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SEPT. 1984
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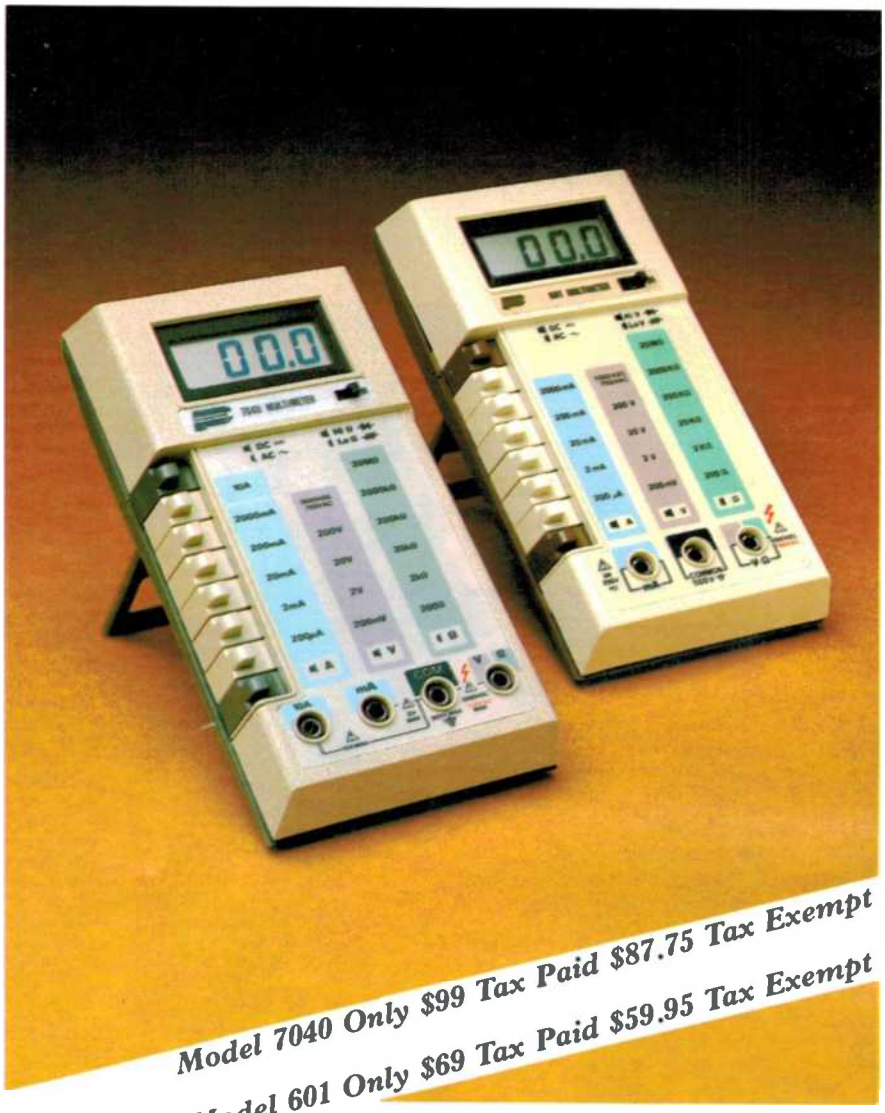

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xypar 397

IS THE VIDEO recorder undergoing a crisis of identity something akin to a sex change? The domestic video recorder these days is quite a sophisticated machine. It is certainly the most sophisticated piece of high technology that resides in the home these days, the home computer notwithstanding. The VCR is a complex assembly of sophisticated, precision mechanics plus sophisticated and complex electronics which is a remarkable amalgam of analogue and digital circuitry. By comparison, the home computer, wonderful though the tricks it can perform, is like a K-mart food processor.

But I digress. Your VCR is for recording/playing video tapes. Right? Wrong. Or, not any more any way. The introduction of 'video hi-fi' gives the VCR the ability to record/replay high quality audio with a performance that is claimed well exceeds the best that reel-to-reel recorders could achieve, and could come close to rivalling current digital systems.

Is the VCR meant to challenge the cassette deck? Nobody's saying. Is it meant to challenge compact disc systems, with the bonus of record facilities as against CD's play-only ability? Nobody's saying. The 'blurring' of the VCR's traditional role is furthered by the availability of digital audio add-ons that turn the machine into a true digital audio recorder.

I suspect, and my suspicions were 'firmed' somewhat at a recent press release for a video hi-fi machine, that the hi-fi facility was developed as a marketing ploy to boost the sales levelling-off that began a little while ago.

The result is an identity crisis for the VCR that may just backfire on the manufacturers unless they can successfully educate the consumer. But the consumer may well decide that video hi-fi is not what they want. I think the days have gone when you can tell the consumer that such-and-such a product was a desirable necessity and to 'take what we tell you to take'. (Not that I'm saying that's what the video companies are doing.) It particularly applies with consumer electronics. Witness the home computer market. Consumers began asking themselves more searching questions about their need for the product last year. The results are well-reported in the press.

Will the video recorder successfully transmogrify into an audio/video machine, eclipsing several separate components? Time will tell.

Wisdom crieth without;
She uttereth her voice in the streets
Proverbs 1:20

Roger Harrison
EDITOR

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SPECIAL OFFERS

Cover. Photograph courtesy STC Cannon Components Pty Ltd.

Design by Ali White.

REVIEWS

NEXT MONTH

VIDEO METAMORPHOSIS
The video world is undergoing radical change at present. The VCR heads a push into audio with 'video hi-fi' for both Beta and VHS formats. The humble TV grows into component video and video disc — who knows? There's a battle going on behind the scenes. This article gives you the state of play.

RADIO TELETYPE SPECIAL
Radio teletype is growing rapidly in popularity amongst radio amateurs and other enthusiasts, aided and abetted by home computers. Next month we have a special emphasis on the subject and introduce two projects: one for the Microbee, one for the VZ200. Not to be missed!

DRUM SYNTHESISER
This simple drum synthesiser is cheap, but effective! It provides a range of sound variations from Chinese block to bed spring boings! It can use 'sound' pickup from a piezo or loudspeaker sensor, as well as taking a digital pulse input. All the bits are widely stocked so hot up your soldering irons!

NEWS

COLUMNS

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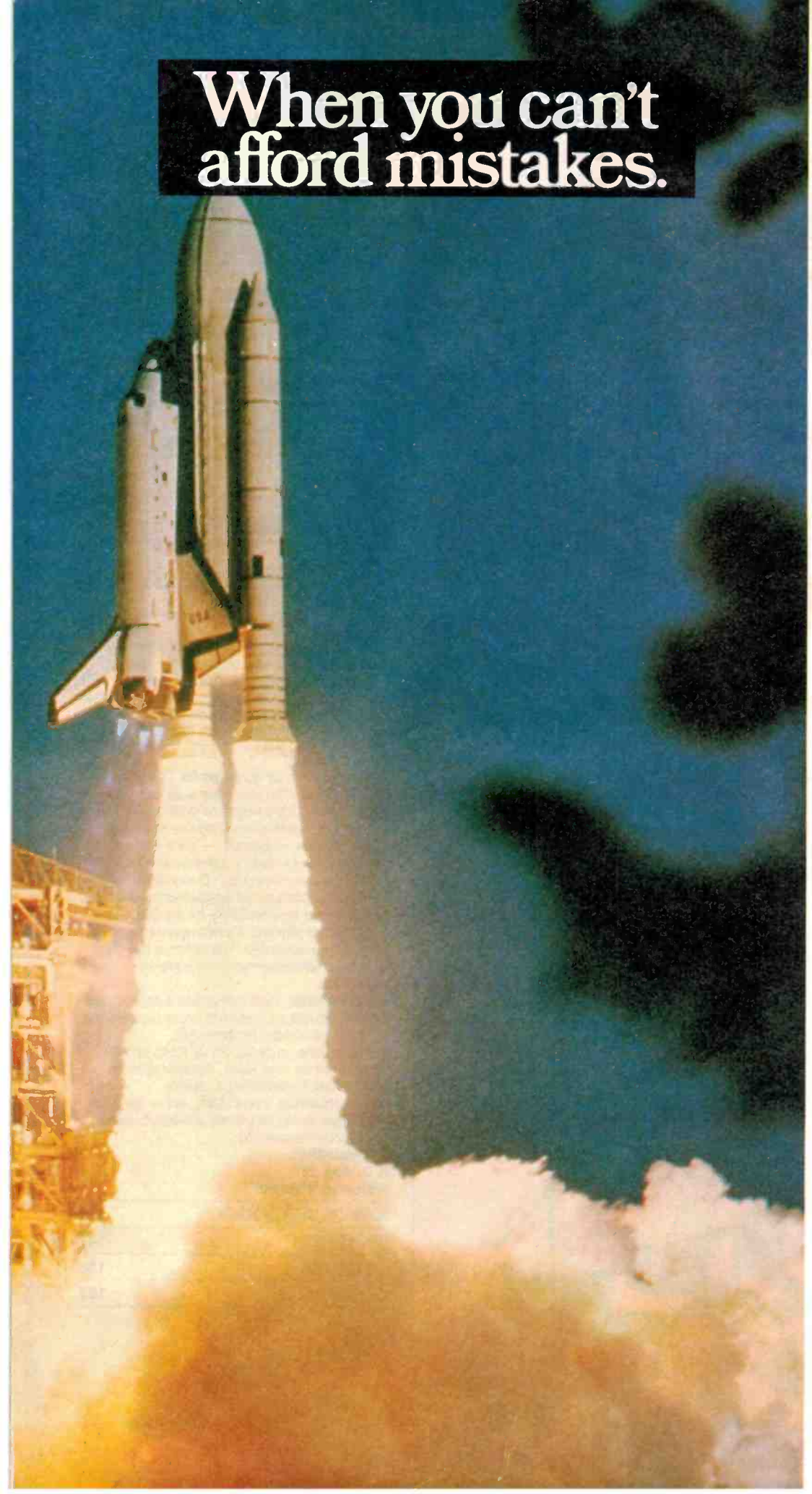

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Export coup for Philips Australia

Philips Australia has just achieved a major export coup. A new automatic radiophone, the FM900, which was developed and manufactured at the Philips plant in Clayton, Victoria, has been sold to British Telecom on an order worth more than $5 million.

The FM900 series radiophone was developed to meet local and international standards. It could become available to Australian users, depending on decisions made by Australian Telecom.

It was designed to meet the needs of a wide variety of people on the move who want to keep in touch. Calls can be made to or received from almost any phone in the world, even to other radiophones fitted in boats or other vehicles. As it is a two-way system the driver can always be contacted, even from a public telephone box.

It is claimed to be the most advanced of its kind on the market, with more facilities than the average conventional phone. This 111-channel VHF radiophone can store 60 telephone numbers in its memory. By pressing three buttons in a short-form code, numbers stored in the memory are dialled automatically with the handset on or off the hook.

An automatic strong-signal search ensures that the best high-level signal is automatically selected. The signal-strength indicator monitors the strength of incoming radio signals.

A number of security features have been built into the Philips FM900. The equipment can be locked so that no-one can use it to make calls, or only a few vital numbers can be accessed. Whatever locking system is used the radiophone can always receive calls. Alternatively, the handset can be unplugged and removed altogether for complete security.

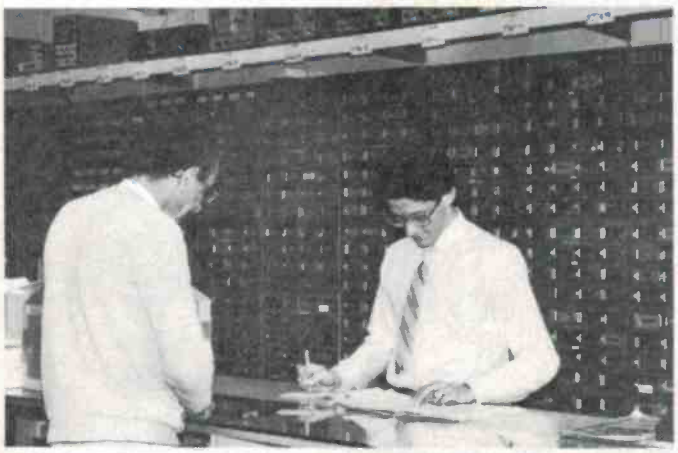
The FM900 is easy to install and simple to operate. The display and handset are all in one which means that calls can be made by anyone in the vehicle — just as one would use a normal phone handset. If the caller wants passengers to hear the conversation a loudspeaker can be switched on for this purpose.

Besides the handset there are only two main elements: the microprocessor-controlled radio transceiver which is housed in the boot of the car, and the aerial which can be electrically controlled.

The FM900 can save time, improve efficiency and gives the users an advantage over those without mobile communications. Sales people can place customer's orders on the spot, or a service engineer can be sent straight to an emergency. If a driver gets delayed in the morning traffic the radiophone can be used to rearrange their day, and they can even reply to their morning mail by dictating direct to their office.

Users of the Philips FM900 radiophones in England wil have the usual public telephone services available — road reports, air travel information, weather, directory enquiries, etc. Owners can even call their answerphone and have it play back messages while they are on the move.

The FM900 is proven professional mobile radio equipment and since it was released in April 1983 it has been in volume production.



What the customer sees. The sales area at Radio Parts in Spencer Street, West Melbourne.

H-P at Radio Parts

Family business and trade-house, Radio Parts, uses its Hewlett-Packard computer to compile an annual catalogue and monthly price list which contains information on its stock of 15 000 items.

The 325-page catalogue has a paid subscription of 4000 throughout Victoria, and includes details on all Radio Parts' products such as radio and television components, appliances, car products, household goods, electronic products, communication and hi-fi equipment.

As well as producing a catalogue and price list the HP 3000 Series III has also simplified the backorder system. On receipt of the customer order the account number is entered, the credit rating checked and if satisfactory, a computer address label printed. The order is then made up in the store and despatched.

Statements are generated on the computer and issued one month after the goods have been despatched. These are prepared in about two days compared to taking two weeks prior to computerisation.

BATTERIES DANGER

Wafer-thin batteries such as used in calculators, cameras, watches, LCD games etc, can spell serious danger for young children.

Because this class of battery is bright and shiny, young children are attracted by them but they can be fatal if swallowed.

A recently reported incident tells of a young boy who swallowed one of these batteries. His parents were unaware of the danger. When they sought medical help a few days later, it was too late. Unfortunately, the strongly alkaline chemicals had destroyed the boy's esophagus.

Apart from that, their size is such that, if one lodged in the windpipe of a small child, suffocation could result.

Keep such batteries, both new and used, out of sight and reach of young children and warn older children of the dangers.

LSI breakthrough

Toshiba has recently developed fundamental technology for a 'resistless' process in which the pattern that makes up an LSI integrated circuit is etched directly on the substrate by laser chemical reaction without the use of a resist.

Commercial implementation of this technology will shorten the etching process. It will make possible the manufacture of proposed 16M devices, which require accuracies better than 0.5 μm.

It was discovered that when a silicon substrate was irradiated using a short wavelength (around 300 nm) laser in a chlorine gas atmosphere, etching occurs by chemical reaction taking place at the irradiated portion only. This marks an important step toward the achievement of a resistless etching process.

It not only renders coating, postbaking and peeling unnecessary, but combines pattern exposure and etching into a single simultaneous operation. And since etching is accomplished by chemical reaction alone, there is no danger that the circuit could be damaged by ion impact.

Commercial implementation still awaits the solution of several problems, but the technique is sure to have a major impact on the manufacture of 16M VLSIs, and constitutes a new field of application for UV lasers.

Chinese trade delegation. Siemens was visited recently by a trade delegation from the People's Republic of China. Members of the delegation are pictured in the small business telephone section of the company's Richmond factory with Siemens executives: (extreme left) Dietmar Weinkoetz, Production Supervisor; (4th from left) Jock Reid, Manager Communications Networks.

IC shortage continues

The continuing under-supply of ICs by the big Japanese manufacturers is still causing problems, in spite of massive capital investment — up 50% in the last two years.

Part of the expanded capacity will go into big increases in the number of 256K memories, while the present high rate of production of 64K units is maintained.

Meanwhile, the consumers of the ICs, makers of cameras, watches and cars, have started making their own as a way to beat long waiting lists with the traditional suppliers.

The question that everyone is asking is how long can the IC boom continue? Industry pundits are speculating that the present situation will last at least until next year. Conditions are being helped somewhat by the growing trend of makers of custom ICs to sell to other manufacturers. The result could be massive over-capacity before the end of the decade.

Pocket blow job

With the widespread introduction of random breath testing in most Australian states, there has been increasing interest in finding out just how many drinks an individual driver can have before putting himself 'at risk'. It varies so widely from person to person and depending on circumstances, that the 'three drinks in the first hour' rule is just a "guide".

Reliable 'personal alcohol breath indicators' have, to date, been either very scarce and/or very expensive. The BloTron alcohol breath indicator is a portable, pocket-sized instrument that claims to reliably indicate the range of blood alcohol level around the 0.05 limit yet costs well under $100.

The BloTron features two indicators: a three-LED readout of green (safe), orange (caution — approaching 0.05) and red (over 0.05); in addition, it has a meter, the needle of which shows, on a green-amber-red scale, the blood alcohol range. So, if you blow into the instrument and the amber LED shows while the meter reads close to the red scale, you know you're at risk and shouldn't drive until a later test shows a reading down in or close to the green scale.

The sensor device is housed in a special pressure sampling chamber and doesn't pass your breath directly across the sensor which makes it sensitive to other components that may be in the breath. Independent tests carried out at a local university, on behalf of the importers, show that the unit performs to a standard which the Traffic Authority of NSW indicated was acceptable, according to the importers, CPI.

The lightweight unit costs around $70 and is battery operated. Further details from **Communications Power Inc, P.O. Box 246, Double Bay NSW 2028. (02)357-2022.**

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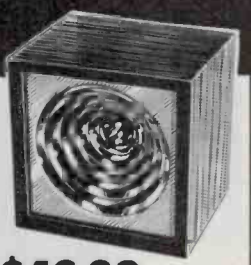

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At last. A telecom line crew install the first production fibre link in Sydney.

Sydney light link

The first commercial installation of AWA optical fibres has been made between the Telecom Radio Tower in the Sydney suburb of Waverley and a central trunk exchange at Haymarket, a distance of some 7 km.

Fibres in this cable have been spliced and the initial system should now be fully operational. Each individual fibre will be capable of carrying digital traffic at 140 Mbits/sec, corresponding to 1920 individual telephone channels.

The optical fibres being used in the Telecom project were manufactured by AWA at its North Ryde facility in Sydney. The company is increasing its optical fibre manufacturing capacity to meet the demands for such products initiated by Telecom and other organisations, including railway and electricity authorities.

Optical fibres for the Waverley-Haymarket link are said to have attenuation of 2.8 dB per kilometre at 850 nm and a band width in excess of 600 MHz per kilometre.

Exciting lighting

The lighting house, Exciting Lighting, has just opened a new showroom in Melbourne.

The owner, Trevor McGaw, has just returned from overseas and has brought back some of the latest lighting design ideas from Europe.

The Lumen lite, for instance, is made of a material that, when exposed to ultraviolet light, will glow in a similar fashion to Neon. The Neonlight is another novel lighting idea consisting of many small lamps contained in a small, robust but very flexible tube.

Many other lines are available and customers are invited to call at the showroom or write for the latest Exciting Lighting catalogue.

The address is 67 Victoria Street, North Richmond Vic 3154. (03)729-6337.

IREECON '85

Organisers of the electronics exhibition held every second year by the Institution of Radio and Electronics Engineers Australia have announced an important expansion of the lecture program for IREECON '85.

They have decided to increase the content of papers dealing with industry related and management oriented subjects to complement the large number traditionally submitted on research and development. This will provide members of the electronics industry with an opportunity to introduce matters of special concern to the profession as a whole.

IREECON '85, The Institution's 20th international convention and exhibition, will take place in Melbourne's Royal Exhibition Building from September 30 to October 4 next year. It is expected to attract a record number of exhibitors, both from within Australia and from abroad, where there is growing interest in the event.

The lecture program will be divided into three principal streams — research and development, policy and trends, and manufacturing and applications — and arrangements are being made for speakers to give keynote addresses on these subjects.

The growth of IREE's biennial event from its inception in 1938 to its present recognized position as Australia's largest and most comprehensive convention and exhibition of professional electronic equipment ensures that exhibitors will feature up-to-the-minute developments in a wide variety of hardware and software.

For further information **Heather Harriman, The Institution of Radio and Electronics Engineers Australia. (02) 29-4051.**

BRIEFS

Software distributor, Software Corporation of Australia, has established a sales and marketing office in Sydney. Located in Edgecliff Centre, the office is manged by David K. Sokol, SCA's NSW Marketing Manager.

Japan exported 3358 robots last year. The total value of the trade to the Japanese is believed to be about US$101 million.

NEC has appointed a former Canberra journalist to the newly created position of Media and Public Relations Officer. She is Deborah Roberts, 26, a former journalist with the Commonwealth Department of Education and Youth Affairs.

Utilux has announced the appointment of Raymond Clark as Branch Manager, Victoria. His experience spans 25 years, including five years 'on-site' with O'Donnell Griffin. As Utilux's branch manager in Victoria, he will be accountable for all branch operations which include sales and marketing activities for the State.

Ampec Electronics has moved. The new address is 21 Bibby St, Chiswick NSW 2046. (02)712-2466.

NOTES & ERRATA

May 1984, The role of ionospheric measurements in high frequency communications, by David G. Cole. The panel on pages 146-147, containing information on the IPS-42 ionosonde manufactured by KEL Aerospace was an addition to the article and not material supplied by the author. The ionogram on page 147, supplied by KEL Aeropsace, is by way of illustration, the table of scaled parameters below it contains errors and should not be taken 'as read'.
Roger Harison, Editor ETI.

Project 563, Fast NiCad Charger, July '80 and Top Projects Vol. 7. Constructors having difficulty obtaining the 1N5625 diodes specified for D6 and D7 in this project, note that Motorola type MR-856 diodes may be substituted.

More functions for the VZ200, March 1984: There is an error in the second column, just above the listing of the short BASIC program. It should be . . . (Can be done directly by POKE 30945,175.)

Small Business Success Kit

"microbee small business success kit offers bright prospects to those who would be masters of their own future"

The **microbee** 128K dual drive small business computer is a total kit package for the serious small business user.

The package consists of a **microbee** with 128K of dynamic RAM controlled by the proven Z80A processor; a dual 400k disk drive; the **microbee** high resolution amber screen monitor; and the **microbee** MB80 dot matrix parallel printer. Included in the price of **only $2,495** is a whole host of bundled software for word processing, terminal emulation and communication with other computers world wide, spreadsheet analysis and more.

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The complete comprehensive package of software includes:

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Wordstar reference manual. Wordstar training guide. Microsoft Multiplan manual and the Microsoft BASIC manual.
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You can be assured of the very latest design innovation, world class quality and continuing after sales support. A unique feature of all **microbees** is that they are designed to be expandable and upgradeable as and when new developments become available. You should not fear obsolescence.

"World class bundled software plus comprehensive user manuals lets you set up your system and start working immediately."

Phone and make an appointment with the manager of your nearest **microbee computer centre**. He will set up your system with you and give you **your** first hour of training free of charge with **your** computer. All manuals and self help tutorials are provided so you can learn at your own pace if you wish. Regular user group classes are also held outside normal business hours at very reasonable rates.

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Standard Specifications:

PROCESSOR:
Z80A running at 3.375 MHZ

KEYBOARD:
60 key FULL SIZED QWERTY layout with full travel.

DISPLAY:
Direct video to external monitor.
80 by 24 and 64 by 16 character display modes, high resolution PCG graphics to 512 by 256 pixels. Upper and lower case with full programmability at any screen location.

INPUT/OUTPUT:
Programmable 8 bit input/output parallel port, programmable RS232 port, cassette interface, direct video, 50 way Z80 expansion bus.

MEMORY:
128K of dynamic RAM, 2K screen and graphics RAM, 8K of system firmware controlled with specially designed memory management unit.

128K **microbee** dual 400K slim line floppy disk drives; amber screen high resolution monitor; bundled software and manuals. $2,245.

With MB80 dot matrix parallel printer .....

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Leasing available from $68 per month to approved purchasers.

CONSUMER ELECTRONICS-

In a state of excitement

The Perth Consumer Electronics Show, August 1-5, had all the latest products which have either just been released in Australia or are due for release soon. Here's the most up-to-date info on what's happening in the industry.

Roger Harrison

We are the robots! The obligatory promotional robots pursued visitors all over the show.

I WRITE as the sixth Perth Consumer Electronics Show is in full swing. The weather has been distinctly reminiscent of Melbourne's 'four seasons in a day', but the crowds are flocking to see, hear, touch and experience all the electronics goodies on display. The aisles, stands and alleyways have been a-crush.

The efforts of virtually every company involved, large and small, have lifted the show to new heights. The overall effect cannot fail to impress anyone who sees it. The range of products on display is dazzling; from electronic watches to video hi-fi, from on-the-go stereo to 'body-sonic' chairs for seeing and feeling with a laser disc system.

I discovered last year that many of the major importers used this show to 'test the waters' with new equipment that would not be seen on the market here for three to six months hence. This year is no exception. What's more, just as in previous years, they're showing lots of 'hot products' — equipment either just released in the past few weeks or due for release in the next month.

What's big?

The attention-getters in this year's show are undoubtedly *video hi-fi, video movie camera/recorders* and *compact disc players*.

Every major Japanese company has a stereo video hi-fi machine on display. The battle is on in earnest between the Beta and VHS camps. The Beta manufacturers hope to lift their market share significantly through video hi-fi sales. Confusion as to the role of the video hi-fi, whether it's a video or an audio machine or 'something else', is being fought off by the VHS camp through promotion of the integrated sight-&-sound system concept.

JVC has come up with a 'Cross Media' series of integrated components built around their new HRD 725 stereo video hi-fi. The system can be mixed and matched amongst six components with optional add-ons. There's a 20-inch monitor/receiver, 'Super A' integrated amp, graphic equaliser, CD player, turntable and tuner. It all fits in an integrated rack system that takes the monitor on top. You can add-on a digital PCM encoder/decoder for making you own digital audio recordings, a spectrum analy-

▲ **Sony's Beta hi-fi video cassette recorder.** The Sony SL-HF100AS will be available for $1149 (rrp).

◀ **VHS Videomovie.** JVC's GR-C1 Videomovie cam-corder features auto-focus, electronic viewfinder and operation at 15 lux light levels. It weighs just 1.9 kg and takes 30 min. VHS-C format tapes.

National's colour video camera. The WVP-55N ▶ has an auto-focus system and a 6x zoom lens.

ser that provides a display on the monitor screen (in colour) and a cassette deck.

Sony, too, is promoting video hi-fi as part of the integrated sight-&-sound system. A large part of the enormous Sony stand, which spans one of the corridors and runs for 20 metres, is devoted to Beta hi-fi video. They have one area set up as a loungeroom with couch and chairs in front of a sight-&-sound system built around their new SL-HF100E Beta hi-fi, released just weeks before the show at a function held in Sydney for the press, duplicators and software distributors.

Most stands I've seen so far are promoting video hi-fi as part of the integrated sight-&-sound system. National, Sharp, NEC, Philips and Hitachi are all promoting the concept.

National's video product manager, Mike Elderborough, reports they've had strong sales of their new NV-850 VHS hi-fi video from their stand at the show. It features a 27-function infrared remote control and a 14-day, 8-programme timer and sells for around $1300.

It seems that early purchasers of the video hi-fi machines overseas were audiophile enthusiasts who were mainly into doing their own recordings and were uninterested in the video side. These sort of purchasers currently represent around 12-15% of the market.

As it's a new format, sales will be dependant on the availability of software. But therein lies a problem. There are no true hi-fi stereo masters available to the duplicator companies! It seems the hardware and software manufacturers don't talk to each other.

While there are some locally-produced music videos in the hi-fi stereo format, no films are available. They are being produced in stereo but the masters were not made to suit the hi-fi video format. From all the indications I could glean, it's going to take until December through to next March to rectify the position.

Notwithstanding that, Sony announced, the night before the show opened, that they'd be selling their Beta stereo hi-fi complete with three pre-recorded tapes, including 'Raiders of the Lost Ark' with stereo soundtrack, setting Harrison Ford amongst the VHS pigeons, so to speak.

Shoot from the shoulder

Video camera/recorders are getting the big push too. The Beta camp is giving the Betamovie heavy promotion. Auto-focus is the attraction this year, a feature that greatly enhances convenience, an important consideration for the inexperienced user.

But it looks like the VHS camp is set to fight back strongly against the popularity of Betamovie's 'convenience' for the home video movie enthusiast. JVC are showing, straight from Japan, a 1.9 kg cam-corder, the model GR-C1 Videomovie which uses VHS-C format tapes that can accommodate 30 minutes of shooting. It's smaller and lighter than the Betamovie and operates right down to 15 lux light levels.

JVC has employed some new technology to achieve the size contraction and performance. It has an electronic viewfinder and an automatic 'quick review' facility that rewinds the final portion of the tape as soon as recording stops so you can quickly check results through the viewfinder. The battery pack just snaps on and off and a fast charger gets you back on the air in 30 minutes. It will be priced to compete with the Betamovie at around $2000.

National aren't showing a cam-corder, but they did have a series of three new, remarkably small and light, cameras and portable recorder systems, two featuring auto-focus. The WVP-200N is their top-line model. It features auto-focus, an electronic viewfinder, time data recording and titling in seven colours. It weighs in at around 2 kg.

The WVP-55N is also an auto-focus model. It has a 6x power zoom as against the '200N's 8x, but it's lighter at 1.7 kg (approx.). Both work down to 25 lux. The size though, is incredible. It measures just 147 mm wide by 252 mm high by 374 mm depth overall. It is easily cradled in one hand.

Not to be outdone, and competing directly against National, is Sharp with a new top-line camera that suits all VHS recorders — the model XC-78. It features auto-focus and a built-in title and date display. This lightweight unit is about the same size as the National cameras and is rated down to 10 lux light levels. It also has a 6:1 zoom lens. Priced at $1200, it's attracting not a little attention.

Japanese enter 8 mm video market

Surprise, surprise — Sanyo has entered the 8 mm video fray. No big fanfare, but the Sanyo stand had an 8 mm video system on display. Unlike Kodak and Polaroid, who went for the cam-corder format with their systems, Sanyo's is a separate camera and portable recorder. The VSC-800 camera looks rather like your conventional 35 mm photographic camera. It features auto-focus, electronic viewfinder and the obligatory built-in microphone. More, I cannot tell you. They kept it firmly 'under glass' and no literature was available at the time of going to press.

CD, CD everywhere

CD players were out in bulk, in every shape and size, but only two colours: black or silver! The trend is to horizontal-play. This seems to be mainly so they can be teamed with system components in a rack where the horizontal-play format seems more at home. Fewer transport problems are reportedly experienced with the horizontal-play format, too.

Everybody reports sales as 'very strong' and models are almost continuously on back order. Retailers are selling all they can get. The popularity of CD is assured.

Highlights

Stereo TV is receiving some attention, but would rank behind the videos and CD. Philips are giving it a heavy push, along with Sharp. But the models currently being offered are all at the top end of the market.

Technics stole a march on all the other audio labels with an innovative and exciting little slim-line 'wall-mount' hi-fi. It's a stereo cassette player and receiver, the SA-R100, about 50 mm thick by 600-700 mm wide and 300 or so mm high. It comes with a pair of wall-mount honeycomb disc speakers, model SB-R100, that appear to have twin-concentric drivers. They, too, are just 50 mm thick and about 300 mm or so square.

In the same line, Pioneer had a pair of wall-mount speakers, labelled the model S-5PC 'Decor'. They comprise a two-way speaker system in an 80 mm thick cabinet 300 mm tall by about 750 mm wide. About two-thirds of the front area can be used for decorative purpose. You can put a record cover behind a glass panel or pin pictures, photos etc to a cork panel.

CBS Colecovision had ranks of their Adam computer system on demonstration. Dubbed 'The Complete Computer', it features a reliable high-speed tape drive on the low-cost version, and disk drive and printer on the top model. Priced at $995, they're aiming at the 'serious' home and education market.

Commodore had their new 16-bit computer on display, but were being very coy about it.

Microbee were in the show for the first time. Applied Technology opened a factory here, just a few weeks before the show. They're making the 128K 'Bee here, mainly to meet the education market demand. Production capacity is 150 units a month.

Digital TV is here! Falk Electrosound, a local distributor, is showing ITT's 'Digivision' digital technology TV set. It is claimed to be more reliable and cheaper to make with hundreds fewer parts in it. Another development to be watched closely.

Sony are back into the 'top end' audio market with a new range of components. Dubbed the 'ES' series, the gear they showed comprised a new CD player, the CD501ES, an 80 W integrated amp, the TA-F444ES, and a 'direct comparator' FM/AM stereo tuner, the S555ES. The direct comparator title refers to the unit's frequency synthesiser which is claimed to provide such accurate tuning that they quote a signal-to-noise ratio in stereo of 86 dB.

If you're into the expensive hi-fi, then Vince Ross Audio has just the system for you — a $22 000 Stax system featuring Stax's new ELS-F83 electrostatic speakers and 100 W Class A mono amp teamed with their recently-released CA-X preamp. The preamp and power amps weigh in at $13 000, the speakers at $9000.

For the 'complete experience' with sight-&-sound, you just have to try Pioneer's 'body sonic' stereo chair. Linked to your stereo system or video (they had it teamed with their laser disc system), you can relax and get stereo sound through speakers mounted in the headrest and feel (and I mean really feel) the low frequency vibrations through the chair.

The 'body sonic' was a huge attraction on Pioneer's stand, totally eclipsing Marantz's 'stereo chair' on the stand opposite. This beast puts the hi-fi gear in the massive arm rests and the speakers either side of the head rest. Problem was, I think, Marantz had a static display. You couldn't try it out.

Convoy had a mini theatre setup to demo their Soundtracker. It's an audio processor for video machines that improves the signal-to-noise ratio and expands the sound. Last month I made mention of Carver's 'Cubelet' amplifier. They had a mockup unit on display and it attracted quite a bit of interest.

It delivers 180 watts per channel and sits easily in the palm of your hand. How he shrunk such a beast into a package that small he's not telling. The bad news is, he's not producing any. Only three exist at present and he's talking about licensing the technology to the Japanese, or the highest bidder. We'll have to follow what happens with this one.

▲ Sony's CD player. The Sony CDP-501ES matches Sony ES series components.

◀ Stax electrostatic speakers. Stax's ELS-F83 single element full range electrostatic loudspeaker system.

Carver's Cubelet. We probably won't see this ▶ 180 W/ch amp in this form.

The question

As I foreshadowed last month, the industry is asking the marketplace, "where now?" Video hi-fi might end up a reject along with the integrated home entertainment centre if it's too early for the marketplace to accept that as a concept. There's lots of room for development in video home movie, and lots of room for confusion with the addition of 8 mm video.

Compact disc looks an assured success and it seems the consumer isn't waiting for the prices to drop. They're buying well at all price levels by all reports. What's more, CD has given the rest of the audio field a real shot in the arm.

On the computer front, toys are out and serious machines are in. People now want machines that will do something for them. It won't be long before we see home/personal computers packaged with printers and a choice of green-screen or colour monitor along with mass storage (disk, bubble, RAM-disk etc) and useful software packs.

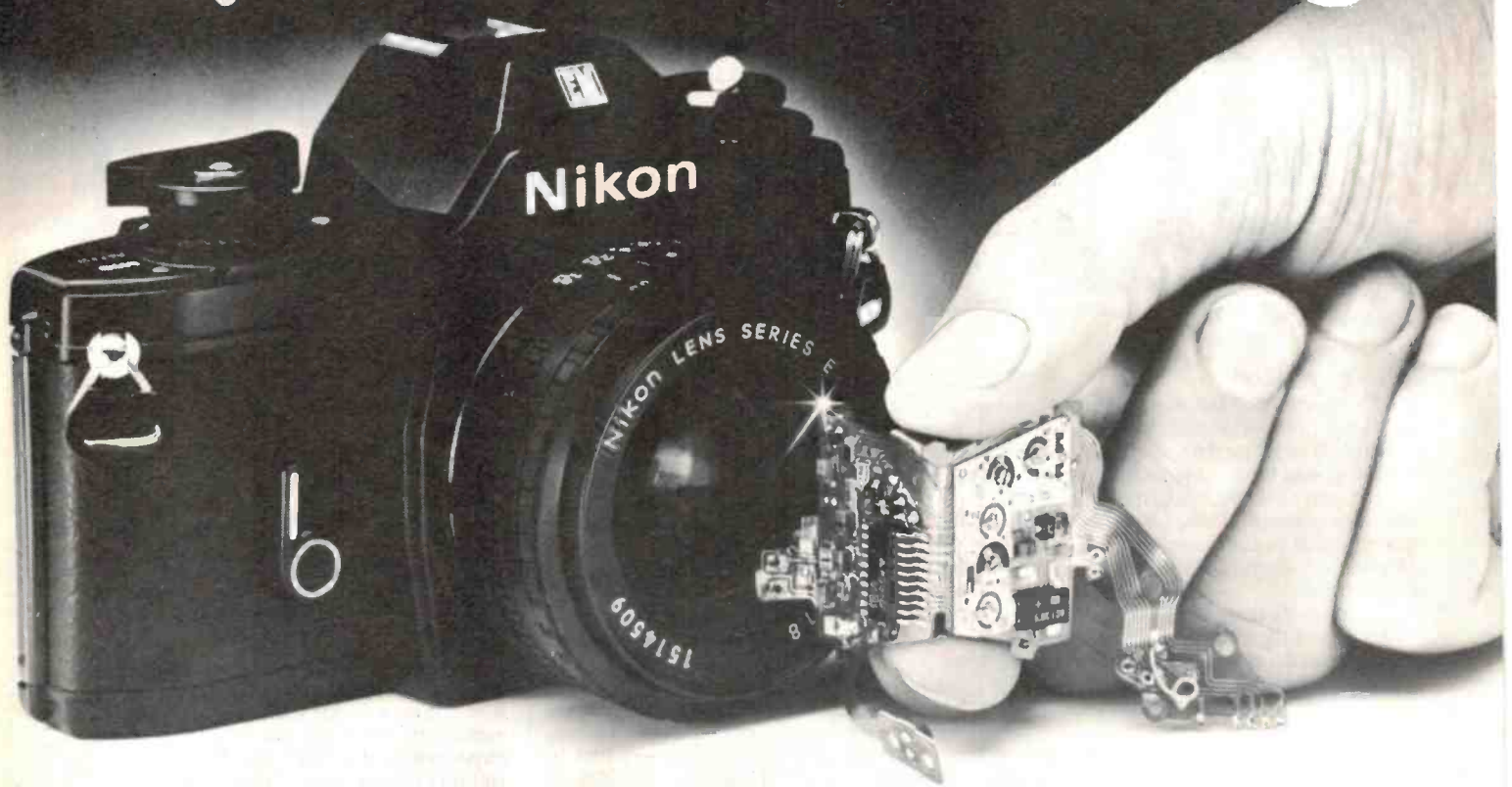
Mountains & Mahomets

The Perth Electronics Show is run by an industry committee, elected each year with members comprised of representatives of the companies involved in the field. As a show to promote the industry and the product to the consumer it has been wildly successful, much more so than shows that have been put on in the eastern states. Problem is, West Australia has only 8% or so of Australia's population and buys around 10% of the product. What about the other 92% of the population?

The show committee has been toying with the idea of chartering a plane next year to bring dealers to the show, according to committee chairman, Leo Overington, from Pioneer. This would give them the opportunity to see so many of the new products on display and to make judgements about how they will sell, and therefore what they should order for the next quarter.

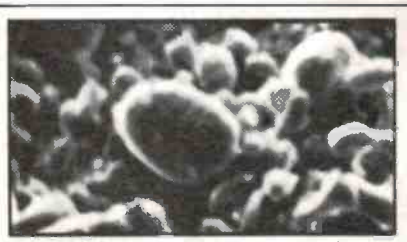
There has been some lobbying with the committee from senior company executives for the show to now take on more of a national trade identity, principally because there is so much new product here that won't be seen on the market in Australia for months to come. It's an admission of the important of this show. "If you ain't here, you don't know what's happening," as one executive put it. It stands to reason. ●

Picture the ultimate in precision soldering.

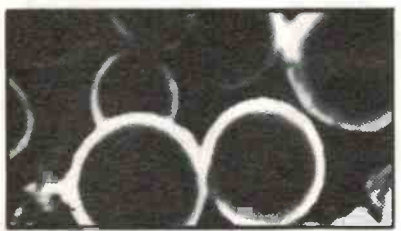


When a solder medium for the microprocessor-based circuitry of the new Nikon EM camera was needed, a Multicore Oxide-Free Solder Cream was chosen.

Multicore, the world's leading authority on solder and soldering, has developed its own unique method of producing solder powders so that they are practically oxide-free. This means that the resultant solder cream will melt and flow as cleanly and as quickly as rosin-cored solder wire. Merely a faint residue of flux is left and any risk of solder globules being formed is minimised or even eliminated altogether.



A typical ordinary cream revealing poor particle shape and dross.



Multicore Oxide-Free Solder Cream displaying clean, uniform globules.

Where the Multicore Oxide-Free Solder Cream differs is in the physical characteristics of its particles. Ordinary creams contain atomised solder powder, with each particle covered with a layer of oxide. This has to be removed by the flux after heating but non-corrosive, rosin-based fluxes cannot do this effectively given the nature of the solder technique used. The particles in Multicore Oxide-Free Solder Cream, as the electron-microscope enlargement shown illustrates, are much cleaner and more uniform. The result: cleaner, quicker soldering.

Available in a wide range of alloys and flux combinations, with particle size, flux content and viscosity equally variable, there can be a Multicore Oxide-Free Solder Cream tailor-made to suit your requirements.

If, like Nikon, you need a solder medium that can be applied with a high degree of accuracy, either by syringe or silk screening, will give you a thoroughly reliable joint, and will fully comply with health and safety regulations*, you need to talk to Multicore about Oxide-Free Solder Creams.

To find out more, contact us direct.

*Multicore Rosin-based Solder Creams are safe to use provided certain precautions are observed. Details of these are available on request. Multicore Solders Ltd. is a Registered Supplier of Solder Creams on the U.K. Defence Contractors List and are type approved by the Ministry of Defence to DTD.599A. Multicore Rosin-based Solder Creams are approved on the Qualified Products List QQ-S-571E of the US Defense Supply Agency.

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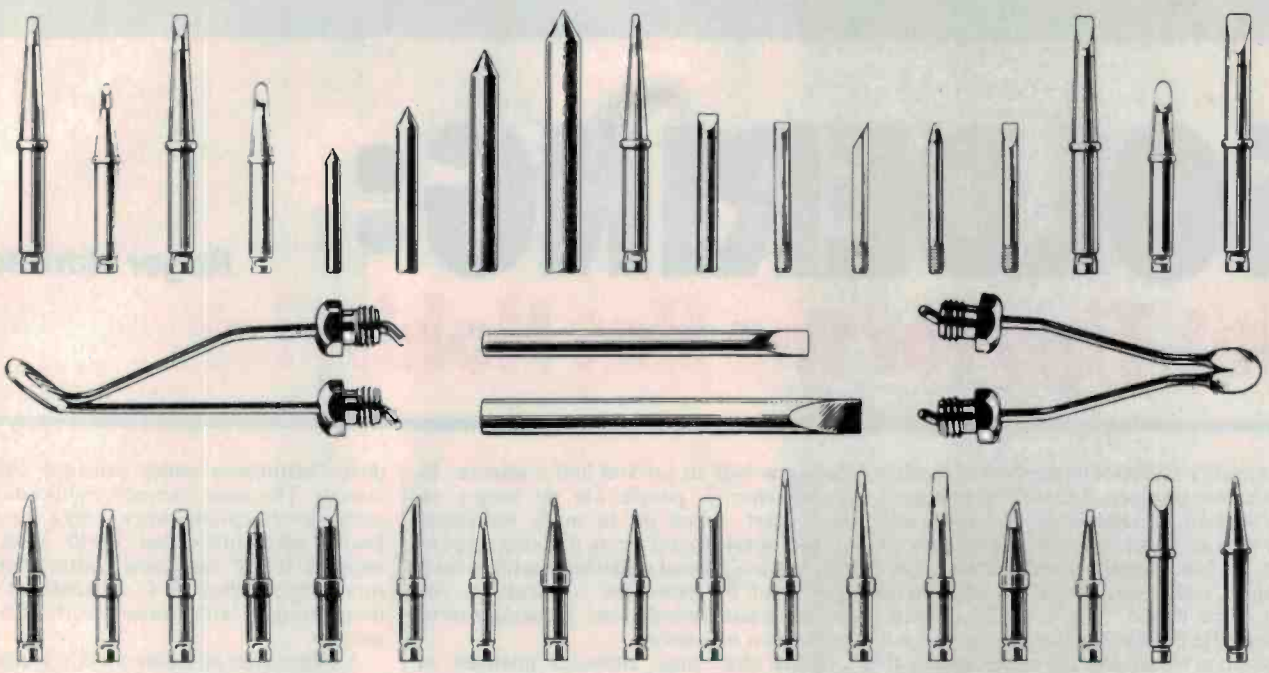
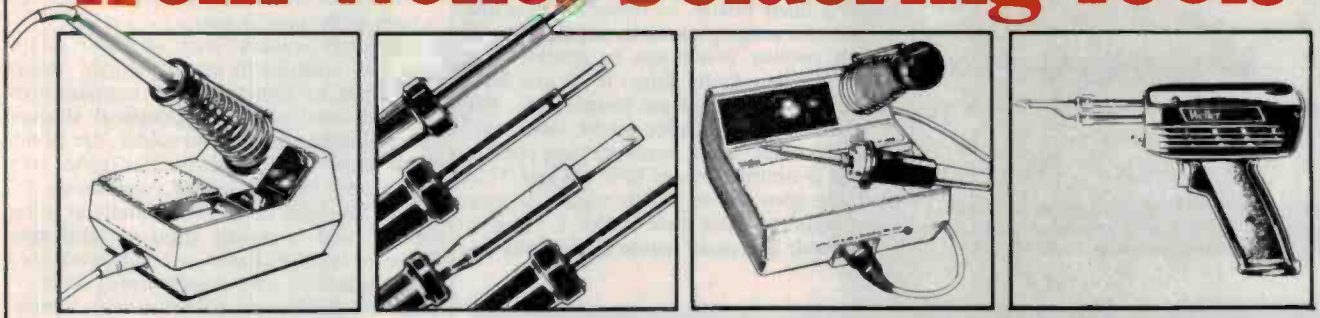


A few tips for getting the best from Weller Soldering Tools



Weller soldering irons have built a reputation for soldering connections you can trust. From the 8100D 100 Watt Soldering Gun through the high performance Marksman range of soldering irons to the sophisticated temperature controlled soldering and desoldering stations.
For the hobbyist and electronic enthusiast the Weller Marksman range from the SP15D 15 Watt through the SP25D 25 Watt, SP40D 40 Watt and SP80D 80 Watt are ideal.

But to guarantee the best results it is essential to use genuine Weller soldering tips. Nickel and iron plated, they prevent the formation of copper oxide and eliminate the tip seizure problems of conventional tips.

For the complimentary copy of the Weller Soldering Guide post the voucher opposite.

The Cooper Tool Group Limited
P.O. Box 366, Albury NSW 2640, Australia.

CooperTools

Weller Soldering Guide

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SOLDERING:

Hot Tips for the Hot Hobbyist

Roger Harrison

THE MOST COMMON method of making connections between electronic components is by soldering. Solder is an alloy of tin and lead that melts at relatively low temperatures. Its function is to make an electromechanical connection between the metal parts to be joined. Solder is fairly ductile, having little mechanical strength, so it is not relied upon to support the components, although one of its functions is to prevent movement of the parts joined. The solder fills the irregular surfaces of a joint, mechanically and electrically bonding them at the same time via an intermetallic bond (see Figure 1).

Seems pretty simple, doesn't it? Well, soldering is half an art and half a science. In manufacturing, people are no longer, in large part, relied on to make individual joints (apart from it being a boring, repetitive task) — special soldering machines do it now. But for prototype construction, for servicing and for hobbyists, knowing how to solder is a necessity.

There are three elements involved in making a joint: the solder, the soldering iron and the parts to be joined. Let's look at them in turn.

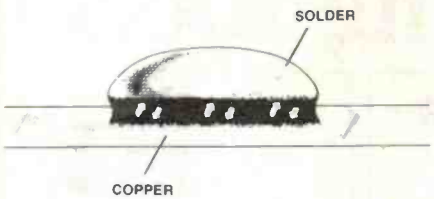


Figure 1. Solder forms an intermetallic bond with the surface of the conductor to which it is applied. (Courtesy Pace training manual, via Coltronics).

Solder

Solder is a very special alloy composed of tin and lead in certain proportions. Tin melts at 327° C and is 'plastic' down to 283° C. Lead melts are 232° C and plastic is down to 183° C. The plastic state of either metal is fairly brittle, so either alone is unsuitable for making a joint as any movement during cooling (even due to contraction) will result in a faulty joint. If tin and lead are mixed in appropriate proportions, the alloy has a much smaller plastic state temperature range and a lower melting point.

With a composition of 63% tin and 37% lead, the alloy has *no* plastic region. It goes from liquid to solid then at 183° C. This is undesirable as a small region of plasticity reduces brittleness under practical circumstances. The most common composition of solder for electronics work is 60% tin, 40% lead — often just called "60/40" solder. It melts at 188° C and has a plastic temperature range of about 5° C. It combines optimum strength with lowest electrical resistance.

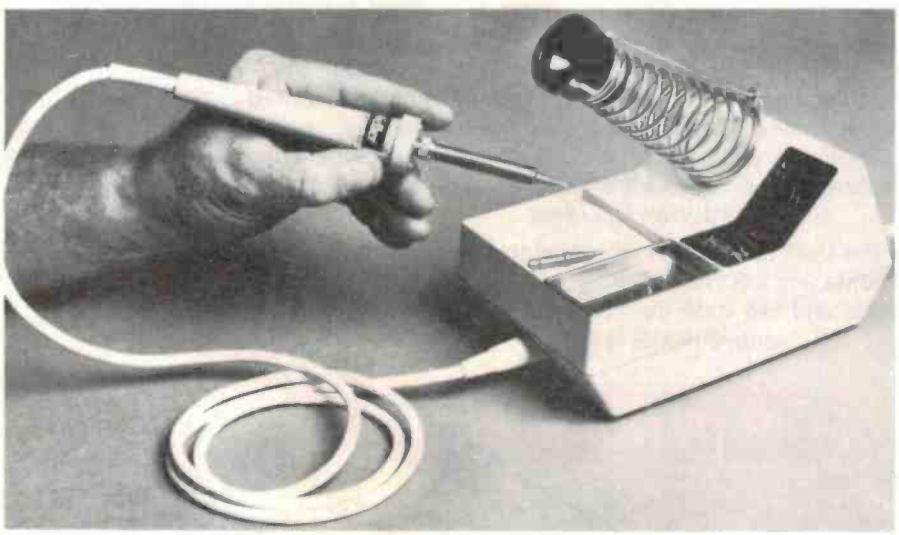
Another type of solder used in electronic work includes about 1.5% copper and is known under the trade name of 'Savbit'. Soldering irons with copper tips corrode rapidly when used with straight 60/40 solder as some of the copper is absorbed into the molten solder. Savbit solder prevents this and can extend the life of copper bit soldering irons by up to 10 times. Some soldering tools have iron-plated tips to reduce this sort of wear and the use of Savbit is not necessary with these irons.

