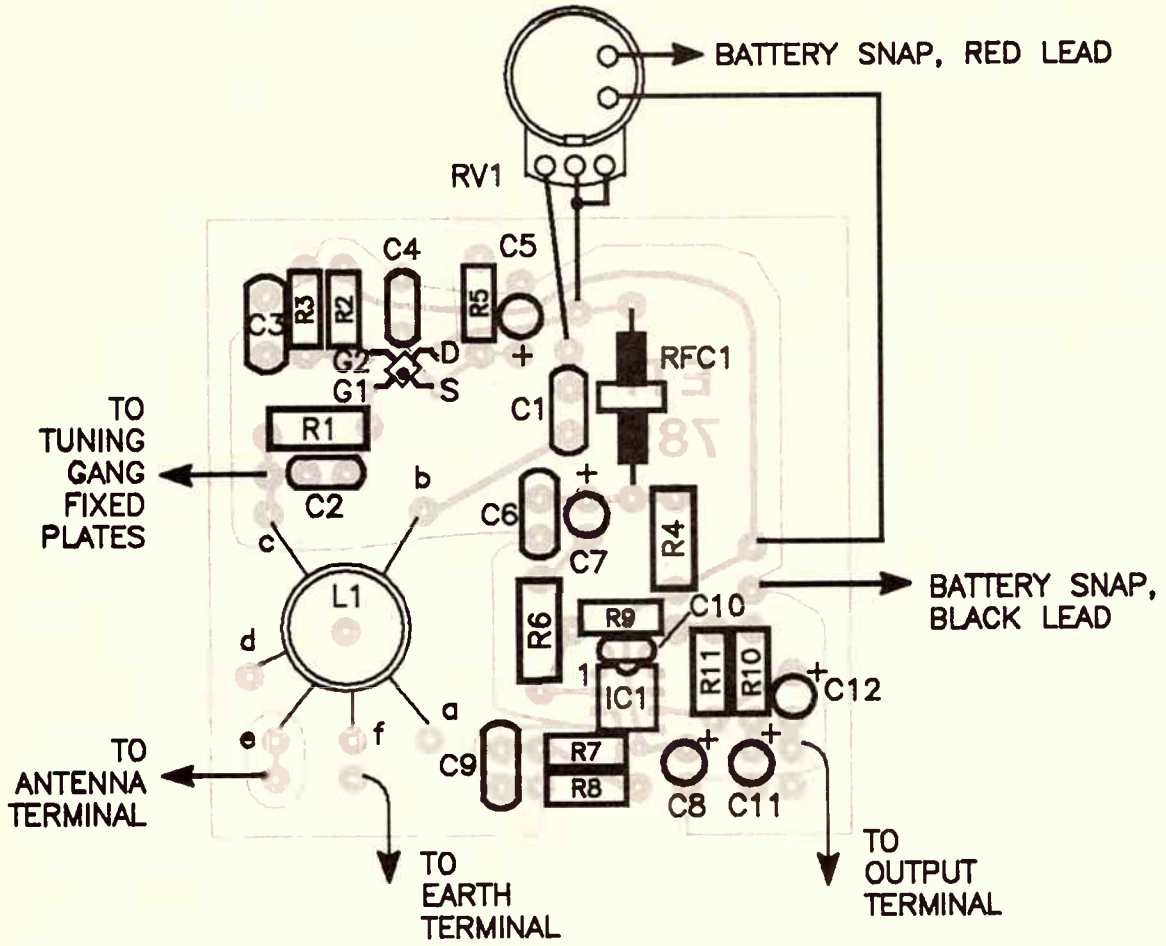
SEMICONDUCTORS
IC1 ..... LM301, uA301
Q1 ..... MPF131, MFE131

RESISTORS all 1/4 W, 5%
R1 ..... 270k
R2 ..... 4k7
R3 ..... 10k
R4 ..... 2k2
R5 ..... 1k
R6 ..... 2k2
R7, R8, R9 ..... 100k
R10 ..... 2k2
R11 ..... 100k
RV1 ..... 5k/log. switch pot.

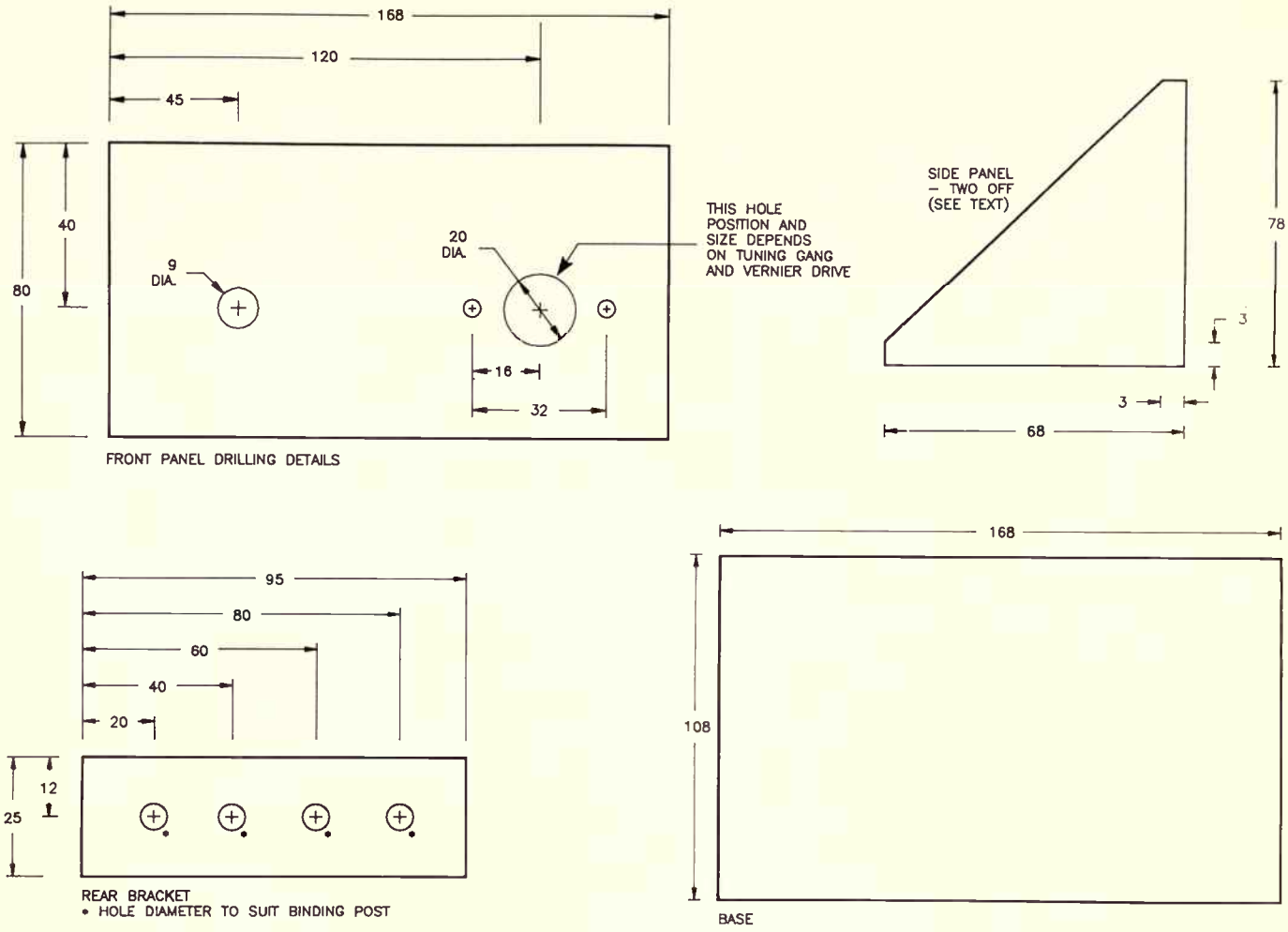
CAPACITORS
C1 ..... 100n greencap
C2 ..... 270p ceramic
C3 ..... 100n greencap
C4 ..... 10n ceramic
C5 ..... 4µ7/16 V RB electro
C6 ..... 1n ceramic
C7 ..... 4µ7/16 V RB electro
C8 ..... 100µ/16 V RB electro
C9 ..... 100n greencap
C10 ..... 3p3 ceramic
C11, C12 ..... 4µ7/16 V RB electro
CV1 ..... tuning gang (see text)

MISCELLANEOUS
L1 ..... see diagram
RFC1 ..... 2.5 mH RF choce
SW1 ..... on RV1

ETI-789 pc board; blank single-sided pc board sufficient to make cabinet; 9 V No. 216 battery and battery snap; reduction drive (eg: DSEC at. no. H-3901, or similar) or vernier dial (with mounting bolts and nuts); one or two knobs, as required; four coloured spring terminals or binding posts; about 200 mm of hookup wire; length of 20 gauge enamelled copper wire (for L1); front panel label (as applicable); hookup wire, two x 6 mm spacers, two x 12 mm bolts and nuts with washers, four solder lugs, plenty of solder.
Approx. cost: $35-$49



Component overlay for the printed circuit, showing where the various components are placed and the off-board connections. You can complete the wiring to the off-board components by reference to our "inside" picture of the project.



Mechanical details of the cabinet, which is made from pieces of single-sided pc board. All dimensions are in millimetres.

shown in Figure 2, and carefully cut them to length after threading them into their respective holes. Scrape the enamel from the coils' ends, tin them and solder each one in place.

With the pc board completed, carefully check it over to see that you've got all components in place and the polarised components the right way around. Examine all the joints and re-heat any dodgy ones that don't look shiny.

The next step involves fitting all the major components to the cabinet. At this stage, you should consider the front panel label. Artwork for a suitable label is reproduced elsewhere in this article. However, as mechanical details will vary somewhat, depending on what gang and tuning dial you're using, this might serve as a starting template only. You could photocopy it, cut and paste the copy to suit your project and then photocopy the result to use as your front panel label.

The reduction drive I used came from Dick Smith Electronics (cat. no. H-3901). I made up a cursor cut from an offcut of clear 2 mm thick plastic. It screws to the front of the drive, just behind the knob. I used a drafting pen to mark a black line in the rear side.

The four terminal posts bolt to the rear bracket. Each has a solder lug secured on the rear end, for attaching connections. On two terminals, just bend the lug over and solder it to the copper of the rear bracket. These will serve as the ground terminals for the audio output and the antenna input.

The tuning gang is loosely bolted in position and aligned with the dial before bolting everything down. Bolt the completed pc board in position using the two 6 mm spacers beneath it. Connect all the off-board leads. The battery I held in place with a small strip of double-sided sticky tape.

Getting it going

Check your work thoroughly. Attach a battery and a pair of high impedance headphones or an audio amplifier. Turn the receiver on and advance the reaction control a little. You should hear a slight hiss. Advance the control a little further and the hiss should increase. At some point, the audio should burst into a squeal; it's oscillating. If this doesn't happen, you may have to carefully dismantle the pc board from the base and swap the connections to L1A. That should set things right.

With the receiver able to oscillate, check that you can get it to oscillate at points right across the tuning range. If not, you will have to carefully prise loose the reaction coil (L1A) and move it closer to the main coil, L1B. Generally, however, you should find your project behaves as it should.

Using it

For best results, you'll need a good, long and high outdoor antenna, although it is possible to hear signals using a piece of wire strung around the room. Figure 3 shows the details of a typical antenna installation that will give good results. The lead-in should not run around inside the house for any distance, so it's best to place the receiver near a window. An earth is not essential, but can help. You can connect it to a water pipe (providing the plumbing's all metal) or a metal spike driven into the ground, if you can arrange it. eti

ELECTRONICS
ETI - 1624

Got a "turbo" switch on your PC? This neat little project provides an impressive two-digit 7-segment display of which clock speed has been selected. By Mick Gulovsen.

'SPEED' DISPLAY FOR YOUR PC

Most PC/XT IBM compatible computers feature a two-speed clock, with the speed being user-selectable at any time. Today's faster microprocessors can run at higher speeds than the original 8088 clocked at 4.77 MHz in the original IBM PC/XT. Hence, the compatibles provide at least two clock 'speeds', the lower speed so that software which is clock-speed dependent may still be used, and the higher speed for the convenience of faster processing action.

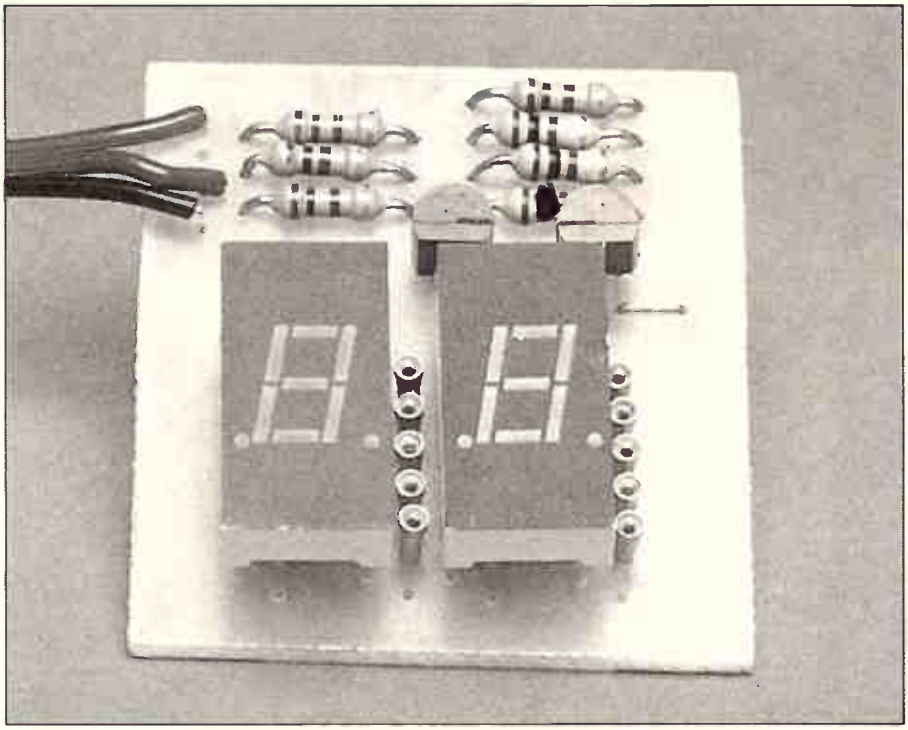
While I was browsing through the crowds and equipment at the PC-88 computer show in Melbourne, one thing that impressed me was the way the fastest and flashiest looking computers had 7-segment displays showing the current clock speed in MHz. So, it was from here that the idea came to me that it would not be very difficult to design a circuit board that could emulate this feature.

The project simply consists of a two-digit 7-segment display and some simple drive circuitry that takes input from the turbo switch on your computer. There are a few options that have to be thought about though before you begin construction. The first of these concerns the display itself. The circuit board supports two different display modes i.e, 4.7 for LOW speed and 8.0 for HIGH speed, or LO for LOW speed and HI for HIGH speed (these I will call 4.7/8.0 and HI/LO).

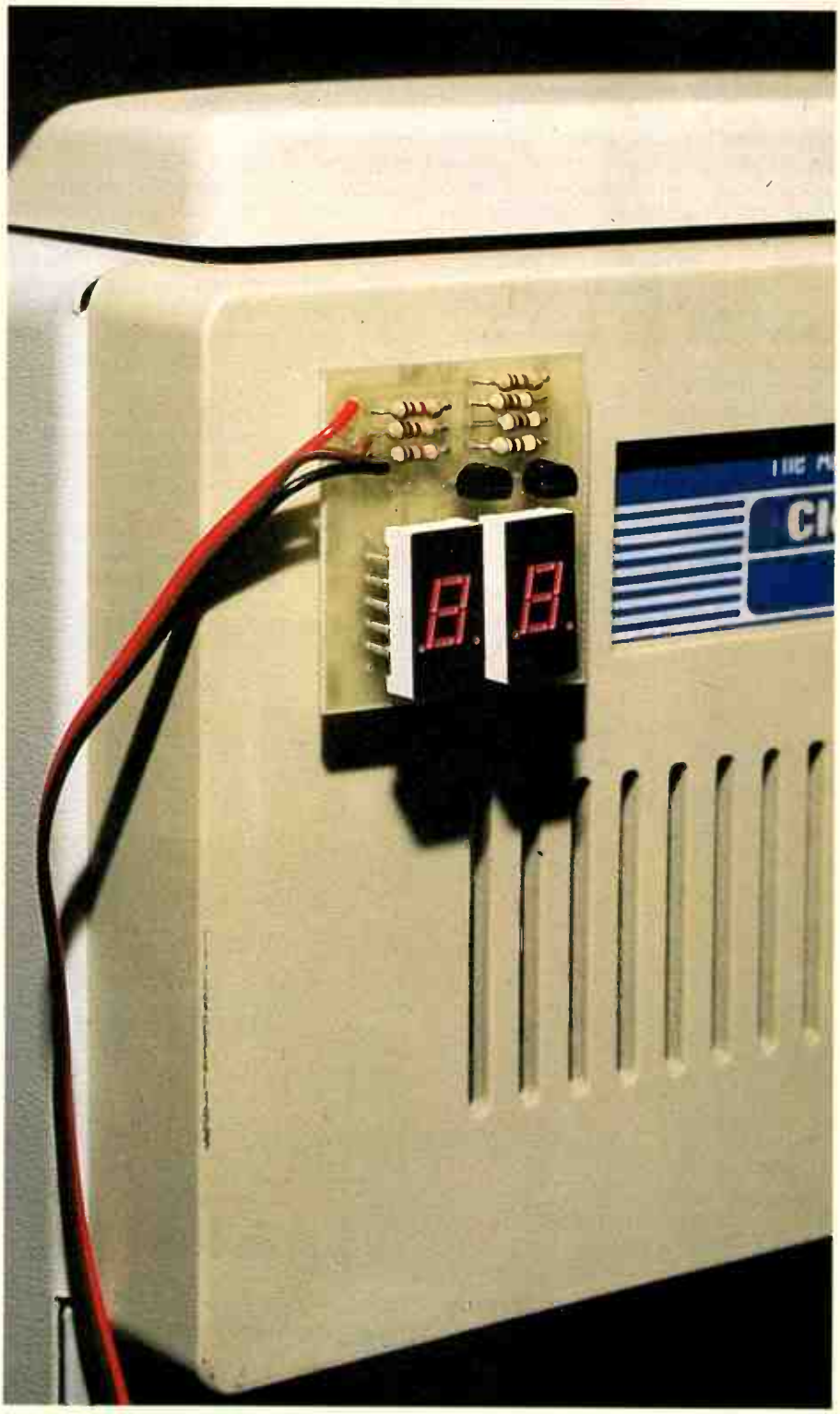
If your PC/XT has an 8 MHz turbo speed (as mine does) then you may prefer to have the project set to display 4.7/8.0, which would indicate that your machine is running at 4.77 MHz when the indicator shows 4.7 and at 8 MHz when the indicator shows 8.0. If, however, your computer has a different turbo speed thon 8 MHz you would probably prefer the display to be set for HI/LO. If you have an AT-type machine, then the latter style of display is the one you need.

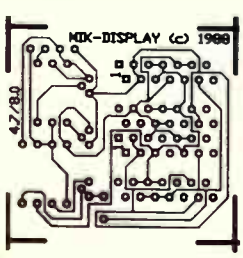
The printed circuit board I have designed has two possible positions for the 7-segment displays. The ones shown in solid lines on the overlay are for the 4.7/8.0 position, while the ones shown in broken relief are for the HI/LO position.

The second option that has to be decided on is the method of driving the circuit as there are no doubt many different methods



View of the completed display board. From this you can see how the LT313 7-segment displays are oriented. Note that this prototype requires an inverted input (explained in the text).





Full-size artwork for the printed circuit board. (Note that this is copyright to the author who has no objection to individual constructors making a one-off board for themselves. Ready-made boards may be obtained from the author if you wish; details are noted at the end of the article.)

of selecting the turbo speed on different computer makes. For this, you'll have to delve inside the guts of your computer to find out a few facts, or consult the circuit diagrams (if you're fortunate enough to have such).

The most common method that I have seen is a software driven switch that uses the spare bit on the 8255 I/O port that was used for the cassette input on the original IBM PC/XT. This appears at pin 20 of the 8255 and is LOW for TURBO speed and HIGH for LOW speed. As this is reverse logic, and if your computer is like this, then the correct input to use for the Speed Display is the INVERTED input (labelled INV on the overlay). In this case, Q1, R1 and R2 are not required.

If your computer selects turbo speed via a switch or some other unknown software method, then it is possible to drive the project from the turbo LED itself. There are two ways the LED could be wired. One is a common +5 volt connection with a LOW applied to the LED and its series resistor when in turbo speed, and the other is a common ground connection with a HIGH applied to the LED and its series resistor when in turbo speed.

If the first case mentioned above is similar to your computer's arrangements, then the INVERTED (INV) input should be used with the connection going to the end of the LED/series resistor that is NOT connected to +5 volts (Q1, R1 and R2 are not required).

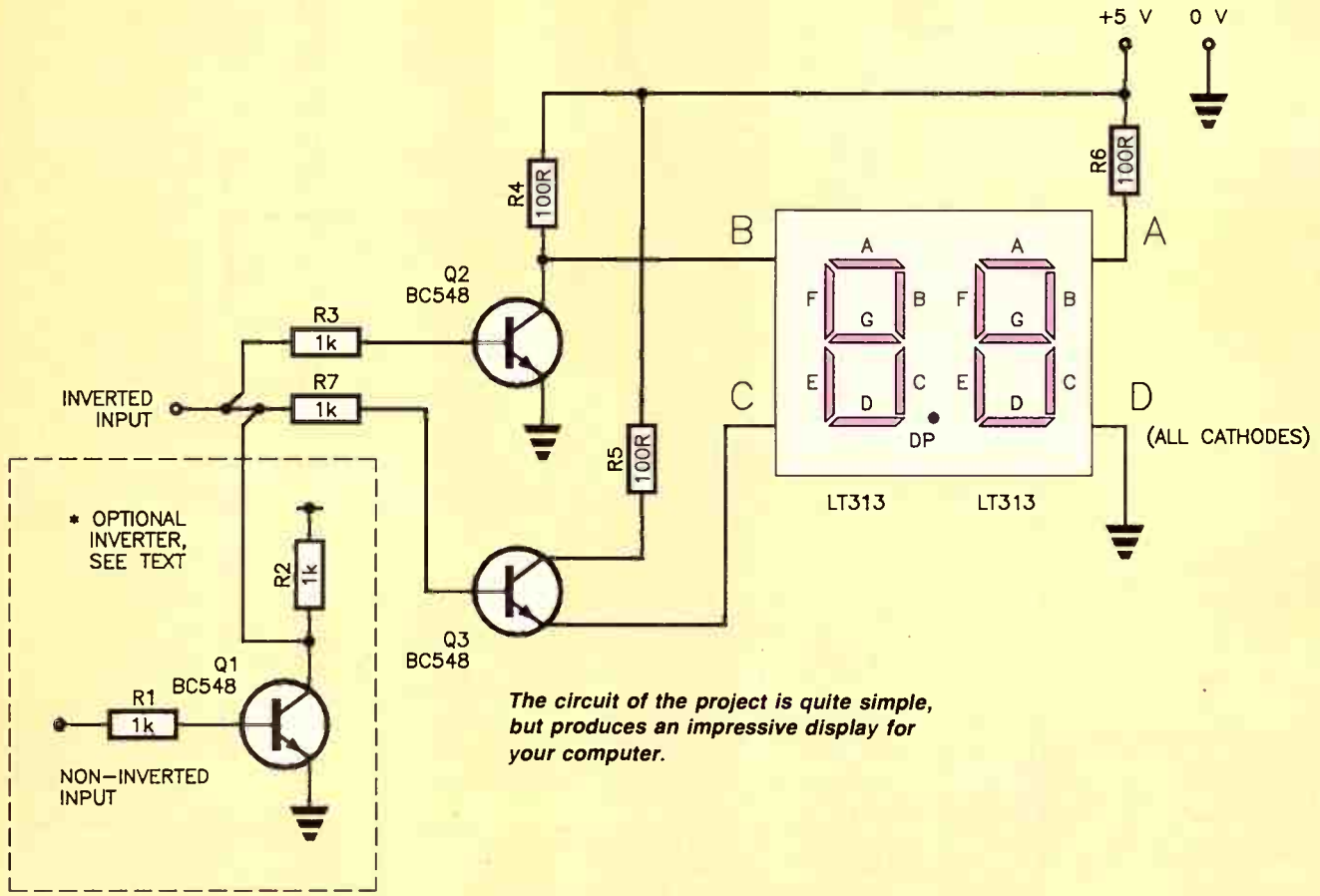
If, however, the second case mentioned above is similar to your computer, then the NON-INVERTED (labelled NON on the overlay) input should be used and the option inverter consisting of Q1, R1 and R2 should be installed on the circuit board, with the connection going to the end of the LED/series resistor that is NOT connected to O V (ground).

Building it

The construction is fairly straightforward and should be started by first checking the print circuit board thoroughly for any faults. Then install the wire link and resistors into the circuit board and solder them in with a fine-tipped soldering iron, trimming the excess leads neatly and being very careful not to create any solder splashes that would short with the neighbouring traces or pads.

After deciding what options you require INV/NON and 4.7/8.O or HI/LO), solder in the transistors and, lastly, solder in the LT313 common cathode 7-segment display units, being very careful as to their orientation (the decimal points should face **away** from the other components).

Also, please note that most of the newer LT313 units have only 10 pins, whereas some older ones had 14 pins with the outer four pins not connected. If you use the devices that have 10 pins only, position them so that there are two holes vacant top and bottom (i.e, pin numbers 1, 7, 8 and 14). Last of all, solder



The circuit of the project is quite simple, but produces an impressive display for your computer.

How it works

The circuit consists of four parts. Each section is extremely simple in concept but combines to produce an impressive display.

The first part of the display circuit is simply a current limiting resistor (R6) in series with the anodes of the common segments of the LT313 common cathode 7-segment displays. As can be seen in the segment table for the HI/LO option, the segments that are common are E and F of the left display character and also E and F on the right display character. These represent the left hand vertical segments of each character which are common to the H on the HI display and the L on the LO display.

The crux of the circuit is the two transistor switches, Q2 and Q3. Transistor Q2 is connected as an inverting switch and Q3 connected as a non-inverting switch. When a LOW is applied to the junction of R3 and R7, both the transistors will be biased off, which would leave the segments that are connected to 'B' in the diagram turned on, powered via the current limiting resistor, R4. The segments that are connected to 'C' would be off as no current flows through Q3.

This would light segments B, C and G on the left character and none on the right character, which would light the vertical segments on the right hand side of the left character as well as the entire horizontal segment and none on the right character. When displayed with the common segments, this would display HI.

When a HIGH is applied to the junction of R3 and R7, both transistors will be biased on, which would leave the segments that are connected to 'C' in the diagram turned on, powered via the current limited resistor, R5. The segments that are connected to 'B' would be off as their anodes would be effectively 'shorted' to OV (ground).

In this example, segment D on the left character would light and segments A, B, C and D on the right character. This would light the bottom horizontal segment on the left character and the top and bottom horizontal segments, and the right hand vertical segments on the right character which, when displayed with the common segments, would show LO.

The last part of the circuit is a simple inverter to provide for both the simple high input = HI circuit as well as the inverted low input = HI circuit.

in connecting leads of the appropriate length.

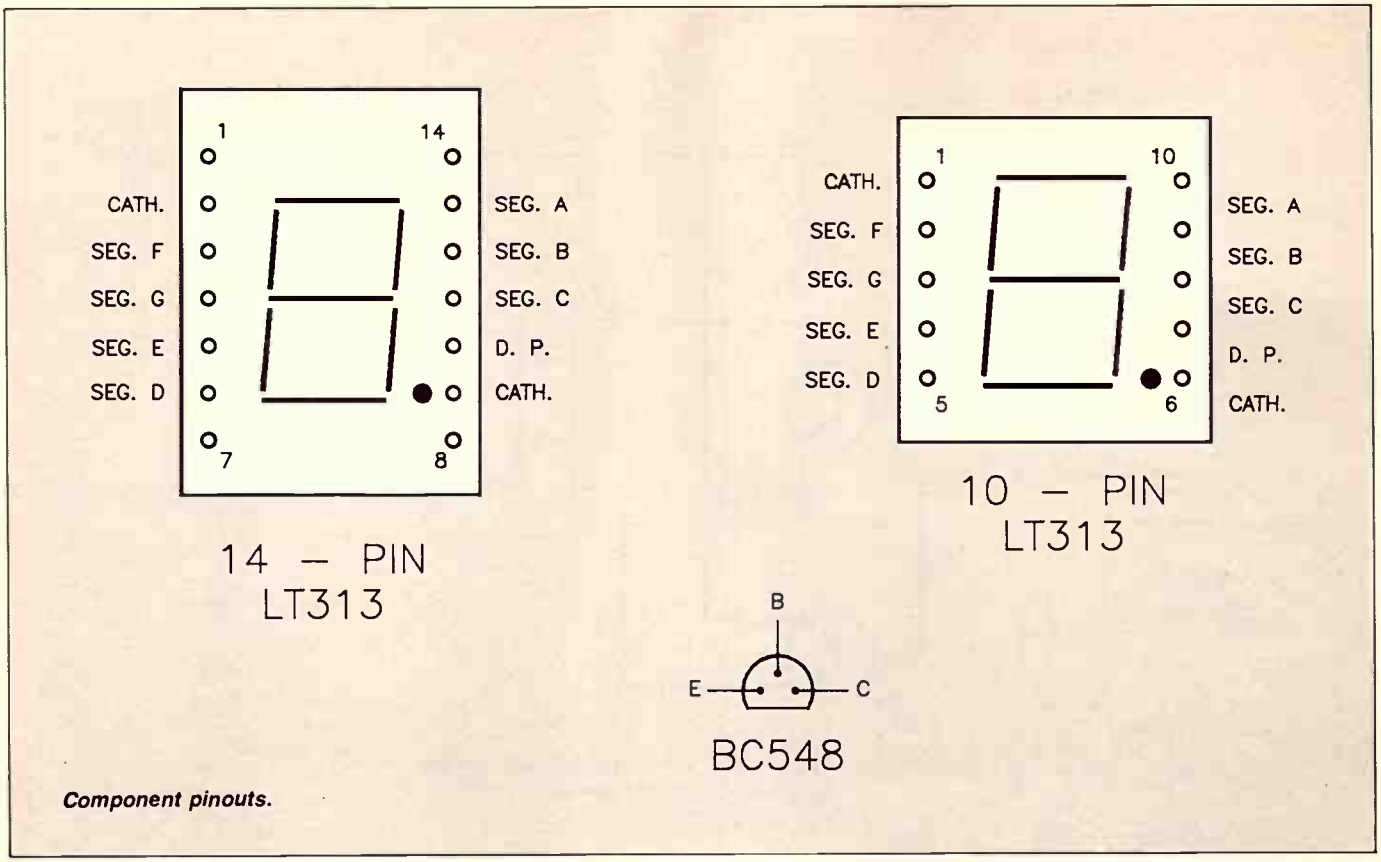
Give the completed project a thorough visual inspection. The tracks and pads on the pc board are quite small and you may have one or two possible solder "bridges" between closely-spaced pads. Check the transistor orientations, too.

