AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY!

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Electronics Today INTERNATIONAL

eti

DECEMBER 1985

INTRODUCING SCANNERS
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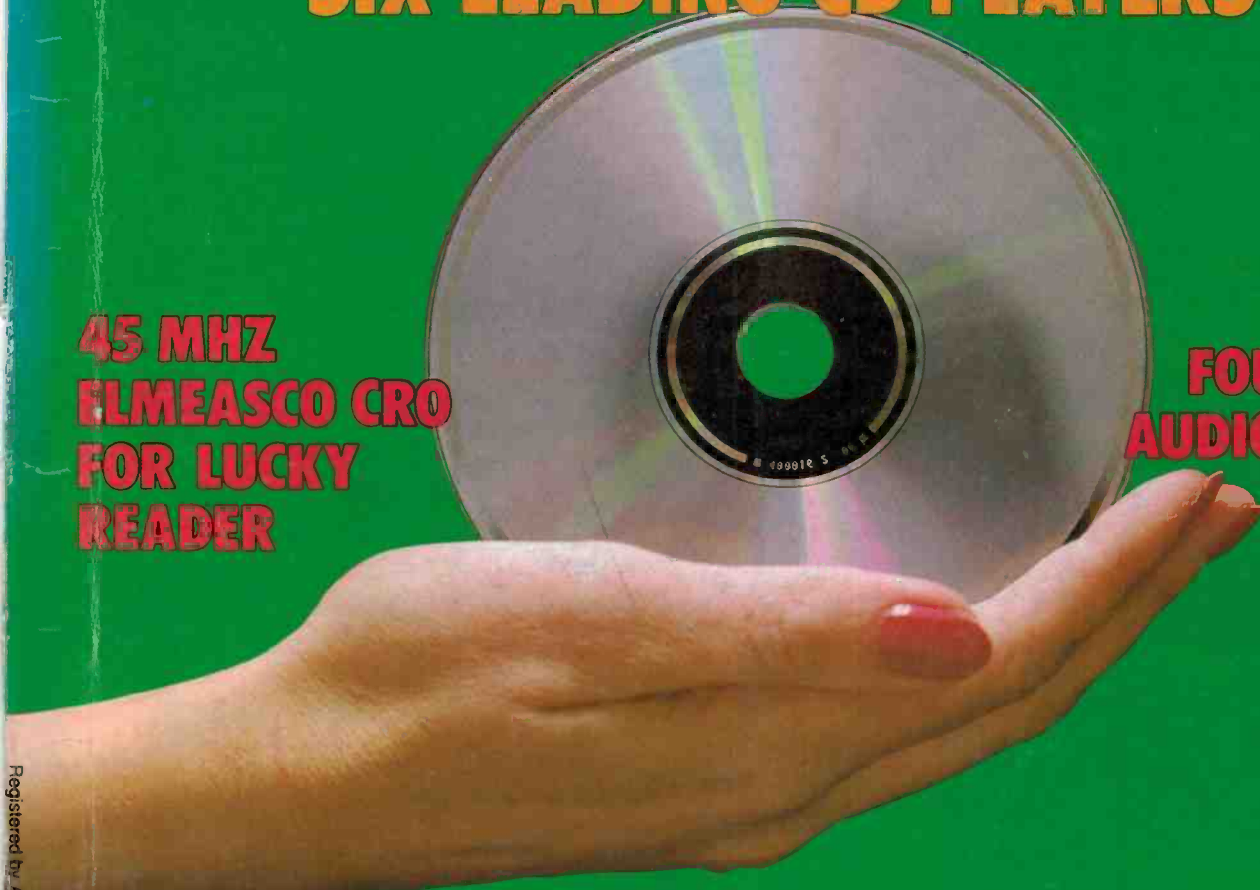

45 MHZ ELMEASCO CRO FOR LUCKY READER

FOUR RANK AUDIO MIXERS TO WIN

SONY'S FRIENDLY SHORTWAVE RECEIVER

PROJECTS:
MINIATURE FM TRANSMITTER
INTELLIGENT VIATEL MODEM
FORTH COMPUTER DISK DRIVE

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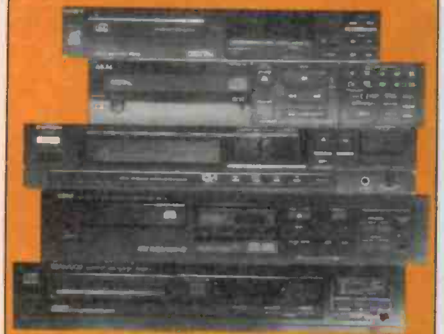

CD PLAYERS
There are definitely practical differences. See our reviews page 19.

STARTING ELECTRONICS
In the beginning was the valve, then the diode, then the transistor, then all the variations in characteristics and configurations you could dream of. For the practical use of these components a little explanation and guidance in their performance-affecting characteristics is what you need.

BATTERIES
In the near two centuries since their invention, batteries have been designed pretty much the same way but applications for the portable power pack have never been wider. So with such pressure for development, where is the battery going? Page 124.

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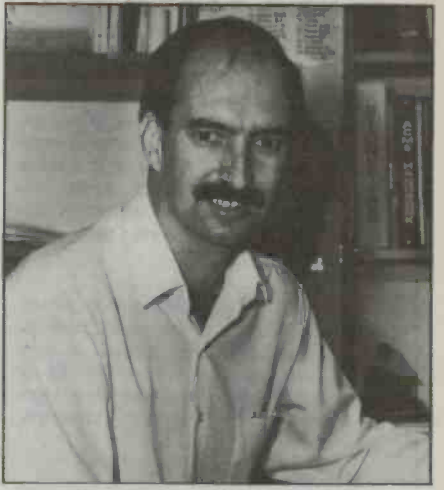
PROUDLY PRINTED IN AUSTRALIA

ELECTRONICS TODAY INTERNATIONAL is published monthly by the Electronics Division of the Federal Publishing Company Pty Limited, 140 Joynton Avenue, Waterloo, NSW 2017 under licence from Double Bay Newspapers Pty Limited, General Newspapers Pty Limited and Suburban Publications Pty Limited. Typeset and printed by ESN-The Litho Centre, Sydney. Distributed by Gordon and Gotch Limited, Sydney. *Maximum and recommended Australian retail price only. Registered by Australia Post, Publication No NBP0407. ISSN No 0013-5216.



IT'S GETTING TO the time of year, with Christmas and the new year in sight, that commentators start waxing philosophical. So in our last issue of the year, I'm determined I'll be the first.

I think it can be very fruitful to occasionally tell ETI readers about how we see our role as a magazine and to invite comment.

The role of a magazine to broadcast information is so prominent it's easy to forget that we behind the magazine depend on your comments to plan the future issues.

I won't claim that we are the most responsive magazine that ever existed, simply because such a claim is so hard to quantify. Certainly we have had our successes. In the last six months there has been an extra 17,000 of you reading each issue of ETI which, by the way, makes us Australia's fastest growing electronics magazine.

A lot of the credit for this goes to readers who have given us encouragement and suggestions for articles in the magazine. Much of the credit also goes to the people who help me put the magazine together, whose tremendous enthusiasm means you can expect better things to come.

Planning a magazine like ours means planning for a readership that is as broad as they come. Our readers range from those with an interest in computers or hi-fi and virtually no knowledge of electronics to some of the top electronics designers and academics in the country.

Our aim is to have something like five magazines in one, with articles on a variety of contemporary topics for readers with varying amounts of experience. We feel an obligation to bring new people into our community with articles for beginners in electronics, communications and computers.

We must also serve our very large number of electronics industry readers. We have 62,000 managers, engineers and technicians as readers according to the Morgan Readership survey, a higher number than has been surveyed for any other Australian electronics magazine.

So where do your comments come in? Well they can be one of the most important sources of ideas for articles in future issues. I say *can* be because in most cases your letters don't give us this opportunity.

Most of our readers' letters are either congratulations or complaints — thankfully, I hasten to add, the vast majority are congratulations.

Occasionally one of these letters tells us something that is very dear to the reader's heart, something they would greatly like us to research for them and something they haven't been able to find anywhere else. This sort of comment is valuable indeed.

To our readers who already help us in this way I say thank you and to those who haven't I make the invitation. For 1986 may all of our readers profit from and greatly enjoy their interest in electronics.

David Kelly
Editor

DATA REFERENCE

ETI apologises. The special data supplement on component characteristics and applications, circuits, electromagnetic spectrum, broadcast bands, etc, promised for this month is now scheduled for January. It will come with special new year cheer.

SOUND REVIEWS

Next month's reviews focus on the small and sometimes overlooked phono cartridge and pan out to take in a whole hi-fi system. The Aiwa V-800 series ambitiously combines amplifier, tuner, cassette deck, (either single or double), turntable, speakers and system rack into a very attractive bundle of goods. Under the microscope is the Ultra cartridge.

NEXT MONTH

CELLULAR RADIO

Cellular radio is what Telecom has planned for mobile radio as from late next year. It involves a lot of money and a revolutionary technique to squeeze the most out of limited frequencies. We detail how it works and what the user needs in the way of equipment and investment.

COMMODORE BUS SHARER

The do-it-yourself Commodore network — this handy project allows you to hook up to eight Commodore computers to a single bus. The end result: eight computers, one bus, one disk drive, one printer, one modem . . .

SERVICES

TECHNICAL INQUIRIES: Technical inquiries by mail must be accompanied by a stamped self-addressed envelope. There is no charge, but we reserve the right to publish the inquiry and the reply in Electronics Today or any of its associated publications. We can only answer queries relating to projects and articles as published. We cannot advise on modifications, other than errata or addenda. Difficult questions may take some time to answer.

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LIABILITY: Comments and test results on 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.

Letters to the Editor

From our monitor

IT NEVER FAILS to impress me just where ETI gets to. In the mail today there was a letter from a listener in the Canary Islands who had been reading the June issue of ETI and wanted some details on some of the subject matter which I had covered in that particular issue. Evidence of ETI beyond the South Pacific area! A letter like that full of complimentary remarks is indeed something which is quite unexpected and shows how widely read ETI is these days.

Arthur Cushen,
Invercargill, NZ

Course to disaster

I PURCHASED A copy of ETI's *Top Projects* published January '84. One project — 558 Masthead Strobe caught my eye. Electronically all is well but one point has been overlooked. A strobe light is an internationally recognised *distress* signal and the use of such a device for any other purpose on the water is illegal. It can also lead to severe embarrassment as well.

Stuart Stafford,
Nedlands, WA 6009

The full picture

HAVING JUST READ the review in September ETI of the Pioneer AM stereo car radio, I would like to say how pleasing it is to see AM performance measurements published for a radio. Those manufacturers who provide good performance products deserve all the support they can be given.

There is one point I would like to take up. The article states that "Radio Manufacturing Engineers . . . has . . . recently commissioned most of the AM stereo modulation units now in use in Australia". In fact, the AM stereo exciters and modulation monitors in use at 2BS, 2MW, 2HD, 2KO, 2KY, 2OO, 2WL, 3AK, 3BA, 3DB, 3MP, 3XY, 4SS, 6IX, 6KY, 6PM, 6PR, 7HO and 7HT were made by Delta Electronics and supplied and commissioned by my company. (3AK bought its first unit from RME, and chose a Delta from me for its second transmitter, so I guess that one only counts as half!)

Delta Electronics and my company, as its representative in Australia for broadcast products, are licensed by Motorola to manufacture, install and commission C-QUAM transmitting equipment. RME has played a great part in getting AM stereo launched in Australia, and has supplied a few more stations than my company, but I believe that to say that they have commissioned most of the AM stereo modulation units now in use in Australia is misleading.

John S. Innes,
Cremorne, NSW 2090

Phone patch storm

TELECOM AUSTRALIA, not satisfied with its massive profits and its super monopoly is now using muscle power against one of Australia's most diplomatic, law abiding, and best international ambassadors . . . a group which has neither the political power nor the finance with which to protect itself or its interests. I refer to the Amateur Radio Service!

Telecom's answer to a request, from the Amateurs, for phone patch privileges is contained in the document, "Interconnection of Mobile, Amateur and Citizen Band Radiocommunications with the Public Switched Telephone Network, Policy and Conditions," Issue 2, June 1985. This document is so restrictive that it makes the use of the telephone system by the Amateur Radio Service unbelievably difficult. In addition, Telecom want us to pay a surcharge (on top of the regular telephone charges) for no more facilities than normal use of the telephone. The Department of Communications makes *no* extra charge for third party privileges!

The Amateur Service cannot, by DOC regulation, make any profit whatsoever, and cannot recover any costs whatsoever — not even the standard telephone charges.

Please help us to encourage Telecom to modify its unreasonable and unnecessary rules and regulations, and remove its demands for unwarranted surcharges on the Amateur Radio Service.

A. D. Tregale VK3QQ,
Watsonia, Vic 3087

Letters to the editor are welcomed, and should include the author's name, address and telephone number. They should be forwarded to:
The Editor,
Electronics Today International,
140 Joynton Ave,
Waterloo, NSW 2017.

Rings of Neptune

Former engineer with this magazine, Peter Ihnat, and an associate, Glen Moore, have discovered evidence of rings surrounding the planet Neptune. The news is exciting because it climaxes an international effort to find evidence for the rings, predicted since the discovery that Jupiter and Uranus both have ring systems.

Planetary rings have been known since Galileo first saw them around Saturn with his first telescope. Generally they are composed of bits of rock and frozen ice, all orbiting in the same plane. As a result they tend to be very wide and extremely thin. The recent discovery confirms that, in fact, all the large gaseous planets in the solar system have rings around them. They have eluded discovery until recently because, with the exception of the Saturnian system, they are all very faint.

The discovery of exceptionally faint, diffuse structures like planetary ring systems must be made by watching occultations, ie, the way in which the planet interferes with light from a distant star passing behind it. One of the most common means of measurement is to chart alterations in the intensity of the light received here on Earth as the planet moves in front of a star.

This method has been used to determine the existence and chart the pressures and compositions of planetary atmospheres far too faint to be studied from Earth. It was also used to discover the ring system around Uranus, a search suggested by the discovery of a faint ring system around Jupiter during the recent Voyager flyby of that planet.

Moore and Ihnat used the half metre reflector on top of Mt Keira near Wollongong, NSW, for the work, which involved making extremely accurate determinations of light intensity and then graphing its variation over time. The study of Neptune has been going on for over four years.

Exploration of Neptune's system has been plagued by contradictory and confusing findings. Commonly noticed by US and French observers: one dip in light intensity, just before the planet passes in front of the star. This suggests a small planet, perhaps a crescent; it does not suggest a ring since that would require symmetrical dips in the light intensity line on both sides of the planet.

However, when Moore and Ihnat examined their findings they discovered two sets of symmetrical dips, suggesting a twin ring system. A more detailed look at the data has allowed the researchers to claim the existence of a single discrete ring on the inside, with a fuzzy, large, group on the outside.

The puzzle is why this has not been seen before. One suggestion is that the system is unstable, constantly forming and reforming. Another suggestion is that Neptune is surrounded by partial rings or arcs. But researchers have not yet suggested how these could be stable features.

Moore and Ihnat have gone back over previous findings to see whether some assumptions about the plane of the rings could be made which would explain the findings. It is easy to believe Neptune's rings could be inclined at an odd angle because Neptune itself is an odd planet, with an axis and direction of rotation quite different from any of the other planets. They believe they have found such a fit, one which makes the planet's rings strongly inclined to its equator.

NASA remote sensing package in Australia

Private enterprise, government agencies and NASA have combined to bring the world's most advanced airborne remote sensing package to Australia for a 30-day survey of sites in most States. The data collected should enable the development of improved techniques for geological mapping.

The US/Australia Joint Scanner Project will collect data for research projects on such diverse topics as groundwater hydrology, soil salinity, wetlands and rangelands mapping, soil degradation processes, rock-type mapping and the detection of mineral deposits.

NASA has provided its C-130 Hercules remote sensing aircraft and a 19-member crew, including air and ground teams and instrument operators, for the survey which began on Monday, 30 September. This aircraft has three major remote sensing instruments that previously have not been used outside the US — the NS001 thermatic mapper simulator, the TIMS thermal infrared multispectral scanner, and the new AIS airborne imaging spectrometer. These instruments will collect digital image data with resolutions varying from 2.5 metres to 20 metres and covering areas from a few hundred metres to 15 kilometres.

The CSIRO research Fokker Friendship aircraft, with its own advanced remote sensing scanners, is also being used for part of the project.

Automated ironing

One of the most tedious chores left in the household is undoubtedly the ironing. Those of you doing it day after day will be interested in developments in Perth where a company called AIM Technology has developed an automatic ironing machine.

AIM has developed the machine to prototype level and is now looking at its first manufacturing run, to be undertaken by International Task Ltd, which will employ 100 people on the project. According to the company the machine will cost $500-$600, and a market of 100,000 is expected in Australia alone. Current plans will have the machine on the market by the end of 1986.

The machine looks much like a conventional two-door refrigerator. Inside, the clothes to be ironed are hung over racks, the doors closed and a start button pressed. Apparently, individual items are then moved automatically into a special compartment, where they are squeezed between two rollers in the presence of steam. They are then transferred into the next compartment from which the operator can collect them.

The whole operation relies for its success on a certain amount of intelligence in the machine. It can recognise different types of materials and adjust pressure and temperature accordingly. It uses optical sensors to detect the shape of the cloth hanging from the rack and uses the information to guide the rollers.

Does it work? AIM is scheduling a press briefing later this year, which ETI will attend with some unironed shirts. We'll let you know.

E-Post national debut

E-Post, the nation's newest electronic mail service, has been launched by Australia Post. Australians can now 'post' a letter and have it delivered in as little as two hours by phone.

E-Post operates alongside the existing Intelpost network. Electronic equipment links post offices in capital cities and regional centres in a large Australia-wide network and provides for the typing of customer letters and messages and their electronic transmission and printing.

Customers can use the service's multiple address capacity. This saves time and money by sending the same text to a number of addresses.

Delivery within two hours can be made to any address in the built-up areas of all capital cities and major regional centres. Guaranteed next day mail delivery at a lower price is available to most areas within Australia. A confirmatory or file copy is forwarded to the sender by the next available mail.

E-Post is a national service but plans are already underway for it to go same-day international. This will complement the present international Intelpost service for same-day document transfer.

Anyone can use E-Post but most customers are expected to come from the business sector. For small business, E-Post offers a complete mail service providing for the acceptance, transmission, printing, enveloping and delivery of business mail. Multiple addressing allows business to easily send standard letters and lettergrams to groups of customers, suppliers or agents.

BRIEFS

Racal wins defence contract

Sydney-based Racal Electronics has been awarded a $A200 million contract by the Australian Department of Defence for Project PARAKEET, a major tactical communications system for the Australian Army. The initial phase, worth about $A6.5 million, covers the detailed equipment specification of a digital trunk communications system.

Anglo-French power link

A £600 million submarine cable link enabling Britain and France to exchange electricity will be switched on before the end of the year, according to the UK Central Electricity Generating Board. The main reason for the interchange is to exploit the difference in peak demand times in the two countries. Though agreeing on the overall plan, the British and French engineers characteristically chose different methods for laying the cable — the work was split on a 50-50 basis.

CSIRONET hosts ISO meeting

Australia's CSIRONET computing network achieved international recognition when it hosted an important meeting of the International Organisation for Standardisation (ISO) working group on open systems interconnection (OSI) in Canberra recently. The meeting was attended by representatives of all major nations working on OSI, including the UK, the USA, France and Japan.

Move over Halleys Comet

With all the hoo-ha about Halleys Comet, you can be forgiven for thinking that next year's intercept of the comet's tail will be the world's first spacecraft encounter with a comet. But that honour goes to Comet Giacobini-Zinner. In September this year a 1054-pound spacecraft travelling at 45,000 mph plunged into the murky tail of this lesser known celestial body, after a spectacular 7-year journey that covered well over a billion miles.

Akai's new audio/video amp

Akai's latest amplifier, the AM-A301 features audio/video compatible input selection. Besides all the standard audio inputs, the AM-A301 features inputs for compact disc, video recorder and video disc players, making it the centre of any multi-media home entertainment system.

The amp delivers plenty of power: the dc servo amp circuitry is claimed to deliver a clear unadulterated 60 watts x 2 output power (1 kHz, 8 ohms).

Other features include A and B speaker switching with electronic speaker protection circuitry; terminals for graphic equaliser connection; LED function and levels display; and bass and treble tone controls. It is available in black and silver at RRP of $399.

NOTES & ERRATA

Data Communications feature, October '85: The number listed for the Telebraille bulletin board is incorrect. This number is currently listed by several other bulletin boards in Sydney, and should be deleted wherever found. The phone's owner calls modem hopeful's more than computer nerds.

Newsagents to cash in on video

Australia's largest newsagent group, Ancol, has signed with the Sydney-based Berkeley Video Rentals company in a deal that is expected to bring video movie rentals to 1600 newsagencies throughout NSW.

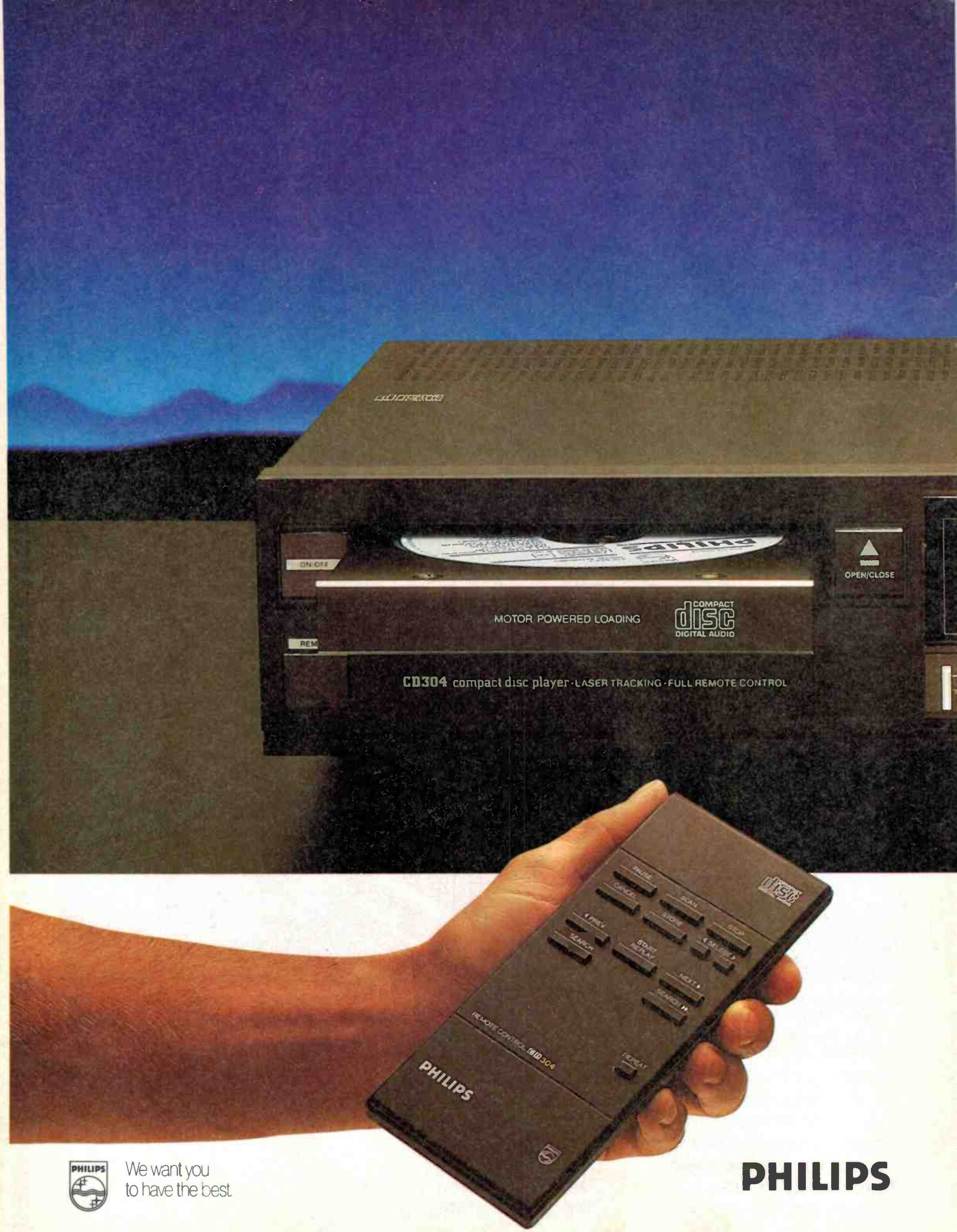
Berkeley Video Rentals managing director, Michael Tenner, said the 'Video Checkout' rental scheme was based on a similar concept which had been highly successful in the United Kingdom.

"The high turnover of customer traffic makes newsagents one of the best locations for renting video movies," he said. "Many newsagency proprieters have already taken advantage of the extra business created by video rentals, and the signing of Ancol would see a significant increase in video rentals from newsagencies."

Berkeley's Video Checkout is claimed to be "a complete rental merchandising programme". It includes top-renting video movies, a free-standing merchandising rack, a library card system for control of hired movies, and point of sale material. Mr Tenner said a major reason for the success of the Berkeley scheme was that 20 per cent of all titles can be replaced every five weeks free of charge.

Mr Tenner has previously been involved with Intervision, an independent video distributor which has established over 6000 outlets in the UK.

With reduced shop and staff overheads, the new Australian 'video newsagencies' may well have a serious impact on some of the existing video specialist shops.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REMOTE CONTROL CD304
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We want you
to have the best.
PHILIPS

Imagine the remote possibilities

There was a time when music played by laser was considered a remote possibility. Then Philips invented the Compact Disc. In doing so they made sure they could produce the very best Compact Disc player there is.

The CD304.

One outstanding feature of the CD304 is the Infra-Red remote control which means you can programme and operate the player from anywhere in the room. Another is the high quality headphone amplifier with separate level control – perfect for pure, private sound.

Combine those features with the unique music scan capable of up to 20 track programming and you'll see why the CD304 is Philips' top of the range Compact Disc player.

Philips imagined perfect sound and invented the Compact Disc. Now, with the CD304, you can experience the very best there is.

Philips Compact Disc.
Imagination leads the way.

PMP V451

SCANNERS

Jon Fairall

Finding a scanner to suit your purposes can be a little intimidating, especially for the uninitiated. Here ETI gives an overview of the subject and outlines the performance requirements you should look for to make a purchase that will give you value for money.

BY CONVENTION THE portion of the electromagnetic spectrum used by radio is divided up into multiples of three; thus the high frequency band extends from 3 to 30 MHz, the very high frequency (VHF) band extends from 30 to 300 MHz and the ultra high frequency (UHF) band extends from 300 MHz to 3 GHz.

It's also possible to denote the spectrum in terms of wavelength. Once again by convention you will find it split, this time in multiples of ten; 10 km to 1000 m is longwave, 1000 m to 100 m is mediumwave, 100 to 10 m is shortwave. The region beyond shortwave is usually denoted extra shortwave down to one centimetre, where it blurs into the infrared.

To convert from one to the other you can use a simple formula that says:

$$\text{frequency} = \frac{\text{the speed of light}}{\text{wavelength}}$$

To use the formula, set the speed of light c = 3×10^8 and express wavelength in metres and frequency in hertz. If you play around with this a bit you will find out that shortwave and high frequency mean the same, and the extra short waves are covered by the VHF/UHF part of the spectrum.

This story is about monitoring the region beyond shortwave; in particular, about the primary tool for doing so, the scanner.

Propagation

It's often supposed that the difference between mediumwave and shortwave is just that mediumwave will go around corners. The extra shorts are strictly line of sight. There is just enough truth in this to be confusing.

In fact, all electromagnetic radiation propagates in straight lines. However, since most of the signals we wish to receive are transmitted and received on Earth, it makes sense to wonder how the presence of such a body makes a difference to electromagnetic propagation. This is especially true since the Earth has a very definite magnetic presence itself.

From our point of view the most important facet of this magnetic signature is the ionosphere, from 75 to 400 kilometres up. In this region the atmosphere is subject to a barrage of high energy particles flowing out from the sun, the so-called solar wind. It consists of a sea of alpha, beta, gamma and ultraviolet particles, brewed up with a few cosmic waves for spice. Fortunately for all life on Earth, this little lot is stopped by the upper atmosphere. There, the molecules rob the solar wind of its energy, and in so doing absorb the charges themselves. They become charged, or ionised.

It's very much the product of the random interaction of the solar wind and the upper atmosphere. Both are in constant, violent motion, so it comes as no surprise that the characteristics of the ionosphere itself are always changing. However, we can say a few things about its macrostructure. For instance, mostly it is composed of a number of different layers, called the D, E and F layers. Often these split up into E1 and E2, F1 and F2. All the layers are denser at night than during the day. They are disturbed by the presence of massive trauma on the surface of the sun like sunspots and flares.

As a result of this movement the effect of the ionosphere on radio communications can't be predicted with any great degree of accuracy. However, we do know something about its gross effect. It acts like a giant lens, absorbing, bending and reflecting in a complex manner. Just what the effect is depends to a large extent on frequency.

The presence of the ionosphere means

AOR 2002 SCANNER

The AOR company of Japan has recently replaced the AOR 2001 with the 2002 version. According to Emtronics, which distributes the machine in Australia, it represents the ultimate in high performance scanners.

Its main selling point is the very wide frequency range: 25 MHz to 1.3 GHz in two bands with a gap between them at 500-800 MHz. It can memorise 20 channels, and scan them at a rate of five channels a second. Sensitivity is claimed to be 1 μV on wide band FM, 0.3 μV on narrow band FM and 0.5 μV on AM. Selectivity is claimed to be of high order, enhanced by image frequency rejection of −50 dB, achieved by running the first IF at 750 MHz instead of 10.7.

Price is $675 from Emtronics, 92-94 Wentworth Ave, Sydney, NSW 2000. (02)211-0988.

REGENCY SCANNER MX4000

This is part of DSE's extensive range of scanners, and is designed expressly for car or other mobile use. It is powered by a 13.5 Vdc input, or by four NiCad cells. There is an onboard charger for the NiCads which can be powered up by a 6 Vdc input. It's small enough to fit under the dash, and also to be removed and carried in a bag afterwards.

The front panel contains information on an LCD display with backlighting if you need to use it in the dark. It's neatly laid out with big volume and squelch sliders across the bottom. On the right is a keypad with keys for entering numerical information as well as the set up controls for the scanning program. Although it's easy to program after a quick scan through the manual, I wouldn't suggest you try to do it while driving the car.

Scanning is done in a number of bands: 60-90, 118-136, 144-148, 148-174, 406-450, 450-525 and 800-899 MHz. Sensitivity is advertised at 0.6 µV in the VHF, 0.9 µV at 450 MHz and 1.3 µV at 800 MHz. It will scan through the channels at a rate of 15 a second.

Cost is $599 from any Dick Smith store.

there are two forms of wave propagation in a terrestrial environment. The first is called the ground or surface wave. This sees the ionosphere as one side of a wave guide, the other being the surface of the Earth itself. The result is that surface waves are ducted around the curvature of the Earth, as if constrained in a tube.

Ideally, we would expect the best propagation from such a system when the size of the incident wave was of the same order as the size of the waveguide. And indeed, we do find the effect getting stronger as wavelength increases, and decreasing towards the shortwave. In fact it is insignificant for wavelengths below 100 m or so; ie, the beginning of shortwave.

A diffraction effect also works at longer wavelengths. Whenever the wave hits something solid it bends around it.

The second type of transmission is the skywave. Skywaves travel in straight lines, and for our purposes we can talk about two modes in which they propagate. One is the line of sight transmission. This is essentially what it says; if you can't see it, you can't receive it either.

The second mode of propagation is reflection by the ionosphere. The ionosphere acts like a mirror at certain frequencies, reflecting waves back to Earth.

The effectiveness of skywaves is highly frequency-dependent. Reflection of the ionosphere is rather insignificant at super high frequencies it becomes progressively more important down to high frequency bands and then tapers off.

As one would expect, line of sight gets progressively more important as frequency gets higher. It really gets going towards the top of UHF, and becomes the primary mode of transmission for SHF. Of course at optical wavelengths, by definition, it is the only mode of propagation.

The upshot of all this is that to monitor the UHF and VHF portions of the spectrum we are mostly interested in skywaves. However, these are not limited necessarily to short range line of sight transmissions, but can include long distance skipping skywaves from the other side of the globe.

Contents

And so, if you do tune in to the extra shortwaves, what will you find? The UHF and VHF spectrum is carved up for various special interest groups by the Department of Communications. These are known as bands, and within each band DOC defines channels, each with a regulated number of users. There are about 20,000 VHF channels, and 100,000 UHF ones. Regulations define the bandwidth of the channel, its centre frequency and the guard bands that exist on either side of it to prevent crosstalk. They also have regulations regarding the type of transmission technology to be used in any particular channel; the type of modulation, power, etc.

A number of bands are taken up with radio and TV broadcasting. Other significant bands are taken up with the requirements of amateur operators in the UHF CB band. There is also a large chunk reserved for Telecom's mobile phone service. When cellular radio arrives next year it, too, will use a UHF band.

Otherwise, listen to the police, firemen and couriers. When Aunt Martha needs a taxi you can be the first on the block to know about it, and when she needs an ambulance too. Most mobile radio type applications are contained in these bands, as is business radio and the airlines.

Of course, given the large number of channels, and the relatively small number of users, much of the spectrum is still unoccupied. It's these gaps that provide the space for DXing (distant reception). Spectrum usage in Australia conforms more or less to international regulations, so you should be able to receive much the same services from around the world, given luck, patience and a good aerial (see later).

History

Usage of this region of the spectrum is rather a recent phenomenon. It wasn't until the 1960s that it really got going. The technology to operate in the area was developed primarily during the second world war, as a natural progression of the work that was going on in shortwave transmission during the 1930s.

The second world war gave a tremendous stimulus to development of small, mobile, short range radio. Primary requirements were for aircraft and battlefield communications, and in both applications lightness, small physical size and reliability were essential.

Almost all of these radios used the UHF and VHF bands, and this carried over into peacetime uses. Mobile radio became common during the 50s in a number of applications such as with police and ambulances. Readers who grew up in the 50s and 60s will remember the advertisements that used to tell us that this or that service was now 'radio controlled'.

As services grew, manufacturers realised they could tempt many regular shortwave operators with equipment that offered some method of covering the VHF/UHF bands. In the first instance, this amounted to no more than a regular superhetrodyne radio with a redesigned front end to accept the higher frequencies. It soon became apparent, however, that the type of traffic was imposing a different operating procedure on the operator.

Whereas the traditional shortwave DXer would find one channel and sit on it for hours, the VHF operator tended to 'scan' — tracking down services on various channels, listening to them for a short while and then moving on again. It got very tedious twiddling that dial.

Sometime in the mid-60s enterprising manufacturers got the idea of lessening the load by putting more crystals in the set and switching between them automatically. It ▶

SCAN THROUGH THESE CHRISTMAS CRACKERS!
6 Band MW/FM/SW Radio
Deluxe features at an economy price! 6 bands covering standard AM & FM PLUS 4 shortwave bands! Packed with features you'd expect to pay $$$ more for. Comes complete with protective carry case and quality headphones — at no extra cost! Cat D-2835
$79
6 Bands and . . . Radio Direction Finder
The ultimate in versatility! For the avid radio listener or boat owner this one's a must. Has 6 bands including all 40 CB channels plus shortwave and VHF. That's not all — use it as a direction finder against AM radio stations or as a PA amp with optional mic! Cat D-2832
$119
The Shortwave Big-Daddy
Our MW/FM/SW 9 Band Radio is astounding value! Superb performance over AM, FM and all 7 SW bands. Offers fantastic sensitivity, selectivity, interference rejection and stability as well as a host of inbuilt features. The ideal gift when you're serious about giving!
Cat D-2837
$119
Programmable World Receiver
Direct Key-In World Receiver with Quartz Alarm Clock/Timer — there's hardly a feature it hasn't got! 5 tuning functions including auto scan, direct key in and preset recall. Nine station memory, full AM band (LW, MW and SW), sleep timer in 9 selections (10-90 minutes), LCD display and much, much more! Cat D-2831
$329
Air Band VHF Radio with . . . AM & FM
Wow! This budget aircraft band radio will have you listening to the pilots and air traffic controllers! Also covers the normal AM and FM bands so you can use it as normal radio. An exceptionally reliable unit and they're great value as well! Cat D-2836
$29.50
BONUS OFFER
With any radio above $50
A copy of the World Radio TV Handbook 1985 edition B-2085. That's right—valued at $32.50 and it's for nothing. Hurry it's for this month only!
FREE!
Yaesu FRG 9600 Scanner
Yes, the ultimate communications receiver has arrived! From Yaesu the FRG-9600 is an all mode scanning receiver providing features never offered before at this price! Covers 60-900 MHz continuously with a massive 100 keypad programmable memory!
Cat D-2825
$799
B067
MX-4000 Desk/Car Mount Scanner
The tiny unit that's big on features! Covers 8 bands including 800 Megs and aircraft. Search and scan, priority controls, large LCD display, 20 programmable channels . . . the list goes on! An ideal quality Christmas gift! Cat D-2818
$599
HX2000 Handheld Scanner.
It performs like a fixed model! Up to 525MHz including aircraft band and 20 memory channels all in one tiny unit! Priority scan and search, whip antenna, Nicads . . . you get the lot! Cat D-2815
$449
Pick Up A Saving!
Our Scanner Antenna for 65-520 megs is fantastic value. You'll Save $10.00. Cat D-4432
WAS $57.50
$47.50
If you've been "should I or shouldn't I" -ing lately, then now you have no excuse!
BONUS OFFER
Free Australian Radio Frequency Handbook with every Scanner purchase. Valued at $8.95
DICK SMITH ELECTRONICS PTY LTD
See Address details page 108

SAIKO SC7000

The SC7000 from Imark has provision for 70 channels, plus some other advanced processor controlled features. It can automatically search between preset frequencies and later recall any active frequencies for monitoring. It also has a host of other operational features that make it a delight to use. However you need to spend a bit of time with the manual first because it's not obvious how it all works.

Power is from either ac mains or automotive 12 Vdc. Special brackets and mounting screws are included in the kit to facilitate mounting under the dashboard.

Frequencies scanned include 60-89, 108-138, 140-144, 144-148, 148-179, 380-470 and 470-519 MHz. Sensitivity varies between 0.4-0.8 μV depending on frequency being monitored. Audio output from the internal speaker is two watts rms at 10% thd.

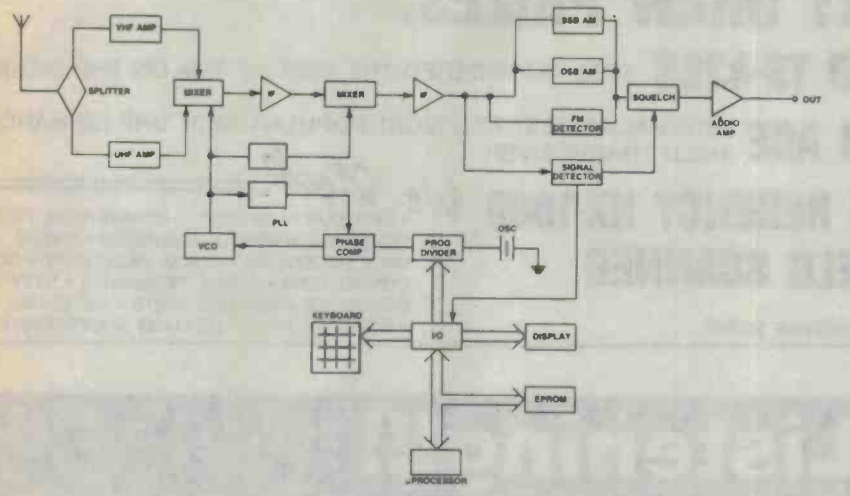


Figure 1. Typical block diagram of a scanner.

was extremely crude, but if you only wanted to sweep a limited number of channels it made sense.

The next big thing to happen to the scanner market was the arrival of computer power. Fortunately, the increasing interest in computers coincided with a revival in the popularity of DXing brought about by the CB boom.

The receiver

Despite a ferocious looking front panel and some complex circuitry inside, the modern scanner is simplicity itself in concept and operation.

Figure 1 is a block diagram of a typical modern scanner. There is usually a discrete front end for both VHF and UHF tuning, and discrete detectors for the different modulation methods. Between them: a double conversion superhet receiver employing two IF frequencies to improve selectivity and image frequency rejection. AGC is absolutely necessary to keep the volume constant in spite of changing station strengths, and this is linked to a well designed squelch circuit to avoid noise while sweeping from one frequency to another.

There is also a phase-locked loop (PLL) serving as a local oscillator. The frequency out of the loop is determined by the divider, which is capable of dividing down the highly stable crystal frequency. The exact number of the division is determined by the microprocessor. If the set must be tuned over a greater range than is possible with the divider, several different oscillators may be provided. In this case, switching between the crystals will also be done by the micro.

The micro is also employed for a number of other functions. At a minimum it reads the keyboard and controls the display. In most sets it also provides a number of memories to store commonly requested frequencies, together with their associated modulation methods. It also controls the operating procedure of the system, whatever that may be. It may be set up to hop, in which case it will stay on a channel for some predetermined period of time and then seek the next one. A manual override permits you to hold a particular channel. It may jump only to channels selected in memory, or simply scan up or down in frequency. Other operating modes are also possible without any hardware changes.

Choosing

Like making any other expensive purchase, buying your first scanner can be a bit nerve-racking. This is especially so when there is no clear right or wrong answer to the problem. You have to find one that matches your requirements of performance versus price. As with most electronic products, you are saved by the competitiveness of the marketplace from having to reject lemons. No retailer can afford to stock them.

Of course that only holds true as long as you are dealing with a reputable dealer. If you buy one that fell of the back of a truck you deserve everything you get.

Be that as it may, what are the performance requirements you should look for? First up, the frequency ranges. Clearly the Rolls Royces of the range have continuous coverage over the entire VHF/UHF spectrum. This allows access to the broadcast bands, so your scanner can double as a bedside tranny. You pay for the privilege, however.

In a more modest price range you might have to settle for one that covers certain bands where interesting things happen. If you want to listen to CB then make sure you include 27 MHz and 476 MHz. A whole host of public utilities cluster around 70-88 MHz. Between 108 and 140 MHz you will find aircraft services including air to ground radio. Between 460 and 500 MHz you will find police and taxis. There are also a couple of bands specifically reserved for amateurs; including 144-148 MHz and 432 MHz.

A second consideration is the amount of memory available: you may want to go back to favourite channels again and again. If so it's nice to have the ability to get to them with one button operation.

A third thought: do you want to use it for portable operations, in the car or indoors? All these possibilities have some implications for the power supply. A wide range of supplies is available. Some require a simple mains supply, others a mixed mains/dc supply, and still others use NiCads and require a separate charger.

Antenna

Once you've got the beast home the next problem is to make sure that it operates as well as possible. This means ensuring that it is provided with the best possible signal. Most scanners come with a 'rubber ducky' type 1/4 wavelength aerial attached, plus provision for a remote antenna if required.

A remote antenna is well worth the trouble if you are operating from a fixed place. This can be as simple as a bit of coax peeled back to 1/4 the wavelength of the wanted signal and carried as high as possible. It can be as complex as a high gain, directional antenna with an aerial rotator. In between, ▶

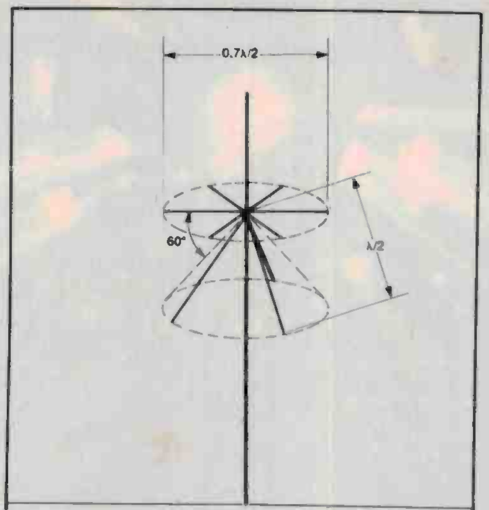


Figure 2. Discone antenna design.

something else may suit your budget, needs and inclination.

One popular type is the discone antenna, or some variation of it. This is literally a disc and cone, with the length of the cone being 1/2 the wavelength of the lowest required frequency, and the disc diameter being 70 per cent of that length. Often the disc and cone are simulated by three posts, situated on the same plane as the disc and three posts in the same plane as the surface of the cone (see Figure 2). Such an aerial is easy to manufacture, and has good wideband performance as well as being omnidirectional.

Whatever type of antenna you use, bear in mind that the maxim to use is: the higher the better. ●

TABLE 1. PRODUCT SURVEY *Also sold by DSE and Emtronics

COMPANY	BRAND	COUNTRY OF ORIGIN	FREQUENCY BAND MHz	MEMORY STORES	FM/AM SSB	PRICE $
Bail Electronic (057)21-6260	YAESU* FR6 9600	Japan	60 905	100	FM/AM LSB USB	725
DSE (02)888-3200	Bearcat 201	USA	66-88 118-136 138-174 399-499	10 or 16	FM AM	429
	Regency HX2000	Japan	66-89 118-136 144-174 436-512	20	FM AM	475
	Regency MX4000	Japan	60-90 118-174 436-512	20	FM AM DSB	599
Imark (03)329-5433	Seiko SC7000	Japan	60-90 140-180 380-520 108-138	70	FM AM DSB	495
	Firealert DS101		144-174 70-80	needs crystal	FM	198
	Tristor Compu 20D		70-84 156-170	20	FM	247
Tandy (02)267-3959	Realistic PRO2003	USA	68-174 410-512	60	FM AM	479.95
	PRO31		60-88 108-136	10	FM	349.95
	PRO3		138-174 380-512	16		429.95
	PRO24		68-88 144-174 430-490	4	FM AM LSB	159.95
	PRO25		66-88 118-136 144-174 450-512	8		199.95
	PRO2009		68-88 144-174 410-512	8		299.95
	PRO2020		68-88 108-136 138-174 410-512	20		429.95
Emtronics (02)211-0988	AOR AR2001	Japan	25-550	20	Wide FM Narrow FM AM	559
	AR2002		25-550 800-1300	20		675

SIMPLY SUPERIOR PERFORMANCE

Technics' superior performance is now remarkably easy to use, with convenience features like full-function remote control, 15-step Random Access programming, large fluorescent function display and Auto Cue for instant starts. Technics 16-bit DAC (digital-to-analogue converter) coupled with a precision optical deck assures high fidelity performance not available elsewhere *at the price!* Discover the simply superior performance of the SLP-3 at your Technics dealer today.

Technics
Hi-Fi Systems

X683

1985 CD PLAYER COMPARISON

If you're thinking of buying a CD player but unsure which brand will best suit your needs, this survey of medium-priced units available in Australia will help you to make a choice.

Louis Challis

IF YOU HAVEN'T found the opportunity to visit your local record or music shop in recent months you wouldn't be aware of the dramatic changes that have occurred in that period. Two years ago virtually all you would expect to find on the display counters or shelves were LP records, seven inch EP 45 rpm records, a small number of half-speed mastered and similar high quality 'direct-to-disc' records, as well as reasonable numbers of pre-recorded cassettes and cartridges. Today you will find between 10% and 60% of the rack space devoted to the display of compact discs.

What began two years ago as 'some low clouds on the horizon' has now come with all the fury of a cyclone to change our thoughts on how music should be played in our homes — and those thoughts have completely altered the marketplace. As a result, close to one in three ETI readers probably already owns a CD player. And those who don't own one may well be seriously contemplating a purchase. With this sort of interest it seemed about time we undertook a comparative review of CD players whose prices fall in the middle to bottom end of the market price range.

A history of differences

Over the last two years reviewers of high fidelity equipment have taken what appear to be two completely different stances on the audible characteristics of CD players. One notable group of English reviewers and their French counterparts have claimed that there are significant (and sometimes even dramatic) audible differences between different CD players. By contrast, a group of American reviewers claims that they can't hear differences (let alone readily measure them in their laboratories).

Obviously, somebody has to be right (or wrong!) and it requires an in-depth comparative review, incorporating both objective and subjective assessments, to provide the sort of information that the intending CD player purchaser so anxiously seeks.

From a theoretical standpoint, a digitally derived audio input signal provided by the CD disc should mean no loss of fidelity and very little likelihood of modifications in the original signal by way of frequency non-linearity, distortion products or unacceptable increases in the signal-to-noise ratios. From a practical standpoint however, much of the testing and reviewing that we have performed (see ETI February 1983, September 1983, February 1984, May 1984, August 1984, March 1985, May 1985) has confirmed that there are significant objective differences and generally fine gradations of perceptible audible differences between one model of CD player and the next.

The major factor underlying these differences between one model and the next in the first generation of CD players was the result of frequency non-linearity, particularly at the lower end of the audible spectrum. It was in this region that the 'digital resolution' was low and the digital-to-analogue conversion non-linearity may not have been as good as the designers had intended. Additional problems can be caused by distortion and intermodulation products produced by the 'in band' amplitude and phase characteristics of the digital or analogue filters. These are essential to avoid 'aliasing' problems associated with the 44.1 kHz sampling frequency. As we have noted in objective tests, some CD players even produce significant measurable output at 44.1 kHz which could then give rise to the possibility of audible intermodulation products.

There are of course many other 'more visible' and technical differences between one model and another. These do not normally lead to acoustical problems (except where the drive motor and slide mechanism are noisy) nor do they figure prominently in the assessment of anybody who wishes to buy the 'cheapest possible player' which provides the minimum number of frills or who simply wants 'to listen to music'.

Test criteria

The objective testing which we undertook for this review was of necessity a little less exhaustive than the testing which we normally perform when evaluating a single piece of equipment. The cricital tests which I elected to perform were:

- An evaluation of the frequency response between 20 Hz and 20 kHz, the results presented with an expanded dynamic range that allows you to really see the minute differences between one player and the next. These responses have been analysed for both the left and right channels with the dynamic range showing variations as small as 0.1 dB. It should be noted, however, that you cannot hear differences of less than 1 dB. A flatter response and better overall linearity normally result in fewer intermodulation products or other peripheral audible problems. Our previous investigations ▶

have shown that most CD players exhibit significant differences between 10 Hz and 20 Hz, a frequency region in which there is normally little musical content.

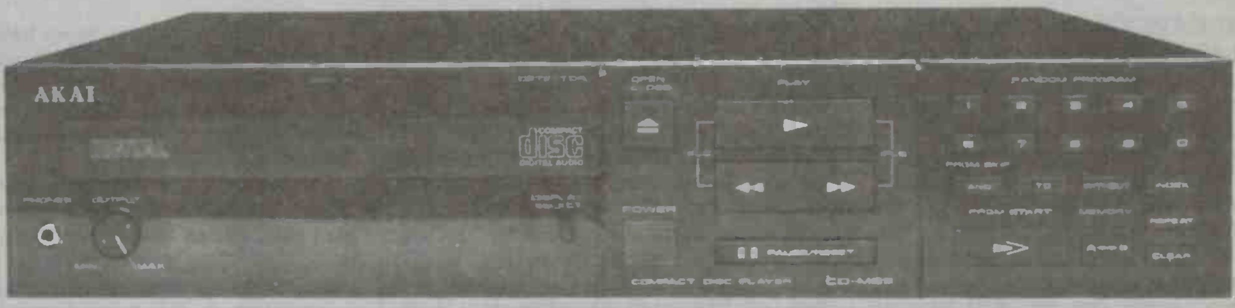
- An evaluation of the digital-to-analogue conversion linearity for both left and right channels over the range −60 dB to −90 dB. We have not presented an analysis over the range 0 to −60 dB as we found no significant non-linearity in that region. These results provide important information on the quality of the conversion linearity of the digital-to-analogue circuitry and the associated output.
- Determination of the channel separation at 0 dB for both left to right and right to left channels at 100 Hz, 1 kHz, 10 kHz and 20 kHz.
- Total harmonic distortion at 0 dB, −10 dB, −40 dB and −80 dB measured by logarithmic addition of the individual distortion products up to sixth order.
- 'Theoretical' signal-to-noise ratio for unweighted and A-weighted response at 0 dB, with and without emphasis.
- Frequency replay accuracy for the 19.999 kHz test signal.
- Output impedance of headphone socket (when provided).
- Output signal level for 0 dB.
- Objective lens drive system tolerance to dirty or scratched records using a commercial test disc and five special discs provided by Polygram.

These tests cumulatively provide a wealth of objective test information facilitating a performance comparison between each of the six CD players.

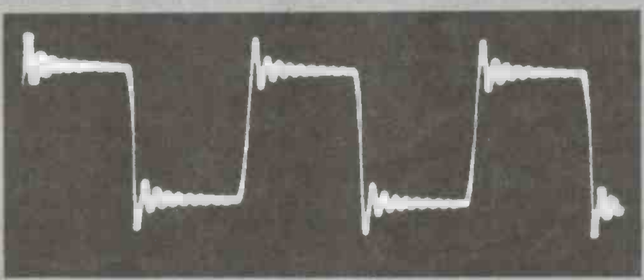
The objective test data was supplemented by functional data on operational features, as well as special characteristics either measured or observed during the objective and subjective assessments. Finally, I played each of the units with the special Philips, and selected commercial, 'over limit' test discs. These are designed for assessing performance with specific disc defects which fall at the outer limits of commercial acceptability nominated by the Philips/Sony 'Red Book'.

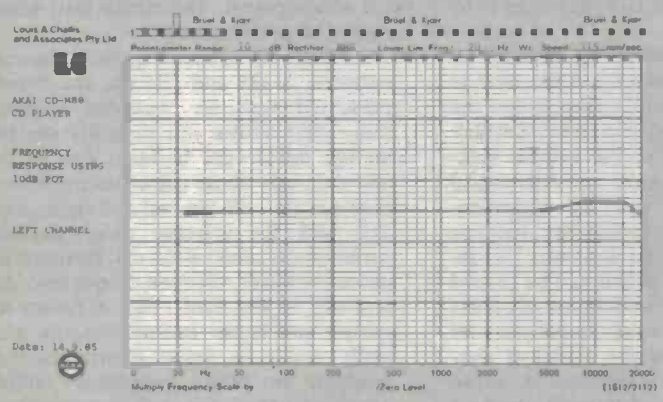
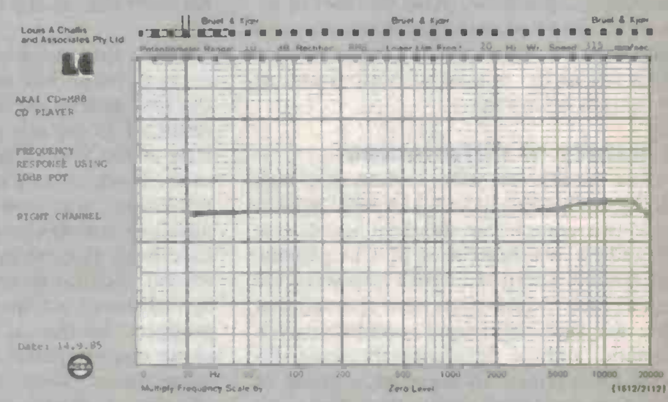
The test results have been tabulated in two charts, one showing the electrical performance characteristics and the other the physical and functional characteristics. This form of tabulation provides a rapid intercomparison which should assist in weighing the cost and benefit achieved by each of the respective players. These are supplemented by frequency response graphs and photos of the square wave response at 1 kHz.

The objective results, with very few exceptions, reveal that the performance characteristics of these individual players have improved in a number of areas compared with the first generation of players. The most significant improvements are in the cost, which is now less than half of what it was two years ago, and in the manufacturers' acceptance that the ergonomic features are in most cases more important than 'visual design' features. The following section provides a more detailed description of each of the players.

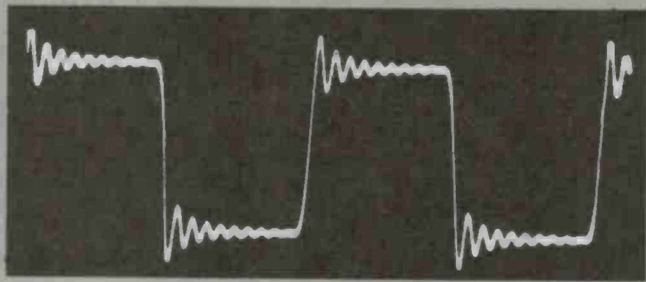


The Akai CD-M88T. Solid engineering and good performance for $699 RRP.