Ordinary solders, such as 60/40 solder, are also referred to as 'soft solder'. Joints that have to withstand high temperatures, or that need greater mechanical strength than obtained with 60/40 solder, are joined with 'hard' solders that melt at higher temperatures. 'Silver' solder, containing 5% tin/93.5% lead/1.5% silver, melts at about 300° C and is mostly used in fabricating brass or copper chassis, etc. Silver solder is usually melted with a gas-burning torch.

Low-temperature solder is also obtainable and is used where components may be damaged or where it is necessary to solder onto a joint that is already soldered without melting the existing joint. This has most applications in special servicing jobs. It consists of 50% tin/33% lead/17% cadmium and melts at 145° C. It requires care in soldering as it tends to fracture the instant it solidifies.

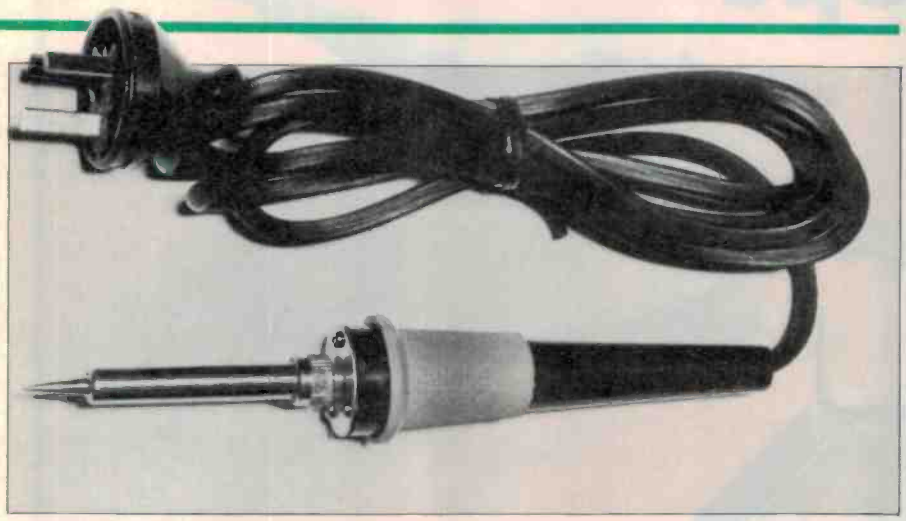
All metals oxidise, or tarnish, on the surface as a result of being exposed to air. This prevents the solder from flowing over the metal surface, resulting in a poor joint; 'flux' is used to remove tarnish. For electronic work this is composed of resin (sometimes spelt rosin), which is obtained from the sap of pine trees plus additives called 'activators'. At soldering temperatures, the activators decompose, liberating an acid that dissolves the tarnish faster than pure resin.

Other fluxes are also made for non-electronic uses, usually sheet-metal work, copper and brassware manufacture. These fluxes are usually highly corrosive (such as



A temperature-controlled iron. This British-made Weller iron, distributed here by the Cooper Tools group, features low-voltage operation and replaceable iron-plated bits that are obtainable for different operating temperatures.

"A good joint is hard to find . . .", someone once said, and we know exactly what they meant. Good soldered joints are of paramount importance in electronics. It's not a matter of 'you make a joint, or you don't'. There are lots of 'not quite' joints — and boy, can they cause trouble! This article's all about the tools and techniques required for making good joints.



Continuous heat iron. This low-cost iron from Altronics, the Micron T2420, features a warm-up time of only a few minutes and fixed temperature operation. The bit is iron-plated and easily replaceable. The ferrule at the end of the handle keeps your fingers cool.

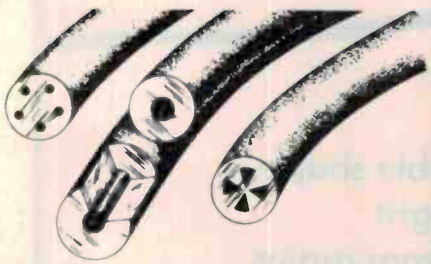


Figure 2. Resin-cored solder comes in a variety of configurations. The solder-resin ratio is varied by varying the configuration of the resin core. (Courtesy Pace training manual, via Coltronics).

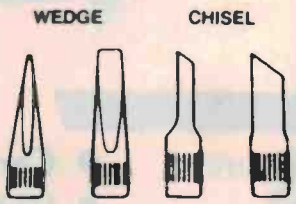


Figure 3. Bits can be obtained in a variety of shapes to suit the job, such as conical, wedge, bevel, chisel, etc. The most common bit shapes are the wedge (or chisel) and the bevel. They can be different diameters and lengths, giving different heat capacities.

hydrochloric acid) and must *never* be used for electronics work as even minute amounts rapidly corrode component leads and printed circuit board tracks.

Solder for electronics work is made as different gauge wires. Most have a resin core along their length, some have up to five separate cores (see Figure 2).

The resin core melts before the solder and flows onto the joint, wetting both the joint and the solder, excluding the air. At the same time the activators dissolve the tarnish on the surface, allowing the solder to flow freely and properly wet the joint. When the solder melts, the increase in temperature deactivates the flux, limiting the possibility of corrosion. It is important to thoroughly heat activated resin during soldering to ensure the complete decomposition of the activators, otherwise they remain corrosive at normal temperatures.

A relatively new flux for flux-cored solders has recently become available, called 'Xersin' (pronounced zersin). This is a chemically compounded flux containing no resin. Developed by Multicore Solders Ltd, it has characteristics very similar to resin at room temperature, melts at 90° C and produces a lot fewer fumes than ordinary resin fluxes when heated to soldering temperatures.

The fumes of resin fluxes can cause bronchial irritation and, occasionally allergic sensitivity in some people, if they work in a situation where the fumes do not readily escape. Xersin is claimed to overcome these problems.

Resin-cored solder is obtainable in a variety of wire gauges. For general and heavy work, such as on sockets, chassis, switch contacts, etc, 16 gauge is suitable. For fine work on printed circuit boards, miniature components, etc, 20 or 22 gauge is best. It pays to have several different gauges handy. Experience will show which is the best under different circumstances.

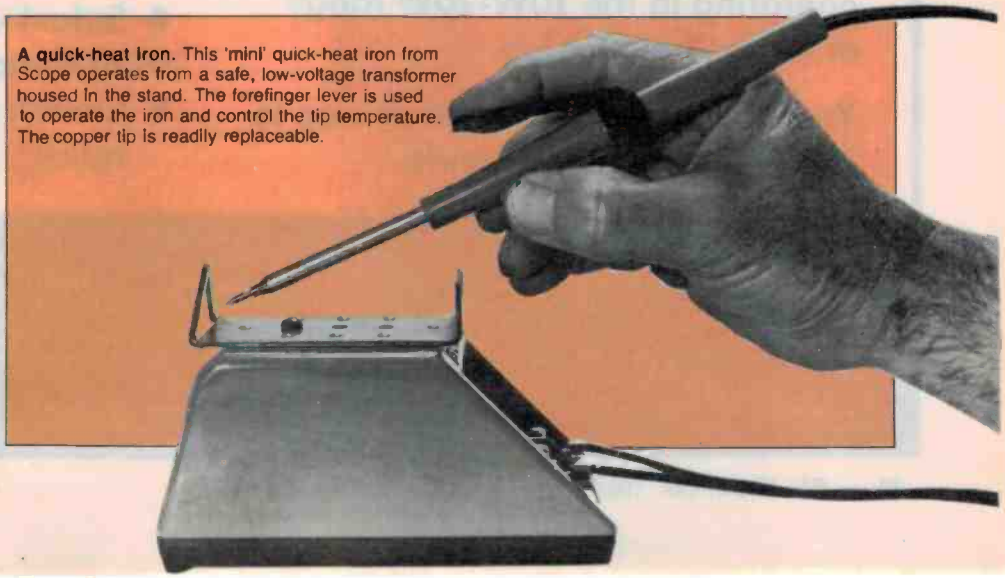
Soldering irons

As I covered soldering irons in Part 1, I won't go over the ground again. However, you will find illustrations of various types through this article. I should emphasise that you should spend as much as you can reasonably afford on a soldiering iron as it will probably be your most-used tool. If you find it hard to make a decision, then start out with a lower priced iron of good quality. You can purchase a more sophisticated iron later when you will know your own needs better.

Soldering bits

The soldering iron bit conducts heat from the iron's element to the joint. Typical bits are shown in Figure 3.

The tip temperature and the amount of heat it stores are important factors in obtaining a good soldered joint. The tip temperature will drop when making a joint due to heat being conducted away by the ▶



A quick-heat iron. This 'mini' quick-heat iron from Scope operates from a safe, low-voltage transformer housed in the stand. The forefinger lever is used to operate the iron and control the tip temperature. The copper tip is readily replaceable.

THE PENCIL IRON WITH REAL POWER – MiniScope

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All the advantages of a miniature soldering station – without the power restrictions.

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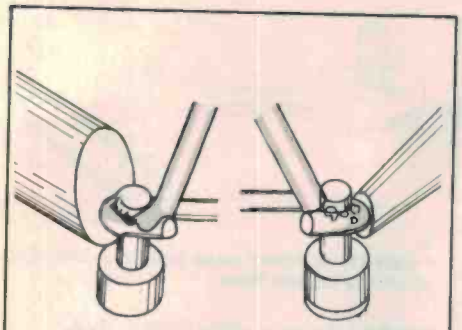


Figure 4. The bit should be large enough for the job, otherwise too much heat is conducted away from it by the joint and the solder will not flow properly. The bit on the left is OK, that on the right is too small.

Figure 5. Plated bits last longer because they do not oxidise as rapidly as unplated bits. They are usually iron-plated.

parts of the joint. Just how much the temperature drops and how fast depends on the capacity of the bit to store heat and the mass of the parts being joined. The larger the bit, the more heat it will store and transfer to a joint, and the less will be the temperature drop. Temperature-controlled irons minimise these problems to a large extent.

For an adequately rated iron, the correct bit for the job will remain above soldering temperature (without burning the joint) and cause the solder to flow properly. If the tip is too small, too much heat will be conducted away, and the solder, while it may melt a little initially, will not melt and flow properly. This is illustrated in Figure 4.

Bits are usually made of copper, copper alloy or iron-plated copper (Figure 5). Unplated bits transfer heat more effectively but oxidise rapidly, reducing their efficiency. Their life is much shorter than plated bits and they require more frequent maintenance.

The area of the tip face determines the rate of heat transferred to to the joint. A small area will have a higher temperature but less heat reserve (or capacity) than a large tip. Generally, the more heat the work is likely to absorb, the larger the tip area should be. However, the area should not be so large that it obscures the work or damages adjacent parts.

The distance the bit protrudes from the barrel of the iron is also important. The shorter this distance, the higher the tip temperature. usually, it is best to select a bit length as short as practicable to reduce the heat path from the element to the tip, and to minimise wobble and bending of the bit. It should not be so short that the barrel touches or radiates onto nearby components or that the tip temperature becomes too high.

One way of reducing the temperature of a small-diameter bit is to increase the length beyond that used for the larger-sized bit — or vice versa. Bent bits can be used in awkward places where a straight bit cannot reach.

Maintenance

For maximum efficiency and consistently good joints, the soldering iron and bit require frequent but simple maintenance. Heating produces oxidation of the barrel and bit, the oxide forming a scale on the parts. This reduces heat transfer as the scale is an insulator. Continuous heat irons are particularly affected. Excessive scaling is produced by high operating temperatures and by prolonged use without descaling.

To remove scale, remove the bit and tap both the barrel and bit firmly on the bench top. This should be done regularly. Only remove a plated bit from the barrel of an iron when it is quite cold.

For efficient transfer of heat from the bit to the work, the face of the bit should be smooth and coated with a shiny layer of resin-free solder. A bit in this condition is said to be 'tinned'. A clean, new bit is tinned by heating it to soldering temperature (test it by lightly touching solder on the face of the bit) and applying a small amount of solder to the face and letting it flow freely to cover the face. Any excess should be removed by wiping it on a lightly damped sponge or cloth.

With use, the face of the bit becomes pitted and the solder layer takes on a dull grey appearance. During soldering, some of the copper from the face is absorbed into the solder and with repeated use the surface beqomes uneven. There is less absorption with plated tips (See Figure 6).

'Pitting' can be removed by filing. Only file off as much as necessary to produce a smooth face again. Excessive filing reduces the heat capacity and increases the bit temperature. Remove any scaling as well. When a clean tip is obtained, re-tin the face. *Never* file plated tips.

Do not pull the tip further out from the barrel to compensate for reduced length as this overheats that section of the heating element not in contact with the bit, producing excessive scaling and eventually causing the element to fail.

Small surface irregularities on plated tips should be repared with fine emery cloth when the tip is cold. Take care not to remove the plating. After cleaning, heat the bit and re-tin the face. Relatively large pitting on a plated bit means that some plating has come off. Attempts to remedy the situation usually result in more plating being removed. In such cases, replace the bit.

During normal soldering with a plated bit, the molten solder on the face should be replenished regularly while the tip is hot. The face can be cleaned by wiping it on a damp, fine-textured sponge (these are usually supplied with controlled temperature irons). Do not overdo it or you will remove all the molten solder. Wait a few seconds after wiping the bit to allow it to recover heat and then lightly re-tin the face. Plated bits should have a small amount of excess solder on teh face while not being used.

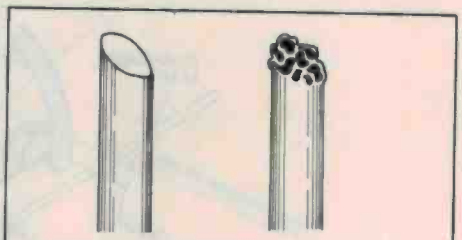


Figure 6. The tip should be in good condition, as at left, for good soldering, not worn, pitted or oxidised, as at right.

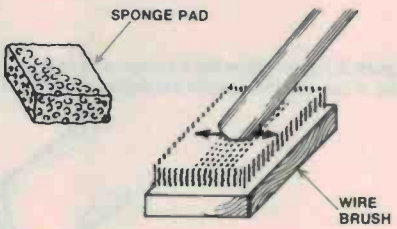


Figure 7. The tip should be cleaned regularly during use. A moist sponge pad (left) is good for frequent wiping, while for unplated tips an occasional scrub on a wire brush keeps the tip in good condition.

With either plated or unplated bits, regular cleaning during the use is a good practice, making soldering easier and ensuring good joints. A damp sponge pad is good for either type of bit. A fine textured wire brush may also be useful with copper bits. (See Figure 7)

Soon after learning soldering, most people will use one of two methods to remove excess solder from the bit: viz: *flicking* or *wiping*. Wiping is the recommended method. Flicking causes blobs of molten solder to splatter on to all sorts of awkward places. If you're a flicker, don't wear shorts!

Apart from ruining the carpet and prompting sudden leaps into the air, molten blobs of solder have a nasty habit of getting into equipment and causing short circuits — which may be disastrous. For habitual flickers, either cure yourself of the habit or screw a low, open-topped container to the bench top and aim in there from close quarters. It is even possible to recycle the solder thus collected — but not in your project.

Basic soldering

Before use, the soldering iron should be turned on for long enough to allow the bit to reach soldering temperature. Irons vary quite a bit in this; some take quite a few minutes to warm up, whereas others are much quicker. The parts to be joined should be bright and clean; if not they ▶

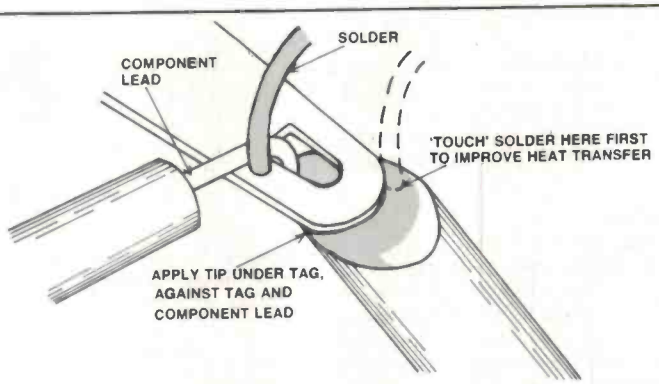


Figure 8. When soldering a component to a tag, apply the iron to the tag and the lead to heat them up. After a few seconds, touch the solder on the iron briefly and then apply the solder to the joint.

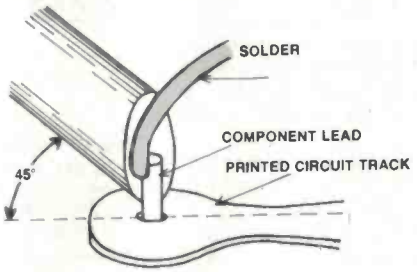


Figure 9. When soldering a component lead to a printed circuit board, apply the iron to the lead with the tip touching the copper track as well.

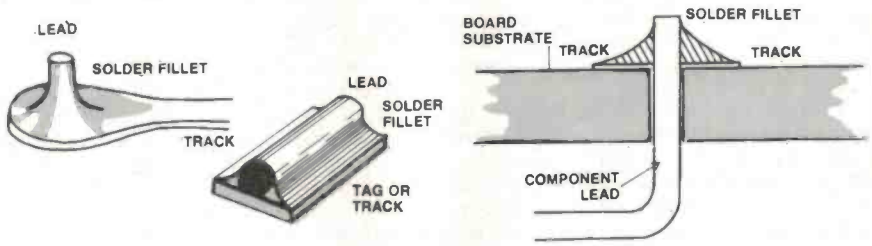


Figure 10. A good joint will be covered by a small fillet of solder which meets the parts of the joint at a tangent. The solder should be smooth and bright.

should first be tinned.

When the parts to be joined are prepared, and with the iron at the correct temperature, apply the face of the bit to that part of the joint having the greatest mass (providing it isn't the most heat sensitive). Allow the joint to heat for a few seconds to raise it to soldering temperature, and then apply a little solder. If the parts are clean, the solder will flow freely as it melts, wetting the joint properly and making a smooth, shiny joint. Remember that the solder must be applied to the joint and *not* to the iron.

Figure 8 shows how to solder a component lead to a tag. Apply the iron to the tag as the tag has the greatest mass. To improve heat transfer and reduce soldering time, first touch the solder to the iron at the junction of the bit and the tag. Just a touch is sufficient. The flux removes any tarnish from the tag and the hot solder tarnish that forms on the face of the bit, allowing rapid heating of a small area. The molten solder improves the thermal contact by wetting both surfaces and filling the minute air spaces between them. Next apply the solder to the tag. The solder will only melt if the tag is at the correct temperature, thus ensuring proper wetting.

Soldering components to a printed circuit board is shown in Figure 9. Always take care not to overheat printed circuit boards as the copper track may lift, damaging the board and making subsequent connections difficult.

Always hold the iron on the joint for a second longer after sufficient solder has been applied. This ensures that all the solder is melted and that the flux has been de-activated. Allow the solder to cool naturally. Don't blow on it to cool it. Don't move the joint while the solder is solidifying — a poor joint may result.

Take care not to apply too much solder as it may conceal a poor joint. On printed circuit boards, too much solder may cause 'solder bridges' to form between tracks.

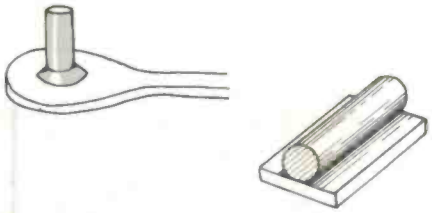
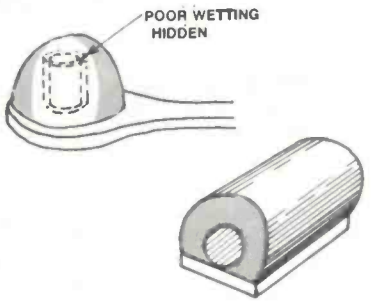
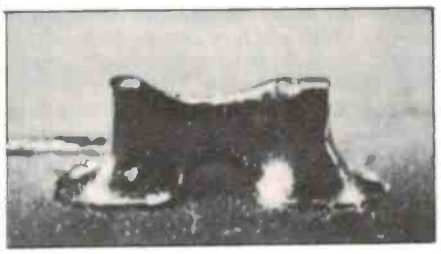


Figure 11. Insufficient solder leads to a weak joint which may become faulty.

Figure 12. Too much solder can hide poorly wetted surfaces (top left), which results in a poor joint. On pc boards with close conductor spacing too much solder leads to 'bridging' (bottom).





A good joint is . . .

How much is the right amount of solder, and what does a good joint look like?

The size of the solder 'fillet' should be large enough to fill the area of the joint and the contours of the parts should be plainly visible. The surface of the solder should be smooth and bright and meet the parts of the joints at a tangent. This 'feathering' indicates good wetting. The characteristics of a good joint are shown in Figure 10.

There must be sufficient solder filling the spaces of the joint to ensure a good mechanical bond. Insufficient solder results in a mechanically weak joint. The joint is likely to go open circuit or intermittent under slight mechanical stress (such as due to vibration or expenasion and contraction with temperature changes). Joints having insufficient solder are shown in Figure 11.

Too much solder can hide poorly wetted joints. In such cases the solder meets the surfaces abruptly. Too much solder can also 'bridge' adjacent pc board tracks or component leads. (See Figure 12) ●

. . . to be continued.

Sony releases two car CD players

Sony CDX-5. DIN-sized car compact disc player.

Sony CDX-R7. DIN-sized FM/AM car compact disc player.

Sony announced its development of one-piece, DIN-sized car compact disc players at the Consumer Electronics show in Chicago. The two models demonstrated were the CDX-5 compact disc player and the CDX-R7 AM/FM compact disc player.

Sony, the co-inventor of the compact disc format and manufacturer of the world's first CD player, claim to be the first company to produce an easy-to-use compact disc player designed to be used in the car.

Sony say their CDX-5 and CDX-R7 feature major technological advances that make them small enough for car installation and rugged enough to perform reliably despite the shocks, shakes and temperature extremes of the car's environment. The players' laser optic assembly is only one-third the size of previous designs for Sony home players.

Sony semiconductor engineers have produced a new very large scale integrated (VLSI) circuit that resulted in a dramatic reduction in the size and weight of CD players. The VLSI (Sony's CX-23035) performs such varied functions as spindle motor speed control, frame sync detection, and the complex tasks of error detection, error correction, and data interpolation.

The compact disc is destined to become the higher-quality music source available for the car. It is claimed that Sony car compact disc players deliver the full measure of performance available from the CD format. For example, dynamic range, the key factor in CD's lifelike sound, is an impressive 90 dB. Total harmonic distortion is a low 0.007%. These figures are comparable to those of home CD players, as are the other audio specifications of the CDX-5 and CDX-R7.

The CDX-5 is designed to be easy to operate when a disc is inserted. It is automatically drawn into position for play. Most controls are feather-touch, and frequently-used buttons are larger to make them more convenient to use. A fluorescent display shows either track number or elapsed time.

A large 'automatic music sensor' button allows the user to skip directly from song to song in either direction. When the 'music scan' button is pressed the disc is played in forward or reverse at ten times normal speed. Samples of music are heard at normal pitch, but at reduced volume. There are two separate modes for uninterrupted music — one for any individual track and the other for the entire disc!

The CDX-5 has preamplifier outputs for connection to a power amplifier. Preamplifier volume, bass and treble controls are logically grouped on the left-hand side of the panel.

The CDX-R7 incorporates both a compact disc player and a quartz frequency synthesiser AM/FM tuner. The CDX-R7 has most of the track-access features of the CDX-5, including automatic loading, automatic music sensor, and forward and reverse music scan.

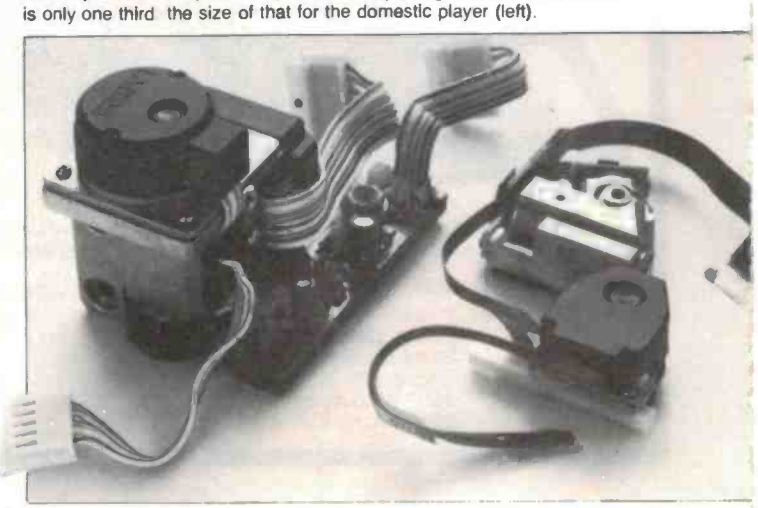
The fluorescent display can be switched to show track number or time of day. In the tuner mode the display shows station frequency. An automatic repeat function replays the entire disc automatically, much like the repeat function of an auto-reverse cassette deck.

Tuning functions include 18 station presents (12 for FM, six for AM), automatic scan tuning, manual tuning, FM stereo/mono switching and FM local/distant switching.

Both new Sony models conform to the new DIN standard for in-dash car stereo units. The chassis mounts easily into most cars. They have dimensions of 178 mm (width) x 50 mm (height) x 155 mm (depth) with a detachable dc converter (120 x 43 x 25 mm). They weigh 1.6 kg.

The CDX-5 CD player and the CDX-R7 AM/FM CD player will be available worldwide by the end of this year. A suggested retail price has not been announced.

A comparison. Sony's laser optic assembly designed for the car (right) is only one third the size of that for the domestic player (left).



The DA-L70: A new multicassette autochanger from Mitsubishi.

Cassette stack

The DA-L70 AM/FM stereo cassette autochanger, the matching LT-70 linear-tracking fully automatic turntable unit and the SS-L70 speaker systems together form the L-70 system, the latest and most innovative member of Mitsubishi's high-fidelity audio systems lineup.

The L-70 system is the first complete audio system to be built around a cassette autochanger.

The cassette door contains a magazine into which seven cassettes can be loaded for sequential replay. The L-70 can play both sides of all seven tapes.

For more information contact **Mitsubishi** or your local record stores.

Need your disks pressed?

Teac, the importers of Denon compact discs, PCM records and Denon audio tape, has announced a unique service for the Australian music industry: custom pressing of compact discs.

The service would be provided by the Denon factory in Japan, one of the most modern and well equipped plants in use today.

For any enquiries contact **Tony Greene at Teac Australia, 115 Whiteman St, South Melbourne Vic. (03)699-6000.**

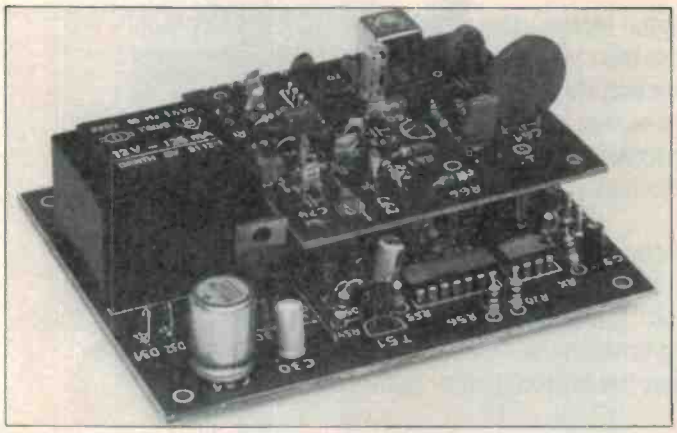
Stereo decoder

Mask-tronix has released an all new stereo decoder for Australian standard stereo TV.

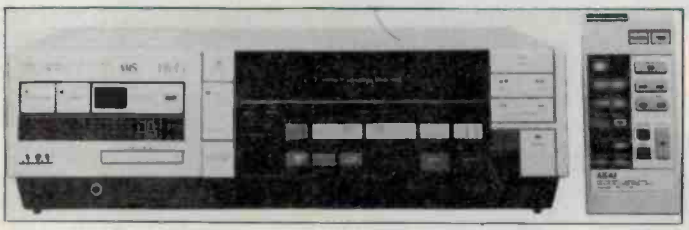
Some Australian television stations are transmitting programmes with hi-fi stereo sound but the vast majority of television receivers in use today cannot take advantage of this brilliant enhancement to colour TV viewing.

Installation of this low cost stereo decoder to a standard mono colour TV receiver will ensure reception of stereo sound through a standard hi-fi stereo system.

For more information contact **Mask-tronix, P.O. Box 248, Collingwood Vic 3066. (03)481-1654.**



Stereo decoder. module from Mask-tronix.



Hi-fi VCR

AKAI has announced the release of their VHS hi-fi VCR, the VS-15EA.

Up to now, tape speed has been the determining factor in improving sound quality. Due to the inherently slow speed of the video tape (roughtly half that of an audio cassette deck in the standard play mode and about one quarter in the long play mode), there was no feasible way of achieving satisfactory sound quality with the conventional system.

The VHS hi-fi system takes an entirely new approach by replacing the conventional fixed audio head with two audio heads placed along with the video heads on the rotating head cylinder.

A frequency modulated (FM) audio signal is recorded on the tape in the same way the video signal is. The video signal is recorded diagonally on the video tape, with a tape speed of 23 mm per second. Each of these tracks is about 97 mm long, but in the space of one second 50 tracks pass by the heads, not just the two linear audio tracks available. These 50 tracks together give an effective tape speed of 4.8 metres per second.

The result is a dynamic range of over 80 dB, frequency response of 20-20 000 Hz and wow and flutter of less than 0.005%, according to Akai.

At the heart of the VS-15 is a built-in multiplex stereo TV tuner which enables programs to be recorded off-air in stereo.

The VS-15 has four video heads and two special audio recording heads. By using this six-head system it's possible to achieve high fidelity sound by eliminating cross itnerference between the audio and video signals, say Akai.

The VS-15 has a 4-week 9-program timer that allows you to program up to a month's viewing in advance.

Other features are motorized front loading, simulcast recording facility, noiseless still frame, sleep timer, quick finder circuit, and an exterior design that is compatible with Akai's full size audio components to enable you to integrate your home hi-fi with a VS-15 hi-fi video.

For more information contact **Akai, PO Box 309, North Ryde NSW 2113. (03)887-2311.**

Hear digital perfection.

Introducing the Sony Compact Disc Player.

When we used our long experience in digital technology to create the CDP-101 Compact Disc Player, we wanted to give you something more than the world's clearest sound.

WIRELESS REMOTE CONTROL Full-function remote control.

3-WAY MUSIC SEARCH ☐ Instant direct access to any selection with the 10-key pad on remote control unit. ☐ AMS (Automatic Music Sensor) allows access to the beginning of next or previous selection. ☐ 2-speed bi-directional search to find any desired music passage.

REPEAT FUNCTION Program to repeat the entire disc, one selection, or a specific portion of music.

3-FUNCTION DIGITAL READOUT DISPLAY ☐ Selection number. ☐ Time lapse of selection being displayed. ☐ Remaining time on the disc.

LINEAR SKATE DISC LOADING Just press the button, platter control and cueing are automatic.

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THE SHRINKING VIDEO CAMERA RECORDER

Dennis Lingane

The undoubted success of the Betamovie portable video camera/recorder has set the scene for a big push by the VHS format manufacturers to attack the video 'home movie' market. JVC are right at the forefront of the VHS camp. Dennis Lingane has had the opportunity to try out their new GX7 recorder-camera — here's his impressions.

THE TWO COMPANIES making the running in the video home movie scene are undoubtedly JVC and Sony. The rest seem happy to confine their efforts to multi-purpose recorders for 'home-and-away' which are really too heavy for the travelling video enthusiast.

Sony has had huge success in the US with its Betamovie, and so it's no surprise to see JVC launch a combination recorder-camera using the VHS compact format (VHS-C) tapes. It is the unit that made headlines at the Japanese electronics shows last October and is only now being introduced into world markets.

But while this combination recorder-camera, which takes a small 30 minute cassette, may be an answer to the Betamovie, JVC's real efforts are going in another direction. They are developing some of the smallest and most versatile cameras on the market.

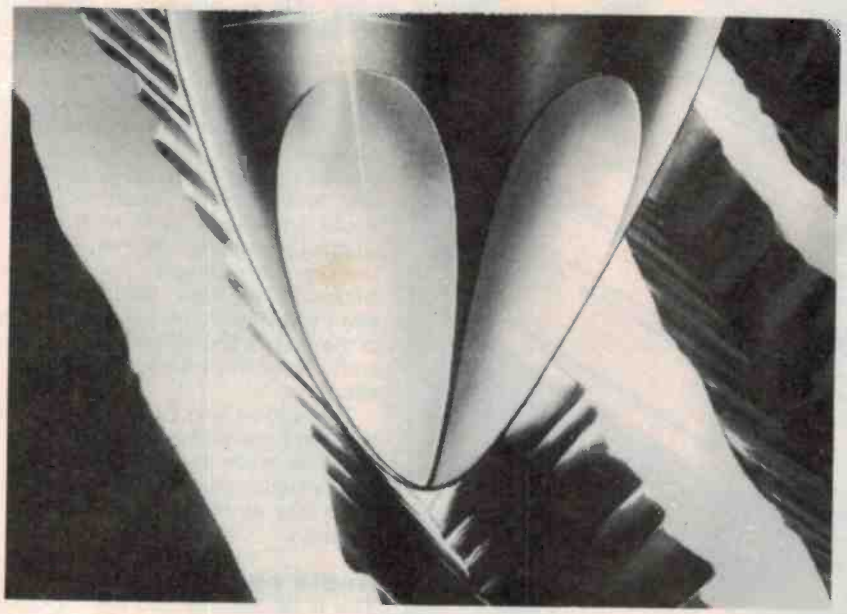
Unveiled

The latest is the GX7 which was unveiled at the Chicago summer Consumer Electronics Show in June, but which, according to past performances, we won't see in Australia for over a year. It is even smaller than the current GZ-5. It is *unique* in that you can use standard lenses made for 35 mm cameras. This makes it an extremely versatile video camera for the photography enthusiast. It also has a new through-the-lens focusing system using infrared ranging technology similar to the new Canon camera VC-20 focusing system.

This JVC camera also has a low light rating of 10 lux, and an add-on character generator. To use standard lenses off a 35 mm camera you simply remove the lens and focusing housing from the camera. This is done by taking out three small screws. When the housing is removed you attach a convertor ring to take whatever lens you want, be they Nikon, Canon, Minolta or whatever. You lose the auto-focusing when ▶

Tiny, but oh so versatile. JVC's new VHS-C camera takes standard 35 mm camera lenses and features an add-on character generator for titling.

THE STANTON EPOCH II SERIES

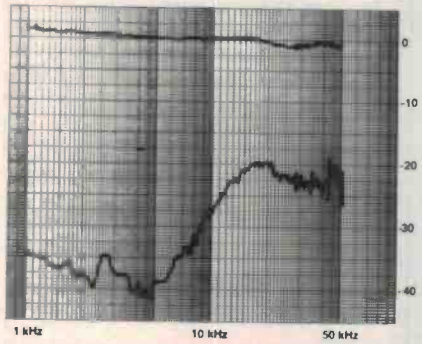


STEREOHEDRON II
...an advanced stylus geometry provides ideal stylus to groove interface. Its smaller tracing radii and smaller front-to-back angle allows for incredibly faithful tracing of the high frequency modulation.

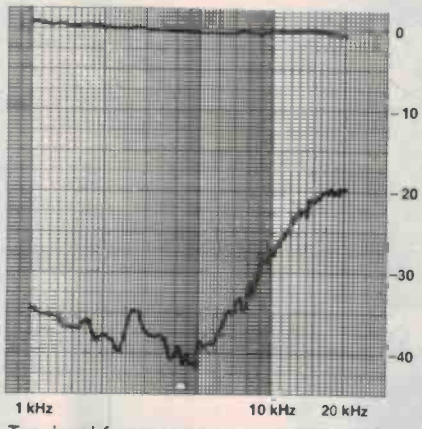
Models HZ9S and LZ9S are factory calibrated. A Calibration Certificate giving the critical performance data of the individual cartridge, accompanies each unit.

Currently two models are available, each in low and high impedance versions.
LZ9S and LZ8S low impedance and HZ9S and HZ8S high impedance.

LZ8S and HZ8S - R.R.P. $199.
LZ9S and HZ9S - R.R.P. $299.



Typical frequency response of LZ9S and channel separation.



Typical frequency response of HZ9S and channel separation.

SPECIFICATIONS:
Detailed specifications are given in the Epoch II leaflet available from the dealers listed below. Just to whet your appetite, frequency response is 10Hz – 50kHz for the LZ9S (try Compact Disc against that!), tracking ability is 90 microns (or, it will play any record ever pressed, with minimal distortion).

EPOCH II challenges any pick-up cartridge, or compact disc, regardless of type or price. With EPOCH II you will hear, probably for the first time, MUSIC from your records, instead of just good sound. You will get the full emotional impact of the recorded music. And that's what it's all about. As Johann Sebastian Bach said, "Music is meant to move the heart with sweet emotion."

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WESTERN AUSTRALIA	
Audio Centre - West Perth	322 5177
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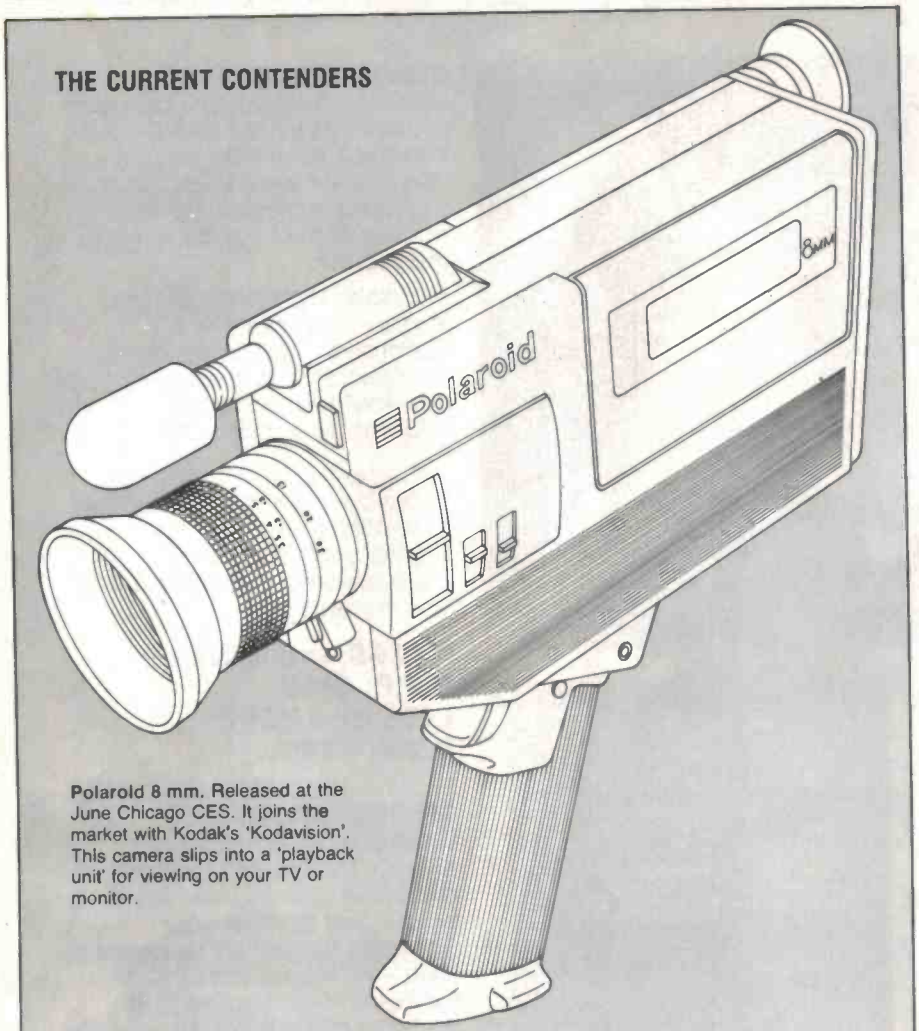
Tasmanian Record Co. - Launceston	31 5588

THE CURRENT CONTENDERS



Polarold 8 mm. Released at the June Chicago CES. It joins the market with Kodak's 'Kodavision'. This camera slips into a 'playback unit' for viewing on your TV or monitor.

Betamovie. Has been quite a success for the 'Beta camp'. It takes a Standard Beta cassette which can be played back in your Beta VCR. Small and light, it was the first true fomestic cam-corder.

Kodavision. The first 8 mm contender. Kodak's huge world-wide network might just carry the day — they hope.

you do this but you do gain the versatility of being able to attach long telephoto or extremely wide angle lens to give added dimension to your home movie-making.

Even though these video cameras have wide-angle settings on their zooms, probably the most valuable lens I have bought was a macro that will fit either my Nikon or the JVC. Using the semi fish-eye lens I was able to do superb panoramic shots that would otherwise have been lost. One unique opportunity I had on a recent overseas trip was to sit in the cockpit of a jumbo landing in Singapore. Using the wide-angle lens I was able to film the complete interior of the cockpit and the scene through the aircraft's front windows for a really excellent effect.

This add-on lens I bought simply screws onto the front of any video camera lens with a 52 mm screw mount. But for the most part, people will find that the built-in 6:1 zoom lens on the GX7 sufficient for most purposes.

Beats solid-state?

This is the smallest and lightest camera so far from JVC and even smaller than some of the solid state cameras being touted by other manufacturers as the answer to portable video systems. If JVC would reduce the size of its VHAS Compact portable recorder by 30 per cent, then I have no doubt it would become the most popular portable system on the market, making the 8 mm video format even less attractive.

The great thing about the small VHS-C format is it is compatible with your current VHS machine. And it really is the only answer the VHS camp has to Sony's Betamovie which is doing so well in the US and Japan.

Meanwhile, Sony has announced a new version of its very successful Betamovie. This has a super cardiod microphone and an auto-focus system. It will be launched later this year and will sell for $200 more than the current model.

Betamovie vs 8 mm vs VHS-C

Home movie making using video is gaining ground and it will be intersting to see the various developments in coming months. It will obvioulsy add up to the Kodak 8 mm format versus the Betamovie versus the JVC Compact portable.

The JVC Compact and Betamovie have the advantage in that they are compatible with current video systems. Kodak's advantage is that it can spread its system all over the world through some 40 000 outlets at the drop of a hat and make it easily accessible.

Tapes will be easy to get as well — something lacking with the JVC Compact System. I had to hunt far and wide to get new tapes when I ran out during my trip. But that is one of the few negatives I can report on the VHS Compact. In every way it came up to my expectations. It was light to carry, easy to use, and now I am at home the 30 minute tapes make it far easier to edit than if I had used a three hour tape. ●

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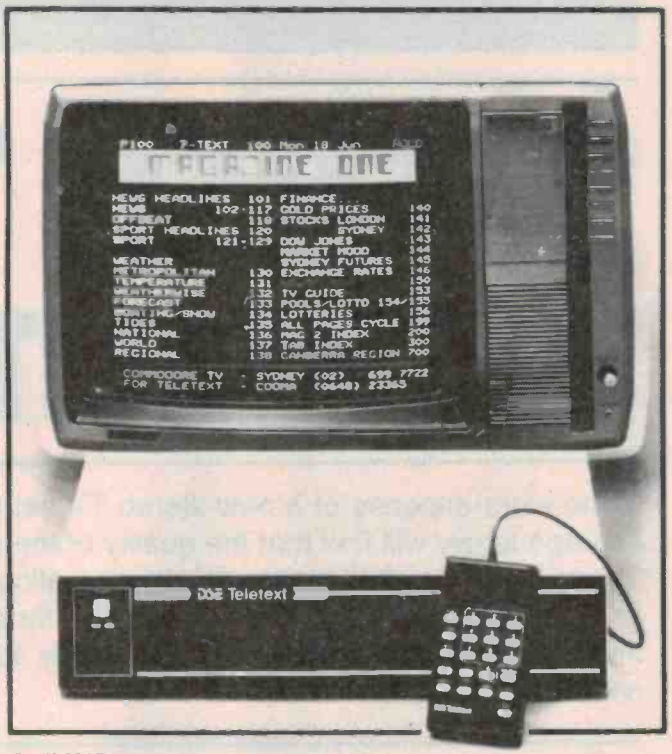
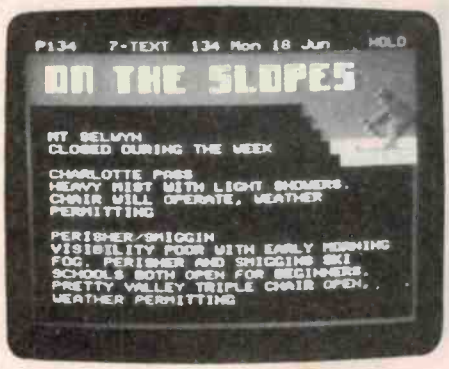
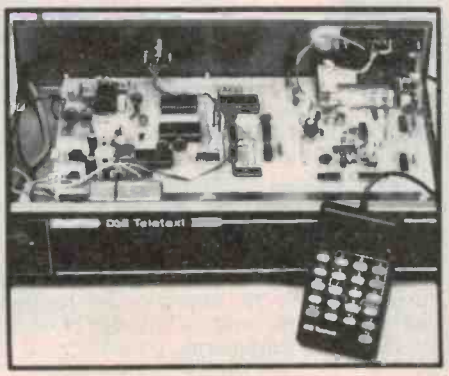
*Not all stations transmit Teletext. Stations in the 7 network (ie those taking Channel 7 news) do as well as ABC stations, and many others have some Teletext transmissions. Most stations transmit Teletext subtitles for deaf people. If in doubt, ring your local station.



Cat K-6315





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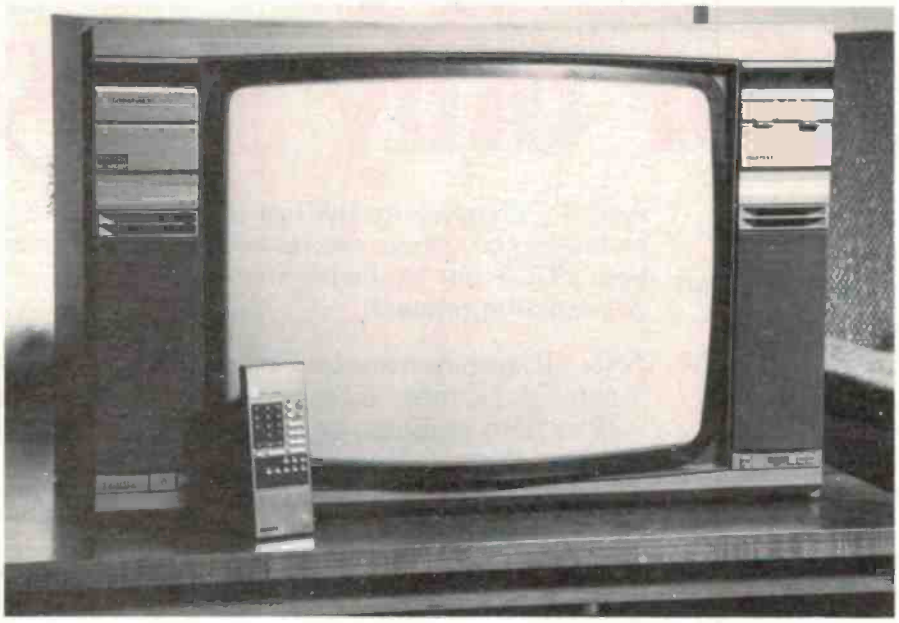


PHILIPS MODEL KR684 STEREO TV

Dimensions:	*792 mm (L) x 505 mm (H) x 480 mm (D)*
Weight:	*52 kg*
Price:	*Rrp $1349 (w/o Teletext) $1449 (with Teletext)*
Manufacturer:	*Philips Australia, Clayton, Victoria.*
Distributor:	*Philips Australia, Philips Bld, Blue St, North Sydney NSW 2060. (02)925-3333.*

SONY MODEL KV-2064EC STEREO TV

Dimensions:	*668 mm (L) x 456 mm (H) x 482 mm (D)*
Weight:	*27 kg*
Price:	*Rrp $999 (w/o Teletext) $1174 (with Teletext)*
Manufacturer:	*Hi-fi audio division of Sony Corp. Japan.*
Distributor:	*Sony, 33-39 Talavera Rd, North Ryde NSW 2113. (02)887-6666.*

STEREO TV: THE REALITY

Is the extra expense of a new stereo TV set justified? The average family will find that the quality of the sound is better. The hi-fi buff may find the results disappointing. Wouldn't it have been better to have waited a little longer for one of those alternative (digital) systems with inherently superior sound, coupled with a large screen format?

FOR A PERIOD of almost 20 years between 1956 and 1976 the highest quality sound, and sometimes the only decent sound that could be picked up on a receiver was the FM audio sub-carrier channel on your TV set.

The lucky people with larger TV sets had the benefit of passable sound which on occasions sounded almost (but not quite) like high-fidelity. The majority of people with small TV sets, incorporating what were undoubtedly apologies for speaker enclosures, had to be satisfied with what I would describe as transistor radio quality sound.

This situation rapidly changed for the better with the introduction of stereo FM broadcasting. The public (and apparently the Government) soon realised that the audible delight of the 50s had become the orphan of the 80s that nobody really liked or even seemed to appreciate anymore.

In December 1983 when the Federal Government announced details of its new technical standards for stereo TV broadcasting in Australia, the remaining local manufacturers, the importers and retailers all breathed an almost audible sigh of relief.

This initial enthusiasm did not prevail in all sectors of the industry and a small vocal group with experience in previous situations believed that the technical papers and the promises did not necessarily mean that the nominated standards were perfect. This particular group, drawn mainly from the Federation of Australian Commercial Television Stations (FACTS), together with a powerful and pragmatic group from the ABC, were very concerned that the choice of system and its practical limitations were inappropriate.

If you have read the evening papers in the last few months you would have noticed a large number of advertisements for TV sets and VCRs at unbelievably low prices. The reason for all these specials is directly attributable to the new standards superceding the old. This has resulted in the unsold equipment becoming last year's models.