Testing it

Before you go to the trouble of installing the unit into your computer, you should test that it is working correctly. You can easily do this by using a 9 volt battery (preferably a bit flat) and connecting the GND wire to the negative side and the +5 wire to the positive side. If you have a variable bench power supply, use that and set it to 5 V.

Conclusion

All that is required now is to find a suitable place to mount the unit. I used two-sided neoprene tape and stuck it to the outside



Component pinouts.

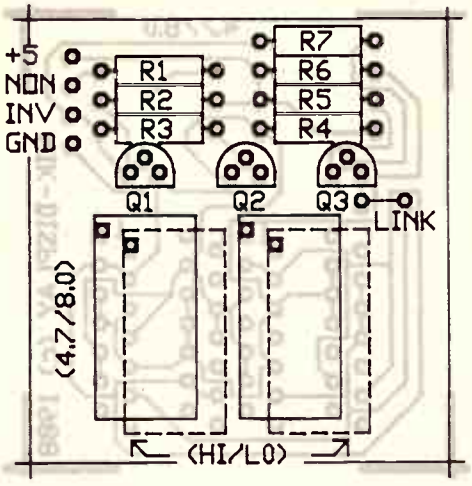
ETI-1624 — PARTS LIST

SEMICONDUCTORS
Q1, Q2, Q3 ..... BC548
LED1, LED2 ..... LT313

RESISTORS ALL 1/4W, 5%
R1, R2, R3 ..... 1k
R4, R5, R7 ..... 100R
R7 ..... 1k

MISCELLANEOUS
ETI–1624 pc board (MIK-DISPLAY); hookup wire, solder, etc.

Approx. cost: $30.



Overlay, showing the component positions. Note that Q1, R1 and R2 are optional. Note also the two possible positions for the LT313 7-segment displays. The solid lines indicate the placement for a "4.7/8.0" display, the broken lines indicate the placement for a "HI/LO" display.

of the front panel of my XT. You may want to carefully cut a hole in the front panel in a suitably convenient spot and mount the unit internally with neoprene tape behind a piece of red perspex filter to give a more professional finish to the job. eti

Ready-made circuit boards may be obtained from the author: Mick Gulovsen, 14 Sutherland St, Glenroy, Vic. 3046 for $7.00 ea plus $1.00 total postage and handling.

Or, he can also supply pre-built and tested units for $29.00 each, plus $1.00 total postage and handling (you must specify what options you require when ordering pre-built units).

	4.7/8.0 DISPLAY		HI/LO DISPLAY	
	SEGMENTS USED		SEGMENTS USED	
	LEFT	RIGHT	LEFT	RIGHT
A	B,C,F,G,DP	A,B,C	E,F	E,F
B	A,D,E	D,E,F	B,C,G	NIL
C	NIL	NIL	D	A,B,C,D
D	ALL CATHODES		ALL CATHODES	

TABLE 1. This table shows how the display segments are connected to the circuit. The column at left: A — B — C — D, refers to the points so marked around the display on the circuit diagram.

TECHNOLOGY

The Australian-owned, Californian-based, Ramtron Corporation has developed a memory chip based on ferroelectric technology. This technology has the potential to affect the design, manufacture and efficiency of computers and other electronic devices. By Mervyn Beamish.

RAMTRON'S FANTASTIC FRAMS

Memories are made of this

The ferroelectric effect occurs when small electrically-asymmetrical elements (dipoles) within certain crystals become instantly polarised. This polarisation occurs under the influence of an external electrical field and remains that way when the field is removed. By applying an oppositely-charged field the polarisation can be reversed. The crystal, therefore, acts as a bistable capacitor, with two distinct polarisation voltage thresholds.

Some engineers think that ferroelectronics is the major breakthrough needed to enable the chip to replace the magnetic disk as the major method used for storing information in computers.

The essence of ferroelectric theory, also known as Ferovskite cell, first revealed itself in 1921. A researcher by the name of Valasek discovered that Rochelle salt, potassium tartrate tetra-hydrate, could be polarised in two directions by the application of an electric field.

Research continued, by Valasek and others, into the individual ferroelectric properties of separate materials. However, a clearer understanding was achieved when two researchers, Anderson and Cochran, commenced looking for a unified theory in 1960.

In the 1970s, researchers, Rohrer and McMillan, (using the then established, but theoretical framework of ferroelectrics), devised and patented a method of integrating stable ferroelectric films with conventional semiconductor technology. This patent eventually led to the formation of Ramtron. The Ferroelectric Random Access Memory, FRAM(TM), the first practical chip, was unveiled in February, 1988, by the corporation.

Figure 1 demonstrates the principle. In very simple terms the mechanics of the ferroelectric effect is the same as putting a dent in a ping pong ball. When the bat applies enough force to the ball's surface, the surface collapses inward and is held there by the rigid skin. The dent can be removed by applying a reverse force greater than that contained within the fabric of the skin. This is usually carried out by heating the air inside the ball.

'The name ferroelectronic is a misnomer'

In ferroelectrics, when the pressure from an electric field is greater than the holding forces within the crystal lattice, the polarising atom clicks into one of two positions. When

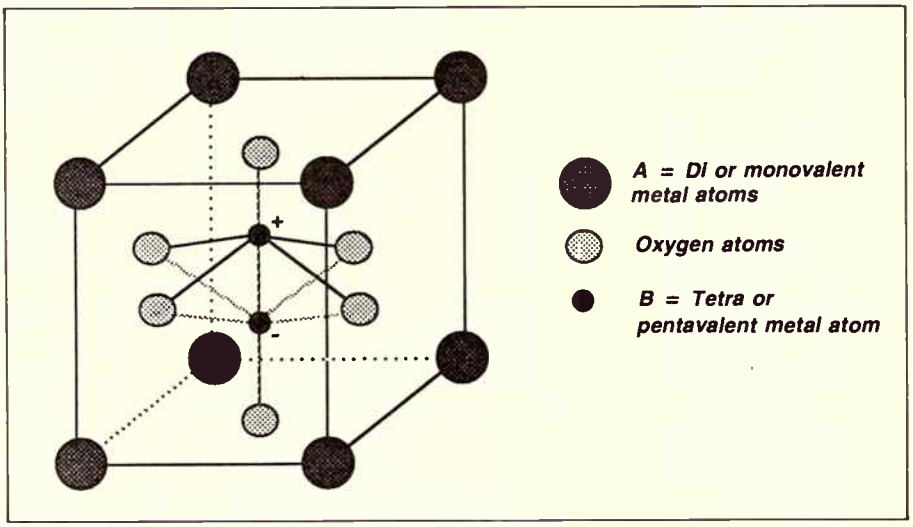
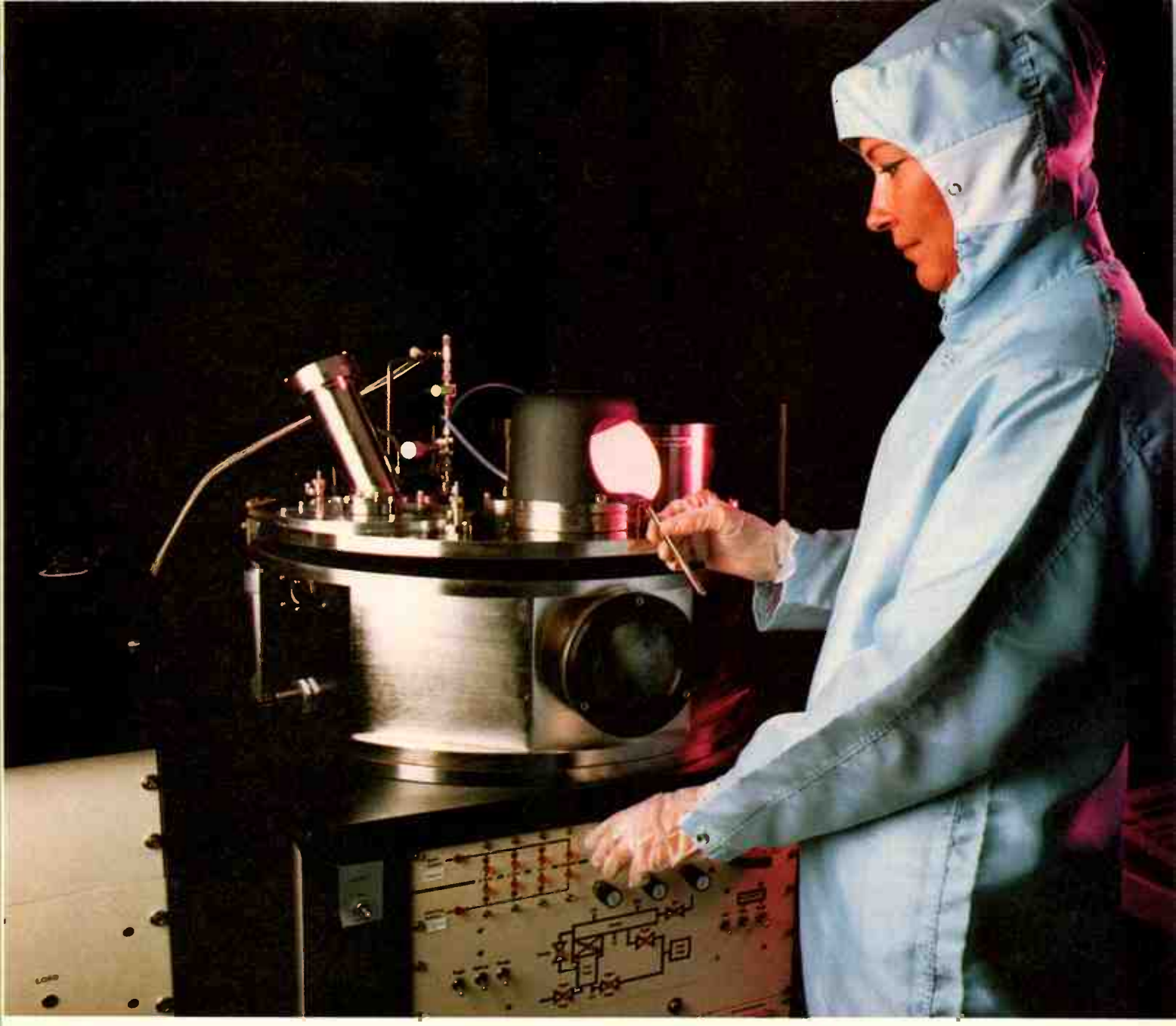
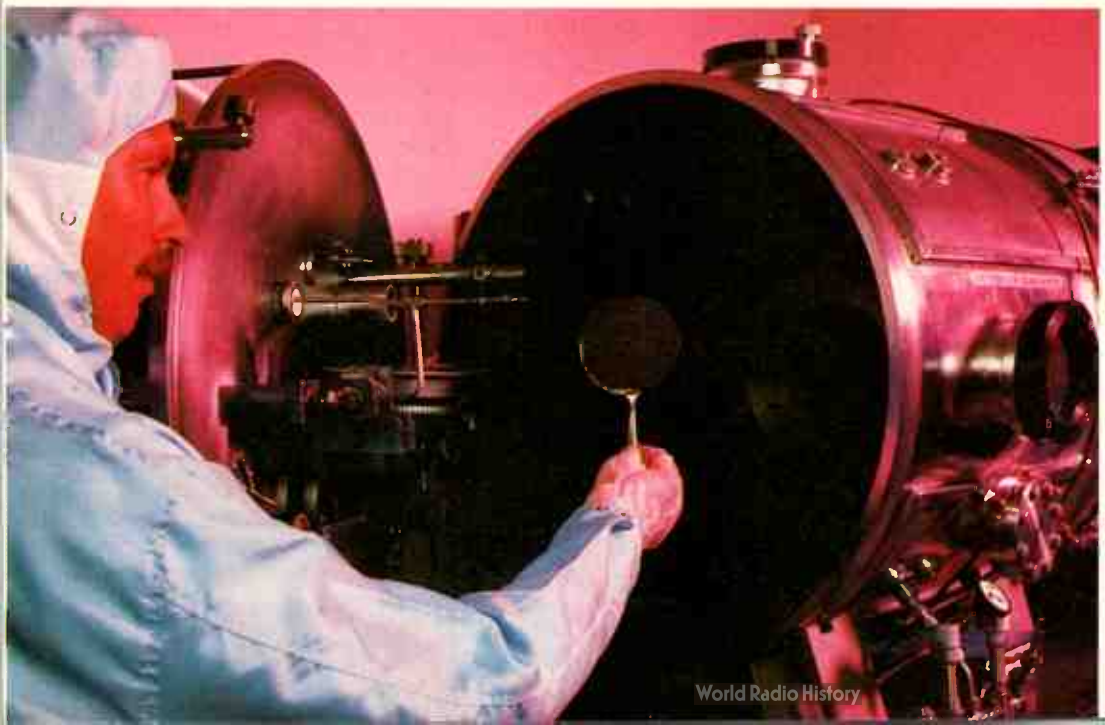


Figure 1: simplified ferroelectric molecule type ABO_3.





ABOVE: Ramtron's proprietary process involves adding a layer of ferroelectronic lead-zirconate-titanate (PZT) to the existing semiconductor underlayers. LEFT: In Ramtron's class 100 clean room facility, standard semiconductor development and fabrication techniques are used to incorporate ferroelectronic materials onto silicon wafers.

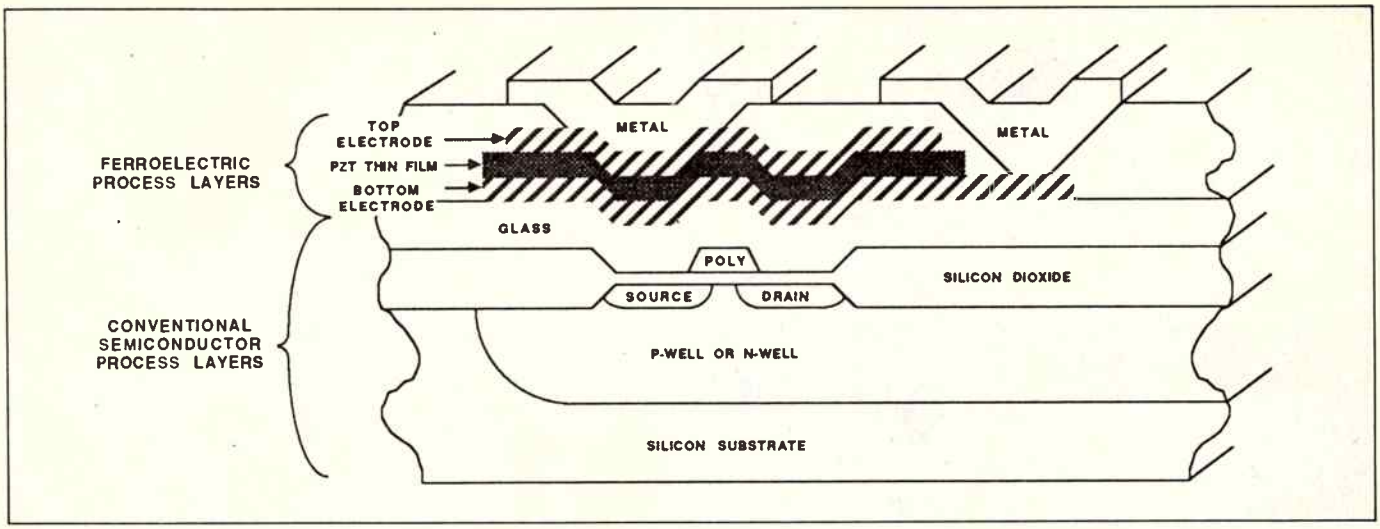


Figure 2: PZT thin film on CMOS.

the electric field is removed the atom is held in that position by the forces of the other atoms within the crystal. It requires no external power to maintain the polarising atom's position. The whole thing can be reversed by applying an oppositely-charged electric field.

Ferroelectric data storage can be scaled to a single molecule per bit and read by applying an electric field. The field is not strong enough to alter the polarisation state, but its interaction with the element can be measured.

The name ferroelectric is a misnomer as there are no iron, or ferrous, compounds involved. The 'ferro' is a tag from earlier attempts to describe and use the effect. It was thought to be related to the ferromagnetic properties of iron-bearing compounds. There is little or nothing in common with ferromagnetism however, except that the Q-V hysteresis loop is similar to corresponding B-H loops in ferromagnetics.

Ramtron has developed a ferroelectric material in the form of a thin ceramic film consisting primarily of lead-zirconate-titanate (PZT). This film is compatible with standard semiconductor fabrication techniques and applied over existing semiconductor circuitry to make nonvolatile digital memory. Figure 2 shows the ferroelectric component added to a conventially produced semiconductor. Two metal electrodes and a PZT dielectric film have been, like an attic, added to the existing layers.

Although this is an effective and practical production process, methods where the electrodes will merge with the metallurgic steps of the base circuit construction are in development. These will exclude the need for electrodes, as such, and involve only the addition of the PZT layer.

Ramtron's first generation FRAM is a 4-transistor SRAM-based memory cell (Figure 3). This cell has a memory life expectancy of 11,416 years even if power is lost once per hour. The FRAM is only polarised at power on or power off by momentary pulses of power. On restoration of the power each cell is strongly biased, forcing it to wake up in the same state as it was when the power was cut.

Currently under development there are memories with the complexities of 256K bits and an endurance of 10E15 read/write cycles. These use the advanced 1-transistor DRAM-style cell design. (Figure 4)

The FRAM seems to have all the most desirable characteristics of the various chip technologies on the market today plus a few more. These characteristics include short access and cycle times, random access read and write cycles of equal duration, low power, nonvolatile low-voltage operation over a wide range of temperatures and a high degree of radiation hardness including

The race is on!

Disks form the basic memory systems of most personal computers today. These rotating memories are slow, noisy and limited by the velocity of the spinning disk. The data retrieval slows as the disk fills and the mechanics are prone to attack by dust, vibration and other gremlins.

With the technological developments in solid state memories the question is fast becoming, not *if* chips will replace the disk but *when*?

The move would vastly change the design of computers. They would become faster, quieter, and more portable. Credit card-sized packs of software would be sold in the store with combined RAM and ROM, causing real headaches for software pirates.

The chip, however, is 'chasing a moving target.'

A few years ago you were lucky if your new personal computer came with two floppy disk drives. Then 20 meg hard disks became affordable, now 40 meg hard disks are common and 100 meg is on the way.

The storage capacity of silicon continues to grow and costs per bit stored are declining faster than magnetic memories. Several companies have already produced 16 megabit chip laboratory samples. Some have predicted that by the turn of the century a chip will be available with 6 times the storage capacity of the 20 megabyte hard disk.

The most popular chips today are Dynamic Random Access Memories, DRAMs. The best of them can hold one megabit with announcements of 4 megabit and 16 megabit already made by Ramtron and other companies.

However, all dreams aside, chip manufacturers have production problems which have led to a world wide shortage of memory chips. This has also slowed the development of the larger 4 megabit chips.

Disk drives themselves are becoming more economical and efficient; one only has to look at the cost of a 20 megabyte hard disk, the cost of diskettes and the reduction in size 31/2 standard diskettes.

The affect on disk manufacturers, unless (like large Japanese firms) they have semiconductor divisions, could be a significant loss of revenue. That is unless they can acquire the technology edge, such are ferroelectric RAMs.

immunity to alpha particles.

Ramtron has made a licensing agreement with TRW, the giant American defence contractor. TRW builds about 70% of the payloads sent into orbit by the USA and this agreement is estimated to be worth $A4b by 1991.

The aerospace industry stands to benefit from ferroelectric memory through the production of cost-effective communication satellites and spacecraft. By minimising back-up memory power, less heat would be generated by the satellite systems, the weight of the water-cooling equipment would be reduced and payload capacity increased.

A nuclear event in space – be it man made, or effects of the Van Allen Belt – could 'knock out' the memory devices in a satellite. The radiation hardness of the FRAM style of memory can reduce the chances of this happening.

Ramtron's president, Richard Horton, has been reported as saying, "This new technology will make computer chips in such satellites immune to sudden power failure. They have an extraordinary ability to withstand radiation, one of the major hazards in space." He continues, "Imagine the benefits of being able to double the life of a communications satellite costing A$100m, simply by improving the on-board electronics.

There are applications in advanced missile, aircraft technology and in other defence operating systems. According to Ramtron, ferroelectrics should be in new components to replace the existing core memory found in aircraft avionics systems. The company believes that those now in use are based on old technology and that avionic systems require the high capacity, low power, and reliable memory systems offered by ferro-electronics.

A joint-development Ramtron/ITT contract negotiated in June, 1988, includes applications in car computers and high definition television.

Ferroelectrics does not have an exclusive in the area of nonvolatile memory technology. Intel Corporation, Seeq Technology in California, and Toshiba Corporation are involved in developing Flash Memory technology. Intel has developed, or is developing, its first Flash Memory chip with the capacity to store 256K bits of information.

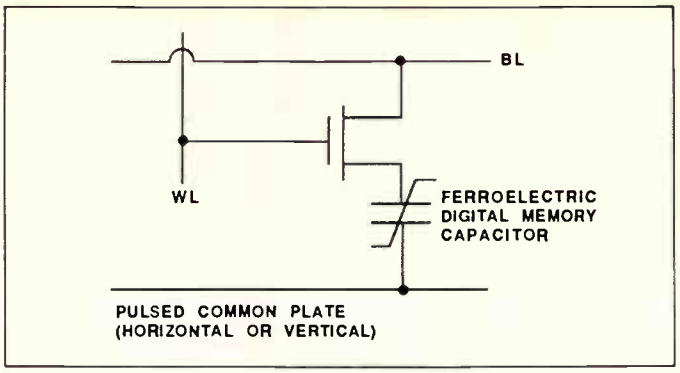


Figure 4: advanced FRAM™ cell.

Flash memories use what is known as a floating gate. Imagine a cone with a pipe vertically through its middle and sealed at the bottom by a remotely controlled valve, or gate. When this pipe is empty it represents a zero; when it contains electrons it represents a one. To get the electrons into the pipe they are accelerated, under introduced force, rapidly up the side of the cone and fall into the pipe. Once inside they cannot climb out, trapped indefinitely and preserving the memory. To get the electrons out – erase the memory, the valve is opened.

'There are applications in advanced missile, aircraft technology and in other defence operating systems'

The Flash Memory can be read quickly; however, it is slow at erasing and recording, and can become slower still after a few hundred cycles.

There is still considerable research into packaging memory with battery backup. However, batteries are the weak link in the chain as they can run out of power. This is typified by bubble memories, which were heralded as the new memory technology of the future. It, however was unable to achieve a significant toe-hold in the market.

Krysalia Corporation of Albuquerque, New Mexico is also developing components using ferroelectric technology. Krysalia's chips use ferroelectric storage exclusively whereas Ramtron's use ferroelectric storage as a backup for information stored on standard DRAM chips.

Possibly the general electronic user will first come into contact with FRAMs through that part of the market now controlled by Erasable Programmable Read Only Memory (EPROMs). EPROMs, compared with other memories are expensive and have a relatively short life cycle.

FRAMs are faster and longer-lasting than EPROMs. The 100 nanosecond write cycle for FRAMs is 10,000 times faster than that of the standard EPROMs and its life cycle endurance is more than one billion times greater. The cost structure of FRAMs should be comparable with that of EPROMs.

The real market that the FRAM must chase is that of the popular Dynamic Read Only Memory (DRAM).

Permanent storage is not the only advantage FRAMs have over DRAMs. Because the ferroelectric component can produce a signal 10 times as strong as those of a DRAM it is easier to miniaturise without garbling stored data.

So far, Ramtron has disturbed a FRAM sample that can store only 256 bits. Major development in greatly expanded chips in the order of 4 and 16 MegaByte will need to come into fruition before the FRAM can really compete in the market place – a market in which, a recent Dataquest research report has predicted, the FRAM's share has the potential to be $US350m ($A416m) by 1992. The same report views this new technology as one of the most exciting in the past three or four years. eti

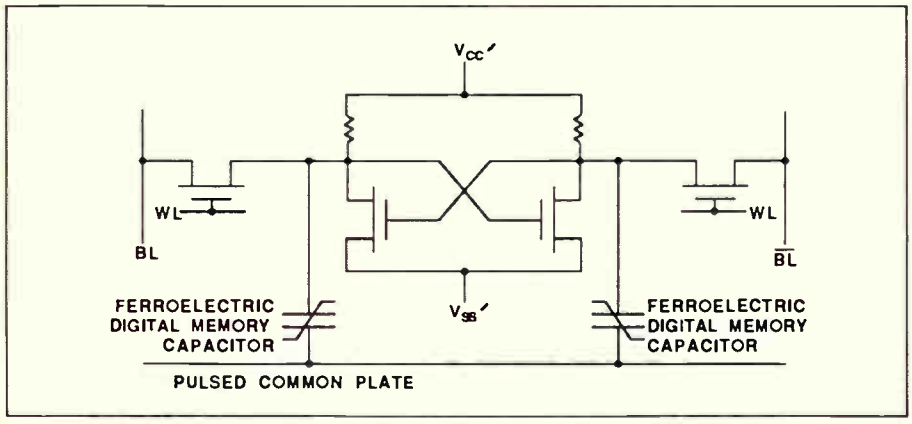


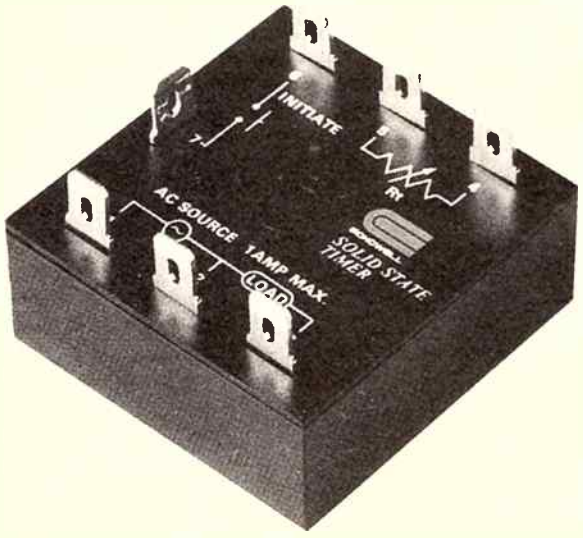
Figure 3: Ferroelectric memory based cell.

*FRAM is a trademark of Ramtron Corporation

TECHNOLOGY

SEMICONDUCTOR WATCH

Roger Harrison takes a look at the latest available in semiconductors.



Solid state timers ▲

MANUFACTURED by Echowell, and available in five standard operation modes, come solid state cube timers. The modes are: delay on make, delay on break, interval, single shot and recycle.

Features include an adjustable time delay, either by external or inbuilt potentiometer; a fixed external resistor, or a factory preset. Time ranges from a few milliseconds to 10 hours are available. All timers can operate from a wide range of input voltages and from AC ro DC on some models.

They are epoxy covered for protection against shock, vibration and moisture. The fact they have no moving parts, according to the manufacturer, ensures a reliable, long-life alternative to the electro-mechanical time delay relay.

Echowell put them through full testing before and after curing.

The digital circuitry is said to provide a high time repeat accuracy, better time stability against temperature and voltage variation, fast recycle times and allows long time delays to be accommodated.

Protection is also provided by a built-in varistor and RC snubber circuit. The cube timers have a wide range of applications, such as the staggering of re-application of loads following a supply voltage brownout or blackout.

There is, the manufacturer says, an Echowell timer for almost every application. For more information contact John Guest, Multicorp Pty Ltd, 35 Wells St, Redfern NSW 2016. ☎ (02) 698-5238.