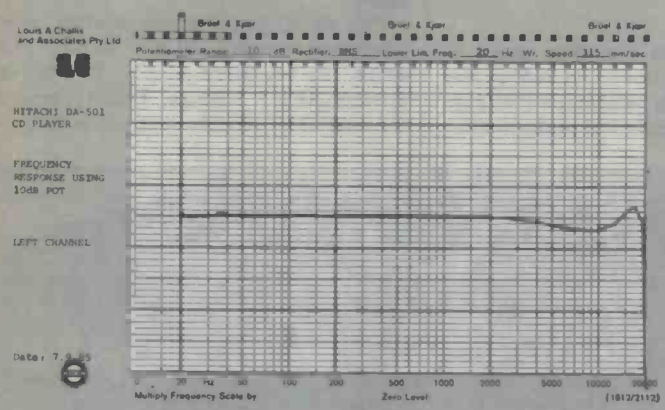


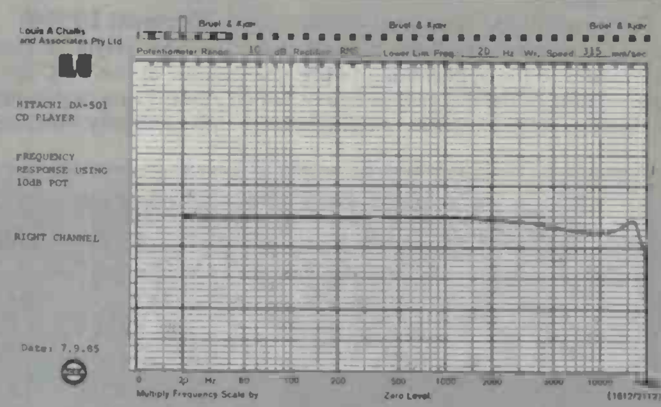
Square wave response at 1 kHz.



The Hitachi DA-501. Commendable performance and quite good physical and functional characteristics for $659.



Square wave response at 1 kHz.





The players

We have chosen six players for our survey, and a detailed description of each follows.

Akai CD-M88/T

This player is a particularly neat unit and features a small slide-out disc loading tray located in the middle of a dark red plastic escutcheon, which overlies the fluorescent display module. This display provides track number, index number, individual elapsed time for the track being played and total time for music remaining on the disc. The controls provide sequential random selection using the front panel controls, as well as the ability to select short sections for repeat play with the A-B sequence buttons.

The main and supplementary functional controls are laid out on the right-hand side of the front panel in two distinct groups. The main controls of PLAY, FAST FORWARD and REVERSE are physically large and ergonomically well conceived, while the PAUSE/RESET buttons are slimmer. The supplementary controls, including random programme switching with all ten numerical key buttons and logically annotated switches, are located on the extreme right-hand side of the panel and are very simple to use. The headphone volume control is of unusual design, but is nonetheless neat in its appearance and is also simple to use. The headphone socket is regrettably a 3 mm diameter 'mini-plug' for which an adaptor would be required when using most high quality headphones. The Akai CD player is the heaviest of the six and this extra weight is primarily the result of the designers' preference for strong steel and die-cast components, in preference to plastics or 'exsert' panel fabrication methods (see ETI May 1985).

The inside of the unit features very well designed printed circuit boards with neat interconnections by means of ribbon cable and plugs and sockets for main connections. Thus the unit is easily maintained and trouble-shooting is greatly simplified. This particular unit has been designed for simple integration into a residential 'mini-system' where its small dimensions and rugged reliable characteristics should provide superior audible output from the system.

Akai experienced design problems with its first generation of CD players. The company has made outstanding improvements in the design of this unit to achieve a degree of reliability which is every bit as good as that provided by its competitors. The latest design is based on a circuitry in which large scale integrated circuits feature prominently.

The functional characteristics of this player, as well as the quality of the sound that it produces are generally excellent, with only the low level distortion characteristics falling outside the 'norm' of the other players. The frequency response is generally good, the linearity is acceptable, the channel separation a little lower than that provided by the other players, but it tracks very well on the test discs and the unit is both objectively and aurally superior to the first generation of Akai CD players.

Hitachi DA-501

This particular player is the very latest unit to be released by Hitachi. It features a two-tiered layout of controls. The power and remote control infrared sensor are located at the left-hand side of the front panel, with the slide-out disc tray adjacent. The major controls, such as the very large combined PLAY/PAUSE pushbutton and separate STOP CONTROL are located at the extreme right-hand side of the facia.

The fluorescent graphic display is located ▶

at the upper level of the front panel adjacent to the OPEN/CLOSE and REPEAT buttons. This display is relatively small and indicates play and pause, as well as track number, index number and time in minutes and seconds for both the track being played or remaining disc playing time. These optional functions are controlled by a small SHIFT button immediately below the OPEN/CLOSE button.

The other controls including SKIP forward and reverse, FAST FORWARD and REVERSE and MEMORY are located on the bottom row of controls adjacent to the headphone socket and its small volume control. The remote control unit is particularly easy to use, with ten separate numerical key buttons, and has a functional range extending over a 160° arc at distances of greater than 6 metres.

The physical and functional characteristics of the unit are excellent; my only criticism relates to the application of only electronic closing of the disc tray in lieu of both mechanical and electrical closing which most users would prefer.

The electrical characteristics of the player are generally good although the distortion at low levels is moderately high and the channel separation at high frequencies is a trifle low. The player does not track the black dots on the Philips 4A Test Disc particularly well. The poor channel separation at 20 kHz and the shape of the frequency response over the range 4 kHz to 20 kHz indicates that the digital filtering used in the design warrants a closer appraisal by the designers. Representative programme material played on the Hitachi player exhibits differences in sound quality from that played on the other CD players and this must be assumed to be primarily the result of the post-digital to analogue conversion and filter circuits.

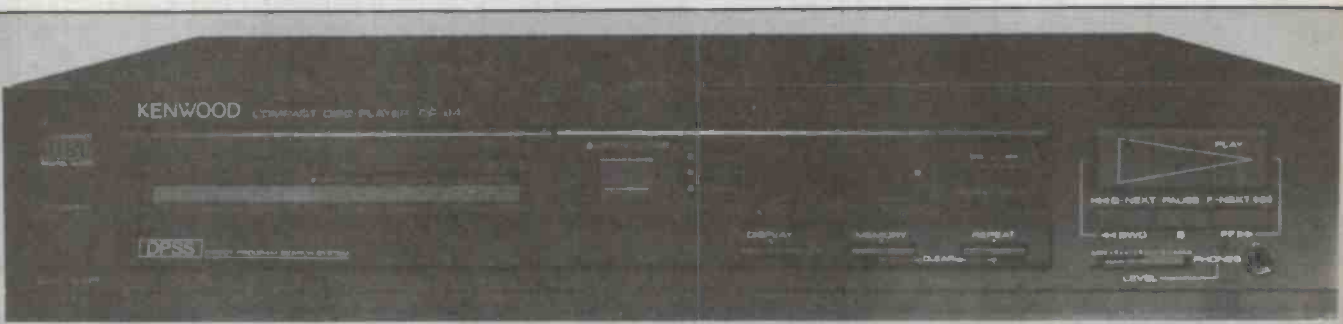
Kenwood DP-840

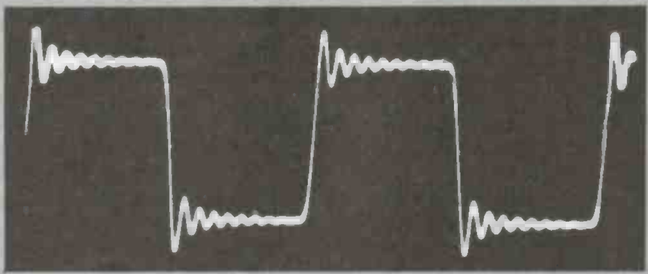
This player is from the same series as used by the ABC in some of its Sydney studios; it has apparently impressed that august authority with its technical performance.

The front panel control system layout is very similar to that selected by the designers of the other units. The power ON/OFF switch is on the left-hand side of the front panel, the disc loading is immediately adjacent and the most important functional controls are on the extreme right-hand side of the front panel.

The graphic display is located at the top centre of the front panel in line with the disc loading tray and flanked on the right by the large PLAY button. The display provides data on the track number, index number and track playing time in minutes and seconds, as well as the remaining playing time on the disc. Additional information is provided on the memory function, and two small light emitting diodes indicate whether the unit is in the REPEAT or PAUSE mode.

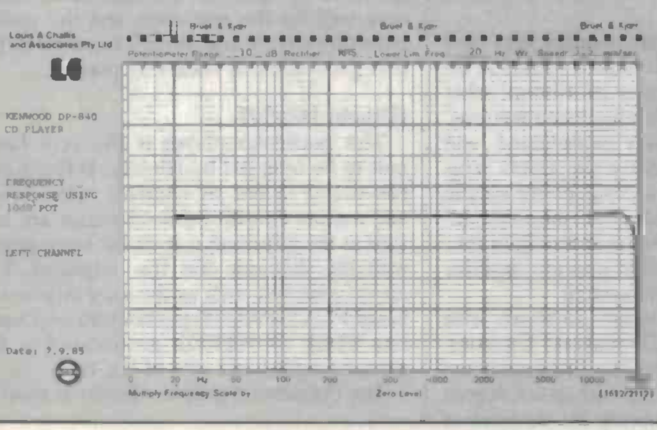
The functional controls include a very large and sensible PLAY button below which are backward-NEXT, PAUSE and forward-NEXT buttons. Below these are the neat slider volume control for the head-

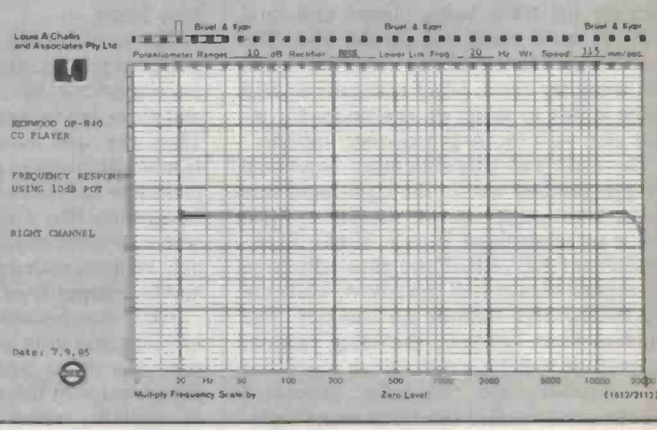


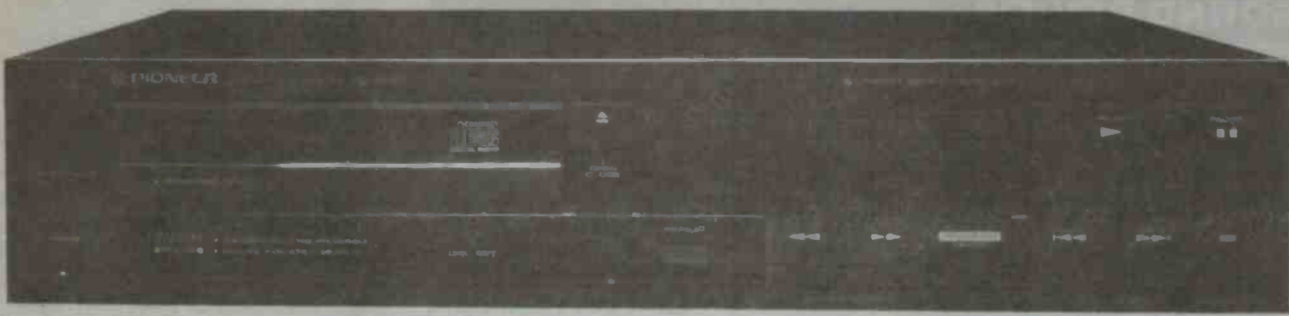


The Kenwood DP 840. Although it doesn't have remote control, this player is one of the easier units to use. Priced at around $799.

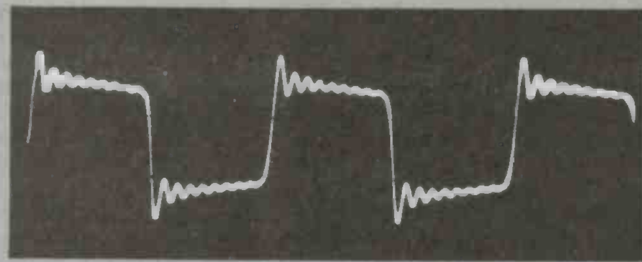
Square wave response at 1 kHz.



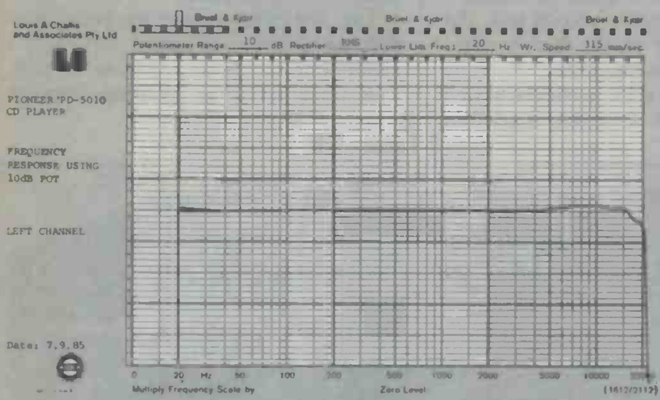


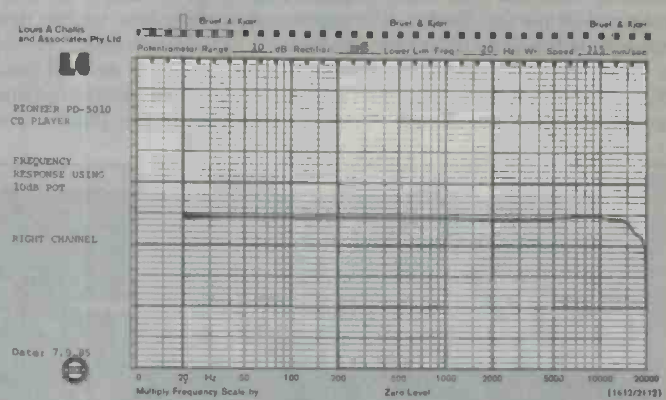


The Pioneer PD 5010 (BK). Good 'no frills' performance, without remote control, for $599 RRP.



Square wave response at 1 kHz.





phones with a standard 6.5 mm tip ring and the sleeve headphone socket. In the centre of the front panel is the OPEN/CLOSE button flanked by the fluorescent display providing details of track number, index number, channel number and/or time in minutes and seconds. Two additional displays provide information on whether the repeat or pause has been activated, and on the bottom row of controls is a display button and two memory buttons for memory repeat and clear.

The inside of the unit features a number of well executed printed circuit boards with a significant number of large second generation ICs. Neat ribbon cable interconnects the parts and full designations for servicing or trouble-shooting are made.

The objective performance testing of the Kenwood player revealed test results which were generally excellent in terms of frequency response, with very good linearity and channel separation which was good at low frequencies but drooped at high frequencies (primarily as a result of the post-digital filtering). It showed reasonably good total harmonic distortion and signal-to-noise ratios. The frequency error of 6 Hz was the highest of the players and indicative of an 'out of limit' frequency crystal in this particular player. The trackability on the Philips Test Disc was passable although the unit stopped playing with an 800 μm black dot.

This player also exhibits audible sound characteristics which are subjectively slightly different from the other players, particularly with low level signals.

My only criticism of its physical characteristics relates to the 'electronic only' closure of the disc tray. The Kenwood player is, however, one of the simpler units in terms of its front panel layout and is particularly easy to use.

Pioneer PD 5010

This player has a frontal appearance which is again reminiscent of the general appearance of other units, differing only in front panel details.

The controls are laid out in two panels with the POWER/ON/OFF button at the left-hand side of the 'sensored' loading tray. Pioneer learnt the lesson with its first model and has now provided the highly desirable mechanical and electrical tray closing capabilities that most users prefer. The open and close button is located immediately to the right of the tray and the fluorescent display is immediately to the right of this. Unlike the other players this unit does not provide timing data, but only track numbers and graphical data on the operational mode of the disc. The data on it in the play, pause or repeat mode is shown on green, amber and red LED displays on the front panel. While not all users would miss these timing controls I must admit that I did, particularly during the objective testing sequence.

The functional controls are large, sensible and easy to use and this particular player is the closest to a true 'no frills' machine of all of the units evaluated.

The objective performance of the Pioneer unit revealed that the frequency response is excellent up to 15 kHz and then rolls over smoothly again, primarily as a result of the type of post-digital circuitry that the designers have selected. The channel separation of the unit is good and the distortion characteristics are quite acceptable. The signal-to-noise ratio of this unit turns out to be the best of all the units evaluated and the trackability also proved to be extremely good. Although the Pioneer has the appearance of a 'no frills' machine, the objective performance and the subjective performance belie its real potential which certainly impressed me. ▶

Sony CDP-30

This CD player is one of the latest offspring sired by the original CDP-101, which was the first CD player I reviewed (and which we still have an example of in the office). It is smaller, neater, lighter and in many respects more attractive than its great-grandfather. The loading tray on this particular unit provides both the mechanical and electrical closer, which was the one obvious deficiency.

The display characteristics of the unit are in many respects superior to those of the CDP-101, although it lacks the advantages of the remote control unit that endeared the original Sony player to so many of its purchasers. The display also shows whether the unit is in the play mode or pause mode and provides data on the activation of the repeat function when the A-B button is pushed on the panel below the display. The functional controls on the Sony player are the smallest of all of the units evaluated, although the PLAY and PAUSE buttons are large enough to satisfy my needs.

Other facilities provided such as the automatic music sensor and indexing follow the basic approach developed by Sony three years ago and work just as well now as they did in the original Sony players.

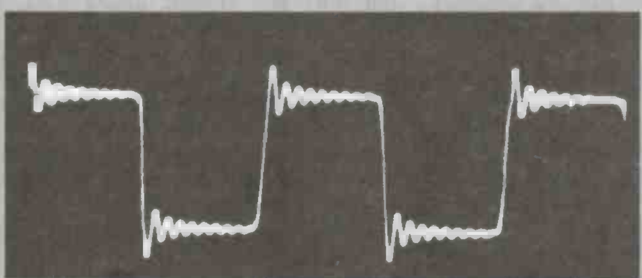
The circuit designers at Sony have spent a considerable amount of time and effort in achieving the highest possible frequency linearity from their players, as the level recordings show quite clearly. The frequency response of this particular player is the best by far of all the units evaluated. The conversion linearity over the range −60 dB to −90 dB is also the tightest of all the units and the channel separation of this unit is exemplary. The total harmonic distortion figures are extremely good, once again being the best of all the units evaluated. The signal-to-noise ratio is exceptionally good and, with the exception of the performance on the defective record test, the characteristics of the player had a slight edge on most of the competition.

This player did not cope particularly well with the Philips Test Disc 4A black dot tests, although it tracked the eccentric test discs substantially better than does the CDP-101. Overall, the CDP-30 performed very well and is a credit to its designers.

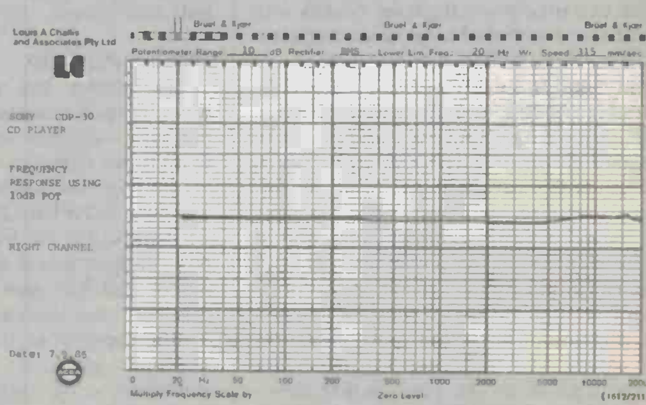
The subjective performance of the unit is in many respects determined by the choice of digital filtering which in turn is determined by the low pass filter (LPF 301) which provides a very sharp notch at 21 kHz. It is the high frequency phase non-uniformity characteristics of this particular filter which result in much of the 'clinical sound' that this unit exhibits. Some detractors of this feature of the Sony circuit design claim that these characteristics are sufficient justification for incorporating the over-sampling techniques and 14-bit resolution originally developed by Philips for its CD players and now also favoured by many other circuit designers.

The Sony player does not provide a random programme selection capability or a headphone socket or a remote control, but it is nonetheless an exciting little player ▶

The Sony CDP-30. The best of the players without remote control, priced at around $529.



Square wave response at 1 kHz.



CHRISTMAS EXTRAVAGANZA!!

PROFESSIONAL SERIES RACK MOUNTING CABINETS

These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance:

- All aluminium construction.
- Removeable top and bottom panels.
- All dimensioning conforms to the International Standard.
- Natural or black finish.
- Ventilated lid
- Deluxe brushed finish anodised front panel.

	1-4	5+
H10401 Natural	$49.50	$44.50
H10402 Natural	$59.50	$53.50
H10403 Natural	$69.50	$62.50
H10411 Black	$56.00	$49.50
H10412 Black	$65.00	$58.50
H10413 Black	$75.00	$67.50

STANDARD DESOLDING PUMP

Light weight, powerful suction, teflon tip. Replacement tips teflon and ceramic. Length 195mm.

Cat. T11241 **$15.95**

MINI DESOLDERING PUMP

Light weight, powerful suction, teflon tip. Replacement tips teflon and ceramic. Length 165mm.

Cat. T11251 **$14.95**

DELUXE DESOLDERING PUMP

Light weight, non conductive, powerful suction, ceramic long life tip. One of the best in the business. Length 210mm, replacement tip HT3C ceramic.

Cat. T11261 **$18.95**

KEYBOARD AND CASE

A stylistic low profile case to give your system the professional look it deserves. Comes with an attached encoded, parallel output keyboard and provisions for 2 x 5¼" slimline disk drives.

Cat. X11080 **$249**

COMPUROBOT

Simply key in a list of commands to the amazing Compurobot and watch him go about performing even your most complex manuevers - up to 48 steps! Forward, backward, left/right turn, left/right curve, robot noises, flashing lights and a multi speed gearbox!

Cat. **$49.50**

ARLEC SUPER TOOL

A versatile 12V electric tool for...

- Sanding
- Engraving
- Grinding
- Polishing
- Cutting
- Drilling
- Milling
- Erasing, etc.

Features:
Operates on safe, low 12 volts from mains electricity via AC adaptor (supplied). Light and easy to handle with touch switch and lock for continuous running. High torque motor, 10,000 R.P.M. Can drill 2mm holes in steel. 2 year guarantee

Contents:

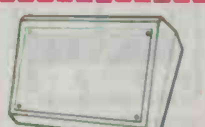
- 12V Super Tool
- Plugpack AC adaptor
- 1 spherical milling cutter
- 1 wire brush
- 1 grinding wheel
- 4 drill bits, 0.6, 0.8, 1.0, 1.2mm
- Set of 5 chuck collets
- 6 eraser sticks
- Instruction sheets

Cat. T12300 **$44.95**

FREE STANDING, FOLD UP MAGNIFIER

An ecconomically priced "hands free" magnifier, lets you take care of all those tricky fine detailed jobs so often encountered in electronics, or any of many other practical uses such as home, work, hobbies etc.

Cat. T12083 **$11.95**



NEW SLOPING CASES

Plastic with metal front panel, available in two sizes:

Cat. H10450 190x120mm **$11.95**
Cat. H10455 256x185mm **$19.95**
(measurements are approx. only)

STROBE LIGHTS 12V

Available in 3 colours, red, blue and yellow. These units have a magnetic base and are fitted with 4 metres of cable terminating in a cigarette lighter plug. Ideal for displays, parties, attention getting, motoring emergencies/breakdowns etc..

Desc.	Cat. No.	Price
Blue	A15046	$32.50
Red	A15047	$32.50
Amber	A15045	$32.50

MODEM PHONE

Check the features and the value for money of this stylish new modem phone...

- Speaker Phone with Built-in Amplifier for Detecting Busy Signal during communication.
- Auto/Manual Answer, Manual Originate, Auto Disconnect.
- Carrier Detect Indication. 20 Memories (each with 18 Digits Capacity) for Auto-dialing.
- BELL 103 CCITT V21 Compatible.
- 300 BPS Full Duplex.
- Last Number Redial
- Pushbutton Keyboard.
- Volume High or Low Control.
- FCC Approved Direct Connect.
- "In-use" Dialing Indicator.

Cat. X19105 Normally $199

Save $25! only $174
(Not Telecom approved)

P.A. SPEAKERS

Low dual cone, wide range. 200mm (8in.). Ideal for public address, background music, etc. Tremendous Value at these prices!

Cat. C12000 **$6.95**

ETI BOOKS

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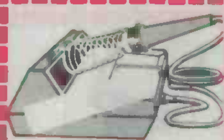
Circuit Techniques Vol.1	$4.75
Circuit Techniques Vol.2	$4.75
Circuit Techniques Vol.3	$4.95
Circuit Techniques Vol.4	$5.95
How to Build Electronic Games	$3.95
Electronic Projects for Cars	$3.95
Project Electronics	$4.75
Radio Experimenters Handbook	$7.95
Electronics Projects for Young Scientists	$3.95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

DESK MOUNTED LAMP MAGNIFIER

This unit magnifies any object under a clear cool fluorescent light. The magnification is the maximum obtainable (lens 127mm diameter biconvex 4 Dioptres, focal length 254mm) consistent with minimum distortion and eyestrain and good off-angle viewing. It is NOT cheap, but then again it will definitely last a lifetime. It is built like a Rolls Royce! Spare fluoro tubes are available from electrical outlets. If you have trouble with fine PCB work or component identification but still want both hands free, this is for you.

TECHNICAL INFORMATION
Illumination: 22W Fluoroscent
Weight: 81.6Kg
Lateral Extension: 254mm
Vertical Extension: 254mm
Fixing: Heavy table base (grey) with two chrome plated flexible arms.

Cat. C92700 **$179**



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.

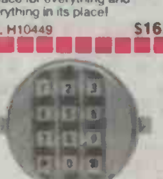
Cat. T12500

R.R.P. $129 **Our price $109**

UTILITY CASE

A must for all technicians, hobbyists and handy-men. Features clear plastic lid so you can tell at a glance the contents, up to 48 compartments, adjustable to suit your needs. A place for everything and everything in its place!

Cat. H10449 **$16.95**



PUSH BUTTON DIALLERS

Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number redial (up to 16 digits) and instructions for an easy changeover.

Cat. A12030 **$19.95**

10W RMS SPEAKERS

Including boxes!! At this price you can afford to put a set of speakers in every room!
Dimensions: H 475 x W 245 x D 200mm

Cat. C12002 **Per Pair $59.50**

4½ DIGIT LCD UNIVERSAL COUNTER - C7224

- **Very Low Power**
- **High Count Rate**

A 4½ digit counter offering counting to 20,000 units at rates up to 10MHz. The low current consumption makes it ideal for use in portable instruments. The counter features high contrast 10mm digits, 5V DC or 7.5V to 15V DC supply (typical consumption 1mA), and programmable decimal points. Standard controls are all TTL/Cmos compatible and include Reset, Count, Inhibit, Store, Leading Zero Blanking, 'Carry' Output. The count input is protected against accidental overload. Supplied complete with mounting kit and connectors.

SPECIFICATIONS:
Supply Voltage: (5.5V Abs. Max.) 7.5 - 15V
Typical Current Consumption: 1mA
Maximum Count: 19999
Max. Counting Rate: 10MHz
Typical (Schmitt Trigger):
Count Input Level: VTH 2.5V VTL 2V
Min. DC Input Level: 0V
Max. DC Input Level: 5V
Operating Temp. Range: 0 - 50-C

Cat. Q15530 **$79.50**

S100 PROTOCARDS

Horizontal Buss
Cat. H19125 **$39.50**

Vertical Buss
Cat. H19130 **$39.50**

Pad per Hole
Cat. H19135 **$39.50**

HORWOOD ALUMINIUM CASES

We have a full range of quality Horwood cases.

Cat.No.	Dimensions	Price
H10382	3x4x2"	$5.50
H10383	3x4x3"	$ 6.50
H10384	3x4x4"	$ 7.50
H10385	3x4x5"	$ 7.95
H10386	3x4x6"	$ 8.50
H10387	3x4x7"	$ 9.50
H10388	3x4x8"	$10.50
H10389	3x4x9"	$10.95
H10390	3x4x10"	$11.95

ULTRASONIC PEST REPELLER

The state of the art in pest control! Perfect for keeping the flies away at your summer Bar-B-Ques and the mossies away after sunset! Further more, no dead pests to dispose of, no toxic chemicals, maintenance free, ecconomical (approx. 2¢ a day) and covers an area up to 2,000 sq.ft. Simply plug it in and enjoy a clean pest free enviroment. Perfect for the home, apartment, restaurant, school, office or any indoor area.

Effectively controls...

- Flies
- Mosquitoes
- Mice/Rats
- Fleas
- Silverfish
- Cockroaches
- Ants
- Crickets
- Moths
- Waterbugs
- and many other pests!

Cat. Y95510 **$55.95**

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 **$79.95**

TOP QUALITY KITS TO MAKE

THE BRILLIANT SERIES 5000

INDIVIDUAL COMPONENTS TO MAKE UP A SUPERB HIFI SYSTEM!

By directly importing and a more technically orientated organisation, ROD IRVING ELECTRONICS can bring you these products at lower prices than their competitors. Enjoy the many other advantages of RIE Series 5000 kits such as "Superb Finish" front panels at no extra cost, top quality components supplied throughout. Over 1,000 sold!
For those who haven't the time and want a quality hi-fi, we also sell the Series 5000 kits assembled and tested.

POWER AMPLIFIER

WHY YOU SHOULD BUY A "ROD IRVING ELECTRONICS" SERIES 5000 POWER AMPLIFIER....

- 1% Metal Film resistors are used where possible.
- Alumlmium case as per the original article.
- All components are top quality.
- Over 1000 of these kits now sold.
- Super Finish front panel supplied at no extra cost.

Please note that the "Superb Quality" Heatsink for the Power Amplifier was designed and developed by ROD IRVING ELECTRONICS and is being supplied to other kit suppliers.

SPECIFICATIONS: 150 W RMS into 4 ohms
POWER AMPLIFIER: 100W RMS into 8 ohms (+ -55V Supply)
FREQUENCY RESPONSE: 8Hz to 20Hz +0=.0.4 dB 2.8Hz to 65KHz. +0=3 dB. NOTE: These figures are determined solely by passive filters
INPUT SENSITIVITY: 1 V RMS for 100W ouput.
HUM: 100 dB below full output (flat).
NOISE: 116 dB below full output (flat, 20KHz bandwidth)
2nd HARMONIC DISTORTION: ·0.001% at 1 KHz (0.0007% on Prototypes) at 100W ouput using a + = 56V SUPPLY rated at 4A continues ·0.0003% for all frequencies less than 10KHz and all powers below clipping.
TOTAL HARMONIC DISTORTION: Determined by 2nd Harmonic Distortion (see above).
INTERMODULATION DISTORTION: 0.003% at 100W. (50Hz and 7KHz mixed 4:1).
STABILITY: Unconditional.

Cat. K44771 — Normally $339, **now only $319**
Assembled and tested $499
packing and post $10

PREAMPLIFIER

THE ADVANTAGES OF BUYING A "ROD IRVING ELECTRONICS" SERIES 5000 PREAMPLIFIER KIT ARE....

- 1% Metal Film Resistors are supplied.
- 14 Metres of Low Capacitance Shielded Cable are supplied (a bit extra in case of mistakes).
- English "Lortin" switches ae supplied (no substitutes here.)
- Specially imported black anodised aluminium knobs.

Available Assembled and Tested. (We believe that dollar for dollar there is not a commercial unit available that sounds as good!)

SPECIFICATIONS:
FREQUENCY RESPONSE: High-level input: 15Hz – 130KHz. +0. – 1dB Low-level input-conforms to RIAA equalisation + = 0.2dB
DISTORTION: 1KHz ·0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N NOISE: High-Level input, master full, with respect to 300mV input signal at full output (1.2V)·92dB flat ·100dB A-weighted, MM input, master full, with respect to full output (1.2V) at 5 mV input 50ohms source resistance connected: ·86dB flat/92dB A-weighted MC input, master full, with respect to full output (1.2V) and 200uV input signal: ·71dB flat ·75dB A-weighted.

Cat. K44791 — Normally $299, **now only $279**
Assembled and tested $599
packing and postage $10

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS:
BANDS: 28 Bands from 31.5Hz to 16KHz.
NOISE: ·0.008mV, sliders at 0, gain at 0(=103dB0).
20KHz BANDWIDTH DISTORTION: 0.007% at 300mV signal, sliders at 0, gain at 0, maximum 0.01%, sliders at minimum.
FREQUENCY RESPONSE: 12Hz=105KHz, +0,=1dB, all controls flat.
BOOST AND CUT: 14dB

Cat. K44590 — 1 Unit ... **$199**
2 Units ... **$389**
packing and postage $10

LOW-COST BIPOLAR MODEL TRAIN CONTROLLER

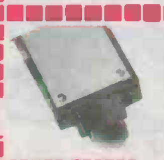
Here is a simple model train control for those enthusiasts who desire something better than the usual rheostat control. It provides much improved low speed performance and is fully overload protected, yet contains relatively few components. Best of all, you don't need to be an electronic genius to construct it. (80TC12) (EA Dec '80)
Cat. K80120 — **$34.50**

ELECTRONIC MOUSETRAP

This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again!
(ETI Aug '84) ETI 1524
Cat. K55240 — **$34.95**

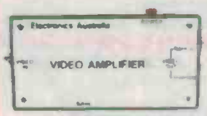
EPROM PROGRAMMER EP1

No need for a Micro with EA's great Eprom Programmer suitable for 2716/2758 Eproms
(EA Jan.'82) 82EP1
Cat. K82013 — **$69.50**
(Including Textool Socket)



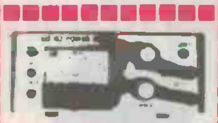
ZENER TESTER

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



VIDEO AMPLIFIER

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



30 V/1 A FULLY PROTECTED POWER SUPPLY

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec.'83) ETI 162
Cat. K41620 — **$52.50**

300 BAUD DIRECT CONNECT MODEM

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

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

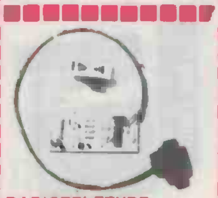
Save on ready built modems.
Cat. K97050 — **$99**

PARALLEL PRINTER SWITCH

Tired of plug swapping when ever you want to change from one printer to another? This low-cost project should suit you down to the ground. It lets you have two Centronics-type printers connected up permanently, so that you can select one or the other at the flick of a switch.
(ETI 666, Feb '85)
Cat. 46660 — **$69.95**

LOW OHMS METER

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



RADIOTELETYPE CONVERTER FOR THE MICROBEE

Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr.'83)
Cat. — **$19.95**

CAR IGNITION KILLER

Most car burgular alarms are easily circumvented, but not this cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterent to thieves! (EA Feb.'84) 84AU1
Cat. K84010 — **$16.95**
(Our kit includes the box!)

ELECTRIC FENCE

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

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting. (EA April '82, 82AO3A/B)
Cat. K82040
Cat. K82041 — **$89.50**

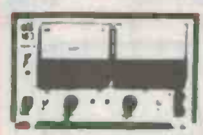
ELECTRONIC WATT METER

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

TRANSISTOR TESTER

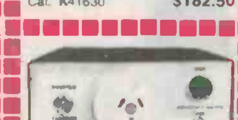
1000's SOLD

Have you ever desoldered a suspect transistor, only to find that it checks OK? Trouble-shooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept '83) 83TT8
Cat. K83080 — **$17.95**



LAB SUPPLY

Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.
(ETI May'83) ETI 163
Cat. K41630 — **$182.50**



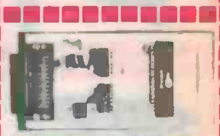
40 W INVERTER

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

MOTORCYLCE INTERCOM

OVER 300 SOLD!

Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!
(EA Feb.'84) 84MC2
Cat. K804020 — **$45.00**



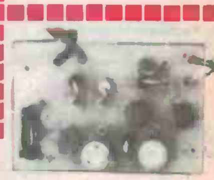
MICROBEE SERIAL-TO-PARALLEL INTERFACE

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

VIDEO ENHANCER

100's SOLD

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



...W BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give your early warning of power failure, and makes a handy beginner's project.
(ETI 280, March '85)
Cat. K42800 — **$7.95**

TEMP PROBE

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

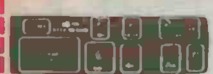
DUAL TRACKING POWER SUPPLY

Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.
(EA March 82) 82PS2
Cat. K82030 — **$87.50**

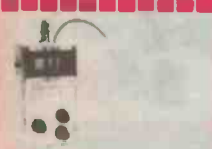
DURING THE HOLIDAYS !!

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

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



COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've been asking for, a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Mircobee, tips are avaialble on interfacing the unit to other computers.
(ETI Nov. '84) ETI 755
Cat. K47550 **$139.00**



PH METER KIT
Build this pH meter for the swimming pool season is here again! From swimming pools to fish tanks to gardening, this pH meter has many applications around the home. This unit features a large 3 1/2 digit liquid crystal display and resolution to .01 pH units, making it suitable for use in the laboratory as well.
(EA Dec. 82) 82PH12
Cat. K82123 **$139**

300W "BRUTE" AMPLIFIER
The "Brute" develops 300W into 4 ohms, 200W into 8 ohms!
For many aduio applications there's no substitue for sheer power - low efficiency speakers, outdoor sound systems, or maybe you like the full flavour of the dynamic range afforded by a high power amp. Whatever your requirement - this 'super power' module should fill the bill. (ETI 466) (ETI Feb '80)
Cat. K44660 **$89.50**
(Heatsink not included)

PLAYMASTER 300 WATT AMPLIFIER
This module will deliver up to 200 watts into an 8 ohm load and up to 300 watts into a 4 ohm load. Comprehensive protection is included and a printer circuit board brings it all together in a rugged easy-to-build module. It can be built in either fully-complementary or quasi-complementary versions, so output transistor shortages should be no problem at all.
(80PA6) (EA July '80)
Cat. K80060 **$79.50**

PARABOLIC MICROPHONE
Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of componenets for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov. '83) 83MA11
Cat. K83110 **$14.95**

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

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

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

150W MOSFET POWER AMPLIFIER
Here's a high power, general purpose 150W Mosfet Power Amp Module! Suitable for guitar and P.A. applications and employing rugged, reliable Mosfets in the output stage. (ETI 499) (ETI March '82)
Cat. K44990 **$79**
(Heatsink not included)
plus transformer $49.50

AUDIO TEST UNIT
Just about everyone these days who has a stereo system also has a good cassette deck, but not many people are able to get the best performance from it. Our Audio Test Unit allows you to set your cassette recorder's bias for optimum frequency response for a given tape or alternatively, it allows you to find out which tape is best for your recorder. (81AO10) (EA Oct '81)
Cat. K81101 **$47.50**

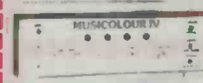
MICROBEE ENHANCER 1
This totally amazing kit for the Microbee is a must for all Microbee owners/users!
Most expansion units up to this time offered at best only one or other features; and this made it impossible to run, for example, complex sound effects mingled with speech. The Enhancer 1 will do all this and much more as well. It is quite amazing how much has been shoe-horned into this compact unit.
The Enhancer 1s' many powerful features include...
- Two ATARI/COMMODORE/COLECO/SEARS type joystick inputs.
- Two TRS COLOR COMPUTER type joystick inputs.
- Allows the connection of Touch Pads, Paddles, Proportional Joysticks, Trakballs, Mice, temperature senors, lights level sensors, transducers, etc, etc!!
- A 4 voice music/sound effects sythesizer.
- A real time clock.
- Unlimited vocabulary speech synthesizer (option).
- Parallel printer interface (option)
- A built-in speaker with volume control.
- Listings of all necesary routines for use.
- An impressive demonstration program package.
- Compatible to all Microbees.
- Digital recording and playback of speech and sound.
- An 8 channel analog to digital converter with variable voltage or variable resistance type analog inputs and also user selectable resolution from 1 to 9 bits.
- A digital to analog converter with selctable resolution from 1-8 bits.
- Allows automatic data acquisition and logging.
- 5 digital input lines, 4 digital ouput lines.
- A voice input channel.
- A 40 pin experimenter socket with all 8 analog inputs, 5 digital inputs, 4 digital ouputs, 3.58 MHz buffered clock, sound output (so that you can play the sound effects through your HI FI), 3 high resolution voltage comparators, DAC output etc.

The amazing Microbee Enhancer is available exclusively from Rod Irving Electronics.
Cat. **$149**

GENERAL PURPOSE AMPLIFIER CLASS B
One of the handiest 'tools' for the electronics experimenter is a genuine purpose audio amp. This module will work from a wide range of supply voltages, has good sensitivity, is robust and reliable - easy to build too! (ETI 453)
(ETI April '80)
Cat. K44530 **$24.50**

50 W AMPLIFIER MODULE (ETI 480)
Cat. K44880 **$27.50**
(Heatsink optional extra)

100 W AMPLIFIER MODULE (ETI 480)
Cat. K44801 **$29.95**
(Heatsink optional extra)



MUSICOLOR IV
Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug. '81) 81MC8
Cat. K81080 **$99.00**

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

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

GENERAL PURPOSE PREAMPLIFIER
A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders or microphones by changing a few components (ETI445) (ETI July '76)
Cat. K44490 **$8.95**

100W SUB-WOOFER AMPLIFIER
Capable of up to 120 watts RMS into 4 ohm loads and up to 80 watts RMS into 8 ohm loads, this power amplifier module has been specifically designed for use as a sub-woofer driver amplifier in a tri-amped hi-fi system. It uses four power Mosfets for rugged, reliable operation. (EA July '82) (82PA7)
Cat. K82075 **$97.50**

SERIES 4000 STEREO PREAMP
This high performance project is designed to complement ETI's 60 watt low distortion amplifier module and forms part of a complete stereo system, the "Series 4000" project. (ETI 471)
(Top Projects Vol. 6)
Cat. K44710 **$54.50**

STEREO ENHANCER
The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an 'enhanced stereo effect' with a small unit which attaches to your amp. (ETI 1405, ETI, MAR '85)
Cat. K54050 **$79.50**

MODEL ENGINE IGNITION SYSTEM
Get sure starts every time and no more glow plug burnouts on your model engines.
(ETI June '83) ETI 1516
Cat. 55160 **$47.50**

ELECTRIC DUMMY LOAD
With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct. '80) ETI 147
Cat. K41470 **$119**

MULTI SECTOR ALARM STATION
The Christmas season always brings with it an increase in home burglaries, so nows the time for installing security equipment. Relieve the boredom, save money, and at the same time protect your home from intruders with this up-to-the-minute burgular alarm system. Its easy to build, costs less than equivalent commercial units, and features eight seperate inputs, individual sector control, battery back up and self-test facility.
Specifications:
- Eight sectors with LED status indication.
- Two delayed entry sectors.
- Variable exit, entry and alarm time settings: entry delay variable between 10 and 75 seconds; exit delay variable between 5 and 45 seconds; alarm time variable between 1 and 15 minutes.
- Resistive loop sensing: suits both normally open and normally closed alarm sensors.
- Battery back-up with in-built charger circuit.
- Built-in siren driver.

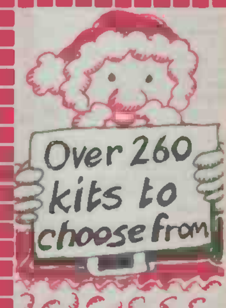
Complete kit including deluxe prepunched metal work and electronics for only...
Cat. K85900 **$129**

HUMIDITY METER
This project can be built to give a readout of relative humidity either on a LED dot-mode display or a conventional meter. In addition it can be used with another project as a controller to turn on and off a water mist spray in a hothouse, for example. (ETI May '81) ETI-256
(Includes humidity sensor $19.50)
Cat. K52460 **$29.50**

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

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

SLIDE CROSS-FADER
Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built varialbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. '81) 81SS11
Cat. K81110 **$85.00**



BANKCARD
VISA
MASTERCARD

SIGNATURE EXPIRY DATE

NAME

ADDRESS

P/CODE

ETI 12/85 DATE

which achieves a highly commendable performance.

Yamaha CD-3

This player is a worthy successor to the CD-1 and CD-2 which revolutionised the cost performance relationship in the CD player market a little more than 18 months ago.

The most unusual feature of this particular player is the incorporation of a combined alpha/numeric display in place of the staid and conventional numeric display featured by most other players. When the OPEN/CLOSE button is pressed the word 'OPEN' is displayed, when the button is pressed once more the tray closes and a series of dashes appear on the display. When the PLAY button is pressed the word 'PLAY' is displayed for three seconds. When the PROGRAMME button is pressed the letter 'P' with the figure '1' is displayed. At the end of the disc the word 'END' is displayed while at the end of the programming cycle 'END' is again displayed. If one attempts to play the unit without loading a disc, the word 'DISC' is automatically displayed.

The display is theoretically capable of providing data on track number, elapsed time and total time, although in the unit that we received for review the total time function could not be induced to work. The functional buttons on the main panel are simple in use and are replicated on the remote control, which is relatively simple yet very effective.

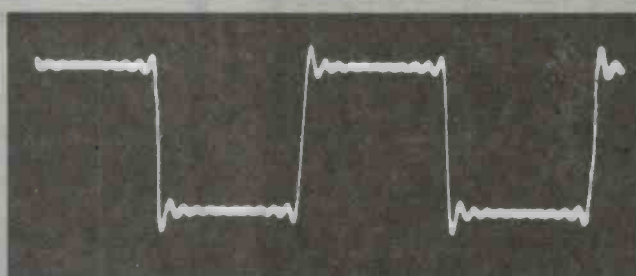
The design of the unit features extensive use of plastics and 'exsert' concepts to keep costs at the lowest possible level. The objective performance of the unit is generally good with the frequency response exhibiting a slight rise of 0.5 dB around 15 kHz. This rise in the response curve is primarily the result of double resolution digital filtering at 88.2 kHz, as the primary digital filtering is followed by an active 'gentle post-digital audio filtering'. These filters also apparently have an impact on the overall circuit linearity which surprisingly provides a positive going characteristic at the −90 dB level.

The channel separation of this unit is adequate and the total harmonic distortion characteristics are good but not outstanding. The signal-to-noise ratio is good and the trackability on the defective record disc is truly excellent because of the characteristics of the three beam laser optical pick-up system. The player tracks defective discs particularly well and provides an audible signal which is clean and generally impressive.

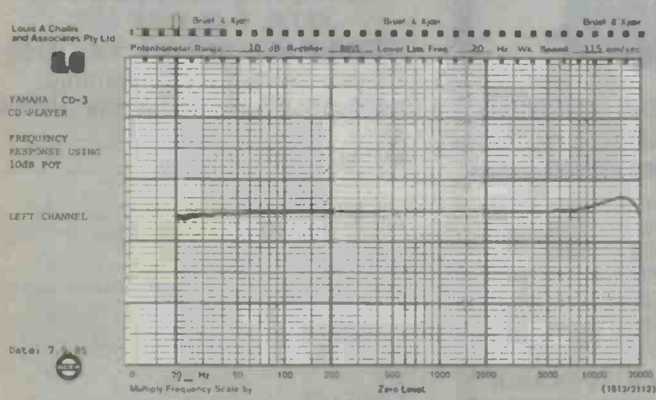
The design of the CD-3 makes maximum use of the large scale Yamaha integrated circuit, which allows Nippon Gakki to produce cost effective consumer items and compete effectively in the marketplace.

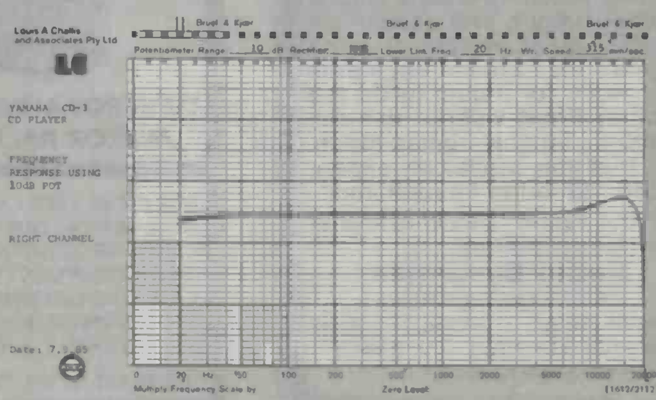
On the high quality programme content, the CD-3 is quite impressive and also sounds somewhat different from most of the other 'more conventional' CD players incorporating sharper filtering in the out-of-band region (which has an impact on the audible characteristics of the sound). It is ▶

The Yamaha CD-3. The best of the players with remote control, for $749 RRP.



Square wave response at 1 kHz.





clear that with the advanced characteristics and 'visible functions' of the CD-3, Yamaha will once again attract a sizable portion of the intending marketplace with the innovative characteristics displayed by this particular player.

Making a decision

In the end, you the intending purchaser will still have a difficult time in selecting. The Yamaha and Sony were the best of the players with and without a remote control. Akai and Pioneer ranked second (and most certainly right behind the first two) of the units with and without remote control. The second ranking units also provided a combination of good objective performance, innovative design features and quality of sound. The Pioneer player warrants almost the same marks in that it offers a simple functional 'no frills' performance, while the Akai offers solid engineering and good performance. Finally I would rank the Hitachi (with remote control) and the Kenwood (without), both of which still provide good performance and in most respects good physical and functional characteristics. All of the units with remote controls provided outstanding angular performance (better than 160°) and performance beyond six metres. All the units which I tested had black fascias, though some of the manufacturers do now offer silver alternatives.

Perhaps your task may be more difficult than mine. I was able to put each unit through its paces and I tend to regard buying price as being a second order factor when compared to performance and ergonomics. ●

PHYSICAL AND FUNCTIONAL CHARACTERISTICS

Model	Dimensions wide x high x deep (mm)	Weight (kg)	Remote Control	Demo Disc supplied	Electronic Opening Closure & manual closure	Random Programme Selection Capability	A—B Programme Repeat	Headphone Socket & Volume Control
AKAI CD-M88/T	350 x 73 x 257	6.5	Yes	Yes	Both	Yes	Yes	Both
HITACHI DA-501	435 x 83 x 264	4.3	Yes	No	Electronic only	Yes	No	Both
KENWOOD DP 840	425 x 84 x 309	4.8	No	No	Electronic Only	Yes	No	Both
PIONEER PD-5010(BK)	420 x 91 x 310	4.7	No	No	Both	Yes	No	Socket only
SONY CDP-30	355 x 70 x 275	3.8	No	No	Both	No	Yes	Neither
YAMAHA CD-3	435 x 93 x 291	4.4	Yes	No	Both	Yes	Yes	Both

ELECTRICAL CHARACTERISTICS

Brand & Model	Frequency Response ± 0.2 dB ± 0.5 dB ± 1 dB	Linearity* -60 dB -70 dB -80 dB -90 dB	*Channel Separation 100 Hz 1 kHz 10 kHz 20 kHz	THD (%) @ 1 kHz 0 dB -10 dB -40 dB -80 dB	S/N @ 0dB Unweighted A-weighted with emphasis	Frequency Error @ 19.999 kHz	Headphone O/P Impedance & Level	Line Output Level @ 0 dB	Defective Record Test (Philips Test Disc 4A) Interruption Black Dot	Defective Record Test (Challis Test Discs 1 to 5) Skew Angle or Eccentric centre	Price RRP $
Akai CD-M88	20-8 kHz 20-20 kHz 20-20 kHz	-0.5 dB -1.4 dB -2.9 dB -6.6 dB	85.2 dB 86.1 dB 86.5 dB 89.2 dB	0.0038 0.0064 0.2 10.3	95.0 dB(L) 101 dB(A)	+0.1 Hz	47 ohms	2 volts	tracks well audible clicks only on 800 μm	tracks well on 4 out of 5 eccentric discs	699
Hitachi DA-501	20-5 kHz 20-18 kHz 20-20 kHz	-0.3 dB -0.8 dB -2.2 dB -5.7 dB	90.8 dB 90.6 dB 73.3 dB 67.4 dB	0.004 0.0024 0.043 10.7	94.5 dB(L) 98.5 dB(A)	-0.2 Hz	56 ohms	2 volts	tracks poorly clicks 300, jumps 500 & 800 um	tracks well on 3 out of 5 eccentric discs	659
Kenwood DP840	20-17 kHz 20-18 kHz 20-19 kHz	0.0 dB -0.1 dB -0.6 dB -3.1 dB	90.5 dB 85.7 dB 68.6 dB 62.8 dB	0.0086 0.0029 - 6.6	90.0 dB(L) 96.0 dB(A)	+6.0 Hz	100 ohms	2 volts	tracks passably fails 500 μm & stops on 800 μm	tracks well on 3 out of 5 eccentric discs	799
Pioneer PD 5010(BK)	20-16 kHz 20-17.5 kHz 20-20 kHz	-0.1 dB -0.4 dB -1.3 dB -4.0 dB	91.4 dB 91.6 dB 82.3 dB 77.4 dB	0.0038 0.0018 0.046 7.7	102.0 dB(L) 104.0 dB(A)	-0.2 Hz	56 ohms	2 volts	tracks well clicks on 800 μm	tracks well on 4 out of 5 eccentric discs	559
Sony CDP-30	20-20 kHz 20-20 kHz 20-20 kHz	+0.1 dB -0.1 dB -0.4 dB -2.1 dB	109.2 dB 108.3 dB 97.7 dB 94.8 dB	0.0025 0.0015 0.024 5.3	99.8 dB(L) 102.2 dB(A)	-1.2 Hz	N.A.	2 volts	tracks passably clicks 300 μm, jumps on 500 μm stops on 800 μm	tracks well on 3 out of 5 eccentric discs	529
Yamaha CD-3	20-9 kHz 20-19 kHz 20-20 kHz	-0.2 dB -0.6 dB -3.4 dB +6.3 dB	87.7 dB 86.7 dB 84.2 dB 79.4 dB	0.003 0.0089 0.15 6.6	88.5 dB(L) 104.5 dB(A)	-0.3 Hz	100 ohms	2 volts	tracks well clicks on 800 μm	tracks well on 4 out of 5 eccentric discs	749

* Worst figure from left or right channel, as recorded

Merry Christmas from Rod Irving Electronics!

MODEMS

RITRON MULTI PURPOSE MODEM
Our New RITRON Multi Purpose Modem has arrived and has all the standards you require.
Just check the Ritron's features:
- CCITT V21 300 Buad Full duplex
- CCITT V23 1200/75
- Bell 103 300 Full duplex
- Bell 202 1200 Half duplex
- Auto answer, auto disconnect

Telecom Approval No. C84/37/1134
$379

1200/75 BAUD RATE/BIT CONVERTER
For computers not capable of split baud rates. Buffers characters at 1200 and converts to 75 baud
Cat. X19105 **$99**

MODEM PHONE
Check the features and the value for money of this stylish new modem phone...
- Auto/Manual Answer, Manual Originate, Auto Disconnect.
- Carrier Detect Indication. 20 Memories (each with 18 Digits Capacity) for Auto-dialing.
- BELL 103 CCITT V21 Compatible.
- 300 BPS Full Duplex.
- Last Number Redial.
- Pushbutton Keyboard.
- Volume High or Low Control.
- "In-use" Dialing Indicator.