Choosing a new system

A number of studies were conducted in Germany, Japan and Sweden to assess the audible quality of various types of stereo-TV transmissions which were intended to be as good or better than the normal single (mono) sound channel. No surprisingly, all of the engineering groups involved in these studies set the following basic requirements for each of their systems:

1. The new system must be compatible with the existing transmission and hence the additional sound signals must not interfere with the performance of existing (mono) receivers.
2. The new system should allow the transmission of a proper stereophonic sound, as well as of two independent sound signals with *full quality* for bilingual applications. The switching to the appropriate mode should be achieved automatically.
3. The resulting service area of a TV transmitter should be limited by the degradation

Louis Challis

of picture quality and should not be limited by the degradation of the sound quality.

Following the assessment of viewers' responses and technical instrumental assessments of the pilot studies of each of these countries, the majority of the groups opted for a system based on a double sound carrier system. The reasons for their choice were easy to comprehend. The existing TV sets would not be made obsolete (although they would be nearly obsolescent), the TV station's signal processing and transmission equipment would be only slightly changed and video cassette recorders of the old style would still be compatable with the new style; the transition from mono to stereo would thus be virtually painless.

There was, of course, another option which was not researched in Australia but was seriously considered in the USA and by other research laboratories, including Philips at Eindhoven in Holland, NHK in Japan and most certainly by the CCIR consultative groups. This alternative was to completely change the TV standards and to introduce digital audio with all its attributes and audible advantages.

The audio signal would then become a digital signal, interleaved with the video signal which could also have its modulation data modified in the appropriate way. This solution would most probably reduce the total transmission bandwidth but would achieve a standard of transmission and a standard of reception significantly better than that currently produced.

Now the concept of 'digital audio' still has many supporters as it was evaluated at the CCIR Plenary Meeting in 1982 for possible introduction in 1984. That meeting naturally balked at the concept as it would cost more than the respective member nations felt was justifiable. The digital audio concept is far more exciting and undoubtedly technically superior to the alternatives chosen by the Australian Broadcasting Control Board (and thus the government). It would, however, necessitate a complete redesign of the television set and, more significantly, the television transmission equipment as well. For that reason it was rejected in favour of the more pragmatic alternatives.

In Australia we had two competing systems to consider in exactly the same way as did the other nations evaluating their options. The first option was to use a multiplex sound system with frequency modulated sub-carrier with single, double and vestigal side bands and associated pilot tone. As all such multiplex systems show a smaller (poorer) signal-to-noise ratio in the second sound channel, as well as distortion caused by multipath propagation, this option was not as strongly favoured as the double sound carrier system.

The double sound carrier system is made feasible by the availability of additional unused bandwidth between the limit of the existing channel's tranmission and the lower band edge of the adjacent TV channel. There is just enough space left for the additional sub-carrier and consequently, in order to meet the first of the compatibility requirements, this is the system that was chosen.

It is the modulation characteristics of the double sound carrier system which have worried many of the TV stations. This is because of the way in which the stereo signals, which I will describe as left channel (L) and right channel (R), are combined into their new transmission format. These carriers are described as the main carrier (M) and the secondary carrier (S). The main carrier is modulated with (L + R)/2. The secondary (new second carrier) channel is modulated with R only.

The convenience of this strategy is that a person with an existing (old) TV set receives a new signal with left and right stereo channel signals combined. The resulting audible signal is thus almost identical to the reception of the stereo signal on your FM stereo receiver when you switch to the mono mode.

The owner of the new stereo TV set has an additional inter-carrier amplifier/demodulator stage installed and this provides the second sound carrier channel. This circuitry is contained in a large integrated circuit which then takes the main carrier (M) and the secondary carrier (S) channels and theoretically combines them and subtracts them to provide the separate left and right channels respectively.

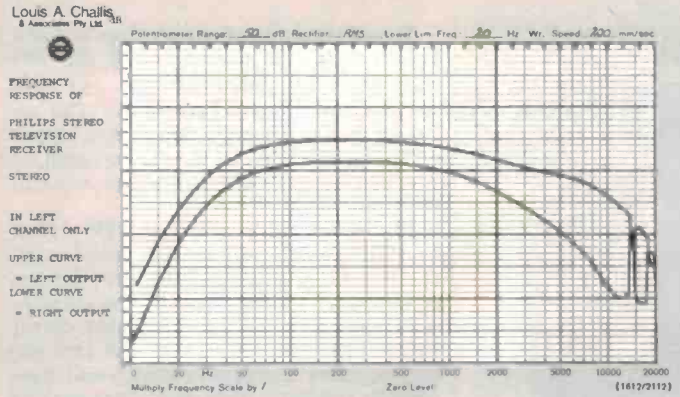
The Europeans were experimenting with a somewhat different system with the main channel (M) carrying a (L + R)/2 signal and the secondary channel (S) carrying (L − R)/2 signal. That option was considered in Australia but rejected. The major deficiency in that system is that if there is coherent interference such as frame buzz, the interference appears in just one channel (the left channel) and is cancelled in the right channel. The system chosen produces the interference in both channels which is regarded as being preferable.

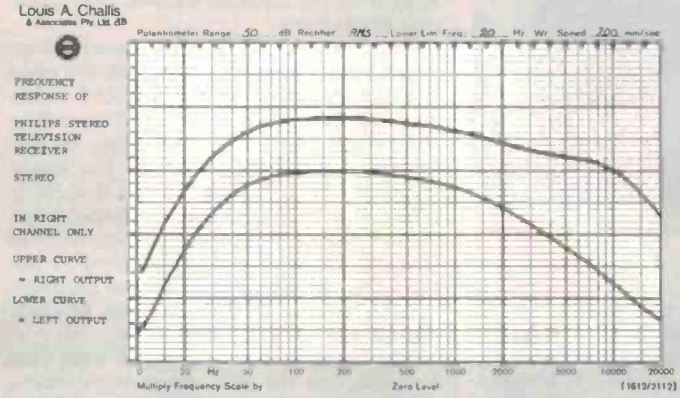
The Europeans' experimental work also revealed that the true stereo signal has a number of subjective deficiences. With a picture the size of a small TV set a true stereo signal can produce some artificial effects which are subjectively disturbing, particularly with widely spaced speakers. The research revealed that if a portion of the left channel is fed into the right channel and visa versa, the resulting sound has a smeared effect which is referred to as 'spatial' sound. Most people prefer this effect with a small TV set and small speakers and the European TV sets incorporate both the true stereo TV capability (separate left and right channels) as well as the 'spatial' sound.

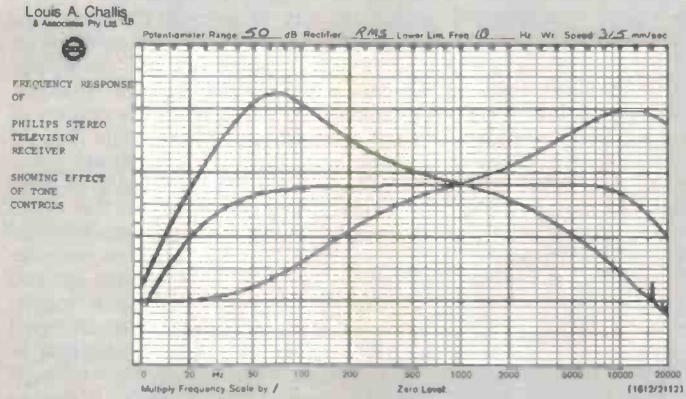
The TV stations transmit a stereo signal but what you hear from your TV set may or may not be the same signal that was originally transmitted. The capability of having the (L + R)/2 and R signals converted into L and R channels or 'spatial' sound was incorporated in the Philips K12Z chassis originally imported for testing and evaluation by TV stations in Australia. Much to our surprise, and I suspect to the surprise of the TV stations as well, the Philips stereo TV sets being marketed in Australia do not incorporate the capability to listen to L and R, but *only the 'spatial' sound signal.*

What a number of the TV stations soon found was that during certain broadcasts and particularly at sporting events, a number of listeners complained of poor quality sound which only occured when the 'spatial' mode was selected. Apparently when the announcer's voice signal was recorded on a pair of stereo microphones in such a way that a coherent signal was fed in-phase to both microphones in the presence of a ▶

PHILIPS







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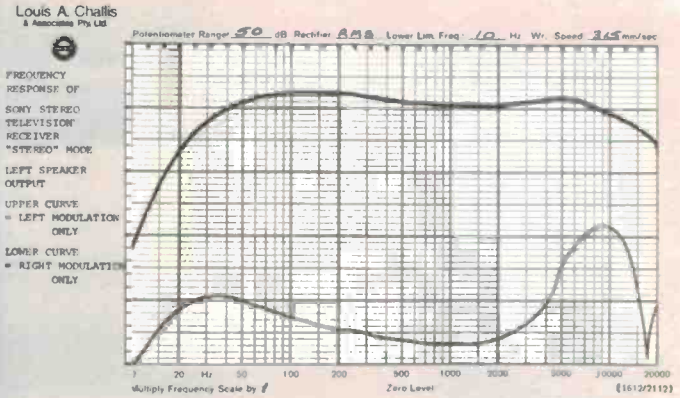

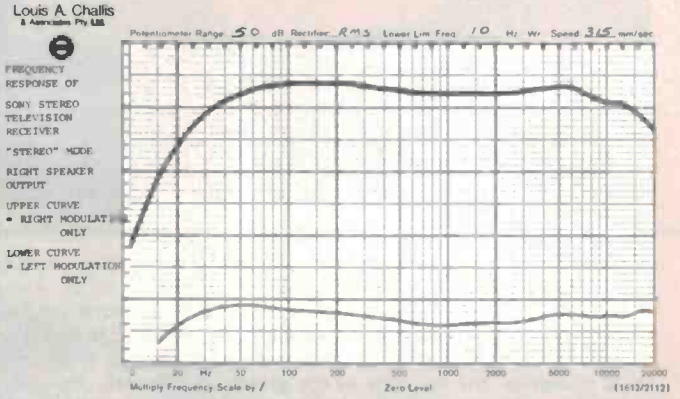

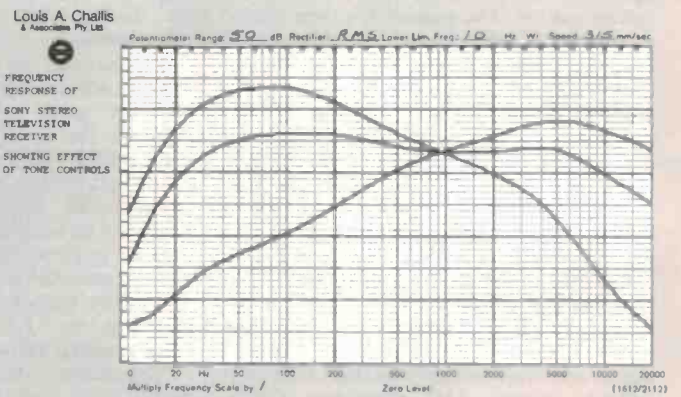

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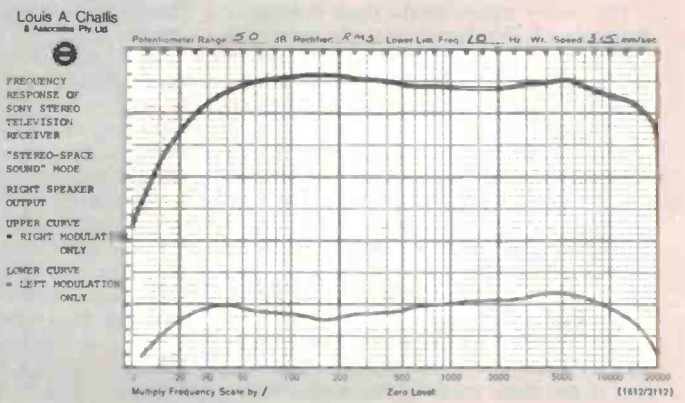

Serial No. 200053

Frequency Response: 22Hz to 10kHz (-3dB)

Crosstalk (measured on prototype):

	STEREO	BILINGUAL
Left into Right	35dB (100Hz)	
	36dB (1kHz)	CHI into II -68dB
	35dB (5kHz)	
Right into Left	35dB (100Hz)	
	37dB (1kHz)	CHII into I -66.3dB
	26dB (5kHz)	

Harmonic Distortion

1kHz, 30kHz deviation

	Left Channel (+0.4dB re 1V 8 ohms)
2nd	-21.3dB
3rd	-47.2dB
4th	-62.8dB
5th	-64.0dB
THD	-21.3dB
	8.6%

100Hz (with same modulation level as 1kHz above)

	Left Channel (-3.5dB re 1V)
2nd	-26.8dB
3rd	-58 dB
4th	-68 dB
5th	-71 dB
THD	-26.8dB
	(4.6%)

6.3kHz (with modulation level as above)

	Left Channel (-0.1dB re 1V)
2nd	-21.9dB
3rd	-22.5dB
4th	-39.0dB
THD	-19.1dB
	(11.0%)

1kHz (-6dB re 30kHz deviation)

	Left Channel
2nd	-27.2dB
3rd	-56.2dB
4th	-
5th	-
THD	-27.2dB
	(4.4%)

1kHz (-20dB re 30kHz deviation)

	Left Channel
2nd	-41.5dB
3rd	-64.3dB
4th	-
5th	-
THD	-41.5dB
	(0.84%)

Sony model KV-2064EC. Measured performance of the stereo television receiver.

strong non-coherent background noise, then there was a possibility that the announcer's voice would be attenuated and that the unwanted background noise signal would be selectively amplified.

The embarrassing part was that instead of superior sound as the viewers would have expected, the announcer's voice all but disappeared into the crowd noise. As you may guess there were some red faces in the technical departments at the respective TV stations.

There are some obvious practical solutions to this problem, including the possibility of switching to normal stereo. However, this can't be done if the TV set is only capable of 'spatial' mode. The other alternative is to switch to mono, but very few of the viewers realised the nature of the problem and therefore we suspect that not many people tried that approach as a solution.

Frequency Response 40Hz -12kHz (-3dB)

Crosstalk:

	STEREO	BILINGUAL
Left into Right	-9dB (1kHz)	
	-19dB (10kHz)	CHI into II -37.3dB
Right into Left	-8dB (1kHz)	
	-18 dB (1kHz)	CHII into I -33.7dB

Harmonic Distortion

1kHz, 30kHz deviation

	Left (1.0v across 8 ohms)	Right
2nd	-27.1dB	-28.6dB
3rd	-55.8dB	-61.9dB
4th	-66.5dB	-72.5dB
5th	-74.9dB	-74.9dB
THD	-27.1dB	-28.6dB
	(4.4%)	(3.7%)

100Hz (with same modulation level as 1kHz above)

	Left (-3.5dB re 1V)	Right (-6.1dB re 1V)
2nd	-26.8dB	-26dB
3rd	-58 dB	-56dB
4th	-68 dB	-66dB
5th	-71 dB	-77dB
THD	-26.8dB	-26dB
	(4.6%)	(5.0%)

6.3kHz (with modulation level as above)

	Left (-3.7dB re 1V)	Right (-8.5dB re 1V)
2nd	-26.7dB	-22dB
3rd	-32.1dB	-34.5dB
4th	-46.8dB	-59.8dB
THD	-25.6dB	-21.8dB
	(5.3%)	(8.1%)

Philips model KR584. Measured performance of the stereo television receiver.

The Sony set, and some of the other Japanese and European-designed TV sets, do provide the option of true stereo as well as 'spatial' sound capabilities.

When we began the evaluation of the two stereo TV sets I was not aware of all the above facts and learnt much of this information as we slowly progressed with the testing.

Features

The Philips model KR684 and Sony model KV-2064EC stereo TV sets are the top-of-the-line models from these two innovative and highly competitive manufacturers. They both offer a standard of technical innovation, design and quality production which is markedly superior to any other TV sets I have seen before. Their greatest advantage is the use of purpose-designed integrated circuits to achieve higher standards of technical performance matched by better reliability and excellent picture linearity.

The TV sets weighed enough to discourage me from moving the units anymore than was absolutely necessary. They both came equipped with excellent infrared remote controls and produced state-of-the-art pictures with a visual quality which I would describe as being of monitor class. The Philips TV set also incorporated an integral Teletext decoder while the Sony set incorporated a plug-in socket to accept the appropriate Teletext decoder printed circuit board.

Both of the TV receivers incorporate a switch to provide for monophonic and 'spatial' stereo sound. The Sony TV set provides an additional switch to select the full stereo capability. Philips Australia has chosen not to incorporate the full stereo facility that was originally incorporated in the Dutch K12Z chassis which I have seen at various TV stations. They either believe that the Australian consumer is less sophisticated than his European counterpart, or they believe that if they were to incorporate the stereo switching facility then the result would be a significant increase in unwarranted TV service calls.

Both TV sets incorporate DIN speaker plug sockets so that external high quality speakers may be connected in lieu of the integral speakers. The Philips handbook, however, cautions the user to place such speakers in close proximity to the TV cabinet. When I connected a set of monitor speakers to the set, the reasons for this advice soon became evident.

If you move the external monitor speakers out from the sides of the set, with a laterial spacing comparable to that required for normal stereo listening, the subjective effect can be quite disturbing. In most cases the original stereo-TV sound has been mixed down in an audio sweetening room to suit the requirements of closely spaced speakers of the type integrated within the TV set's cabinet.

Objective testing

I soon discovered that 'stereo-TV' produced by TV sets is not quite the stereo-TV I had expected. Unlike stereo-FM, which has a pilot tone carrier system and the ability to provide completely separate information on the left and right channels, the stereo-TV audio channel has been devised to comply with a different set of operational constraints.

Testing the TVs was a problem as a signal generator specially designed for the purpose is needed. Its performance must be as good as, or preferably better than, the TV standards. Finding exactly how the stereo TV system works was also a problem. Another problem was designing an appropriate test procedure which would provide a realistic evaluation.

Philips Australia solved one problem when they provided me with one of their new model PM5519 Colour TV Pattern Generators. It incorporates an appropriate modulation section with which a stereo test signal may be produced.

I became aware that my understanding of the 'spatial' concept was different to the theoretical data on stereo TV which had been given to me by Philips. At first I suspected there was something wrong with the TV stereo signal pattern generator. I then suspected that there was something wrong with the TV sets, particularly as all my reading had lead me to believe that the double sound carrier system is capable of providing better than 30 dB channel separation.

But irrespective of what measurement procedure was used we could not begin to even approach such a figure. I checked with

continued on page 43 ▶

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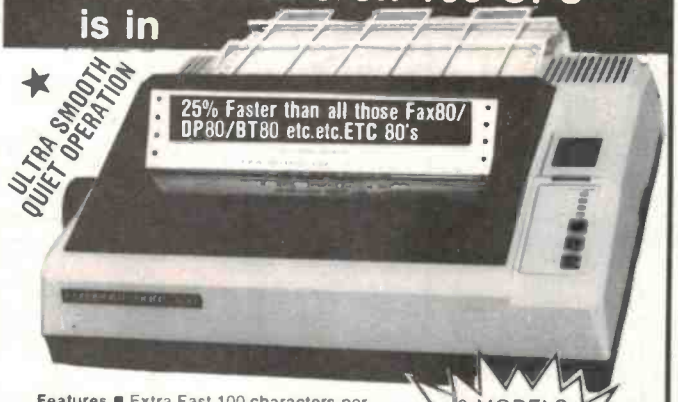

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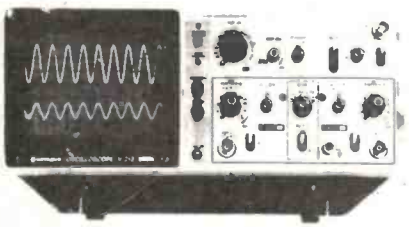

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Q 0152 ~~$699~~ Now $599

$100 off and free 10:1 Colline Probe this Month

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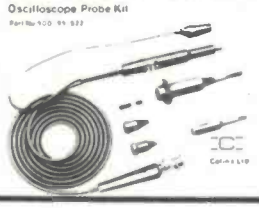

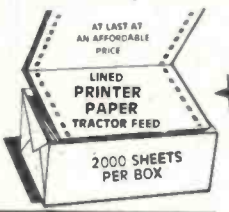

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Both D 1115 and D 1116 utilize Non Glare High Grade Monitor Tubes.

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- 6v DC operation - USE WITH M9000 PLUG PACK **ensures** low hum levels.
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(NOT AVAILABLE FROM DEALERS — SHOP AND MAIL ORDER ONLY)

C-20

D 1141
From 99¢

MICRON data cassette

1 - 9	10 - 99	100 up
1.50	1.25	99¢

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A high quality item eminently suited to mixers, PA amplifiers and where an ultra low "hum" pickup level is desired.

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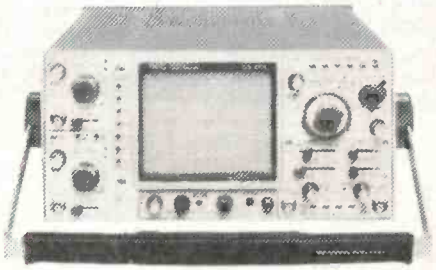

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4049	.64
4050	.78
4051	.92
4052	$1.15
4053	$1.39
4056	$1.35
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4066	.81
4068	.61
4069	.52
4070	$1.15
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4076	$1.79
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AD570JD	$49.11
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DAC0800LCN	$5.06
DAC0808LCN	$3.16
DAC1408-8Q	$4.13

7400 SERIES

7400	.46
7401	.46
7402	.46
7403	.46
7404	.46
7405	.46
7406	.52
7407	.55
7408	.46
7410	.46
7411	.46
7413	.46
7414	.46
7417	.46
7420	.46
7426	.46
7430	.46
7432	.46
7440	.46
7441	$1.07
7442	.67
7445	.98
7446	.98
7447	.75
7448	$1.44
7460	.46
7473	.46
7474	.46
7475	.46
7476	.46
7485	.69
7486	.46
7490	.58
7492	.63
7493	.58
7494	$1.75
7495	.58
7496	.81
74107	.58
74109	.63
74121	.61
74123	.66
74125	.52
74145	$1.25
74151	.58
74154	$1.73
74164	.69
74165	.81
74174	.58
74175	.58
74191	$1.14
74192	$1.05
74193	.95
74196	$1.84
74365	.81
74367	.81

74LS SERIES

74LS00	.44
74LS01	.44
74LS02	.44
74LS03	.44
74LS04	.55
74LS05	.44
74LS08	.44
74LS09	.44
74LS10	.44
74LS11	.44
74LS12	.44
74LS13	.44
74LS14	.64
74LS15	.44
74LS20	.44
74LS21	.44
74LS22	.44
74LS26	.44
74LS27	.44
74LS30	.44
74LS32	.44
74LS37	.44
74LS38	.44
74LS40	.44
74LS42	.58
74LS47	.67
74LS48	.71
74LS49	$1.38
74LS51	.44
74LS54	.44
74LS55	.44
74LS73	.44
74LS74	.55
74LS75	.52
74LS76	.52
74LS78	.58
74LS83	.71
74LS85	.52
74LS86	.44
74LS90	.60
74LS92	.60
74LS93	.69
74LS107	.58
74LS109	.52
74LS112	.46
74LS113	.52
74LS122	.69
74LS123	.81
74LS125	.58
74LS126	.63
74LS132	.58
74LS136	.76
74LS138	.81
74LS139	.81
74LS151	.58
74LS153	.52
74LS154	$2.48
74LS155	.69
74LS157	.69
74LS158	.69
74LS160	$2.30
74LS161	.81
74LS162	.81
74LS163	.81
74LS164	.81
74LS165	$1.38
74LS168	$1.63
74LS169	$1.63
74LS170	$1.04
74LS173	.75
74LS174	.69
74LS175	.69
74LS189	$6.13
74LS190	$1.04
74LS191	$1.04
74LS192	.75
74LS193	$1.04
74LS194	.81
74LS195	.81
74LS196	.81
74LS197	$1.15
74LS221	.81
74LS240	.92
74LS241	$1.15
74LS242	.86
74LS243	.86
74LS244	$1.38
74LS245	$1.61
74LS247	.83
74LS248	$1.77
74LS249	$1.38
74LS251	.75
74LS257	.58
74LS258	.52
74LS266	.52
74LS279	.69
74LS283	.58
74LS290	.58
74LS293	.58
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74LS374	$1.50
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74HC191N	$2.02
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74HC243N	$2.65
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ASY26	$4.11	BC559	.28	BD682	$1.17	BU126	$2.49	MPF102	.71
BC107	.38	BC559C	.28	2N5245	.62	BUX80	$4.63	MPF103	.62
BC108	.38	BC639	.44	2N5294	$1.42	BDV64B	$3.11	2N697	.66
BC109	.38	BC640	.44	2N5458	.62	BDV65B	$3.11	2N1613	.75
BC159	.48	BCY71	.68	2N5459	.62	MJ2955	$1.62	2N1711	$1.00
BC177	.45	BD135	.63	2N5401	$1.00	MJ15003	$5.10	2N2102	$1.24
BC178	.45	BD136	.63	2N5485	.62	MJ15004	$5.10	2N2219	$1.00
BC179	.50	BD139	.63	2N5770	.38	MJ4502	$4.35	2N2222	.25
BC318	.28	BD140	.63	FT2955	$1.59	MJ802	$5.85	2N2270	.81
BC327	.28	BD202	$1.87	MJE3340	$1.07			2N2905A	.67
BC337	.28	BD233	$1.87	MJE3055M	$2.38	2N3055	$1.12	2N2907A	.67
BC338	.28	BD234	$1.05	MJE350	$2.74	BF115	$1.50	2N3019	.67
BC546	.28	BD237	.80	MJE2955M	$2.45	BF167	.70	2N3053	$1.00
BC547	.28	BD238	.80			BF173	.86	2N3563	.34
BC547B	.28	BD262	$1.17	TIP2955	$1.61	BF180	.94	2N3564	.38
BC548	.28	BD263	$1.17	TIP3055	$1.24	BF469	$1.00	2N3566	.38
BC548C	.28	BD266	$1.99	TIP31C	$1.04	BF470	$1.00	2N3567	.25
BC549	.28	BD267	$2.24	TIP32C	$1.00	BF494	.28	2N3568 (MPSA-06)	.37
BC549C	.28	BD435	$1.89	TIP34C	$2.11	BFR84	$2.08	PN3638A	.34
BC550	.28	BD437	$1.17	TIP35C	$3.83			PN3569	.38
BC556	.28	BD438	.96	TIP41C	$1.39			PN3641	.38
								PN3643	.25
								PN3645	.28
								PN3646	.30
								2N3819	$1.00
								2N3866	$1.96
								2N3904	.45
								2N3906	.62
								2N4036	$1.00
								PN4121	.38
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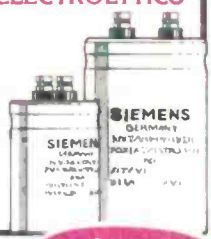

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my friends in the Engineering Department at Channel 9 and the ABC, and they confirmed that their measurements on the Philips set produced similar results to my own.

As you can see from the level recordings, the mid-band channel separation for the Philips set is only approximately 8 dB between the right and left channel, and 4 dB between the left and right channel, with somewhat better separation above 5 kHz. This channel separation performance is even poorer than that provided by single unit stereo record players in the early 60s.

What surprised me even more was the difference between the mono mode frequency response, which is reasonably flat from 40 Hz to 10 kHz, and that provided in the spatial mode which is 6 db down at 30 Hz and 4 kHz.

With 30 kHz deviation from the signal generator the distortion is extremely high producing −27 dB on the Philips and −21 dB on the Sony. This distortion was virtually independent of frequency on both receivers. The absolute accuracy of this distortion could not be confirmed as the signal generator could not be calibrated as we normally would with our own equipment.

At lower deviations the distortion is still moderately high and most certainly higher than the average hi-fi buff has come to expect from his FM stereo receiver, cassette player or turntable. The source of these distortion characteristics could not be precisely defined and both sets seemed to generate similar characteristics.

The speakers installed in both sets and their method of mounting further exacerbates this problem. The use of external speaker enclosures improves this situation but not dramatically.

Subjective testing

The subjective evaluation of the two TV sets produced results which were somewhat different to what I would have initially expected had I not seen the results of the objective laboratory tests.

I was able to perform A-B comparisons on the same stereo program content in my living room. The results, however, were not quite what we would have expected, as the two TV sets appeared to have different sound quality and audibly different channel separation characteristics.

If you choose to use the 'spatial' mode in the Sony set (which you automatically hear in the Philips set) the resulting stereo separation is markedly different from the stereo signal originally transmitted. The program content no longer produces the sharp imaging or definition that I have grown to expect from both stereo records, stereo FM radio stations or from other stereo program content heard on a high fidelity system.

The characteristics of the sound closely resemble what I vaguely remember, and you may also recall, from the period circa 1959 to 1962. At that time EMI, Kreisler and many other local record player manufacturers produced single unit stereo record players with the left and right channel speakers mounted on the opposite sides of what were usually small plastic cabinets. Those players produced what I thought was a 'spatial' effect rather than a 'stereo' effect. They had extremely poor stereo imaging and a rather ill-defined stereo effect which matched the poor frequency responses and channel separation of the crystal cartridges used in most of those units.

Even when I tried moving the external loud speakers away from the sides of the TV cabinet I was still aware of what I can only describe as a strange phenomena. Although I was looking at what were relatively large TV screens the breadth of the 'spatial' sound did not quite match the limited size of the TV screen and the effect was disconcerting.

When I observed this phenomena, I recalled some of the comments I have recently heard about the research work being conducted at the NHK Laboratories in Japan. They have been using large-scale projection TVs in conjunction with high quality loudspeaker enclosures for their assessment of stereo TVs. Obviously a stereo sound source should be matched with a video image of equal breadth. If the two are poorly matched the overall perception must suffer.

This, of course, is part of the problem that Philips has perceived and I believe has honestly attempted to solve. We have a visual medium which is restricted by the size of the TV set and this is coupled to an audible facility which could in theory be made as large as your viewing room. The decision to link the two together through the use of a 'spatial' system is not quite as silly as it may seem at first.

I was aware of the obvious differences between the two TV sets. The quality of sound from the Philips set was slightly better than that from the Sony set, although this proved to be the result of a faulty demodulator unit in the particular Sony TV set which I was testing. When I finally realised that there was an electronic fault Sony provided another set which unfortunately arrived too late for another full A-B evaluation.

The initial picture quality from the Sony set was marginally better than that from the Philips set. But this was because the Philips set had an inadvertent magnetisation of part of the TV deflection circuitry which caused a colour smear on the two sides of the screen. Fortunately, this problem disappeared before the TV serviceman arrived and thereafter the picture quality of both sets was extremely good.

It is essential to have a good TV signal if you wish to be able to receive an adequate secondary channel signal. The reason for this relates to the signal strength of the secondary channel which is 13 dB down with respect to the main channel. If the secondary channel is received with insufficient strength to activate the demodulation circuitry you will almost certainly be left with something that is not quite stereo and not quite spatial.

I had to organise for Electrocraft Manufacturing to install a new Hills EFC 3-24 TV antenna as during my subjective evaluations the audible quality was neither stereo nor spatial. In fact, it was only suitable for mono reception.

Notwithstanding the 'spatial' sound or the quality of the picture, the junior members of my family much preferred the Philips set primarily because of the technological delights and the extent of the information that its Teletext decoder provided.

I don't often look or listen to TV programs and consequently I was not used to mono TV any more than spatial TV. The audible quality of the spatial TV is unquestionably superior to the mono version to which you are undoubtedly accustomed. However, the quality of that sound still leaves much to be desired.

Conclusions

At this stage an overall assessment of stereo TV is obviously warranted. The results of that assessment will differ depending on your requirements, attitude, preconditioning and expectations. In the case of the average family the response will be positive as the quality of the sound is better, normally cleaner and generally more natural with differing channel inputs on the left and right channels respectively.

In the case of a hi-fi buff who has now become accustomed to the quality of sound from FM receivers, high quality amplifiers and above average or excellent loudspeakers, the results may well be a trifle disappointing. In the case of the members of FACTS the results are most probably disappointing, generally disconcerting and on occasion when they experience problems of the type I have recounted, even humiliating.

In the end when you consider the significance of the compromises which have been imposed upon you, firstly by the breadth of your visual image, secondly by the quality of the audible signal and thirdly by the single choice of 'spatial' sound in the Philips TV sets, you must wonder, "Is the extra expense of a new stereo TV set jusified? Would it not have been better to have waited a little longer for one of those alternative (digital) systems with inherently superior sound, coupled with a large screen projection format?"

I belive that we can not currently afford digital TV. However, the approach which Philips has chosen in their Australian TV sets is not the most appropriate and they should have made provision for the user to be able to select true stereo sound and not just 'spatial' sound. ●

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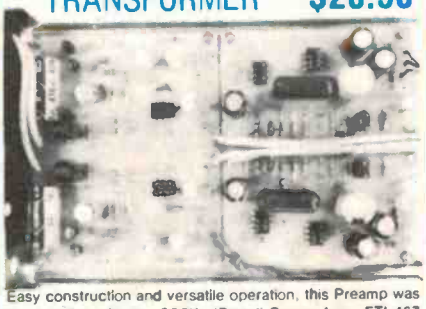

Easy construction and versatile operation, this Preamp was for coupling with the 300W "Brute" Power Amp. ETI 467 July 80

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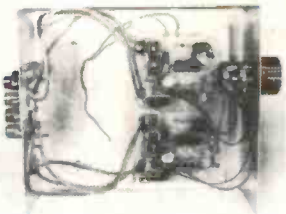

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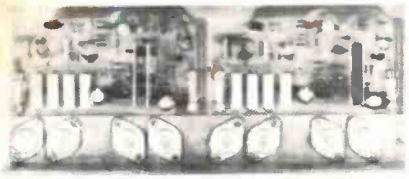

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New Keithley 5½-digit DMM cuts cost of measurement

Keithley's new Model 197 autoranging five-function bench/portable digital multimeter features 5½-digit readout with microvolt/milliohm and nanoamp sensitivity. Scientific Devices, the distributors, expect it will be priced at over $100 less than competitive instruments.

The Model 197 is designed to address the growing need to make sensitive measurements, says Keithley. The main market is seen to be researchers, designers and those working in engineering services and production test operations where sensitivity, accuracy and interface-ability are important requirements.

The makers claim its voltage sensitivity allows transducer output measurements without the necessity for preamplification. The +/− 220 000-count liquid crystal display enables full use of the 5½-digit capability beyond the normal 199 999 maximum display limitation of standard 5½-digit DMMs, says Keithley.

Basic dc accuracy is quoted as 0.013% and the true RMS bandwidth is given as 100 kHz. Resistance measurement can use either the two-terminal our four-terminal technique over an 11-decade span from one milliohm to 220M. The resistance function also allows direct measurement of transistor and diode junction voltages.

The Model 197's autoranging is fast enough to be virtually invisible to the user, Keithley claim. A 100-point data logger facility allows storage of up to 100 readings either at six selectable rates or by manual trigger. A min/max feature captures the highest and lowest measurements and stores them independently of the data logger.

The Model 197 offers a choice of either of two IEEE-488 interface options. The Model 1973 has interface talk/listen capability, range programmability on volts and ohms, trigger, SRQ and other commands. The Model 1972 interface adds an isolated analogue output for users who require real-time monitoring capability. All the front panel indicators (dB, data logger etc) are also available over the buss for computer manipulation of the data.

Digital calibration is included, all calibration factors for each range being stored in non-volatile RAM. This feature avoids periodic visits to a calibration lab, reducing ownership costs over the life of the instrument.

An optional battery pack permits six hours of portable operation, Keithley claim. Further details from the distributors, **Scientific Devices Australia P/L, 2 Jacks Rd, South Oakleigh 3167. (03)579-3622.**

Switch regulated power supplies

Power Supplies. Part of the range of Izumi Denki switch regulated power supplies.

The Izumi Denki model PSR and PSR-H ac/dc input switch regulated power supplies are designed to be suitable for both commercial and industrial applications.

The power supplies are available on two input voltage ranges 85-132 Vac, and 170-264 Vac at frequencies of 47-440 Hz.

Dc output voltages available are 5 V, 12 V and 24 V and each of these can be provided in four power ranges, 15 W, 30 W, 50 W and 100 W.

The output voltage can be adjusted ± 10% of nominal. All models are galvanically isolated input to output and are fitted with overcurrent protection. The PSR-H series also has over-voltage protection, facilities for remote 'on/off' operation and remote sensing.

The units are housed in a small, sheet-metal enclosure with screw terminals on the front for all input and output connections.

For more information contact **Email, Valetta Building, Campbell St, Artarmon NSW 2064. (02)439-3311.**

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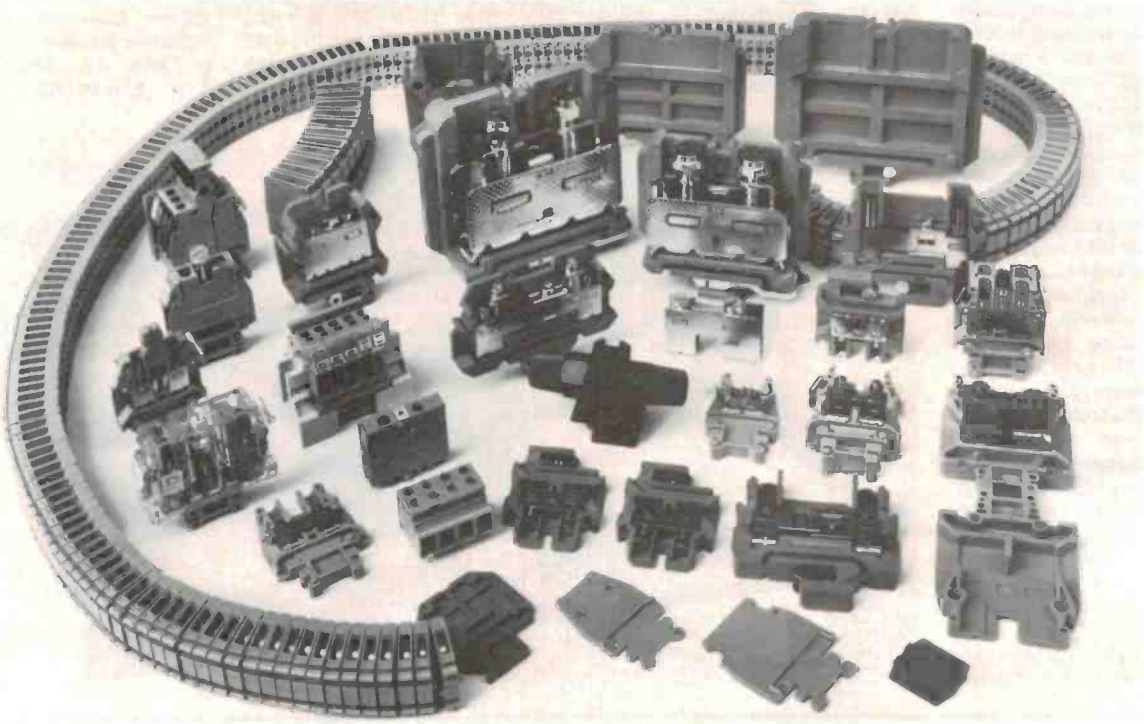

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Boom for flat panel displays

Impressive reductions in price coupled with improvements in size and image quality, is driving the flat-panel display market rapidly upward. Flat planels are now challenging traditional CRT display technologies in many applications.

Among several fast-growing consumer uses for flat-panel displays will be large-screen wall-mounted televisions which will compete with today's projection televisions. According to an International Resource Development (IRD) report very large wall-mounted flat-panel displays will also be used for teleconferencing.

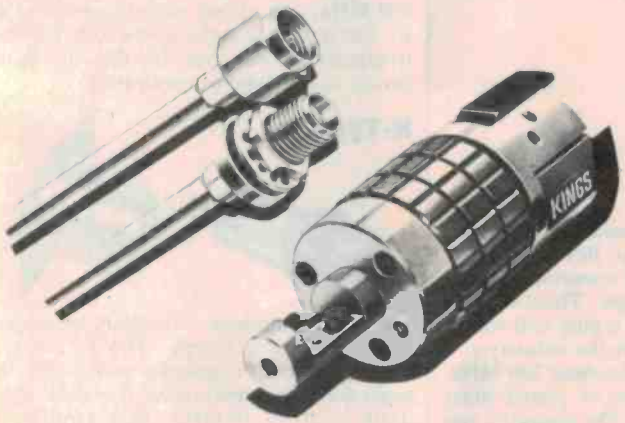
The report hints at the possible emergence of three-dimensional displays utilizing a 'sandwich' of multiple (and normally transparent) flat panels. Such a three-dimensional display (providing full life-size images) may form the basis of a teleconferencing system which would provide extremely life-like 'telepresence'. Three-dimensional flat-panel displays are further along than competing holographic technologies, and could be implemented on a commercial basis in the late 1980s.

Flat-panel technology is also used in small portable pocket and wrist televisions. Seiko, Casio and others have already introduced wrist TVs based upon the use of LCD technology, and Suwa Seikosha has demonstrated prototypes of a colour pocket LCD TV.

Flat panels compete in these applications with flat-screen CRT configurations, such as those used in Sinclair's pocket television (soon to be available in the US for just under $100) and in Sony's Watchman pocket TV.

Recently, moderate-sized flat-panel-based instrument clusters have appeared on a number of cars which use vacuum fluorescent displays. LCD clusters have been developed by several suppliers to the auto industry. Smiths Industries has developed electroluminescent panels combining analogue and digital readouts for autos.

The trend is towards the incorporation of a greater number of features and functions in the flat-panel dashboard displays. Eventually, the displays may provide TV reception and the display of navigation and travel map information, according to the IRD report.



Crimp connectors

Kings Electronics, USA, has announced the release of a new range of SMA crimp connectors and a trim tool for use with 0.141" semi-rigid coaxial cables.

Use of the tool and connectors will allow a cable to be terminated in less than 60 seconds. The tool accurately removes the outer cable jacket exposing the centre conductor. A further application of the tool tapers the centre conductor which is now the centre contact, i.e: no pin is needed.

The SMA body is slid over the cable, aligned with the jig, and crimped into position using a standard crimp tool.

A prepared cable can be set and crimped in less than 15 seconds, according to Kings.

Further information can be obtained from **Acme Electronics, 2-18 Canterbury Road, Kilsyth Vic 3137. (03)729-8999.**

SMA crimp connectors. Non-solder connectors from Kings Electronics.

AXR the low-cost XLR

Improve your professional audio performance and save money with the new Canon 'AXR' range of audio connectors, says STC-Cannon.

The lower cost streamlined AXR series, like its predecessor the XLR, is destined to become the industrial standard, Cannon claim.

It retains the unique XLR type resilient insulator with anti-vibration projections and precision contacts and it offers many new features to enhance performance and reliability: flame retardant UL-94-VO materials, earth contacts in pin versions, new stream-lined styling, etc.

Assembly is fast and simple. The cable socket version has only three parts and new grub screw clamping.

The new AXR line is fully inter-mateable with XLR and is ideally suited to audio, video and other low level circuit applications where reliability and the elimination of radio, electrical and mechanical interference is necessary. These include television cameras, computers, medical electronics and industrial control devices. Available in 3-7 pin contacts.

The series also includes a range of AXR-LNE mains power connectors rated at 250 volt, 6 amps. This new streamlined version is ideal for numerous industrial applications where latch-lock quick-connect and disconnect is desirable.

For more information, contact **STC-Cannon Components, 248 Wickham Road, Moorabbin Vic. 3189. (03)555-1566.** ▶

THROUGH THE CONNECTOR JUNGLE

Jon Fairall

A WAG ONCE NOTED, with regard to the opposite sex, that there were fat ones and thin ones, big ones and little ones. He might have been talking about connectors.

To be a little more precise, connectors are the electromechanical devices that serve to interconnect the separate parts of a system, whether via wires, cables or printed circuit boards.

We have broken this huge field up into a number of categories based on the application of the connector, and then listed the most important types for that application, together with some information on the advantages and disadvantages of each type.

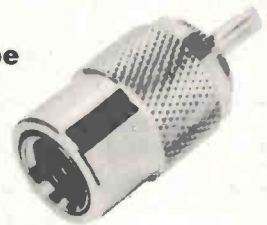
RF CONNECTORS

Radio frequency connectors are used in systems up to 10 GHz. By far the majority of RF connectors made are meant for attachment to coaxial cables. As a general rule, the different types of connector can be categorized according to the highest frequency they are designed to work. The higher the frequency the greater the dimensional precision and stability required.

Also, the greater the price.

RF connectors are also categorised according to the characteristic impedance of the cable. Typical values of coaxial cable are 50 or 75 ohm. Most of the connectors listed here are available to suit both impedances.

'UHF' Type



There are a number of connectors especially made for connection to flexible coaxial cables. By far the most common are the PL259 and the SO239 type. These are US Army parts numbers for a plug and socket that have been adopted by the industry as a standard for working up to about 200 MHz. They are generally made of plated brass with a hollow centre pin. The dielectric can range from brown phenolic ('mud' in the trade) to PTFE (rare).

The PL259 plug has two parts: the body and the ferrule. The latter has an internal thread that mates with the socket which has an external thread (see illustration). The cable shield braid is soldered to the body just behind the mating shoulder. The latter has teeth on the facing edge that mate with teeth around the rim of the SO239. This prevents twisting in use. The centre pin of both the plug and socket is usually plated with one of the noble metals.

There are two sizes of PL259 available, intended for fitting on either 10 mm RG8/RG213 cable or 13 mm cable. The type to suit 10 mm cable is the most common. If there is a need it is possible to fit PL259s to 6.5 mm coax (RG58) with the use of an adaptor.

One reason for the popularity of UHF plugs and sockets is that when properly connected and terminated they are designed to be extremely rigid, so that they will hold even when subject to extremes of shock or vibration. They are also relatively inexpensive. However, they do have one limitation, and that is that they are not constant impedance types, and in modern applications they are not recommended above 50 MHz. They will give tolerable results up to about 200 MHz, and in fact were designed to do so, but now that better connectors for high frequency use are available they are losing favour in this type of application.

N-Type

One of the modern connectors to replace UHF types is the 'N-type'. This is a constant impedance type connector with much the same frequency limitations as coaxial cable itself — about 10 GHz. They tend to be about the same physical size as the UHF types, but the signal carrying components are recessed inside the body. Typically these will be silver plated spring copper while the body will be made of a hard copper alloy. The dielectric is usually PTFE. The plug's centre pin is solid, except for a short hollow section at the rear, designed to accept the cable inner conductor. The plug pin and the pin-socket in the socket mate such that the dimensional accuracy of the line is maintained. In addition, spring fingers in the plug mate with the inside rim of the socket, preserving the line's outer conductor integrity. It is these factors which make N-type connectors constant imped-

One of the most neglected and maligned components in electronics must surely be the humble connector. Yet, the performance of a whole system can critically depend on the performance of a single one. But, connector classes, types and styles must nearly match the species of life on Earth! It's a veritable jungle with many a pitfall and trap for the unwary. This article should help you battle through the connector jungle.

ance. Both 50 and 75 ohm versions are obtainable.

The N-type plug secures the cable's shield braid with an internal metal O-ring and clamp ferrule, plus a rubber ring that effectively seals the cable termination from the ingress of moisture. While originally designed to have the centre pin soldered to the cable centre conductor, crimp-on models have recently become available. Like the PL259, the N-type plug has a threaded ferrule to secure it to the socket.

When the plug and socket are properly screwed together the fitting is virtually moisture-proof, which is one of the advantages of N-type connectors. The assembly is also mechanically very strong.

A similar quick connect/disconnect bayonet-type fitting is available, called the C-type.

N-type plugs and sockets are available in a positively huge variety of configurations: right-angle, line and chassis mount, shrouded, etc. Reducing adaptors are available for terminating smaller diameter cables. N-types for fitting to rigid and semi-rigid coax are also available.

BNC

Probably one of the best known of all the RF types. BNC connectors are typically used up to 1 GHz for attachment to the smaller diameter (5 mm, 6.5 mm) coaxial cables, such as RG58 and RG59. They are constant impedance types, and so preserve the impedance of the cable at least up to their design frequency. Their construction emulates the N-type, except that the BNC plug features a bayonet securing ferrule. Both 50 and 75 ohm versions are obtainable, though the 50 ohm type is the most common.

The body is made of plated brass, the dielectric usually being PTFE. The cable terminating arrangements are similar to the N-type. Crimp types have latterly become available, avoiding the necessity of soldering. Both the centre pin, shield braid and sheath are clamped, making this type of BNC mechanically very strong. A special tool is required.

The biggest advantages of BNCs are relative cheapness, small size and the fact that the bayonet lock allows for quick and easy connect and disconnect.

BNC connectors come in a number of different configurations. You can choose between in-line or panel mounting versions, right-angle etc, for both the sockets and plugs. BNCs for fitting to rigid and semi- ▶

rigid coax can also be obtained.

Physically, they are quite a bit smaller than N-types or UHFs. It is possible to get versions sealed into nylon jackets to increase their resistance to oils, salt water and the like. Adaptors for fitting BNCs to small diameter coax are also available (e.g: to fit RG 734, 3 mm coax).

Typical materials used in BNC connectors include silver plated brass for the cable termination, and sometimes for the whole body of the plug. The centre contacts are usually beryllium copper or brass, a choice of contact material that minimizes contact erosion with repeated insertion.

Belling-Lee or PAL types

'Belling-Lee' is the trade name for the 'standard' 75 ohm coaxial connector for TV antenna installations, after the company, Belling & Lee, that first introduced them. Latterly, as many companies now make facsimilies, they are referred to as 'PAL' connectors (after the 625-line TV system). They are designed to be as simple and cheap as possible while still giving adequate service across the VHF and UHF television bands. Note that the Belling-Lee company makes a wide variety of all types of connectors.

The plug body has three parts: the barrel, ferrule and clamp. The barrel is generally made of aluminium alloy these days, though other alloys (e.g: brass) are sometimes employed. The ferrule serves to secure the clamp which holds the cable shield against the rear end of the barrel. The clamp is usually of plated copper and has fingers which also clamp the cable sheath when the ferrule is screwed down. The ferrule is made either of the body material or plastic. The cable centre conductor is passed through the hollow centre pin and soldered at the tip. The dielectric is generally a translucent thermoplastic and care has to be exercised when soldering the centre pin to avoid melting the dielectric and misaligning the centre pin.

The Belling-Lee socket has a split body with an encircling spring clip to ensure good mating and contact with the plug barrel. Some models have plastic bodies with internal metal spring fingers. They are less robust than the all-metal types. The pin-socket is bifurcated and usually made of spring copper, plated with one of the noble metals. Again, the dielectric is usually of thermoplastic and care must be exercised when soldering to the centre pin.

No doubt because they are the domestic TV standard, and thus very popular, there is an enormous variety of assembly arrangements in Belling-Lee connectors. Although all have the same basic centre contact and shield it is possible to buy a number of different configurations. Many of the cheap ones have a plastic body assembly with metallic contacting parts. Others are moulded into a box containing a balun, allowing direct interfacing to 300 ohm twin-wire line.