READER INFO No. 300

64K CMOS fast static RAM

SAID to complement its existing series, SGS-Thomson has released the MK48H64-120 static RAM. It is a 120 ns device, and pin-compatible with standard 6264s. Faster speeds of 35/45/55/70 ns are available, all with 10 uA stand-by current.

For further information contact Promark Electronics (Aust) Pty Ltd, PO Box 381, Crows Nest NSW 2065. ☎ (02) 439-6477.

READER INFO No. 299

Lowpass filter op-amp from Maxim

A 5th order all pole instrumentation lowpass filter with no dc error, the MAX280, isolates the IC from the dc signal path, using an external resistor and capacitor to provide dc accuracy.

With the on-chip 4th order switched capacitor filter, this resistor and capacitor form a 5th order low-pass filter. Two MAX280s can be cascaded, forming a 10th order lowpass filter.

Filter cutoff frequency is set by an internal clock. This can be externally driven. With a clock to cutoff frequency ratio of 100:1, allowing clock ripple to be easily removed, the MAX280 is an enhanced version of the LTC1062 with tighter specs on the internal clock oscillator frequency and the buffer offset voltage, the makers claim.

Representing a 250% improvement over the highest grade OP07 (the OPP7A) and a 500% improvement over the best commercial temperature range device (OP07E), the MAX400 guaranteed maximum 10 uV offset error is the lowest input offset voltage of any commercially available (non-chopper) monolithic amplifier, according to Maxim.

The offset voltage drift is guaranteed to be a maximum of 0.3uC/C which is also an improvement over the OP07 family. Applications include precision amplifiers; thermo-couple amps; low level signal processing; medical instrumentation; strain gauge amps and high accuracy data acquisition.

The MAX400 fits OP07, AD510, 725, 108A/308A sockets. For further information contact Veltek Pty Ltd, 22 Harker St, Burwood NSW 2134.

READER INFO No. 298

First 1 Mbit flash EEPROM

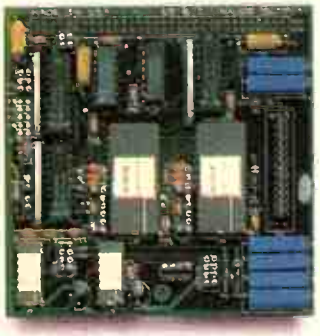
FLASH EEPROMs are said to offer a combination of features to enhance systems' manufacturability, testability, remote serviceability and to lower overall systems cost. The 27F010, a 1 Mbit FLASH EEPROM from SEEQ, can be erased and programmed at room temperature, can endure up to 100 cycles, and is designed for cost-sensitive applications.

The CMOS 48F010 is said to increase programming flexibility with a sector erase capability, allowing its 128 sectors of 1024 bytes to be individually erased and reprogrammed. It can also be bulk-erased in under five seconds.

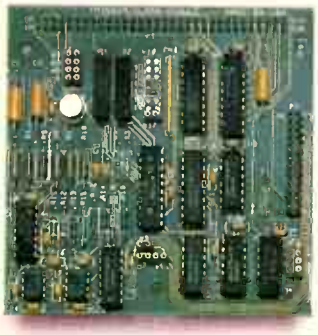
On-chip latches and timers ▶

One PC data acquisition system grows up: PCI-20000.

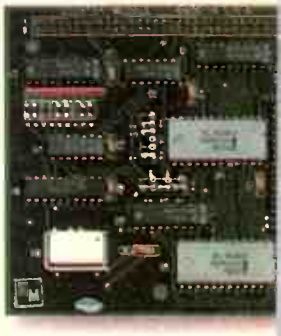
Analog input modules: programmable gain or high speed (180kHz).



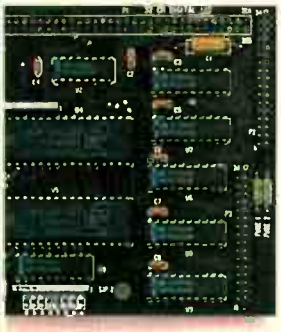
Analog output modules: 2 or 8 channel, 12 or 16 bits, V_O or I_O.



Special function modules: trigger/ alarm, simultaneous sample/hold.



Counter/timer, clock, pulse generator & frequency measurement module.



Expandable digital I/O module (to 128 points per carrier).

DMA carrier board with clock and digital I/O transfers data at 360 kBytes/sec. Holds 3 modules.

Expandable analog input module (to 80 channels per carrier).

The others just grow old.

Some personal computer data I/O systems make you pay for functions you don't need. These same inflexible systems can't be updated—at any price.

The unique PCI-20000 modular system, on the other hand, is easily configured to provide literally thousands of data acquisition, test, measurement and/or control options. Just plug the application-specific modules you need into a carrier board. Then plug the carrier into your IBM/compatible PC. Change or add modules as your needs change. In other words, the PCI-20000 grows up, not old!

Up to 128 digital I/O points or 80 analog inputs can be configured on a single carrier board. A unique DMA carrier/module combination transfers analog, digital and or counter data at speeds limited only by your computer. Capture, analyze and react to real-world events in real-time. Plus, ruggedly constructed termination panels provide long-lasting screw-in connections to analog and digital I/O signals.

No programming experience needed. Many easy to use, menu driven software packages support the entire PCI-20000 family. Multiple language software drivers are also available. Best of all, years from now when other systems are collecting cobwebs, your PCI-20000 will still be collecting data.

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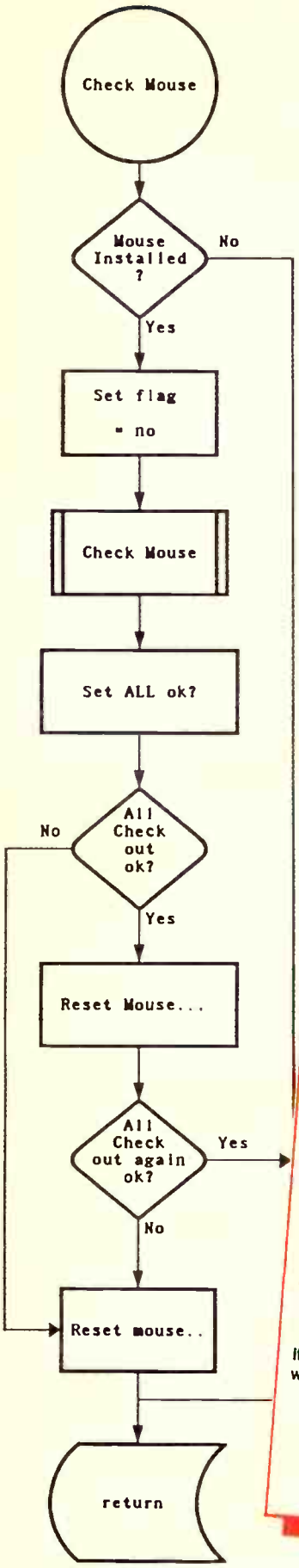
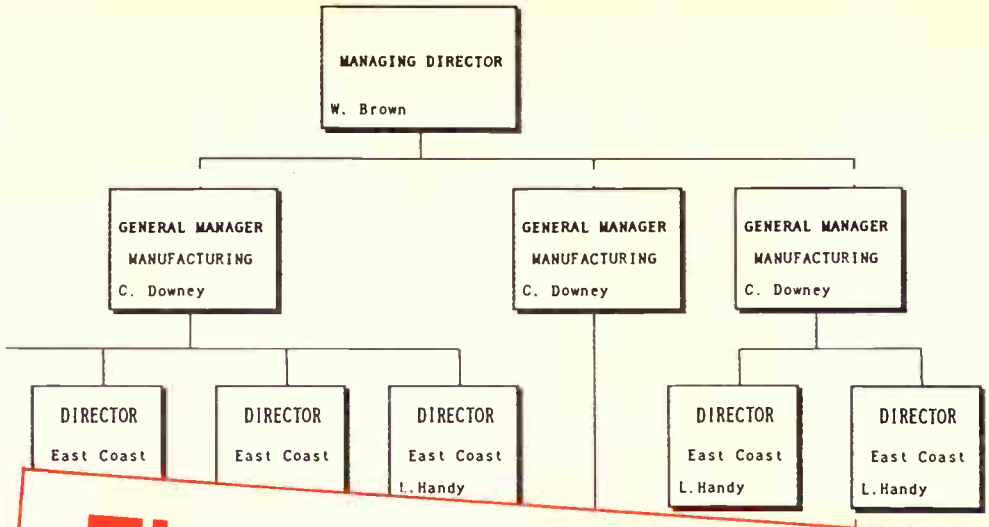




allow simplified microprocessor interface, freeing the microprocessor to perform other tasks once write, erase and read cycles have been initiated.

Applications for the 48FO1O include replacing existing forms of non-volatile semiconductor memory, like UVEPROMs, ROMs, and bubble memories.

READER INFO No. 297

First 28-pin EEPLD

THE 28-pin 26V12, the second EEPLD developed by SEEQ and Advanced Micro Devices (AMD), is manufactured using a new, high-performance, double-metal, sub-micron CMOS process. Propagation delays are 2O ns maximum for the faster part. A 25ns part is also available. Both operate at clock frequencies beyond 4O MHz.

It offers a fifth more logic, four more pins, a second clock input and more output flexibility than the industry standard 22V1O. The CMOS 26V12 needs under half the power of the bipolar 22V1O.

The DIP version of the 26V12 has power pins in the centre to minimise lead inductance and ground-bounce effects. This eliminates noise-related problems at the board level.

On-chip performance is enhanced by increasing the number of pins available for input-output. And significant board savings can be realised because one 26V121 can replace over 1O standard logic chips.

The 26V12 can be rapidly and easily reprogrammed, even in low-cost plastic packages. Last minute alterations are no problem, according to the manufacturers, as EEPLD's are easy to program as blank devices.

READER INFO No. 296

Motorola's switch tactic in Hitachi suit

THE federal patent-infringement suit by Motorola against Hitachi Ltd, which was to be held in the neutral territory of Chicago (Motorola's HQ), has been dropped.

Instead, a new suit has been filed on pretty much the same grounds. But this time it will be held in Austin, where Motorola has two plants and lots of employees.

Hitachi claims to be mystified by such maneuverings, and has said they will resist these tactics to avoid the Chicago courts.

Motorola has said the move is just "procedural". Austin, it claims, is the centre of Motorola's microprocessor activity, and the site of all its documents and evidence.

Back in Chicago, Hitachi has brought a suit of its own against Motorola, alleging its 68HC11 micro-controller infringes a Hitachi patent.

READER INFO No. 295

Quad SPDT CMOS analogue switch from Maxim

MAXIM, famous for its RS232 level converter chips, the MAX231 and MAX232, has released a quad single pole, double throw (SPDT) analogue, dubbed the MAX333.

Each individual switch is able to be operated with bipolar power supplies ranging from +5 V to +18 V, or single-ended ones ranging from +1O V to +3O V.

It has break-before-make switching (2OO ns typical), a maximum turn-off time of 5OO ns, and a maximum turn on time of 1OO ns, according to the specifications.

Logic inputs are fully TTL and CMOS compatible and guaranteed over a +O.8 V to +2.4 V range regardless of supply voltage. Logic inputs and switched analogue signals can range anywhere between the supply voltages without damage.

The MAX333 is a replacement for a DG211/DG212 pair when used as a quad SPDT switch. Its quiescent current is 25O maximum with all inputs high, and less with all inputs low. This makes it ideal for portable operation, according to Maxim.

Australian distributor for Maxim is Veltek Pty Ltd, 22 Harker St, Burwood NSW 2134.

READER INFO No. 294

Multi-tap video shift register ▼

THE Bt424 from Brooktree is a 25O MHz, 4O-bit, multi-tap video shift register for use in high resolution graphics systems. It is designed with flexibility to adapt to a range of frame buffers and RAM D-A converter archictectures to simplify system design.

The register loads pixel data from the frame buffer at standard low speed TTL thresholds. Data is then transferred from the input latch to the shift register using an ECL compatible load signal.

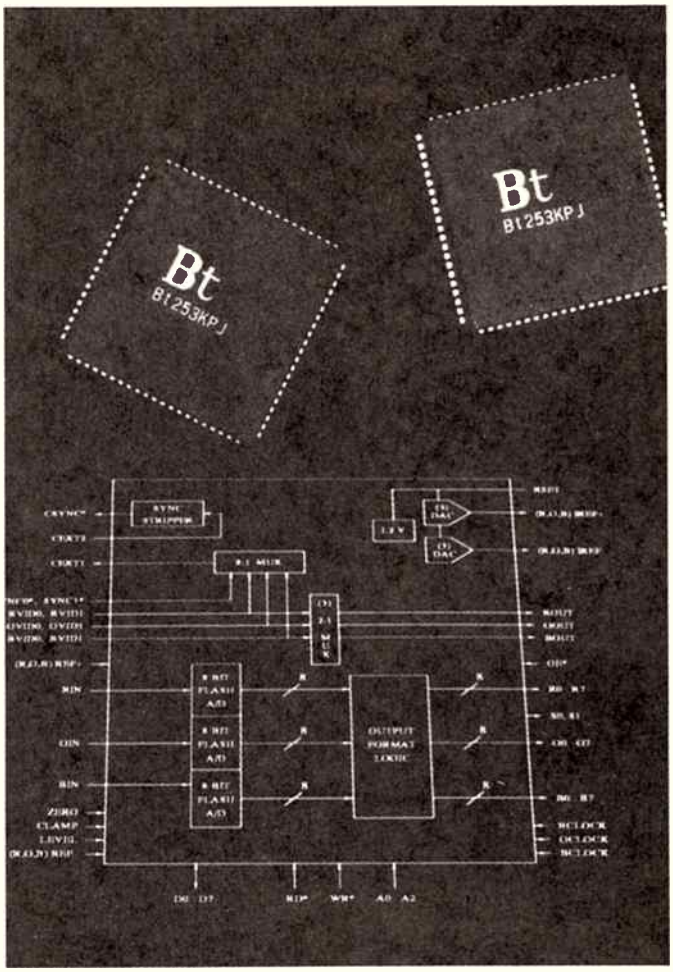
Because the part uses both TTL and ECL circuits it solves the design problem of a low-to-high speed interface and simplifies system timing, according to Brooktree.

The register is designed to have flexibility to adapt to a number of architectures. Configurations are one 4O-bit shift registers; four 1O bit shift registers or five 8-bit shift registers.

The part has separate TTL and ECL supply pins which enable it to be operated from a single +5 V power supply or +5 V and -5.2 V supply. It is packaged in a 68-pin PGA and has a typical power dissipation of 1.25 W.

For further information contact Energy Control International Pty Ltd, 26 Boron St, Sumner Park, Brisbane Qld 4O74. ☎ (O7) 376-2955.

READER INFO No. 293



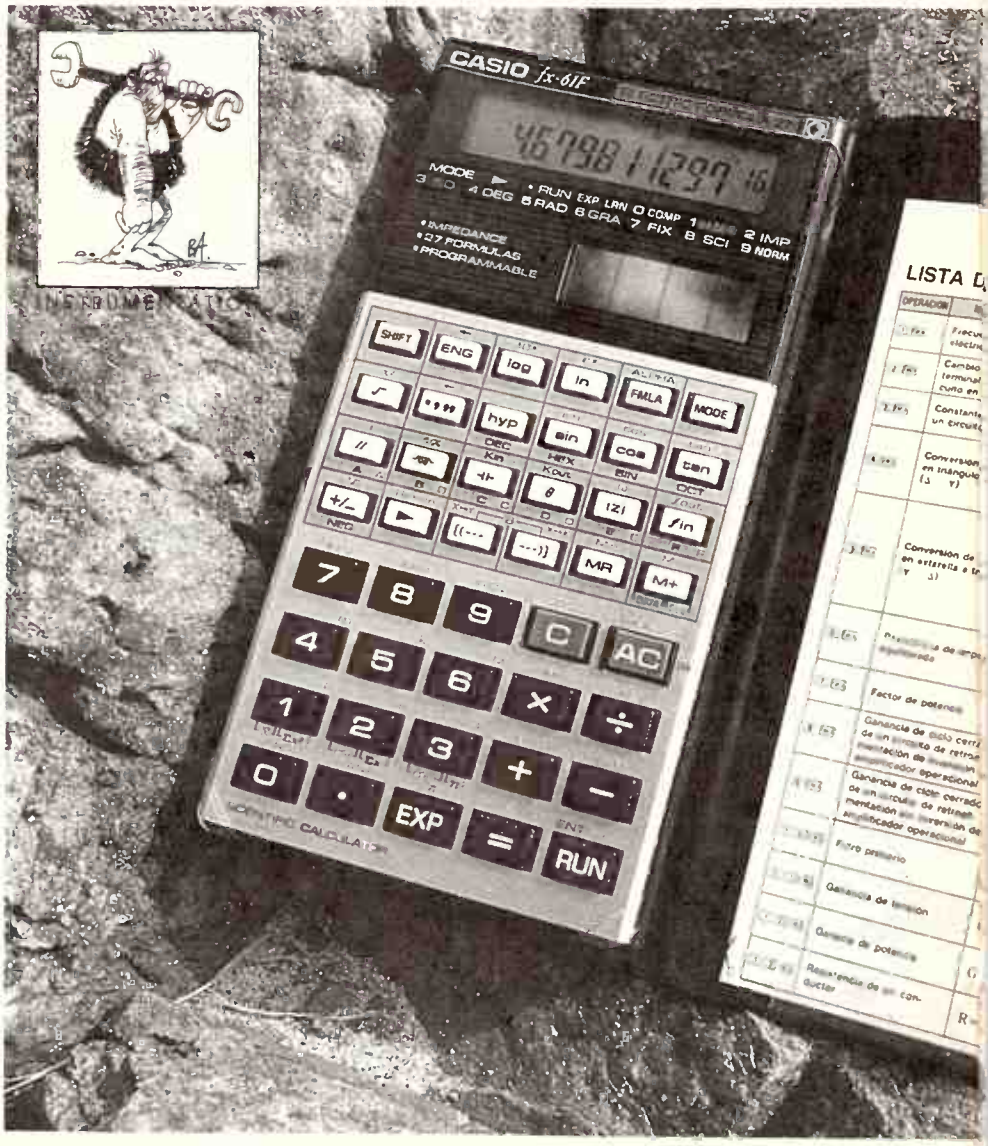
CASIO'S fx-61F

Calculated to make life easier

Jonathan Powers takes Casio's new scientific calculator for a test drive. He finds it easy to use, and recommends it to anyone dealing regularly with electronic circuits.

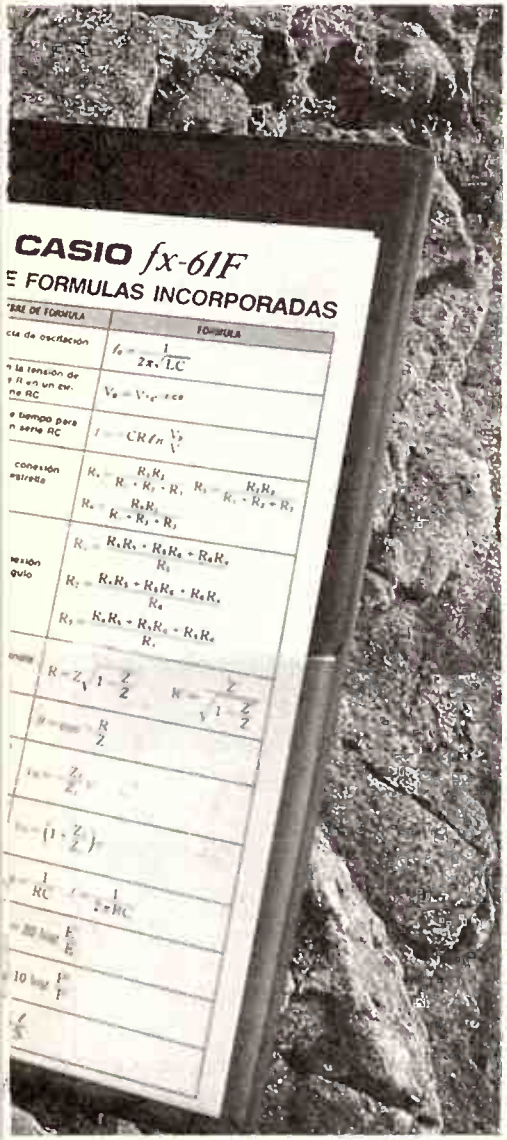
There's been a lot of solder under the bridge since those days of endless assignments and exams when I was but a mere engineering student. Since then I've probably forgotten more formulae than I've remembered. Thank god for that pile of old lecture notes stacked in the corner of the room – despised at the time, but home to a wealth of information that, contrary to the popular belief, does come in useful after the exams are over. In an attempt to make life a little easier for all of us who are either studying, working in or just playing around with electronics Casio has released a welcome addition to its excellent range of scientific calculators.

Called the fx-61F, it combines all the features of a fully-fledged scientific calculator with a useful range of special functions and formulae in the electronics area including complex numbers, special exponent keys for milli, kilo, mega etc and 27 common electronic formulae built in. Modes are provided which allow the user to work and calculate in binary, octal, decimal and hex and convert between them easily



– a handy facility for those who do work in the digital field.

A bank of 24 multifunction buttons provides all the usual trigonometric functions and also includes buttons with capacitor and inductor symbols. These provide a means of direct entry of component values and, combined with frequency entry, modulus and parallel resistance keys, give the means to solve LCR circuit problems with maximum efficiency. A second function on the numerical keys also allows one key entry of some of the more common exponents such as milli, pico, kilo etc. All these special function keys ensure that electrical problem solving is streamlined and eliminate a good deal of keystrokes that would be required on other calculators. I found the exponent keys particularly convenient and time-saving. Entry of a value of, say, 1pF was cut down from 5 to 3 keystrokes and represented a considerable saving in time and effort in complex impedance calculations. The built-in parallel impedance function also saw quite a deal of use.



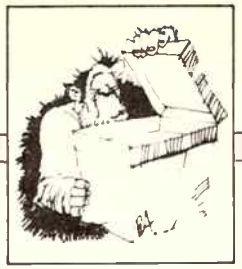
The fx-61F has an array of 27 pre-programmed formulae which can be called up. These include resonant frequency of an LCR circuit, closed loop gain of an OP amp, Coulomb's law, magnetic force, Y to delta conversion and a range of others. The formulae provide alpha prompts on the screen to enable the user to enter the relevant variables. The formulae themselves were quite useful; however, I must make some criticism of the symbols used. A reference card is supplied with the calculator which lists the code numbers of the various formulae. This also gives the algebraic expression for the formula in standard electrical symbols. When a formula is called up, however, the prompt symbols are often different from those used in the explanation. For example, the symbol shown for the feedback resistance in the gain of an OP amp is Zf. When the formula is called up, however, the on screen prompt appears as Z'. The difference in symbols is noted in the instruction book but it is very inconvenient to have to keep referring back. It would have been a great help to have this information on the reference card, which is housed in a pocket in the wallet type case. In time, any differences in the more commonly used formulae would become second nature but some of the occasionally used ones would still have the user reaching for the instruction book.

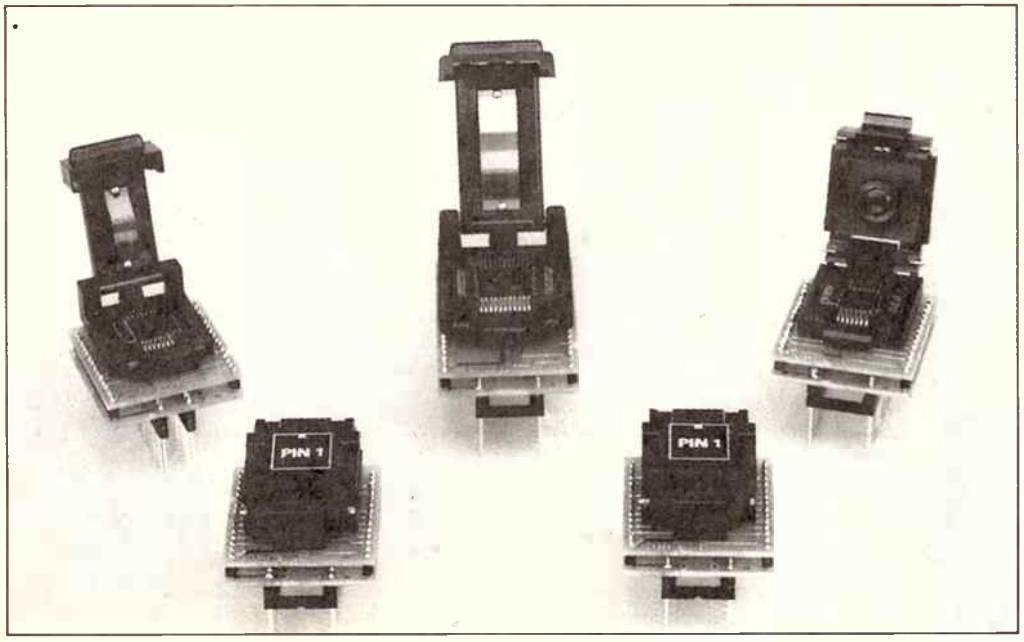
A limited user programming facility is also available to allow you to enter a formula of your own. Up to 30 steps can be entered and only one formula at a time may be programmed. Some basic program branching and decision making can be entered and the letters A to F may be used as variable names for screen data prompts.

The power supply for the unit is a combination of a lithium battery and an amorphous solar cell which resides on the front panel just under the display. The two work in tandem with the solar cell minimising the drain on the battery when the light level is high enough. The quoted life of the battery is given as 7 years at around one hour a day's use. The display itself is the now familiar liquid crystal type which can display up to ten digits plus exponent as well as the associated mode and formula prompt information.

The calculator is reasonably pocket-sized at 8.5 x 73 x 140mm, weighs in at 68 grams and, as mentioned earlier, comes housed in a fold-out wallet type cover which neatly protects the unit as well as providing a pocket to hold the formula reference list.

In general, I found the fx-61F fairly easy to use and, when dealing with electrical circuit calculations, a definite advantage over a normal scientific calculator. The built-in formulae covered a good range and, the symbol discrepancy not withstanding, were pretty useful. The impedance mode made complex number calculations a breeze and the engineering exponent keys saved a lot of button pushing. eti





DIL/PLCC programming adaptors ▲

CONVENTIONAL DIL programmers can be easily and cheaply adapted to accommodate the growing number of PLCC and ceramic leadless chip carrier packages using the GP Industries socket adaptors.

They are designed to accommodate surface mount programmable devices, and are apparently easy to fit and use in the DIL sockets of existing programmers.

Providing the flexibility to handle equivalent parts in plastic and ceramic mount packages, the Textool programming sockets are used in the adaptors to ensure easy loading and unloading and consistent programming yields.

The range consists of 17 sockets covering surface mount packs from 0.3 inches by 30. inches to 0.65 inches by 0.65 inches. More details may be acquired from Clarke and Severn Electronics, PO Box 129, St Leonards NSW 2065.

READER INFO No. 292

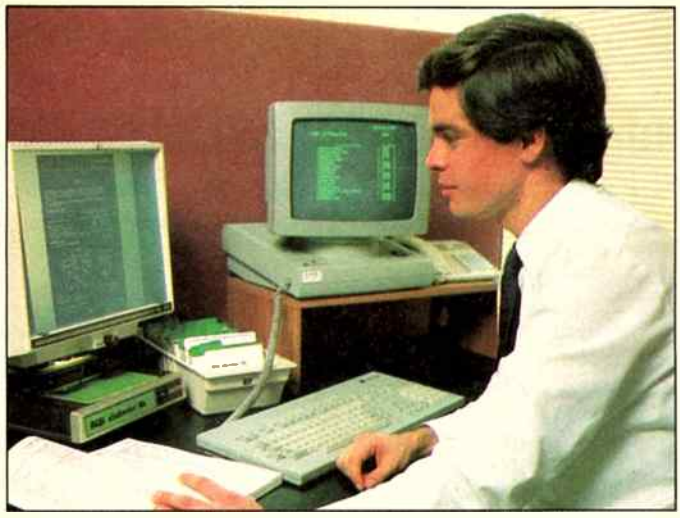
High output piezo siren ▲

MANUFACTURED in Taiwan to IRH specifications, the JPE 500 from IRH Components has a sound pressure level of 110 dB (A) at 30 cm, 85 dB(A) at 3 m, at 12 volts dc. It is for use in alarms where high dB(A) and pcb mounting are required.

It is 50 mm diameter by 28.9 mm high. IRH says it is ideal where small size and loud noise is required, as in car alarms, gas alarms, fire alarm control panels and duress alarms on home burglar alarms.

For additional low-down, contact IRH Components, 32 Parramatta Road, Lidcombe NSW 2141. ☎ (02) 648-5455.

READER INFO No. 291



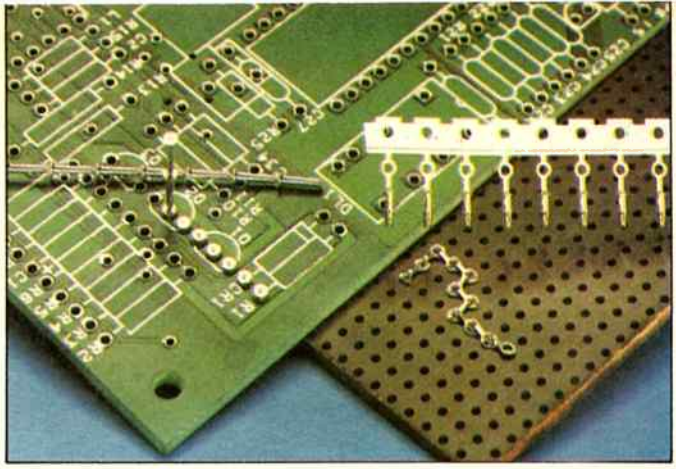
Chips on fiche!

