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SMALL FOOTPRINT

640PC SPECIFICATIONS

Processor:	*8088-2 running at 8MHz/4.77MHz (software selectable) Socket for optional 8087 maths co-processor*	*Keyboard:*	*84-key, AT-style layout.*
Memory:	*768K DRAM (640K of main memory, 128K configurable as a RAM disk Four DMA channels*	*I/O:*	*Five full-length expansion slots. Real-time clock Serial and parallel ports*
Mass storage:	*single 5.25" 360K floppy disk (controller card supports up to four 360K drives)*	*Power supply:*	*145 W switch mode power supply*
Display:	*Video circuitry on main board - compatible with MDA, CGA, Hercules and Plantronics cards.*	*Software:*	*MS-DOS v3.2 GW-BASIC 3.2 Licensed BIOS from Phoenix Technologies 16K internal ROM (expandable to 64K)*
		Dimensions	*:140 x 340 x 412 mm (HxWxD)*

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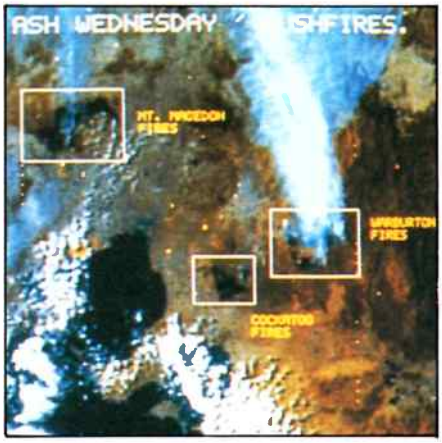
Electronics Today International

SEPTEMBER 1987

FEATURES

PROJECTS

DEPARTMENTS



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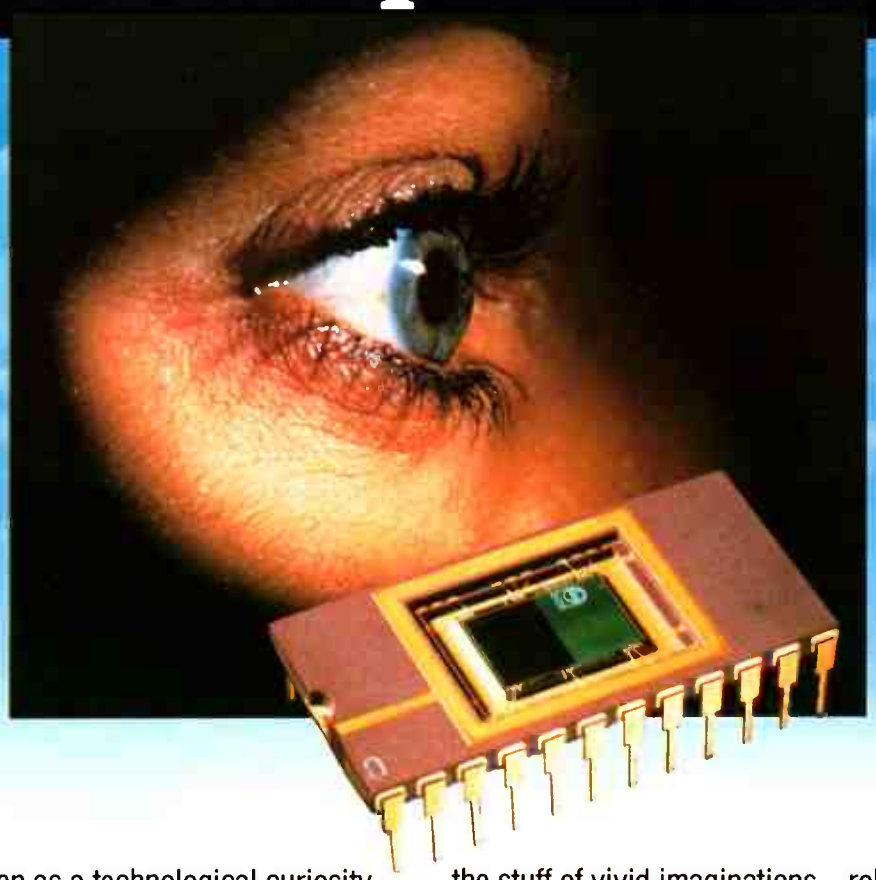
SOUND INSIGHTS

COVER Model Mandy Miller A Greg McBean photo

The things ICs will make possible...



At first it was seen as a technological curiosity. Now it's a practical reality, thanks to Philips.

Solid state imaging is a fine example of how Philips development of IC technology is changing the face of consumer electronics, medical technology, telecommunications and aerospace.

These amazing Philips Integrated Circuits allow the design of video cameras that are ultra lightweight with minute dimensions, low power needs, greater durability and longer life.

Already, Philips solid state imaging is achieving broadcast quality and in some applications replacing camera tubes altogether. A revolution.

The other things it will make possible were once the stuff of vivid imaginations – robot eyes, videophones and advanced character recognition devices.

As electronics approaches the precision and complexity of the human body, Philips ICs and microprocessor innovations are leading the conquest of new technological frontiers.

While you may not be in the market today for solid state imaging, the Philips quest for new technology solutions is applied to everything we do.

Some even more remarkable advances are on our drawing boards around the world.

Think of the things Philips leadership will make possible... we are.

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Electronic Components and Materials

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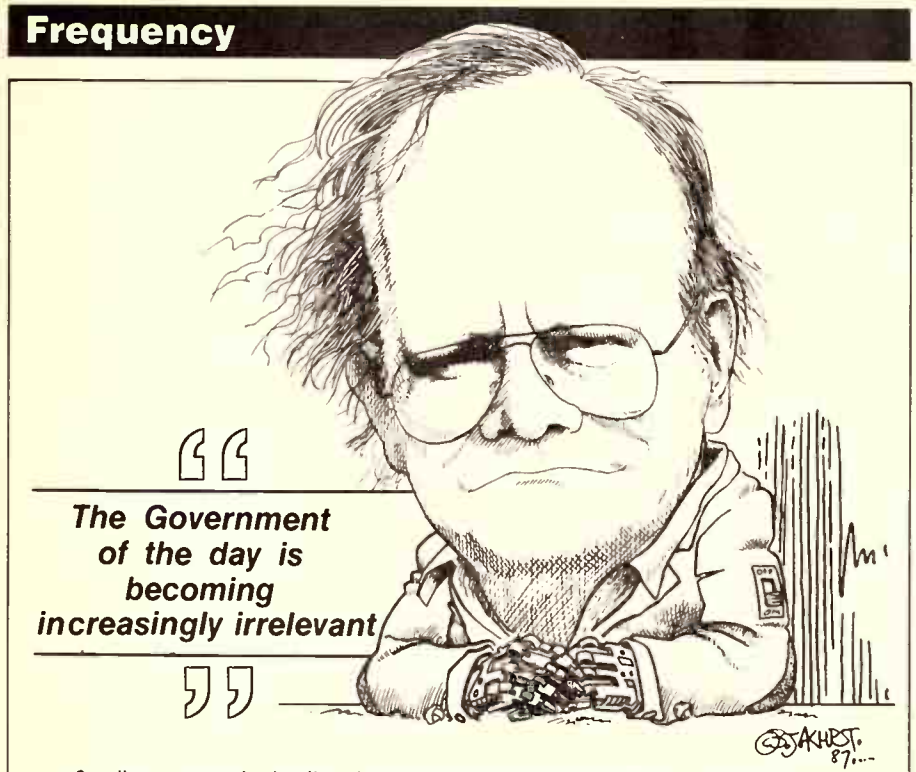
Frequency



So, the general election has come and gone without too much fuss and bother. At best the candidates were uninspired, at worst, downright mediocre. Such is life in the middle of the '80s.

With the election out of the way, the govemment appears to be adhering to the first law of Good Management: look busy. It matter's not one jot whether you are actually out to acomplish something, or even whether you accomplish what you set out to do; the main object of the exercise is to appear to be doing something.

So we have the reorganization of the public service into a series of mega departments. The Department of Science has been split amoung a number of different departments, and Mr Barry Jones demoted to the outer ministry. Over the road, Communications is now part of transport. The minister, Senator Gareth Evans, will be responsible not only for the deregulation of the airline industry, media ownership, and transpacific air route competition, but also radio spectrum frequency management and coastal shipping.

What does all this accomplish? The govemment claims to be doing something about the profligacy of the public service. We will have a more streamlined, effective public service if we have less departments — that's the argument.

However, the moves will not result in one less public servant. Mr Hawke has been quick to assure the Public Service Association that no jobs are threatened. Secondly, it is most unlikely that any great efficiencies of scale will suddenly become apparent. The amalgamation of departments will take place at a section level so that their functions will continue as before. Only the letterhead on the paper will change.

There will be one result worthy of consideration however, and that is that it will now be just that much more difficult for a minister to become familiar with the problems of his portfolio. In fact, unless the minister is of exceptional ability, we can safely assume that in future ministers will know precious little about their areas of responsibility. Who will know? The experts, of course, will be the public servants themselves and the bucanners of the free enterprise system, who have had a lifetime to familiarize themselves with the all the intricacies of their respective industries. Their needs and priorities will not neccessarily be yours or mine.

It would be laughable were it not for the fact that the democratic system depends on the ability of the elected leaders of the people to control government and implement policy. If they are incapable of that then the final rationale for the silly little charade we saw last month is revealed for what it is. The Government of the day is becoming increasingly irrelevant.

— Jon Fairall

EDITOR
Jon Fairall B.A.

ASSISTANT EDITOR
Simon O'Brien B.A. (Hons), M.A.

EDITORIAL STAFF
S. K. Hui B.Sc. (Hons), M.Eng.Sc. MIEEE, MIREE
Terry Kee B.Sc. (Hons), M. Phil.

DRAUGHTING
Karen Rowlands

DESIGNER
Clive Davis

ART STAFF
Ray Eirth

PRODUCTION
Mal Burgess

ADVERTISING MANAGER
Peter Hayes B.Sc.

ADVERTISING PRODUCTION
Brett Baker

SECRETARY
Nina Stevens

ACOUSTICAL CONSULTANTS
Louis Challis and Associates

PUBLISHER
Michael Hannan

MANAGING EDITOR
Brad Boxall

HEAD OFFICE
180 Bourke Road,
(PO Box 227, Waterloo, NSW 2017
Alexandria, NSW 2015.
Phone: (02) 693-6666.
Telex: AA74488, FEDPUB.
Federal Facsimile: (02) 693-2842.

ADVERTISING
New South Wales & Queensland: Peter Hayes, Mark Lewis, The Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Phone (02) 693-6666. Telex: AA74488 FEDPUB.
Victoria and Tasmania: Valerie Newton, The Federal Publishing Company, 221a Bay Street, Port Melbourne, Vic. 3207. Phone (03) 646-3111. Facsimile: (03) 646-5494. Telex: AA34340, FEDPUB.
South Australia and Northern Territory: Michael Mullins, C/- John Fairfax & Sons, 101-105 Waymouth Street, Adelaide, 5000. Phone (08) 212-1212. Telex: AA82930. Facsimile: (08) 212-1210.
Western Australia: Estelle de San Miguel, C/- John Fairfax & Sons, 454 Murray Street, Perth, WA 6000. Phone: (09) 481-3171. Telex: AA92635. Facsimile: (09) 481-4228.
New Zealand: John Easton, J.E.S. Media, P.O. Box 8770, Symonds Street, Auckland. Phone 49-6096. Fax: (09) 77-4826.
Britain: Peter Holloway, C/- John Fairfax and Sons, 12 Norwich Street, London EC4A IBH. Phone 353-9321.
USA: Frank Crook, Sydney Morning Herald, 21st Floor, 1500 Broadway, New York, NY 10036. Phone 398-9494.
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Tasman 2 Progress

Plans for the Construction of a billion dollar communications network linking countries of the Pacific are on track according to the initiators.

Tenders for TASMAN-2, the first stage 2500 kilometre Australia-New Zealand link closed in June with strong national and international interest in the hundred million dollar plus contract.

To be constructed for OTC and Telecom Corporation of New Zealand (TCNZ), Tasman-2 is expected to interconnect with similar cables planned and already under construction in the North Pacific. Together they will form part of a Pacific wide cable network linking the two countries with North America and Asia by the late 1990s.

First announced in briefings to Australian and New Zealand industry in May, 1986, tenders which were called in December, 1986, included the requirement of an option for local manufacturers of at least the submarine cable portion.

Mr John Phillips, the Project Controller said:
"While tender evaluation by a joint OTC/TCNZ team will take some time, it is already clear that competitive tenders have been received which are responsive to the need for Local Content and incorporate the latest Digital Communication Technology."

Tenders under evaluation have been received from:

- STC PLC of the UK (trading in Australia as Stantel) in conjunction with Amalgamated Wireless (Australasia) Ltd;
- AT&T of the USA in conjunction with Olex Cables of Australia;
- Submarcom of France in conjunction with STC of Australia who are both part of the Alcatel N.V. Group;

NEC Corporation of Japan and Ocean Cable Company/Sumitomo Electric Industries, also of Japan.

In addition to the major construction contracts Mr Phillips announced that three (3) preliminary contracts have already been let.

- A contract with Geomex Surveys of Perth, for the shallow water route survey off New Zealand and Sydney, which is scheduled to be completed by end August, 1987. Geomex have employed British Telecom International (Marine) as their cable engineering consultants and the New Zealand Oceanographic Institute for marine survey work off New Zealand.
- A contract with Transrubicon of Sydney, for a marine population survey to ascertain the potential risk to the TASMAN-2 cable through shark attack and deep sea (greater than 1000 metres) trawling.
- A contract with TMD Consultants of Auckland to assess the potential for New Zealand industry to participate in the manufacture of TASMAN-2 and follow-on systems to North America and Asia.

Grace Bros and Bar Codes

Grace Bros claims to have become the first department store retailer in Australia to use bar code technology to streamline the delivery of merchandise from its central warehouse to stores.

The company has commissioned a computerised bar code materials handling system, valued at more than $250,000, at its Lidcombe distribution centre in Sydney's western suburbs. It was designed and implemented by Distributon Technology (Distech), a company formed in 1986 by US based Bell & Howell to develop and install real-time control systems.

Grace Bros' distribution centre, the largest of its type in Australia, supplies merchandise to all 46 Grace Bros department stores throughout metropolitan Sydney, country NSW, the ACT, and its single store in Victoria.

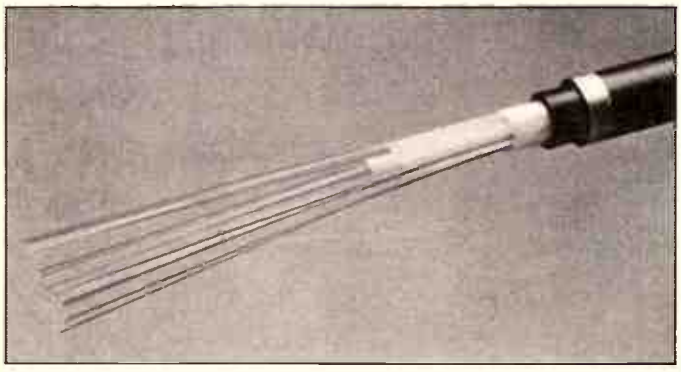
The system provides on-line merchandise identification, automatic data collection and real-time procedural control, and will enable Grace Bros to achieve two important cost and time-saving goals. The first is to eliminate the cost of locating and retrieving merchandise sent to the wrong store, and the second is to free distribution centre staff from the time-consuming and error-prone task of completing shipping manifests.

Based on these and other savings, Grace Bros' Keith Campbell said the new system will pay for itself within 18 months of operation.

To suit the centre's stringent operational requirements, the new system incorporates several features not found in any other materials handling system. They include a pair of interchangeable processors which guarantee continual operation, an elevated gantry system which keeps unused bar code scanners out of the way of loading dock workers, and a specially-designed bar code label for consolidated loads.

Using bar code labels to identify individual store orders, the new system will enable centre management to track, for the first time, the movement of goods through the warehouse, and to answer store queries about despatched stock which may arise later.

The new system is the first part of a planned three-stage bar coding system in which the functions of physical stock movement and stock and financial information will be integrated.



10km Fibre

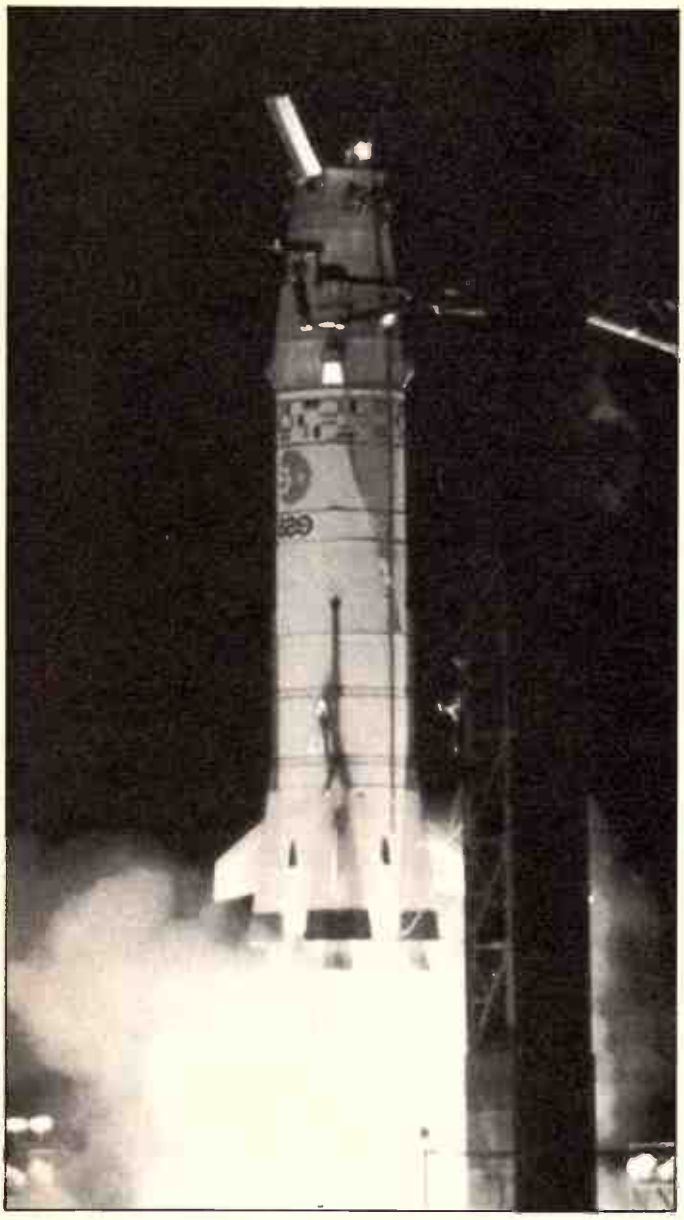
Olex Cables has produced a 10 km long fibre optic cable, the longest continuous run of fibre optic cable ever made in Australia.

The cable length was manufactured to a Telecom specification for use in the Perth to Kalgoorlie stage of the East-West fibre optic link across Australia. The project has called for various cable lengths, up to the record breaking 10 kilometres.

Olex Cables Production Engineer, Ken McLean, said that there is technically no limit to the length of fibre optic cable that can be produced, however, the length of fibreglass reinforced plastic rod is currently the limiting factor. Also drum lengths substantially longer than 10 kilometres would be difficult to transport. The maximum continuous length of conventional co-axial cable is about 1 kilometre.

The finished cable was wound onto a perfectly balanced drum with a total weight of over 1.7 tonnes. It will be transported by road from Olex's plant at Tottenham in Victoria to Western Australia.

The exceptionally long cable lengths will lead to cost-savings on the Telecom project because less joints are required. At least one complete cable joint is saved over a repeater length. Such long lengths are inconceivable in conventional metal cables because of the handling problems associated with their heavier weights.



On Contract

The firm British Aerospace Australia Limited (BAeA) has just received approval to proceed to the second stage of a contract to build, design and install Australian reception and processing facilities to handle data from the European Remote sensing satellite (ERS-1).

The contract is worth $A6-million and has been awarded by the space Programs Branch of the Department of Industry, Technology and Commerce (DITAC) on the advice of the Australian Space Board. ERS-1 is scheduled for launch by the Ariane launcher from French Guiana in 1989, and is currently being developed by the European Space Agency. Sensors carried by ERS-1 will primarily be used for oceanographic and coastal applications.

The Australian project involves two sites — an earth receiving station at Alice Springs and a centre to process the data in Canberra. Both sites are opeated by the Australian Centre for Remote Sensing.

The Role of Government

Research grants, official inquiries, encouraging speeches and workshops have all been used by the government to display its commitment to industrial development.

Bill Kricker, chairman of the Industry Research and Development Board has announced discretionary grants totalling no less than $6.42 million to assist mainly small Australian firms to conduct research and development activities. The grants are to be made under the Grants for Industry Research and Development (GIRD) scheme. At the discretion of the IR and D board they are made to firms which are unable to take advantage of the 150 per cent tax concession for R&D.

To date grants have been awarded to companies such as Neutralysis Industries of Queensland to develop an efficient form of disposing of municipal waste, Mindata Limited of Victoria to develop a remote intelligent sensing system capable of being used in bore holes and Optical Systems Design of New South Wales to develop a low cost, high performance fibre optic communication system for use in advanced local area networks.

Senator Button apparently believes that Australia's Information and Technical Industries are much in need of development. As a consequence he has managed to persuade his government to commission to study into the Australian electronic components industry. Furthermore Senator Button's department is sponsoring a national workshop designed to nominate areas of technology vital to the future development of the economy.

The study into the electronic components industry has been given two questions to answer. First of all what opportunities exist for establishing in Australia internationally competitive sectors of the electronic components manufacturing industry? Secondly, what actions are required to realize an enhanced electronic components manufacturing industry in Australia? Senator Button has given a joint consortium $50,000 to answer these inquiries.

Button is backing this up by lobbying for an increased number of places in the information oriented courses in the Universities and TAFES. According to the excellent Senator: "We want to encourage the use of advanced technology systems and we want more of it to be Australian."

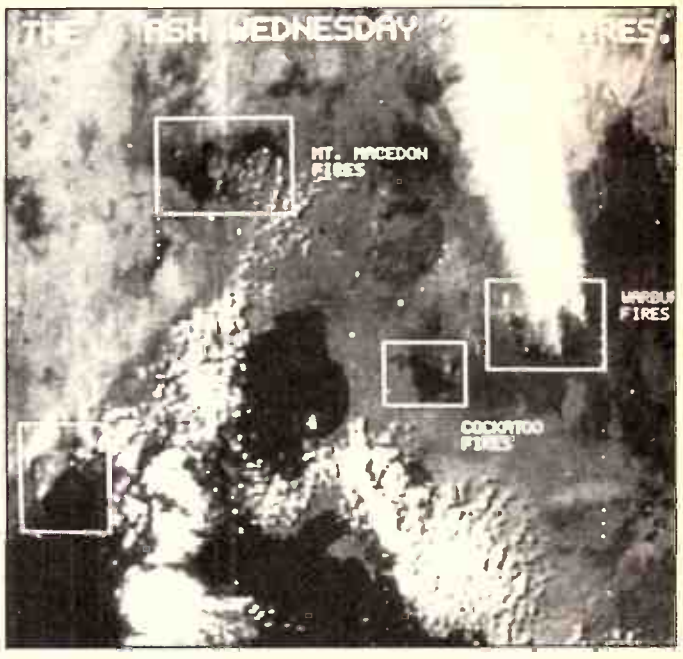
An important inquiry into quality in Australian industry was released by Senator Button on 9 July, 1987. The committee conducting the inquiry was led by Dr Kevin Foley. The committee made 20 recommendations including the following: that the Commonwealth government issue a national quality strategy statement listing plans and objectives "as a matter of urgency", that the government establish a national organisation to be known as the Australian Quality Authority to undertake policy development and that the Federal government in conjunction with the State governments "adopt a uniform policy of using and applying Australian Standards in regulations and purchasing".

A Talking Hand

The inaugural Jeans West Science and Technology Young Achiever of the Year Award has been won by 24 year old Michael Walsh, a former Queensland University medalist. Mr Walsh won the award for his "talking hand" invention which he developed whilst at University.

This device works by converting finger pressure on a palm held pad into "normal sounding" words. The coded pressure impulses are converted into audio tones by a compact speed processor. The words are broadcast on a small speaker which can be hand held. The device will be manufactured by Laser Dynamics Limited in Queensland.

NEWS DIGEST



Aust/Japan Remote Sensing

One of the last moves by the old Department of Science was the signing of an agreement between CSIRO and the National Space Development Agency of Japan (NASDA). The agreement covers cooperation in the field of remote sensing from satellites, specifically the new Marine Observation Satellite (MOS-1).

Under the agreement, Australian and Japanese scientists will use data from Japan's Marine Observation Satellite (MOS-1), launched from the Tanegashima space centre in Japan in February this year. The MOS-1 satellite carries instruments to observe the earth's surface, particularly the oceans.

The data will be received at the Division of National Mapping, Department of Resources and Energy's facility at Alice Springs.

Reception of information will commence in April 1988 and experiments using the data will continue over a six-month period.

The MOS-1 satellite, also known as "Momo" (peach), is Japan's first remote sensing satellite. Further satellites are planned, including an identical satelite, MOS-1b, and an Earth Resources Satellite employing an advanced radar system.

The instruments onboard MOS-1 will measure the "brightness" of the earth's surface and atmosphere in the visible, infrared and microwave regions of the spectrum. MOS-1 also carries a data collection system which can relay information gathered from remote automatic sensors on the ground or at sea.

The agreement was signed by Dr Keith Boardman of CSIRO and Mr Hiroyuki Osawa of NASDA at Canberra in June. The ceremony was attended by Mr Barry Jones, the Minister for Science, as well as Japan's Parliamentary Vice-Minister of State for Science, Tetsuro Shimura.

Kuru Muna

An Adelaide company has won Defence Department contracts worth $850,000 to develop an infra-red surveillance system to identify military targets.

The surveillance system is to be developed for the Army by C. J. Abell & Co. It will be capable of pin-point-

ing equipment or personnel over great distances by sensing body warmth or engine heat.

It also will be able to be used in search and rescue operations, but will have a far greater field of view than existing equipment.

This will enable vast areas to be covered much quicker.

The contract calls on Abell's to develop a field prototype of what will be known as the Kuru Muna thermal imaging system over the next six months.

Kuru Muna is an Aboriginal word meaning eye in the dark.

The Kuru Muna infra-red system has been under development within the Defence Science and Technology Organisations of the Department of Defence since 1984.

It draws on 10 years of DSTO research and development into infra-red detection and thermal imaging. Kuru Muna will be unique in that it will operate over an extremely wide field of view.

It will be able to take in an area 47 degrees horizontally and five degrees vertically.

Under its contract with the Defence Department, C. J. Abell & Co will design, develop and supply:

- a frame store module to capture and store images;
- a target detection module which will enable the Kuru Muna system's computer to extract targets from background objects; and
- a target display marker module to enable an operator to identify and monitor targets.

The whole system will be about the same size as a portable television set, but will have processing power equivalent to 2000 personal computers.

The camera — which is being developed by the DSTO — will be able to be mounted on mobile equipment, such as vehicles, ships and aircraft, or mounted on a tripod at a forward observation post, with concealed operators.

In civil applications it would be a dramatic improvement on existing infra-red scanners used to help locate missing persons.

It would be invaluable for search parties such as the one which combed Wilson's Promontory for several days earlier this month in an unsuccessful hunt for a missing Melbourne child.

The scanner's wide field of view means that if mounted on a helicopter it would enable wide sweeps of even dense scrub to be made at high speed, reducing search times dramatically at the same time as increasing their effectiveness.

Plessey Pulls Out

The large British telecommunications firm Plessey has withdrawn from a research project that was intended to build a typewriter that could produce text from dictation. Britain is a world leader in the field of voice research which is centred on Edinburgh University.

The project which Plessey was in the process of developing differs from others in other countries in that it was aimed at producing a machine which would understand words from their context rather than matching voice patterns with pre-recorded patterns to identify what is being said. The unit was to be known as a 'speech input word processor' and it was hoped to produce a prototype by 1989.

Which brings us to the question of why Plessey withdrew. Apparently the firm was unable to procure any more money from the London financial market to pursue its research. Plessey had already spent no less than £500,000 on the project and have received £700,000 in grants. Negotiations are underway to get Plessey's chief rival GEC in on the idea but no definite answer has yet been obtained. It will be a pity if the whole idea is abandoned since American market researchers predict profits of some 4 million pounds if any such device were to enter the market.

Perth Planetarium

Construction of the Perth Omni Theatre and Planetarium is fast approaching completion. It is due to open in mid-October, and is the first to be constructed in Australia containing a planetarium instrument.

The most widely used modern planetarium instrument, the Spitz System 512, is being installed at the Omni Theatre. This custom-made Southern hemisphere model will project a complement of 4050 stars, accurately depicting not only position but colour and magnitude of the Milky Way, major nebulae, galactic clusters, the sun and the solar planets.

The majesty of the night sky will be accompanied by a computer controlled audio visual system currently consisting of a two scene seven cell panorama system and 13 Kodak Ektagraphic S/AV 2050's arranged in multi-screen projections.

Installation of the 17 metre hemisphere, titled at 30 degrees is being done by Spitz Space Systems and begins in early August. The dome is coated with Spitz's patented directionally lenticular latex which has a reflective coefficient of 0.3. This enables maximum light projection on the surface of the dome without the interior reflection problems associated with "white" domes.

The Planetarium productions will be choreographed through a R.A. Gray MC-10 media control computer. This Z-80 based dedicated microprocessor has been designed specifically to control the special effects in planetarium productions. Richard Gray developed this instrument while production manager of the Ruben H. Fleet Space Theatre in San Diego, the first Omnimax Theatre which was built in 1973.

The Omni Theatre has an IMAX Rolling Loop Projector. The Rolling Loop System, invented by the Brisbane inventor, the late Ron Jones, uses standard 70mm film stock with the film plane oriented 90 degrees to normal. This allows a much larger image area. The standard cinemascope format has an image size of 22mm x 49mm whereas the Omnimax system has 50mm x 70mm of projectable image resulting in 1.40 to 1 aspect ratio. This, coupled with a specially ground Leitz lens, allows a high fidelity image projected through 180 degrees horizontal and 125 degrees vertical viewing.

There is also a 20 kW six channel programmable sound system. It boasts a 5A tri-amped BGW powered system driving eight stations of full range and two stations of eight channel sub-bass JBL drivers.

Picopulses

IBM scientists have made and measured the world's shortest electrical pulses, an important step in designing the ultrafast electronic computer components of the future. Using a laser and a very fast switch, they produced electrical pulses lasting only one half of a picosecond (0.5×10^{-12}s).

Until this experiment, researchers had never broken the "picosecond barrier" with an electrical device. The fastest experimental silicon logic devices can switch on and off in about 30 picoseconds; gallium arsenide devices in about 10 picoseconds. But to investigate the electrical behaviour of these devices, researchers must be able to measure pulses at least 10 times faster than these switching times.

To generate the pulses, researchers fabricated a transmission line on a thin silicon layer. The transmission line consists of two parallel one-micron-wide aluminium strips two microns apart. During operation, a voltage is maintained across the aluminium lines.

A pulsed laser beam, consisting of a series of sub-picosecond light pulses, is split into two beams by a mirror. Because the beams follow different paths it is possible to delay one light pulse stream.

The first light pulse strikes the silicon between the two aluminium lines, shorting them for a fraction of a picosecond and creating an electrical pulse that travels down the transmission line. The electrical pulse is an ultrashort charge in the voltage that moves down the line. As the electrical pulse travels down the line it passes a very fast optical switch, which samples it.

The second light pulse, time-delayed slightly by the longer optical path, drives the sampling switch, measuring the electrical pulse as it flies by. Researchers measure the time delay necessary to collect the electrical signal to determine the duration of the pulse.

With this technique, IBM scientists have an important tool to study the characteristics of experimental computer components such as the transmission lines, and how they affect an electrical pulse as it travels through them.

Wilson Quits

Mike Wilson, Managing Director of Dick Smith Electronics in Australia and New Zealand has announced his resignation from the company.

Mike Wilson approached Woolworths, the current owners, late last year about a possible management buy out of Dick Smith Electronics in Australia and New Zealand. According to the company, the approach was rejected. Mr Wilson intends to capitalise on his past experience in the computer industry and is examining several opportunities.

He has been replaced at DSE by Jeff Grover who comes from Downtown Duty Free, a large Sydney Retail store.

Jeff Grover

NEW! NEW! NEW! NEW! NEW!

CD PLAYER ADAPTOR

Many amplifiers have only one auxiliary input. This makes using a compact disk player as well as another auxiliary input inconvenient. Also the majority of CD players have an output voltage of 1·6 or 2 volts whereas the auxiliary input norm is 750mV. This CD adaptor allows dual auxiliary input, and one input has variable gain setting.

SPECIFICATIONS:
- Input 2 sets of 2 x RCA sockets
- Gain 150, 300, 600mV, 1V and 2V
- Output 2 x RCA sockets

A16020 ..... **$23.95**

SPEAKER CONTROLLER (TAA801)

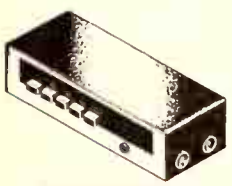
- Enables up to 5 pairs of stereo speakers to be switched on or off in any combination
- Rated at 50 watts continuous per channel
- Stereo headphone socket available for private listening
- Constant minimum load circuit protects amplifier regardless of how many speakers are connected
- Dual circuit breaker protection

Cat. A16054 ..... **$59.95**

SPEAKER CONTROLLER (TAA803)

- Enables 2 amplifiers (or TV & Amp) to be switched to 4 pairs of speakers in any combination
- Rated at 50 watts continuous per channel
- Headphone output can be utilized without interfering with the speaker
- Constant minimum load circuit protects amplifier regardless of how many speakers are connected
- Each channel is protected separately by circuit breakers

Cat. A16058 ..... **$59.95**



TAPE DIRECTOR (TAA802)

Ideal for those who do a lot of dubbing and recording. Features facilities for amplifier, auxiliary, 2 tape inputs and 2 amplifier, 2 tape outputs, by simply selecting and pressing the appropiate switch you are able to

- Record from either tape unit while listening to another source through your system
- Dub direct from tape 1 to tape 2 whilst listening to tape 1 or 2
- Record from auxiliary to tape 1 or tape 2 while listening to auxiliary through the amplifier
- Record from amplifier to tape 1 or 2 while listening to the amplifier

Cat. A16056 ..... **$59.95**

ANTI VIBRATION MICROPHONE HOLDER

- Suspends microphones in an eight section rubber mount
- Fits most standard body 25-30mm diameter microphones
- Standard 5/8" x 27 thread and 5/8" to 3/8" reducer

A10065 ..... **$15.95**

STEREO WIRELESS TRANSMITTER

This unit was developed to allow portable compact disc players to be used in cars by transmitting the headphone output signal directly in to your stereo FM car radio. It will also transmit any mono/stereo signal from any headphone output to any FM receiver.

SPECIFICATIONS:
- Input 3·5mm stereo phone plug Impedance 32 ohm
- Mono/stereo switch has plug mounting clip
- FM Transmission approx 90-35MHz (Tuneable 89-91MHz)
- Range 15 metres (below 15mV/m at 100 metres)
- Power 1·5V AAA size batteries (100 hours continuous use)
- Size 72 x 38 x 21mm

A16100 ..... **$69.95**

COMPACT DISC CLEANER

Even compact discs need to be kept clean otherwise the listening pleasure will be spoiled by drop outs or skips

- Cabinet incorporates working base to place disc
- Soft suede cleaning pad (with pad cleaning brush)
- Spray which will gently loosen contaminents and not damage discs
- With disc cloth for handling discs
- Replacement cleaning pad and spray available separately

A10025 ..... **$19.95**

COMPACT DISC CLEANER PAD & SOLUTION

Replacement pad and cleaning solution for to suit above (A10025)

A10026 ..... **$9.95**

ROTATING LIGHT

Motor driven rotating reflecting mirror with a flash rate of about 150 per minute. Large lens fit right to base, making unit weatherproof. Spare globe included

SPECIFICATIONS:
- Available in Blue or Orange
- 150 Revolutions per minute (approximately)
- Shock absorbing rubber mounting legs
- Connecting wire fitted through base
- 12V DC 750mA
- Base diameter 102mm Height 140mm

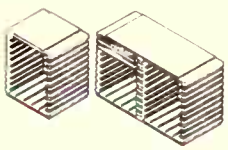
A15042 Blue **$42.95**
A15043 Orange... **$42.95**

VIDEO/AUDIO TRANSMITTER

A small compact unit that allows transmission of video and audio signals (RF) to any TV set or VCR within a range of 30 metres (100"). simply by tuning in on Channel 11 Can be used as a transmitter for a video camera. With power on LED, on/off switch, audio and video leads and supplied with an AC adaptor.

Transmission: VHF, channel 11 (PAL)
Video Input: 75 ohms, 1V p-p
Audio Input: 600 ohms
Output Control: Audio-video fine adjustment
Power Sources: 9V battery or power adaptor
Accessories: RCA to RCA audio lead RCA to BNC video lead
Size: 70(W) x 85(D) x 26(H)mm
Weight: 170 grams

A16150 ..... **$69.95**



COMPACT DISC STORAGE UNITS

- Holds 10/20 compact discs in their cases
- Interlocking modular design allows vertical and horizontal interlocking
- Discs slide into place horizontally making titles easy to read
- Wall mount or free standing

A10031 (10 discs) **$12.95**
A10032 (20 discs) **$19.95**

COMPACT DISC CASE

Standard replacement compact disc case

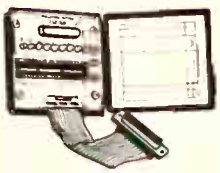
A10030 ..... **$6.95**

PIR FLOODLIGHT

A perfect all night security device with dual element Passive Infra Red sensor. All weather outdoor operation. Features off, automatic, test and manual on at your wall switch. Complete with wall mounting bracket, cable terminations and instructions.

SPECIFICATIONS:
Detecting range: minimum 6 to 15 metres with variable control
Detecting zones: 5 at 15° short, 12 at 8° medium, 12 at long range
Preset time: From 1 to 20 minutes with manual overide
Photocell sensitivity: Activates circuit at about 2 footcandles, off at about 8 footcandles of light
Positioning Adjustment: 2 ball joints allow free adjustment to suit area
Relay output: Up to 500W of incandescent load only
Power: 240V AC 50Hz

A15597 ..... **$185**

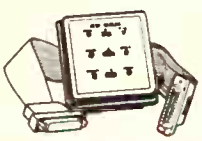


RS232 BREAK OUT BOX

A simple way of monitoring RS232 interface lead activity. Interface powered, pocket size for circuit testing, monitoring and patching. 10 signal powered LED's and 2 spares. 24 switches enables you to break out circuits or reconfigure and patch any or all the 24 active positions.

SPECIFICATIONS:
Connectors: DB25 plug on 80mm ribbon cable and DB25 socket
Indicators: Tricolour LED's for TD, RD, RTS, CTS, DSR, CD, TC, RC, DTR, (E)TC
Jumper Wires: 20 tinned end pieces
Power: Interface power
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm

X15700 ..... **$94.95**



RS232 FAST CABLER

Makes RS232 interface configurating fast and simple. 3 slide switches enable line swapping functions, positive and negative voltages are displayed on 6 tricolour LED's

SPECIFICATIONS:
Connector: DB25 plug on 100mm cable and DB25 socket on 100mm cable
Indicators: Tricolour LED's for pins 2(TD), 3(RD), 4(RTS), 5(CTS), 6(DSR), 20(DTR)
Switches: 3 Slide switches to swap leads
Power: Interface power
Enclosure: Black, high impact plastic
Dimensions: 85 x 95 x 30mm

X15710 ..... **$145**

U.S. 6 PIN TELEPHONE PLUG

- 6 slot, 4 pins wired
- Medium sized
- Crimp type

Cat No	1-9	10+
Y16006	$2.75	$2.55

U.S. 6 PIN TELEPHONE PLUG

- 6 slot, 6 pins wired
- Medium sized
- Crimp type

Cat No	1-9	10+
Y16007	$3.25	$2.95

4 PIN, 4 SLOT PCB MOUNTING U.S. PHONE SOCKET

- 4 Slot, 4 pins wired
- Small sized

Cat No	1-9	10+
Y16008	$2.60	$2.40

6 PIN, 6 SLOT PCB MOUNTING U.S. PHONE SOCKET

- 6 Slot, 6 pins wired
- Medium sized

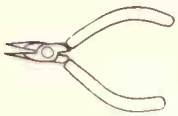
Cat No	1-9	10+
Y16009	$2.95	$2.75

BIG MOUTH CAR ALARM

FEATURES.....
- Easy installation
- Automatic on/off
- Loud alarm signal
- Auto reset
- Low Price!

SPECIFICATIONS:
Power: DC 12V battery
Current Consumption: 10mA at 12V DC
Dimensions: 139 x 165 x 136mm
Exit Delay: 60 seconds approx
Entry Delay: 12 seconds approx
Auto reset: 90 Seconds approx

S15048 ..... **$39.95**



HOBBYIST LEAD NIPPERS

Great value for money! Perfect for the hobbyist

T12055 (PP-1) **$6.95**

HOBBYIST SIDE CUTTERS

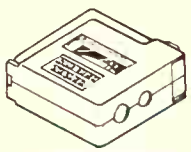
Value for money side cutters! Perfect for the hobbyist

T12071 (PC-1) **$6.95**

HOBBYIST FLUSH CUTTERS

Great value for money! Perfect for the hobbyist

T12074 (PC-2) **$6.95**



POCKET SIZE BATTERY TESTER

- Tests all 9V to 1·5V batteries including button cells
- Arms extend to various battery sizes
- Easy to read meter
- Requires no power source

M23521 ..... **$11.95**

NEW COLOUR KNOBS!

Standard metric fluted shaft with black dot marker and available in six different colours!

Dimensions 17·2mm high 12·8mm top diameter, 17mm bottom diameter

Cat.No.	Colour	1-9	10+
H10070	Black	$0.75	$0.65
H10071	Blue	$0.75	$0.65
H10072	Green	$0.75	$0.65
H10073	Grey	$0.75	$0.65
H10074	Red	$0.75	$0.65
H10075	Yellow	$0.75	$0.65

MINIATURE HOBBY VICE

- Lever operated suction grip base for instant mounting and portability
- Mounts on smooth non-porous surfaces.
- Ideal for holding components, and other small/light objects.

Cat.T12458 ... **only $5.45**

AUTOMATIC CABLE STRIPPER

- Strips cable with diameter of 1·1·6 2·2·6 3·2mm
- Fully automatic action. Squeeze grip will simultaneously strip and eject insulation
- Length 180mm (7")

T11532 ..... **$19.95**

6 WAY U.S. TELEPHONE CABLE (W11332)

- 6 conductors, 7 strands 0·16mm
- Conductor insulated O.D. 1mm
- Sheath cream P.V.C
- O.D. 7 x 2·5mm

1-9 metres	10+ metres
$0.90/m	**$0.75/m**

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Phone (03) 663 6151

425 High St, NORTHCOTE
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Telex: AA 151938

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(STRICTLY ORDERS ONLY)

LOCAL ORDERS & INQUIRIES (03) 543 7877

POSTAGE RATES:

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

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 1KG!!

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

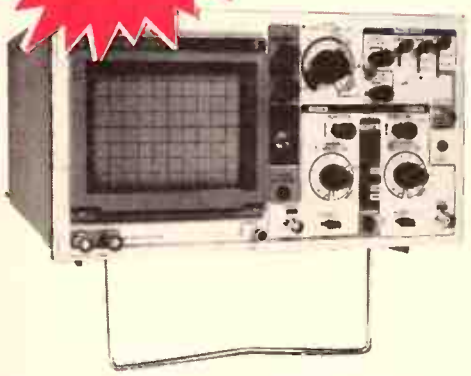
All sales tax exempt orders and wholesale inquiries to: RITRONICS WHOLESALE. 56 Renver Rd, Clayton. Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

*Apple and Mac are registered trade names

MasterCard VISA

12 months warranty!



HUNG CHANG (RITRON) 20 MHz DUAL TRACE OSCILLOSCOPE

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

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

CRT

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

VERTICAL

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

HORIZONTAL

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

TRIGGERING

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

X-Y OPERATIONS

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

COMPONENT TESTER

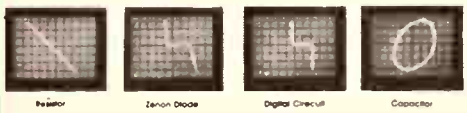
Component Tester: Max AC 9V at the terminal with no load Max current 2mA when the terminal is shorted (Internal resistance is 4.7K ohm)

OTHER SPECIFICATIONS

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

Cat. Q12105 ..... **only $849**
(tax exempt only *$695*)

Bulk orders, schools, please phone (03) 543 2166 for special low pricing



METEX M-3650 MULTIMETER

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

This spectacular, rugged and compact DMM has a bright yellow high impact plastic case. It features a frequency counter (to 200kHz), diode and transistor test, continuity (with buzzer), capacitance meter, up to 20 amp current measurement and comprehensive AC/DC voltage, current and resistance ranges.

CHECK THESE FEATURES....
- Push-button ON/OFF switch
- Audible continuity test
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection
- Transistor test
- Diode test
- Quality probes
- ½" High contrast LCD
- Full overload protection
- 20 Amp
- Built in tilting bail
- Capacitance meter
- Instruction manual

SPECIFICATIONS:
DC VOLTAGE:
Range: 200mV, 2V, 20V, 1000V
Resolution: 100uV, 1mV, 10mV, 100mV, 1V
Accuracy: 200mV - 1000V +/-0.3% +1 digit
AC VOLTAGE:
Range: 200mV, 2V, 20V, 200V, 750V
Resolution: 100uV, 1mV, 10mV, 100mV, 1V
Accuracy: 200mV - 200V +/-0.8% rdg +3 digits
750V +/-1.2% rdg +3 digits
Input Impedance: 10M ohm
DC CURRENT:
Range: 200uA, 2mA, 20mA, 200mA, 20A
Resolution: 100nA, 1nA, 10uA, 100uA, 10mA
Accuracy: 200uA - 20mA +/-0.5% rdg +1 digit
200mA +/-1.2% rdg +gt
10A +/-2% rdg +5 digits (10A range unfused)
Max. I/P Amps: 10A (20A up to 60 seconds)
AC CURRENT:
Range: 2mA, 20mA, 200mA, 10A
Resolution: 1uA, 10uA, 100uA, 10mA
Accuracy: 2mA - 20mA +/-1% rdg +3 digits
200mA +/-1.8% rdg +3 digits
10A +/-3% rdg +7 digits (10A range unfused)
RESISTANCE:
Range: 200, 2k, 20k, 200k, 2M, 20M ohms
Resolution: 0.1, 1, 10, 100, 1k, 10k ohms
Accuracy: 200 ohm +/-0.5% rdg +3 digits
2k ohm - 2M ohm +/-0.5% rdg +1 digit
20M ohm +/-0.5% rdg +2 digits
Overload: 200 ohm 250V DC/AC rms, 2k-20M ohm 500V
Protection: DC/AC rms
CAPACITANCE:
Range: 200nF, 2uF 20uF
Resolution: 100pF 1nF, 10nF
Accuracy: 200nF-uF +/-3% +5 digits
FREQUENCY RANGE: 0-20kHz, 0-200kHz

Cat. Q91550 ..... **only $165**

METEX 4500H MULTIMETER

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

The Metex 4500H is perfect for the technician, engineer or enthusiast who requires the higher accuracy of a 4½ digit multimeter. This meter is exceptionally accurate, (just look at the specifications), and yet, still retains an exceptionally low price!

The Metex 4500H features digital hold which is normally only found on very expensive multimeters. This enables you take a reading and hold that reading on display even after you have removed the probes, simply by pressing the hold button.

CHECK THESE FEATURES...
- Readout hold
- Transistor Tester
- 4½ digit x ½"(H) LCD
- Audible continuity tester
- Push-button ON/OFF switch.
- Quality set of probes
- Single function, 30 position easy to use rotary switch for FUNCTION and RANGE selection
- Built in tilting bail
- Instruction manual
- Full overload protection
- hFE test
- Battery and Spare fuse
- Diode Tester
- Vinyl case

SPECIFICATIONS:
DC VOLTAGE:
Range: 200mV, 2V, 20V, 1000V
Resolution: 10uV, 100uV, 1mV, 10mV, 100mV
Accuracy: 200mV - 1000V +/-0.05% rdg +3 digits
Input Impedance: 10M ohms
AC VOLTAGE:
Range: 200mV, 2V, 20V, 200V, 750V
Resolution: 100uV, 100uV, 1mV, 10mV, 100mV
Accuracy: 200mV - 200V +/-0.5% rdg +10 digits
750V +/-0.8% rdg +15 digits
Input Impedance: 10M ohm
DC CURRENT:
Range: 200uA, 2mA, 20mA, 200mA, 2A, 10A
Resolution: 10nA, 100nA, 1uA, 10uA, 100uA, 1mA
Accuracy: 200uA - 20mA +/-0.3% rdg +3 digits
200mA - 2A +/-0.5% rdg +3 digits
10A +/-1% rdg +5 digits (10A range unfused)
Max. I/P Amps: 10A (20A up to 60 seconds)
AC CURRENT:
Range: 200uA, 2mA, 20mA, 200mA, 2A, 10A
Resolution: 1nA, 10nA, 1uA, 10uA, 100uA, 1mA
Accuracy: 200uA - 20mA +/-0.8% rdg +10 digits
200mA - 2A +/-1% rdg +10 digits
10A +/-1.5% +5 digits (10A range unfused)
Max I/P Amp: 10A (20A up to 60 seconds)
RESISTANCE:
Range: 200, 2k, 20k, 2M, 20M ohms
Resolution: 10m ohm, 100m ohm, 1, 10, 100, 1k ohms
Accuracy: 200 ohm +/-0.2% rdg +5 digits
2k ohm - 2M ohm +/-0.1% rdg +3 digits
20M ohm +/-0.5% rdg +5 digits
OVERLOAD PROTECTION: 200 ohm 250V DC/AC rms, 2k-20M ohm 500V DC/AC rms

Cat. Q91560 ..... **only $175**

METEX 3800 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current Resistance and Diode, for testing Audible continuity and transistor hFE The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication Full overload is provided It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications

Features...
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- ½" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Diode testing with 1 mA fixed current.
- Audible Continuity Test
- Transistor hFE Test

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

Cat Q91530 Normally $109
SPECIAL $79

METEX 3530 MULTIMETER

This instrument is a compact, rugged, battery operated, hand held 3½ digit multimeter for measuring DC and AC voltage, DC and AC current, Resistance and Diode, Capacitance, Transistor hFE and Continuity Test The Dual-slope A-D Converter uses C-MOS technology for auto-zeroing, polarity selection and over-range indication Full overload is provided It is an ideal instrument for use in the field, laboratory, workshop, hobby and home applications

Features...
- Push-button ON/OFF power switch
- Single 30 position easy to use rotary switch for FUNCTION and RANGE selection
- ½" high contrast LCD
- Automatic over-range indication with the "1" displayed
- Automatic polarity indication on DC ranges
- All ranges fully protected plus Automatic "ZERO" of all ranges without short circuit except 200 ohm Range which shows "000 or 001"
- High Surge Voltage protection 1.5 KV-3 KV
- Capacitance measurements to 1pF
- Diode testing with 1 mA fixed current.
- Audible Continuity Test
- Transistor hFE Test

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

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

WELLER WTCPN SOLDERING STATION

The WTCPN Features:
- Power Unit 240 V AC
- Temperature controlled iron, 24 V AC
- Flexible silicon lead for ease of use
- Can be left on without fear of damaged tips!

The best is always worth having.

Cat. T12500 ..... R.R.P. $149
SPECIAL, ONLY $129

CORDLESS RECHARGEABLE SOLDERING IRON

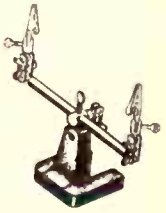
- Built in solder point illumination
- Easy replacement of solder tip
- Protective stand which also functions as charging unit
- Sponge pad attach to stand
- Plug pack power adaptor
- Includes Nicad battery
- Instruction manual
- 12 months warranty

Cat. T12480 ..... Normally $79.95
SPECIAL, $69.95

SCOPE 60W SOLDERING SYSTEM

- Infinitely adjustable temp. 200 C to 470 C. Sliding control selects desired tip temperature (LED readout monitors tip temp.)
- Safety holder features ceramic burn-proof bush and can be converted to left-hand-side
- Soft and cool hand grip in pliable rubber
- Screw type connector prevents accidental plug removal and guarantees solid contacts.
- Temperature lock allows production supervisors to control soldering temperatures
- Anti seize tip retention design reduces risk of thread seizure by removing locking nut to cooler end of barrel.
- Optional 30W soldering pencil is available for finer work.