CONTACT RESISTANCE — THE SEARCH FOR THE PERFECT JOINT

Contact resistance, as the name implies, is the resistance that appears across a connector. We can consider it as the sum of three resistances, i.e: the resistance across the wire-to-conductor interfaces on both sides of the connector, and the interface between the mated halves of the connector itself.

In most applications, the wire-to-connector interface will be a soldered joint. The better the joint, the less the resistance. To find out what is meant by a good joint read the article on soldering elsewhere in this issue.

The connection inside the plug, the interface, also has a resistance. It depends on four factors: the material from which the contacts are made, the condition of the surface, its shape and finally, the pressure upon the contacts. Unfortunately, these factors impose contradictory requirements on the design, so the final solution has to be a compromise, in which certain aspect of the total requirements are emphasised at the expense of others.

Consider the material from which the plug is to be made. We want it to have low resistance, obviously, but we also require that it should be as hard as possible, so that it doesn't wear away with repeated use. Unfortunately, it seems that the materials with the best electrical qualities are also the softest, as well as being the most expensive. Gold, silver and copper are all excellent conductors, but they are also comparatively soft. On the other hand, the materials renowned for hardness, iron or tungsten for instance, are terrible electrical conductors. We can lift the game somewhat with alloys and even more so with plating techniques, but the basic problem remains.

The preferred contact material is gold. It's expensive, of course, but it's the only element that combines outstanding electrical qualities with low susceptibility to oxidation. Oxidation is the process by which the element is converted into its oxide by exposure to the atmosphere. What happens is that, over time, a layer forms on all the exposed parts of the metal. A group of elements, notably gold and silver (the noble metals), form an extremely thin layer, only a few molecules thick, and are then completely stable. Others, like copper or iron, form oxides very readily, and once started will continue until all the metal is consumed. (Note that rust is just the oxide of iron).

There are a few elements that break down over time to something other than an oxide. Silver is one of these. The black layer that covers tarnished silver is a sulphide, silver sulphide, which forms when the silver comes in contact with contaminants in the air.

How serious a problem this is depends on the electrical qualities of the oxide. Gold, silver and nickel are all used because, even when an oxide forms, its presence doesn't affect the electrical parameters of the contact by any significant amount. Predictably, copper oxide (CuO), is a terrible conductor. Worse still, it can form a semiconductor.

Experience has shown that there are certain physical characteristics of contact surfaces that minimize resistance. Contrary to one's intuition, the surface should not be too smooth. A slight degree of roughness actually maximizes the area through which current will flow. Lubrication can also help under the right conditions, depending very much on the composition of the lubricant. It goes without saying that dirt on the contacts really messes things up.

The shape of the contact surface should be such as to maximize contact area. Bear in mind that resistance is related to the total area in contact (all other things being equal). The other criterion is that there should be no sharp corners, as it then becomes possible to wear away the mating surface in an irregular fashion. This leads to an optimum requirement for a round, pillar-like contact.

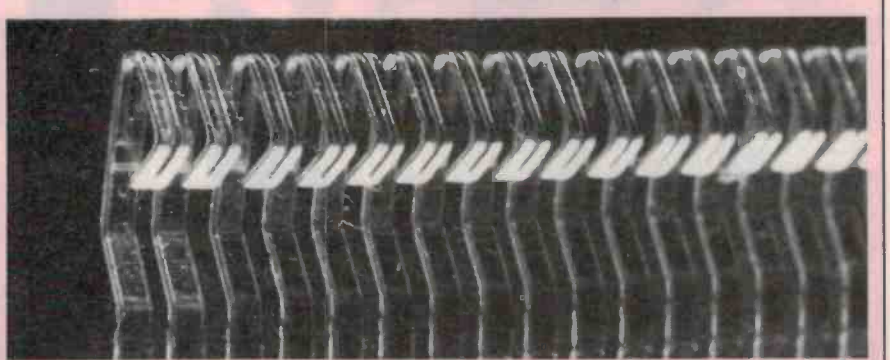
The problem with round contacts is that it's difficult to design a socket for one that can exert pressure to the same degree as a rectangular one. We want maximum pressure on the contacts to ensure the greatest possible mechanical bonding between the two surfaces. However, this causes a number of other problems.

The greater the pressure on the contact surfaces the more the contact surface will be worn away when the plug is operated. There's not much point designing an exotic, low resistance conducting surface if it's going to be worn away when the plug has been operated half a dozen times. Whatever the contact shape, the greater the pressure you apply it, the more it will deform as the two halves slide over each other.

In practice, these considerations have led to a number of standard designs which experience has shown are a reasonable compromise between the competing requirements. Typically, there will be a hard core, made of some hard conductor like beryllium-copper, brass etc, coated with some softer contact material like gold or silver, or, in cheaper plugs, nickel.

As to shape, the bellows-type connector, in which the natural spring of the contact material exerts the pressure is one answer. These are frequently used in edge connectors and such like application.

Round pillar-and-sockets are also extremely common. As well as the properties discussed above, these types also have the advantage that oxidation is less of a problem due to the scraping action as the plug slides into the socket. As a result they frequently use nickel as the contact material. Pressure is often applied to the joint by a screw top or spring loaded catch of some kind.



Gold! Plated contacts before assembly in an edge connector. Note the shape of the contacts. When the circuit board is slotted into place pressure on the contacts will be maintained by the springiness of the metal.

CONNECTORS

AUDIO CONNECTORS

The types described here are used almost exclusively for audio applications. Other types often used in audio work have been included under multiway connectors because of the flexibility of their pin layouts and their wide use in other applications.

Tip-sleeve 'jacks'

Tip-sleeve and tip-ring-sleeve 'jack' connectors have a long barrel with either a shaped, insulated tip or an insulated tip with a ring behind it. The barrel serves as the common or 'ground' connection, while the tip and/or ring provide the 'live' connections. The standard jack plug has a 6.5 mm diameter barrel. The tip-sleeve type is for mono (single channel) use, while the t-r-s jack is for stereo (or dual channel) use. In stereo applications the right channel connects to the tip and left goes to the ring.

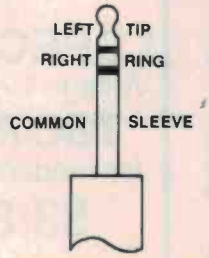


Figure 2: The layout of a typical tip-ring-sleeve jack.

A shroud or ferrule screws on the rear, covering the connections. A large lug attached to the shoulder behind the barrel has lugs to secure the incoming cable sheath, the ground or shield being soldered to this lug too. The shroud can be either metal or hard plastic.

The tip and ring contacts are brought up the centre of the plug to solder tag terminations under the plastic shroud.

The sockets comprise a hollow threaded metal shaft which serves to both secure the socket and provide contact to the plug barrel. Spring fingers contact the tip and/or ring. Some types have integral shorting contacts that ground the live connections when the plug is not inserted. More complicated versions have multiple switch contacts, rather like a relay, that are operated when the plug is inserted.

continued on page 57

CABLE TERMINATION — GETTING THE END RIGHT

Obviously, the joint you make between the wire and the connector itself is just as significant in determining the overall electrical characteristics of the unit as any other design consideration. There are a number of ways of doing it, all of varying degrees of difficulty.

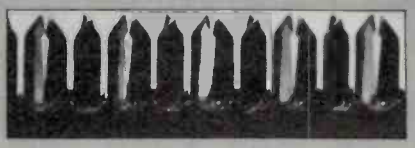
IDC CONNECTORS

The easiest to do are the Insulation Displacement Connector (IDC) types. They come in two halves, one side carrying the contacts, the other a backing plate. Each contact has split knife blades, such that when cable is placed between the two halves and squeezed together the knives cut through the insulation and come into contact with the conductor.

IDCs really come into their own with ribbon cable. They offer the wonderful advantage of not needing any solder, and if you've ever tried to solder up a 36-pin plug, you'll know how wonderful it is! They also make it possible to 'daisychain' DIL connectors on a cable rather easily, i.e: place a number of connectors in parallel along a length of ribbon cable. This is frequently required in computer systems, where various busses need to be fed to a number of different locations. While this is certainly possible with solder joints, in practice it is very infrequently found because it's so difficult to do properly.

CRIMP

Another type of jointing technique is crimping. Here the wire is squeezed between two metal flanges on the connector. Provided this is done properly it's actually a surprisingly good method of terminating cable. Crimping often requires no more than a pair of shaped pliers with which to squeeze the flanges together. Some manufacturers make special proprietary systems in which the connector must be terminated with a special tool. The spade connectors on telephone handsets are a good example of this.



Above: The cutting edge of an IDC. The wire gets forced down between the knife blades which cut the insulation as it does so.

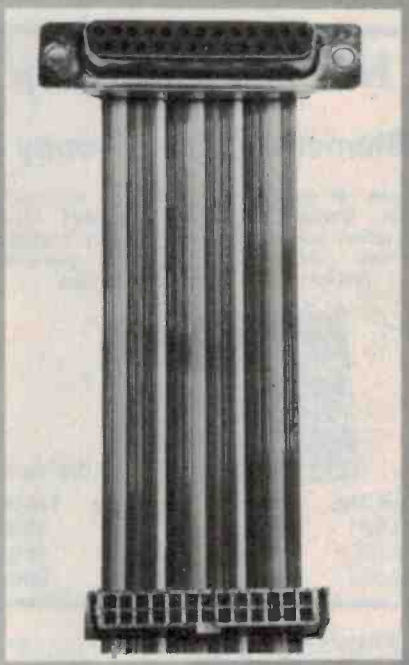
Right: A daisychain formed by an IDC connector joined to some ribon cable.

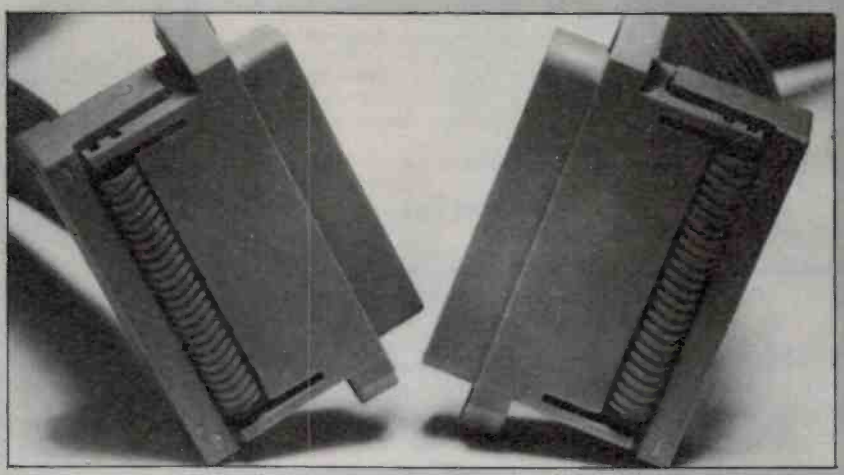
Below: Two D type IDC plugs.

COAXIAL

Probably the most difficult terminating job involves joining coaxial cable to connectors. The precise details of how this is done vary from connector to connector, but generally you need to solder the centre conductor to the centre pin, and then connect the outer to the shroud in some way. The usual system is that when the shroud is screwed down on the body of the connector the shield braid gets squeezed between the two. This means that the shield braid provides strain relief for the soldered joint in the centre, and is responsible for the integrity of the entire joint. Some types also clamp the outer sheath, reducing the strain relief role of the shield braid.

Another type of termination, much favoured on DIL connectors, is wire wrapping. Wire wrap terminals are square to give a good grip to the cable that is twisted around them. They have a number of advantages over other methods, including the fact that as the cable is twisted around the terminal it breaks through the oxide layer on it, thereby ensuring a tight, low resistance joint. It is also possible to vary the resistance by increasing or decreasing the area under the wrap. But perhaps the greatest advantage of all is that if you blow it, you get another chance!





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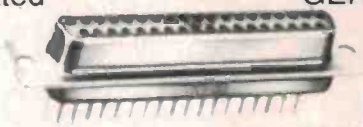

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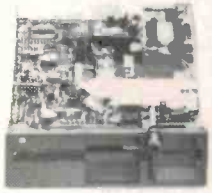

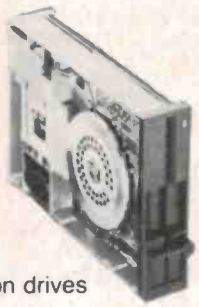

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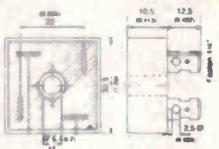

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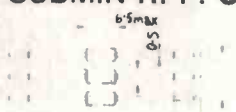

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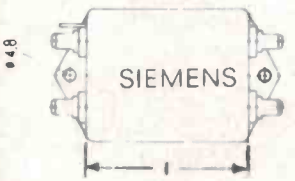

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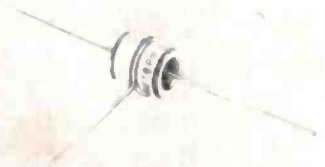

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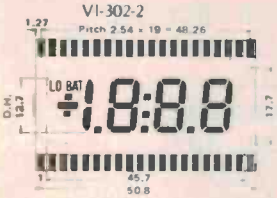

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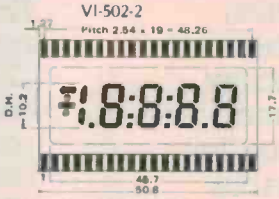

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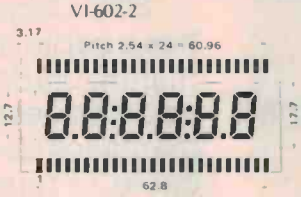

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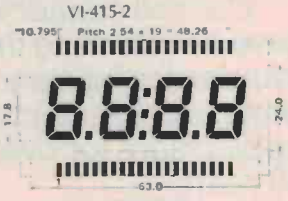

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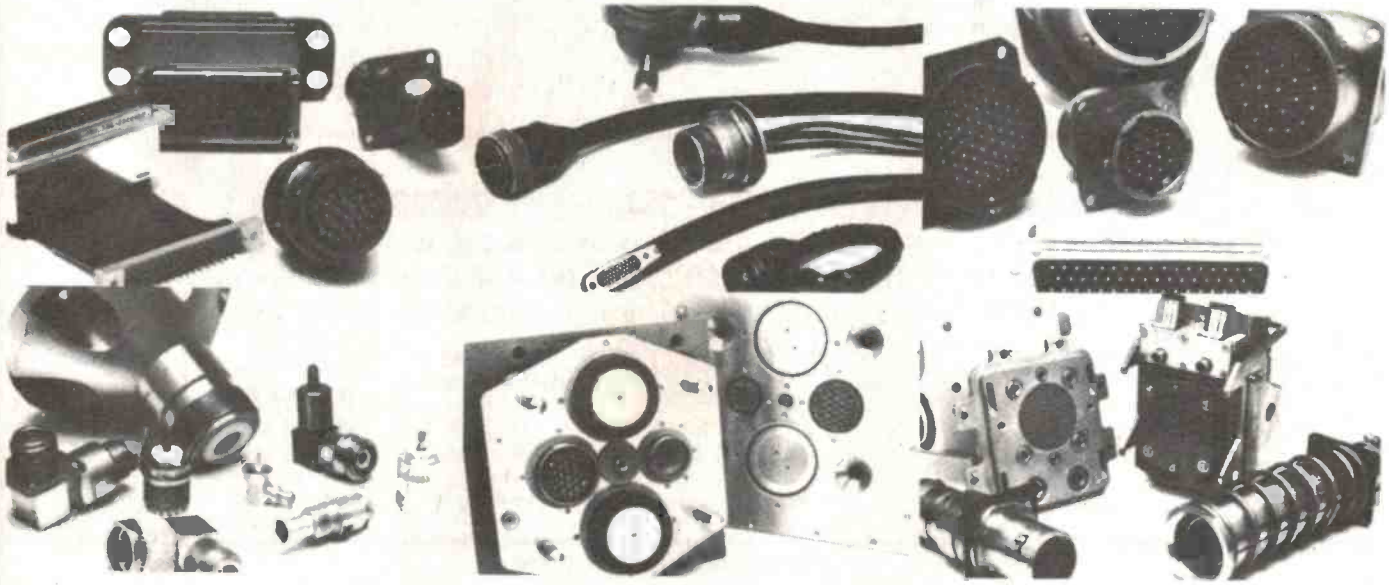

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The 6.5 mm jack is predominantly found on guitar and headphone leads, applications where ease of insertion and withdrawal is important. They are designed to be operated a great many times with perfect reliability.

The spring metal tip contact fits into a groove in the tip of the plug. This means the plug will be held securely even after many thousands of insertions. Lateral pressure holds the plug barrel securely against the socket ferrule. Note that some sockets have an insulated ferrule with internal spring metal contacts.

In 6.5 mm plugs, the metal parts are usually of copper alloy or brass plated with a thick, hard layer of nickel or chrome to resist wear and prevent surface corrosion of the base metal.

For domestic applications, smaller versions of the 'standard' 6.5 mm jack are available. These follow the same pattern but come in 2.5 mm and 3.5 mm diameter versions. They are popular for much the same reasons as the bigger one, although they tend to be less robust, but then they're cheaper as well. They are very convenient where space is at a premium, hence you find them used as headphone and microphone connectors on portable cassette recorders etc.

RCA connectors

This line audio connector is a low cost utility type originally designed by RCA for use in semi-permanent applications with coaxial or shielded leads. They consist of a single hollow centre connector with a concentric metal body having slits around the rim that provide laterial pressure on the socket body. This ensures good contact and mechanical stability. The insulator holding the centre pin is usually of moulded phenolic. The cable centre conductor passes through the centre pin and is soldered at the tip. The cable shield simply solders to the rear of the plug body. A coloured plastic shroud covers the termination at the rear. The metal parts are usually of copper alloy, generally plated with nickel or some other corrosion-resistant metal. 'Deluxe' types are gold-plated.

The sockets are quite simple with a split barrel-type centre pin and a concentric metal body. Again, the insulator holding the centre pin is usually moulded phenolic.

RCA plugs and sockets can be bought in a variety of configurations: in-line, chassis mount, insulated chassis mount, etc. One very useful variation has a number of sockets mounted on a single strip. You'll mostly find such things on the rear of audio gear such as amplifiers, cassette decks etc. in a neat row.

Figure 3: A double-male BNC sex changer.

WIRING AC CONNECTORS — HOW TO STAY ALIVE

No one with an interest in electronics should forget that it's a potentially lethal interest, and no more so than when dealing with the mains. No piece of equipment you use should allow a user direct access to 240 Vac under any circumstances.

Equipment in protected by two different methods — earthing and double-insulating. Double-insulated equipment usually only has a two prong plug and frequently carries a warning "double insulated — do not earth". Double insulated equipment has, as its name suggests, two sets of insulation between any live conductor and the user. The equipment should be laid out such that in the event of failure of any single insulator the equipment is still safe.

Earthed equipment, on the other hand, has a connection between the case and local ground via the third pin on the plug. This means that no significant potential can exist between the case and a person touching it.

It goes without saying that it is vital that any mains connection you do should be done properly. Cable for mains use comes in combinations of red, black and green, or brown, blue and green/yellow, which carry the active, neutral and earth respectively. (See diagram)

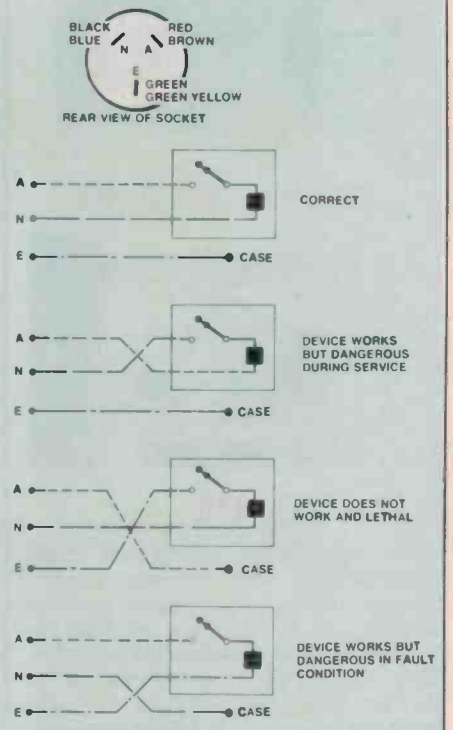
Note that a number of mistakes can be made in wiring up mains connectors that will result in a hazardous situation existing, even though the device may work. If, for instance, you interchange active and neutral (a very common mistake) the device will still work, and will still be protected by the earth lead. However, the switch in the device will be inserted into the active line. So, if you have the plug wiring the wrong way around a situation could arise where, even though the switch is off all the components inside are still live. Moral: always unplug before fiddling.

Another tricky one is interposing neutral and earth. The device will still work, but is no longer protected by the earth cable. If a short develops between the supply and the case then it will rise to supply potential, and so will anything else attached to it. Since this will include every other metal case attached to the earth circuit this is a very dangerous situation, and one that could lie dormant for years.

Should you ever transpose active and earth, you get one chance to realize you've made a mistake: the device will not work. However, if you touch the case, you probably won't be in any condition to worry about it!

The mechanics of wiring up plugs vary from maker to maker. One point worth noting, however, is that mains plugs do not rely on the connection between the wire and the pin to take cable strain. Older style plugs had a cable clamp that need to be screwed down. Modern types rely on a tortuous path for the cable inside the plug to take the strain. In either case do not be tempted to take short cuts — the plug may work now, but will it in six months time when it has been stressed a couple of times.

Another tip worth noting is that when wiring up mains cable always try to leave the earth connector slightly longer than the other two. This means that if the cable is stressed, and the clamps or whatever do not work properly, at least the earth connection will be the last to feel the strain.



Caution. One correct and three incorrect ways of wiring up a mains plug. Examples of interconnections with pin headers.

ADAPTORS

With so many different types of connectors available, it is inevitable that a need for adaptors will present itself. Many manufacturers make a range to not only adapt between connector types but to change the sex too! Sex changers are usually simple arrangements (Figure 3) in which either plugs or sockets are mounted back to back.

The most common adaptors are undoubtedly those that change the various sizes of coaxial plug. These generally come as an in-line unit with a plug on one side and a socket on the other. Another very common type permits interconnection of BNC to the other RF types. But with a bit of perseverence it should be possible to find just about any combination you want. Some companies make N-type to 2.5 mm jacks others, BNC to GR plug etc!

Another very common type of adaptor permits the connection of three cables, usually one input and two outputs, but some- ▶

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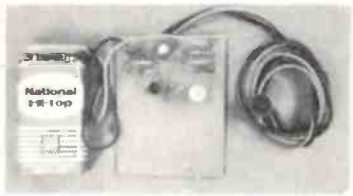

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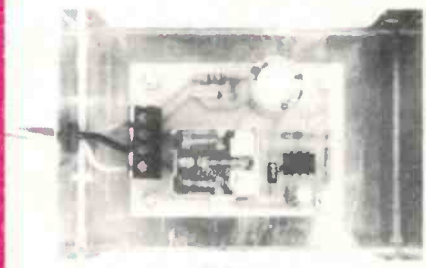

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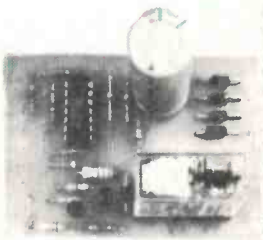

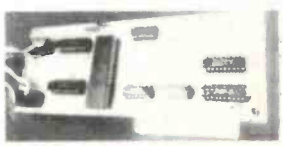

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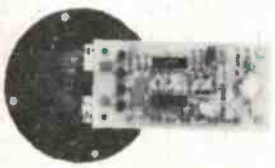

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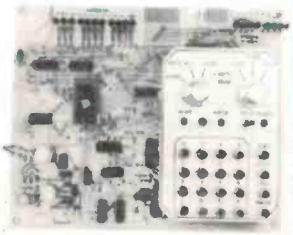

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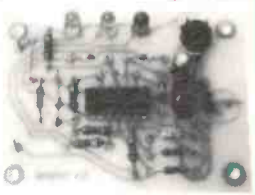

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times an output and two inputs. Because they are generally t-shaped, they are called T-adaptors (obviously!).

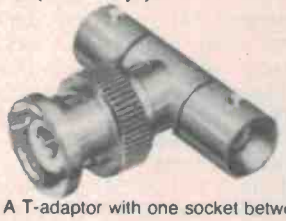


Figure 4. A T-adaptor with one socket between two plugs.

PC BOARD CONNECTORS

There are two main types of connectors designed specifically for printed circuit applications: edge connectors and in-line types.

There are certainly plenty of other types of connectors adapted for mounting on pc boards, but here we'll consider only those types specifically designed for use in conjunction with pc boards. Let us take them in turn.

Edge connectors

An edge connector is designed, as its name suggests, to provide connections to and from a printed circuit board via tracks brought out conveniently to an edge of the board. It is undoubtedly the cheapest and simplest way of connecting wires to a pc board in a non-permanent way. From the design point of view it is also one of the most flexible. There are two fundamental types: direct and indirect.

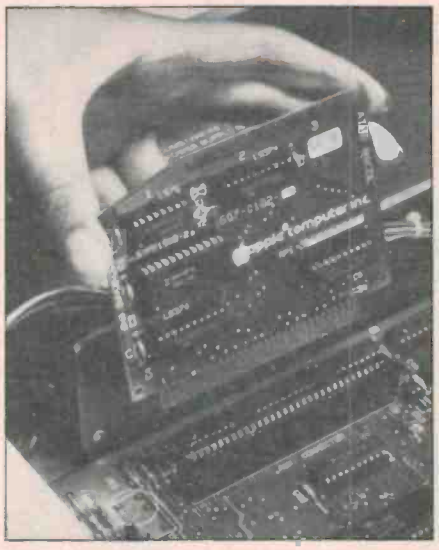


Figure 5: A typical edge connection system as utilized by the Apple IIe.

Direct edge connectors are sockets that mate directly with tracks that terminate at the edge of a board, arranged in certain standard widths and spacings (the 'pitch'). Probably the most familiar application is seen on computing equipment. In 'the trade', several are well known through wide application: the 100-pin 'S100' buss connector, the 56-pin STD buss connector, the

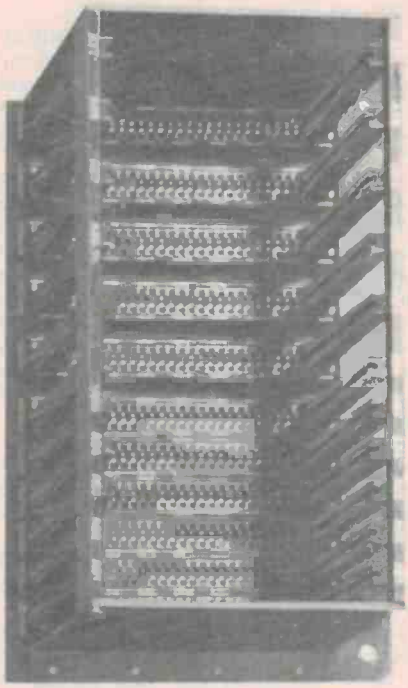


Figure 6: A typical rack assembly. Printed circuit boards can be slid in or put on the rack to maximise ease of servicing. ▶

IEEE-488 buss connector, etc.

The connector tracks on the board will always be plated to prevent corrosion of the copper track and to reduce wear. Tin and nickel plating are common. Gold is also used, usually plated over nickel but, as you would expect, it's more expensive.

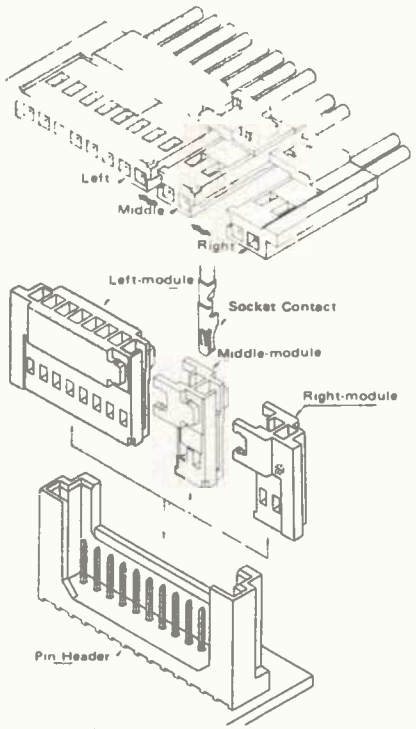
Indirect edge connectors are of the plug-&-socket variety. One mounts on the board, its pins being soldered to pads to which the connections are brought out. The mating connector mounts on the chassis in which the board is mounted, usually in a slide-in/out rack assembly. (See Figure 6) Probably the two most familiar examples are the ISEP and the G06/G60 types designed to meet the European DIN and IEC electronic packaging standards.

Typically it is possible to find edge connectors with almost any number of contact ranging from four to 100 or more. The dielectric body is generally made of plastics such as polyester or polycarbonate.

Edge connector sockets can be obtained with either solder-trype or wire-wrap terminations.

Direct edge connectors suffer from one dissadvantage — repeated insertions of the pc board will cause the track plating to deteriorate. For this reason, heavy plating with one of the hard metals or alloys is often employed.

In-line connectors



Above. A pin-header and plugs. Modular design means the user decides how many connectors there should be.

Another way of connecting wires onto circuit boards is via in-line packages where the connector pins are arranged side-by-side in line — hence the name!

There are a number of different types in this category. The simplest are the 'pin headers' which consist of a row of pins mounted in a dielectric (usually polycarbonate). The pin stubs protrude through one side. These fit into the pc board and are soldered to track pads. A pin header socket mates with the pins.

Both single in-line (SIL) and dual in-line (DIL) styles are available. As the name implies, the DIL type has parallel rows of pins. The pins are generally of hard copper alloy, plated with nickel or gold, though other metals are used.

A variation of this theme are those plugs designed to fit into IC sockets. These come in the familiar 14- to 40-pin DIP (Dual in-line package) versions.

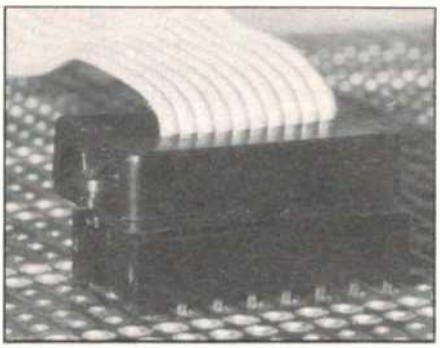


Figure 7. A 14 pin DIP IDC fitted to an IC socket ▶

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MULTIWAY CONNECTORS

This is a category for all those types of connectors that have more than two pins, in various configurations, and that have applications in various fields and don't comfortably fit into the other categories!

Probably the two most famous types would be 'XLR' and 'MS' connectors. However, special connectors are now made for the narrowest applications and multiway connector types are legion. We can only hope to cover the common generic types here.

XLR

The XLR started out as the 'industry standard' for audio interconnections. It is produced by a number of different manufacturers and comes under a variety of names.

Originally produced by Cannon, it is often simply called by that proprietary name. Cannon themselves recently released a new version of the XLR called the AXR, with lower cost components and fewer parts. Other compatible products include types made by Neutrik, the Switchcraft Q6 or the Radiospares X series, for example.

All these names describe a product that has a circular metallic body surrounding a dielectric having between two and seven pins in a standard arrangement. The body can serve as an integral part of the connection scheme, as a common or ground, while providing mechanical coupling and rigidity, or it may be isolated.

The plug pins are solid, hard copper alloy, plated with a hard-wearing metal. The socket pins employ a split-finger construction and are made of the same material as the plug pins. They can be obtained with gold-on-silver plating for best wear characteristics. A locking finger on the socket snaps into a channel in the plug. This construction provides a rugged, hard-wearing, low noise connector that cannot be dislodged under cable tension.

The most popular version in audio applications is the 3-pin type, while a special 4-pin version is often used for dc and ac power applications. By convention, the latter type has a red dielectric. Versions with five, six and seven pins are obtainable. The contacts on the 3-pin versions can carry currents up to 15 amps. The 4-pin one will carry up to 10 amps per contact, while the five and six pin versions are rated at 7.5 amps per contact. The 7-pin one will carry 5 A per contact. The dielectric is rated at 250 Vac (RMS).

Other fields of application include video and medical equipment, industrial control devices and telecommunications equipment.

Because of their fields of application, the design of the XLR has emphasised rugged construction and the ability to handle extreme environmental conditions even after many insertions. The insulator, for instance, is manufactured with special anti-vibration ribs to eliminate the effects of vibration.

The design of the contacts maximizes ease of insertion, while at the same time minimizing the erosive effects of wear. The socket has a conical shoulder to guide the incoming plug.

An enormous range of styles is available. Both plugs and sockets are available with shrouds for in-line terminating, or with a flange for panel mounting. The flange can be square or round or specially designed for wall mounting. Others are designed for right-angled cable entry. All in-line types feature a cable camp to prevent stress on the terminations when the cable is under tension.

DIN

Another very common type of multiway connector is the DIN family. DIN is an acronym for a German industrial standards body. They consist of between two and seven connectors surrounded by a metal shield/connector body. The multi-pin types have the pins arranged around a semicircle in the dielectric, which may be of thermoplastic material or polycarbonate, etc. The two-pin types are a little different. The body parts may be all-metal of diecast construction, or a combination of moulded plastic and stamped metal parts. A variety of cable securing methods are used.

DIN connectors were originally used in audio applications, though these days they are found in all sorts of fields.

The two-pin type consists of one square and one round connector, mounted one above the other. It is intended primarily for domestic audio use on speaker cables and similar applications, though they're often used as a general purpose polarised connector (e.g: on the dc lines). ▶

CONNECTORS

The three, five, and seven pin versions all consist of solid, round plated copper alloy connectors placed in a semi-circle around the inside of the shield. The DIN specification designates the central pin (pin 2) as the signal earth. (See the accompanying diagram) and the chassis earth goes on the shield (in applications where the two are separated. Sometimes the shield is not connected at all).

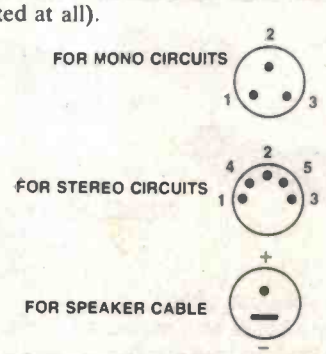


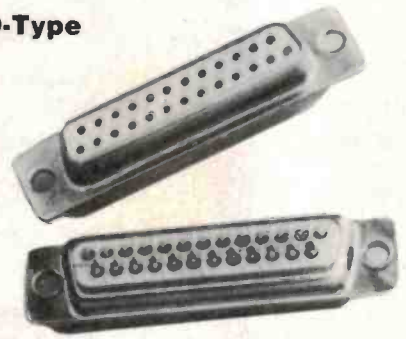
Figure 8: The three basic DIN configurations. Notice the strange pin numbering system on the five pin DIN. Seen from the back of the plug.

DIN plugs come in a variety of mounting styles. For instance, they are available as in-line connectors to be used when connecting two cables together. Generally, this type has a grey plastic shroud, but some manufacturers are now starting to supply them with a variety of coloured plastic covers for colour-coding.

Types with a locking ring to prevent accidental uncoupling are available, along with types having a special shroud for moisture-proofing, etc. Some manufacturers provide latch-locking types, too. They are also available with flanges to enable panel mounting (either male or female). Usually the flange is connected directly to the shield, but it is possible to find ones where the flange is completely insulated.

There is usually provision for either terminating the connectors in wires or directly onto a printed circuit board. Often this type has the pins at 90 degrees to enable the plug to be mounted vertically on a horizontal board.

D-Type



So-named because of its cross-sectional shape, the D-type is heavily favoured in the computer industry where it is almost universally used for input/output ports. To accommodate a wide variety of needs in the industry it is possible to specify between five and seventy-odd pins in the D-type format. Indeed, such is the flexibility of the system, it is possible to buy the dielectric, pins and shell separately and assemble them in any desired configuration. The common element in all cases is the trapezoidal polarizing flange which locates the male over the female.

A wide variety of shell types are available for the D-type. A cable clamp is provided to secure the cable and prevent any tension straining the cable terminations. Most have some type of locking mechanism on them, generally consisting of screws passing through flanges at either side of the connector body. Both metal and plastic shells are available in clip-on and screw-on styles. (See also 'IDC' connectors).

Pin construction varies widely, from solid, plated copper alloy to rolled-plate pins. The body dielectric is usually a polycarbonate material.

The 25-pin 'RS232' computer connector is probably one of the most well-known, along with the 9-pin type commonly used on home computer joystick interfaces.

Another common D-type is known as the 'JD' series. These employ a cantilever-type flat spring leaf contact on both the plug and socket. They are generally obtainable in 14, 24, 36 and 50 pin versions. The socket is generally for chassis mounting and the plug for line termination. A lock spring mechanism for holding the plug to the socket is sometimes employed. The 36-pin version is known as a 'Centronics' connector in the computer trade, commonly used on printer interfaces.

Circular multipins

Multipin circular connectors come in a huge variety of configurations. They are available with up to 50 or so pins and are much favoured by the military where their rugged construction and environmental tolerance are much appreciated. Originally known as 'military series' connectors. Similar, low-cost versions are known as CA types.

Typically the shell is made of some aluminium alloy, perhaps with an anti-corrosion coating like cadmium. Contacts are usually a copper alloy with hard gold plating. Often the pin enclosure is sealed with rubber gaskets around the cable entry. Mostly they are held together with a screw ring. The cable is generally held in a screwed-down clamp. The plug has a slot on one side to mate with a key in the socket that guides it in during insertion and prevents rotary shear pressure being exerted on the pins. Mounting arrangements provide for both line and chassis, or 'bulkhead', mounting. ▶

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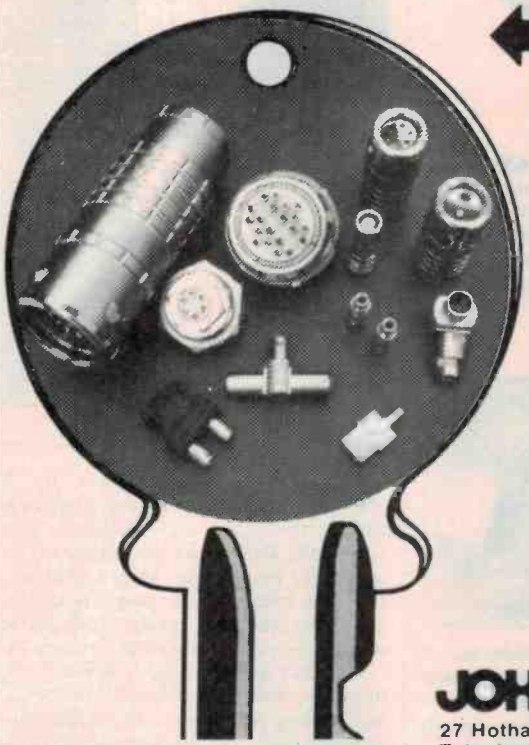

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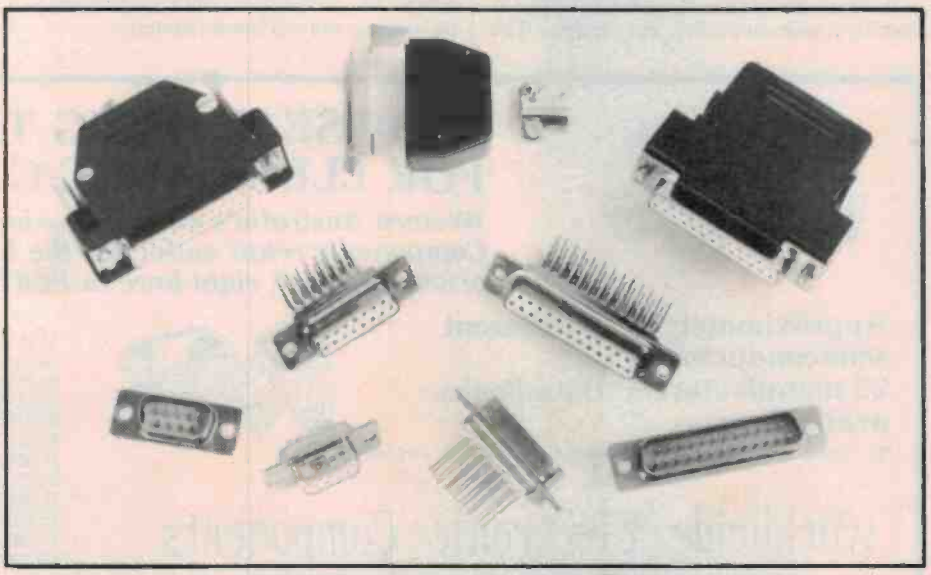

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Pin current ratings vary widely, as does the insulation voltage rating. Cable termination is by soldering.

Other common multipin connectors are the 'K' type which feature quick connect/disconnect and the 'EP' series which are a keyed spring-latch type. Similar miniature types are known as SRC series. All have circular construction.

Square types

Square multipin connectors are usually blocks of Nylon that comes with the contacts separate from the body of the plug. After the wire has been soldered to the contact they are rammed into the body so that when the plug and socket are mated together that Nylon body completely encloses the contacts and terminations. Most have a latch locking mechanism integral with the body.

As a result of their construction they are relatively impervious to hostile environments and are much favoured for use in motor cars and other vehicles. They are virtually immune to the effects of vibration, oil humidity and temperature experienced in vehicles.

TEMPORARY CONNECTORS

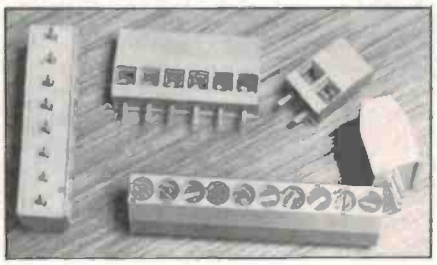
This category covers a multitude of connector types that can be used for making temporary connections. The common factor among them all is that they are very simple to use.

Hook connectors

One popular form of temporary connector is the hook connector. It is often supplied as standard with measuring instruments. The

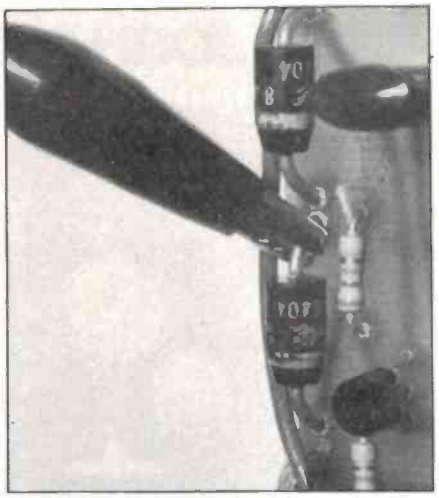
connector consists of a plastic handle with a spring-loaded button on it. Operation of the button causes a small hook to protrude from the bottom of the instrument. This can then be hooked over any appropriate component lead, the spring maintaining tension on the joint.

Terminal blocks



The perennial experimenters problem, of course, is how to get wires onto a printed circuit, matrix or vero board with connections that don't fall apart when you breath on them. One modern answer is the terminal block (like electricians use) with a printed circuit board pin at the bottom. They provide a quick and exceptionally reliable way of making connections. The connection is made by inserting wires into a bored-out metal block which has a grub screw through the side to secure the wires.

There are a number of different styles on the market. Some are square, others have the front face sloped at 45 degrees to make for easier cable access. Some types are supplied individually and some in long strips that can be cut down to your own requirements. The dielectric is either a soft thermoplastic or a polycarbonate material.



Alligator clips

Another option is the alligator clip. These consist of two spring loaded jaws between which the wire or whatever can be squeezed. Their chief advantage is convenience and ease of use. One disadvantage is that the contact they make is unreliable, especially when the spring ages a bit and/or wear allows corrosion of the teeth.

Another disadvantage is that the body of the clip consists of a beautiful short circuit just waiting to happen. There are varieties available with a plastic shroud over them to solve this problem. Cost is directly proportional to quality.

Spade connectors

Spade connectors consist of a flat piece of metal that slips into a mating shell to make the contact. Flying leads may be joined to the connector with solder or by crimping, or even, in some cases, by screws. More expensive versions often come with a plastic shroud over them to prevent short circuits.

Typical construction materials are aluminium, brass or copper alloys. They are generally nickel plated or passivated.

continued on page 160 ▶

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MOTORCYCLE INTERCOM $40

INVERTER 40 WATTS $49.50

MAY EA 1982

This 12 240V inverter can be used to power mains appliances rated up to 40W, 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.

MUSICOLOR IV $84.00

Add excitement to parties, card nights and discos with EAs new 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 August 81

TV PATTERN GENERATOR $67.50

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns dot crosshatch checkerboard grey scale and white raster.

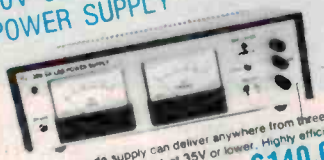
Electric fence $19.50

Check our prices

SEPTEMBER EA 1982

Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian Standard 3129

50V 5A LABORATORY POWER SUPPLY



New switchmode supply can deliver anywhere from three to 50V DC and currents of 5A at 35V or lower. Highly efficient design. EA May, June 1983 $140.00

ETI-1516 MODEL ENGINE IGNITION SYSTEM $41.50

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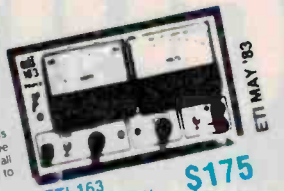
ETI-162 30 V/1 A FULLY PROTECTED POWER SUPPLY $47.50

ETI DEC '83

The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0 V to 30 V and selectable current limit. Both voltage and current metering is provided.



ETI MAY '83

ETI-163 LAB SUPPLY $175

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

HEADPHONE AMPLIFIER $28

EA MARCH 84

ETI-335 PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

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PARABOLIC MICROPHONE $15

EA NOVEMBER '83

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 components for this project is around $15 including sales tax, but not the cost of batteries or headphones.

1000's SOLD TRANSISTOR TESTER $15

EA SEPTEMBER 83

Have you ever desoldered a suspect transistor, only to find that it checks OK? Troubleshooting 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.

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JUNE EA 1982

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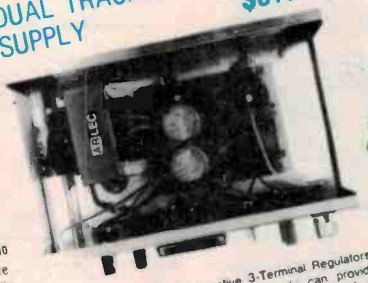


Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages from ±1.3V to ±22V at currents up to 2A. In addition, the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway. EA March 82

ETI-164 ZENER TESTER

$9.50 ETI MAY '83

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-733 RADIOTELETYPE CONVERTER FOR THE MICROBEE $20.00

ETI APRIL '83

Have your computer print the latest news from the internation shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee's parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too.

SLIDE CROSS FADER $85.00

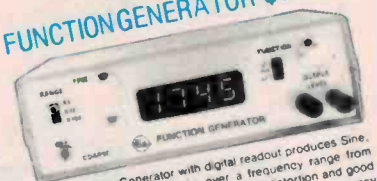
EA November 81

ETI-153 TEMP PROBE $19.95

ETI JUNE '83

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

FUNCTION GENERATOR $79.50



This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160kHz 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

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Project 1410

150W BASS GUITAR AMP

Part 2

Robert Irwin

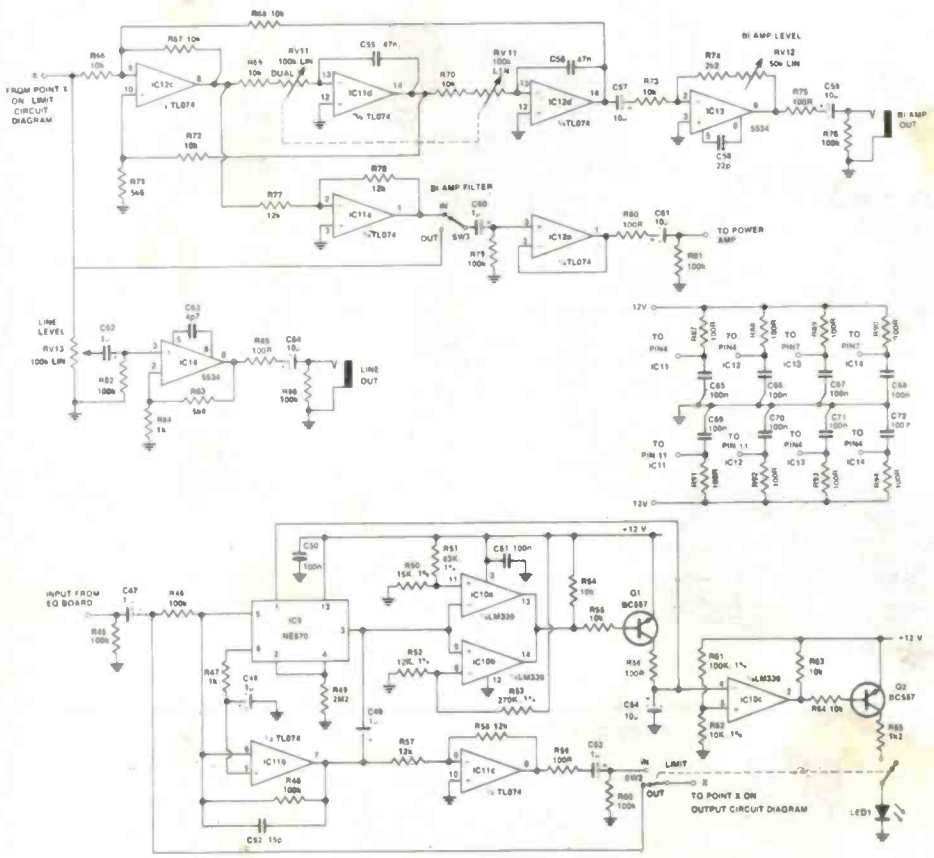
IN PART 1 the constructional details for the power supply board and input board were given. This article completes the picture, with details of the equaliser board and the output/limiter board, plus gives full constructional details for the complete amp.

Construction of the boards

The equaliser circuitry is contained on two boards, ETI-1410 c & d. The ETI-1410d board contains the main circuitry and the ETI-1410c board supports the six slider pots used for the adjustment of boost and cut. The construction of both boards is straightforward.

Start with the ETI-1410d. Solder in all the resistors first. The capacitors should be soldered in next but take special care to get the values in the correct place as these set the equaliser frequencies. Take care to get the orientation correct on the electrolytics and tantalums. Solder pins should be soldered into the holes for the input, output and power supply connecting leads as these will be connected after the board has been mounted and the underside will not be accessable for soldering.

The next step is to locate and solder in the ICs. This should be done with care as it is easy to bridge the tracks between IC pins with solder. Also take care to get the ICs the right way round. The only thing left to do on this board at the moment is to solder lengths of tinned copper wire (about 40 mm each) into the holes which will join to the board containing the sliders. These will be connected to the other board after both boards have been mounted in the case. The switch and pot shown on the circuit diagram are external to the board and will be attached with hookup wire at a later stage.