MAINTAINING an up-to-date, easily accessible collection of databooks necessary in an electronics organisation is an ongoing nightmare.

For this reason a number of electronics organisations in Australia are using the ACEL Electronics File consisting of over 350,000 pages of databooks and product information, converted onto microfiche, thoroughly indexed and regularly updated.

For further information, or a demonstration of the system contact Ann Hayden, ACEI Information Pty Ltd, 71 Queens Road, Melbourne 3004. ☎ (03) 529-5200.

READER INFO No. 289



Breadboarding system

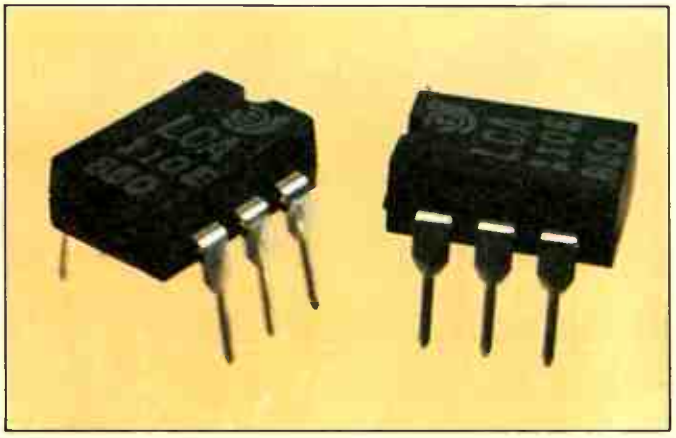
HERWIN Engineers have recently introduced their unique breadboarding system using track sockets. The sockets are designed to fit into a 1 mm diameter hole and have a small tail that can be used as a shorting link to the adjacent hole.

This tail can also be used as a test point and is suitable for the hook type testing leads. The track sockets have many applications, such as prototype working and classroom teaching on small electronic assemblies.

Components such as resistors and capacitors can be easily inserted and withdrawn according to circuit needs. The system comes in a kit form comprising a pre-drilled board 160 x 100 mm, 245 Track Sockets on a bandolier and an insertion tool. Packs of 500 Track Sockets are available to those who already have boards.

Further details may be obtained from Glenn Carke at Clarke and Severn Electronics, PO Box 129, St Leonards NSW 2065. ☎ (02) 437-4199.

READER INFO No. 287



Solid state switch for ac/dc ▲

THETA-J'S OPTOMOS solid state switch LCA110E with optical isolation of 3750 V RMS is the first of a series of Theta-J solid state switches to be released with Telecom approval (RA88/141).

It is ideal for Telecom tip/ring, dial pulse and ring generator switching as well as data acquisition multiplexing operations. The LCA110E controls a pair of custom DMOS output chips by optically coupling an LED with a proprietory photovoltiac IC.

This provides the capability of driving ac and dc loads directly from CMOS circuits. The 2 mV of driver power is 100 times lower than most sensitive mechanical relays and allows direct drive from a microprocessor.

It generates no EMI/RFI has a 2 mA maximum input control current, load current (continuous) 100mA 100% dv/dt immunity, and is rated to 300 V dc or peak ac, according to the specifications.

The LCA110E is available in two packages; a 6-pin mini DIP through hole and 6-pin mini DIP SMD package. Quality is assured as all product is 100% final electrical tested to data sheet parameters and then done per MIL-STD-105 and MIL-STD-202.

Quality documentation follows MIL-Q-9858A. Further information can be gained from IRH Components, 32 Parramatta Rd, Lidcombe NSW 2141. ☎ (02) 648-5455.

READER INFO No. 284

Big battery pack ▼

THIS Marktronics product is a large capacity pack to suit the Electrophone TX475, (40ch UHF CB handheld). Catalogue No BP 1300 is a 9.6 VDC, 1600 MAH Nicad pack stylishly designed, contoured, colour matched and reasonably priced.

The BP 1300 locks securely to the YX475 and provides the largest capacity (for its size) handheld on the market.

To complement and protect this combination, the latest in carry case design, CP475L uses military and medical grade materials, and the LCH475 chest harness can be coupled to provide carrying convenience and almost hands-free operation.

These three products have proven very popular in the Queensland rural areas since their debut at the September '88 Farm Festival.

Wholesale price is $150.

READER INFO No. 285

Mobile HF transceiver

BARRETT Communications Pty Ltd of Perth, manufacturers of the single sideband SB250, believe this product offers a number of features not found in transceivers supplied in Australia by other companies.

They include a capacity for 256 channels; the fact they are approved for land and marine use; marine distress and Royal Flying Doctor Service (RFDS) alarms are both standard; it has a direct current isolated chassis; it covers broadcast bands to 500 KHz; displays information in English; receives from 0.5 to 20 MHz uninterrupted and has more than 60 pre-programmed channels.

The SB250 is apparently the only synthesised transceiver compatible with the ARQ radio telex system also manufactured and distributed by Barrett Communications. And it is said to include other features lacking in some transceivers.

It can support selective calling via front panel keypad for the selcall system. It is user programmable with frequencies entered from the front panel into the computer program. It can also support automatic and manual marine serial tuners.

The SB250L as a remote control version; transmits uninterrupted from 2-18.1 MHz; has a single keypress for the 2182 kHz AM emergency channel, and a standard accessory outlet.

It also includes the following standard features: 100 watt PEP output; 12 volt operation; 512 frequency storage system; channel scanner; supertwisted LCD; automatic tuner interface; impulse noise blanker; analogue volume and mute controls; digital clarifier and high/low power selection.

Mr Martin Bain, Sales Manager at Barrett Communications, said, "The SB250 has its receiver programmer permanently enabled and can be used as a general coverage receiver."

Typical frequencies available using the general coverage transceiver include the AM broadcast band from 500 to 1600 kHz, short wave broadcasts such as the ABC on 9610 kHz, time signals on 10 and 15 MHz and weather fax broadcasts.

Further details can be obtained from Barrett Communications Pty Ltd at 10 Port Kembla Drive, Bibra Lake, WA 6163. ☎ (09) 418-4141.

READER INFO No. 286

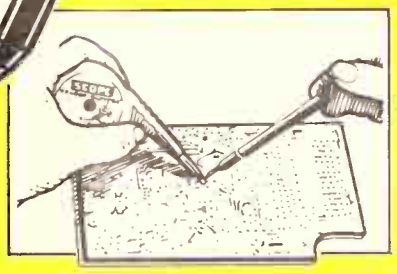
DESOLDERING SYSTEMS FOR WORKSHOPS & PRODUCTION

DESOLDER TOOLS

DESOLDER BRAID

YELLOW – Code TW1.5
Width 1.5mm Length 1.5M
GREEN – Code TW2.0
Width 2.0mm Length 1.5M
BLUE – Code TW3.0
Width 3.0mm Length 1.55M
BROWN – Code TW3.5
Width 3.5mm Length 1.5M

READER INFO No. 50



SOLDER BLOTTER

Full 2 metre length (30% more than most brands)
Avoid Burnt Fingers with Wind Back Dispenser.

READER INFO No. 51

TIME EFFICIENT WORK-AIDS FOR PRODUCTION & WORKSHOP

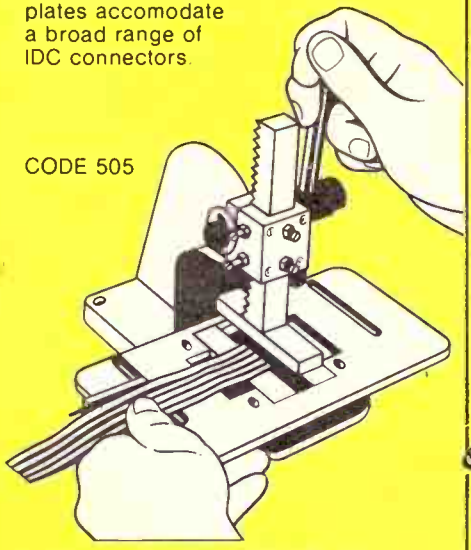
PCB ASSEMBLY JIG

Four sizes available. Standard type with one sliding rail.
PCSS1 270 x 220mm PCSS2 500 x 220mm
PCSS3 750 x 220mm PCSS4 500 x 350mm
Additional sliding rails available.

CODE PCSS2 **READER INFO No. 52**

PANAPRESS IDC BENCH ASSEMBLY PRESS

The quarter ton manual IDC Bench Assembly Press is a rugged, practical installation tool designed for low volume, mass termination of various IDC connectors on flat (ribbon) cable. Inter-changeable base plates accomodate a broad range of IDC connectors.



CODE 505

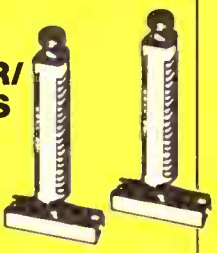
READER INFO No. 53

INSERTERS FLUSH CUTTERS HEAT SINKS

READER INFO No. 54

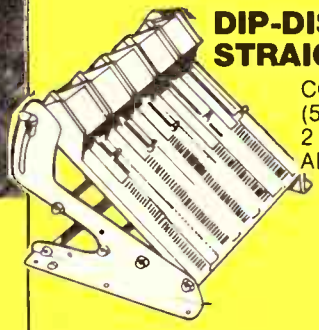
DIP-IC INSERTER/ STRAIGHTENERS

CODES SIT8, SIT1416, SIT 1820, SIT 2428, SIT 3640, SIT 22
READER INFO No. 105

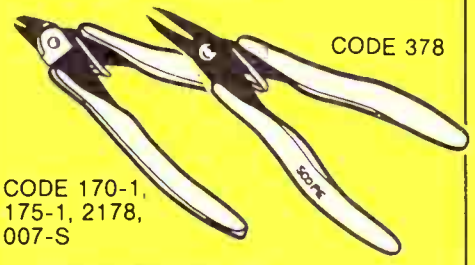


DIP-DISPENSER/ STRAIGHTENERS

CODE DS 1440-5 (5 CHANNEL)
2 & 10 CHANNEL ALSO AVAILABLE



FLUSHCUTTERS

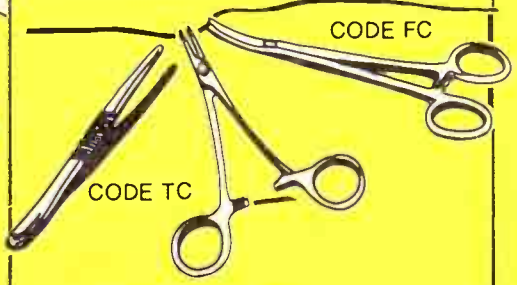


CODE 378

CODE 170-1, 175-1, 2178, 007-S

READER INFO No. 55

FORCEPS-HEAT SINKS



CODE FC

CODE TC

READER INFO No. 56

WANT MORE INFORMATION THEN CONTACT

VICTORIA: **(03) 338 1566** NEW SOUTH WALES: **(02) 546 6144**
QUEENSLAND: BRISBANE: **(07) 52 5231** TOWNSVILLE: **(077) 79 3855**
SOUTH AUSTRALIA: **(08) 352 1166** WESTERN AUSTRALIA: **(09) 362 5011**
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FAX (03) 338 5675

FAX (03) 338 5675

Ripper Stripper

A great tool for stripping off the tractor feed edges from computer printouts. The Ripper Stripper firmly grips the perforated edge so you can tear off many pages at once. RRP $9.95.

READER INFO No. 283

PS/2 chipset in baby AT m'board

A six-layer baby AT motherboard has been released using the VLSI Technology Inc five-chip CMOS chipset similar to that used by IBM in its recently released PS2-30/286 PC.

Dubbed the AT-4000, it features 12 MHz operation, zero wait states; Norton speed index 15.3; 1M or 256K RAMs may be used; 80,1000 or 120 nanosecond RAMs may be used; 616 bit expansion slots; CMOS chip set, low power consumption; designer's guide schematic and timing diagrams available; battery backed real-time clock and set-up; speaker output, reset connector; AMI Bios; is socketed for up to 4M Bytes of RAM on board; has a socket for a maths co-processor and also ha a one year guarantee.

The motherboard is suitable for use in applications such as CAD/CAM where memory and high speed processing is required. Contact Energy Control International Pty Ltd, 26 Boron St, Sumner Park, Brisbane Qld 4074. ☎ (07) 376-2955.

READER INFO No. 282

Super strength fasteners

PROVIDING up to 100% greater assembly tension than commercially-available types, a line of super high strength industrial fasteners has been developed by the Cygnus Metallurgical Division of Magna Industrial Company Ltd.

Most products in the line feature an exclusive "Cygnaplate" finish. This is an exclusive metal impregnation/bond process which provides a non-porous protection treatment that resists rust and corrosion.

The manufacturer claims it is superior to ordinary finishes.

Together with matching Cygnalloy washers or lockwashers, the Cygnus "Balanced Assembly" of fasteners are engineered to replace standard fasteners, providing what is said to be unheard-of clamping and locking strength.

This is important for use or operating equipment where original tolerances have altered because of wear, vibration, heat or abrasion. The secret of Cygnus' Cygnalloy Balanced Assembly is the alloy steel used in the manufacture, the company says.

It provides a uniform refined grain structure which permits the use of cold-forming methods for added fatigue life and extra service durability and reuseability.

For additional details contact Mr Andy Kwok, Magna Industrial Co. Ltd. 1 Hysan Ave, Causeway Bay, Hong Kong.

READER INFO No. 281

Electrotec service

AFTER being an industry supplier for many years, Electrotec has decided to go in for an area it believes has been lacking. Service. Hence the announcement of its new Corporate Services Division.

The new division will concentrate on areas like multiple accounts, fully itemised invoicing, flexible payment terms as well as a number of other options.

For further details, contact Electrotec Pty Ltd, PO Box 179, 2B Beaumont Street, Vic 3133. ☎ (03) 873-5099.

READER INFO No. 280

ELECTRONICS TODAY

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ELECTRONICS · TECHNOLOGY INNOVATION

Reader Information Card

On the reverse of this page you will find the Reader Information Card. This is a service ETI provides free to readers who want more information about products advertised or otherwise mentioned in the magazine. At the bottom of the article or advert you will find a RI number. Just circle that number on the card and send the card to us. We will pass on your address to our contacts, either the advertiser or our source for the story, who will then inundate you with literature on the product of your choice. Another feature: to the right, there is a blank space. Why not use it to drop us a line, and let us know what you think of the magazine. We are particularly interested in ideas from readers on how we can improve things.

Note to the Editor:

Name:.....

Address:.....

.....

Postcode:.....

Two instrument controllers

THE HP R/332 and 332, additions to Hewlett-Packard's family of HP 9000 Series 300 instrument controllers, are said to offer a 400% price-performance increase over the company's most popular controller, the Model 310.

Both products are based on a single-board computer that contains a 16.67-MHz MC68030 processor, a graphics frame buffer, HP-IB (IEEE-488) and RS-232-C interface, direct-memory access and a human interface connector for a keyboard and other input devices.

The CPU board will also accommodate an optional MC68882 floating-point coprocessor running at 16.67 MHz. High speed RAM is available on daughter cards that plug directly into the processor board and come in 1-Mbyte or 4-Mbyte versions. Two RAM boards can be used for a maximum of 8 Mbytes of memory.

The HP R/332 comprises an integrated 9 inch cathode ray tube (CRT); a removable hinged keyboard; a flexible-disk drive, up to 40-Mbyte fixed disk drive and an optional touch screen.

It also offers eight expansion slots that allow flexible interfacing, and can be mounted with other instrumentation in standard 19 inch racks. It was apparently designed for systems requiring rack space optimisation.

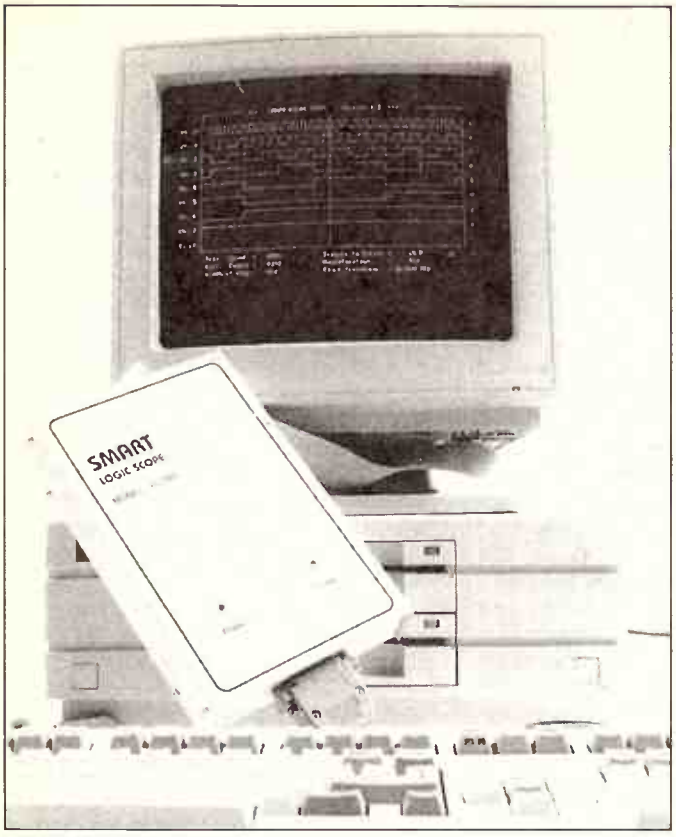
The HP 332 includes a system-processing unit with four expansion slots, a monitor, and a keyboard designed for lab-benchtop desktop use. The standard graphics-frame buffer on the CPU board will drive a 512 400 pixel, 12 inch monochrome monitor or an option 1,024 768 pixel, 17 inch monochrome monitor.

Optional colour monitors are also available. Flexibility and modular design is said to make the Model 332 practical for developers of test applications who need highly customised configurations.

Both models are compatible with the Series 300 product line, which ranges from the 10-MHz MC68010-based Model 310 to the 33-MHz MC68030-based Model 370. Model 310 users who wish to upgrade to a Model 332 can apparently do so through a simple board swap.

The software is designed to be object-compatible between the systems. Full details from Hewlett-Packard Australia, ☎ (03) 895-2644.

READER INFO No. 279



Powerful new logic analyser ▲

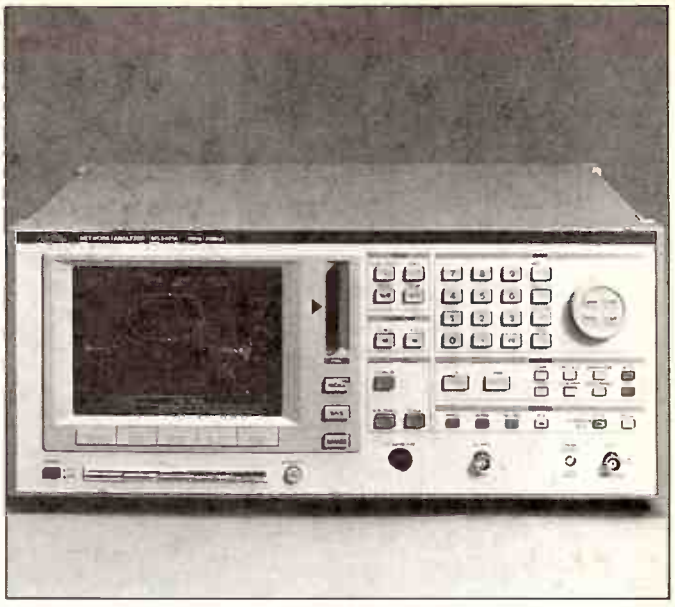
THE Smart Logic Scope model 7001 is an easy to use, high performance digital circuit tracer (logic analyser), so Computronics tells us. It can be attached to any IBM XT/AT compatible and it is said to be an essential tool for trouble-shooting and testing microprocessor systems and personal computers.

It is controlled through the computer keyboard. You operate it through pull-down menus. Installation apparently takes only a few minutes, with cables and probes and operating software (provided on an IBM-formatted floppy disk) included in the package.

To operate, connect test probes to test points and select the clock rate and triggering point, and all logic states of the test points will be captured and displayed on the computer screen in graphic format. The Scope also provides various formatted data helpful for digital circuits analysis.

For more information ask for Ole Hansen at Computronics, 31 Kensington Street, East Perth, WA 6000. ☎ (09) 221-2121.

READER INFO No. 277



New network analyser ▲

THE Anritsu Network Analyser MS3401A provides a quick and economical method of assessing the performance of a range of analogue components used in modern electronic equipment such as VCRs, CD players and video disk players, the makers claim.

It produces swept frequency output to accurately and quickly measure transmission and impedance characteristics of networks operating throughout the frequency bands of 10Hz to 30MHz.

It is easy to use and can be automatically controlled through a general purpose IEEE 488 interface. This is said to make it ideal for all stages of manufacture. The MS3401A uses a crystal oscillator and digital synthesis to give highly accurate, high speed sweep output.

Frequency intervals can be set as low as 0.01 Hz and there is a logarithmic sweep for broadband devices. The CRT display gives digital and analogue display of measurements, and there is provision for output to optional hard copy recording devices.

All parameters and measurements of particular tests can be stored in plug-in memory cards. Stored settings can be displayed on the screen for easy identification. A high level Personal Test Language, a version of Basic, allows complex test programs to be created on the MS3401A using a PC or optional keyboard.

For more information contact Alcatel-STC, Measuring Instruments, ☎ (03) 952-7200.

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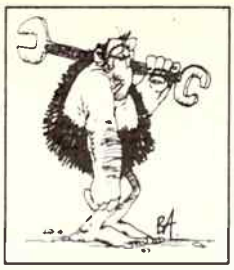

TECHNOLOGY

Adam Searle does some detective work on Dindima's new security surveillance system.

SUPER SLEUTHING

The generally high cost of security surveillance systems (around $20,000) has often limited their usage to sites like art galleries and defence installations – places where cost is no object.

Also, a common problem in this field is the detection and identification of people in sensitive areas. Although closed circuit television has been used for such purposes, a moment's distraction on the part of the operator can lead to unauthorised access or other events going undetected.

A way of minimising this risk is the "snapshotting" of CCTV pictures of sensitive areas when people are present. The development of electronic systems that "grab" images quickly by detecting motion in specific areas inside the field of view of a closed-circuit television camera is an extension of this principle.

Any such system should allow the "windowing" of areas in a picture, like doors, windows, filing cabinets and such. It is also appropriate that the threshold of detection in windowed areas should be able to be preset so that the passage of a pet through a door or the swish of a curtain does not trigger image capture and alarms.

Using digital techniques to grab images permits "contrast enhancement" and other processing to give better identification of an intruder. It also facilitates the storage and the transmission of images over dial-up telephone lines or radio links.

Although systems of this kind have been developed in the past, their costs have been such that general usage has been prohibited.

Using the technology for the NSW drivers' license contract it had won, the Melbourne-based Dindima Group produced the Super Sleuth. This system is based on a frame grabber which plugs into an IBM-PC or compatible, a compact CCD (charge coupled device) camera (or multiples) and software.

The camera is focussed on the area. Then, using the computer, a total of four areas on the screen can be defined for surveillance. The cost is under $2000 before tax.

Briefly, the system detects motion in designated areas. The sensitivity of motion detection can be preset for designated areas; it can archive captured images; it provides contact closure to trigger alarms; successive still pictures can be captured to "freeze" actions of the intruder; and such captured images can be viewed on a computer VGA monitor.

These images can be transmitted over telephone lines to remote locations via modems. The FG.302 TV frame grabber pc board takes up only one slot of the IBM PC. It stores one field of a TV frame in 256 x 256 pixel resolution and transfers the image data to the computer memory in sequential DMA

cycles.

The two video inputs feed an input select relay which is controlled by an on-board software driven 1-bit control register. Selected video input is back porch clamped and buffered into a 7-bit video A-D converter, with the output fed to the 256 x 256 x 7-bit field store.

Image acquisition is triggered when the FG.302 control register is addressed. When this happens, a sequence is set in progress. First, the video input relay is set to select either the video 1 or video 2 input.

Then, after a 3 ms delay to allow the relay to settle, the next odd TV field of digitised video data is loaded into the field store. Immediately following the loading of the field store the FG.302 signals a DMA request by activating one of the DRQ lines.

Next, the PC DMA controller executes an I/O read cycle. The DRQ line is repeatedly activated to initiate further DMA I/O read cycles until all image data has been transferred. The read sequence is in raster format – left to right, top to bottom. Thereafter, the DRQ line remains inactive until the FG.302 control register is again addressed.

Establishing the system requires the positioning of variable size rectangular zones, with a maximum of four. These are superimposed on the image for ease of setting up.

The user has the option of making each individual zone motion sensitive, or making a combination of all zones trigger the system. A test procedure is used to indicate a trigger condition.

Options for the system include programmable time for system operation; date and time "stamp" displayed on archived images; multiple successive image captures on trigger (with a maximum of eight); variable intervals between image captures; variable delay time after each trigger and variable exit delay time.

The naming and filing of images can be determined by the operator. Viewing of images can be done by selecting the files displayed on screen. Searching between images can be done with up or down cursor keys.

The system has a resolution of 256 x 200. Image size is 52 Kbytes, and it is compatible with any IBM PC, XT, AT or compatibles. A CCIR or RS170 video input is needed. VGA display is also required.

A printer driver is provided to print the images on a popular dot matrix printer.

Further details are available from The Dindima Group, PO Box 106 Vermont Vic 3133. ☎ (03) 873-4455. eti

Using digital techniques to grab images permits 'contrast enhancement' and other processing to give better identification of an intruder.

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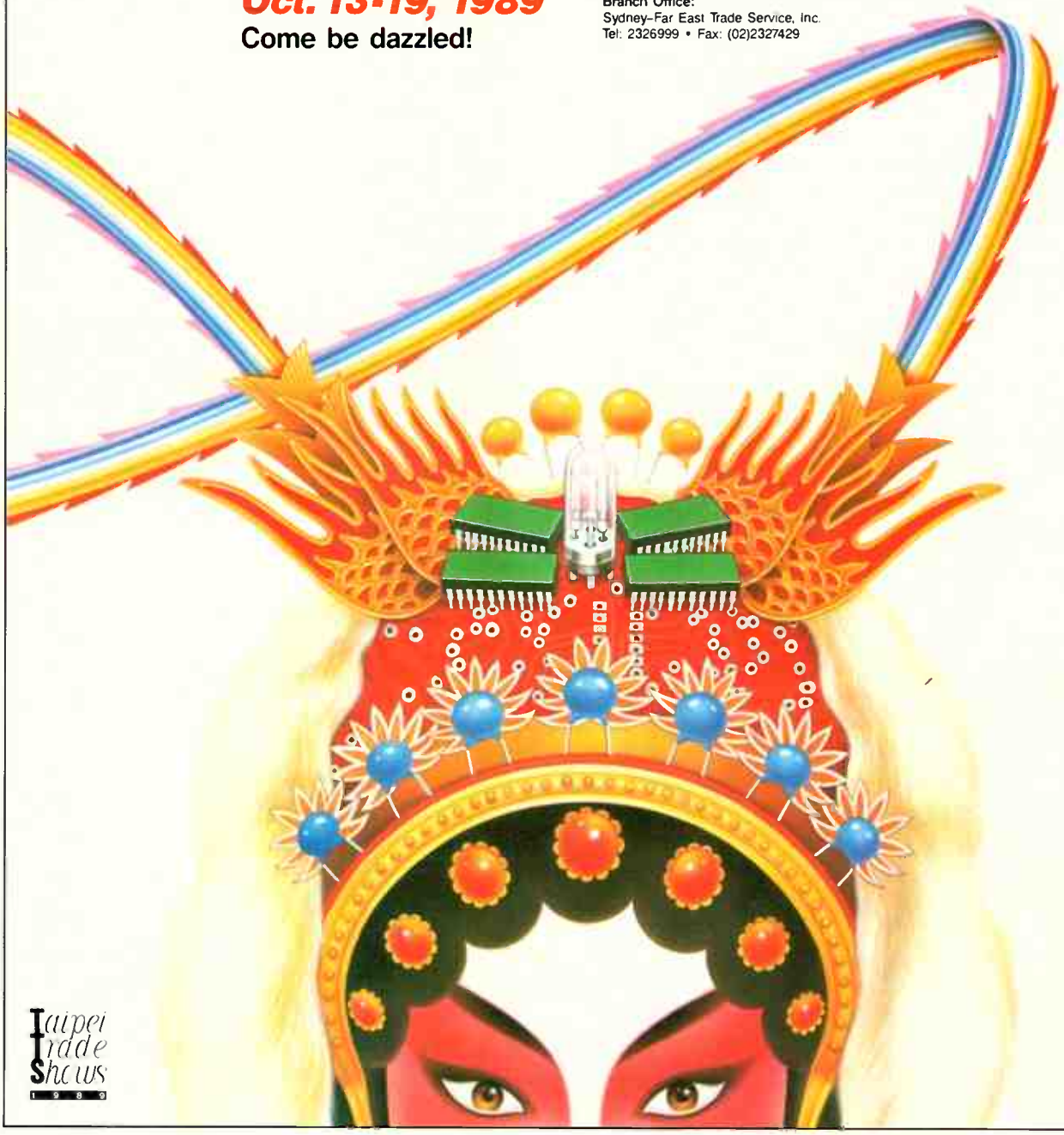

Taipei Trade Shows 1989

READER INFO No. 24

ROGERS COLUMN

ROGER HARRISON

ANSWERS & ARGUMENTS

This column is intended as a forum for exchange between you, the readers, and the magazine. I'll answer queries on projects, general questions on electronics and related subjects that may puzzle or concern you, engage in a little argument on topics of interest, or discuss subjects you might like raised. It's up to you! Short letters will be appreciated, long ones may be edited; if asking questions, confine your letter to one or two topics please. Send your letters to: Locked Bag 888, Rozelle, NSW 2039.