Cat. X19105 **$199**
(Not Telecom approved)

SOFTWARE & ACCESSORIES

GRAPHIC MOUSE SYSTEM
Now everybody can create superb computer graphics in minutes. Think of how much more professional your work could look with the 'Graphic Mouse'! An absolute must for Apple IIe users. Includes software and mouse.
Cat. X17037 only **$99**

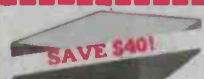
JOYSTICKS

APPLE JOYSTICKS
Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 **$29.95**

JOYSTICK FOR IBM
Features:
- Selectable "Spring centering" or "free floating"
- Electrical trim adjustments on both axis
- 360 degree cursor control

Cat. C14205 **$39.95**

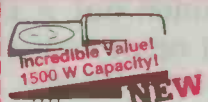
DRIVES



APPLE* COMPATIBLE SLIMLINE DISK DRIVE
Japanese Chinon mechanism
Normally $225 This month **$185**
(*Apple is a registered trade mark)

HARDWARE

130W IBM COMPATIBLE SWITCH MODE POWER SUPPLY
DC output: +5/13A, -5V/0.5A, +12V/4.5A -12V/0.5A
AC input: 240V AC + -15% 1.5A 47Hz - 63Hz
Cat. X11096 **$239**



SUPPRESSION FILTER
- Suppresses over a wide frequency range 100Hz to 50MHz
- Incorporates voltage dependent transient suppression device
- Ideal for word processors, personal computers etc. Will also suppress interference on audio and video equipment
- Voltage drop on full load 1.5 volts
- Earth leakage at 250V 50Hz is 0.35mA
- DC resistance 50 milliohms - series inductance 3.5mH
- Current rating 6 amps at 250V-50Hz

Cat. X10094 **$39.95**

UV EPROM ERASER
Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).
Features include:
- Erase up to 9 chips at a time
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

Cat. X14950 **$89.50**

CARDS

APPLE* COMPATIBLE CARDS

Printer Card Cat. X17029	$89
Drive Card Cat. X17019	$95
80 Column Card Cat. X17025	$109
Speech Card Cat. X17009	$69
Music Card Cat. X17011	$99
Super Serial Cat. X17035	$129
RGB Card Cat. X17039	$79

IBM COMPATIBLE CARDS

MULTIFUNCTION CARD
(384K RAM) Parallel, serial and game port. Plus battery backup clock
Cat. X18013 **$429**

DISK CONTROLLER CARD
Controls 2 slimline drives
Cat. X18005 **$149**

HIGH RESOLUTION MONOCHROME GRAPHICS CARD
Give your IBM real graphics capability
Cat. X18007 **$249**

512K RAM CARD
(Includes RAM)
Cat. X18015 **$399**

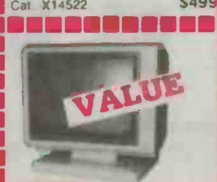
MONITORS

PHOENIX 4
- R.G.B., TTL
- High Resolution
- 13" CRT Dot Pitch 0.31mm
- Horiz. Resolution 720 dots
- Vert. Resolution 240 T.V. Lines
- Display Characters 2000 Ch. (80 x 25)
- 8 Display colours and intensity
- Green text display

Cat. X14520 **$799**

PHOENIX 5
Suits Apple, Commodore, even your VCR!
- Pal and R.G.B.
- Normal Resolution
- 13" CRT Dot Pitch 0.65mm
- Horiz. Resol. 320 TV lines
- Vert. Resol. 560 TV lines
- Display Characters 1,000 Ch (40x25)
- 16 Colours (Pal)
- Green text display

Cat. X14522 **$499**



RITRON 2
Stylish swivel base monitor, available in amber or green.

Green	Cat. X14500	$215
Amber	Cat. X14500	$219

DISKETTES

5¼" FLOPPY DISK SPECIALS!

	1-9	10+
XIDEX		
S/S D/D Cat C12401	$31.00	$29.00
D/S D/D Cat. C12410	$38.95	$36.50
VERBATIM DATALIFE		
S/D D/D Cat. C12501	$27.95	$26.95
D/D D/D Cat. C12504	$39.95	$37.95
VERBATIM VALULIFE		
S/D D/D Cat. C12421	$24.95	$22.95
D/D D/D Cat. C12425	$31.95	$29.95

3½" XIDEX DISKETTES!
Yes, that's right, we now have 'hard to get' 3½" diskettes!
Cat. C12600 S/S box of 10 **$65**

MINI DISK STORAGE BOX
Holds up to 30 x 5¼" diskettes
Cat. C16020 **$16.95**

COMPUTER CASSETTES
Quality 20 minute tapes.
Cat. D11141

1-9	10+	100+
$1.50	$1.40	$1.20

CABLES AND CONNECTORS

COMPUTER LEADS
We have a wide range of computer leads available, all at very reasonable prices!

APPLE:
- Apple II, IIe, II+, with parallel interface card
- Dual 10 pin (20 contacts) connector to Centronics 36 pin plug
- Length 2.4 metres

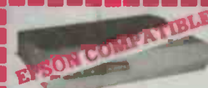
Cat. P19025 **$24.95**

IBM
- IBM PC, XT and look alikes with 25 pin "D" plug on computer end to Centronics 36 pin plug on printer end.
- Length 2.1 metres

Cat. P19029 **$34.95**

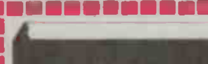
RS232 GENDER CHANGERS
Saves modifying or replacing non-mating RS232 cables by changing from male to female to male. All 25 pins wired straight through
Male to male Cat. X15650 **$19.95**
Female to female Cat. X15652 **$19.95**

PRINTERS



NEW 180 CPS PRINTER! KAITEC KAI 180 EX
Standard 80 column Dot Matrix Printer. High quality printing by NLQ mode. 3K Buffer. High-speed, low-energy consumption 9 wire dot head gives: Printing speed 180 C.P.S.
Logic seeking printing or incremental printing with high response, stepping motor. Use of fan-fold, roll or cut-sheet paper is possible with adjustable sprocket pin feed and friction feed. Both fixed and proportional character pitches are available. Emphasized and double print modes are possible. 9 graphic modes are available. 8 language international character font internalized.
SPECIFICATIONS:
Printing Type: Impact Dot Matrix
Maximum Printing Range: 203mm
Print Types: ASCII 96 Others 7 language
Character Format: Character Mode Standard 9 x 9 dots NLQ 18 x 20 dots Graphic Mode
Printer Modes: (a) Fixed pitch mode (b) Proportional pitch mode
Character Size: 2.42(H)x 1.99(W)
Printing Speed: 180 Character per sec. (pica)
Paper Feed Method: (a) Adjustable sprocket pin feed paper width 4-10 inch (pull through) (b) Friction feed paper width 4-8.5 inch
Interface: Parallel interface 8-bit parallel (Conforms to Centronics)
Cat. C20020 Only **$499**

JUKI PRINTER
Professional daisy wheel printer 18CPS full incremental mode Diablo 630 emulation. Large range of daisy wheels. 8K internal buffer available
Cat. C20040 **$785**



PRINTER RIBBONS
CP80, BX80, DP80, BX100, MB100
$9.90

IBM* COMPATIBLES from $1,495!

Incredible deals to suit everyone including our special package deals!

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

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

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

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

*IBM is a registered trademark

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Rank Electronics Pty. Limited & eti

AUDIO MIXER COMPETITION

$2400 IN PRIZES

4 GREAT VESTA FIRE MR-10

PORTABLE STUDIOS TO WIN!!

★ Multitrack recorder ★ Overdubbing ★ Punch-in/punch out ★ Mix down
★ Ping-Pong ★ VU meter bridge ★ dbx Type II noise reduction
PLUS phono inputs with fader and DIN connectors
VALUED AT $600 EACH

To win one of these great prizes, tell us in 25 words or less of the most original use you can think of for a portable multi-track mixer such as the Vesta Fire MR-10.

Name: ____________________

Address: ____________________

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State: ____________ Phone: ____________

SEND YOUR ENTRY TO: eti The Federal Publishing Company Pty Ltd, PO Box 227, Waterloo, NSW, 2017.

Competition closes 31 December 1985

Winners will be chosen by the Editor of ETI on 6 January 1986 and announced in the next possible issue of ETI. Employees of the Federal Publishing Company and Rank Electronics, and their direct relatives, are ineligible to enter this competition. Entrants from South Australia may enter on a separate piece of paper.

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Look up the name of the advertiser in the index at right and transfer the code number shown to a box on one of the tear-out reply-paid response cards opposite. To specify a particular product, you may need to add a code number (eg, product code number) shown in the advertisement itself. Do this for up to six products, if you wish. Then fill in the rest of the card and drop it in the mail.

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The cards in this issue must reach us before the end of the month of publication (ie, the month on the cover).

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ADVERTISERS' INDEX

Canon 8 mm release

Competition has begun to hot up for the 8 mm dollar. Canon recently released its contender during a press conference aboard a boat on Sydney harbour. The unit was well received by an enthusiastic press corps who spent a delightful few hours swanning about in Style taking home movies of the foreshore and each other.

The Canovision VM-E1 compares favourably with the other runner, Sony's Video 8. It is about the same weight, marginally smaller and has a similar layout and operating procedure. One important difference: the Canon has an auto focus facility.

Canon has been playing up this difference as a fundamental difference in philosophy between Canon and all the other manufacturers, including those who haven't yet released a product in this country. Canon is the only optical company among all the electronic giants. It claims this has given it the edge in designing the optical system, and also allowed it to develop a better, more natural colour.

Certainly the optical system is something to write home about. Centre stage is an f1.2 lens with power zoom between 8.4 mm and 51 mm. If you're a 35 mm camera owner, multiply by four to get an idea of what these numbers mean in terms of frame size. Zooming can be carried out manually or via a rocker switch on the hand grip. This is significant because it's the only function on the lens that is necessary to operate. Everything else is fully automatic.

The viewfinder uses a 0.7 inch black and white CRT with 300 lines resolution. It's located on a detachable beam that runs across the top of the camera. All in all it's a design that emphasises smallness and flexibility, so much so that it probably goes too far for comfort. I found it hard to get my eye lined up comfortably with the view finder without squashing my face against the side of the camera body.

Focusing is via an infrared sensor, the transmitter of which is mounted next to the lens in the pistol grip. The signal is received back through the lens and filtered out of the optical system via a prism. An infrared detector then sends a signal to the focusing computer which controls a motor to wind the lens into focus. It seems that the system looks at about the middle ten per cent of the screen for its information, so in order to bring something into focus it's only necessary to bring it into centre screen. There is a manual override if you want to do something arty with the focus.

There is also an override facility on the iris control, as well as front light and back light switches that open and close it one stop. Special care has been taken to maximise the speed of the lens in order to achieve good low light performance. In fact it can shoot as low as 19 lux, according to Canon. Canon believes low light performance is exceptionally important in a home movie system, because one of the primary applications is to record events inside a home, without the benefit of proper lighting.

Canon has chosen to remain with a picture tube, instead of a charge coupled device as other manufacturers have done. The company's reasoning is that the CCDs are simply not yet developed enough to warrant their inclusion, although there appeared to be a belief that the CCD is the technology of the future.

Playback is via a TV plugged into the back of the camera. It is exceptionally simple. The rf modulator also comes with a charging unit so that the on-board battery is charged up at the same time as the tape is played back. Other power supplies include car adaptors and a mains unit for long indoor sessions.

Canon intends to sell the unit through traditional photographic outlets, rather than electronic stores. This reflects the company's marketing philosophy, which is that the unit is a replacement for 8 mm film cameras, not for ½-inch tape systems like Beta and VHS.

All in all it's an excellent little system, that should do well on the Australian market. I would have liked it even more if the eyepiece had been easier to use.

— Jon Fairall

Yamaha car audio

The Yamaha car audio range has been launched with four radio cassette players, four power amplifiers, two graphic equalisers, eleven sets of speakers and a car compact disc player.

Each radio cassette combination provides the ability to 'add to' at a later stage without having to change the basis of the system at all. This is done by the incorporation of pre-amplified outputs as well as an inbuilt power amplifier. Consequently, consumers can purchase a cassette radio and high performance speakers, later adding graphic equaliser or power amplifier.

Features like auto reverse, separate bass and treble, seek/scan radio tuning, Dolby noise reduction, and music search are standard on all but the base radio cassette player. Added to this, of the eleven pairs of speakers, nine are water and weather proof.

Yamaha's car CD player, the YCD1000, can be utilised in a Yamaha system as well as with other brands on the market that have pre out facilities. The YCD1000 is DIN size and can be dash mounted.

Prices start at around $400 for a radio cassette player and $59 for a pair of speakers. Amplifiers will commence at around $99.

BRIEFS

JVC cassette decks

JVC has developed two new cassette deck models, the TD-W10A and the TD-W20A. The TD-W10A has ANRS/Dolby B noise reduction and features metal tape compatibility. The TD-W20A incorporates double speed dubbing, the Dolby B/C noise reduction system, metal tape compatibility and stereo microphone jacks.

High flying car unit

Sonic International has recently released the Concord HPL 518 AM/FM car radio/cassette with auto reverse, digital tuning with automatic scanning, FM noise reduction, Dolby noise reduction, dc servo tape drive, metal tape facility and separate bass/treble/fader.

Dual receiver

Dual's latest product is the CR1320, a 2 x 40 watt receiver with a quartz synthesised tuner, digital frequency readout, auto scan, and a 7 x 7 station memory. It also includes facilities for connection of compact disc or two tape recorders with direct tape to tape dubbing.

AM/FM stereo tuner

The Carver TX-2 AM/FM stereo tuner with asymmetrical charge coupled FM detector needs only five microvolts in FM signal at its antenna terminal to provide full 50 dB quieting, full stereo separation and full frequency response (20 Hz to 15 kHz ±1.5 dB). With its dark pewter-finish anodised aluminium face plate, the TX-2 is compatible with the Carver M-200t 120 watt per channel magnetic field power amplifier and the Carver C-2 Pre-amplifier.

Midi component system

Sanyo Australia's W-10 is a midi component system with an AM/FM stereo receiver, double cassette deck, belt drive turntable and flat base reflex speaker. The double cassette deck features continuous play from Tape 1 to Tape 2 and back to Tape 1.

Moving coil transformer

The Carver MCt matches the low signal output of a moving coil phono cartridge to the desired input sensitivity of a receiver or pre-amplifier. Mu-metal shielded nickel steel alloy laminations ensure freedom from saturation in bass frequencies and minimise sensitivity from radiated signals from other equipment.

AM/FM car stereo cassette

The model FT-522M has been added to Sanyo's Hi-Fisound series of products which provide 25 watts per channel. Features include metal tape play capability, a tape jamming protector and built-in auto reverse function. FT532M comes with an automatic music select system that automatically finds and plays a chosen song by sensing the gaps between songs on a tape.

Car cassette tuners

The YCT-450 cassette player, in Yamaha's 'Maximum Reception' MR Series, features Dolby B and C noise reduction, metal/chrome compatibility and auto reverse. The tuner is designed to reinforce weak signals as well as to handle excessively strong signals.

Rank distributes Onkyo products

Rank Electronics has made an agreement to distribute Onkyo audio products in Australia. Onkyo's range of consumer electronic products includes the 'Integra' series of hi-fi audio components, plus a range of audio systems.

CD cleaning system

The Nagaoka CD Cleaning System consists of a special liquid formula, a lamb's leather pad and a special cleaning brush. The manufacturer claims it removes contaminants such as fingerprints, liquids, tobacco, smoke, dirt and dust easily and effectively.

Sanyo adds CD player

The Sanyo CP-667 has a horizontal-slide front loading system with all the soft push controls, including the open and close function, actuated by microcomputer. To help prevent damage to the player and discs, incorrectly loaded discs are automatically ejected.

Users can listen to up to 16 selections with the CP-667's programmable auto search system.

Other control functions include pause, access, reset and repeat keys.

A memory touch control will program the compact disc player with your favourite sequence of songs. The track number and index is shown by a multi display fluorescent indicator.

Sanyo's CP-667 comes in silver or black and costs around $429 RRP.

Mechanics improved for phono cartridge

Audio Engineers has announced the release of the Ultra series, a new up-market range of phono cartridges. According to Audio Engineers, Shure has improved the performance of the cartridges by concentrating on the mechanics of mounting.

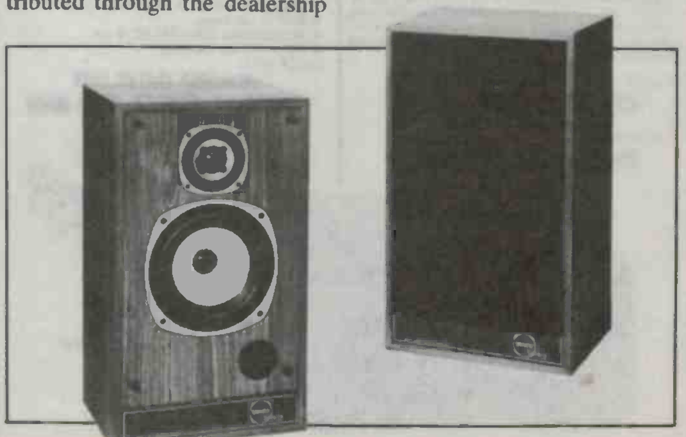
A broader top on the cartridge body is designed for better contact with the tonearm headshell. This mounting arrangement and special headshell bolts are said to significantly improve sound quality by eliminating all resonances.

Tannoy speakers for hi-fi

The British-made Tannoy loudspeakers are now available through specialist hi-fi retailers.

Tannoy is known for its development of the 'dual concentric loudspeakers' and for loudspeakers used by recording studios.

The loudspeakers will be distributed through the dealership network of Rank Electronics. Andrew Harrisson, general manager of Rank Electronics' Audio Division, said the active promotion of Tannoy speakers to the general consumer market was in response to the growing audio sophistication of this sector.



XMAS TIME IS KIT GIVING TIME

(to yourself that is. . .)

Join the Compact Disc Owners Club - ring (02) 747 1888 or call in to one of our stores for details.

NEW KITS FROM JAYCAR

The big news this month is from Electronics Australia. They announce 2 major projects in their December issue.

The first project is the world beating AM stereo/FM stereo fully synthesised Hi Fi tuner. The staff of EA have designed a tuner which they believe has no peer. Nothing from Japan, Europe or the USA can beat it. Because of the complexity, this project will run over several months.

Jaycar as usual will be providing a full kit of this project. It will include a fully punched chassis with all original components. We have not finalised costing yet BUT save your pennies! You won't believe the sound once you have built it.

Project No.2 is a fully functioning 5 axis robot arm with substantial and payload capability. This robot features a unique construction material - blank printed circuit board!! All axes are precision servo-controlled and a considerable amount of software is provided. Truly an exciting and world class project! Also of note is the Dave Tillbrook designed ultra-fidelity preamp. Jaycar will have a full kit of this one too!

☆ ☆ NEW ☆ ☆ Motor/Gearbox Kit

This fantastic new kit enables you to produce a shaft speed between 3 and 2,000 RPM!

It uses a small DC motor with a 'modular' gearbox attached. You are supplied with gear wheels, spacers etc to configure your gearbox to almost any speed within the 3-2,000 RPM range. Measures only 48(H) x 25(W) x 37(D)mm (not including output shaft)

Cat. YX-2600

ONLY $14.95

OTHER POPULAR KITS

Please excuse the lack of photographs - not enough space.

Electronics Australia Popular Kits

☆ Playmaster Series II 200W MOSFET Amp

Cat. KA-1500

Fully integrated amp kit. No compromise type design. A classic.

ONLY $439.00

Car Booster Amp - EA August 1985 - This brute gives you 2 x 50W RMS in your car!

Cat. KA-1600

ONLY $179.00

300 WATT Inverter (New Design) Ref: EA September 1985 - New rugged project featuring high impact plastic case, double power outlets, auto start up, easy construction and lower cost than old model.

Cat. KA-1610

ONLY $199.00

8 Sector Burglar Alarm

Ref: EA January/February 1985 - the TOTALLY PROFESSIONAL alarm for the concerned householder. Very comprehensive.

Cat. KA-1580

ONLY $149.00

"PEST OFF" Ultrasonic Pest Repeller - EA November 1985 - A mozzie season special. See last months EA for more information.

Cat. KA-1620

ONLY $39.95

Bench Type Digital Capacitance Meter - Ref: EA August 1985 - measure from 1pF to 99.9uF with this handy piece of equipment.

Cat. KA-1595

ONLY $79.95

ELECTRONICS TODAY INTERNATIONAL

ETI 5000 Series Amps

Still without doubt our most popular Hi Fi amp kits ever! You KNOW that you always wanted the best. Now that it's Xmas time why not shout yourself a system on your Bankcard?

ETI 699 Modem - Ref: May 1985. One of the most popular ETI kits for years. 300 Baud, built to Telecom specs, and very low cost!

Cat. KE-4695

ONLY $149.00

ETI 1404 4 Input Mixer

Ref: July 1985 - Jaycar's SHORT FORM kit now includes the Cannon connectors at no extra cost.

Cat. KE-4700

$99.00 - A Bargain!!

ETI 341 Electronic Jumper Leads - A nifty and easy way to recharge a flat battery in a car without lifting the bonnet!

Cat. KE-4703

ONLY $39.95

ETI 698 Microbee Dialler - Ref: July 1985 - A handy addition to the 'Bee if you are into communication.

Cat. KE-4696

ONLY $23.95

ETI 342 Pulse Shaped Discharge Ignition

Ref: April 1984 - Brilliant design. A must for high performance ignition enthusiasts. Can be Hall Triggered. Complete kit.

Cat. KE-4690

ONLY $79.50

ETI 675 RS-232 to Centronics Interface

One of our most consistently popular kits.

Cat. KE-4666

ONLY $29.95

AUSTRALIAN ELECTRONICS MONTHLY KITS

AEM 3500 'The Listening Post'

Ref: July 1985 - Decode all that info on your short wave radio to show Morse code, RTTY, Weather maps etc. Wonderful! (A personal computer is required).

Cat. KM-3015

$29.50 Very Popular

AEM 6500 60/120W Utility Mosfet Amp

Modules designed by David Tillbrook. Brilliant performance 60W or 120W versions.

Cat. KM-3010 (60W)

ONLY $49.50

Cat. KM-3012 (120W)

ONLY $65.00

AEM 8500 Courtesy Light Extender

Ref: November 1985 - Fit this to your car and your cabin light will stay on for a specified period - just like the very expensive cars!

Cat. KM-3025

ONLY $8.95

AEM 9500 Beat Triggered Strobe

Dance to the inbeat flash or the strobe or operate it in conventional fashion!

Complete kit.

Cat. KM-3018

ONLY $59.00

Jaycar also carries dozens of other EA kits - just ask!!

MAIL ORDER HOTLINE (02) 747 1888

☆ ☆ NEW ☆ ☆ 300 WATT INVERTER WITH AUTO START

NOT A KIT - BUILT, TESTED & GUARANTEED

This is the built version of the "Electronics Australia" September 1985 project!

Just think how handy it would be to have 240 volts AC mains power when camping, or for your boat or caravan - well this brilliant new design is the answer. ● Super compact - tough ABS case ● Uses high efficiency toroid transformer which keeps the weight down, battery drain and heat dissipation ● Auto start draws power from your battery on when appliance is plugged in and 'turned on' i.e. battery can be left permanently connected ● Thermal overload automatically shuts down if/when output stage is overheated (through high ambient temperature and high load or combination thereof - automatic reset ● Current regulated inverter ensures the unit is being used within designed overload limits ● Current overload unit self limits - LED indicates overload condition.

COMPLETE KIT VERSION

Cat. KA-1610

ONLY $199.00

FULLY BUILT & TESTED

Cat. MI-5000

ONLY $249.00

INFRA RED MOVEMENT DETECTOR

The infra red or IR detector for short, falls into the Black Magic category. It basically is a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna?) which has a "Commutated field of view. Its reception pattern is comb like, but highly tuned to the IR wavelength of human bodies. When a human passes within proximity of the pickup area, the lens will selectively pick up IR radiation and then not. Movement across the pickup area will result in a series of pulses sent to a detector circuit.

IR detectors are very reliable as they do not transmit and will not respond to non heat radiating objects. Curtains, for example, can wave about without tripping the alarm. Even the cat is unlikely to trip the unit.

FEATURES:

- 12V DC powered
- Small 77mm x 62mm x 51mm
- Double sensor
- Computerised OC to lower failure rate
- Built-in test lamp
- Alarm output SPST 30V DC @ 1A
- NO or NC terminations

Cat. LA-5017

SAVE $20.00

ONLY $89.00 ea

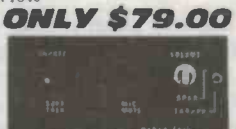
☆ ☆ NEW ☆ ☆ HANDS-FREE TELEPHONE ADAPTOR

Ref: EA November 1985

Jaycar now has stocks of this superbly designed project. Call in and check it out now! Note: this unit is ORIGINAL to the design.

Cat. KA-1640

ONLY $79.00



OPEN THURS NIGHT 'TILL 8.30 p.m. YORK ST. CITY HURSTVILLE CARLINGFORD BRISBANE

AEM 6010 ULTRA FIDELITY PREAMP

Ref: Australian Electronics Monthly

As we write this kit is nearing completion. By the time that you read this we will have the full kit price. Call in or ring us for further details.

Steam Sound Simulator

Ref: EA December 1984

Build this realistic steam sound simulator for your model train layout. It features an infra-red optical switch to synchronise the "chuffs" to the wheel rotation. Like the KA-1561, it picks up the power from the railway tracks. All specified components supplied including 32 ohm headphone type transducer.

Cat. KA-1562

$17.95

"RAILMASTER" Pulse-Power Train Controller

Ref: EA September 1984

This is a state-of-the-art train controller offering tremendous features

- ★ Variable simulated Inertia
- ★ Full short circuit protection including both audible and visual indicators
- ★ Power and track monitoring indicators
- ★ Adequate power for double and triple heading locos
- ★ Fixed 12V DC and 15V AC power for lighting and accessories
- ★ Optional walk-around throttle

The Jaycar kit includes realistic Scotchcal front panel and the special console case only available from us. The large paddle switches have been specially imported just for this kit. We believe that you will be delighted with this unit.

Cat. KA-1560

$89.95

Optional Walk Around Controller Cat. KA-1559

ONLY $9.95

Diesel Sound Simulator

Ref: Ea November 1984

This project mounts inside a model train (i.e. goods wagon) and produces a noise similar to a diesel locomotive. The 'speed' varies according to the throttle action for added realism. All listed parts provided.

Cat. KA-1561

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Cat. XE-4950

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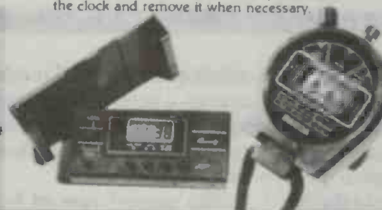

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Cat. XW-0310

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This ultra thin watch is a copy of the latest "high fashion" watches from Japan. Note the triangular yellow function change button on the face of the watch - not the small difficult to operate button normally found on the side.

Quartz Stop Watch

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Cat. YT-6500

ONLY $59.95

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★ It is a clock (an excellent travel clock in fact).
★ It has an alarm in the clock function
★ It is a full function calculator
★ It is supplied with a quality Dralon pouch.
★ It uses readily available AAA batteries.

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Cat. YT-6505

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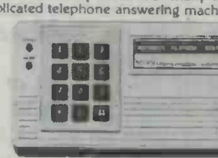

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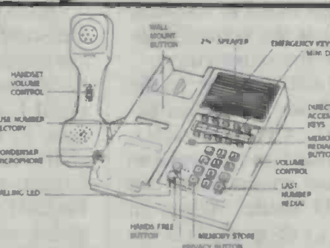

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Cat. YT-7010
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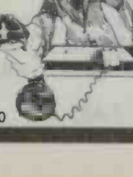

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EQUIPMENT REVIEW

THE RANGE OF THE SCOPE — Gould 1421 CRO

Or the scope of the range? It's certainly a contender. This review describes the functions and features of the Gould 1421 digital storage oscilloscope — and might sort things out.

IN THE ETI lab recently a situation arose which required the measurement of some fast transient current waveforms and switch-on voltage characteristics of a particular circuit. A quick call to Elmeasco soon produced one of the new series of Gould digital storage CROs, the 1421. So while using it to make the necessary measurements I took the opportunity to have a quick play around with the unit and see what it could do.

The unit is a 20 MHz dual channel scope with digital storage capability on both channels. The two channels are identical except for a signal invert facility on channel 2. Physically, the unit is compact (140 x 305 x 460 mm) and logically set out. An 8 x 10 cm rectangular screen occupies the left-half of the front panel and under this are the INTENSITY and FOCUS controls. The INTENSITY control also acts as the power switch. The right half of the front panel contains the remaining controls and the input BNC sockets.

All the familiar CRO controls are there. The sensitivity is switchable from 2 mV to 10 V per division on both channels in the familiar 1-2-5 sequence and is continuously variable within each range using the VAR control. With the VAR control set fully clockwise (an indent pot lets you know when you're there) the channels are in their calibrated positions.

The timebase covers the range 0.5 μs to 0.2 s per division in a 1-2-5 sequence and a button to the right of the timebase control allows this to be extended to 50 s per division when the sampling mode is being used. This extension of the timebase allows relatively long transients to be examined and could be handy for measuring thermal drifts or long time constant transients.

The top right-hand corner of the unit contains two rows of six pushbuttons. The top row contains the NORM/STORE switch to select either normal mode, in which the unit acts as a real time analogue scope, or storage mode. The remaining buttons in this row are only used in storage mode and will be discussed later.

The second row of buttons controls the trigger action and includes buttons for NORMAL/AUDIO, CH1, CH2, ac, dc, + and −. Pressing the CH1 and CH2 buttons simultaneously selects the external trigger and pressing the ac and dc buttons together allows the CRO to be triggered from a 1 V signal. This 1 V coupling consists of an active sync separator with line/frame selected by the timebase switch between 50 and 100 μs/div.

To the left of these rows of buttons are two controls for altering the vertical trace position for each channel. Directly below this are the two VAR controls which vary the vertical sensitivity. While using it, I found that I was constantly reaching for the VAR control each time I wanted to change the trace position; this might have been a fault of the layout or just that I'm too used to my old CRO, which has the vertical position pots directly above the sensitivity.

Between the two VAR controls is the mode selector which allows the choice between x-y, CH1, DUAL, CH2 and ADD. An invert switch is provided on channel 2 so that waveform distortion comparisons can be made in the ADD mode. When in DUAL mode alternate or chop mode is automatically selected depending on the timebase setting. At settings between 0.2 ms and 0.5 μs/div the alternate mode is used. At the slower sweep ranges the signals are displayed in chop mode with a chopping frequency of about 500 kHz.

Digital facilities

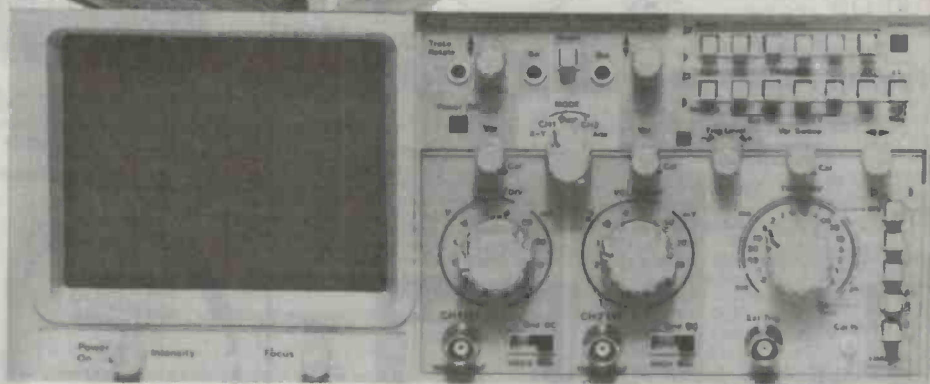
Obviously, the main attraction of this particular CRO is its digital storage capabilities. In STORE mode (selected by a pushbutton on the front panel) the CRO becomes a waveform sampling and storage unit, and in this mode it can be used in several ways.

The row of buttons in the top left-hand corner can be used to select the various data collection and display options available. Incoming signals are sent through an 8-bit analogue-to-digital converter (ADC) and sampled into a 1024 x 8-bit memory store. The sampling speed is dependent on the timebase setting and has a maximum frequency of 2 MHz. As those of you who have heard the name Nyquist will know, this means that, in a one shot sampling situation, the signal being sampled would have to contain only frequency components below 1 MHz. This limits the minimum time for fast transients to greater than 1 μs. For repetitive waveforms with a frequency greater than 1 MHz the CRO uses a repetitive sampling technique to generate a representation of the waveform.

In the unit's continuous acquisition mode (selected by the RELEASE button) data are continuously fed to the memory and can be either continuously fed to the display (ROLL mode), which gives a view analogous to that of looking at the output of a chart recorder, or displayed on receipt of a trigger as in a conventional CRO (REFRESH mode). This has the advantage of giving very low timebase operation with a flicker free display.

A single shot mode is also available which allows the scope to display one-off transients. This is initialised with an ARM button. An LED on the left-hand side of the front panel flashes to indicate that the CRO is ready to receive a trigger. Once triggered the CRO will sample the waveform over one horizontal sweep and display it until the ARM button is pressed once again.

Robert Irwin



The plot

One useful feature of the 1421 is the facility to interface with an x-y plotter. In any of the store modes the screen can be 'frozen' by depressing one of the HOLD buttons. Both channels can be frozen or just channel 2. The displayed waveforms can then be plotted using the PLOT1 or PLOT2 pushbuttons. The interface to the plotter is on the rear of the unit and consists of two 4 mm sockets which fit banana type plugs.

The output voltage has an amplitude of 100 mV/div. There is also a PEN LIFT output which gives a TTL compatible signal to indicate the start and end of the plot.

Also featured on the front panel is a 'calibrator pin'. This pin is an output which provides a 1 V 2% square wave at a frequency of 1 kHz and can be used to check the sensitivity of the instrument or to set any particular calibrated sensitivity.

The horizontal trace can be rotated by a recessed trimpot accessed from the front panel. Two more recessed trimpots can be accessed to adjust the balance on each channel.

In conclusion

In the short time I used the unit I was impressed with its easy operation and versatility. Although only borrowed for one particular need, the 1421 soon became a popular piece of equipment in the lab. With a price tag around the $3500 mark this CRO should be quite a popular unit. That sort of money may seem a little extravagant compared to the cost of normal analogue units but the added flexibility of the digital facilities offered makes this CRO the sort of investment that you are not likely to regret. The 1421 is only one is a series of digital CROs manufactured by Gould. For more information contact Elmeasco, 15 McDonald St, Mortlake, NSW 2137. ●

GOULD 1421 SPECIFICATIONS

Bandwidth (−3 dB):	dc to 20 MHz (2 Hz to 20 MHz on ac)
Sensitivity:	2 mV/div to 10 V/div in a 1-2-5 sequence (cont variable within each range)
Accuracy:	3%
Sweep rate	
normal mode:	0.5 μs/div to 0.2 s/div in 1-2-5 sequence
store mode:	0.5 μs/div to 50 s/div in 1-2-5 sequence (cont variable in both modes): *Note* — x10 pushbutton gives fastest speed of 50 ns/div
Input impedance:	1M /28 pF
Max input:	400 Vdc or peak ac
Trigger source:	Ch1, Ch2 or external
Sensitivity	
internal:	dc 0.3 div to 2 MHz 1 div to 20 MHz ac 0.3 div 10 Hz to 2 MHz 1 div 4 Hz to 20 MHz
external:	dc 150 mV to 2 MHz 600 mV to 20 MHz ac 150 mV 10 Hz to 2 MHz 600 mV 4 Hz to 20 MHz
Input impedance:	100k/10 pF
Input protection:	250 Vdc or peak ac
Digital facilities	
store size:	1024 x 8-bits per channel
resolution:	vertical 30 steps/div; horizontal 100 samples/div
sample rate:	2 MHz @ 0.5 μs reducing in proportion to timebase
Plotting facilities	
y output:	amplitude 100 mV/div
x output:	amplitude 100 mV/div
output impedance:	100R
Operating temp:	0° to 50°C
Dimensions:	140 x 305 x 460 mm
Weight:	6 kg approx

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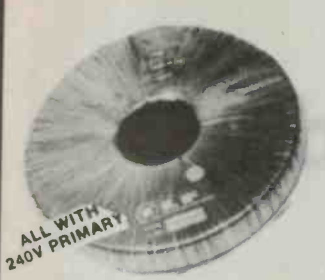

For the same price as your common garden heavy, bulky, buzzing iron (any old iron at that!) transformer you can now design in a superb Toroid Power Transformer from Altronics.

Why a Toroid?

- Smaller size and weight to meet modern "Slimline" requirements.
- Low electrically induced noise demanded by compact equipment.
- High efficiency enabling conservative rating whilst maintaining size advantages.
- Lower operating temperature.
- Simple, quick single bolt mounting.

Cat No.	Sec V	VA	Ea.	10Up
M 3050	12V + 12V	160W	45.00	43.50
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M 3070	35V + 35V	160W	45.00	43.50
M 3075	40V + 40V	160W	45.50	43.50
M 3080	45V + 45V	160W	45.50	43.50
M 3085	12V + 12V	300W	55.00	52.50
M 3088	25V + 25V	300W	55.00	52.50
M 3090	30V + 30V	300W	55.00	52.50
M 3092	35V + 35V	300W	55.00	52.50
M 3100	40V + 40V	300W	55.00	52.50
M 3105	45V + 45V	300W	55.00	52.50

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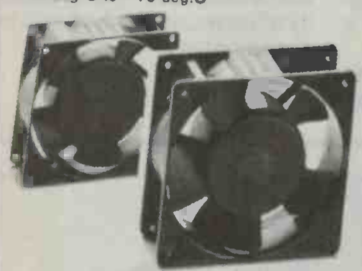

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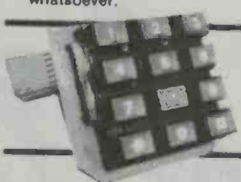
Cat A 0920 **$399**



12 Key Keypad (Commercial Grade)

These sturdy keypads were previously standard supply on STC telecom phones — so naturally the quality speaks for itself — Brand new fully assembled with PCB and 8 way wiring harness. Just the shot for microprocessor assemblies, combination locks etc.etc. A 0495

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If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.

TECHNICAL INFORMATION Illumination: 22W Fluorescent **Weight:** 8.16kg **Lateral Extension:** 254mm **Vertical Extension:** 254mm **Fixing:** Heavy table base (grey & Ivory) with two chrome plated flexible arms. Cat A 0980

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Intel/Signetics accord

A technology and product exchange agreement covering 16-bit single-chip microcontrollers has been reached between Intel and Signetics, a Philips company.

Signetics/Philips will be alternative sources for Intel's MCS-96 family of microcontrollers. The principal member of the family is the 8096. This third-generation microcontroller combines a 16-bit CPU with many input/output (I/O) features on the same piece of silicon.

The agreement follows earlier accords between the companies covering 8-bit microcontrollers and derivatives.

Intel and Signetics intend to work together to define and design 16-bit single-chip microcontrollers that are derived from the MCS-96 family architecture. Each will have the option of manufacturing and marketing on a worldwide basis products developed under the agreement.

Signetics/Philips have been licensed alternative sources for Intel's 8-bit microcontrollers since 1977. This new agreement is a natural extension of existing co-operative efforts on the MCS-48 and MCS-51 microcontroller families, according to a spokesperson for Philips.

As well as contributing to the establishment of the 8096 architecture as a world standard, Signetics/ Philips intend to develop application-optimised versions when appropriate.

Philips and Signetics plan to sample the 8094, 8095, 8096 and 8097 during 1986. The availability of derivative products will be announced at a later date.

Philips SMDs

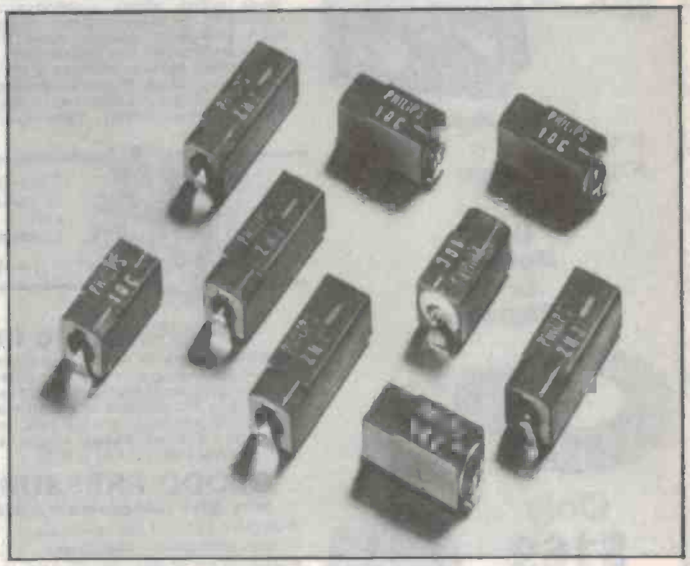
Philips Scientific and Industrial is now supplying a series of wet aluminium electrolytics for surface mounting, suitable for all current soldering methods including the recently developed vapour phase method.

The 085-series SMDs can be totally immersed in a solder bath at 260°C for 10 seconds. These new wet electrolytics will compete with solid tantalum SMD capacitors, as they offer comparable performance at almost half the price.

The electrolytic cell consists of etched aluminium foil electrodes separated by an electrolyte-impregnated paper strip.

It is sealed into a tiny aluminium can which is then housed in a rectangular plastic case. Two case sizes are available: 9 mm x 4 mm x 4 mm and 12 mm x 4 mm x 4 mm. The new capacitors are mainly for smoothing, coupling and decoupling in consumer applications such as audio and television circuits. They can also be used in general industrial circuits, for example, timing and delay circuits.

For further information contact **Philips Scientific & Industrial, 25-27 Paul St, North Ryde, NSW 2113. (02)888-0403.**



Robotics camera

The CCD4001 robotics camera is a small, rugged, solid-state unit designed for use in industrial environments. The CCD4001 incorporates a 256 x 256 element sensor with a square pixel pitch format. The camera can provide NTSC television video output signals for display of images on standard monitors or for digital analysis using NTSC image processing equipment.

The camera output is a 525-line interlaced format with a resolution of 256 lines per field by 256 elements per line. Each frame of video is composed of two identical fields.

The camera can be used as a single-piece unit or separated into a camera control unit and sense head connected by a flexible cable. The small, rugged, lightweight sense head is designed to tolerate high acclerations and vibrations which might be encountered on a quickly moving robot arm.

For more information contact **Fairchild Australia, 366 Whitehorse Rd, Nunawading, Vic 3131. (03)877-5444.**

Bubble memory module

The Fujitsu Bubble Memory Module series consists of a bubble memory device and peripheral linear ICs mounted on the same package. The BMM series modules use TTL level I/O, so only some control ICs are required to create a reliable maintenance-free, solid-state file memory.

All components use TTL level I/O. From 128K up to 4 MB can be directly controlled, and high-speed file memories with an access time of 12.5 ms can be created.

Specifications include minor loop memory capacity of 1,075,722 bits (2053 bits x 524 loops). Boot loop memory capacity is 4106 bits. Data transfer rate is 100K bit/s. Access time is 11.2 ms. Power source is +5 V ± 5%, 110 mA, +12 V ± 5%, 18 mA, −12 V ± 5%, 190 mA, −5 V ± 5%, 20 mA. Dimensions are 65.5 mm x 43.5 mm x 14.1 mm; structure is 40-pin DIP and the BMM series weighs approximately 75 grams.

For further information contact **IRH, 32 Parramatta Rd, Lidcombe, NSW 2141. (02)648-5455.**

BRIEFS

Source for 6800s and 68000s

Thomson Semiconductors has been licensed by Motorola to produce the 6800 and 68000 series microprocessors, derivatives and peripherals. The range includes approximately 60 devices in NMOS and CMOS including 8-bit 6800, 6802, 6803, 6804, 6808 and 6809; and 16- and 8-bit 68000, 68008 and 68010. Recently Thomson has also been given the sole licence to produce the 32-bit 68020. For more information contact Promark Electronics, PO Box 381, Crows Nest, NSW 2065.

Improving EPROMs

The M2716 is a 16K ultraviolet erasable and electrically programmable read-only memory (EEPROM). It operates from a single −5 V power supply, has a static standby mode, features fast single address location programming, and makes designing with EPROMs faster, easier and more economical. With its single 5 volt supply and an access time up to 350 ns, the M2716 is ideal for use with the newer high performance +5 V microprocessors such as the Z8, Z80 and Z8000. For more details contact Ellistronics Pty Ltd, 797 Springvale Rd, Mulgrave, Vic 3170. (03)561-5844.

IC temperature controller

The Telefunken U263B is a monolythic triac driver with inbuilt temperature sensor and zero voltage synchroniser for controlling heater loads. The IC is housed in an 8-pin mini DIP, runs on 240 Vac and features simple circuitry. It is suitable for low cost, simple heating controllers for domestic and industrial use. For more information contact Promark Electronics, PO Box 381, Crows Nest, NSW 2065.

'Wide-angle' LEDs

Siemens now has 5 mm LEDs with an increased half-intensity angle of 80 degrees. The new 'wide-angle' components come in four colours — standard red, high efficiency red, yellow and green. The maximum luminous intensity is 32 mcd at a forward current of 10 mA. The range also includes standard 5 mm LEDs with 50-degree angles. Further information is available from Siemens, 544 Church St, Richmond, Vic 3121. (03)420-7204.

9450 processors

Fairchild has developed a 16-bit floating point microprocessor, the F9450. Combining Isoplanar Integrated Injection Logic technology with architectural innovations, the F9450 fully implements the mature instructions set architecture of MIL-STD-1750A. Several support circuits are offered, including the F9451 memory management units and the F9452 block protect unit, and a comprehensive set of hardware and software development tools is also available. The CPU has 16 user accessible general purpose registers.

High speed static

Motorola has introduced the MCM6164, the first of a family of 64K high speed static random access memory devices. Fabricated using Motorola's high density HCMOS III technology, the MCM6164 design uses 1.5 micron rules to maximise speed and minimise power consumption.

Element line scan sensor

The CCD151 is a 3456-element line image sensor designed for page scanning applications including facsimile, copier, optical character recognition and other imaging applications which require very high resolution, high sensitivity and high data rates. It provides a 400-line per inch resolution across an 8½-inch page which is double the international facsimile standard and satisfactory for many copier applications. For more information contact Fairchild Australia Pty Ltd, 366 Whitehorse Rd, Nunawading, Vic 3131. (03)877-5444.

Video display, graphics controller

Intel has announced a new chip that combines video display and graphics control functions on a single chip. The 82716 is aimed at such applications as low-cost video display, graphics and videotex terminals as well as personal computers. The chip's high level of integration allows manufacturers to build in graphics capabilities while improving the reliability of displays by keeping the number of components low. More details are available from Intel Australia Pty Ltd, Level 6, 200 Pacific Hwy, Crows Nest, NSW 2065. (02)957-2744.

Modulation at 860 MHz

A new modulator IC marketed by Siemens considerably raises the previous frequency threshold (around 600 MHz) for such devices. The 5660 IDA operates on the rf level at frequencies from 30 MHz to 860 MHz. This enables the signals (picture and sound) for UHF and VHF to be modulated and mixed on a single chip.

The TDA 5660 is suitable for use in TV sets and video devices, cable and TV converters, video generators, domestic video monitoring systems, amateur TV and PCs.

With FM modulation, the sound signal vf is capacitively coupled to pin 1. The carrier spacing for picture and sound can be modified by applying a voltage to pin 16 which deviates from the internal reference voltage. For AM modulation, the sound signal is capacitively coupled to pin 16; pins 1 and 2 are simply interconnected.

The video input processes frequencies of between 0 and 5 MHz, the sound input frequencies of between 4 and 7 MHz and the frequency for the compound output signals lying between 30 and 860 MHz. Previously, the upper frequency range had to be covered by discrete circuitry, but with the TDA 5660, this can be completely dispensed with.

For more information contact **Siemens, 544 Church St, Richmond, Vic 3121. (03)420-7204.**

The M68000KIT

Motorola has assembled the M68000KIT, a design package which enables the design engineer to develop M68000-based systems. The design kit contains the MC68000 and MC68008 microprocessors, six peripheral devices, related data sheets, application notes and supportive documentation.

Included in the M68000KIT are the following devices: the 68000 16-bit microprocessor; the 68008, an 8-bit external data bus version of the MC68000; the 68230 parallel interface timer; the 68901 multifunction peripheral; the 68440 dual DMA (direct memory access); the 68652 multi-protocol communications control; a 68661 enhanced peripheral communications interface; and the 68681 dual universal asynchronous receiver/transmitter.

A complete library of Motorola documentation in the M68000KIT supports system design. Programmer's reference manuals, instruction reference booklets and programming reference cards for the MC68000 and MC68008 are included. For all devices the M68000KIT provides data sheets, application notes and article reprints with actual system design examples. A catalogue lists software and system level hardware available to support the M68000 family.

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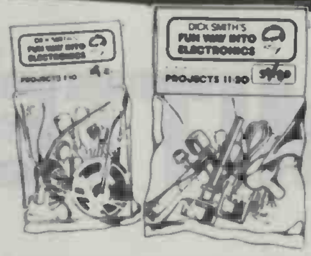

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SEE PAGE 108 FOR ADDRESS DETAILS

DICK SMITH ELECTRONICS PTY LTD

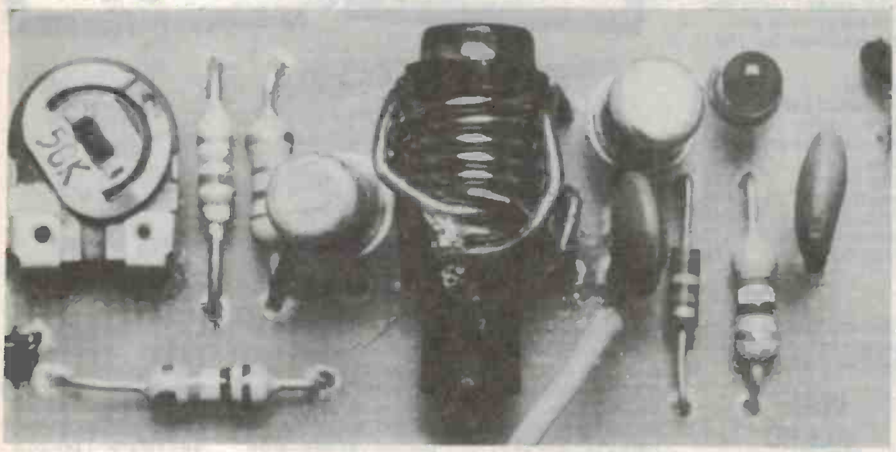
Project 751

MINIATURE FM TRANSMITTER

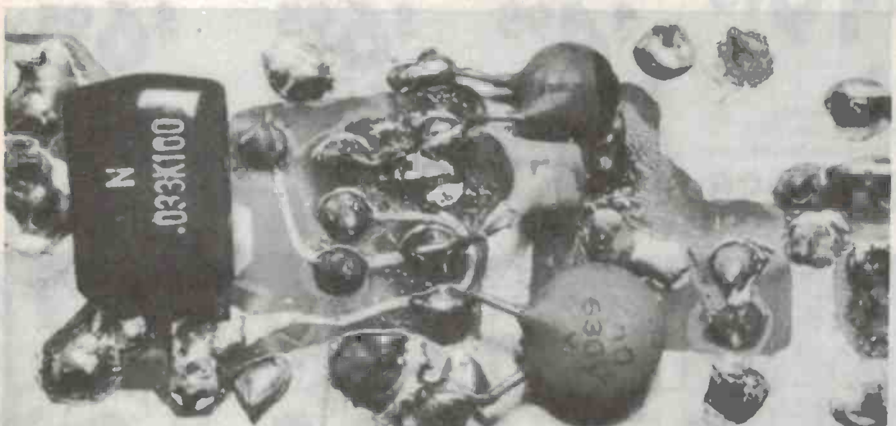
S.K. Hui

Jon Fairall

ETI continues its quest for smallness almost to vanishing point. The biggest part of this ultra tiny device is the battery. A fun project for Christmas.



Both sides of the board. Note the capacitors soldered to the bottom.



WE HAVE PUBLISHED several extremely compact projects recently. These have included the transmitter section of the optical car alarm switch (September '85) and the ETI-741 radio mic (January '85). For one reason or another both these projects were extremely complex and building them required considerable experience and a good deal of patience.

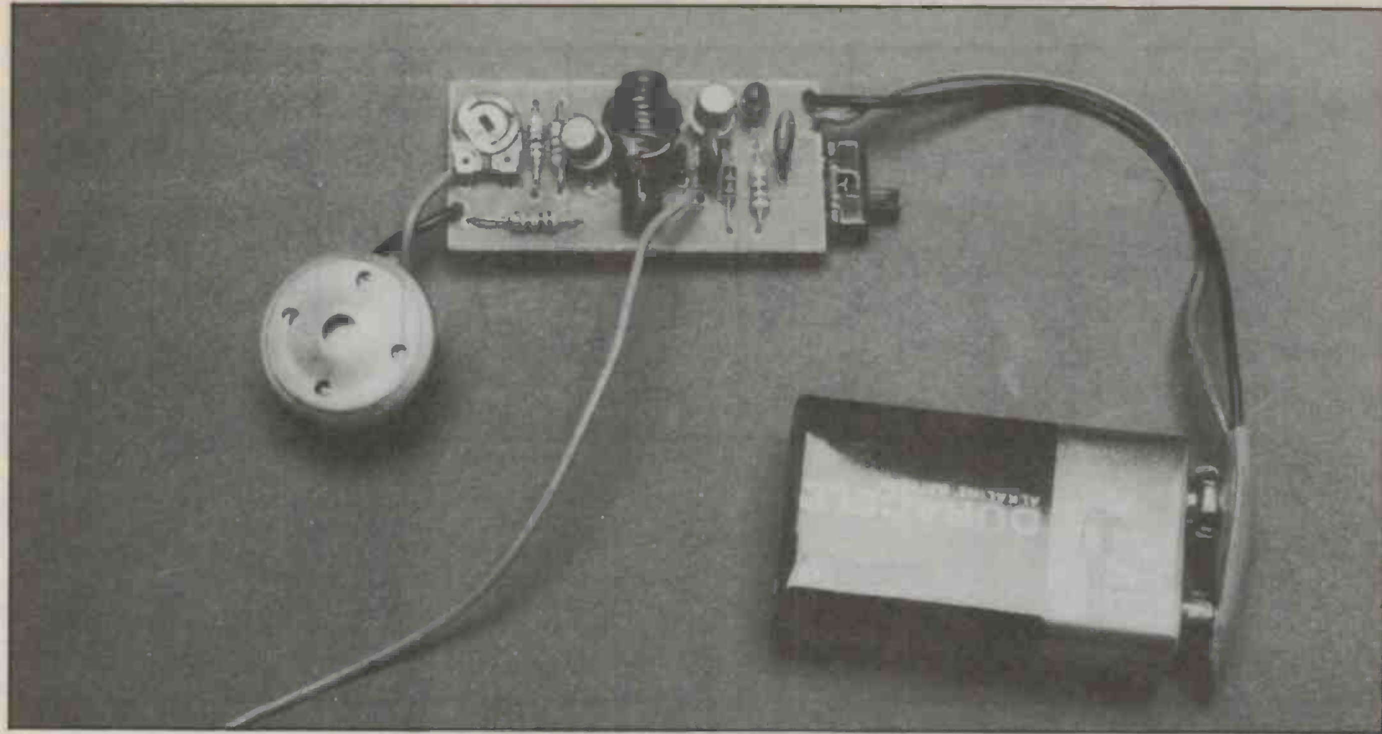
Here we publish something that's ultra small and easy to build. It's a minimum component radio transmitter operating at the bottom of the VHF radio band, somewhere around 88-90 MHz. We make no great claims for its fidelity, (strictly lo-fi) but it is perfectly adequate for transmitting speech over distances of 15 to 20 metres indoors, and further distances outside.

The design emphasises simplicity to the exclusion of almost every other consideration. The audio frequency from the microphone modulates a tuned circuit formed by the coil and some capacitors to derive an FM signal in the text book manner. Output from this is buffered and amplified by a single transistor amplifier and then fed to an aerial.

Construction

Construction is quite straightforward. First check the circuit board. Notice that it is rather small, so check that the etchant hasn't eaten right through the tracks anywhere, and also that no bridges remain where they shouldn't. It's a good idea to clean the board with some abrasive cleaner and plenty of water at this stage — that way you get to look at it closely.

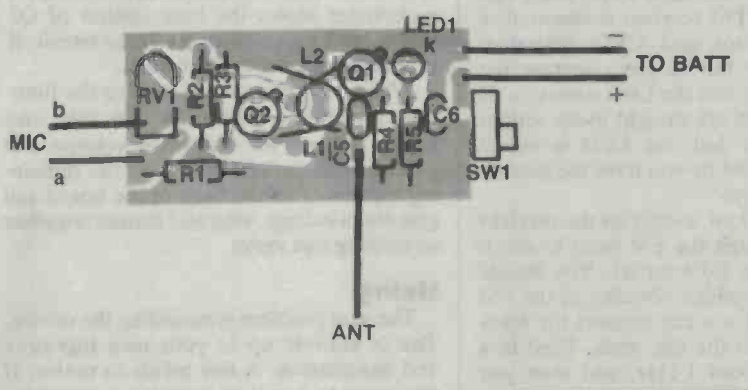
If the board hasn't already been drilled, do it now. Note that some of the components are soldered on to the back, so some of the pads don't have holes in the middle of them. Don't drill these out.



Now begin to solder the components on to the board. Begin with the resistors, then solder the two microphone leads into place. Then place the variable resistor. Do it in this order because one of the mic leads goes under the resistor, and it's rather tricky trying to get the wire into place if the resistors are already there. When you've done this, solder the two capacitors that fit on the component side into place, then the two transistors and the LED. Check the orientation of these components.