Cat. T12900 ..... **Normally $229**
SPECIAL $199



PC BOARD HOLDER

Better than an extra pair of hands!
A must for all PCB work

Cat. T12444 ..... **$9.95**

SAVE!

IBM* XT COMPATIBLE COMPUTERS $795*

Check these features and our prices. We're sure you'll agree they're exceptional value for money!

- Assembled in Australia!
- Tested by us for 24 hours prior to delivery!
- 150W power supply
- AT style keyboard
- 8 Slot motherboard
- 6 months warranty!

(Japanese drives available for an extra $50 each)
(4.77/8MHz Turbo Motherboard with Soft/Hard switch, available for an extra $100)

* $795 COMPATIBLE COMPUTER

256K RAM Single Drive, Graphics and Disk Controller Card $795

256K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card,(which has Disk Controller, Clock/Calender including Timer disk, 1 Serial Port, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card. $1,095

640K RAM COMPATIBLE COMPUTER

2 x 360K Disk Drives, Multifunction Card,(which has Disk Controller, Clock/Calender including Timer disk, 1 Serial Port, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card. ..... only $1,150

20 M/BYTE HARD DISK COMPATIBLE COMPUTER

20 M/Byte Hard Disk, 360K Disk Drive(s), 640K RAM, Multifunction Card, (which has Disk Controller, Clock/Calender including Timer disk, 1 Serial Port, 1 Parallel Port and 1 Games Port) and your choice of Colour Graphics Card or Monochrome Graphics Card.
Single 360K Floppy Disk Drive ..... only $1,850
Dual 360K Floppy Disk Drives ..... only $1,995

IBM* TURBO AT COMPATIBLE $2,795

ASSEMBLED & TESTED IN AUSTRALIA!

- 1 M/Byte Main Board
- 1.2 M/Byte Floppy Disk Drive
- Colour Graphics Display Card
- Floppy & Hard Disk Controller Card
- Printer Card and RS232
- 200W Power Supply
- 10 MHz
- 80286 CPU
- 8 Slots
- 20 M/Byte Hard Disk
- Keyboard
- 6 Months Warranty

IBM* BABY AT COMPATIBLE $2,795

Switchable 8/10/12 MHz

VERBATIM DISKS!

(All prices per box of 10 disks)

Description	1-9 boxes	10+
3¼" 1S/2D	$47.50	$46.50
3¼" 2S/2D	$49.50	$48.50
5¼" 1S/2D	$24.95	$22.50
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NEWS DIGEST

Search and Rescue

PCM Electronics of Melboume have just landed a contract from Astro-Pacific (a combination of Hawker Pacific and Canadian Electronics) to supply and develop front-end electronics for use in the ground stations of the COSPAS-SARSAT search and rescue satellite system.

Under the terms of the contract, PCM Electronics, with support from the Univer-

COMING EVENTS

September

LABEX '87 will be held in Melbourne from September 7 to 10. This exhibition is geared to displaying 'every aspect of the laboratory activity'. For more information ring BPI Exhibitions LTD, Sydney (02) 266 9799 or Melbourne (03) 699 9266.

ECOC '87 The European Conference on Optical Communications will be held in Helsinki's Finlandia Hall. For more information contact The Consulting Committee of the Professional Electroengineer Organizations in Finland (CPEF) c/o Sahkoinsinooriliito, Mr Heikki P S Leivo, Merikasarmink. 7 J 53, 00160 Helsinki, tel (9) 0 71 050.

The Australian Video Festival Awards, which are sponsored by Sony are to be held in Sydney from the 4th to the 10th September. There are a number of awards ranging from Video Art to home videos. For more information telephone Sydney (02) 360 2325.

Australian Computer Exhibition and Conference will be held in the Royal Exhibition building in Melbourne over 8-10 September. Ph Riddell House Promotions (03) 429-6088.

Keksinto '87. An International exhibition of industrial inventions will be held in Jyvaskyla Finland Sept 15-18. For more information contact Jyvaskylan Messut, PB 127, 40101 Jyvaskyla, FINLAND (9) 41-611 288.

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

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

APCON, the annual convention of the Sydney PC Users Group, takes place over the 22 to 23 of September. Wayne Ratliffe, the author of dBASE will speak at the convention. Contact the coordinator Geoff May on (02) 699-3518 or the Group's president Ron Pollak (02) 290 3655.

October

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

The 38th International Astronautical Congress will be held in Brighton, England, 10-17 October. The theme 'thirty years of progress in space' will be developed through in series of symposia. Contact the Astronautical Society of WA, COSSA, (09) 397 5642.

The CAD/CAM version of the Whats New Products Show will be held at the Homebush State Sports Centre, Sydney. Contact G. Maugham (02) 487 2700.

Industrial Vision by Computer is the name given to a seminar organised by the French-Singapore Institute. It

sity of Queensland, will modify equipment currently being produced for the NOAA weather satellite stations and will deliver two units to Astro Pacific for initial prototype testing.

The front-end electronics consist of a channel filter, low noise amplifier and down-converter unit which pick up satellite signals directly from the tracking antenna, shifts them to a lower frequency and sends them to the ground station's electronic processing system.

will take place over October 26-30 in Singapore. The seminar is designed to examine most factors concerning factory automation. For more information contact the French Singapore Institute 12 Scienc Centre Road, Jurong, Singapore 2260, tel 56 1140.

November

A Professional and Commercial Radio Communications Show will be held in Sydney, November 4-5. For more information contact Westwick Farrow (02) 487 2700.

The International Robot Show is scheduled from the 7th to 10th of November at Sydney Centrepoint. Sponsored by the Australian Robot Association the show will display and explain the many functions of modern robots. Australian Exhibition Services Pty Ltd, Illoura Plaza, 424 St Kilda Rd, Melbourne, VIC 3004. Tel (03) 267 4500.

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

Globecom '87 — Global Communications Conference will be held in Tokyo Japan 15-18 November. For more information contact H. Miyakawa, Dept of Electrical Engineering, Faculty of Engineering, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113, Japan. Telephone 812 211, ext 6654.

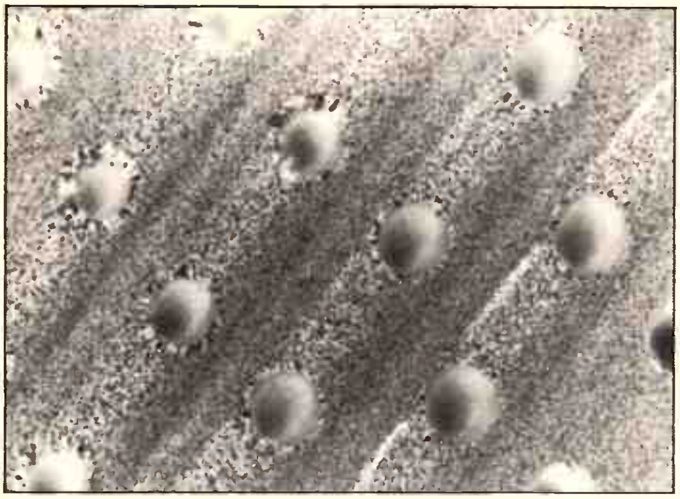
Australian Joint Artificial Intelligence Conference. This will be held in the Masonic Centre in Sydney. Contact Professor John Gero, University of Sydney, NSW 2006. Telephone (02) 439 0033.

The First International Pacific Air and Space Technology Conference will be held in Melbourne over November 12-17. The Conference is being sponsored by the North American and Australasian Societies of Automotive Engineers with the theme "The Global Challenge in Air and Space". Please contact Mrs Jill Atkinson, Melbourne (03) 654-7533.

CALITE '87, the fifth annual conference on Computer-aided learning in Tertiary Education will be held at Sydney University from November 30 to December 2. Contact the Continuing Education Support Unit, University of NSW, PO Box 1, Kensington, NSW 2033. Tel (02) 697 3175.

December

Intelligent Autonomous Systems Conference will be held over December 8-11 Amsterdam. Contact: Secretariat, Conference IAS c/o Congressbureau "Van Neutegen", PO Box 27783, 3003 MB Rotterdam; tel (010) 433 3179.



CDRAM Soon

Researchers at Philips Research Laboratories in Eindhoven have found a highly promising new group of materials for erasable, optical recording. These are semiconductor materials such as gallium antimonide (GaSb) and indium antimonide (InSb) doped with other elements, as in the manufacture of semiconductor material for IC chips. These new compounds have a number of specific properties that make them suitable for the repeated recording and erasure of information with a laser beam. Information is read out by the familiar laser-optical technique used in Videodisc and Compact Disc technology.

Development of an erasable optical disc would be a bonus for Philips. Currently Philips hold a patent on CD technology jointly with Sony. The importance of this situation is under threat because of the advent of Digital Audio Tape (DAT). DAT is fully recordable, and offers equivalent performance to CD's. Philips is concerned at the future of the CD market when DAT becomes available about mid 1988.

The essential differences between the various laser-optical systems are in the material on which the information is recorded and the way in which the information is 'written' on the disc. Videodisc and Compact Disc are pressed, with the information contained in the press pattern. The user can't change it at all. In the DOR system (Digital Optical Recording) the user can record information once only; this is done with a laser beam which melts a pattern of holes into the material.

Other methods and materials have long been sought that could be used indefinitely for recording, readout and erasure of information. The difference in reflection between the crystalline form and the non-crystalline (amorphous) form of the same material was a good starting point.

The information is recorded by rapidly heating small areas in a thin layer of crystalline material to slightly above melting point with a fairly powerful laser beam. These small areas then solidify (the 'supercooled phase'). This produces amorphous areas in a crystalline material and these can be detected optically by the variation in reflectance. The differences in reflection are quite sufficient for digital readout and sufficiently well-defined for the reproduction of analogue video signals.

Because the crystalline form of materials is the most stable, all materials naturally tend to change into this phase. This effect can be used to erase the information on the disc. Heating to just below melting point with a laser beam will return the material to its fully crystalline state.

These materials have a long shelf life and are insensitive to ordinary ambient temperatures and to humidity. Information can be erased and re-recorded about a thousand times, which is quite satisfactory for consumer applications, but not enough for professional use. Existing non-erasable discs can be played on equipment developed for erasable recording.

Scitec's Exports

Scitec communications of Australia has just received two major orders for its Saturn 20, 2 Megabit long range digital modem. The orders come from Koorcom which is a division of the giant Israeli Koor Corporation and Teleinform Ag in Switzerland.

Altogether Koorcom has ordered about 200 units worth a total of $US600,000. The modems will probably be used by the Israeli government's communications authority. The Swiss have installed their units into Swiss Air, Credite Suisse and a number of other corporations.

Errata

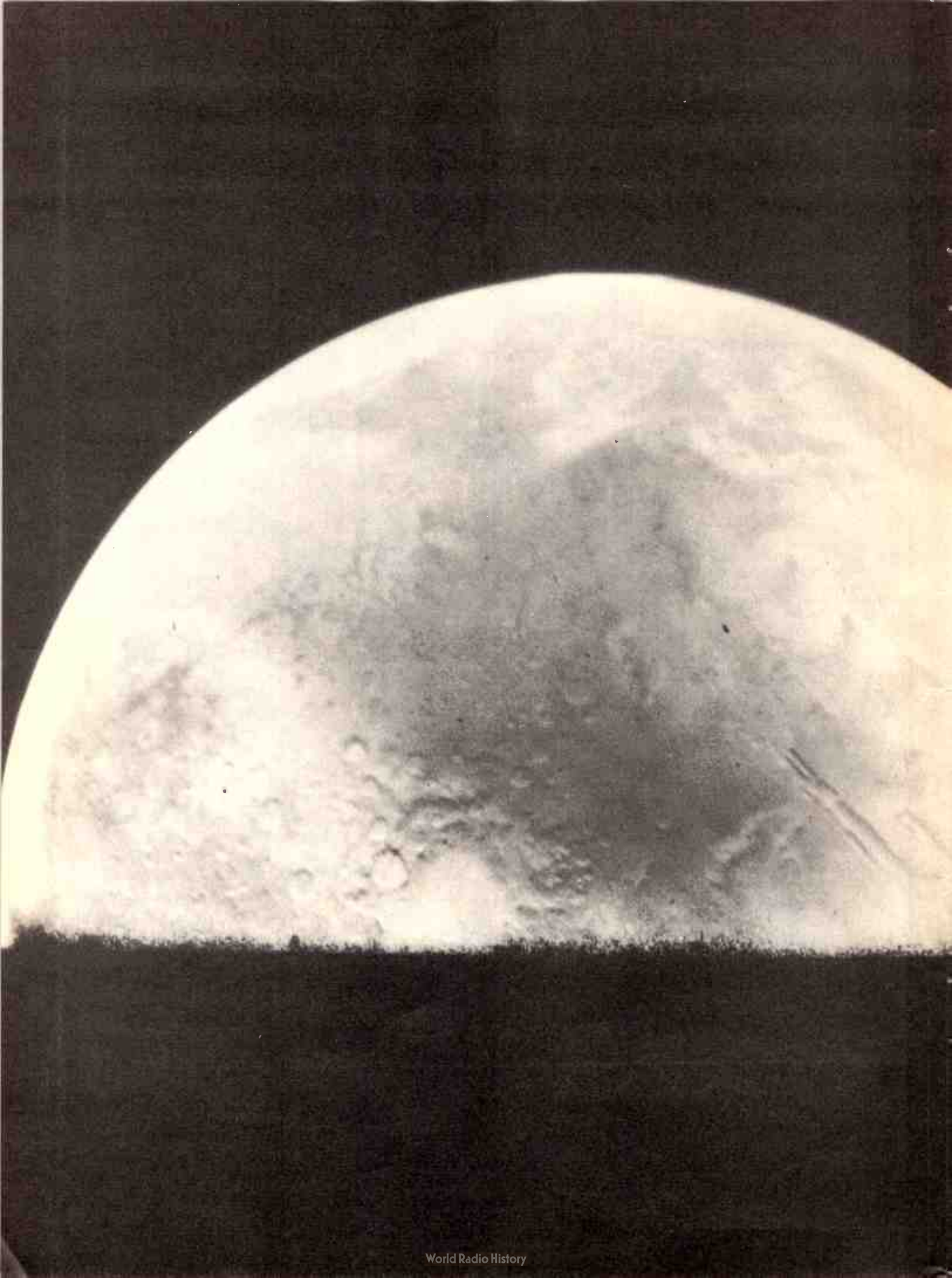
In our article on Do-it-Yourself TV published in May ETI, we stated that SAM Technologies was a Dutch firm, it is in fact an Australian one and rightly proud of the fact — mea culpa lapis lingui.

Services

READER SERVICES: All enquiries regarding back issues, photocopies of articles, artwork or technical enquiries must be directed by mail to ETI Reader Services, PO Box 227, Waterloo, NSW 2017. Enclose cheque or money order to the appropriate value with your request. Relevant charges including postage within Australia and New Zealand are: back issues $4, photostat copies $4 per article or $6 if project spreads over more than one issue, artwork $5 per board or panel up to 10 cm² or equivalent, $10 for larger boards.

TECHNICAL ENQUIRIES: Enquiries by telephone will only be accepted between 4.30 and 5 pm. Readers have two options: to submit a written enquiry with $5 money order or cheque and receive a postal reply. This service is limited to projects published within the last five years; alternatively, they may forward enquiry without money and expect a published reply in the Feed Forward column at the editor's discretion.

LIABILITY: Comments and test results of equipment reviewed refer to the particular item submitted for review and may not necessarily pertain to other units of the same make or model number. Whilst every effort has been made to ensure that all constructional projects referred to in this edition will operate as indicated efficiently and properly and that all necessary components to manufacture the same will be available, no responsibility is accepted in respect of the failure for any reason at all of the project to operate effectively or at all whether due to any fault in design or otherwise and no responsibility is accepted for the failure to obtain any component parts in respect of any such project. Further, no responsibility is accepted in respect of any injury or damage caused by any fault in the design of any such project as aforesaid.



RED STAR ON THE RED PLANET

The Russian assault on Mars is underway. Plans revealed recently have shown a sophisticated plan to get a man to the red planet within the next twenty years.

Kathryn Doolan

The Russians have announced their intention of going to Mars. During the next decade a flotila of robots will bounce, float, drill and dig across and into the Martian surface. It's the biggest, most comprehensive, and most expensive space plan to be announced since the Americans began their Moon plans almost twenty years ago. The first stage of the Soviet exploration of Mars involves sending unmanned probes to the planet, starting with the launch of two spacecraft to study Mars and its moon Phobos during 1988.

The first probe will study the evolution of Martian geology, atmosphere and climate. The craft landing on Phobos will deposit two small landers onto the satellite's surface for different purposes. One of the landers will be a long-stay, experimental package to study the soil content. It will also examine Phobos' journey around Mars and possible variations in the orbit. The other probe will be a "hopper". It will study the surface chemistry at several selected points on Phobos.

1992 will see the launch of a large satellite designed to make a thorough study of the Martian surface. Included in the 200 kg 250 kg payload will be a television camera for high resolution photography of the surface — the images obtained will be comparable to the LANDSAT photography of Earths surface. Spectral and radar analysis will study the changing Martian weather and detail chemical composition studies of the surface.

Perhaps the most fascinating experiment of this payload will be a double shell balloon. The balloon, reacting to the Sun's daytime heating of the Martian atmosphere, will fly over the surface during the day at an altitude of approximately six kilometres taking high resolution photographs. During the evening the balloon will descend to the surface and will sample the chemical composition of the soil at different landing sites. It is anticipated that in ten Martian days the balloon will travel 5000 kilometres and take sample at ten different landing sites.

At one stage a small rover was included in the 1992 design, but this has now been omitted because of lack of design time. However, it is expected that by 1994 the Soviets will have launched a Mars rover to coincide with that year's launch window. This mission would use two small robot "moles" to penetrate the Martian soil to a depth of 20 to 30 metres. One of the

RED STAR ON RED PLANET

Frost on the Martian Surface

"moles" would carry instruments to search for signs of life on Mars while the other will carry instruments for chemical analysis of the soil. Soviet space scientists are hoping to use the rover to carry out drilling and sampling soil and rocks at several locations and then analyse the results using the rover's small laboratory.

The culmination of the Soviet unmanned exploration of Mars will be the launch of a sample return mission in 1996. It is expected that international participation will take place in this mission. Currently French scientists are planning the mission profile with the Soviets deciding which experiments will be carried out.

The European Space Agency have expressed interest as well, and there is even the possibility that NASA will be participating.

After the comprehensive unmanned program is completed, the question of manned spaceflight to Mars will undoubtedly crop up. However the problems are formidable.

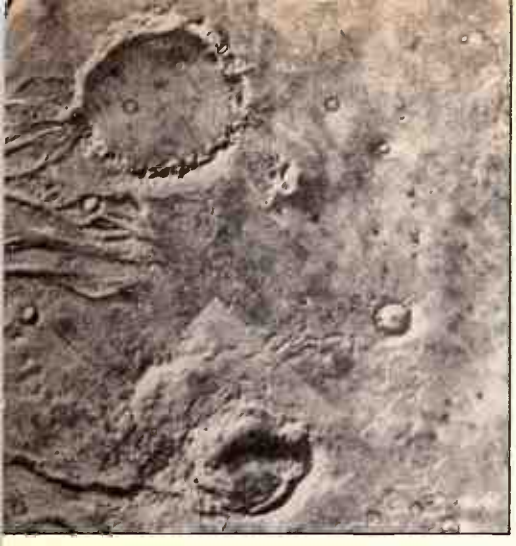
The Soviets have concentrated their efforts on long term manned space stations since the late 1960s (while the US was racing for the moon), with the intention of finding out how the human body reacts to weightlessness.

It has been found that in zero gravity the human body undergoes some drastic changes, including the deterioration of calcium in the bones, changes to the blood system, the heart and the kidneys. These changes take place over long term flights which are defined by the Soviets as being over 30 days in zero gravity.

The longest stay by the Soviets so far has been 237 days. The current crew of the "Mir" space station are expected to stay for months.

It has been determined that a flight to Mars and back will be between 700 and 1000 days, including a ten month stay on the Martian surface.

Both Russian and US doctors have stated that a practical spacecraft would have to provide some sort of artificial gravity for a long duration flight to help the crew come to terms with zero gravity.



◀ *Martian dry river channels*

▼ *Olympus Mons — The largest volcano in the solar system*

This solution would be especially necessary if the crew are expected to work on the Martian surface. Mir crew returning to Earth need to be helped from the landing craft and frequently can't walk for days or weeks on their return from orbit. However, extensive exercise programmes and special diets do seem to be able to reduce some of these effects, and they are still using Mir to extend the length of stays in space. When they reach three years, the Mars trip will be on! Interestingly, most of the effects of zero gravity seem to be reversable, so there is no long term damage as a result of space travel.

Another item of crucial importance is the life support system. Air, food, water and energy for a three year trip will be required. Some form of self sufficiency will be required as the spacecraft will simply not be big enough to hold three years' supplies for a number of people.

Currently water is recycled from body wastes on Mir and rudimentary efforts at growing food have been tried. If a manned mission to Mars is mounted in the near future, these items will be near the top of the list of difficult technical problems for planners. Either solar or nuclear energy would be required to power the spacecraft's systems. With safety issues taking a bigger part in all space programs — a safe form of nuclear energy will have to be developed, so as not to endanger the cosmonauts on board.

Once the craft gets to Mars it will have to be protected from temperature extremes, solar flares and meteorite showers and this again will pose serious questions for mission planners.

Man on Mars is a fascinating possibility for the human race. In a short 150 years the human race has progressed from the ground to the air, then to space and the moon. An expedition to Mars will possibly be the start of manned space flights to other planets and the opportunity for us or our descendants to make homes in space one day. ●

Kathryn M. Doolan is with the space association of Australia.

This month Paul Budde surveys the videotex revolution in France

Videotex News

When French Telecom (DGT) announced their plan to install free videotex terminals in 1979 most of the industry was unimpressed. The main argument against the French idea was that free terminals are useless if the users are not willing to use them.

The critics have been proven wrong. With 2.6 million users of whom more than 70 per cent are frequent users, the French DGT is a raging success. It is the most popular videotex service in the world.

The critics also predicted that there would be no demand for domestic use. Wrong again ... more than 65 per cent of the revenue comes from games, quizzes, horoscopes, chatlines and bulletin boards. Most popular are the sex services, including the now famous French dating service.

History

At the end of two videotex trials launched in 1980 and 1981, DGT decided in October 1982 to generalise videotex in France with the creation of a national distributed gateway architecture for videotex host computers (*the Servers*). This was based on the public X.25 packet switching network, Transpac, and the distribution of standalone videotex terminals (*the Minitels*). The network protocol used is X.29, an international standard (CCITT) endorsed by all computer manufacturers and used for classical remote data processing activities.

As a result, the computer can be used to provide services to videotex terminals and data processing terminals through the same network. The public switched phone network can be accessed via Videotex Access Point (VAP). VAPs are in fact electronic telephone switches and can handle 450 simultaneous calls. Acting as transit centres, they allow a variable billing mechanism based on the several different rhythms of the telephone pulsing to charge customers for using videotex services.

Videotex network capacity and traffic

The French videotex network now has 32,420 ports to which 10,560 access ports will be added for the Electronic Telephone Directory Service. That is a total of 42,980 ports.

To this figure must also be added the estimated 5,000 ports opened on videotex host computers not connected to the Transpac network but to the public switched telephone network. In some cases they are videotex "answering machines" with one access port only.

In February 1987, the videotex network received 39 million calls, representing about 4.15 million hours of connection time (125,000 hours in January 1985 alone). To this number must be added 869,000 hours of connection time to the Electronic Directory Service.

The average duration of one videotex session is 6.4 minutes. The average usage of the Minitel is 104 minutes per month for videotex and 22 minutes for the Electronic Directory, a total of 2 hours per month.

The Electronic Kiosk

In many cases, videotex service users wish to remain anonymous. DGT has provided for this by providing videotext kiosks, which function much like public telephones.

The principle is:

After having established a connection with the desired service available on the Electronic Kiosk, the user's telephone meter receives pulses covering on one hand the costs of using Transpac and the telephone network and on the other hand the videotex service charges.

For the time being the videotex service fee is the same for all Kiosk services and is based on the connect time to the service regardless of when the call is made. The service provider receives 5/8 of the amount collected by the DGT, which keeps the rest to cover communication and administrative costs.

International Access

To satisfy the demand from outside France for access to the Minitel service, the DGT has implemented three international direct dial lines. The English language version of the French Electronic Director can be accessed as well as the BBC news.

Paul Budde Communication is, together with Intelmatique France the international arm of the French Telecom organisation investigating the possibility of a gateway between Viatel and the French videotex network.

The Minitel today

The Minitels distributed by the DGT's commercial agencies in France are a compact, easy to use, portable, stand alone terminal comprising a 9" black and white screen, an alphanumeric keyboard with ten clearly identified function keys and a built-in modem. These terminals are leased with maintenance included for a minimum leasing period of six months.

A more sophisticated terminal, the Minitel 10, includes an integrated electronic telephone set and an electronic repetoire for local storage of several videotex services' phone numbers, plus autodial and autolog-on function.

In places where the Electronic Directory is provided as a substitute for the paper

Telebox

After the early rejection of the French way of videotex, more and more countries are now finding out that most probably it is the only way of establishing a profitable videotex service.

A new Australian company, Telebox, recently started a research program to find out if service providers of electronic services, hardware suppliers and data base and network operators are willing to combine their forces in order to bulk buy videotex terminals.

Telebox in its turn then will sell "cheap" terminals, modems, decoders, etc, to service providers, rental companies and directly to the users. Data base and network operators should financially support Telebox or share extra revenue with Telebox.

As the research only started recently, the results are not yet known.

directory, the basic standard terminal is available for an additional charge to phone subscribers as part of the normal phone subscription, just as for the standard telephone set. The terminal remains the property of the DGT.

The range of Minitels includes special units designed and marketed directly by the manufacturers to answer specific needs. Moreover, many emulators are used to change microcomputers into Minitels so as to handle videotex information locally. The most popular are Apple IIe, Macintosh, IBM PC and compatibles.

In June 1987, the number of Minitels installed in France reached 2,600,000 units. Another 35,000 Minitels were sold directly by the manufacturers. More than 210,000 terminals are leased (mostly by business users). This represents, added to the terminals sold, twice the number of Prestel terminals installed in the UK, and four times the total number of Bildschirmtext (Btx) terminals in West Germany. At the lowest estimate 3.2 million terminals will be installed by the end of 1987.

Minitel applications in France

There are more than 4,800 operational services in France on about 2,500 Servers. Although the videotex services designed for the general public are very successful in France, the business oriented services and the private videotex systems are still significant since they represent about 35 per cent of the total videotex traffic.

Applications are very diverse but the electronic mailbox service appears to be very popular. The various closed applications for inventory control and order entry, which require a lot of interactivity with Servers, are also very successful. Telebanking services continue to develop and expand rapidly. No less than 230 banks and financial organisations are involved in videotex.

In the field of "videotex for everybody" services, newspapers are in the top position and they offer services that go beyond their traditional publishing role; there is, for example, a craze for real time electronic chat lines and store and forward mailboxes. More than 60 newspapers in France are running a videotex service.

The Future

The frontier between videotex and remote data processing is fading. The reason is that production costs of any "old" style videotex service remains very heavy due to the inefficient, costly and oversophisticated presentation of the information displayed on the screen.

Today the emphasis is on application software. Servers must be capable to handling very efficiently a number of simultaneous calls and to react with speed and efficiency if they want to maintain their user's interest and prevent them from switching to a competitor's service.

Telephone companies in the US and organisations in the UK, The Netherlands and Germany are bulk buying French minitel terminals and are packaging these terminals in their videotex product. ●

ADVERTISERS' INDEX

Arthur Cushen tells us about sunspots and Bhutan in this, the first of his regular columns

Kilohertz Comment

SUNSPOTS ON WAY UP

The 11-year solar cycle, which govems shortwave frequency usage, has reached its lowest point and as sunspots begin to increase international broadcasters are beginning to schedule the use of the 13 and 16 metre bands.

The latest sunspot count is carried by Radio Australia and is also part of "Talkback" heard at 031OUTC on Sunday on 15240 kHz and repeated at 0710 on 9655 kHz. Radio Nederland "Media Network" also carries a sunspot and ionisphere prediction service at the end of the programme at 082O kHz on Thursdays on 9630 and 9715 kHz, which is repeated at 112 kHz on 6020 kHz and 96500 kHz. Both of these programmes are produced by Mike Bird of Radio Australia in collaboration with the Ionispheric Prediction Service in Sydney.

The prediction for the sunspot count in the coming months are September: 24; October: 25; November: 26; December: 28; and January, 1988: 31. This gradual increase will mean better high frequency reception.

BBC links relay by satellite

All the BBC relay bases overseas have now been linked by satellite to give better quality reception of the World Service and other language programmes. The last relay base to be linked was Lesotho in southern Africa, which is also to receive a second operating transmitter by the end of the year.

The new transmitter in Hong Kong is also expected to operate within the next two months, and will be linked by satellite as will the proposed BBC relay in the Seychelles. The BBC is now using two satellites, one over the Indian Ocean which feeds Cyprus, Masirah, Singapore and is intended to cater for Hong Kong and Seychelles, and another over the Atlantic Ocean which feeds Ascension Island, Lesotho and Antigua. There are six channels actually in use on the Indian Ocean satellite, with a dormant seventh which is intended to feed Hong Kong. There are five channels used on the Atlantic Ocean satellite.

The relay station which the BBC is building in Hong Kong, consists of two 250 kW transmitters, and four curtain antennas which will serve North Asia from China across to Japan. This new Hong Kong relay will generally improve reception in the area, which in the past has relied on rebroadcasts from Singapore.

Moscow moves clear channels

The end of the jamming of "Voice of America' broadcasts in Russia follows the discontinuation of the jamming of BBC broadcasts in January. According to Western sources the jamming costs the USSR US$800m. a year. The lifting of jamming means that many new channels and stations are now being clearly received.

On the other hand Radio Moscow seems to be interested in trying to improve its image as an organisation willing to co-operate in the sharing of frequencies. Recent comments to Radio Moscow about the use of historic frequencies which have been always designated to western broadcasters resulted in the reply that . . . "We have consulted our engineering service about the frequencies 9885 and 9895 kHz. They promised to apply to the Ministry of Telecommunications, with your complaint of bad quality reception of programmes on these frequencies . . ."

Moscow's schedule shows a huge amount of duplication of programmes which would lead one to expect that a reduction in the use of channels is necessary. At 0330 for example Radio Moscow's service in English is shown with 31 frequencies, while at the same time Arabic is carried on 10, English to Africa on 11, Chinese on 8, Spanish on 23, Swahili on 5 and Polish on 5 frequencies. This makes a total of 93 transmitters in use at 0330 carrying 6 languages. This saturation of the shortwave frequencies is the major cause of the interference problems facing foreign broadcasters. As a comparison the 'Voice of America' with its multi-language broadcasts is using 60 channels at the same time, while the BBC is also using around 60 frequencies to carry 11 languages.

Short waves

AUSTRALIA: The closing of the ABC shortwave service at Lyndhurst, Victoria has cleared four shortwave frequencies but has removed a reliable signal for listeners in Central Australia and the South Pacific.

Lyndhurst was first heard in March, 1934 when VLR commenced operation using 600 watts. Shortly after that in 1938 a 2 kW transmitter was installed and 6150 and 1188 kHz were added to the first channel of 9580 kHz. Radio Australia commenced operation on December 20, 1939 using the slogan "Australia Calling" and the VLR transmitter, together with two transmitters at Pennant Hill near Sydney were used.

By 1946 there were three transmitters, VLR, VLG and VLH all using either 5 or 10 kW, and in 1958 all transmitters were running 10 kW. The service to the inland of Australia is now provided by the high powered low frequency stations at Alice Springs, Tennant Creek and Katherine, thus reducing the value of VLR and the Lyndhurst transmitters.

BHUTAN: Broadcasts from Bhutan in the eastern Himalayas continue to be received on 6035 kHz with English from 1330. After opening announcements a news bulletin is presented, then rural news and other features with some light music before closing at 1359UTC.

NEPAL: Broadcasts from Kathmandu have been received on two frequencies, 3230 and 5005 kHz with English news at 1415 at the commencement of the transmission.

SAIPAN: KYOI the Super Rock station, has made a frequency change to its tranmission at 0200-0600. Broadcasts are now heard on 17780 kHz and the former frequency of 17775 kHz is now providing reception of Dubai, which in the past was covered by KYOI. The Dubai tranmission of news in English at 0530 on 17775 kHz is well received, while an earlier tranmission at 0330 from Dubai, UAE is available on 17890 kHz.

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

INTELLIGENT HOUSING

Mervyn Beamish

Think of the mangrove swamp of cables and wiring that your house currently contains; AC power cables, low voltage wiring for such things as door bells, television antenna coax, telephone and speaker cables, maybe thermostat and security wiring. Now look how your furniture, indeed how your whole house is laid out to function around the various fixed outlet points of this cabling. With 'intelligent housing' you will have a freedom to redesign both the furniture layout and function of your house. As an occupant of an intelligent, or 'Smart', house you will be able to plug into reading lamps, telephones or stereo speakers into specially designed power sockets anywhere within the house or yard.

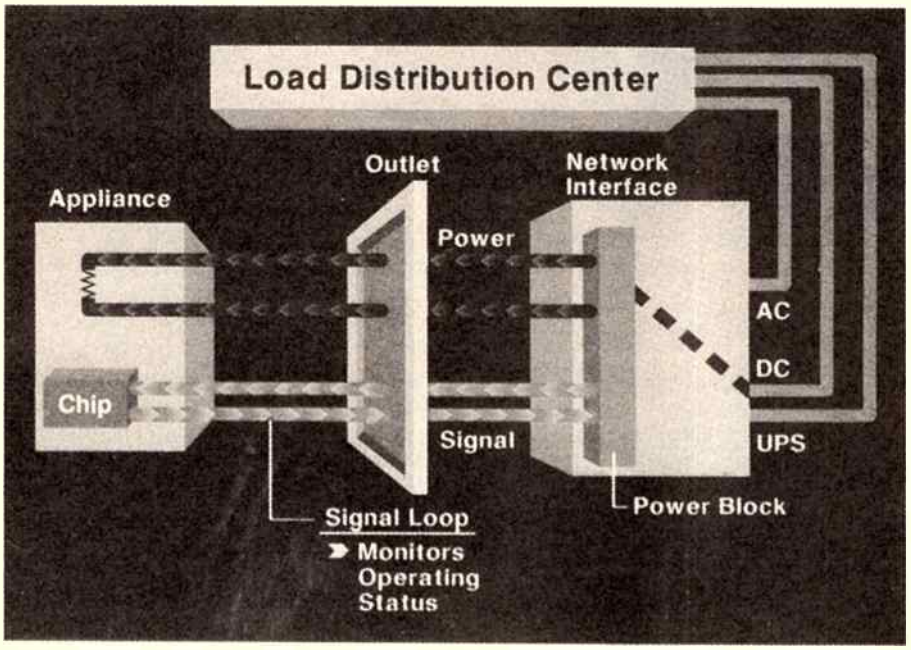
The term 'intelligent housing' is a little bit of a misnomer. In actual fact it is more an intelligent cabling system that can be installed within existing homes or built into new constructions. It is based around a single cable linked with a controller system which performs three primary functions:

1) Programmable power distribution.
2) Control/data signal distribution.
3) Audio/video signal distribution.

Power

Power is distributed on a closed loop system that continually monitors the performance of all electrical devices. It removes power from those not in use, raises the alarm if one starts drawing more energy than it should (i.e. needs maintenance), eliminates shock and reduces electrical fire hazards.

The whole system is computer controlled and each device has an inexpensive chip built into its circuits that identify it and specifies its power requirements. You would be able to plug a 9 Vdc radio into the same power outlet as a 240 Vac washing machine. When a device is not in use the power is cut off, except in such cases as a computer, or the deepfreeze. The sys-



Once an appliance identifies itself and signals for energy, it is supplied and its use is continually monitored. AC or DC may be called up by the appliance. A low-voltage uninterruptable power supply (UPS) maintains signalling operations should main power fail. In the case of gas interface monitors pressure and flow.

tem can also control gas appliances as well. One immediate effect is a saving in power consumption.

The controller doesn't just switch the power on and then go back to sleep, it constantly monitors each appliance which, in turn, is constantly sending signals back to the controller. If a plug becomes faulty, or there is a sudden power increase, or decrease; a capacitance effect caused by a frayed cable; a little finger in a socket; the controller will act immediately with the appropriate response be it cutting the power, instructing the device to slow down, or calling in a serviceman.

The ability to program power output, for example supply dc or ac current on demand, will have an effect on the design of domestic appliances. It is cheaper and easier to build washing machines and cloth driers with dc motors than ac ones. Some imported appliances will work on 110V ac, others 32V dc. The controller can channel the correct power to each individual appliance.

Talking Houses

Various sensing devices can be applied to the loop and monitored by the system controller. Sensors to detect specific

odours, smoke, heat, sound, movement or light can obviously be combined to make effective security and fire detection systems. They also can assist in day to day household safety — an elderly person falls in an otherwise empty house, the house can detect the fall, react to a cry for help, or note the lack of movement from an unconscious occupant and call for help. The system will detect a hotplate on a stove accidentally left on and notify an occupant using voice synthesis, or not permit a child to play with the gas cooker while there is no adult in the house.

The system is not confined to the perimeters of your house and yard. Your house can communicate, via telephone, to police, ambulance, fire brigade and your own cellular telephone if you wish. You can phone the house and instruct it, using the telephone key pad, as to what time to start dinner, or confirm the identity of a visitor or repairman so that they can gain entry when you are not there at the same time telling it to close off sections of the house that they have no need to enter. Obviously this facility will become more effective with computer voice recognition.

This communications ability can decentralize the control system so that it can be part of a commercial network of distributed intelligence.

How Realistic Is It?

All of this is here now. The Europeans, Japanese and Americans are sorting out compatibility problems in their whitegoods and audio/visual areas. The National Research Center of America has set up a Research program (called 'Smart House') that has already built and tested houses, is running training courses for builders and has conferences and mobile exhibitions. The Japanese have developed and commenced installation of the microchip technology into entertainment and other household appliances.

Australia is not out in the cold either. Our own National Building Technology Centre (NBTC), in North Ryde, is ready to move at industry's request having already compiled contacts with the main players in the game. Graham Millett of NBTC says that they are planning a seminar on the subject later this year or early next, accoding to demand. Len Wallis Audio of Lane Cove has introduced on to the market an audio/visual and domestic environment cabling and control system which demonstrates a significant step in the demonstration of intelligent housing within Australia. Also, in our big commercial complexes, such as the new IBM Center, the technologies and control systems are functioning and becoming accepted by both architects and designers, who, in the not too distant future, will be using similar devices within domestic buildings.

It is envisaged that by late 1988 or early 1989 intelligent housing will be a markable domestic product and a recognised industry within the USA. Australia will start seeing these houses shortly after the US, maybe with control systems that open and close blinds and moving solar collectors to take advantage of sunlight and the free energy it supplies, or aiming our dish antenna for reception of overseas television programs. We may actually complain because, just at a highly romantic and sensual moment in our video program, the house flashes a sign on the video screen telling us the dishwasher has finished the dishes, or that the cat wants to go out!

Whether you interpret these developments as the horrors of Orwell's '1984', or the wonders of Clark's '2001', makes little difference — time and technology, it seems, waits for no man. ●

HIGH TEMPERATURE SUPERCONDUCTORS

Progress contniues, but stable room temperature remains elusive.

J. C. Macfarlane and D. M. Eagles

Since the announcement by research scientists at the University of Houston, USA, in February of this year that they had observed superconductivity in a compound involving yttrium, barium, copper and oxygen at temperatures above 90 degrees Kelvin (ie −183°C), there has been a very rapid growth in activity in this subject throughout the world. A description of these materials and some of their applications was given by Bob Beale in the July 1987 issue of ETI.

Since that article was written, workers in the USA, Japan and China have made other similar compounds with the difference that yttrium is replaced by other rare-earth elements. Almost all rare earths have been successfully substituted except, as far as we know, cerium and terbium, and transition temperatures close to 90K have again been found. This is an important finding, because some of the rare earths, notably lanthanum and neodymium, are cheaper and more abundant than yttrium.

Reports have also been received that tend to confirm the rumours of higher transition temperatures mentioned in the July article. On June 4, John Bell of this Division was informed by Professor C. W. Chu that he and his co-workers at Houston had observed zero resistance at 225K, (−48°C), in a compound which he would not identify. The phase involved was not stable, and the superconductivity was not present after two weeks.

The most obvious property of superconductors (which of course gave rise to their name) is the complete vanishing of resistance below the transition temperature. This property is expected to find its principal application in the construction of high-field magnets with lossless windings. Such magnets would be used in electric motors, power generators, magnetic resonance imaging devices for medical diagnosis, and in scientific research, eg: in nuclear particle accelerators.

The ability of the new superconductors to carry sufficiently high currents in wires (at least 10^3 amps/square centimetre) has not yet been proved, however, and a great deal of technological development will be required in this area. But there are other applications of superconductors which do not require the use of extremely high currents, and these are at present the subject of intensive study in many laboratories around the world. Some examples of the work going on at the CSIRO Division of Applied Physics will be used to illustrate the range and diversity of these possible applications. An illustration of one of the effects of superconductors is shown in Fig. 1, where a rare-earth based magnet is levitated above a slab of superconducting material prepared in the Division.

Work in progress

CSIRO Division of Applied Physics, located in the National Measurement Laboratory, Lindfield, NSW, has a history of achievements in superconductivity going back to 1970 when it was one of the first national laboratories in the world to develop a highly-accurate voltage standard based on the Josephson effects in superconductors. Since then the Division has gained an international reputation through its contributions to superconductivity, particularly in the field of measurement science. It was no accident, therefore, that the Division quickly established itself as one of the leading Australian centres for the development of the new high-temperature superconductors. Not only did the Division have the relevant expertise in superconducting technology, it was also fortunate in having among its staff a number of experts in rare-earth materials. It was a natural extension of their ongoing work to swing into the production of superconducting materials such as yttrium barium copper oxide. So it came about that on April 2, 1987, the Division was amongst the first Australian groups to achieve superconductivity at liquid nitrogen temperatures. Since then work has proceeded at a rapid pace, firstly to characterise the new materials that were being produced and determine their critical properties; and subsequently to identify applications for high-temperature superconductors in areas where the Division is particularly well equipped, and to focus on two or three well-defined goals which hold promise of success for Australian industry.

Highlights of current work

1. Materials

Work has concentrated until now on yttrium barium copper oxide, the first known material to become superconducting in liquid nitrogen. The starting materials are the separate oxides or carbonates of yttrium, barium and copper; they are thoroughly mixed and ground together in powder form in the correct 1:2:3 atomic proportions, then heated at 900-950°C for 30 hours in air. They are ground again, pressed into the required final shape in a hydraulic press, sintered at 900°C for 6 hours, annealed at 400°C and slowly cooled. A typical resistivity vs temperature curve is shown in Fig. 2; the material becomes superconducting below 93K.

Since this article was written the temperature at which superconductivity has been observed has risen to higher and higher temperatures. An article in the science journal *Nature* (327, 658; 1987) summarising recent developments, reports transition temperatures in a yttrium-barium compound at 220 K. This is attributed to D Djerek at Zagreb University. CW Chu at Houston University reports that in these compounds resistivity reduces in steps at 240 K, 220 K, and 190 K before becoming truly superconducting at 90 K. This has led to the suggestion that there might be phases within the material that become superconducting at these temperatures. The challenge of course is to determine what the compound is, and then to isolate it. Other workers have reported the effect in fluorinated compounds ($YBa_2Cu_3F_20_Y$) at 155 K. Apparently the Meissener effect in these materials is very small, and magnetic flux exclusions of less than 4% are typical.

Meanwhile, superconductor scientists have been meeting at Berkeley in California to assess the state of play. 400 physicists assembled at the end of June and agreed there is a lot they don't understand. One of the big worries is that many of the experimental results appearing in scientific literature appears unverifiable.

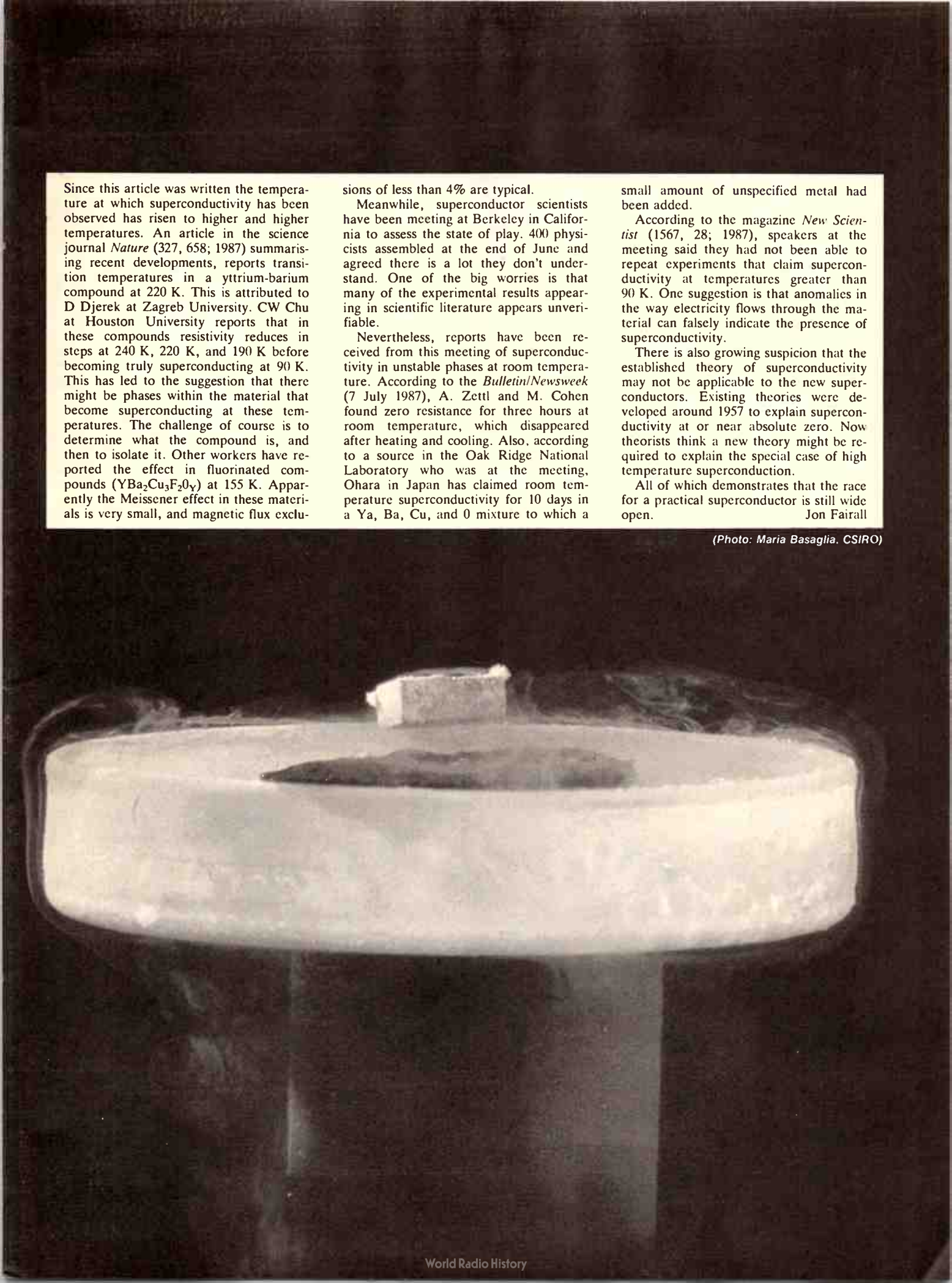
Nevertheless, reports have been received from this meeting of superconductivity in unstable phases at room temperature. According to the *Bulletin/Newsweek* (7 July 1987), A. Zettl and M. Cohen found zero resistance for three hours at room temperature, which disappeared after heating and cooling. Also, according to a source in the Oak Ridge National Laboratory who was at the meeting, Ohara in Japan has claimed room temperature superconductivity for 10 days in a Ya, Ba, Cu, and 0 mixture to which a small amount of unspecified metal had been added.

According to the magazine *New Scientist* (1567, 28; 1987), speakers at the meeting said they had not been able to repeat experiments that claim superconductivity at temperatures greater than 90 K. One suggestion is that anomalies in the way electricity flows through the material can falsely indicate the presence of superconductivity.

There is also growing suspicion that the established theory of superconductivity may not be applicable to the new superconductors. Existing theories were developed around 1957 to explain superconductivity at or near absolute zero. Now theorists think a new theory might be required to explain the special case of high temperature superconduction.

All of which demonstrates that the race for a practical superconductor is still wide open.

Jon Fairall



(Photo: Maria Basaglia. CSIRO)

2. Thin films

It is certain that applications of the new superconductors will include their production in the form of thin films. Examples of such applications include the use of loss-free interconnects in integrated circuits, and the development of faster computer circuits. The Division has extensive experience in thin-film technology. Work is under way on the preparation of thin films of yttrium barium copper oxide by several techniques, including ion-beam sputtering, magnetron sputtering and electron-beam evaporation. Plasma spray coating is also being investigated for the treatment of large areas.

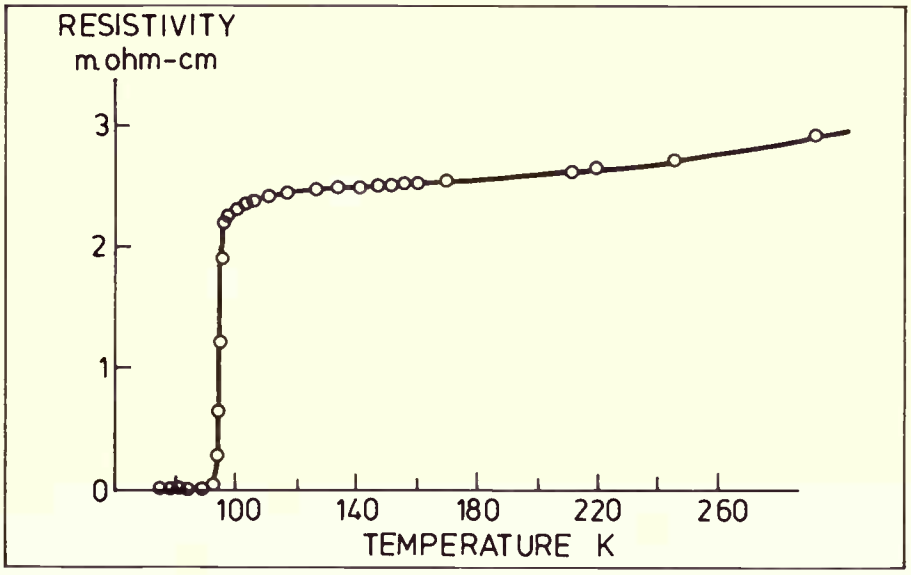


Figure 1: Neodymium-iron-boron magnet levitating in a magnetic field due to persistent circulating currents in a sample superconductor produced by R Driver, CSIRO.

3. Electrical devices

The sharp transition in the resistivity shown in Figure 2 is accompanied by an equally dramatic change in the magnetic properties of the material. A universal property of superconductors is their complete exclusion of magnetic flux for fields less than some critical value. An inductor wound on a core of such material therefore has a sharp change in inductance as the material becomes superconducting (Figure 3). These effects, when studied in detail, suggest a number of possible applications such as sensitive heat sensors (bolometers) and field or temperature dependent inductors.

4. Magnetic sensing devices

For at least a decade, it has been possible with "conventional" superconductors working in liquid helium to detect extremely weak magnetic fields by means of the device known as a SQUID (Superconducting QUantum Interference Device). This essentially is a ring of superconductor broken in one or more places by a "weak link" or Josephson junction. It has applications in precise measurement technology, advanced computers and in

wider areas such as bio-magnetism where the magnetic fields generated by nerve currents in living organisms can be detected. Neurological research has become a growing area for the application of superconducting instrumentation, and the Division is engaged in a collaborative project with Westmead Hospital on the development of improved SQUID devices for this work. It is clear that enormous benefits in cost and convenience would be achieved by the use of liquid nitrogen rather than liquid helium.

CSIRO and Industry

The above examples illustrate some possible applications of the new high-temperature superconductors in areas related to electronics. Other applications could emerge, some of the more obvious possibilities being in transportation (magnetically-levitated vehicles), electric power generation and distribution (lossless machines and transmission lines), magnetically shielded enclosures (superconducting walls), and infra-red imaging detectors (superconducting-transition bolometers).

CSIRO, and the Division of Applied Physics in particular, is actively seeking expressions of interest from industrial or commercial partners with the goal of developing products and devices based on high-temperature superconductors. There may be a long way to go before these new materials can be turned into profitable products but it is certain that the only way to be in a position to exploit the applications when they emerge is to be in at the beginning. ●

Enquiries about the superconductivity project at the Division of Applied Physics should be directed to John Macfarlane or Ian Harvey, telephone no. (02) 467 6211.

The authors are at the CSIRO Division of Applied Physics, Lindfield, 2070.