Why do you bother?

I'm wondering why you bother publishing projects like the ETI-1418 and ETI-1613, etc, and don't print the pc board artwork and overlay.

Obviously, we are to buy the kit to build the projects, so I would assume the kit details and instructions come with the kits.

So, why print them in your magazine?

N.S.,
Morwell, Vic.

Well, I "wasn't here" when the ETI-1418 Expandable Audio Mixing Console and ETI-1613 Baby AT Computer projects were published, but I'm not going to use that as an excuse to get out of delivering an explanation.

Both projects were published over August-September-October 1988. Take the case of the mixing console first. The dimensions of the boards are such that clear reproduction of an overlay is not practicable. The project was developed and kits produced by Glen Thurect and Andrew Robb of Applied Audio Consultants; copyright was retained on the pc board artwork for the modules and for this reason, apart from the mechanical limitations, it was not reproduced.

In the case of the ETI-1613 Baby AT, matters are a little different. For a start, it employs a multi-layer, through-hole plated printed circuit board not much smaller in size than two open pages of the magazine! Hardly the sort of board you'd attempt to etch in the home workshop, assuming you could work to the extremely small tolerances required. A component placement diagram for this project, rather than an overlay, was printed on page 103 of the September 1988 issue. The pc board, supplied by Energy Control International, comes complete with full component annotation printed on the top side, making for easy component assembly.

Projects such as these are worthwhile publishing, even when mechanical or other limitations prevent or obstruct reproduction of an overlay or the pc board artwork. Describing projects of the magnitude and complexity such as these two in the magazine gives readers an insight into the technology and circuit techniques employed, as well as providing a practical basis for assembling something for themselves – something which strongly motivates readers to buy the magazine in the first place.

Where d'ya get it?

I am having difficulty tracking down a 40110 IC as used in your ETI-190 Digital Transistor Tester (ETI, March 1989). Could you please let me know a source of supply?

S.F.,
Perth, W.A.

The 40110 deserves to be a more widely stocked device. It's a CMOS up/down decade counter, latch and 7-segment display decoder/driver all rolled into one little 16-pin DIL package!

You're in luck, as there's a supplier in your city. RS Components at 3 Walters Drive, Osborne Park can sell you a 40110 (catalogue number 637-400) for $4.34, according to its latest "Unit Price List". All that, and cheap to boot!

For readers in other states, RS Components has outlets in Adelaide, Brisbane, Melbourne and Sydney.

Telephone problem

I recently built the ETI-291 Telephone Intercom Power Unit (February 1988, page 88). I got just about everything put together without any problems, except for the 2851 type transformer. In the circuit diagram, it is shown with all windings connected in series, but in the wiring diagram one lead from it is marked "N/C". Does this mean "not connected"? I connected all windings, primary and secondaries, in series.

I didn't use a Series 800 Telecom telephone, but a cheap pushbutton phone instead.

When I first turned the power on, the LED came on. When I dialled, the ringer worked OK, but when I picked up the other phone it sort of went sick, no guts.

Every now and then the phone works; it's possible to hear the person on the other end speak, but you cannot speak back.

I have tried these phones on Telecom lines and they work fine. I have checked the connections to the phone socket and they are all OK. Could you please shed some light on my problems?

M.A.,
Renmark, S.A.

*I would suspect you probably have more than one problem. However, your main problem probably lies in the connections to the 2851 transformer. This is used here as a "choke", providing some inductance. If, for some reason, the windings are not all **actually** in series, it will be a very poor inductor. For starters, I suggest you try reversing the connections to the 2851's primary, and see what that does. It should improve matters dramatically.*

It also seems you have an intermittent joint somewhere. Examine all your soldered joints in the power supply carefully, looking for one where the solder is slightly "frosty" on the surface, rather than shiny. Or, it may appear like a water droplet on a greasy surface – all rounded, not "wetting" the parts of the joint. These are the telltale signs of bad joints that give rise to intermittent connections that work sometimes and not others, quite unpredictably.

The cure? Simply re-heat the joint thoroughly with your iron and apply a little more resin-cored solder. In bad cases, you may have to remove all solder and clean the parts of the joint by scraping them with a sharp pen knife blade or "hobby" knife.

JIM TUCKER

FROM BEEPS TO BEETHOVEN

This column is for electronics enthusiasts who take an interest in computers and computing — a significant percentage, apparently. From month to month we'll touch on aspects of various popular computers, depending on contributions from readers. IBM user and enthusiast, Jim Tucker, will give practical advice, hints and tips on making the most of your PC/compatible.

I've always been a bit annoyed by those Atari and Commodore folk. They have you-beaut computers but they never seem to be doing any work. They're either playing games, drawing pictures or making music. "Listen to this," they say, and out comes phenomenal sound. Grrr.

The best I could get out of a humble PC was a few feeble beeps from the itsy-bitsy speaker which didn't even impress my kids. But ah – PC revenge! Twelve channels of sound, stereo, connected to my 100 watt amplifier. All for $299! Even Lucy the cat was impressed. She left the room.

It's a board, of course – called the CMS Music Board – which slips into any spare slot on a PC or compatible. It connects to a stereo system, small speakers, or you can use headphones. Now, when the local computer smarties drop into my computer room and ask "What's new?" I say "Not much," and press Control-5. *Boom!* They get a blast of Beethoven at about 110 dB. (Heh, heh).

My computer room is small. My speakers are big. It took Peter (a neighbourhood ratbag) at least a minute to recover!

Here we have a simple short board. There are only 10 ICs – six of them 74LS series gates which control the sound frequencies. The main chip is a 40-pin EPROM and who knows what secrets lurk inside there.

At the back end is a TEA2025B amplifier IC. Output is to a small stereo socket suitable for inexpensive headphones or two RCA sockets which can be connected to small speakers or the tape input of your amplifier. There's also an external control to adjust the line level.

Putting it in place

Installing the music board in a PC is simple. Just put it into an empty slot. There may be some conflict with the board's I/O address if you have other fancy boards installed, but as the manual explains clearly there's an easy way to solve that. You simply move a jumper on the board to a different address (there are six available) and run a program called "install" until it works . I didn't try this – mine worked first time.

The board itself is neat and all components are clearly labelled. The jumpers include the I/O address for each position (something I wish other board manufacturers would do so you can change things without looking up the manual).

Not many people have a stereo amp near their computer and my only gripe was having to make a cable long enough. Soldering irons and I aren't exactly friends. Don't ask your local electronic shop for an off-the-shelf 10-metre shielded stereo cable. Mine runs 10 metres but I suspect any reasonable length is okay.

The line output can only be adjusted from the control on your sound system. I sometimes wish you could adjust it from the keyboard. Loud for Beethoven, quiet for Greensleeves.

The software

The board is supplied with seven disks of sophisticated software. I used the CMS installation program to copy them on to my hard disk.

The main program is CMSDRV which is the memory resident driver. It's best to load it from AUTOEXEC. It uses only 5K of memory and steals the first available interrupt after 80 hex so the sound driver can be interfaced to other programs.

The main feature is that music can be played as a background task. Tunes can be interfaced to games or anything you care to write, either in assembler, Basic or Pascal. The user guide describes this with examples of Basic and Pascal. Alas, only interpreted Basic, and there are no examples of assembler although the manual does tell you how it should work.

The latest Sierra games, such as Leisure Suite Larry II, are supported. The devil puts a quarter in the jukebox and it plays real music – as loud as you like.

A hot key (Control 5) will pause playing – for instance when you have to answer the phone or your smart neighbour starts shouting in pain. Hitting the same key in the proper sequence will either resume playing from where you paused or return to the start.

There are 50 tunes supplied. Playing time: 3 hours 10 minutes. You can either key PLAY TUNENAME from the DOS prompt or, if you have loaded the pop up music menu, just press Control F10 (you can change that) to interrupt what you are doing. Up pops a colourful display of easy-to-use options.

When you have chosen a tune, or an album containing a list of tunes, press E to exit and you're back in your application program (word processor or whatever) with music in the background.

There are two other main programs. One lets you write a composition as an ASCII file in twelve voice. The other turns your keyboard into an electronic organ.

Organic sound

The organ program is the easiest to use. In performance it's like a small synthesiser which sells for about $200. It has 20 voices, percussion, bass, automatic arpeggio, timing, change of key and all the things you would expect. The advantage is that anything you play can be saved on disk. The disadvantage for musicians is you have to imagine the PC keyboard looks like a piano.

Reminds me of the tourist in New York who asked how to get to Carnegie Hall. "Practice, son. Practice."

Still, as a fun instrument it works well. As an educational tool it should be considered seriously by primary schools.

But if you really want the full blown orchestral sound, such as those in the demo tunes, you'll have to write your own arrangements.

It isn't easy

Da-da-da-dum! Beethoven started out with some pretty simple songs. Most of us can pick out a tune with one finger. It's when you have to play more than one note at a time that things get hard. Imagine writing a score for a symphony orchestra – 120 instruments going like the clappers.

CMS is a little more modest. In effect, you have 12 instruments. But creating an orchestral arrangement, even for a tune written by somebody else, isn't for amateurs. So don't expect to create Beethoven's Tenth on your music board overnight. Keying in several voices means you really need to be a musician.

For example, here's the first four bars of Twinkle, Twinkle Little Star as described in the manual.

M1 : 1 1 : 5 5 : 6 6 : 5 - :
AA : C : C : F : G :

Simple enough. If you know about music you'll probably even understand it without reading a word of the manual. The top line is the first voice register in numeric form and the bottom line contains the bass chords. You can create music using a simple word processor but if you run this it sounds boring. The version of Twinkle on the CMS disk sounds much more interesting. Here are the same four bars with eight voices and the words.

M1: Q1 Q1 : Q5 Q5 : Q6 Q6 : Q5 - :
M6:C 0101/ :C 0101/ :C 0404/ :C 0505/ :
M7:C 0303/ :C 0303/ :C 0606/ :C0707/ :
M8:C 0505/ :C 0505/ :C 0 + 101/ :C 0 + 202/ :
M9:C 0 + 101/ :C 0 + 101/ :C 0- + 404/ :C 0 + 505/ :
M10: OxOx/ : OxOx/ : OxOx/ : OxOx/ :
M11:C – 1050/ :C – 1050/ :C – - 40 + 10/ :C – 50 + 20/ :
M12:C 1050/ :C 1050/ :C 40 + 10/ :C 50 + 20/ :
;T: Twin-kle twin-kle lit-tle star %%

That lasts about three seconds. Do you reckon you could work it out? How long to arrange a full-blown arrangement lasting five minutes? Obviously, there's a lot to learn.

And more. You can create your own musical instruments on all 12 voices by defining the sound with such things as attack, decay, sustain and release. In effect you can invent a new instrument you might like to call a "Vianona."

There's an instrument on the organ program which defies description – they call it "crazy."

Documentation

I'll give the user guides (there are several) 8 out of 10. It's a bit hard to document seven disks of software without turning people off. CMS gives it a darn good shot. If you really want to compose tunes it assumes you know a little bit about music. And if you want to amaze your friends then just play some of the 50 tunes supplied. You should have most things working within an hour.

The manuals are written in plain English but there are no technical specifications and only a brief attempt at explaining how to interface the music board to assembler programs.

Da-da-da-dum

Now I'll turn music critic. Alice (who is 12) and I played all 50 tunes and rated them on a scale of 1 to 10. Don't expect anything on the teenage top 40 here. There's a lot of the usual synthesiser demo stuff. Who needs Rudolf, Jingle Bells and A Little Brown Jug in June? But I do like Beethoven's G minuet. I've renamed the disk file GMINUET.CMS to BASIL.CMS. Why?

Some of the arrangements have obviously been created with the synthesiser (perhaps part of the organ program) because the chords are wrong. But others are awfully clever. Unfortunately, the ASCII source code for the Flight of the Bumble Bee isn't included. It must be a maze of magic numbers.

Finally, a few loose points. Creating an album is easy. Simply key an ASCII file of song titles and run ALBUM ALBUMNAME from the DOS command or choose PLAY ALBUM from the pop up menu.

There's an advanced feature which lets you display graphics on screen and play music at the same time. The batch file demo does this. Then there are a couple of sing-along programs which display the words on the screen. Just follow the bouncing ball.

By the way, if you're wondering about BASIL, Beethoven's G minuet is the theme for Fawlty Towers! **Eti**

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I recently ran into a colleague with whom I had shared a workplace some years back and, over the odd pint of Guinness and schooner of Reschs, we got to discussing those days and comparing them with the present.

The tedium, tyranny and frustration of written communications have been stripped away by the ubiquitous fax machine. "I reckon they've personalised things, which has to be a major leap forward," my colleague opined. "Putting *G'day. Where's me bloody crystals-capacitors-MC1O116Ls!* or whatever on a piece of paper and shooting it off on the fax is a damn sight more effective than *on the 10th I ordered xxxx, purchase order number 15467...* etc, transcribed on to letterhead by some tyrant or tyro of a typist and sent a week later, never to be replied to...," he continued.

"There's not a great deal I really miss about business in those times," he ventured, "except for the old-time company rep. You know, like old Charlie from xxxx," and he named an instrument company still widely known today.

I well remembered the gentleman named by my colleague. An ex-services type, he had the air of a retired naval or RAAF officer; perhaps he'd been a Chief Petty Officer on a carrier, or a Wing Commander (Signals), or somesuch. No matter, he had a jaunty step, a stiff back, was immaculately groomed and sported a well-groomed moustache reminiscent of the era. His manner was courteous, friendly but not familiar. He always had a ready joke and winked at the girls in the front office.

His patient explanations and demonstrations of the newest piece of electronic instrumentation were always calculated to get right to the heart of our latest frustrations with the equipment we existed on, creating a want while demonstrating the need! He'd then let us loose with his seemingly pristine instrument, which we knew was more than the boss would/could afford. He would watch unflinchingly, with a benign, fatherly, smile on his face as we tripped over the control settings, shorted output terminals, etc. and finally did in 10 minutes what would take hours on our battered and slightly shamefaced gear.

Our curiosity and eagerness about the new equipment satisfied for the moment, old Charlie would accept a cup of Kinkara tea (sorry, no Twinings, old chap!) chat casually about the productivity and product quality improvements his marvel of the age would bring, wax lyrical about its quality and reliability, and politely phone his office to reserve one for us, leaving a shilling by the phone (when phone calls cost a penny!), intimating to us as he dialled that he'd be letting down the excellent team "at HQ" if we didn't place an order now.

"It was a pleasure to have a thousand quid ripped out of your budget," my colleague observed. "I wouldn't spend a thousand *dollars* on some of the wallies they send around selling gear these days," he spat out with some vehemence.

"Take the specimen that came in and asked to see me the other month.

"I know it's either illegal or impossible, but he couldn't have been over 12. Definitely didn't shave.

"He opened his code-locked briefcase and showered me with glossy, full colour brochures of some new instrument.

"Without so much as a sample unit to demonstrate, he graphically described it, its functions, its features and its numerous applications with such passion he looked like the lead in an Italian opera or one of those American TV evangelists confessing he'd been fooling around!" he exclaimed, pausing for a pull on his Reschs.

"The staff stood around with their mouths open. This thing had apparently been designed by the guys who'd won the Nobel Prize for high temperature superconductivity, or at least had some distant connection with them.

"For the piece de resistance he whipped open his case and, with a well practised flourish, unfurled this brilliant colour poster/calendar which snapped open between his outstretched arms. It featured a naked lady with various models of this device positioned in strategic places.

"The lab staff applauded," he said, appalled.

"I was shocked, shattered and limp. But just as he reached for his order book, the pager on his belt burst into life. Saved by the beeper; praise be to modern technology," my friend exclaimed.

"He bolted for his Nissan and sped off, jabbering into his cellular carphone, leaving tyre spin marks in the car park gravel," he said with a resigned air, shaking his head and taking a long, refreshing gulp from his schooner.

"Despite all that, and definitely not because of it, I was somewhat impressed by the product. I rang a few days later to get a demo, or at least to get a demo unit for a week or two. You'd have thought he could have brought one the first time.

"But it was like getting money from debtors," he spat, disgustedly. "Finally, in the last week of the month, I had to pull the old trick of threatening to order one so it looked as if he could boost his figures, and his commission, for the month."

I could only agree with him on the effectiveness of this ploy.

"It arrived quick smart, and then the fun began," he went on, with no trace of humour in his voice.

"It was like the poster, all show and little substance. The sheer weight of the mains cable dragged it off the back of my desk," he exclaimed incredulously.

"It was described as *fully user configurable*, sporting a small keyboard on the front panel. Half a day later, after poring over what was loosely described as the User Manual, all I could get it to do was light up the liquid crystal display," he said in a defeated voice.

"So I rang their 'technical hotline'. You know what I got? Another bloody salesman," he spat, with a grimace Basil Fawlty would have been proud of.

"The next time a sales rep like old Charlie calls around, I'm going to treat him to proper percolated coffee from the private machine at the back of the lab, I'll put my purchase order book out on the desk and find some excuse to introduce him to that lady in the front office he's got his eye on and who keeps asking after him. And I'll pre-order a bottle of his favourite Scotch for Christmas.

"For the rest, I'll ring up all the other reptiles from the competitors as if I'm going to place an order, make an appointment for them all to see me at the same time on the same day, bring them all in and have them put their pitch simultaneously. That should really provide some entertainment for the lab staff," he chuckled into his empty schooner.

eti

ETI Sound Insights

SPECIAL FEATURE: AUDIO CARE ACCESSORIES

COVER: HITACHI'S NEW VM RANGE OF VIDEO CAMERAS

REVIEWS: EUROVOX, TECHNICS

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READER INFO No. 26

THE "SHRINKING" WORLD OF HI-FI

Developments in the hi-fi industry can produce some fast-breaking news at times! No sooner had last month's feature on trends in loudspeaker designs been "put to bed", than I was treated to a demonstration of yet another development in the world-wide rash of effort aimed at reducing the cubic volume of loudspeakers. And it shows some promise. I'm talking about Yamaha's Active Servo Technology, as they've dubbed it, a mite mysteriously. By Roger Harrison.

As you are probably well aware, small speaker enclosures generally cannot achieve good, low bass frequency response. Squeezing another octave below about 100 Hz out of a speaker that may be just the size of four house bricks or so is asking a lot. Of necessity, the bass drive is such that a small cabinet can only have a limited diameter. Which means, to move the volume of air required to reproduce those bass notes, it must have a "long throw" voice coil and a very linear suspension system.

These are contradictory requirements, no matter whether you're using a sealed box or a ported system. Just think of the size of a double-bass; your speaker's so much smaller, and you're asking it to reproduce the sound of that double-bass! Many small speaker systems exhibit a characteristic rise in bass end distortion, particularly at higher sound pressure levels, even when run well within their power limits.

What Yamaha has done is to exploit the resonance effect of a tube connected to a volume of air. Set up sound waves in such a contraption – vibrating the air – and, at a certain frequency, it will "sing". At, and around, this frequency it takes very little sound pressure to produce a very loud note. The properties of such a "resonator" were first explored and described by the German physiologist, Helmholtz, last century.

Make a ported loudspeaker cabinet act like a Helmholtz resonator at some suitable bass frequency and you can boost its bass output. Small sound signal amplitudes within the cabinet will be radiated as large signal amplitudes by the port, Yamaha explains, provided the cabinet volume and port size are scaled to match a certain ratio.

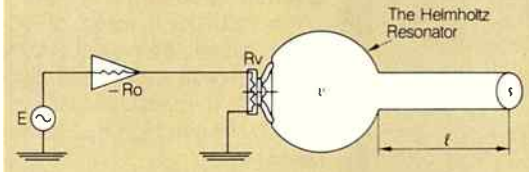
The bass driver in the speaker must be able to provide the correct drive for such a system, and to do this, Yamaha says it provides the driving amplifier with a negative impedance output. A system employing this combination can produce an extremely wide frequency range in the bass, down to 28 Hz, with low distortion.

Such a system requires the dc resistance of the bass driver's voice coil to be as low as possible, preferably zero. The latter is impossible, except perhaps with a superconductive voice coil! However, electronically, the same effect can be achieved by making the driving amplifier's output impedance negative and equal to the value of the voice coil's resistance. It is this, Yamaha says, that ensures linear operation throughout the lowest frequency range, regardless of cabinet volume.

How do they do it? Well, from the sketchy "technical" papers Yamaha provides, and some delving into circuitry, they add a gyrator between the amplifier's preamp output and power amp stage input. Now, a gyrator is an electronic filter using resistors and capacitors in the feedback network around an amplifier stage (an op-amp in Yamaha's arrangement) that behaves rather like a "pure" inductance. It has a resonant frequency, and at that frequency, the gyrator's impedance is effectively negative.

Now, if the port resonance and the gyrator frequency are aligned correctly, and set at a frequency well down on the bass driver's low frequency rolloff, then their combined effects will provide considerable "lift" to the

Active Servo Technology Principle

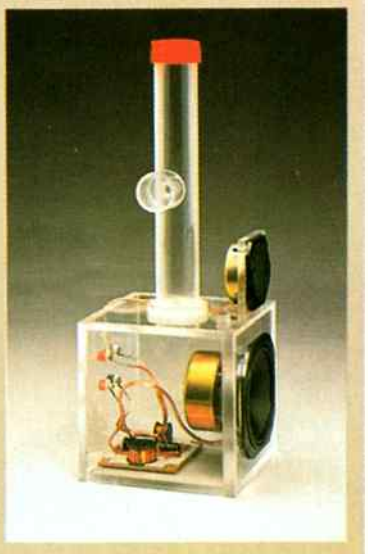


Driving force $F = B \cdot L \cdot I = B \cdot L \cdot \frac{E}{Rv - Ro}$

Speaker Q factor $Q = \frac{Rv - Ro}{(B \cdot L)^2} \sqrt{m_e \cdot S_e}$

Resonance frequency $fp = \frac{C}{2 \cdot \pi} \sqrt{\frac{s}{\ell \cdot v}}$

B: Magnetic flux density (T)
L: Voice coil effective length (m)
I: Driving current (A)
E: Driving voltage (V)
Rv: Voice coil electric resistance (Ω)
-Ro: Driving impedance (Ω)
m_e: Equivalent mass (kg)
S_e: Stiffness of unit and cabinet (Nm)
C: Acoustic velocity (340 m/s)
s: Port area (m^2)
ℓ: Port length (m)
v: Chamber capacity (m^3)



speaker's bass end output, most radiation coming from the port. Strictly speaking, it's not a "servo" system as there's no external feedback mechanism (not one that I can see, anyway).

There aren't enough details available as yet to go into the complexities of the system in order to get a complete explanation, but the performance I heard at a Yamaha showing in Sydney recently was intriguing enough that I will pursue it further. Watch this space, as they say.

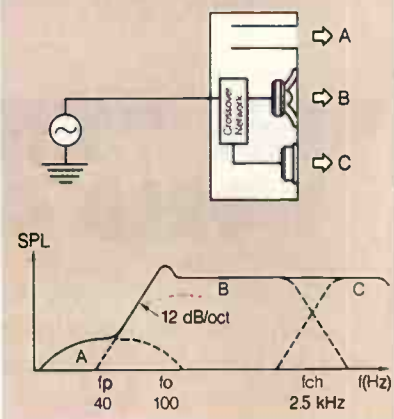
Yamaha's practical realisation of this technique comes in various forms. Firstly, it will be releasing a range of AST amplifiers and a variety of AST speakers. The amplifiers have an edge connector socket in the rear and each AST speaker comes with its own "AST cartridge". You plug the cartridge into the amplifier, hookup your speaker, and away you go! If you choose to use conventional speakers with an AST amplifier, no problem. Without the cartridge, it's a conventional high quality amp!

First products to be released will be the AST-S1 speakers and AST-A10 amplifier. The speakers measure a tiny 188 mm wide by 297 mm high by 230 mm deep. They're a two-way system with a 30 mm soft-dome tweeter and a 160 mm bass-mid driver featuring a polypropylene cone. The 36 mm diameter port faces frontwards. Claimed frequency response is from a phenomenal 28 Hz up to 20 kHz. SPL output is given as 112 dB for 1 W at 1 m.

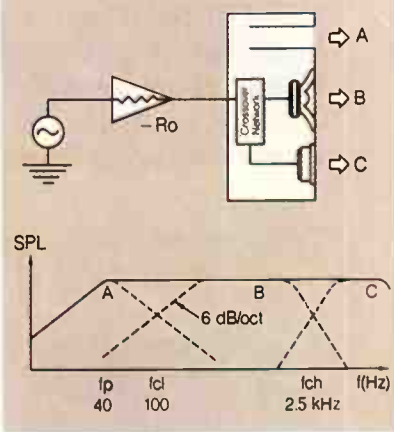
The AST-A10 is rated at 50 watts RMS into 8 Ohms at 0.02% distortion (with AST-KS1 cartridge inserted). It measures 435 mm wide by 96 mm high by 372 mm deep.

Yamaha will be releasing a set of "flat" profile AST loudspeakers designed for standing on a bookshelf or directly on a wall. And this just adds another string to the bow in the trend towards flat-panel, wall-mount loudspeakers. There's also an AST midi system in the works, with a distinct change cosmetically that should start another trend in audio component appearance. But more of that some other time. Also in the works is a small "unified" system with integrated amp, tuner, double cassette deck and CD player, with AST speakers. Not a music centre, nor a ghetto blaster, but compact and "luggable".

Conventional Speaker System



Active Servo Technology



Head of Panasonic passes away

MR Konosuke Matsushita, founder and executive advisor of Panasonic Australia Pty Ltd's parent company, Matsushita Electric Industrial Co, has died, aged 94, from pneumonia at Matsushita Memorial Hospital in Osaka.

MEI, one of the world's largest consumer and industrial electronic and electrical goods manufacturers, was established by Konosuke Matsushita in 1918 to produce a double adaptor socket.

The company now employs more than 150,000 people

Mr Konosuke Matsushita

worldwide and markets 14,000 products under the brand names Panasonic, National, Quasar and Technics.

Outside Japan, MEI has stocks listed on the Amsterdam, Dusseldorf, Frankfurt, New York, Pacific and Paris stock exchanges.

Matsushita's philosophy was to contribute to the progress of society through the manufacture and sale of electric products. He founded the PHP (Peace and Happiness through Prosperity) Institute in 1946 and started publishing a monthly magazine title PHP.

In addition to serving as a director on a number of boards, for both private companies and government instrumentalities, Matsushita was a prolific writer. His major publications included "My Thoughts on Man", "Japan at the Brink" and "21st Century Japan".

Video camera boom

THE video industry was making predictions last year that some 30,000 video cameras of the consumer class would be sold that year. 1988 saw just over 48,000 pieces go over retailers' counters. For this year? They're punting on selling over 60,000 units. At an average price around $2000 each, it's an industry sector worth over $100m.

Apparently, some 60% of consumers that purchase video cameras do so to record family events. The Box Brownie goes electronic! eti

Pioneer twin CD Prologue ▲ shelf system

PIONEER'S new Prologue shelf system allows two compact discs to be loaded and played in sequence giving versatility to the listener's music program and flexibility to change discs without breaks in the music.

Pioneer first led the development in multiplay some five years ago, when it released the award winning PDM6 with its 6 disc magazine, and has continued to broaden its appeal with the inclusion of the Double CD player in the Prologue.

The twin player allows the listener to choose to play one disc after another in a normal manner, random play with the machine selecting at will from both discs or playing according to a pre-set program of up to 24 tracks from the two discs.

In addition to the double play facility, the Pioneer Prologue shelf system offers all the components of the more expensive midi and floor systems to budget conscious purchasers at $999.

The system has great appeal to flat dwellers as the first introductory step into hi-fi of a budding audiophile, building confidence and appreciation for more sophisticated equipment, or as the auxilliary stereo system for the other room or the beach house.

The Prologue is powered by a 22 watt amplifier with five band equaliser and remote control volume. Its twin cassette gives double or normal speed dubbing facility and both decks are operated by soft touch controls. The tuner has 6 presets each for FM and AM giving easy and convenient selection.

The system is equipped with 2-way bookshelf speakers comprising a 16cm woofer and 6cm tweeter in each, and all components are easily accessed by a convenient cordless remote control which allows the user to power on or off, mute sound for breaks, adjust volume, change functions and scan preset stations.

For further information please contact: Paul Clarke or Robert Costello, Pioneer Electronics, ☎ (03) 580 9111 or, Keith Millar, White Millar & Co, ☎ (03) 699 3000.

Challenge to CD falters

THE plans of US company Finial Technology to challenge the CD player with a turntable that uses laser beams to read the grooves of normal analogue LP records are not working out to plan, tch tch!