Now turn the board over and place the switch and four capacitors on the back. The easiest way of doing the capacitors is to first bend the legs at right angles about one mm from the component body. Cut the leg about one mm from the corner. Now drop some solder on to the pads, rest the capacitor on top of the fillet and apply some heat to the leg. This will heat the solder below and the component will sink into it. Apart from anything else, this method means you never need more than two hands for the operation. (Have you ever noticed how often in electronics you need one hand to hold the board, one hand for the component, one for the solder and one for the iron? If God had meant us to be electronic technicians we would all look like a multi armed Buddhist statue.) When you've finished this, fold over the 33n greencap, but leave the others standing upright for the time being.

Now comes the fun part — winding the coil. First wind on two turns around the former, cut the ends off and tin them. This forms L2. Next do the same for L1 making eight turns, and solder the four ends on to the board. Finally, solder the battery leads and the aerial in place, and go back over your work, searching for misplaced components, solder bridges or splatter.



PARTS LIST — ETI-751

Resistors .... all ¼ W, 5%

- R1 .... 10k
- R2 .... 82k
- R3 .... 2k2
- R4 .... 560R
- R5 .... 470R
- RV1 .... 50k

Capacitors

- C1 .... 33n greencap
- C2, 6 .... 1n ceramic
- C3 .... 1p ceramic
- C4 .... 3p ceramic
- C5 .... 100p ceramic

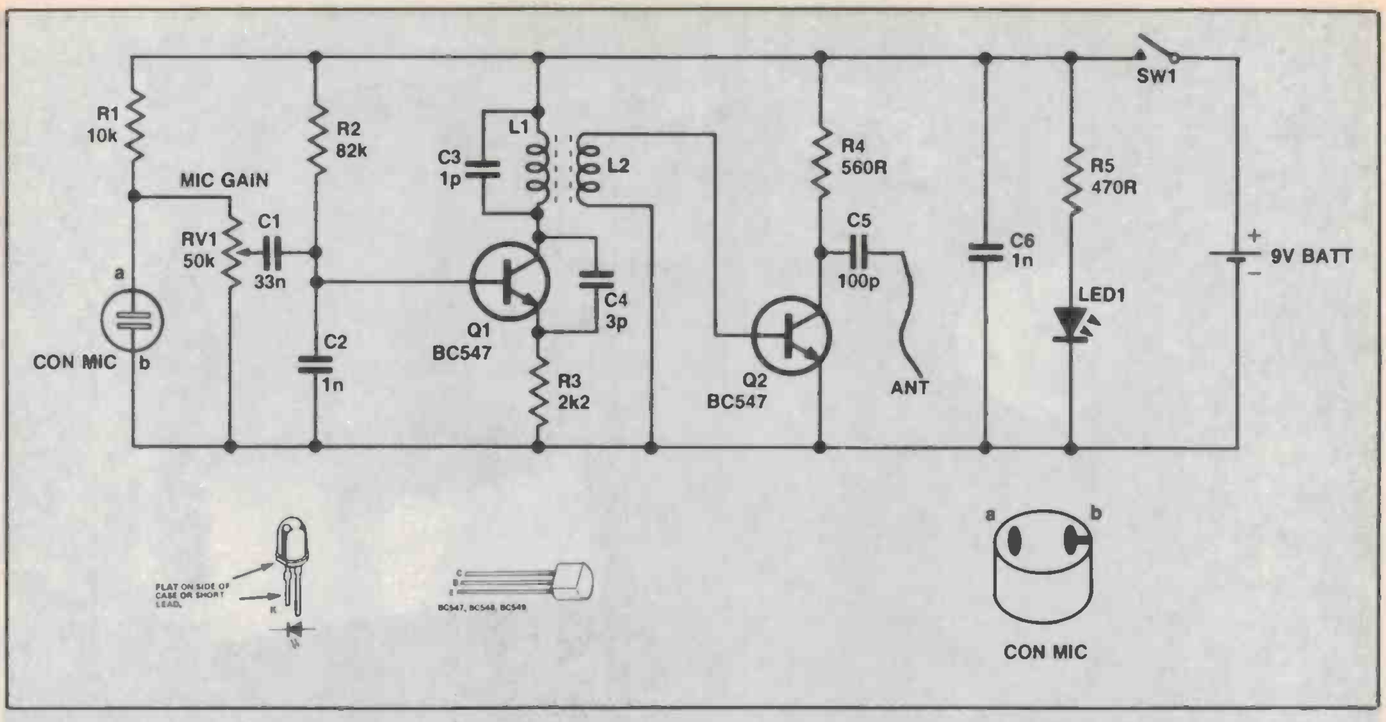
Semiconductors

- Q1, 2 .... BC547, '549 or equivalent
- LED1 .... 3 mm round LED

Miscellaneous

1 x 5 mm coil former, DSE Cat L-1010, together with a ferrite core like DSE Cat L-1302 and some enamelled 0.8 mm winding wire like DSE Cat W-3120; one ultra miniature SPDT slide switch (DSE Cat S-1015). The microphone should be an electret type — we used the DSE C-1160. A battery type 216 snap connector and 1300 mm of thin hook up wire to serve as the antenna.

Price estimate: $8.50



Setting up

At this stage, you need some other bits and pieces. An FM receiver is essential, a function generator and CRO desirable. Firstly, connect the battery, operate the switch and check that the LED comes on. If it doesn't, switch off straight away. Either the battery is a dud, the LED is in the wrong way around or you have the battery leads swopped over.

With the LED on, switch on the receiver and sweep through the FM band to see if you can find the 751's carrier. You should detect this as a sudden silencing of the FM noise. It helps if you can connect the function generator to the mic leads. Feed in a sine wave of about 1 kHz, and then you should hear tone from the receiver when you're tuned in.

More than likely you will find nothing on this first attempt. Tune the receiver to about 88 MHz, right at the bottom of the FM band, and screw the slug through the barrel. Still no luck? Carefully remove one side of L1 and take a turning off the coil, and then repeat the whole process. The frequency of the coil is quite sensitive to the number of turns and the position of the slug, so you may have to do this a number of times. We eventually got ours set up at about six turns.

It's a good idea to put on more turns than you need. That way you know that if it's not tuning properly you must remove coils. Also, if you need to increase the number of turns, you don't have to start right from the beginning again with a new piece of wire. Be careful to use the minimum amount of heat possible during all this resoldering, to avoid damaging the tracks.

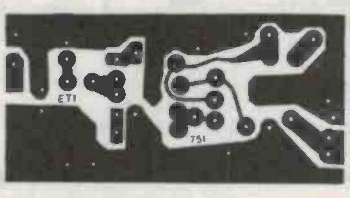
If you have trouble during this stage of the operation, a CRO is very helpful. If you probe the collector of Q1 you should see the oscillator waveform, which will tell you what is happening. If you don't have access to a CRO that will run about 90 MHz, a multimeter across the base emitter of Q1 will at least prove that part of the circuit, if it reads approximately 0.6 volts.

When you get it set up remove the function generator, solder in the mic and adjust the pot for maximum volume and minimum distortion. Fold over the remaining capacitors on the back of the board and glue the windings, slug and former together so nothing can move.

Using

The next problem is mounting the device. This is entirely up to your own ingenuity and imagination. A few points to notice. If you want to use it to monitor a particular position, you may not need the switch. In that case remove it and bridge across the switch pads with a bit of wire. The LED then serves very little purpose, so you may wish to consider removing it together with its associated resistor. As a bonus this will also reduce battery drain.

However you do it, make sure the mic is securely mounted. If you leave it to dangle off the leads it won't last long. If you intend mounting the device in a case things will take care of themselves. If not, consider using a short piece of one of the component legs instead of wire for the connection. That should lead to a sufficiently stiff mounting. ●



HOW IT WORKS — ETI-751

The principle of the circuit is obvious but the exact solutions for characteristics of the oscillator are hard to calculate. Making rough approximations on the way, we found that the inductor L1 would be somewhere around 500 nH. A working sample of the inductor was actually measured under the L-C-R bridge. We obtained a value which is fairly near to the calculated one.

The signals picked up by the condenser microphone are ac coupled to the transistor Q1. RV1 can be manually set to attenuate this coupling. Varying this pot will affect the sensitivity and the distortion of the circuit.

The ac signal from the microphone will vary the ac emitter current of transistor Q1. This changing current changes the effectiveness of the capacitor C4 as seen by the tuned circuit formed by L1, R3, C3 and C4. The apparent changing capacitance of C4 shifts the oscillation frequency of the tuned circuits.

Capacitor, C4, also plays an important feedback role keeping the oscillator oscillating. The free running frequency of the tuned circuit with no input microphone signal is around 88 MHz. This is the carrier frequency. The modulation of this frequency by the microphone signal generates the FM signal which can be picked up by a normal radio.

To stop the antenna from loading the tuned circuit directly, a secondary wiring is used to couple the signal to transistor Q2. This also introduces a bit more gain to the circuit. If the output resistance of Q1 is Ro and the input resistance of Q2 is Ri, the turns ratio N of the transformer formed by L1 and L2 is given as:

$$N = k \frac{Ro}{Ri}$$

where k is the coupling between the windings. Its value depends solely on the material of the slug. The LED and R5 form a circuit ON indicator when the battery is connected to the circuit.

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Project 684

INTELLIGENT MODEM

Part 1

'Modem' holds its place but shakily in most peoples' computer vocabularies. They might be able to tell you what it does but be hard put to tell you how. ETI intends to let all caring people into the mystery workings of modems with this intelligent, auto dialling, 1200/75 baud, 'world beating' modem which even operates when you're not there. Tutorial 1 begins by comprehensively explaining operation and design considerations.

S.K. Hui

DON'T BE DISAPPOINTED that the World Beating modem we promised isn't explained completely in this one issue. A sophisticated project like this deserves a full treatment and it's just too difficult to explain so many things in a few pages in just one article. And it's always safer to build something that you can understand from the start.

Saga of the project preparation

I know there are a lot of well educated ETI readers out there who have known the theories of modems for years, but knowing theories isn't, unfortunately, enough to design a good modem. Telecom safety rules about line interfacing, CCITT standard like the V.21 and V.23 call establishment handshakes etc, all have to be observed. There is a plethora of restrictions and a good modem should comply with them.

The ETI-684 intelligent modem is *not* Telecom approved just by being published (despite that many requests for the design of this modem were actually from Telecom engineers and technicians). *It is your responsibility to seek approval from Telecom before using it.* Obviously, it is a great advantage to your application if you know the safety requirements in connecting private apparatus to the Telecom line. We, of course, don't want to see anyone get hurt or into trouble as a result of using the modem. Some of the important regulations will be mentioned as reminders in this article.

In the development so far, I didn't encounter any real problems with the auto dialling and bell detector circuit. Much time has been devoted to the literature especially Telecom rules, and the rest has been spent on setting up a proper development system. Yes! In fact this modem is going to be controlled by a dedicated microcomputer — well, this is intelligence!

This approach is better than using discrete logic chips. It would cost a fortune if all the complex functions were performed by discrete chips. (A few months ago, a

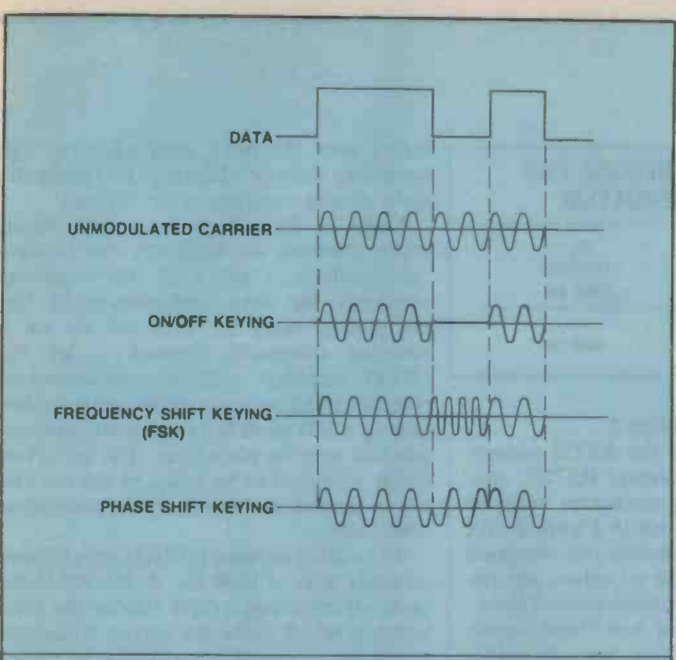


Figure 1. Three different types of modulation.

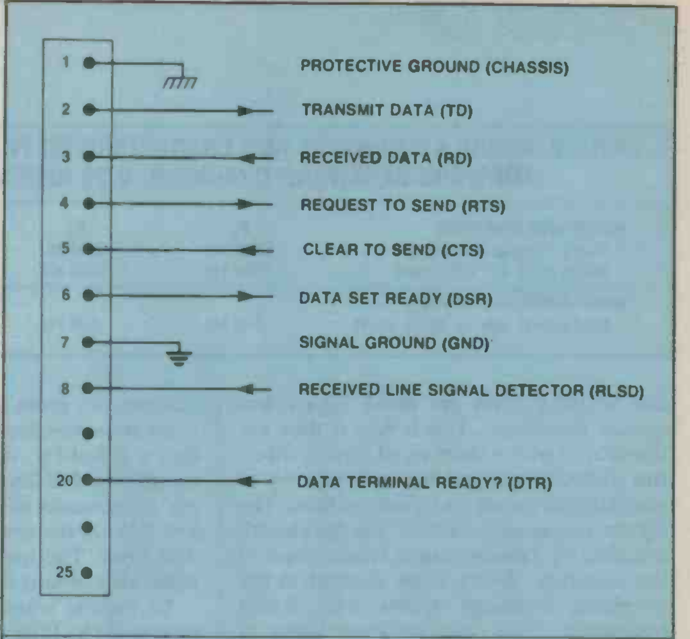


Figure 2. RS232C connector signals.

European magazine published a modem project along these lines. The end product is an extremely complex circuit.) A micro with an inbuilt control program seemed the cheapest solution.

A lot of resources were needed in preparation of this project. I would like to acknowledge D. Anisimoff, C. Begg, G. Taatjes from National Semiconductor for their full co-operation and technical backup on this project. Special thanks are also due to J. Skebe and P.C. Ng for their tremendous help in setting up the development system. With the generosity of Lynstan Microsystems, a development system was used to develop the software for the modem. Thanks to Elmeasco Instruments, the object file was directly down-loaded into a GP-XP640 EPROM programmer (or the GP-XM512 emulator for in-circuit EPROM emulation). This greatly shortened the software development time for the controller of the intelligent modem project.

The following sections will be on the literature side of the modem: basically on the jargon, the theories and a bit of the design approach and specifications of the intelligent modem. This article will provide the necessary background if you want to build this project or simply want to know more about data communications.

What is a modem?

Like humans, computers need to communicate with each other! To facilitate this, information stored in form of bytes in the memory of one computer needs to be transferred to another computer's memory. Two different methods of transfer are possible. The first is the so-called parallel transfer (your Centronics printer works on this principle). As the name implies, all the bits in the byte are transferred at the same time. It is usually done by latching the bits to an eight-stage flipflop with a common clock (trigger). The familiar strobe pulse is used to trigger the flipflops to latch the bits in parallel. This scheme is fast but uses too many wires.

Serial transfer uses fewer wires and is suitable for long distance communications. The serial transfer can be synchronous or asynchronous. In the former case data and clock signals are transmitted simultaneously. The received clock signal is then used to sample the data. Synchronous serial transmission is accurate but an extra wire is needed for the clock signal or a complex encoder is needed to embed the clock to the data signal.

Asynchronous transfer is more usual. The famous RS232C is the typical standard for serial asynchronous transmission. Synchronisation of data and sampling for the receiving end is achieved using the start and stop bits but no clocking signal is sent to the receiver. So, for example, a byte of 8 bits would require a start bit to be transmitted before the transmission of the data bits, then finally a stop bit.

In transferring the data an agreement on the baud rate has to be made between the sending and the receiving end. The baud rate is the number of bits sent per second. Depending on the agreement between the two ends, a special format (protocol) is used. A typical protocol has one start bit, eight data bits, an odd parity bit, followed by two stop bits. The initial start bit resets the local oscillator at the receiving end and the subsequent data bits are sampled by the local timing. The local timing is derived from the local oscillator which is free running at a speed the same as that at the transmitting end. There is no connection between the two oscillators and drift between them is quite possible. Therefore every byte of data transferred has to have the start/stop bits attached in order to re-synchronise at the receiving end.

The parity bit is sent as an error detector bit. It is given a logic value depending on the total number of 1s in the word, which have to match the parity at the receiving end.

What relation does all this have to the modem? The serial transfer mentioned above involves digital pulses travelling along cable which needs an extremely wide bandwidth. Some years ago a bloke called Fourier discovered that any repetitive waveform which is not sine or cosine in shape consists of many harmonics (pure sine waves) with frequencies two, three, four times, etc, higher than the frequency of the original waveform. This means your logic 1s ▶

TABLE 1. RS232C ELECTRICAL SPECIFICATION

Communication rate	0-20,000 bits per second
Driver output voltage levels, maximum no load	−25 V logic 1 +25 V logic 0
Driver output voltage ranges for loads between 3k and 7k ohms	logic 1: −15 V (7k) — −5 V (3k) logic 0: +15 V (7k) — +5 V (3k)
Driver output current, short circuited	500 mA maximum
Driver output impedance with power off	300 ohms minimum
Maximum driver output slew rate	30 volts per microsecond
Receiver input resistance	7k ohms maximum, 3k ohms minimum
Effective rceiver input capacitance	2500 pF maximum
Maximum receiver input voltage range	−25 V to +25 V

TABLE 2. MODULATION RATES AND CHARACTERISTIC FREQUENCIES FOR FORWARD/BACKWARD CHANNELS, V.23 RECOMMENDATION

	F_0	F_Z	F_A
FORWARD CHANNEL			
Mode 1: up to 600 baud	1500 Hz	1300 Hz	1700 Hz
Mode 2: up to 1200 baud	1700 Hz	1300 Hz	2100 Hz
BACKWARD CHANNEL			
Modulation rate up to 75 baud	420 Hz	390 Hz	450 Hz

and 0s pulse train has many higher frequency harmonics. This is fine if they are transferred over a short set of private wires. But Telecom will get furious if you try to pump digital pulses into Telecom lines. The higher frequencies outside the bandwidth specified by Telecom might create chaos in the exchange. Every voice channel in the telephone exchange allows only 3 kHz bandwidth. (This may be even lower in some international exchanges.)

Although Telecom has sharp cutoff filters in the exchange to protect equipment and the quality of the signal against out-of-band signals, you are breaking the *Telecom Act* to transmit anything outside that bandwidth. Even within the band, some of the frequencies such as 700-800 Hz, 2230-2330 Hz, 550-650 Hz are reserved for Telecom uses (see Telecom Specification 1053, Issue 4, Clause 14.1.2). There are a lot of catches to watch out for when you connect something to the lines!

A modem is a device to transform your digital pulses into a form suitable to be transmitted over the telephone voice channel and vice versa. Transformations like on-off keying, frequency shift keying (FSK) and phase shift keying (PSK) all make use of a carrier tone, a pure sine wave oscillating at a particular frequency depending on the data baud rate and the standard (V.21, Bell 202 etc) used. As shown in Figure 1, the digital pulses alter the presence/absence, frequency and phase of the carrier signal. This alteration is called modulation of the carrier. The demodulation process converts the changed characteristics of the carrier back to digital pulses. The most common LSI modem chips will perform both types of modulations using the FSK technique.

Standards

A modem has two friends to talk to: a terminal (or computer) and a remote modem via Telecom lines. Normally, the terminal is close to the local modem. Full digital pulses can be used in communicating between the two without any bandwidth problem.

The RS232C standard, published in August, 1969 by Electronic Industries Association (EIA) in the USA, set down the standard for serial digital communication. The standard defines a set of control signals, voltage swings for the signal, different speeds of baud rate etc. Full electrical specifications are given in Table 1.

Some explanation of the RS232 convention is called for. A standard RS232C connector is a DB 25-way connector with the pin assignments as shown in Figure 2. TX and RD are the transmission and reception data lines. The majority of others are peripherals and host handshake control lines.

To explain when and how these signals such as DTR, RTS, CTS etc are used here is an example: Say the host is a computer and the peripheral is a terminal. To check whether the terminal is on or not, the computer activates the data terminal ready (DTR) line. If the terminal does not respond on the data set ready (DSR) line, the computer simply ignores the terminal. To send something to the computer, the request to send (RTS) signal from the terminal is acknowledged by the activated clear to send (CTS) signal from a free computer. Data can then be sent down to the waiting computer.

The standard is pretty general to cover all sorts of equipment and peripherals employing serial communication. Some of the control signals are therefore redundant in certain applications depending on what type of peripherals are involved. In the above example, the received line signal detector (RLSD) line is not used. This line is also known as the data carrier detect line. It is quite an important line if the peripherals concerned are modem and terminal. It signals the terminal to stop transmitting if the carrier tone in the telephone line is lost.

So much for the standards concerning the digital side of the modem. V.21, V.23, Bell 202 etc, are standards used in the analogue or telephone side of the modem. They define the call establishment procedures for different baud rate transmissions on the telephone voice channel.

The American Bell 202 and the high baud rate standard V.22 cannot be used on a normal 3 kHz wide voice channel without using sophisticated modulation techniques. High baud rate data transmission is usually made by big companies or the military on hired wideband Telecom lines. Some of them allow very high baud rates by employing an encoder. The encoder encodes the incoming data bits from the terminal into a so-called 'symbol'. Several bits usually form one symbol. The symbol runs at a slower rate than the bits but contains the same information. It is the symbols that are actually transferred over the lines, thus allowing high baud rate without violating the bandwidth restriction in a normal voice channel.

None of these high baud rate details really concerns us, however; our modem can handle V.21 and V.23. These are the standards for data transmission at low modulation rates on calls set up on a switched telephone network under the CCITT standard. V.21 is a collection of recommendations and requirements for setting up a 300 baud full duplex communication link over the phone line. The important things you need to be aware of are the carrier tones and the modulated frequencies at both ends.

The calling modem (ORIG) should have a carrier tone of 1080 Hz. A MARK is the result of receiving a digit 1 from the local terminal which shifts the carrier frequency to 980 Hz. A digital 0 modulates the carrier frequency to the SPACE of frequency 1180 Hz. The answering modem, although running at the same baud rate, would have to have entirely different frequencies in a full duplex system. In a full duplex system, both modems are transmitting and receiving at the same time.

The only way for a modem to avoid receiving its own messages is to have a bandpass filter tuned to the carrier from the other side, rejecting the reception of the sent out messages. In a full duplex system, the carriers are at different frequencies. The answering (called) modem, running at 300 baud has a carrier frequency of 1750 Hz. The corresponding MARK and SPACE frequencies are 1650 Hz and 1850 Hz. Call establishment procedures for V.21 and V.23 will be explained further in later sections.

V.23 defines a set of requirements for a split baud rate system. A modem operating at this mode would transmit at one baud rate but receive at another. This is a useful standard in situations such as when people connect to a bulletin board. The central computer has to talk to many users at the same time. It downloads the information at the higher baud rate while the users, who respond much more slowly, transmit to the host computer using the lower baud rate. In many other applications, this slower baud rate channel is used as an error control and/or supervisory channel.

In the V.23 standard, baud rates are handled independently by the main (forward) channel and the backward channel. The forward channel is the one which normally handles the higher baud. The backward channel, as you guessed already, takes care of the lower baud rate. Depending on whether the modem is the calling (ORIG) one or called (ANSW) one, the forward/backward channels can be used for transmission or reception. Telecom's Viatel modems, for example, will have their forward channel transmitting to the users at

1200 bps and backward channels receiving at 75 bps. On the other hand, the Viatel users would have their modems transmitting at 75 baud on the backward channel and receiving at 1200 baud on the forward channel.

According to the V.23 standard, the highest baud rates available to the forward channel are 600 baud and 1200 baud. Only one speed is available to the backward channel, which is 75 baud. The frequencies for these different baud rates are listed in Table 2.

Call establishment procedure

Without the intelligence endowed in us by our creator, making a phone call would be a very difficult task. And just like human beings, once a call is connected, a computer has to identify itself and at the same time, check the identification of the other end. (It's a bit disconcerting to discover that the wrong person has been talking to you only *after* a long conversation.)

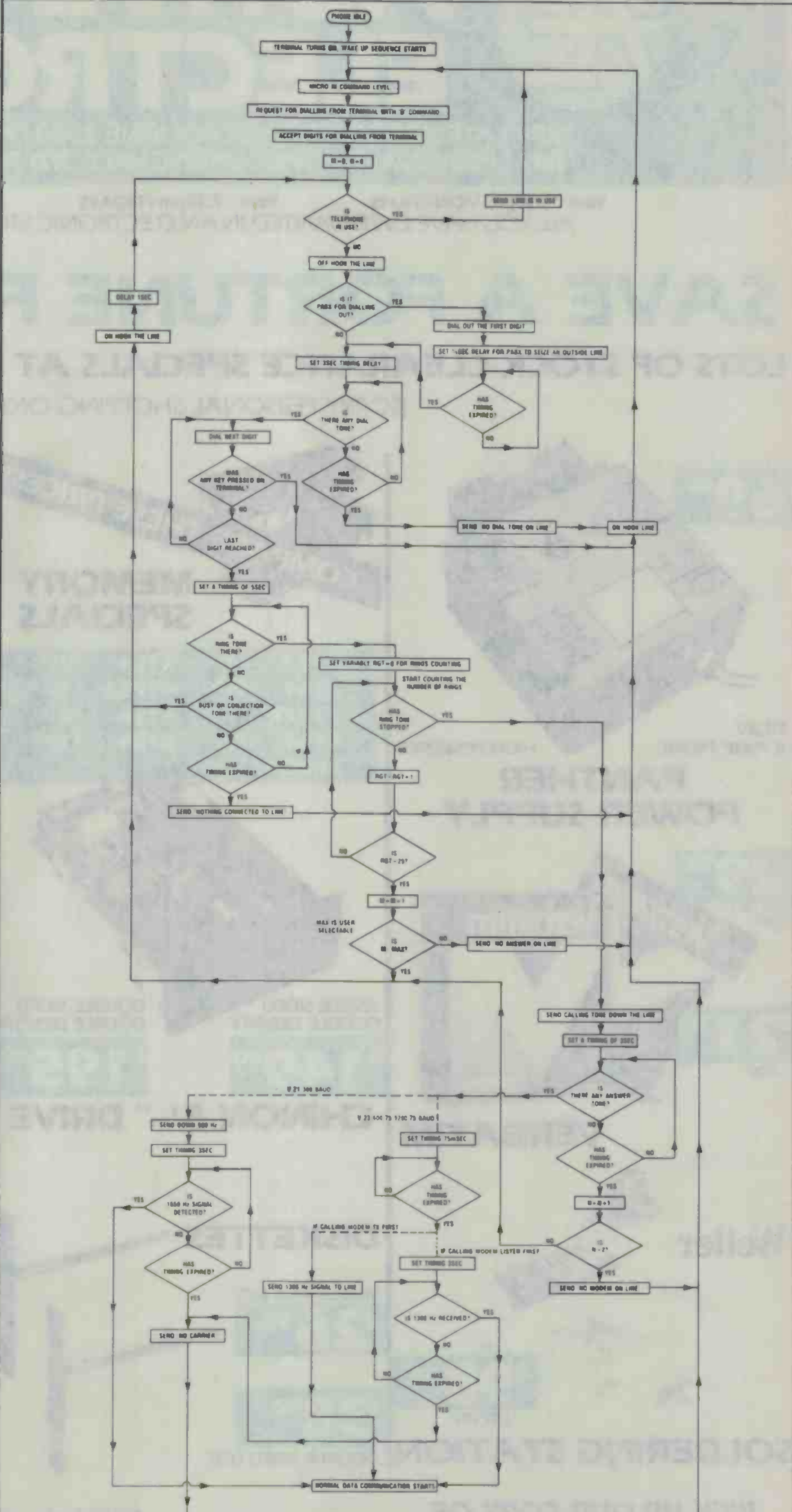
The identification process involves each device sending tones to the other, a bit like in the movie "Close Encounters Of The Third Kind", in which scientists communicate with the UFO using tones from a synthesiser.

Of course, it is all laid down clearly on V.21, V.23, Bell 103 etc, what frequency and duration of the tones is appropriate to that particular standard. Normal data communication can commence as soon as these tones are recognized by the two modems operating on the same standard. Since our intelligent modem is fully automatic, it has to do more than just that. What if the modem call is answered by an unsuspecting human? What if the telephone number given to the modem to dial is wrong? What if the number dialled is busy? And what if the number connected keeps ringing while no one answers? These problems have to be taken into account by our modem, the circumstances weighed up and reaction determined accordingly.

So just how difficult is it to perform the above functions? The accompanying flow charts should give you some idea. Before I go into the explanation of the flow charts, there are several hardware facilities on the modem that you have to be aware of.

In 1977, an American company called DC Hayes Corp introduced the Smartmodem 300 similar to the RS232C standard to the market. This modem was a Bell 103 standard modem which could be commanded by software to handle auto dial, auto answer and its operating mode. Our ETI modem has been designed to handle these Hayes commands as well. There is hardware on board to detect the ring tone, busy tone, the bell signals etc. Furthermore, the ETI modem is capable of generating the necessary tones in V.21 and V.23 standards for modem identification purposes. These ▶

CALLING MODEM FLOW CHART



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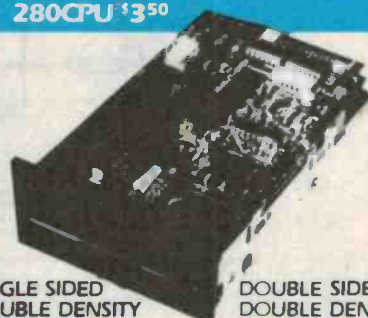

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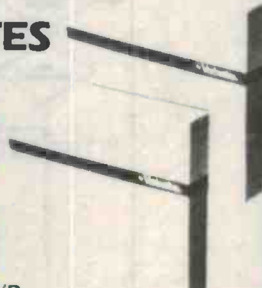

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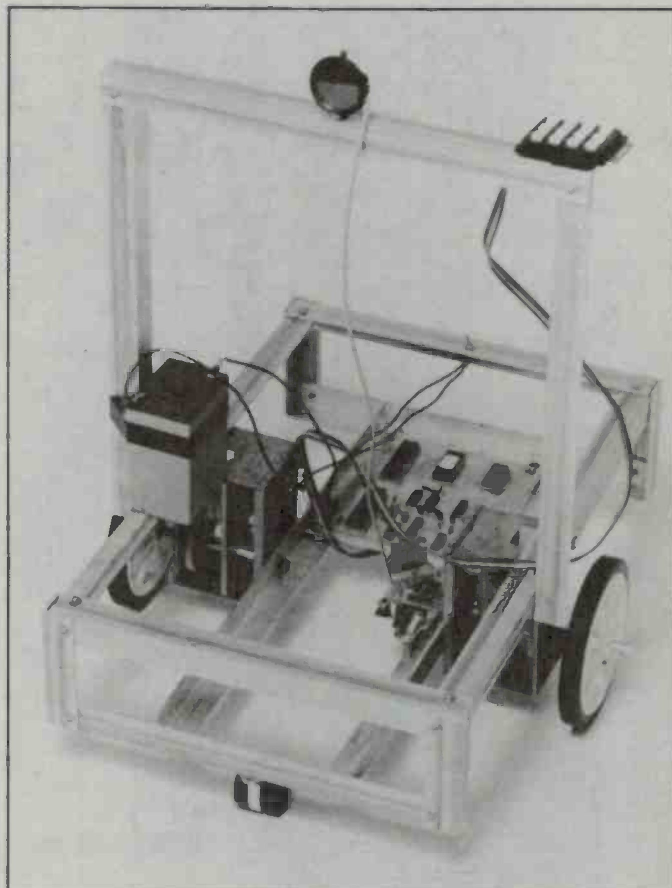

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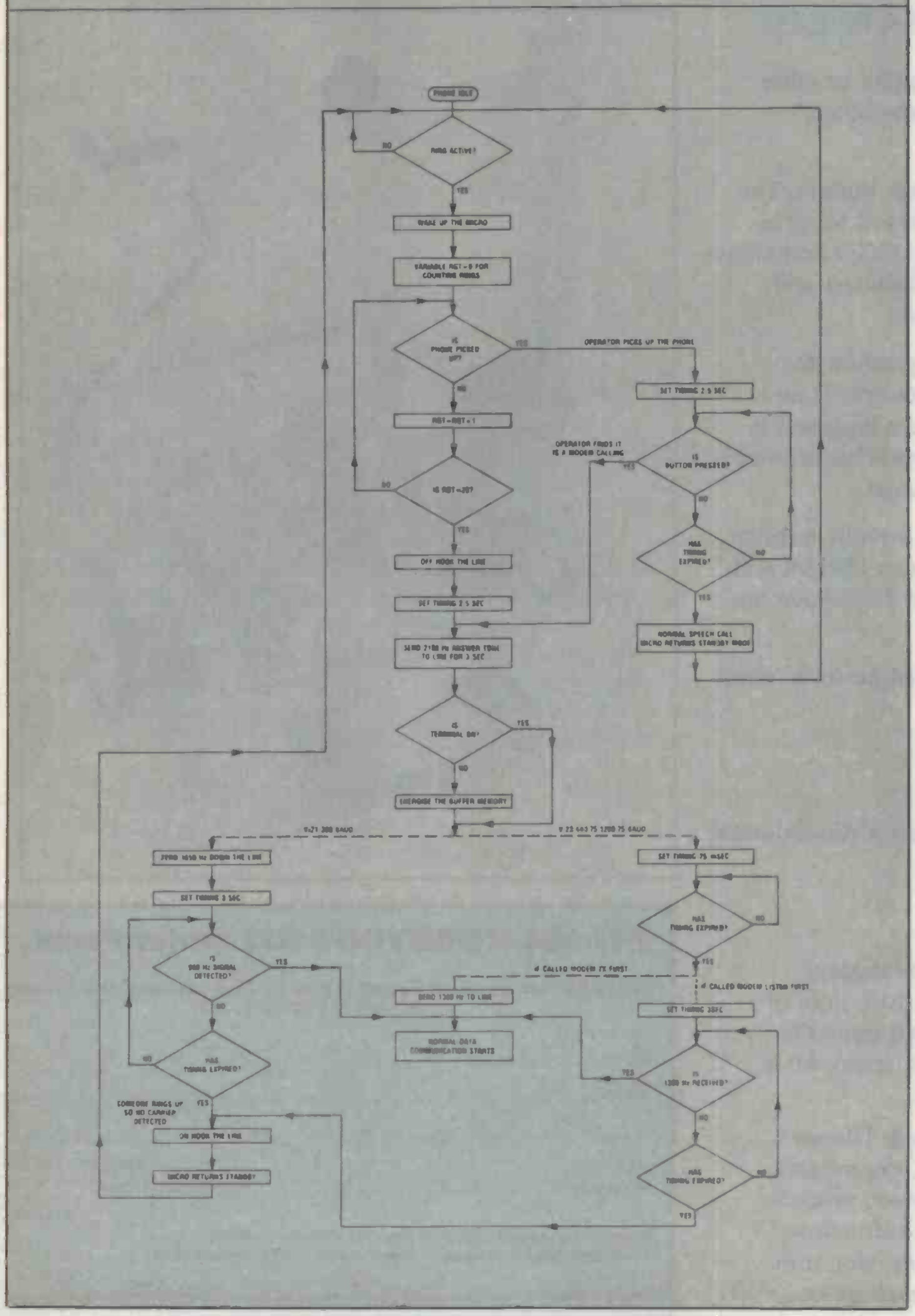
capabilities affect the strategies outlined in the flow charts.

Let's start with the flow chart of the calling modem (ORIG). The modem is woken up from the low power sleeping mode by the DTR signal when the terminal is turned on. To dial a telephone number, a standard Hayes command is typed and transferred to the modem. The micro sets a variable N=0 (the significance of which will become clear later). Before the micro operates a relay to off-hook the phone line, it has to make sure the phone is not in use (Telecom Spec 1255, Clause 9.8a).

If the phone is not being used the micro loops the line and waits for the dial tone to come from the exchange (Telecom Spec 1255, Clause 8.1). If the modem has not received a dial tone after three seconds, a message is sent back to the operator to indicate the Telecom line is unconnected and the dial command is abandoned. The control on-hooks the line and returns to the command level.

CALLED MODEM FLOW CHART



As soon as the dial tone *is* detected dialling starts. It usually takes a short while to dial and any key pressed in this period stops the dialling process — a handy feature if you discover that the number is incorrect. Once the dialling is done, the micro waits for either a busy tone or a ring tone. If neither is detected within the set time, the micro abandons the call. A 'no phone connected at far end' message is sent to the operator's terminal.

If, however, the busy tone is detected, the micro will on-hook the line, delay one second and try again. The micro will keep trying until the far end of the line is free.

Eventually, when the ringing tone is sensed by the micro, it will send a calling tone with frequency 1300 Hz, 0.5 to 0.7 seconds ON, 1.5 to 2 seconds OFF (Telecom Spec 1255, Clause 2.1.3).

The micro waits 25 rings before it abandons the call. It increments a variable M representing the number of call attempts. Before repeating the procedure, the value of M is checked to see if it equals the maximum value (or the number of times the user sets the micro to call an unanswered number).

Given that the phone is picked up within the timing period, the micro sets a 2.6 to 3 second delay and waits for the answering tone at frequency 2100 Hz (Telecom Spec 1255, Clause 2.1.2; also CCITT Orange Book Volume III.1 Recommendation G161). If there is no sign of the answering tone within six seconds of the line being connected, the micro will hang up.

The phone at the other end may be picked up in three different situations: (1) by a normal person; (2) by a computer operator; or (3) by an ETI modem.

(1) In this circumstance, all the answering person would hear is the boring calling tone sent from the calling modem. The respondent does not know what a modem is and naturally, thinks someone is mucking around and would simply hang up. The calling modem, not receiving the 2100 Hz answer tone, hangs up when the timing expires.

Before a second attempt at dialling the same number, variable N (counting the call attempts) is incremented, and a check is made to see whether it has reached the maximum. If it has, the whole thing is abandoned. The maximum value of N limits the number of times the modem calls an unanswered tone and is important since there is always a chance that the user has supplied a wrong number for the modem to dial. The maximum value of N is suggested to be no more than 3.

(2) The interrupting tone indicates the modem has called the computer operator. The operator presses a button on his modem and hangs up. His modem generates the answer tone, the Telecom line is switched to the modem automatically and

TABLE 3. COMMON SERVICE TONE CHARACTERISTICS

Dial tone	Basic unsuppressed carrier frequency of 425 Hz amplitude, modulated with depth greater than 90% of the carrier by a low frequency in the range 16-25 Hz. Dial tone shall be a continuous signal. No significant harmonic power is premitted outside the 400-450 Hz frequency range.
Ringing tone	Same as the dial tone with the cadence of: 0.4 seconds ON 0.2 seconds OFF 0.4 seconds ON 2 seconds OFF
Busy tone	Same basic frequency as the above but with a cadence of: 0.375 seconds ON 0.375 seconds OFF
Congestion tone	Same as for busy tone 0.375 s ON, 0.375 s OFF, but every alternate burst shall be attenuated by 10 +1 dB.

the answer tone sent down the line — so long as the operator works within the time limit of three seconds set by the calling modem. The identifying procedure will then start.

(3) The called (ANSW) modem will wake up from the standby mode when the phone rings. It does not answer the call immediately but waits in case an operator answers. The modem counts 20 rings or so. The auto answer procedure may be either V.21 or V.23 standard depending on the switch setting. The beauty of this modem is that the terminal connected to the called modem does not have to be on when the call is made. The called modem answers the phone and knows that there is no operator. Any messages received will be automatically stored in RAMs on board and the stored messages examined later when the operator returns.

The flow chart for the called modem (ANSW) is quite simple. A bell signal detector circuit is active all the time but the rest of the modem circuit is half asleep. The ringing on the phone wakes up the rest of the circuit. The number of rings is counted. If the phone is picked up before the maximum count is reached (sensed by the absence of the bell), the micro sets a timing loop of a few seconds. The call picked up by the operator may have been made by a human or a calling modem. If the button is pressed by the operator within the set period, the micro assumes the call was made by a modem and auto answer procedure starts immediately. Another timing period is initiated in case a mistake was made in pressing the button. If the auto answer and identification processes are unsuccessful, the micro hangs up at the end of that timing period. If, on the other hand, the button is not pressed within the timing period (it being a normal human call), the modem goes back to sleep.

In the case of there being no one to answer the phone after the twentieth ring, the micro answers the phone. Regardless of who is calling, the called modem sends out the answer tone and depending on what standard it is set (V.21, V.23), it proceeds to sense the calling tone. A timing loop of several seconds is again initiated: if a reply tone is not sensed within the timing period, the called modem hangs up assuming it was a person, not a modem that rang.

It is important to note that, despite no conversation a charge is made for the call and thus the reason why the called modem does not answer the phone until the twentieth ring. How many people would be patient enough to wait 20 rings? It is your job to inform your friends not to wait too long on the phone if it keeps ringing. Hanging up quickly and trying again is best.

A lot of complex procedures in the modem cannot be realised without the ability to detect and distinguish the service tones from the Telecom exchanges. Full details of the specifications of these tones are set out in Telecom Specs 1104, Issue 3. Anyone who is interested can obtain a copy from Telecom. For our ETI readers' convenience, the specifications for the most common service tones are listed in Table 3.

References and bibliography

Telecom Specifications:

1053 — Attachment Of Private Apparatus To The Public Switched Telephone Network.

1036 — Attachment Of Privately Owned Data Terminal Equipment To Telecom Australia Datel Modems.

1051 — Telephone Answering Machines — Technical Conditions.

1055 — Automatic Dialling Alarm Systems.

1104 — Audible Signals For The Australian Telephone Network.

1240 — Attachment Of Privately Owned Data Modems To The Telecommunications Network.

1254 — Line Interface For Remotely Controlled Authorised Apparatus Associated With A PABX.

1255 — Automatic Calling Equipment For Association With Authorised Apparatus Connected To The Public Switched Telephone Network.

1302 — Electrical Safety Requirements For Authorised Apparatus.

1364 — Line Isolation Units.

CCITT Recommendations:

White Book Volume V, Yellow Book Volume III, Volume V and Volume VI, Orange Book Volume III.1 Volume VIII.1.

V.21, V.22, V.23, V.24 Recommendations (Geneva, 1964, amended at Mar del Plata, 1968, and at Geneva, 1972). ●

RSC-FORTH CARD EXTENSION

S.K. Hui

Rockwell's Forth microcomputer card offers the power of a high level language coupled with the speed you could expect at machine level. This, the second in our series on the Rockwell board, describes the implementation of a disk drive and house keeping commands.

EVERY COMPUTER enthusiast has a special regard for the computer manual. Full of jargon and special terms, even the formally trained can find it a little daunting.

Manuals are usually divided into sections, with each section covering a particular command or feature. While individual sections can be quite clear the links between the sections or features can be poorly covered. The other sort of manual of course is the type that is very easy to read but provides only shallow discussion of the hardware and software.

The problems of understanding the computer manual become even greater when you start to work at machine level. The commands needed to store files on a disk, send a file from the screen to the printer or transfer a file from the disk to the printer are no longer self-explanatory.

Fortunately the Rockwell Forth manual is of the type that will become more and more useful as you go along. Unfortunately it is the type that takes some effort to assimilate.

The main approach of this article will be to get you started on the important housekeeping operations so when you make that step into the manual, it will be much less daunting. This approach should suit beginners as well as the computer literate.

The kit

This kit is somewhat different from most described in this magazine. It is based on a Rockwell single-chip computer that has a 6502 CPU, the heart or kernel of the operating system in ROM, RAM, a timer and input and output ports — all on one chip.

The CPU, pc board and any 'rare' parts are available in a kit from Energy Control in Brisbane. The double sided, solder masked and screen printed boards were developed by Rockwell and Energy Control and will greatly simplify construction. In the May issue this year Peter Ihnat described the construction of the basic computer board. A number of extension kits like the one for the disk drive controller described in this article are also available from Energy Control.

The sections of this article are presented in the same order that you will have to follow in setting up your Forth computer board. It will help if you follow this sequence faithfully.

Construction and setting up

Whether you already have the basic computer board or are starting from scratch, construction of the kit is relatively simple. You are less likely to be plagued by forgotten feed through wires and solder bridging as the pc boards are plated through and solder masked. A screen printed component overlay simplifies component placement. As a result these construction hints apply equally to the basic or extension kits.

As usual, insert the least sensitive parts first, placing components in the order of links, connectors, switches, IC sockets, resistors and capacitors before soldering in the ICs or placing ICs in sockets.

Be careful to correctly orientate all ICs and electros. The body of the 2 MHz crystal should be connected to ground by soldering a wire between the case and one of the holes in the board at the side of the crystal package.

There are a number of jumpers on the board marked A, B, M2 etc, which configure the board for different CPU and memory options. The arrangement of the jumpers for this project is shown on the component overlay.

You should now be ready to set up the board for initial testing. Connect 5 Vdc to the terminal block (TB1). Be careful of the polarity of the wires and check that the board draws about 400 mA from your power supply.

To communicate with the Forth board, you will need a terminal. If your terminal outputs true RS232 signals with ±12 V swings, it can be directly hooked to the Forth board. For some other voltages, you could contact our technical service for help.

To connect the RS232 interface, only three wires are needed. J2 on the Forth board is a DB-25 connector intended for an RS232 serial interface. Pin 3 on the connector is the transmit pin and pin 2 accepts serial signals from your terminal. The ground line on pin 7 should join to the ground pin in your terminal.

Now set your terminal to 2400 baud and 7 bit data with two stop bits, no parity check, no echo and full duplex. If your terminal has the X-ON X-OFF option, leave it out. Turn on the 5 V power supply to the Forth card and your screen should display

```
RSC-FORTH V1.7
```

Pressing the reset button on the Forth card or typing COLD then pressing RETURN on your keyboard should cause the same message to be displayed again. A few simple interactive commands can be tried out immediately. Type

```
VLIST [RETURN]
```

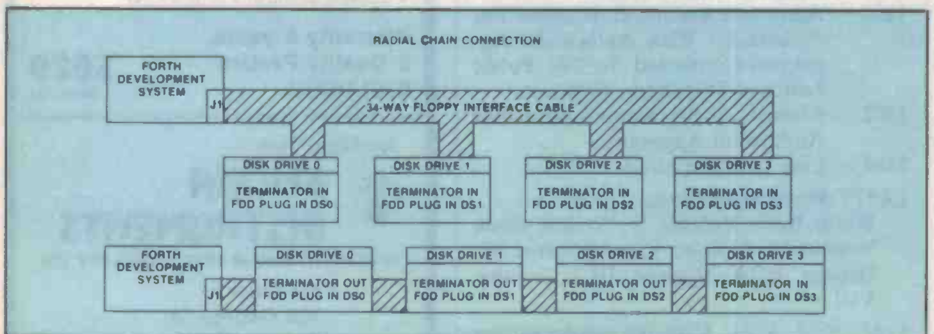


Figure 1. Multi-disk drive connection configurations.

The screen will start to display a list of all the possible Forth words (commands) that you can use. The listing will take a few seconds to finish. Pressing the control key and the S key together on your keyboard will terminate the listing action earlier.

One of the simpler commands you can try is multiplication. Type

```
5 8 * [RETURN]
```

The Forth card will respond with OK immediately after RETURN is pressed. The numbers 5 and 8 are first pushed on to the stack with 8 on the top of the stack. Encountering the *, the Forth compiler will compile and execute the multiplying function. It pulls the top two numbers from the stack, multiplies them and puts the answer back on the top of the stack. You can verify your answer by typing

```
. [RETURN]
```

The response is

```
40 OK.
```

The . command allows you to pull the value from top of the stack to be displayed on screen. Other simple commands like +, −, /, . S etc could be explored with the help of the RSC-Forth manual. If everything looks fine, the next step is to hook up the disk drive and the printer.

Disk and printer set up

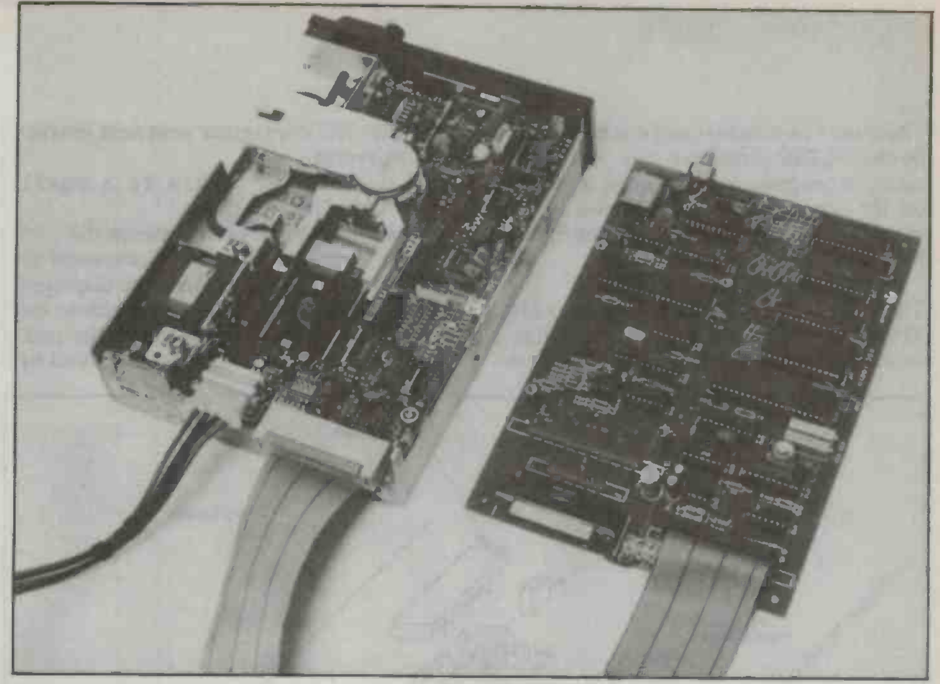
To save trouble and time, I suggest for your disk drive you use the TEC FB-503 40 track, which is available from Energy Control.

The Forth board is capable of controlling up to four disk drives. They can be connected in a daisy chain or radial chain manner as shown in Figure 1. Each drive has a terminator installed when shipped from the factory which looks rather like a 14-pin IC. Remove this terminator if necessary.

The numbering of each drive is determined by the FDD shorting plug. On the assumption that most people will use only one drive, the FDD plug is put in the DS0 position before shipment. DS0, DS1 etc have been marked on the pc board against the jumper socket. Refer to Figure 2.

The connector cables are your next problem. Every disk drive needs two cables; one connects the power and the other is for the I/O signalling. The power cable consists of four wires connecting the drive to +12 V, +5 V and two grounds (see photo). If the TEC disk drive is used, the J1 connector on the Forth card is pin-to-pin compatible with that on the disk drive. A 34-way ribbon cable is used to link up the two units.

The J4 connector on the Forth card is to drive a Centronics printer. To save room on the board, J4 is only a 20-way connector (the standard Centronics connector has 34 pins). On the card end a 20-way ribbon cable is cramped into a normal 20-way connector. At the other end the 20-way cable has to be placed against the pin 1 side of the 34-pin connector (see photo). To print something, you need to consult the accompanying printer driver program.



Disk drive (left) and Forth card (right) showing power cable combination.

You should expect the disk drive to draw about 200 mA from your 12 V supply when idle. This could go up to 500 or 600 mA when the motors are running. Your 5 V power supply has to be able to supply at least 900 mA when the Forth card (drawing 400 mA) and the disk drive are hooked up to it.

Now turn the power to the system back on. The same start up message RSC–FORTH V1.7 should be displayed. The system needs at least 6K memory to run a disk. So make sure you have 6116 RAMs in sockets 8, 9, 10.

Put a 5¼-inch floppy disk into the disk drive ready for formatting. The disk operating system has to know where the top of the RAM memory is. So on resetting you should type

```
HEX 1800 MEMTOP [RETURN]
```

The system will respond with OK. Hex tells the system that any number received will be in hexadecimal. The addresses of the RAMs range from 0200 to 17FF (in hex). The next address is 1800 and this is the one you should nominate with the command memory top (MEMTOP). Once this parameter is set, you format the disk by typing

```
DECIMAL 40 0 FORMAT
```

Two ends of the 20-way printer cable, one cramped to a 34-way Centronics plug.

The disk drive should start to format the disk immediately. DECIMAL tells the system to change back to decimal mode. The 40 tells the system that the disk is 40 track and 0 tells the system to format disk drive 0 (remember that the system can control up to four drives). This job takes about a minute or so to do. When the OK sign is displayed, you are ready to create your program and store it in the disk.

Disk file handling

A 40-track drive gives you 314 blocks. They are from block 0 to 157 and block 320 to 476. Blocks between 158 and 319 are used by an 80-track drive. Details can be found in appendix N of the Forth manual and the "Disk Interface" box. A block consists of 1024 bytes. Blocks 0 and 1 are reserved for storing system parameters. To create a file or program, type

```
5 LIST [RETURN]
```

The system responds by displaying

```
SCR #5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
OK
```

These are line numbers and can be modified by the >LINE command. Say you want to create a program for displaying a message on the screen when you execute it. You enter the instruction of the program in line 0 by typing

```
0 >LINE : TRY [RETURN]
```

There needs to be a space between 0 and >. The : is a Forth command for creating a word called, in our example, TRY. To define what TRY does, enter your next instruction by typing

```
1 >LINE .'' This is a small
testing program '';
```

A space must be allowed between the .'' command and the This. The command allows the string of characters to be displayed inside the double quotes. To terminate the definition of TRY, the ; is put at the end. You can look at what you have entered by typing 5 LIST [RETURN] again. The screen will display

```
SCR #5
0 : TRY
1 .'' This is a small testing
program '';
2
3
4
5
6
7
8
9
10
11
12
13
14
15
OK
```

If the listing shows a mistake in any line, it can be corrected by using the x >LINE command, where x is the number of the line carrying the mistake. You can also erase a whole line by typing

```
x >LINE
```

followed by two or more spaces and then [RETURN]

Line x will be totally erased. You can verify this with

```
0 >LINE [RETURN]
5 LIST [RETURN]
```

Line 0 should be a blank line. Now retype your erased instruction in line 0 to complete your program. To store the program in the disk type

```
FLUSH [RETURN]
```

The system responds with OK. The command INDEX in the Forth dictionary allows you to check what is on the disk. An execution of this command will display the first line in every block in the disk you want to look at. Type

```
DECIMAL [RETURN]
0 10 INDEX [RETURN]
```

The DECIMAL command is just to make sure the 0 and the 10 are not in hexadecimal. The system will display

```
0
1
2
3
4
5 : TRY
6
7
8
9
10 OK
```

Indeed, the program is actually stored in the disk, block 5. Although blocks 0 and 1 seem to be empty, they are reserved for system use. So don't store any user programs there.

You can verify the storing action by turning off the power to the system. Leave it for a few seconds and turn it back on again.