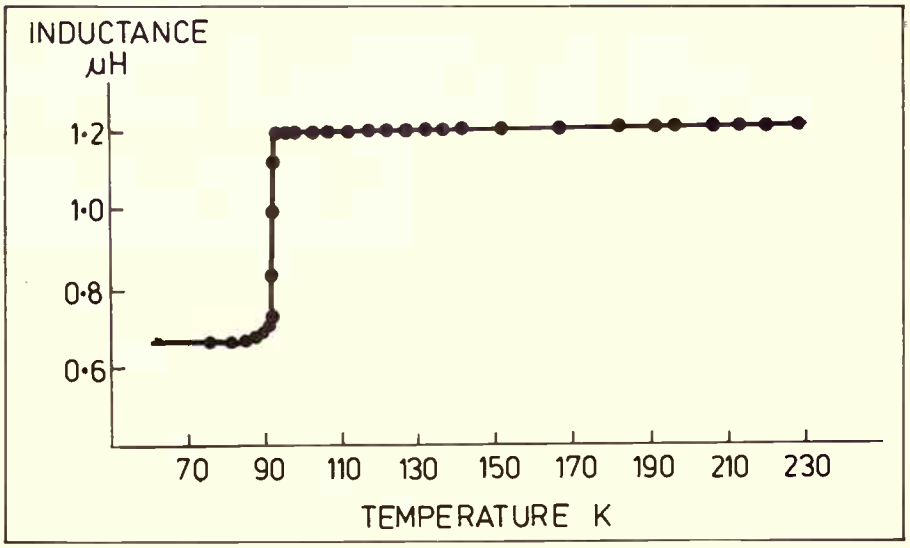


Figure 2: A typical resistance versus temperature graph for a superconducting material showing superconductivity at liquid Nitrogen temperatures.

Part II

A PRACTICAL INTRODUCTION TO RADAR

In this second article the concepts of frequency-modulated carrier wave radar are explained and its advantages, disadvantages and uses are discussed.

John Bell

Last month the elementary principles of simple ground-based Doppler and pulse radars were discussed. It was noted that the Doppler system would give target speed and indicate whether the target was approaching or receding from the radar but could not give target position. Conversely it was noted that the pulse CW radar defined target position but not speed. It was also noted that neither system was capable of positively identifying a specific target and that the pulse radar system described had no in-built features to determine aircraft height. Furthermore, it was pointed out that a simple pulse radar system would display returns from both moving and static targets simultaneously. Therefore, moving target(s) could well be obscured by "clutter" unless special design features were incorporated.

New Concepts

Before introducing any new concepts, various improvements to the two basic systems need to be made to make them more likely to suit operational requirements. We will regard "major operational requirements" as consisting of the ability to measure and display radar-to-target range and position and the ability to determine as much information about the target as possible. In practice, of course, there will be significant variations between different requirements and these are defined according to the purpose to which the radar is to be put: for instance, the needs of an aircraft pilot using radar as a navigation aid are quite different from those of air traffic control (ATC) radar operators controlling aircraft in the vicinity of a busy airport. Similarly the needs of a meteorologist will differ too.

In the following discussions we will concentrate upon systems used to determine the position, and if possible the nature, of targets relative to the radar rather than in the determination of target speed alone. In general it is helpful to consider the targets or users of the radar as being aircraft. It should also be realised that it is sometimes difficult to separate certain operational requirements from each other as these become exceedingly complex; put another way, although the basic principles remain the same the designer may be forced to integrate several concepts in one system.

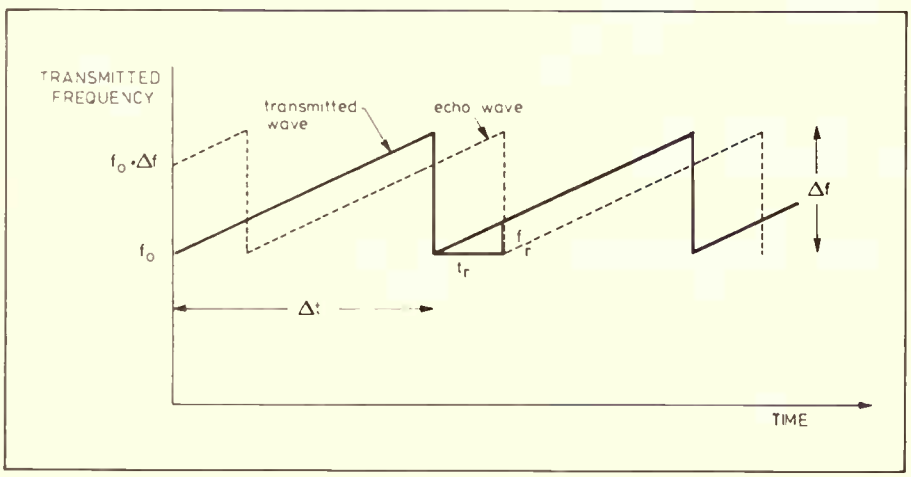


Figure 1 *The sawtooth frequency modulation of a CW of fundamental frequency f_0 by Δf in time Δt provides range information from a fixed target. The echo signal received will lag the transmitter signal by t_r and so if the frequency difference f_r is measured at this point the range may be determined and displayed.*

Frequency Modulated Doppler Radar

This is normally called FM-CW radar and it is of particular use in the measurement of distance to a clearly defined target. It is often used as a radio-altimeter by aircraft and in sounding equipment used by Meteorologists.

In FM-CW radar the basic carrier wave is frequency modulated so that the CW frequency is periodically altered at some linear rate. Figure 1 indicates the relationship between the FM-CW transmitted and echo waves when they encounter a fixed target. The FM-CW echo will be delayed by a given amount dependent upon the target's range. The difference in frequen-

cies f_d at this point is a measure of range because the nearer the target the less will be the frequency shift and conversely the greater the range the greater the frequency shift. The range may thus be deduced using the relationship:

$$R = \frac{ct_r}{2} \quad \ldots\ldots(1)$$

where c = speed of light ($3 \times 10^8 ms^{-1}$). Because there is a two way path to and from the target the factor two appears in the numerator.

FM-CW for moving targets

Consider the case where the target is moving towards a ground-based FM-CW radar; the basic building blocks and mode of operation are present in Figure 2. The situation has now changed from the static target case because the echo return now contains a Doppler shift (f_r) which will increase the apparent frequency. Figure 3 indicates the relationship between a carrier frequency (f_c) which is frequency modulated by a sawtooth sweep of frequency f_m for both the stationary and moving targets.

It will be seen that the echo frequency return is delayed by the simple factor t_r as in Figure 1 for the stationary target. However, if the target is moving towards the radar the resultant Doppler shift reduced the up-sweep frequency due to a stationary target by f_d: similarly on the down-sweep frequency the echo frequency is increased by f_d. The best frequency (f_r) is derived by mixing the transmitter frequency with the received echo frequency.

The net result is that, for an approaching target the up-beat frequency f_{up} is reduced by f_d which is increased on the down-sweep. Hence

$$f_{up} = f_r - f_d \quad \ldots\ldots(2)$$

and

$$f_{down} = f_r + f_d \quad \ldots\ldots(3)$$

Combining these equations the average beat frequency due to the target's range is found by dividing by two:

$$f_r = \frac{f_{up} + f_{down}}{2} \quad \ldots\ldots(4)$$

The range may then be computed using either of the following equations*:

$$f_r = \frac{4\,R\,f_m}{c} \quad \ldots\ldots(5)$$

or

$$f_r = \frac{4\,R\,f_r \Delta f}{c} \quad \ldots\ldots(6)$$

Comments on FM-CW radar

There are two principal problems with FM-CW radar which tend to restrict it's use to aircraft radio altimeters, meteorological measurements and other simple, or very specialised, cases.

The first problem arises because of the necessity to average out the beat frequency f_r between the up and down-sweeps to avoid duplication due to the two values of f_r.

This, in turn, means that if there is more than one target present it is absolutely essential to determine which echo frequency belongs to which target: more precisely, multiple echo frequencies will lead to all sorts of target number and range ambiguities unless extremely complex signal processing is used which would then complicate what is essentially a simple system. Just consider the problems faced if such a radar were to be used to monitor aircraft movements in the vicinty of a large airport.

The second major factor, and this is not entirely a drawback in all cases, is that as FM-CW operates on the basis of a continuous transmission special precautions must be taken to avoid unwanted transmitter power from leaking in the receiver circuits. It is for this reason that FM-CW transmitters are normally kept at low power levels (compared to pulse radars) unless the transmit and receive antennas can be physically separated at sufficient distance to avoid this problem.

One advantage FM-CW has over pulse-type radars is that the received signals may be processed almost continuously as opposed to the pulse-type system where the receive circuits lie dormant waiting for the return of a limited number of relatively high-power echoes. The radar engineer will say that FM-CW has a "high" (nearly 100%) duty cycle and that the pulse radar has a "low" (probably below 1%) duty cycle.

In summary one may conclude by saying that FM-CW is normally restricted to low-power ranging (and perhaps detection) applications involving a single target. More complex forms of FM-CW, backed by elaborate signal processing systems, may lead to its use where multiple targets are to be tracked. And, of course, the presence of Doppler shift allows target speed to be calculated if required.

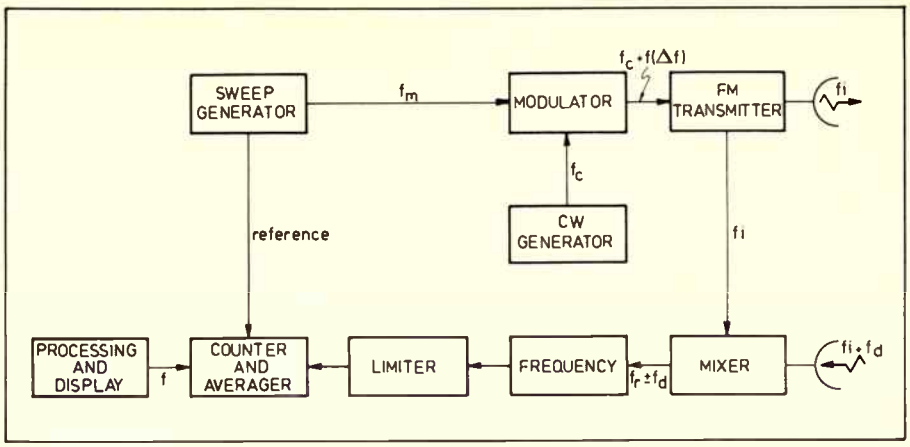


Figure 2 *The basic operation of an FM-CW radar to determine the range of moving targets is shown above. A CW is modulated at rate f_m which results in an instantaneous frequency (f_i) of $f_c \pm f(\Delta f)$ at any given time. The effect of a target moving towards the receive antenna is to increase f_i by the Doppler shift f_d. The time delay due to the two way path to the target and return also introduces a beat frequency difference (f_r) between the transmitted and received frequencies which allows range to be calculated once the Doppler frequency component is removed. The mixer produces $f_r - f_d$ on the transmitter frequency up-sweep and $f_r + f_d$ on the down-sweep; the signs of f_d would be reversed for a target moving away from the radar. The counters and averager remove the Doppler term to give the true beat frequency f_r for a single target and hence the radar-to-target range may be displayed.*

Primary and secondary surveillance radar

Some principles of pulse radar systems have already been discussed and it was noted that such systems are primarily used to plot the positions of targets relative to the radar system. Pulse radars may take several operational forms: typical examples include their use in tracking aircraft or ships from fixed or moving platforms, as mapping or navigational aids, as part of complex weapons or other instrumentation systems and so on. To be consistent the following discussion will continue to relate, as far as possible, to ground-based radar systems used for the detection and tracking of aircraft.

Ground-based radars operate in either the primary or secondary mode or both. In the primary mode the radar system receives an echo signal from a passive uncooperating target and processes it to obtain target position and, if possible, height. Hence in the primary mode the received echo from an aircraft is simply the reflected energy which originated from the transmitter's antenna system. The waveform received will thus be a much lower power version of the original pulse excepting that it will have been changed in frequency slightly by the Doppler shift if there is relative movement between the aircraft and ground-based radar. In the secondary mode the received "echo" is generated by a special transmitter, which

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* For the more mathematically minded

$$f_r = f_c t_r = \frac{2R\,f_c}{c} \text{ where } f_c = 2\triangle ff$$

forms part of a transponder system carried by the aircraft itself.

A transponder is a combination of a receiver, signal processing circuits and a transmitter. Normally transponders operate at frequencies well away from the frequencies used by the primary radar system although some part of the antenna system will be common. In general the standard transponder is activated by a (second) frequency of 1030 MHz, modulated by a special code, radiated from a second antenna mounted on the primary surveillance rotating antenna. Upon receiving the coded CW the transponder transmitter responds by sending coded data back to the secondary antenna using a modulated carrier of 1090 MHz. Transponders may operate in several modes. Typically, for a light aircraft with limited instrumentation they may only return data which identifies the aircraft. With larger aircraft the encoded data will contain other information such as aircraft height derived from the FM-CW or pressure altimeter as appropriate.

Because the transponder is an active device the signal strengths received at the ground-based radar antenna will be far in excess of those received by echoes from the simple primary system alone. Figure 4 outlines the differences between the primary and secondary surveillance systems.

It should be clear that the secondary system conveys several advantages over operation in the primary mode. For a start it allows aircraft to be tracked at greater ranges than would normally be possible in the primary mode: this increase in received signal strength also makes the radar system less weather dependent. Furthermore, aircraft carrying a transponder, not only allow the ground-based operators to uniquely identify the aircraft (so making aircraft control in high denisty areas possible) but they also give an accurate representation of aircraft height which allows cross checking between pilot and both ground-based and airborne instrumentation to be accomplished.

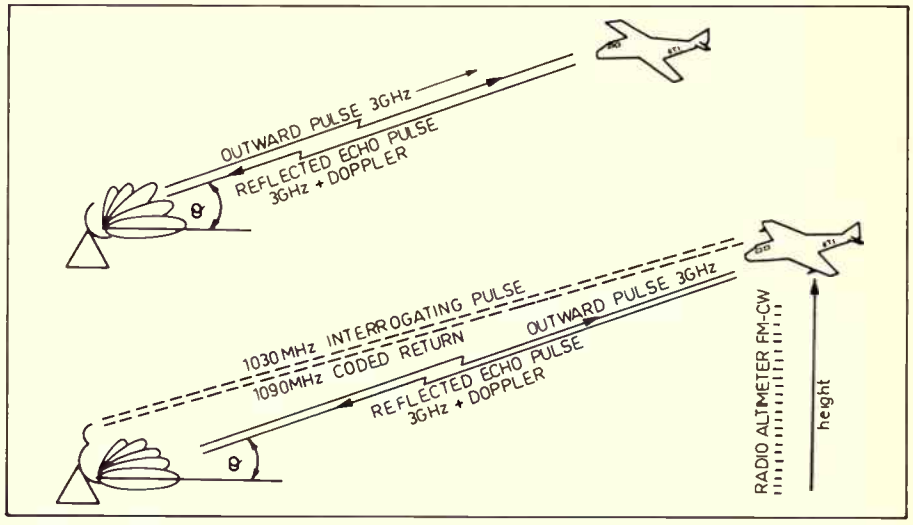

Figure 4 *A comparison of primary and secondary radar operation is made above. In primary surveillance, the angle of the reflected echo pulse (theta) is estimated by the receiving circuits associated with the individual antenna beams: knowing the delay the range and aircraft height may then be determined. The position in space is then known as the horizontal pointing angle of the antenna system. It is fed through to the receiver display circuits. In the secondary surveillance mode a second system interrogates the transponder which responds with a coded signal identifying the aircraft and if available, estimated aircraft height from on-board instrumentation. As in the primary mode the aircraft position is space relative to the radar, or any other fixed point is then displayed. In large installations both modes of operation will be used depending upon operational requirements at a given time.*

The use of secondary surveillance systems originated during World War II where it became necessary to be able to identify friend from foe (so leading to the name IFF) as aircraft were brought to battle. Today, of course, the Military still use IFF; indeed it is more important today as the reaction times available are short and as some weapons systems are almost automatic it is essential to take all reasonable precautions to avoid shooting at one's own aircraft.

The display of information to the ground-based air traffic control operators using primary and secondary surveillance radars allows much cross checking to be done. Furthermore the displays allow operational staff to survey the position and height of uniquely identified aircraft within a given controlled airspace. It also assists them in spotting aircraft which may have unintentionally strayed into controlled airspace.

Without pursuing the subject at this stage it may be observed that military requirements will differ from civilian requirements in the applications of radar. Put another way, civilian and friendly aircraft will be doing their best to cooperate with the system whilst an enemy will be doing their best to defeat it.

In the next article some more principles and practice will be introduced prior to having a closer look at high-power pulse radars and an elementary analysis of some particular facets of the application of radar to the real world. ●

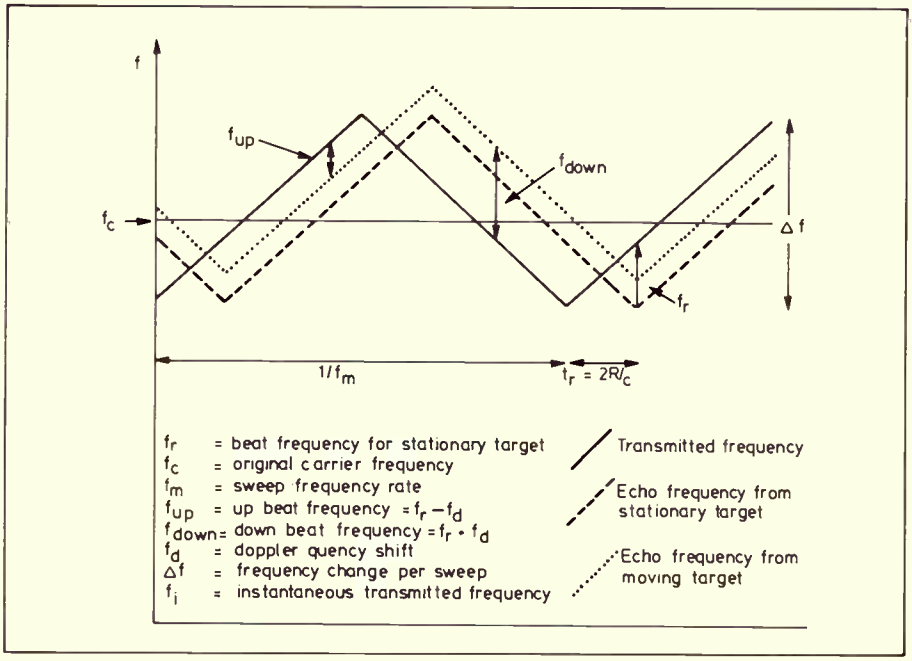

Figure 3 *FM-CW may be used to determine the range of a moving target. The CW of frequency f is modulated in frequency over a period $1/f_m$. On the up-sweep the echo signal range frequency f_r will be reduced by the Doppler shift f_d whilst on the down-swing the echo frequency will be increased by f_d. The range may then be deduced.*

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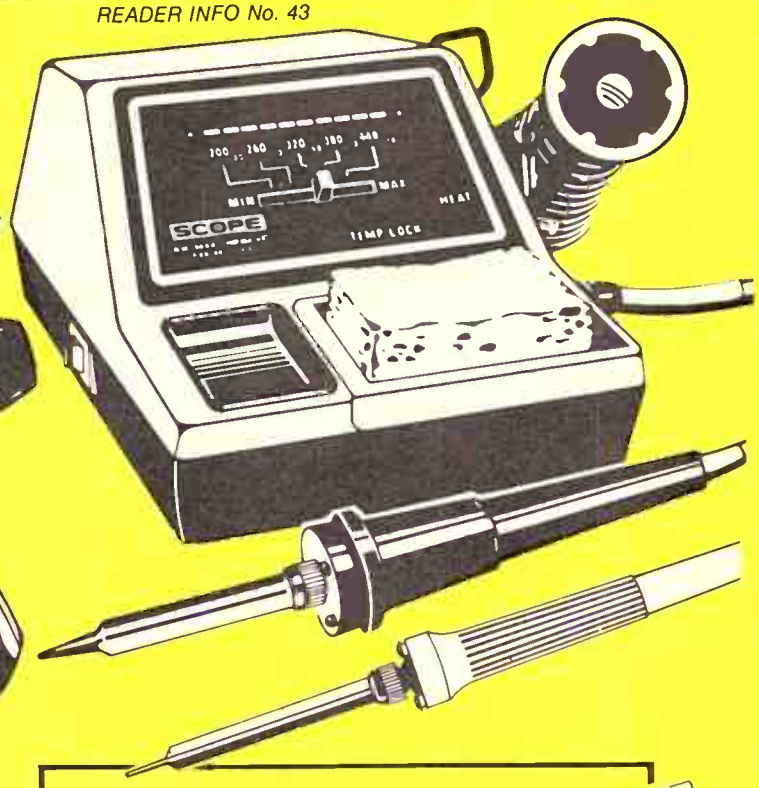

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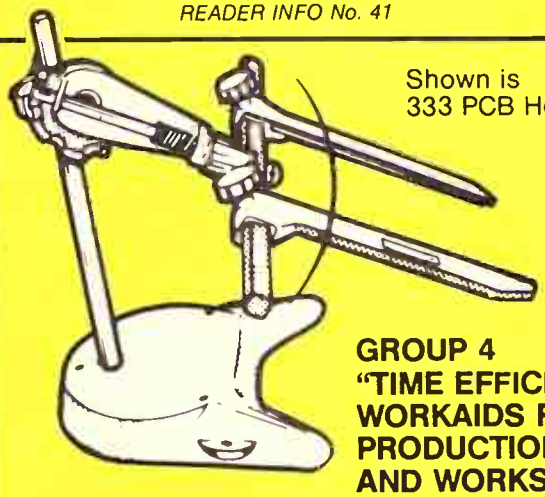

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ETI SEPT '87

ISDN

The pros and cons of Telecom's new venture

Stewart Fist

When I first started collecting cuttings and articles on Integrated Services Digital Network (ISDN), it was remote pie-in-the-sky telephone technology. But next year ISDN is here — albeit in a limited form.

Common Standards

The move behind ISDN comes from Telecom and similar PTTs around the world; they see this as the way to simplify their telephone/telex/data systems. European countries have been plowing ahead with ISDN, while in North America the deregulated telephone companies are scrambling to get anything remotely called ISDN to market ahead of the competition — and, to hell with the standards.

Around the world we now have a reasonably common telephone standard, but it is a system that has grown over the last one hundred years from an analogue base. On top of this basic voice-communications system we have progressively superimposed requirements for broadcast-quality audio and video signals, videotex and teletex, facsimile and high-speed data transmissions.

Until recently, the only economical way of adding a new and different service was to create parallel facilities specially designed to handle the new forms of transmission. The point is that our communications system, like Topsy "just growed" — it wasn't planned.

Solving Problems

ISDN is the first major world push to rectify these problems. That's what 'I' and 'S' mean — 'Integrated Services' — from now on, the aim is to push all these services down the same pipe, in the same way.

The 'D' for 'Digital' comes in because everyone now accepts that any analogue system has inherent noise and generation-degradation problems which can't be solved by analogue techniques. Digital systems, although wasteful in terms of bandwidth, offer the possibilities of error- and degradation-free transmission and storage for everything from video and voice signals, to gigabyte/sec data links down optical fibre cables.

The ISDN System

So ISDN was conceived back in 1972, but it has taken the CCITT committee (who look after such matters) until now to supposedly standardise the system . . .

The idea behind ISDN is that all communications services should be delivered to/from the user by multiplexing through a single interface. If you are a one-person business or a residential subscriber, you will eventually have what is called a 'Basic 2B+D' interface at your office or home. In Telecom jargon this is known as Basic Rate Access or BRA.

> ***Telephone companies are scrambling to get ISDN to market.***

BRA is the minimum connection that Telecom will supply on the ISDN system. It gives you two 64K bits/sec "B" channels for communications and one 16K b/s "D" channel which is primarily for signalling and supervision.

D Signalling

The concept of a "D" signalling channel is quite new, and it is one of the most interesting features of ISDN. All signalling information (whether the telephone is on or off the hook, the dialed digits, charging information, etc.) is carried by this special packet-switching D-channel and since it is not circuit-switched, it is constantly in touch with the national ISDN network.

This one D-channel handles the signalling information for both "B"lines, and when it is not required for signalling purposes it can be used independently as a packet-switch data line. So, in effect, one ISDN link gives you three independent circuits to your home or office — two Bs, plus the secondary use of the D. The B-channels are rated at 64K-b/s and in most cases one will be used for voice signals and the other for data — but this doesn't need to be so. You can have two voice circuits if you wish, or two 'whatevers'.

Your existing telephone handsets will be no use, of course, you'll have to buy a handset that digitises the voice signals using a Pulse Code Modulated (PCM) A-Law standard. But digital data from your home computer should be able to stream down the line without the need of a modem.

Primary Rate Access

For larger businesses Telecom will provide what they call Primary Rate Access (PRA), with 30B+D channels and a total of 2Mb/s (in the US and Japan the PRA will be 1.5Mb/s with 23B+D). This is roughly equivalent to the present 2M-bit/-sec Megalink service that Telecom provide for large users at the present moment.

In PRA the D-channel will handle 64Kb/s of signalling and control all 30 voice/data B-channels. The CCITT specification for the D-channel connection between a PRA and the exchange (and also beteen exchanges) is called the No. 7 Common Channel Signalling Protocol — and this is one of the areas of international contention since not all PTTs conform rigidly to this standard.

Telecom Australia is one of those who have redesigned the No. 7 standard to its own liking, although this won't give trouble with overseas connections, it does mean that Australia will need special non-standard chips in the new interface equipment. Whether this is good or bad for the country depends on your point of view —

and whether you are in the electronic chip manufacturing business.

ISDN Specification

ISDN is a hybrid system in the sense that it uses both circuit switched and packet switched technologies. The D-channel is packet-switched, and the B's are all circuit switched.

The ISDN specification also allows for 'intelligent' routing of voice and data, dependent upon line-load and fault conditions. The system is designed to automatically reconfigure itself and instantly re-route signal traffic when problems occur. The ISDN system will also be linked to the conventional PSTN (Public Switched Telephone Network), the telex service, and to the public data packet-switched networks (MIDAS and Austpac). You don't have to change over to ISDN next year if you don't want to.

For the next few years ISDN will be an additional facility superimposed over all other Telecom services — but in the long-term it should replace them as the older systems wear out.

Future Uses

The D-channel with its packet-switching technology promises to be extremely useful. It can provide home and office telemetry for remote water, gas and electricity meter readings, and for fire and security systems. It will also give you a fast two second call-up time; the ability to wait in a queue if the called party is engaged; indicator lights that show when people are waiting in the queue; a log of unanswered calls; abbreviated dialling; and call diversion and forwarding when you are out of the office.

In addition there are possibilities with electronic directories, and advanced 008-type services. Future ISDN phones will probably have a LED display which will progressively show the cost of interstate and international calls, and this same display will reveal the identity (phone number) of the caller before you pick up the phone. Since this information is always available on the D-channel, it won't be long before private electronic designers introduce all sorts of exotic message and recording systems which respond differently to different callers.

The 2D+B Basic Rate Access requires only two wires and so we are, in effect, getting at least double use out of our existing twisted-pair telephone wires — that's assuming that two 64K b/s channels are needed. The Primary Rate Access requires 4 wire connections. These physical requirements are established by Layer 1 of the three layer OSI Protocol Reference Model, which also defines the method of line coding, timing and sychronisation, etc.

OSI's second Data Link layer defines the error detection and correction schemes that apply to Layer 3. For the technically minded: Layer 2 uses a HDLC protocol similar to that used in X.25 computer networks. This layer also specifies the Data Link Connection Identifier (DLCI) — which carries the 'called' and 'caller' information from one end of the link to the other.

Layer 3 is the Network Layer, and here the D-channel protocol has a considerable repertoire of message types so that it can support circuit-switched (telephone, videotex, teletex, etc.) calls, packet-switched calls, etc.

Reservations

To understand the progress and future of ISDN we must be prepared to grapple with more than just technical issues, there are also marketing, regulatory, standards and user issues involved.

> **"ISDN is a Clayton's standard."**

From the user's side of the communications equation, the enthusiasm is reserved — to say the least. Have a look at these headlines: "ISDN: Another version of the emperor's new clothes?", "Hype, strategy, and false starts as chip makers race for ISDN gold" (both *Data Communications* Dec 86) and "Does ISDN have its wires crossed?" (*Computerworld May 1, 87*).

So there are plenty of reservations about ISDN, and they fall roughly into three categories:

1. ISDN is an international 'standard' that is not yet standardised. Most PTTs, including Telecom, moved ahead with the implmentation of ISDN before the final CCITT recommendation was fixed. It is doubtful whether this will effect the operations of the system much, but it might add to the intial costs since the interface chips will have to be manufactured locally.
2. ISDN may rationalise services and save operational costs for Telecom, but the installation costs will more than offset that, and therefore user charges will probably increase.
3. ISDN does little more than present multiple services can do. True, but it does it better, and every little addition helps.
4. ISDN allows charging for all services, local, interstate and overseas, on a direct user data/bit basis. We have become use to single-charge local phone calls for voice as well as data, but now Telecom have a means of charging us on the basis of the number of bits carried.
5. An enormous amount of communications equipment — PABXs, LANs, etc — will have to be modified or replaced to use ISDN. But ISDN will slide in gradually, so there is no imperative to replace new equipment immediately.
6. Lease-line data links have a degree of security not possible with common-carrier systems like ISDN. Security will obviously be a problem for many companies.
7. Telecom has a reputation for introducing new business services at a low rate and then dramatically up-ing the price when the user gets hooked. They did this with Megalink, so why not with ISDN? Who will take the risk unless there are more obvious benefits?

Money and Power

The world's chip makers see ISDN as a great bonanza, and they've been throwing as much effort behind ISDN as their resources will allow. So there has been a blizzard of ISDN-related chips, and a vertible snow-storm of chip-maker's hype.

The fact is, that until there is a shake-out in the complete specification with the Americans coming into line, ISDN is only a Clayton's standard, any company that purchases equipment could find the standards change and their equipment becoming obsolete. It is unlikely, but it could happen.

Anyone with any sense is going to sit back, watch quietly, and wait and see, because it is hard to see the benefits outweighing the risk. ●

Stop Press

It has just been announced that the fuli feasability study into the VFT is about to begin. The Premier of NSW Barrie Unsworth claims that work could start on the project in two years. Apparently Unsworth hopes that the new train will be built by Comeng and Goninans who built the XPT.

THE VERY FAST TRAIN

The railways are coming back in style. One innovative proposal by a former head of the CSIRO will make it quicker to travel between Sydney and Melbourne by train than plane.

Simon O'Brien

ONE of the most difficult things about living in Australia is the size of the country. It takes days to travel between the various state capitals and up to now commuters have had to resign themselves to tedious car and train journeys or enormously expensive intercity flights.

All that may change, for Sydney and Melbourne anyway, if the Very Fast Train (VFT) team get their way. The plan calls for a 350 kph train link between Sydney and Melbourne via Canberra. The train will run on conventional balasted track and be powered by conventional 25 kVac supply from an overhead line. It would take an hour to get from Sydney to Canberra, and two hours to go between Canberra and Melbourne.

A consortium of Kumagai (the Japanese company building the Sydney harbour tunnel), TNT and Elders IXL has been formed to fund a 'pre-feasibility study' into the VFT concept. The study is being done by the CSIRO, where the idea of the VFT was first developed in 1984, and championed by the then head of CSIRO, Dr Paul Wild.

The Federal government was not ecstatic over the matter. In fact the minister of transport compared the idea with the building of new canal (whatever that means). However, he did promise not to impede any private concern from looking at the proposal. Now a private group has decided that there is a future for the idea.

Foreign Experience

The idea of supertrains is not new. Both the French and Japanese have been leaders in this field. In 1964 the Japanese opened the Shinkansen line between Tokyo and Osaka. These 'bullet' trains reached speeds of 210 km/h when first developed. Since then the network has been expanded and it is hoped to eventually increase the speed to 270 km/h.

Fast Train

Not to be outdone the French National Railway (SNCF) began the Train a Grande Vitesse (TGV) between Paris and Lyons in 1983. The TGV travels at 270 km/h but there are plans to increase this speed. In 1995 the French expect the TGV to be travelling at 350 km/h, making it a rival of the Australian proposal.

Costings

In Australia it has always been accepted that trains lose money, lots of money. However, the consortium believes that a fast train service between Sydney, Melbourne and Canberra could be enormously profitable. The 1978 National Travel Survey recorded that some three million passenger trips were made between the three capitals in that year. Trips between the various other stations along the route might bring the total to some 6 million trips a year. According to the consortium at 3% per annum growth this would come to a total of around 10 million Sydney-Melbourne trip equivalents or 8700 passenger km per annum in 1985.

Given that the expected one way fare on the VFT will be $105 the consortium is looking to make big money especially when freight revenue is added to the equation. Of course large amounts of revenue do not necessarily mean large amounts of profit. The construction costs of the VFT, are estimated at 2.9 billion dollars. Operating costs are estimated at 169 million per annum. Going by these tentative figures it is estimated that the project's capital costs would be paid in 12 years form the start of the operations.

Technology

So the new service will probably be profitable, but will it work? One needs three basic elements to install a fast train service. The first concerns the nature of the track. One of the consequences of Newton's Laws of motion is that the higher the speed of the train the straighter the route needs to be. As a consequence the curves in the track of the VFT must be a lot more gentle then those used by ordinary trains.

In ordinary circumstances railway tracks are banked in a curve, with the outside rail raised as high as 200 mm above the inside rail. When the curve is configured like this, a passenger travelling in a train going 100 km/h around a curve of 0.5 km radius is stressed so little by intertial forces that they can be ignored. To keep the forces acting on the passengers within the same range, the VFT track must have curves with a radius of now less then 6.7 km. The consortium intends to build all curves for the VFT with a radius of some 7 km.

All this means that the new train must have a new track. However, on the plus side the VFT will be able to ascend much steeper gradients then ordinary trains. The French VFT can handle gradients as steep as 3.5% (1:28:5) in contrast to ordinary railways which tend to avoid any gradients higher than 1.5% (1:6:7).

Next comes the question of power. The VFT will be an electric locomotive fed by overhead wires supplying 25,000 volts ac. The pre-feasibility study used a model for their calculations in which the train weighed 400 tonnes with a capacity of 400 passengers and an installed power of 100 MW.

Of course such a train would require a new type of signalling system. All trains in the system will be controlled from a central point by computer. Union opposition is guaranteed by the fact that on the VFT "drivers are unnecessary" except in a supervisory role.

Advantages

The CSIRO and the consortium see great advantages to the country emerging out of this project. First there is the immense profit to be made out of the system. Secondly there all the advantages, commercial and strategic, of providing a fast and cheap form of communication between the most populous areas of the country. The amount of freight the train could carry at high speed could have immense possibilities for commerce over and above those gained by increasing passenger traffic between the two centres.

It is also calculated that the new line would give employment to some 25,000 people both in the construction and maintenance of the system. This should help ease the chronic unemployment which persists in those country towns scattered along the route of the VFT. These areas should also benefit from the predicted increase in the number of tourists to visit these regions, particularly the Snowy Mountains.

Finally there should be a lessening of the road toll. As the VFT will provide such an attractive form of alternative transport fewer people will be attacted to tackle the journey between the various cities by car. As regards the safety of the VFT itself there seem to be few problems. Similar services in France and Japan have an excellent safety record.

Disadvantages

However, there are some nagging questions still to be answered. First off, there is the issue of noise pollution. Suburban trains are loud enough; what about one that steams along at 350 kph?

Dr Wild, who is in charge of the initial stages of the VFT project answers that those who live in Sydney and Melbourne will not notice much difference as the VFT will travel at normal speeds in built-up areas. But what about the countryside? Wild says the VFT will not be much noiser than a jet aircraft. Unfortunately jet aircraft are incredibly noisy, as the inhabitants of Mascot and Tullamrine can testify.

Next we have the disruption to the environment caused by the construction of the VFT track. As can be seen in the diagram the route of the VFT will differ substantially from that taken by trains today. Highly sensitive ecological zones like the Snowy Mountains national park are on the route. The answer to this problem, at least as far as animals are concerned, could be to construct tunnels under the rails to allow the fauna to move as they wish. This has been tried overseas; successfully in some instances. Unfortunately, some animals will never adjust to the sight and sound of a very fast train rushing across their habitat. Consequently the ecological impact of the VFT poses a very real problem for the project.

But perhaps this is all jumping the gun. As yet the VFT is still just an idea. It has been costed but no final plan has been agreed upon by the consortium. The first part of the feasibility study has just begun and will not be complete until next year. We on the Sydney Melbourne access have plenty of time to reflect on both the positive negative aspects of the VFT. ●

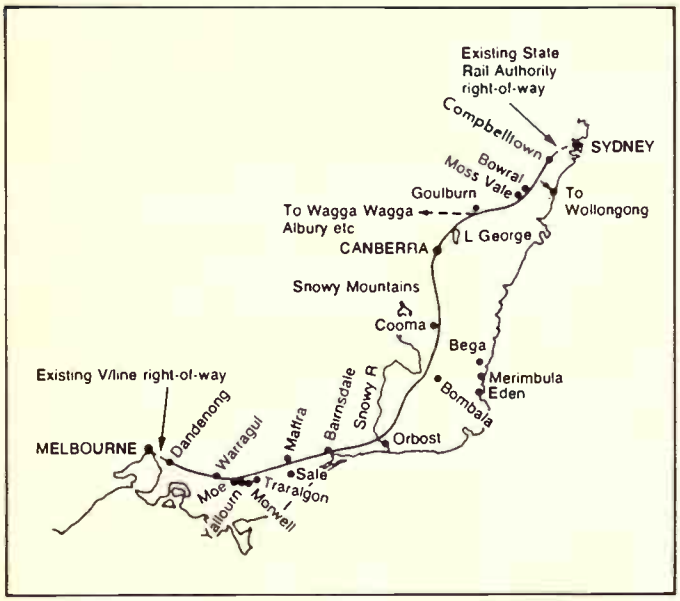

Figure 1. The route

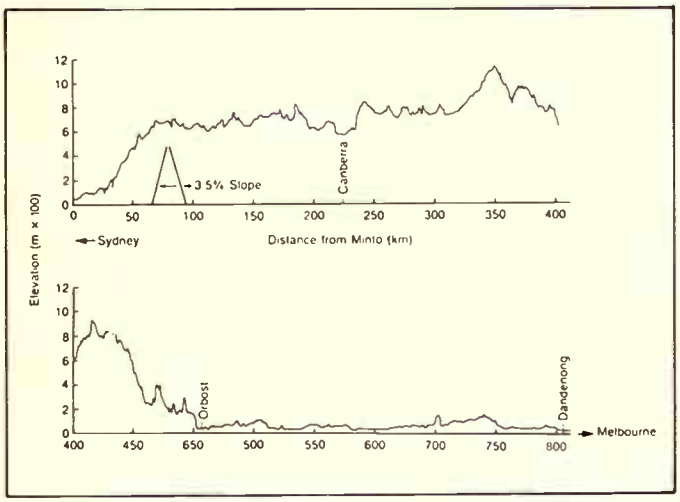

Figure 2. Natural surface profile from Sydney to Melbourne, along the route of the VFT

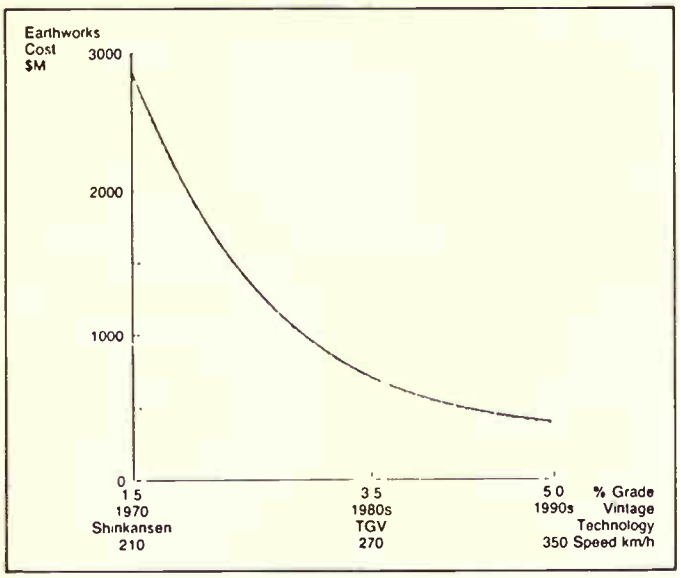

Figure 3. Earthworks cost us grade limit, technology, speed

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World Radio History

A new receiver from Carver, a CD player from Micro-Seiki and a new range of laser-disc players from Pioneer are featured in this month's —

Sight and Sound News

The Carver 2000

Cover Shot

A new AM stereo FM stereo receiver, the Carver 2000, has been released into the Australian market by Odyl Communications of Melbourne.

Power for the receiver is rated at 200 watts per channel with no more than .15% THD into 8 ohms (RMS power both channels driven) and is provided by a Magnetic Field Amplifier rated at 200W. This amp provides the unit with 200 watts per channel of 'pure, clean power'. Furthermore, this power is provided without the need for heavy heat sinks, massive transformers, and enormous power capacitors.

In order to ensure that the signal received by this unit is free of noise hiss and interference, the 2000 includes an Asymmetrical Charge Coupled FM Detector circuit. Carver claim that this circuit enables you to hear the signal 'with space, depth and ambience'.

One of the most interesting features of the Carver 2000 is a Sonic Hologram Generator. Apparently the Sonic Hologram 'presents timing and phase information that exists in sonic program material — but is normally inaudible. Carver state that with Sonic Holography such information emerges in three dimensional space around the listener 'who is thus able to establish the precise location of the instruments and voice'.

How does the Sonic Hologram work? Carver explains it this way: 'In real life, a single sonic event — like the violin note — can never cause more than TWO sonic arrivals: One at the left ear and one at the right ear, as opposed to the four arrivals occurring in conventional stereo playback. Those extra, second-sound arrivals confuse our ear/brain system. The Sonic Hologram Generator eliminates those extra sonic arrivals occurring in conventional stereo playback. In part this is accomplished by cancelling out the unwanted second-sound arrivals from each loudspeaker to the opposite-side ear. Each ear is, then, free to concentrate its attention on the same-side loudspeaker. In other words, left ear hearing the left loudspeaker, right ear hearing the right loudspeaker'. R.I. 101

EDITOR
Jon Fairall B.A.

ASSISTANT EDITOR
Simon O'Brien B.A. (Hons), M.A.

DESIGNER
Clive Davis

ART STAFF
Ray Eirth

PRODUCTION
Mal Burgess

ADVERTISING MANAGER
Peter Hayes B.Sc.

ADVERTISING PRODUCTION
Brett Baker

SECRETARY
Nina Stevens

ACOUSTICAL CONSULTANTS
Louis Challis and Associates

PUBLISHER
Michael Hannan

MANAGING EDITOR
Brad Boxall

HEAD OFFICE
180 Bourke Road,
(PO Box 227, Waterloo, NSW 2017
Alexandria, NSW 2015.
Phone: (02) 693-6666.
Telex: AA74488, FEDPUB.
Federal Facsimile: (02) 693-2842.

ADVERTISING
New South Wales & Queensland: Peter Hayes, Mark Lewis, The Federal Publishing Company, 180 Bourke Road, Alexandria, NSW 2015. Phone (02) 693-6666. Telex: AA74488 FEDPUB.
Victoria and Tasmania: Valerie Newton, The Federal Publishing Company, 221a Bay Street, Port Melbourne, Vic. 3207. Phone (03) 646-3111. Facsimile: (03) 646-5494. Telex: AA34340, FEDPUB.

The age of remote

Onkyo have developed the RC-AV1M universal remote control, which is intended to replace the clutter of key pads that surround a modern audio-video set-up. It operates up to six components from a single remote control.

The RC-AV1M can not only control any Onkyo remote controlled product, but can be programmed to imitate virtually any component operated by infra-red remote control from any manufacturer. The RC-AV1M can learn the functions of as many units as it's memory can store (tuner amp, video disc player and video cassette recorder, for example). The RC-AV1M is the first unit of its kind and "provides the key to a successful marriage of audio and video".

the RC-AV1M is available from Hi-Phon Distributors, exclusive Australian distributors of all Onkyo products. For further information please contact Andrew Harrison, Hi-Phon Distributors, 1/356a Eastern Valley Way, Chatswood 2067. Tel: (02) 417 7088. R.I. 102

NAD 2600 Power Amplifier

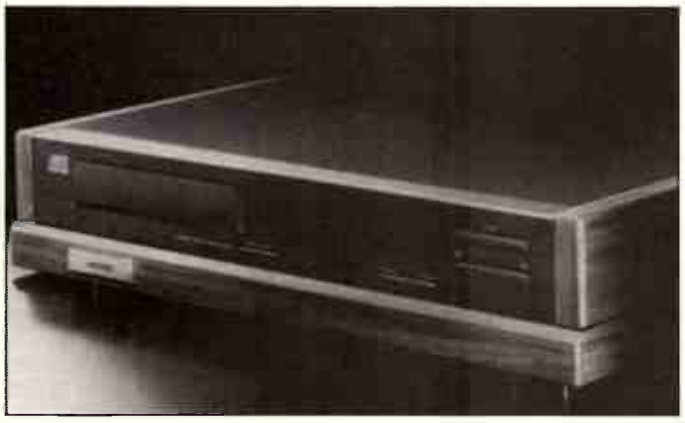
This is an updated version of the NAD 2200 power amp, rated at 150 watts/channel continuous power for test tones and featuring Power Envelope circuitry that delivers 500 watts per channel of tone-burst power for music.

It has approximately the same size, weight, heat dissipation, and price as other 150 watt amplifiers. A bridging switching converts the NAD 2600 to a mono amp conservatively rated at 400 watts continuous and 1200 watts dynamic power. R.I. 103

The Big Break

An $80,000 competition launched nationwide this month (July) gives Australian musicians and songwriters the chance to hit the big time.

The first prize is worth $50,000 and presents the winner with a complete record release package, an $8000 video clip and a home studio worth more than $38,000. Another 10 prizes, including smaller home studios and instruments, will be given away. The Big Music Competition has been launched by Sonics — the Australian music makers' magazine — to discover and encourage new talent. R.I. 104



The Micro Seiki (CD-M2)

Audio Investments of Sydney have announced the release of the Micro Seiki CD-M2 Compact Disc Player.

Micro Seiki's chief aim has been the elimination of external and internal vibration and this accounts for the heavy grade zinc aluminium top panel of the CD-M2, which is based on a COSMAL-Z alloy. A newly developed metal designed for extreme rigidness and vibration damping characteristics compared to conventional aluminium alloys.

To further eliminate vibration the bottom panel of the CD-M2 uses a triplex vibration damping structure comprising of lead, ferrite and alloy materials. In addition, the chassis rigidity is assured by the use of a zinc die cast frame. These special materials give the CD-M2 a weight of 22 kgs.

The CD-M2 offers 4 times over sampling, true 16 bit vertical resolution, twin D/A convertors, signal to noise ratio of more than 104 dB and crosstalk of less than 100 dB. It also features a 16 bit, over sampling digital filter, and a third order bessel filter for higher resolution and increased linear phase characteristics. R.I. 105

TM351–Compact disc cleaner

Trackmate, whose products are distributed by Amaray of Sydney, has reached an agreement with Eastman Kodak to supply a special cleaning solution for CDs. This Kodak solution is packaged in the open, and applied to the disc via a patented brush.

The Compact Disc is basically a lens that focuses laser light on a coded mirror (on the label side). If the surface of the disc is dirty (even microscopically) it blocks some of the laser light or diffuses other laser light. The net effect is that less laser light enters the disc to reflect off the mirror. Surface dirt also interferes with the light leaving the disc to return to the sensor in the CD player that reads the signal. The net effect is a reduction in laser light returning to the sensor (signal). R.I. 106

Robust, Flexible and Advanced

1987 sees the launch of a comprehensive range of Pioneer NTSC Laserdisc players. From the robust LD-V2000 to the flexible LD-F4200 and the advanced LD-V6000A.

For stand-alone applications such as demonstrations and presentations, the LD-V2000 is said to be ideal. This laserdisc player is said to boast a high imaging video clarity with 400 lines horizontal resolution. With its self-detecting CX Noise Reduction on, the signal-to-noise ratio is better than 70 dB. Coupled with a variety of servo mechanisms and circuits, distortion is virtually down to zero! The LD-V2000 will be available in July for approximately $800.

The next level of sophistication and price takes you to the LD-V4200 with a RS-232C port interface. This allows easy connection to a wide variety of computers and sophisticated software. Complex controls in the LD-V4200 are simplified with the use of Mnemonic Command Language. Random Access Programming allows rapid search with minimal disturbance of images on-screen. Multi-speed play is possible to vary the playback speed. This unit costs $1375.

Pioneer claims that its LD-V6000A is a "state-of-the-art" laserdisc player, designed for the most sophisticated industrial, multi-screen and simulation applications. High Speed Random Access provides almost instantaneous access. The newly developed Initial Mapping System accesses any frame in under two seconds. It sells for $2500. R.I. 107

Car CD from Sony

Sony Australia have released the CDX-R88 automotive CD player system with FM/AM tuner and power amplifier. The unit is equipped with a 25W per channel amplifier which gives the CD system all the power that is required to produce digital sound perfection.

The CD functions include AMS (Automatic Music Sensor) which lets you select the individual track you prefer. The manual search function allows cue and review operations and the return button lets you automatically return to the beginning of the first selection on the disc. It also has auto repeat which automatically plays back the selected disc once the original tracks have been played.

The high sensitive, high performance FM/AM tuner has 18 station preset tuning, 12 for FM stations and 6 for AM stations, plus seek tuning which tunes into the next strong station up or down the band. Another interesting feature of the CDX-R88 is the digital display indicating elapsed or track number while the CD is playing.

The CDX-R88 has been specifically designed to incorporate line in/out jacks to integrate with existing car installations, or future system expansion such as the soon to be released slimline. XK-8D cassette deck and the XE-8 graphic equalizer which when combined provide the ultimate in car audio enjoyment.

R.I. 108

Weatherproof Sound

ALTRONICS of Western Australia are releasing the Redford Weatherproof Speaker and Sound Column Range, made in Australia. The Redford range are not only highly directional and wide-range, but are said to have an efficiency approaching that of "reflex horns"!

Constructed from heavy gauge extruded aluminium, the speakers are coated in white or black industrial grade powdercoat. The ends are sealed with moulded caps made from super tough UV resistant 'Luran S' plastic.

Full weatherproofing has apparently been achievea by doping the cones with a patented moisture repellant process.

Five models are available to suit various applications:

- 10 Watt 16 ohm (one speaker)
- 20 Watt 8ohm (two speakers)
- 10 Watt 100V line (one speaker)
- 20 Watt 100V line (two speaker)
- 40 Watt 100V line (four speakers)

R.I. 109

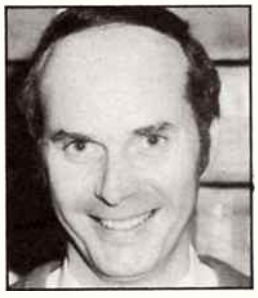
Stereo Microphone

Amber Technology of Sydney, have just released a new microphone system from Neumann. Designed for stereo location reporting amid noisy surroundings, the RSM 190i system comprises a shotgun microphone and a stereo microphone together with a mixer.

In any given situation the stereo mike will pick up the ambience of a situation whilst the shotgun will focus on one particular figure or sound. Another application for the RSM 190i System is for live or dubbed stereo film sound.

A stereo microphone with a high directivity index and six different, remote controlled directional characteristics, forms the basis of the system.

R.I. 127



Service Co-Ordinator

Akai Audio/Video Australia today announced the appointment of John Griffin as Akai Service Co-ordinator. This appointment will lead to Mr Griffin's eventual appointment as National Service Manager for Akai Audio/Video Australia (Pty.) Ltd.

R.I. 128

Video Phones

A video telephone will go on sale in Japan this September. The system developed by Sony works on conventional telephone lines. All past video telephones needed special lines with a wide bandwidth of frenquencies.

The new phone plugs into an ordinary telephone socket on the wall. It has a hand-set, alongside a unit with a black-and-white TV camera and TV tube of 10 centimetres. The picture unit has three keys, marked "view", "take" and "transmit". When the operator presses "view", the screen shows what is placed in front of the camera. When the "take" key is pressed the displayed image is converted into digital code and frozen as a still picture into solid-state memory. When the "transmit" key is pressed the stored image is transmitted over the telephone line. It can be received and displayed by a marching unit at the other end of the line.