They have developed the device, but cannot find a partner to commercialise it. The Finial laser turntable applies a laser to the right and left walls of the LP groove, scans the beam's rapidly changing reflections and converts them to hi-fi sound said to be as good as that from a CD player.

But just to break even, Finial would have to sell each turntable for about US$12,000. They have been demonstrating in Japan to convince someone to invest US$10m in the project to get the price down.

There are no takers as yet, possibly because LPs are not as appealing as CDs. In Japan the production ratio is 12 million LPs a year as compared to 110 million CDs. Such is the inexorable law of economics?

Serge Rancev joins Oz

SERGE Rancev, a leading Melbourne audio maintenance specialist, has joined Audio Oz. He is widely known for his technical expertise and is qualified to service all leading makes of professional sound equipment.

Audio Oz supplies a range of professional products, advice and support.

They have recently received limited stock of the acclaimed Music Fidelity P270 and A370 power amplifiers, which are said to provide good quality and superb distortion specifications.

Taking care of your audio and video machinery

A survey of care accessories for all your cassette tape, LP record, compact disc and video gear. Roger Harrison reports.

"Take your fingers off it, don't you dare touch it..." go the words of an old skiffle song of the 1920s, and it's good advice these days when it comes to taking care of the media and machinery which we use for our audio and video entertainment.

Audiophiles and enthusiasts have long known that they must keep the grooves of their vinyl LPs free from dust, dirt and other contaminants, and the debate over video head cleaning has waxed and waned over the years since the first domestic video recorders appeared on the market. When compact discs first appeared, they were the "perfect medium" – indestructible. But reality has proved to be a little different.

A number of companies have sprung up around the world to service needs of consumers where equipment and media care is concerned, and a wide variety of products is produced and marketed. Differing techniques are required for each media category so I'll tackle them individually, looking at the techniques employed and the products available.

Let me say at the outset that the inclusion of a company and its products here does not imply approval, nor does omission imply the opposite.

LP records

Now that LPs are on the decline in both new issue releases and sales, it is increasingly important that they be well cared for – replacements will become increasingly hard to get, expensive and in due course, impossible. The old 78 disc took some 30 years to cease production after microgroove LP records were introduced. That doesn't mean to say that there aren't still enthusiasts out there who appreciate the myriad of artists and performances represented on 78s.

The LP gained acceptance slowly at first, then leaped ahead with the introduction of the stereo LP. Sales volumes massively exceeded that of 78s the world over, so there's a huge investment in LPs out there.

The LP has had a 40-year run as a consumer product and it's not dead yet, by a long shot. Indeed, sales of quality, high performance turntables are reported to have grown over the five years since the introduction of the compact disc.

The spiral groove that tracks from the rim to the label on a vinyl LP is typically half a kilometre long, a whole kilometre or so of groove when both sides are taken into account. What falls into that groove? Dust, dirt, fingerprints, cigarette smoke residue, skin

Trackmate's LP cleaner.

KEEP IT CLEAN!

oils, mildew, etc. Dust and dirt can be heard as noise, crackles and pops; other things affect the groove's frequency response, particularly at the higher frequencies.

Cleaning long-neglected discs that show a heavy build-up of dust, mildew, etc, may simply require a careful wash in warm, mildly soapy water using pure soap and a soft cloth, before letting them dry naturally.

Probably the simplest LP record cleaning device on offer, and the one that's been around the longest, is a simple lint-free cloth, impregnated with a chemical that attracts and holds dust but, supposedly, does not leave a residue on the LP. Then there are various brushes and pads, usually with cleaning fluids, some of which are simply distilled water, others which are claimed to be "antistatic". The role of cleaning fluids is to dissolve oils and mildews and to counteract static charges. Brushes and pads are most conveniently used with the record on the turntable, either stationary or spinning.

Static, in fact, has long been identified as a major problem with LPs. Various antistatic solutions for applying to the surface of records have been promoted over the years, some with more success than others.

Simply slipping a record out of its sleeve is enough to impart a charge to its surface. Just walking around, you develop a charge on your body which can be imparted to a record when you handle it. The charged disc attracts dust present in the air.

One of the widest ranges of simple, low-cost record care accessories is distributed by Arista, based in Sydney. Prices range from $2.99 for their RCC2 record cleaning cloth, through $3.95 for their RCB3 record cleaning brush which comes complete with cleaning solution, to $7.95 for their RCB2 carbon fibre filament record cleaning brush. The latter features thousands of carbon fibre conductive filaments to discharge static as you clean the record.

Your pickup cartridge stylus will pick up dust and dirt from the record grooves and needs care from time to time, too. Surprisingly, the temperature at the tip as it courses the walls of your record's groove runs at something between 300 and 430°C. Didn't know that, did you? This can glaze the microscopic dust particles to your stylus's tip which, in turn, grinds off the highs from your precious record's grooves. You don't see that glaze underneath the lint and hair you do see gathered on the stylus.

For shifting all manner of garbage from styli, there are various brushes and cleaning, solutions available. Again, Arista is well represented here, with their RCB1 combined record cleaning pad and stylus brush for $2.95 and their stylus cleaning fluid and brush for $3.45.

Discwasher, distributed in Australia by Arena Distributors of Perth, has a record care brush with cleaning fluid, the D4+. The manufacturer claims the fluid lifts and suspends dust particles and contaminants from the record surface, while the brush fibres dig it out from the grooves. The D4+ costs $32.95.

A stylus care kit is also put out by Discwasher, the SC-2. It consists of a brush of densely-packed nylon fibres with a magnifying mirror attached so you can inspect the stylus. It is used in conjunction with a cleaning fluid. The SC-2 sells for $16.95 rrp. Refills for the fluid cost $4.95.

Musicway, distributed by Rainbow of Melbourne, offers a range of vinyl record care products, including an antistatic brush with earth wire for discharging static on records, a novel approach. Other distributors stock antistatic sprays and antistatic guns, which are for use each time you take a record from its sleeve to put on the turntable. The gun sprays a neutralising charge on the record surface, obviating dust and dirt pickup that would otherwise be attracted by static changes. All the other treatments are meant for periodic application or use.

Arista's ASG839 Antistatic Gun costs $13.95 and generates up to 15,000 volts. Discwasher's Zerostat 3 gun is recommended for use before the application of the D4+ treatment and costs $29.95. Both are operated in the same way: you point the business end at the record surface from a short distance, and then squeeze a spring-loaded handle or grip. These gadgets are also useful for neutralising static buildup on camera lenses, negatives and slides, so we're told.

The limitation with record cleaning cloths is that you are pretty well required to handle the platter, which is admittedly awkward, while you're doing the job. With brushes and pads, you do it *in situ* on the turntable which, with some turntables, is not a good idea.

Because the groove runs circumferentially around the disc, the cleaning action when using a brush, cloth or pad also requires that you move it circumferentially. Drag it radially across the surface and you can put tiny – or not so tiny! – scratches in the grooves to which the pickup responds and you hear noise. And it worsens as time goes on. Two manufacturers have designed products to overcome these limitations, Allsop and Trackmate.

The Allsop 3 Orbitrac cleaning system employs a circular pad at the end of a triangular arm, the apex of which has a stud which fits into the hole in the middle of the record. You hold a circular, freewheeling handle above the pad and sweep the pad around the disc. The specially constructed, lint-free, natural fibre pad is fixed with respect to the grooves, so dirt, etc, cannot be swept across the disc. An antistatic cleaning solution is supplied which you spray on the pad before use. A small brush is supplied with the kit to clean the pad after use. The pads are replaceable and cleaning fluid refills are available, too.

The disc is placed on a special, antistatic rubber mat for cleaning, which avoids using the turntable, allowing a little downward pressure to be applied to really dirty discs. The Orbitrac comes in a neat little jewel case of its own so that it can be stored out of the way when not required, covered to prevent the accumulation of dust, etc. The mat could double as an antislip, antistatic mat on your turntable, too! The Allsop 3 Orbitrac sells for

The Allsop 3 Orbitrac cleaning system.

$49.95 rrp. Allsop products are distributed by the Sydney-based Allsop Fidelity Accessories.

Trackmate's TM451 employs a tuning fork-shaped device that pivots on the turntable spindle at the bottom of the fork. Twin brushes, one on each of the fork's arms, lift gunge from the groove while a marker pen system applies a cleaning solution ahead of the brushes. A freewheeling round handle provides a grip for you to rotate the fork around the platter. The disc sits on the motionless turntable while you do the job. The Trackmate TM451 retails for a recommended $29.95. Trackmate products are distributed by Amaray International, also based in Sydney.

Audio cassette tapes and players

I was once told by a bloke who spent a lot of time servicing hi-fi gear for a major audio specialist that many an enthusiast would trade in a cassette deck and buy a new model or another brand because they became dissatisfied or disenchanted with the sound. "So often, all the deck needed was a simple head clean. You wouldn't trade in your car for a new one, or another model because you thought the performance had dropped off. You'd take it to the garage and get it tuned, wouldn't you?" he said. Many a good cassette deck had a head clean, the alignment tickled, a spruce-up and was then put on the seconds rack and sold off for a handsome return. That's how he got his Nakamichi...

The cassette shell holds the tape, presenting a section at the front of the shell so that it can be gripped by the capstan and pinch roller and driven past the heads. The tape has a very thin layer consisting of a compound of iron oxide (Sapristi! That's rust!) bound to the surface of the plastic substrate.

Keep it clean!

The oxide layer may have other metals mixed in, depending on the formulation. But it is this surface which contacts the tape heads, actually rubs across it, and across the pinch wheel or roller.

While the surface of the tape is smooth, the oxide grains and crystals actually present a slightly abrasive surface; new tape heads are made so that they are deliberately worn in by use. A certain amount of wear is taken into account in tape head design, so that they retain their characteristics.

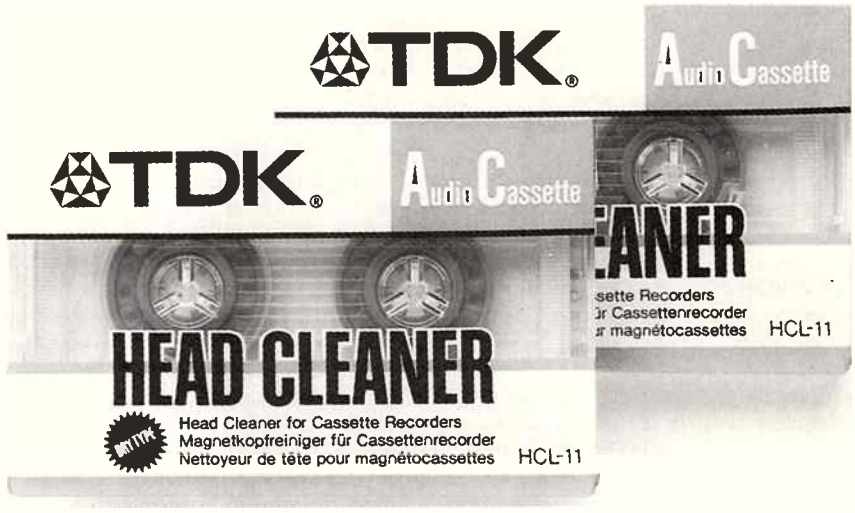
However, the contact between the tape and the head and between the tape and pinch roller means that, with time, a deposit built up from some of the oxide from all the tapes played in the machine will appear on the heads and pinch roller. On the heads, it affects frequency response and distortion, among other things, while on the roller it can cause an increase in flutter. These deposits can also abrade any tape you use in the machine, so we're told. Then there's the unavoidable build up of dirt and grime transported into the machine through the air or via your cassettes.

So, you can see the necessity for keeping the tape path in your cassette deck clean, even in your Walkman or ghetto blaster!

As in conservative politics, there are two schools of thought when it comes to cassette deck cleaners – the drys and the wets.

Wet cleaning systems employ a fluid to dissolve the contaminants which are then removed by a variety of ingenious means.

Trackmate's TM151 system for audio cassettes.



TDK's new HCL-11 head cleaner.

The simplest, and oldest, employs cleaning swabs – large, lengthy, single-ended "cotton buds" – and a cleaning fluid. In the days when reel-to-reel recorders were king and where the heads were large, generally well exposed and easily accessible, this sort of cleaning kit reigned supreme. Ethyl alcohol was used as the cleaning solution, or in a pinch, methyl alcohol. Both alcohol and freon solutions are used today.

Typical of this simple sort of cleaning kit is Arista's TA22. It consists of a set of swabs and two bottles of cleaning solution – one for the pinch roller and one for the heads. You dip the swab in the solution and scrub the head and other parts as required.

Pinch rollers, I learned, do not take kindly to a rubbing with alcohol, even though you might. Hence the two fluids. It is not stated what they are, but both are flammable. The TA22 kit costs just $4.45.

The Dutch-based electronics giant, Philips, markets a tape cleaning kit, the SBA243, released earlier this year. It features a chamois and cotton swabs, plus a cleaning solution and small dentist's mirror so you can peer inside the deck's depths. Cost? – $7.95 rrp.

However – and I say that with some emphasis because this is the part where I reveal the fly in the ointment or the sand in the KY jelly, so to speak – many cassette decks are constructed in such a way that their heads and pinch rollers are all but impossible to get at.

"Trying to clean such decks with a cotton swab is asking for trouble," Lawrence Rodny of Allsop Fidelity Accessories in Sydney told me. "You can so easily bend the pinch roller," he explained, "and that's just for a start."

Car cassette players are the best example. Just try even looking in there and you'll see what I mean, or rather, not see it! Torch and dentist's mirror notwithstanding.

It was this very problem that gave rise to the very first Allsop 3 cleaning cassette for audio cassette decks over a decade ago. That device was very ingenious and its arrival in Australia was first reported in *ETI*'s News Digest pages in the April 1979 issue. Housed in a cassette shell, it employed a lever which wiped a felt pad back and forth across the head, driven by a cam in turn driven from the take-up sprocket; the deck being set to play. Another, stationary, felt pad wiped the pinch roller. Unique, effective and covered by a swag of patents.

Revolutionary as it was, this first Allsop cleaner could only be placed in the deck one way and failed to work in auto-reverse decks but the design was pretty soon upgraded to make it virtually universal and foolproof.

The current Allsop 3 Cleaning Cassette is claimed to be the only product in its

The Discwasher System II dual action tape deck cleaning system.

AN unusual approach to record cleaning is that adopted by the British-made Hunt EDA range of products, distributed in Australia by Audio 2000. Hunt's P2 record cleaner is claimed to remove a mysterious substance called mould release agent from the record's groove. This stuff is used during the record's manufacture to facilitate the disc's removal from the press and, according to EDA's Keith Hunt, it causes a number of audible problems. The P2 kit of liquid and brush clears the record of MRA and thus improves reproduction.

The EDA range also includes the Mk 6 record brush and, for CDs, the P3 kit. The Mk 6 has carbon fibre bristles around the cleaning pad, which is rested on the record's surface for an initial scrub of the groove. A second pass is made during which the exertion of a little pressure pushes the pad onto the disc, picking up dust. Simple and effective. P3 comprises a fluid application brush and the fluid, adapted for use on CDs. Full details from Audio 2000 on (02) 819 6533, fax (02) 819 6312.

category. It is designed to clean the tape head, capstan shaft and pinch roller – the entire tape path contact points.

Like the earlier model, the latest Allsop 3 employs a lever driven by a cam, but this time the cam is driven by gears from either sprocket hole so that it does not matter which way up you insert the cleaner. The mechanism is clear from Figure 1. Likewise, two pad sets are included for the capstan/pinch roller, again so that it does not matter which way up you insert the cleaner. And it works with auto-reverse decks, which are legion these days. It can be bought for around $20-odd.

A solvent solution is supplied in a small bottle with the cleaner, which Allsop claims to be 100 per cent compatible with all materials. All pads are replaceable; spares are supplied and replacement pad kits are available. It is manufactured in the USA. Perhaps a measure of its acceptance and success can be gleaned from the fact that it is supplied with every new BMW, Saab Turbo and Jaguar sold in America, along with some models of Peugot, Lincoln/Mercury and Mercedes.

A number of manufacturers were quick to follow in Allsop's footsteps. The Trackmate Automatic Cleaning System, TM151, for audio cassettes distributed by Amaray, has a set of epicyclic gears, driven by the take-up sprocket. This drives a pivoted brush which sweeps back and forth across the tape head. Other adjacent brushes press on the capstan/pinch roller. A cleaning solution (formulation unknown, as with the Allsop), supplied with the unit, is applied to the brushes before use. The brushes are replaceable. The Trackmate has a recommended retail price of $21.95.

Arista has no less than three wet-type cassette cleaners. They're housed in cassette shells and all employ pads which press on the heads and capstan/pinch roller. The TA11 Automatic Cassette Cleaner costs $3.45 and requires insertion the right way up. The TA88 Wellclean Cassette Cleaner employs a tape and a felt pad, the tape being drawn past the head. This one costs $3.95 and comes with spare pads. This also requires insertion the right way up.

Arista's TA77 Automatic Cassette Head Cleaner employs a gear-driven escapement lever, powered from the take-up sprocket, the lever being spring-loaded by a rubber band contrivance that pulls the lever back once the gear escapement has wiped its pad across the head. It includes a pad for the capstan and pinch roller. It must be inserted the right way up. Replacement pads are included and it costs $7.95. All three products come with a small bottle of cleaning fluid.

Philips introduced a cleaning cassette for heads and capstan/pinch roller earlier this year, the model SBA247. It is available at $4.95 rrp.

The dry-type tape cleaners have a short length of either a plastic or fibre tape inside a cassette shell; it may be driven between the two spools, or a continuous loop, powered by the take-up sprocket. Some types are abrasive, generally the plastic tape type, while other types employ a claimedly non-abrasive fibre tape.

A swag of non-abrasive dry type cleaners

Trackmate's CD cleaning system.

are marketed by various firms, all of them generally called cassette head cleaners. Arista's TA55 is a dry cleaner, priced at $1.95. Philips has a dry cleaner, the 811CCT, priced at $2.95. Akai also has a dry type head cleaner, the CK-7, which sells for $4.95. There are others, but these products give you some idea of the range available.

Keep it clean!

The Allsop 3 CD cleaner.

Meanwhile, Discwasher has a foot in both dry and wet camps. The Discwasher System II employs a continuous fibre belt that is driven past the heads, while a pad and cleaning solution tackle the capstan and pinch roller. Discwasher claim the matrix of the fibre belt carries away oxide and other residues from the head without abrasion. The cleaning solution used for the capstan/pinch roller is said to clean it safely, without any adverse effect on the rubber roller.

But what about microcassettes? Your mini-recorder or verbal note-taker has all the same accoutrements as its bigger brother, but in miniature. And it still suffers from the same problem of oxide and other residue build up on the head and other parts. Allsop supply the only microcassette cleaner we could track down, and it features the same action as its bigger brother.

There is some debate about the advantages, disadvantages and applications of wet and dry, abrasive and non-abrasive tape cleaners. But it all seems to come down to this: the non-abrasive wet or dry types are best used on a regular basis as a preventive, while the abrasive types are advised where there has been little or no maintenance for some time and/or there may be substantial build-up of oxide and residue. Regular maintenance cleaning should be done every 20-30 hours of use for best effect.

And what about the new digital audio tape format, DAT? It uses a transport and record/replay technology akin to video cassette recorders, with a head spinning diagonally across the tape in a helical scan, while the tape is drawn slowly past it (that is, the R-DAT format). DAT heads need cleaning, too. On-the-ball TDK has already released a dry type R-DAT head cleaner, type RCL-11. No price details were available.

In case you're wondering, I haven't covered demagnetisers and head alignment tapes because, really, they each require an article on their own as they are more in the way of technical maintenance products. I did note, however, that some distributors have a combined demagnetiser and cleaner cassette.

Compact discs

Now what could possibly go wrong with compact discs and their players? The pickup is a beam of laser light, the recorded information is in the form of minute pits in a silvered layer sandwiched within the plastic platter. There's no physical contact, the CDs are taken from a protective jewel case and played inside the player, out of harm's way. However, handling will leave skin oils on the disc surface, and life isn't perfect, so discs do get left out of the cases on occasion, leaving them vulnerable to dust attraction and coffee, wine or other beverage spillages.

The player's laser has to read through any surface contamination. Where sections of pits in the spiral track are so obscured, the player's electronics can fill in. But where this may be substantial, drop outs occur which can be heard as little clicks behind the music. At worst, the laser pickup will mistrack and a definite interruption occurs. Different players react differently, depending on the technology employed.

The solution? Keep the non-label side of the disc clean. And it must be cleaned without scratching; another reason for not leaving your CDs lying around out of their cases is to avoid the possibility of scratching. They aren't indestructible. Unlike vinyl LPs, radial scratches are readily tolerated, but circumferential scratches can have a devastating effect, perhaps rendering a CD unplayable.

For this reason, all CD manufacturers recommend the discs be wiped clean radially, from the centre hole outwards. This

DICK Smith Electronics' latest catalogue contains a range of hi-fi care accessories. For clean video heads there's Philip's VHS head cleaning tape and, for Betamax owners, a similar Beta head cleaner tape.

For cassette players, there's a capstan-servicing and head-cleaning tape plus fluid. Prolonged cassette player use means the development of potentially harmful magnetic patterns; to remove these from the cassette head DSE has an electronic demagnetiser tape. It has a special power-saving circuit built in to a standard cassette case.

Akai's CK-512 combined cassette deck and CD liquid cleaner.

The Sony range of audio care equipment.

can be done with a soft, lint-free cloth perhaps used in conjunction with a cleaning solution of some sort. Musicway has a pad and cleaning solution which is applied to the pad. It relies on you rubbing the pad across the disc radially.

A number of manufacturers make mechanical contrivances that ensure the CD is wiped clean with a radial motion. Allsop, Arista, Discwasher and Trackmate all have CD cleaners of this type.

The Allsop 3 Compact Disc Cleaner (model 5000) looks rather reminiscent of an oyster. You open the oyster and place the CD, label side down, on a platter which has a toothed rim. This engages with a small pin gear near the oyster's hinge. In the oyster's lid is another, smaller, platter which holds an annular cleaning pad, and this platter has a toothed rim that engages the pin gear when you close the oyster. Rotate the handle and the annular pad rotates radially across the CD's surface while the CD is rotated beneath it. Cunningly simple and heavily patented.

Trackmate's CD cleaner.

A cleaning solution is applied to the cleaning pad, which is replaceable. Three spares are supplied. The material used looks and feels the same as the cleaning pad on the Orbitrac LP cleaner. So you may notice that the pad crosses the disc near the centre hole, running circumferentially more or less for a little way. But that's in the unused area, so it doesn't matter.

Trackmate's TM351 CD cleaner is used with the disc sitting in its jewel case, label side down. It has an annular cleaning brush rather than a pad, a central pivot and an internal system of gears that rotate the brush while you swing it around the surface of the disc. A cleaning fluid comes with it, said to be the same as camera lens-cleaning fluid. A small grooming brush is supplied, for cleaning off the brush, along with a spare brush. Cost? $39.95 rrp.

The Discwasher CD Cleaner is not unlike the Allsop in action. It is housed in a small see-through case which has a platter in the bottom that holds the CD. This has a toothed rim that meshes with the lower gear of a dual gear. The upper gear meshes with the toothed rim of a smaller platter in the case's lid. A dial on top of the lid drives the upper platter which has the cleaning pad on it. Again, you apply a cleaning solution to this pad; it's supplied in a small pump bottle with the unit. A small brush is included for grooming the cleaning pad. Arena distributors have it priced at $39.95 rrp.

Arista's CD2 Compact Disc Cleaner is housed in a case rather like a CD jewel case. You open it up, place the disc in a circular well label side down and put a small, plastic disc – which has a cleaning pad on its lower face – over it. This has a toothed rim that engages with the edge of the disc well, and then you roll it around the disc. A small spray bottle of cleaning fluid is supplied, along with a small brush to groom the cleaning pad, and a cloth is provided for handling the cleaned discs. It's priced at $19.95.

Akai distributes a combined cleaning kit for cassette decks and compact discs, the CK-512. It incorporates separate fluids for disc cleaning, and tape head and roller rubber cleaning. Akai has priced it at $21.95.

VCR cleaners

Of all the care accessories available for consumer electronics entertainment equipment, video care products generate the most controversy. But I'll get into that shortly. As with audio cassette tape decks, video cassette recorders suffer from the accumulation of tape oxide and other residues on heads and other components along the tape path. Here too, there are two schools – the wets and the drys, with abrasive and non-abrasive factions.

There are many players in this field, and products to suit the various formats: VHS and VHS-C (compact VHS), Beta and Video8 (8 mm format). All the cleaners available employ a tape of some sort that is driven through the machine's tape path; some include pads to scrub the capstan and pinch roller. The tape may be a non-abrasive cloth or fibre matrix, wet with a cleaning solution in some makes or used dry in others. Or the tape may be a plastic substrate coated with an abrasive material. They are all housed in a video cassette housing to suit the applicable format.

Some VCR manufacturers strongly recommend that you DON'T USE ANY cleaner. Instead, they advise you to put your

Keep it clean!

VCR in for a good clean once a year. Undoubtedly, a professional technician skilled and experienced in VCR service can do a better job than you could, and better than the VCR cleaner products on the market. But, as with most things, prevention is better than cure, and judicious, regular use of a suitable VCR cleaner will avoid trouble.

However, users are cautioned that abrasive tape cleaners may cause, or more properly, accelerate, head wear if used frequently or excessively. Head replacement may set you back $200-$300. And you don't need to do that any earlier than would otherwise be necessary!

The heads in a Beta system are apparently somewhat more susceptible to premature wear or damage than VHS system heads, because the Beta system always maintains the tape in contact with the heads. However, all wear and oxide buildup is dependent on the quality and grade of tape used. Lower-cost, lower quality tapes are more susceptible to leaving oxide behind than premium quality or HQ tapes.

As with audio cassette heads, video heads are designed so that they wear in and a certain amount of wear is expected throughout the life of the heads. Heads for the new Super VHS format VCRs and cameras are much harder than the older,

CRESTMORE is the agent for the American-made Stanton range of products. The Stanton SC4 stylus cleaning kit adds life to styli and combines a specially formulated cleaning fluid to dissolve contamination and a brush, with 'controlled penetration' bristles.

The RC5 Plus brush has high pile velvet plus cleaning fluid to remove dust, debris and reduce static charges at the same time. If you prefer the dry approach, the ARC5 carbon fibre brush gives a quick, safe and effective dry scrub, eliminating static buildup.

standard VHS heads, but the S-VHS tape formula is also somewhat more abrasive. All video tape formulations comprise a mix of magnetic material, binder and lubricant (eg: BASF adds Teflon as a lubricant). A new tape is more abrasive than a tape that has been played, even if it has only been run through the machine once!

Back in the May 1983 issue of ETI, I organised for Louis Challis to review a range of then available VCR cleaners. There were wet and dry types, abrasive and non-abrasive. Louis' conclusions then would most probably also apply today: the wet and mildly abrasive cleaners are most effective on light oxide deposits and are the safest to use on a regular basis. The abrasive cleaners, by way of contrast, are effective in removing deposits from really dirty or caked heads and "... should only be used when the dropouts become severe or on the occasion the other cleaners are ineffective."

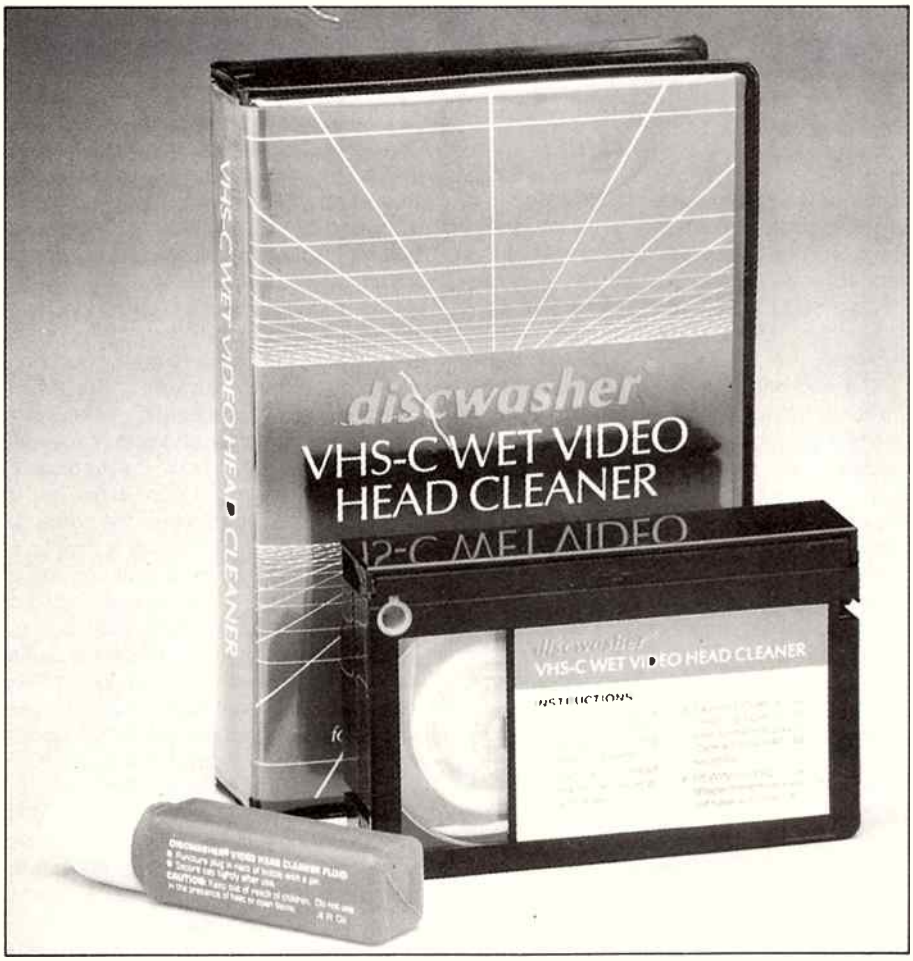
Rental tapes are widely blamed for leaving oxide deposits on your VCR's heads. So if you play a lot of rental tapes, a non-abrasive cleaner used regularly is recommended. A dirty tape path will damage the edges of a videotape and on VHS this affects the audio track that runs along one edge. The damage shows up as flutter, dropouts and distortion. Time to clean! If this does happen, it may require a trip to your VCR serviceman for a thorough going over.