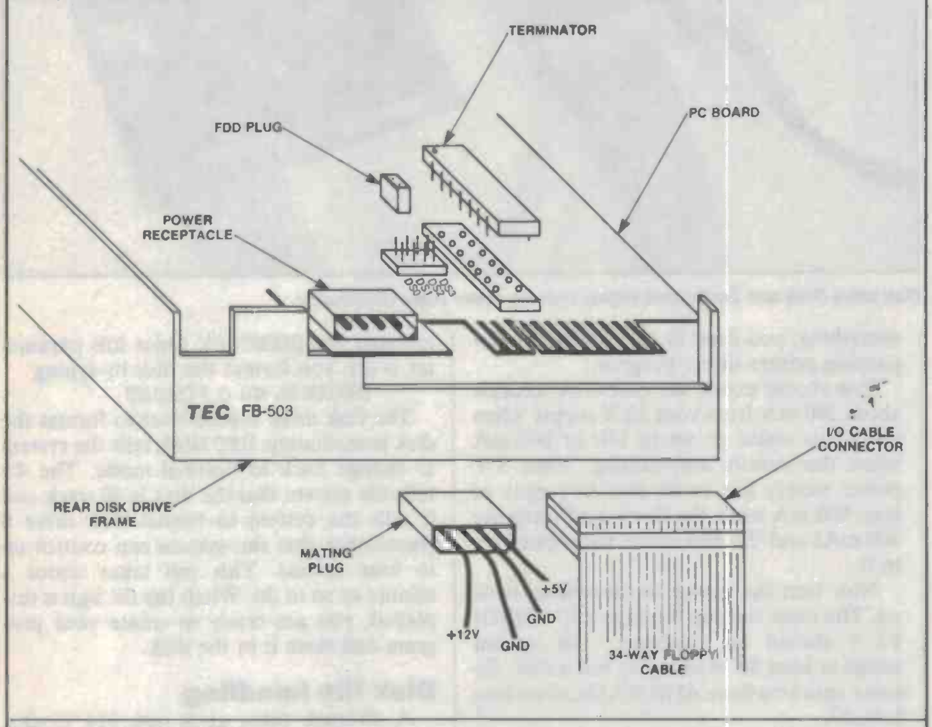
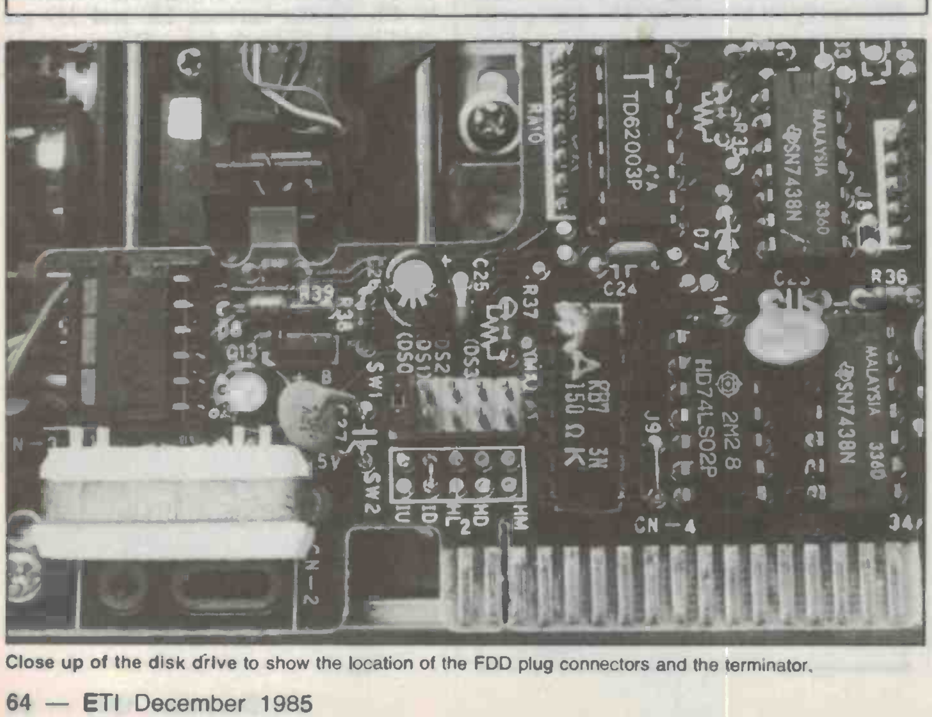


Figure 2. Disk drive hardware set up.



Close up of the disk drive to show the location of the FDD plug connectors and the terminator.

Type

```
COLD [RETURN]
```

to reset the system. Then initialise the memory for the disk drive again by typing

```
HEX 1800 MEMTOP [RETURN]
```

Do a disk read by typing

```
0 10 INDEX [RETURN]
```

You should get

```
0
1
2
3
4
5 : TRY
6
7
8
9
A
B
C
D
E
F
10 OK
```

Note that this time the 10 is in hexadecimal. The system stays in one number base until it is changed. On the cold start, the default base is decimal until it is changed by hex. To run your program, the easiest way is to type

```
5 LOAD [RETURN]
```

The LOAD command will put the program you created in block 5 on to the Forth dictionary. The word TRY you created becomes another Forth word. Calling the word will execute the function defined by the word.

Now try running your program by typing

```
TRY [RETURN]
```

The system will display

```
This is a small testing
program OK
```

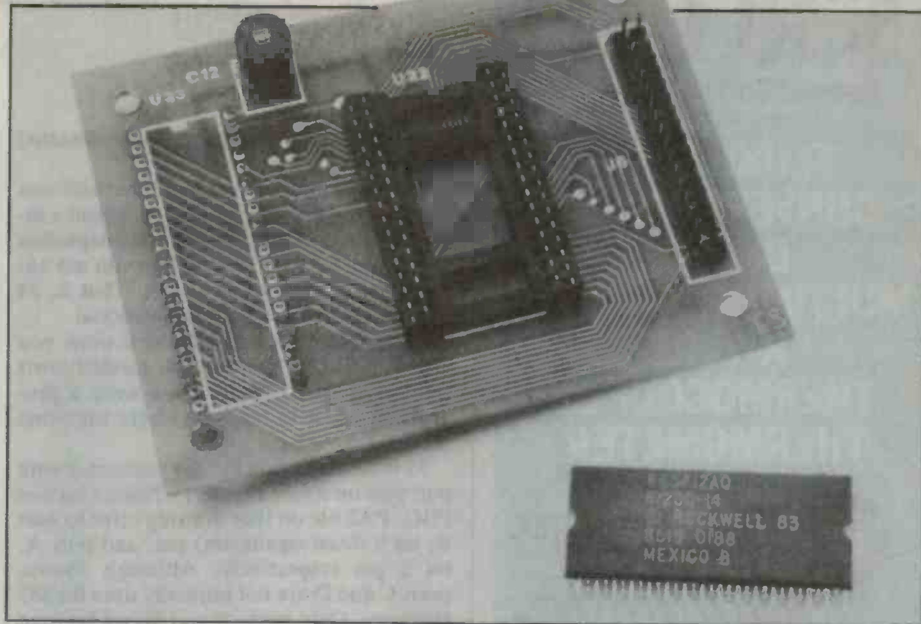
So far so good, but what about erasing files on the disk? You can, of course, list that file and erase line by line until the file is blank and store it back. This is a lengthy method. Unfortunately, the word WIPE which exists in the RSC-Forth manual does not exist in this system. There is no single Forth word to enable you to erase a file on the disk.

But, don't worry, ETI has solved the problem with a program to erase files on the disk. A listing of this program is shown here (as well as in the RSC-Forth manual). This program is created using the commands discussed above. If you want to store this program in block 12 (decimal), type

```
DECIMAL 12 LIST [RETURN]
```

Then enter your instructions using the x >LINE command. The finished program looks like the following

```
SCR #12
0 (Word to clear a screen)
1
2 (S - S WIPE BLANKS etc.)
3 : WIPE BLOCK 1024 BLANKS
4 UPDATE FLUSH ;
5
6
7
8
9
10
11
12
13
14
15 ;S
```



Piggy-back board for the Forth card if 65F12 is used.

Store the program in the disk using the FLUSH command. To run it, type

```
12 LOAD [RETURN]
```

The definition WIPE created by you is put into the Forth dictionary. Typing

```
5 WIPE [RETURN]
```

will erase the block (screen) 5 on the disk for you. You can verify this by typing

```
0 5 INDEX [RETURN]
```

Block 5 should be a blank block.

Printing files

It is not always convenient if you can only check and correct your programs on the screen. The Forth operating system kernel and the development ROM do not allow you to print files from disk to a printer directly. A printer driver program has to be written and stored in the disk for future use.

To print any file, that program has to be called from the disk and compiled using the LOAD command. The listing of the printer program is as follows:

```
SCR #10
0 (Centronics Driver: P-On,
  P-Off, Print)
1 (FILTER OUT FORM FEEDS)
  BASE @ HEX
2 LATEST DP @ 100 + H/C
3 CODE STB-PRT 10 3 RMB, 0 2
  RMB, 0 2 SMB, RTS, END-CODE
4 CODE ACK-WT BEGIN, 11 3
  BITSET UNTIL, RTS, END-
CODE
5 CODE HOUT 1 STA, 0A # CMP, 0=
  NOT IF, 'STB-PRT CFA @ JSR,
6 'ACK-WT CFA @ JSR, THEN,
  RTS, END-CODE
7 0 HEADERLESS !
8 : P-ON [ ' HOUT CFA @ ]
  LITERAL 0046 ! ;
9 : P-OFF F5EF 0046 ! ;
10 : FORM-FEED 0C EMIT
11 ' P-ON LFA ! BASE !
12 : PRINT 1+ OVER P-ON DO DUP
  LIST 1+ LOOP P-OFF ;
13 : P-SCR P-ON LIST P-OFF ;
14 ;S
15
```

Store the printer driver program in the disk with FLUSH command. As usual type

```
10 LOAD [RETURN]
```

to put the word into the Forth dictionary. To print blocks 10 to 20 from the disk on to the printer, type

```
10 20 PRINT [RETURN]
```

If only one block is to be printed, try

```
10, P-SCR [RETURN]
```

Whatever is on block 10 will be printed.

There was a problem when I first tried this program. It does not output a line-feed to the printer and, consequently, the whole file gets printed on the same line. To avoid this, you have to choose the auto line-feed option in your printer. This facility is normally selectable by the rocker switches in your printer. For the one I was using, connecting a 0 V (ground) line to pin 14 on the Centronics plug has the same effect.

Input/output ports

It would be a pretty useless computer if the Forth card could not control general purpose ports with software. A quick look at the specifications of the mother chip 65F11 will leave you stunned. Apart from the usual parallel ports, under *your* program's control, you can address two 16-bit counter latches and a full duplex serial communication channel.

Hardware interrupt signals applied to ▶

some handshake pins can also be detected by software.

The input/output power of the card can be enhanced if you are willing to spend a little more money. A piggy-back adaptation board with a 65F12 chip will let you use another three 8-bit parallel ports. That is, 24 I/O lines which are fully bidirectional.

The following paragraphs will show you how to read and write to the parallel ports (port A, port B). Before you write a program, it's best to find out where the ports are.

J3 is an expansion header connector with port pins on it (see Figure 1). Names such as PBO, PA2 etc on that drawing refer to port B, bit 0 (least significant) pin, and port A, bit 2 pin respectively. Although shown, ports C and D are not normally used for I/O purposes. Only ports A and B can be used with the 65F11.

After locating which pins on J3 correspond to what bit in the port, you can read the port by the following

```
COLD [RETURN]
```

COLD will reset the system. The default of ports A and B is input ports. Now type

```
HEX PB C@ [RETURN]
```

The system will respond with OK. HEX changes the number base of the system to hexadecimal. PB C@ causes the voltages on pins of port B to be read and stored in the stack. To read what they are, type

```
[RETURN]
```

The system will display

```
FF OK
```

meaning all the eight pins on port B are at logic 1.

Now try to earth some of the pins of port B with a wire connected to ground, say, connecting pin PBO for the sake of trying something simple. The logic pattern on port should be 11111110. Type

```
PB C@ . [RETURN]
```

TEC DISK DRIVE ALIGNMENT

There are three adjustments to be made. As they require measurement of quite fast pulses you will need an oscilloscope of reasonable bandwidth to give good results. 15 MHz or better is desirable.

You will note there is a jumper at pin 1 of the 2793. Taking this jumper to +5 volts enables internal precompensation. Taking this pin to ground disables precompensation. The drives used were TEC 40-track drives from Energy Control. The precompensation adjustment was disabled as it was found to be unnecessary. If other drives are used, refer to the manufacturer's data to find what precompensation pulse-width is required. Write-precompensation provides a delay before a write-pulse is issued to the write-head of the drive. The actual delay is adjustable between 100 ns and 250 ns. If you choose to use precompensation carefully follow this procedure:

1. Set TEST (pin 22 U12) to a high.
2. Push the RESET button.
3. Set TEST (pin 22 U12) to a low; inserting a jumper at the link marked T will accomplish this.
4. Observe pulse-width (pin 31 U12).
5. Adjust R22 for the desired precompensation pulse-width.

DATA SEPARATOR ADJUSTMENT

The following adjustments should be made carefully as misalignment will cause read/write errors:

1. Set TEST (pin 22 U12) high by removing link T.
2. Push the RESET button.
3. Set TEST low by inserting jumper at T.
4. Observe pulse-width (pin 29 U12).
5. Adjust R23 for a pulse-width of 500 ns.
6. Measure the frequency (pin 16 U12).
7. Adjust C7 for 250 kHz at pin 16 U12.
8. Set TEST (pin 22 U12) to a high (remove jumper from T).

DISK STORAGE WITH FORTH

Disk-based systems have traditionally required a disk operating system (DOS) to handle such functions as program and data storage, file maintenance, loading and execution of programs, and so on. Forth, however, does not provide a DOS in the usual sense. Programs or 'words' as they are referred to in Forth are stored in blocks of 1024 bytes. The words 'block' and 'screen' are often used interchangeably in Forth but they represent the same thing. 'Screen' is perhaps more representative of how a block appears on the user's terminal. A screen is organised as 16 lines of 64 characters. The number of screens that can be stored on a disk is a function of the drive size. For example, an 80-track double density drive can provide 637 screens.

It should be noted that enough system RAM must be provided to allow memory allocation for screen buffers. The bipolar PROM decoder supplied by Energy Control allows three 2K by 8-bit RAM chips. It will be necessary to provide at least 6K to effectively use the disk system.

The heart of the disk interface is the 2793 floppy disk controller (FDC) chip (in socket U12). This chip provides all the functions necessary to step the head, seek tracks, and read/write sectors and tracks.

U21 is used as a monostable to delay the head load timing signal on U12 pin 40. It is triggered by the head load signal on U12 pin 28.

The FDC address is derived from the FDC signal from the bipolar decoding PROM (U6). Forth requires the FDC at $100. Additional decoding is provided by U13 and U4 for drive status and control registers at $106. Reading $106 provides status information on D5 to D7 via U14. Writing to $106 latches data into U15 to provide control of drive and side select, and also a signal to turn the drive motor on. U18 and U19 are open-collector buffers to interface the disk drive control lines.

The network C6, CR1, R14 attached to U12 pin 23 is a filter that controls the response of the internal VCO of the 2793 during data recovery.

The system should respond correctly with

```
FE OK
```

To write something to port B, you have to send a byte of 00 (in HEX) to port B to turn it into an output (rather than input) port. Once this is done, port B will remain an output until it is changed. Perform this with

```
HEX 0 PB C! [RETURN]
```

Now any binary pattern can be loaded into port B by, for example, typing

```
A5 PB C! [RETURN]
```

A multimeter may be used to check the voltages appearing on port B pins.

This testing procedure is logical but a bit boring. The accompanying listed program is a lot more interesting. Before you try it, a simple hardware interface circuit has to be built. Use a breadboard if you wish to save time and components.

The schematic of the interfacing hardware is shown in Figure 4. Try this simple program interactively on the console. That is, the program will not be stored in the disk; it is executed directly from the keyboard to be thrown away later. Reset the system with

```
COLD [RETURN]
HEX 1800 MEMTOP [RETURN]
0 PB C! [RETURN]
DECIMAL [RETURN]
```

Create your program as usual with

```
6 LIST [RETURN]
```

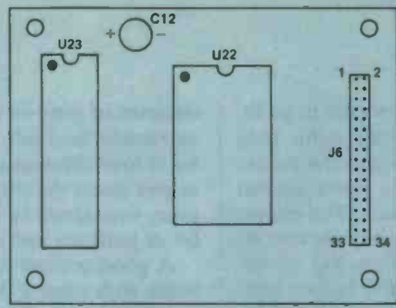
Use x >LINE command to enter your instructions as before. Don't use the FLUSH command if the program is not to be stored in the disk. The listing of the program is shown below.

```
SCR #6
0 : ( Turn LEDs on/off in a
  binary pattern )
1 : FLASH CR 500 0 DO I PB C!
  2000 0 DO LOOP LOOP ;
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```

Do a 6 LOAD [RETURN] command straight away. It compiles your program and the new Forth word FLASH is put in the Forth dictionary. To run your program, type

```
FLASH [RETURN]
```

You should see the eight LEDs turn on and off like a counter counting up the binary scale. That is, the LED connecting to PB0 will flash twice as fast as that to PB1 and four times as fast as the LED connected to PB2 etc. The counting keeps going on until the nested DO loop finishes itself. Changing the 500 to a larger number, say 1000, will double the time this flashing operation lasts before it stops. Changing to 2000 will, on the other hand, affect the flashing rate of the LEDs.



1 = PG7	9 = V_{SS} (GROUND)	19 = V_{SS}	29 = V_{CC}
2 = PG6	10 = V_{SS} (GROUND)	20 = V_{SS}	30 = V_{SS}
3 = PG5	11 = PF7	21 = PE7	31 = $\overline{\text{RESET}}$
4 = PG4	12 = PF6	22 = PE6	32 = φ2 (CLOCK)
5 = PG3	13 = PF5	23 = PE5	33 = V_{SS}
6 = PG2	14 = PF4	24 = PE4	34 = V_{SS}
7 = PG1	15 = PF3	25 = PE3	
8 = PG0	16 = PF2	26 = PE2	
	17 = PF1	27 = PE1	
	18 = PF0	28 = PE0	

Figure 3. J6 pin assignment on the piggy-back board.

Precautionary notes

Extra I/O capability of the Forth card can be obtained if 65F12 is used. A small piggy-back adaptation board allows for the different sizes of the 65F11 and 65F12. The white silkscreened position U23 is not for soldering a chip on to. Instead, two 20-way header connectors have to be soldered on the bottom side of the board.

The pins of the headers connect the two boards up electrically. Naturally, the 65F11 (U1) has to be unplugged from its socket, ▶

allowing the header connector pins to go in. You will find the pins aren't quite long enough. Pushing them deep into the socket will force the little board to press against U1's neighbouring components. The easiest solution to this problem is to buy another 40 pin IC socket. Stack it up on top of the original socket to make it taller before joining the two boards. It is a good idea to put four standoffs between the two boards and fix them tight with screws. Holes are already drilled on both boards for this purpose.

A 64-pin IC socket has to be soldered on to U22. A double row 34-way header connector is soldered on to J6. A fine soldering tip is recommended. Next, insert the 65F12 into the socket. Inserting this chip properly will be much harder than you think! To ensure good contact between the IC and the socket, pins of the IC are flared outwards. The pins are forced back when you insert them.

The fact that this 'fat' monster has two columns of pins on each side makes for an extremely hard job. Somehow, you have to bend four columns of pins at the same time as you insert the chip into the socket. However, you should be able to manage it with a bit of patience and care.

A good contact is very important. For a while with mine I thought there was a bug on the board. My screen kept displaying garbage symbols and the cursor buzzed crazily. Not until a fifth attempt at inserting this monster chip could I eventually get it working.

There is no information on the pin assignment of the 34-way header connector in J6. I have tracked this down by tracing through the tracks on the little board. As you might have guessed, most of the pins on the connector are for the additional ports offered by 65F12. The pin assignment for J6 is shown in Figure 3. This uses the convention of PEO, PF6 etc, where PE, PF are ports E and F respectively and 0 and 6 refer to the bit position of the specified ports. ●

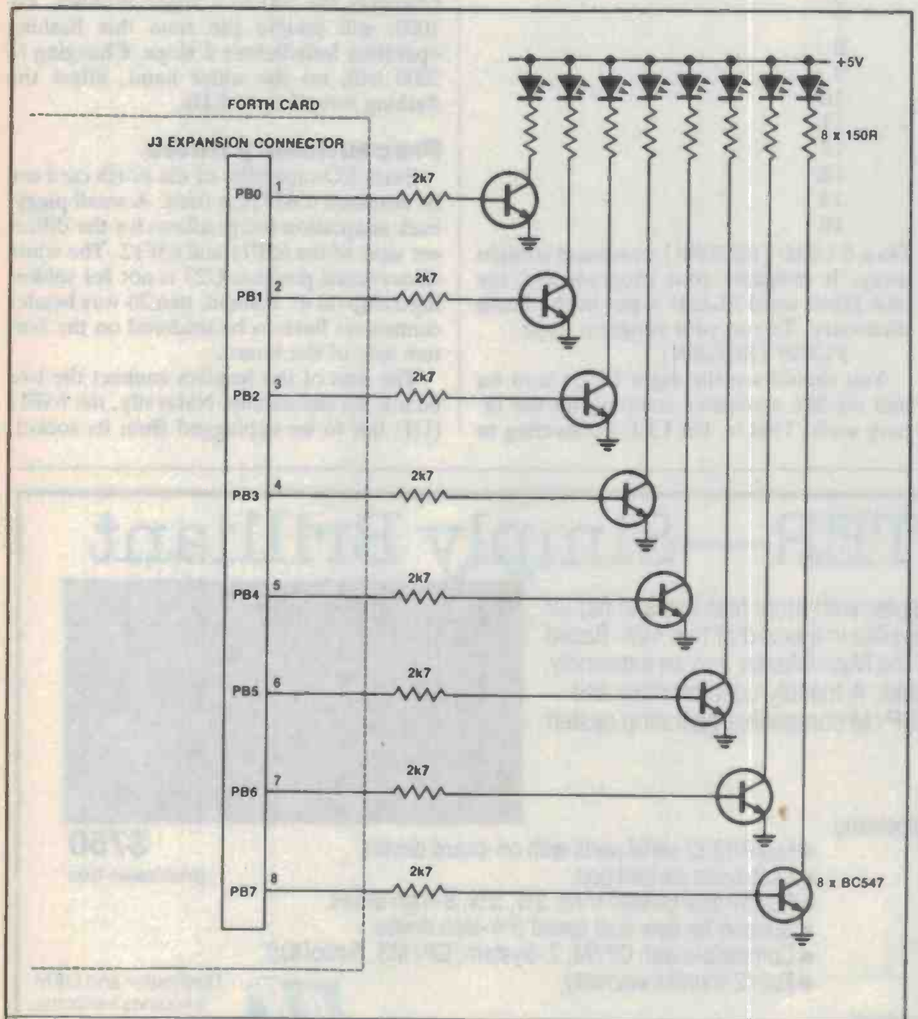


Figure 4. Port B testing hardware.

PARTS LIST

The basic model consists of 2 MHz crystal, 65F11, bipolar PROM, R65FR1 ROM and pc board, and costs around $159. You can enhance the I/O power by replacing the 65F11 with 65F12. The piggy-back adaptation board with the 65F12 and a few header connectors necessary for connecting to the mother board cost $54. The Forth card cannot drive a disk drive without the 2793A disk controller chip. The chip itself costs $27. A 40-track TEC-FB503 disk drive complete with connectors is available for around $200. All the above parts are available from Energy Control. See below for full parts lists.

PARTS FOR BASIC FORTH CARD

Resistors.................all ¼ W, 5%
R1, 2 .... 1M
R3, 9-12 .... 4k7
R5, 6, 8, 25-27 .... 1k8
R7 .... 330R
R24 .... 2k2
R30-33 .... 4k7

Capacitors
C1, 13-19 .... 100n ceramic bypass
C2 .... 10n
C3 .... 220n
C4, 5 .... 10p
C9, 10 .... 10µ 16 V RB electro
C11 .... 100µ 16 V RB electro

Semiconductors
CR1-4 .... 1N914
U2 .... 74LS373
U3 .... 74LS04 (must be LS)
U4 .... 74LS10
U5 .... '555
U8-10 .... 6116 2K RAM
U11 .... 74LS32
U14 .... 74LS240
U16 .... ICL7660
U17 .... LM1458
Y1 .... 2 MHz crystal

Miscellaneous
1 x 40-pin IC socket; 2 x 24-pin IC sockets; 2 x 28-pin IC sockets; 1 x 20-pin IC socket; DB-25 female connector (right angle pc mount) normally open pushbutton; and the RSC-Forth development kit* which includes:
U1 .... R65F11
U6 .... 256 x 8 bipolar PROM
U7 .... R65FR1 development ROM
pc board and literature.

PARTS FOR DISK CONTROLLER

Resistors
R13 .... 4k7
R14 .... 1k
R15, 16 .... 10k
R17 .... 1k8
R18-21 .... 150R ½ W
R22 .... 10k multi-turn trimpot
R23 .... 50k multi-turn trimpot
R28 .... 10k
R29 .... 470k

Capacitors
C6 .... 220n
C7 .... 10-100p trimming capacitor
C26,27 .... 10n
C28 .... 1µ5

Semiconductors
CR1 .... 1N914 diode
U12 .... WD2793*
U14 .... 74LS240
U15 .... 74LS273
U18 7406
U19 7406
U21 .... '555

* available from Energy Control.

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PROLOGUE 10

The slim, probe shape of the Prologue 10 is intended to give the unit a low profile when hand-held or stand-mounted in both vocal and instrumental applications. It is an excellent choice for podium use also. It is available as either a high-impedance (10H-LC) or low-impedance (10L-LC) model. Frequency response is 80 to 10,000Hz.

PROLOGUE 12

The popular ball shape of this model is designed to provide increased ruggedness, plus added protection against speech-produced "popping" sounds. It is also better suited to hand-held use than probe-shaped microphones. Available in either the high-impedance (12H-LC) or low-impedance (12L-LC) model. Frequency response is 80 to 10,000Hz.

PROLOGUE 14

The Model 14 has all the advantages of a ball micrphone, plus such additional features as improved performance, a durable, non-glare matte finish case and switch-locking capability. Available in either the high-impedance (14H-LC) or low-impedance (14L-LC) model. Frequency response is 40 to 13,000Hz.

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Cat. SL-2700

DESK MOUNTED LAMP MAGNIFIER

This unit magnifies any object under a clear cool fluorescent light. The magnification is the maximum obtainable (lens 127mm diameter biconvex 4 Dioptres, focal length 254mm) consistent with minimum distortion and eyestrain and good off-angle viewing.

It is NOT cheap, but then again it will definitely last a lifetime. It is built like a Rolls Royce. (We doubt whether 20 years continuous use would wear out the German made flexible arms for example). Spare fluoro tubes are available either from us or electrical outlets. If you have trouble with fine PCB work or component identification but still want both hands free, this is for you. We thoroughly recommend this quality Australian made product.

Technical Information

Illumination **22W Fluorescent**
Weight **8.16kg**
Lateral Extension **254mm**
Vertical Extension **254mm**
Fixing **Heavy table base (grey) with two chrome plated flexible arms.**
Lens **(see text)**

NOTE: **This is the GENUINE 'Maggylamp' - don't fall for cheap substitutes.**

AT LAST! A low cost 10 Amp Digital Multimeter/ Transistor Tester & Capacitance Meter!

Jaycar is proud to announce a genuine low cost high performance combination Multimeter/Capacitance meter for the enthusiast! This unit is all the most commonly needed test gear rolled into one!

Similar units are on the market to sell from around $150 to over $200. Why pay more when you can get a Jaycar direct import for less?

DC VOLT	0.1mV - 1000V
AC VOLT	0.1mV - 700V
DC CURRENT	1uA - 10A (20A max 30 secs)
AC CURRENT	1uA - 10A (20A max 30 secs)
RESISTANCE	0.1 - 20M ohms
CAPACITANCE	1pF - 20uF (2%)
CONTINUITY	less than 30 ohms @ 1mA
hFE TEST	0-1000, 10uA 2.8V
DIODE TEST	1mA (Buzzer & LED)

FEATURES

- ★ 0.5" high digits
- ★ High quality probes supplied!
- ★ LED and Buzzer continuity test
- ★ Precision thin film resistors for long term stability
- ★ CMOS logic. 1000 - 2000 hours battery life!
- ★ Meter protection. Fused
- ★ Complete with battery, quality probes, spare fuse
- ★ Floating decimal point
- ★ Auto polarity
- ★ Impact resistant case

Cat. QM-1540

$129.00

Join the Compact Disc Owners Club - ring (02) 747 1888 or call in to one of our stores for details.

ONLY $169

FREE DEMONSTRATION!

We now have the Dave Tillbrook designed Vifa 8" 2 way speakers on demonstration at our Sydney city and Gore Hill stores and in our Brisbane store. Call in now!!

Call in to any Jaycar store in December and see our great range of Christmas gifts. We simply do not have time to list them all.

YOU WILL NOT BE SORRY!

Squeaky Clean Mains Filter - Two fantastic low cost models. MS-4010 will supply up to 4 appliances. Each 240V socket is isolated from the other, i.e. interference from disc drives is de-coupled from the CPU power supply etc. It will supply up to 4 outlets with a total load of 6 amps (unswitched).

Cat. MS 4010

ONLY $125.00

Single 7.5 amp line socket type filter.
(Unswitched)

Cat. MS-4012

ONLY $34.95

☆ ☆ NEW ☆ ☆ BALANCE (Curve M-N) POTS

For Playmaster Series 200 Amp Kits

Were the balance pots missing from your Playmaster 200 amp kit? It certainly would not have been if you purchased a Jaycar kit.

Jaycar have sufficient stocks of the ORIGINAL balance pots (as used in the EA prototype) for other uses. Please note, however, that these pots are the ¼" shaft pot (with flat) as ORIGINALLY used by EA. They are not "metric" pots.

You can purchase one of these pots and so finish off your valuable project.

Cat. EE-4200

ONLY $3.95

BACK IN STOCK VOYAGER CAR COMPUTER FUEL FLOW SENSORS

At last after being out of stock for a year we now have stock. If you are a Voyager owner it may be prudent to buy a spare. The Voyager is now out of production in the UK and we do not expect to ever get any more of this item.

Cat. XC-2036

ONLY $45.00

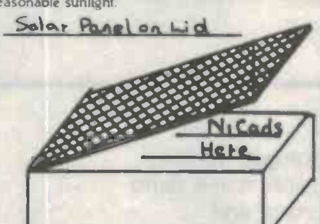
☆ ☆ NEW ☆ ☆ SOLAR BATTERY CHARGER

Cat. MB-3502

ONLY $16.95

This is a genuine new product which we feel will have tons of appeal.

The solar panel in the lid will charge up to 4 x AA NiCads in a fairly short time! It is ideal for yachts, campers or anywhere where 240V is not readily available. It is NO DEARER than an ORDINARY NiCad charger but takes about the same time to charge in reasonable sunlight.



☆ EXCLUSIVE!! ☆ GREAT NEW BOARD GAME FOR XMAS! "TUOHK"

A great treat for Jaycar customers who own a Commodore VIC-64

Jaycar is the exclusive NSW distributor of the great new board game called "University of Hard Knocks".

Basically the game works like this:

You load a cassette into your VIC-64 which contains:
5000 'Trivia' type questions
"Community chest" or "Chance"
Type statements
Other instructions

You then lay out the attractive vinyl covered playing board and play the game. The computer provides all questions and answers as well as the odd setback if you land on the wrong square. The game can also be played at different levels so accommodating people playing at the same time with different degrees of general (trivial?) knowledge.

The game progresses until you achieve a "Degree" in the trivia subjects that you have mastered.

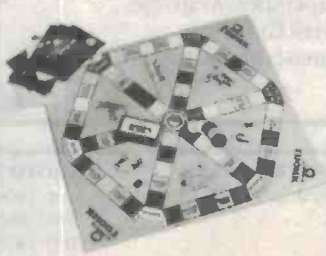
No computer skill is required. The computer simply provides information to operate the board game.

Around the same price as conventional board games.

Cat. XG-6000

ONLY $49.95

All game pieces etc included.



Call in or telephone Jaycar for a FREE copy of our GIANT XMAS MAILER. It's full of incredible bargains!

☆ ☆ NEW ☆ ☆ HEADPHONE WITH INBUILT MICROPHONE

★ Quality dynamic mic insert. Omnidirectional. 600 ohm impedance. -84dB sensitivity, cord length 7 feet.
★ Headphone 40mm Mylar drivers. 400mW rating, 28-32 ohm impedance, stereo, 6 foot cord.

These quality phones feature an excellent gymbal mic boom adjustment. This multi axis adjustment enables you to position the mic comfortably close to your mouth - no matter what shape head you have!

Cat. AA-2020

ONLY $29.95

- ★ Ideal for pop groups
- ★ CB, amateur radio use etc.
- ★ Telephone etc.

240V NEGATIVE AIR IONISER

Whilst the scientific proof is thin, many people swear by the efficacy of negative ionisers. This unit is locally made and highly regarded.

Cat. YX-2900

ONLY $69.95

MAIL ORDER HOTLINE (02) 747 1888

ETONE 10" SUBWOOFER

As used in the Electronics Australia subwoofer system.
★ Size 10" (250mm) ★ Cast frame, QT = 0.39, VAS = 631 ★ Power handling 100 watts rms ★ Free air resonance 32Hz ±1Hz ★ Voice coil diameter 2" ★ Magnet assembly 3kg (6.6lbs)

Cat. CW-2119

ONLY $99.95

AA NICADS

RECHARGEABLE BATTERIES

AA size, 1.2V - 450mA. Charges at 45-50mA (14-16 hours). Will outlast well over 1000 recharge cycles with average use.

Cat. SB-2452

1-9 $2.50
10-24 $2.20
25-99 $2.00
100 up $1.80 each

OPEN THURS NIGHT 'TILL 8.30 p.m.
YORK ST. CITY
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CARLINGFORD
BRISBANE

QUARTZ CRYSTAL CLOCK MOVEMENT

● Very compact and reliable ● Self starting one-second stepping motor has strong torque ● Powered by 1.5V AA battery that lasts for one year ● Supplied with one set of hands ● ±15 second/month accuracy ● 56mm square, 15mm deep ● Complete with data sheet, instructions.

Cat. XC-0100

ONLY $12.95

CORRECTION

The AVTEK MULTIMODEMS prices advertised on page 13 November 1985 E.A. should have been: Cat XC-4820 at $365; Cat XC-4822 at $399. Jaycar apologises for any inconvenience caused to customers.

FAX/RTTY DECODER FOR THE CAT COMPUTER

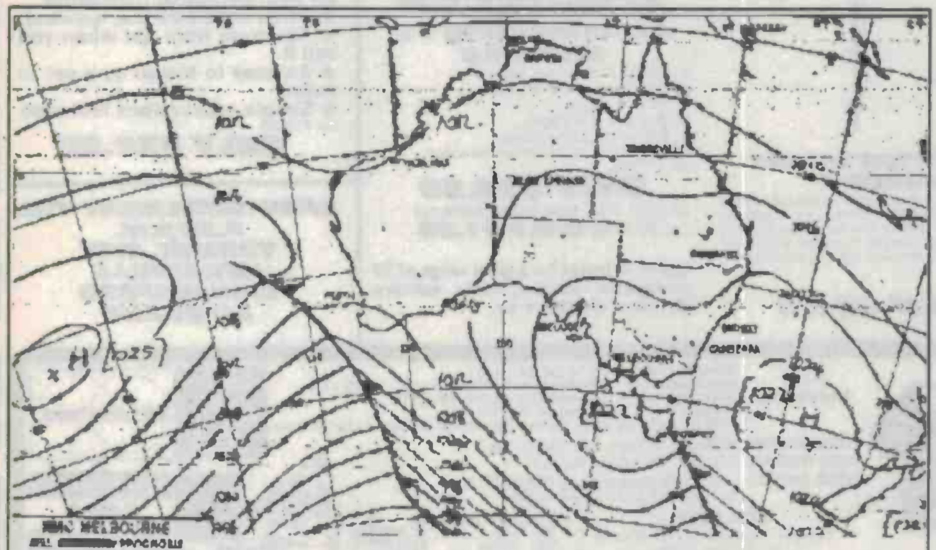
Part 2

Design by Andrew Keir, VK2XKK,
Dick Smith Electronics

Development by Robert Irwin

This FAX/RTTY decoder for the Cat computer will introduce you to the world of pictures and text over radio. With your set constructed you can start decoding weather information or adapting the software to decode more esoteric signals.

FAX picture from a satellite, re-broadcast from AXM.



Typical AXM Met weather map showing pressure systems.

THE DECODER is powered from the computer itself, so to set it up is merely a matter of plugging it into the games paddles port and connecting your receiver's audio output to the audio input of the decoder.

To get started it is best to begin with AXM so that you know the signal formats are compatible. Tune your receiver to 5.1 MHz. You can figure our whether FAX or RTTY is being transmitted by checking the time: from the hour to half past the hour RTTY will be broadcast and the remaining half hour will be FAX. Let's look at FAX first.

Before each picture a period of high tone is usually sent. You can use this to tune your receiver for maximum meter deflection on the decoder. Set the volume of the receiver output to give about ¾ scale deflection on the decoder's meter.

Before the start of the picture, alternate bursts of high and low tone will be sent at about 300 Hz. Following this will be the phasing pulses. These consist of the low tone with a burst of high tone to indicate the end of a line. At this stage the PHASE pushbutton should be momentarily pressed (the SYNC switch should be in the 'on' position). Doing this will set the internal flip-flop of the decoder and allow the sync pulses of the decoder to be phase shifted each cycle with respect to the phasing pulses.

On the front panel you should be able to see the SYNC LED flashing and the meter 'bouncing' up and down. These bounces on the meter should slowly catch up with the flashes of the SYNC LED and once they do the PHASE LED should light, indicating that the decoder has locked on to the incoming phasing pulses. Sometimes, under noisy listening conditions, it is possible for the PHASE LED to be triggered before the decoder is actually in phase. In these cases you should be able to see that the SYNC LED is not flashing in time with the bounces on the meter. If this happens just press the PHASE button and try again.

Once the decoder has locked on to the phasing pulses you should keep watching the meter. When it goes high and stays there it means that the picture is being transmitted. You should then start the data collection program and go and make yourself a nice cup of tea. It will take about eight or nine minutes for the picture to be collected and then the program will stop execution. You can then either save the picture to disk for future reference or print it out. A printout will usually take about two minutes.

To receive the RTTY signal, the set up is as it was for FAX except the SYNC is switched out. All that is necessary is to tune your receiver to the correct frequency and run the RTTY program. The incoming data will then automatically be displayed on the screen for you to read. You may use the front panel meter to peak the receiver tuning, however this is not all that critical with the RTTY transmissions.

Surveying the software

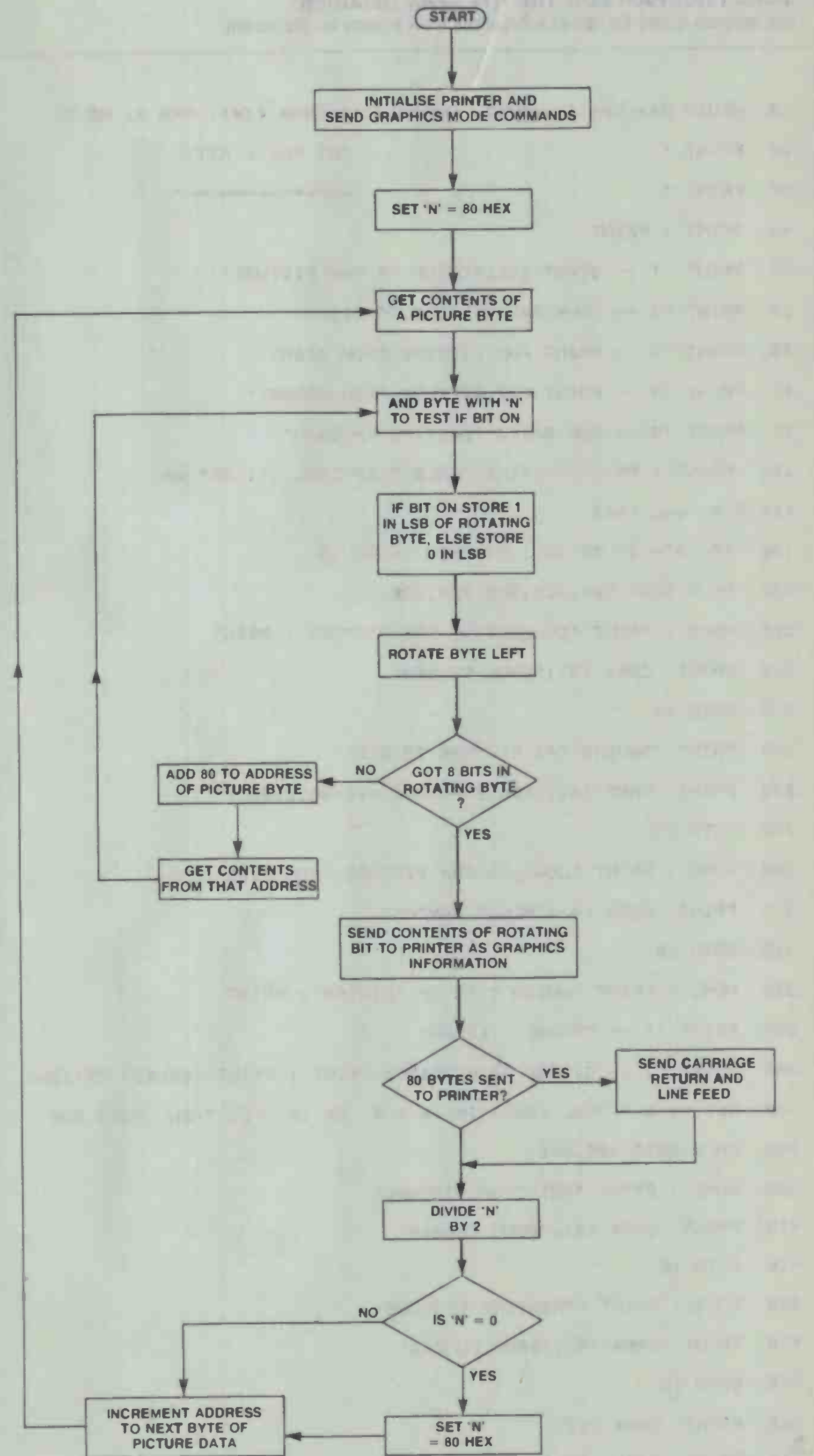
The software comprises three main modules. These are for RTTY, FAX data collection and FAX picture printing. A floppy disk containing all necessary software will be supplied as part of the kit from Dick Smith Electronics.

The FAX data collection program initially examines the sync pulse input on SW1 of the games paddle and when the sync pulse is seen commences to sample the SW0 input.

The SW0 input is sampled 1920 times in each half second period. After each three samples are obtained, they are examined and if the majority of samples are logic high, one is stored in a memory location as the LSB. If the sample is low then zero is stored in the LSB. The memory location is then rotated left and the operation repeated until 8 bits have been stored in the memory location. The resulting byte is then stored in memory.

When 80 bytes have been collected (640 bits) the program waits for the sync pulse on SW1 before starting the next line. Due to memory constraints and in the interest of providing a reasonable aspect ratio for the picture, each three lines collected are

FAX PRINTER DUMP FLOWCHART



BASIC PROGRAM FOR THE RTTY/FAX DECODER:
this program allows the call of subroutines from a menu on the screen.

```
10  WIDTH 80; PR# 1: PRINT  CHR$ (27); CHR$ (64); PR# 0: HOME
20  PRINT "                               CAT FAX / RTTY"
30  PRINT "                               =============="
40  PRINT : PRINT
50  PRINT "1 -- START COLLECTION OF FAX PICTURE"
60  PRINT "2 -- SAVE FAX PICTURE TO DISK"
70  PRINT "3 -- PRINT FAX PICTURE FROM DISK"
80  PRINT "4 -- PRINT FAX PICTURE FROM MEMORY"
90  PRINT "5 -- RUN RADIO TELETYPE PROGRAM"
100  PRINT : PRINT : PRINT "SELECT OPTION...": GET A$
110 A =  VAL (A$)
120  IF (A = 0) OR (A > 5) THEN  GOTO 10
130  ON A GOTO 200,220,300,320,600
200  HOME : PRINT "COLLECTING FAX PICTURE": PRINT
210  PRINT  CHR$ (4);"BRUN FAXOBJ"
215  GOTO 10
220  PRINT "SAVING FAX PICTURE TO DISK"
230  PRINT  CHR$ (4);"BSAVE FAXPC0,A$2480,L$6B81"
240  GOTO 10
300  HOME : PRINT "LOADING FAX PICTURE FROM DISK"
310  PRINT  CHR$ (4);"BLOAD FAXPC0"
315  GOTO 10
320  HOME : PRINT "WHICH TYPE OF PRINTER": PRINT
330  PRINT "1 -- CPA-80 / EPSON"
340  PRINT "2 -- C-ITOH 8510/8515": PRINT : PRINT "SELECT OPTION..."
350  GET A$:A =  VAL (A$): IF (A = 0) OR (A > 2) THEN  GOTO 320
360  ON A GOTO 400,500
400  HOME : PRINT "PRINTING PICTURE"
410  PRINT  CHR$ (4);"BRUN CPA80A"
420  GOTO 10
500  HOME : PRINT "PRINTING PICTURE"
510  PRINT  CHR$ (4);"BRUN DUMPOB"
520  GOTO 10
600  PRINT  CHR$ (12)
610  PRINT  CHR$ (4);"BRUN RTTY2"
620  GOTO 10
```

ANDed together to form one line stored in memory. When a pre-defined upper memory location is reached the program exits.

If the program was called from BASIC then control will be returned to BASIC at this point and the BSAVE command may be used to store the picture on disk. The picture occupies memory from 2480 HEX to 8FFF HEX.

After setting the printer into graphics mode the printer dump program examines the picture stored in memory and sends data to the printer one byte at a time. Each byte sent is composed of a vertical row of eight dots. As an example, at the start of the picture the program builds a byte composed of the dots in the left most position of the first eight lines of the picture. This byte is sent to the printer which fires the printhead wires corresponding to the bits which are high. The process repeats using the next vertical row of eight dots and so on.

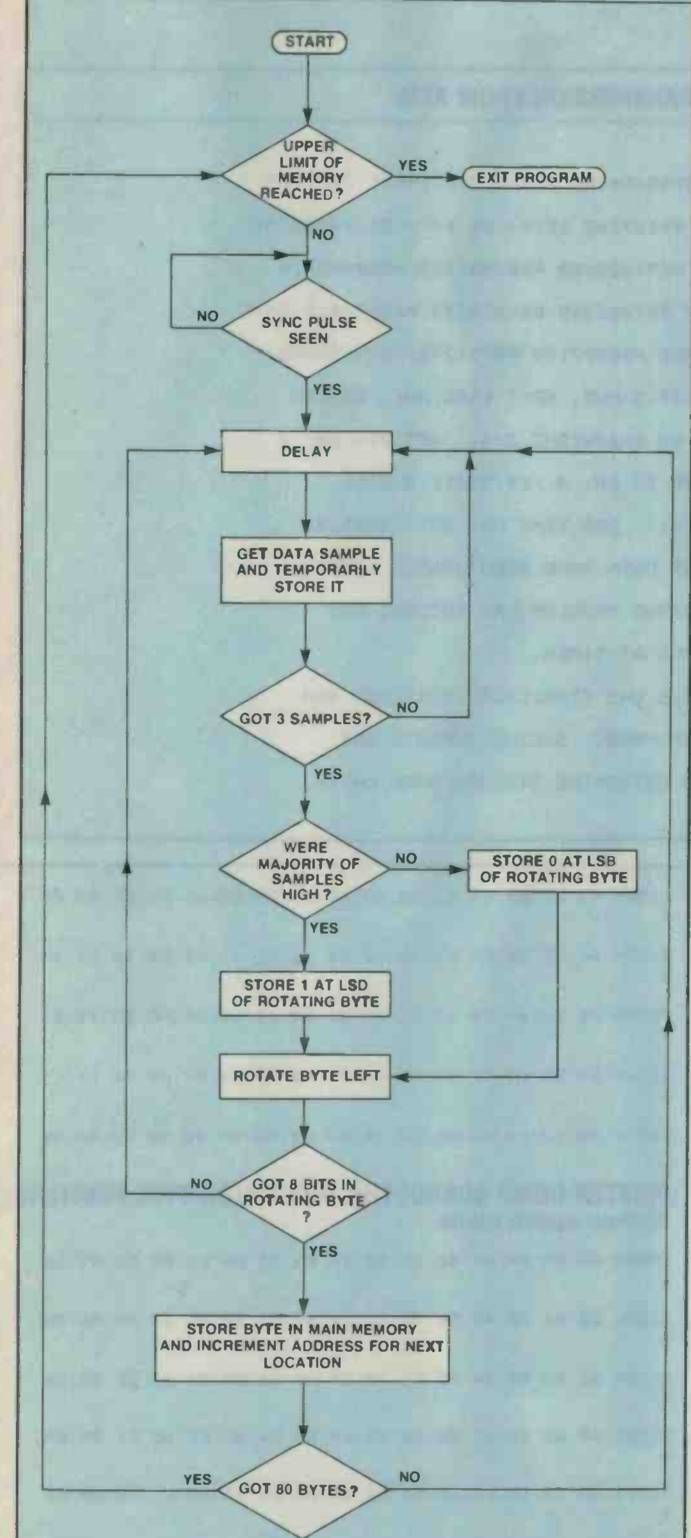
Two versions of the printer dump are provided. These are for the C-ITOH type 8510 printer and the CPA80/Epson type printer. These two types of printer require differing commands for their graphic modes and also the order of bits corresponding to the printhead wires is inverted. Both versions of the printer dump program use their own printer driver routines to avoid the resident printer driver from masking some bytes sent to the printer.

The RTTY software operates in a similar manner to the FAX data collection program. The program initially examines the SW0 input and loops waiting for a pulse which exceeds a preset length. This pulse is the stop pulse. The program then waits for the start of the next pulse and delays for a time corresponding to the middle of the next pulse. A sample of the input is made and the result is stored in the LSB of a memory location which is then rotated left as in the FAX program.

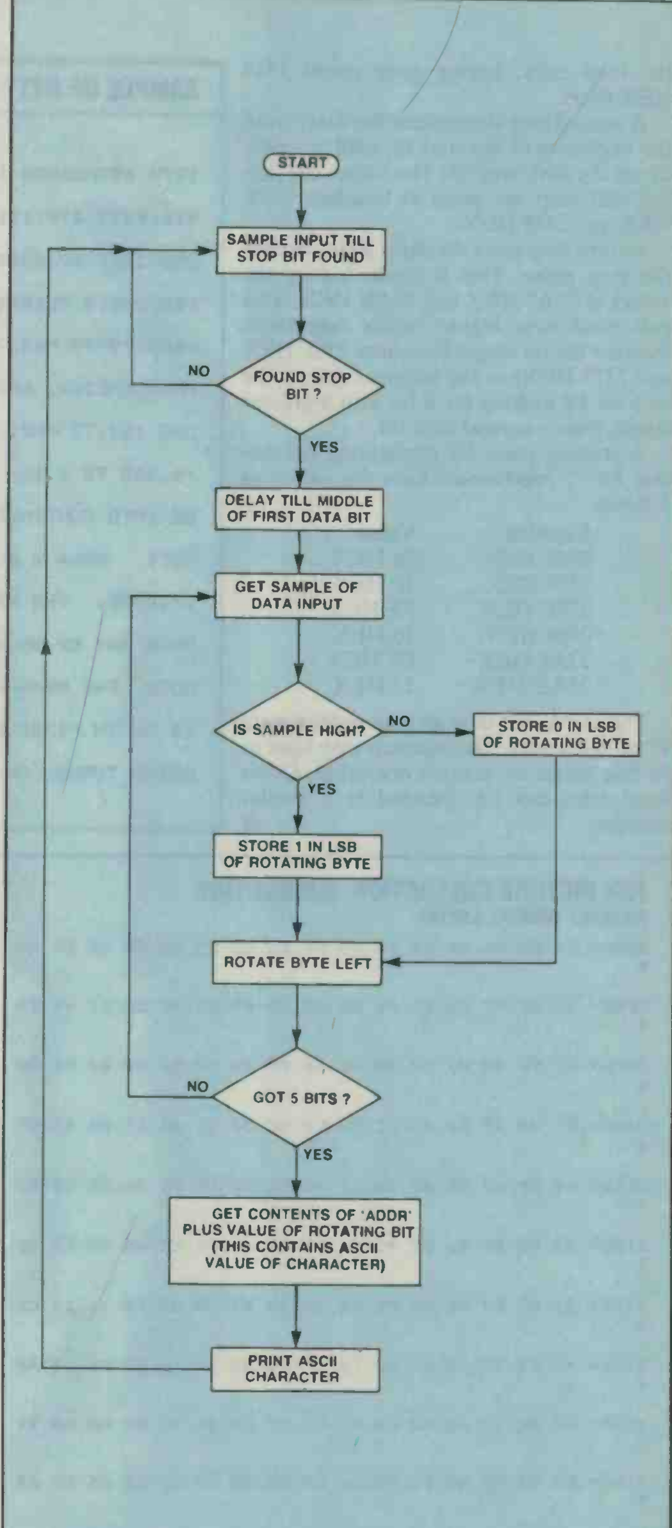
As RTTY is sent using the 5-bit Baudot code the program loops until 5 bits have been collected in the storage byte. When 5 bits have been collected the resulting value in the storage byte is used as an offset to point to a location in memory which contains the ASCII code of the character received. The ASCII character is then displayed on the screen and if the printer flag is set sends the character to the printer.

The program then examines the keyboard to see if a key is pressed. If not it simply waits for the stop bit and continues with the next character. If a key is pressed the program looks to see which key it is. If a 'P' is pressed the printer flag is set and all subsequent characters are sent to the printer. If a 'Q' is pressed the printer flag is reset. If an 'L' is pressed the program is forced into the 'letters' mode and if an 'F' is pressed it is forced into 'FIGS' mode. If any other key is pressed the program will exit.

FAX DATA COLLECTION FLOWCHART



RTTY FLOWCHART



Modifying the program

The majority of pictures transmitted by AXM have a predominantly white background so the dump program has been arranged in the same format. If you wish to reverse the black and white areas, the byte at 214C HEX in both the DUMPOB and CPA80A subroutines must be changed from D0 HEX to F0 HEX.

The listed software for RTTY reception (RTTY2) is set up to receive at 50 baud which is the standard transmitted by AXM. If you wish to change this you will need to change the values in three of the program loops.

The loop which provides the delay between bits has its values stored at 236F HEX and 2379 HEX. These are given in the program as 48 HEX and 16 HEX respectively. The value 48 HEX is decremented until it equals zero. Each time it reaches zero a register is incremented and compared with the value in memory location 2379 HEX (16 HEX). When the two values agree ▶

the loop exits, having gone round 1548 HEX times.

A second loop determines the delay from the beginning of the start bit until the middle of the first data bit. The values controlling this loop are given at locations 237E HEX and 2388 HEX.

A third loop gives the delay which detects the stop pulse. This is controlled by the values at 23A7 HEX and 23AE HEX. This pair must have higher values than those used for the bit length (locations 236F HEX and 2379 HEX) as the program detects the stop bit by looking for a bit with a greater length than a normal data bit.

A starting point for configuring the system for 75 baud would have the values as follows:

Location	Value
236F HEX	48 HEX
2379 HEX	10 HEX
237E HEX	FF HEX
2388 HEX	16 HEX
23A9 HEX	FF HEX
23AE HEX	12 HEX

The above will only give an approximate 75 baud decoder. The numbers may have to be fine tuned for reliable operation. Other baud rates can be obtained in a similar manner. ●

SAMPLE OF RTTY TRANSMISSION FROM AXM

```
1979 057A30828 152935636700 850601222719011 2271711

01010672 01011217 00127162 10754126 1774721 09852338

25272287 07184270 M071625688 P006584925 M000000910

P00118013 P0109679 P07362360 004053273 069076012 9449

0000499999 M00276388 P00097108 P00512926 SPNESPARE

FREQUENCIES, APT 137.5 MHZ, HRPT 1698 MHZ, BEACON

DSB 136.77 MHZ.  -05 $-6/NIGHT 2/4.  APT VIS CH. 2

/0.725 TO 1.10/ AND IR CH. 4 /10.5TO11.5/WILL

BE XMTD CONTINUOUSLY.  DCS TIME DAY 351 62215.0.

NOTE   NOAA K AVHRR DATA HAVE BEEN USABLE SINCE

1/18/85.  THE PREVIOUS PROBLEM MAY ROCCUR, AND

DATA MAY BE UNUSABLE AT TIMES.