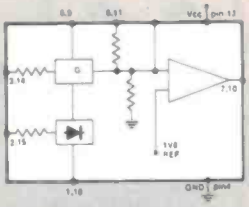


HOW IT WORKS ETI 1410e LIMITER/OUTPUT BOARD

This board has two main areas of circuitry, the limiter circuit and the output circuitry. They are independent of each other, so we can deal with them separately.

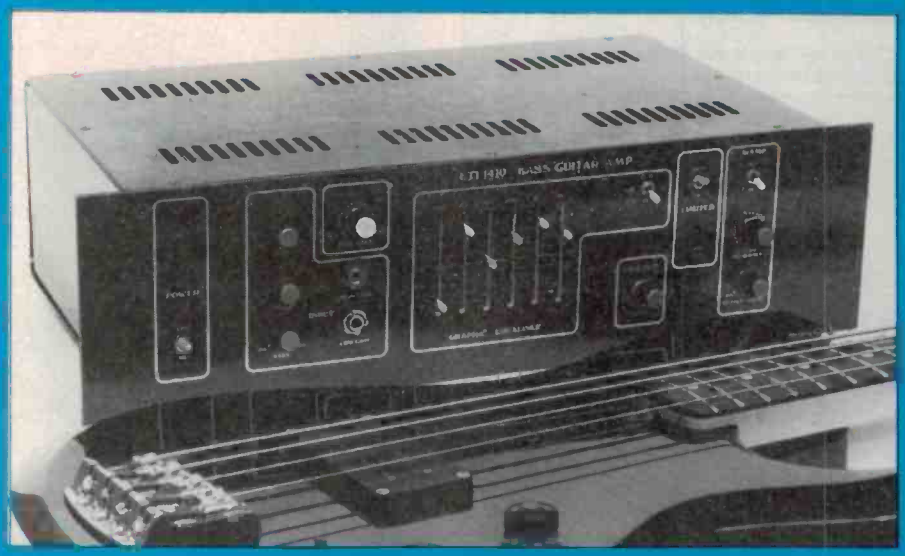
LIMITER

The heart of the circuit is the NE 570 Compander IC. This IC contains two identical gain control circuits which can be configured to produce a variety of compression and expansion type circuits. In this application only one of the circuits is used and this is configured as a hard limiter circuit designed to limit the output to a maximum of 1 V RMS.



The input from the EQ board is ac coupled by C47 and R45. The input is taken to an inverting amplifier stage formed by R46, R48 and IC11b (¼ of a TL074). Note that IC11b is used as a replacement for the internal op-amp incorporated on the NE570 chip which is not used here. Also incorporated in the feedback network of IC11b is the variable gain cell of the NE570 (pins 3 and 5) which is in paral-

bass guitar amp



The final part of this project looks at the operation of the sections not covered in Part 1. There are also full details of construction, powering-up and testing.

The ETI-1410c board contains only the six sliders. These should be soldered in at the top and bottom lugs only. The slider lugs will be connected to the main board once the boards have been mounted. Make sure that the sliders sit flush against the pc board and are sitting straight and square.

The final board left to construct is the limiter/output board (ETI-1410e). This is a relatively complex board and should be checked thoroughly for any bridged or broken tracks before you start. If all is well then start in the usual manner with the resistors and capacitors. After these have been soldered in, the eight links should be soldered in place. Tinned copper wire can be used for the links as they have been spaced far enough from other component leads so as not to be in danger of shorting.

Once again, solder pegs should be soldered in to the input, output and power supply holes. Solder in the ICs and transistors next; making sure that you get them the correct way round (note that the two NE5534's are the opposite orientation to the other IC's). An IC socket can be used with the NE570 in case it is necessary to replace it at some later date.

Once you have finished soldering in all the components, go back and double check that they are all in the right places and are the right way round. Once you are satisfied that all the boards are correct we can get on to the job of putting the thing together.

Constructional details

The prototype unit was mounted in a standard 19" (424 x 250 x 140 mm) rack-mount, black anodised instrument case. This was supplied disassembled, but if you have one already built up then start by taking it apart. ▶

lel with the feedback resistor, R48.

C49 insures that the dc gain of the op-amp is not afected by changes in the variable gain cell. For small input signals less than 1 V RMS the variable gain cell is turned off and presents a high impedance which won't affect the gain of IC11b.

The gain for the signals less than 1 V RMS will be unity (set by R46 and R48). If the input signal rises above 1 V RMS a threshold level will be exceeded on the dual comparators formed by IC10a and IC10b. IC10a will detect positive going peaks and IC10b will detect negative going peaks. Pin 3 of the NE570 is internally biased to 1.8 Vdc so the threshold voltages for the positive and negative comparators are 3.2 Vdc and 0.4 Vdc respectively (since 1 V RMS represents a peak voltage of 1.4 V).

When a comparator threshold is exceeded then the comparator output will swing low and turn on the transistor Q1. This charges C54 through R56. As the voltage on C54 rises the variable gain cell is turned on due to the increase in voltage on pin 1 of the NE570. This has the effect of lowering the effective resistance of the variable gain cell which, in turn, increases the ac feedback on IC11b and lowers the ac gain. This will hold the output voltage to 1 V RMS regardless of how high the input voltage is.

IC10c is another comparator which detects the rise in voltage on C54 and turns on Q2 to supply current to the LED which indicates that limiting has occurred. R49 trickles a small amount of current through the variable gain cell so as to keep the capacitor C54 slightly biased on. This ensures a fast turn on time when the limit circuit is activated. The attack time of the limiting action is set by the RC time constant of R56 and C54. The component values shown given an attack time of less than 1 millisecond. This can be varied by varying R56. When the limit action is turned off (i.e: when the input falls below 1 V RMS) C54 discharges through an internal 10k resistor in the NE570. The components given give a release time of around 100 mS. To vary this you can vary the value of C54 but the value of R56 will have to be adjusted to give the correct attack time.

The positive input of IC11b is connected to pin 8 of the NE570 which is internally biased to 1.8 Vdc. This biases the op-amp output. R47 and C48 provide noise decoupling.

IC11c is configured as a unity gain inverter which is used to buffer the output and to put the output in phase wiht the input. C53 and R60 provide ac output coupling and R59 isolates any capacitive loading. The limiter circuitry can be bypassed using SW3.

OUTPUT

The output circuitry provides three separate outputs: line output, the bi-amp output and the power amp drive. The line out is provided by IC14, an NE5534 op-amp. This is configured as a non-inverting amp with a gain of 6.6 set by the equation:

$$Av = 1 + R83/R84$$

RV13 provides level control and C62 and C64 provide ac input and output coupling. C63 provides frequency compensation for the 5534.

IC12c, IC12d and IC11d form a state variable filter network. A state variable filter produces a highpass, lowpass and bandpass output all with the same cutoff frequency. Only the highpass and lowpass outputs are used here. The highpass output comes from the output of IC12c and is fed to an inverting buffer, IC11a. This gives the correct phase on the output. The output is then fed to IC12a which provides output drive to the main power amp. C61 provides ac coupling to the power amp.

The lowpass output is derviced from the output of IC12d and is ac coupled via C57 to an inverting amp stage formed by IC13. The gain is given by

$$Av = (R74 + RV12)/R75$$

This can be varied from 0.2 to 5.2 by varying RV12. The output of IC13 is ac coupled to the bi-amp output jack by C59 and R76. C58 provides compensation for the 5534.

The cutoff frequency of the filter network is given by:

$$F_c = \frac{\pi}{2}(RV11 + R69 \times C55)$$

For the values given this can be varied from 30Hz to 340Hz by varying RV11. The input to the power amp can be switched from bi-amp to the output of the limiter section by SW4.

Power supply noise de-coupling to all the IC's is accomplished by R87 to R94 and C65 to C72.

HOW IT WORKS ETI-1410c and 1410d EQUALISER BOARD

The equiliser board is an adaptation of the series 5000 ⅓ octave graphic equiliser published in the November 1982 issue of ETI. It incorporates selective filters in the feedback loop of an op-amp, to generate frequency selective gain.

Signals from the input board are fed to IC6c, which is connected as a buffer and provides a low driving impedance for the equiliser section. The input impedance is set to 10K by R20. RV4 provides a master control and feeds signals to IC8, an NE5534 op-amp which is connected as a non-inverting ac amplifier. The gain of this op-amp is set at 58 by the network R24 and R25. This can be altered if desired by changing R25. C48 is used to lower the effective gain at high frequency and thus prevent oscillation. C27 and C28 provide ac coupling. A switch, SW2, is provided to switch the equiliser in or out of circuit.

Figure 1 is the equivalent circuit of the graphic equiliser. The way it works is best understood by considering its behaviour with only a single frequency dependant circuit (labelled Z). If Z is a high impedance, then the op-amp will act like a simple unity gain voltage follower. However, if Z is low the circuit will exhibit both cut and boost depending on the position of RV. When the wiper of RV is in the centre position the input resistor forms a potential divider with half of RV. The other side of RV forms a potential divider with the feedback resistor. If both feedback and input resistors are the same value then the op-amp gain will be the inverse of the input attenuation, so the overall gain will be unity.

However, if the wiper is moved towards the inverting terminal, then the attenuation in the feedback loop will increase causing the gain of the op-amp to increase. At the same time the input attenuation will decrease, so adding to the overall increase in gain of the network. If the wiper is moved in the opposite direction, then a similar chain of reasoning shows that gain will decrease.

Thus we have a circuit that will give boost and cut when at resonance, and merely buffer any frequencies not at resonance. In the 1410 there are six impedances connected in parallel. Each one consists of a capacitor and a simulated inductor, the gyrator. The resonant frequency can be calculated in the traditional manner from

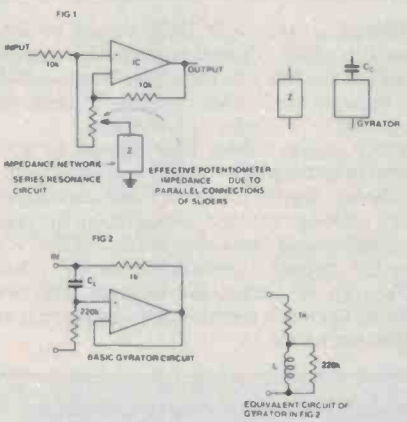
$$F = \frac{1}{2\pi\sqrt{LC}}$$

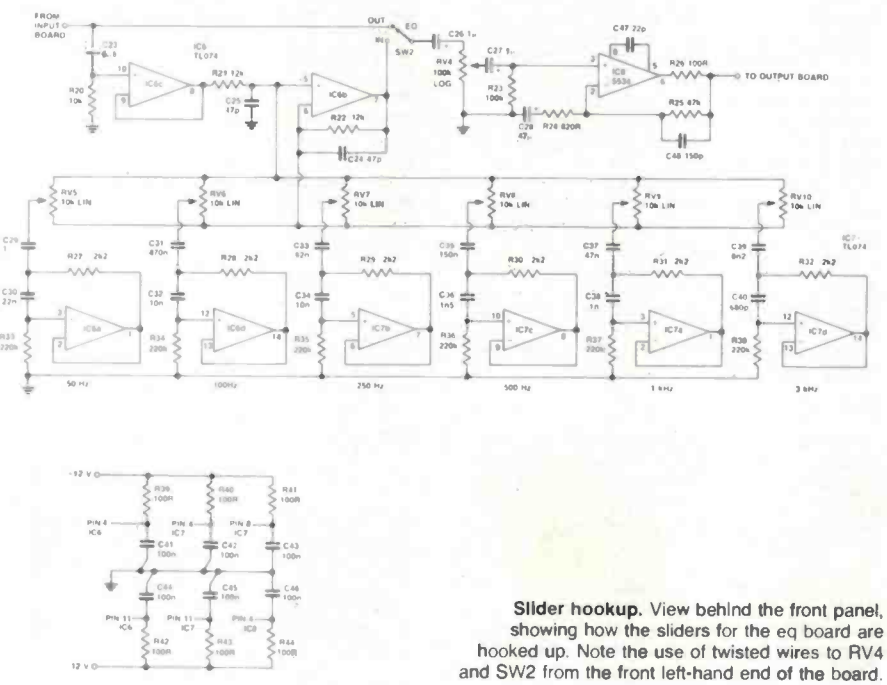
The general circuit of a gyrator can be seen in figure 2. It was used to avoid the necessity of winding up six coils of the appropriate inductance. The amount of inductance present can be calculated from:

$$L = 2K2 \times 220K \times C1$$

In the 1410 the gyrators are formed by IC6a, 6d, 7a, 7b, 7c and 7d plus their surrounding networks.

The power supply for all the op-amps is decoupled from the power supply noise by an RC filter network. This is formed by R39-44 and C41-46.





PARTS LIST ETI-1410c and d

Resistors

R20	10k, ¼ Watt, 5%
R21, R22	12k
R23	100k
R24	820R
R25	47k
R26	100R
R27, R28 . . . R32	2k2
R33, R34 . . . R38	220k
R39, R40 . . . R44	100R
RV4	100k log rotary pot.
RV5, RV6 . . . RV10	10k lin 45 mm slider.

Capacitors

C23	6µ8, 35 V Tant.
C24, C25	47p ceramic
C26, C27	1µ, 35 V electro.
C28	47µ, 35 V Tant.
C29	1µ Greencap
C30	22n Greencap
C31	470n Greencap
C32	10n ceramic
C33	82n Greencap
C34	10n ceramic
C35	150n Greencap
C36	1n5 ceramic
C37	47n Greencap
C38	1n ceramic
C39	8n2 ceramic
C40	680p ceramic
C41, C42 . . . C46	100n ceramic bypass
C47	22p ceramic
C48	150p ceramic

Semiconductors

IC6, IC7	TL074 quad op-amp
IC8	NE5534 op-amp

Miscellaneous

SW2	SPDT Toggle

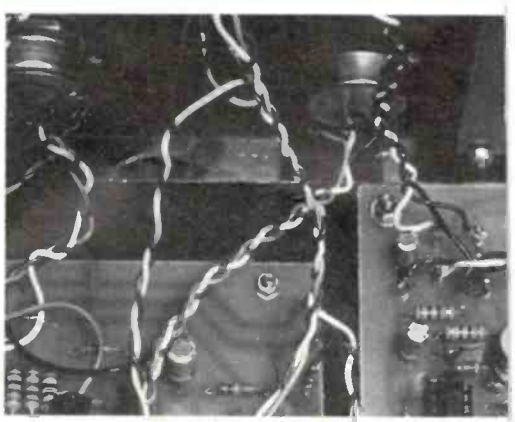
ETI1410c and ETI1410d pc board.

General Parts

T1	Ferguson PF4361-1

Mains flex and plug, terminal block, DPDT mains toggle, NE2 Neon, six insulated stereo 6.5 mm sockets, 3AG panel mount fuse holder, 3AG in-line fuse holder, 3A 3AG fuse, 8A 3AG fuse, 42.5 x 25 x 14 cm rack mount case, seven small plastic knobs, ETI-1410 front and back panel, 300 mm length of radial fin heatsink, two 100n ceramic bypass caps, shielded hook-up cable, mains grommet, mains clamp, two solder lugs, eight 12 mm pc board spacers, hook-up wire, nuts and bolts, 4 rubber feet.

Estimated price: $250-$280
including ETI-499 power amp module



Slider hookup. View behind the front panel, showing how the sliders for the eq board are hooked up. Note the use of twisted wires to RV4 and SW2 from the front left-hand end of the board.

ETI-1410e

Resistors

R45, R46, R48, R60, R76, R79, R81, R82, R86	100k, ¼ W, 5%
R47	1k
R49	2M2
R50	15k, 1%
R51	43k, 1%
R52	12k, 1%
R53	270k, 1%
R54, R55, R63, R64, R66, R67, R68, R69, R70, R72, R73	10k ¼ W, 5%
R56, R59, R75, R80, R85, R87, R88, R89, R90, R91, R92, R93, R94	100R
R57, R58, R77, R78	12k
R61	100k, 1%
R62	10k 1%
R65	1k2
R71, R83	5k6
R74	2k2
R84	1k
RV11	100k lin dual ganged rotary pot
RV12	50k lin pot
RV13	100k lin pot

Capacitors

C47, C48, C49, C53, C60, C62	1µ, 35V electro
C50, C51, C65, C66, C67, C68, C69, C70, C71, C72	100n ceramic bypass
C52	15p ceramic
C54, C57, C58, C61, C64	10µ, 35 V tant.
C55, C56	47n greencap
C58	22p ceramic
C63	4p7 ceramic

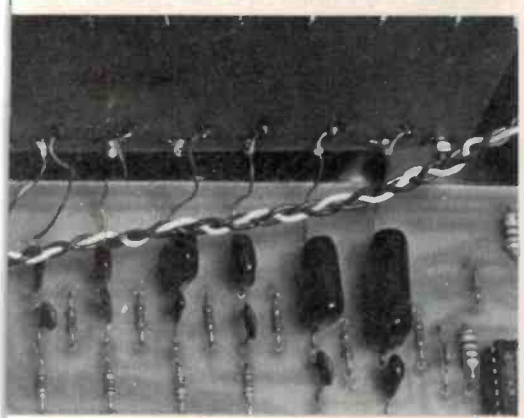
Semiconductors

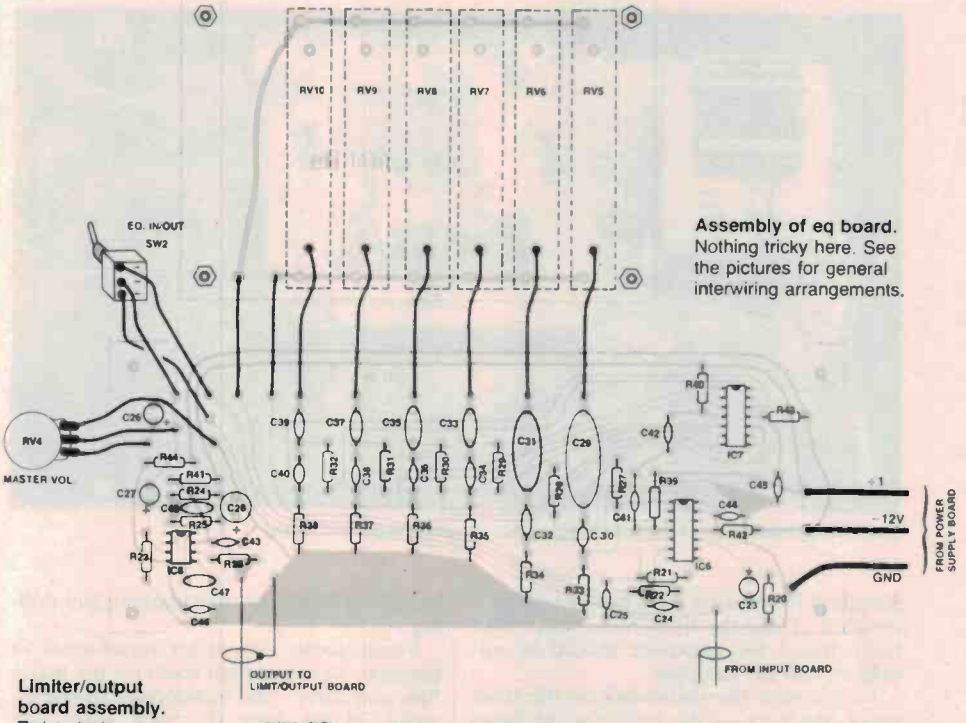
IC9	NE570 compander
IC10	LM339 Quad comparator
IC11, IC12	TL074
IC13, IC14	NE5534
Q1, Q2	BC557
LED1	Red LED

Miscellaneous

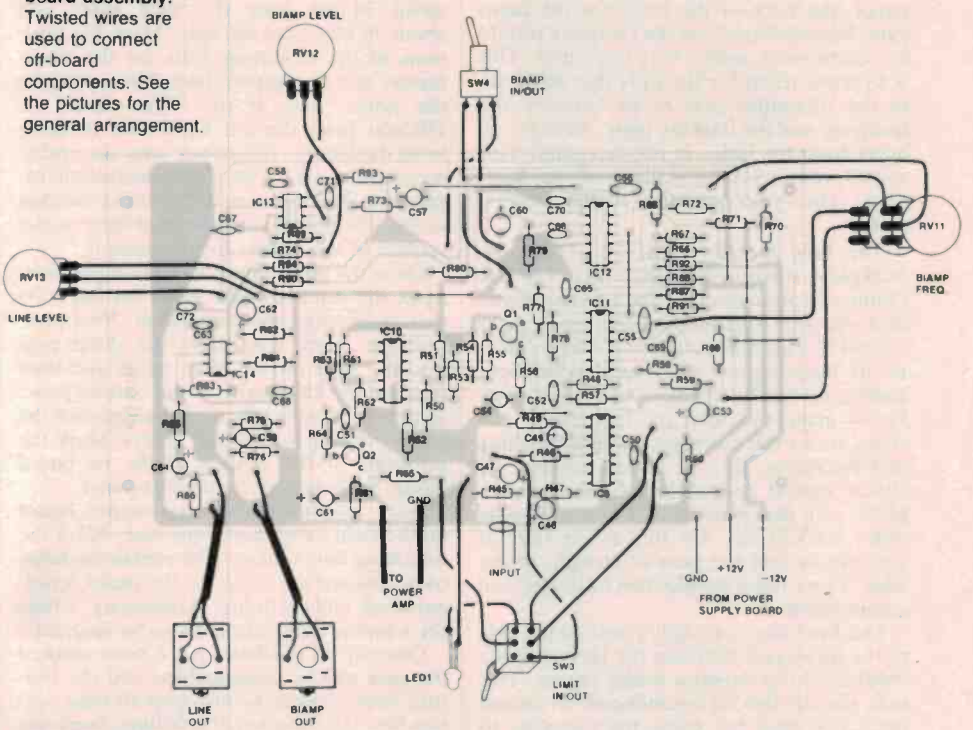
SW3	DPDT Toggle
SW4	SPDT Toggle

ETI-1410e pc board, 1 x 16 pin DIL IC socket, LED mounting Grommet.





Assembly of eq board. Nothing tricky here. See the pictures for general interwiring arrangements.

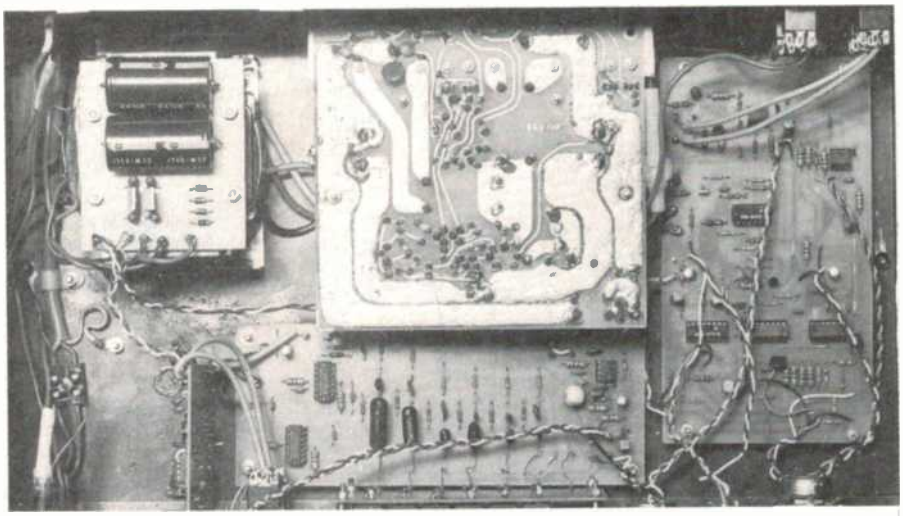


Limiter/output board assembly. Twisted wires are used to connect off-board components. See the pictures for the general arrangement.

The first thing to do is to cut the slots for the sliders in the front panel. If you're handy with a drill and file then you can get into a bit of manual labour and, using a 3 mm diameter drill, drill a series of holes where the slots are supposed to go and then file away the intervening metal to form a nice, smooth, even, straight slot (or so the story goes!).

If your vocation doesn't lie in the metal-working field, then an alternative is to ring around the local engineering machine shops and see if you can get the front panel slots milled (thats what we did anyway). Note that the front of the case consists of two parts, the thick front panel and the backing plate. These should be bolted together and cut together to ensure that the holes line up accurately.

After the slots have been cut the rest of the front panel holes should be drilled. This can be done from the drilling diagram or the ▶



The works! Inside view of the completed project showing the general layout.

Scotchcal front panel mask can be used as a template. Once the front panel holes have been drilled the backplate should be unbolted from the faceplate.

To complete the metalwork on the front panel, the back of the holes for the input gain, bass and treble on the faceplate should be countersunk with a very large drill. This is to allow room for the nuts that screw on to the miniature pots to sit between the faceplate and the backing plate. Remove all burrs from the holes in the faceplate. This should complete the drilling of the faceplate. Turn your attention to the backing plate.

The hole for the LIMIT LED on the backplate should be drilled out to 10 mm diamter to accommodate the LED grommet and the area surrounding the input jacks should be cut away to allow the input jacks to sit flush against the faceplate without fouling on the backplate. Do a trial assembly to make sure that the input jacks can screw on to the faceplate without touching and backplate. The pc board housing the sliders should be positioned on the backplate and the positions of the mounting holes marked out. Do this as carefully as you can so that the pots sit straight in the slots. These holes should then be drilled and countersunk.

The final step is to drill a hole to the side of the input jack between the jacks and the input board to mount a solder lug on. This hole should also be countersunk to ensure the screw does not cause the faceplate to stand off from the backplate when it is mounted.

At this point it is advisable to re-assemble the case so that the layout of the boards can be seen. The picture of the inside layout will give you a general idea of where the boards are positioned. Note that the power amp board is positioned upside down and that the power supply board is mounted on top of the transformer. Once you have familiarised yourself with the position of all of the boards, it is time to start marking and drilling.

Firstly locate the mains transformer in position. Leave enough room for the mains fuse and cable. The transformer should be about 30 mm from the back panel and about 30 mm from the side. Mark the positions of the mounting bolts for the transformer and centre-pop them. Next, position the power amp board. This should be 150 mm from the left hand side (looking from the front). The power amp sits upside down and rests on the large electrolytic capacitors. The holes on the heatsink bracket of the 499 should already be drilled as described in the article documenting it.

Once the power amp board is in position, mark the centres of the holes for the bolts that go through the back panel. Now position the board containing the slider pots into the slots on the front panel and then position the EQ board on the bottom panel so that the connecting wires line up with the corresponding lugs on the sliders. Mark the positions of the centres of the pc board mounting holes on the bottom panel.

Next, position the limiter/output board on the right hand side of the case. Mark the mounting hole centres. The remaining holes to be marked are those for the mains terminal block and earth lug. If necessary, a hole for a mains clamp should also be marked.

Once all of the holes have been marked the case can be disassembled and the bottom panel drilled. Centre-pop all hole centres first. To complete the drilling, mark out the positions of the mains fuse and mains grommet and also the four output jacks. The output jacks should be kept so far to the right hand side (looking from the front of the amp) as possible and the Scotchcal back panel label should be used as a template to get the spacing. Drill the back panel holes. Note that if a locking type mains grommet is used then the hole will have to be drilled slightly smaller and filed out to the correct shape.

The heatsink specified is a 300 mm length of radial-fin extruded aluminium. This should be located in the centre of the back panel with the top edge of the heatsink flush with the top edge of the back panel. Be sure that the heatsink won't foul any of the output sockets. Once in position the centres of the holes should be marked using the previously drilled holes in the back panel. The holes in the heatsink should now be drilled. This should complete all the drilling needed.

Now for the fun part! The wiring up. Firstly, though, the Scotchcal front panel label should be attached to the faceplate. Drill small pilot holes at the centres of all the holes to give yourself something to line up with. If you don't have the steady hand of a microsurgeon then the best method is to peel the backing paper from the Scotchal and then run water over the back of the label. Also, run water over the faceplate. The Scotchcal can then be applied to the faceplate and the water allows you to move the label into position. Once in position, press the Scotchcal firmly into place and squeeze out the excess water with a soft, dry cloth. The front panel should be left for a few hours to dry and stick properly. After it has dried, press it down firmly once again to make sure that it has stuck.

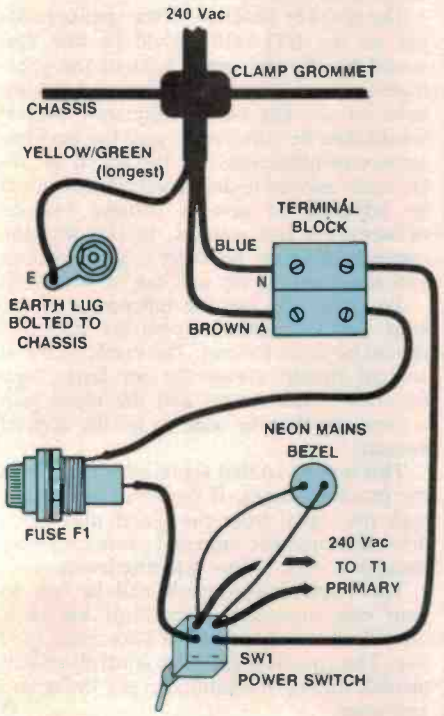
The input board should be bolted onto the frontpanel backplate. The pc board with the sliders should also be mounted to the backplate with 25 mm long countersunk bolts. Put the bolts through the holes in the backplate and then screw a nut on tight to hold the bolt in position. Place 12 mm spacers on the bolts and then bolt the pc board into position. The body of the pots should be standing a few millimetres off the backplate and the sliders should run smoothly and straight in the slots. The solder lug should be bolted in position next to the input jack hole. The case can now be reassembled.

The mains transformer should be mounted next. It should be mounted so that the input and output wires come out at the bottom of the transformer. This leaves the 15-0-15 V winding lugs facing up for easy access. The fuse holder can be mounted on the back panel and the power switch on the front panel. The mains cord and grommet can now be inserted and the mains wiring should be done in accordance with the mains wiring diagram. The mains input goes straight to the terminal block and the earth is connected to the chassis solder lug. It should be arranged so that the earth wire will be the last to break if the mains cord is somehow pulled out.

From the terminal block the active wire is taken to one side of the mains fuse. The other side of the fuse is connected to one pole of the mains switch. The neutral is taken from the terminal block straight to the other pole of the switch. The two outputs from the switch are then connected to both the primary of the transformer and the mains bezel. Make sure that the mains

NOTE: The front panel artwork is too large to reproduce in the magazine. Photostat copies may be obtained by sending an A4-sized stamped, addressed envelope to **ETI-1410 Artwork Photostats, ETI Reader Services, PO Box 227 Waterloo NSW 2017.** If you want positive or negative same-size film transparencies, the complete set costs $20 or front panel film only costs $10 from **ETI-1410 Artwork Sales, ETI Magazine, PO Box 227, Waterloo NSW 2017.** Make out your cheque or money order to 'ETI Artwork Sales' and ensure you ask for positives or negatives as you require. The printed circuit board and rear panel artwork are on page 156.

Power wiring. General arrangement for the mains power wiring. If you don't use a clamp grommet, use an ordinary grommet in the rear chassis backdrop and a cable clamp inside on the chassis bottom.

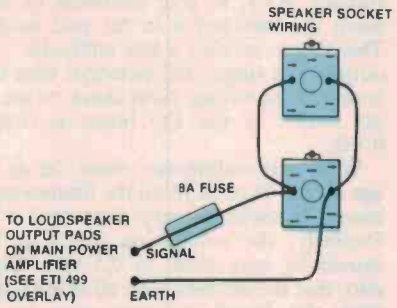


switch and bezel are both firmly screwed in place and will not come loose during operation. Be very careful when wiring up the mains side of the transformer since mains voltages are lethal.

All exposed terminals should be protected with heatshrink insulation to prevent anyone accidentally coming in contact with mains voltages. The mains cord should also be securely attached so that it won't come out even when pulled. Carefully double and triple check your mains wiring to make sure you haven't made any silly mistakes like connecting the active to the chassis. This completes the mains wiring.

The secondary of the transformer can now be connected to the power amplifier. Referring to the overlay for the ETI-499 MOSFET module on page 27 of the March 1982 issue of ETI, the two 35 V lines shown correspond to the yellow and black wires from the PF4361/1 transformer secondary.

Output jacks. Wiring up the speaker output jacks. Note the use of an in-line type fuse.

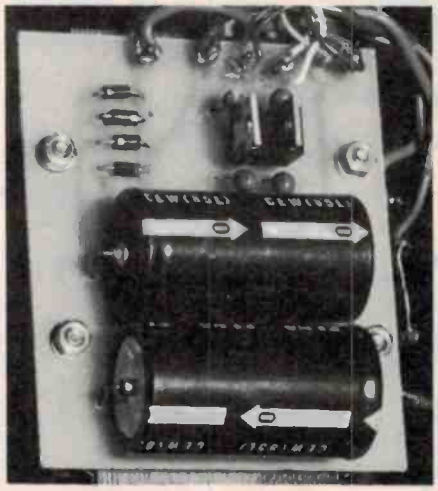


The orange and red wires are connected together and form the centre-tap connection on the board. At this time it is also advisable to connect good lengths of heavy duty hookup wire to the input and output holes on the power amp board. Colour code these and write down which is which so that you will know where to connect them later.

Note that an in-line fuse is used in the speaker output line. Before finally turning the power amp board topsy turvy and bolting it to the back panel you should carefully follow the power-up procedure given in the article. Be careful that none of the components or tracks of the power amp are shorting to the case when you are doing this and also make sure that the wires connected to the output terminals don't touch anything.

Once the power amp is set up OK you can then turn it off and pull out the plug. The power amp board and heatsink can now be bolted to the back panel. Heat conductive silicon grease should be liberally smeared between the power amp heatsink bracket and the backpanel as well as between the backpanel and heatsink. Securely fasten these bolts.

The next step is to bolt the power supply board to the top of the transformer. A nut is used as a spacer to lift the board off the transformer and ensure that the top of the transformer doesn't short out any of the tracks on the underside of the board. Once the board is mounted the 15 Vac should be connected. The transformer has four lugs which are the connections for the two 15 V windings. The two centre terminals should be connected together and a wire taken to the earth of the pc board. The two outside windings should be hooked up to the ac input of the power supply board.



Power supply. The power supply board (see Part 1) is mounted on top of the PF4361/1 transformer. The supply connections to the ETI-499 MOSFET module should be heavy duty hookup wire.

The unit can now be plugged in again and turned on. Measure the voltage on the outputs of the regulators to earth. You should get +12 V and −12 V dc respectively. If you don't then turn off, pull out the plug and double check all the wiring and components. Once you get the correct voltages you are ready to proceed. WARNING: Make sure that, from now on, whenever you are poking around on the inside of the case that the mains plug is pulled out of the wall socket. We don't like losing readers!

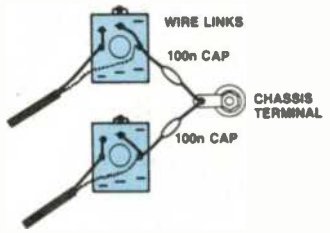
Bolts should now be put through the mounting holes for the two other pc boards and nuts screwed on to secure them. Place the equaliser board temporarily in position. Note the approximate distance from the master volume pot to the appropriate connection points on the pc board and cut suitable lengths of hookup wire. You will need to allow more wire than the actual distance since the wires will need to be twisted together.

Remove the board and solder the hookup wire to the pc board (if you have used solder pins for the connection points then you can mount the board permanently now). Once you have twisted the wire together and have the length right you can solder the wires to the pot (make sure you get them the correct way round). Repeat this procedure for the EQ IN/OUT switch and then do the same for the three pots, LED, and two switches connected to the limiter/output board.

Once all the pots and switches have been connected, the two boards can be mounted on the bolts using 12 mm spacers and bolted down. The wires connecting the slider pot board to the EQ board can now be attached and all the pots and switches mounted onto the front panel. The LED should be mounted using a standard LED mounting grommet.

The next step is to tackle the inter-board wiring. First, take three pieces of hookup wire and connect the +12 V, -12 V, and earth outputs from the power supply board to the appropriate pins on the input board. These should be twisted together. Do the same for the power supply connections to the EQ board and the limiter/output board. At this stage, if a CRO and signal generator are handy, the operation of each board can be checked individually. If not, then continue and live in hope!

Shielded cable should be used to make the connections between the output of the input board and the input of the EQ board and similarly between the EQ board and limiter/output board. Note that the shield is ▶



Input jacks. Wiring the input jacks. The inputs are shorted with no plug inserted.

connected *at one end only* since the earth connection between boards is already made by the power supply wiring. The input to the power amp should be left disconnected for the moment.

The only remaining connections are those to the input and output jacks. These should be wired as shown in the accompanying diagrams. Note the wire links used on the input sockets. This is done so that when there is no plug in the socket the input terminal is shorted to ground.Note also that 100 nF caps are connected from the input signal ground to the chassis. Once the input and output sockets have been wired they can be mounted and connected to the appropriate terminals. This then completes the construction.

Powering-up and testing

Without a signal generator and CRO there isn't a lot of testing you can do. The first thing to do though is, with the input to the power amp disconnected, switch on and measure the voltages at the power supply input pins to all the boards. These should all be within 0.1 V of +12 V or -12 Vdc. If the voltage regulator ICs start getting really hot at this point then there is probably a short somewhere on one of the boards. Take off the power supply leads to all of the boards and connect them back one board at a time to try to isolate which board has the short. Remove this board and check it thoroughly. NOTE: Make sure you always switch off at the wall socket before making any adjustments to the circuit.

Once the power supply wiring checks out look at the output (pin 6) of IC5. Set the trimpot, RV4, to give minimum dc offset when the bass pot is in the mid position. This should be only a few millivolts. If the output is at supply rail potential then there is something wrong. Next check to see that the output of the EQ board is close to 0 Vdc.

With your multimeter, check the dc voltage on pin 11 of IC10 on the limited/output board. It shold be very close to 3.1 Vdc. Similarly, the voltage on pin 8 of IC10 should be very close to 0.5 Vdc. Check, also, that the dc voltage on all of the outputs from this board are very close to 0 V. Switch the limiter switch to the IN position and ensure that the LED doesn't light.

If everything checks out OK then switch off, connect the power amp input to the appropriate terminals on the limiter/output board and insert a three amp fuse into the fuse holder in the speaker output line. Connect up a speaker and, with all the volume controls down, switch on. If no smoke comes from anywhere and the speaker is still intact then there is a reasonable chance that everything is fine. If so then turn off, replace the 3 A fuse in the speaker line with an 8 A one and plug in your bass (note that the mains power fuse must still be 3 A type).

Turn the amp on, turn up the volume a little and try a few notes. If you hear those mellow, bassy tones carressing your ears then all is well and you're on the way to rock 'n' roll stardom!

Hints on using it

All the controls are fairly self-explanatory with the possible exception of the bi-amp controls. To obtain the best sound from a bass it is often desirable to split the signals into a high end and a low end. This then allows the low and high frequencies to be driven by separate amp/speaker combinations, each tailored to the appropriate frequency range.

The bi-amp filter incorporated into the output board of the 1410 acts like a crossover which separates the signal into high frequencies and low frequencies. The crossover point (whether the signal is considered high or low) is set by the CUTOFF FREQUENCY control on the front of the amp. The high frequencies are sent to the internal power amplifier and the low frequencies are directed to the BI-AMP OUT socket at the rear of the amp.

A typical way to set up a bi-amp system would be as follows. The BI-AMP OUT would be connected to the input of an external power amp (which should be of a higher power than the 150 watts of the internal amp). A speaker, attached to the external power amp, should be particularly suited to the very low end of the audio spectrum i.e: 20 Hz to around 300 Hz.

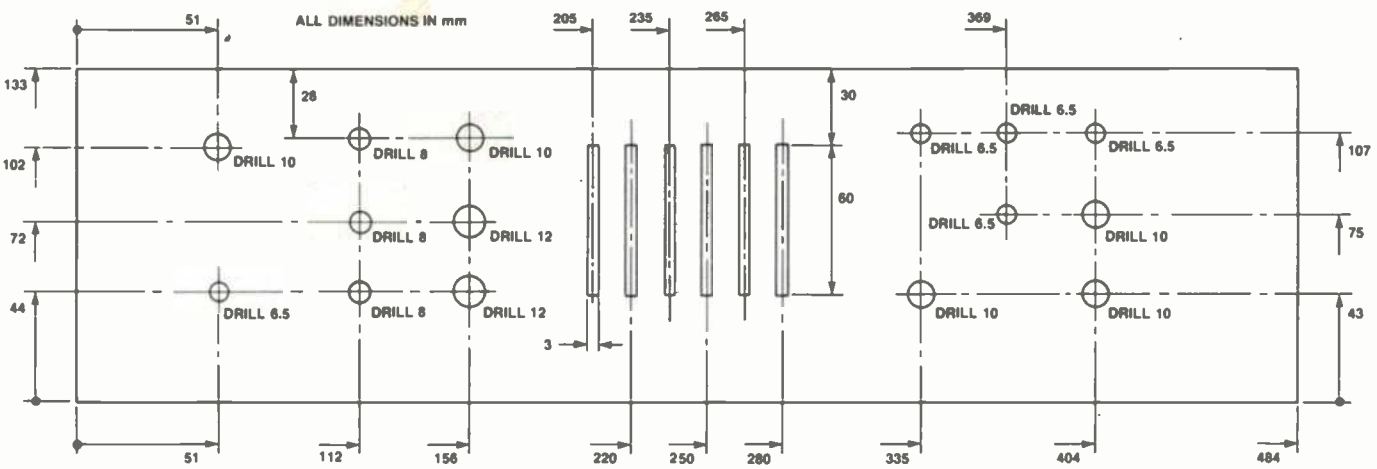
The speaker attached to the speaker output on the ETI-1410 should be one that would handle the upper part of the spectrum i.e: from around 300 Hz to a few kilohertz or so. The cutoff frequency control would then be adjusted to give the best frequency combinations for the actual speakers used, and the bi-amp level control would be adjusted to give a volume balance between the two systems. In this way the optimum balance between a good bottom end and a cutting top end can be achieved.

To effectively use the full power of the amp the two volume controls provided should be set as follows. The master volume control should always be set fairly high (around ¾ full range) and the input gain control can then be used to set the desired volume.

This is done so that signal does not clip in the pre-amp stages. If the input gain is too high the signal from the guitar may overdrive the input pre-amp and cause excessive distortion even at low listening levels.

The remaining controls will be left to your own ingenuity. Everybody has their own idea about what sort of bass sound they like. The equaliser and tone controls should provide enough versatility to get the sound you want. ●

Front panel. Complete drilling details for the front panel to suit the case specified.



NEW KITS FOR THIS MONTH

THIS MONTH'S KITS

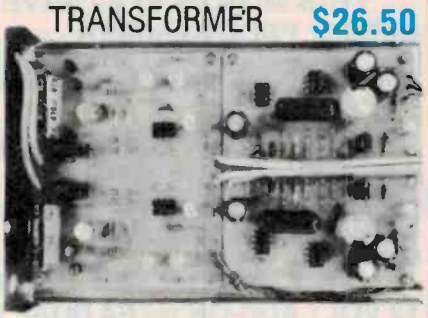
ETI-337 CAR ANTENNA CONTROLLER
AUTOMATIC WHIP UP/WHIP DOWN WHEN YOU TURN YOUR RADIO/CASSETTE PLAYER ON OR OFF. SIMPLE TO BUILD, ADJUSTMENTS FOR EXTENSION AND RETRATION ARE PROVIDED.

ETI-442 STEREO
A LOW COST STEREO AMP SUITABLE FOR TEAMING WITH A STEREO RECORD PLAYER WITH A CERAMIC CARTRIDGE. OVER 30W PEAK OUTPUT PER CHANNEL, PHONO, TAPE AND TUNER INPUTS, FULL TONE CONTROLS,SINGLE-BOARD CONSTRUCTIONS.

CRYSTAL MARKER (INC 1MHZ X) $34.50

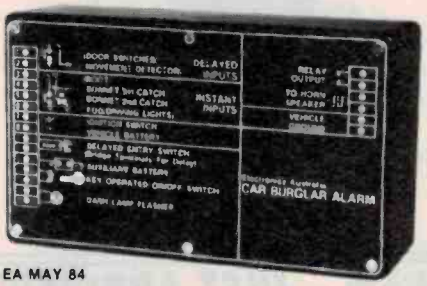
ETI 157 October 81

MIXER PREAMP TRANSFORMER $26.50



Easy construction and versatile operation, this Preamp was for coupling with the 300W "Brute" Power Amp. ETI 467 July 80

CAR BURGLAR ALARM $70



EA MAY 84

AUDIO TEST UNIT FOR CASS DECKS $47.50

EA October 81

MUSICOLOR IV $84.00

Add excitement to parties, card nights and discos with EAs new 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 August 81

HEADPHONE AMPLIFIER $28

EA MARCH 84

TV PATTERN GENERATOR $67.50

Anyone wishing to obtain the maximum performance from a colour TV receiver needs a pattern generator. Why not build this completely new design which provides five separate patterns: dot, crosshatch, checkerboard, grey scale and white raster.

VCR SOUND PROCESSOR $69.00

EA APRIL 84

Give the sound from your VCR a lift with this new VCR Sound Processor. Main features include an effective stereo simulator circuit, a 5-band graphic equaliser, and noise filtering.

TRANSISTOR ASSISTED IGNITION $34.50

EA November 79

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★ ★ NEW ★ ★

PROGRAMMABLE MOBILE ROBOT

Low-cost fun learning with this sophisticated robot! Have hours of educational fun programming this fun device to do what you command through the 25-key keyboard on its head!!

FEATURES:

- ☆ *4 bit microprocessor controlled*
- ☆ *3 speed gears selected by programming thru' micro*
- ☆ *Can travel in 4 directions plus angles and curves*
- ☆ *Has lights and audio*
- ☆ *Complex routines can be easily programmed (up to 48 commands long)*

SAVE WITH JAYCAR

Cat XR-1024

ONLY $49.95

★ SPECIAL ANNOUNCEMENT

From September onwards, all kits containing static sensitive devices (i.e. "MOS" or "CMOS" etc) will have new protection. The sensitive parts will be packed in *SPECIAL CONDUCTIVE BAGS*. These will be supplied to the kit user **AT NO additional cost**. The protection that these expensive containers provide will give you further assurance that the parts will arrive to you in the condition they were intended.

This is further evidence of Jaycars commitment to kit quality and another first for us.

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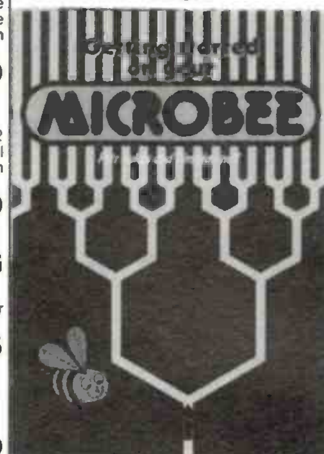
Fantastic new book for Microbee newcomers! A typical "Everything you wanted to know..." book with chapter headings such as: ☆ *Starting out* ☆ *Putting things on the screen* ☆ *Changing in mid-stream* ☆ *Getting into music* ☆ *Adding life to programs* ☆ *14 chapters in all!!* Contains many simple programs! Cover 250 x 180mm. 105 pages.



Cat XB-9015

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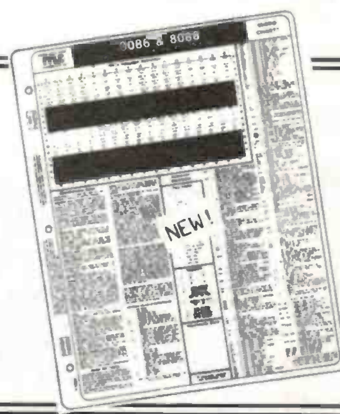

★ ★ KIT SALE ★ ★

CYLON VOICE - Ref: EA Feb 1981
Produce a variety of effects including the metallic robot voices similar to Darth Vader, the Daleks and the Cylons.
Cat. KA-1090 .... **Normally $18.95**
THIS MONTH $12 - SAVE $6.95

EPROM PROGRAMMER - Ref: EA Jan 1982
Simple and inexpensive. Data entry is via a hexadecimal keypad and the address and data readout is indicated with LEDs in Binary code. Suitable for 2716/2758 EPROMs. Single PCB with provision for future expansion complete kit of parts as specified.
Cat. KA-1402 .... **Normally $59**
THIS MONTH $39 - SAVE $20

LCD HEARTRATE MONITOR - Ref: EA July 82
Small enough to carry when jogging. Optical sensor, no electrical connections to the body. In-built calibration circuit and direct readout on large LCD. Jaycar kit comes complete.
Cat. KA-1466 .... **Normally $69**
THIS MONTH $55 - SAVE $14

12 VOLT ADD-ON for EA DUAL TRACKING POWER SUPPLY
Now you can add a fixed 12V to the popular EA Dual Tracking Power Supply!
Cat. KA-1521 .... **Normally $14.95**
THIS MONTH ONLY $10!!

ETI 084 ECONOMICAL CAR ALARM
Low cost car protection.
Cat. KE-4018 .... **Normally $12.50**
THIS MONTH ONLY $10!!

ETI 1509 DC-DC INVERTER
This popular project is virtually a "universal" inverter. Grab one while they last!
Cat. KE-4019 .... **Normally $35.00**
THIS MONTH $25 - SAVE $10

ETI BALANCED INPUT PREAMP
A very handy project when a balanced input is required. Kit contains circuit board and components.
Cat. KE-4028 .... **Normally $13.50**
THIS MONTH ONLY $10!!

ETI 1515 MOTOR SPEED CONTROLLER
This kit enables you to control motors as found in drills, saws, grinders, blenders etc. Keeps good motor speed over varying loads.
Cat. KE-4031 .... **Normally $19.95**
THIS MONTH $14.95 - SAVE $5

FAMOUS ETI 330 CAR ALARM
Hundreds sold! This incredible "current trip" car alarm is one of the most reliable units ever designed. Very popular!
Cat. KE-4105 .... **Normally $29.50**
THIS MONTH $19.50 - SAVE $10!!

ETI 735 UHF CONVERTER
This kit will convert a UHF TV signal (either from the station or a VCR) down to an unoccupied channel on the VHF TV band.
Cat. KE-4552 .... **$32.50**
THIS MONTH $19.50!
STAGGERING SAVING!

CHORUS GENERATOR - A JAYCAR KIT
This kit will generate a "chorus" i.e. multiple voice effect from a single line input. A great add-on unit for guitar, keyboard, voice etc. Uses Bucket Brigade technology. PCB and all components.
Cat. KJ-6508 .... **Normally $69.95**
THIS MONTH $49.95 - SAVE $20!!

NEW - JUST ARRIVED!

NEW MICROCHARTS!