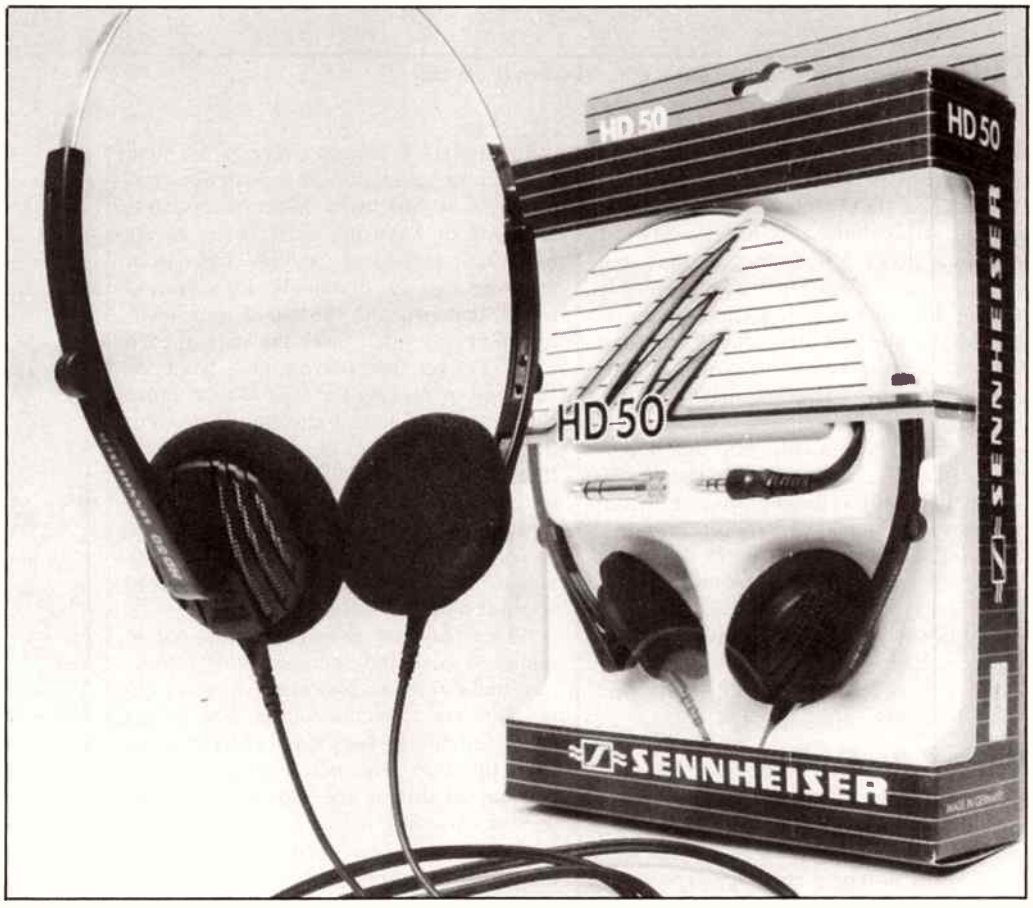
So anyone making a telephone call can illustrate a point by showing an object. The person at the other end can keep a visual record of the illustration on an audio cassette. *R.I. 129*

Bacterial Speakers

Sony has patented a way of making hi-fi loudspeakers from bacteria. Apparently in micro organisms such as those from the *Acetobacter* and *Agrobacterium* groups can be used to produce moulded material with the high dynamic strength needed for speaker cones or diaphragms.

The bacteria are fed on materials containing nitrogen, carbon and inorganic salts. After a few days, they produce a layer of cellulose in gel form. This is washed with water and dried and rolled by pressing. The resulting paper material can be made into a honeycomb material and used as a flat loud-speaker diaphragm, or pressed into a cone.

Sony claims that paper made in this way makes ideal speaker material for hi-fi. Whether the Australian quarantine authorities agree is another question. *R.I. 130*



Sennheiser Headphones

Sennheiser Electronics have developed a new lightweight stereo headphone, the HD50. The latest addition to the extensive Sennheiser Headphone range.

Principally designed for "Walkman" type use, the HD50 offers Slim Line design and a very high degree of user comfort. This model will appeal to those portable users who demand excellent bass response together with clean, uniform sound reproduction similar to that found in domestic Hi Fi.

The HD50 is equally suited for use with Compact Disc, Stereo TV/VCR and conventional Hi Fi Equipment.

R.I. 131

CD or not CD,
DAT is the question.

The digital revolution

A late model Philips Compact Disc player with dockable remote control

AUSTRALIAN distributors are racing to see who can be first to release a Digital Audio Tape (DAT) player onto the local market. Aiwa showed its Excelia XD 001 at a press preview in Sydney in June, but local distributors warn that it will probably be mid 1988 before Aiwa can ship product. Meanwhile industry sources say that National is the company to watch. Apparently the company hopes to have a player in the store by Christmas.

It's taking an unusually long time for us to see DAT players in the shops. By March 1987 all the major Japanese manufacturers had released product at home (See *Sound Insights* July 1987), so it will be upward of eighteen months before things start happening here. The lack of supply is not the only peculiarity surrouding the release of DAT. Other queries include: Why is it being released at all? And will it succeed?

Digital Audio Tape

DAT was proposed several years ago, and is an outgrowth of the technology developed for small video recorders as well as advances in tape technology. The result is a system that supports exceptionally wide bandwidth on a tape format essentially the same as current audio cassettes.

The DAT standard was agreed upon at a meeting in 1983 between all the big Japanese hi-fi companies, with the rest of the world, especially Philips, looking on. Some of the big talking points were: compatability with CD, ease of use, software and a new cassette design.

Making DAT players easier to use than the current generation of tape players was achieved in two ways: faster access time and long tape playing time. Faster access time to individual tracks has been achieved by an extremely high rewind speed, matched with the use of track identification codes that mark the start of each track. Longer tape playing time has been achieved by making the tape longer. More can be packed into a cassette of conventional size because the tape is actually thinner than ordinary tape. As well, the use of rotating heads and a helical scan means that the tape runs through the mechanism slower than it otherwise would, even though the tape-to-head speed is quite considerable.

A new cassette design was required to minimise cost and increase both robustness and durabilty. However, the most important single function of the new design was its ability to keep dust and dirt away from the tape. The new format is not as tolerant of dirt as the old one, so some way of excluding it had to be found. The new cassettes have a small door that shuts across the tape opening for this purpose.

Copyright

The question of recording, copyright and royalities remained unresolved in 1983, however, and seems to have finally been settled only now. It all hinges around the major difference between CD and DAT. CD does not have a record mode. Indeed, the creation of compact discs is so difficult that many companies who produce vinyl

The Aiwa Digital Audio Tape player shown to the press in May. It samples at 48 kHz, and has deliberately been made incompatible with compact disc players, which sample at multiples of 44.1 kHz.

Jon Fairall

records have still not got around to making them. There is thus little problem with engineering a system of payments for artists, record companies, distributors and so on; the record industry has every reason to like CDs.

DAT, of course, is a very different kettle of fish. The record industry has been concerned for years at the level of forgone revenue due to illegal copying of conventional analogue cassettes. There has been one limit on the process, however. By and large, pirated cassettes sound terrible. The source material is probably many generations removed from the master, and the stock onto which the material is copied is probably not much good either. These factors have reduced the scope for pirating, at least in sophisticated markets like the Australian one.

DAT technology turns this situation on its head. Using digital techniques, there is no degeneration of the signal from one generation of tape to the next, allowing copying *ad infinitum*. For the same reasons, any tape that is playable will deliver the full frequency response and dynamic range. It's a pirate's haven, and the considerable clout of the record industry was marshalled to stop it.

A range of proposals was put up, ranging from the ridiculous to the sublime. The record company CBS, for instance, proposed putting a notch in the response of all CDs. This would be in the middle of the audio band, at about 4 kHz. It would only be a few Hertz wide, and about 60 dB deep. The result would be inaudible, according to CBS engineers, but provide a tell tale trace for any recording device. The plan was that DAT players would have a circuit to detect the notch. If it was discovered, the player would refuse to record. In the end, CBS abandoned the plan as too expensive, too complex, and what's more, too audible.

Other plans ranged from an outright ban in the US (which has sufficient clout on the world stage to make the technology non-viable) to a royalty on all blank DAT cassettes. In the end, this latter strategy seems to have been adopted. The record industry argued that since all blank cassettes will probably be used to record copywrite material, a blanket royalty was quite justifiable. This appears to have been the basis of the agreement between the US recording industry and the Japanese recently, with the result that US (and other foreign) shipment of DAT players is now being planned.

This should not give the impression that the DAT makers entirely favour copying. The Aiwa Excelia shown to the press in June (a look inside showed that it is essentially a re-badged Sony product) will not record from a CD player. If it finds the 44.1 kHz sampling frequency it will not go into the record mode. It is quite happy at 48kHz (i.e: another DAT player) or to record from its analogue input.

This strange strategy was imposed on the maker by Japan's Ministry of International trade, or MITI, as a sop to western recording interests. However, the arrangement doesn't stop one copying a compact disc through the analogue output of the CD player into the analogue input of the DAT player. All it does is prevent digital recording. The difference is probably measurable in a laboratory, but certainly not the human ear.

Strategy

This might make sense if one puts the development of DAT into the overall context of the digital hi-fi market. As things stand, this is dominated by the compact disc player. It was originally developed by Philips, with help from Sony, and these

two companies hold all the patents on the technology. This implies that all the Japanese manufacturers are in the invidious situation of having to pay royalties on every CD player they produce.

The development of DAT provides a way out. Encourage the consumers to switch to DAT and the market looks much less monopolistic. Part of this strategy would be to force consumers to make a choice between DAT and CD by making them as incompatible as possible, and in this context the Aiwa design becomes understandable.

A battle between CD and DAT will be good news for consumers. With both technologies offering the same level of sound performance, the battle will be fought on the basis of price and programming. As if shaping up to the threat, CD player vendors have dropped their prices remarkably, but at the same time, the software has gone up to ludicrous heights. It is now not uncommon to pay $30 for a disc.

But if this is the strategy of the DAT camp, they are going about it the wrong way. The first DAT players are reaching the market in Japan priced at about $2000, two to three times as much as equivilent CD designs. To make a dent in the marketplace they must come down rapidly. Tapes are also expensive. Industry sources say that if the current Japanese pricing structure continues, they will be selling unrecorded tapes for around $30. The price of recorded tapes is likely to be more.

CD appears to have the advantage here. There are two things working in its favour. Firstly, the price of CD software is now completely market driven. Discs can be shipped out of the factory for a few dollars, so there is no reason why they should not appear in the shops for A$10 or less. The fact that they don't is simply a function of market place economics. This means that if a credible threat from DAT does emerge, the industry has plenty of fat left to cut out.

DAT appears to be less well served. The technology of making the tapes is incredibly complex and expensive, and it may well not be possible to bring the price down as low as compact discs, albeit that the $30 tag represents a nice profit for the maker.

The second problem for DAT is that recordable CDs are getting closer. Both Nakamichi and Philips have announced prototypes of recordable magneto-optical discs that can be recorded many times. Discs that can be written on once by the purchaser have been on the market for a while, but the new generation of discs will provide a practical home recording medium.

If this can be achieved, there would be nothing to choose between CD and DAT, except perhaps, that DAT would have the edge in the portable market. If both formats are economically viable in the long run then we could wind up with the worst of all possible worlds: two different, incompatible digital hi-fi formats. Hi-fi would join VCRs (VHS/Beta) and TV (PAL-Secam/NTSC) for no real reason.

Of course, this begs a large question. If the DAT/CD fight turned into a Japanese/European scrap, then the story might be quite different. The Japanese could completely abandon CD, and devote their considerable manufacturing and marketing skills to turning out low cost, highly reliable DAT players. This would leave Philips, with perhaps a few small European and US hangers on, trying to defend the world CD market. Based on past experience, the smart money would have to be on the Japanese, but then experience is not always the best guide. ●

Australia now has its own CD factory located at Braeside in Victoria. It is leading the world in terms of quantity and quality.

Disc developments

Using the laser scanner to check for quality.

AUSTRALIA not only has its own compact disc plant but it appears to have the best compact disc plant in the world.

The Disctronics plant in the outer Melbourne suburb of Braeside publicly rolled into action in May with our first locally-made disc, John Farnham's hit album 'Whispering Jack'. In fact it had been in production since March.

In theory, the $40 million factory and its products should be much the same as those in other countries. The Japanese Meiki company supplied the manufacturing plant in a "turnkey" operation. Meiki supplied all the equipment and the expertise, supervised the installation and handed over the key when everything was in place and running. The deal with Meiki includes access to the latest CD production technology as techniques are improved.

Australian Content

While Meiki is building similar factories in other parts of the world, the Australian factory has one feature that makes it different from all the rest, a leading-edge clean-air process designed and installed by Australians.

One of the greatest problems for anybody producing Compact Discs is the need for scrupulously clean air. An air-particle level of Class 10,000 is the norm in disc factories and requires staff to wear special clothing and to take an "air shower" before entering a production area. The Disctronics plant lays claim to an air-particle level of Class 100, 10 times better than the other factories, and that makes all the difference both to the quality of the discs produced and to Disctronics' chances to make a profit.

Consider, for a start, the assertion by the Dutch inventor of the Compact Disc, Philips, that the pits on a disc are so tiny that if they were the size of a grain of rice the disc would be the size of a football field.

Just one speck of dust in the wrong spot during production can upset the flow of information from such a disc sufficiently to give a hi-fi system's CD player all the symptoms of a nervous breakdown.

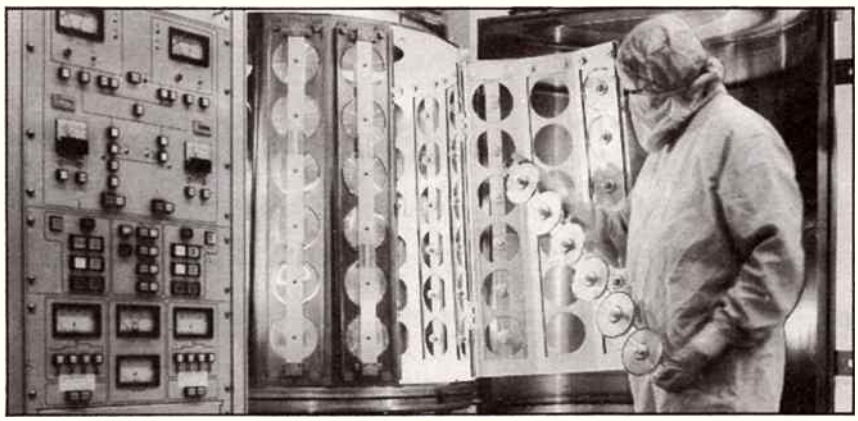
Rejection Rates

Now consider that when factories first started making compact discs, only one in 300 passed the quality tests; the other 299 were junked. That didn't worry the manufacturers very much. They knew that the rate would improve and the electronics industry, which makes very expensive components out of cheap material (after all, the plastic and aluminium in a compact disc are worth at best only a few cents), is used to operating with surprisingly high rejection rates.

The production rate has improved. Most factories overseas have a recovery rate (discs that pass the tests) of about 60 per cent. The Australian factory, however, has a recovery rate of 95 to 97 per cent which Disctronics claim is easily the best in the world. This in turn has enabled the company to be particularly stringent in its quality standards.

That is important because, although all discs made anywhere in the world have to comply to the Philips "Red Book" standards for drop-out, clock rate and error rate, going too close to the mark can sometimes produce discs that will play sometimes and not at other times, that will play on some players and not on others (usually the cheaper ones) and that will develop hiccups on some tracks. The fact that the manufacturers can prove that the disc will function quite happily on one player is little consolation to the music lover who finds that it misbehaves on another.

The Disctronics internal quality standards are roughly double those of the Red



The vacuum metalising process which deposits a film of aluminium on the disc substrate.

Book and should ensure trouble-free playing on all but the most under-privileged of players.

Most of the 17,000 discs being produced each day are being made for overseas record companies. The fall of the value of the Australian dollar has made the Disctronics prices particularly competitive. The company has space reserved on all Qantas flights to London, Los Angeles and New York and most of them carry a supply of

The first disc to be made in the Melbourne factory.

discs (just the discs in protective sleeves, the individual boxes are supplied and packed at their destination) which will reach the record company within 24 hours of coming off the production line. More than 80 per cent of the first year's production will go to overseas companies.

The production line, running two shifts a day on four moulding machines, was being expanded with another four units as this article was being written and another four will be installed in August.

The extra production will mean that Australian record companies should have little difficulty in getting access to their own locally-made discs.

Specialist Discs

Disctronics sets its prices on a basic production run of 1000 discs but the operation is flexible and it is quite willing to negotiate a smaller run. The lowest number of discs ordered so far has been for a special run of six discs only of music for a complex computer-controlled audio-visual display for music for the Bicentenary. Certainly, the Australian companies wanting to hit the market with a limited pressing of a specialist album should now be able to do so with a compact disc.

At the moment, Disctronics is having its master disc and stampers made overseas but it is installing equipment to enable the whole operation from CD master tape to disc to be completed at Braeside.

Disctronics has also established an optical storage subsidiary to develop CD-ROM data storage systems. One archive-quality CD-ROM disc can store up to 250,000 A4 single-spaced typed pages of data. The system is seen as a major advance in information storage that offers considerable savings in storage and cost.

A Fascinating Amalgam

The Compact Disc is a fascinating amalgam of old and new recording technology. Like the vinyl disc it is made by a stamping process or injection moulding and goes through similar stages of mastering and manufacturing via the traditional father-mother-son process (record production is very much a family business with fascinating sexual overtones).

The differences in the end product are, of course, considerable. For a start, the information is packed much more densely on a compact disc to enable it to get up to 70 minutes of playing time from a disc the size of a saucer.

The information stored in a pattern of pits on the disc, is "read" by a laser beam at a constant linear velocity of 1.3 metres per second as the beam tracks from the inside to the outside of the disc. To keep the linear tracking speed constant, the rate of rotation of the disc changes progressively from 500 rpm to 200 rpm as the beam moves towards the edge.

The main difference in compact disc manufacture is not the technique employed but the greater precision and cleanliness the process demands.

As with the vinyl disc, the process starts with a CD tape master which is a tape with the required program recorded in digital format as well as the subcode information required for synchronisation, error correction and track information for the album.

From the CD master tape a master disc is produced. This starts out as an optically ground and polished glass disc that is coated with a material similar to the coating on a photographic film. The tape is played and the encoded digital information is transferred to the disc by a high power laser which writes a pattern of pits in the coating.

The exposed pits are etched away and the disc is silvered and then electroplated with nickel. When the plating is separated from the disc master it forms the metal "negative" known as the father. While this father could be used to stamp out production discs it would soon wear out and the normal process is to use it to stamp out several more positive "mother" discs and from these the "sons" or stampers are produced.

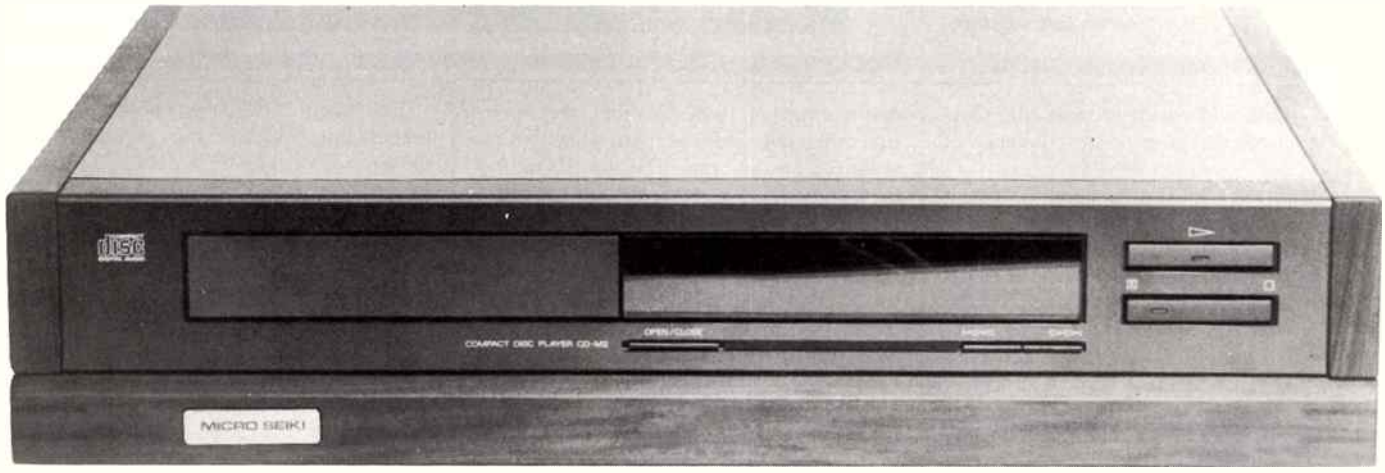
The stampers are used in an injection-moulding process to make the final discs.

When the pattern of pits has been stamped on the plastic disc the surface carrying the information is coated with a microthin layer of aluminium to provide the reflective surface. The fragile mirror layer is then protected with lacquer and printed with the label. The last task is precision centring the disc and punching out the centre hole.

When it is played, the laser scans the information through the body of the plastic disc.

Patrick Hayes

Micro Seiki CD:
Very 'eavy, not so 'umble



After the Consumer Electronic Show in Las Vegas last year, I saw fit to devote considerable editorial comment to the large numbers of CD players displayed and the advertising hype surrounding their release. I noted with some irreverence that all the manufacturers of high priced CD players were experiencing a marketing and credibility problem. Because the industry has not done such a good job of explaining the 'perfection of CD sound reproduction', most consumers now believe that any and every CD player has achieved the same level of perfection.

Enter Micro-Seiki's CD-M2 Compact Disc Player which is one of the heaviest (at 22 kg) and most expensive (at $5,500) units to hit the Australian market. The question which now arises "What extra performance and benefit can you achieve in a CD player costing 20 times the price of the cheapest CD player on the market that justified all that expense?"

The Lead Bottom

The first thing I noticed about the CD-M2 when I picked it up was that I must have been picking up a loudspeaker, not a CD player. Micro-Seiki freely admit in their literature that they have applied the same principles to the development of their turntables as the the development of their first CD player. Micro-Seiki claim that their basic design philosophy has been directed at eliminating external and internal vibration and this accounts for the exceptionally heavy grade of zinc aluminium top panel, based on a newly developed COSMAL-Z alloy and the TRIPLE THICKNESS LEAD LINED 4 mm thick bottom steel panel and associated felt isolating feet utilised in the construction of the CD player's casing. These concepts are supplemented by the use of a massive rigid zinc die cast internal frame which goes to far greater lengths to achieve mechanical stiffness and damping than those applied to any other CD player I have previously seen.

The internal electronic design is only briefly described by the manufacturer (unless you can read Japanese) and the heart of the electronics features two (separate) 16 bit resolution digital to analogue (A to D) converters which, they claim, achieves a signal to noise ratio of better than 104 dB. Cross talk is claimed to be less than −100 dB between channels. The D to A converters operate on a 4 times over sampling basis at 176.4 kHz (i.e. four times the normal 44.1 kHz sampling frequency.) This approach allows them to utilise low pass third order analogue Bessel filters with far more gentle roll off rates than would be required in the more ubiquitous digital filters that most low cost CD players incorporate. These filters and this sampling frequency ensure minimisation of phase shift and are also claimed to achieve, remarkably as it transpires, 'lower distortion'.

Appearance

The external appearance of the Micro-Seiki CD-M2 is rather deceptive. The cabinet features expensive solid rosewood ends and matching timber lower facing featuring a golden anodised POWER ON-OFF switch at the lower left-hand corner. The front panel utilises a dark grey anodised front escutcheon switch with four other controls discreetly placed on the front panel. These are respectively a thin elongated OPEN-CLOSE button, a similar TRACK FORWARD and TRACK BACKWARDS button with universal symbols and at the left hand end of the panel a large rectangular PLAY button. Below this is an elongated toggle bar with similar dimensions; one end provides the PAUSE function, whilst the other end provides the STOP/RESET function.

The large display provides data on the track number, index number, track time remaining, total time remaining, time played and indications on recall, index and faulty disc. Apart from the most basic control functions, virtually all other controls have to be exercised by means of the Micro Commander CDR-M2 infra red re-

mote control unit. This provides the normal STOP, PAUSE, PLAY controls, FORWARD and REVERSE SEARCH, FORWARD and REVERSE TRACK, FORWARD and REVERSE INDEX, AUTOMATIC MUSIC SEARCH, REPEAT function, LAP/RE-MAINING TIME CONTROLS FOR THE DISPLAY, RECALL function, the new relatively conventional A-B control for starting as a specific point A and playing to a specific point B before recycling, MEMORY RECORD function, SELECT function, CLEAR controls and numerals 1 to 60 for keying in two digit track numbers up to 99 sequentially. Not so surprisingly, the Micro Commander is provided with a beautiful solid rosewood slide-in stand which provides extra weight, improved appearance and certainly much better location stability when placed on a table, edge of chair or piece of furniture.

The rear of the unit incorporated a number of functions and features which are not currently found on other CD players. In addition to the conventional gold plated RCA type co-axial connectors for left and right channels, the unit incorporates a pair of balanced male XLR type cannon connectors, a co-axial digital output and much to my surprise an optical wave guide output connection for unspecified use.

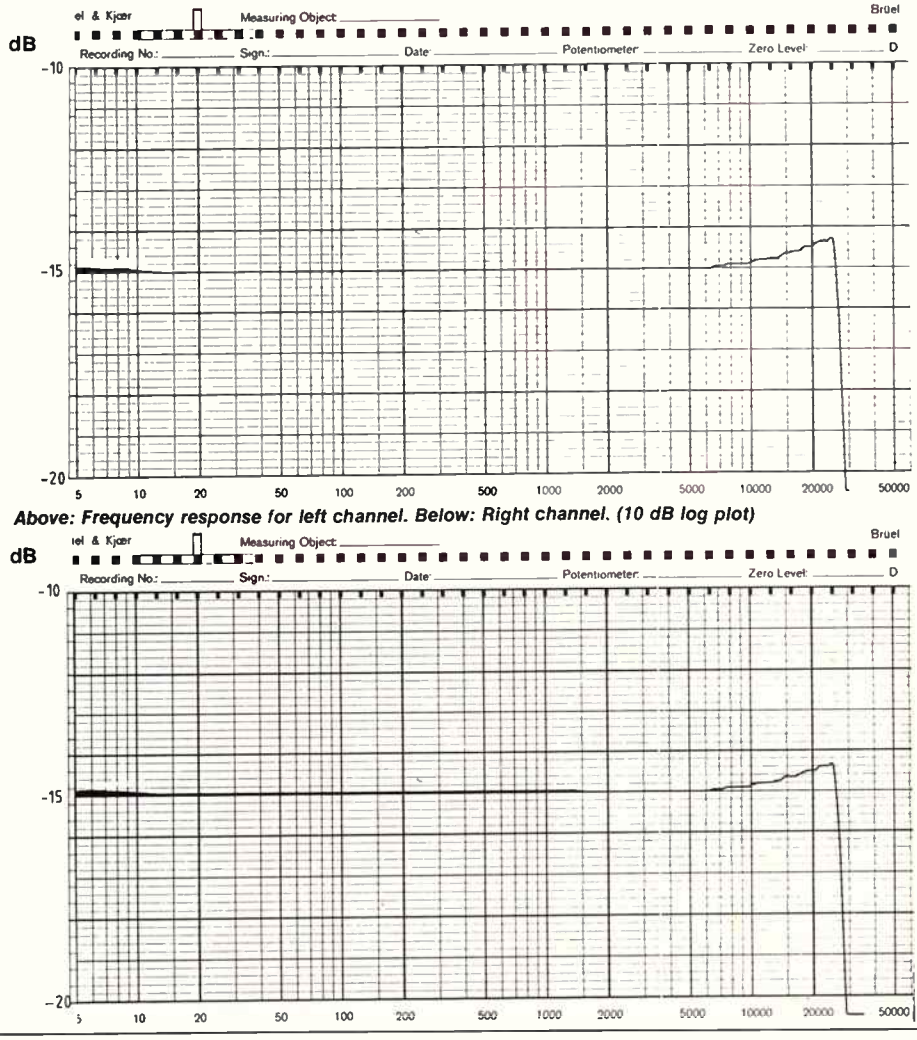
The inside of the unit is difficult to describe as we were only able to remove the bottom panel to inspect the electronics as the top panel screws just would not come out. What we were able to see was beautifully made. The player incorporates the latest generation of Philips swing arm laser beam mechanism which is, if you hadn't guessed, vibrationally mounted within the heavy die cast framework. Even with the massive bottom panel removed the remaining electronics were still clearly triple screened, carefully protected and with large power transformers and copper plated steel case only just visible.

Objective Testing

The objective testing of the CD-M2 produced more than a few surprises and most of them were not what I would have expected! Although the unit is claimed to have a frequency response of 2 Hz to 20 kHz±0.1 dB, our measurements with two different test discs revealed a marginally inferior frequency response over the range 5 Hz to 20 kHz which showed a rose of +0.6dB at 20 kHz.

This minor discrepancy in stated performance may be 'nit pocking', but when you pay $5500 for a CD player you would reasonably expect the unit to "deliver the goods". The overall linearity of the player over the range zero to −90 dB was exceptionally good on the left channel, being within a cooee of perfection to −70 dBm but not quite as good on the right channel, where minor discrepancies started to make their presence felt at −60 dB. The channel separation was, however, exceptional to say the least, as was the signal to noise ratio, which was undoubtedly the best we have yet seen from any CD player. The CD-M2 achieved the almost unbelievable performance of 105 dB linear, with emphasis and 120 dB(A) with emphasis.

When I came to measure the distortion at high signal levels, i.e., between zero and −10 dB, the performance was superior to the manufacturer's claims. It was, in fact, either superior or remarkably good all the way down to −50 dB and I suspect better than any other CD player I



Above: Frequency response for left channel. Below: Right channel. (10 dB log plot)

MEASURED PERFORMANCE OF MICRO SEIKI CD PLAYER
MODEL No. CD-M2
SERIAL No. 07040W29

1. **FREQUENCY RESPONSE** 20 Hz to 20 kHz +0.6 dB
5 Hz to 22.05 kHz + 0.7 dB

2. **LINEARITY** @ 1 kHz

NOMINAL LEVEL (dB)	LEFT OUTPUT (dB)	RIGHT OUTPUT (dB)
0.0	0.0	0.0
−1.0	−1.0	−1.0
−3.0	−3.0	−3.0
−6.0	−6.0	−6.0
−10.0	−10.0	−10.0
−20.0	−20.0	−20.0
−30.0	−30.0	−30.0
−40.0	−40.1	−40.1
−50.0	−50.0	−50.0
−60.0	−60.0	−60.1
−70.0	−70.2	−70.5
−80.0	−81.0	−82.3
−90.0	−90.1	−94.5

3. **CHANNEL SEPARATION**

FREQUENCY	RIGHT INTO LEFT (dB)	LEFT INTO RIGHT (dB)
100 Hz	−119.4	−120.5
1 kHz	−114.9	−114.4
10 kHz	−108.1	−108.1
20 kHz	−109.6	−109.3

4. **DISTORTION** (@ 1 kHz)

Level	2nd	3rd	4th	5th	THD%
	102.3	—	105.4	105.6	0.0011
−1.0	—	103.6	107.4	108.6	0.0009
−3.0	—	112.6	104.3	106.2	0.0008
−6.0	102.9	—	104.1	109.2	0.001
−10.0	92.2	—	91.1	101.5	0.001
−20.0	88.9	94.4	—	—	0.0041
−30.0	—	—	66.2	78.4	0.05
−40.0	62.8	72.6	62.0	71.3	0.11
−50.0	64.2	48.2	—	—	0.39
−60.0	45.0	46.2	53.5	—	0.77
−70.0	48.8	41.0	43.1	28.0	4.1
−80.0	23.4	15.9	27.2	16.8	23.0
−90.0	+1.3	−25.3	−3.1	16.8	100%

(@ 100 Hz)

Level	2nd	3rd	4th	5th	THD%
0.0	—	—	—	103.9	0.00064
−20.0	88.4	92.5	86.0	95.9	0.0064
−40.0	63.5	77.5	63.8	69.8	0.099
−60.0	—	—	61.9	55.3	0.19

(@ 6.3 kHz)

0.0	99.1	100.7	—	—	0.0014

5. **EMPHASIS**

Frequency	Recorded Level	Output Level (L)	Output Level (R)
1 kHz	−0.37 dB	−0.4	−0.4
5 kHz	−4.53 dB	−4.6	−4.6
16 kHz	−9.04 dB	−9.1	−9.1

6. **SIGNAL TO NOISE RATIO**

Without Emphasis	98.8 (Lin)	114.0 dB(A)
With Emphasis	105.0 (Lin)	120.0 dB(A)

7. **FREQUENCY ACCURACY**
(19.999 kHz) −1.0 Hz for 20 kHz test signal

8. **SQUARE WAVE RESPONSE AND IMPULSE TEST**
(See attached photos)

DIRTY RECORD TEST
Using Philips NR4A (410-056-2)

Interruption In Information Layer	Black Dot At Read Out Side
400 micrometer; Passed	300 micrometer; Passed
500 micrometer; Passed	500 micrometer; Passed
600 micrometer; Passed	600 micrometer; Passed
700 micrometer; Passed	800 micrometer; Passed
800 micrometer; Passed	
900 micrometer; Passed	

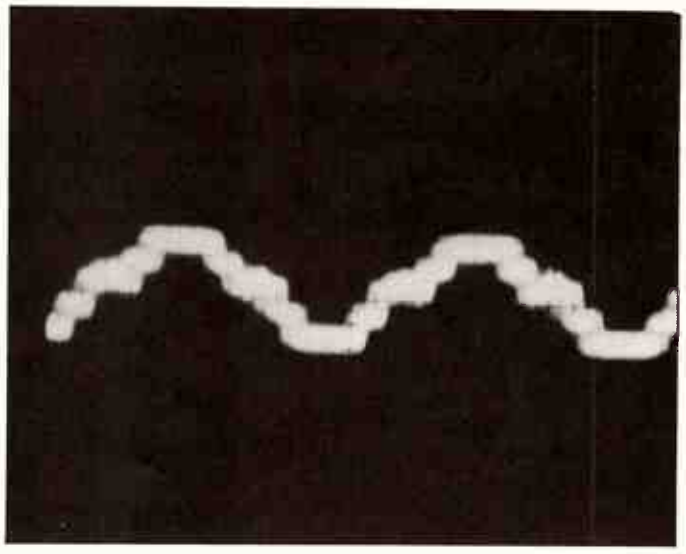
BLACK STRIPE TEST (Passed)

VIBRATION OR DISPLACEMENT TEST
Acceleration level: 1.5 grms over range 5 Hz to 10 Hz: passed
Displacement test: 150mm @ 7.5 Hz excitation: passed

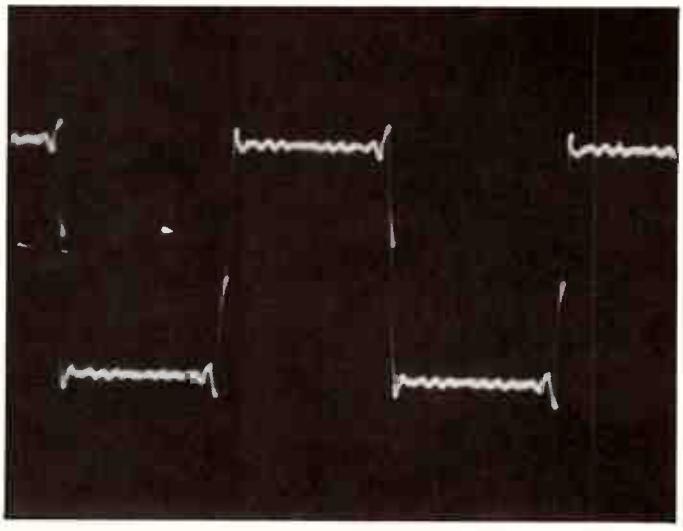
9. **ACOUSTIC EXCITATION TEST**
Passed with flying colours

MICRO-SEIKI CD-M2 COMPACT DISC PLAYER

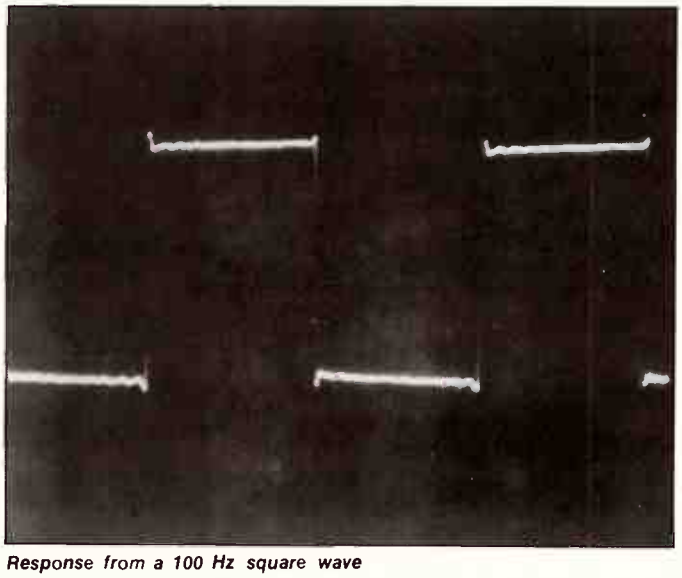
Dimensions: 4500mm width + 100m height + 330mm depth
Weight: 22 kg
Manufacturer: Micro-Seiki Japan
Price: $5,500 R.R.P.



Output from a sine wave input at -80 dB



Response from a 1kHz square wave



Response from a 100 Hz square wave

have yet evaluated. Below this point, however, and generally in the region of −60 db, the level of distortion increased rapidly and much to my surprise at a faster rate than any other CD player I have yet evaluated. At first I suspected that I had been given a faulty player, so I requested a second unit. Much to my surprise, the second unit produced virtually the same performance as the first. It became obvious on reflection that because of the four times over sampling and phase linear low attenuation third order low pass analogue Bessel filter, the distortion products are not attenuated as rapidly, nor as effectively, as they are by the more mundane (and cheaper) digital filters that other units use.

The CD-M2 produces an exceptionally high distortion of 23% at −80 db and the initially disturbing values of more than 100% at −90 db, where the second harmonic is greater than the fundamental.

The measured frequency accuracy of the unit is −1 kHz test signal whilst the square wave testing revealed a smooth, clean response with relatively little overshoot at either at 100 Hz or 1 kHz which I would have expected as a result of the care and attention applied to the filtering.

The electro-mechanical and tracking performance of the CD-M2 is exceptional. I subjected the player to both the Philips and Technics interruption, black dot and fingerprint test records and for every single test it provided a perfect score. I then subjected the player to our own scratched test record which most other CD players do not track adequately and which they generally 'spew out' unceremoniously.

The Nastiest Disc

Pleasingly the CD-M2 once again scored 100%. As a 'piece de resistance' I then produced my nastiest test disc which has an eccentric centre as well as imperfectly matrixed digital data, which virtually all other players fail to track. 'Lo and behold' the CD-M2 took this disc in its stride and proceeded to play music that is both clearly marked and nearly always found to be 'unsuitable for playing'.

The past of the major tests that I applied to the CD-M2 was a test that I have never previously found cause to use. Having made so many claims on its 'acoustical isolation' and on the merits of such isolation, I felt duty bound to put the advertising department to the test! Now I must admit I was, and still am sceptical of the concept of a smiliarity between the potential vibration transmission problems that affect a conventional record player and similarities that can be drawn to the transmission and interaction in a CD player. I decided to mount the CD-M2 on a solid (but not completely rigid) cardboard carton directly in front of one of my high powered laboratory speaker systems. This speaker is capable of generating levels in excess of 110 dB from below 50 hz to well beyond 10 kHz. I then proceeded to slowly play a swept sine wave through the amplifier and speaker system. During the course of this test I simultaneously monitored the CD player's electrical output while it was playing a section of a track with 16 zeros corresponding to zero output signal. I then monitored the CD player's output on a digital one-third octave band real time analysers. This was set to monitor the electrical signals between −127 dB to −67 dB re 0 dB.

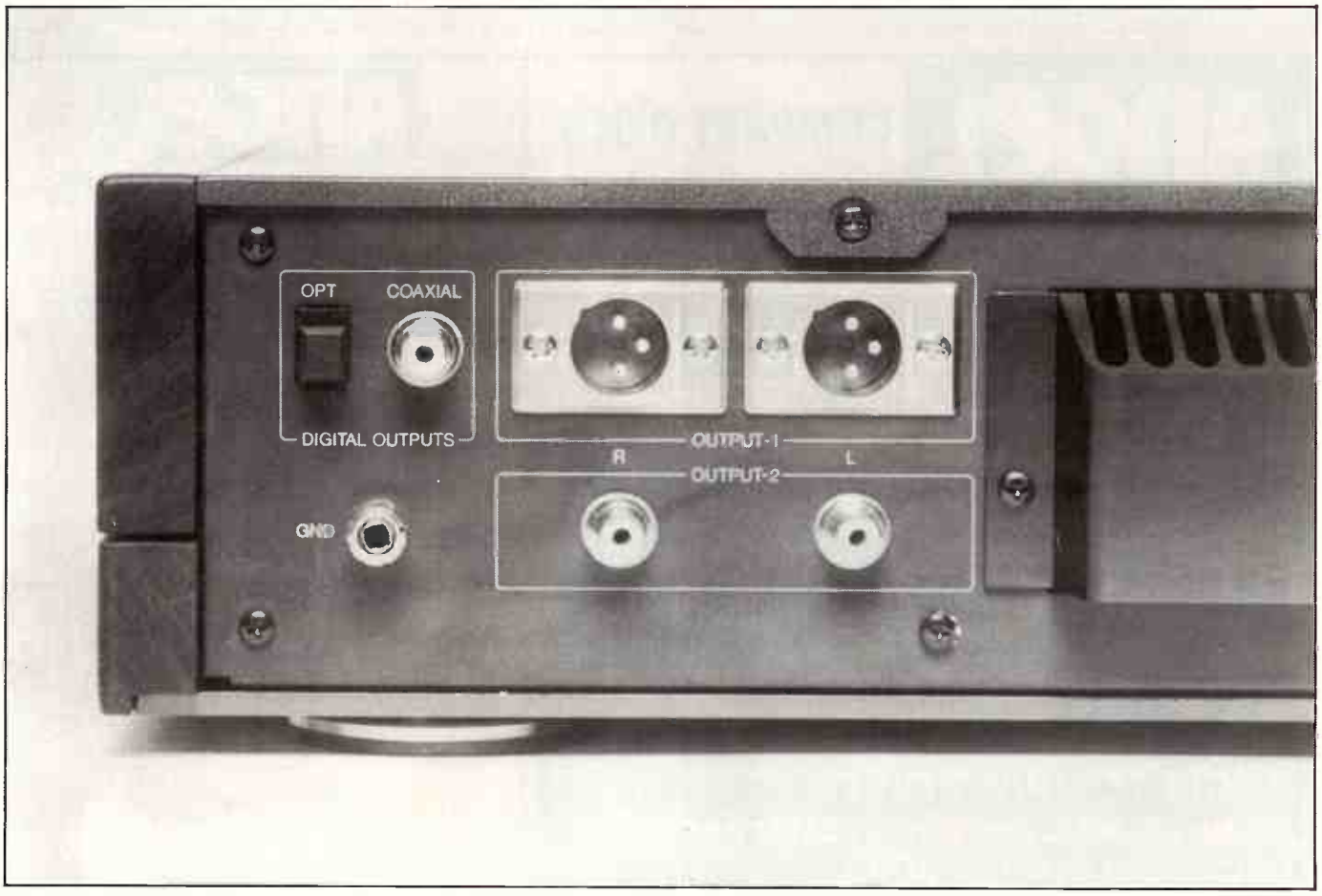
Awe Inspiring Results

The results were awe inspiring to say the least, for at the worst resonant frequency that I could detect in the real time analyser, the electrical output signal did not exceed a value of −90 dB relative to the

zero dB signal. This did not substantially change when I increased the acoustical signal to 115 dB sound pressure level! Wonderful! — I thought. At that point, however, I had the feeling that I should check what happens with a more mundane CD player which is not designed for such exacting standards. I thus gabbed my son's Sony D50 portable CD player and subjected it to precisely the same nasty test — Lo and behond, although it did not achieve the same magical numbers as the Micro-Seiki, nonetheless, it put up quite a commendable performance. The maximum electrical output signal that it produced was only about 20 dB inferior, i.e., 115 dB of sound pressure level only produced an electrical output signal which was at or below −7 dB re 0 dB reference signal.

By now the reality was staring me straight between the eyes. Who can possibly hear the distortion or resonance products generated by the excitation of a CD player when these signals are themselves more than 70 dB below the fundamental acoustical signal which is already at an almost earshattering level. In the case of the

Above: The remote control unit. Below: The block panel showing the optical line output.



Sony player the additive level would be totally inaudible, whilst in the case of the Micro-Seiki 20 decibels lesser audibility still does not change the comparatives! As you now undoubtedly comprehend, the whole concept of seeking such isolation perfection appears to be an academic question rather than a real issue warranting such exacting design standards or such numerical perfection.

Having satisfied myself on the vexing issue of structural and acoustical isolation, I proceeded with a subjective evaluation of the CD-M2's player's performance. The results of that evaluation were in many respects even more remarkable than my objective assessment, as the CD-M2 produced audible results which were both gratifying and to say the least exciting. With 'software' selected carefully for that purpose both my test panel and I were clearly able to hear improvement and advances in audible quality which I would not have expected from my prior assessment. The discs that I selected for the assessment were Telarc Digital Sampler Volume 1 (CD.80101), "Kiri (Portrait of Kiri Te Kanawa)", decca 417645-2, "Franck Symphony in D Minor", Denon 33CO-1255, and "Otmar Suitner Schubert 3rd and 6th Symphony", Denon 33CO-1253.

Kiri Te Kanawa provided a voice that is very much a musical instrument and allowed me and the rest of the panel to assess the subtle differences which are so easily detected from the human voice, whilst the other test material provided transient and frequency content which were well suited for this task.

The experience was rich and I believe most rewarding, for Micro-Seiki have created a CD player which is capable of extracting audible nuances and refinements from the original material content that neither my assistants nor I would have believed possible.

The Micro-Seiki CD-M2 is a very expensive CD player on the Australian market and its publicity is loaded with just as much 'hype' as the player is loaded with lead. Notwithstanding such criticism, the CD-M2 achieves a level of aural performanced which I believe is somewhere between half to an order of magnitude superior to anything else I have previously heard. Even if you can't afford to buy one (and I doubt that many of you will) this CD player is still worth hearing, particularly if the listening environment and associated electro-acoustic equipment is as carefully selected and prepared as mine was for its assessment. ●

The CDM2 is available from Audax Loudspeakers (03) 543-5266 or Audio Investments (02) 488 8184.

Jon Fairall looks at a quiet revolution in TV technology. Its expensive, but this is the way to the future.

Digital TV arrives

IN DECEMBER, 1984 I wrote an article for ETI on some new developments in West Germany, where the local ITT subsidiary, Intermetal, had developed the worlds first wholly digital TV set. I found the technology fascinating; pregnant with possibilities. So when Falk Elestrosound recently said they were importing the first digital TV's based on this technology, I jumped at an opportunity to see at first hand what Digital TV looked like.

The first thing that needs to be said is that the Digivision range is not for the fainthearted. With prices ranging from $1390 (42 cm) up to $4000 (70 cm), you need to want it a lot. The second thing is that you are not paying for a better picture, since the Digivisions do not give you a noticeably better picture than a good analogue set with a good aerial system and a good signal. So what features are you paying for?

ITT are banking on the fact that many, perhaps most, people do not live with a perfect picture. In practical situations noise and ghosting, at least on some channels, are just something to put up with.

It'll change the way you watch videos forever.

With Yamaha's new AVC-30 Video Integrated Amplifier, you'll be watching videos with your ears. As much as you do with your eyes. Now that may sound strange. But with the AVC-30, that's the only thing that will sound strange. Because once you plug your video cassette recorder and speakers into the AVC-30, the room will be filled with incredibly lifelike sound. And when you plug in your graphic equaliser, compact disc player, stereo tuner and turntable, the AVC-30 becomes the control console of your own surround sound video centre. When you hear your next video you'll see exactly what we mean. The AVC-30 Video Integrated Amplifier. For just $899.* From Yamaha.

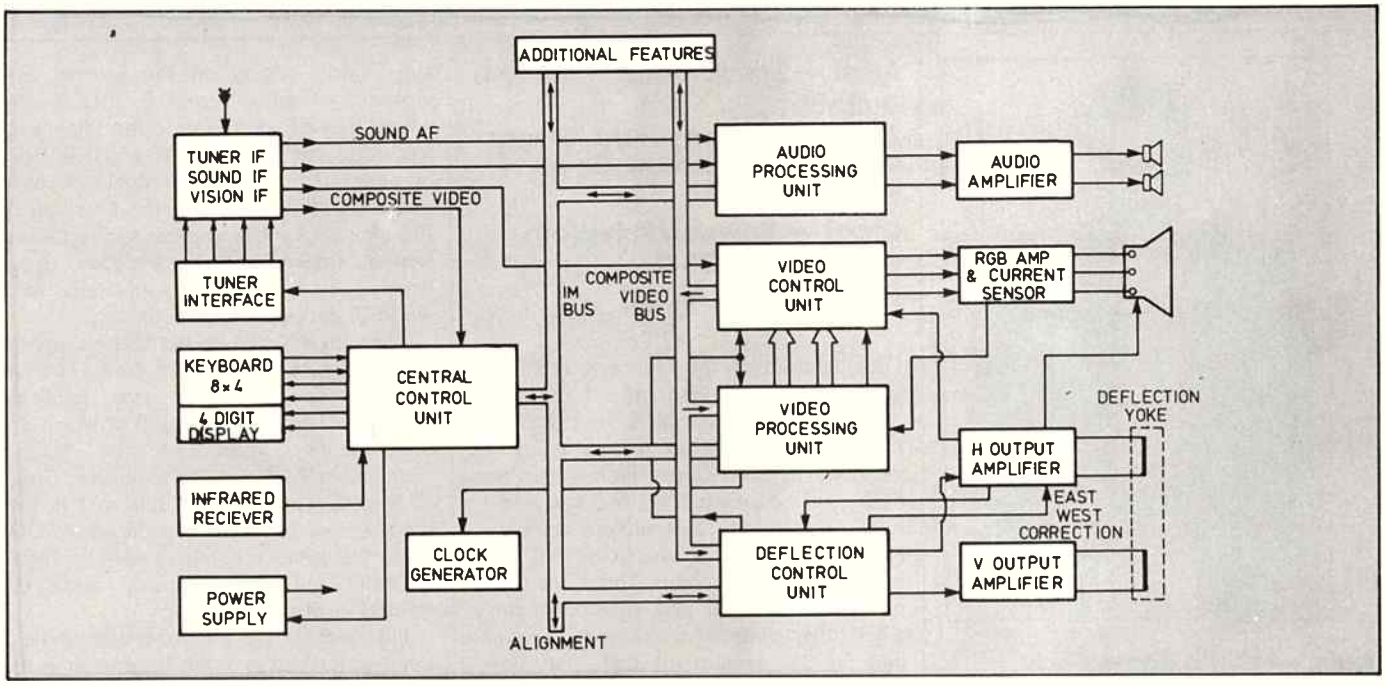
YAMAHA 100 YAMAHA 1887-1987

5 YEAR WARRANTY.

Saatchi YAM 028/R

READER INFO No. 22

* Rec. retail price.



Digivision tries to do something about this. It can process and restore the signal using image enhancement techniques so that 'snow' and speckle are eliminated completely. ITT also claim to be able to reduce the effects of ghosts. A subjective assessment on weak signals is that there is noticeably less noise on the screen. On the other hand "ghost elimination" does not completely eliminate ghosts. You still need a good aerial.

ITT have crammed just about every imaginable feature into the Digivision lineup, as a way, no doubt, of spreading the huge cost of the digital componentry. It's fully controllable from an Infra Red remote, has two SCART connectors on the back to allow the connection of cameras, VCRs, satellite receivers and so on. It can also accept RGB input from computers and VCRs for high resolution pictures. An optional pc board can be fitted to allow the machine to receive the French/Russian SECAM standard.

There are audio inputs and outputs for connection to a hi-fi system. The equipment will decode the stereo signal from the TV station, and it will also decode bilingual broadcasting if that ever gets off the ground in this country. It has a 40 Watt amplifier on board, so it can function as a quite useful audio amplifier if required. There is a facility for extension speakers to be connected via the DIN plugs on the back panel. Unfortunately, Falk do not have access to performance figures for the audio system, but subjectively it seemed quite good. I watched some late night rock video programmes and some classical music, and in both cases the frequency response seemed quite exceptional for a TV. The in-built speakers, in fact, are surprisingly pleasant on the ears. There is nothing cheap and nasty here, but then at this price you wouldn't expect there to be.

It comes Teletext compatible. All the teletext controls are available on the remote, and frames can be accessed either on their own, or over the picture on the screen. There is even an alarm facility built in, so that you can bring up a frame at a specified time.