Consistent use of the pause and still frame features keeps the head in contact with the tape for long periods, indicating the necessity for more frequent cleaning.

By far the dominant supplier in the field of VCR cleaners is Allsop, with eight models, all of the non-abrasive, wet type. They have three for VHS, two for Beta and one each for Video8, VHS-C and U-matic formats.

The top-of-the-line Allsop Video Recorder Cleaner, model #60300, employs a special ribbed, or ridged, cloth tape and felt pressure pads that bear on the capstan and pinch roller. The tape and pads are replaceable. A bottle of cleaning solution (formulation unknown) is supplied. You apply the cleaning solution to the tape through holes in the cassette housing and also directly to the felt pads.

You insert the cleaner into the VCR as you would a video tape and operate the machine in play mode for 15 seconds. The ribs or ridges across the width of the tape sweep up the debris and deposit it in the valleys between, carrying it away. Allsop says it provides 20 cleaning cycles at which time the tape and pads are replaced. Refill kits are available. There's only one initial cost and a much lower cost for repeated refills.



Discwasher's VHS-C video head cleaner.

Trackmate's VHS cleaning system.

Arista has three VCR cleaners, the VH310 for VHS and BT300 for Beta machines. They are wet/dry/wet types, said to clean heads and capstan/pinch roller. Cleaning fluid is supplied. They also have the VHC8 for 8 mm video machines. The VH310 and BT300 cost $11.95, and the VHC8 costs $15.95; you buy a new one when the tape runs out, but replacement cleaning fluid is available.

Discwasher offers both wet and dry types for VHS; clearly, they're each-way punters! Each drives a tape through the machine. The dry type is good for 50 uses and is priced at $39.95 rrp, the wet type at $24.95 rrp, good for 100 cleaning cycles (cleaning fluid supplied). They offer a dry type for Beta machines, too, for $39.95 rrp.

Trackmate's TM261 VHS cleaner uses a tape and features pressure pads to the capstan and pinch roller. It comes with cleaning fluid which is applied to the tape and pads. It sells for $36.95 rrp. Trackmate claims it sweeps outside the tape path as well, cleaning oxide and dirt thrown to the side that may possibly get onto the tape drive parts and the heads.

TDK, like Discwasher, offers both wet and dry cleaners. Their TCL-11 is a dry type for VHS and Super VHS systems and sells for $15. TDK claims that it not only cleans the heads but "regulates" the head's surface. Their TCW-11 is a wet type. It retails for $49.95 and features a system for applying a specific amount of cleaning fluid. Musicway has wet and dry type cleaners, too.

Hagemeyer, the JVC distributor, markets two abrasive cleaner, one for VHS and one for Beta, the TCL-2 and TCC-2 respectively. The former provides 200 cleans of 15 seconds, the latter provides 100 cleans. Sony has abrasive type cleaners for Beta and Video8, but don't promote them. They recommend they only be used when a problem arises, not on a regular basis.

Philips distributes two wet type VCR cleaners. The SBC470 is for Beta machines, while the SBC461 is for VHS. Both are priced at $19.95 rrp.

STOP, THIEF!

Don't touch that dial

Les Cardilini looks at the new Eurovox MCC 6860E car sound system, incorporating the latest in PIN-type security.

Eurovox MCC 6860E car sound system.

As sure as you go out and buy a decent car radio or sound system these days there will be someone willing to steal it from you, given half a chance.

But perhaps the thief should not have to bear all of the blame. After all, if there was no ready market for stolen goods there would be no point in the thief's stealing the car radio in the first place. And who knows, the next radio offered for sale on the cheap could be yours!

One way around the problem, of course, is for potential customers to refrain from buying car radios which, as the euphemism goes, have just fallen off the back of a truck.

But a more practical way to circumvent the temptation altogether (from both sides) is to render stolen car radios virtually unsaleable. It is to this end that several sets now utilise a security coding principle similar to the personal identification number (PIN) system that is used by banks. The number system, hopefully, helps prevent car radios from being stolen or, perhaps more correctly, lessens their chances of being resold if they are taken illegally.

For those not yet familiar with the typical security code system a four digit number must be entered using the front panel push-buttons when the radio is first installed in a vehicle. Unless the correct security code is keyed in, the set will not function. Once the correct security code has been entered, and recognised by the internal electronics, the set is then "enabled" and can be operated normally.

The security code does not have to be used on a day-to-day basis to switch the set on and off but whenever the security code-protected car radio is disconnected from the battery the code registered in the set's volatile memory "evaporates". The radio will then not work normally, until it is re-connected to the battery, and the correct security code again keyed at the front panel.

Basically, the thief, or anyone else for that matter, has about as much chance of getting the stolen radio working again as he or she has of cracking the PIN on your bank transaction or credit card.

And, in the same way that automatic teller machines confiscate account cards after a succession of wrong PINs have been entered, some radios will become disabled semi-permanently after several incorrect codes have been entered. This thwarts the possibility of keying sequentially from OOOO and working through to 9999, for example, in an attempt to find the code by a patient process of elimination.

Once a set of this type is disabled by multiple incorrect code entries normal operation can only be restored with the help of the manufacturer or distributor (who ordinarily would require proof of ownership of the delinquent set before he would hand over a duplicate of the vital code). Initially, the bona fide owner is given the all important number on a card which should be kept in a safe place away from the vehicle. Of course, the code might also be needed on occasions other than when the radio has been pilfered, such as when it has to be serviced or re-fitted to a new vehicle, or when the battery in the vehicle has to be routinely replaced or disconnected.

Electronic security coding makes acquiring a stolen car radio an increasingly worthless or risky venture and it seems both surprising and a pity that a similar protection against theft is not widely incorporated into VCRs.

Anti-theft security coding is featured in the Eurovox Model MCC 686OE stereo AM-FM car radio along with other sets in the Eurovox range. In fact, Eurovox United Pty Ltd, an Australian company, was among the first here to include the security code feature in its car sound products. (Just out of interest, the name Eurovox is Australian in flavour,

despite its continental twang. Euro is from the biological name of a species of kangaroo while vox is commonly known to denote "voice", hence, Eurovox, "voice of the kangaroo".)

Two likely problems with car radio reception in this country, compared with driving in, say, Europe or Japan, are the greater distances between radio stations, and the typical level of road and vehicle noise which tend to drown out the sound from the system at high driving speeds. Car radios need to be more sensitive to counteract the effect of weaker radio signals. If the radio is not sensitive enough the stations sound hissy and are more affected by interference before the vehicle has travelled very far. An efficient and properly adjusted car radio aerial, is also needed to take advantage of improved sensitivity. City commuters might not encounter this problem until they drive to the country or interstate.

According to Eurovox engineer Klaus Schuhen, the company's car sound products are designed specially for Australian motoring conditions.

Quieting sensitivity on the AM band of the MCC 686OE and the next model down the Eurovox range, the MCC 683OE, is claimed to be a respectable 22.4 microvolts for 20 dB signal-to-noise ratio on the AM band and 1.8 microvolts for 26 dB signal-to-noise ratio on the FM band. The lower the microvolts figure for the same dB signal-to-noise ratio the better the sensitivity. As a rule, sensitivity tends to appear better – that is, fewer microvolts – on the FM band than on AM.

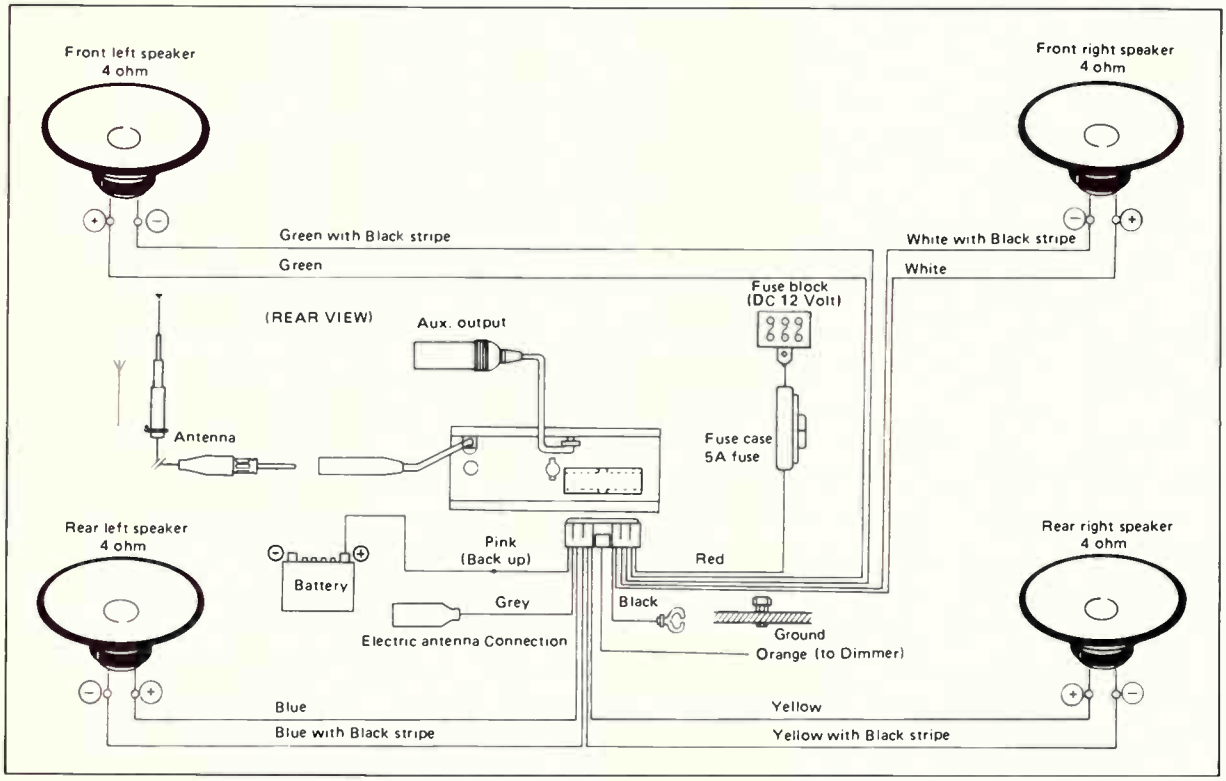
Higher power, 15 watts in each of four channels, or a total of 60 watts in the Eurovox MCC 686OE, is available to combat road noise and to allow the system to be operated at volume levels where distortion might be a problem in sets having less power output. A master volume control adjusts the overall volume from the four channels while a single joystick control adjusts the stereo balance between the left, right, front and rear speakers.

Additional external power amplifiers, if required, can be connected to the MCC 686OE via an auxiliary socket which is a standard fitting on this model. A portable compact disc player can also be plugged into the CD input socket mounted conveniently in the front panel – no fiddling under the dash to find the wires.

The MCC 686OE can pick up mono or stereo stations on both AM and FM bands and has automatic optimum reception control for optimising sound quality while retaining some stereo separation in weak signal or poor reception areas. (As a general rule, stronger signals are needed to give noise-free stereo reception, compared with mono. This applies to both AM and FM stereo and the effect can be observed on the stereo FM band in most systems at home where the noisy weaker channels sound clearer with the set switched to mono than they do in stereo.)

Automatic optimum reception control in the MCC 686OE senses when the stereo signal is getting weaker, and then automatically adjusts to a blend of mono and stereo which retains a practical degree of channel separation consistent with a respectable signal-to-noise ratio having regard to the strength of the signal. This subtle compromising feature saves having to switch the set to mono to obtain clearer sound as the signals from stereo stations become weaker with distance.

A wide-narrow band switch is also provided to capture higher fidelity in AM stereo programs in good signal areas, on the one hand, and to minimise noise and



Electrical connections for the 6860E.

Eurovox MCC 6860E

The 6830E model.

interface where the AM radio signals are weaker, on the other. In the narrow position the signal, for example. In the wide position, used typically when stronger and relatively noise-free signals are present, the bandwidth expands to approximately 14kHz (plus and minus 7kHz) to take advantage of the wider frequency response of stereo AM radio.

Minimal attention from the driver is needed to select stations and operate other functions on the MCC 686OE. A total of 12 stations, six AM and six FM, can be pre-programmed into the six station pushbuttons on the front panel. The set can also be tuned manually and has an automatic search, or seek, mode in which it searches progressively up or down the band for another radio station. A local-distant facility affords the option of skipping over weak stations during the automatic tuning search, if preferred.

Not knowing what local stations are available in a new area and where to find them on the dial can be frustrating. But perhaps more important, from a safety point of view, it can also be distracting for drivers who have to operate the radio to find stations while driving at high speed or in heavy traffic. Anyone who has experienced this problem shoula appreciate the auto store feature on the MCC 686OE. The auto store memory can be used out on the road and in unfamiliar areas to find and select stations along the way, without the driver's having to find them individually and preset them manually to begin with.

In the auto store mode the set searches on command along the selected band and locates and stores in a separate station memory six radio stations it finds in the new area. These stations, up to six on each band, can then be selected by using the regular tuning pushbuttons without affecting the primary, "home" stations which are held in a separate memory. In fact, the set can be switched back to the primary memory on returning home and if you have no plans to travel, the auto store memory can also be used for local stations thus increasing the capocity of the set's tuning memory to 12 AM and 12 FM stations, 24 in all.

The stereo cassette player in the MCC 686OE also has a number of attractive features including auto-reverse, Dolby noise reduction, automatic program selection (APS) in both forward and reverse, and metal tape facility. A demonstration tape is included in the accessories pack. The APS function detects unrecorded lengths of tape (more than four seconds long) and then locates the beginning of the next program of the tape, in either the fast forward or fast rewind modes. Eurovox also points out that a feature of the cassette deck, not obvious on the outside, is the number of additional points at which the mechanism is pinned or supported to further minimise wow and flutter.

The familiar loudness control, perhaps one of hi-fi's most misused devices, is conspicuous by its absence from the front panel of the MCC 686OE. However, the set does have a built-in loudness contour circuit to enhance both bass and treble response at low volume levels, where loudness controls are supposed to work. Basically, a loudness control is used to boost the extreme bass and treble ranges to account for peculiarities of the human hearing process, mainly deficiencies in bass and treble response, at low volume levels. It is not intended to be simply another ten or 20 decibels of available bass boost. Ideally, the loudness control would have negligible effect on the sound quality at high volume levels anyway, which is mainly where car sound systems tend to operate because of relatively high levels of ambient noise. In fact, the absence of an otherwise superfluous switch, in this instance, further simplifies an already conservative and uncluttered front panel.

By simply pressing the volume control knob the digital display on the MCC 686OE can be prioritised to show the current station and status of the radio cassette system or, alternatively, as a clock to show the time of day. Illumination of the display can be controlled by the vehicle's dash light dimming system while optional green, orange or natural lighting may be chosen to match the car's instrumentation – as Eurovox points out, "it's up to you". The set will also switch an electric antenna.

Eurovox has included tips on care and maintenance, and easy to follow pictorial connection diagrams of different installation options for the MCC 686OE, in its 16-page handbook that comes with the set. Sales, installation and back-up service are provided through some 100 outlets and 200 service centres around Australia, and a list of Eurovox specialists, by suburb, town and state, including STD codes and telephone numbers is packed with the radio, together with a card outlining the Eurovox 12 month warranty.

The MCC 686OE Digitalic Auto Reverse Cassette Stereo Player, AM-Stereo FM-Stereo Radio installs in a standard DIN opening in the vehicle dash or console and has bigger and smaller brothers in Eurovox's current price range. Eurovox's Stereo-AM models automatically decode the Motorola C-Quam Stereo AM system used by Australian stereo AM stations.

Recommended retrail price for the MCC 686OE is $899 which does not include speakers and aerial. The lower-power MCC 683OE has 7 watts per channel, nominal, and sells for $719, rrp.. More information: Eurovox United Pty Ltd, 6 University Place, North Clayton, Victoria 3168, ☎ (03) 561 5244. **Eti**

SPECIFICATIONS — GENERAL — 6860E

Power supply voltage	**DC14V (11V — 16V allowable)**
Polarity	**Negative ground**
Output impedance	**4 ohm**
Max. current drain	**5A**
Tone control — Bass	**±10dB (125 Hz)**
Treble	**±10dB (10kHz)**
Digital Aux. input	**150mV**
Automatic Loundess contour	**Bass-boost + 10dB (125Hz)**
	Hi-boost + 6dB (6.3kHz)
Aux output	**4 channel (Max 200mV, 600 ohm)**
Output power (Max)	**15W per channel x 4 (Self-contained**
	40W per channel x 4 (MO -4200 Add-on power amp)
Dimensions (mm)-Case	**180(W)x53(H)x150(D)**
-Front face	**190(W)x60(H)x10(D)**
Weight	**1.4 kg net**

THE TECHNICS HI-FI CHALLENGE:

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READER INFO NO. 31

TECHNIC-ALLY SPEAKING . . .

Louis Challis reviews the Technics SB-AFP10 audio-flat-panel speaker system. Those who are lucky enough to own one, he concludes, will be delighted.

Every major television set manufacturer in the world has been striving to manufacture a set with a flat cathode-ray tube or liquid crystal display that performs the same task.

In an entirely analogous manner almost every Japanese loudspeaker manufacturer dreams of producing a loudspeaker which is extremely flat and has true high fidelity performance rivalling the best that large vertical speaker enclosures can provide.

If you have wondered why Technics and many other Japanese manufacturers are obsessed with flat speakers, then you have to understand that the average living room in a Japanese house or apartment is extremely small, and generally has a floor area of less than 10 square metres.

The average Japanese audiophile wants a pair of speakers that are as thin as possible, which can be placed as close as possible to the back wall to conserve the precious remaining floor space for 'plain, old-fashioned living'. Now although the SB-AFP10s don't quite fit that bill, it is nonetheless clear that the underlying design philosophy which motivated their development sought to produce just such a loudspeaker system.

No speaker manufacturer tries harder than Technics to achieve this goal and I suspect that none has invested quite as much money or time on the project as Technics.

One of its most notable previous efforts was its SBR100, which was definitely the 'state of the art' and is still one of the finest examples of its type for use in audiometric laboratory testing of human subjects.

Following my review of the SBR100, and subsequently the Technics SBR50, I was really delighted to be asked to review the SB-AFP10 – the smallest of the three 'super flat panel' speaker systems which have been developed by Technics – to satisfy what I can only really describe as a magnificent obsession.

To provide these unusual speakers, which look more like esoteric musical instruments than loudspeakers, the Technic's design engineers redefined acoustical enclosure theory and almost the very basis of conventional electrodymanic speaker construction as well.

Now, in the classical situation with a conventional speaker in a large sealed enclosure, the measured frequency response of the bass driver generally looks like the graph in Figure 1. As the cabinet volume is reduced the critical resonance

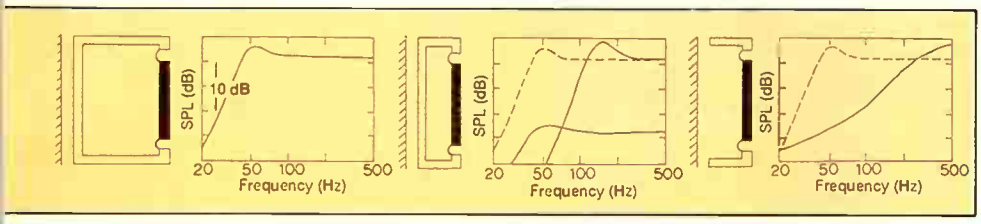


Figure 1. *Figure 2.* *Figure 3.*

frequency is raised to a higher point and the speaker's low frequency response drops off and generally becomes almost unusable, (see Figure 2). If the cabinet has a thin open-backed enclosure, of the type shown in Figure 3, then the low frequency response also drops off as a result of the interacting sound waves from the front and back of the speaker coinciding and cancelling each other at the open edges. As a consequence, neither a sealed enclosure, a vented enclosure nor an open-backed enclosure adopted as a unique concept can provide a flat frequency response. However, by combining the attributes of all three, and in an optimal configuration, the end result can produce a very desirable and much vaunted almost flat frequency response.

Now as the Technics loudspeaker design group or the company's management seemed to be obsessed with flat speakers, it was obvious that they would have to develop a true 'linear piston' speaker system. They wanted one which could provide maximum acoustical output with minimum distortion and minimum phase and/or inter-related harmonic distortion.

Their track record up to date has been excellent as both the SBR100 and the SBR50 speakers achieved excellent linear piston performance over a fairly broad frequency range and they are still amongst the most technically advanced consumer loudspeaker systems designed for apartments with only limited space for speaker placement.

During my visit to the Technics design laboratory, circa 1983, they showed me a number of technically advanced prototype speakers, most of which were directed at achieving true 'linear piston' performance. If the woofer's diaphragm could be made stiff enough, and if the diagphragm could be constructed with a very large face area so that it would behave as a true linear piston, then the acoustical output would increase while speaker displacement could be reduced. The resulting distortion products would then be reduced dramatically, especially when compared with those produced by a conventional 300mm (12 inch) or even 375mm (15 inch) diameter driver.

The designers' approach was really unusual as they developed a series of large flat panel speakers with rectangular diaphragms and with dimensions of 800 mm x 300 mm. Each of these has an effective radiation area equal to a circular loudspeaker with a diameter of 780mm. Behind each of these flat panels are four (4) separate drive coils and magnet assemblies which operate well below the fundamental resonance mode of the panel structure.

This concept has a number of attributes, as well as some obvious disadvantages. The foremost disadvantage is the dramatic increase in manufacturing costs; the second is the consequent increases in the amount of stiffness required in the supporting structure and the third, which flows from the second, is obviously a dramatic increase in the weight of the structure. Yes, these speakers really are heavy, as I found when we had to move them about during the testing.

The design of the panel structure caused the design team some real headaches as they had to develop and perfect some new and relatively complex cellular structure for the flat panel woofer diaphragms. The system that they finally selected as being the best uses multi-layers of sandwiched mica-foam, mica sheet and external paper-pulp strengthened by a material called Chitin which is principally a 'muco-polysaccharide'.

That term probably means even less to you than it did to me. Well Chitin is the fundamental substance found in crustacean shells and has characteristics which are basically very similar to cellulose. The Chitin binder in the paper-pulp forms chemical bonds with the cellulose molecules during the manufacturing process when the speaker diaphragm material is being manufactured. The designers' preference for this material stems from their findings that the Chitinised paper pulp has 20% more rigidity than conventional speaker diaphragm's material and exhibits three times the internal loss characteristics, which ensures that spurious resonance effects are rapidly attenuated and damped out.

This fancy material is applied to both sides of the flat panel cellular structure to achieve a very stable, strong vibration resistance, which is superior to aluminium honey comb, titanium honey comb and other space age materials currently adopted by other speaker manufacturers for this purpose. The unique feature of these speakers is their extremely large radiating surface area.

If you were listening to these speakers in a small living room you would find yourself generally within the 'near field' of the main drivers. The sound field then becomes planar rather than being hemispherical. You are then enveloped by the sound rather than perceiving it as coming from a point source. This is, of course, only true for a small living room. In a large room (as I discovered) the speakers' radiation characteristics are once more like a conventional loudspeaker.

The front of each of the large woofer panel elements is finished in a brilliant Japanese indigo lacquer which is similar to the high quality lacquered plates and Japanese

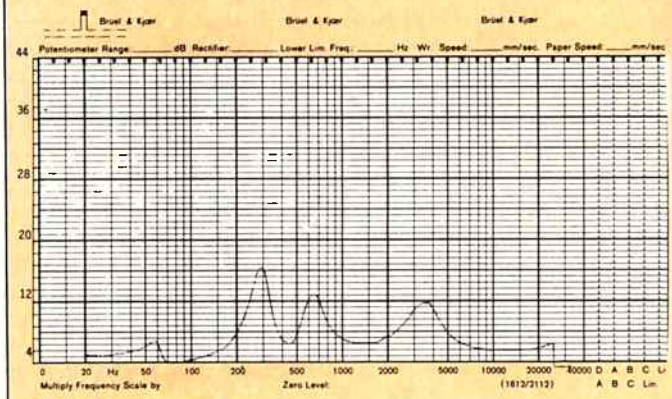
TECHNICS SB-AFP10 AUDIO-FLAT-PANEL SPEAKER SYSTEM

Measured performance of: Technics SBAFP10
Frequency response: 40Hz to above 20kHz
Crossover frequencies: 500Hz-3.5kHz
Sensitivity:
(for 96dB average at 1m) 8.6 V r.m.s. = 9.2 Watts (nominal into 8 Ohms)

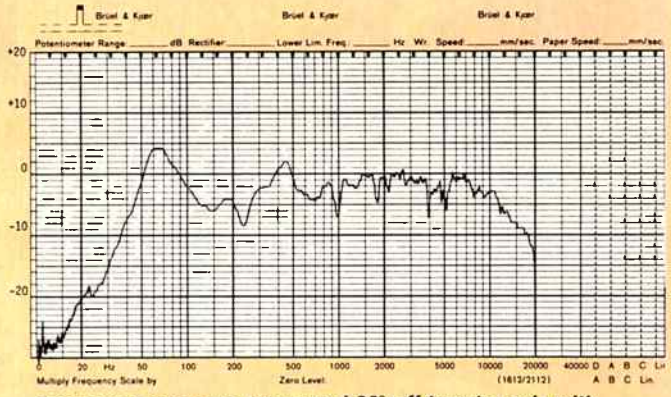
Harmonic distortion:		**100Hz**	**1kHz**	**6.3kHz**	
(for 96dB at 1m)	**2nd**	**-41.6**	**-51.3**	**-50.9**	**dB**
	3rd	**-53.8**	**-62.3**	**-56.5**	**dB**
	4th	**—**	**-71.9**	**-61.4**	**dB**
	5th	**—**	**—**	**—**	**dB**
	THD	**0.86**	**0.28**	**0.33**	**%**

Input impedance one test:	**100Hz/7kHz 4:1**	
100Hz	**4.3**	**ohms**
1kHz	**7.0**	**ohms**
6.3kHz	**6.4**	**ohms**
Min at 75 Hz	**4.0**	**ohms**

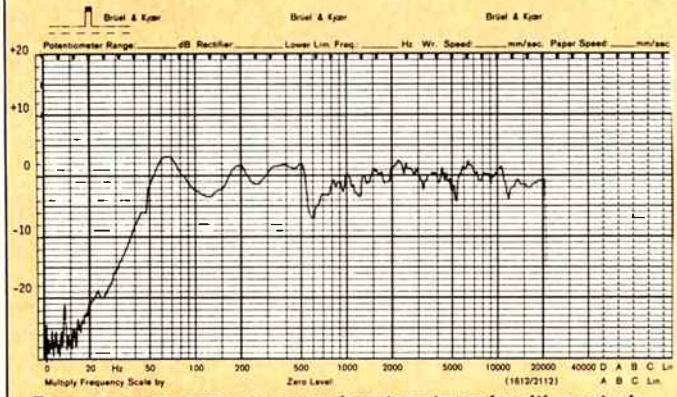
Date: 2 April 1989



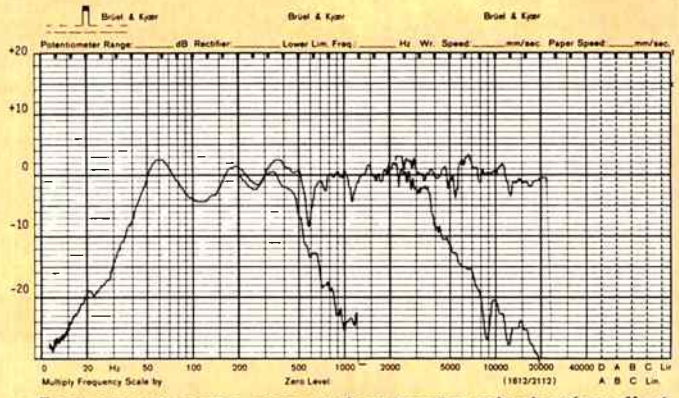
Input impedance.



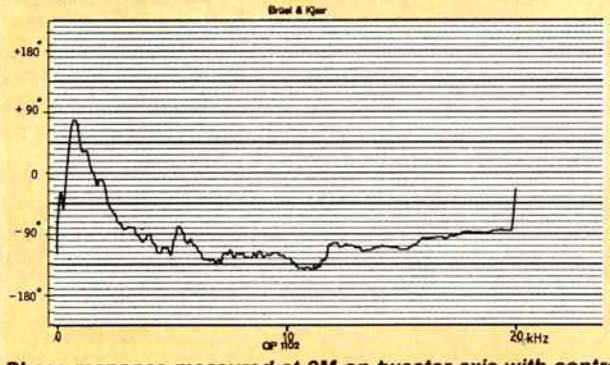
Frequency response measured 30° off tweeter axis with control at mid position.