- MICROCHARTS are fact packed charts which give key data to microprocessor and Integrated circuit users.
- These cards eliminate the need to stumble through manufacturer manuals and summaries
- Clear and concise data on microprocessor instruction sets, 5400 & 7400 TTL pinouts, and BASIC algorithms, popular software, and more
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- Instant access - no more searching for the right page
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WORDSTAR® MICROCHART All of the Wordstar control commands at your fingertips. Each command described in detail. All info on one double-sided piece of plastic.
Cat BM-8506 **$9.95**

8086/8 MICROCHART Full Instruction set, ASCII, hex & dec conversions, flags, cycle times, interrupt structure, pinout, disassembly table, key mem locations, reg map, and cautionary notes. No binary codes to translate.
Cat BM-8508 **$9.95**

OTHER POPULAR MICROCHARTS

Z80/A CPU	Cat BM-8500
8080A/8085A	Cat BM-8501
6502(65XX)	Cat BM-8502
54/7400 (+LS)	Cat BM-8503
BASIC ALGORITHMS	Cat BM-8504

All priced at $9.95 each

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SENSATIONAL!
LOW COST RECORD PLAYER KIT

Ref: ETI September 1984 (ETI 442)

This is the lowest price TRUE HI FI system that we have ever seen!! Around 20 WRMS per channel with separate Bass, Treble, Balance and volume controls. Around 20 w (RMS) per channel into 8 ohms!

The amplifier unit INCLUDES power supply, all controls, knobs, RCA input sockets, speaker connectors, front panel, mains cord etc.

Complete instructions (as per ETI article) are provided as well as plans for the turntable/amp cabinet.

GRAB THIS FANTASTIC KIT

FOR ONLY $59.95

Cat KE-4683

SPECIAL HI FI BELT DRIVE TURNTABLE to suit - as used in the original ETI article - (see details of this unit in our other ads in this magazine)

Cat AA-0290

ONLY $29.95

SPECIAL LOW COST HI FI SPEAKERS TO SUIT - 6" woofer/midrange unit with curvelinear cone. Ideal for the ETI 442 amp project! (The voice coil has a 4 ohm impedance which is O.K.)

Cat AS-3011

ONLY $6.95 EACH!!

HI FI TWEETER to suit (no x'over required)
Cat CT-1910 ONLY $9.95

If you want the extra bass of an 8" speaker, we have an 8" twin cone unit for only $19.95 Cat CE-2330

SPECIAL "PACKAGE DEAL" OFFER

Make further savings if you buy the lot.

ETI 442 AMP KIT KE-4683	$59.95
BELT DRIVE T/T AA-02900	$29.95
2x6" SPEAKERS AS-3011 ...	$13.90
2xTWEETERS CT-1910	$19.90
TOTAL	$123.70

SPECIAL INTRODUCTORY PACKAGE

ONLY $99.50

FOR ALL OF THE ABOVE!!

HEY! THAT'S NEARLY A 20% SAVING!!

30W + 30W STEREO AMPLIFIER

★ Fully built and tested ★ Separate Bass, Treble, Balance and Volume controls ★ Less than 0.1% distortion ★ Mic, Phono and Aux inputs (line) ★ Power supply components on board.

Back at last! No hassle amplifiers. Just connect a transformer, speakers a signal and you're away!

STAGGERING VALUE

ONLY $34.95

Cat. AA-0300

SOLAR-POWERED HOUSE NUMBER SIGN

Ref: EA September 1984

A truly amazing project! Display your house number AT NIGHT AUTOMATICALLY with high brightness LEDs! No external electric power source is required. The unit recharges itself from the sun during the day and discharges at night. Because each house number and installation will be different, we are selling the parts only, not a kit.

200mCd LEDs Cat ZD-1790
69¢ ea (1-9) 60¢ ea 10 or more
30° 78mA Solar Cell Cat ZM-9004
$3.25 ea (1-9) $2.95 ea 10 or more
(or $35.40 for the 12 sectors)
"Gates" 2.5 A.H. Gel Batteries Cat SB-2490
ONLY $9.95 each
PCB to suit Cat EE-7085 $4.95

JAYCAR NO.1 FOR SUPERBRIGHT LEDS

We carry a great range of high brightness/high efficiency LEDs. Remember a 15¢ LED will give you around 1.8mCd at 20mA. Just think what 500mCd at 20mA would look like! And they will take 40mA - so double the numbers! They will also give very useful light output at low current - even 1mA, so they are useful for portable gear.

RED 500mCd Cat ZD-1792	$2.95
GREEN 80mCd Cat ZD-1794	95¢
YELLOW 160mCd Cat ZD-1795	95¢

NEW - Ref: EA September 1984
HALL EFFECT SWITCH VANE INTERRUPTED

If you have a car that won't take the Jaycar KJ-6655 Hall Effect Kit (i.e. an Australian six or V8) this could be for you! It is the SIEMENS (German) made Hall Switch. It will operate from −30 to +130°C. A simple soft iron vane cut with appropriate slots will commutate the unit.

Cat HK-2101

PCB to suit 84T19 $3.45

$19.95

★★★★★★★★★★★★★★★★★★★

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$5 - $9.99	$1.50
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$50 - $99.99	$6.50
$100 - $198	$8.00
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COMET ROAD FREIGHT ANYWHERE IN AUSTRALIA ONLY $12.00

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CARLINGFORD, CONCORD & HURSTVILLE
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Thurs Night: 8.30 pm (Not Concord)

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SUPER BARGAIN TIME!!
"LYREBIRD" PIANOS

Ref: EA Dec 81-Jan 82

Never before have we offered these famous kits at such low, low prices!

BECAUSE WE EXPECT DEMAND TO BE GREAT, PLEASE ALLOW UP TO 4 WEEKS FOR DELIVERY. (PARTS SHORTAGES FORCE THIS UPON US).

For full specs see our Catalogue page 31, EA December 1981 or send stamped self-addressed envelope request.

2 MODELS: 6 OCTAVE (73 NOTE) F-F
7¼ OCTAVE (88 NOTE) A-C

Apart from the size of the keyboard, the models are identical.

FEATURES:

- ★ TOUCH SENSITIVE ON ALL VOICES
- ★ FIVE VOICES. Mellow, Normal, Bright, Harpsicord & Honky-Tonk (voices can be mixed)
- ★ Tremolo & Phasing effects
- ★ Output will drive amp (line-in) or headphones
- ★ Realistic looking soft & sustain pedals provided!
- ★ Adjustable attack and decay
- ★ All IC sockets provided

88 NOTE: NORMALLY $589
SEPTEMBER ORDERS ONLY
$425 SAVE $164

73 NOTE: NORMALLY $475
SEPTEMBER ORDERS ONLY
$375 SAVE $100

Quality metal piano stand (similar but not the same as illustration) STILL INCLUDED!!

(Please allow $20 for shipping and packing anywhere in Australia and seriously consider insurance which is 1% extra).

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Project 337

WHIP IT UP WHIP IT DOWN

Let's have some music — but what's all the static? Oh! — forgot to put the aerial up! This project saves you the frustration and circumvents your forgetfulness.

SOME CARS are fitted with power aerials which glide silently up when the radio is activated, and recede discreetly when it is turned off. Such deluxe items are fine, but the automation of the process requires that the aerial have end-switches to detect when the aerial is actually up or fully down, and that the radio itself have an output to indicate that it wants the aerial up.

The commonly available power aerials, which these days sell for somewhere under $20 in many places, do not have the end-switches, even if the radio is suitably equipped to run them. In addition, where the automatic system is used, you do not get any choice as to how high the aerial will be — it is fully up or fully down. This is annoying if you require only a short aerial height to get the radio working and want to avoid low trees in the driveway, or excessive wind pressure when travelling quickly.

The automated aerial is not only an indulgent convenience but a safety feature in cars where the only convenient mounting position for the switch in the vehicle is out of the driver's easy reach. In the case of a normal switch-operated aerial, the groping and waiting can divert the driver's attention from the road.

This project basically offers the opportunity to have automatic raising and lowering of the aerial when the radio or radio/cassette is turned on and off. Where it is desired to have less than full extension there is a preset potentiometer which sets the extension normally used. In the event you are annoyed by the situation where the aerial rises when you are only listening to the cassette, because the unit does not differentiate its operation from the radio, the automatic rise can be disabled. A pushbutton can be installed to activate the rise or the retraction. (This is not, however, recommended as the annoyance is replaced by another, namely that the aerial retraction mechanism triggers each time that the sound system is turned off, even if the radio was not used.)

The box of 'tricks'. It may not be pretty, but it sure is functional. We housed the unit in a small aluminium 'Horwood' box, bolting the power transistor directly to the case.

The circuit

The circuit senses the current drain of the radio and responds to this. Where the radio has an output already to indicate that the aerial should go up, D1, D2, R3 and Q1 may be omitted, and this connection led directly to the junction of R1 and R5.

Finally, while it is not intended that this project offer any *extra* knobs to the driver at all, but rather remove one, it would be possible to have the preset potentiometer defining aerial height accessible, so that the degree of extension can be altered. In general, there will be a convenient height for any given car.

Building it

Construction and alignment of the unit is straightforward. The pc board designed for it, which we recommend you use (it reduces hassles) holds all the components except the driver transistor, and of course, the aerial motor itself. The only critical part is the mechanical attachment of the box itself.

Automatic car aerial controller

Jonathan Scott
Mark Simmonds

The extra expense of a metallic box will almost certainly be worthwhile if the aerial driver is destined to live in a harsh environment, such as a boot or similar, where granny's 53 kilo suitcase would make *corn crisps* out of a plastic jiffy box. The box selected should be large enough to hold the pc board and leave room for wire terminations, and should ideally be pretty dust-and-garbage tight.

Once you have selected the box, drill it to allow mounting of the pc board and the box itself to the car. Holes also need to be ▶

HOW IT WORKS — ETI-337

Consider, initially, that the aerial is down and the radio off. When the radio is turned on, it draws supply current through D1 and D2, turning Q1 on. This turns on Q2 and Q3. Relay RL1 closes, which selects the direction the aerial motor will go (up when the radio is turned on). For now disregard RV1, Q4 and R10. At this point, what happens is dictated by whether the circuit is wired to automatically raise the aerial or to wait for a button push to do so.

If C2, D5 and R8 have been omitted, no further activity takes place. If present, they form an OR gate with C1, R7 and D4. As the potential on the collector of Q2 falls, the OR gate applies a falling edge to pin 2 of IC1, the 555, which is wired as a monostable multivibrator.

In the event that PB1 is used in place of D4, etc, it applies a similar pulse when pressed. (This option exists to handle the situation where a cassette player would also draw current, putting up the aerial for no purpose. In this case, a button is necessary to indicate that the aerial is actually needed. See text.)

When the negative edge arrives at the trigger input of IC1, it sends its output high for a period of time set by RV2. Thus, RV2 effectively defines the height to which the aerial rises, and can be set either to the full extent of the particular unit in use, or to some lesser level if it is desired to limit the extension for any reason.

Since the relay was closed at the time the current drain commenced, the aerial travels upwards. The motor current is supplied by Q5 and Q6. The latter pair are configured so as to minimise the voltage drop across the driving stage, as well as to leave the case of the final transistor at 0 volts. Thus, Q6 (MJ2955) does not need any insulating washers nor a plastic cover to prevent shorts.

When the current drain of the radio falls after it is turned off, the reverse of the first stage of operation occurs: Q1, Q2 and Q3 turn off, and RL1 opens. C1 and D3 convey the falling edge on the collector of Q1 to IC1, which again triggers, this time driving the aerial down, because the reversing relay is now open.

This would be the full extent of the unit's function, if it were not for the problem that aerials often take a little longer going in one direction than they do going the other. RV1, Q3 and R7 provide a function to alter the relative lengths of the up and down drive durations by a few per cent. This is achieved by adjusting IC1's voltage reference. This alters the point at which its internal comparators reset the output.

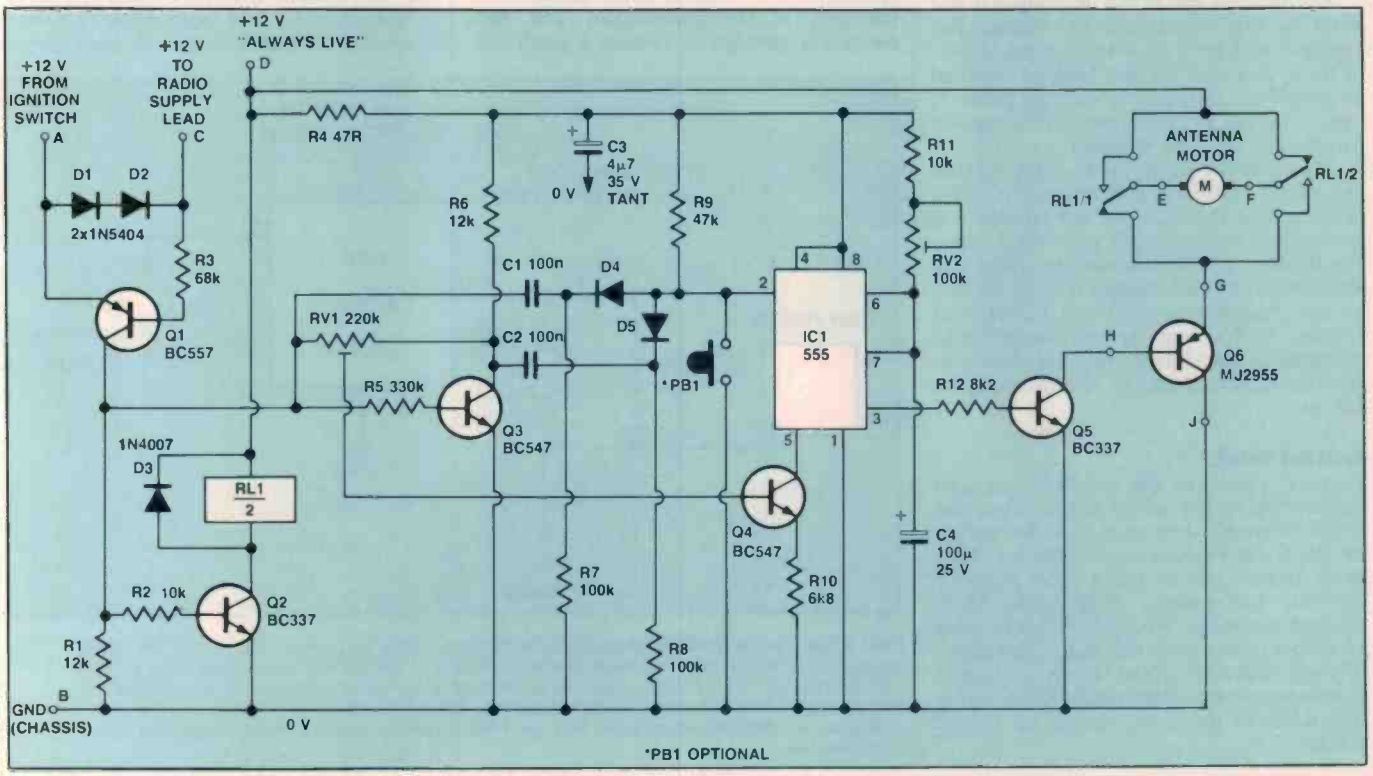
While it is true that aerials usually have a slip clutch built in, allowing overdrive in either direction, this is of little use when the aerial is not taken to its full extent. A slightly slower descent would leave the aerial a little higher each cycle, so some change in drive times going up and down is necessary in general.

To effect the variation, RV1 is wired between the collectors of Q1 and Q3, which are at opposite potentials to each other and at opposite potentials when the radio is off and on. Hence, adjustment of its potentiometer to either side of centre will allow either a more positive voltage on the wiper when the radio is on and the aerial rising, or a more negative one when it is falling, or vice versa.

This permits the adjustment to cope with longer rising or falling time, with no reliance on a slip clutch. (Slip clutches are sometimes noisy, and unaesthetic in a mechanical sense anyway, as they rely on springs and bearing surfaces to achieve their function).

The varying voltage on the wiper is converted to varying time delay by Q4 and R10, which act as a current source loading the resistive divider reference inside IC1, via pin 5.

Supply decoupling for most of the circuitry is provided by R4 and C3. Diode D5 clamps the back-end of the relay coil when Q2 turns off, preventing possible damage to Q2.



drilled for the large output transistor, and to allow the passage of the cables to the car wiring and motor, etc. A sizeable grommet should be used, as the cables need to be automotive grade, to carry a couple of amps at least.

Before assembling the pc board, give it a thorough visual inspection, whether you've built it yourself or bought it ready-made. See that there are no minute cracks in the tracks (rare) and no small copper 'fingers' between tracks where they pass close together. See that all the holes are drilled and that they're the correct size.

If all's well, you can commence assembling the board. Put the semiconductors on first. If you intend to use a socket for IC1 then solder that in now. Check that the semiconductors are correctly oriented, particularly the diodes.

Solder the resistors on next, but leave the two trimpots off for the moment. Solder in the link which is located between RV1 and R10. The capacitors can go on the board next, then solder on the two trimpots and the relay.

All the leads from the terminal block should be heavy duty leads, at least 10x0.2 mm or 24x0.2 mm. There will be a number of flying leads leaving the terminal block, so use different coloured leads so that you can identify them.

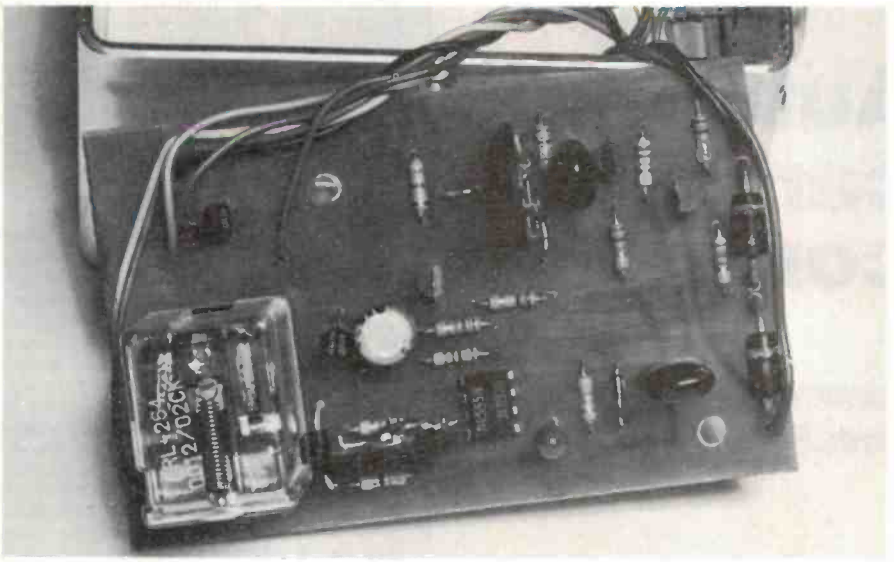
Feed these cables through the exit grommet and secure them inside the box. A simple knot is not recommended as the method of securing, as this can fracture the leads and subsequently break them, though it will probably be sufficient if the box is not likely to be often disturbed.

Terminals A and D can be bridged if you want to, but if you have the manual rise option you'll need six wires instead of five. If these terminals are not bridged terminal D should be connected to the fuse panel. If you are going to fit the manual rise option you'll need an extra terminal.

Now bolt the pc board in place. Secure the power transistor and attach the leads, making sure that you get the emitter and base connections the right way round. Use a lug for the collector connection. Note that there is no need to insulate it from the box or car chassis as its collector (case) is at 0 volts. At this stage, before proceeding to mechanical installation, the electrical testing should be carried out and the trimpots set up.

Initial test

Connect power to the supply leads, and connect the motor of the aerial. Place the aerial where it is free to rise and fall unhindered, if still working outside the car. Now draw some current, via a light globe, a 180 ohm 1 W resistor or the radio itself, through the sensor lead, which will be used to supply power from the unit to the radio. The aerial should extend. If not, go back a few steps and search for errors in the wiring up. Remove the load; the aerial should retract.



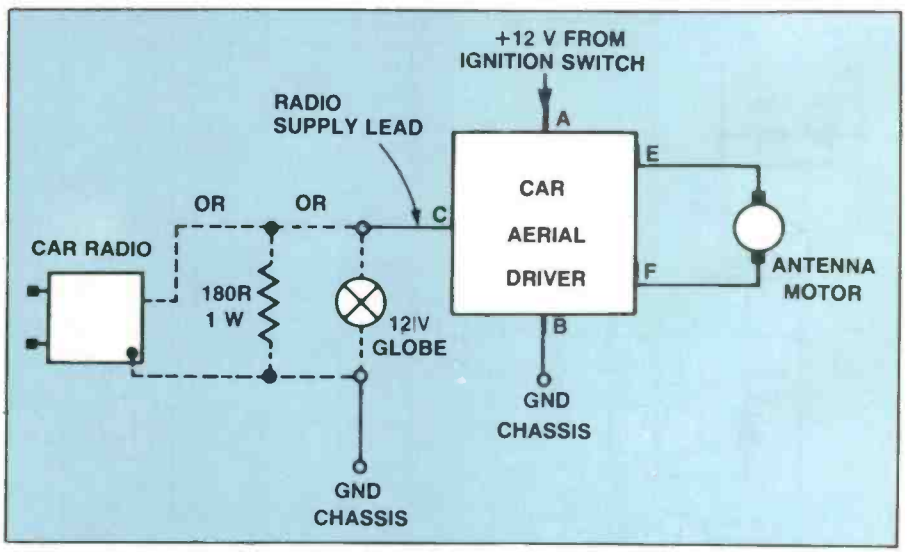
It looks like this. View of the completed printed circuit board.

Repeat this procedure, adjusting RV2 to set the desired extension on initial activation to the desired level, and RV1 to ensure full retraction. This latter pot merely adjusts the relative duration of the retraction drive to the extensive one, so should be started in the middle of its throw, and adjusted second, once RV2 is happily set. This procedure completed, you may finalise the installation.

Installation

Mechanical installation is the last part of the operation, and requires some initiative on the part of the constructor. The best method is perhaps to fashion a small aluminium bracket and bolt this onto the box containing the electronics, then bolt this onto the chosen part of the car. It may be possible to attach the box to the aerial motor case, if suitable bolts are available and the motor is sufficiently robust to hold the extra weight. If you use bolts and nuts, be sure to include a spring washer of some type to prevent the box working loose.

Self tapping screws are another good idea, as they exhibit a certain vibration resistance and also do not require access to both sides of the panel being used. The box may be attached directly to a panel, if there is one suitable, and both sides of it are accessible. If this technique is used, some



Test setup. You can test the operation of the unit by connecting up the antenna motor, the +12 V supply and GND and then drawing current from terminal C using either the car radio itself, a 180 ohm resistor or a 12 V light globe. When the load is connected to terminal C, the antenna should extend. When the load is disconnected the antenna should retract. You can use this procedure to adjust the two trimpots, RV1 and RV2, to get the desired extention length and retraction time.

PARTS LIST — ETI-337

Resistors ..... all ½ W, 5%
- R1, R6 ..... 12k
- R2, R11 ..... 10k
- R3 ..... 68k
- R4 ..... 47R
- R5 ..... 330k
- R7, R8 ..... 100k
- R9 ..... 47k
- R10 ..... 6k8
- R12 ..... 8k2
- RV1 ..... 220k, vert. mount trimpot
- RV2 ..... 100k, vert. mount trimpot

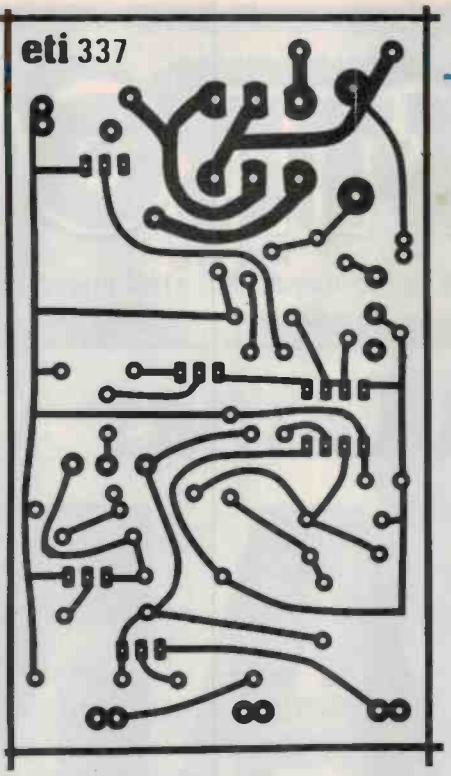
Capacitors
- C1, C2 ..... 100n greencaps
- C3 ..... 4µ7 35 V Tantalum
- C4 ..... 100µ 25 V RB electro.

Semiconductors
- IC1 555
- Q1 ..... BC557
- Q2, Q5 ..... BC337
- Q3, Q4 ..... BC547
- Q6 ..... MJ2955
- D1, D2 ..... 1N5404
- D3 ..... 1N4007
- D4, D5 ..... 1N914, 1N4148

Miscellaneous
- RL1 ..... DPDT relay with at least 5 A rated contacts (Fujitsu FRL-264 DO12.02CK or similar), e.g: D.S.E. S-7200).

ETI-337 pc board; 6-way terminal block; hookup wire (see text); small Horwood aluminium box (100 x 72 x 50 mm); two 6 mm standoffs, nuts, bolts, etc.

Price estimate: $20-$25



Board artwork. Full-size pc board layout.

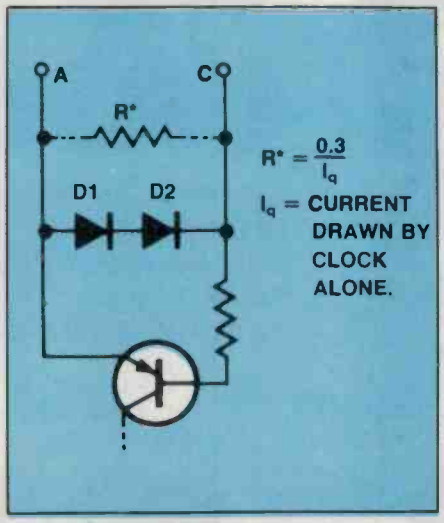


Figure 1. To get the controller to "ignore" the current drawn by a clock on the car radio/cassette unit, add a suitable resistor across D1 and D2 (between terminals A and C). Measure the current drawn by the clock alone, then calculate the resistor's value from the equation above. Use the nearest preferred value resistor. ▶

thin sheet of foam rubber (or even adhesive double-sided tape) should be included to firm up the connection and reduce vibration within the box.

Fit automotive grade (1 mm diameter, or preferably heavier) cables long enough to reach the vehicle power, chassis, antenna, motor and radio, as indicated on the overlay diagram.

Optional pushbutton

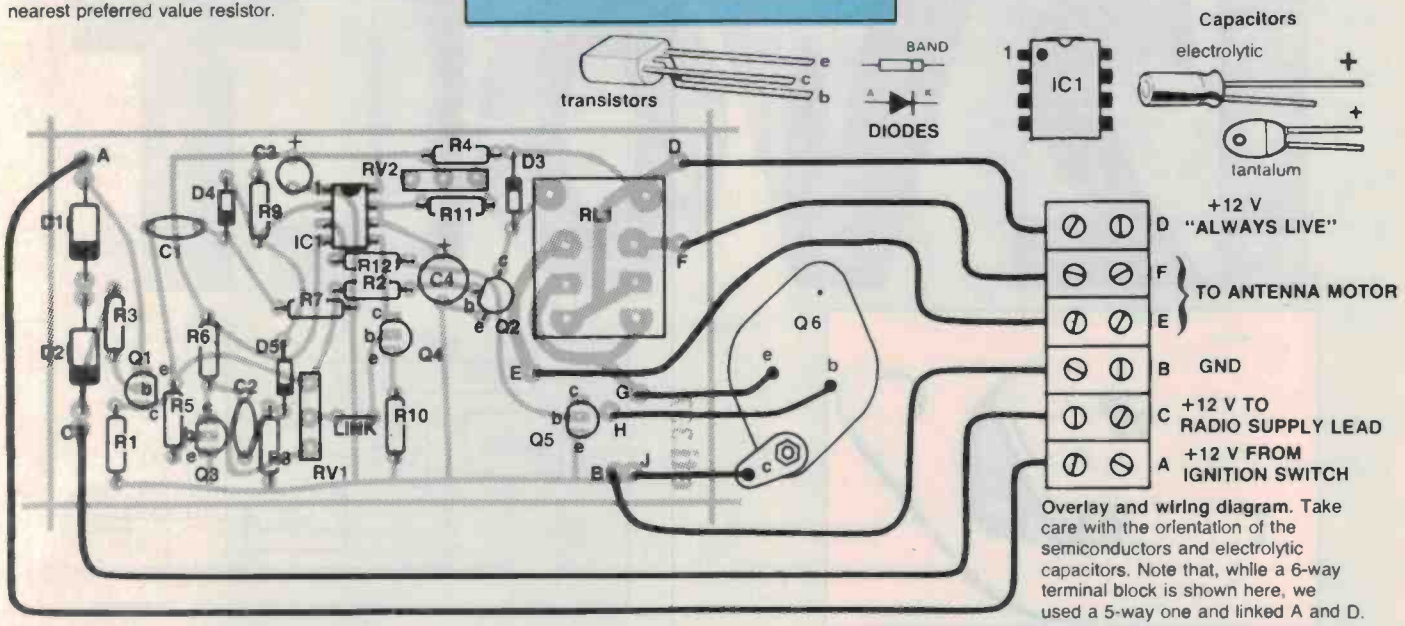
If you intend to include the optional button and delete the automatic rising facility the following changes to the procedure need to be observed. Firstly, omit D5, C2 and R8. Next run a wire from the hole left vacant by the anode of D5 to the dash position where the button is to be placed. Install the button, which should be a momentary contact type, and connect the wire to one terminal and the car chassis to the other.

Next, certain radio/cassettes have in-built clocks. This is fine, except that some draw power whenever the ignition is on rather than only when the radio is used. In this case it is necessary to set a threshold current below which the controller considers the radio turned off.

This is easily achieved by placing a resistor in parallel with the two supply sensor diodes (D1-D2). It should have a value equal to about 0.3/Iq volts, where Iq is found by measuring the quiescent current of the clock section of the radio unit. This is illustrated in Figure 1.

Where a cassette is provided with a wire specifically for the purpose of powering an automatic aerial, this can be employed by deleting D1, D2, R3 and Q1. The connection to the control wire should be made at the now unused collector connection of Q1. The same number of cables are in fact run, so the modification (should you later upgrade the car hi-fi to one with this facility) is simple.

Many happy (auto) ups and downs! ●



Overlay and wiring diagram. Take care with the orientation of the semiconductors and electrolytic capacitors. Note that, while a 6-way terminal block is shown here, we used a 5-way one and linked A and D.

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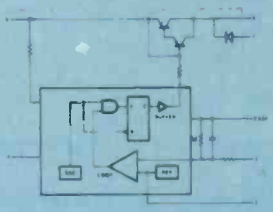

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- INTERNAL SHORT CIRCUIT PROTECTION
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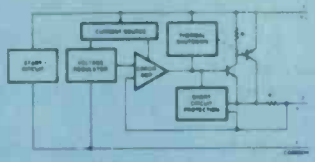
- 50 W POWER DISSIPATION
- STEEL TO-3 PACKAGE
- ALL PIN-FOR-PIN COMPATIBLE WITH THE LM323, SG323



μA78H05ASC

$5.93

EACH*

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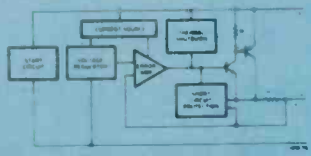
- INTERNAL CURRENT AND THERMAL OVERLOAD PROTECTION
- INTERNAL SHORT CIRCUIT PROTECTION
- LOW DROPOUT VOLTAGE (TYPICALLY 2.3 V @ 5.0 A)
- 50 W POWER DISSIPATION
- STEEL TO-3 PACKAGE
- ALL PIN-FOR-PIN COMPATIBLE WITH THE SH323

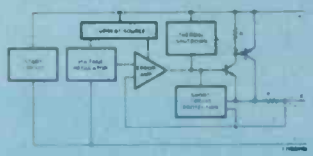


μA78H12ASC

$7.13

EACH*

- 5.0 A OUTPUT CURRENT
- INTERNAL CURRENT AND THERMAL LIMITING
- INTERNAL SHORT CIRCUIT CURRENT LIMIT
- LOW DROPOUT VOLTAGE (TYPICALLY 2.3 V @ 5.0 A)
- 50 W POWER DISSIPATION
- ELECTRICALLY NEUTRAL CASE
- STEEL TO-3 PACKAGE
- ALL PIN-FOR-PIN COMPATIBLE WITH μA78HG

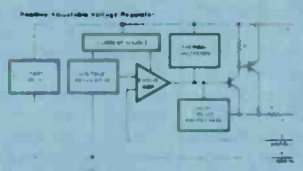


μA78HGASC

$7.02

EACH*

- 5.0 A OUTPUT CURRENT
- INTERNAL CURRENT AND THERMAL OVERLOAD PROTECTION
- INTERNAL SHORT CIRCUIT PROTECTION
- LOW DROPOUT VOLTAGE (TYPICALLY 2.3 V @ 5.0 A)
- 50 W POWER DISSIPATION
- STEEL TO-3 PACKAGE

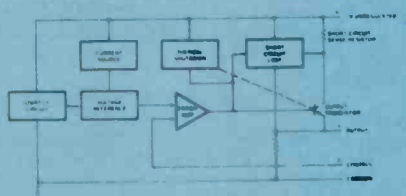


μA79HGSC

$12.53

EACH*

- −5.0 A OUTPUT CURRENT
- INTERNAL CURRENT AND THERMAL OVERLOAD PROTECTION
- INTERNAL SHORT CIRCUIT CURRENT LIMIT
- LOW DROP-OUT VOLTAGE (TYPICALLY 2.2 V @ 5.0 A)
- 50 W POWER DISSIPATION
- ELECTRICALLY NEUTRAL CASE
- STEEL TO-3 CASE



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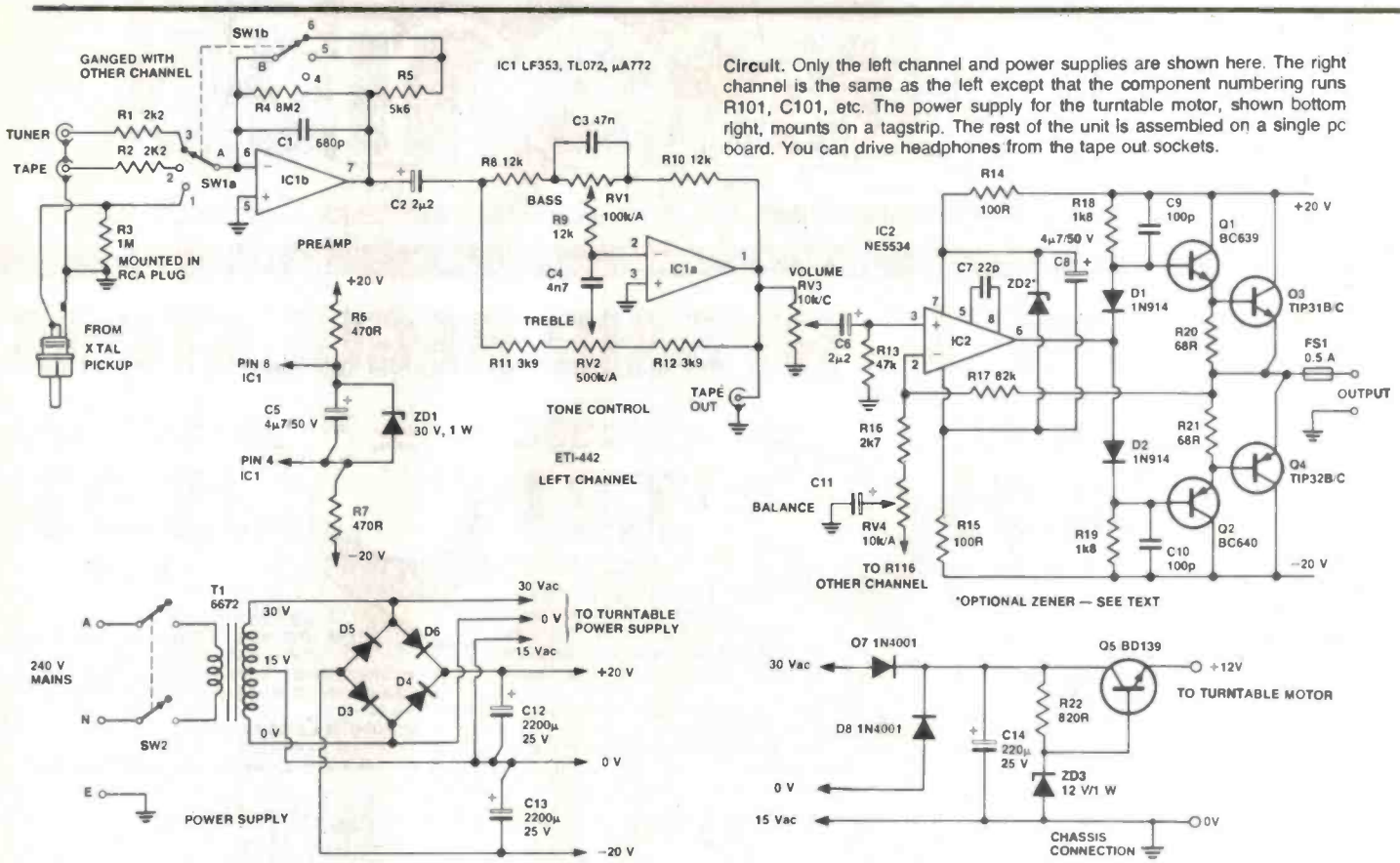

Circuit. Only the left channel and power supplies are shown here. The right channel is the same as the left except that the component numbering runs R101, C101, etc. The power supply for the turntable motor, shown bottom right, mounts on a tagstrip. The rest of the unit is assembled on a single pc board. You can drive headphones from the tape out sockets.

HOW IT WORKS — ETI-442

The circuit divides logically into four sections — the pre-amplifier, the tone control stage, the power amp and the power supplies.

Since each channel of the amplifier is identical we have numbered the left channel components from number 1 and the right channel components from number 100. The following description refers to the left channel component numbers.

PREAMPLIFIER

One half of a dual FET input op-amp IC1b is used, together with rotary switch SW1 and associated components to implement the preamplifier. The circuit is basically an inverting amplifier with switching to change the input and feedback components to suit the selected signal source.

The gain of an inverting amplifier is determined by the ratio of the impedances of the feedback components divided by the input components.

When the tuner (or tape) input is selected by SW1 the input impedance is the sum of the source impedance and R1 (or R2), while the feedback impedance comprises the parallel combination of R4, R5 and C1. This results in a frequency response that is essentially flat up to 10 kHz with a gain of 2.5 and rolls off by 3 dB at 20 kHz because of the decreasing impedance of C1.

When the phono input is selected, the op-amp is configured as a charge amplifier by removing R5 from the feedback circuit and connecting the ceramic cartridge directly to the inverting input. The gain is determined by the ratio of the cartridge capacitance to the feedback capacitor (C1) except at low frequencies where R4 rolls off the response below 40 Hz. R4 is required to avoid saturation of the op-amp due to input offset current through C1.

The ceramic cartridge may be represented as a voltage source in series with a capacitor of a few hundred picofarads. Since the input impedance (the cartridge) and the feedback impedance (C1) are both capacitive their ratio is independent of frequency, and so the overall frequency response of the preamp is essentially flat.

The situation is complicated by the manufacturing compromises involved in making the ceramic cartridge (discussed in ETI June 1975) which lead to a rising response at low frequencies. This has been compensated for by adjusting R4. The value of 8M2 was found by listening tests and may need to be changed if a different cartridge is used.

TONE CONTROL STAGE

Firstly, R6, R7, C5 and ZD1 combine to decouple and limit the power supply voltage to the pre-amp and tone control op-amps to the rated maximum.

The preamplifier is coupled to the tone control stage through capacitor C2 which removes any dc offset voltage. The detailed circuit operation of the standard tone control has been discussed in text books so we shall confine the description to a more intuitive level.

The tone control stage is based around an inverting op-amp IC1a, the gain of which is determined by the ratio of the feedback impedance to the input impedance. When the bass and treble pots are centered the overall feedback and input impedances are equal and the stage gain is one, i.e: 0 dB. At low frequencies the capacitors are high impedances and therefore C4 isolates the treble control pot from the circuit, leaving the bass pot RV1 to determine the gain of the stage.

If the wiper of RV1 moves toward R8 the ratio of feedback to input impedance increases so the gain also increases. As the frequency increases two things happen — first C3 starts to bypass the bass pot and decrease its effect on the stage gain; also the impedance of C4 decreases and the treble pot RV2 starts to have an effect on the stage gain.

The treble pot works in a similar way to the bass pot. If the wiper of RV2 moves towards R11 the ratio of feedback to input impedance increases, resulting in an increase in stage gain — only this time at high frequencies where C3 has effectively bypassed the bass pot, thus preventing it from affecting the stage gain.

The output of the tone control stage is fed to the volume pot (and also to the tape output) and thence through coupling capacitor C6 to the power amplifier.

POWER AMPLIFIER

This stage is based on a number of amplifiers published in previous ETI projects, beginning with the ETI-452 guitar practise amp in January 1980. The general design is to use an op-amp for voltage gain and a transistor-follower output to drive the low impedance speaker load. The transistors are biased off when no signal is present by silicon diodes; this eliminates any setting up adjustments.

We have taken advantage of the drive capability of the 5534 op-amp (which wasn't available until the 5000 series projects were developed) to simplify the previous circuits by eliminating one current amplifier stage transistor and reducing the diode bias network by one diode.

'MASTERPLAY' STEREO

Geoff Nicholls
Peter Ihnat

This beaut little, low cost stereo amp/record player unit is easy to build and gives good performance. It will deliver over 30 watts (peak) per channel making the unit ideal for the bedroom or den. We teamed the amp with a low cost turntable, thus keeping the cost of the system under $100. An ideal weekend project — heat up your soldering iron!

THIS PROJECT was born in the back bar of a certain well-known Sydney 'trade union' pub. A certain well-known 'party peripheral' (and we're not saying which party) pressed upon us that what the magazine needed was more ". . . projects for the proletariat". All the super-wank Z80-based, dynamic RAM, MOSFET-matched, low noise home entertainment and burglar alarm systems were all very well, but most people didn't build them because, well — they couldn't *afford* them. (Or they lost patience saving up.)

As music was now the ". . . opiate of the masses", what the magazine needed to do, so the argument went, was to provide the instrument by which the masses could imbibe their opiate. To wit — a stereo record player. But it had to be cheap. What parameters and compromises would satisfy the criterion?

Well, it was a longish session, even the bartender provided some input (apart from what went in the schooners, that is), but we came away with a few fundamental parameters. In the end, I think we spent more on the beer than we did in the bits for the prototype! (Well, there *were* half a dozen of us.) Design by consensus — it's a new buzz phrase.

The obvious first requirement was a low-cost turntable. Jaycar and Altronics recently advertised a BSR unit complete with tone arm and ceramic cartridge for around $30, so that solved that problem. The next problem was the electronics design.

Design development

Once we had decided to develop a stereo based around the BSR turntable, the usual arguments were bandied about — the suppliers wanted the price to be the lowest possible while the lab staff felt the performance should not be sacrificed, after all ETI has a reputation to uphold (witness the success of the no-compromise Series 5000 equipment). The availability of high quality minimum component IC power amplifiers has always been erratic, in our experience, so we decided early on to reject that approach and stick with components that are widely stocked.

We feel that the project has extracted just about all that can be obtained from the BSR turntable with the ceramic cartridge supplied and that it would make an excellent first project for those taking up electronics, or a low-cost alternative system for those who are reluctant to subject their megabuck sound system to the rigours of parties. Although the power output is only around 10 W RMS per ▶

R13 sets the ground reference to allow dc coupling of the output stage while R16 and RV4 along with the R116 from the other channel are used to effect a balance control by varying the power amp gains between the left and right channels. C11 is used to ac couple the balance pot wiper to minimise dc offsets in the power amp. The overall gain is determined by the ratio between R17 and R16 plus the balance pot to ground through C11.

Q1 and Q3 form a NPN darlington pair while Q2 and Q4 form a complementary PNP pair, both of which are biased in class B by the two 1N914 diodes and the biasing resistors R18 and R19.

FS1 protects the loudspeakers against catastrophic failure of the output stage where either supply rail is shorted to the output. C9 and C10 are used to stabilise the output stage against high frequency oscillations.

The power supply to the op-amp IC2 is decoupled through R14, R15 and C8. If NE5534 (Signetics) devices, or the exact equivalents are used, then ZD2 may be deleted and R14, R15 decreased to 39R since Signetics devices are rated for supply rails up to ±22 V.

If other op-amps are used for IC2 then ZD2 may be required to limit the maximum supply voltage — this will usually be a 36 V zener since most 5534 copies have a ±18 V rating.

POWER SUPPLY

Transformer T1 is used to provide the ±22 V dc supply to the amplifier via a full-wave complementary rectifier circuit comprising D3 and D6 and C12 and C13.

The recommended turntable requires +12 V dc which is provided by the series transistor-zener regulator circuit with full wave rectifier and capacitor C14.

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EA October 81

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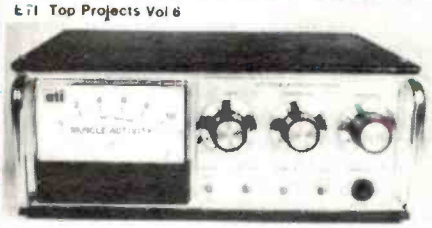
The unit described here will measure the power consumption of any mains appliance with a rating up to three kilowatts. It makes use of a special op amp called an "output transconductance amplifier" or OTA, for short.

EA SEPTEMBER 83

ELECTROMYOGRAM $99.00

ETI Top Projects Vol 6



DIGITAL ENG. ANALYSER $48.50

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How many times have you cursed your Multimeter when you had to measure a low-value resistance. Well alas, 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 158 November 81

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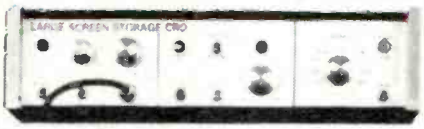

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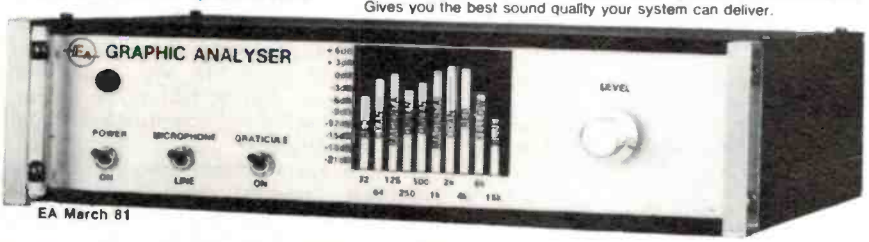

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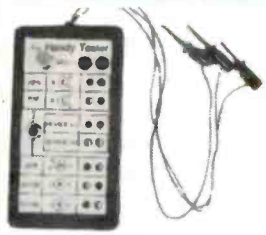

Have you ever desoldered a suspect transistor, only to find that it checks OK? Troubleshooting exercises are often hindered by this type of false alarm, but many of them could be avoided with an "in-circuit" component tester such as the EA Handy Tester.

EA SEPTEMBER 83

ELECTRONIC DUMMY LOAD $99.00

With this unit you can test power supplies at currents up to 15 Amps and Voltages 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 147 October 80

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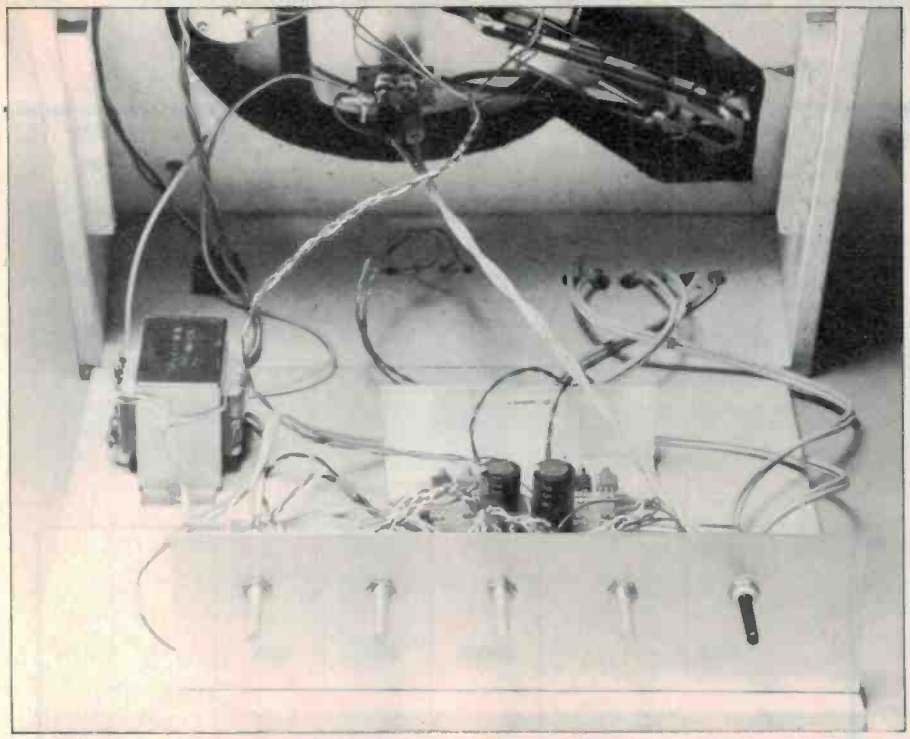


Inside view. Showing the general positioning of the bracket that holds all the controls, the main pc board and the transformer.

channel, we have found it to be entirely adequate for most circumstances, though some orchestral music has more dynamic range than the system can provide.

The design of the amplifier is straightforward and incorporates updated versions of previous ETI circuits. The pickup on the BSR turntable is a ceramic type, which is usually associated with poor frequency response because most cheap and nasty stereos use ceramic pickups. ETI discovered long ago (June 1975) that the ceramic pickup can produce good results if used with a 'charge amplifier' instead of the usual high input impedance circuits, so we used a charge amp with the '442.

The charge amp produces a near-flat frequency response which minimises the 'hole' that ceramic cartridges usually exhibit around 2 kHz. A single op-amp is switched between the charge amp configuration for the phono pickup and the more common inverting amplifier for the tuner and tape inputs by virtue of a 4-pole, 3-position rotary switch.

An active bass and treble tone control stage with around 20 dB of boost and cut follows the preamp, in line with the lower quality loudspeakers many will use with the project. Incidentally the prototype, which has been used with a pair of excellent bookshelf speakers, spends most of the time with the tone controls virtually flat. The tone stage is intended more to compensate for loudspeaker response deficiencies.

The power amp was designed with ease of construction in mind — we wanted to eliminate any setting up adjustments of bias currents which plague most published power amps. This requirement led naturally to a pure class B power amplifier and it was easy to update an earlier ETI circuit in light of currently available components. The circuit used is a modification of David Tilbrook's General Purpose Amp module, the ETI-453. We even managed to reduce the component count!

Construction

There are two aspects to the construction of this project: (a) the wooden box which houses everything, and (b) the electronics. The best place to start is with the wooden box preparation, assembly and finishing.