The most novel feature is the capability for projecting a small frame into the top right corner of the big screen, showing the input from one of the other channel. This picture in picture (PIP) facility allows you to monitor a camera while watching the main screen. The camera might be in a child's bedroom, or at the front door. You can also watch one channel while monitoring another off-air, or a tape. In addition, this small frame can be frozen for later inspection.

The PIP facility is the first commercial manifestation of the frame store, a digital memory map of screen information. ITT have set aside 64 k of RAM for this function. Unfortunately, the resolution of the screen is strongly limited by the amount of memory, and it also appears to have a rather slow refresh rate, so not only is the picture not as sharp as one would like, it also blurrs when there is any movement on the screen. This is not a problem in this application, where great resolution is not really required, but it would be quite useless as a real screen.

Nevertheless, the frame store does illustrate the direction we may expect for TV technology over the next few years. The beauty of a frame store is that it allows complete decoupling of the screen from the incoming signal. One can take the signal from the TV transmitter, reprocess it to your hearts content, and then put it back on the screen.

For instance, one plan that has been strongly mooted is to use frame stores to create enhanced definition TV. This could be done by storing one frame, and then projecting it twice, or possibly saving one frame and interlacing it with the next one. Either way the result would be to double the number of lines on the screen, and also, just as importantly, double the refresh rate, ending the annoying flicker that TV pictures are prone too.

Another possible use of frame stores would be in making TV sets that could adapt themselves automatically to any of the TV standards currently in operation. This would make it possible for TV makers to go after world sales with one design of TV, instead of needing three different versions. When one considers the size of the possible market this introduces, one can see why ITT is going down the digital road. ●

Reviews

Artist — Colin James hay
Title — Looking for Jack
Producer — Robin Millar
Label — CBS
Cat # — 4500 355.4
Format — AAD

This CD is the first solo effort from the now defunct Men At Work lead vocalist and chief tunesmith Colin James Hay and, on it, he displays all the imagination and zest that drove that band to international prominence in the early eighties.

Surrounding himself with crack session players, Hay has come up with a very credible offering. The style is reminiscent of his former band, with quirky lyrics and plaintive vocals, but Hay has progressed beyond Men at Work. On this disc he exhibits increased control and maturity.

Stand out songs are "Hold Me" an African influenced number with tasteful brass embellishment; "Looking For Jack" a lively jazz tinged track with piano assistance from Herbie Hancock; "Nature Of The Beast" an intense percussive tune with interesting guitar and unusual harmonies; "Ways Of The World" a darker, more introspective song with terrific guitar provided by Robbie McIntosh (Pretenders), and "Fisherman's Friend" a wistful acoustic influenced tune that builds slowly and has tasteful cello and double bass accompaniement.

This release of eleven tracks contains many moods and changing rhythms and effectively demonstrates the abundant talents of this burgeoning Australian artist.

Recommended.

— Mark Lewis

Artist — London cast, Phantom Orchestra,
Title — Phantom of the Opera
Producer — Andrew Lloyd Webber
Label — Polydor/Polygram
Cat # -831 273-2
Format — Not Listed

The Phantom of the Opera is the latest musical triumph by the world renowned Andrew Lloyd Webber. Like his earlier works the Phantom has apparently been a huge commercial success and has been one of the chief events of the London season.

The reasons for this success are clear. First of all there is the story itself; it's both cogent and exciting. This alone raises the Phantom head and shoulders above most other musicals which seem to compete in the banality of their plot lines. Webber and his lyricist have based their story fairly closely on the original tale written by Gaston Leroux in 1911. Fortunately they decided to drop the Phantom's name; in the book he was called Eric. Somehow Eric the Ghost does not have quite the same impact as the Phantom of the Opera. As it is Webber shows the essential tragedy of a sensitive figure trapped by his hideous appearance in a world of darkness, hatred and fear.

Then there is the music. Quite simply it is Webber at his brilliant best. He has concocted a tapestry of rich, haunting melodies. The most beautiful of which are undoubtedly 'Music of the Night', 'Remember Me' and the exquisite 'Angel of Music'. These are the hits, but in fact there are no bad tracks on the whole CD. Even the smaller numbers such as 'Masquerade' and 'Prima Donna' make extremely enjoyable listening.

Finally there are the singers themselves. Leading the cast is Sarah Brightman in the role of Christine Daae the heroine of the

Compact Discs reviewed on this page supplied by Angel Compact Discs. Phone (02) 253-3690.

piece. Webber is said to have written the Phantom to create a role especially for her. She has a voice that is both full and delicate and demonstrates quite a startling range. Michael Crawford (who we all remember as the hapless Frank in "Some Mothers do Ave 'em") manages to infuse his role as the Phantom with just the right amount of pathos and danger. His singing will excite both pity and disgust for the part man, part gargoyle Phantom. The leads are well supported by Steve Barton in the role of Raoul Christine's lover and by John Isavident and David Firth as Firmin and Andre. These latter manage to extract just the right amount of comedy from their songs without becoming downright farcical.

The Phantom of the Opera is one of the greatest musical happenings of this year. The double set CD sells for $56. Its good value for anyone who want to enjoy a unique musical experience.

Simon O'Brien

Artist — Mike Batt and Friends
Title — The Hunting of the Snark
Label — Epic Records
Cat # — CDEPC 57023
Format — DDD

The Hunting of the Snark was written by Lewis Carroll (Charles Dodgson) in 1876. Apparently the poem was originally subtitled "An Agony in Eight Fits", a title which could accurately be applied to this CD.

The idea of making an album inspired by Carroll's poem belongs to Mike Batt who wrote all the music and lyrics. He also assembled all the artists, ranging from John Hurt to Art Garfunkel. Given the galaxy of names who appear on the cover one might have expected "The Hunting of the Snark" to be one of the classic albums of the eighties.

Unfortunately however the Snark is a classic disaster. This is so for several reasons. First and foremost there is the music. It is not much good. The melodies are neither stimulating nor enjoyable. Not even the brilliant talents of Stephane Grappelli, George Harrison and the London Symphony Orchestra can save the Snark.

Next there are the singers. At first glance Batt seems to have gathered together a glittering cast but this impression tarnishes on closer inspection. What, for example does Captain Sensible have in common with Art Garfunkel? Crooner Deniece Williams with old rocker Roger Daltrey? Cliff Richard with Mike Batt? And why has Julian Lennon been included at all? The only thing which seems to link all these people is that their careers appear to have hit the doldrums.

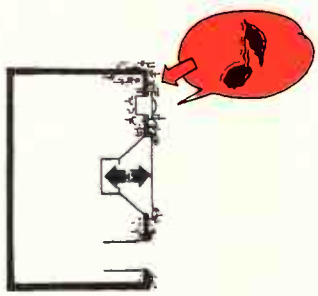
The best parts of the 'Snark' are the narrations by John Gielgud and John Hurt. They provide the only interesting material on the whole album. It is somewhat surprising that Batt did not ask them to sing. Not recommended.

Simon O'Brien

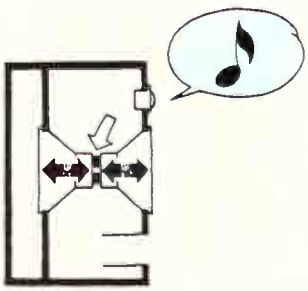
EUROPE'S FINEST

The new DALI-40 loudspeakers are the finest we have ever created. They incorporate technology and design features which make them technically and musically superior to virtually anything else available today.

The manner in which the bass drivers are mounted, back-to-back, gives an equalisation of vibrations caused by Newton's 3rd law. This elegant solution, whilst removing the need for concrete construction, completely eliminates front panel resonances.



Conventional loudspeaker



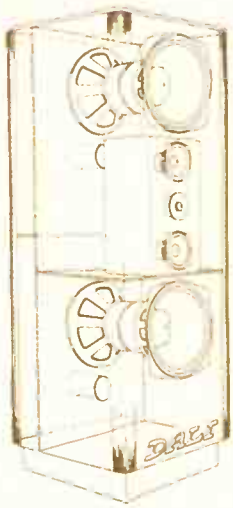
Total elimination of high- and mid-frequency distortion caused by cabinet vibrations.

The duplication of the bass and mid-range drivers with the centrally mounted 1″ dome tweeter ensure that the sound at all frequencies appears to originate from one central point of each loudspeaker.

Definition, imaging, and stereo separation are all outstanding as is the superlative cabinetry finish – the combination of solid timber, anodised aluminium and glass.

The new DALI-40 is a loudspeaker with truly state-of-the-art performance, worthy of the finest source and amplification equipment.

DALI-40 contains four PP-woofers with 25mm linear excursion



Each cabinet is divided into five separate chambers, of which two are of the band-pass bass reflex type.

Its reproduction of the musical sound stage will thrill you.

Write or telephone the sole Australian distributor Scan Audio for full information about the new DALI-40 and the entire range of DALI loudspeakers.

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DALI

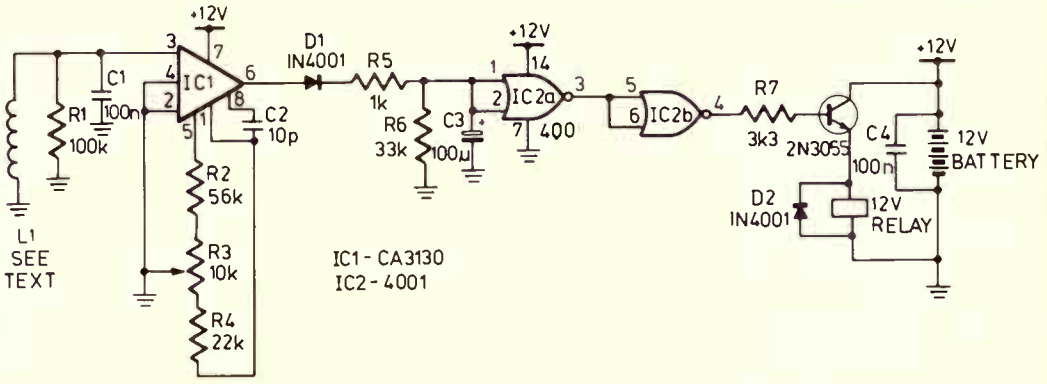
S&T 4623

READER INFO No. 24

Telephone operated relay

This circuit will operate a relay when the telephone rings. It may be used to switch on any device when the phone rings, or as a telephone bell extender. It has been adapted from a project in ETI of June 1977.

The pickup coil consists of abut 200 tums of 0.125 mm enamelled copper wire wound in a donut shape of approximately 50 mm diameter. Solder terminal leads of flexible hook-up wire to the ends, and cover the coil with insulating tape. This coil is placed close to the phone, and when the bell rings the resulting magnetic field will induce a voltage across it.



This small signal is amplified by IC1, rectified by D1, and the resultant DC used to charge C3. This capacitor, together with R6, provides a time delay to hold the relay on for a suitable time. IC2 acts as a buffer to prevent C3 discharging through the transistor. R3 is a sensitivity control, adjusting the offset voltage of IC1 so that the small input voltage will trigger the circuit.

A bell extender, a siren or even a car hom could be switched by the relay contacts. To switch an appliance on from a remote phone, the relay will need to be "latched" on. This could be done by using a spare set of relay contacts to join the collector and emitter terminals of the transistor together when the relay is energised. A normally on push button switch should be in series with this set of contacts to unlatch the circuit. Obviously any 240 V wiring should be in accordance with regulations and relay contacts should be capable of handling the current and voltage used.

N. Jackson,
Wandin East,
Victoria

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

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

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

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

'Idea of the month' contest

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

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

RULES

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

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

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

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

COUPON

Cut and send to: **Scope-ETI 'Idea of the Month' Contest/ Computing Column, ETI Magazine, PO Box 227, Waterloo NSW 2017.**

"I agree to the above terms and grant *Electronics Today International* all rights to publish my idea/program in ETI Magazine or other publications produced by it. I declare that the attached idea/program is my own original material, that it has not previously been published and that its publication does not violate any other copyright.*"

* Breach of copyright is now a criminal offence.

Title of idea/program .....

Signature ..... **Date** .....

Name .....

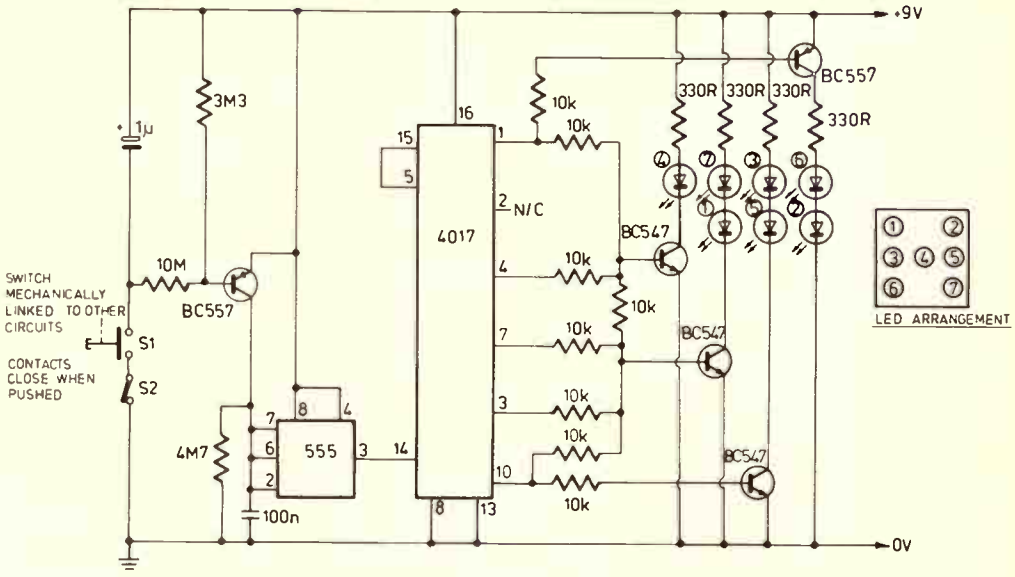
Address .....

..... **Postcode** .....

Multiple Electronic Dice

This circuit is used to play the game 'Yahzee' that requires five dice, so five separate circuits are required. S2 are individual toggle switches and S1 is a multi-contact momentary push switch. I removed a record switch from an old cassette recorder which made an ideal push switch for this project. Normally all toggle switches are closed. Operating the push switch will make all the dice run and come to a random stop. The toggle switches are opened to hold selected numbers, while the push button is operated to toss unwanted numbers as per the rules of the game.

G. B. Wolfe,
Bombala,
NSW



```
]LIST

10  REM      **************
20  REM      *            *
30  REM      *   ROTON!   *
40  REM      *            *
50  REM      * BY B.SPREY *
60  REM      *            *
70  REM      **************
80  REM
90  POKE 232,0: POKE 233,3: SCALE= 5
100  FOR G = 768 TO 768 + 14
110  READ H: POKE G,H
120  NEXT G
130  DATA  2,0,6,0,9,0,44,62,0,4,44,20,59,12,0
140 S = 0
150  HOME : HGR : HCOLOR= 2
160  VTAB 22: PRINT "SCORE : ";S
170  HPLOT 0,0 TO 278,0 TO 279,159 TO 0,159 TO 0,0
180 X =  INT ( RND (1) * 260 + 10): IF X > 50 AND X <
    230 THEN 180
190 Y =  INT ( RND (1) * 140 + 10): IF Y > 50 AND Y <
    110 THEN 190
200 XI = (X - 140) /  - 10
210 YI = (Y - 80) /  - 10
220 Q =  INT ( RND (1) * 2 + 1)
230  IF S > 10 THEN Q = Q + 1
240  IF S > 20 THEN Q = Q + 1
250  FOR R = 1 TO 64 STEP Q
260  ROT= R: XDRAW 2 AT 140,80
270  ROT= 8: XDRAW 1 AT X,Y
280  IF  PEEK ( - 16384) > 127 THEN  GET A$
290  FOR D = 1 TO 15: NEXT D
300  XDRAW 1 AT X,Y
310  IF A$ = "" THEN 340
320 X = X + XI:Y = Y + YI
330  IF  PEEK (234) <  > 0 THEN 360
340  ROT= R: XDRAW 2 AT 140,80
350  NEXT R: GOTO 250
360  PRINT  CHR$ (7)
370 XZ =  INT (X - XI)
380 YZ =  INT (Y - YI)
390  IF XZ > 138 AND XZ < 142 AND YZ > 78 AND YZ
    < 82 THEN 420
400 S = S + 0: IF S > 30 THEN 460
410 A$ = "": GOTO 150
420  VTAB 22: HTAB 15: INVERSE : PRINT "<GAME OVER!>"
430  ROT= 32: FOR R = 1 TO 60: SCALE= R: XDRAW 2 AT
    140,1: NEXT
440  VTAB 23: NORMAL : PRINT "ANOTHER GAME?  (Y/N):";:
    GET 0$: IF 0$ = "Y" THEN RUN
450  END
460  FLASH : HOME : VTAB 22: HTAB 16: PRINT "YOU WIN!"
470  FOR R = 1 TO 64: ROT= R: SCALE= R: XDRAW
    1 AT 140,80
480  ROT= R + 32: XDRAW 1 AT 140,80: NEXT R
490  GOTO 440

]
```

Roton

ROTON is a game of reflex, the object being to hit the top of the rotating icon in the middle of the screen. To do this, just hit any key and this will hire the square at the rotor. The faster the rotor is spinning, the more you will be awarded. To win, you must score 30 points but unfortunately, if you miss, it's game over for you.

B. Sprey
Mt. Gravatt
Brisbane, Qld.

```
00001 REM12345678901234567890
00100 REM ** LINE ONE MUST BE TYPED EXACTLY FOR MACHINE CODE **
00110 FOR T=2309 TO 2327
00120 READD:POKET,D:NEXTT
00130 IF PEEK(64000)=0:U=USR(2309)
00140 DATA 33,0,250,1,240,5,126,47,87,35,178,119,35,11,120,177,32,244,201
00150 DISKRESET"A"
00160 POKE 220,96
00170 GOSUB 700
00180 A0$="A"
00190 POKE 33852,42
00200 CLS
00210 REM ***** START OF MAIN PROGRAM *****
00220 ON ERROR GOTO 690
00230 CURS 25,5:PCG:PRINT"\]  OPTIONS  \]"::NORMAL
00240 NORMAL
00250 CURS 20,6:PRINT"1. Directory of logged disk"
00260 CURS 20,7:PRINT"2. Change logged disk drive"
00270 CURS 20,8:PRINT"3. Run a program in Basic"
00280 CURS 20,9:PRINT"4. Exit to Basic"
00290 CURS 20,10:PRINT"5. Exit to CPM"
00300 CURS 20,11:PRINT"6. Rename a file"
00310 CURS 20,12:PRINT"7. Erase a file"
00320 CURS 45,15:PRINT"Default Disk "A0$
00330 I0$=KEY$:IF I0$="" THEN GOTO 330
00340 I=INT(VAL(I0$))
00350 IF I<1 OR I>7 THEN GOTO 330
00360 ON I GOSUB 410,460,500,520,570,610,640
00370 GOTO 200
00380 REM
00390 REM **** START OF ****
00400 REM ****   SUBS   ****
00410 SPEED 25:DIR
00420 PCG:PRINT\\\"\]    Press any key please Master    \]":NORMAL
00430 I0$=KEY$:IF I0$="" THEN GOTO 430
00440 SPEED 0
00450 RETURN
00460 CURS 5,14:INPUT"Please enter new Disk Drive (without :) Master:":A0$
00470 CURS 0:PRINT [A56 32]
00480 DISKRESET A0$
00490 RETURN
00500 CURS 5,14:INPUT"Please enter program name Master:":B0$
00510 RUN B0$
00520 CURS 1,13:PCG:PRINT"Are you sure Master?":NORMAL
00530 I1$=KEY$:IF I1$="" THEN GOTO 530
00540 IF I1$="Y" THEN GOTO 560
00550 GOTO 200
00560 CLS:PCG:PRINT"Returning you to Basic Master":NORMAL:END
00570 CLS:PCG:PRINT"Are you sure Master ? (Y/N)":NORMAL
00580 I0$=KEY$:IF I0$="" THEN GOTO 580
00590 IF I0$<>"Y" THEN GOTO 200
00600 SYSTEM
00610 CURS 1,13:INPUT"Rename:":A1$:CURS 25,13:INPUT"as :":A2$
00620 NAME A1$ AS A2$
00630 RETURN
00640 CURS 1,13:INPUT"File to erase Master:":E0$
00650 PCG:CURS 1,14:INPUT"Are you sure Master?":R0$:NORMAL
00660 IF R0$<>"Y" THEN RETURN
00670 KILL E0$
00680 RETURN
00690 CURS 1,13:PCG:PRINT"ERROR "ERROR" IN LINE "ERRORL:NORMAL[illegible]:GO
TO 230
00700 REM PCG FOR MICROBEE SIGN
00710 FOR I= 64960 TO 64951
00720 READ J:POKE I,J:NEXT I
00730 DATA [illegible]
00740 DATA [illegible]
00750 RETURN
```

Disc Menu

This program provides the user with a menu of seven choices:

a. Directory of the logged disk.
b. Change the logged disk drive.
c. Run a program in Basic.
d. Exit to Basic.
e. Exit to CP/M.
f. Rename a file.
g. Erase a file.

It uses PCG Graphics for emphasised type and to display the Microbee logo. Line one must be typed exactly as listed. The program also has an error handling routine that indicates when an incorrect line is entered. The error message may be cleared from the screen by pressing the space bar.

R. Gibson,
Yamanto,
Qld.

Letters

Sweet Voices

Good stuff, its about time we had an alternative Hi-Fi Mag in Oz (even if its a bit small).

Its good to see a review that covers a product's faults as well as its achievements (Richter Oracles). Not like the others who only give good reviews — a pox on them!

Keep up the good work!

Timothy J. Ward
Nth Bexley
NSW

I would like to take this opportunity to compliment you on a fine Australian Electronics Magazine.

More articles, construction projects, software, etc, would be appreciated on Dick Smith's VZ-300 computer which, after checking sales figure I am sure would be popular.

R. D. McDonal
MT Gambier
SA

This reader's stuff is a U-Beaudy idea. Even if the yanks invented it!

However the exiguity of circuits is deleterious to the quintessence of this publication. May I suggest the inclusion of machine descriptions, data sheets, etc, et al?

As for the humour — keep it up (or should I rephrase that . . .)

Colin R. B. Stewart
Broken Hill
NSW

And one not so sweet

The new format introduced, whilst interesting, tends to regrade this magazine into a hybrid hi-fi/electronics publication.

Your front section cannot compete with WNIE (Whats New In Electronics) and your hi-fi section is also not competitive. Bring back more hobbyist articles of better quality or you will lose your hobbyist readers.

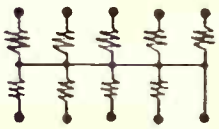
R. ALLAN
Castle Hill, NSW

Genuine Fujitsu Relay for only $3.50

Geoff has managed to obtain a quantity of genuine Fujitsu 4 pole changeover relays type FRL263. They have solder/plug-in terminals and offer four changeover contacts rated at 3A. The coil is 24V nominal (650ohm). Fully enclosed.
Measures 22 x 28 x 40mm approx.

Fujitsu FRL263.....only $3.50

10 pin SIL Resistor Networks



By popular request Geoff is now stocking resistor networks. They consist of nine resistors sharing a common connection in a ten pin in-line package. Available in the following values :
220, 330, 470, 680, 1k0, 2k2, 3k3, 4k7, 10k, 22k, 33k, 47k, 100k and 200k.
1/8W rating. Fits 0.1" grid.

Specify value... all 60cents

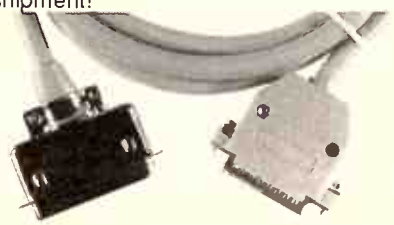
68000 Processor Chips on Special

Thomson brand 10MHz CPU chips. Yes the 68000 microprocessor for under $25!

TS68000CP10.....$24.00

IBM Printer Cables

Approx 1.5m long with quality connectors on each end. You couldn't make one yourself for the price. We only hope our stocks last till this advertisment appears because you'll be paying more than $15 for the next shipment!



IBM Cable.....$15.00

** 4000hour battery life*
** LCD display*
** Audible continuity*

Model EDM-2347

Escort Battery/Mains operated Bench Type Multimeters

EDM2116 3 1/2 digit with capacitance

Ranges		Accuracy
Vdc	200mV to 100V	0.5%
Vac	200mV to 100V	1%
Adc	200uA to 20A	1%
Aac	200uA to 20A	1.5%
Ohms	200 to 20M	0.75%
Caps	2nF to 20uF	2%

EDM2166.....$216 ex tax
$254 inc tax

EDM2347 4 1/2 digit with true rms,dB, frequency

Ranges		Accuracy
Vdc	200mV to 100V	0.03%
Vac	200mV to 100	0.5%
Adc	200uA to 20A	0.3%
Aac	200uA to 20A	1%
Ohms	200 to 20M	0.1%
Freq	20kHz to 200kHz	0.5%

EDM2347.....$406.35 ex tax
$471.36 inc tax

SPECIAL PRICES ON 'D' & CENTRONICS CONNECTORS

'D' Connectors

	1-9	10 UP	100 UP
DE9P	$1.68	$1.51	84¢
DE9S	1.80	1.44	90¢
DA15P	2.34	2.11	1.17
DA15S	2.42	2.18	1.21
DB25P	2.20	1.98	1.10
DB25S	2.72	2.45	1.36

Covers Metallised

9 pin	1.80	1.62	1.25
15 pin	1.80	1.62	1.25
25 pin	1.80	1.62	1.25

Covers Plastic

9 pin	1.60	1.44	90¢
15 pin	1.60	1.44	90¢
25 pin	1.65	1.48	95¢

Centronics Solder

24 way male	9.60	8.64	4.80
24 way fem	10.00	9.00	5.00
36 way male	6.60	5.94	3.30
36 way fem	9.50	8.55	5.28

Centronics I.D.C.

36 way male	8.00	7.20	5.20
36 way fem	8.40	7.56	5.40

Microprocessor Transformer - ideal for projects

The JT348 is a locally made transformer specifically designed for you microproessor enthusiasts. It features three secondary windings giving you -

12V at 1A
12V at 1A
9V at 2.5A

Measures 115 x 70 x 65mm

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Mail Orders add $5.00 to cover postal charges.

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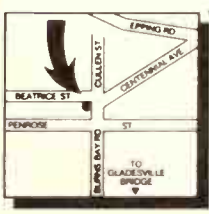

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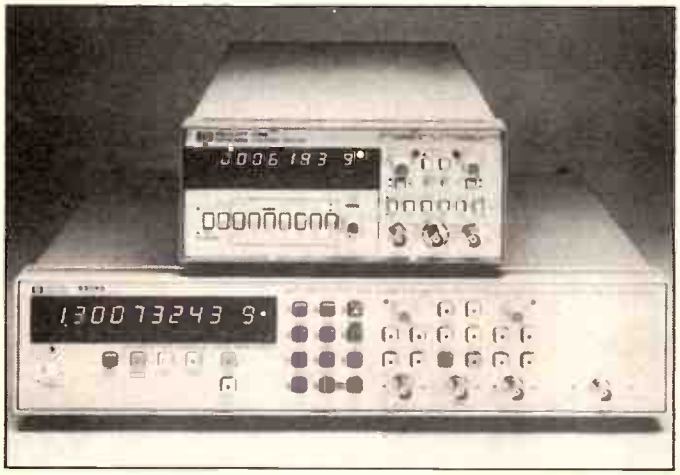


Universal Counters

Hewlett-Packard has introduced value-engineered versions of the HP 5334A and HP 5316A universal counters, enhanced by new components and simpler designs. The company claims that these counters "will save customers 37 per cent on the HP 5334B and 30 per cent on the HP 5316B. There is no sacrifice of frequency or time-measurement capabilities.

The HP 5316's frequency ratio and event-totalise functions are provided to 100 MHz. Its standard HP-IB interface provides remote control of these measurement functions, as well as the trigger-level and slope controls. For more measurement accuracy and longer intervals between calibrations, TCXO and over-timebase options are available.

The HP 5334B expands the traditional definition of an under $4000 universal counter by adding push-button waveform-characterization measurements such as rise time, fall time, pulse width and ac peak amplitude. Additional functions include offset, normalize and average for greater use of results, and auto triggering and auto attenuation for user convenience.

The HP 5334B has a 100MHz universal counter with a frequency and period resolution of nine digits per second of gate time, plus a 2ns, single-shot, time-interval resolution (200 ps with averaging).

Full HP-IB programmability comes standard on the HP 5334B, allowing up to 140 unprocessed readings per second in an ATE application. Optional rear inputs also are available to simplify system cabling. The optional 1.3Hz C channel and oven timebase are said to make high-accuracy communication and navigation-frequency measurements convenient and easy to perform.

R.I. 110

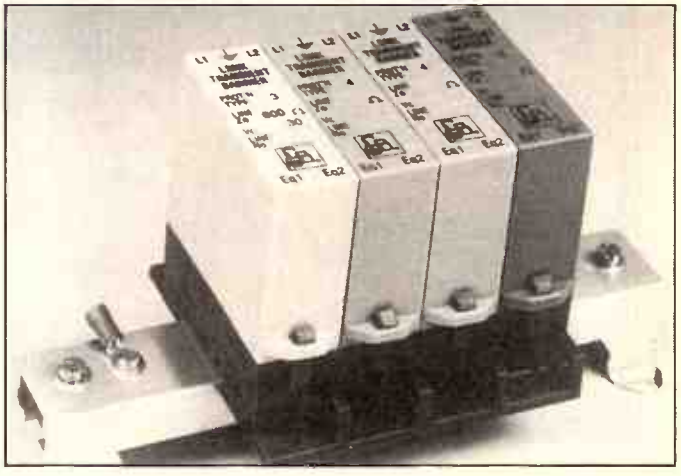
Gang Programming

A new module for the PP40 series of programmers from Stag Electronic Designs allow gang programming of up to eight Intel (or equivalent) single chip microcomputers.

Groups of microcomputers from the Intel range (or other compatible types) housed in 40-pin DIL packages can be programmed quickly using the new 41M200 module from Stag. The company claims that up to eight devices at a time can be inserted and programmed simultaneously, either from data held in the programmer's RAM, or from a master EPROM or a microcomputer that is already programmed.

Like the earlier M100 series of modules for Megabit EPROMs, the 41M200 mounted on a PP40 series programmer allows fast programming algorithms to be employed to reduce programming times. Other features of the system include recognition of Electronic Identifiers of the devices inserted, blowing of the security fuses to prevent devices being read, a time saving 'auto recall' feature of the set up, and extensive self test routines of power-up.

R.I. 111



Transient Barriers

Hobart based manufacturer, Component Resources has recently released the LSHK series transient barriers. The LSHK transient protection barriers are new generation devices offering improved performance in the production of signalling, data and communication circuits. The series replaces previous models.

The base of each unit contains a 10kA three element gas arrestor together with input, output and earth terminations. Secondary protection is provided by a series of caps which may be selected according to system requirements. A strap cap is also available when secondary protection is not required.

The secondary protection caps contain a wide range of circuit configurations to cater for various clamping parameters. Preselected output clamping voltages range from 1.5-200 volts and cover most line operating voltages. A filter unit is also included to cater for currents up to 1.5 A where master battery power is being transmitted to remote devices.

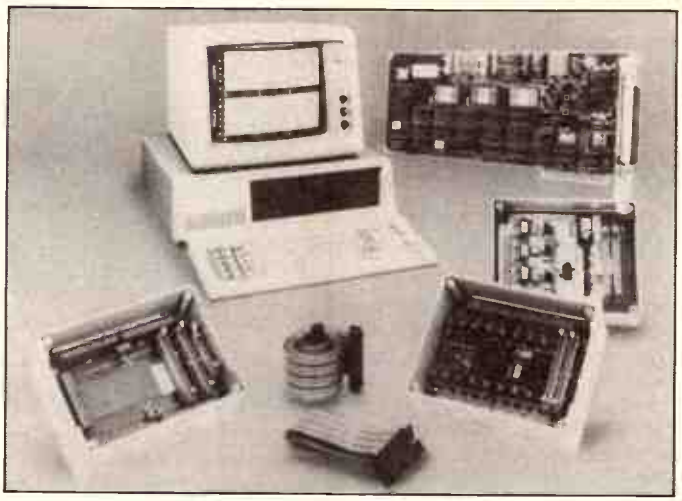
R.I. 112

Standard Transceiver

Standard Communications have just released the new TX64 Series 27 MHz, 5 Watt, 6 Channel AM General Purpose Handheld Transceiver. The TX64 Series utilises traditional commercial radio construction which is said to ensure an extremely rugged and durable handheld radio especially suited to Govemment Department and bush-walking environments.

The TX64 comes equipped with 3 general purpose channels fitted: Channel 1 — 27.550 MHz; Channel 2 — 27.560 MHz — Channel 3 — 27.590 MHz; Channels 4, 5, and 6 can be fitted with crystals to suit user requirements.

The TX64 Series are available with the traditional telescopic aerial or with a SO239 Socket installed to accept a standard PL259 screw-on 600 millimetre flexi whip antenna. The unit incorporates variable squelch, channel selector, 'On/Off' Volume control and LED battery indicator. The unit weights only 650 grams. R.I. 113



High Performance Board

Novatech Controls have just released MetraByte's new DAS-20, a high performance analogue and digital I/O board for IBM PC/XT/AT and compatible computers. The DAS-20 plugs directly into any expansion slot within the computer.

The board includes 16 single-ended, or 8 differential analogue input channels with software programmable input ranges. The board uses a 12-bit A/D converter (1 part in 4096) and provides input resolutions from 4.88 mV to 24.4 μV (depending on input range selected). The maximum input sampling rate is 100,000 samples per second (in a Direct Memory Access (DMA) model. A unique 2048 Byte queuing RAM allows complex sequences of channels and or gains to be scanned at high speed.

In addition to the analogue input capabilities, the DAS-20 also provides 2 channels of 12-bit resolution analogue output. The D/A converters can be written to in a DMA mode at output rates up to 200,000 conversions per second. Output ranges of ±5 or 10 volt or 0-10 Volt are switch selectable. R.I. 114

DATEL Thermistor

Elmeasco has released the Datel PM-5060, the second member of the PM-5000 series process monitors, for applications requiring high-accuracy temperature monitoring.

The PM-5060 is DATEL's Intelligent process monitor and display offering a complete solution to real-time thermocouple data acquisition and control. The monitor accepts a low-level isolated analogue signal from thermocouples such as 100 ohm platinum for European curve (alpha = 0.00385, DIN 43760) and 100 ohm platinum for American curve (alpha = 0.00391). The monitor also processes inputs from 2252 ohm, 3000 ohm, 5000 ohm and 10000 ohm thermistors.

The input signal is filtered, amplified, and converted to digital data using precision voltage-to-frequency conversion technique. This technique offers noise filtering, high-isolation from common mode voltages (up to 1400V), no missing codes and elimination of electromagnetic interference (EMI).

The on-board microprocessor in the monitor linearizes and calculates the temperature and outputs the data to the vacuum fluorescent display. The PM-5060 measures temperature in degrees C or F and at 0.1 or 1.0 degree resolution. The monitor has a full five digit display that allows all thermocouple temperaures to be displayed at 0.1 degree accuracy. The PM-5060 is configurable for two, three, or four wire inputs. The input type and configuration is selectable either by front panel keypad or serial communications port. R.I. 115

Australian ACET

A Western Australian company, ACET, recently sent off $250,000 worth of data logging equipment to China.

The devices, Transportable Data Recorders, are used, among other things, to measure forces in train brake pressure. With the master unit in the driver's cab and three sets of information gatherers along the train, a Chinese train driver will be able to see what effect his driving techniques have on the running of the train. For example, braking at different points on a downhill section of track, can produce very different force effects on the train.

With long haulage train costs in the millions, it's vital to minimise the damage done by inexperienced drivers and in China today, trains are up to 1 km long. This is where ACET's specialised knowledge comes in. The sort of problems the Chinese are encountering now, were faced long ago in The Pilbara region of WA.

This is a rare kind of sale for an Australian company. Most Australian exports to China are raw materials such as aluminium, iron ore, and wool. Only 1.6% of our exports are for machinery. ($24m for machinery in 1985-6 out of total exports of $1500m.) Ian MacFarlane, Trade Commissioner for Railways in Canberra regards the ACET contract as "something of a break through". He says he's very pleased because "very little trade has taken place with China in this kind of area".

Rob Antulov, an electronic engineer, will be going to China for 4-6 weeks to commission and install the system. He'll also hold courses to train the Chinese in the use of the equipment. R.I. 116

Low-Cost IBM PC/AT Chip set

A new, low-cost IBM PC/AT compatible chip set, introduced by VLSI Technology, allegedly provides the lowest chip count replacement on the market while providing an easy path for customization.

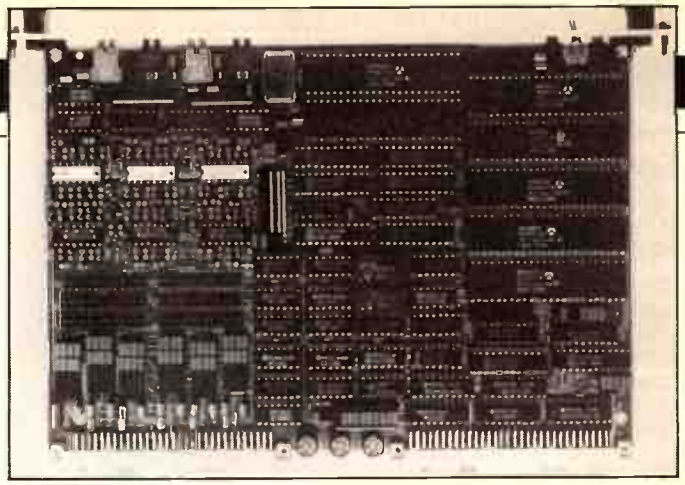
This five-chip set reduces the total device count of IBM PC/AT — compatible computers from 110 industry-standard non-memory devices to 16 integrated circuits. Because of the high level of integration, VLSI's chip set offers a cost savings of approximately 20 per cent over other leading IBM PC/AT replacement vendors.

Another significant advantage of VLSI's chip set is the fact that it is built out of proven building block components. The megacells used in these chips are available as off-the-shelf chips for customers who want to build "breadboards", or test printed circuit boards that emulate a new chip design. R.I. 117

8K x 8K Static RAM

The GM76C88 is a 64k static random access memory from Goldstar Semi-conductor. Organised as 8,192 words by 8 bits using CMOS technology and operated from a single 5 volt supply, advanced circuit techniques provide both high speed and low power features with a maximum operating current of 80 mA and minimum cycle time of 60ns.

The combination of speed optimised circuitry results in a very high speed memory device. Thus the GM76C88 is suitable for use in various micro-processor application systems where high speeds are required. The GM76C88 is offered in a 28 pin dip package. R.I. 118



New Force Board

Force Computers have announced the production of a new serial I/O board, the SYS68K/SIO-2. The board contains six serial I/O channels based on the Multi-Protocol Communications Controllers (MPCC 68561) used for each channel.

The interface to the communications equipment is either RS-232 or RS-422 compatible and may be freely selected by the user. In addition, an option is available which provides the user with two optical links. Each channel is able to generate an interrupt to the VMEbus (levels 1-7) and to drive three different interrupt vectors.

All the communication signals generated by the MPCC devices are available to the outside world. Force also offers the connection of six 25-pin D-sub connectors on the front panel via the optional AYA68K/SIO-1FP module. R.I. 119

IMARK PS-4

Imark of Melboume have released the Australian designed and manufactured IMARK PS-4 Regulated Power Supply for use with CB transceivers, amateur transceivers, security systems, car cassette/radio players or as a bench power supply.

The PS-4 Power Supply operates from the 240 Volt mains supply and provides 4 amps of regulated 13.8 V dc. It features all solid state devices and short circuit and overload protection: Dimensions are 190(D) x 125(W) x 85(H) mm and the weight is 2.2 kgs. R.I. 120

80886: Speed Is Of The Essence

A new 20 MHz version of Intel's 32-bit 80886 microprocessor is said to add 25% more performance to its 16 MHz counterpart. The 80386-20 operates at four- to five MIPS (million instructions-per-second) and exceeds the VAX 8600 and IBM 4381 in CPU performance. The new microprocessor runs at five times the MIP rate of a VAX 11/780, and it performs between 8,000 and 9,000 Dhrystones per second.

When combined with Intel's new 82380 integrated system peripheral component, the new 80387 numeric coprocessor, and the new 82385 cache controller, the 80386-20 apparently becomes the heart of a very high-performance 80386 computing engine.

When an 80386 computing engine is combined with operating system software, graphics software, and mass storage, it operates as the core of a standard "computing platform" that can be tuned for specific applications, such as computer-aided design, computer-aided engineering, and departmental computing.

As market forces drive the computer industry to standard platforms, the growing 80386 architecture is crossing traditional boundaries to bridge markets previously served only by personal computers, workstations, or minicomputers. The expanding 80386 architecture has the software capabilities and performance to serve various applications in all three markets. R.I. 121

A Plus For PCs

IBM PC owners needing a new motherboard and those building a pc from scratch now have access to a 10 MHz motherboard from Electronic Solutions.

The board is a direct drop-in replacement for the IBM PC board, but runs at approximately four times the speed. It has complete IBM compatibility, and utilises a 8088-1 processor.

The board comes with 640K of memory and uses the latest high-speed 41256 chips.

The cost is $475 including tax. R.I. 122

DCB Work System

The CAE Systems Division of Tektronix, has announced a new release of its PCB Work-System that features full support of surface mount technology (SMT) for printed circuit board designs.

SMT allows for higher component density which can reduce the size of the board, or increase functionality in the same size board. The increasing use of surface mount devices coupled with the availability of high-speed pick and place equipment will further automate printed circuit assembly and lower manufacturing costs. R.I. 123

Multi User dBase

DataBridge/4GL is an Australian software product designed to allow users of dBase III to run their existing applications unmodified on VAX/VMS and UNIX System V, and create new applications using a familiar tool, but with the facility, extensions and power that larger machines offer. DataBridge/4GL is also compatible with other major database products.

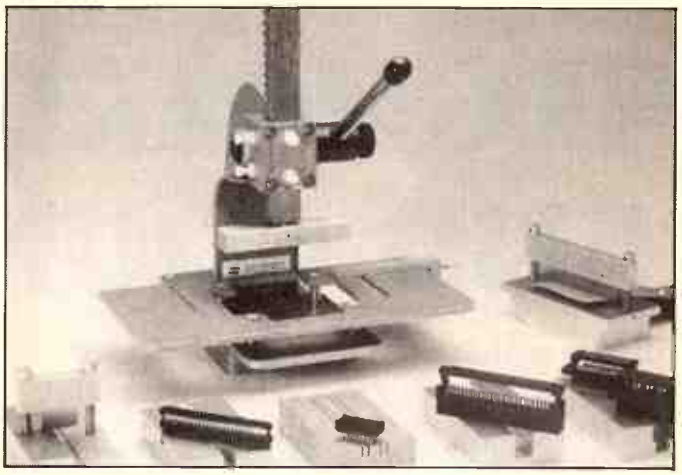
Users who are familiar with dBase III on a PC can either use DataBridge/4GL in a way they are accustomed to, or through a high level menu system which requires very few keystrokes. In addition, since individual applications developed by pc users are often creative, and very much in touch with the users' specific needs, the benefits of this programming expertise can be shared by multiple users.

R.I. 124

Pocket Disk Drive

Sharp Corporation has announced the release of the pocket disk drive for their mid-range pocket computers.

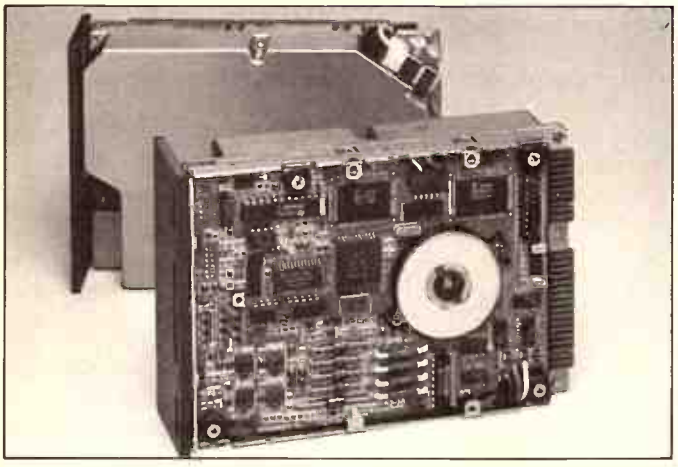
The pocket disk drive is a fully portable unit that runs off either five penlight battieres, or an optional A.C. adaptor. Designed as a small, compact unit, the pocket disk drive utilises 2.5 inch disks with a total capacity of 128K



Expanding Capability

Scope's Panavise FRC Press range has been extended to cope with a wider range of flat ribbon connectors and to square cut cable strip header connectors. No tools are required to change the six base plates and cable guide.

R.I. 125



Winchester Drives

Fujitsu Australia Limited has just released the M222XD series 3.5" and the 8" M2344K Winchester Disk Drives. The 3.5" range incorporates three capacities: M2225D 25 Mb; M2226D 38 Mb; M2227D 51 Mb. This drive is claimed to be the first drive of its size in the marketplace with such high capacities — up to 51 Mb (unformatted).

The implementation of a voice coil motor allows the drive to access data at 40 milliseconds. Data transfer rate is 625 kb/s incorporating a ST506/412 interface. The data on these drives is recorded using MFM coding on 834 tracks/inch and recording density is 14,845 bits/inch.

The drives' 3.5" form factor makes is very compact to integrate this product into PCs. An optional front bezel and mounting frame to mount the drive inside PCs, can also be made available. Reliability, in MTBF, is specified at 30,000 hours.

This new compact hard disk drive is said to be a forerunner of future products for the small computer system market.

R.I. 126

Panorama Antennas

For over 25 years Panorama has been one of the leading manufacturers of antennas for mobile and portable, civil and military applications in the UK. Now with the introduction of the cellular telephone system, Panorama have introduced these latest additions to their range — cellular unity and gain whips — in black and chrome highlights — 820/960 MHz — and all fully interchangeable. They are now available in Australia from Scalar Antennas Pty Ltd.

R.I. No. 131

SPECIFICATIONS	TYPE AFCQ	ACQ	ACPS	ACPS	ACPSH	ACPCH
Frequency range (MHz)	825-890	825-890	825-890	825-890	825-890	825-890
Typical bandwidth at 1.5:1 VSWR	120 MHz	120 MHz	100 MHz	100 MHz	100 MHz	100 MHz
Gain compared with ¼ wave	Unity	Unity	3 dB	3 dB	3 dB	3 dB

Motor Control

One of the most common problems in the field with positioning motors or modulating actuators is dirt build-up causing faulty contact on the feedback potentiometer, generally required by motor positioning controllers.

Novatech controls claim to have solved this problem by eliminating the need for a feedback potentiometer in their new MDC10 type "B" controller, which provides auto-tuning floating PID control at apparently low cost.

R.I. No. 132

REGISTERS, FLAGS AND COUNTERS

Having introduced the fundamentals of machine code programming last month, Phil Cohen continues with more of the internals of a processor.

In all of the examples quoted last month, I talked about the processor 'storing' information somewhere within it, about it loading values, incrementing them and printing them.

The places within a processor in which those values are stored are called 'registers'. A register is actually a memory location built onto the processor chip itself. Various instructions cause the processor to do various things with the values in its registers — all processors have more than one register.

For example, the load instruction I dealt with last month actually caused the processor to take a value from the program and store it in a register:

Instruction	Value in Register
CLR	0
LD 06	6
PRI	6 (prints the value '6')

Different Registers

There are a number of different registers in a processor, and although they are very similar and all work in a similar way, they are used for different functions. The most commonly-used register in any processor is often called the 'accumulator' (for historical reasons). When a processor loads a value from a program or from other memory, it usually puts it into the accumulator.

Another register, called the 'program counter' keeps track of where in the program (i.e. which memory location) the processor is at present. The value in the program counter is increased after each instruction, so that it contains the value of the memory location that contains the next instruction. It is said to 'point' to the next instruction.

When the processor wants to jump to a new location (bypassing the normal flow of the program from one instruction to the next) all it has to do is to change the value in the program counter to 'point' to the instruction it wants to jump to.

The next instruction to be executed will be the one that the program counter now poins to, and the program will continue from there.

Here's an example — first, the program:

Location	Mnemonic	Value
0	INC	14
1	INC	14
2	JMP 6	20 06
4	INC	14
5	INC	14
6	PRI	16
7	CLR	10

Now the way in which the processor would follow it:

Program counter	Instruction	Accumulator
		0
0	INC	1
1	INC	2
2	JMP 6	(sets program counter to new value)
6	PRI	2
7	CLR	0

The 8088

Instead of talking any more about hypothetical processors with hypothetical instruction sets, what about some real-life examples?

The 8088 is a 16-bit microprocessor, which simply means that its registers are arranged in pairs. The accumulator, for example, consists of two 8-bit accumulators 'side by side':

Each of these two accumulators, AH and AL, is capable of holding one byte of information 8 bits. There are instructions to load AH (A = accumulator, H = high end) from memory, increment it, and so on. And there are instructions to load AL (L = low end) from memory, and so on. The 8088 is called a 16-bit processor because there are also instructions which work on *both* AH and AL at the same time.

For example, MOV AX, 45 65 will load the value 45 (hex) into AH and the value 65 into AL. The code 'AX' is simply taken by the assembler as meaning 'both AH and AL'. Because the 8088 is a 16-bit processor, you can if you like think of this as one 16-bit operation instead of two 8-bit ones. So you could say that MOV AX, 4565 moved the value (hex) into the accumulator AX.

That's the basic difference between the older 8-bit processors and the modern 16-bit ones. The 16-bit ones can work with two bytes at a time. The even more powerful 32-bit processors work with four bytes at a time.

As well as the accumulator, the 8088 has three other sets of general-purpose registers:

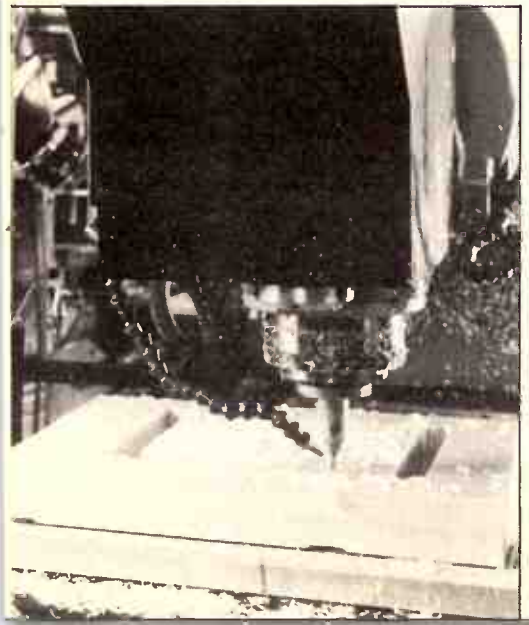
AX	AH	AL
BX	BH	BL
CX	CH	CL
DX	DH	DL

Any of these registers can be altered by a wide variety of instructions to do things like move data to and from registers into memory, move data from one register to another, add the contents of one to the contents of another, and so on. In a sense, these registers are like variables in BASIC — each of them will have a particular meaning in terms of the section of program you are writing.

IP

The 8088 also has a 16-bit program counter, called the 'instruction pointer':

IP



Unlike the other registers, you can't use the IP as if it were two separate 8-bit registers. But you can copy the contents of the IP into one of the other registers, work on it there, and then copy it back.

Working with the values in an IP can have some interesting applications. Although not used in the 8088, one way of handling subroutines (in which the processor moves temporarily to another part of the program, returning to where it jumped from when it's finished) involves copying the IP into another register.

What happens is this: when the subroutine is 'called', the current value of the IP is stored in a register somewhere, and the location of the start of the subroutine is put into the IP instead. This means that the next instruction to be followed will be the first one of the subroutine.

At the end of the subroutine, a series of instructions simply copies the value in the register that held the original location, into the IP. The next instruction to be executed will be the one *after* the one the subroutine was called from.

Flags

There's another register in the 8088 that holds nothing but a collection of 1-bit 'flags'. This is called the 'Flags Register' (surprise surprise). Each of these 16 flags (some are not used) has a particular meaning, and its value will change depending on what's going on in the processor.

For example, one flag shows whether the last addition which was carried out had any 'overflow'. Overflow happens when you add two numbers and try to put the result in a register that is too small to hold it. In binary, if you add two 8-bit numbers you can sometimes get a 9-bit result — when this happens, the 9th bit goes into the 'carry flag' of the flags register.

Other instructions let you 'test' the various flags, and take different action depending on what the 'state' of each flag is. For example, the 'jump if carry' instruction JC will jump to a new part of the program if the carry flag is 1.

In fact, there are a lot more registers in the 8088 than I've mentioned here — no less than fourteen 16-bit registers. The 8088 also has over 70 types of instructions, and each of these instructions has numerous possible modes of use (eg, move register to memory, move register to register, move memory to memory).