Frequency response measured on tweeter axis with controls at mid position.



Frequency response measured on tweeter axis showing effect of mid and treble controls at max 4.



Phase response measured at 2M on tweeter axis with controls set at normal.

lacquer which is sought after by tourists in Japan. This lacquered surface has an almost 'diamond hardness' and provides added rigidity and, more significantly, appropriate moisture resistance against the inclement heat and moisture in which these speakers are likely to find themselves. Each speaker has two large woofers placed on either side of a similar but much smaller rectangular 'mid-low' driver with a 'mid-high' 8cm diameter driver above it and a 2.7cm flat diaphragm tweeter at the top of the array.

The face of each speaker combination is then covered by a rigidly framed panel with a fine black cloth cover. This provides protection for the system and also softens the otherwise stark appearance of these bright, blue, flat panels which sit in a brilliant, gloss black, lacquered surface.

With a weight of 74kgs the task of moving one of these SB-AFP10s into the anechoic room to measure its electro-acoustic characteristics proved to be difficult. Whilst sheer hard work won the day, it soon became apparent that to mount the speaker on top of our turntable to measure its polar plot would be pressing our luck too far.

In the end I decided to skip this test and satisfied the need by measuring the frequency response on-axis and off-axis with the speaker mounted in one fixed location on top of the mesh flooring in our anechoic room.

The measured frequency response on-axis proved to be quite outstanding, with a basic performance that is better than ±6dB all the way from 50Hz through to 20kHz. The response between 500Hz to 20kHz is absolutely outstanding.

As I noted, there is a small measure of interaction between the two woofer drivers and the section of the response from 50Hz to 500Hz exhibits three gentle peaks at 65Hz, 200Hz and a final shallow peak extending from approximately 300Hz to 500Hz. The level of these peaks are approximately 6dB above the nulls or troughs in the response and are neither audible nor unacceptable in terms of what would be specified as a design parameter. The small step in the response at 600 Hz is also quite acceptable. However, when the mid range control on the back of the speaker is rotated to its maximum attenuation position the amount of attenuation that it provides proved to be a trifle more effective than I

would have expected, as virtually all frequency components above 500Hz were cut off with an attenuation rate of approximately 20dB per octave. Similarly, when the treble control was rotated to its fully attenuated position the frequency components above 4kHz were also severely attenuated. With these controls set to the neutral position the frequency response at 30° to the main access only exhibited a modest loss of output beyond the 10kHz point. The resulting attenuation at 20Hz was still only just over 10dB down c.f. of the rest of the response.

It was also interesting to note that by moving the microphone off-axis in that way, I could measure the effects of interaction between the two main low frequency driver elements. This resulted in a boost of signal at 65Hz relative to the notches at 150 and 250Hz. A listening position 30° off-axis with one of these speakers is really 'off-axis'. Most purchasers of these speakers would have no difficulty in placing themselves within the main ± 30° angle that most living rooms would impose.

The phase response of the SB-AFP10s is exceptionally flat all the way from 600Hz through to 20kHz. This uniformity of phase response is the direct result of all the drivers being truly planar, as well as being the result of using flat diaphragms. The impedance curve had also been well controlled so that it is typically 4 ohms over most of the low frequency end of the range. There are only three relative shallow peaks in the impedance curve with a peak of 16 ohms at 300Hz, a somewhat lower peak of just under 11 ohms at 650Hz and a gentle peak of 10 ohms at 3kHz. These speakers are thus able to extract 'real power' from the driving amplifier.

The greatest attribute and real piece de resistance of these speakers is their distortion characteristics. I have not previously seen any speaker system with such low distortion. The distortion products at 96dB at 1 metre were existing with only 0.86% at 100Hz. The distortion at 1kHz and 6.3kHz were also extremely low at 0.28% and 0.33%.

The SB-AFP10's decay response spectra is extremely smooth and it exhibits only one significant resonance at approximately 3.5kHz. The remainder of the response characteristics are almost optimally flat and the supporting panel structure generates minimal vibration and exhibits minimal resonance characteristics in the criticalradiation region which typically occurs about 300 to 500 micro-seconds after onset of the excitation pulse. The decay response curves confirm fairly conclusively that the Technics design engineers have achieved most of their initial design aims and that the speakers are literally at the top of the class in all technical departments (apart from weight).

On completing my objective tests and having convinced myself that these were no ordinary speakers. I managed to get them disassembled and re-assembled in my home. That task as it transpired, was also far from simple, as unlike the majority of other speakers which will fit in the boot of my car, these speakers required professional movers.

Once set up at home, I was amply rewarded for all the trouble I, and my willing helpers, had gone to. Without question the SB-AFP10s are one of the outstanding speaker systems in the world. I had already listened to the SB-AFP1000's in Osaka and had been mesmerised by their superb and faithfuly sound reproduction which, because of their size, each with face areas of more than 2 metres x 2 metres made it easy for one to be seated in their 'near field' even in a relatively large listening room. In order to assess the SP-AFP10s, however, I elected to listen to them in two different locations, and place the emphasis on assessing them in my family room which is somewhat smaller than my living room.

Right from the outset I was impressed by the lack of colouration which these speakers exhibit. I found their ability to generate high level signals without perceptible distortion a new and most uncommon characteristic that few other loudspeakers share.

Although I listened to a lot of tried and true music, the most outstanding discs that I used for my evaluation were some relatively new ones, a number of which are of Australian origin. The first and foremost of these was "Building Bridges – Australia has a Black History" (CBS463261 2) which is one of the most outstanding Australian CD discs yet. Although I am not an avid fan of rock, and particularly hard rock , the musical content on this disc is just so impressive, that I feel I need to do a little hard selling, if only to convince you of the need to listen to it if and when you get the chance. Virtually every single track on the disc is outstanding, and a few are exceptional, because they are all Australian, with a star studded line-up of musicians and music that relates to the Australian Aborigines and our racial disharmony. Obviously, one of the outstanding pieces is track 11 with INXS and the "Original Sin", which initially earned them some mighty strong demerit points in America where the racial connotations of that particular number were not well received.

Once again the sheer quality of the music and its almost effervescent delivery turned what would otherwise have been a racial hangover into an oustanding success. The same is most probably true of most of the other numbers on this disc including Spy v. Spy's "Injustice" and even Midnight Oil's "Warakurna". It's not often that I can say that I was really moved by rock and modern music, but on this occasion the combination of the ultri-fidelity of the flat panel speakers and this most outstanding music created a truly rare effect.

I moved on to "Bagdad Cafe" (Festival D 30054) which is the original motion picture sound track of a really funky film which is dragging in more money and more viewers than most other films on the circuits at the moment. The first track "Calling You" with Jevetta Steele is both the theme song of the film and one of the most innovative and exciting classical pieces of modern blues music which you can hear, and my family and visitors were subjected to multiple repeats of this number.

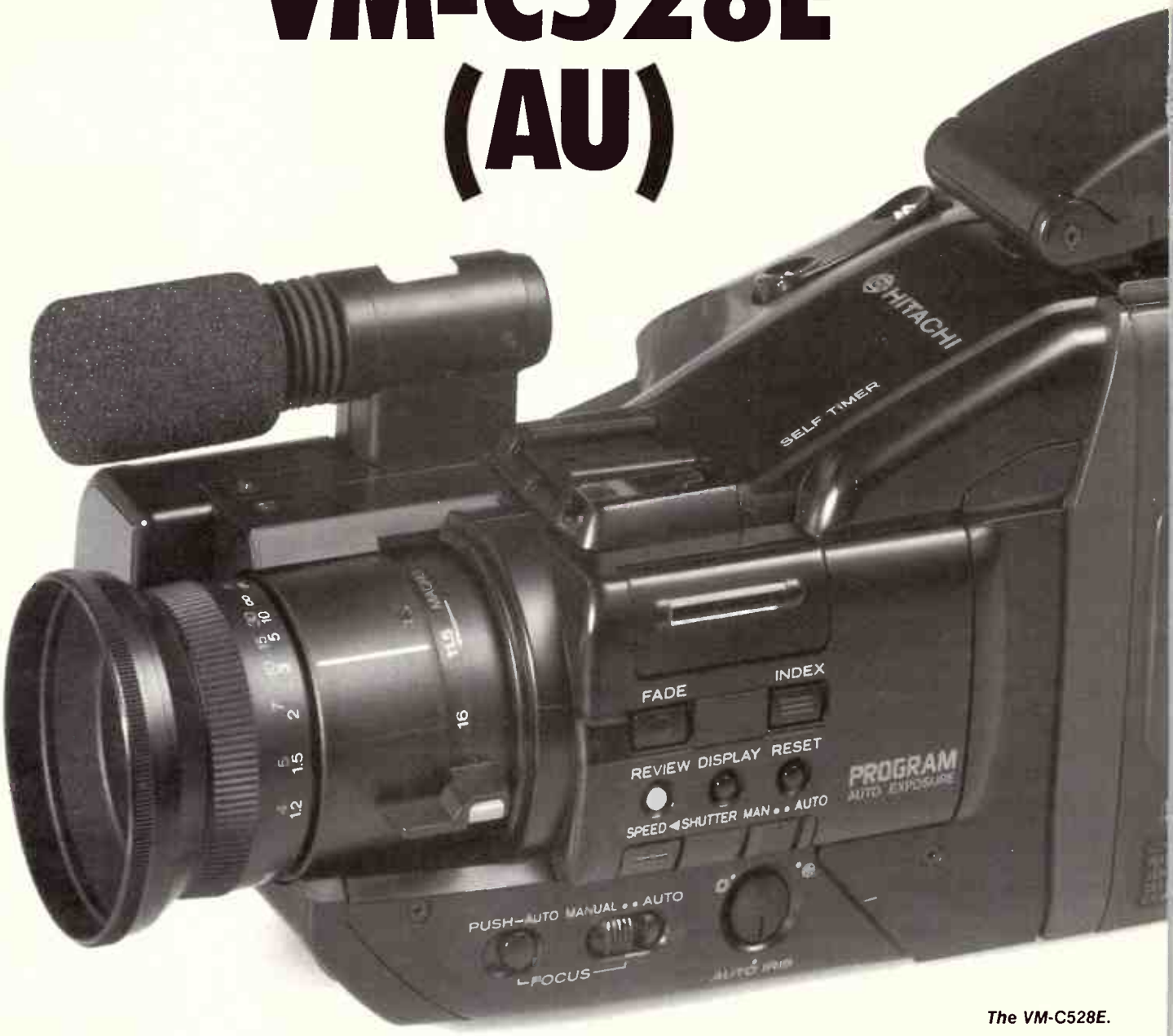
Next I auditioned "John William's Greatest Hits" (CBS 462441 2), which is a recent release of some of the most beautiful classical guitar music that John Williams has ever recorded. Three of the pieces "Granados Spanish Dance No. 5", "Labeniz Asturias" and Rodrigo: Fantasia Para Un Gentilhombre-Fantasia Canarios", are absolutely delightful and with my eyes closed I was really sitting in the recording studio with John Williams and the English Chamber Orchestra, rather than where I really was, which was in my family room. The reproduction of the classical guitar was absolutely outstanding and the percussion peaks of the guitar were magically real.

I listened to the same pieces on my monitor speakers, which are exceptionally good, but the low frequency performance and lower distortion of the SB-AFP10s was perceptibly superior at high listening levels and also in terms of the measure of presence that they achieved.

The last of the reference discs that I used was one of James Newtown Howard's most outstanding pieces "She" (Tower of Power YCD-8503) which is one of my favourites because of its superb recording and rendition of the tympany, and I and my guests revelled in its delightful (nay superlative) music revellery. No other speaker that I have ever listened to has been able to produce such spine tingling sensations and such acoustical intimacy coupled with superb fidelity.

Yes, I'm sold – the SB-AFP10 is one of the outstanding speakers in the world. They are also one of the most visually obtrusive, notwithstanding their original designer's aim of being able to place them against the wall where they would merge into the background. Although no ordinary speaker, I fear that the Australian price tag of $30,000 (or what the Americans would describe as 30 Grand) will dampen (nay drown) the ardour of most potential buyers. Don't be discouraged; these are no ordinary speakers, and I venture that few will be purchased by ordinary people. Those who are lucky enough to purchase them will, however, be amply rewarded for their trouble. eti

HITACHI-VCR MODEL VM-C528E (AU)



The VM-C528E.

Les Cardilini test-shoots with Hitachi's latest camcorder — and doesn't even have to put his specs on!

My, how times have changed.

It seems not so long ago that taking a video camera on a holiday outing or to a family event, such as a wedding, was a major exercise. There was the operator with a camera hoisted onto one shoulder and a portapak VCR hanging from the other, with perhaps a reluctant accomplice to drag along the powerful lights needed for working at night with early-model cameras – not to mention spare batteries and a tangle of cables. The "crew" was hardly a subtle sight to behold and with such an array of conspicuous paraphernalia it was not an easy feat to stalk and obtain candid shots of unsuspecting objects.

But not any more.

Nowadays, at a moment's notice you can start shooting with a lightweight video camera-recorder (camcorder) like the Hitachi VM-C528E (AU). The VM-C528E (AU) takes shots in candlelight if necessary, records HQ video and sound on a small cassette that slips inside the camera, and is powered by a quick change, clip-on rechargeable ni-cad battery that doubles as a comfortable hand grip, on the camera.

The VM-C528E (AU) uses the VHS-C compact video cassette which will record for up to 30 minutes at the standard speed (SP) or for one hour in the long play (LP) mode and is compatible with other VHS systems. Tapes can be played back immediately after they have been recorded, and watched either directly on the camera's own electronic viewfinder screen or on a TV set tuned to one of the alternative channels on the RF Modulator that is supplied with the CM-C528E (AU). Alternatively, the compact, VHS-C videocassette can be slipped into a VHS Cassette Adaptor (also supplied with the camera) and played back in any standard VHS VCR, like a regular size VHS cassette.

Relatively featherweight

A relative featherweight at only 1.2 kilograms (minus its battery), the VM-C528E (AU) nestles comfortably and securely in a ready-to-shoot grip in the palm of the hand, held firmly by an adjustable, quick release Velcro strap. If preferred, the set can be carried, hands-free style, on the shoulder strap provided. Either way, the VM-C528E (AU) balances well and is easily supported at eye level to record a scene or to preview a tape already recorded. The camera can also be mounted readily on a tripod (not supplied).

The thumb and fingers on the right hand gripping the camera immediately rest naturally and comfortably on the Record/Pause button and the Power Zoom switch, respectively, while on the rear of the camera body the power On-Off switch is coupled to a slide panel which moves either up or down to cover up controls not used in the selected mode of operation; that is, while recording in the camera mode or playing back using the camcorder as a VTR. This simplifies considerably the appearance

The VM-3280.

of the rear control panel which, while the camera recorder is switched off, reveals only the tape speed selector switch and cassette eject switch.

In the Camera mode the Video Dub and Quick Edit buttons are also accessible for finding appropriate edit points and inserting new pictures, without affecting previously recorded sound. A flying erase head also eliminates picture interference between separately recorded segments along the tape.

Sliding the switch now into the VTR mode covers up the Edit and Video Dub controls and provides access to the regular Play, Rewind, Fast Forward, Pause and Stop buttons. In this position an Audio Dub switch can be used for recording new sound or music, without erasing the video already recorded – a handy means of adding music and dialogue to home movies and holiday scenes.

A natural 90 degree roll of the wrist from the shooting grip turns the VM-C528E (AU) around so that the cassette compartment and the lens and exposure switches and controls face the operator. Provided the battery or AC power is connected, videocassettes can be loaded or unloaded with the main function switch in any of the camera, VTR or Off positions. When a videocassette is inserted with the power switch ON, for example, the set will automatically enter the appropriate mode. This also simplifies using the camera recorder – perhaps it just cannot be bothered arguing with befuddled operators!

Selectable, Manual and Automatic controls are provided for Iris, Focus and five Shutter speeds, on this side of the camera.

Infrared beam

The focussing system uses an infrared beam and causes the optical system to focus on the nearest object directly in front of the lens. It is therefore necessary, on the one hand, to manually focus the VM-C528E (AU) on subjects behind glass and other transparent screens. On the other hand, the infrared system does not require the lens to be uncapped in order to focus automatically. The Manual Focus can be over-ridden by an additional pusbutton to avoid having to switch back to the main Auto Focus setting for a casual automatic focussing of the lens, if required.

Five shutter speeds up to 1/2000th of a second are available in the VM-C528E (AU) for obtaining sharper "stills" in fast action video recordings such as motor racing and ball sports. At regular, low shutter speeds a tennis ball leaving a racquet, for example, might look more like a comet and less like a ball on the video screen. A higher shutter speed enables a fast moving subject to be captured with less "smear". In the VM-C528E (AU) the shutter speed can be set automatically by the available light or manually, by stepping through the 1/50th, 1/100th, 1/250th, 1/1000th and 1/2000th of a second shutter speeds using a single pushbutton on the side of the camera. Shutter speeds above 1/50th of a second are displayed on the viewfinder screen, for ready reference, when the camera is in the recording mode.

The VM-57280E.

The data displayed in the electronic viewfinder can be stepped sequentially to provide current information on the system modes and status and can be removed altogether from the viewfinder screen if desired. It also shows the condition of the battery and warns of an impending loss of batter power.

Comet tails of a different kind to those caused simply by a fast moving subject can also result from panning across bright lights with a video camera which uses a camera tube. Like many other video cameras of its generation, however, the Hitachi VM-C528E (AU) uses a solid-state image sensor which is not prone to the same comet-tailing effects when panned past bright lights set against a relatively dark background. The solid state image sensor also tends to give sharper picture resolutions, 380 lines in this camera, Hitachi claims.

A further simplification in operation with the VM-C528E (AU) results from its ability, like the human eye, to maintain White Balance automatically as lighting conditions change. Ordinarily, scenes videotaped under incandescent lighting, for example, would tend to take on a reddish tint unless the white balance in the colour video camera system is adjusted for that kind of lighting. Similarly, fluorescent lights throw a greenish haze that, although not perceived by the naked eye, shows up distinctly in video camera pictures that have not been "White Balanced" in that incident light. In many cameras the White Balance has to be adjusted manually or at least activated manually as different lighting conditions are encountered by the camera, otherwise colours are effected, accordingly.

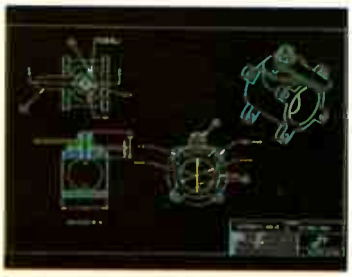
Other likely, popular features on the Hitachi VM-C528E (AU) include a Self-Timer which allows the operator to become part of the video action and Time Lapse recording.

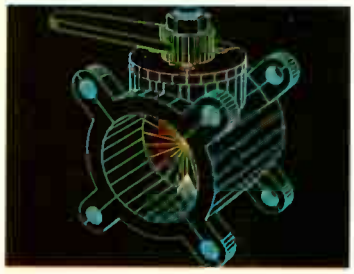
In the Self-Timer mode the camera waits for ten seconds for the operator to position himself or herself in the scene and then switches ON and records for 30 seconds. Alternatively, the camera can be made to wait the ten seconds and then switch ON and record indefinitely, depending on how much tape remains, of course. A red light located beside the Self-Timer switch flashes until the camera enters the recording mode and shooting begins.

Security surveillance

Time Lapse Recording in the VM-C528E (AU) is ideally suited to home security surveillance and doubtless many other serious applications. It might also be used simply for fun. It provides 1-second recording at regular time intervals, 30 seconds, one minute, two minutes and five minutes, or one-shot manual operation. Hitachi suggests it might also be used for recording those special events of mother nature, such as flowers opening, eggs

VERSACAD Design





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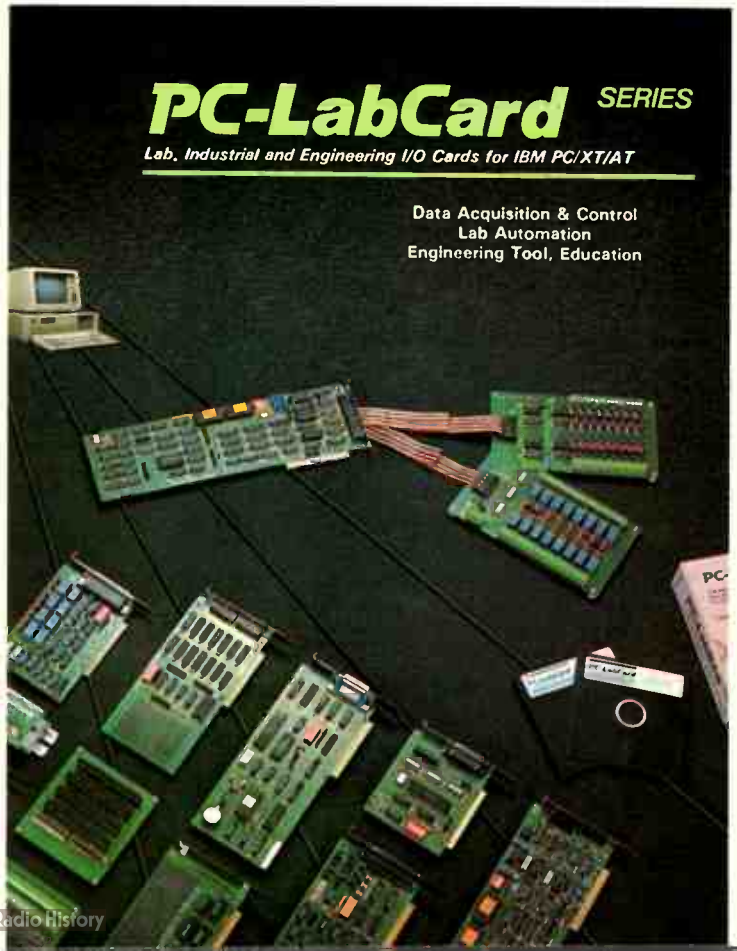

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hatching, sunsets and thunderstorms, to name a few.

A simple one-touch Fade function is also available to add a professional touch to recordings made using the VM-C528E (AU). Scenes can be smoothly faded in or out at the touch of a button and picture fades are accompanied by a matching fade in the volume of the accompanying sound picked up in the system microphone. A windshield covers the microphone, shock-mounted on the camera body, but a Wind switch is provided to obtain a further improvement in the quality of sound in especially windy conditions. Alternatively, external microphones can be used with the VM-C528E (AU) or mixed with existing soundtrack, via a MIC MIX switch on the camera.

Video images seen by the camera can be recorded in either their positive or negative form simply by changing a switch under the lens. Apart from adding useful effects to normal home video movies this feature is also useful for transferring film and movie photographic slides and negatives onto videotape, using the Telecine Adaptor, model VMDP7OE, an optional video camera accessory available from Hitachi.

The electronic viewfinder on the VM-C528E (AU) is also worthy of mention. To begin with it swings through 27O° azimuthal rotation and 18O° in the vertical plane providing a number of positions in which the camera might be held while shooting awkward scenes. It can even be swung around so that it is possible to shoot backwards, over the shoulder, without the operator's turning around to face the subject although it is not as easy to operate the camera record button and power zoom controls, using that stance. The shaped rubber eye cap on the viewfinder can be rotated for either left or right eye camera sighting and the shaped shade folds back to better accommodate spectacles.

Adjustable diopter ring

As well, an adjustable diopter ring brings the viewfinder screen into focus over possibly a wide range of eyesight parameters. I was able to adjust the ring to focus sharply on the small screen in the viewfinder, without my using spectacles and also through each lens in a pair of tri-focals! Being able to adjust for glasses was very handy, as removing them and adjusting the diopter for naked eye camera operation creates more problems when trying to read the lettering on the panel controls. When you are as long sighted as I am the VM-C528E (AU) lets you have it both ways.

Invisible indexing for use in compatible Hitachi VCRs is also provided in the VM-C528E (AU). Indexing allows faster accessing of predetermined points along a recorded tape when played back in compatible equipment. An internal clock and calendar that runs from its own battery even when the set is switched off can be displayed in the viewfinder and also recorded for future reference, if required.

Vital statistics for the camera lens: f1.6 (11.5-92mm) 8:1 power zoom with auto iris, auto focus and macro closeup.

The VM-1280

Standard accessories supplied with the VM-C528E (AU) include a carrying case and adjustable shoulder strap, RF Convertor Unit, VHS Cassette Adaptor, AV Leads and Plugs, and 100-240 volts ac Adaptor/Battery Charger. Recommended retail price is $2699 and the set carries a 12 month warranty.

Further information: Hitachi Sales Australia Pty. Ltd., 153 Keys Road, Moorabbin Victoria 3189, ☎ (03) 555 8722. eti

SPECIFICATIONS — VM-C528E (AU)

General	
Power requirements	9.6V DC
Power consumption	7.9 watts (When AUTO/MAN FOCUS switch is "MAN".)
Dimensions	118(W) x 147(H) x 289(D) mm
Weight	1.2 kg
Operating temperature	0°C - 40°C
Storage temperature	-20°C - 50°C
Video Recorder Section	
Format	VHS
Record/playback system	Four video record/playback heads
Video signal	PAL colour & CCIR monochrome signals 625 lines
Tape speed	SP: 23.39 mm/sec., LP: 11.7 mm/sec.
Video output	1.0 Vp-p, 75 ohm
Mic input	-68 dBs, more than 1K ohm
Audio output	-8 dBs, less than 1K ohm
Earphone output	-26 dBs, (8 ohms terminal)
Camera Section	
Scanning	625 lines/50 fields/25 frames
Required minimum illumination	10 lux
Camera device	2/3" solid state MOS imager
Lens diameter	46 mm

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.

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!

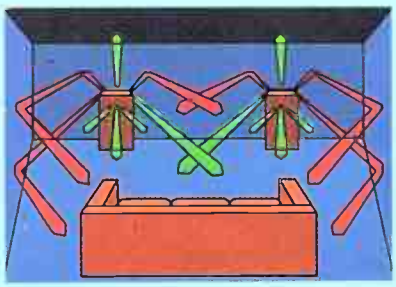
In a live performance, the majority of sound reaches your ears after being reflected off the walls, floors and ceiling. With conventional speakers, you mainly hear only direct sound. Bose Direct/Reflecting® speakers add the missing elements of music by bringing you the natural combination of direct and reflected sound (see diagrams at right). The result is a lifelike soundstage that's practically like being there.

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

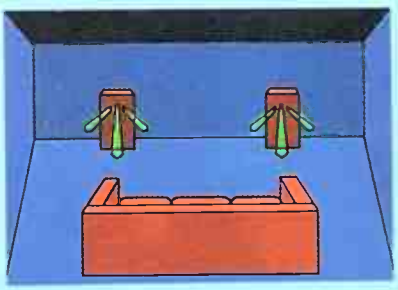
everywhere in the room—even when you are directly in front of one of the speakers.

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.

Boller7

READER INFO NO. 41

FLUKE AND PHILIPS - THE GLOBAL ALLIANCE IN TEST & MEASUREMENT

FLUKE

PHILIPS

Other meters show half the picture

The new Fluke 45 has dual display versatility.

With 2 multifunction displays and 16 different measurement capabilities, the new Fluke 45 does virtually everything you want a meter to do. And for a surprisingly affordable price.

The 5-digit, 100,000 count dual displays give you more information in less time — and with less effort. For example, measure the VDC output of a power supply while measuring the VAC ripple. Or check the amplitude and frequency of an AC signal. From a single test connection!

And the Fluke 45 is designed to make complex measurements easier, with standard features like a 1 MHz frequency counter, Min Max, limits testing (Hi/Lo/Pass), Touch Hold® and Relative modes. There are 21 different reference impedances for dB measurements; in the 2 Ω to 16 Ω ranges, audio power can be automatically displayed in watts.

Accuracy to get the job done right.

The Fluke 45 is a true-rms meter, with 0.02% basic dc voltage accuracy and 100,000 count resolution on both displays. Basic dc current accuracy is 0.05%, making the 45 ideal for servicing 4-20 mA current loops. Closed-case calibration simplifies the calibration process and increases uptime.

Even an RS-232 interface is standard.

Connecting the Fluke 45 to PCs, RS-232 printers and modems is as easy as attaching the cable. An IEEE-488.2 interface and rechargeable batteries are available as options.

Get everything you've ever wanted.

For all the information on the new Fluke 45, contact your local distributor.

FLUKE 45 DUAL DISPLAY MULTIMETER

Dual Display	Compare and Relative functions
True-rms voltage and current, including ac+dc	Min Max and Touch Hold® functions
0.02% basic dc voltage accuracy	Optional PC software for RS-232 applications
0.05% basic dc current accuracy	Optional IEEE-488.2 interface, battery pack
1 MHz frequency counter	One year warranty
RS-232 interface standard	
dB, with 21 reference impedances, and audio power calculations	

READER INFO No. 33

For Further Information Contact Your Local Philips Test & Measurement Organisation: Sydney (02) 888 0416, Brisbane (07) 844 0191, Melbourne (03) 235 3666, Adelaide (08) 348 2888, Perth (09) 277 4199, Auckland (09) 89 4160, Wellington (04) 88 9788.