NOTE  THE N0AA-8 S/C WAS STABILIZED 5/23/85. SAR

IS ON IN FIXED GAIN MODE.  S/CINSTRUMENTS ARE

BEING TURNED ON TO DETERMINE STATUS. MORE LATER.
```

FAX PICTURE COLLECTION SUBROUTINE

FAXOBJ A$20D0, L$0130

```
20D0= EA EA EA EA EA EA 78 A9 00 85 E5 85 E6 85 E7 A9
*
20E0- 24 85 E4 85 E2 A9 80 85 E1 85 E3 4C EC 21 A6 E4
*
20F0= E0 90 30 02 58 60 18 A0 00 A9 00 A2 00 86 EE 86
*
2100= EF 20 28 21 AE 61 C0 E0 80 30 11 A6 EF E8 86 EF
*
2110= A6 EE E8 E0 02 F0 19 86 EE 4C 01 21 A6 EE E8 E0
*
2120= 02 F0 0D 86 EE 4C 01 21 A2 66 CA E0 00 D0 FB 60
*
2130= A6 EF E0 00 F0 0D EA 18 69 01 C0 07 F0 11 2A C8
*
2140= 4C FB 20 18 69 00 C0 07 F0 05 2A C8 4C FB 20 A0
*
2150= 00 A6 E7 E0 00 F0 06 E0 02 F0 06 31 E3 A0 00 91
*
2160= E3 A0 00 A6 E5 E8 86 E5 E0 50 F0 1D 18 A5 E3 69
*
2170= 08 85 EC A5 E4 69 00 85 ED A5 EC 85 E3 A5 ED 85
*
2180= E4 18 A0 00 A9 00 4C FB 20 A6 E7 E0 02 F0 14 A6
*
2190= E7 E8 86 E7 A2 00 86 E5 A6 E1 86 E3 A6 E2 86 E4
*
21A0= 4C EC 21 A2 00 86 E7 A6 E6 E8 E0 08 F0 1D 86 E6
*
21B0= A6 E1 E8 86 E1 86 E3 E0 00 D0 05 A6 E2 E8 86 E2
*
21C0= A6 E2 86 E4 A2 00 86 E5 4C EC 21 A2 00 86 E6 18
*
21D0= A5 E1 69 79 85 E8 A5 E2 69 02 65 E9 A5 E8 85 E1
*
21E0= 85 E3 A5 E9 85 E2 85 E4 A2 00 86 E5 AD 62 C0 C9
*
21F0= 80 10 F9 4C EE 20 00 00 00 00 00 00 00 00 00 00
```

PRINTER DUMP SUBROUTINE FOR C-ITOH-TYPE PRINTERS

DUMPOB A$20F0, L$0160

```
20F0= EA EA EA EA EA EA EA EA EA EA EA EA EA EA A9 1B
*
2100= 20 36 22 A9 54 20 36 22 A9 31 20 36 22 A9 36 20
*
2110= 36 22 A9 24 85 E3 85 E7 A9 80 85 E4 85 E2 85 E6
*
2120= A9 00 85 E5 85 E8 85 E9 85 EA 85 EB 85 E1 EA EA
*
2130= EA EA EA EA EA EA EA EA EA EA 20 0A 22 A0 00 A6
*
2140= E3 E0 90 30 01 60 B1 E2 25 E4 C9 00 D0 29 A5 E9
*
2150= 18 69 80 A6 E5 E8 86 E5 E0 08 F0 42 6A 85 E9 18
*
2160= A5 E2 69 01 85 E0 A5 E3 69 00 85 E1 A5 E0 85 E2
*
2170= A5 E1 85 E3 4C 3F 21 18 A5 E9 A6 E5 E8 86 E5 E0
*
```

```
2180= Ø8 FØ·1B 6A 85 E9 18 A5 E2 69 Ø1 85 EØ A5 E3 69
*
2190= ØØ 85 E1 A5 EØ 85 E2 A5 E1 85 E3 4C 3F 21 85 E9
*
21AØ= A2 ØØ 86 E5 A5 E9 2Ø 36 22 2Ø EF 21 A6 E8 EØ Ø7
*
21BØ= DØ 24 A2 ØØ 86 E8 18 A5 E6 69 Ø8 85 E2 A5 E7 69
*
21CØ= ØØ 85 E3 A5 E2 85 E6 A5 E3 85 E7 A9 ØØ 85 E9 A2
*
21DØ= 8Ø 86 E4 4C 3F 21 A6 E8 E8 86 E8 A5 E6 85 E2 A5
*
21EØ= E7 85 E3 A5 E4 6A 85 E4 A9 ØØ 85 E9 4C 3F 21 A6
*
21FØ= EA E8 86 EA EØ ØØ FØ Ø5 EØ 8Ø FØ Ø7 6Ø A6 EB E8
*
22ØØ= 86 EB 6Ø A6 EB EØ Ø2 FØ Ø1 6Ø A9 ØA 2Ø 36 22 A9
*
221Ø= 1B 2Ø 36 22 A9 53 2Ø 36 22 A9 3Ø 2Ø 36 22 A9 36
*
222Ø= 2Ø 36 22 A9 34 2Ø 36 22 A9 3Ø 2Ø 36 22 A2 ØØ 86
*
223Ø= EA 86 EB 6Ø ØØ ØØ 48 AD C1 C1 3Ø FB 68 8D 9Ø CØ
*
224Ø= 6Ø ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
```

PRINTER DUMP SUBROUTINE FOR EPSON-TYPES

CPA 80A A$20F0, L$0160

```
2ØFØ= EA EA EA EA EA EA EA EA EA A9 1B 2Ø 36 22 A9 41
*
21ØØ= 2Ø 36 22 A9 Ø8 2Ø 36 22 A9 24 85 E3 85 E7 A9 8Ø
*
211Ø= 85 E4 85 E2 85 E6 A9 ØØ 85 E5 85 E8 85 E9 85 EA
*
212Ø= 85 EB 85 E1 EA EA EA EA EA EA EA EA EA EA EA EA
*
213Ø= EA EA EA EA EA EA EA EA EA EA 2Ø ØA 22 AØ ØØ A6
*
214Ø= E3 EØ 9Ø 3Ø Ø1 6Ø B1 E2 25 E4 C9 ØØ DØ 29 A5 E9
*
215Ø= 18 69 Ø1 A6 E5 E8 86 E5 EØ Ø8 FØ 42 2A 85 E9 18
*
216Ø= A5 E2 69 Ø1 85 EØ A5 E3 69 ØØ 85 E1 A5 EØ 85 E2
*
217Ø= A5 E1 85 E3 4C 3F 21 18 A5 E9 A6 E5 E8 86 E5 EØ
*
218Ø= Ø8 FØ 1B 2A 85 E9 18 A5 E2 69 Ø1 85 EØ A5 E3 69
*
219Ø= ØØ 85 E1 A5 EØ 85 E2 A5 E1 85 E3 4C 3F 21 85 E9
*
21AØ= A2 ØØ 86 E5 A5 E9 2Ø 36 22 2Ø EF 21 A6 E8 EØ Ø7
*
21BØ= DØ 24 A2 ØØ 86 E8 18 A5 E6 69 Ø8 85 E2 A5 E7 69
*
21CØ= ØØ 85 E3 A5 E2 85 E6 A5 E3 85 E7 A9 ØØ 85 E9 A2
*
21DØ= 8Ø 86 E4 4C 3F 21 A6 E8 E8 86 E8 A5 E6 85 E2 A5
*
21EØ= E7 65 E3 A5 E4 6A 85 E4 A9 ØØ 85 E9 4C 3F 21 A6
*
```


```
21FØ= EA E8 86 EA EØ ØØ FØ Ø5 EØ 8Ø FØ Ø7 6Ø A6 EB E8
*
22ØØ= 86 EB 6Ø A6 EB EØ Ø2 FØ Ø1 6Ø A9 ØA 2Ø 36 22 A9
*
```


```
221Ø= 1B 2Ø 36 22 A9 4B 2Ø 36 22 A9 8Ø 2Ø 36 22 A9 Ø2
*
222Ø= 2Ø 36 22 EA EA EA EA EA EA EA EA EA EA A2 ØØ 86
*
223Ø= EA 86 EB 6Ø ØØ ØØ 48 AD C1 C1 3Ø FB 68 8D 9Ø CØ
*
224Ø= 6Ø ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
```

HEX MACHINE CODE LISTING FOR THE RTTY SUBROUTINE

RTTY2 A$22D0, L$0171

```
22DØ= EA EA EA EA EA A9 ØØ 8D 4Ø 25 8D 41 25 4C 9C 23
*
22EØ= 18 AD 61 CØ C9 8Ø 3Ø F9 2Ø 7D 23 A9 Ø8 AC 61 CØ
*
22FØ= CØ 8Ø 1Ø ØE 18 69 Ø1 C9 7F 1Ø 15 2A 2Ø 6E 23 4C
*
23ØØ= ED 22 18 69 ØØ C9 7F 1Ø Ø7 2A 2Ø 6E 23 4C ED 22
*
231Ø= 29 7F AC 4Ø 25 CØ Ø1 DØ 34 18 69 1F AA BD ØØ 24
*
232Ø= C9 66 FØ 68 C9 6C FØ 6C C9 ØD FØ ØC C9 ØA FØ Ø8
*
233Ø= C9 5A 1Ø A9 C9 2Ø 3Ø A5 48 2Ø F9 C9 68 AE 41 25
*
234Ø= EØ Ø1 FØ Ø3 4C DD 22 2Ø E8 23 4C DD 22 AA BD ØØ
*
235Ø= 24 C9 66 FØ 37 C9 6C FØ 3B 48 2Ø F9 C9 68 AE 41
*
236Ø= 25 EØ Ø1 FØ Ø3 4C DD 22 2Ø E8 23 4C DD 22 A2 48
*
237Ø= AØ ØØ CA EØ ØØ DØ FB C8 CØ 16 DØ F6 6Ø A2 FF AØ
*
238Ø= ØØ CA EØ ØØ DØ FB C8 CØ 23 DØ F6 6Ø A9 Ø1 8D 4Ø
*
239Ø= 25 4C DD 22 A9 ØØ 8D 4Ø 25 4C DD 22 AD 61 CØ C9
*
23AØ= 8Ø 1Ø F9 A2 ØØ AØ ØØ E8 EØ FF DØ FB C8 CØ 18 DØ
*
23BØ= F6 AD 61 CØ C9 8Ø 1Ø E4 AD ØØ CØ 3Ø Ø3 4C EØ 22
*
23CØ= 2Ø 4D C8 AA EA CC FØ CC EØ C6 FØ CØ EØ DØ FØ Ø5
*
23DØ= EØ D1 FØ Ø9 6Ø A2 Ø1 8E 41 25 4C EØ 22 A2 ØØ 8E
*
23EØ= 41 25 4C EØ 22 4C EØ 22 48 AD C1 C1 3Ø FB 68 8D
*
23FØ= 9Ø CØ 6Ø ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ
*
24ØØ= ØØ 54 ØA 4F 2Ø 48 4E 4D ØD 4C 52 47 49 5Ø 43 56
*
241Ø= 45 5A 44 42 53 59 46 58 41 57 4A 66 55 51 4B 6C
*
242Ø= 35 ØA 39 2Ø 23 2C 2E ØD 29 34 26 38 3Ø 3A 3B 33
*
243Ø= 22 24 3F Ø7 36 21 2F 2D 32 27 66 37 31 28 6C ØØ
```

HOBBYBOT easy-to-build navigating robot

The hardware construction of your Hobbybot in Part 1 (November ETI) had *you* doing everything for your robot. And for some, that was probably a little frustrating. Now you can have your revenge with software programs that will keep you sane and send your Hobbybot around the bend.

IN LAST MONTH'S ETI we showed you how to build your Hobbybot. Now it's time to look at software programs so you can put your robot to use.

A comprehensive robot control language has been developed for the Hobbybot, with all of the features of advanced programming languages.

Figure 8 shows that the Hobbybot is normally in command mode (green LED on). From there you have a choice of four different functions:

1. You can run the robot manually by selecting sequences of F, B, L, R and STOP from the keypad.
2. You can learn a program by storing a sequence of commands. The full set of software commands is available in learn mode, not just the F, B, L, R and STOP commands.
3. Having learned a program or programs, you can select one to run. When in run mode, you can pause a program by pressing the DELAY button and then continue on by pressing DELAY again, or you can exit the program by pressing any other button.
4. You can clear any or all previously learned programs.

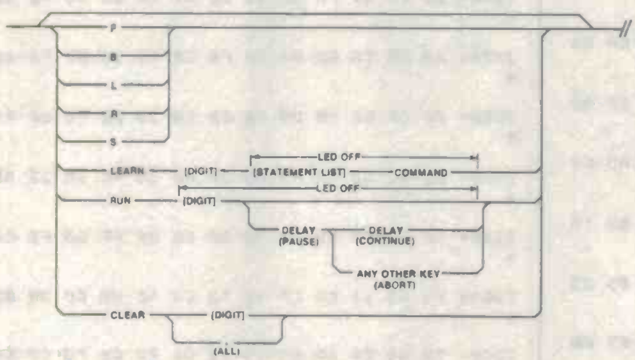


Figure 8. Command mode.

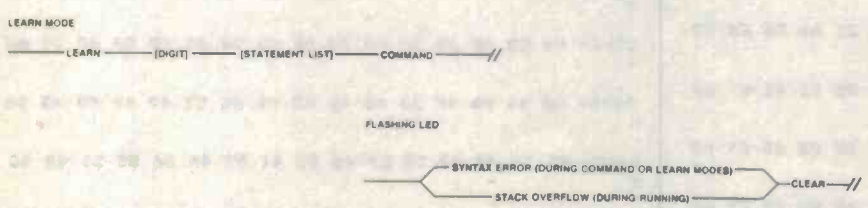


Figure 9. Learn mode.

Using the keypad

Each keypad has two possible functions (the second function can be obtained by hitting the 2ND key before pressing the desired key). Also, some functions require numbers to be entered: the digits (0-9) are like a third function for each key, but because the robot knows when it wants a number and when it doesn't there is no need to tell it when these 3RD key values are required (ie, the numbers are 'context sensitive').

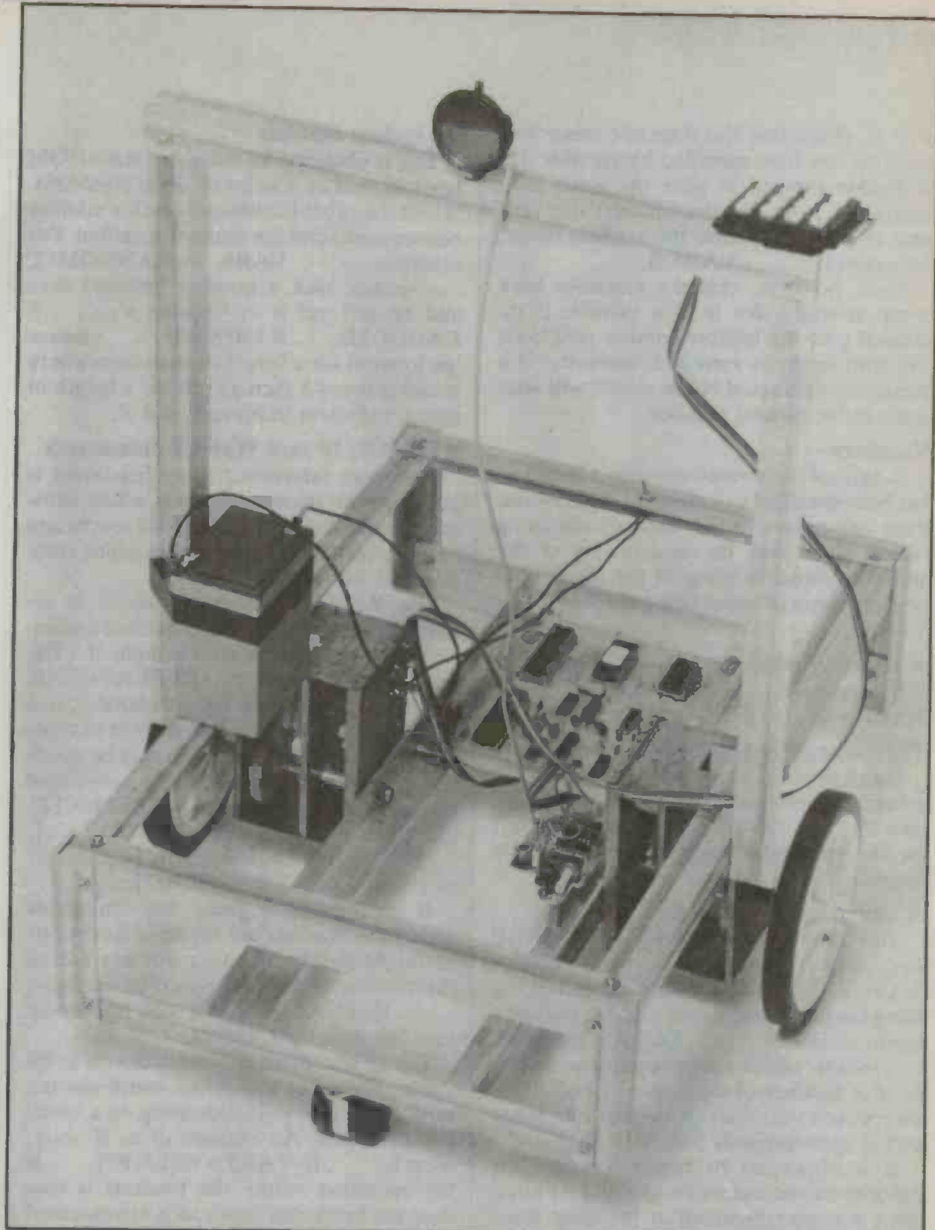
Operating the Hobbybot

When the robot is first turned on it is in command mode (the two lights will be on to indicate this) and can be driven around manually using the F, B, L and R commands. Also, in this mode programs can be run or cleared or the robot can be told to 'learn' a program, thus entering learn mode. (Note that during run mode or learn mode the green light will be off until the robot returns to command mode.)

The robot may be programmed with up to 10 programs by pressing the LEARN key followed by a digit (0-9). The robot will then be in learn mode and ready to receive commands from the keypad and add them to the specified program. If a program has already been learned it will be necessary to 'clear' the old commands before entering a new program — this can be done before en-

Part 2

Allan Branch



tering learn mode by hitting the CLEAR key followed by the number of the program. (Note that during learn mode the CLEAR key means something different — ie, 'clear the current command'.) If the , (comma) key is hit after CLEAR, all programs will be cleared.

When the program is completed press the COMM key to return to command mode.

The program can now be run by hitting the RUN key followed by the appropriate program number. The execution of the program can be suspended at any time by hitting the DELAY key, which causes the robot to stop whatever it is doing until this key is pressed again. If any other key is pressed while a program is running then it will immediately return to command mode and await further instructions.

Programs

A program consists of a string of commands separated by commas (,). If you happen to hit the wrong key, the current command can be cleared using the CLEAR button. Should the green light start to flash when you are entering a program, a syntax error has been made (or the memory capacity has been exceeded). The flashing will continue until the CLEAR button is pressed — the last command (which caused the error) can now be re-entered or learn mode can be exited in the usual way.

The robot programming commands are as follows:

F,B,L,R

Turns the motors on to go forwards, backwards, left and right respectively.

DELAY

This command followed by a number (0-65535) will cause the program to pause for this number of time units before going on to the next step. For example . . . ,DELAY 45, . . . will cause a delay of 45 time units (one time unit is approximately half a second).

STOP

Turns the motors off.

The commands can be used to very easily specify mobile robot behaviour. For example: F, DELAY 10, STOP turns the motors on; waits for 10 time units then turns them off again. So the robot goes forward for a time then stops. F, DELAY 2, STOP, L, DELAY 6, STOP causes the robot to go forward for one time unit then turn left for six time units then stop.

Shortcut form

To avoid pressing a lot of buttons the commands F, B, L and R may be followed by a positive number (0-65535) which takes the place of the DELAY and STOP commands. So, . . . ,F 10, . . . has the same effect as . . . , F, DELAY 10, STOP, . . . and . . . ,L 6, . . . has the same effect as . . . , L, DELAY 6, STOP, . . .

For more interesting robot behaviour the following command features have been included.

Variables

The variables are nine memories in the robot which each hold a positive integer (0-65535). Each variable is specified by the VAR key followed by one of the digit keys (1-9). For example, 'VAR2', 'VAR7', etc.

Numerical values may be put into (or 'assigned to') each variable by using the = (equals key). For example, . . . , VAR4 = 34, . . . means 'put into variable 4 the value 34' or 'variable 4 is assigned 34'.

Changing the value of a variable

The values assigned to the variables can be altered in several ways. One way is to assign another value over the top of the old one. Another way is to add 1 to (or 'increment') the variable by pressing F after the variable name. For example, . . . , VAR4 F, . . . means 'increase the value of variable ▶

4 by 1'. (Note that this does not mean 'forward for the time specified by variable 4'.) A further method to alter the value is to subtract 1 from (or 'decrement') the variable by pressing B after the variable name, for example, . . . , VAR6 B, . . .

Note, however, that the variables have 'wrap around'; that is, if a variable is increased past the highest number (65535) it will start again at zero and, similarly, if a variable is decreased below zero it will start again at the highest number.

Numbers

In each of the above examples a 'number' has been specified as a string of digits — but there are several other ways of obtaining values which may be used in any of the above examples in place of the digits. The possible forms of specifying a number are as follows:

A string of digits

For example, . . . , VAR3 = 2556, . . ., VAR1 = 0, . . . ,F 3, . . ., etc.

The value of another variable

For example, . . . , VAR4 = VAR5, . . . means 'put into variable 4 the value of variable 5'; . . . , L VAR3, . . . means 'go left for the number of time units specified by variable 3'.

A sonar range reading

This can be obtained by the RANGE key. For example, . . . , VAR1 = RANGE, . . . means 'take a range reading using the ultrasonic sensor and put the number in variable 1'; . . . , DELAY RANGE, . . . means 'take a range reading and delay for this number of time units' (should you ever want to do this). Note that one range unit is approximately 3 centimetres.

It is important to remember that the robot must not use its motors and its ultrasonic sensing equipment at the same time, so the motors will automatically stop (for a very short time) whenever a RANGE is to be taken, and then continue on with whatever they were doing.

A random number

This is obtained by using the RANDOM key followed by a string of digits (0-65535). It tells the robot to randomly pick a number between zero and the number specified. For example, . . . , VAR6 = RANDOM12, . . . means 'pick a number between zero and 12 and put it in variable 6'; . . ., F RANDOM5, L RANDOM3, . . . means 'go forward for a length of time somewhere between 0 and 5 then go left for a length of time somewhere between 0 and 3'.

REPEAT, IF and WHILE statements

Even more interesting robot behaviour is possible with these commands which allow the robot to repeat command sequences and to make certain decisions about which commands it will execute next.

The REPEAT statement allows a sequence of commands to be repeated a specified number of times. An example of a Repeat command is . . . , REPEAT45[F10, L3], . . . which means 'repeat whatever is in the brackets 45 times'. The number of repetitions (in this case 45) can in fact be specified using any of the methods mentioned previously. For example, . . . , REPEAT22 [. . .], . . .; . . . , REPEAT VAR1 [. . .], . . .; . . . , REPEAT RANGE [. . .], . . .; or . . . , REPEAT RANDOM7 [. . .], ...

If no number is given, the commands within the brackets are repeated forever or until told to stop by hitting any key during the running of the program. For example, . . . , REPEAT [L3, R3] will repeatedly turn left then right forever.

The IF statement enables decisions to be made. The robot can choose which instructions to execute next depending on a specified condition. An example of an IF statement is . . . , IF VAR5 > 63[L2, F5], . . . If the condition before the brackets is true then the bracketed commands are executed before continuing on with the program. In this case the robot will only perform the 'L2, F5' commands if variable 5 has a value greater than 63. If the condition is not true (VAR5 = 60, say) then the brackets are skipped and the commands following the brackets are executed as normal.

In the above example the condition on which the brackets were executed was 'VAR5 > 63' but in fact any two possible number specifications could be compared using any of the following comparisons: > (greater than); > = (greater than or equal to); = (equals); or = > (not equals). For example, RANGE > 45; VAR9 > = RANGE; RANDOM10 = 5; VAR5 > VAR1; 61 = VAR7; etc.

An example using IF which would cause the robot to stop if an object were too close in front of it is: . . ., IF 25 > RANGE [STOP], . . .

The ELSE command may be used with the IF command in the following way: . . ., IF VAR4 > = 12 [F1] ELSE [STOP], . . .

'If' the condition is true then only the first set of brackets is executed or 'else' only the second set is executed before continuing on with the rest of the program. So the effect of the above example is to go forward for one time unit if variable 4 is greater than or equal to 12; otherwise stop the motors, then continue with the rest of the program. For example, . . . , IF RANGE > 20 [F] ELSE [B], DELAY5, STOP, . . . will take a range reading and use it to decide whether to go forward or backwards for five time units.

An exampleof the WHILE statement is . . . , WHILE RANGE > 30 [F1, VAR4 F], . . . This repeats the bracketed commands 'while' the condition is true. The robot first decides whether the condition is true or not. If it is not true then it skips over the bracketed commands and continues on without executing them. If the condition is true it executes the bracketed commands then jumps back and rechecks the condition, and if it is still true it does the bracketed commands again, and continues in this way until the condition becomes false.

The example above would repeatedly go forward for one time unit and increment variable 4 until the range reading is no longer greater than 30. This has the effect of going forward until the robot is 30 range units away from the nearest object, with variable 4 keeping a count of the number of time units actually spent doing this.

When using conditions containing the RANGE function, remember that the motors are turned off for a short time WHILE using the ultrasonic sensor, so when commands F,B,L and R are used inside a while statement a DELAY should also be included inside the brackets to give the motors time to get started before taking another reading, ie, . . . , WHILE RANGE > 20[F 1], . . . causes the program to wait for one time unit before going back and retesting the condition.

Programs within programs

It is possible for a program to cause an-

TABLE 2. PERSONAL ROBOT COMPARISON

Robot	Voice synthesis	Functioning arm	Preprogrammed software available	Can be used without separate microcomputer	Base price (including voice if available) approx	Other options available
Topo	Yes	No	No	No	$2279	snack tray
Hero 1	Optional	Optional	No	Yes	$3143*	robotics course
RB5X	Optional	Optional	Yes	Yes	$3843	RCL software
Hubot	Yes	No	Yes	Yes	$5000	small printer
Hero Jr	Yes	No	Yes	Yes	$1429	radio control
Turtle Tot	Optional	No	Yes	No	$445	infrared link
Fred	Yes	No	No	Yes	$714	battery charger
Omnibot	No	No	No	Yes	$357	none
Hobbybot	No	No	Yes	Yes	$299	expandable
Polaroid Sensor Kit (as a stand alone evaluation kit)					$204	

* including arm

Adapted from *A Robot in Every Home* by Mike Higgins other program to be executed by entering say . . . , RUN4, . . . as a program command. In this example program 4 would be executed then the rest of the current program would be continued in the normal way. If program 4 has not yet been learned, then the command will 'do nothing' when it is executed and the robot will go straight on with the next commands.

Another example is:

```
LEARN 1
  WHILE RANGE > 20 [F1], L10
COMM
LEARN2
  REPEAT 7 [RUN 1]
COMM
```

In this example, running program 2 (by hitting RUN2 whilst in command mode) will cause program 1 to be performed seven times. The robot will go forward until it is near an object and then turn left for 10 time units, after which the entire sequence of events will repeat again until it has happened seven times.

Nesting the commands

The REPEAT, IF and WHILE commands may be used repeatedly inside each other (or 'nested') thus enabling very simple or very complex behaviour to be specified. For example, REPEAT [WHILE RANGE > 30 [F1], VAR1 = RANDOM2, IF VAR1 = 0 [B3] ELSE [IF VAR1 = 1 [L3] ELSE [R3]]]. This example would cause the Hobbybot to go forward until near an object then randomly choose whether to back up or turn left or turn right and then repeat the process forever.

Another example, REPEAT [WHILE 20 > RANGE [B1], WHILE RANGE > 30 [F1]] causes the Hobbybot to back if an object gets too close and go forward if an object gets too far away.

The input/output port

The hardware for the port can be added to the Hobbybot as an optional extra. Once installed the port enables the robot to communicate electronically with the outside world, thus enabling it to control a range of add-on hardware devices.

There are actually two 8-bit ports, one for input and one for output, which are both controlled using the PORT key. During programming this PORT function may be treated exactly like a variable: when 'assigning' to the port (ie, . . . , PORT = 255, . . .) the number will appear in binary form at the output port; when 'obtaining the value' of the port (ie, . . . , VAR1 = PORT, . . .) the input port is read. Note that incrementing and decrementing the port (ie, . . . , PORTF, . . . , PORTB, . . . ,) causes the number at the output port to be incremented or decremented (for further details see the port technical specifications).

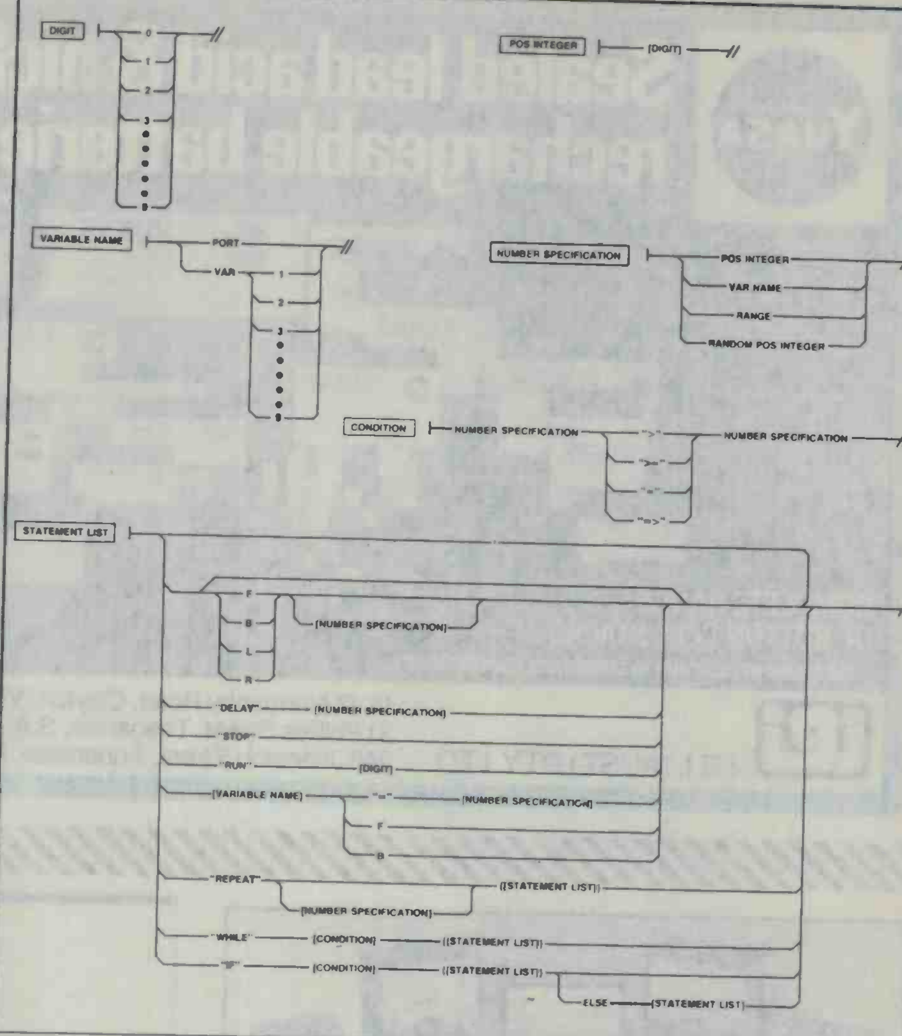


Figure 10. Syntax diagrams

Sample programs

Person follower program

```
LEARN 1
  VAR6 = RANDOM 1, REPEAT VAR1
  = RANGE, IF 15 > VAR1 [B1]
  ELSE [IF 20 > VAR1 [STOP]
  ELSE [IF 30 > VAR1 [F1]
  ELSE [RUN 8]]]]
LEARN 8
  RUN 7, VAR5 = 0, VAR 9=0, WHILE
  VAR5 = 0 [VAR9F, RUN7, RUN9,
  IF VAR5 = 0 [VAR 9F, RUN7, RUN9]]
LEARN 9
  VAR 7 = 0, WHILE VAR9 > VAR7
  [VAR 7F, IF VAR6 = 1 [L1] ELSE [R1],
  IF 30 > RANGE [VAR5F, VAR7 =
  VAR9]]
LEARN 7
  IF VAR6 = 1 [VAR6B] ELSE [VAR6F]
```

Wall follower

```
LEARN 2
  REPEAT [L3, WHILE 35 > RANGE
  [R1], R2, F3]
```

Play with 35 and R2 to suit your house.

Person monitor

```
REPEAT [VAR = RANGE, IF 15 >
VAR1 [B1] ELSE [IF VAR1 > 25
[F1] ELSE [STOP]]]
```

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Heuristics, Judea Pearl
Robotics Research, Michael Brady and Richard Paul
The Robots are Here, Alvin and Virginia Silverstein
Robots: Fact, Fiction and Prediction, Jasia Reichardt

Australian Robot Association,
GPO Box 1527,
Sydney, NSW 2001.
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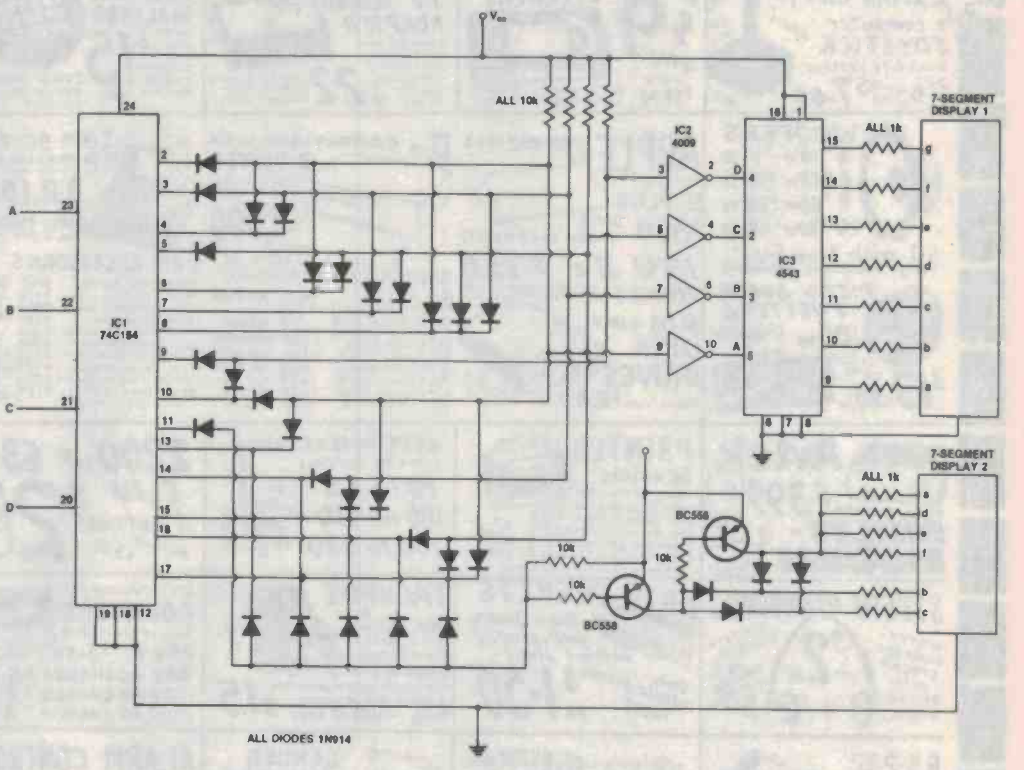
Binary display

One way of getting a binary output to display decimal is to use a 74185 driver. However, these chips are not available everywhere, so you might like to copy **Ian Davies of Cheltenham Vic**, who built his own out of a zillion diodes and some common-as-mud chips.

IC1 is a one-of-sixteen decoder, from which is derived a BCD output for the 4543. The MSD is driven by outputs 13 to 17. If any of these is active, it pulls the base of Q1 down, and so turns the digit into a '1'.



'IDEA OF THE MONTH' CONTEST

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month we will be giving away a 60 W Portable Cordless Soldering Iron, a 240 Volt Charging Adaptor together with a Holder Bracket. The prize is worth approx. $100.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each person will be paid $20 for an item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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

Title of Idea ....

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

Name ....

Address ....

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

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

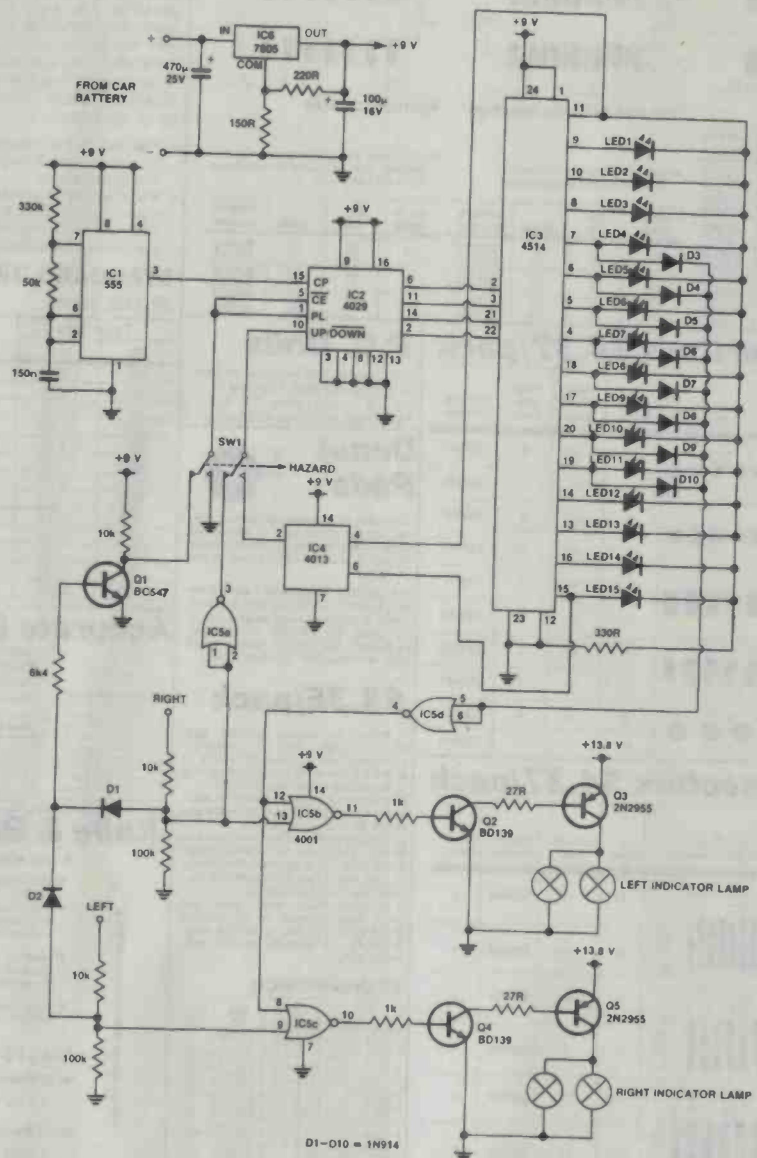
Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked to and including the date of the last day of the month.

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

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

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

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



Indicators

Mark Barber,
Geelong, Vic 3220

This circuit was developed for a rebuilt F100 truck but can be fitted to almost any vehicle. It completely replaces the existing system, with the exception of the indicator switch assembly.

Initially, with SW1 in the position shown, the junction of D1-D2 is low so TR1 holds 4-bit counter IC2 disabled, via pin 5 (CE), and in the parallel load mode (pin 1 high). Zero is loaded into the counter. If the left input is taken to +13.8 V, via the existing switch assembly, diode OR gate D1-D2 goes high, TR1 conducts, and IC2 starts counting in the up direction due to clock pulses from the '555 astable. IC3 decodes each binary code to light the respective LED. Thus LEDs D3-D17 form a left moving dot, which when mounted on the dashboard provides an indication to the driver of the direction indicated.

Similarly, applying +13 V to the right input also enables the counter but now the count direction pin (10) is low due to inverter IC5a. The counter counts downward, and the dot moves to the right.

When any of the middle eight LEDs are lit, diode OR gate D18-D25 provides a high signal (of 50% duty cycle) to IC5 gates b and c, via inverter IC5d. During right indication, IC5 gate b is disabled, so only the right indicator lamps flash, via driver circuitry TR2-3. IC5 gate c is disabled during left indication and so only the left lamps flash.

If SW1 is moved to the familiar 'hazard' position, IC2 is enabled and the LED display dot starts moving, only now the count direction is reversed when the dot reaches its limits (D3-D17) by the flip-flop IC4, and the appearance of a bouncing dot is given. Since during hazard indication the indicator switch will be at the neutral position, both gates b and c of IC5 will be enabled and all four indicator lamps will flash in unison.

Since the bulk of the circuitry operates from 9 Vdc, the IC regulator in Figure 2 will provide the lower voltage needed to run from the vehicle's nominal 13.8 Vdc supply.

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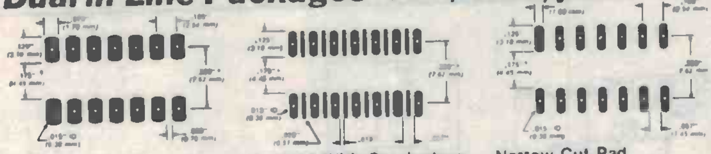

Cut Pad

No. of Leads	Qty/ Pkg.	Scale	Catalog Number
14	32 28	1X 2X	EZ6014 EZ6038
16	32 28	1X 2X	EZ6004 EZ6109
18	28 26	1X 2X	EZ6900 EZ6901
24	12 12	1X 2X	EZ6535 EZ6536
28	12 12	1X 2X	EZ6903 EZ6904
40	8 8	1X 2X	EZ6906 EZ6907

Cut Pad With Conductors

- Use where conductor traces must be routed between pads

No. of Leads	Qty/ Pkg.	Scale	Catalog Number
14	32 28	1X 2X	EZ6760 EZ6761
16	32 28	1X 2X	EZ6763 EZ6764
40	8 8	1X 2X	EZ6984 EZ6985

Narrow Cut Pad

- Use where a longer terminal area is desired. Can be used with conductors between terminals.

No. of Leads	Qty/ Pkg.	Scale	Catalog Number
14	32 28	1X 2X	EZ6013 EZ6071
16	32 28	1X 2X	EZ6453 EZ6244
40	8 8	1X 2X	EZ6987 EZ6988

Pre-Spaced Pads $4.37/pack

Center to Center Spacing	Pad Type	Scale	Pads Per Strip	Strips Per Pack	Catalog Number
.100"		1X	40	6	EZ5000
		2X	20	7	EZ5001
		1X	40	6	EZ5003
		2X	20	7	EZ5004
		1X	40	6	EZ5017
		2X	20	7	EZ5018
		1X	40	6	EZ5020
		2X	20	7	EZ5021
.156"		1X	25	6	EZ5014
		2X	13	7	EZ5015

Edge Connectors $4.37/pack

Center to Center Spacing	Patterns shown 1X (1:1) scale. Dimensions shown 1X (1:1) scale; for 2X scale, multiply values shown by 2.	Scale	Contacts/ Strip	Catalog Number	Strips/ Pack
.100"		1X	44	EZ6805	2
		2X	22	EZ6809	5
.125"		1X	35	EZ6704	2
		2X	17	EZ6716	4
.156"		1X	28	EZ6708	3
		2X	14	EZ6720	5

P.C. Drills

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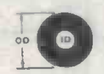
Donut Pads



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2. A small ID makes registration easy, but may make it difficult to locate pad center after photo reduction.
3. Choose an ID smaller than hole to be drilled. (Drill size for plated-through holes must be larger than final hole.)
4. Use Multi-Pad configurations for multi-pad terminal patterns.

It is much easier, much faster, and much more accurate to lay down a whole pattern printed to specific tolerances than to tediously position individual pads.

STANDARD INCH

OD in.	OD mm	ID in.	ID mm	Cat. No.	Qty/ Pkg.
.080	2.03	.031	0.79	EZD216	96
.100	2.54	.031	0.79	EZD101	96
.120	3.05	.031	0.79	EZD230	96
.125	3.18	.031	0.79	EZD102	96
.150	3.81	.031	0.79	EZD144	96
.156	3.96	.031	0.79	EZD103	96
.160	4.06	.040	1.02	EZD247	108
.187	4.75	.031	0.79	EZD138	108
.200	5.08	.031	0.79	EZD139	108
.250	6.35	.062	1.57	EZD108	128
.300	7.62	.062	1.57	EZD111	112

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20 Yds./Roll

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.026	0.66	EZC3002 $3.05
.031	0.79	EZC3004 $3.25
.040	1.02	EZC3006 $3.25
.050	1.27	EZC3008 $3.25
.062	1.57	EZC3010 $3.35
.080	2.03	EZC3012 $3.35
.093	2.36	EZC3014 $3.35
.100	2.54	EZC3016 $3.35
.125	3.18	EZC3018 $3.35
.200	5.08	EZC3020 $3.46
.250	6.35	EZC3022 $4.57
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- Includes X-Acto blade (Order No. EZ3108, shown below)

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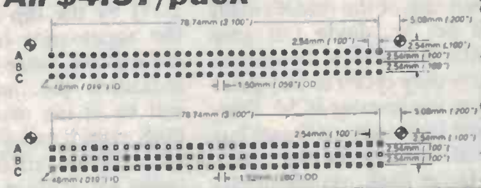

DIN41612 connectors patterns have three row designations A, B and C. Three pattern combinations are available AB, AC and ABC. They are also available with round or square pads

ROUND PAD

64-Pin Pattern (A-B) Scale	Symbols Per Pkg	Catalog Number	64-Pin Pattern (A-C) Scale	Symbols Per Pkg	Catalog Number	96-Pin Pattern (A-B-C) Scale	Symbols Per Pkg	Catalog Number
1X	2	EZ6869	1X	2	EZ6875	1X	2	EZ6871
2X	2	EZ6870	2X	2	EZ6876	2X	2	EZ6872

SQUARE PAD

64-Pin Pattern (A-B) Scale	Symbols Per Pkg	Catalog Number	64-Pin Pattern (A-C) Scale	Symbols Per Pkg	Catalog Number	96-Pin Pattern (A-B-C) Scale	Symbols Per Pkg	Catalog Number
1X	2	EZ6878	1X	2	EZ6881	1X	2	EZ6884
2X	2	EZ6879	2X	2	EZ6882	2X	2	EZ6885

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DSE to sell Toshiba lap-top

Dick Smith Electronics is to market the Toshiba T 1100, an IBM compatible lap-top computer, throughout Australia.

The T 1100 has 256K RAM and an integrated 720K, 3½-inch floppy disk. It will also support an optional, external 3½ or 5½-inch floppy disk. It will run for up to eight hours under rechargeable battery power and has an optional ac adaptor for mains power. Claims are the computer can run all the popular IBM-PC programs. The machine incorporates a low energy consumption LCD screen or can be connected to a video monitor.

The selling price of this 4.1 kg battery powered machine and Access IV package is $2995.

The T 1100 will be sold through the Dick Smith Electronics network of 56 stores across Australia, with hardware support being provided by Toshiba's service network.

Apple adds might to memories

Apple Computer Australia has announced significant enhancements to its Apple II line of personal computers.

The enhancements include the UniDisk 3.5, a 3½-inch floppy disk drive capable of storing up to 800K of information (more than five times the capacity of Apple's current 5¼-inch drives); and the Apple II memory expansion card, an interface card capable of expanding the Apple II's maximum internal memory to over one megabyte (the current maximum is 128K).

The new 800K disk drive is said to bridge the storage and speed gap between Apple's low-end 143K floppy disk drives and the high-capacity 10M Apple ProFile hard disk.

The extra RAM memory can also be used as an internal disk drive (called a RAM disk), allowing programs to be directly loaded and executed in the computer's internal memory, enhancing program operating speed. With revised software, the extra memory can be used for creating much larger documents or many more small files.

Apple is also introducing the MouseDesk program selector to allow several software programs to be stored at once on either the UniDisk 3.5, ProFile or the memory expansion card.

According to Apple more than 100 software developers have been working with UniDisk 3.5, the Apple II memory expansion card and MouseDesk since early this year, and approximately 40 companies plan to release new or enhanced software by the end of this year that supports one or more of these new products.

Videotex on IBM-PC & Apricot

Mview is a low cost videotex emulation package launched by Supertext Videotex at the inaugural Pan Pacific Computer Conference.

Its claims are to convert any IBM-PC, Apricot or BBC into an advanced videotex terminal. Once installed Mview gives a range of videotex facilities including double/single height characters; coloured backgrounds; flashing text graphics; the choice between separated and contiguous graphics; the ability to inspect a local database; carousel facility and the ability to print out frame content. Mview can reportedly communicate with most Viatel-type systems throughout the world.

The Mview package comes with a free instructional disk, and instructional and technical handbooks for $250.

For more information contact **Australian Caption Centre, 1st Level, Fortune House, 88-90 Foveaux St, Surry Hills, NSW 2010. (02)212-5277.**

CLUB CALL

A new club, **Personal Programmers of Melbourne** has formed, devoted to hand-held computers or calculators (Casio, Sharp, HP, etc). Many members have Forth, BASIC and HP RPN experience. The club meets 3rd Tuesday each month at 9th Floor, Menzies Building, Monash University at 8 pm. Paul Cooper, 40 Karen St, Box Hill Nth, Vic 3129, (03)898-7672 ah, can be contacted for information.

BRIEFS

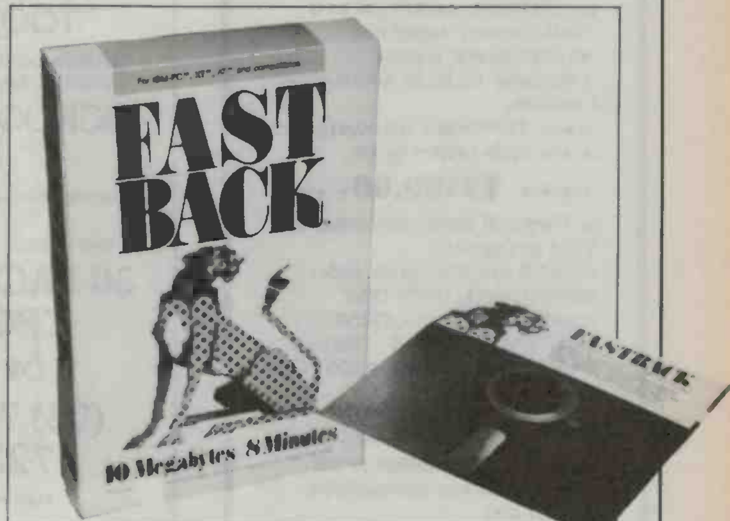
Qld Microsoft distributor
Microsoft has appointed Brisbane based company, Qsoft, Queensland distributor of its products, making it responsible for supporting them as well as providing training. Qsoft was established this year by Margaret Willis, Robyn Dunn, and Dennis Hobb.

Synchronous RS422 fibre optic modem
The IFS MX422 is a high performance, low cost fibre optic modem, designed for the transmission of RS422 data signals. It transmits both asynchronous and synchronous signals over several kilometres of standard low cost telecommunications 50/125 fibre. It operates between dc and 10 Mbps. For more information contact Integral Fibre Systems Pty Ltd, 2 Thomas Street, Chatswood, NSW 2067.

3½" 320K drive for the apple
The Interlink S/320-D is a double capacity 3½" drive for the Apple designed to work with the standard Apple drive controller. Patch disks are supplied with the drive to support ProDos, DOS 3.3 and CP/M 2.0. For more information contact Interlink, 171 Dorcas St, South Melbourne, Vic 3205. (03)699-4177.

Sendata 1275 modem
This new device features 75TX/1200RX (Videotex), 300 bps full duplex transmission rates, a mode switch, −45 dBm receiver sensitivity, and RS[illegible] Australia[illegible] signed and manufactured [illegible] Telecom approval number C83/37/1045. More information is available from Sendata, 11 Stamford Rd, Oakleigh, Vic 3166. (03)568-6299.

No-tape rapid backup
The new Fastback from Daneva is designed to eliminate the need for expensive tape backup systems for the IBM-PC, XT and AT. 10 Mbyte is backed up on a single drive IBM-PC in eight minutes using 23 standard 5¼" floppy disks. Fastback works with PC-DOS or MS-DOS version 2.0 or higher. For more information contact Daneva Australia, 64-66 Bay Road, Sandringham, Vic 3191. (03)598-5622.



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	Double Sided Board	Was ea	Now ea
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DS/150	230mm x 85mm	$3.95	$1.95
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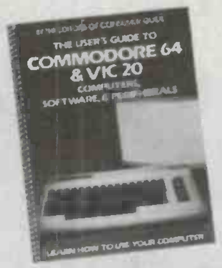

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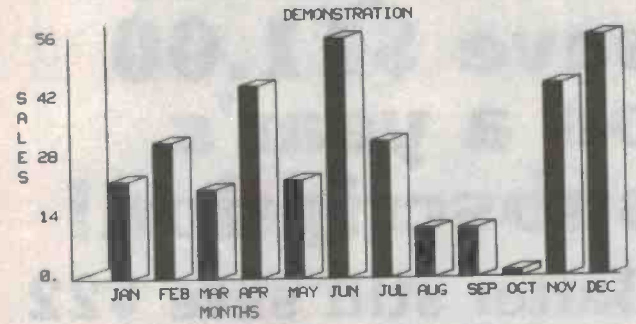
Three Dimensional Bar Graphs

Richard Bushell
Baulkham Hills, NSW 2153

This program uses hi-res graphics to plot a 3D bar graph on the screen which can be dumped to an XX-80 type series/parallel printer.

This can be used to display sales etc for 12 months, or for comparing items for a maximum of 12 separate periods.

The data is input at the prompt, and may be saved to tape when finished. The program uses colour for converted Microbees but will run on any Microbee.