Glossary

8088: The processor used in the IBM PC.
Accumulator: The most-used register in a processor.
Byte: 8 bits.
Call: To start the operation of a subroutine.
Carry flag: A 1-bit memory location that holds information on whether the last addition carried out resulted in an overflow.
Counter: A register that is used to count the occurrence of a particular event.
Flag: A 1-bit memory location.
Flags register: A register that holds all of the flags in a processor.
Instruction Pointer: A register which contains the number of the location which contains the next step in a program.
Instruction set: A list of all possible instructions for a particular processor.
Jump: To move from one part of a program to another.
Load: To copy a value from memory into a register.
Location: A small area of memory capable of holding one byte of information.
Overflow: What happens when you try to put the results of a 9-bit operation into an 8-bit register.
Point: To hold the number of a memory location.
Program counter: Same as instruction pointer.
Register: A memory location actually held inside a processor.
State: 1 or 0.
Variable: A name given to a particular memory location, so that it can be referred to by name rather than by location. ●

EXPOSED

Laboratories equipped with whiz-bang electronic gadgets, have produced an enormous number of creations ranging from Frankenstein to dry water, as all sci-fi devotees know. On a less surrealistic plane, we are going to remove the mystery and examine the type of equipment generally found in the 'normal' electronic laboratory, from the converted shed variety to a standard laboratory.

Peter Phillips

Laboratory — 'a building or part thereof fitted with apparatus for conducting scientific experiments, tests, etc . . .; compared to **workshop** — 'an area in which work, especially mechanical work is carried on.' (definitions more or less from the Macquarie Dictionary). Whatever it's called, the laboratory (or workshop) needs electronic measuring equipment if it's to rate the adjective 'electronics'. But what sort of equipment and to what degree of accuracy is required; and at what cost? Is an analogue meter more suitable than a digital type, how useful is a CRO to a hobbyist? We present an overview of a very broad scene, starting with the most common laborary of all — that of the enthusiast. But first, a look at the electrical values that need to be measured, and an argument that it's often unnecessary anyway.

The Serviceman/ Experimenter Argument

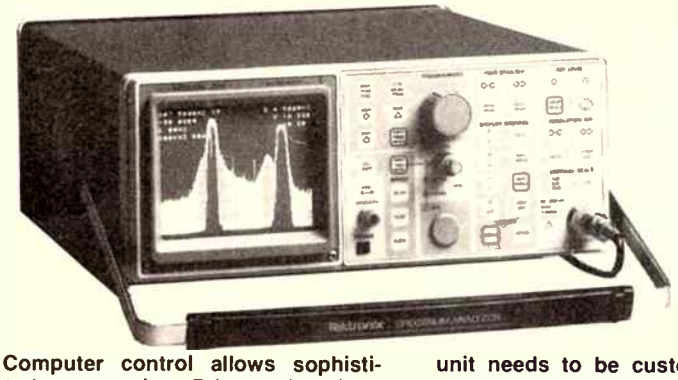
Electronics is the livelihood of many individuals, exemplified by the TV serviceperson. The question is; do the needs differ if you are involved in servicing only, or indulging in research/development? Many TV technicians operate in the field with limited test equipment, and often find the complex paraphernalia of an electronics laboratory a hindrance. Servicing is often largely a matter of experience and card jockeying, and a trusty multimeter may well be adequate. This is not to denigrate servicing; rather to illustrate a practically. Servicing in general is often more economical if wholesale replacement is performed instead of trying to find the one faulty device. Sometimes the faulty card may be later repaired under workshop conditions, but often it is still not worth the effort.

A 'servicing only' workshop therefore has different needs to one where circuit development/evaluation is being undertaken. Domestic/commercial servicing workshops will often have a pattern generator for picture aligment of a colour TV, but will usually have a large range of spares in lieu of test equipment. However, servicing is not always for domestic products, and many service laboratories, particularly the industrial variety need a wide range of gear to carry out their tasks. The technology being repaired or researched will dictate the type of equipment needed and generalising is therefore difficult, as the electronics field is so broad. We'll start with the basic general purpose requir-

Spectrum Analyser

Tektronix latest spectrum analyser has a bandwidth from 10 kHz-1.8 GHz. What do you get for your money? Quite a lot actually. It has four trace digital storage, and what's more, you can subtract one from the other, save maximum values, evaluate trends and so on. Each trace has a full marker capability, as well as delta marker evaluation. The position of the markers is displayed to an accuracy of 10^{-5}

The 2710 also features 80 dB dynamic range and a built in preamp which allows inputs as low as -139 dBm. It has built in AM/FM detectors, plus audio amplifiers and a speaker.



Computer control allows sophisticated ergonomics. Primary functions are accessed via dedicated keys on the front panel, and less important ones via menu driven displays. If the unit needs to be customised further, the operator can use the control programme that allows one to reduce oft repeated sequences to single key stroke functions. *R.I. No. 133*

Power supply

Hewlett-Packard has released a new single output intelligent dc power supply. It integrates the functions of a power supply, IEE-488 isolated digital to analogue programmer, a digital voltmeter and a current shunt monitor in one compact package.

In addition, there is a standard HP-IB interface, which allows remote programming of voltage and current, and readback of actual measured values. It is possible to set over voltage set points and current dissable levels so as to protect a device under test. It is also possible to dissable the output if

required. Calibration can be achieved via internal software and their is also a self test function.

Total power output is 100 watts, in an 88 mm high 19 inch rack case. A series regulator is used to achieve low output noise 13 mV p-p according to HP). *R.I. No. 134*

ments and work up.

The Basic Setup

The fundamental 'tools of the trade' are the multimeter, audio oscillator, CRO, and a variable power supply. An RF signal generator is essential for those into communications, but the first four items suffice for basic servicing, circuit development and kit construction needs. Most training institutions provide students of electronics with a work station consisting of at least these items. As the multimeter is the quintessential measuring instrument, it deserves some discussion.

A multimeter provides measurements of various ranges of voltage, resistance and current. Meters are graded on their sensitivity, accuracy and facilities, qualities all reflected in the price. For general purpose use, a $100 instrument is likely to satisfy most basic needs. The question is; analogue or digital — an argument with no definitive answer. The case for both sides goes like this.

The analogue meter is generally cheaper than a DVM, it shows changing values, is usually owner serviceable, and is more reliable in resistance measurement, particularly PN junction conditions. It is more fragile, often less accurate and less sensitive, and harder to read than a digital meter, which has a numerical readout and a higher resolution. However, a high resolution is not a replacement for low accuracy. A displayed value on a DVM with 3 per cent accuracy of, say 15.34 volts makes the decimal value somewhat redundant. However, a 3.5 digit resolution facilitates comparison between various values as well as observation of small variations. An analogue meter has a lower resolution, more consistent with its usual accuracy, but it can readily indicate a changing value. DVMs have a constant input impedance of around 11 M ohms, a moving coil voltmeter has a loading that depends on the scale setting. A voltmeter with a 10 uA meter movement will have a 10 M ohm input resistance when on its 100 V range, and as low as 100 k on the one volt range.

So what's the answer? If you have only one choice, a digital multimeter is probably the best one. However, one of each provides the best of both worlds, and two meters are useful anyway.

Next in the hierachy is the CRO. TV technicians will often only resort to a CRO for the occasional bench job, not so the researcher/experimenter. The CRO can almost replace the multimeter, but the reverse is far from true. The fact that a waveform is visible removes the guess work, and allows true analysis of what's happening in the circuit. The CRO Buyer's guide (ETI June '87) lists virtually every CRO available in Australia; the question is — which one? Unless you intend only working with audio waveforms, a 10 MHz unit is probably the minimum bandwidth required. A dual trace, fully calibrated CRO is virtually the norm, and you can expect to pay around $800 for a 20 MHz unit. Hobbyists involved in project construction may find lower priced instruments suitable, but should try at least for a calibrated version.

The final two basic items required are the audio signal generator and a variable power supply; both available as kits, bringing savings and satsifaction to those so inclined. An audio signal generator is mandatory for audio work, to both test and fault-find amplifiers, to tune speaker boxes, or to generator signals for circuit development. Most commercial units have a range of 10 Hz to 1 MHz, an output impendance of 600 ohms, a 10 V, (pK-pK) outputs, adjustable with fine and coarse attenuators, and feature both sine and square functions. The price depends on features such as distortion, accuracy to the dial, stability, etc, and start at around $200. Kits also vary in price, depending on the quality of the unit, but for general purposes, something less than $100 would suffice. An RF signal generator is useful for communications and radio/TV work, but would otherwise languish on the bench. A variable power supply, capable of 0 to 30 V at 1 amp is essential if you are involved in circuit development, even at the most simple level. Basic units can be built for less than $38, but become pricey once the current rating goes over the 1.5A mark.

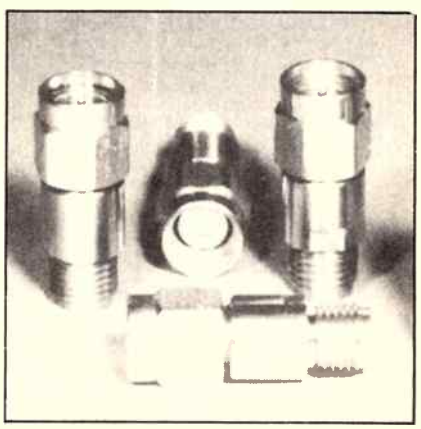
Industrial Requirements

In the industrial arena, an electronics laboratory is needed to maintain and repair equipment used in the plant, although in some instances, development work on a limited basis may be involved. In setups of this nature, equipment pertinent to the gear being maintained is required, and we can only generalise as industrial electronics ranges from measurement/control in-

Connectors

Anyone who has spent time in a lab will know that one of the perpetual beefs of every engineer and technician concerns the quality of the connectors. Although they are often treated as an afterthought, poor connectors can make developing a prototype a nightmare, and making trouble shooting almost impossible. Good quality is worth paying for.

AP Imports has put together the range of connectors from Rediall in France pictured right. It includes everything from simple banana plugs up to high performance coaxial atenuators specified from dc to 18 GHz. *R.I. No. 135*



High resolution DMM

Scientific Devices is the distributor for Keithly, one of the better known instrument makers. Their latest is a 6.5 digit multimeter with extremely high resolution. It can read as little as 1/3 parts per million. It also has extremely accurate voltage readings.

One of the best features of the Model 196 is the speed with which it works. In fact the device can make 1000 measurements a second.

R.I. No. 136

strumentation, through control systems to robotics and beyond. The centre piece is usually a more sophisticated CRO (or CROs), perhaps with a wider bandwidth, greater sensitivity and more facilities such as trigger delay, attenuator probes, etc, compared to that needed in a domestic/-commercial workshop. Unless the work being carried out is fairly sophisticated, a storage CRO is probably a luxury that can't be justified. Additional to the four basic items so far discussed are the frequency counter, capacitance measuring instrument, and a high accuracy (1 per cent at least) voltmeter, perhaps fitted with a high-voltage probe to measure voltages in the KV range.

Frequency counters vary in many ways, but most commercial units allow measurements up to 100 MHz with a 20 mV sensitivity. Usually, period, pulse count and timer functions are incorporated, and better quality counters will have an oven controlled reference. A highly accurate counter is needed for communications work to tune transmitting equipment to its designated frequency, but otherwise units ranging in price from $200 up are often adequate; although a pre-scaler to get up to 1 GHz would be necessary for UHF work.

The need to measure capacitance occurs more often than some readers may think, and some form of measuring instrument is essential for development work. Instruments that measure capacitance range from simple digital devices to units that also display the losses of the capacitor. Conventional LCR bridges are handy, but are often fiddly to operate, although current generation units are microprocessor controlled, and have LED readouts, making them very simple to use.

The High Tech Lab

A high quality research/development laboratory costs a lot of money. Apart from the quality of the equipment, various types of each instrument become necessary. If power control electronics is being developed, a multi-trace, balance input power 'scope is essential. This device allows SCR and TRIAC circuits to be analysed by examining up to six traces simultaneously, with each input above earth, preventing multiple earth conflicts usual with normal CROs. At least one other CRO will need storage facilities, trigger delay, and screen cursor/setting indications to allow photographing of the waveforms. CROs of this nature cost around $10,000 or more, but permit extremely high detail to be examined.

Another device usually only found in reasonably high tech labs is the curve tracer. Again you 'get what you pays for', but $1000 would buy a basic unit. A curve tracer allows active device characteristics to be measured and displayed, including breakdown voltages and device gain. It is possible to display the characteristic curves of FETS, diodes and transistors, providing 'on the spot' analysis of the device, tested under dynamic conditions. Most curve tracers worth their salt will output test voltages up to 1 kV, and some care is needed in their use.

Because voltage measurement is so essential, bench multimeters usually abound in these laboratories. Apart from a fundamental high accuracy, a quality bench meter will have facilities to read true RMS voltage, regardless of the input waveshape, either with or without the dc component. Many so called true RMS voltmeters don't allow a dc component to be included, due to a series input capacitor. Another feature usually inherent in quality bench meters is the facility to read ac voltages at frequencies extending beyond 100 kHz. And of course you also get features like touch-hold, peak following, and auto ranging. A multimeter often found in labs where money is no object is the famous AVO analogue meter. These instru-

Digital Troubleshooting

ECQ Electronics in Queensland has released a universal system tester called the Huntron 4500. It lets you diagnose and analyse a variety of microprocessor based equipment and related peripherals, such as printers and disc drives.

The key to the 4500 is a series of pre-programmed diagnostic tests that simulate the behaviour of a live processor. This helps to eliminate fault free areas of the circuit, narrowing the search of a suspect board. A combination of menu driven software and clear English instructions makes the 4500 easier to use that comparable devices which use numeric fault codes.

Once you've connected the 4500 to the device under test, the operator can choose from a series of tests displayed in a menu. In most cases these tests will only serve to point you in the right direction, they will not find the specific fault. However, it is possible to directly stimulate the processor vi the keyboard on the 4500. It is also possible to write test routines for specific equipment, and then store the programme in a demountable test pack.

R.I. No. 137

ments are beloved of learning institutions as they are virtually indestructible, and are accurate as high as 1 per cent. Another popular meter in this genre is the Fluke 77, a favourite of salesmen who enjoy throwing it on the floor to the amazement of the prospective customer.

Other more specialised equipment includes the distortion analyser, used in audio amplifier evaluation, alignment generators for tuning the IF amplifiers of radios, TVs, etc, a function generator, and a spectrum analyser. This latter device may be for audio frequencies, essential for acoustic engineers, or for RF applications. Prices usually start at $30,000, as they are complex beasties. However, a good spectrum analyser can divulge information not otherwise obtainable. Function generators produce a range of waveshapes over a wide band of frequencies, and are used in analogue circuit development/testing.

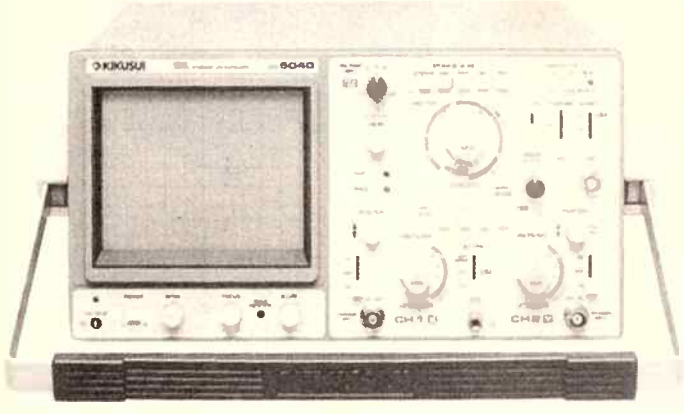
Most research labs need facilities to develop printed circuit board layouts, and the trend is toward CAD systems. Usually a plotter is required, driven by a computer software package. The availability of a computer means facilities to program EPROMS, test ICs, to even design and dynamically test a circuit .

Workshops set up to repair/maintain test equipment need gear that has specifications exceeding those of the instruments being serviced. Calibration equipment is usual, which itself needs regular checking against a standard. If the technology being repaired/researched is digital, a logic analyser and a wide band (100 MHz to 300 MHz) CRO are often required. Current generation mainframe computers operate at very high speeds, and pulse widths of 0.5 nanoseconds often need to be examined in relation to other pulses.

A Standards Laboratory

Most large organisations such as Qantas, Telecom and County Councils have a standards laboratory, used to calibrate field equipment used by the instrumentality. Telecom, for example, needs highly accurate equipment to align and tune its many microwave links and accurately calibrated pulse equiment used to find breaks in a line and so on. The accuracy of the measuring equipment is maintained by regular maintenance and calibration to a standard, which is itself calibrated against a highly accurate standard maintained by the National Measurements Laboratory operated by the CSIRO.

This establishment offers a standard volt, accurate to one part in a million, and a frequency reference accurate to one part in 10,000 million, both generated using atomic physics. Standard values of resistance, inductance and capacitance (0.5 picofarad, accurate of one part in 10 million) are also maintained. However, don't rush in with your $50 DVM, they only calibrate high quality reference instruments, which can subsequently be used as a standard. •



Portable storage CRO

Emona is distributing the Kikisui DSS 5040. It can function as a 25 MHz sampling osciloscope, with an eight bit, 25 mega samples a second analogue to digital converter for waveform storage. By utilising intelligent interpolation, a storage bandwidth of about 10 MHz is available. Alternatively, it can function as a non storage CRO with a 40 MHz bandwidth.

The front panel is processor controlled, which reduces the difficulty of operation by a considerable amount. Apart from the usual horizontal and vertical controls, there is a trigger point control which allows either pre or post triggering, and various storage modes, including pulse or sine interpolation, saving to memory, and pen output to an x-y plotter. *R.I. No. 138*

AEM 4510 RS-TRUE-232 INTERFACE

Ref: AEM September 1987

Cat. KM-3062

$24.95

NEW

Many so called RS-232 interfaces don't fully conform to the RS-232 interface standard. In many cases this is OK as all handshaking signals are not required. When they are required, your 'nominal' RS232 falls over! Enter the AEM 4510! This uses the new MAX232 chip which generates both the positive & NEGATIVE signals that are needed for true RS-232 from TTL or CMOS drive. Just the thing for Commodores, MicroBees & many Tandy computers. Kit supplied as board level project or /- MAX232 IC, DB25 connector & other RB parts.

NEW NEW NEW NEW

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Ref: EA Sept '87

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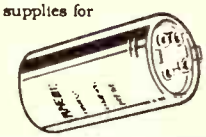
NEW



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REF EA August 1987 This project allows a low cost electronic flash to be used as an electronic stroboscope.

Cat. KA-1688

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AY-5-4007	4 digit counter/display driver	$10.00
AY-5-9510	CMOS clock generator	$5.00
AY-3-8760-1	Motorcycle game (525 line?)	$4.00
AY-3-3550	4.75 digit multimeter/counter autoranging	$10.00
AY-1-0212T	Top Octave generator* (we don't know what the T-suffix means)	$20.00
AY-1-1320	12 key IC Piano keyboard with sustain & loudness velocity facilities ('Electronic piano chip)	$10.00

NEW

(AY-1-0212, AY-1-5050 & 5 x AY-1-1320 will give you the basic electronics of a 5 octave touch sensitive electronic piano.

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REF AEM August 1987

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Cat. KM-3060

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REF: AEM August 1987

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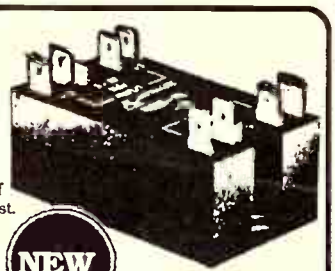

NEW

Now you can switch up to a 40 amp 240 volt load with TTL device at a fraction of normal cost! That's right, Jaycar has another scoop buy where you get an incredible product at a price which you can now afford!

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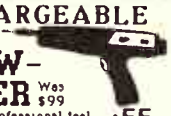

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10-49 $16 ea

50-99 $14 ea

100+ $12 ea

$20 EA Buy Now!

3" (80mm) 115V AC Cat 06-1019

3" (80mm) 240V AC Cat 06-1020

5" (120mm) 115V AC Cat 06-1029

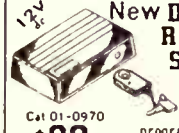
5" (120mm) 240V AC Cat 06-1030

Finger Guards now available!

3" (80mm) $1.50 ea Cat 06-1022

5" (120mm) $1.50 ea Cat 06-1032

New DIGITAL REMOTE SWITCH



Radio control, single trans and receiver, programmable code, range 12-15 metres

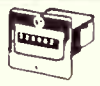
Cat 01-0970 $89

MINIATURE 12V DC DIL RELAYS

Single pole, 1K ohms, new, best quality. Electrothermal brand.

$2 ea 10+ $1.80 Cat 19-4094

Electromagnetic COUNTERS



NON-RESETTABLE

24V DC $5.50 ea

24V DC Chassis	S5011	$6.50 ea
110V AC Chassis	S5012	$3.00 ea
220V AC Chassis	S5013	$5.95 ea

Buy 10+ Less 10%

DIGITAL REMOTE CONTROL

Wireless trans/rec remote switch 2x10 Amp outputs to lock/unlock car central locking systems.

$149 Programmable code, 12Vdc. Cat 01-0972 LED indic.

Electronics Australia's DIGITAL ELECTRONICS LOCK KIT

The modern fool-proof combination lock with easily changed access code and endless applications.

$29.50 Cat 11-1542

12V elect. lock release 19-4090 $39.90

AEROSOL SERVICE SPRAYS

LIGHT OIL	$6.50
Similar WD40	20-2396
GRAPHITE	$6.50
Conductive coating	20-2395
CONTACT LUBRICANT for relays, switches	$6.50 20-2397
SAFETY CLEANER Harmless, leaves no residue	$6.50 20-2390
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FREEZE SPRAY Hyper refrigerant cooler	$6.50 20-2393
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ANTI-STATIC CLEANER for tape heads, records, etc	$6.50 20-2398

HIGH QUALITY HEAVY DUTY SOLENOIDS

Buy 10, less 10%

24V AC	19-4091	4.90
24V DC	19-4092	7.50
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240V AC	19-4094	6.50

FANS 5" 220V AC

All tested OK

Cat No 06-1100

$10 ea EX-COMPUTER

ULTRASONIC DETECTOR ONLY $49 FOR CAR ALARMS Cat 19-5252

Use with most alarms, detects movement inside the vehicle, relay N.O./N.C. 12Vdc

DIGITAL CODE KEYPAD

Replaces standard key-operated switch, relay output, programmable 4 digit code, alarmed if wrong number, LED status indicators, 12Vdc

$69 ea Cat 01-0937

PREMIUM QUALITY 'ERG' DIL SWITCHES 6 WAY COLOUR-CODED, PCB mtg

Cat 19-3056 $1.50

SOLDERING TOOL KIT

Includes heatsink, reamer, scraper, brush, tweezers and screwdriver

Was $7.95 Save $3

Cat 20-2456 $4.95

PHONE LINE TESTER

For latest USA type 4 pin phone connectors. Dual colour LED indicates status e.g. pos, neg or open circuit.

Cat 24-3068 $1.00 EA

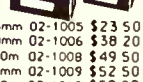
Were $4.95, what a BARGAIN this is!

JACKPOT Box No 6

Cat 24-0020 $15

- Resistors
- Capacitors
- Semiconductors
- Switches
- Electrolytics
- Potentiometers
- Connectors
- Samples
- Manufacturer's surplus stock.

Sealed GEL Batteries



- Rechargeable
- Low leakage
- Long life

1.2AH 100x45x53mm	02-1005	$23.50
2.7AH 134x68x60mm	02-1006	$38.20
4.0AH 130x65x100m	02-1008	$49.50
4.5AH 152x65x95mm	02-1009	$52.50
6.0AH 150x65x100m	02-1010	$59.90

Nicad Rechargeable NiCad batteries

High quality nickel cadmium batteries you can use again and again, and we have the biggest range!

			Cat	each
AA	1.2V	450mAH	02-1050	$ 3.50
AA	1.2V	500mAH	02-1051	$ 4.85
C	1.2V	1.2AH	02-1054	$11.70
C	1.2V	1.8AH	02-1055	$13.25
D	1.2V	1.2AH	02-1058	$11.70
D	1.2V	4AH	02-1059	$22.20
AAA	1.2V	180mAH	02-1062	$ 4.75
NRN	1.2V	150mAH	02-1064	$ 4.35
216	9V		02-1066	$18.95

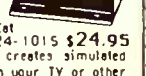
Buy any 10, deduct 10%

FM WIRELESS MIKE and RECEIVER

for PA etc. 37.10MHz xtal controlled for stability, range 100m, 9v batt.

Cat 03-0398 $95

STEREO SOUND from TV's



Cat 240VAC/12VDC 24-1015 $24.95

Active circuitry creates simulated stereo sound from your TV or other mono source, connects to Hi-Fi system!

8,000uF 75vw ELECTROLYTICS

New, top quality 34mm diam x 85mm high

Cat no 18-3500.....ea $8

10+.....ea $7.20

GEL Battery Chargers

Specially made for charging sealed gel batteries at correct current rating over a 10 hour period

120mA (1.2AH)	02-2001	$10.50
300mA (3.0AH)	02-2002	$11.50
450mA (4.5AH)	02-2003	$13.90

MICROPHONE with BASE/TREBLE CONTROLS

Uni-Directional 600Ω

80-12KHz Cat 03-0345 $24.50

DUAL IMPEDANCE 600/50KΩ MIKE

Cat 03-0347 $27.50

Uni-Directional 100-10KHz 6.5mm plug

STEREO AUDIO MIXER with BASS & TREBLE controls

PARTS VALUE PAKS

- Lucky Dip Assortments

$2 EACH PAK

250 0.25w, 0.5w, 1w resistors

15 PAKS TO CHOOSE FROM

500	0.5w resistors
200	1w resistors
100	ceramic caps
30	greencaps
45	electrolytics
20	potentiometers
25	preset pots
30	mica caps
40	radio/TV knobs
15	various fuses
25	rf chokes
20	rf/if/osc coils
10	audio transform
50	tagstrips

MICRO-DIN PLUGS FOR COMPUTERS, ETC shielded

3 pin micro-DIN	Cat 16-1047	$2.25
4 pin micro-DIN	Cat 16-1049	$2.25
5 pin micro-DIN	Cat 16-1050	$2.25
6 pin micro-DIN	Cat 16-1056	$2.40
7 pin micro-DIN	Cat 16-1057	$2.60
8 pin micro-DIN	Cat 16-1058	$2.60

Universal NiCad Charger

Charges 4 batteries at one time with LED indicators and panel meter tester.

$29.50 Cat

Recharge nicads overnight! 02-2010

NEW, COLORED MIKES

White, Black, Red, Yellow, Blue, Gold.

Uni-Directional 600Ω 100-15KHz, on-off switch

$15.95 Lightweight plastic, please give colour preference

Cat 03-0340

STEREO HI-FI SOUND AMPLIFIER

DISCO OPERATOR'S CHOICE!

2 Stereo magnetic phono inputs 3mV, microphone input with 18dB Talkover over-ride switch, 2 aux inputs for tape or tuner, tape record output, max 900mV, input headphone monitoring, 20-20KHz, 1.0V output, 2 x VU level meters, 48dB s/n ratio, 240V Cat 03-0415

$189

Extra loud BELL

3" (80 mm) diam 24V AC or DC

English Chloride Gent 150mA current

Cat 03-2019 $7.50 10+ $6.75 ea

Professional SOUND HI-FI STEREO H'PHONES

(1/2 Price were $9.90)

$5 Cat 03-9002

4 ch MICROPHONE MIXER

High quality 600Ω inputs, individual plus master volume controls, 55dB s/n, 20-20KHz, 9V batt operation, 6.5mm input sockets

Cat [illegible] $39.50

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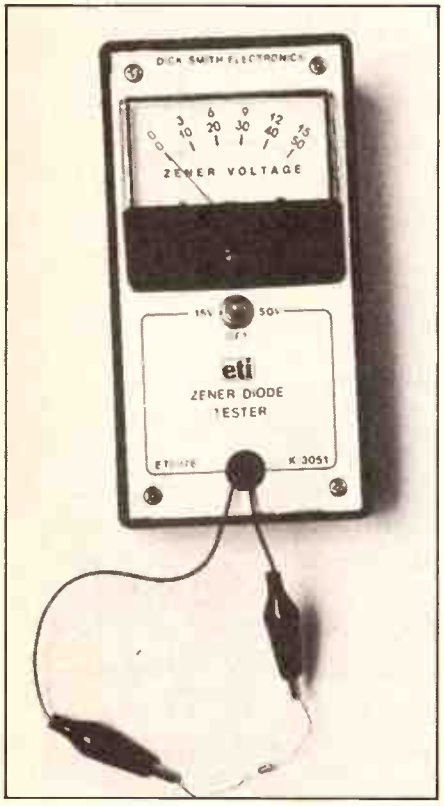
BANKCARD MASTERCARD VISA AMEX

Pack/Post - $3 plus 5% of order value, extra for heavy items.

WANTED: Electronic parts, computers, test equipment, CASH paid.

ETI-176 ZENER DIODE TESTER

REX CALLOHAN



THE ETI-176 IS A simple, battery-powered meter used to measure the zener breakdown voltage of a device connected across its test clips. It is invaluable when sorting devices with indistinct or unfamiliar type numbers and is suitable for measuring devices with zener voltages of up to 50 volts. To improve reading accuracy the meter has two ranges; 0-15 volts and 0-50 volts. If a more accurate reading is required, an analogue or digital voltmeter can be connected directly across the zener while it is connected to the tester.

Ideally, zener diodes should be tested at their manufacturer's rated test current. Because of the diode's "dynamic resistance" the measured breakdown voltage is somewhat dependent upon the current at which it is measured. As a rule of thumb, the test current is roughly that current which causes the zener to dissipate about a quarter of its rated power dissipation. Therefore, to properly test zener diodes, a voltmeter, high voltage power supply and potentiometer or a variable current source would br required. Even if this equipment was readily available, its use would become rather cumbersome, particularly if more than a few devices had to be tested. Additionally, to correctly adjust the test equipment, you would need to know what type of zener you are measuring before you make the measurement to determine what type of zener it is! An easy-to-use unit of the simplicity of the ETI-176 cannot hope to achieve "lab-standard" accuracy with a wide range of zeners, but in practice the small differences between rated and measured zener voltages are of little concern.

Construction

Begin construction by examining the pc board for broken or bridged tracks. When you are satisfied with this, start loading the components, working up to the largest, with the proviso that delicate components like semiconductors ought to be left until last. Be careful to get the polarity of the big 470 µF capacitor, the diodes and the transformer correct. To finish off, cut five lengths of wire to about 150 mm and solder them onto the board in accordance with the wiring diagram. Don't solder the probes on at this stage. You will find this exercise easier if you tin the ends of the wires before you insert them into the holes. Complete this stage by soldering the battery leads into place.

Put the board to one side and begin work on the front panel. Begin by drilling out the required holes in accordance with the drilling diagram, and then stick down the scotchcal. Because the bezels cover the edges of the holes, its not neccesary to get this absolutely precise, but you don't have too much room to spare, so be careful during this operation.

Now mount the meter and the 15/off/50 switch, and insert the rubber gromet for the probes. Pull the probes through their hole, and solder them onto the board (Make sure the clips are on the side with the scotchcal, not the other way around!) Now solder the leads to the switch and the meter. You will find this process a lot easier if you have used multicoloured wire.

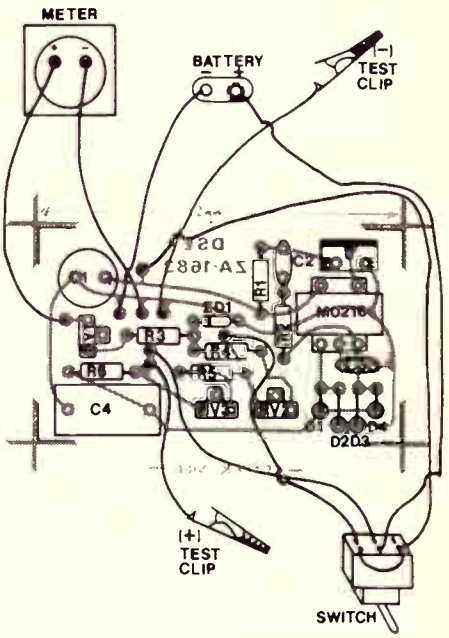
Finally, ensure the switch is in on the off (centre) position and connect the battery. The needle should not deflect and the transistor should stay cold. If either is not the case, disconnect the battery immediately and go back over your work, checking it carefully. If all is well, proceed to calibration.

Calibration

Note that two zener diodes have been included for the calibration procedure. (12V 400mW — 1N 963, 30V 1W — 1N 4751).

Firstly, with the switch set to the 50V range and the test leads open-circuit, set RV2 and RV3 to maximum resistance and adjust RV1 so the meter reads just over full scale deflection.

Next, with the switch set on the 15V range, connect the 12V zener diode across the test clips. Adjust RV2 for a correct reading on the 15V scale. Now switch to



the 50V range and connect the 30V zener across the test clips. Adjust RV3 for a correct reading. This completes the setup procedure.

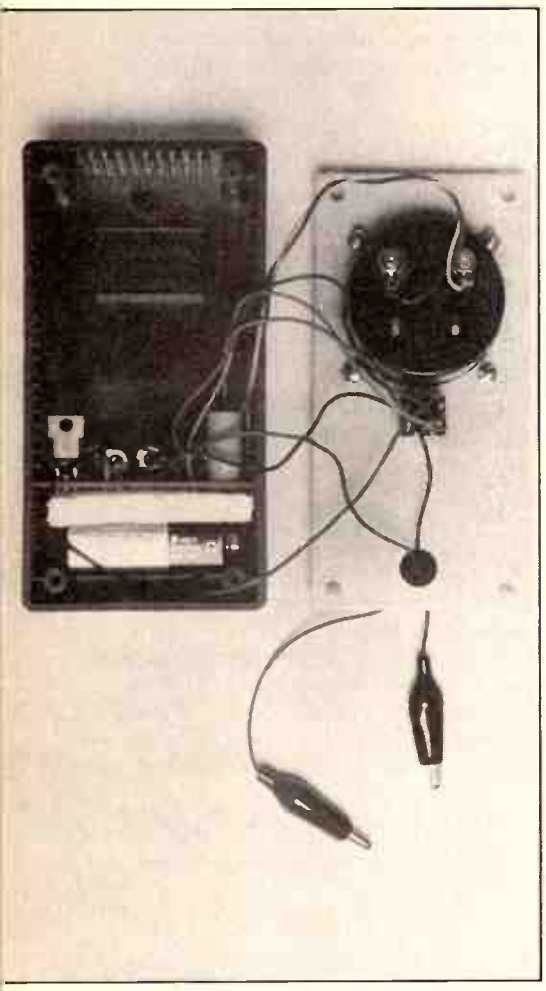
Operation

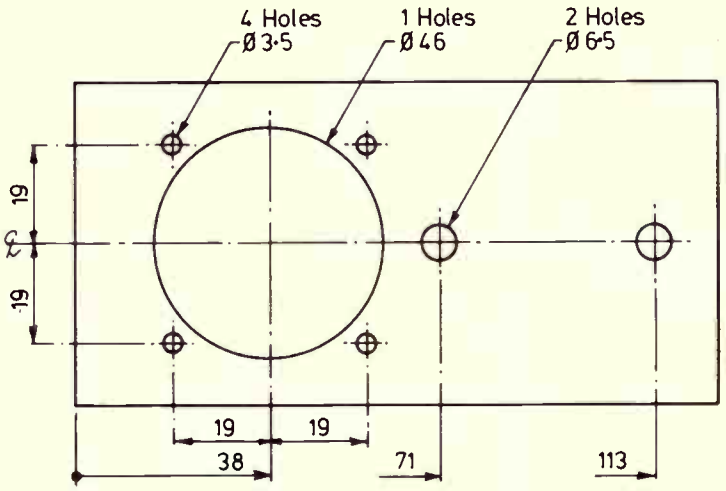
The open-circuit voltage at the test clips is about 100 volts and is current limited to about 8mA. While being quiet safe, there is sufficient current to cause a slight "tingle" if the test clips are touched while the unit is turned on. For this reason, it is recommended that connections only be made to the unit while the power-range switch is in the "Off" position.

As zener diodes are reverse breakdown devices, the cathode of the diode (usually the end with the stripe) is connected to the Red test clip and the anode of the diode is connected to the Black test clip.

After connecting the device to the test clips, switch the power/range switch to the 50 volt range and read the voltage from the meter scale. If the indicated voltage is less than 15 volts, the meter can be switched to the lower range for improved resolution. If the reading is less than about 1 volt, check that the test clips are not reversed. If the reading is greater than 50 volts, the zener may be a high-voltage type or it may be open circuit. ●

Rex Callohan is in the R & D department of Dick Smith Electronics.





PARTS LIST — ETI-176

Semiconductors

D1,2,3,4	IN4002
Q1	MJE 3055
ZD1	6VZ ZENER 400mW
TFMR	M0216 TRANSFORMER

Resistors

(all ¼W unless otherwise stated)

R1,2	10K
R3	47K
R4	82K
R5	330K
R6	10K

Capacitors

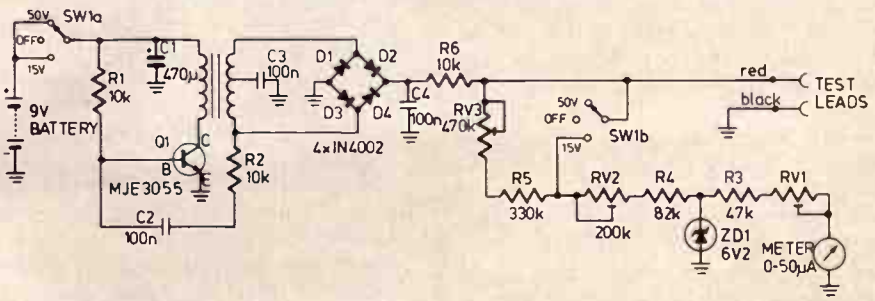
C1	470µF 17V RB
C2	.1µF CERAMIC
C3	.1µF CERAMIC
C4	.1µF 630V

Miscellaneous

SW1	DPDT CENTRE — OFF TOGGLE SWITCH
	METER 0 → 50µA ZIPPY BOX
VR1	200K MINI VERTICAL TRIMPOT
VR2	200K MINI VERTICAL TRIMPOT
VR3	500K MINI VERTICAL TRIMPOT
	GROMMET "A1" x 1
	BATTERY SNAP — suit 216-9V
	ALLIGATOR CLIPS BLACK x 1
	(MINI) RED x 1
	RIBBON CABLE (200mm)

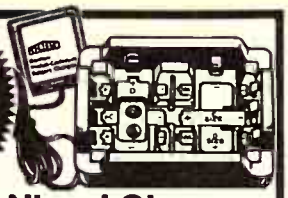
HOW IT WORKS

An oscillator is formed by Q1 and a transformer having about 1:10 turns ratio. The voltage across the secondary of the transformer is rectified by a diode bridge and results in 80-100 volts dc across capacitor C4, depending on the condition of the 9V battery. This voltage is presented to the zener diode via the current limiting resistor R6. Across the zener diode under test is the voltmeter circuit which scales the voltage into two ranges chosen by the 15V/50V switch. ZD1 acts with RV1 as a meter voltage protection circuit, should there be no connection at the test clips. The maximum available test current is around 8mA. The actual current in the zener-under-test will vary according to its zener voltage.



DICK SMITH ELECTRONICS

Transform Yourself!



Eveready Nicad Charger

Multi-size (AA, C,D or 9V) NiCad battery charger. Takes two 1.2V at a time or one 9V. Complete unit including plug-pack: nothing extra to buy. Cat M-9515

$27.50

Transistor Audio Transformers

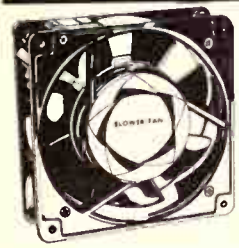
Ideal for transistor radio replacements, good for transistor projects including oscillator circuits, requiring coupling transformers. Miniature size.

Model M-0222 — • Primary 1k ohm • Secondary 3k ohm • Use — coupling • Iron Core • Size 17(l) × 15.5(w) × 15(h)mm. **$1.40** Cat M-0222

Model M-0216 — • Primary 1k ohm • Secondary 8 ohm • Use — 350mW O/P • Ferrite Core • Size 15(l) × 14(w) × 11.5(h)mm. **$1.40** Cat M-0216

10% Discount off Tantalums

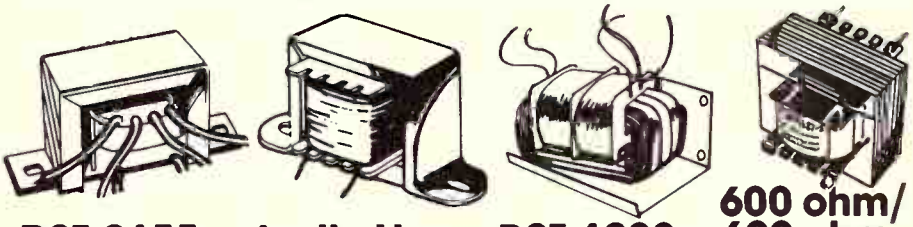
VAL. IN uF	VOLT-AGE	CAT NO.	WAS	$ 1-9	$ 10 up
0.1	35	R-4700	70	63¢	56¢
0.22	35	R-4705	70¢	63¢	56¢
0.33	35	R-4710	70¢	63¢	56¢
0.47	35	R-4715	70¢	63¢	56¢
1	35	R-4720	70¢	63¢	56¢
2.2	35	R-4730	70¢	63¢	56¢
3.3	35	R-4735	70¢	63¢	56¢
4.7	35	R-4740	70¢	85¢	76¢
6.8	35	R-4745	70¢	85¢	76¢
10	25	R-4750	95¢	85¢	76¢
22	16	R-4760	95¢	85¢	76¢



Rotary Fan Blower

Getting a bit hot under the collar? Use one of these superb rotary fans; FANtastic for any device that needs forced air cooling. And they can be mounted to suck or blow. Standard size: 120mm square × 40mm deep. Cat Y-8500

$29.95



DSE 2155 Audio Line Transformer

Primary: 240V, 50Hz. Secondary voltage: 6.3, 7.5, 8.5, 9.5, 12 & 15V. Secondary current: 1 amp. Terminations: Flying Leads. Cat M-2155

$7.95

This transformer has been engineered to cover more than 95% of all PA — BGM applications. Suited to all speaker impedances. Cat M-1100

$6.25

DSE 1200

Primary: 240V. Secondary voltage: 40V @ 10mA, 19V @ 200mA, 11.2V @ 450mA. Terminations: Flying Leads. Cat M-1200

$9.95

600 ohm/ 600 ohm Isolation Transformer

Intended for modems and other telephone line applications. Fully approved by Telecom Cat M-1210

$13.15

BOOKS-BOOKS-BOOKS-

Funway Volume 1

The ideal introduction to electronics for beginners. It will show you what the components look like, how to connect them into the circuit and for complete safety no soldering is required. Cat B-2600

$4.95

Funway Volume 2

The next step after Funway 1. It's bigger, better, more interesting, more exciting! Teaches you how to solder and how to use printed circuit boards. Plus — printed labels for your finished projects. Cat B-2605

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Encyclopedia of Electronic Circuits

A 'must' for all hobbyist and serviceman...anyone who is concerned with electronics! Over 750 pages containing nearly 1,300 most needed circuit schematics. Cat B-1760

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CB PLL Data Book

A mine of information for the avid CB'er. Contains details of the phase locked loops used in just about every CB ever made. And if you repair CB's this is indispensable for the technical data it gives — data you won't find anywhere else. Cat B-2326

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Because Funway 3 projects are based on integrated circuits — you'll be really advanced. 100 pages of fun with projects which can be built in a variety of forms so there are as many individual projects as in the other books. Cat B-2610

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A hard spine magazine binder with metal rods for placement and protection of those valuable mags. Vinyl covered. Holds 12 issues (1 year) of any mag to a maximum size of 280mm high by 210mm. Cat B-4045

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1987 ARRL Handbook

You got so much from last year's ARRL handbook, why not have an even better New Year with the '87 edition? All the updates on basic and advanced information, theory and a fascinating section on satellites. Cat B-2220

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Alternate Energy Projects

Hundreds of pages of state-of-art designs for solar and wind control and monitoring devices. Learn how to use energy more efficiently! Cat B-1775

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Power up!

Power Supply 16V AC 900mA

The biggest problem with most projects is fitting in the transformer! This one obviates the problem — keep the supply components inside, but the plug-pack hangs on the power point! With a very healthy 16V at 900mA, it's perfect for 12 volt DC supplies. Energy authority approved. Cat M-9567

$14.95

3-4.5-6-7.5-9-12V @ 300mA

An extremely versatile supply ready for just about any application. Switchable output gives 6 different voltages ranging from 3V to 12V, at up to 300mA. Cat M-9526

$18.95

3-6-9V @ 200mA

This great value Power Supply has the three most used voltages for battery powered equipment.3, 6 & 9V @ 200mA. Cat M-9525

$17.50

9V DC @ 200mA

For all equipment requiring a 9V transistor type battery or many other static hobby models that require 9V. Eliminator module simply plugs into a 240V AC power socket. Cat M-9514

$11.95

3-6-9-12V DC @ 1 amp

Invaluable around the house or workshop. It will give a maximum of 1 amp at 3, 6, 9 and 12 volts DC. Simply plugs into 240V AC power socket — DC connections via screw terminals on front of unit. Ideal for use with alarm systems, intercoms, etc. Cat M-9530

$32.95

The Alternative Phone Company.

DSE Economy Phone

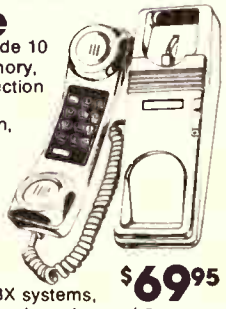
Perfect as a replacement or second phone in 5 fashion colours, attractive styling, features push button dialling, last number redial, mute button and ringer ON/OFF switch. Comes complete with coiled cord, wall plug and wall bracket!

Cat F-5185 White
Cat F-5186 Red
Cat F-5187 Pink
Cat F-5191 Blue
Cat F-5192 Brown

$19.95

10 Memory Wall or Desk Mount Phone

Features include 10 (18-digit) memory, sturdy construction and slim-line modern design, push button convenience, ringer ON/OFF with flashing LED for number redial and access pause for PABX systems, pulse dialling and much more! Cat F-5180



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Call Forwarding 2 Tape Answering Machine

NEW

Totally Programmable — Totally controllable

You won't believe that an answering machine could offer so much - at such a low price. But then it's much, much more than an answering machine. Just look at the incredible features this state-of-the-art machine has to offer:

- Call forwarding
- Emergency message sending
- Security coded
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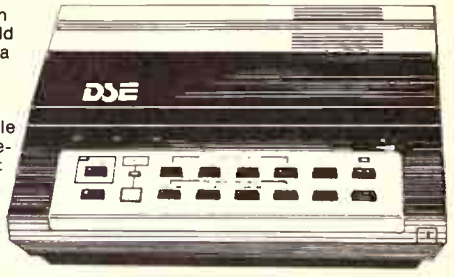
- Answer delay
- Total remote control



$399 Cat F-6145

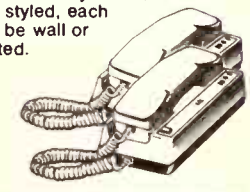
Expandable FM Wireless Intercom

As your demands increase, so does this system. Add up to 6 stations allowing 3 simultaneous conversations. Built-in squelch for superior sound. Cat F-1013

$79.95 PR.

Phone-type Duplex 2-Station Intercom

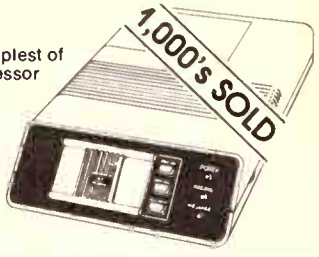
Just lift the handset and use like an ordinary phone: full duplex operation means automatic 2-way operation...no buttons to press or hold. Perfect for noisy areas — factory floors, etc. Attractively styled, each station can be wall or desk mounted. Cat F-1015



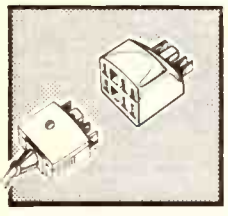
$99 PR.

Single Tape Answering Machine

This fantastic machine has got to be the simplest of all to use...in fact, the solid state microprocessor circuitry is activated by the slide of a button. Revolutionary VOX (Voice activated) remote control - no costly beeper required. Voice activated message time means more messages per tape and no wasted space. Unbelievable value! Cat F-6130



$199



Telephone Double Adaptor

Now you can plug two phones in, or a phone and an answering machine. Cat F-5112

$7.95

Shh! Is that the phone?

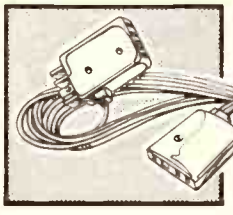
If you're in the garden, workshop you need never miss the phone again. Simply plugs into your existing telephone socket and gives you 5 metres of cord and extension bell.

Cat F-5119 $19.95

Phone Extension Reel

15 metre length provides freedom to move about the house or even outside. A retractable spool prevents any possible danger of tripping over a tangled cord. Features a convenient carry handle. Cat F-5113

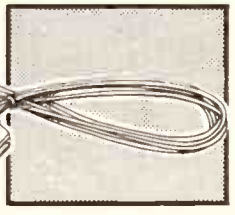
$18.95



10m Cord With Double Adaptor

15m of phone freedom — PLUS a double adaptor for your cordless phone, answering machine, etc. Cat F-5103
Telecom authorised

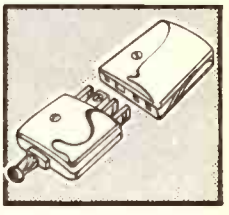
$16.95



15m Cord With Double Adaptor

A little shorter, a little cheaper. Also includes double adaptor. Cat F-5115

$12.95



Phone Plug and Socket

Easy connection for standard Australian phone systems.
Plug Cat F-5117
Socket Cat F-5118

$4.50 Ea.

DICK SMITH ELECTRONICS PTY LTD

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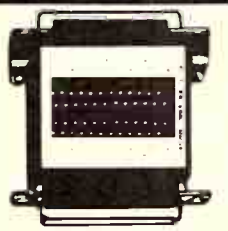
Computers for the clever buyer



RS232 Breakout Box

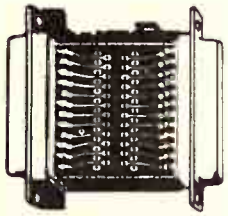
Ideal for modems and other serial applications where connections need changing. DB25 male to DB25 female, pin 1 permanently wired, all others open with wire links supplied.
Cat X-3568

$27.50

Permanent RS232 Jumper Box

Similar to above, but connections made internally and soldered for permanent applications. All 25 pins open. Wire links supplied ready for soldering. Cat X-3569

$17.50



Female/Female Gender Bender

Adapts male serial cables without resoldering or reconnecting. Simply plug in — twin female DB25 sockets with all 25 pins wired pin to pin.
Cat X-3566

$15.95

Male/Maler Gender Bender

As above, but twin male plugs permanently wired. Cat X-3565

$15.95

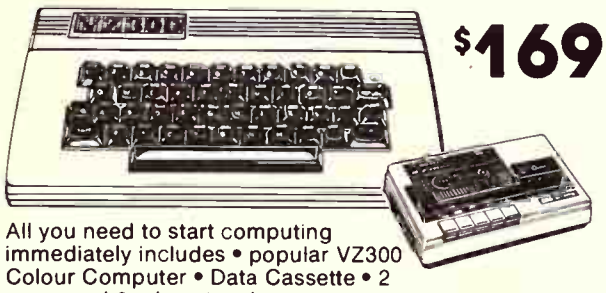
PC-500 System 1

The DSE Multitech PC-500 System 1 started the Affordable PC compatible revolution by being the first to break the $1000 price hurdle. It's still the leader when it comes to quality, versatility and value! With 256K memory (expandable to 512K), single 360K disk drive, 4.77MHz clock speed, CGA card, parallel and serial ports and MS-DOS — it's not hard to see why! Cat X-8000

$995

*Monitor not included

VZ 300 Family Pack



$169

All you need to start computing immediately includes • popular VZ300 Colour Computer • Data Cassette • 2 game and 2 educational programs. Cat X-7307

Famous Xidex Diskettes

Single sided, double density (40 track): Box 10 disks. Cat X-3512

$44.95

Double sided, double density (40 track): Box 10 disks. Cat X-3514

$49.95

For "AT" machines with high (1.2Mb) capacity drives: Double sided, high energy (80 track): Box 10 disks.
Cat X-3516

$79

For laptops and other machines using 3½" (9cm) format disks: Double sided, double density: Box 10 disks.
Cat X-3503

$85

Budget DSE Diskettes

Why pay more? Top quality computer media at a realistic price, made exclusively for Dick Smith Electronics.
(13cm) standard size.