The wooden box

The electronics and turntable can be mounted in a variety of ways. For example, if you own an old system which still looks good but needs some updated electronics and/or turntable then the housing problem is solved. If you're building the system from scratch then a unit like our prototype is quite easy to build.

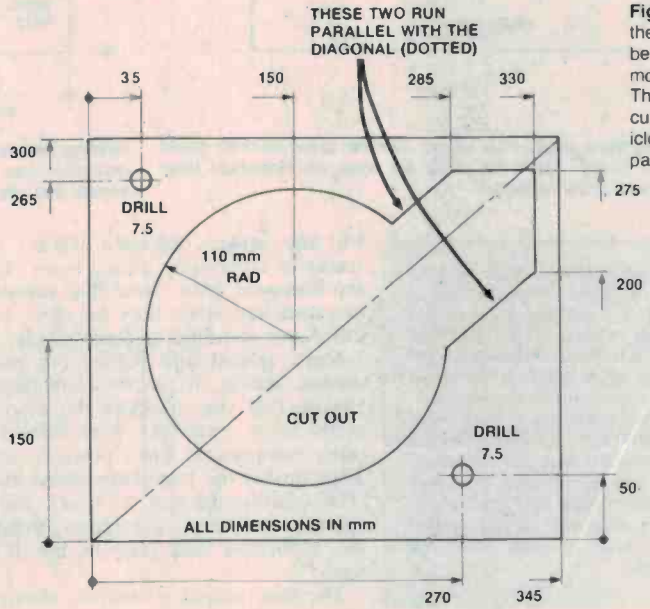
The top and base were cut from 10 mm particle board since they are not directly visible in the final unit. Figure 1 shows the section which needs to be removed to accommodate the turntable itself. Transfer the measurements given onto the wood and cut it out using a jigsaw. If you don't own a jigsaw, drill lots of holes just inside the perimeter of the cutout and push it out. A rasp should tidy the rest of it up. Be careful though, since the panel is severely weakened by the amount of wood removed, especially in the top right-hand corner. Drill the two turntable mounting holes next and finally, paint the entire panel matt black.

The four side panels are next. These can be cut from pine and later stained, but unless you have the required wood-working tools and skills this is not recommended. The method used to build the prototype is simpler and produces quite an attractive unit. We used particleboard and thermoveneer (more commonly known as iron-on veneer). This enables all the joints to be butted together and held with nails. The veneer is ironed on to hide any imperfections.

The four sides are cut from the same material as the top and base (see Figure 2). Next, drill the holes in the front and rear panels. Rectangular cutouts can simply be drilled and filed. Ensure that the hole for the power switch is not too tight since this may result in its internal mechanism jamming.

The box can be nailed together using panel pins and some Selley's 'Aquadhere' glue in the joints. The top panel with the turntable cutout actually sits 5 mm down from the top edge of the side panels. When the glue is dry, paint this 5 mm high area black before any veneering is done since paint splashes on veneer are difficult to remove. Nail some strips of 13 x 13 mm maple lath about 10 mm in from the bottom edge of the side and back panels. The base panel will be screwed to these when the unit is completed.

When all is dry, the veneering can be performed. Cut three pieces of veneer ▶



DETAILS OF TOP

Figure 1. This shows the section which must be removed to accommodate the turntable. The top of the box is cut out of 10 mm particle board which is painted matt black.

slightly oversize (the front panel will be Scotchcal and doesn't need veneering). Iron on the back sheet first, following the instructions supplied with the material. When cool, trim with a Stanley knife and file it level with the edges. Similarly, apply each of the two sides. Finally, cut four oversize strips to do the top edges. We cut 45° angles at the end of each strip to give the appearance of the side panels being cut at 45° before being joined.

When complete, the whole unit can be sanded and either sprayed with a clear matt enamel or oiled with one of the Scandanavian finishing oils (very effective on teak veneer).

Finally, mount the IEC mains socket on the back of the unit, fit the mains switch and connect them as shown in the overlay. (If you wish to forgo the IEC mains connectors, you'll need to use a cable clamp where the mains cord enters the box. Drill a slightly oversize hole at the cable entry point in the rear panel.) Leave a suitable length of cable for connection to the transformer. Cut three 300 mm lengths of green mains cable and attach a lug to five of the six free ends. The remaining end connects to the IEC connector. One end of each of these will be bolted to one of the transformer mounting lugs.

The electronics

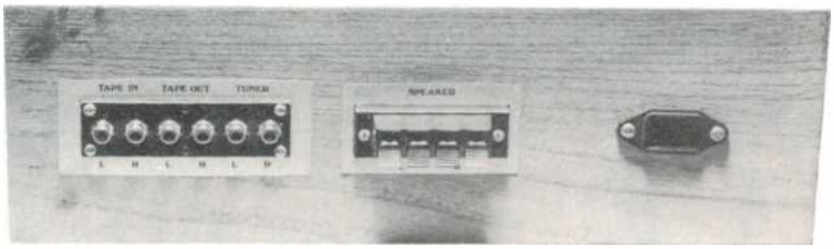
The components should be mounted on the specified pc board. Other constructional methods can be used but the design shown here produced a very compact unit. Begin construction by checking the board for any bridges between tracks, broken tracks or incorrectly drilled holes. Then fit the four wire links. Note that two of them are insulated since they lie close to each other and surrounding components.

Next, mount and solder the resistors, diodes, zeners, IC sockets and fuse clips. Ensure that you orientate the diodes correctly since a mistake here may damage other components when power is applied. Then mount the transistors (leave the four 'TIP' output devices till last) and once again, check their orientation. Finally, fit the capacitors and plug in the ICs and fuses.

The four output transistors mount on a heatsink. In the prototype, we used a 140 mm length of 50 x 50 x 3 mm aluminium angle bracket and found that it worked quite well.

Firstly, mount the four output transistors on the pc board and bend them back to lie parallel with the board. Then position the heatsink so that the transistors sit on it and mark and drill the four mounting holes. Drill one extra hole in the middle of the heatsink for a mounting bolt (explained later).

The output transistors can now be mounted on the heatsink with mica insulating washers and plastic bushes (these are available as a set of TO-220 insulated ▶



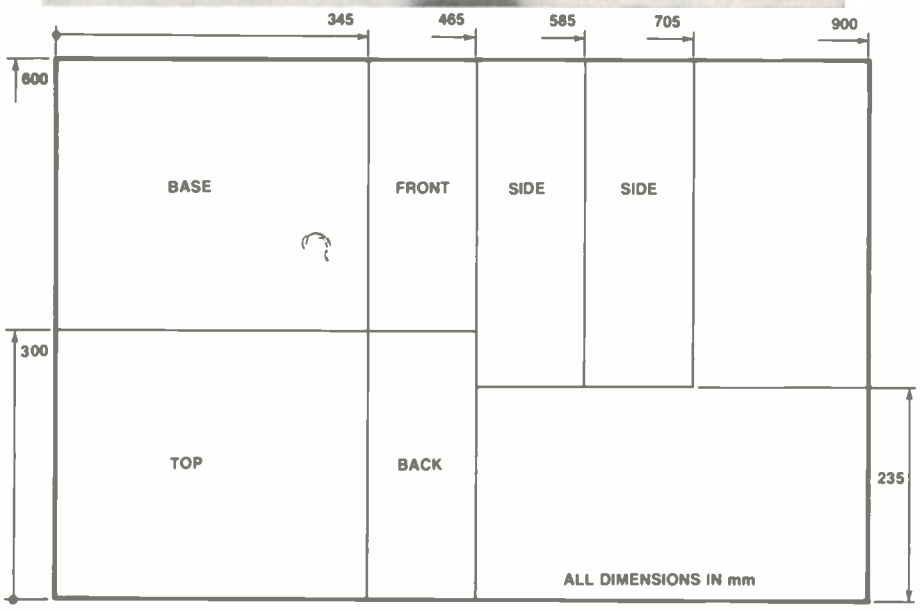
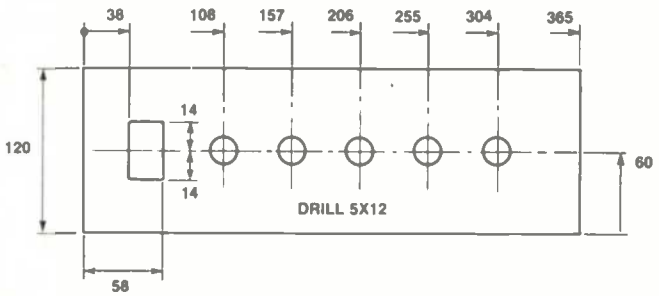
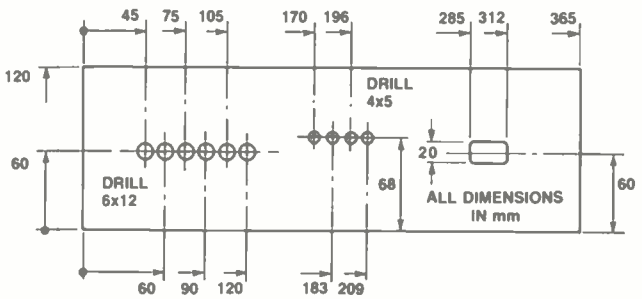


Figure 2. The turntable box is cut out of 900x600x10 mm particle board (standard size available). Iron-on veneer will hide any imperfections.



Drilling details for the front panel. Five 12 mm diameter holes must be drilled in the 10 mm particle board. The front panel will have the Scotchcal label applied so it doesn't need to be veneered.



Drilling details for the rear panel. Six 12 mm diameter holes and four 5 mm diameter holes must be drilled in the 10 mm particle board. Then iron-on the veneer and trim.

NOTE: The front panel artwork is too large to reproduce in the magazine. Photostat copies may be obtained by sending an A4-sized stamped, addressed envelope to **ETI-442 Artwork Photostats, ETI Reader Services, PO Box 227 Waterloo NSW 2017.** If you want positive or negative same-size film transparencies, the complete set costs $14 or front panel film only costs $10 from **ETI-442 Artwork Sales, ETI Magazine, PO Box 227, Waterloo NSW 2017.** Make out your cheque or money order to 'ETI Artwork Sales' and ensure you ask for positives or negatives as you require. The printed circuit board and rear panel artwork are on page 156.

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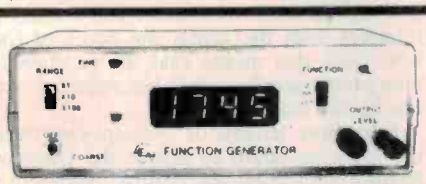

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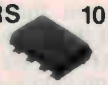

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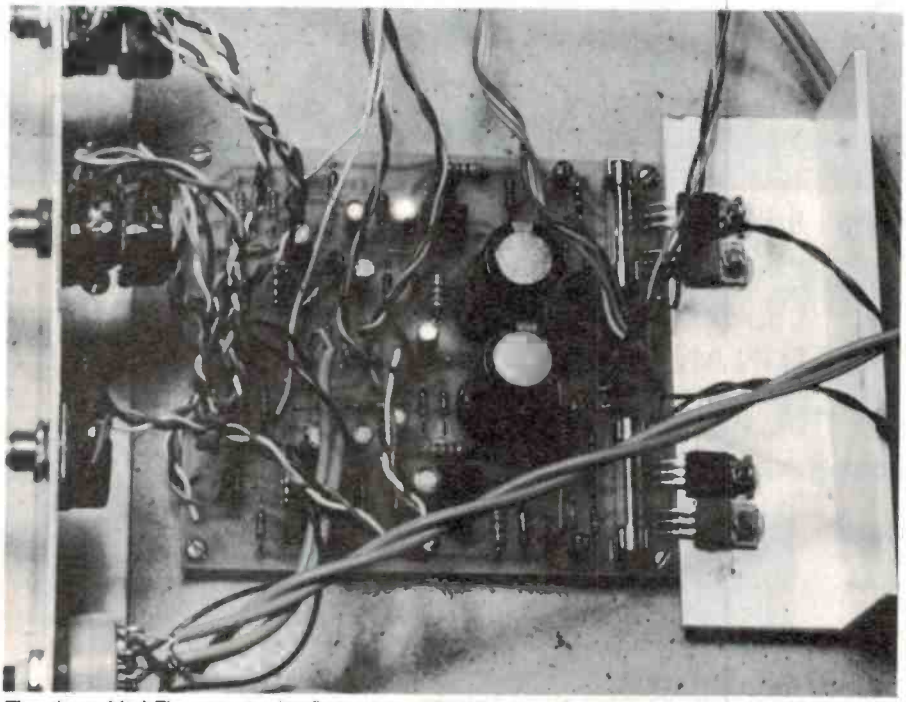
ALL PRICES INCLUDE TAX. PRICES CORRECT MONTH OF ISSUE.



The clever bits! The amp circuitry fits on one pc board, mounted on the base of the box. Note the aluminium angle heatsink for the power output transistors.

transistor mounting kits). Don't forget a smear of silicone grease between the transistors, washers and heatsink. As a precaution against shorts, measure the resistance between the heatsink and the collector (middle leg) of each output transistor. Each measurement should indicate open circuit. If not, there is a chance that a small burr may have become lodged between the transistor and mica or the mica and heatsink. In this case, unbolt the suspect transistor, wipe the heatsink, washer and transistor clean and remount. Don't proceed unless the measurements are OK. Connect 21 lengths of hookup wire to the tone control connections of the pc board. The other ends will be connected later.

In the prototype, we mounted the transformer and pc board directly onto the baseboard. The transformer is bolted down with a couple of self-tapping screws. Connect the three earth leads to the transformer body at one of its mounting lugs. The pc board sits on four 6 mm spacers, the screws passing through the board, spacer and then into the wood. Although not implemented on the prototype we recommend that an extra spacer and screw be used to support the heatsink (the reason for the extra hole being drilled) to reduce any strain on the transistor leads.

The four pots and the 'select' switch are mounted on an aluminium bracket which, once again, is mounted on the baseboard. We used a 250 x 100 mm piece of 1.5 mm aluminium bent about 20 mm along one edge. To mark the positions of the controls, firstly assemble the box by inserting its bottom panel. Don't fit the turntable though. Reach through the turntable cut-out and hold the bracket against the inside of the front panel. Position it well clear of the mains switch and use a pencil from the front to mark the position of each control on the bracket. Dismantle the unit and drill holes in the bracket to suit the pots and rotary switch used. Also drill a few smaller holes in the 20 mm section to allow the bracket to be bolted to the base.

We haven't included specific details on where to mount the bracket since that depends on the lengths of the switch and pot shafts. Mount the pots and switch on the bracket and once again assemble the box. This time, position the bracket behind the front panel so that the *shortest shaft* protrudes about 10 mm through it (10 mm positioned our knobs about 1 mm off the front panel but depending on which knobs you are using, this may have to be increased or decreased). Mark the position of the bracket on the baseboard and, while you're at it, place a mark on the shafts which have to be shortened. Once again, dismantle the unit, cut the pot or switch shafts that you marked and, finally, bolt the bracket onto the baseboard in the position you just determined. Connect one of the earth leads to one of the bracket mounting screws for protection and to help reduce noise pickup by the tone controls.

All that remains is the actual wiring to the controls, inputs and outputs. Study the overlay carefully and run connections to the controls and stereo speaker connector *exactly as shown*.

Next, solder resistors R1, R2, R101 and R102 onto the back of their corresponding input sockets. Cut three 350 mm lengths of stereo shielded cable and bare each end. Connect each one to an input socket or one of the resistors just mentioned.

The wiring to the select switch is the trickiest part of the construction. The circuit diagram uses contact numbers found on the back of the switch so if these are followed, no problems should arise. Solder short pieces of wire to connect pin A to B, 5 to 6, C to D and 11 to 12. The shielded cable from the inputs can now be connected to the switch as shown in the wiring diagram. Cut two more lengths of shielded cable, 300 mm and 100 mm long. The longer cable is the phono connection and is soldered to pins 1 and 7 of the switch. The shorter piece connects point A (and B) and C (and D) of the switch back to the pc board. At the switch, twist and solder all the right channel shields together (i.e: tape in, tuner, phono and connection back to pc board). Similarly with the left channel. The final connection to the switch is the one from R5 (and R105) and this goes to pin 5 and 6 (or 11 and 12 in the case of R105). Shielded cable is not needed for this connection.

Powering the turntable

The supply for the turntable uses six components and for simplicity we mounted them on a 7-way tag strip. Mount the components exactly as shown, checking the orientation of the diodes, transistor and capacitor. Note that the tag strip's mounting lug is one of the supply's connections and is automatically connected when bolted to the turntable.

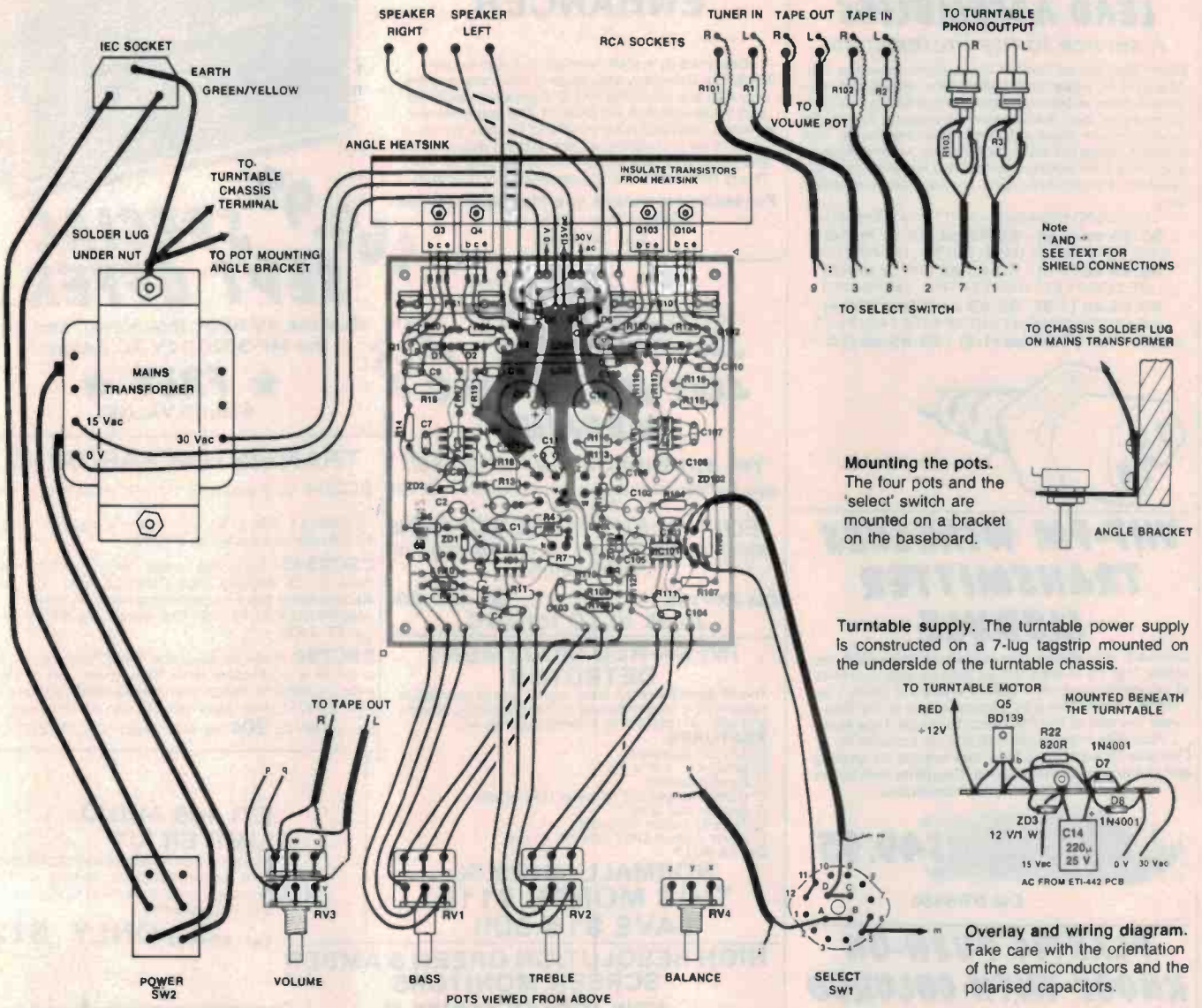
Its location is not critical so any spare hole can be used. Just ensure that it doesn't interfere with the actual top panel of the box. This also means that the turntable's blue power supply wire is not required and can be cut short.

Run three lengths of hookup wire from the main pc board to power the tagstrip. Before connecting the positive connection of the turntable (red wire), power the circuit up and check that it produces about 12 volts. The voltage here is not too critical but should not be below 9 or above 14 volts.

The remaining shielded cable for the phono connection needs RCA plugs fitted. We mounted resistors R3 and R103 inside the plugs. This is possible if 1/4 watt or 1/8 watt resistors are used.

Well, the moment of truth — to see if the power stages operate. Assemble the unit temporarily without the turntable or speakers connected. Apply power — switch off immediately at any sign of smoke. If all is well, measure the voltage on each speaker output. These should certainly be less than 100 mV. Rectify the situation immediately and on no account should you connect any speakers until the offset is reduced.

If all is well, connect the turntable and connect the final green earth wire to the bolt which holds the phono RCA sockets in place beneath the turntable. The system is complete. ●



Mounting the pots. The four pots and the 'select' switch are mounted on a bracket on the baseboard.

Turntable supply. The turntable power supply is constructed on a 7-lug tagstrip mounted on the underside of the turntable chassis.

Overlay and wiring diagram. Take care with the orientation of the semiconductors and the polarised capacitors.

PARTS LIST — ETI-442

Resistors ..... all ½ W, 5%

R1, R2, R101, R102	2k2
R3, R103	1M
R4, R104	8M2
R5, R105	5k6
R6, R7, R106, R107	470R
R8, R9, R10, R108, R109, R110	12k
R11, R12, R111, R112	3k9
R13, R113	47k
R14, R15, R114, R115	100R
R16, R116	2k7
R17, R117	82k
R18, R19, R118, R119	1k8
R20, R21, R120, R121	68R
R22	820R
RV1	100k/A lin dual pot
RV2	500k/A lin dual pot
RV3	10k/C log dual pot
RV4	10k/A lin single pot

Capacitors

C1, C101	680p ceramic
C2, C6, C11, C102, C106	2µ2 25 VW RV electro
C3, C103	47n greencap
C4, C104	4n7 greencap
C5, C8, C105, C108	4µ7 50 VW RB electro
C7, C107	22p ceramic
C9, C10, C109, C110	100p ceramic
C12, C13	2200µ 25 VW RB electro
C14	220µ 25 VW RB electro

Semiconductors

IC1, IC101	LF353, TL072, µA772
IC2, IC102	NE5534 . . . see text
Q1, Q101	BC639
Q2, Q102	BC640
Q3, Q103	TIP31B/C
Q4, Q104	TIP32B/C
Q5	BD139
D1, D2, D101, D102	1N914
D3-D8	1N4001
ZD1, ZD101	30 V/1 W
ZD2, ZD102	36 V/1 W . . . see text
ZD3	12 V/1 W

Miscellaneous

T1	6672 30 V/1 A transformer
SW1	4-pole, 3-position rotary switch

4 pc mount fuseholders
2 0.5 A 3AG fuses (1 A for 4 ohm loads)
1 ETI-442 pc board
1 ETI-442 panel set
1 140 mm length 50x50 mm angle bracket
1 bracket to mount pots and switch
2 RCA plugs
1 6-way RCA socket set
1 stereo loudspeaker connector
1 2-pole illuminated mains switch
5 knobs
1 IEC mains cord
1 IEC mains socket
1 wooden box
1 turntable with ceramic pickup
4 spacers; hookup wire; shielded cable.

Price estimate: $100-$115

IEC-320 STYLE MAINS LEAD ASSEMBLIES

A service to the Professional

Most imported equipment these days now uses IEC-320 style AC power inlet connectors. Indeed, the electronics mags will soon be specifying these connectors on many of their mains-powered projects to simplify (and therefore make safer) mains wiring. Jaycar now stocks a range of Electricity Authority Approved mains line cords. Each cord is a generous 2 metres long and is rated at 7.5 amps continuous. They are only available in grey.

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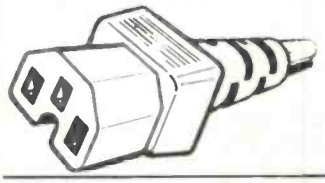
$3.95 ea (1-9) - $3.45 ea (10 or more)
LINE CORD LEFT HAND ENTRY - Cat PS-4104
$3.95 ea (1-9) - $3.45 ea (10 or more)
LINE CORD STRAIGHT ENTRY WITH 240V PLUG
Cat PS-4106 **$4.95 ea (1-9) - $4.45 ea (10 +)**



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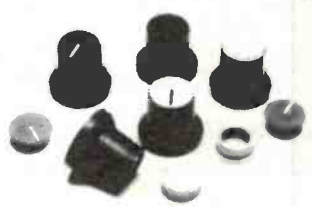
- *Ideal for mixers and other PA gear*
- *Contrasting pointer on cap*
- *Knob body has flange to cover pot nut*

Cat No	Cap	1-9	10+
HK-7704	Red	38¢	32¢
HK-7706	Black	38¢	32¢
HK-7708	Blue	38¢	32¢
HK-7710	Green	38¢	32¢
HK-7712	Yellow	38¢	32¢
HK-7714	White	38¢	32¢
HK-7716	Grey	38¢	32¢
HK-7702	Knob Body Black	75¢	65¢



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For technical details see the latest Jaycar catalogue - page 19.
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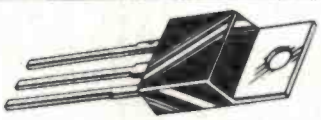

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CONSUMER GUIDE

BEATING THE MAIL ORDER BLUES

Jim Rowe (with boot polish). Caught busking in Chicago's Maxwell Street Market!

Jim Rowe

Buying electronic parts and kits by mail order can be very convenient — and also quite reliable, providing you go about it the right way.
Follow these guidelines and you shouldn't get caught.

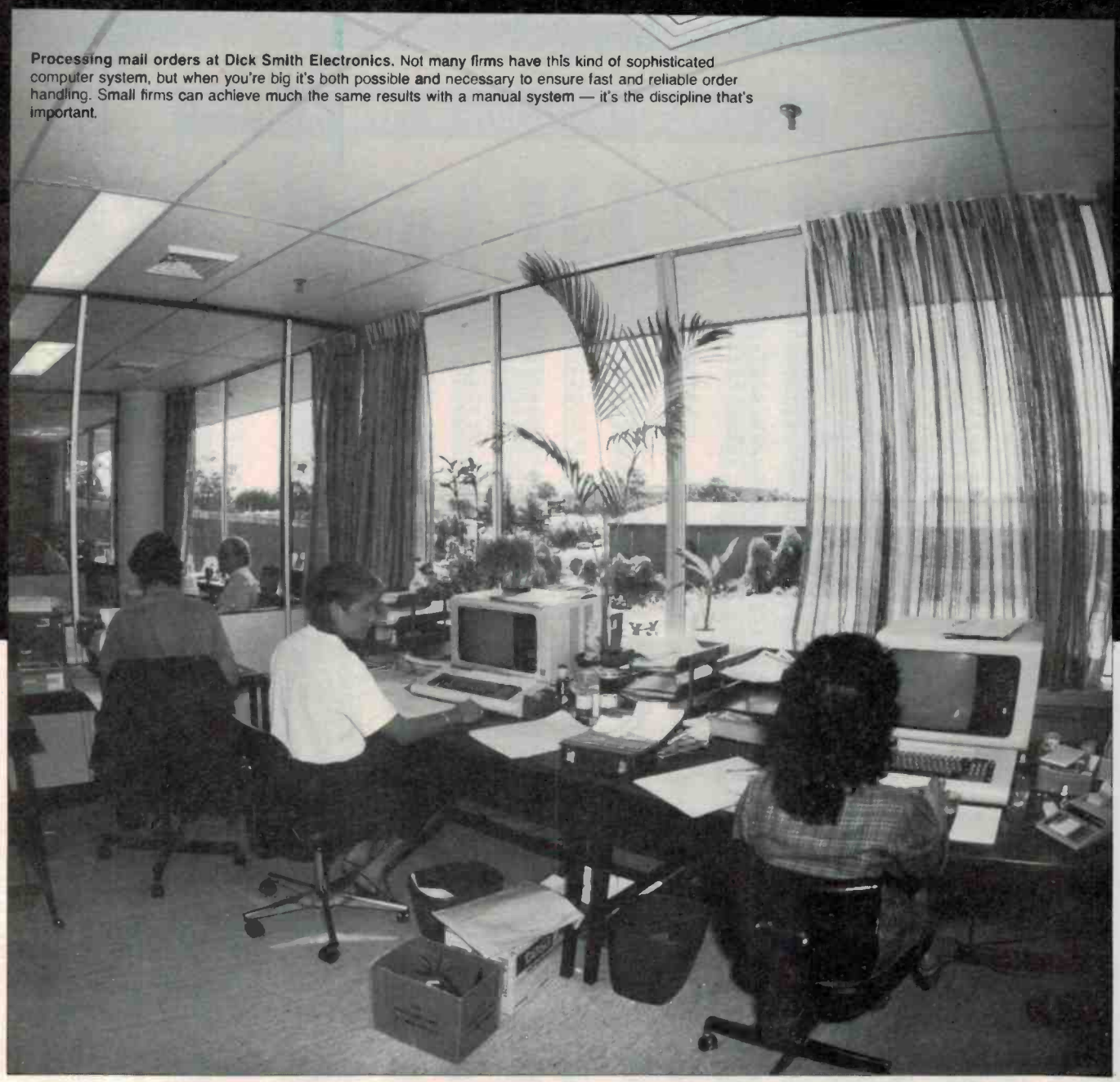
WITHOUT A DOUBT, the best possible way to buy electronic parts and kits is directly over the counter — just as it is with anything else. You can see what you're getting, pay your money and walk away with it immediately. Or if what you really want currently isn't in stock, you can make an instant decision to either accept an alternative, or go and try somewhere else.

Of course, electronics stores aren't exactly on every street corner. In fact, getting to your nearest store can be quite a problem, if you happen to live out of town. Even if you live in the 'big smoke', it isn't always easy to get to your friendly local store at times when they're open (particularly if you're like most of us, and have to work for a living!).

The logical alternative is mail order. But, I hear you ask, isn't that risky? Yes, it can be. From time to time, firms in the mail order business go bust, and customers get caught along with suppliers. But you can minimise the risks by going about things the right way.

Probably the most important thing to do is try to ensure that you deal with a reputable and well-organised company. Admittedly that's easier to say than to do, but for a start you can assume that the biggest and longest-established firms are a pretty safe bet. They wouldn't have survived and reached their current size if they were dishonest or hopelessly muddled.

In a country like Australia with a relatively small population spread over a large area, most of the larger electronics retailers depend upon mail order business. It provides a significant part of their turnover and profit. So they have a vested interest to protect their reputation, and provide their mail-order customers with fast and reliable service. Hence all the impressive mail-order catalogues and the fancy claims about 24-



Processing mail orders at Dick Smith Electronics. Not many firms have this kind of sophisticated computer system, but when you're big it's both possible and necessary to ensure fast and reliable order handling. Small firms can achieve much the same results with a manual system — it's the discipline that's important.

hour service, delivery by return mail, etc.

Big vs small

So it's pretty safe to deal with the big names. But what about the smaller firms — are these all risky? Not at all. The only problem here is that it's harder to tell the 'goodies' from the 'baddies', particularly when you're at a distance.

Ideally you should try to visit the firm you deal with personally, at least once to check them out and establish contact. Five minutes in the store and you'll have a pretty good idea whether they're the right kind of people to buy from.

Remember that even where the 'bad' mail order firms are concerned, most of them are not actually dishonest, just hopeless at running an efficient business. They don't have any organised 'system' to process orders, so they tend to lose orders and misplace correspondence. This is why most of them go broke — they end up in such a muddle that they can't even pay their bills.

If you can't visit the store, or get a friend or relative to visit them, try them out with a few small orders that don't involve risking a lot of money. Use these to judge them, in terms of speed of response, professional paperwork and packing, and efficiency in handling temporary out-of-stock situations or any other problems that may arise. Then if they pass muster, try them with larger orders.

By the way, I'm not suggesting that you should only deal with firms boasting fancy computer invoicing systems or whatever. Everyone has to start somewhere, and until they get to a certain size a firm generally can't afford too many frills. But even the smallest mail-order operation can be properly organised, with records of all orders received and despatched, serial-numbered receipts to allow tracking, and so on — even if these things are all written out by hand. If these things are not done, the company will end up in a mess, and *your* order is likely to get lost.

Of course there'll always be the occasional mixup, even with the largest and best organised mail-order companies. Components get tipped in the wrong bin, kits get packed in the wrong boxes, letters drop under the desk, people get sick or go on holidays and forget to enter orders. These things don't happen all that often, but they do crop up occasionally. We'll come back to this shortly.

Before we go any further, I should point out here that a lot of mail order troubles are actually caused by customers themselves. Things that are so simple, but can com-

continued on page 98 ▶

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ICL7611	6.95
ICL7612	6.95
ICL7660	5.90
ICL7663	4.90
ICL7664	4.90
ICM7211	12.50
ICM7216A	48.50
ICM7216B	44.50
ICM7217A	18.50
ICM7218A	18.50
ICM7224A	21.50
ICM7226A	48.50
ICM7227A	19.95
ICM7213A	15.50
ICM7240	7.50
ICM7242	3.90
ICM7250	7.90
ICM7260	7.90
ICM7555	2.75
ICM7556	2.95

74 S

74S00	1.00
74S02	1.00
74S03	1.00
74S04	1.00
74S05	1.50
74S08	1.00
74S09	1.50
74S10	1.00
74S11	1.00
74S15	1.60
74S20	1.20
74S22	1.50
74S30	1.00
74S32	1.00
74S37	1.70
74S38	1.70
74S40	1.20
74S51	.80
74S64	1.20
74S65	1.20
74S74	1.30
74S86	1.60
74S109	2.50
74S112	1.30
74S113	1.30
74S114	2.50
74S124	5.90
74S132	3.50
74S133	1.20
74S134	1.40
74S135	1.30
74S138	3.30
74S139	3.30
74S140	1.90
74S151	3.10
74S153	2.00
74S157	3.10
74S158	3.10
74S160	5.90
74S161	5.90
74S162	7.90
74S163	7.90
74S168	11.50
74S169	11.50
74S174	4.50
74S174	4.50
74S181	8.50
74S182	3.40
74S188AN	4.10
74S189	8.50
74S194	3.30
74S195	2.90
74S196/82590	4.90
74S197/82591	4.90
74S201	9.90
74S214AN	P.O.A.
74S225	10.90
74S226	7.90
74S240	6.90
74S241	6.90
74S244	9.90
74S251	3.90
74S253	4.90
74S257	3.30
74S258	3.30
74S260	2.90
74S274	P.O.A.
74S275	P.O.A.
74S280	5.90
74S281	P.O.A.
74S283	7.90
74S287	4.90
74S288	4.90
74S299	13.90
74S301	13.90
74S314	P.O.A.
74S330	P.O.A.
74S331	P.O.A.
74S373	9.90
74S374	9.90
74S381	9.90
74S387	3.30
74S412/8212	5.90
74S428/8228	7.90
74S470	9.90
74S471	9.90
74S472	P.O.A.
74S473	P.O.A.
74S474	P.O.A.
74S475	P.O.A.
74S482	11.90
74S489	7.90

74H

74H00	.80
74H01	.80
74H02	.80
74H03	.80
74H04	.80
74H05	.90
74H08	1.10
74H10	.80
74H11	.80
74H12	.80
74H15	.80
74H20	.80
74H21	.90
74H22	.80
74H30	.90
74H40	.90
74H50	.90
74H51	.90
74H52	.90
74H53	.90
74H54	.90
74H55	.90
74H60	.90
74H61	.90
74H62	.90
74H64	.90
74H65	.90
74H71	1.40
74H72	1.20
74H73	1.80
74H74	1.80
74H76	1.90
74H78	1.90
74H87	7.90
74H101	1.80
74H102	1.80
74H103	2.50
74H106	2.50
74H108	2.50
74H113	1.10
74H114	1.10
74H183	7.90

74C

74C00	.80
74C02	.80
74C04	.80
74C08	.80
74C10	0.80
74C14	1.40
74C20	0.80
74C30	.80
74C32	.80
74C42	1.90
74C48	2.50
74C73	1.40
74C74	2.40
74C76	1.90
74C83	2.30
74C85	2.30
74C86	1.50
74C89	8.90
74C90	1.90
74C93	1.90
74C95	2.00
74C107	1.20
74C150	6.50
74C151	4.20
74C154	6.00
74C157	3.75
74C160	1.90
74C161	1.90
74C162	2.00
74C163	2.00
74C164	2.50
74C165	2.50
74C173	1.90
74C174	1.90
74C175	1.90
74C192	2.00
74C193	2.00
74C195	2.00
74C200	14.00
74C221	2.75
74C240	3.75
74C244	3.95
74C373	5.75
74C374	5.45
74C901	3.00
74C902	2.50
74C903	2.50
74C904	2.50
74C905	15.00
74C906	2.90
74C907	2.90
74C908	2.75
74C910	14.00
74C911	12.50
74C912	12.50
74C914	4.50
74C915	4.00
74C917	15.50
74C918	2.90
74C920	12.50
74C921	12.50
74C922	7.50
74C923	7.90
74C925	8.90
74C926	8.90
74C927	9.90
74C928	9.00
74C929	9.50
74C930	2.75
74C932	2.50
74C941	2.50
74C989	8.90

74LS

74LS00	.60
74LS01	.60
74LS02	.60
74LS03	.60
74LS04	.90
74LS05	.90
74LS08	.60
74LS09	.80
74LS10	.80
74LS11	.80
74LS12	.80
74LS13	.90
74LS14	.80
74LS15	.80
74LS19	.90
74LS20	.90
74LS21	.90
74LS22	.90
74LS24	.90
74LS26	.90
74LS27	.90
74LS28	.90
74LS30	.80
74LS32	.70
74LS33	.70
74LS37	.70
74LS38	.80
74LS40	.80
74LS42	1.50
74LS47	1.80
74LS48	1.80
74LS49	1.80
74LS51	.70
74LS54	.80
74LS55	.80
74LS63	2.80
74LS73	1.00
74LS74	0.80
74LS75	1.00
74LS76	1.00
74LS77	1.00
74LS78	1.10
74LS83	1.70
74LS85	.90
74LS86	.80
74LS90	1.20
74LS91	1.20
74LS92	1.20
74LS93	1.70
74LS95	1.20
74LS96	1.20
74LS107	.90
74LS109	.90
74LS112	.70
74LS113	.70
74LS114	.80
74LS122	1.30
74LS123	1.30
74LS125	.80
74LS126	1.20
74LS132	1.50
74LS133	4.90
74LS136	1.50
74LS138	1.00
74LS139	1.00
74LS145	2.10
74LS147	2.50
74LS148	1.90
74LS151	1.20
74LS152	1.95
74LS153	1.00
74LS154	2.95
74LS155	1.00
74LS156	1.50
74LS157	1.10
74LS158	1.00
74LS160	1.00
74LS161	1.00
74LS162	1.50
74LS163	1.10
74LS164	1.40
74LS165	1.00
74LS166	2.55
74LS169	2.45
74LS173	1.20
74LS174	1.20
74LS175	.80
74LS181	4.00
74LS190	1.50
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.70
74LS196	1.70
74LS197	1.75
74LS221	2.00
74LS240	2.40
74LS241	2.40
74LS242	2.40
74LS243	2.40
74LS244	2.50
74LS245	2.95
74LS247	1.30
74LS248	1.50
74LS249	1.60
74LS251	1.50
74LS253	1.20
74LS257	1.20
74LS258	1.20
74LS259	1.50
74LS261	2.50
74LS266	1.20
74LS273	1.95
74LS275	6.80
74LS279	1.00
74LS280	2.60
74LS283	1.50
74LS290	1.50
74LS293	1.30
74LS295	1.75
74LS297	16.50
74LS298	1.20
74LS299	3.90
74LS320	3.95
74LS321	3.95
74LS322	6.75
74LS323	6.50
74LS324	2.20
74LS326	2.20
74LS327	2.20
74LS352	2.20
74LS353	2.20
74LS354	3.95
74LS365	1.00
74LS366	1.00
74LS367	1.00
74LS368	1.00
74LS373	1.90
74LS374	1.90
74LS375	1.00
74LS377	2.15
74LS378	1.20
74LS379	1.90
74LS386	1.00
74LS390	1.80
74LS393	1.80
74LS395	2.00
74LS396	2.50
74LS398	3.00
74LS399	1.90
74LS424	5.50
74LS440	5.50
74LS441	5.50
74LS442	5.50
74LS443	550
74LS445	2.20
74LS446	5.50
74LS447	1.90
74LS448	5.50
74LS449	5.50
74LS490	3.20
74LS540	5.95
74LS541	7.95
74LS621	2.75
74LS622	2.75
74LS623	5.95
74LS629	5.95
74LS640	3.95
74LS641	2.75
74LS642	2.75
74LS643	2.75
74LS644	2.75
74LS645	2.75
74LS668	1.75
74LS669	1.75
74LS670	2.75
74LS673	12.55
74LS674	12.55
74LS690	3.95
74LS691	3.95
74LS692	3.95
74LS693	3.95
74LS696	3.95
74LS699	3.95

CDP

CDP1802	16.50
CDP1864	17.50

CPU

6502	13.00
6502A	14.00
6503	13.00
6504	13.00
6505	13.00
6507	13.00
6520	5.50
6521	5.90
6522	13.00
6522A	13.00
6532	14.00
6545	19.50
6551	12.90
2650	21.00
2651	23.00
6800	6.00
6802	7.00
6808	12.50
6809	10.00
6810	3.50
68B10	7.50
6820	5.50
6821	5.50
68B21	7.50
6840	6.50
6844	12.80
6845	7.50
6847	3.50
6850	7.90
68B50	10.00
6860	19.50
6875	5.00
Z80CPU	6.00
Z80ACPU	8.00
Z80BCPU	16.00
Z80P10	4.50
Z80AP10	6.50
Z80CTC	6.50
Z80ACTC	8.50
Z80DMA	16.00
Z80ADMA	19.00
Z80AS10	15.00
Z80S10	13.00
AD570	69.50
AD590	9.50
AD7524	17.50
AY-3-8910	14.50
AY-3-2513	14.50
MSM5832	16.50
MM58174	19.50
MM5303	7.50
MM5309	14.50
MM5369	4.95
LH0002	9.50
LH0042CH	7.50
LH0070	7.50
LH0071	7.50
TL061	1.50
TL062	2.90
TL064	4.90
TL071	1.20
TL072	2.90
TL073	3.20
TL074	4.90
TL081	1.90
TL082	2.50
TL083	2.90
TL084	3.45
TL494	4.90
TCA220	9.50
TCA280	4.50
TDA1024	2.90
TA7205P	3.90
TEA1002	17.50
UAA170	5.95
UAA180	3.75
LM10CH	7.50
LM301	1.00
LM301H	1.50
LM302H	6.50
LM305H	1.50
LM307CN	1.00
LM307H	1.60
LM308	1.00
LM308H	1.80
LM309K	1.90
LM310N	3.20
LM310H	3.20
LM311	1.00
LM311H	1.80
LM317T	2.50
LM317K	4.50
LM318	4.90
LM319	4.90
LM324	1.50
LM325	4.50
LM326	4.50
LM329DZ	.90
LM344Z	1.70
LM335Z	2.20
LM336 2.5V	2.95
LM338K	12.50
LM339	1.20
LM348	1.80
LM349	1.60
LM350K	8.50
LM351N	1.00
LM353	2.50
LM356N	1.40
LM357	1.40
LM358	1.40
LM361	3.50
LM377	4.90
LM378	3.95
LM379-S	7.95
LM380 8PIN	1.80
LM380 14PIN	1.90
LM381	3.50
LM382	3.50
LM383	3.90
LM384	3.50
LM386	1.95
LM387A	LM3.95
LM387	2.00
LM390	2.95
LM391	2.90
LM393	1.00
LM394	4.95
LM395T	9.95
LM396K	22.50
LF398	5.90
NE544	6.50
NE555	.60
NE556	1.80
NE558	6.90
NE560	4.60
NE561	4.60
NE565	1.60
NE566	2.90
NE567	2.00
NE570	5.90
NE571	5.90
NE592	6.90
NE594	9.50
LM709-14	1.50
UA710CN	1.00
LM711	1.20
LM723	.75
LM723CH	1.50
LM725	4.75
LM733	1.50
UA739	2.75
741	.80
UA747	1.30
UA748	1.00
MC1310	9.50
MC1312	7.95
MC1314	7.95
MC1315	8.95
MC1327	7.95
MC1350	1.95
MC1408L8	7.50
MC1437	4.95
MC1445	5.95
MC1456	1.95
MC1458	1.20
MC1466L	14.50
MC1469R	6.90
MC1488	1.20
MC1489	1.20
MC1494	8.40
MC1495	8.90
MC1496	2.50
LM1596	3.00
MC1648	8.90
LM1812	10.50
LM1830	3.90
LM2907	3.90
LM2917 8PIN	4.90
LM2917 14PIN	4.90
MN3001	17.50
CA3028	2.00
CA3046	1.90
CA3056	6.50
CA3059	5.95
CA3080	1.90
CA3086	1.90
CA3089	3.90
CA3100E	7.95
CA3130E	2.20
CA3130T	2.95
CA3140E	2.20
CA3140T	2.95
CA3240E	11.95
LM3401	1.00
LM3900	1.20
LM3905	1.75
LM3909	2.95
LM3911	2.95
LM3914	5.90
LM3915	5.90
LM3916	5.90
LM3999Z	2.60
RL4136	1.95
RC4145	20.90
RC4194	3.90
MM 5369	4.95

SCR & TRIACS

SC141D	1.50
SC141E	1.95
SC142E	2.95
SC146D	2.85
SC146M	2.95
SC150D	4.95
SC151D	2.95
C103YY	.90
C103B	.90
C106B	.90
C106D	.90
C122D	2.50
C122E	2.95
C260D	8.50
C260E	9.90
2N2646	1.20
2N2647	2.50
2N6027	.90

TRANS.

AC125	1.20
AC126	1.20
AC127	1.20
AC128	1.20
AC187	1.50
AC188	1.50
AC149	3.40
AD161	2.90
AD162	2.90
AF118	2.90
AF126	2.90
AF127	1.50
BC 107	.50
BC 108	.50
BC 109	.50
BC 159	.50
BC 177	.60
BC 178	.60
BC 179	.60
BC 182L	
BC 212	.30
BC 318	.30
BC 320	.40
BC 327	.30
BC 328	.30
BC 337	
BC 338	.40
BC 546	.40
BC 547	.20
BC 548	.20
BC 549	.20
BC 550	.40
BC 556	.40
BC 557	.20
BC 558	.20
BC 559	.20
BC 635	.80
BC 636	.80
BC 637	.80
BC 638	.80
BC 639	.50
BC 640	.50
BC Y70	1.90
BC Y71	1.90
BD135	1.00
BD136	.90
BD137	.90
BD138	.90
BD139	.80
BD140	.80
BD201	.90
BD202	.90
BD232	.90
BD233	.90
BS235	.90
BD236	.90
BD237	.90
BD238	.90
BD262	1.20
BD263	1.20
BD437	1.50
BD488	1.50
BD647	1.80
BD648	1.80
BD677	1.80
BD681	2.00
BD682	2.00
BDV64B	5.50
BDV65B	5.50
BDX63	6.50
Y96 (BUX 80)	4.90
BDY97 (BUX 80)	4.90
BF115	1.50
BF167	1.20
BF173	1.20
BF177	1.20
BF180	1.20
BF182	.90
BF183	.60
BF184	.60
BF198	.60
BF199	.60
BF200	1.20
BF245	1.50
BF337	1.50
BF338	1.90
BF458	1.00
BF459	1.00
BF469	1.20
BF470	1.20
BF494	.90
BF495	.90
BFW10	1.50
BFW11	1.50
BFW16	1.50
BFY50	1.20
BFY90	1.90
BFX90	1.50
BU126	2.50
BU208	4.90
BU326	3.90
BUX80	4.90
MFE131	2.90
MFE3001	9.90
MFE3003	6.95
MJ413	5.90
MJ802	7.50
MJ901	4.50
MJ1001	3.90
MJ11011	9.90
MJ11015	14.50
MJ11016	14.50
MJ15003	6.50
MJ15004	6.50
MJ15024	10.00
MJ2501	8.90
MJ2955	1.50
MJ3001	6.90
MJ4032	12.50
MJ4035	11.90
MJ4502	6.90
MJE340	2.00
MJE350	2.50
MJE371	2.90
MJE521	2.50
MJE700	3.50
MJE800	2.90
MJE2801	3.95
MJE2955	4.90
MJE3055	3.90
MJE13005	5.90
MJE13007	7.90
MJE13009	12.50
MPF121	2.50
MPF131	2.50
MPSA05	1.00
MPSA06	1.00
MPSA10	1.00
MPSA12	1.00
MPSA13	1.00
MPSA14	1.00
MPSA20	1.00
MPSA42	1.00
MPSA43	1.20
MPSA55	1.00
MPSA56	1.00
MPSA63	1.00
MPSA65	1.00
MPSA92	1.00
MPSA93	1.20
MPF102	.90
MPF103	.90
MPF105	.90
MPF106	.90
MPF109	.90
MPSL01	1.50
MPSL51	1.50
MPSU02	1.75
MPSU52	1.90
MPSU56	1.75
MPU131	1.75
MRF221	19.50
MRF237	3.90
MRF238	19.50
MRF245	43.50
MRF421	43.50
MRF454	42.50
MRF455	27.00
MRF455A	27.00
MRF475	4.70
MRF603	19.50
MRF641	39.00
MRF646	43.00
MRF901	2.75
MPF131	1.90
TIP31A	.90
TIP31B	1.00
TIP31C	1.20
TIP32A	.90
TIP32B	1.00
TIP32C	1.20
TIP41A	1.40
TIP41C	1.50
TIP42A	1.40
TIP42C	1.50
TIP49	1.90
TIP50	2.20
TIP53	2.50
TIP111	1.50
TIP112	1.50
TIP116	1.50
TIP117	1.50
TIP120	1.50
TIP122	1.50
TIP125	1.50
TIP127	1.50
145	3.40
TIP2955	1.90
TIP3055	1.90
2N301	4.00
2N697	1.00
2N918	1.00
2N1304	1.00
2N1613	1.20
2N2102	1.90
2N2219	.90
2N2222A	1.00
2N2369	1.00
2N2484	1.00
2N2646	1.20
2N2647	2.50
2N2894	1.00
2N2904	1.10
2N2905	1.10
2N2906	1.10
2N2907	1.10
2N3019	1.90
2N3053	.90
2N3054	1.90
2N3055	1.40
2N3096	1.20
2N3109	1.90
2N3251	1.90
2N3302	1.90
2N3440	1.80
2N3441	2.90
2N3442	3.50
2N3563	.30
2N3564	.30
2N3565	.30
2N3566	.30
2N3567	.30
2N3568	.30
2N3569	.30
2N3638	.30
2N3640	.30
2N3641	.30
2N3642	.30
2N3643	.30
2N3644	.30
2N3645	.30
2N3646	.30
2N3702	1.20
2N3704	1.40
2N3739	4.50
2N3771	5.50
2N3772	5.70
2N3773	5.90
2N3792	6.00

ROD IRVING ELECTRONICS

425 High St., Northcote 3070 (03) 489 8866 (03) 489 8131
48-50 A'Beckett St., Melbourne (03) 347 9251

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To Order By Phone
Mail Order Hotline (03) 481 1436

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$500+	$12.00		

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Cert. post for orders over $100 included "free".
Reg. post for orders over $200 included "free".
Account orders from schools, govt. depts., public co's., gratefully accepted. Min order amount $20.00 (or a min. $5.00 accounting charge will apply.) Comet Road Freight, Airmail etc. are extra.