```
DATA

     JAN=    23.    FEB= 32.     MAR= 21.    APR= 45.
     MAY=    23.    JUN= 56.     JUL= 32.    AUG= 12.
     SEP=    12.    OCT= 2.      NOV= 45.    DEC= 56.
```

```
BAR CHART PRINTING PROGRAM
By RICHARD BUSHELL

00100 ON ERROR GOTO 960
00110 CLS
00120 COLOR 16
00130 PRINT TAB(25)" BAR CHART "
00140 PRINT TAB(24) "R.BUSHELL 8/85 "
00150 PRINT TAB(13)"FOR MICROBEE WITH XX-80 TYPE PRINTER"
00160 PRINT
00170 COLOR 6
00180 PRINT "This program draws a 3 dimensional bar graph to your data input.":
CURS 10,13: PRINT"  X axis is horizontal, Y axis is vertical."
00190 CURS 14,16 : PLAY22,1:INPUT "Do you wish to load data from tape ? ";D1$
00200 IF D1$(;1,1)="Y" THEN 860
00210 CLS
00220 REM ****** INPUT DATA
00230 PLAY22,1:INPUT  "Heading ? ";H1$
00240 PLAY22,1:INPUT  "Label for X axis ? ";X1$
00250 IF X1$="" THEN 240
00260 PLAY22,1:INPUT "Label for Y axis ? ";Y1$
00270 IF Y1$="" THEN 260
00280 PLAY22,1:INPUT "Number of Sections ? (Max.12)";S
00290 IF S>12 THEN PRINT "ERROR" : GOTO 280
00300 COLORB 1:COLOR 2
00310 CLS:CURS5,4:PRINT "DUMP RESULTS TO WHERE ?"\\\\TAB(40)"1=Parallel,"\TAB(40
)"4=300bd Serial,"\TAB(40)"5=1200bd Serial,"\TAB(40)"7=No Dump ":PLAY 20,1:INPUT
K
00320 PRINT "Save data to tape when finished (Y/N) ? "
00330 D1$=KEY : IF D1$<>"Y" AND D1$<>"N" THEN 330
00340 DIM S1(S),S2(S),S3(S)
00350 FOR I=1 TO S
00360 CLS
00370 PRINT "Section "I" name.(3 char.) ";:PLAY22,1:INPUT S1$(I)
00380 IF LEN(S1$(I))>3 THEN PLAY 2,3 : PRINT "ERROR" : GOTO 370
00390 PRINT "Data for section "I;:PLAY22,1:INPUT S2(I)
00400 IF S2(I)>S2(M) THEN LET M=I
00410 NEXT I
00420 FOR I=1 TO S
00430 S3(I)=(S2(I)/S2(M))*195
00440 REM ***** DISPLAY GRAPH
00450 NEXT I
00460 CLS : HIRES
00470 COLORB 4 : COLOR 4
00480 PLOT 50,230 TO 50,34 TO 491,34
00490 CURS 20,16 : PRINT X1$;
00500 FOR I=1 TO LEN(Y1$) : CURS 2,I+4 : PRINT Y1$(;I,1);: NEXTI
00510 CURS (64-LEN(Y1$))/2,1 : PRINT H1$
00520 I=62
00530 RESTORE 640
00540 FOR T=1 TO S
00550 COLOR T+2
00560 W=INT(S3(T))+33 : I=I+35
00570 PLOT I,34 TO I,W TO I-15,W TO I-15,34
00580 PLOT 50,34 TO 80,44 TO 80,240
00590 PLOT I,34 TO I+15,39 TO I+15,W+5 TO I,W TO I-15,W TO I,W+5 TO I+15,W+5
00600 FOR P=1 TO 15 : PLOT I-P,34 TO I-P,W : NEXT P
00610 READ O:CURS O,15:PRINT S1$(T)
00620 NEXT T
00630 FOR O1=1 TO 3 : CURS 3,2+INT(O1*3) : PRINT INT(S2(M)-S2(M)*O1/4) : NEXT O1
: CURS 3,14 : PRINT 0 : CURS 3,2 : PRINT INT(S2(M))
00640 DATA 11,16,20,24,29,33,38,42,47,51,55,59
00650 REM ******* SCREEN DUMP
00660 IF K=7 THEN 760
00670 OUTL#K :LPRINT CHR(27)"5": RESTORE 820  : FOR X=336 TO 371 : READ Y : POKE
 X,Y : NEXT X
00680 LPRINT CHR(27);"A";CHR(8);
00690 FOR Y=0 TO 15
00700 FOR U=0 TO 8 STEP 8 : LPRINT CHR(27)"K"CHR(0)CHR(2);
00710 FOR X=0 TO 63 :A=USR(336,61440+U+16*PEEK(61440+Y*64+X)) : NEXT X
00720 LPRINT CHR(10);
00730 NEXT U : NEXT Y
00740 LPRINT CHR(27)"2"CHR(7);
00750 LPRINT :LPRINT"DATA": FOR I=1 TO S STEP 4 : FOR U=0 TO 3 : LPRINT TAB(U*11
+10) S1$(I+U);"=";TAB(U*11+16);S2(I+U);"    ";:NEXT U : LPRINT CHR(13) : NEXT I
00760 IF D1$="N" THEN END : REM **** SAVE ON TAPE 300 BAUD
00770 OUTL#2 :CURS 10,16 :  PLAY22,1:INPUT  "START TAPE AND PRESS RETURN ";D1$
00780 LPRINT "#$%&'()": PLAY0,2
00790 LPRINT H1$:PLAY0,2:LPRINTX1$:PLAY0,2:LPRINTY1$:PLAY0,2:LPRINTS:PLAY0,2
00800 FOR I=1 TO S : LPRINT S1$(I):PLAY0,2:LPRINTS2(I):PLAY0,2:NEXT I
00810 END
00820 DATA 62,1,211,11,96,105,14,128,229,6,8,203,34,126,161
00830 DATA 40,2,203,194,35,16,245,122,205,69,128,225,203,57
00840 DATA 48,233,61,0,211,11,201
00850 REM ******* LOAD FROM TAPE 300bd
00860 IN#2 :INPUT K1$:IFK1$<>"#$%&'()" THEN 860 ELSE INPUT H1$:INPUT X1$ : INPUT
 Y1$ : INPUT S
00870 DIM S1(S),S2(S),S3(S)
00880 FOR I=1 TO S : INPUT S1$(I) : INPUT S2(I)
00890 IF S2(I)>S2(M) THEN LET M=I
00900 NEXT I
00910 IN#0
00920 PLAY22,1:INPUT "Dump results to where ? (1=Parallel,4=300bd Serial,5=1200b
d Serial,7=No Dump) ";K
00930 D1$="N"
00940 GOTO420
00950 REM ***** PCG OVERFLOW
00960 CLS : PRINT "CATASTROPHIC SYSTEM ERROR - PROGRAM WILL RERUN" : PLAY 0,24:R
UN
```

CONTRIBUTORS PLEASE NOTE

All contributions to this column should be accompanied by a listing of the program from a printer. Hand written or typed listings are not acceptable.

There are two reasons for this. The first is that a listing from your computer gives us some guarantee that *you* have the listing correct.

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Contributors will be paid $20 for each item published in this column. Submissions must be original programs which have not been previously published. You may send as many programs as you wish with the accompanying declaration.

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Undo Utility

Philip Summers
Mt Lawley, WA 6050

The following code provides a method of recovering a BASIC program after erasing it with the NEW command. The code is written in Z80 assembly language because of its small size, speed and ability to be stored in EPROM.

The program works by searching the BASIC program area for two end-of-file markers, (FFH), which indicate the end of a program. The address of the end-of-file markers is then stored at 8D2 Hex, the location containing the program end pointer.

To use the program, simply store it in any free memory or in any EPROM and execute it using the BASIC command USR(n).

```
ADDR   CODE     LINE   LABEL  MNEM   OPERAND
                00100 ;
                00110 ;              OLD - restore BASIC program after NEW.
                00120 ;
0400 210209     00130 OLD     LD     HL,902H        ; start of BASIC program.
0403 7C         00140 LOOP    LD     A,H            ; check for top of memory
0404 FE40       00150         CP     40H            ; 80H for 32K Microbee's
0406 C8         00160         RET    Z              ; top of memory reached.
0407 7E         00170         LD     A,(HL)         ; gett a byte
0408 23         00180         INC    HL             ; point to next location
0409 FEFF       00190         CP     0FFH           ; is it 1st EOF flag?
040B 20F6       00200         JR     NZ,LOOP        ; no, so continue search
040D 7E         00210         LD     A,(HL)         ; yes, so get next byte
040E FEFF       00220         CP     0FFH           ; is it 2nd EOF flag?
0410 20F1       00230         JR     NZ,LOOP        ; no, so continue search
0412 22D208     00240         LD     (8D2H),HL      ; yes, restore prog. end
0415 210001     00250         LD     HL,1<8         ; erase EOF flags and
0418 220009     00260         LD     (900H),HL      ; restore 1st line no.
041B C9         00270         RET
0F89            00280         END    200585
00000 Total errors

LOOP    0403    OLD     0400
```

Reaction Times

David Rapson
Bellevue Heights, SA 5050

This program can be used to check a person's reaction time to either visual or audible stimulus. An approximate indication of the time taken is displayed in hundreds of seconds.

```
00100 REM                    Program REACTION.MWB
00110 REM This prgram will test your reaction time, to visual and audible respon
ses
00120 REM Written by David Rapson, S. Aust.  28 April 1985
00130 CLS
00140 HIRES : PLOT 0,0 TO 0,255 TO 511,255 TO 511,0 TO 0,0
00150 CURS 23,2 : PRINT "Reaction Time Tester"
00160 CURS 23,3 : PRINT "~~~~~~~~~~~~~~~~~~~~"
00170 CURS 8,15 : PRINT "Use the <space> bar to start and stop the timer."
00180 CURS 15,8  : PRINT "Select  Visual or Audible response";
00190 C1$=KEY$
00200 IF C1$="V" OR C1$="v" THEN LET L=0 :GOTO 230
00210 IF C1$="A" OR C1$="a" THEN LET L=1 :GOTO 230
00220 GOTO 190
00230 CLS
00240 IN#0
00250 CURS 1,1 : PRINT "Press <space> to start REACTION TIMER";
00260 A1$=KEY$: IF A1$="" THEN 260
00270 CLS : POKE 220,22 :REM remove the cursor
00280 CURS 1,7 : PRINT "Get Ready...";
00290 R=INT(RND*5000)
00300 IN#0 OFF
00310 FOR J=1 TO R :NEXT J :REM wait for a random length of time
00320 I=0
00330 IF L=0 THEN CURS 1,7 :INVERSE: PRINT [A15 133];" Go-Go  hit <space>  Go-Go
 ";[A15 133] : IN#0
00340 IF L=1 THEN OUT 2,0: OUT 2,64 :IN#0
00350 B1$=KEY$ :I=I+1 :IF B1$="" THEN 350
00360 NORMAL
00370 POKE 220,111 :REM restore the cursor to normal
00380 I2=FLT(I)/177 :REM timing factor, try 1/3 of 177 for 2MHz Microbees
00390 CURS 1,12 :PRINT "Your Reaction Time is ";[F6.2 I2];" seconds"
00400 IF I2<0.1 THEN PRINT "Fluke !!!"
00410 IF I2>0.1 AND I2<=0.2 THEN PRINT "That's quick..."
00420 IF I2>0.2 AND I2<=0.3 THEN PRINT "What's OK..."
00430 IF I2>0.3 AND I2<=1 THEN PRINT "You're a little slow..."
00440 IF I2>1 THEN PRINT "Wake up when you're ready'!"
00450 GOTO 240
```

Simpson's Method

Miroslav Kostecki
Elizabeth Pk, SA 5113

If you use any maths at all in your life, this program may make it easier, but even if you just like graphics, definitely try it.

An integral is simply the area under a graph, down to where x = 0. A specific integral is the area between two points along a graph. Integrals are very useful for calculating areas, volumes, times, etc, if these are complex.

The program uses Simpson's Method to find the integral of the function in line 130. An ODD number of steps should be used. A hi-res graph is plotted on the screen of the section. This graph has been automatically scaled in both the x and y directions.