Single Sided:
Box 10 disks Cat X-3500 $27.50

Double Sided:
Box 10 disks
Cat X-3501 $29.50

More Modem — Better Value!

$399

The New Bit Blitzer Modem is loaded with features and comes at a LOW, low price! 1200/1200 or 300/300 Baud, auto dial, answer and disconnect, Hayes AT command set compatability, fully keyboard controllable and some of the best instructions we've ever seen! Cat X-3306

Software Made Simple

Now with Listen & Learn you can master those complex computer software programs in your own time, at your own pace! You'll save money on training programs AND you can use Listen & Learn over and over again.
MS-DOS Cat X-9800

$99

DICK SMITH ELECTRONICS COMPUTER CENTRE

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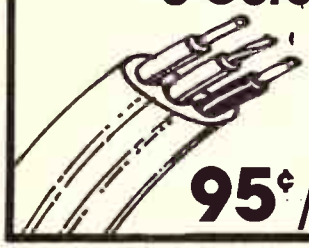
Calling ALL 'Sparks'...

Where do you get all those plugs, leads, sockets, switches and things to get your home working? Why, your DSE store of course!! DSE for great value, great prices and a great range.

Now you can get it at DSE!!

3 Core Flat Light Cable



Need an extra light in the bathroom, laundry, workspace, etc? 3 core flat 1/113 light cable with insulated earth and rated at 10 amps (1.13mm) at super low prices!! And at DSE there's no need to buy huge volumes to get the best price. Cat W-2060

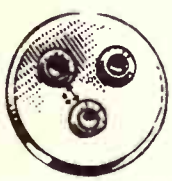
95¢/metre

3 Core Power Cable

Save even more! 3 core flat 1/178 Power Cable with insulated earth at this fantastic low price. This stuff is usually referred to as builder's cable. Rated at 25 amps (2.5mm) you can have power wherever you need it! Cat W-2062

$1.50/metre

Power Point Safety Tester



Check newly installed power points, old homes, etc. Just plug in and light pattern reveals any faults. Cat P-5300 **$7.55**

3 Pin Plug Side Entry

Standard 3 pin AC plug with cable entry on the side — ideal for using with awkward equipment. Cat P-5402

$2.25

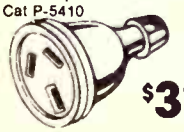
3 Pin Piggy Back Plug

Standard 3-pin plug with 3 pin socket as well — doubles up one power point. Cat P-5405

$3.95

Line Socket

Ideal for making up extension cords — standard 3 pin AC socket. Cat P-5410



$3.95

Wall Board Clip

Can be mounted from the front. Mount power outlets, switch plates, on any cavity wall (other than brick) without the need for a mounting block. Cat P-5530

$1.30

Spotlight Holder

Edison screw holder to suit PAR38 and other ES bulbs. Can be adjusted over 30° for exact positioning. (Suits coloured bulbs). Cat P-5620

$6.25

Child-Proof Protector

Stop young children's prying fingers by placing these plastic safety plugs into the outlet when not in use. Cat P-5420

$2.95

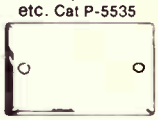
Surface Socket

Standard 3 pin AC socket that can be screwed to boards or walls — ideal for workshop use. Cat P-5415

$3.70

Blank Plate

Same size as power point, but blank: ideal for gap-filling when you move points, switches, etc. Cat P-5535



$2.25

Double Adaptor

Standard 3 pin AC plug into 2 AC sockets enabling you to use 2 appliances on one outlet. Cat P-5440

$3.40

3Pin IEC Line Plug

Female line socket. Standard IEC. Cat P-5580

$4.15

3 Pin IEC Chassis Socket

Male Chassis socket, as used with above plug. 3 pin vertical IEC pattern. Cat P-5585

$3.15

Light Socket

Light socket for bayonet mount lamps. Ideal replacement for light fittings. Comes in white plastic. Cat P-5510

$2.50

Line Switch

High impact plastic moulded switch for insertion in any cord for remote on/off. Ideal for putting on/off switch in a floor standing lamp. Cat P-5515

$6.25

Suppressor Plug

Standard 3 pin AC plug, with capacitors fitted to reduce unwanted pops and crackles from audio equipment. Cat P-5425

$7.35

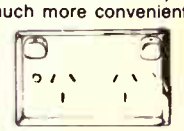
Standard Mounting Box

Mount power points, plates, etc on any surface including brick. Cat P-5531

$2.25

Double Power Point

Replace old single outlets with a double; much more convenient.



Cat P-5560 **$11.80**

Architrave Switch

Standard architrave switch — can be used to replace old, worn out units in your home. Positive action switching. Cat P-5570

$4.95

Don't change Fuses

Forget about fumbling around in the dark! With these great Circuit Breakers you need never change a fuse again. They simply fit in the existing fuse holder.

Cat P-5910 10 Amp
Cat P-5915 15 Amp
Cat P-5920 16 Amp
Cat P-5925 20 Amp

ONLY $10.95

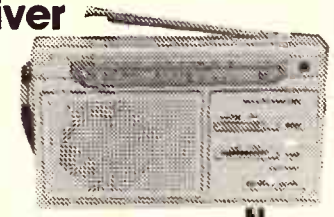
DICK SMITH ELECTRONICS

LISTEN HERE

10 Band portable!

Bargain priced 10 Band portable from Sangean! AM/FM plus 8 shortwave bands to listen to. Has phones and DC sockets and comes with soft carry case! Cat D-2834 **$89**

Air Band Receiver



Listen to the air controllers and the pilots with this amazing value Air Band VHF & AM broadcast band. This compact device tunes to the entire band – so you won't miss a thing. Cat D-2836

EXCEPTIONAL VALUE! $29.95

Desk Top Scanner

Here's the best! From Uniden the Bearcat 175 XL gives you 16 channel, fully programmable scanning with more features than you could imagine. Auto search, direct channel access... it's got everything! Cat D-2812

$499

Uniden Hand-Held

You won't believe they could put so much in a hand held! The Bearcat 50XL has 10 channels, 10 bands with manual or auto select, track tuning and more! Fantastic quality, great price! Cat D-2814

$299

Helical Dipole Antenna

Superb Helical Dipole scanner antenna which covers all major bands - 70 to 174 and 400 to 500MHz. Just 155mm long it's easily mounted and comes fitted with 3.5m cable. Cat D-4432

$39.95

Mobile Scanner Antenna

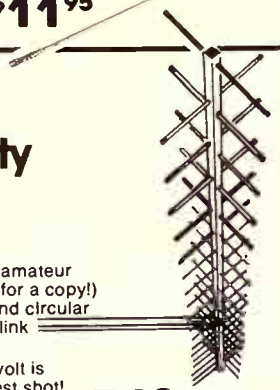
Broadband antenna covering 65-520MHz! Just screw it to your antenna base! Cat D-4434

BARGAIN

$11.95

NEW!

Professional Quality Amateur Satellite Antenna



Satracker SA270 is the ultimate antenna for amateur satellite work it's received rave reviews (ask for a copy!) Features remote switchable left and right hand circular polarisation, with 70cm uplink and 2m downlink (suitable for Oscar, Jamsat, Russians, etc.)

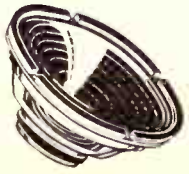
If you work satellites, you'll know every picovolt is precious: the Satracker will give you your best shot! Complete with coax harness and all mounting hardware. Cat D-4706

$749

MAGNAVOX

Check out these amazing value speakers from Magnavox! Ideal as replacement speakers or for that new system. Trust DSE to bring you superb quality at rock bottom prices.

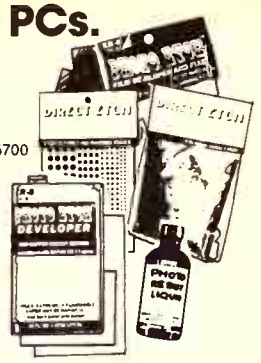
Cat No.	Type	Size	Rating	Price
C-2050	Woofer	300mm	80 watts	$49.95
C-2052	Woofer	250mm	65 watts	$39.95
C-2054	Woofer	200mm	80 watts	$29.95
C-2062	Midrange	100mm	3 watts	$9.95
C-2070	Tweeter	80mm	30 watts	$9.95
C-2080	Twin Cone	200mm	20 watts	$19.95
C-2082	Twin Cone	200mm	55 watts	$24.95



New!! Build your own PCs.

With Photo Etch you can now make your own professional printed circuit boards from original art or a printed page. And there's no darkroom, camera, film cutting or tracing. Kit comes complete with everything you need including comprehensive instruction book! Cat N-5700

$104.95 Famous **DATAK** range. Made in USA.



Look at this!

N-5705 6 sheets of photocopy film 5"× 6" **$18.85**
N-5709 2 sheets of photcopy film 8"× 11" **$18.95**
N-5710 Profession contact printing frame for up to 9"× 12" negs or positives. **$35.65**
N-5711 Positive - Negative yellow filter **$10.45**
N-5905 16 fluid ounces of negative resist developer. **$11.00**
N-5750 Dry transfers. Switch and marks patterns. **$11.95**
N-5766 Dry transfers. Large assorted pack. **$19.95**
N-5820 Dry transfers. Assorted registers and targets. **$7.95**
N-5715 Quality Burnishing Tool. **$10.45**
N-5730 Tinnit bright tin plate powder. Makes 1 pint. **$12.55**
N-5900 Circuit fix kit. Modify PCB's with pure copper tracks and donuts. **$62.95**

Fold away Solar Calc.

Fits neatly in your pocket or purse. From Sharp the EL352 has all the standard functions including percentage and square root. Works on any light source! Cat V-3844

$59.95

Solar Metric Converter

Still having to convert to/ from those dreaded Imperial measurements? The Sharp EL-344 solar powered converter makes it a breeze. Also acts as a standard calculator! Cat V-3845

$34.95

Plugs, sockets etc.

PLUG AND SOCKET BARGAIN BAZAAR!!

Stock up now at these great value prices!

Computer Connectors

P-2680 Printer Plug. 57-30360 suits most Centronics printers **$9.50**
P-2681 As above printer socket. Centronics type. **$12.30**
P-2678 36 way IDC flat ribbon Centronics type plug. **$9.50.**
P-2693 25 pin IDC flat ribbon plug **$10.45**
P-2694 25 pin IDC flat ribbon socket **$9.95**
P-2750 34 way IDC flat ribbon socket **$5.50**
P-2752 40 way IDC flat ribbon socket **$6.50**
P-2754 50 way IDC flat ribbon socket **$6.95**
P-2760 34 way Card Edge IDC connector **$9.50**
P-2762 40 way Card Edge IDC connector **$11.95**
P-2764 50 way Card Edge IDC connector **$14.95**

Standard 'D' Type Connectors

P-2684	9 pin plug	$2.75
P-2685	9 pin socket	$3.60
P-2686	9 pin backshell	$2.15
P-2687	15 pin plug	$3.25
P-2688	15 pin socket	$3.95
P-2689	15 pin backshell	$2.15
P-2690	25 pin plug	$2.95
P-2691	25 pin socket	$4.25
P-2692	25 pin backshell	$2.20

IDS Flat Cable (peel off what you need)

W-2750	26 way flat cable	$3.10/metre
W-2752	34 way flat cable	$3.85/metre
W-2754	40 way flat cable	$4.95/metre
W-2756	50 way flat cable	$5.75/metre

Budget Scientific Calc.

Ideal for high school and Uni students. The Sharp El-531A has 34 programmable functions, log, trig...all the most needed stuff! Cat V-3865

GREAT PRICE!

$29.95

DICK SMITH ELECTRONICS

PTY LTD

NZ BARGAINS

LIMITED STOCKS

Sing along Tape Recorder

Save $20! Fantastic for the kids! Tape Recorder with Microphone lets you record or play back your favourite music and sing along at the same time. Don't pay more!
Cat A-4100

WAS $49.95 NOW $29.95

4.5 Digit LCD with 0.05% Accuracy

Professional quality multimeter that you'll be proud to own and readily depend on! Large LCD reads voltage/current, continuity (buzzer also), low battery warning and overrange indication with the 4 least significant digits blanked. Features gold plated PCB, 10M ohm input impedance on all AC/DC ranges.
Cat Q-1510

$195 WAS $295

AF Signal Generator

Square/Sine wave output audio signal generator, essential for work on huge range of circuits. With wide 20Hz-200kHz output and high accuracy, it is the perfect partner for the above RF generator.
Cat Q-1310

WAS $239 $179

Incredible value!

Our 1/4 Wave CB Helical has always been a popular choice amongst discerning CBers - now it's better value than ever! Only 1200mm long. Cat D-4413

WAS $56.50 $29.95

Whip up a bargain!

It's amazing! What incredible value for this Top Load Whip Antenna - it's ideal for truckies. Only 1700mm long with stainless steel tuning tips!
Cat D-4417

WAS $69.95 DISCOUNTED TO $39.95

Master Electronics

With the fantastic Blocktronics Deluxe Kit you can design and build your own circuits. Over 160 different configurations to build! Cat K- 2616

WAS $99 SAVE $30 $69

Blocktronic Empty

With these empty Blocktronics modules you can custom design your own circuits.
Cat K-2618

$9.95

Less than 1/2 Price

Budget Communications

Ideal for the home or workshop! Three Station Intercom comes complete with wire, two slave units and master.
Cat F-1030

WAS $76.95 NOW ONLY $49.95

Listen to secret conversations

With the incredible Parabolic Ear you can listen to what's happening up to 6 metres away. Great fun!!
Cat J-7046

WAS $39.95 $24.50

Alarming Discount!

Save an enormous $30 on our popular 2 Sector Alarm Module. Protect your property without spending a fortune! The bare bones system which doesn't cut corners on quality.
Cat L-5055

WAS $79.95 Down to $49.95

Alarm Ultrasonic

Fully self contained Ultrasonic Alarm at an alarming low price! Everything is built into this one. Cat L-5108

WAS $170 NOW $99

Suppressor Ignition Lead

You can install these resistive suppressors (50K) anywhere in the HT lead to eliminate or reduce ignition noise.
Cat A-7904

WAS $2.40 95¢

Discount Door Chime

Here's a bargain! Quality Door Chime with lead and instructions at this incredibly low price. Save $10!!
Cat Y-7000

SAVER $19.95

Disk Doubler

Get up to double the capacity from those single sided disks with the great value Disk Notcher!
Cat X-3505

$7.95 WAS $12.95 SAVE $5

Single Sided Disks

Half Price!! Colourful and quality Single Sided Double Density Diskettes. Stock up while they're hot!
Cat X-3507

WAS $3.99 JUST $1.99

Disk Bargains

How's this? Quality DSE Double Sided Double Density Diskettes now are under $3!!! Stock up now! Cat X-3509

Was $4.95 Can't Miss at $2.99

9 Pin Plug & Socket

Save $4! Real bargain stuff!
Cat P-1910

Bargain $1.50 Was $5.50

7 Core ELV Cable

7/0.2mm circular cable for low voltage applications.
Cat W-2110

WAS $1.85 NOW 90¢

TRANSFORMERS

High power 'C' Core

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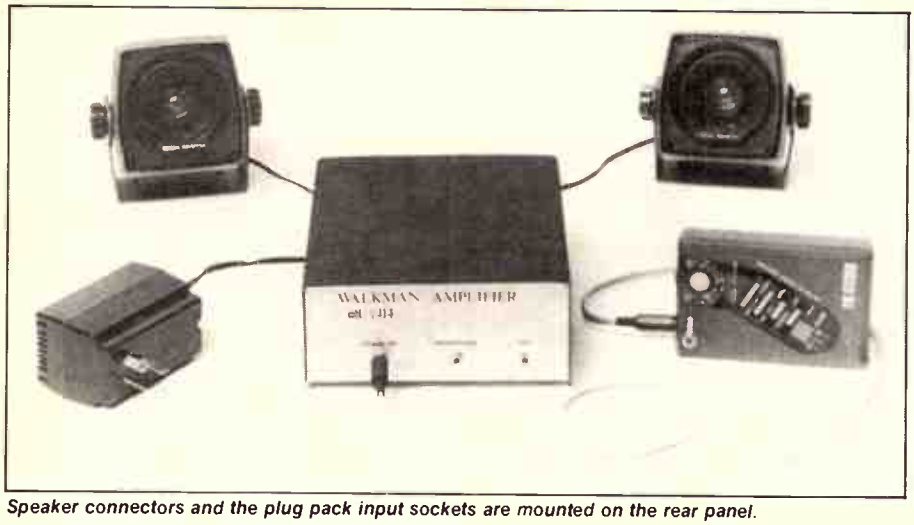
WALKMAN AMPLIFIER

S K Hui



Speaker connectors and the plug pack input sockets are mounted on the rear panel.

THE WALKMAN TYPE radio and tape player is one of the most popular electronic gadgets of modern times. Surprisingly, their fairly high price tag has survived simply because of one unique feature — portability.

Their biggest disadvantage is that the output is available to only one person. The aim of this project is to change that. One solution would be to put the line-out of the walkman directly into a big amplifier. If you experiment with this you will find that the walkman doesn't sound nearly as good as it used to. This is because it uses the headphone cord as part of its antenna system. In fact, the antenna is coupled into the audio output section of the walkman via a pair of capacitors. A second problem is that the essential portability of the walkman system is lost because the amplifier will require mains power.

So the requirements of a walkman amplifier are that it should be able to match the antenna correctly in its output, be small, drive a set of small speakers to a reasonable loudness level and be powered by batteries.

The ETI-1414 walkman amplifier has been designed deliberately to tackle this requirement. Every walkman owner should build one or your unit is just like coffee without coffeemate.

The circuit is housed in a tough mild steel box. It can be powered from either an internal battery pack, a 12 Vdc plug pack for use as a bookshelf amplifier or directly from the cigarette lighter socket in your car. The spec' for this little beauty is shown in the table.

Construction

The emphasis of this project is on portability and simplicity. Construction of this project should take no more than a couple of enjoyable hours on a Sunday afternoon. By the evening you should have a fully working amp on your bookshelf. No time consuming tuning is required. The only tool used in testing is a multi-meter.

The pc board itself sits on four plastic standoffs. One edge of the pc board has a switch (SW1), and two 3.5 mm phono sockets (SK1, SK2). This side of the board has to be flush against the metal front panel of the box to allow the switch and the sockets to be accessed from the front. This scheme reduces a lot of time consuming wiring and mistakes. The only difficult task is the accurate positioning of the holes that have to be drilled on the box. So before you assemble the pc board, make sure you have the mounting holes on the bottom floor of the box for the standoffs.

In order to get the positions of the holes drilled correctly, place the pc board on the floor of the box against the front metal panel. By using the pc board itself as a template mark the four holes to be drilled. Next, drill the holes on the front and rear panels of the box. Use the published panel artwork in the article as a drilling template if you like, but don't touch your plastic Scotchcal panels at this stage. Save them for last, as they are easily damaged. To ensure the holes drilled have the right sizes, use the actual components to try them out. A round needle file or a small reamer may be needed. Always start with a small drill bit and gradually enlarge it to the size required with a file or a reamer. It takes longer but you get a perfect hole.

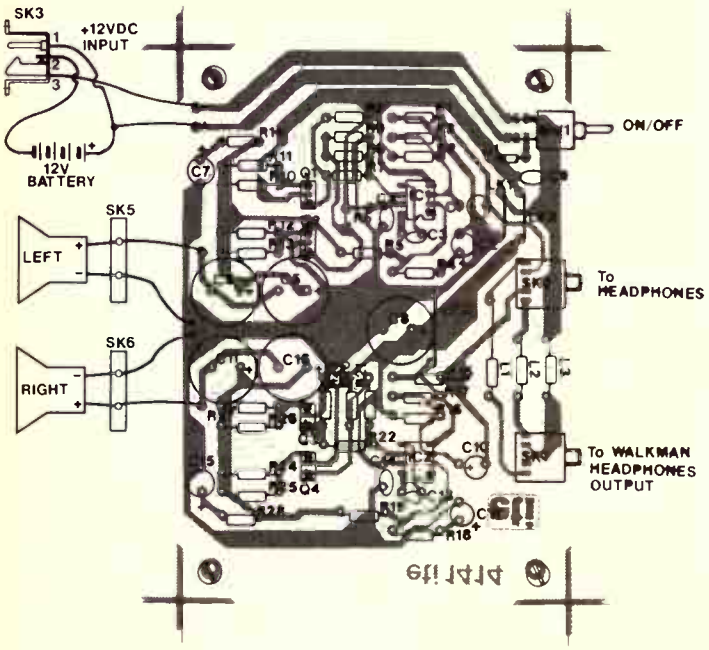
Apart from getting the right sizes, it is also important to get the right positions. Especially the three holes drilled on the front panel for SW1, SK1 and SK2 as they are rigidly soldered onto the pc board. Solder the three components on the pc board and see if you can mount the board on the standoffs. Usually, a bit of enlargement of the holes and re-adjustment of the board is needed.

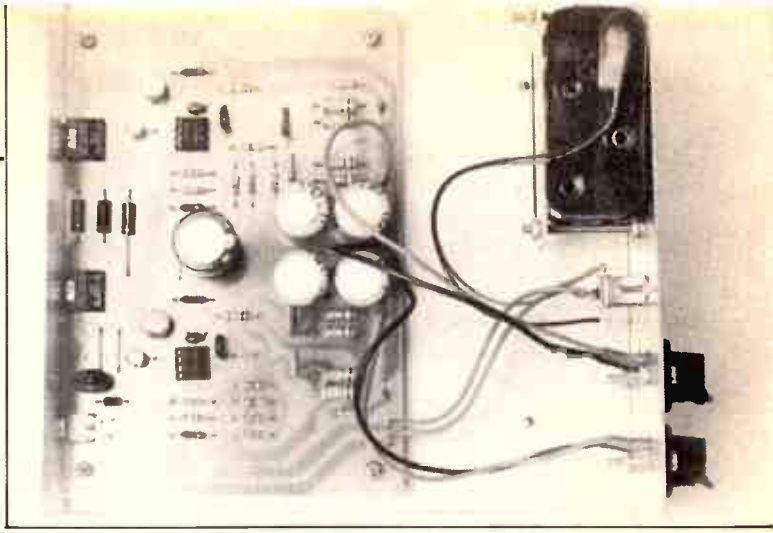
When you assemble the pc board, it doesn't matter which component you start with. If you have all the components available, the assembling should not take more than 45 minutes. To ensure success, watch out with the polarity of the transistors, diodes, electrolytic capacitors and the op-amps. Putting a heat sink on the transistor is not necessary with this type of power output. You can do so if you really wish but make sure the heat sinks do not short circuit each other.

Testing and Setting Up

Before you flick the power switch on, check again that the polarity of the battery or plug pack input is correct. Although the amplifier circuit is protected by diode D1 against any reverse power input, the testing procedure cannot proceed with the wrong input. Unplug the cord connecting the Walkman and the amplifier and the switching action of the socket SK1 will automatically ground the left(L) and right(R) channels. With the speakers disconnected, turn on the power switch (SW1) and put your fingers on the transistors for 30 sec to see if they get hot. Under normal circumstances, especially when there is nothing being played, it should stay cold. If any of them do get hot, you are likely to have the biasing voltage (hence, the biasing current) wrong for that transistor. The biasing current for the transistors Q1, Q2 is solely controlled by R6, R7, R8 and R9. Likewise, R20-R23 for transistor Q3 and Q4 in the right channel. Check that you have the right resistors in the right places.

Next check the output voltages of the cir-

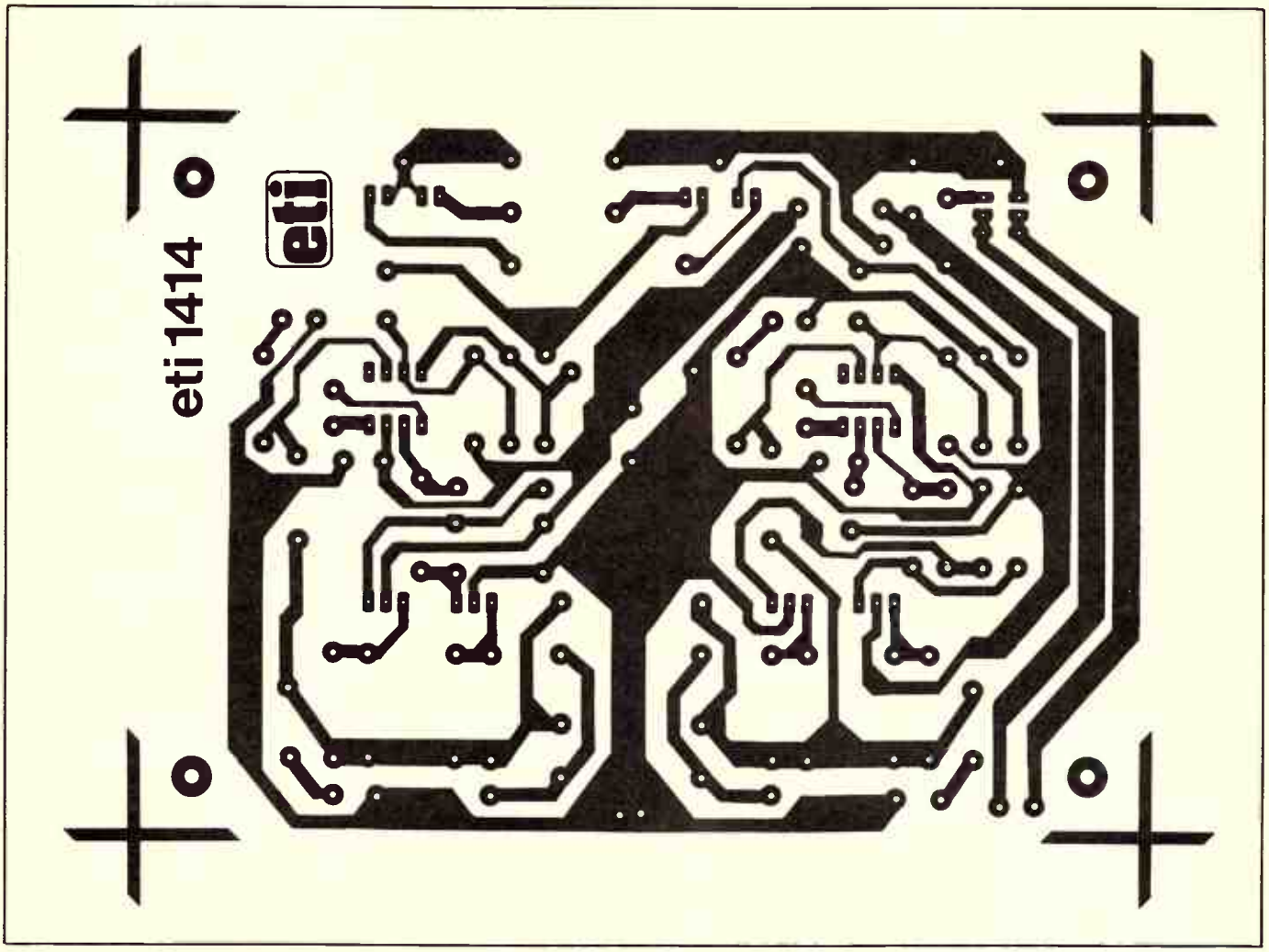




Top view of the pc board and the battery holder inside the box.

Specifications

Test Conditions: 4 ohm load, +12V supply, 400mV ptp input at 1kHz
Frequency Response (−3dB point): 40 Hz to above 100kHz
Sensitivity: about 0.6V
Total Distortion: between 0.1 and 0.3%
Output Power (rms(: 0.8W per channel
Cross-talk: 400mV at 1kHz injected in one channel with signal amplitude measured at 80dB on another channel.



cuit with a multi-meter. The node where the four 1 ohm resistors are joined should be sitting at 6V dc above ground for a 12V supply. This allows a maximum swing in both directions above and below 6V. If it is slightly different from 6V, it is likely that the power supply voltage is not exactly 12V. In the circuit diagram, several vital points have their voltages given so a comparison can be made on yours. Check them with your multi-meter's dc voltage measurement. The values you obtain on yours do not have to be identical to mine, usually, a few hundred millivolts discrepancy is expected. The final check is on the speaker output connector SK5 and SK6. Make sure that no dc voltage (0V) exists at that point, or your speaker will be permanently damaged.

The last thing to make is a cable connecting the walkman headphone output into the 'signal-in' socket on your amplifier. Preferably, use a double-core (stereo) screened microphone cable. A standard 3.5 mm stereo phono jack is soldered on each end of the cable. Apart from serving as an audio link, the cable acts as an antenna for your walkman radio (see How it Works). Obviously, for better reception, the cable should be a generous length.

Connect the speakers the connectors SK5, SK6. Plug the cable link into the walkman and the amplifier and you are ready to go! Don't forget if you are using batteries as a power source, use new ones. ●

Parts List

Resistors (all 0.25W, 1% metal film unless stated otherwise)

R1, R4, R15, R18 ..... 1k5
R2, R3, R16, R17 ..... 120k
R5, R19 ..... 10k
R7, R8, R21, R22 ..... 330R
R6, R9, R20, R23 ..... 2k7
R10, R11, R12, R13, R24, R25, R26, R27 ..... 1R (0.5W, tolerance 5%)
R14, R28 ..... 2R7

Capacitators

C1, C10 ..... 10uF/25V (Elec)
C2, C12 ..... 22uF/25V (Elec)
C3, C13 ..... 220pF (Disc ceramic)
C4, C14 ..... 33nF (Green)
C5, C6, C16, C11, C8 ..... 470uF/25V (Elec)
C7, C15 ..... 1uF/35V (Elec)
C9 ..... 120nF (Green)

RF chokes

L1, L2, L3 ..... 470uH
(From Dick Smith Electronics Cat L-1811)

Semiconductors

IC1, IC2 ..... NE5534
Q1, Q4 ..... BD139
Q2, Q3 ..... BD140
D1 ..... 1N4002 or iN4004

Miscellaneous

A standard rectangular battery holder for carrying eight 'AA' cells, Dick Smith cat. -6128. A single sided pc board. PC board mounting mini toggle switch (Sw1) for ON/OFF. I could only find this switch from Dick Smith Electronics. Two stereo 3.5mm phono sockets (SK1, SK2) with switching action can be obtained from Jaycar Electronics. A 2.5mm DC power socket with switching action (SK3), Dick Smith cat. p-1665. A metal box about 185 x 70 x 160mm, Dick Smith cat. H-2744. Two stereo clip-on type speaker connector Dick Smith cat. H-6770.

The following parts may or may not be supplied in the kit: The stereo audio cable link between the walkman and the 'Signal In' on to the amplifier. A piece of plastic or bare pc board with two 6BA screws and nuts for clamping the battery holder. For obvious reasons, a pair of book shelf speakers will definitely not be included.

We would like to thank Dick Smith Electronics for supplying the walkman radio and speakers used in the development of this project.

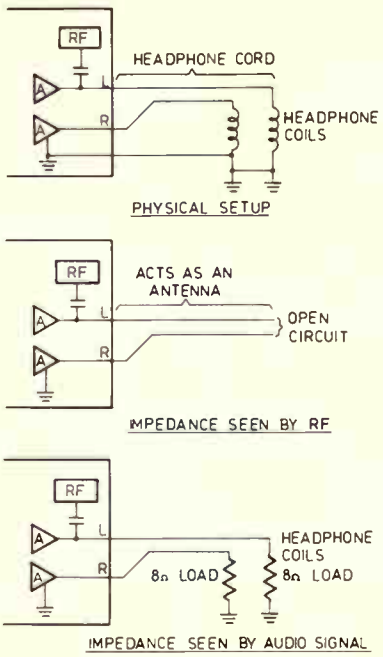
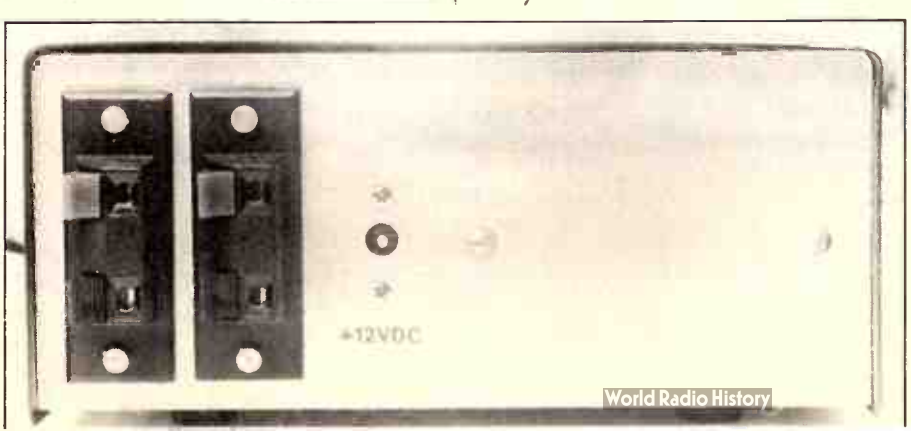


Figure 1: The walkman antenna system.



How It Works

Input section

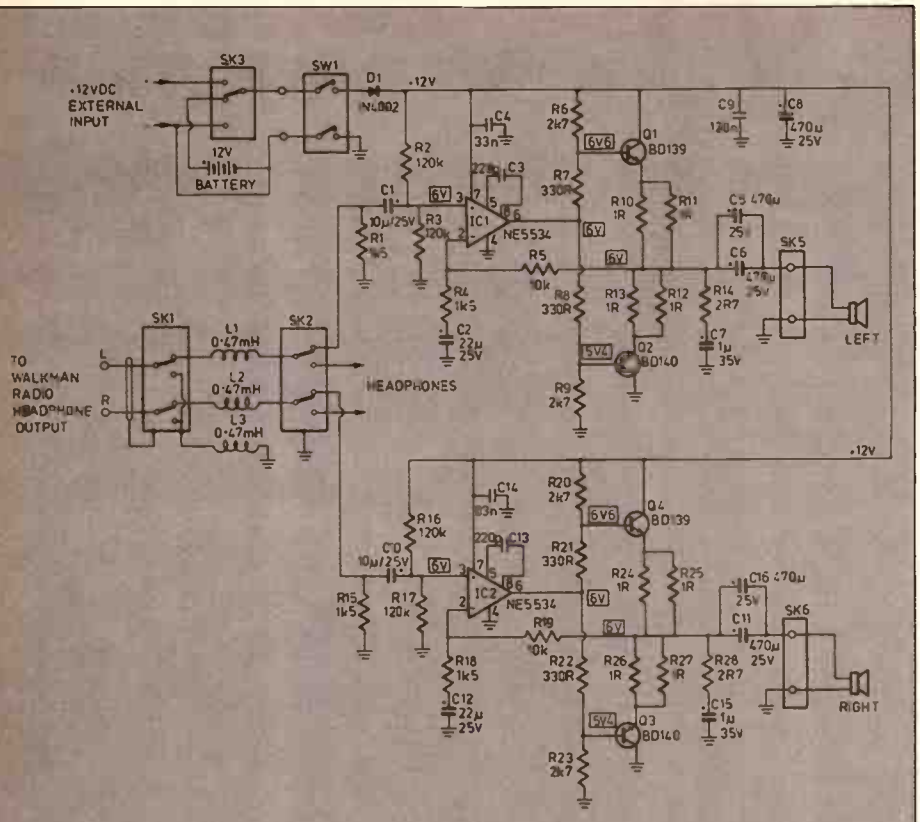
The input section begins with three RF chokes in series with the signal. Their function is to stop the amplifier input impedance from loading the Walkman antenna. To get good radio reception, a Walkman radio uses a headphone cord that serves as an antenna. The headphone coils inside the headphone have such a high impedance at RF frequencies that it is nearly an open circuit as far as RF frequencies are concerned. For audio frequencies, the Walkman sees a dc load of about 8 ohm (for an 8 ohm impedance headphone). Without the coils, the cable (antenna) will be loaded by the input impedance of the amplifier of about 1.5 k. Figure 1 shows the effective impedance as seen by the audio and the RF frequencies.

The audio input impedance of the amplifier is simply equal to the parallel resistance of R1, R2 and R3 (R16, R15 and R17 for the right channel). It works out to be around 1.5 k, which is a compromised value after some iterative testing. Lower impedance is possible but will start to load the Walkman output, resulting in a poorer transient and bass response. Any higher impedance and the coils (L1, L3) will start to pick up strong signals nearby like a generator or a alternator, etc. The cutoff, frequency at the input is determined by an emperical equation,

$$\text{Low Frequency Cutoff} = \frac{1}{2\pi\, C1 \times 1.5\,K} \quad 11\ HZ$$

The amplifier

The amplifier is basically configurated as a high current output op-amp by buffering the output of the op-amp to drive a low impedance speaker. Since the supply is only fixed at +12 V, it is desirable to have the ouput sitting at a dc level of +6 V for maximum swing in both directions. To achieve that input level, pin 3 of the op-amp is fixed at +6 V with a potential divider consisting of R2 and R3. Using the op-amp as a linear amplifying device (as opposed to a comparator), the inverting input of the op-amp (pin 2) must carry the same dc voltage (neglecting input offset voltages). Hence the dc voltage on the output of the op-amp is also fixed at +6 V. If the bases of the npn and pnp transistors connect directly to it, a standard class B amplifier is obtained. The usual cross-over distortion is fairly bad for class B operation, so the transistors have to be biased slightly on during no signal conditions. For the output (where R10-13 joins) sitting at +6 V, the base of Q1, Q2 must be sitting at roughly 0.6 V higher/lower than +6 V respectively. This requires that resistors R6 and R7,R8 and R9 be a fixed ratio. To calculate that, assume we have a +12 V supply and the op-amp output is sitting at exactly 6V. We want the



base of the pnp transistor (Q2) sitting at 6 − 0.6 V = 5.4 V, so we have

$$\frac{6\text{ V}}{(R8 + R9)} \times R9 = 5.4\text{ V, hence } R9 = 9(R8)$$

The above equation only gives an indication of their ratio but the actual value depends solely on the gain of the output transistors. After some trial-and-error, I came up with 330R and 2k7 for R8 and R9. The output emitter resistors R10-R13 form a current feedback to stablize the quiescent current due to fluctuation supply voltage. The higher the emitter resistance, the more the stablizing effect. But at the same time, the output voltage swing is more limited due to the drop in the resistors and results in smaller output power. Hence a good compromise is about 0.22 R, but I have checked around with a few major kit supplier only to find 1R in a 0.5 W package. In my design, I have used two commonly available 1 ohm resistors connected in parallel to achieve a 0.5 ohm resistance.

Feedback

The network is controlled by R5, R4 and C2. In the design, the dc voltage feedback from R5 is one. Since dc voltage can't go past capacitor C2, the +6 V dc on the output of the transistor is fully fed back directly onto pin 2 of the op-amp. This overall dc feedback is essential to keep the quiescent state of the circuit unchange. Any drift to voltage on the output of the circuit will cause an opposing change on the op-amp output to suppress the drift.

On the other hand, ac signals are fed back with a ratio determined by R4/ (R4 + R5). A five second mathematical manipulation shows that the gain for the ac signals is equal to;

$$\text{AC Voltage Gain} = 1 + \frac{R5}{R4} = 7.6$$

Bear in mind that this gain figure is frequency dependent. As frequencies drop to below 100 Hz, the gain will be largely determined by C2 and R4. The high frequency gain roll off at a point controlled by the compensating capacitor C3.

Wiring

Sockets SK1 and SK3 are 3.5 mm stereo phono sockets with in built switching action. As indicated in the circuit diagram, with the cable link unplugged from the amplifier, the coils L1 and L3 are grounded to avoid picking up any spurious signals. SK2 will divert the input signals from the Walkman to the headphone if it is plugged into the socket and hence, the speakers will be quiet. Socket SK3 is a dc plug pack type socket with a single pole switching action. If nothing is plugged in, the internal battery pack is connected to the circuit board. If an external power source is plugged in, the battery pack is switched out and power is drawn directly from the external source.

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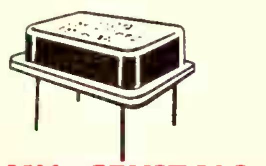

24 MHz CRYSTALS

With a few simple modifications and one of these 24MHz Crystals you can turbo boost your old IBM* XT up to 8MHz.

1-9	10+
$11.50	$10.50

41256-15

1-9	10+	100+
$7.95	$6.95	$5.95

4164

1-9	10+	100+
$3.95	$2.95	$2.75

27128

1-9	10+	100+
$9.95	$8.95	$7.95

27512

1-9	10+	100+
$19.50	$18.50	$17.50

6116 LP-3
(150ns)

1-9	10+	100+
$3.95	$3.75	$3.50

NE5534AN

1-9	10+	100+
$1.95	$1.85	$1.75

6264

1-9	10+	100+
$7.95	$6.95	$6.50

2732

1-9	10+	100+
$8.95	$8.50	$7.95

CA3130E

1-9	10+	100+
$1.95	$1.75	$1.50

Errors & Ommisions Excepted

SERIES 4000	
4000	.75
4001	.45
4002	.45
4006	1.55
4007	.45
4008	1.70
4009	.90
4010	.90
4011	.45
4012	.45
4013	.70
4014	1.45
4015	1.45
4016	0.70
4017	1.35
4018	1.50
4019	.80
4020	1.40
4021	1.50
4022	1.45
4023	1.45
4024	1.30
4025	0.45
4026	2.40
4027	0.65
4028	1.15
4029	1.50
4030	1.50
4031	2.95
4032	2.30
4033	2.75
4034	3.10
4035	1.80
4038	2.25
4040	1.20
4041	1.50
4042	1.50
4043	1.20
4044	1.25
4045	4.90
4046	1.90
4047	1.90
4048	1.20
4049	0.60
4050	0.60
4051	1.20
4052	1.20
4053	1.20
4054	3.90
4055	3.90
4056	4.20
4060	2.50
4063	2.00
4066	0.80
4067	9.90
4068	0.50
4069	0.50
4070	.50
4071	.50
4072	.50
4073	.50
4075	.50
4076	1.40
4077	.50
4078	.50
4081	.50
4082	.50
4085	2.20
4086	2.30
4093	.80
4094	3.35
4095	2.40
4096	2.40
4097	6.50
4098	2.90
4099	3.90
4194	1.70
4510	1.40
4511	1.45
4512	1.40
4513	2.65
4514	2.60
4515	2.90
4516	1.60
4517	4.80
4518	1.50
4519	0.90
4520	1.50
4521	3.40
4522	1.90
4526	1.90
4527	1.90
4528	1.95
4558	2.25
4584	.90
4585	2.10
74 SERIES	
7400	.80
7401	.90
7402	1.00
7403	1.00
7404	1.00
7405	1.00
7406	1.00
7407	1.00
7408	1.00
7409	1.00
7410	1.20
7411	1.00
7412	1.20
7413	1.00
7414	1.50
7416	1.20
7417	1.20
7420	.90
7425	1.20
7427	1.20
7430	1.00
7432	1.00
7437	1.00
7438	1.00
7440	1.00
7442	1.50
7445	1.95
7446	1.20
7447	1.75
7449	1.20
7450	0.90
7451	1.00
7473	1.20
7474	1.00
7475	1.20
7476	1.50
7485	1.50
7486	1.20
7489	3.90
7490	1.20
7493	1.25
7495	1.20
7497	2.75
74100	1.65
74107	1.20
74109	.90
74110	1.50
74121	.90
74122	.90
74123	1.50
74125	1.00
74128	1.80
74132	1.00
74139	1.50

74145	1.45
74150	1.90
74151	1.20
74154	2.50
74155	1.20
74161	1.20
74163	1.40
74164	1.20
74165	1.50
74166	1.95
74174	1.45
74175	1.20
74180	1.20
74190	1.00
74191	1.45
74192	1.00
74193	1.50
74194	1.10
74195	1.00
74197	1.20
74221	2.50
74367	1.50
74368	1.10
75107	2.50
75110	2.50
75150	2.50
75154	2.50
75450	1.50
75451	.90
75452	.90
75453	.90
75461	1.50
75462	1.50
75471	3.00
75472	3.00
75491	2.00
75492	2.00
75493	3.00
74C	
74C00	1.00
74C02	1.00
74C04	1.20
74C08	1.00
74C10	1.00
74C14	1.75
74C20	1.00
74C30	1.00
74C32	1.10
74C42	2.25
74C48	2.95
74C73	1.75
74C74	2.40
74C76	2.25
74C83	3.95
74C85	3.95
74C86	1.50
74C89	9.90
74C90	2.90
74C93	2.90
74C95	3.90
74C107	2.95
74C150	7.50
74C151	5.95
74C154	9.95
74C157	6.50
74C160	2.95
74C161	2.95
74C162	2.75
74C163	2.95
74C164	3.50
74C165	3.50
74C173	2.50
74C174	2.50
74C175	2.50
74C192	3.50
74C193	3.00
74C195	2.95
74C200	14.00
74C221	3.95
74C240	3.75
74C244	3.95
74C373	6.95
74C374	5.95
74C901	3.95
74C902	3.90
74C903	3.90
74C904	3.90
74C905	15.00
74C906	2.90
74C907	3.95
74C908	3.75
74C910	15.00
74C911	15.50
74C912	17.95
74C914	2.95
74C915	4.95
74C917	17.95
74C918	3.95
74C920	12.50
74C921	14.50
74C922	9.95
74C923	9.95
74C925	9.90
74C926	13.90
74C927	12.50
74C928	9.90
74C929	9.90
74C930	3.95
74C932	3.50
74C941	2.95
74C989	12.50
74F SERIES	
74F00	.79
74F02	.79
74F04	.92
74F08	.79
74F10	.79
74F11	.79
74F20	.79
74F32	.79
74F64	.79
74F74	.89
74F86	1.19
74F109	.99
74F138	1.79
74F139	1.99
74F151	1.79
74F153	1.79
74F157	1.79
74F158	1.79
74F175	2.78
74F181	5.98
74F182	2.73
74F189	7.44
74F190	4.86
74F191	4.86
74F192	5.66
74F194	2.41
74F241	3.72
74F243	4.34
74F244	3.72
74F245	5.50
74F251	1.93
74F253	1.93
74F257	1.93
74F258	1.93
74F283	2.40
74F350	4.34
74F352	1.93
74F353	1.93
74F373	4.64

74F374	3.95
74F399	2.78
74F521	4.22
74F533	4.84
74F534	4.84
74HC SERIES	
74HC00	.60
74HC02	.60
74HC04	.60
74HC08	.60
74HC11	.60
74HC14	1.40
74HC27	.60
74HC30	.60
74HC32	.60
74HC74	1.10
74HC76	1.10
74HC85	1.40
74HC86	1.10
74HC123	1.40
74HC138	1.40
74HC139	1.40
74HC157	1.40
74HC165	2.50
74HC174	1.40
74HC221	3.60
74HC240	2.50
74HC244	2.50
74HC245	3.90
74HC367	1.40
74HC373	2.90
74LS	
74LS00	.75
74LS01	.60
74LS02	.60
74LS03	.60
74LS04	.75
74LS05	.75
74LS08	.60
74LS09	.80
74LS10	.60
74LS11	.75
74LS12	.80
74LS13	.90
74LS14	.80
74LS15	.80
74LS19	.90
74LS20	.60
74LS21	.90
74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.60
74LS32	.60
74LS33	.60
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	1.20
74LS47	1.80
74LS48	1.80
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	.60
74LS74	1.00
74LS75	1.00
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	1.20
74LS85	.85
74LS86	.60
74LS90	1.20
74LS91	1.20
74LS92	1.20
74LS93	1.50
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.90
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	1.30
74LS125	1.00
74LS126	1.00
74LS132	1.00
74LS133	0.90
74LS136	1.20
74LS138	1.20
74LS139	1.00
74LS145	1.50
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	3.80
74LS155	1.50
74LS156	1.50
74LS157	1.20
74LS158	1.00
74LS160	1.50
74LS161	1.00
74LS162	1.50
74LS163	1.10
74LS164	1.40
74LS165	1.20
74LS166	2.55
74LS169	2.95
74LS173	1.20
74LS174	1.20
74LS175	1.00
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.00
74LS196	1.20
74LS197	1.35
74LS221	2.00
74LS240	2.40
74LS241	2.40
74LS242	2.40
74LS243	2.10
74LS244	2.50
74LS245	2.95
74LS247	1.30
74LS248	1.40
74LS249	1.50
74LS251	1.50
74LS253	1.35
74LS257	1.20
74LS258	1.20
74LS259	2.25
74LS261	2.50
74LS266	0.70
74LS273	1.95
74LS275	6.80
74LS279	.80
74LS280	2.60
74LS283	1.20
74LS290	1.20

74LS293	1.10
74LS295	1.50
74LS297	6.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	1.00
74LS368	1.00
74LS373	2.00
74LS374	2.00
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	5.50
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	2.95
74LS541	3.50
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95
74S SERIES	
74S00	1.00
74S02	1.00
74S03	1.00
74S04	1.20
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	0.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	3.50
74S175	1.95
74S181	8.50
74S182	3.40
74S189	8.50
74S194	3.30
74S195	2.90
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S280	5.90
74S283	7.90
74S287	3.30
74S288	4.90
74S299	13.90
74S301	13.90
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412/8212	5.90
74S428/8212	7.90
74S470	9.90
74S471	9.90
74S472	9.90
74S473	9.90
74S474	9.90
74S475	9.90
74S482	11.90
74S489	7.90
8000 SERIES	
8035	6.90
8039	7.90
8080	7.95
8085	12.50

8086	19.50
8088	19.50
8121	5.00
8123	4.00
8130	6.95
8131	5.95
8136	6.95
8155	6.50
8158	11.50
8165	37.50
81LS95	3.75
81LS96	3.75
81LS97	3.75
81LS98	3.75
8203	58.50
8212	2.90
8214	4.90
8216	3.00
8224	3.50
8226	4.90
8228	5.50
8237	19.50
8238	9.50
8243	8.50
8251	6.90
8253	7.50
8255	5.50
8257	16.50
8259	6.50
8275	38.50
8276	28.50
8279	8.50
8283	6.50
8284	8.50
8286	6.50
8287	6.50
82S23	5.95
82S123	5.95
8304	6.95
8748	59.00
8749	58.50
8820	6.95
8830	6.95
8832	6.95
8833	6.95
8834	6.95
8835	5.95
8T13	2.95
8T14	2.95
8T26	3.00
8T28	3.00
8T30	3.00
8T96	1.80
8T97	1.80
LINEAR	
LH0002	9.50
LH0042	19.00
LH0070	14.95
LH0071	9.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.20
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.90
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TA7205P	3.90
TEA1002	17.50
LM10CH	7.50
LM301	1.00
LM301H	1.20
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM308	1.00
LM308H	1.80
LM309K	2.90
LM310H	3.20
LM310N	3.20
LM311	1.00
LM311H	1.80
LM317K	4.50
LM317T	2.50
LM318	4.90
LM319	3.95
LM324	1.00
LM325	4.50
LM326	5.50
LM329DZ	.90
LM335Z	4.00
LM336 2.5V	2.95
LM337T	2.90
LM344Z	1.90
LM338K	12.50
LM339	1.20
LM347	4.50
LM348	1.80
LM349	2.95
LM350K	10.50
LM350T	6.50
LM351	1.20
LM351N	1.00
LM353	2.50
LM356N	2.40
LM357	2.40
LM358	1.40
LM361	4.95
LM377	4.90
LM378	6.95
LM380 8 pin	1.80
LM380 14 pin	1.90
LM381	3.50
LM382	3.50
LM383	5.95
LM384	3.50
LM386	1.95
LM387A	3.95
LM387	2.00
LM390	3.90
LM391	2.90
LM392	2.20
LM393	1.00
LM394CH	7.95
LM395T	9.95
LM396K	22.50
LF398	5.90
LM3999Z	2.60
NE544	6.50
NE555	.60
NE556	1.20
NE558	5.00
NE560	4.60
NE564	6.95
NE565	1.95
NE566	2.90
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50

LM725	4.75
LM733	1.50
LM739	2.75
LM741	.60
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.50
MC1437	4.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1466L	21.50
MC1469R	6.90
MC1488	1.20
MC1489	1.20
MC1494	8.40
MC1495	8.90
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM2907	3.90
LM2917 8 PIN	4.90
LM2917 14 PIN	4.90
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3100E	7.95
CA3130E	2.90
CA3130T	3.50
CA3140E	2.20
CA3140T	2.95
CA3401	1.00
CA3900	1.20
CA3905	1.75
CA3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	2.60
RL4136	1.95
RC4194	3.90
CPU	
6502	15.00
6502A	15.00
6522	15.00
6522A	15.00
6532	14.00
6551	12.90
6800	6.00
6802	7.00
6808	12.50
6809	10.00
6810	3.50
6821	5.50
6840	6.50
6845	12.50
6847	3.50
6850	7.90
6875	15.00
Z80CPU	5.00
Z80ACPU	5.00
Z80BCPU	12.00
Z80P10	4.50
Z80AP10	4.50
Z80CTC	5.50
Z80ACTC	5.50
Z80DMA	16.00
Z80ADMA	16.00
Z80AS10	13.00
Z80S10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5309	14.50
MM5369	4.95
FD1791 (8876)	19.00
FD1793 (8877)	19.00
FD1795	39.00
FD1797	39.00
WD1691	29.50
WD2143	24.50
WD1931	22.50
WD1933	34.00
WD2123	26.50
WD8250	29.50
TR1602 (S1883)	8.50
COM8116	24.00
BR1941	23.00
CRT8002A	59.90
MEMORY	
2101 (5101) (8101)	7.90
2102	2.50
2114	4.95
2532	12.50
2708	12.50
2716	9.90
2732	8.95
2764	8.95
27128	9.95
27256	12.95
27512	29.50
4116	2.95
4164	3.95
41256	8.95
5101	7.90
58725 (6116)	5.00
6116	7.95
6264	8.95
8101	7.90
OPTO	
4N25	1.50
4N26	1.50
4N27	1.50
4N28	1.50
4N29	1.50
4N30	2.00
4N32	2.50
4N33	2.50
4N35	2.50
4N37	2.50
MCT6	2.50
MCT66	6.90
MCT2	1.50
1LD74	5.90
1LO74	6.50

FND507	2.00
TIL31A	2.95
TIL81A	2.95
TIL306	22.50
BPW50	2.25
CQY89A	1.95
HP5082-2811	4.95
HLMP 6620	3.95
LEDS	
3mm RED	.15
3mm YELL	.30
3mm GRN	.30
5mm RED	.15
5mm YELL	.30
5mm GRN	.30
5mm ORA	.30
RED RECT	.30
GRN RECT	.40
YEL RECT	.40
RED CHROME BEZEL	1.20
YELLOW CHME BEZEL	1.20
GRN CHRME BEZEL	1.20
SPECIAL FUNCTION	
LM4250	2.45
NE5534N	2.95
NE5534AN	3.50
MC3340	2.90
76489	9.95
8038	6.50
OM335	22.50
OM350	12.50
XR2206	8.95
XR2207	7.95
XR2208	6.90
XR2209	6.90
XR2211	7.95
XR2216	5.90
XR2240	6.95
XR2243	7.95
XR8038	7.50
95H90	8.50
11C90	16.50
LM7555	2.90
LM7556	3.90
MC10116L	1.50
LM13600	3.95
DM2502	22.50
ZN414	1.95
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ICM7216B	69.50
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ADC0800LCN	22.50
ADC0801LCN	23.95
ADC0803LCN	7.50
ADC0804LCN	6.50
ADC0808LCN	14.95
ADC0820LCN	24.95
DAC0800	4.95
DAC0808	4.95
DAC0832LCN	6.95
DAC1020LCN	19.95
DAC1220LCN	19.95
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AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
BC107	.75
BC108	.75
BC182L	.40
BC212	.30
BC318	.30
BC320	.40
BC327	.25
BC328	.25
BC337	.25
BC338	.25
BC546	.40
BC547	.20
BC548	.20
BC549	.20
BC550	.40
BC556	.40
BC557	.20
BC558	.20
BC559	.20
BC639	.50
BC640	.50
BCY70	1.90
BCY71	1.90
BD139	.60
BD140	.75
BD232	.75
BD233	.90
BD235	.90
BD236	.90
BD237	.90
BD238	.90
BD262	1.20
BD263	1.20
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	5.50
BDV65B	5.50
BDX63	6.50
BDY96 (BUX80)	4.90
BDY97 (BUX80)	4.90
BF115	1.50
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20

BF494	.90
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BFW16	1.50
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BFY90	1.90
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MFE3001	9.90
MFE3003	8.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	2.50
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MPF121	2.90
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MPSA05	1.00
MPSA06	1.00
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MPSA12	1.00
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MP131	2.75
MPF131	2.90
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MRF238	29.50
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MRF455	37.00
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MRF646	53.00
MRF901	2.90
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TIP31B	1.00
TIP31C	1.00
TIP32A	1.00
TIP32B	1.00
TIP32C	1.00
TIP41C	1.90
TIP42A	1.90
TIP42C	1.90
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
TIP145	3.40
TIP2955	3.50
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2N	
2N301	4.00
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.90
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.95
2N2647	3.95
2N2894	1.00
2N2904	1.10
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.90
2N3054	1.90
2N3055	1.50
2N3096	1.20
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	4.50
2N3771	5.50
2N3772	6.90
2N3773	6.90

2N3792	6.00
2N3819	1.20
2N3866	2.95
2N3904	1.00
2N3906	1.00
2N4030	1.50
2N4032	2.20
2N4033	2.20
2N4036	2.50
2N4121	1.50
2N4123	1.50
2N4236	1.90
2N4237	1.90
2N4248	.40
2N4249	.40
2N4250	.40
2N4258	.50
2N4355	.50
2N4356	.50
2N4360	1.00
2N4401	.30
2N4402	.30
2N4403	.30
2N4416	1.90
2N4427	3.90
2N4919	2.90
2N5088	1.00
2N5089	1.00
2N5139	1.20
2N5179	1.20
2N5190	2.50
2N5191	3.30
2N5192	3.10
2N5193	2.50
2N5194	2.95
2N5195	3.30
2N5210	1.50
2N5245	1.50
2N5303	8.50
2N5401	1.50
2N5457	1.00
2N5458	.90
2N5459	.90
2N5461	.90
2N5462	.90
2N5485	.90
2N5486	.90
2N5489	14.50
2N5590	26.50
2N5591	29.50
2N5641	19.50
2N5656	2.50
2N5770	.30
2N5777	1.50
2N5830	.30
2N5831	.30
2N5873	1.40
2N5874	1.70
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2N5945	39.95
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VN88AF	3.95
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1N4004	.10
1N4007	.20
1N4148	.10
1N5404	.30
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7805UC	.80
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7812UC	1.20
7812KC	2.50
7815UC	1.20
7815KC	2.50
7818UC	1.20
7818KC	2.50
7824UC	1.20
7824KC	2.50

7905UC	1.90
7905KC	3.00
7912UC	1.90
7912KC	2.50
7915UC	1.90
7915KC	2.50
7918UC	1.90
7924UC	1.90
78L05	.80
78L12	.80
78L15	.80
78L18	.80
78L24	.80
79L05	1.20
79L12	1.20
79L18	1.20
79L24	1.20
LM309K (7805KC)	1.90
LM317T	2.50
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LM317HV	9.50
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LM338K	10.50
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LM350K	8.50
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C103B	.90
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C122E	2.95
C260D	8.50
C260E	9.90
2N2646	1.95
2N2647	2.50
2N6027	.90
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1MHz	9.50
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2MHz	5.90
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2.4576MHz	5.50
2.7648MHz	4.90
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4.433618MHz	2.90
4.44MHz	2.90
4.75MHz	2.90
4.915200MHz	6.90
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5.00MHz	2.90
5.0688MHz	2.90
6MHz	2.90
6.14MHz	2.90
6.6670MHz	2.90
8MHz	2.90
8.867238MHz	4.90
10MHz	4.90
10.6445MHz	4.90
11MHz	2.90
12MHz	2.90
14.31818MHz	4.90
15MHz	4.90
16MHz	4.90
18MHz	4.90
18.432MHz	4.90
20MHz	4.90
24MHz	4.90
27MHz	4.90
32MHz	4.90
36MHz	4.90
32.768MHz	4.90

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SAVE ON COMPONENTS!

ELECTROLYTICS (PCB MOUNTING)

16 VOLT

Cat.No.	Description	1-9	10+
R15461	10uF	$0.25	$0.20
R15481	22uF	$0.25	$0.20
R15511	33uF	$0.25	$0.20
R15521	47uF	$0.25	$0.20
R15531	100uF	$0.30	$0.25
R15541	220uF	$0.60	$0.50
R15551	330uF	$0.75	$0.65
R15561	470uF	$0.75	$0.65
R15571	640uF	$0.90	$0.80
R15581	1000uF	$0.90	$0.80
R15601	2200/2500uF	$1.20	$1.10

25 VOLT

Cat.No.	Description	1-9	10+
R15422	2.2uF	$0.25	$0.20
R15432	3.3uF	$0.25	$0.20
R15442	4.7uF	$0.25	$0.20
R15462	10uF	$0.25	$0.20
R15502	25uF	$0.30	$0.25
R15512	33uF	$0.30	$0.25
R15522	47uF	$0.30	$0.25
R15532	100uF	$0.40	$0.35
R15542	220uF	$0.70	$0.65
R15552	330uF	$0.75	$0.65
R15562	470uF	$0.75	$0.65
R15582	1000uF	$1.00	$0.90
R15602	2200/2500uF	$1.40	$1.20

35 VOLT

Cat.No.	Description	1-9	10+
R15443	4.7uF	$0.30	$0.25
R15463	10uF	$0.30	$0.25
R15483	22uF	$0.30	$0.25
R15513	33uF	$0.40	$0.35
R15523	47uF	$0.40	$0.35
R15533	100uF	$0.60	$0.55
R15543	220uF	$0.60	$0.55
R15563	470uF	$0.70	$0.60
R15583	1000uF	$1.20	$1.10
R15593	2200/2500uF	$1.50	$1.30

50 VOLT

Cat.No.	Description	1-9	10+
R15404	0.47uF	$0.25	$0.22
R15414	1uF	$0.25	$0.22
R15424	2.2uF	$0.30	$0.25
R15434	3.3uF	$0.30	$0.25
R15444	4.7uF	$0.40	$0.35
R15464	10uF	$0.40	$0.35
R15484	22uF	$0.40	$0.35
R15514	33uF	$0.40	$0.35
R15524	47uF	$0.50	$0.45
R15534	100uF	$0.60	$0.55
R15544	220uF	$0.90	$0.80
R15564	470uF	$1.00	$0.90

63 VOLT

Cat.No.	Description	1-9	10+
R15405	0.47uF	$0.30	$0.25
R15415	1uF	$0.30	$0.25
R15425	2.2uF	$0.30	$0.25
R15435	3.3uF	$0.30	$0.25
R15445	4.7uF	$0.30	$0.25
R15465	10uF	$0.40	$0.35
R15505	25uF	$0.50	$0.45
R15525	47uF	$0.50	$0.45
R15535	100uF	$0.60	$0.55
R15545	220uF	$0.90	$0.80
R15555	330uF	$1.20	$1.10
R15565	470uF	$1.40	$1.20

TAG TANTALUM CAPACITORS SPECIALS!

Cat.No.	Description	Price
R16124	16V 4.7uF	$0.48
R16125	16V 10uF	$0.52
R16126	16V 15uF	$0.75
R16128	16V 22uF	$0.85
R16216	25V 2.2uF	$0.40
R16220	25V 4.7uF	$0.70
R16222	25V 6.8uF	$0.70
R16224	25V 10uF	$0.60
R16228	25V 22uF	$2.40
R16300	35V 0.1uF	$0.30
R16302	35V 0.15uF	$0.30
R16304	35V 0.22uF	$0.30
R16306	35V 0.33uF	$0.30
R16308	35V 0.47uF	$0.30
R16310	35V 0.68uF	$0.35
R16311	35V 0.82uF	$0.35
R16312	35V 1.0uF	$0.30
R16314	35V 1.5uF	$0.50
R16316	35V 2.2uF	$0.50
R16318	35V 3.3uF	$0.35
R16320	35V 4.7uF	$0.70
R16322	35V 6.8uF	$0.80
R16324	35V 10uF	$0.80
R16326	35V 15uF	$1.40
R16328	35V 22uF	$3.50

UNIVERSAL HEATSINK

Universal because of the hole pattern which allows it to be mounted to most "power" type semiconductors. Features vented sides and black anodised finish for maximum efficiency.
Dimensions: 60(L)x35(W)x30(H)mm
Cat. H10601 ..... Normally $1.75

1-9	10+	100+
$0.75	$0.65	$0.60

ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A Cat. M12155	$9.95	$8.95
2156 240V 6-15V 2A Cat. M12156	$14.95	$13.95
2840 240V 9V CT Cat. M12840	$5.95	$4.95
2851 240V 12-6V CT 150mA Cat. M12851	$5.95	$5.50
2860 240V 15V CT 250mA Cat. M12860	$5.95	$4.95
6672 240V 15-30V 1A tapped Cat. M16672	$14.95	$13.95

QUALITY LEDS

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

CRYSTALS SPECIALS!

Description	Cat.No.	1-9	10+
1MHz	Y11000	$7.50	$7.00
4.433618MHz	Y11023	$2.95	$2.75
8.867238MHz	Y11055	$2.95	$2.75
12MHz	Y11070	$2.95	$2.75
14.31818MHz	Y11072	$2.95	$2.75

TRIGGER TRANSFORMERS

Cat. M10104 ..... $1.45

6.35mm STEREO PLUGS

UNBELIEVABLE PRICES!!
P10121 (plastic plug) Normally $1.00

1-9	10+	100+
$0.50	$0.45	$0.40

MINIATURE HEATSINK!

A great little fellow if you are short of space. Great price too, because we import direct so you save!
Dimensions: 19(L) x 13(W) x 9(H)mm
Cat.No. ..... 1-9 ..... 10+
H10606 ..... $0.40 ..... $0.35

MINI "U" HEATSINK

Used extensively on PCB's this heatsink suits most flat (plastic type) semiconductors, and has vertical flutes for maximum thermal efficiency.
Cat. H10602 ..... Normally $1.25

1-9	10+	100+
$0.65	$0.55	$0.50

CANNON TYPE CONNECTORS SPECIALS

Cat. No.	Description	Price
P10960	3 pin line male Was $3.90	NOW $2.90
P10962	3 pin chasis male Was $3.00	NOW $2.40
P10964	3 pin line female Was $4.50	NOW $3.25
P10966	3 pin chasis female Was $4.95	NOW $3.45

RCA GOLD PLATED PLUGS AND SOCKETS

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

Plug	Cat. P10151	$3.75
Socket	Cat. P10150	$2.95

RCA GOLD PLATED CHASIS SOCKET

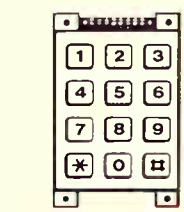
For the ultimate connection!
Cat. P10229 ..... Normally $1.95

1-9	10+	100+
$1.00	$0.90	$0.85

CENTRONICS PLUG SPECIAL!

36 WAY MALE (P12200)

1-9	10+	100+
$3.95	$3.50	$3.00



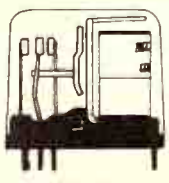
NUMERIC KEYPAD

Unencoded keypad, 10 digit keys plus two utility keys. Light grey in colour.
OUTPUT ARRANGEMENT:

Output Pin No.	Symbol
1	N.A
2	Shield plate
3	Column 2
4	Row 4
5	Column 3
6	Row 1
7	Column 1
8	Row 2
9	Row 3
10	N.A

Cat C19030

1-9	10+	100+
$2.95	$2.50	$1.95



10 AMP RELAY

S.P.D.T 12V Coil, 240V (S14114)

1-9	10+	100+
$4.95	$3.95	$3.75

SPECTROL MULTIDIALS

MODEL 15-1-11
Number of turns: 10
Minor Scale Division: 1/500 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 25.4 x 44.45mm (1 x 1 3/4")
Depth: 25.4mm (1")
Weight: 45.4g (1.6oz.)
Cat.R14405 ..... $45.95

MODEL 16-1-11
Number of turns: 15
Minor Scale Division: 1/50 turn
Shaft Bore: 6.35mm (1/4")
Finish: Clear Anodize
Body Size: 22.2mm diameter (.875")
Depth: 22.2mm (.875")
Weight: 19.8g (0.7oz.)
Cat.R14400 ..... $26.95

MODEL 21-1-11
Number of turns: 15
Minor Scale Division: 1/100 turn
Shaft Bore: 6.35mm (1/4")
Finish: Satin Chrome
Body Size: 46.04mm diameter (1.812")
Depth: 25.4mm (1")
Weight: 85.g (3oz.)
Cat.R14410 ..... $46.95

5 PIN DIN PLUG

UNBELIEVABLE PRICE!
Cat. P10157 ..... Normally $1.00

1-9	10+	100+
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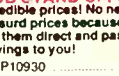

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Pin 2 Segment D	Pin 7 Segment A
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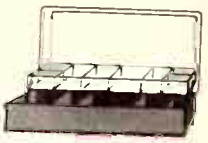

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WHAT ARE OFF LINE SWITCHERS?

Ian Thomas

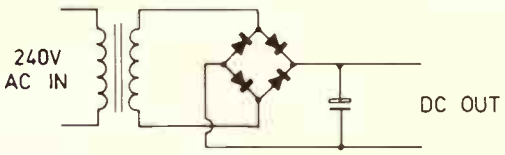


Figure 1: The simplest power supply.

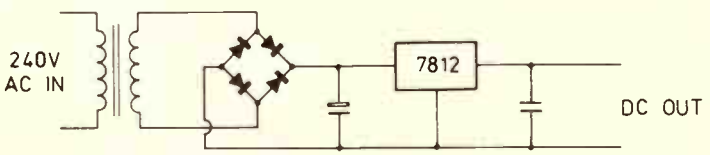


Figure 2: The first degree of complexity; a regulator.

In this glorious age of ours electronic devices are pretty commonplace. It would be nearly impossible to get through a day without using something with silicon in it. All these devices perform innumerable tasks but all have one factor in common — they need electric power to operate.

The smaller devices can easily get enough power from batteries or solar cells and no more need be said about them here. However, larger machines such as videos, computers or TVs need to be powered off the ac mains supply. Since most electronic circuits cannot operate off 240 Vac, some form of power supply circuit is needed to convert the power to a more useable form.

The power supply circuit has not only to transform the power into a useable voltage for the rest of the equipment but must perform one other very important function. This is to provide isolation between the 240 volt input and the rest of the equipment. It is a requirement with all mains powered equipment that complete electrical isolation be provided between the mains input section of the equipment and the rest of the machine. In fact a test to be performed is to apply 3000 Vac to the two power input leads connected together. No flashover is allowed and no excess earth leakage current is permitted to flow. These tests are designed to ensure that when lightning strikes the power distribution system the end user receives minimal nasty surprises.

The requirement for isolation has always meant that a mains power transformer be an integral part of the power supply circuit. The simplest power supply circuit using a transformer and providing dc to equipment is shown in figure 1. The input transformer steps the 240 volts down to about 9 volts ac. The output voltage is then rectified to give about 12 volts dc. The output filter capacitor smooths the very lumpy voltage out of the rectifier to provide a (more or less) smooth dc supply.

The is adequate for many applications but in some the residual ripple from the rectifiers is unacceptable. Audio circuits in general cannot tolerate the residual 100 Hz which shows up as an annoying hum in the output. To solve this problem it is common practise to use the circuit shown in figure 2. The circuit is identical to the first one except that the transformer output voltage has been increased to about 13 volts and a semiconductor voltage regular has been added.

Resistors and Regulators

The regulator acts as an infinitely variable resistor whose value is continuously being adjusted by its internal workings such that the voltage on its ouput is always exactly 12 volts. When a very small current is flowing the resistance becomes high and when large currents are flowing it drops to a low value. For high currents a quite large ripple voltage will still appear on the filter capacitor but on the output of the regulator the ripple voltage will be reduced by more than 60 dB or 1000 times.

The simple series regulator solves the ripple problem very nicely but introduces another. In order for the regulator to work it is necessary to increase the voltage out of the transformer and drop this voltage in the regulator. This must result in the regulator getting HOT. For low power circuits this is no great sweat but when the supply currents get up to amps, getting rid of heat from the regulator gets to be a major problem. It requires massive heat sinks with lots of fins and is, in general, a messy and expensive business.

There is a solution to the power problem with regulators too. The device that actually controls the current in the previous example (usually a transistor) acts as a resistor and as such generates heat. If the main control element can be made to act as a switch then the heat generated can be made almost negligible. When the transistor is carrying current there will be no voltage drop across it and when there is a large voltage drop across it there is no current flowing. In either case there is no power dissipated.

The problem with this arrangement is that the circuit generates an enormous square wave rather than a smooth dc output voltage. However, with the addition of a suitable inductor and filter capacitor the output can be made as smooth as desired. The basic circuit for this is shown in figure 3a. Figure 3b shows the voltage on the collector of the transistor and the associated currents.

A diode has been added in as well as the inductor and filter capacitor as the current through the inductor flows continuously. The voltage on the collector of the transistor goes negative when the transistor turns off until the diode turns on and provides a path for the inductor current. If the diode were omitted then the collector

voltage would continue to go negative until something broke (usually the transistor)!

Switching Regulators

The circuit illustrated is only one of a miriad configurations called switching regulators. By rearranging the basic diode, transistor, inductor and capacitor they can be made to step up, step down or regulate either way. As a class of design they are extremely versatile and their main disadvantages are cost (mostly of the inductor) and a tendency to generate electrical noise (which can be controlled with more cost in filter capacitors!). However, in tight spots their size advantage and efficiency outweigh these problems.

Power supply designers have been using switching regulators as a matter of course for yonks but for mains powered equipment there was still the problem of the mains transformer. This provided the necessary isolation from the mains and brought the voltages to be handled down to more manageable values. However, for a 250 watt power supply the transformer needed is about the size of a half brick and a good deal heavier.

It is instructive to consider just why it is necessary to have so much iron and copper in a power transformer. By making vast and sweeping assumptions it can be said that the weight of a transformer is proportional to the power to be transmitted and inversely proportional to the operating frequency of the power supply. This second factor is forced on the designer by the regrettable fact that iron can only tolerate so much magnetic field before it saturates and ceases to be a magnetic material. It is a part of the design process to arrange that the magnetic field generated in the iron core by the incoming alternating supply is reversed before it is strong enough to saturate the iron.

It just so happens that, given the properties of iron, copper and a 50 Hz supply you finish up with a half brick for a 250 watt transformer. The Americans have it slightly easier with their 60 Hz supply but not enough to make a significant difference. Also (praise be!) they've heard about the rest of the world and 50 Hz and tend to make allowances, but I digress. In aircraft, where redundant half house bricks are definitely frowned on, power distribution is normally done at 400 Hz to make the transformers smaller and lighter.

Transformers

Power supply designers have had their collective beady little eyes fixed on transformers since power supplies were invented. It was the advent of reliable high voltage transistors, combined with the frequency dependance of transformer size that enabled a major breakthrough. The philosophy is quite simple. If a higher operating frequency is necessary to reduce the size of transformers then generate the high frequency electronically using switching transistors.

The first step is to generate a dc supply from the incoming ac mains. A simple diode bridge and filter capacitor does this and gives 340 volts dc output. It is important to note that while there is 340 volts across the filter capacitor neither side of the capacitor is at ground or neutral potential. In fact both sides have the incoming ac voltage imposed on them so they CANNOT be touched!!

The next problem is to reconvert the dc back to ac at a (much) higher frequency. The high frequency ac need not be a sine wave and in fact almost never is. A very important point to be borne in mind here is that transformers of all sorts violently resent having dc through their windings and usually quit unless it's allowed for in the design. This is because the dc produces a static field in the core which reduces the ac field excursion available.

Bearing the dc problem in mind the most obvious way to convert the dc supply to ac is to use a push-pull arrangement of transistors together with a transformer as shown in figure 4. Drive is arranged to switch each transistor on for exactly the same time to ensure that there is no dc (this of course assumes that both windings have exactly the same number of turns). It also requires that a small auxiliary power supply be available to provide gate drive but a simple diode capacitor arrangement is enough and half bricks are definitely not needed. In point of fact for the straightforward stepdown it's easy to delete the power supply but for more complex arrangements it is needed.

Getting low voltage dc out is easy. A secondary with the appropriate number of turns, a second diode bridge and a filter capacitor and Bob's your uncle! (Unless you're a Liberal.) It's easy to arrange that the isolation between the primary and secondary windings conforms to all the safety standards and a configuration like this is much smaller than the equivalent mains transformer supply.

If simple stepping down the mains was all there is to the story it would be arguable whether it would be worth the trouble. However, there are much better things to come. Suppose an inductor is added in between the output diode bridge and filter capacitor as shown in the dotted box in figure 4. Also suppose that a few more turns are wound on the secondary so its output voltage is higher than required. Finally suppose that the high side base drive circuit has some smarts and can vary the on time of the transistors while keeping the operating frequency the same. It is important to ensure that both transistors are on for the same length of time each cycle (unequal times = dc offset = BAD! but there is absolutely no reason why the time cannot be varied. Then by controlling the on time it is possible to control the output voltage. When either high side transistor is

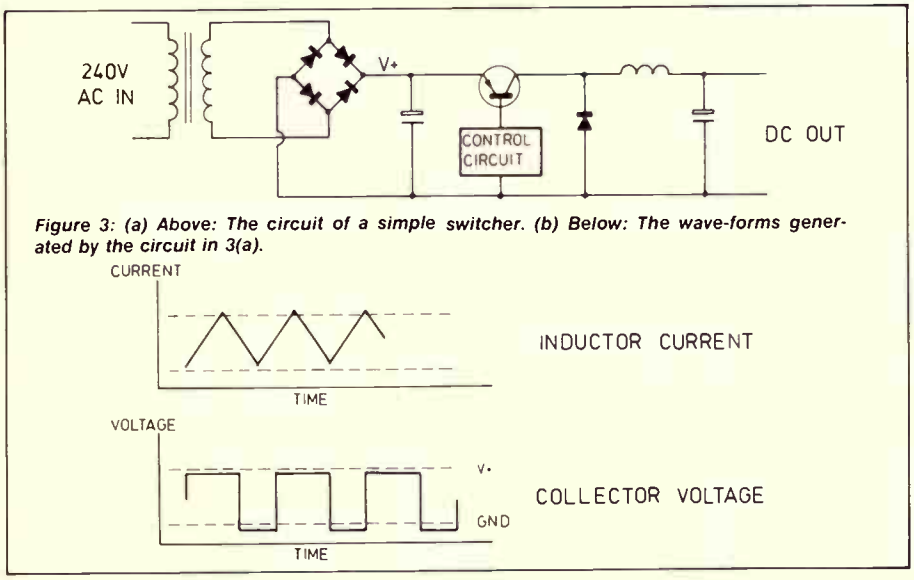


Figure 3: (a) Above: The circuit of a simple switcher. (b) Below: The wave-forms generated by the circuit in 3(a).

on current is run up the same as the simple switching regulator down converter we discussed a while back. When either high side transistor is on current is run up in the inductor and when they are off the current runs down again through the diode bridge exactly as in the diode in the simple switching regulator. This is where the whole thing starts to get worthwhile. Not only do you get a smaller supply but it regulates as well.

To complete the regulator it is necessary to arrange some circuitry on the output side to sense the output voltage and feed information back to the main switching control circuitry. The important thing here is to realise that the control circuitry is HOT so the control information must go through some form of isolation as well. This completes all the necessary functions for a basic complete off line switching regulator which is shown in block diagram form in figure 5.

Optocoupler

Two common approaches are used to achieve the necessary isolation in the feedback path. The first is to use an optocoupler. Self powering circuitry is arranged on the output side to turn the optocoupler LED on when the desired output voltage has been reached. The phototransistor on the hot side is used to control the on time of the drive transistors.

The second is to tie the auxiliary power supply to the output side and perform all control functions referred to a nice safe earth. You can touch what you like without fear of death or disfigurement. The two base drive signals to the hot side transistors are coupled through small transformers.

The optocoupler arrangement has the advantage that it is cheaper but means that the optocoupler is an integral part of the feedback loop. The gain phase characteristic of optocouplers is at best a bit ratty and makes for interesting problems associated with control loop stability. A switching regulator connected to a 240 volt outlet has access, to all intents and purposes, to infinite energy so if the control loop of an off line switcher goes unstable then "interesting phenomena" can occur. I have seen an off line regulator drop its bundle to the extent that all that was left of a TO220 transistor was three charred stubs of leads protruding from a board — *awesome!* The transformer coupled base drive arrangement is dearer as the two base drive transformers are needed as well as the auxiliary supply transformer but it's a lot simpler to get going.

Feedforward Converters

The push pull configuration that we've been discussing requires two hot side transistors, both of which must be able to withstand twice the 340 volts input dc. It also requires that the transformer have two primary side windings which is a bit of a waste of copper and is therefore not used very often. I've only discussed it in detail here as it's fairly easy to understand. In practise our beady eyed designers have long since realised that both the transformer and output inductor consist of wires around some sort of core (usually ferrite at the frequencies we're dealing with). Transformers certainly have stray inductance and inductors can be made into transformers by whacking an extra winding or two on. Thus both the main transformer and output inductor can, in some circuit configurations, be combined into one. Unless very large amounts of power are to be handled it would also be nice to need only one transistor.

Therefore a more common design, at least in the 50 to 100 watt range, is the so called single ended feedforward converter which is shown in figure 6. This is a type of switcher which still has two inductors but only has one main switching transistor. One major problem with single transistor converters is the ubiquitous dc bias. The inverter operates by turning the transistor on for a time determined by the control circuitry. The transformer operates normally and generates a voltage in the output winding S1 exactly as in the push pull version we've already discussed. However, in this case the transformer is specially designed with an air gap to tolerate a dc component in its windings. The transformer can be considered to be an ideal transformer with an inductor in parallel

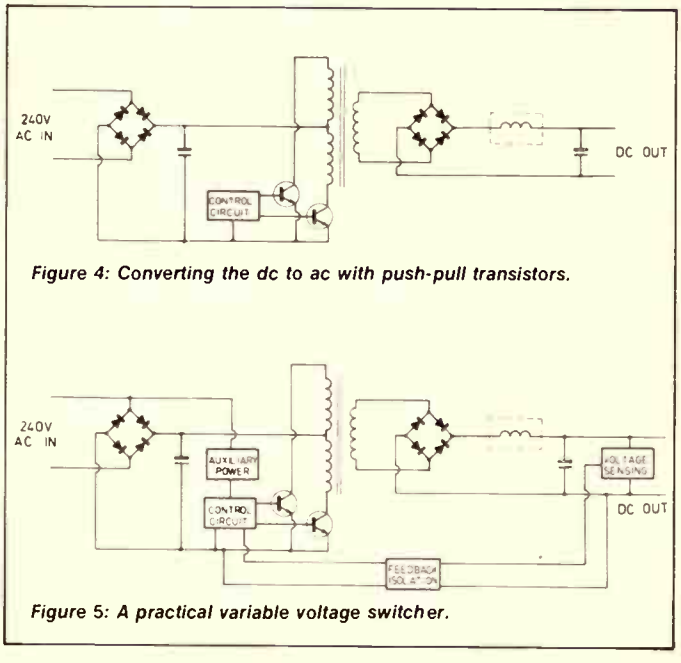


Figure 4: Converting the dc to ac with push-pull transistors.

Figure 5: A practical variable voltage switcher.

with the primary (or secondary for that matter). At the same time as output current is flowing in S1 energy is being stored in the main transformer inductance (referred to as the magnetising inductance). When the main transistor turns off the voltage its collector rises to some hundreds of volts above the 340 volt supply and at the same time the voltage at the output of S1 reverses.

At this time the other secondary winding takes over and S2's diode is turned on to recover the energy stored in the transformer magnetising inductance. In this way the evil dc bias problem is turned into a positive advantage or at least specifically allowed for. During this part of the cycle the converter is acting as a classical flyback converter. If the designer wishes it the whole converter can be operated as a flyback converter. In that case the output inductor may be dispensed with as well as S1 and its diode, although stabilising flyback converters is a bit of a challenge and the main inverter core isn't used particularly efficiently. There are no rules and you can design to optimise whatever parameters you want.

The Half Bridge

If large amounts of power are needed then a configuration that is often used is called the half bridge. When high powers are the order of the day, transistors are needed that can handle many amps. Transistors with this capability and a 800 to 1000 volt Vceo (or Vds) cost an arm and a leg so it's better to keep the peak voltages down to the 340 volts of the rectified mains. For the half bridge the input filter capacitor is split into two which in effect creates an intermediate voltage of 170 volts (as an added bonus the 200 volt capacitors seem to be easier to get — perhaps because designers fancy half bridge inverters).

The other half of the half bridge is formed by two transistors in series as shown in figure 7. The converter transformer primary is connected between the two centre nodes. Since one end of the transformer is connected only to two capacitors there can be no dc problem (YAY!). In normal operation the transformer only sees 170 volts which makes insulation a bit easier (not that it's a very great problem). The drive for the top transistor has to be isolated with a transformer which can be a nuisance as well.

The only really important point about this class of converter is that the control circuit that drives both transistors must be EXCEEDINGLY careful not to turn both on at once or what is laughingly known as a current excursion occurs. As a matter of interest we believe this is what happened to the utterly destroyed TO220 transistors I mentioned earlier. We didn't allow enough for transistor storage time. We don't know as we couldn't find any of the transistors. Off line switchers can be built to operate into the Kilowatt range without too much trouble and at these power levels the saving in cost and particularly size can be quite spectacular.

One final point can be made about off line switchers. Since the first thing that happens to the input power is to rectify it and turn it into dc the converter will operate perfectly happily from a 340 Vdc power supply. So if you have a small TV that has an off line switching power supply you can build a 12 to 340 volt dc-dc converter which is a lot easier and cheaper and lighter than a dc-ac inverter and power it from your car — great for camping. In fact such units are available commercially now in Australia which exploit exactly this fact.

Testing to see if a machine uses an off line switcher is easy too. All you have to do is measure the dc resistance into the mains input lead. The pins to measure between are the two on the plug that are at an angle to each other. The slightly longer central one's the earth and that had better be high resistance! You can use any multimeter but don't use continuity checkers — they tend to make assumptions about the circuit. If the device uses a transformer then the primary side dc resistance will be 10s to 100s of ohms. If it uses an off line switcher then the input resistance will be open circuit after the input capacitor charges through the input diode bridge. ●

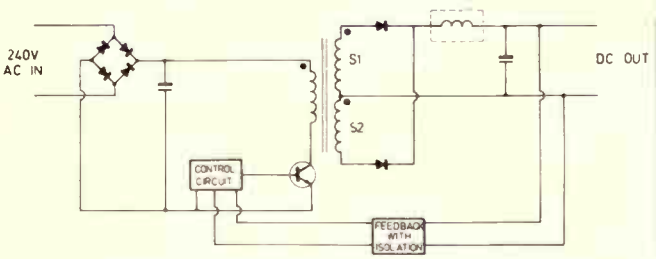


Figure 6: A typical switcher design for the 50-100 V range.

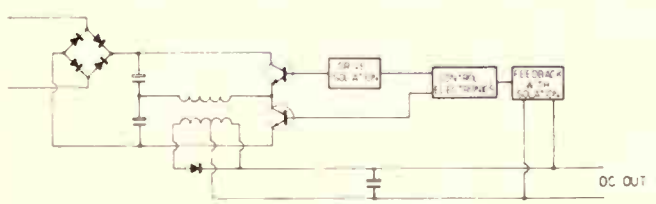


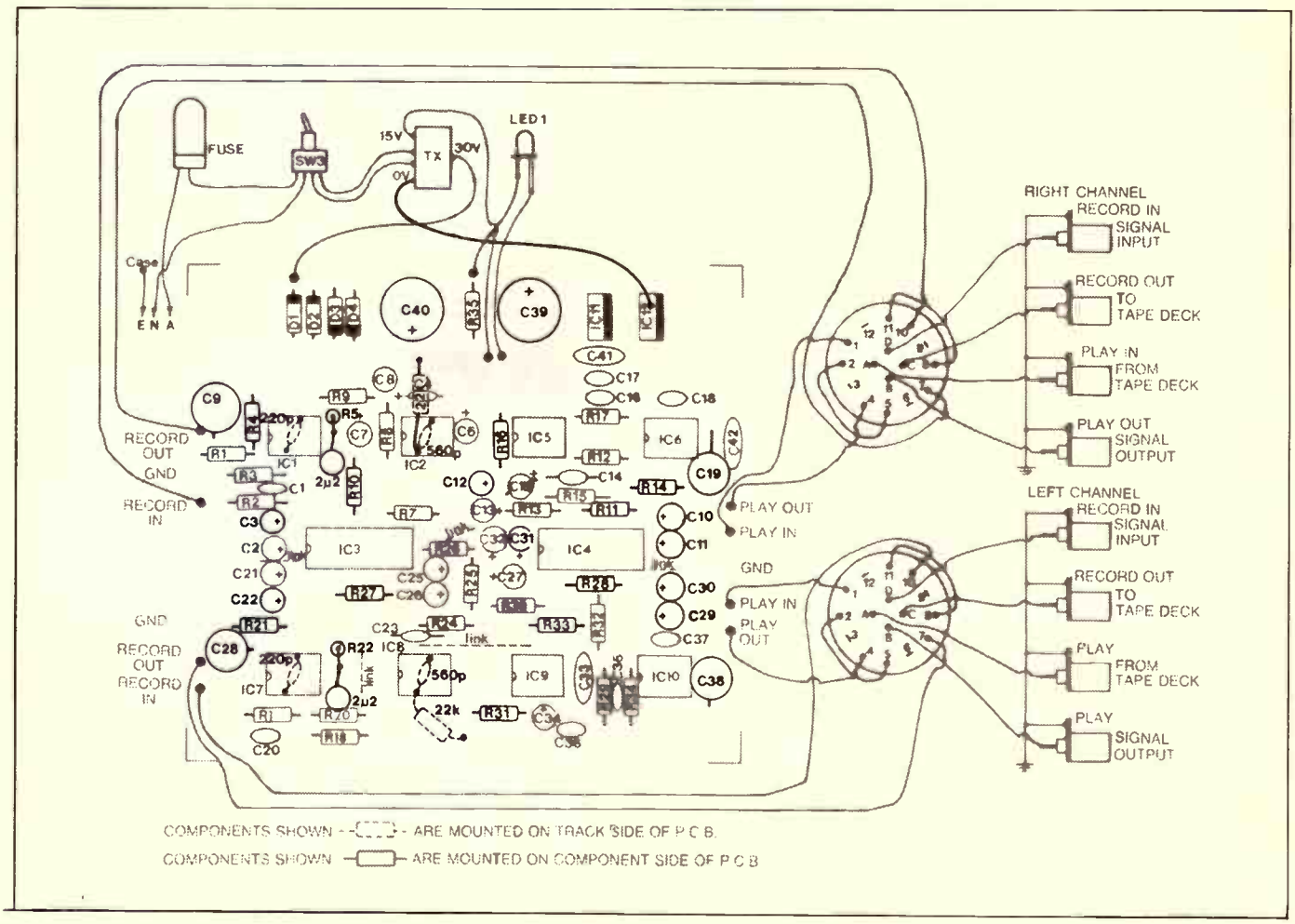
Figure 7: For high power a half bridge is ideal.

NOISE REDUCTION UNIT

READER FEEDBACK INDICATED that there was a problem with the NR unit (1407) published in December, 1986. We re-opened the file and looked into the matter. If you have built up the project and are experiencing problems like clicking occurring on high frequency transients (particularly with CD players), pumping effects, oscillations, loss of bass frequencies and low frequency instability, then the following modifications should solve it.

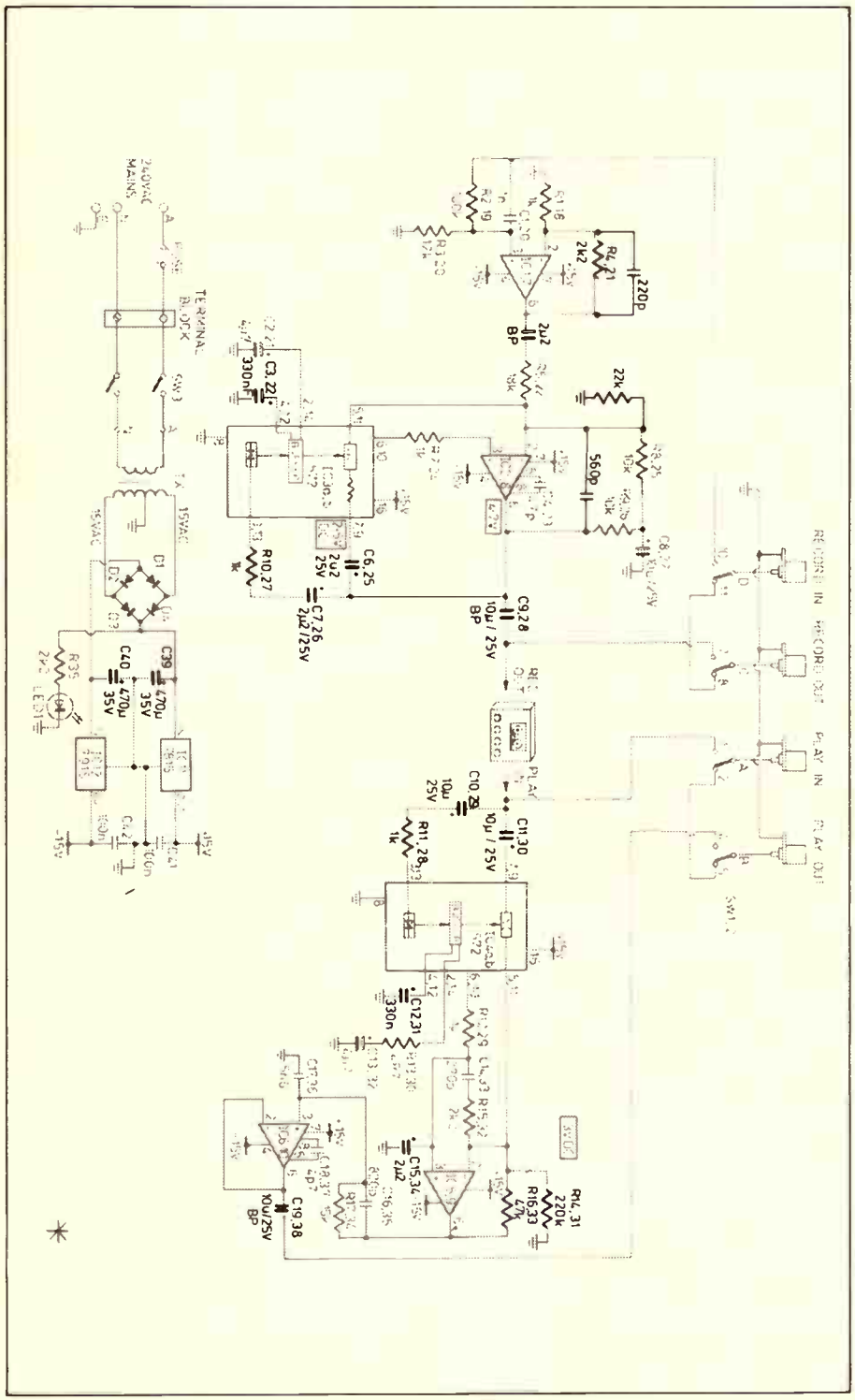
Note that these mods are highlighted in the new schematic diagram and overlay.

a. Change R4,R21 to a 2k2 1% resistor.
b. Change R10,27, 11, 28 to a 1k 1% resistor.
c. Change R16,33 to a 47k 1% resistor.
d. Change R14,31 to a 220k 1% resistor.
e. Change C9,28,19,38 to a 10u/25V Bipolar electrolytic.
f. Change C3,22,12 and 31 to a 330n tantalum. Note the polarity on the overlay.
g. Change C10,29,11,30 to a 10u/25V electrolytic. Note the polarity on the overlay.
h. Use a 470u/35V for the smoothing capacitors C39,40 on the power supply.
i. Take out C5,24 and R6,23 as per the original circuit diagram and leave the pads open circuit.
j. Disconnect the OV hook-up connection from the transformer and solder the wire directly to the OV pins of the 15V regulators on the solder side of the circuit board, see the overlay.
k. Solder a 220p ceramic capacitor across pin 2 and 6 of IC1 and 7. Mount the capacitors directly under the IC's keeping the leads as short as possible. Use some sleeving to prevent any short circuits. Do the same for IC2 and 8 but use a 560p ceramic capacitor.
l. Insert a 2u2/25V Bipolar electrolytic in series with R5 and 22 and pin 6 of IC1 and 7, see the overlay and schematic diagram.
m. Connect a 22k resistor 5% from pin 2 of IC2 and 8 to OV directly on the solder side of the pc board, see the overlay. ●



UPDATE

T. Kee



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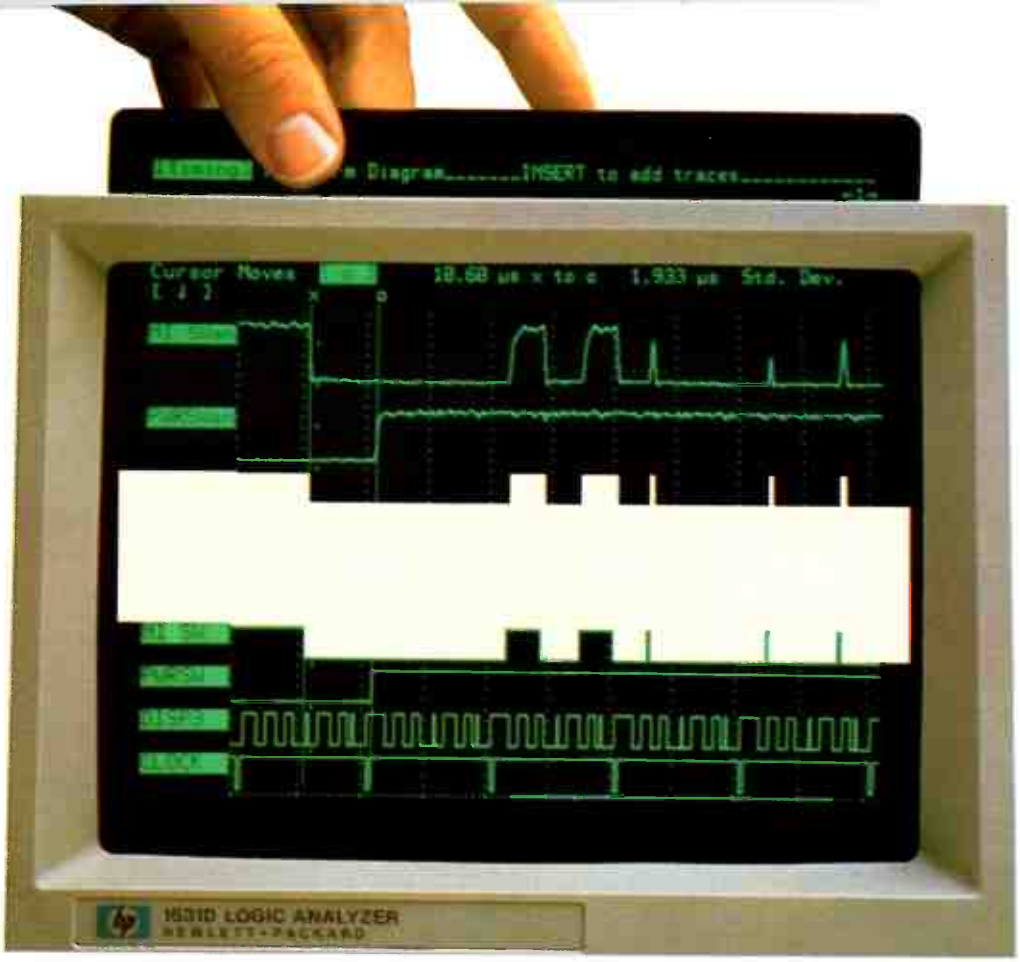

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READER INFO No. 35

Dai Ode, the illegitimate Welsh Hi-Tech. Poet

DAI'S birth certificate said that his father was Electra Ode, a bus conductor with a terminal disease. Electra's rugby mates called him 'Try'. He had two elder sisters; Kath and Anne, they came from a long line of Welsh coppers.

Dai's mother, Poly Mirrh, worked in a spaghetti factory.

One night, after a victory on the athletic circuit, Try became enwrapped in Poly and was well and truly routed, though some say he sold'er out in the end. Try had scored full points, Poly was converted by his long jumps and shiny coat.

Dai was the result of this union, but he only survived birth by a cat's-whisker. He was born at the bus junction, in a DO-35 case, so he was well set to become a SOD — 27 years later. Dai's father, Try was not so lucky, his heart valves burnt out on the way to the altar.

So Dai was a bastard. Although he had little capacity for learning, he'd readily coil up with a good volume (something bass no doubt), pick the treble at Flemington, or watch biased, unbalanced current affairs on TV. Dai was a powerful reactionary, along with his mates Ray Deo, Ann Tenna & Q. 'Multi' Pliers. Watt he couldn't resist was vigorous argument on a complex topic, he had eigen values and ample time for reVolting verses.

Being a Welshman, he used to work in the tunnels, then he made a few fast switches: a cement mixer, a piano tuner, a detective, a PIN salesman, the protection racket, a signaller, a shunter. This was all a heavy load and LED to high tension and eventually a breakdown.

After his recovery, Dai began to hang around with 2 hotties from the Printing Control Board. They worked opposite shifts, thereby complimenting each other. However, much to his surprise, he found they were Trans-sisters, and both had had implants and silicon treatment.

That really had him con-Fused. Was he reverse biased? Would he go poof? They'd tricked him by cutting off their third leg! Oh well, back to the push-pull stage . . .

Inspiration

All of these drains proved to be a source of inspiration, a gateway to the full wave of his poetic genius. His meter was perfect to the last digit, his syllables had cleared up . . . he caught that from an inverse square root by a log, which gave him a tan to a number of significant places — cos it's a sine of the times, a real plus, secant you shall find a minus contan' hat . . . is this an hyperbole?

His reputation was established by "The Rate of the Clock", first published in the Times. Its frequency of sales enabled him to count himself successful.

Dai permeated all barriers. Nothing impeded his induction and acceptance into the Hall (effect) of Fame. He had the most magnetic personality in his field and lived on a pad called Maxwell Hours. Henry Franklin used to dyne there a lot, until he was charged for self induction and erging the in-Siemen-ation of an EMU, with an ill-eagle, from a fair 'ite. He was arrested with lightning speed for violation of Kirchhoff's Law, an un-paralleled series offence. The networks forked-out huge sums for the story behind his motive.

Barry Ion lepton its fundamentals, which formed the nucleus of his book : "Quark, me son, Quark", which was X-ray-ted.

Meanwhile, Dai had produced a number of average anthologies, the standard stuff, with little deviation, a bit square, but his mode changed when he consulted a median. The result was the classic, but somewhat distorted, "Rise and Fall of the Third Harmonic", a crossover hit on the Output Stage.

His fascination with Pope led to "Dai — Polish Verse, RPN" and "Pent-up Odes" and the bewitchng "HEX Odes".

Dai entered a third phase with his book "Zen Air Di Ode' wandering around chanting "Ohm, Ohm . . .", it was rumoured that he was a bit kinky, weak kneed and leaked a lot.

However, his play "Dai Acts : Thy Wrist Tore Essie's Arse", showed that he'd slowed down and was working to a steady drill. In fact, some found his torque a bit boring, but his name was in Neon Lights at the Palladium.

There was a police Rad-on the video. They said that they had an iron-clad case, but they didn't nick 'll the evidence. It boron and lead to a couple of Chrome-Dome coppers sent to the (tin) can, namely 'Oxy' GeneTent and The Dutch detective, Van Adium. It became known as the 'Arse Nick Tape Farce".

Dai was heating up a Pi in the microwave when BANG! A Schottky Gunn blast! Fired by his archaic rifle (sic) — Selenium Stack, just discharged from a battery charge, he'd broken plates over someone's head, poured acid on an Ox-hide jacket, but trying to hot-wire a VW lead to the end of his short car-rear.

Stack's most successful poem was "The Charges of the Light Company — Bayonet Fixings". Later he was converted by Eddie's son, Washington dc to screw the system. Stack was sent to the electric chair at RMIT.

Decline and Death

Dai never recovered, his writing became illegible, nobody recognized him, he was in an epoxy state and his head band was worn out. His skin was stained from a trip to England, in October — he fell into a VAT, and whined a lot. Finally, Dai dyed.

He was buried in car Diff.'s High Gate cemetery, near the source of a drain which actually flowed into that channel above which, on the bridge, he used to chat with his PALs about their FETtishes.

He was heavily in debt, but nobody worried Watt Dai owed.

On Being a Voltage Doubler

Dai Ode

Then let no solderer's ragged hand deface,
In thee thy circuit, ere thou be de-sux'd
Make sweet some board, solder thou someplace
With 'lectrician's alloy, oh be it self-flux'd!
That use is not forbidden circuitry,
Which pleases those that switch it on
That's for thyself to make double volts
Or two times voltage, be it two for one
Two times the input were sparkier than thou start
If two of thine two times extra volts
Then what could Fuse do if thou shouldst spark,
Electrons free seeking positive vaults?
Be not half wave, for thou have much too spare
To be Fuse conquest and currents share.

Apologies to Bill Shakespeare,
Sonnets VI.

By Colin Robert Bruce Stewart.

Valediction

It is with regret that we bid farewell to Gerry Hui who was one of our project engineers. Gerry joined ETI in March 1985 and has been one of the most valuable members of our team. He developed the Walkman Amplifier featured in this issue as well as the famous Intelligent Modem which appeared in no less than six issues of ETI.

We here at ETI are always trying to lead the field in electronic publishing. If we have succeeded it is due in large part to Gerry's efforts. We wish him well. ●

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