```
00100 REM  Find Specific Integral
00110 REM   using Simpsons Method.
00120 SD 8
00130 FN1= #*#*# +#*# +#
00140 INPUT"START,END,STEPS"A1,B1,C
00150 IN #0 OFF
00160 DIM A0(C),B0(C)
00170 Z1=FN1(A1)*2
00180 A0(0)=0: B0(0)=Z1/2
00190 D1=(B1-A1)/FLT(C)
00200 FOR X=1 TO C-1
00210  A0(X)=D1*FLT(X)
00220  B0(X)=FN1(A1+A0(X))
00230  Z2=2*B0(X)
00240  Z1=Z1+Z2+Z2/5E5
00250  IF X/2*2=X: Z1=Z1+Z2
00260 CURS 16,16: PRINT [I6 X];
00270 NEXT X
00280 Z1=FN1(B1)+Z1: Z1=D1*(1/3)*Z1
00290 A0(C)=B1-A1: B0(C)=FN1(B1)
00300 REM    Scale and plot.
00310 H1=-9E30: L1=9E30
00320 FOR I=0 TO C
00330  IF H1<B0(I): H1=B0(I)
00340  IF L1>B0(I): L1=B0(I)
00350 NEXT I
00360 P1=255/(H1-L1)
00370 P2=511/A0(C)
00380 FOR I=0 TO C
00390  A0(I)=A0(I)*P2
00400  B0(I)=(B0(I)-L1)*P1
00410 NEXT I
00420 HIRES
00430 R=INT(A0(0))
00440 S=INT(ABS(B0(0)))
00450 FOR I=0 TO C
00460  X=INT(A0(I))
00470  Y=INT(ABS(B0(I)))
00480  PLOT R,S TO X,Y
00490  R=X: S=Y
00500 NEXT I
00510 CURS0: IN #0 ON
00520 PRINT "Between";A1;" and";B1
00530 PRINT " the Integral=";Z1
```

Interrupting the Interrupt

Lindsay R. Ford
Eltham North, Vic 3095

Owners of Microbee Personal Communicators or earlier machines that have been upgraded may have difficulties in verifying 1200 baud BASIC or WordBee tape files and in using ROM based software (such as my Chip-8 interpreter/compiler) because of a factory mod on the motherboard. In some machines a link has been installed between IC9, pin 40 (the Z80 MPU) and IC1, pin 34 (the PIO) to enable an interrupt to drive the real time clock in the Telcom ROM. This causes major headaches unless the interrupt can be turned off when the clock is not in use.

Machines fitted with Telcom V2 or later *and* multiple EPROM sockets can avoid these problems by turning off the clock when not in use, but earlier versions of Telcom don't have this facility. Applied Technology suggests that the answer is to cut the link (Engineering Notes ECN 1-40684), but this causes even bigger problems as it leaves the interrupt pin on the Z80 floating and interrupts will now occur randomly every time there is a little stray electrical interference. If this link is cut then it is essential to connect IC9, pin 40 via a 4k7 resistor to V+. A resistor pad (R7 — left side of PIO when viewed from the front) is provided for this purpose, but often either the resistor isn't installed or is left unconnected after people cut the link.

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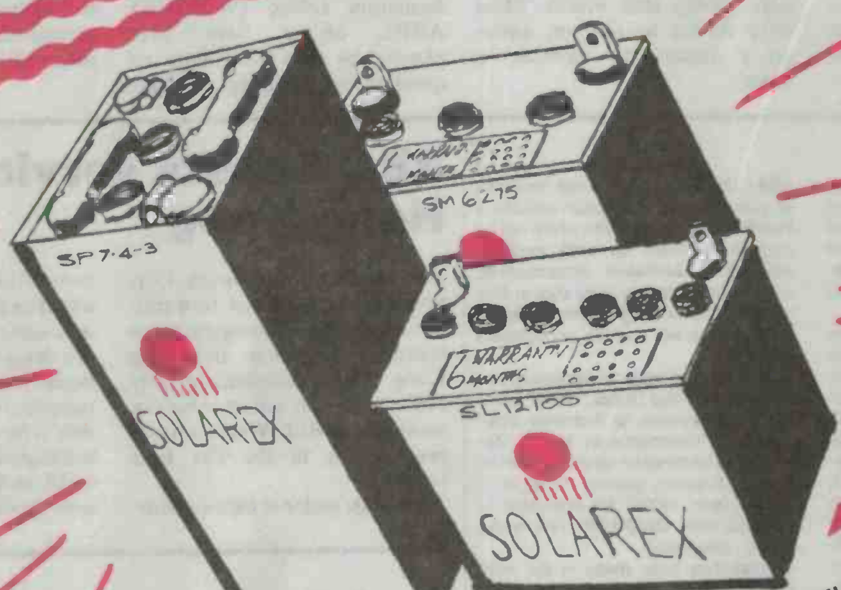

To get the best results from your Solar power system requires the use of the very best equipment. To this end, Solarex have decided to market a range of batteries designed specifically for solar use.

Known as the Solarex "S" range, they include an SL Battery for use on small solar systems with low current draw, such as lighting kits. This battery, similar in appearance to an automotive* battery but designed for deep cycling, has a life expectancy of 2 to 3 years.

The second and more powerful model is the "SM". This battery is once again similar in appearance to an automotive* battery, but is built along the lines of a traditional traction battery, designed for use with both domestic and commercial systems where cost is important, and has a life expectancy of from 4 to 5 years.

The last model in the range is the "SP", or Premium Duty Battery, consisting of three interconnected 2V cells. This battery incorporates State of the Art Technology, and can be used for any size project. It has remarkable cycling capability, and is ideal for remote areas where its low maintenance, high performance features come to the fore. Life expectancy on these excellent units is 8 to 10 years.

* Solarex do not recommend the use of automotive batteries in Solar Systems.

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TELEPHONE (02) 727 4455
TELEX AA121975

Mexico radio

The earthquake in Mexico has caused an upsurge of interest in amateur radio following the central communications function performed by hams during the disaster.

The earthquake hit on 20 September at 7.20 am local time. It measured 8.1 on the Richter scale and was centred 290 km north of Acapulco. It did little damage in the resort city, but hammered Mexico City. Afterquakes rolled through during the day, some measuring as high as 7.5.

News reports said the death toll was in the thousands, with half the buildings in the centre of the world's largest city destroyed. Significantly, older buildings survived the quakes. People in modern buildings — the hotels, hospitals and telecommunications facilities were most at risk.

In fact, the scale of the disaster was so savage that for 24 hours there was only one TV station broadcasting information to the city's 18 million people. All international and much of the internal telephone traffic was also destroyed. In this situation ham operators, of which there are many in the city, sprang into action. Most were forced to rely on emergency power to provide a service.

Initially most of the traffic consisted of damage reports and aid requests directed to the various Mexican consulates and Red Cross agencies, who were quick to respond to the disaster. The international news media also began working the hams in an effort to get news of what was happening. Also demanding a lot of attention were requests to pass on "are you all right" messages from worried friends and relatives.

According to the American Radio Relay League Public Information Office (WA3VJB), ARRL offices have been plagued by calls from hams requesting help passing messages into Mexico. There is a large Mexican population in the south of the US and particularly in Los Angeles.

An emergency network sprung up spontaneously during the hours after the earthquake on 14.275 MHz. As time went on this net expanded right through the 20 metre band during the day time, spilling over into 40 MHz and 80 MHz at night. According to observers in the area, most of the English language transmissions were on 20 MHz, with 80 MHz reserved for Spanish speakers. 40 MHz apparently sounded like the tower of Babel.

KILOHERTZ COMMENT

GERMANY: The regional station at Baden-Baden known as South West Rundfunk is heard on 7265 kHz at 0630 UTC and later. The power is 20 kW and the station uses a new omnidirectional aerial. The full schedule is 0300-2205 UTC.

Deutsche Welle is using some new frequencies for its transmissions to Australia both in German and English. The transmission in English 0930-1020 UTC is now on 9650, 9770, 15160, 15245, 17780, 17800, 21500, 21680 kHz and the second transmission is at 2100-2150 UTC on 6185, 7130, 9765 kHz. The transmission in German for evening reception at 0600-1000 UTC is on 9690, 9735, 11785, 11795, 15105, 17845, 21560 kHz. Broadcasts originate from two transmitter sites in Germany as well as relay bases on Antigua, Monserrate and Sri Lanka.

NEPAL: Radio Nepal at Katmandu is now heard using two frequencies with English news up to 1502 UTC. Frequencies of 7165 and 5005 kHz are used and there is interference on both channels up to 1500 UTC. Radio Korea is using 7165 kHz up to this time with Radio Malaysia also using 5005 kHz to sign off at 1500 UTC. After the close of English news, Radio Nepal continues with local programmes which include many commercial announcements in Nepali.

PHILIPPINES: The Far East Broadcasting Company at Manila is using 11865 kHz for a broadcast in English 0000-0300 UTC. The FEBC transmission to Australia is on 11890 kHz, 0800-1000 UTC and includes news at 0830 UTC. On Friday at 0840 UTC there is a special program for shortwave listeners with the title "DX Dial" and is contributed by Alok das Gupta, of Calcutta.

USA: The Voice of America indicates its plans for the Caribbean include a Puerto Rican relay station which will include transmitters for both mediumwave and shortwave broadcasting, while the new station to be built in Belize will have two high powered transmitters which will operate on separate frequencies.

The latest private commercial station in the United States, NDXE, is to beam programmes to Australia when operations commence in March. According to information received from H. Dickson Norman, general manager of Global Radio, NDXE will broadcast to Australia from 0900-1200 UTC using the 49 metre band.

There has been delay in the construction of the station due to equipment delivery but key staff members have been appointed including Mr G. Taylor, former president and general manager of WLS in Chicago. NDXE plans a mass appeal format and a program service unique in shortwave broadcasting. It will operate with 100 kW power and the proposed schedule covers transmissions beamed to Europe, North and South America and the Pacific, with all transmissions in English. The schedule is for 24 hours a day operation. The address of NDXE is Global Radio, 705 Second Ave, Opelika, Alabama 36801, USA.

This item was contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All times quoted are UTC (GMT) which is 10 hours behind Australian Eastern Standard Time; areas observing Daylight Time should add a further hour to these schedules.

BBC boosts service from Hong Kong

The British Broadcasting Corporation has ordered transmitters and antennas to equip a new transmitter station in Hong Kong. When completed in early 1987 the station will improve the audibility of BBC World Service programmes in the Far East region.

The first order is for two Marconi B6131 250 kW transmitters incorporating advanced Pulsam modulation. The transmitters are designed for high overall efficiency and will be equipped for remote control via a digital data link. The second order is for the associated antennas comprising 4 HF multi-band curtain arrays with mode/slew switching.

Red Cross radio

Following the introduction of a new schedule at Swiss Radio International the test transmissions of the International Committee of the Red Cross have been retimed for Australia. The broadcasts are now heard 0740-0757 UTC in English on 9560, 15305, 15570 and 17830 kHz.

The Red Cross Broadcasting Service began during the final days of World War II, when the ICRC broadcast lists of prisoners awaiting repatriation, and of people who were missing because of the war. In 1948 the ICRC was granted the use of a frequency in time of major crisis, and then began test transmissions. It has its own recording studio in Geneva and broadcasting facilities are given free of charge by the Swiss PTT and Swiss Radio International. The programmes in English, French, German, Spanish, Portuguese and Arabic contain news of Red Cross action around the world.

The Red Cross Broadcasting Service has listeners in every continent and welcomes reports, comments and questions to: International Committee of the Red Cross, 17 Avenue de la Paix — CH 1211 Geneva, Switzerland. IRCs are appreciated.

— Arthur Cushen

Christian Science Monitor joins broadcasters

The *Christian Science Monitor*, Boston, Massachusetts, which has been published for more than 75 years is planning to move into shortwave broadcasts. The paper has no religious content and is a respected publication with its own news source.

The publisher, John Hogland, plans to put a 24 hour news service on shortwave. The first goal is to broadcast into Europe for evening reception in that area with an expected schedule of 1800-2400 UTC. The station plans to present the entire newspaper which will be adapted for radio broadcasting. In addition some of the best known series of religious magazines published by the *Christian Science Monitor* are to be rewritten for broadcasting.

In a recent interview with Jonathan Marks of Radio Nederland, Mr Hogland advised that the station would be located in north eastern Maine for broadcast in Europe and will use 500 kW and 100 kW transmitters and high gain aerials. The station plans later to have a similar facility in the south eastern United States to cover Latin America and Africa and later possibly on Guam to broadcast to Asia and the Pacific. The construction of the full project will take five years and application for the first station has been made to the Federal Communications Commission.

Broadcasts in English only are anticipated even though there is a multitude of languages in Europe. It is felt that just as the paper reaches readers in almost every country, the radio broadcast would reach a sizeable audience of listeners with a knowledge of English.

Funding of the station will be by the Christian Science Church. The *Christian Science Monitor* is not a profit making venture, but intended as a public service, so the new station will be noncommercial.

— Arthur Cushen

Radio Japan

Radio Japan is the name of the shortwave service of the Broadcasting Corporation of Japan (NHK). Broadcasting had its beginning in Japan in 1925 on mediumwave with the first broadcast of Nippon Hoso Kyokai (NHK). The shortwave service began ten years later.

Overseas broadcasting started on 1 June, 1935 with daily one hour transmissions in English and Japanese directed to the west coast of North America. The transmission went out at 1000 UTC and was also beamed to Hawaii. One transmitter with a power of 20 kW was used for the first broadcast, but by 1937 transmitter power had been raised to 50 kW and broadcasts to Europe and South East Asia added to the schedule. Also in 1937, with the Chinese-Japanese War, Radio Japan became the voice of the Japanese Government, and lost its independence.

By 1941 broadcasts were extended and women were added to the announcing staff.

In September 1945, at the end of World War II, overseas broadcasts from Japan were prohibited by the Allied Forces, and it was February 1952 before they were resumed. Shortwave broadcasts were renamed Radio Japan and the new domestic structure allowed private commercial stations as well as NHK to operate on the mediumwave band.

Radio Japan today focuses on a cross-section of Japanese life and provides several specialist programmes including one for the shortwave listener. Ten years ago there was a boom in shortwave listening in Japan and even today 45,000 members still belong to Japan's largest shortwave federation.

— Arthur Cushen

BRIEFS

Audio scrambler chip

Total Electronics is distributing the COM9046, a single band scrambler/descrambler chip containing two identical channels (for full duplex operation), with either channel capable of performing the scrambling or descrambling functions. The COM9046 offers high S/N ratio and low insertion loss. For further information contact Total Electronics, 9 Harker St, Burwood, Vic 3125. (03)288-4044.

Simplex radio link

The new version SDX-PKT 1.2 CPU-100 modem is designed to provide error free data communications over a standard voice bandwidth simplex radio link. It connects between a terminal, computer or remote sensing device via an RS232 port and the radio transceiver. The data rate on the link is 1200 baud depending on radio link quality. See GFS Electronic Imports, 17 McKeon Rd, Mitcham, Vic 3132. (03)873-3777.

New rf power meter frequency counter

The new Fujisoku power meter with built-in frequency counter, covers the frequency ranges 0-150 MHz, 30-500 MHz and 330-960 MHz. Three power ranges of 1.5, 7 and 15 watts are available. For further information contact Vicom Australia, PO Box 366, South Melbourne, Vic 3205. (03)62-6931.

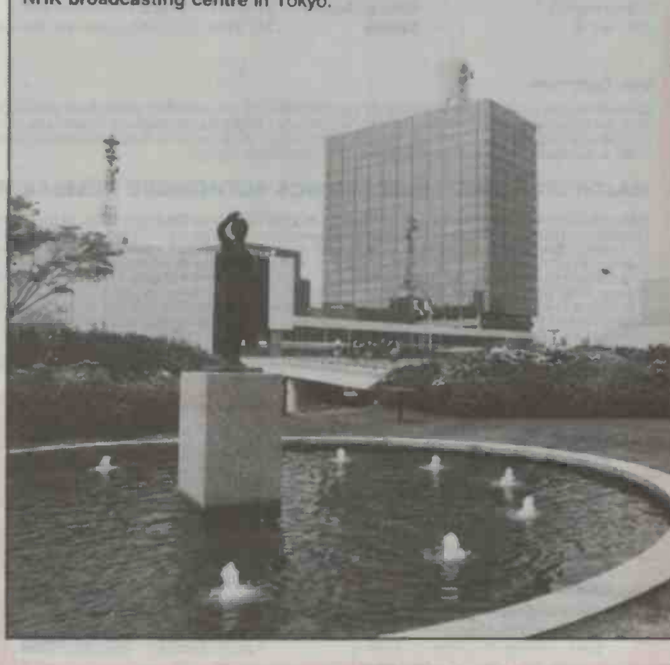
Codan to sell Midland

Codan is to distribute all Midland Syntech mobile and portable radios in Australia. This includes VHF/UHF land mobile radios, for which accessories and spare parts will be stocked at its Adelaide facilities.

An rf exposure meter

With the recent release of an Australian standard for maximum exposure levels, it is now possible to routinely check for excessive radiation. Tech-Rentals has available the Holaday type HI-3002 field strength meter, designed to make both E-field and H-field measurements. For further information contact Tech-Rentals on (03)879-2266.

NHK broadcasting centre in Tokyo.



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$13.50

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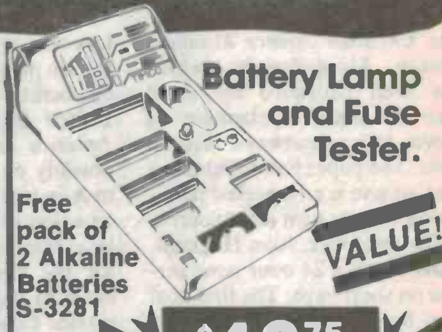

Battery Lamp and Fuse Tester.

Free pack of 2 Alkaline Batteries S-3281

VALUE!

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Don't throw those old batteries away — you could be throwing good money out! This battery, lamp and fuse tester checks a huge range of cells from 1.5V-9V actually under load! Checks Nicads, calculator and watch batteries and miniature lamps and cartridge fuses! Cat Q-1525

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Swift & Young Sts.	**Albury**	21 8399	263 Keira St	**Wollongong**	28 3800	Bowen & Ruthven Sts	**Toowoomba**	38 4300
T55 Terrace Level	**Bankstown Sq**	707 4888	**ACT**			Ingham Rd & Cowley St West End	**Townsville**	72 5722
Shop 1, 65-75 Main St	**Blacktown**	671 7722	96 Gladstone St	**Fyshwick**	80 4944	Cnr Pacific Hwy & Kingston Woodridge Rd	**Underwood**	341 0844
613 Princess Hwy	**Blackehurst**	546 7744	**VIC**					
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Shop 235, Archer St Entrance	**Chatswood Chase**	411 1955	Hawthorn Rd & Nepean Hwy	**East Brighton**	592 2366	Main North Rd & Darlington St	**Enfield**	260 6088
147 Hume Hwy	**Chullora**	642 8922	260 Sydney Rd	**Coburg**	383 4455	24 Park Terrace	**Salisbury**	281 1593
162 Pacific Hwy	**Gore Hill**	439 5311	1150 Mt Alexander Rd	**Essendon**	379 7444	**WA**		
315 Mann St	**Gosford**	25 0235	Nepean Hwy & Ross Smith Ave	**Frankston**	783 9144	Wharf St & Albany Hwy	**Cannington**	451 8666
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450 High St	**Maitland**	33 7866	Bridge Rd & The Boulevarde	**Richmond**	428 1614	Centreway Acde, Hay St	**Perth City**	321 4357
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Lane Cove & Waterloo Rds	**North Ryde**	88 3855	**QLD**			25 Barrack St	**Hobart**	31 0800
George & Smith Sts	**Parramatta**	689 2188	157-159 Elizabeth St	**Brisbane**	229 9377	**NT**		
The Gateway High & Henry Sts	**Penrith**	32 3400	166 Logan Rd	**Buranda**	391 6233	17 Stuart Hwy	**Stuart Park**	81 1977
818 George St	**Railway Square**	211 3777	Gympie & Hamilton Rds	**Chermside**	359 6255			
125 York St	**Sydney**	267 9111	Queen Elizabeth Dr & Bernard St	**Rockhampton**	27 9644			

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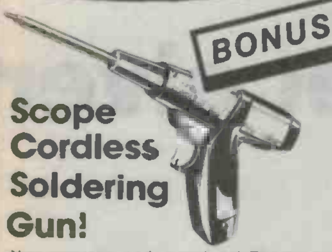

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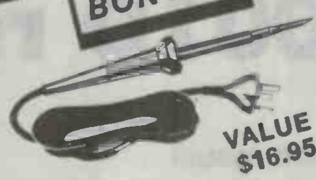

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If you've got a die set you'll need a tap set so you can do a professional job! Here's fantastic value! A five piece tap set with 2mm to 5mm taps and 4 jaw tap holder. You'll save over 25%! Cat T-4910

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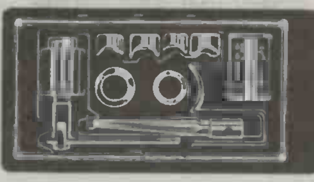

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Save heaps! Over 300 precision 1% 1/4W E-12 metal film resistors for this all time low price. Now there's no excuse for not using metal film resistors in your projects! Cat R-7015

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$8.50

SETTING THE PACE

— Sony ICF 2001D receiver

For the DX enthusiast, the 'airband browser' or the casual listener, this Sony receiver has a lot to offer. Tricks like scanning add some novelty value to the receiver's performance, but the Sony 2001D incorporates some true functional innovations.

Peter D. Williams

THE SONY ICF 2001D is a PLL-synthesised receiver covering from below the broadcasting band to 30 MHz as well as FM broadcasts and the aircraft band. To the uninitiated or non-technical reader PLL means phase-locked loop which synthesises or generates the various tuning frequencies needed.

This receiver is, of course, designed for the shortwave enthusiast who likes to listen to AM or FM entertainment bands. Most avid DXers and those with an interest in airband snooping should find their needs catered for also, and there is plenty to interest the casual listener with one finger exercises on the control keyboard.

If you are a budding SWL or casual listener, then we should take time out to indicate that there are three major classifications of 'communication' receivers (here listed in decreasing cost):

1. professional 'communication receivers';
2. semi-professional receivers — used by dedicated enthusiasts or the radio amateur; and
3. those for casual listeners, or people wanting to get their feet wet with DX.

Professional communication receivers are rugged specialised units with very stable oscillators, remote control facilities and exemplary specifications in all the areas which contribute to reliable reception — possibly for 24 hours a day, seven days a week service. For example professional receivers exhibit good cross modulation, adjacent channel selectivity and blocking performances, as needed in such professional applications as marine or other government point-to-point services. For $9000 upwards you can have one of these.

The semi-professional receiver will do everything the professional receiver does, but for less money. However, the compromise is in somewhat reduced performance specifications; frequency stability, bandwidth options and other specialised functions are not quite as sophisticated or demanding. This type of receiver is perfectly adequate for most applications and now often includes scanning and memory functions. For $950 up to around $2000 you can indulge your tastes and have almost professional performance with appearance not quite lounge-room quality, but definitely not out of place in the den or shack.

The Sony ICF 2001D falls into the last class. Professional performance is definitely not part of its act. Nor is a multitude of little used controls. This is the type of receiver I would suspect has been developed by 'marketing' with assistance from the engineers! These cosmetically appealing receivers, produced for the casual listener as well as the budding DX enthusiast, cover other bands such as the FM and airbands which are not usually available (nor wanted) in professional and semi-professional equipment.

Features

The Australian version of the ICF 2001D provides the following ranges:

AM/SSB	150 kHz to 30 MHz
FM	76 MHz to 108 MHz
airband	76 MHz to 136 MHz

Some models for overseas markets do not have airband or single sideband facilities. People visiting Singapore or Hong Kong with empty shopping bags, beware!

A programmable timer will turn the receiver on at a desired time and you can automatically program it to turn off after 60, 30 or 15 minutes. Four timer programmes can be selected which means that four separate frequencies can be turned on and off at predetermined times.

The sleep timer will turn the receiver off either 60, 30 or 15 minutes after it is activated. You can also see how long it takes you to go to sleep as the remaining time is also displayed! If this sounds Irish, may I commend to your attention the manual which says that reception of 455 kHz may be difficult! For the non-technical reader, one of the frequencies used in practically all receivers to carry the signal through to the speaker is 455 kHz. Anyone transmitting on this intermediate frequency would, with sufficient power, block out the reception of any other wanted signal. Needless to say, the world's broadcasting services are prohibited from using this or other common IF signal frequencies such as 10.7 MHz and 21.4 MHz.

There are several scanning modes. The scan range can be checked by pressing the SHIFT key and L1 and L2. You can then see the lower frequency or the highest frequency of any preset scan range.

Band scan buttons on the keyboard enable any of the bands the receiver is capable of handling to be monitored. The keyboard is a dual function device which means that keys can act as memory positions or select bands, depending on whether you activate the shift button to reverse the function.

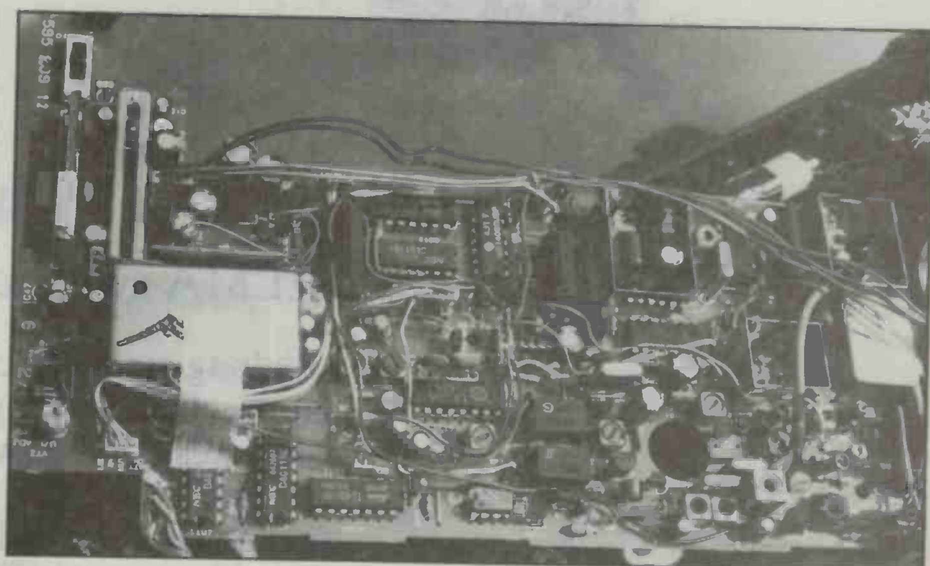
Also included is scanning of the 32 preprogrammed memories, the scanning will stop for 5 seconds on each of the stations. When a desired programme comes up, the

scanning can be stopped by pressing the memory stop key. If you want to omit stations on the broadcast band for instance, you can arrange the program to skip those stations. Really keen band watchers can initiate another method of covering the action called 'scan tuning'. This is somewhat similar to the scanning function in the recently reviewed Yaesu amateur VHF transceiver. You can scan bands, parts of bands or scan between frequency limits. The mode can be selected to stop scanning at the first station located or to dwell for 1.5 seconds at each station located. I would have liked the dwell time to be longer on airband as 1.5 seconds is not quite long enough to press the stop button if a choice bit of airline repartee is not to be missed. Most airband transmissions are short enough anyway. There is a little juggling to be done when scanning and selecting a station. Because scanning action stops as a result of detector voltages being applied to the processor, strong signals may inhibit the scanning action before the receiver is correctly tuned, which means that you have to make a small adjustment with the manual tuning knob.

When scanning the mediumwave bands, the scanning interval is preset at 9 kHz but it is possible to select a 10 kHz interval which is the frequency allocation step in the USA and Canada. There is no doubt that all scanning and dual functions perform admirably. I wonder however, if these facilities are really necessary and how much use they would get in practice.

The Sony is an attractive 288 x 159 x 52 mm package weighing in at 1.7 kg, a clean-cut design with solid construction.

It can be powered by internal battery, 240 Vac or a car battery with appropriate adaptors. We only had the battery supply (3D cells). Readout is by way of LCD for time via a quartz clock, and for actual frequency of station received, another LCD display is used.



Inside view showing oscillator/VCO boxes and relatively uncluttered layout.

Front panel

Important controls are conveniently located. The tuning knob is on the top right hand side with a slider volume control at the lower right hand side. You have to read the manual if you want the best performance. We had red faces after checking AM sensitivity and getting low figures and found that the rf gain control was down to minimum. The rf gain control is on the lower right hand side and can be missed. However, it only works on AM or SSB.

Immediately below it is a three-position tone switch, again slider operated. A new term for tone controls is introduced: the three positions are labelled HIGH, LOW and 'NEWS'. The implication of this is to expect a reduction of high frequency audio static when in the NEWS position.

The main tuning knob has a slow/fast switch associated with it. The slow position allows 5 kHz per revolution of the tuning knob and the LCD display increments in 100 Hz steps. This is perfectly adequate for broadcast band and AM tuning but requires ▶

When elders give good advice to their juniors,

talk is certain to turn to
ELMA switches

As long-standing customers, they appreciate the long service lives of ELMA switches (25000 switching cycles are guaranteed). And the short delivery times, even when the call is for special designs. Quality control at ELMA also ensures that – years later – each individual switch can be reproduced exactly. In fact, ordering ELMA switches becomes a habit in time. And one which is definitely worth passing on.

Associated Controls
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131/385 MK/WB

some care when resolving amateur band single sideband transmissions.

The rf gain control which only operates on AM/SSB, also needs some judicious use as strong SSB signals cause a disconcerting 'pumping' action of the AGC (automatic gain control). Reducing the rf gain clears up this annoying effect.

The fast tuning switch position works on 50 kHz per revolution and is perfectly adequate for rapid excursions when tuning the shortwave bands. The LCD display will show 1 kHz increments in fast tune. You then select the slow tuning rate to get a desired frequency or tune in SSB.

For FM the LCD display will show 50 kHz increments. I found this perfectly satisfactory.

There is a total of 67 pushbuttons — more PBs than transistors/ICs — a figure not intended to be off-putting as most of them are used infrequently and labelled so that they are self explanatory.

The top row sets the programmable time and the three operation times outlined earlier. The TIME SET button is to the right and when pressed while turning the tuning knob it allows time to be set. This dual function of the tuning knob is unique.

The next row of buttons selects AIR, FM or AM and then mode controls such as SYNC, USB, LSB/CW together with the two bandwidth controls WIDE/NARROW. (I will have something to say about SYNC later as it is a detector or mode that is not currently available on even more expensive communication receivers.)

Scan stop-start buttons are to the left although for most people, major activity will centre on the 32 pushbuttons in the centre of the panel which serve as frequency memories and band selectors. These pushbuttons/keys are 'dual function'. All functions can be activated by the keyboard; direct tuning can be done by the small keyboard to the right of the memory keyboard buttons.

One annoying feature is the lack of squelch or audio muting when manually tuning the air band. The background noise is aggravating but if the receiver is set to SCAN the airband, audio muting is activated and the distraction of the background noise is eliminated.

Reception

Using the built in telescoping whip, sensitivity was more than adequate for local listening to the entertainment programmes.

Tuning by means of the keyboard or manually (direct entry) was simple and effortless, but with the limitations on tuning rate expressed earlier; nevertheless, adequate for the casual listener.

The signal strength indicator consists of 10 small LED 'pin heads' which progressively light up as signal strength increases.

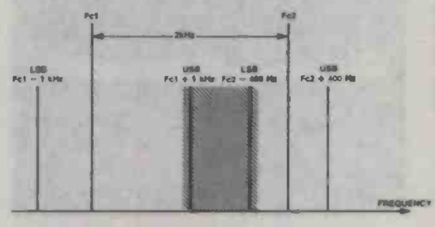


Figure 1. Area of greatest interference. When in SYNC, tune USB of Fc2 if you want to listen to this signal. Tune LSB of Fc1 if this is the signal of interest. Assume that there are no other signals adjacent to either Fc1 or Fc2.

The same LEDs are used too for indicating the state of the battery supply.

Using an external antenna, signal pickup was vastly improved. Sensitivity and general performance was more than adequate for a receiver of this type. I should caution against using coaxial cable feed line if you are planning to use an external antenna of indiscriminate length. Coax cable is fine if matched to the antenna for a specific narrow frequency range or for coupling from an antenna tuner if you decide to be serious. If used as lead-in from a long wire with its high impedance, the capacitance between the conductors will shunt or attenuate the radio frequency energy and give the impression that the receiver is insensitive.

If you are primarily interested in airband, arrange for a ground plane or discone type of antenna by all means, but don't expect it to be efficient on shortwave or commercial broadcast. The converse is also true: a long wire will not be particularly good for airband or FM unless you are within the metropolitan areas of capital cities.

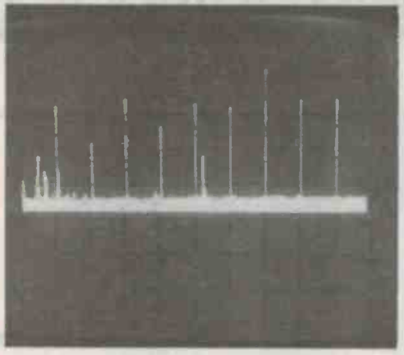
Synchronous detection

One of the problems with AM reception, especially relevant to the DX listener on either shortwave or commercial broadcast is living with fading distortion and interference from other stations.

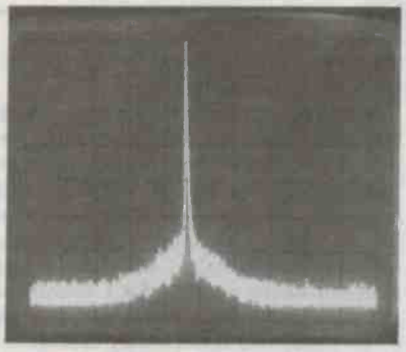
Fading distortion in normal diode detectors is caused by the received carrier being attenuated by propagation effects and resulting in over modulation, and hence, distortion. It may also happen that phase reversals during passage to and from the ionosphere may reduce the carrier to zero and as everyone knows, you can't have a useful detector for AM without a 'carrier'. No carrier, no audio: too little carrier gives distorted audio.

The second problem is interference, and despite filters, the double sideband transmission of AM stations means that you will hear annoying interference beats from adjacent stations if they are close to one sideband and/or stronger than the station you wish to hear.

Both these problems can be overcome to ▶



Local oscillator antenna radiation. Reference level −40 dBm; vertical 10 dB/div; centre 500 MHz, 100 MHz/div; 100 kHz resolution. Highest level at 700 MHz (−48 dBm).



Local oscillator injection at 100 MHz. Vertical reference −50 dBm, 10 dB/div; horizontal 5 kHz/div; 100 Hz resolution 10 Hz VF. Note freedom from spurs and low noise close to oscillator frequency. This helps to produce a good reciprocal mixing figure and clean signals when using the synchronous detector.

LAB REPORT

SENSITIVITY:
Mode SSB for 10 dB $\frac{S+N}{N}$.
Frequency of test 14.1 MHz
Test figure −119 dBm.
AM
Test figure −109 dBm using narrow filter.
Test figure −106 dBm using wide filter.
Using synchronous detector, the test figures were about the same, although there was a slight increase in background noise. The sensitivity figures were quite good overall and there was little variation from one end of the tuning range to the other.

AIRBAND:
The sensitivity was worst when on this band and we could only manage −98 dBm at 122 MHz for 12 dB SINAD. This is not particularly good but airband listening is done on a local basis and aircraft at high altitude have no trouble making themselves heard.

FM BAND:
We used 45 kHz deviation at 1 kHz and for a 12 dB SINAD the sensitivity was −111 dBm at 100 MHz. This is perfectly satisfactory.

MDS (Minimum discernible signal):
The figures show the following:

SSB at	14.1 MHz is	−131 dBm
AM at	14.1 MHz is	−134 dBm
FM at	100 MHz is	−114 dBm
Airband	122 MHz is	−117 dBm

On the broadcast band at 1000 kHz and using the narrow filter, our MDS level was −108 dBm.

SIGNAL ('S') METER INDICATOR:
As mentioned in the text, a 10 LED 'pin head' progressively illuminates according to signal strength. The first LED illuminates at around −110 dBm with number 10 lit up at −80 dBm.

AUDIO RESPONSE:
For AM with 30% modulation and using the three positions of the tone switch, NEWS, LOW and HIGH, we have the following at the −3 dB points, measured at earphone socket:

	NEWS	LOW	HIGH
Upper	1.5 kHz	1.6 kHz	1.8 kHz
Lower	190 Hz	83 Hz	83 Hz

Roll of 40 dB octave.
For FM 50 kHz deviation at −3 dB points:

	NEWS	LOW	HIGH
Upper	1.5 kHz	1.7 kHz	10 kHz
Lower	90 Hz	22 Hz	25 Hz

The response for FM in high was only 1 dB down at 10 kHz — very good for recording.

INPUT IMPEDANCE:
AM/SSB high impedance
AIR high impedance
FM 100 ohms at 100 MHz

RECIPROCAL MIXING at 10 kHz:
Our figure of 148 dB per Hz is quite good. The local oscillator appears to have good 'close in' characteristics without high noise sidebands.

BLOCKING DYNAMIC RANGE:
Measured with 20 kHz separation at 14.1 MHz we got a figure of 90 dB. With 10 kHz separation, our figure was 78 dB. Not particularly good, but then this is not a communication receiver.

THIRD ORDER IMD DR:
With 20 kHz separation and at test frequencies of 14.1 and 14.12 MHz the IMD DR (3rd order) was 85 dB.

IMAGE REJECTION:
These figures were 30 dB for FM, 69 dB for airband and 83.6 dB for AM. They are quite good for airband and AM but poor if FM was a communication band.

SPURIOUS SIGNALS:
Looked at on the antenna socket, spurious signals extending up to 700 MHz were seen with worst level at this frequency of −48 dBm which is 1 mV. On airband and AM maximum level was −55 dBm at around 55 MHz. Most of this came from the local oscillator.

a large extent with synchronous detection, which works like this. A carrier frequency is introduced, or synthesised in the receiver with no level variation and synchronised with the original carrier. With no carrier to fluctuate when the signal fades, there is no fading distortion. Any interference can be minimised too, as it is possible to tune each sideband independently. Any interference on the one sideband will be well down in amplitude.

We had to devise our own test for this type of detector feature in the Sony. What we did was to use two signal generators, one modulated with 1 kHz at 30% and the other signal generator 2 kHz away and modulated with 400 Hz, 30%. With the receiver on synchronous detection and tuned to the upper sideband of Fc2, or the lower sideband of Fc1 there was a 20 dB reduction in the unwanted tone (see Figure 1). Aurally, it was just a slight nuisance in the background. On the other hand, on going back to 'ordinary' AM, it was difficult to tune either carrier and the tone sidebands were indistinguishable.

The Sony gave a good account of itself with AM and those interested in shortwave DXing would find that pushing the SYNC button helps a lot. One of two small LEDs illuminates to show which sideband has been tuned.

From a marketing and indeed operational point of view, the provision of optimum AM detection is a decided plus. I have no idea of how many listeners there are who would appreciate the benefit that synchronous detection gives. Suffice it to say that receivers for serious DXers on shortwave bands should have it.

Evaluation

As a 'class 3 receiver', per earlier discussion, the Sony is an admirable performer. It will receive all signals in the commercial broadcast and SW bands that more expensive professional receivers do. Selectivity and tuning rates are not optimum, nor is ultimate stability but then it does not have to perform to exacting professional requirements.

To my mind scanning functions are for shortwave and constitute the 'bells and whistles' of this receiver which endear themselves to the marketing department. The only concession I would make is that scanning the airband is a useful feature, however the dwell time is a little short as mentioned earlier.

The tuning rate is a little sharp which does not always make it easy to tune in sideband. However, the greatest plus on this Sony is the synchronous detection. I spent some days in the country trying to listen to the broadcast band at night. Fading and heterodyne whistles were a nuisance until the synchronous detector was activated.

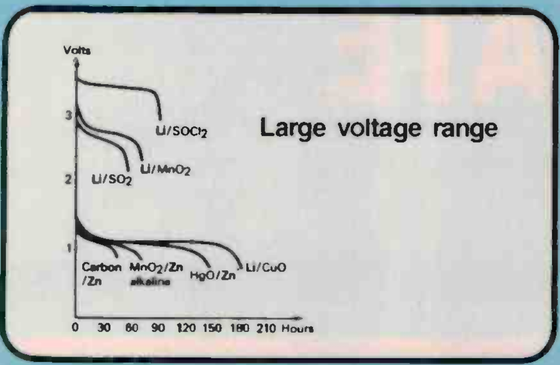
For people camping or boating and away from capital cities, SD on broadcast or popular SW bands is the real bonus and marketing can take full credit for this one.

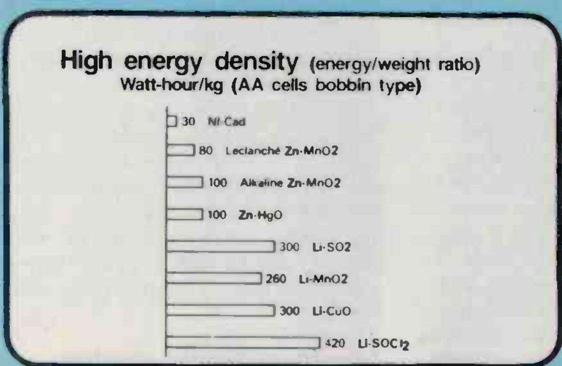
The serious listener can use the Sony ICF 2001D as an auxiliary receiver; its size and performance will keep him or her in touch with events on the bands. For the newcomer to the world of DX listening, airband monitoring or just bedside FM music, the Sony is an excellent choice.

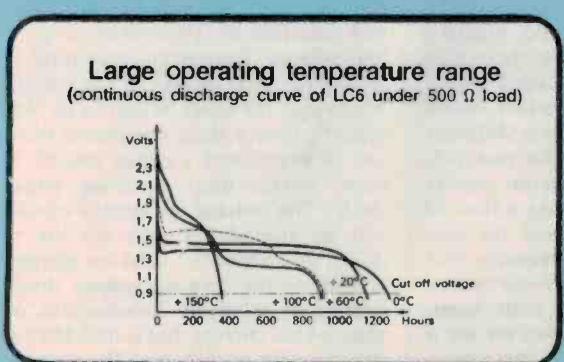
Last but not least is to mention the operating and technical manuals (not supplied with the receiver). Both books are superb in the usual Sony way and troubleshooting for those familiar with PLL would be assisted by using the clear, well documented schematics. At an RRP of $569 the receiver is good SW listening value. For the person who has a comms receiver, this is just what you need to take away on that vacation. ●

Peter Williams is director of Associated Calibration Laboratories, Melbourne.

LITHIUM BATTERIES from PLESSEY Components







WHY LITHIUM?

A lithium battery is a battery using lithium as the anode material. Different cathode materials give rise to various specific characteristics, but all hermetically sealed lithium cells have a number of features in common including:

— long active shelf life (over 10 years)
— high energy density (up to 10 times greater than Zn-C batteries)
— large operating temperature range

TYPES OF APPLICATION

The three main types of application are as follows:

- Backup power sources for CMOS-RAM type memories;
- Continuous energy supply immediately following installation;
- Very long-term storage of the battery together with its associated equipment (during which time the battery is not operating), followed by a brief period of supplying energy (lasting from a few milliseconds to a few hours).

HIGH ENERGY DENSITY

Lithium, the lightest metal known, has the highest electrode potential of any metallic element with a theoretical electrochemical capacity of 3862 Ah/kg. So, if we compare energy/weight ratios (we could do the same thing with energy/volume ratios), we can see that the energy/weight ratio for Ni-cad is only 30 Wh kg while it is nearly 14 times as much again for L-$SOCl_2$ cells (AA size). (See figure 2).

LARGE OPERATING TEMPERATURE RANGE

The use of non-aqueous electrolytes gives lithium cells the ability to function over a wide temperature range. The electrolytes may be inorganic or organic.

Compared with conventional batteries which provide poor services below −10°C and above +40°C, lithium batteries are capable of operating at temperatures as low as −55°C and as high as +150°C. Fig 3 shows the discharge curve of Li-Cu0 at different temperatures under a 500 ohm load, and we can observe the good performance at +150°C.

Plessey components also supply an extenisive range of Nickel-Cadmium cells and batteries to suit all professional applications

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GETTING ACTIVE ON SOLID STATE

Want to be active in electronics? Then you need to know something about active components. The world of active components and solid state is ever changing. Transistors and diodes are the starting point, with lots more to come.

Peter Phillips

SOLID STATE is the buzz expression of the times used to define any active electronic device that is not borne of valve technology; an active device is one that requires an external power source to enable its operation. The demise of the valve is now virtually complete and its successor, the transistor, already faces considerable competition from the integrated circuit. Perhaps nowhere in recorded history has technology moved so quickly as in solid state electronics, making the study of this field exciting and challenging.

A starting point

In the same way as the steam vessel overtook the sailing ship, valve technology, developed over 60 odd years, fell victim to the introduction of solid state. Smaller, more reliable and far more efficient, the invention of the pn junction heralded a solid state equivalent for virtually every thermionic device known, and provided many more possible variations.

The diode valve was invented in 1904 by J.A. Fleming with Lee de Forest adding a third element in 1906, resulting in the triode. Diodes are simply electronic devices that allow an electrical current to flow in only one direction, blocking the current should it try to reverse its direction. The triode, however, is a device capable of amplifying a voltage; its invention represents the beginning of electronics as we know it today. Further development of the valve nevertheless continued over the decades, radio and television providing great stimulus to the valve industry.

On the afternoon of 23 December 1947, however, Walter H. Brattain, John Bardeen and William Shockley, from Bell Telephone Laboratories demonstrated the amplifying action of the first transistor. Using semiconductor materials, this device has spawned the vast array of components that has enabled moon landings, hi-fi videos, computers, etc.

The pn junction

The first diodes used as detectors in radio receivers were, in fact, solid state. Referred to as point contact diodes, a fine wire (cat's whisker) was held against a point on the surface of a galena crystal (lead sulphide), to form a small pn junction. Point contact diodes are still manufactured in encapsulated form, and are used primarily in applications employing low power at high frequencies, such as in radio receivers. However, the majority of diodes in common use are of a more rugged construction, allowing higher currents and higher reverse voltages.

As already mentioned, a diode is a device that permits current (a flow of electrons) to pass in one direction only. This property is fundamental to electronics and finds applications in many areas of the field. Figure 1 illustrates what's behind the concept of a pn junction. Diodes are often called 'semiconductors', and are made of either silicon or germanium (which gives them different characteristics). A semiconductor material, as the name implies, is a material neither good at conducting nor resisting a flow of electrons. In diode manufacture the material is 'doped' by adding an impurity that imparts a property to the otherwise benign semiconductor. Doping either adds 'carriers' in the form of 'free' electrons for the n negative material, or 'holes' for the p positive type.

This combination creates an effect at the junction of the two pieces of material which permits, in the case of the diode, uni-directional properties. One important characteristic of a pn junction is the value of the 'barrier voltage' that needs to be overcome if conduction is to occur. This value is around 0.5-0.7 volts for silicon devices, and 0.2-0.4 volts for germanium. A study of the physics of semiconductor devices is complex, and necessary only if a deep understanding is required. Our concern is for the effects, rather than the cause, but interested readers may like to pursue the matter by consulting textbooks on the subject.

The pn junction is the basis of most solid state active devices. Transistors require a sandwich of three pieces of doped semiconductor to provide two junctions; other devices use one or three junctions. The resulting component depends on the construction, the degree of doping, the type of materials used and the manner of using the end product.

Semiconductor diodes

The simplest semiconductor device is the diode with a single pn junction. Figure 2 shows the identifying diode marks and current flow. As this diagram also shows, the two terminals are referred to as the anode and cathode. Current can flow if the anode is positive with respect to the cathode, in which case the diode is said to be 'forward biased'. Under these conditions the diode can be considered a closed switch, with a small voltage drop occurring across the diode. This voltage, as already mentioned, will be around 0.6 volts for the silicon diode, and about 0.2 volts for germanium. Known as the forward voltage drop, this voltage is relatively independent of the value of the current, but is affected by temperature: for each °C rise the voltage falls by 25 mV.

Reversing the battery to give 'reverse bias' causes the diode to behave as an open switch, with a very small leakage current flowing. As germanium diodes exhibit higher reverse leakage currents, particularly at higher temperatures, silicon devices are preferred and are the most common types. Obviously there is a limit to the value of voltage the diode can withstand when it is

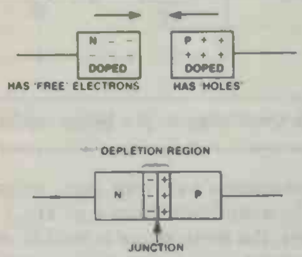


Figure 1. The pn junction: the doping process does not impart an electrical charge to the material; that is, if you measured it with a voltmeter no voltage would register. Rather, doping imparts carriers. The concentration of these carriers (holes and electrons) in the depletion region creates a barrier voltage of around 0.6 V for silicon and 0.2 V for germanium which must be overcome before the device can conduct.

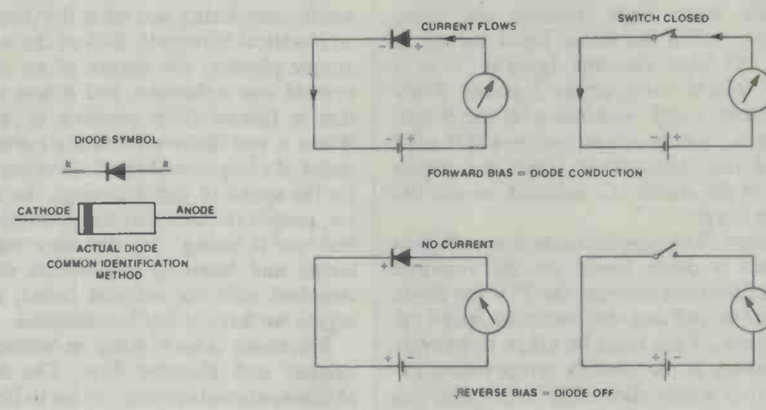


Figure 2. Diodes showing 'conventional current' flow, from positive to negative. A diode only conducts when the anode is positive with respect to the cathode.

reverse biased, and all diodes are given a rating, known as the peak inverse voltage rating (PIV). This rating is one of the most important characteristics to be aware of; the other is the value of forward current the device can handle.

Special very high frequency diodes differ from the diodes discussed so far, and should be specially chosen in accordance with the circuit specifications. However, most applications use the common types and a knowledge of their characteristics is necessary to bring about the correct selection of a diode for a given purpose.

Signal diodes

Diodes can be generally grouped as either power or signal devices; signal diodes are usually much smaller physically than their power counterpart. Signal diodes are used extensively in digital circuits, where the 'binary' closed-open switch concept is basic. In analogue circuitry applications, such as amplifiers, radios, audio processors, etc, signal diodes are used for signal processing, clipping, signal switching, and a host of other purposes.

A very commonly used signal diode is the 1N4148 (the 1N914 is a near equivalent). Rated at 200 mA, (75 mA for the 1N914), 75 volt PIV, these diodes are classed as switching diodes, meaning that their switching speed from open to closed is very fast (around 4 nanoseconds). Other types often encountered include the OA200 and OA202. These general purpose signal diodes can be used in non-switching applications such as low power signal rectifiers, or where high switching speed is not critical. The OA202 features a PIV of 150 volts and a forward current of 160 mA; it is frequently found in small signal applications.

A more specialised application is radio signal 'detection'. The purpose of the detector (or demodulator) is to separate the intelligence from the carrier frequency used by a transmitter to send the information. Because the frequencies involved are usually high, special detector diodes using the point-contact construction are employed. A typical detector diode is the OA90; its higher voltage counterpart is the OA91.

Another special signal diode is the OA202, which is not used as a diode, but rather as a 'capacitor' capable of being varied by a reverse bias. This type of diode is known as a varactor or vari-cap diode and finds its application in TV and FM tuners.

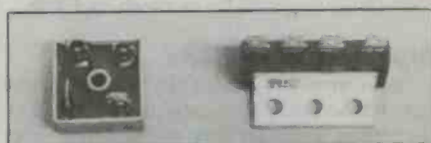
All these diodes are cheap, at prices around 5 cents to 50 cents each and are available from most parts suppliers. They cover most small signal applications.

Power diodes

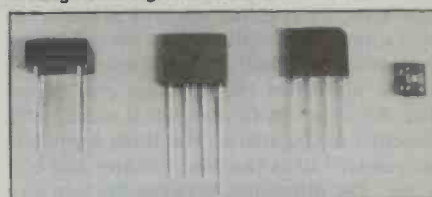
A power diode is required to pass high values of current, for example in a power supply. Other uses include protection (eg, across a coil to limit the back-emf created at switch-off), special uses in TV receivers (scan circuitry), current switching applications in power control circuitry and so on. These diodes come in a range of package styles; stud mounted types for heatsink mounting, bridge assemblies and axial lead styles are the most common.

For general purpose power supplies involving less than 1 amp of load current, the 1N4000 series is often used. Table 1 shows how the PIV rating varies with the type number. There is very little price difference between each type; the 1N4007 represents a good general purpose power diode to keep on hand. For currents up to 3 amps the 1N5400 series is useful. The PIV ratings are shown in Table 2 for each type number. For higher currents, such as in a battery charger, the choice is restricted to either stud mount diodes or a power bridge.

In some switching applications it is *imperative* to select the right diode. In high speed



A range of bridge rectifiers is available.



switching circuits such as in switching regulators or the scan circuitry of a TV receiver, the switching speed as well as the power capabilities of the diode must be considered. It is good practice to replace a faulty diode with one of the same type, or with an equivalent or better one. A typical fast-recovery diode for these applications is the BYX71-600R (PIV 600 volt, forward current 7 amps).

Power diode bridges are manufactured in various package styles. A bridge rectifier is one incorporating four diodes, interconnected to allow two diodes to be conducting while the other two are off, and vice versa. Figure 3 shows a bridge diode rectifier circuit. Most power supplies use this configuration of diodes in conjunction with the ac input to produce a dc output voltage. A very common 1 amp bridge is the WO series bridge; the WO-4 is a 400 volt PIV device and the WO-8 is a PIV of 800 volts. For higher currents, the PB40, rated at 25 amps, 400 volts can be used; the MB series rates at 1.6 amps and the PA series handles 8 amps.

The Schottky diode is another power diode which features a high switching speed and a low forward voltage drop. Forward ▶

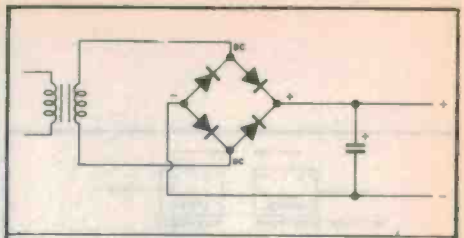


Figure 3. Circuit diagram of a bridge rectifier.

voltage drop in ordinary diodes becomes a problem when high currents are being passed or when the initial input voltage is small. At high currents (greater than 1 amp), voltage drop across a power diode can exceed 1 volt, whereas with the Schottky diode, voltage drops only reach 0.4-0.6 volts during conduction. Thus the power losses in the diode are reduced, as are the voltage drops.

In most diode applications it is sufficient to select a diode based on the required value of forward current, the PIV the diode must withstand and the switching speed requirements. Care must be taken to provide heatsinking if the diode's temperature exceeds that which allows the 'touch test', as the ratings for the diode are generally for 25°C. (A 'touch test' is passed if the finger can remain on the case of the device being touched!) Good design practice dictates using components the ratings of which exceed those required by as much as 100%.

Bipolar transistors

The transistor, essentially a simple device, has so many applications that it makes electronics seem terribly complicated. Figure 4 shows the electrical symbol for the transistor, its construction and principle of operation. Two symbols are necessary, as transistors are made in two basic arrangements, known as the npn and pnp types. The difference in the symbol is merely the direction of the arrow. The three terminals are referred to as the base, emitter and collector. The difference between the npn and pnp is the direction of the currents flowing in the transistor.

Before dealing with the transistor, it's worth considering just what the direction of an electrical current is. Before the advent of atomic physics, the nature of an electrical current was unknown, and it was assumed that it flowed from positive to negative. When it was discovered that a current consisted of a large number of electrons flowing (at the speed of light) through the conductor, people realised that the previous theory had 'got it wrong'. By this time many text books and learning institutions were entrenched with the original belief, and the legacy we have today is confusion.

Reference is now made to 'conventional current' and 'electron flow'. The direction of 'conventional current' is said to flow from positive to negative, when actually electrons travel from negative to positive. Although referring to the same thing, the differentiation is made to allow compatibility with standards derived from years before. The electrical symbols used for solid state devices usually have an arrow of some sort; this arrow points in the direction 'conventional current' will flow. The direction of the current is not usually important, but it helps to understand the polarity of the required voltage. We will use the 'conventional currrent' concept, suggesting the arrow points in the current's direction, when really the arrow's tip will be negative compared to the other end.

As Figure 4 illustrates, the principle of a transistor is simply one whereby a small current flowing between the base and emitter controls a larger collector-emitter current. The ratio of the collector-emitter current (I_c) to base-emitter current (I_b) is a measure of the transistor's current gain, referred to as its β (sometimes known as H_{FE}). In an amplifier, the input signal is used to vary the base current (I_b), which then varies, by a larger amount, the collector current (I_c). This varying collector current, when passed through a resistor produces a varying voltage that is an amplified replica of the input.

Other uses for transistors include switching a high collector current by switching the much lower base current, or controlling the value of a collector current using the base current. The collector current would also flow through a load in these examples, and allows a low power signal to control a high power load. How all the various circuits work is beyond the scope of this series, our main concern being how to choose a transistor for a given application.

Transistor packages

Any semiconductor device comes to the public housed in various types of package. These range from small plastic packages, eg, TO-92, to metal constructions such as the TO-3 package. Transistors are no exception.

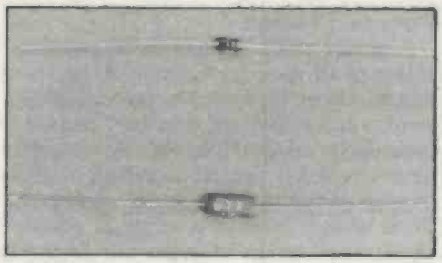
When replacing a transistor, it is usually necessary for the replacement to have the same package outline. When selecting a package outline for a design, considerations need to be given to the power dissipation re-

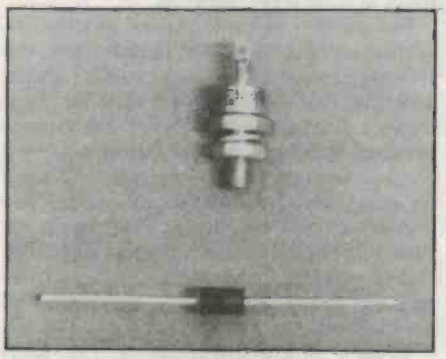
Table 1. List of PIV ratings for the IN4000 series 1 amp power diodes.

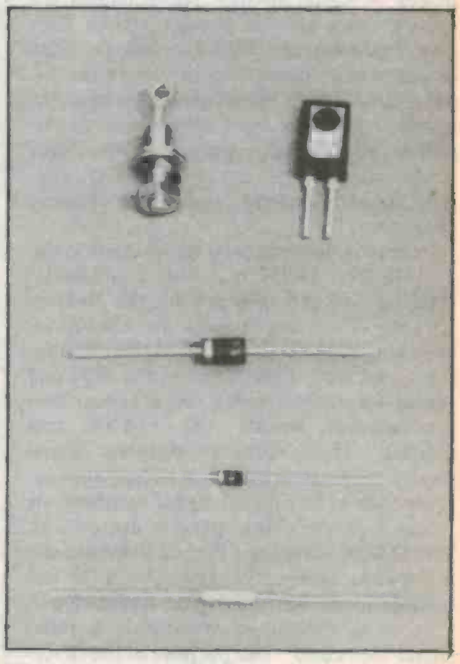
Type Number	PIV
IN4001	50 V
IN4002	100 V
IN4003	200 V
IN4004	400 V
IN4005	600 V
IN4006	800 V
IN4007	1000 V

Table 2. List of PIV ratings for the IN5400 series 3 amp power diodes.

Type Number	PIV
IN5401	100 V
IN5402	200 V
IN5404	400 V
IN5406	600 V
IN5408	1000 V


Small signal diodes.


Schottky barrier diodes.


Various sized power diodes.

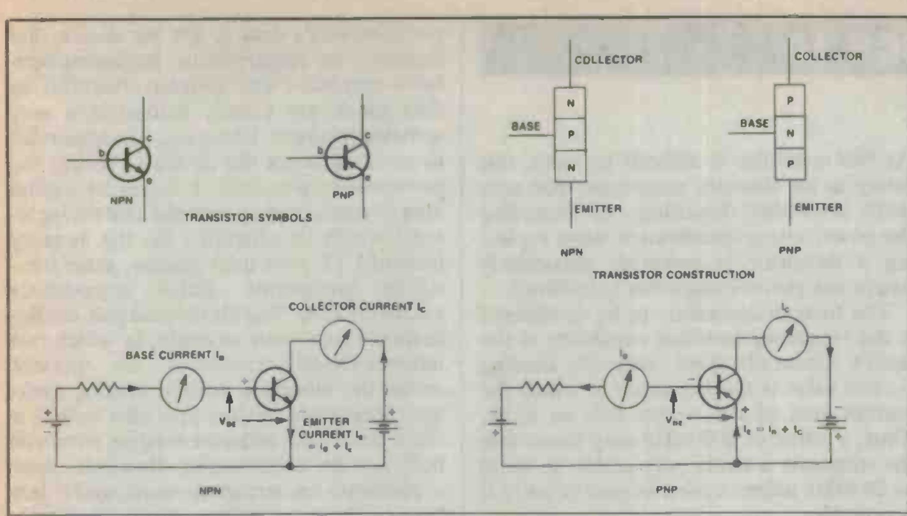
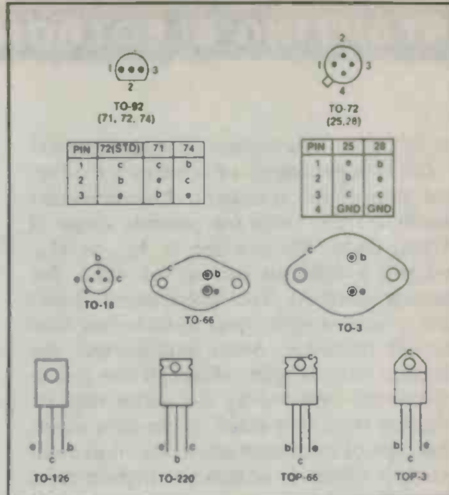


Figure 4. The principle of transistor operation whereby I_B controls I_C, with I_B being much smaller than I_C. V_{BE} = 0.6 V for silicon; 0.2 V for germanium.



PIN	72(STD)	71	74
1	c	c	b
2	b	e	c
3	e	b	e

PIN	25	28
1	e	b
2	b	e
3	c	c
4	GND	GND

Figure 5. Typical semiconductor outlines or packages.

quired. The TO-3 outline is designed to mount directly on to a heatsink, and can often handle a very high power (50 to 100 watts). The TO-220, TO-126, TO-202 *et al* can be directly mounted on the pcb; a heatsink is attached to the package as required.

The lead configuration (b, c, e) is not standard for particular packages so it is necessary to refer to manufacturers' data to determine lead identification. For example the TO-92 comes in three different variations as described in Figure 5.

Generally the metal part of a transistor's case is connected to the collector, allowing the most efficient dissipation of the generated heat. When mounting a transistor this usually requires insulating the transistor's body from the heatsink. An all-plastic package, such as the TO-92 or SOT-30 is confined to low power transistors. Other popular packages include the TOP-3, TO-66, TO-18 and SOT-25 (two variations). Most transistor packages have three leads, however some such as the TO-72 have an extra lead which is connected to the metal of the package. This extra lead can be connected to ground to allow shielding of the actual transistor pellet, often necessary in high frequency applications.

Transistor voltage ratings

Like the diode, a transistor can withstand certain values of voltage beyond which it breaks down. Transistor voltage ratings refer to the maximum *forward* voltage the device can withstand. The forward voltage for a diode is the barrier voltage, but a transistor operates differently, and requires different ratings.

Abbreviated transistor data generally gives a V_{ceo} value, which means the maximum forward voltage that can be applied across the collector-emitter terminals, with the base not connected to anything (open circuit). Having the base open circuit is the worst case situation, hence this voltage rating is usually improved when the base circuit is considered. The V_{ceo} value can range from 10 volts to 2 kV, and is an important parameter to know. If a circuit operates from, say, 50 volts supply, then a transistor with a V_{ceo} exceeding 60 or 70 volts may be required.

Reversing the polarity of this voltage will usually cause the transistor to break down, as most smaller transistors conduct between collector and emitter at reverse voltages as low as 6 volts. Normally most applications make this polarity reversal impossible, with protection devices otherwise included if necessary. However, if a transistor is inadvertently connected with its collector and emitter terminals reversed, or the power supply terminals are accidentally swapped around, the demise of the transistor is likely.

The forward voltage drop across the base emitter terminals is (like the diode) around 0.6 volts for silicon and 0.2 volts for germanium; silicon transistors are by far the most common. If the polarity of V_{be} is changed, reverse conduction usually occurs at voltages of 5 volts or more. This condition should be avoided or steps taken to limit this reverse current to a very small value. Sometimes the maximum forward voltage rating between the collector and base is given; it is usually higher than V_{ceo}.

Data for some of the more common transistors is given in the accompanying table. Figure 6 gives an explanation of the voltages being referred to. The polarities of these voltages are shown for the npn and pnp transistors.

Reading transistor data sheets

There are countless numbers of transistor types. (Obscure varieties often appear in cheap imported items of domestic equipment.) Books are published that aspire to give data on every registered transistor; such a book is valuable if you intend getting into servicing.

Selection of a type of transistor is not critical, and a near match to what you want may be all that is required. Some specialised circuits, however, will demand a transistor that is a direct replacement; such instances are often noted on the circuit diagram. This situation occurs in many high frequency applications, in TV scan circuits, switching regulators, high voltage power supplies, and so on. When in doubt, aim for either a direct replacement or one that has better characteristics on all points.

Replacing an otherwise unobtainable transistor requires matching the original on seven basic specifications. As already mentioned, the package outline should be the same, although small signal transistors of differing lead configurations can often be accommodated on the pcb by judicious lead rearranging. The next parameter is the polarity of the transistor, which *must* be the same as the original. Also, the semiconductor material should match, a point to watch when repairing relatively old equipment. Transistor data usually identify the polarity/semiconductor material by terms such as NS for npn/silicon, or PG for pnp/germanium. The package outline to refer to for lead identification will be listed, with these case outlines usually being presented at the end of the book.

The voltage ratings of the replacement transistor should equal or exceed the original. If data on the transistor being replaced is unavailable, appropriate ratings can often be determined knowing the operating voltages of the circuit. Exercise caution here if the circuit involves inductors, as high voltages can occur that are not readily measurable.

The current rating for a transistor is usually given as the maximum collector current the device can handle. The size of the device gives a guide, but is not a reliable indicator in that current ratings for a given package outline can vary enormously. Most small signal transistors are operated below their maximum current rating, allowing some flexibility in the selection of a replacement. Power devices should be replaced with devices that equal or exceed the current rating of the original, to allow for peak current values that may not be accounted ▶

STARTING ELECTRONICS 10

for by casual observation or measurement.

The fifth parameter of concern is the current gain of the transistor. Manufacturers usually list this value (or possible range of values) under the heading β, h_{fe}, or H_{FE} and give a collector current for which this value is specified. The replacement should have a current gain equal to or higher than the old transistor. Some multimeters can measure current gain, although the collector current supplied by the meter may be different from that listed in the data sheet. This type of measurement is useful in comparing β values to obtain the highest from the stock on hand.

Power ratings of transistors are usually given assuming a case temperature of 25°C. As this condition is difficult to meet, this rating is an absolute maximum, not normally attainable. Equalling, or exceeding the power rating specification when replacing a transistor is essential, particularly where any power dissipation is involved.

The final characteristic to be considered is the frequency handling capability of the device. Generally listed under the heading f_T, this value is the frequency at which the current gain of the device falls to unity. Thus, a value of 300 MHz may mean that the transistor is really only usable up to 10 or 20 MHz unless a current gain of unity is acceptable.

Selecting a transistor for a circuit under development requires interpreting the manufacturer's data to get the device that matches your requirements. Beginning hobbyists may feel a little daunted about this, as data sheets are usually written in a very technical manner. However, it is important to carefully select the device to ensure the performance you want. It might be a good idea to retain and consult the Data Supplement which in scheduled for the January issue of ETI. As a final caution, some transistors incorporate added components within the case. The Darlington pair configuration is one such example, in which two interconnected transistors are present within the otherwise normal looking package. Specialised devices may also include a diode across the collector-emitter terminals built into the construction. However, most applications are straightforward, and if you keep to the more basic circuits, using transistors will involve no major hassles. ●

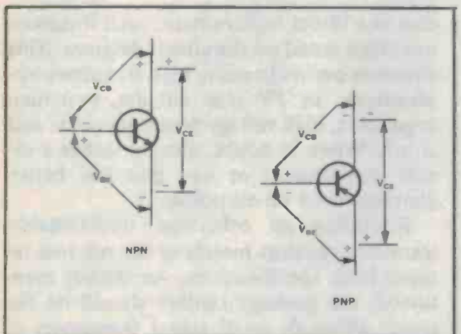
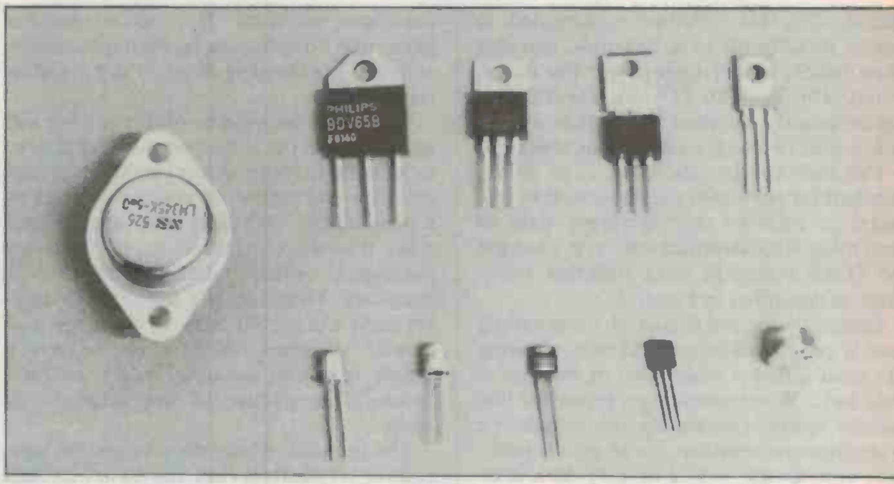


Figure 6. The names and polarities of normal operating voltages across transistors. V_{BE} is normally 0.6 V for a silicon transistor. V_{CEO} is the maximum value of V_{CE} that can be safely applied across the transistor. Reversing the polarity of V_{CE} or V_{BE} will often cause conduction in the reverse direction at voltages of about 5 V to 10 V.



Transistors come in various packages. Shown here are (top, from left to right) a TO-3, SOT-93, TO-220, TO-202, TO-126; (bottom, from left to right) TO-72, TO-168, TO-92, TO-92 and TO-39.

BIPOLAR TRANSISTORS

Data on some common transistors. (Courtesy Dick Smith Electronics.)

TYPE	CASE	POL MAT	Vce	Vcb	IC mA	Vces	@ IC	Hfe	@ IC mA	MHz Ft	@ IC mA	Ptot mW	USE	COMPARABLE TYPES
BC107	TO-18	NS	45	50	100	0.2	10	110-450	2	300	10	300	S.S. Amp.	BC207, BC147, BC182
BC108	TO-18	NS	20	30	100	0.2	10	110-800	2	300	10	300	S.S. Amp.	BC208, BC148, BC183
BC109	TO-18	NS	20	30	100	0.2	10	200-800	2	300	10	300	Low Noise S.S. Amp.	BC209, BC149, BC184
BC109C	TO-18	NS	20	30	100	0.2	10	420-800	2	300	10	300	Low Noise High Gain	BC209C, BC184C, BC149C
BC157	SOT-25	PS	45	50	100	0.25	10	75-260	2	150	10	300	S.S. Amp.	BC177, BC307, BC212
BC158	SOT-25	PS	25	30	100	0.25	10	75-500	2	150	10	300	S.S. Amp.	BC178, BC308, BC213
BC159	SOT-25	PS	20	25	100	0.25	10	125-500	2	150	10	300	S.S. Amp.	BC179, BC309, BC214
BC177	TO-18	PS	45	50	100	0.25	10	75-260	2	150	10	300	S.S. Amp.	BC157, BC307, BC212
BC178	TO-18	PS	25	30	100	0.25	10	75-500	2	150	10	300	S.S. Amp.	BC158, BC308, BC213
BC179	TO-18	PS	20	25	100	0.25	10	125-500	2	150	10	300	S.S. Amp	BC159, BC309, BC124
BC182(L)	SOT-30 (TO-92/74)	NS	50	60	200	0.25	10	100-480	2	150	10	300	S.S. Amp.	BC107, BC207, BC147
BC183(L)	SOT-30 (TO-92/74)	NS	30	45	200	0.25	10	100-850	2	150	10	300	S.S. Amp.	BC108, BC208, BC148
BC184(L)	SOT-30	NS	30	45	200	0.25	10	250-850	2	150	10	300	Low Noise High Gain	BC109, BC209, BC149
BC546	TO-92 (VAR)	NS	80	80	100	0.6	100	125-500	2	300	10	500	S.S. Amp.	
BC547	TO-92 (VAR)	NS	45	50	100	0.6	100	110-800	2	300	10	500	S.S. Amp.	BC107, BC207, BC147
BC548	TO-92 (VAR)	NS	30	30	100	0.6	100	110-800	2	300	10	500	S.S. Amp.	BC108, BC208, BC148
BC549	TO-92 (VAR)	NS	30	30	100	0.6	100	200-800	2	300	10	500	Low Noise Small Sig.	BC109, BC209, BC149
BC549C	TO-92 (VAR)	NS	30	30	100	0.6	100	420-800	2	300	10	500	Low Noise High Gain	BC109C, BC149C
BC556	TO-92 (VAR)	PS	80	80	100	0.65	100	75-500	2	150	10	500	S.S. Amp	
BC557	TO-92 (VAR)	PS	45	50	100			110-330	2	150		500	G.P. Small Sig.	BC157, DS557
BC558	TO-92 (VAR)	PS	30	30	100			75	2	150		500	G.P. Small Sig.	BC158, DS558
BC559	TO-92 (VAR)	PS	30	30	100			125-600	2	150		500	G.P. Small Sig.	BC159
BCY70	TO-18	PS	40	50	200	0.5	50	50	10	250	50	350	G.P.	BC212
BCY71	TO-18	PS	45	45	200	0.5	50	100-600	10	200	50	350	G.P.	BC212
BCY72	TO-18	PS	25	25	200	0.5	50	50	10	200	50	350	G.P.	BC213
BD137	TO-126	NS	60	60	1A	0.5	500	40-160	150	250	500	8W	G.P. O/P	BD139
BD138	TO-126	PS	60	60	1A	0.5	500	40-160	150	75	500	8W	G.P. O/P	BD140
BD139	TO-126	NS	60	100	1A	0.5	500	40-160	150	250	500	8W	G.P. O/P	40409
BD140	TO-126	PS	80	100	1A	0.5	500	40-160	150	75	500	8W	G.P. O/P	40410

MINI MART

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SHOPAROUND

ETI-751: Miniature FM transmitter

This project is short on components and shopping worries. None of the components could be easier to get hold of. If you need spoon feeding go to Dick Smith Electronics with the catalogue numbers given in the parts list (see article).

ETI-696: RSC-Forth card extension

This project comes as a kit from Energy Control, 73 Eric St, Goodna, Qld 4300. You need the basic kit, which consists of the computer board, and the extra chip for the disk drive. The project requires a miscellany of parts (details in the parts lists) which are available from the corner electronics store.

ETI-664: Hobbybot Robot

Because the EPROM is proprietary information this project can only be purchased as a kit from **Allan Branch, Corporate Research and Planning, 40 Grove Rd, Glenorchy, Tas 7010. (002) 72-0629.** Price is $337 including tax and freight.

ETI-757: FAX/RTTY Decoder for the Cat

There are no obscure parts in this project barring the MM5369 crystal divider. It can be obtained from DSE which, in any case, will be doing a kit for this one.

Artwork

For those making their own pc boards or front panels from the ground up, same size positive or negative transparencies are available from our 'Artwork Sales'. Please address requests for this service to:

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ETI Magazine
PO Box 227
Waterloo
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When ordering, make sure you specify positive or negative, according to the requirements of your photoresist. Your cheque or money order should be made payable to 'ETI Artwork Sales'. Prices for this month's projects are:

ETI-751 pc board	$1.95
ETI-664 pc board	$8.72
ETI-757 pc board	$6.00
front panel	$5.17
rear panel	$5.17

You might also care to know that almost every pc board (and most front panels) ever published by ETI may be obtained from:

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Dandenong, Vic 2175

Jaetronics
58 Appian Drive
St Albans, Vic 3021

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117 York St
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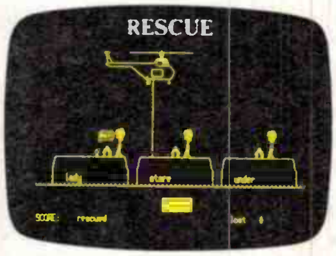

THE INTERFACE OF TECHNOLOGY AND EDUCATION

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THE CHARGE AHEAD

Developments in the battery have been sporadic since its invention in the 1800s. While it got off the ground, so to speak (and into spacecraft), its fundamental design has not really changed and similar constraints hold over design as they did decades ago. But while the battery is not charging ahead with developments, its sedately paced improvements are worth noting.

Jon Fairall

THE STORAGE OF electrical power remains one of the greatest challenges to modern science. In spite of huge amounts of money being invested, countless optimistic statements and numerous false alarms, the path to simple, inexpensive mass storage of electricity is proving rocky.

Some statistics illustrate the point. Since World War II the energy output from a typical battery has improved by only 30 per cent. Compare that with the progress of miniaturisation of electronic components (1000%?), or any of the other physical sciences. In over 100 years the basic methods of cell construction have changed little. We have introduced a small range of new materials, but they all do the same thing and follow the same pattern.

Yet the number of applications that could benefit from small, cheap, portable sources of power multiplies daily, and advances in micro-electronics only make the situation more frustrating. In fact, it's not too much of an exaggeration to say that progress is being held up in many fields of electronics simply because power requirements make further miniaturisation worthless. Portable communications systems are a case in point. Portable computers another.

Electric cars are in a field of their own. The disadvantages of our present way of powering private motor vehicles are obvious. As cities get bigger and more cars pack into a smaller area the problems get worse. Electric cars could solve a lot of those problems. In spite of years of research the problems remain intractable.

History

A potted battery history: In March 1800 Alessandro Volta announced "construction of an apparatus of unfailing charge, of perpetual power". Up until that time, experimentation had all been done with static electricity, and electrical scientists were required to be immune to both bangs and sparks. Progress was slow.

With Volta's new apparatus, things quietened down a little, and experimenters and mathematicians took over from the wild boys with the singed hair. In 1819 Oersted discovered that a relationship existed between electricity and magnetism. In 1820 Ampere discovered the law of current interaction. The law due to Ohm came in 1827, to Faraday in 1831.

The existence of cells led to a golden age of scientific discovery in electricity, but nothing of much practical benefit occurred until 1870 when the first electromagnetic generators came on to the market. For the first time electricity was both abundant and cheap. The benefits of a half century of research flowed through to the community, changing it beyond recognition.

Batteries came back into their own in 1912 in the US, when Henry Ford put one into a motor car to drive the starter motor. Structurally, the market for batteries has not changed much since then, for the needs of the motor industry still dominate the market. That's not to say that other important applications haven't opened up. In the 1920s for instance, the emerging field of broadcasting made big use of batteries for powering radios.

The battery market began to expand again in the 1950s, as transistors, integration and home electronics brought power requirements down to a level that made battery power practical. And then the battery powered car was on everyone's mind. Unfortunately, that's where it stayed.

Physics

So what was Volta's apparatus and what has happened to it since? Volta discovered that if he dipped two lumps of metal into a solution of acid, he could make a current flow along a wire connecting them. At the same time he noticed that a chemical reaction began between the metals and the solution. Disconnect the wire and the reaction stopped. He correctly deduced that he had discovered an electrochemical transducer, a device that would transfer chemical energy into electrical energy.

The basic transducer unit we call a cell. It has a voltage dependent only on the nature of the chemical reaction going on inside it. A group of cells, connected in series to give a higher voltage, is called a battery.

Volta's metal strips became known as electrodes, the solution as electrolyte. And while Volta used copper and zinc in his experiment it soon became apparent that there was a large number of metals that exhibited the same properties. (See Table 1.)

TABLE 1. STANDARD ELECTRODE POTENTIALS

Electrode	Electrode Reaction	E° (volts)
	(Acid Solutions)	
Li/Li^+	$Li^+ + e \rightleftarrows Li$	−3.045
K/K^+	$K^+ + e \rightleftarrows K$	−2.925
Cs/Cs^+	$Cs^+ + e \rightleftarrows Cs$	−2.923
Ba/Ba^{++}	$Ba^{++} + 2e \rightleftarrows Ba$	−2.90
Ca/Ca^{++}	$Ca^{++} + 2e \rightleftarrows Ca$	−2.87
Na/Na^+	$Na^+ + e \rightleftarrows Na$	−2.714
Mg/Mg^{++}	$Mg^{++} + 2e \rightleftarrows Mg$	−2.37
Al/Al^{+3}	$Al^{+3} + 3e \rightleftarrows Al$	−1.66
Zn/Zn^{++}	$Zn^{++} + 2e \rightleftarrows Zn$	−0.763
Fe/Fe^{++}	$Fe^{++} + 2e \rightleftarrows Fe$	−0.440
Cd/Cd^{++}	$Cd^{++} + 2e \rightleftarrows Cd$	−0.403
Sn/Sn^{++}	$Sn^{++} + 2e \rightleftarrows Sn$	−0.136
Pb/Pb^{++}	$Pb^{++} + 2e \rightleftarrows Pb$	−0.126
Fe/Fe^{+3}	$Fe^{+3} + 3e \rightleftarrows Fe$	−0.036
$Pt/D_2/D^+$	$2D^+ + 2e \rightleftarrows D_2$	−0.0034
$Pt/H_2/H^+$	$2H^+ + 2e \rightleftarrows H_2$	ZERO
$Pt/Sn^{+2},Sn^{+4}$	$Sn^{+4} + 2e \rightleftarrows Sn^{+2}$	+0.15
$Pt/Cu^+, Cu^{++}$	$Cu^{++} + e \rightleftarrows Cu^+$	+0.153
$Pt/S_2O_3^{=}, S_4O_6^{=}$	$S_4O_6^{=} + 2e \rightleftarrows 2S_2O_3^{=}$	+0.17
Cu/Cu^{++}	$Cu^{++} + 2e \rightleftarrows Cu$	+0.337
$Pt/I_2/I^-$	$I_2 + 2e \rightleftarrows 2I^-$	+0.5355
$Pt/Fe(CN_6)^{-4}, Fe(CN)_6^{-3}$	$Fe(CN)_6^{-3} + e \rightleftarrows Fe(CN)_6^{-4}$	+0.69
$Pt/Fe^{+2}, Fe^{+3}$	$Fe^{+3} + e \rightleftarrows Fe^{+2}$	+0.771
Ag/Ag^+	$Ag^+ + e \rightleftarrows Ag$	+0.7991
Hg/Hg^{++}	$Hg^{++} + 2e \rightleftarrows Hg$	+0.854
$Pt/Hg_2^{++}, Hg^{++}$	$2Hg^{++} + 2e \rightleftarrows Hg_2^{++}$	+0.92
$Pt/Br_2/Br^-$	$Br_2 + 2e \rightleftarrows 2Br^-$	+1.0652
$Pt/MnO_2/Mn^{++}, H^+$	$MnO_2 - 4H^+ + 2e \rightleftarrows Mn^{++} + 2H_2O$	+1.23
$Pt/Cr^{+3},Cr_2O_7^{=}, H^+$	$Cr_2O_7^{=} + 14H^+ + 6e \rightleftarrows 2Cr^{+3} + 7H_2O$	+1.33
$Pt/Cl_2/Cl^-$	$Cl_2 + 2e \rightleftarrows 2Cl^-$	+1.3595
$Pt/Ce^{+3}, Ce^{+4}$	$Ce^{+4} + e \rightleftarrows Ce^{+3}$	+1.61
$Pt/Co^{+2}, Co^{+3}$	$Co^{+3} + e \rightleftarrows Co^{+2}$	+1.82
$Pt/SO_4^{=}, S_2O_8^{=}$	$S_2O_8^{=} + 2\,e \rightleftarrows 2SO_4^{=}$	+1.98
	(Basic Solutions)	
$Pt/Ca/Ca(OH)_2/OH^-$	$Ca(OH)_2 + 2e \rightleftarrows 2OH^- + Ca$	−3.03
$Pt/H_2PO_2^-, HPO_3^{=}, OH^-$	$HPO_3^{=} + 2e \rightleftarrows H_2PO_2^- + 3OH^-$	−1.57
$Zn/ZnO_2^{=}, OH^-$	$ZnO_2^{=} + 2H_2O + 2e \rightleftarrows Zn + 4OH^-$	−1.216
$Pt/SO_3^{=}, SO_4^{=}, OH^-$	$SO_4^{=} + H_2O + 2e \rightleftarrows SO_3^{=} + 2OH^-$	−0.93
$Pt/H_2/OH^-$	$2H_2O + 2e \rightleftarrows H_2 + 2OH^-$	−0.828
$Ni/Ni(OH)_2/OH^-$	$Ni(OH)_2 + 2e \rightleftarrows Ni + 2OH^-$	−0.72
$Pb/PbCO_3/CO_3$	$PbCO_3 + 2e \rightleftarrows Pn + CO_3^{=}$	−0.506
$Pt/OH^-, HO_2^-$	$HO_2^- + H_2O + 2e \rightleftarrows 3OH^-$	+0.88

From: W.M. Latimer, *Oxidation Potentials* (New York, Prentice-Hall, 2nd ed, 1952)

How did it work? The chemical cell takes advantage of two complementary chemical processes: oxidation and reduction, known to the *cognoscente* as the redox reaction. At one electrode (called the negative electrode) the metal combines with a negative ion and is oxidised, ie, combined with an oxygen atom to form an oxide. At the other electrode the metal is reduced, ie, an oxygen atom is stripped away and a positive ion liberated. Typical chemical equations look like this:

at the negative electrode:

$$Zn+20H \rightarrow ZnO+H_2O+2e$$

at the positive electrode:

$$Ag_2O+H_2O+2e \rightarrow 2Ag+20H$$

The chemistry of the whole cell may be summarised by:

$$Ag_2\,0+2n \rightarrow 2Ag+ZnO$$

The elements are frequently different but all follow the same pattern typical of redox reactions; namely that oxygen is swapped between the elements. Actually, it doesn't even need to involve oxygen. The pattern is so familiar that a whole class of non-oxygen substances using reactions are called redox reactions.

The critical point to notice about these reactions is that in order for them to be balanced, an electron must be emitted from one electrode and absorbed into the other. The way this is done is to allow the electrons to flow down a connector between the cells. This electron flow is a force capable of doing useful work. We call it electricity.

Types

Essentially all cells work in this way. However there are three divisions it is possible to make in the types of cells.

Primary

Primary cells have a one-way reaction. The most familiar example is the ordinary 'C' or 'D' cell you put in your torch or camera flash unit. This type of cell has undergone some major changes over the years. Exotic materials have been used to provide powerful combinations of current, voltage or capacity. However, economics, the old bottom line, ensures that carbon zinc remains the most popular choice for general applications.

Carbon zinc

This is one of the oldest cell types, often known as the Le Clanche cell after its discoverer. Typical construction consists of a zinc can with a carbon rod in the centre. A paste of magnesium dioxide is packed around the carbon rod, and separated from the zinc by a separator. The reaction eats the zinc and removes the oxygen from the manganese. As time goes by the internal resistance of the cell rises and it steadily loses working voltage.

Alkaline

This describes a family of cells that use alkaline rather than acid electrolytes. They have a lower internal resistance than carbon zinc, and tolerate high current drain much better than the traditional cell.

Lithium

A generic term for cell types that use a lithium anode and a carbon cathode, with a variety of electrolytes. They feature a very high voltage (3.6 V) and exceptional shelf life. Some manufacturers claim that capacity drops by only 20 per cent after ten year's storage. Their main disadvantages are expense and the 'slow start' phenomenon. When the cell is not in use an oxide layer forms on the lithium, forming a dielectric layer. This inhibits the reaction of the cell. It's the reason that it lasts so long, but it also means the cell doesn't work very well until the oxide disappears. It is necessary to draw current from it for a few minutes before this happens. One possibility is to place a small bleed resistor across the cell to keep a trickle of current, a few microamps, flowing. This is sufficient to stop the oxide forming.

Silver oxide

This cell has exceptional voltage performance and energy density. The main problem, as one would expect, is price.

Secondary

Secondary cells were the first type to be developed. The distinguishing feature is that the reaction that powers them is revers- ▶

ible, ie, it is possible to pull electricity out of them and push it in. The reaction inside the cell just reverses itself.

Lead acid

For instance, in the standard secondary cell, the type used to power car starters, the electrodes are of lead and lead dioxide. The electrolyte is sulphuric acid. At the positive plate the lead dioxide is converted into lead sulphate and the acid turned into water. At the negative plate the lead is turned into lead sulphate and the acid turned to water. So over time both plates become more alike and the voltage between them drops. Also the acid becomes more and more diluted.

Now if we force current back into the cell, precisely the opposite reaction occurs. The acid becomes more concentrated, and one plate turns into lead dioxide and the other into pure lead.

NiCad

The other really common rechargeable cell type is nickel-cadmium, the NiCad battery. The positive plate is nickel. A common electrolyte is cadmium hydroxide. These cells have been used for nearly fifty years in small power applications where rechargeability is important. Modern NiCads are practically indestructible, with lifetimes measured in thousands of cyles.

Fuel cells

If the ordinary cell can be thought of as a device for turning chemical energy into electricity, the fuel cell is the ultimate transducer. The idea is that it is possible to design a primary cell in which some chemical is absorbed and turned into electricity. The limit on the capacity of such a cell is the amount of the necessary chemicals inside the cell. It could be made infinite if the chemical being consumed could be stored outside the cell and fed in as required.

The first attempt at what we would consider a fuel cell was made by the Englishman, Grove, in 1839. Modern interest began with the work of O.K. Dartian in 1947 and research reached a peak in the 1970s. There were some notable successes: Mercury, Gemini and Apollo spacecraft all used fuel cells. However, an economically viable unit has proven elusive.

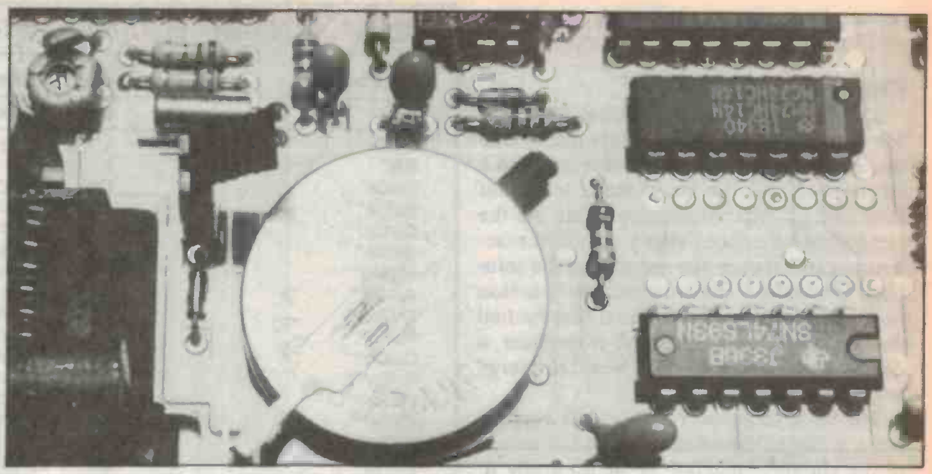
Some promising technologies:

Hydrogen oxygen

A typical fuel cell type reaction has hydrogen being fed to one electrode, where it forms hydrogen ions in the presence of a catalyst. At the other electrode, oxygen is reacting with water to form negatively charged OH radicals. Both then combine in the electrolyte to form water. The electrons liberated at the negative electrode are accepted back at the positive one.

So the input is hydrogen and oxygen and the output is water and power. You can see why fuel cells are an attractive idea.

One production variant, manufactured



A typical application of lithium cells: memory back-up. The cell is soldered to the pcb and will last the lifetime of the unit.

by GE and flown aboard the Gemini spacecraft weighed 68 lb (31 kg) — ten cubic feet for every kilowatt. It delivered 23.3 to 26.5 volts and produced a pint of water for every kilowatt hour. All electrodes were platinum.

Metal air

Another variation on this theme is the metal air battery, in which the positive electrode is oxygen. The first of these was developed by Heise and Schumacher in 1932. It uses a porous carbon block, open to the air, as the positive electrode.

Research

So, what's going on? After all the hype, and in view of the importance of the problem, why no radically new solutions? For a start, as people in the industry will hasten to assure you, a lot *is* going on. Numerous different combinations of battery have been tried, new themes have been played on old fiddles, and the result has been slow but steady improvement in the quality of the batteries available.

The biggest problem has been, and continues to be, an economic one. It is very difficult to design economic electrochemical transducers. For instance, during the seventies electric cars were produced that had performance figures from a single charge better than those from an equivalent car with a tank full of petrol. At the right price quite a proposition, you might think. The problem was that the batteries used silver electrodes. Take half the weight of your typical family sedan, multiply by the cost of silver, and add on a bit for bodywork and passenger comforts and you have some idea of why electric cars didn't make it on the world market.

Researchers in the US even played around with the idea of using gold electrodes, which have better properties than silver. The economics boggle the mind.

Fuel cells have also come up against the same types of difficulty. It turns out that the idea of replenishing the cell from outside is not quite as simple as might be supposed.

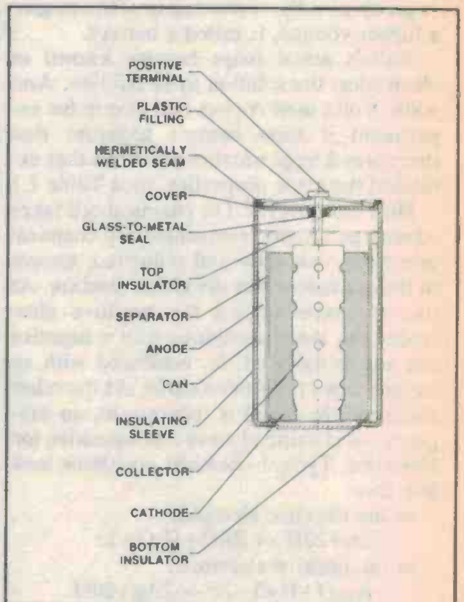


Figure 1. Cut-away of a lithium cell, courtesy Technica.

For a start, the types of reaction under consideration need a very stable controlled environment, usually at elevated temperatures. Values above 2500°C are common for the best reactions. Secondly, it turns out that reactions are quite sensitive to the amounts of chemicals actually present, so complex control systems need to be built in that monitor the amounts of chemicals and arrange for addition or removal of chemicals from the cell. Thirdly, it turns out that although the inputs and outputs are very simple, the types of reaction we want will only work in the presence of dangerous and/or expensive catalysts.

All these put limitations on the type of uses fuel cells can enjoy. Firstly they need expert care all the time. Secondly they need a controlled and predictable environment, thirdly, price must be no object and finally, weight must be considered. All of which leaves you with spacecraft and a few special military applications. Certainly they don't go in the family sedan.

Nevertheless, all is not doom and gloom. There have been a number of interesting

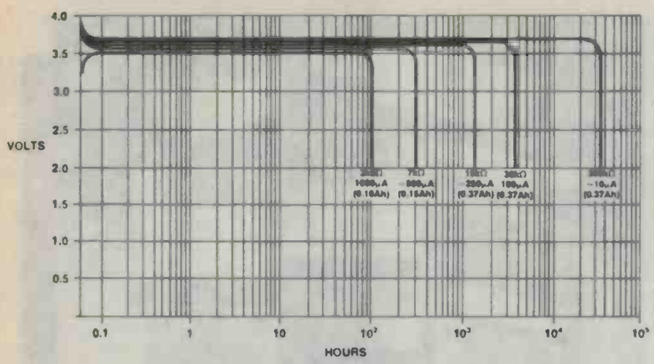


Figure 2. Voltage over time for lithium cells. Notice the 'slow start' when high current drain is called for, due to oxidation of the plates; also flat voltage rating over most of the life of the cell. Courtesy Tadiran.

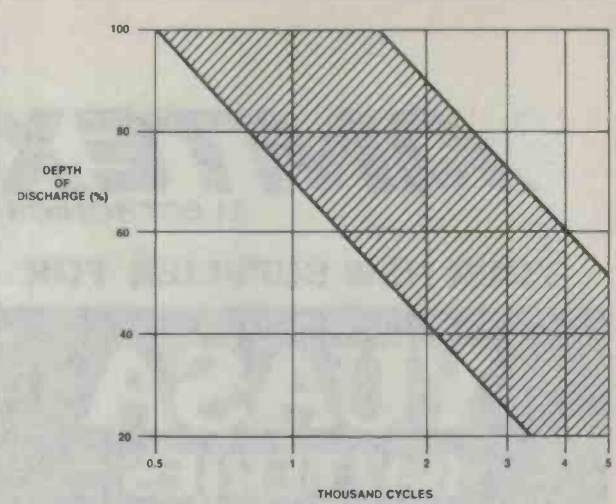
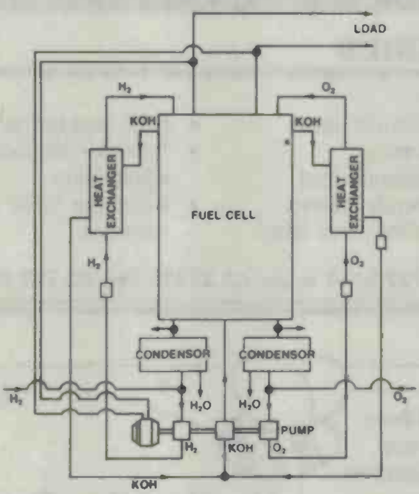


Figure 3. How to cycle NiCads — estimated life as a function of depth of discharge. Courtesy Technica.



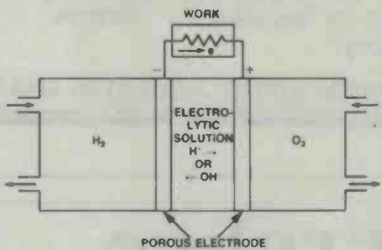


Figure 4. The basics of a hydrogen oxygen cell. It's a little more complex than the structural diagram looks! Courtesy IEI.

developments, which, while they do not shake the world, still improve the quality of the product. Sealed batteries for use in motor cars are one classic example. The problem with an ordinary car battery is that while it's on charge it 'gasses', that is, gives off oxygen and hydrogen gas at the expense of water. Clearly this must be vented to the outside if pressure is not to build up inside the battery.

A considerable amount of work has been done on recombination batteries, in which the gasses are forced to recombine as water, thus alleviating the pressure and replenishing the water supply. In fact it should result in a steady state system in which the amount of gas just matches the amount of water. Result: a battery that never needs topping up with water, or any other maintenance. This has immense appeal to the motoring public, as well as being an ideal source for powering remote equipment where maintenance is difficult or uneconomic.

Another trend has been the use of thinner plates in all sorts of batteries, which results in greater storage capacity for the same weight or in lighter batteries. Also of concern has been decreasing the internal resistance of the cell, thus increasing its ability to handle rapid charge and discharge. This research has particular implications for NiCad batteries which are very vulnerable to excess current drain, particularly on the charge cycle.

Above all, though, the battery market is device driven. A battery is a pointless piece of equipment without something to power. Thus a considerable amount of research time and energy is spent on changing the packaging of well understood technologies to fit suitable applications.

The recent, spectacular, growth in lithium and silver batteries is a case in point. Both these types are superb when it comes to long life, low drain applications, as for instance, in memory back-up or watches. Here the current requirements might be of the order of microamps for several years. In addition, because the devices they must drive are small, they should be physically small too.

This changes the whole economics of battery production. If the battery is small, the material cost is also small, relative to the cost of packaging and distribution, so one can use more exotic materials.

The future

One would like to say that in a few years we will have the ability to power our motor cars with water in a fuel cell, receive satellite signals from a wristwatch powered by a tiny battery that supplied amps of current indefinitely, but that picture is most unlikely.

The amount of research money available is a key constraint, of course, and that will depend to a large extent on the future of oil prices. People in that industry say that around the turn of the century we may expect the price to go through the roof again, so maybe that's how long it will take.

On the other hand there is also a school of thought that sees the production of batteries as something of a black art. Improvements don't come from laboratories, but from the slow development of ideas on the shop floor of battery plants. ●

Silly software dept

ACCORDING TO AN EXPERT witness testifying before a court in the USA, the computer program used to count more than one third of the votes in the last general election could have been tampered with to provide false results.

The allegation that vote tallies calculated by the system may have been secretly altered has raised concern among election officials and computer experts, according to the *New York Times*. It has also raised concern at the Kremlin, but for entirely different reasons.

Officials have said the rapidly increasing use of such systems, the lack of Federal or State standards and the widespread lack of computer skill in local voting authorities constituted a serious risk of electoral fraud.

The vote counting program has been subject to court scrutiny in the states of West Virginia, Indiana and Maryland. Apparently the locals there trust their politicians about as much as people in New South Wales or Queensland trust the local variety.

Court actions have been instituted by losing candidates who have hired computer programmers to look over the program, with a view to finding parts that could be manipulated. The designer of the program, John Kemp, says it's impossible to design a program you can't tamper with.

Bladder pacemaker

Do you have an embarrassing problem? You can't keep yourself to yourself? Well in the US, where everything is bigger and better than everywhere else — including the problems, scientists at the University of California have come up with a device to control the urinary tract.

Apparently, during normal urine evacuation, the bladder muscles contract; during storage they relax. Now scientists at UCLA have come up with a device that consists of a surgical implant to control the nerves that control the bladder muscles, and a small hand-held switch that controls the implant. By turning a switch one can make the bladder muscles do the appropriate things.

Wags among you will reflect on the ability for misuse presented, should such a device fall into wrong hands.

Fiery temper

At the end of the day, the purpose of all our endeavours is to bring smiles of happiness to the users of equipment we design or maintain. Nowhere is this more apparent than in the broadcasting area. However, as technical people we are inclined to remain aloof from the hurly-burly created by our fellow citizens when they pour vitriol on hapless program makers. Occasionally, in more excitable places than Australia, things get a little out of hand. Arthur Cushen on the shaky isles reports:

Recently Dunedin Radio 4XD was put off the air when an irate listener set fire to the transmitter building. Radio 4XD is the world's oldest non-commercial radio station, opening in 1922. It is operated by the Otago Radio Association and the staff are all volunteers.

Radio 4XD broadcasts easy listening music and some transcribed gospel programmes. It is popular with older listeners in the southern part of New Zealand for its entertaining sessions.

The fire was observed by Post Office employees visiting the site on Highcliff, which is also the location of the transmitters and masts of 4YA, 4YC, 4ZB and 4XO. They found the transmitting hut completely burnt out and two transmitters beyond repair. The heat from the fire blistered the lattice tower, but it was not badly damaged. The transmitter was a 2 kW unit, a standby unit and VHF links back to the city studios at a loss estimated at $NZ50,000.

When I interviewed the station manager of 4XD, Lindsay Rackley, he remembered abusive phone calls and one letter from a listener who was frustrated because he could not listen to Hit Radio 3ZM Christchurch on 1323 kHz due to interference from 4XD on 1305 kHz. A Dunedin man has since been arrested and charged with setting fire to the 4XD transmitting building.

In the meantime the Broadcasting Corporation of New Zealand has hired a caravan for the station, complete with a 1 kW transmitter. Broadcasts have again resumed on 1305 kHz with transmissions Monday-Saturday at 0600-1100 UTC and Saturday 2100 to 1100 Sunday. The 1 kW transmitter has been replaced with a 400 W transmitter which is housed in a concrete block transmitting building and later this transmitter will be replaced with a 2 kW unit so 4XD will be back to its authorised power.

An appeal has been launched by Dunedin Senior Citizens in order to raise funds towards rebuilding the station, which was only partially insured. About $5000 has already been raised towards the replacement costs.

Something remains . . .