AND SCARCER STOCK UP NOW!

Integrated Circuits & Transistors

2N3819	1.20	2SD288	3.95	7482	1.80	74367	1.50	8228	5.50	74F521	4.22	78L12	.75	4024	1.20	4514	2.90	SC152D	6.90
2N3866	2.95	2SD325	2.95	7483	1.10	74368	1.50	8231	199.00	74F533	4.84	78L15	.75	4025	.80	4515	2.90	OM335	18.50
2N3904	1.00	2SD525	3.95	7485	1.20	74373	2.25	8232	199.00	74F534	4.84	78L18	.75	4026	2.40	4516	1.45		
2N3906	1.00	2SK45	3.95	7486	1.20	74374	2.25	8237	39.00			78L24	.75	4027	1.20	4517	8.75	**ANALOG/DIGITAL**	
2N4030	1.50	2SJ49	7.50	7489	3.90	74375	1.75	8238	9.50	**MEMORY**		79L05	1.20	4028	1.20	4518	2.50		
2N4032	2.20	2SJ56	12.50	7490	1.00	74377	2.45	8243	8.50	2101	6.90	79L12	1.20	4029	1.50	4519	1.90	ADC0800LCN	22.50
2N4033	2.20	2SK45	3.95	7491	1.00	74390	1.95	8251	4.90	2102	2.50	79L15	1.20	4030	1.50	4520	2.55	ADC0801LCN	23.95
2N4036	2.50	2SK134	7.50	7492	1.00	74393	1.95	8253	7.50	2112	7.90	79L18	1.20	4031	2.95	4521	3.90	ADC0803LCN	7.50
2N4121	1.50	2SK176	12.50	7493	1.00	74425	2.55	8255	5.50	2114	2.95	79L24	1.20	4032	2.75	4522	1.90	ADC0804LCN	6.50
2N4123	1.50	1N4001	.10	7494	1.50	74426	2.55	8257	16.50	3147	6.90			4033	2.75	4526	1.85	ADC0808LCN	14.95
2N4236	1.90	1N4002	.15	7495	1.00	74490	2.65	8259	6.50	2708	8.90	LM309K		4034	3.50	4527	2.65	DAC1220LCN	14.95
2N4237	1.90	1N4007	.20	7496	1.50	9300	1.50	8271	89.00	2716	6.90	(7805KC)	1.90	4035	1.95	4528	1.15	DAC1020LCN	13.95
2N4248	.40	1N5400	.40	7497	2.30	9301	2.50	8272	33.00	2732	7.00	LM317T	2.50	4038	3.25	4529	1.80	DAC0832LCN	5.50
2N4249	.40	1N5404	.40	74100	1.65	9302	2.90	8273	65.00	2764	12.00	LM317K	4.50	4040	1.90	4530	1.60		
2N4250	.40	1N5408	.60	74107	1.20	9304	4.00	8274	42.50	27128	49.00	LM317HV	9.50	4041	1.50	4531	1.65	**NEW IC**	
2N4258	.50	0A47	.80	74109	.90	9305	2.40	8275	38.50	4116	3.95	LM323K	6.50	4042	1.00	4532	2.65		
2N4355	.50	0A90	.50	74110	1.50	9307	3.80	8276	28.50	4164	10.00	LM337T	2.90	4043	1.60	4534	8.90	74LS169	2.50
2N4356	.50	0A91	.50	74111	1.50	9308	2.60	8279	8.50	6116	10.00	LM337K	6.50	4044	1.20	4536	6.50	A7-3-1050	12.50
2N4360	1.00	0A95	.50	74112	1.50	9309	2.40	8282	6.90	6164	99.00	LM338K	9.50	4045	4.90	4538	3.50		
2N4401	.30	5082-2800	2.95	74113	1.50	9310	1.50	8283	6.50	58725 (6116)		LM350T	6.50	4046	2.50	4539	1.65	WD2791	59.00
2N4402	.30	5082-2811	4.95	74114	1.50	9311	2.50	8284	8.50		9.00	LM350K	7.50	4047	1.90	4541	1.60	WD2793	59.00
2N4403	.30	HLMP6620	5.95	74120	1.95	9312	2.50	8286	6.50	2101 (5101)		LM395K	22.50	4048	1.20	4543	2.50	WD2795	59.00
2N4416	1.90			74121	.90	9313	6.00	8287	6.50	(8101)	7.90	LM396K	19.50	4049	1.00	4544	10.50	WD2797	59.00
2N4427	2.90	**BRIDGES**		74122	.90	9314	2.40	8288	25.00	5101	7.90			4050	1.00	4549	7.25		
2N4919	2.90	1.5AMP		74123	1.50	9316	1.90	8289	73.00	8101	7.90	78H 05KC	9.00	4051	1.50	4551	1.80	**NEW ICS**	
2N5088	1.00	W005	.50	74125	1.00	9317	4.20	8291	43.00	2532	12.50	78H 12KC	9.00	4052	1.50	4553	5.50		
2N5089	1.00	W02	.60	74126	1.00	9318	4.60	8292	34.50			78HGKC	9.50	4053	1.50	4554	2.35	LM11CN	2.95
2N5139	1.20	W04	.60	74128	1.80	9319	2.00	8293-10	26.50	**OPTO**		78P 05KC	16.50	4054	3.90	4555	1.10	LM1871	5.95
2N5179	1.20	6AMP		74132	1.00	9320	6.90	8741	57.50	4N25	1.20	ITEM		4055	3.90	4556	1.25	LM1872	5.95
2N5190	2.50	BPC602	2.90	74136	1.00	9321	2.40	8748	65.00	4N26	1.20	RETAIL COST		4056	4.20	4557	7.85		
2N5191	3.30	KBPC604	3.50	74138	1.80	9322	1.90	8749	58.50	4N27	1.20	79HGKC	16.50	4060	2.50	4558	2.25		
2N5192	3.10	KBPC608	4.50	74139	1.50	9324	1.40	8755	33.50	4N28	1.20	78S 40	3.50	4063	2.00	4559	7.25		
2N5193	2.50	10AMP		74141	1.10	9328	4.90	2911	26.50	4N29	1.50	MC1496L	14.50	4066	2.50	4560	3.75		
2N5194	2.95	KBPC10005	3.90	74142	1.45	9334	6.00	2912	27.50	4N30	1.60			4067	9.90	4561	1.80		
2N5195	3.30	KBPC1002	4.20	74143	1.45	9338	5.90	2920	239.00	4N32	2.50			4068	1.00	4562	8.45		
2N5210	1.50	KBPC1004	4.90	74144	3.90	9340	9.90	3205/8205	9.90	4N33	2.50	**SPECIAL FUNCTION**		4069	1.00	4566	3.00		
2N5245	1.50	35AMP		74145	1.45	9342	5.90	3242	17.50	4N35	2.50			4070	.90	4568	4.25		
2N5303	8.50	KBPC3502	5.90	74147	1.95	9368	2.20	3245	10.90	4N37	2.00	LM 4250	2.45	4071	.80	4569	2.50		
2N5401	1.50	KBPC35014/MD		74148	2.00	9374	3.30	3628	18.50	MCT6	2.50	NE5534 N	2.50	4072	.90	4572	.75		
2N5457	1.00	A3504	6.90	74150	1.50	9386	2.40	8008-1	62.50	MCT66	6.90	NE5534 AN	2.95	4073	.90	4580	8.95		
2N5458	.90	KBPC3510/MDA		74151	1.20	75107	2.50	8031-3	29.50	MCT2	1.50	MC3340	1.90	4075	.90	4581	3.10		
2N5459	.90	3510	9.90	74154	1.75	75110	2.50	8035	6.90	1LD 74	5.90	MC3341	2.90	4076	1.50	4582	2.25		
2N5461	.90			74155	1.20	75150	2.50	8039	7.90	1LQ 74	6.50	76477	8.95	4077	.80	4583	1.65		
2N5462	.90	**74**		74156	1.70	75154	2.50	FD1771	19.00	FND357	1.80	76488	8.95	4078	.80	4584	.85		
2N5485	.90	7400	.60	74157	1.00	75450	1.50	FD1791 (8876)		FND500	1.80	76489	9.95	4081	.80	4585	2.10		
2N5486	.90	7401	.60	74158	1.00	75451	.90		39.00	FND507	1.80	6C36	6.50	4082	.80	4597			
2N5489	14.50	7402	.60	74160	1.00	75452	.90	FD1793 (8877)		FND800	3.50	OM335	22.50	4085	2.20	4599	3.45		
2N5590	16.50	7403	.60	74161	1.20	75453	.90		39.00	TIL31A	2.95	OM350	10.50	4086	2.30	45104	7.25		
2N5591	18.50	7404	.60	74162	1.20	75461	1.50	FD1795	39.00	TIL81A	2.95			4089	3.50	45106	7.85		
2N5641	19.50	7405	.80	74163	1.40	75462	1.50	FD1797	39.00	TIL306	12.50	IM65X08CPE	5.00	4093	1.30	45107	7.25		
2N5656	2.50	7406	.80	74164	1.20	75471	3.00	WD1691	29.50	MAN72 (DL702)				4094	3.35	45109	7.25		
2N5770	.30	7407	.80	74165	1.20	75472	3.00	WD2143	14.50		3.50	XR2206	7.95	4095	2.40	45112	7.85		
2N5777	1.50	7408	.60	74166	1.70	75491	2.00	WD1931	22.50	MAN74 (DL704)		XR2207	7.95	4096	2.40				
2N5830	.30	7409	.60	74167	2.20	75492	2.00	WD1933	34.00		3.50	XR2208	6.90	4097	6.50				
2N5831	.30	7410	.60	74174	1.45	75493	3.00	WD1983	14.75	BPW50	2.50	XR2209	6.90	4098	2.90				
2N5873	1.40	7411	.70	74175	1.20	75494	3.00	WD1993	59.00	HP5082-2811		XR2211	7.45	4099	3.90				
2N5874	1.70	7412	.70	74176	1.40	8121	5.00	WD2123	26.50		4.95	XR2216	5.90	4104	6.90				
2N5944	15.50	7413	.70	74177	1.40	8123	4.00	WD8250	16.50	HLMP 6620	3.95	XR2240	6.95	4160	1.25				
2N5945	18.50	7414	.80	74178	2.15	8130	7.95	TR1602 (S1883)		CQY89	1.50	XR2243	7.95	4161	1.25				
2N5946	19.50	7415	.70	74179	2.15	8131	7.95		8.50	MOC3011	2.95	XR8038	7.50	4162	1.25				
2N5961	1.90	7416	.80	74180	1.20	8135	6.95	TR1863	8.90	MOC3020	2.50			4163	1.25				
2N6027	1.00	7417	.80	74182	1.20	8136	6.95	COM8116	24.00	MOC3021	2.95	ICC7660	12.50	4174	1.25				
2N6049	1.90	7420	.60	74184	1.20	8303	5.50	BR1941	23.00	LEDS		95H90	8.50	4175	1.60				
2N6080	18.50	7421	.80	74190	1.00	8304	6.95	CRT8002A	59.90	3mm RED	.25	11C90	16.50	4194	1.95				
2N6083	21.90	7422	.80	74191	1.45	82S23	5.95			3mm YELLOW	.30	LM7555	1.90	4402	1.00				
2N6084	32.50	7423	.90	74192	1.65	82S123	6.95	**74F SERIES**		3mm GREEN	.30	LM7556	3.50	4404	1.15				
2N6124	1.90	7425	.90	74193	.80	8311	5.95	74F00	.79	5mm RED	.15	MC10116L	1.50	4408	6.90				
2N6125	1.90	7426	.70	74194	1.10	8641	5.95	74F02	.79	5mm YELLOW	.30	LM13600	3.95	4409	13.50				
2N6130	1.90	7427	.80	74195	1.00	8820	6.95	74F04	.92	5mm GREEN	.30	LF13741	.80	4410	11.50				
2N6133	1.90	7428	.80	74196	1.20	8830	6.95	74F08	.79	ITEM		LF13741-H	1.50	4411	12.60				
2N6256	14.50	7430	.70	74197	1.10	8831	6.95	74F10	.79	RETAIL COST		OS75451	.60	4412	5.45				
2N6259	13.50	7432	.70	74198	1.10	8832	6.95	74F11	.79	5mm ORANGE	.30	DS75452	.60	4415	10.15				
2N6274	29.50	7433	.70	74199	1.30	8833	6.95	74F20	.79	RED RECT	.30	DS75491	2.00	4416	5.60				
2N6378	4.90	7437	.80	74221	1.90	8834	6.95	74F32	.79	GREEN RECT	.30	DS75492	2.00	4419	3.45				
2N6425	4.50	7438	.90	74240	2.90	8835	5.95	74F64	.79	YELLOW RECT	.30			4422	9.50				
2N6578	5.90	7439	.90	74241	2.90	8836	3.75	74F74	.89	RED CHROME		DM2502	12.50	4426	2.35				
3N201	1.50	7440	.90	74242	2.40	1488	1.00	74F86	1.19	BEZEL	1.20	ADC080	16.00	4428	1.75				
2SA683	2.95	7442	.90	74243	1.90	1489	1.00	74F109	.99	YELLOW		ADC808	17.00	4433	2.75				
2SC2028	3.95	7443	1.60	74244	1.90	81LS95	3.75	74F138	1.79	CHROME BEZEL		DAC0800	4.50	MC14433	13.90				
2SC2029	3.95	7444	1.50	74245	2.40	81LS96	3.75	74F139	1.79		1.20	DAC0808	4.50	4435	7.95				
2SC2166	4.95	7445	1.00	74246	2.25	81LS97	3.75	74F151	1.79	GREEN CHROME		SAK140	9.50	4441	1.50				
2SC1730	1.95	7446	1.20	74247	2.25	81LS98	3.75	74F153	1.79	BEZEL	1.20	ZN414	1.95	4443	3.90				
2SC1969	6.30	7447	1.50	74248	2.25	8T26	3.00	74F157	1.79			UA170	5.95	4445	2.65				
2SC1973	3.95	7448	1.20	74249	2.25	8T28	3.00	74F158	1.79	**VOLTAGE REGS**				4446	3.55				
VN88AF	3.95	7449	1.20	74251	1.10	8T30	3.00	74F175	2.78	78050C	1.20	4000	.60	4449	1.00				
2SC372	1.95	7450	.90	74253	1.10	8T96	1.80	74F181	5.98	7805KC	2.50	4001	.60	4450	3.75				
2SC495	2.95	7451	.90	74257	1.50	8T97	1.80	74F182	2.73	7812UC	1.20	4002	.80	4451	3.75				
2SC710D	1.95	7452	.80	74258	1.50	8T13	2.95	74F189	7.44	7812KC	2.50	4006	1.90	4457	5.90				
2SC735	1.95	7453	.70	74249	2.45	8T14	2.95	74F190	4.86	7815UC	1.20	4007	.80	4458	9.90				
2SC900F	1.95	7454	.80	74273	2.45	8080	8.00	74F191	4.86	7815KC	2.50	4008	1.70	4469	14.90				
2SC945A	1.95	7455	.90	74276	2.45	8085	9.50	74F194	2.41	7818UC	1.20	4009	.90	4490	5.90				
2SC1014	2.50	7460	.70	74278	3.45	8086	59.00	74F241	3.72	7818KC	2.50	4010	.90	4495	3.95				
2SC1017	4.95	7461	.90	74279	.85	8088	29.00	74F243	4.34	7824UC	1.20	4011	.60	4500	8.90				
2SC1018	4.95	7462	1.00	74283	2.45	8155	6.50	74F244	3.72	7824KC	2.50	4012	.90	4501	.50				
2SC1061	2.95	7463	1.20	74289	3.25	8156	11.50	74F251	1.93	7905UC	1.90	4013	1.20	4502	1.80				
2SC1096	2.95	7470	.80	74290	.90	8185	37.50	74F253	1.93	7905KC	3.00	4014	1.90	4503	.90				
2SC1173	2.95	7472	.90	74293	.90	8202	52.50	74F257	1.93	7912UC	1.90	4015	1.20	4504	2.00				
2SC1226	2.95	7473	.90	74295	1.65	8203	69.50	74F258	1.93	7912KC	3.00	4016	1.00	4506	.75				
2SC1306	6.30	7474	.70	74298	2.45	8206	115.50	74F350	4.34	7915UC	1.90	4017	1.50	4507	.40				
2SC1419	2.95	7475	.70	74299	1.75	8212	2.90	74F352	1.93	7915KC	3.00	4018	1.90	4508	4.50				
2SC1449	1.95	7476	.80	74351	1.85	8214	4.90	74F353	1.93	7918UC	1.90	4019	.80	4510	1.50				
2SC1674	1.95	7477	1.20	74352	1.85	8216	2.90	74F373	4.84	7924UC	1.90	4020	1.50	4511	1.50				
2SC1675	1.95	7478	1.20	74365	1.50	8224	3.50	74F374	4.84	78L05	.75	4021	1.50	4512	1.10				
2SC1307	6.90	7480	1.20	74366	1.50	8226	4.90	74F399	2.78			4022	1.50	4513	2.65				
												4023	.75						

CRYSTALS

Y11000	1MHz crystals	11.50	9.50
Y11003	1.832MHz crystal	7.50	7.50
Y11005	2MHz crystal	6.90	6.90
Y11007	2.3040MHz crystal	6.50	6.50
Y11008	2.4576MHz crystal	6.50	6.50
Y11009	2.7648MHz crystal	4.90	4.90
Y11010	3MHz crystal	4.90	4.90
Y11015	3.5795MHz crystal	3.00	3.00
Y11018	3.93216MHz crystal	4.90	4.90
Y11020	4MHz crystal	4.90	4.90
Y11022	4.194304MHz crystal	3.90	3.90
Y11023	4.433618MHz crystal	4.90	4.90
Y11024	4.44MHz crystal	4.90	4.90
Y11025	4.75MHz crystal	4.90	4.90
Y11026	4.915200MHz crystal	6.90	6.00
Y11027	4.9562MHz crystal	4.90	4.90
Y11030	5.00MHz crystal	4.90	4.90
Y11033	5.0688MHz crystal	4.90	4.90
Y11040	6MHz crystal	4.90	4.90
Y11042	6.14MHz crystal	4.90	4.90
Y11045	6.6670MHz crystal	4.90	4.90
Y11050	8MHz crystal	4.90	4.90
Y11055	8.867238MHz crystal	4.90	4.90
Y11060	10MHz crystal	4.90	4.90
Y11061	10.6445MHz crystal	4.90	4.90
Y11065	11MHz crystal	4.90	4.90
Y11070	12MHz crystal	4.90	4.90
Y11072	14.31818MHz crystal	4.90	4.90
Y11075	15MHz crystal	4.90	4.90
Y11080	16MHz crystal	4.90	4.90
Y11082	18MHz crystal	4.90	4.90
Y11085	18.432MHz crystal	4.90	4.90
Y11090	20MHz crystal	4.90	4.90
Y11095	24MHz crystal	4.90	4.90
Y11100	27MHz crystal	4.90	4.90
Y11105	32MHz crystal	4.90	4.90
Y11110	36MHz crystal	4.90	4.90
Y11115	48MHz crystal	4.90	4.90
Y11120	100MHz crystal	6.90	6.90
Y11125	32.768MHz crystal	4.90	4.90

Errors & omissions excepted.

BEATING THE MAIL ORDER BLUES

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pletely stymie the poor person trying to fill your order — like writing that no-one else can decipher, or forgetting to provide your own name and address.

Do it right yourself

So make sure that *you* fill out your order clearly, preferably printing it in block letters. If possible, don't just describe the things you want in words, but quote the type numbers as well — plus the company's catalogue number, if they make these known. It all helps to ensure that they're going to send you what you want. And *you* wouldn't forget to provide your own name and address, would you?

Another point: never send cash through the mails — it's too risky. Send your remittance by personal cheque, bank cheque or money order. Even better: if you have a Bankcard, Mastercard of other credit card, many companies allow you simply to fill in your card number on the order and sign it.

Credit card ordering

By the way, a lot of firms now allow you to place your order by 'phone, if you have a credit card. All you have to do is quote your card number. This lets you chop out at least one time-delay (and element of risk) in the traditional mail-order cycle: the delay in the 'forward' mail journey. It also removes the risk of your order and remittance going astray in the mail, and never getting to the company at all. Just make sure that you get the name of the person who takes your order, in case of trouble. It's also a good idea to get them to read back your name, address and order details, as a check for errors.

If you are ordering expensive items, you might also consider arranging for the company to send them back via one of the private 'overnight' delivery services. While these are a little more expensive than the mail, they are generally faster and more reliable.

When things go wrong

OK then, let's say you've done all the right things, but Murphy's Law has struck. The weeks have passed and you've heard nothing. Now what do your do?

First of all, before you do anything, consider whether you've allowed a reasonable time for your order to get through the mail to the firm concerned, then to process it, and then the goods to get back to you through the mail again. Even if the firm does achieve the much-vaunted 24-hour turnaround, the round trip can still take at least 10 days, due to delays in our wonderful postal system.

In fact over the last few months, companies who do business through the mails have been experiencing delays of weeks and weeks, due to a large number of strikes, go-slows and overtime bans etc. Many of these problems don't seem to have been reported in the media, because they've been too numerous and not sufficiently newsworthy. Apparently Australia Post has been changing over to a system of many smaller distribution centres, instead of a few large centres, and there have been many 'minor' and localised industrial problems.

So don't be too eager to blame the mail order company. They may have done their job, and your goodies are still struggling back through the Australia Post delay line. Allow another week or two, just to make sure.

Be prepared

Then again, you may have omitted to include your address and your order's awaiting this valuable advice.

Next, you should have made sure in advance that like a scout, you were prepared for any possible trouble. Keep a record of your order: what you ordered, the cheque or money order serial number, the date it was posted, and so on. Then you'll be properly organised yourself, if a problem arises.

The first thing to do when trouble actually strikes is give the company's mail order department a ring.

Entering orders at Jaycar Electronics. Like all successful mail order firms, Jaycar keeps well-organised records of all orders it receives and processes

If it's one of the bigger companies, with normal retail outlets as well as mail order, make sure that you ring their advertised MAIL ORDER phone number. Generally the mail orders are all processed by a separate, centralised department specially organised to handle mail orders properly. If you try ringing one of their normal retail stores, the staff probably won't know what you're talking about.

Try to talk to either the manager of the mail order department, or one of the order processing people. And make sure that you get the name of the person you talk to, for future reference. If you're dealing with a reputable company, any of its employees should be happy to give you their names — it's part of the service.

Because you've kept a good record of your order, you should be able to give the person all of the information they need to check up on its progress. They in turn should be able to give you a report on its status either straight away, or within 24 hours at the very most. Generally you'll get an answer within 30 minutes, and it'll all be sorted out to your satisfaction.

If not, the next step is to go right to the top and complain to the boss: the general manager, the managing director or whatever. Whether you do this by phone or in writing, it will usually get results fast — for the simple reason that the person at the top is generally sensible enough to know the damage that poor service can do to the company's name and profitability.

THE 'GOLDEN RULES' OF MAIL ORDER

1. Deal with a reputable company, preferably one that is well known and long established.

2. If sending *your* order by mail, make sure you PRINT your name and address *clearly* in block letters on your order.

3. CLEARLY specify the goods you want, quoting any applicable type numbers and catalogue numbers wherever possible, as well as describing them in words.

4. NEVER send cash through the mail — always use a personal cheque, money order or bank cheque. Or if possible, just quote the number of your Bankcard, Mastercard or other credit card (if the company accepts such).

5. If you do have a credit card, enquire if the company will take 'phone orders. This can speed up your order and also reduces the risk of loss in the mails.

6. If you deal with the company by 'phone, either to place your order or to make an enquiry, make sure you get the name of the person with whom you deal — for possible future reference.

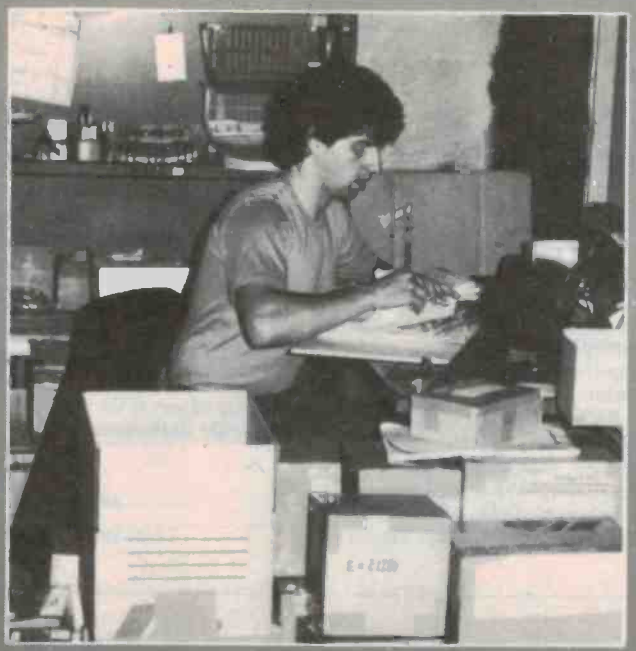
7. For expensive items, consider the alternative of using an overnight delivery service instead of the mails. Although more expensive, it is generally faster and safer.

8. Allow a reasonable time for your order to reach the company, for them to process it, and for your goods to return to you. Then if the goods haven't turned up, ring the company's mail order department.

9. If you still can't get satisfaction, contact the boss of the company and complain.

10. If all else fails, write to the electronics magazines and/or the Department of Consumer Affairs.

No, not a scene at the local supermarket. Looks a bit like it, but it's really a mail order being picked from stock at Jaycar. What the admonition on the box means, we're not too sure — staff motivation, perhaps?



Orders being despatched — at Jaycar again. Each order is recorded as it's sent out. If this kind of paperwork isn't done, all sorts of problems can occur. Firms that don't have this discipline usually don't stay around long.

The last resort — or two

With the vast majority of mail order companies, you'll never need to go so far — or if you do, it'll be in rare and exceptional circumstances. And if that should happen, going direct to the boss will almost always get results.

Of course, this assumes that the company is honest and above board, and luckily most of them are. But there's always the odd rotten apple, and you might just be unlucky enough to find them the hard way. What then?

Well, you can try writing to one of the magazines they advertise in, like Electronics Today. Generally the magazines can exert quite a deal of pressure on 'difficult' advertisers, either by having a direct word with them or by publishing your letter of complaint.

You can also write to the Department of Consumer Affairs in your state, and lodge a formal complaint. Depending upon the exact problem, you might also be able to complain to the Trade Practices Commission.

Just make sure, before you take these more drastic steps, that you case is reasonable and you have your facts straight — otherwise it could be very embarrassing. There have been cases where customers have created all sorts of strife, only to find that the problem was caused by their own terrible and ambiguous handwriting, or by them having moved to a different address after sending in their order.

Disasters

There's one situation I haven't covered yet. A reputable firm may suddenly go out of business, due to things like the death or illness of the owner, a disastrous fire, a burglary or some other totally unexpected catastrophe. Things like this can always happen, although they're luckily very rare.

Needless to say, the honest and reputable mail order firms are very concerned to protect the reputation of their industry, and to ensure that customers have confidence in mail ordering. After all, if consumers lose confidence in mail ordering as a way of doing business, these firms stand to suffer a lot.

A 'fidelity' fund?

An interesting suggestion has been put forward by Gary Johnston, the Managing Director of Jaycar Pty Ltd. This is that the reputable mail order firms should get together and set up an industry 'fidelity bond' system, to protect customers.

This would work like the systems set up by the Master Builders Association and by solicitors. All of the member firms would lodge a suitable amount of bond money in the industry fund, which would be used to repay customers if any of the member firms became unable to fulfil orders.

One criticism of this kind of scheme is that it would tend to favour the bigger firms — because supposedly only these firms would be able to put up the necessary bond money. The little firms just starting up wouldn't be able to afford money tied up in this way.

That's probably true. But on the other hand, it's also true that anyone setting up in business has a responsibility to their customers, and to society as a whole, to conduct that business in a stable and reliable fashion. This really means providing themselves with sufficient working capital to protect themselves and their customers.

Viewed in this light, it's surely not unreasonable to expect anyone setting up in the mail order business (and accepting customers' money in exchange for goods offered), to be prepared to lodge a fidelity bond as a demonstration of their responsibility and serious intentions.

Presumably if this scheme is established, the firms concerned would be able to advertise their membership in the scheme. This would be an ideal way to let you, the customer, identify the companies that you could deal with in complete confidence.

Personally, I think it's a great idea, and I hope Gary can get support for it from the other leading mail-order firms. What do you think?

Here's a suggestion: if you like the convenience of mail order buying, and would appreciate the extra safety that such a bonding system would bring, why not write to us here at Electronics Today, and lend your support. If there seems to be enough people in favour, we'll get together with Gary Johnston and our other mail-order advertisers and see what can be organised. ●

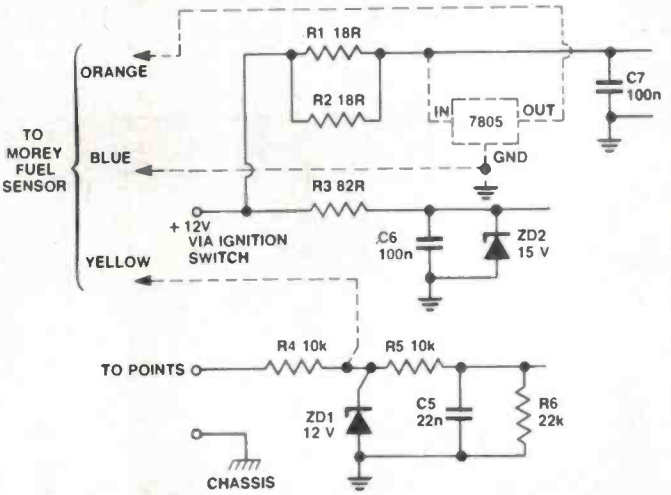
Tacho modification

Here's a particularly interesting application of the ETI-324 LED tacho project we published in October 1980. It was sent to us by **Clyden Anderson of Woolloongabba Qld,** who had a requirement for a fuel flow meter.

Present designs of digital fuel flow meters require some time to read, especially if the level is fluctuating. What he wanted was a 'relative' display for monitoring fuel consumption. This was easily done with a simple modification to the ETI-324, and a Moray fuel flow sensor.

A 7805 regulator supplies five volts to the Moray sensor. Suitable values for the driving range of the tacho are C1, 100µ and C3, 3µ3. For the tuning range leave C2 at 220µ and C4 at 4µ7.

Calibration is simple, knowing the fuel sensor calibration and having a square wave generator to adjust RV1 and RV2 for full scale deflection.

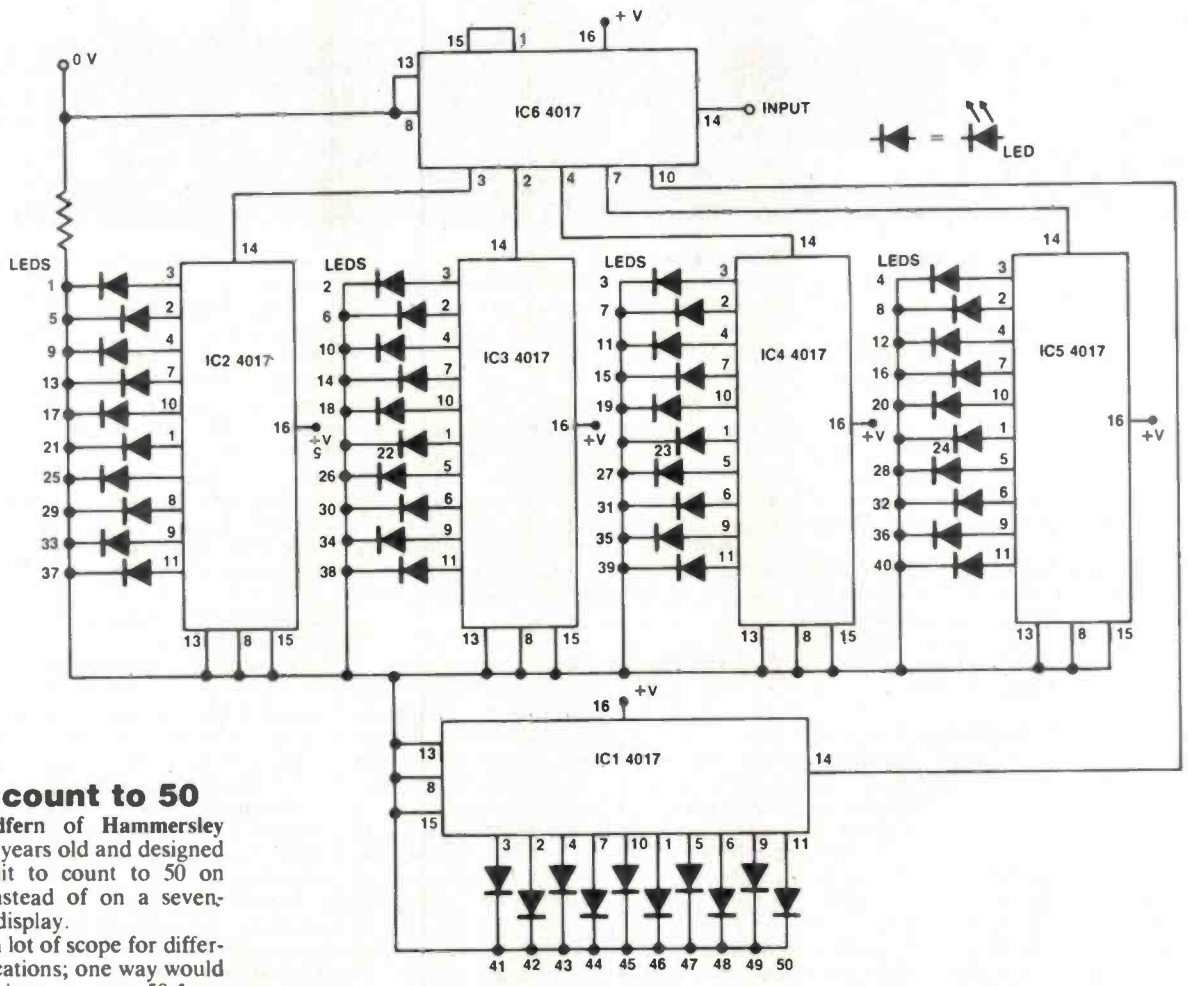


Let's count to 50

Paul Redfern of Hammersley WA is 13 years old and designed this circuit to count to 50 on LEDs, instead of on a seven-segment display.

It has a lot of scope for different applications; one way would be to use it to count to 50 for a computer game.

A multivibrator could be added to the input and it could be used to time someone and you could then time yourself doing the same thing.



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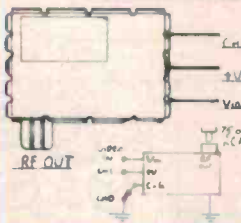

1-9 $4.95 10+ $3.95

Our RF Modulators are channel selectable either Channel 0 or Channel 1

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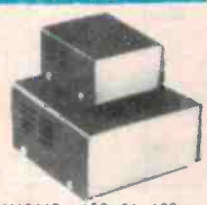

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Light and comfortable as easy to wear as your hair. Incredible sound for headphones this size.

SPECIFICATIONS

TYPE	DYNAMIC
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IMPEDANCE	32 ohms
SENSITIVITY	100 db@ 1000 Hz
POWER HANDLING CAPACITY	0.1W
FREQUENCY RESPONSE	20-20000 Hz
CORD LENGTH	4.5FT long with phone plug
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6.3mm STEREO PLUG INCLUDED

¼ WATT 5% RESISTORS E24 VALVES

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Massive 3A contacts at 24VDC or 100VAC Nominal 12V Coil but will work OK from 9–15V.

SPECIFICATIONS	S.P.D.T. S14060	D.P.D.T. S14061
Nominal Coil Voltage	12V	12V
Contact Current (max)	3A	3A
Contact Voltage (max)	125VAC	60VAC
Coil Resistance	400 ohm	300 ohm
PRICE		
1-9	$1.20	$1.50
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Unbelievable Value

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5" A. B. S. Material Horn Speaker 8 ohm. Freq. Range: 600—5000Hz Max Power: 8 W

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6A 400V Bridge $1.50

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Q10505	MU45	0-50uA	9.75	6.95
Q10518	MU45	0-1A	9.75	6.95
Q10510	MU45	0-5A	9.75	6.95
Q10515	MU45	0-10A	9.75	6.95
Q10520	MU45	0-20V	9.75	6.95
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Q10535	MU45	VU	10.95	8.95
Q10530	MU52E	0-1mA	10.95	7.95
Q10533	MU52E	0-5A	10.95	7.95
Q10538	MU65	0-50uA	13.95	7.95
Q10540	MU65	0-1mA	13.95	7.95
Q10550	MU65	0-100uA	13.95	7.95
Q10560	MU65	0-20V	13.95	7.95

Errors and Ommissions Excepted

IC SOCKETS (LOW PROFILE)

HOW CHEAP CAN THEY GO

	1-9	10-99	100-999	1000+
8 Pin	.15	.14	.12	.9
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16 Pin	.17	.16	.15	.11
18 Pin	.18	.17	.16	.13
20 Pin	.29	.28	.27	.26
24 Pin	.35	.33	.32	.28
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MORE PANEL METER BARGAINS

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Q10400
250 ua Sensitivity Panel cut-out 36mm x 16mm. Mounting hole centres at 49mm.

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250 ua Sensitivity centre "0" very useful for balanced circuit and applications needing a centre "0" or null indication.

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$500+	$12.00		

(All above charges are for surface mail and some heavy items will vary from these rates.)

Cert. post for orders over $100 included "free"
Reg. post for orders over $200 included "free"
Account orders from schools, govt. depts., public co's., gratefully accepted. Min order amount $20.00 (or a min. $5.00 accounting charge will apply.) Comet Road Freight, Airmail etc. are extra.

IDEA OF THE MONTH

Battery voltage indicator

D. Baillie, Moe Vic.

This circuit uses a single tri-state LED to indicate the voltage of the car battery. The different colours of the LED make it possible to indicate four levels of voltage: red is less than or equal to 11 V, Yellow is 11-13.3 V, green is 13.3-14.2 V, flashing red and green is 14.2 V and higher.

The voltage regulator, R1, Q1 and ZD1, provides a constant voltage for the circuit while the supply voltage varies with the normal operation of the car. IC1a is an oscillator which produces a sawtooth waveform with a voltage of 3.55-4.74 V at a frequency of approximately 200 Hz. This is output at pin 2 and is connected to pin 6 of IC1b.

When the voltage of the car's battery rises, say from 8 V, the voltage applied to IC1 pin 5 via D1, D2, R7 and R8 is much lower than that of pin 6, so the output at IC1b remains low. Therefore Q3 is biased on via R9 and R11, and Q2 is biased off via R9 and R10. The tri-state LED (a Radioshack device) should be inserted so that it glows red in this mode.

For the moment consider that Q5 is biased on, but it will be discussed in detail later.

As the voltage rises on IC1 pin 5 it starts to intersect the waveform, switching the tri-state LED on and off from red to green at approximately 200 Hz.

The mark/space ratio of the square wave output at IC1b varies as the battery voltage rises. At about 12 V, when the mark/space ratio is equal, the LED appears to be yellow. As the voltage continues to increase the green becomes more dominant until it is bright green at about 14 V.

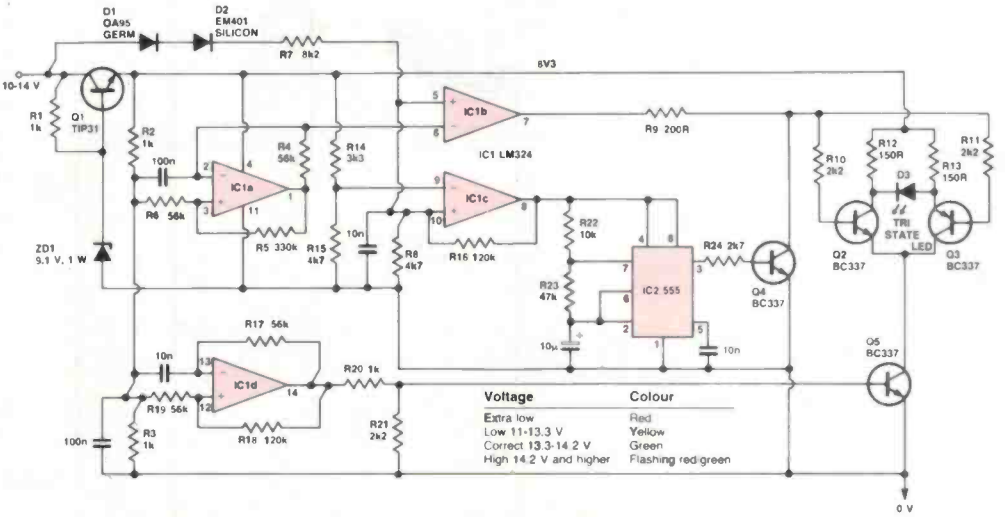
When the voltage rises above 14.2 V IC1c triggers and its output goes high, enabling the timer IC, which has an output of 1 Hz. R16 provides a small amount of positive feedback to enable a clean switching operation without creating too much hysteresis on the switching voltages.

Q4 is then turned on and off at 1 Hz, in turn biasing Q2 off and Q3 on at the same frequency, making the LED flash red and green.

Q5 is driven on and off at about 2 kHz by the oscillator IC1d, enabling a much higher current to pass through the tri-state LED making it much brighter.

Final trimming of the triggering voltages and the colour change voltages can be varied by replacing D1 and D2 with various germanium and silicon diode combinations, making use of their different Vd characteristics.

2 x silicon = 1.4 V
2 x germanium = 0.4 V
1 silicon + 1 germanium = 0.9 V ●



'IDEA OF THE MONTH' CONTEST

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 .....

Name .....

Date .....

Address .....

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

Scope pc board Work Centre

PRIZE WORTH $123!

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 pc board Work Centre consisting of the Model 315 adjustable pc board holder with capacity to accept 300 mm boards, Model 300 180° swivel and lock base which can be attached to the Model 312 tray base with wet sponge receptacle, Model 371 solder spool holder and Model STS 3 soldering iron safety stand. Please note prize does not include solder or scope TC60 temperature controlled iron shown above. The prize is worth $123!

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

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 prior 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.

ROD IRVING ELECTRONICS

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"BIG BOARD II"

Over 1,000 sold

Jim Ferguson, designer of the "Big Board" distributed by Digital Research Computers, has produced a stunning new Computer, "Big Board II". It has the following features:

4 MHz Z80-CPU AND PERIPHERAL CHIPS
The Ferguson computer runs at 4 MHz. Its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.

64K DYNAMIC RAM + 4K STATIC CRT RAM + 24K E(E)PROM OR STATIC RAM
"Big Board II" has the three memory banks: the first memory bank has eight 4164 RAMs that provide 60K of user space and 4K of monitor space. The second memory bank has two SKx8 SRAMs for the memory-mapped CRT display and space for six 2732 As, 2Kx8 static RAMS, or pin-compatible E(E)PROMs, the third memory bank is for RAM or ROM added to the board via the STD bus. Whether bought as a bare board, a full kit, or assembled and tested, it comes with a 450nS2732A EPROM containing the monitor.

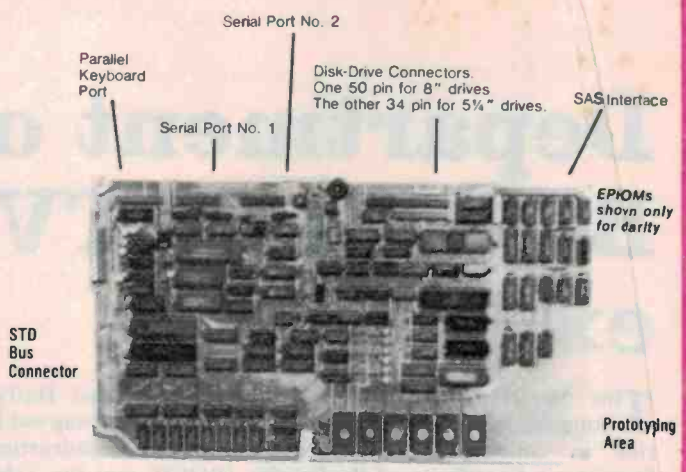
MULTIPLE-DENSITY CONTROLLER FOR SS/DS FLOPPY DISKS
The new Ferguson single-board computer has a multiple-density disk controller, it can use 1793 or 8877 controller chips since it generated the signal with TTL parts. The board has two connectors for disk signal with 34 pins for 5.25" drivers, the other with 50 pins 8" drives.

VASTLY IMPROVED CRT DISPLAY
The new Ferguson SBC uses a 6845s CRT controller and 8002 Video Attributed controller to produce a display that will rival the display of quality terminals. Characters are formed by a 5 x 7 dot matrix on 15.75 KHz monitors and 7x9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.

STD BUS CONNECTOR
The Ferguson computer brings its bus signals to a convenient place on the PC board where users can solder a DSTD, bus cards can be plugged directly into it, and it can as well be connected by bus cable to industry-standard card cages.

A Z80-A S10/0 = TWO ASYNCHRONOUS/SYNCHRONOUS SERIAL PORTS

TWO Z80-A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS
The new Ferguson computer has two Z80-A CTCs. One is used to clock data into and out of the Z80-A S10/0, while the other is for systems and application use.



PROM PROGRAMMING CIRCUITRY AND SOFTWARE
The new Ferguson SBC has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E) EPROMs. Software $25 extra.

CP/M
CP/M with Russell Smith's CB10S for the new Ferguson computer is available for $230. + TAX
The CB10S is available separately for $65. + TAX
Actual board size: 39.6cm x 22.2cm. 5 inch B10S being developed. Approx price $95. + TAX

Kit Price

$695 inc tax Less 10% for 3+

$895 Assembled and Tested

KIT PRICE FOR THIS MONTH

$649.00

NEW SINGLE BOARD PRODUCTS AND PRICING

THE 6809 "UNIBOARD"™

SINGLE BOARD COMPUTER KIT

PERFECT FOR COLLEGES, OEM'S, INDUSTRIAL AND SCIENTIFIC USES!

64K RAM! DOUBLE DENSITY FLOPPY DISK CONTROLLER!

FEATURES THE POWERFUL, THIRD GENERATION, MOTOROLA 6809 PROCESSOR!

Many software professionals feel that the 6809 features probably the most powerful instruction set available today on ANY 8 bit micro. Now, at last, all of that immense computing power is available at a truly unbelievably low price.

FEATURES:
- ★ 64K RAM using 4116 RAMS.
- ★ 6809E Motorola CPU.
- ★ Double Density Floppy Disk Controller for either 5·1/4 or 8 inch drives. Uses WD 1793.
- ★ On board 80 x 24 video for a low cost console. Uses 2716 Char Gen Programmable Formats. Uses 6845 CRT Controller.
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- ★ Serial I/O (6551) for RS232C or 20 MA loop.
- ★ Centronics compatible parallel printer interface. (6522)
- ★ Buss expansion interface with DMA channel. (6844)
- ★ Dual timer for real time clock application.
- ★ Powerful on board system monitor (2732). Features commands such as Go To, Alter, Fill, Move, Display, or Test Memory. Also Read and Write Sectors. Boot Normal, Unknown, and General Flex™.

PC BOARD IS
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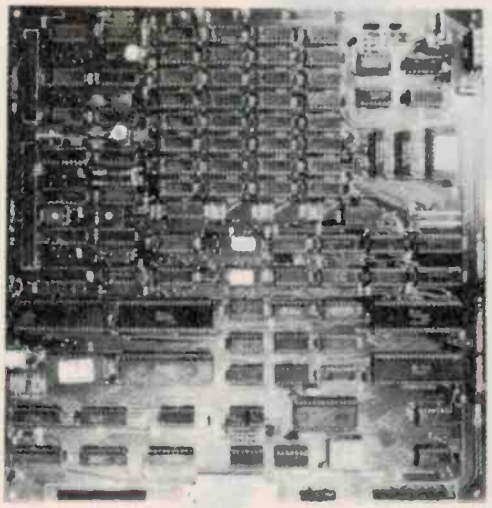

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Department out of BOCP and TVOCP exams

The Minister for Communications, Mr Michael Duffy, announced in June that the Department was phasing out its role in conducting examinations for the Broadcasting Operator's Certificate of Proficiency (BOCP) and the Television Operator's Certificate of Proficiency (TVOCP).

Tertiary institutions wanting to provide persons with training in the operation of transmitting equipment for radio and television stations may now apply to the Department of Communications to have courses approved.

However, to ensure that persons wanting to undertake examinations in the 1984 academic year were not disadvantaged by the new arrangements, the Department would still conduct both BOCP and TVOCP examinations this year.

Mr Duffy said that the courses which tertiary institutions intended to run would have to meet certain standards laid down by the Deparment. Graduates of approved courses could apply for a certificate to be issued by the Minister. This was because under the *Broadcasting and Television Act* 1942, staff responsible for the operation and maintenance of transmitting stations must, in the opinion of the Minister, be competent in their jobs.

Committees consisting of DOC, educational, industry and union representatives would be established to monitor approved courses and examinations and to review and upgrade the courses to ensure they maintained pace with technological development.

The committees would also be involved in developing transitional arrangements for examinations, and ensuring that practical training was available to students in country areas.

Any tertiary institutions wishing to conduct courses, and any candidates wishing to enquire about the new arrangements, should write to **The Assistant Secretary, Station Establishment and Operations Branch, Department of Communications, GPO Box 5412 CC, Melbourne Vic. 3001.**

Another ham for the Shuttle

On June 19, another radio amateur was announced as a member of the NASA Shuttle astronaut corps. He is Dr Ron Parise WA4SIR.

Dr Parise holds a Ph.D. and was previously a NASA scientist at the Goddard Space Flight Centre in Greenbelt, Maryland USA. He has been appointed as a 'payload specialist'.

Parise becomes the third US amateur who will fly a mission and probably operate from space.

Dr Owen Garriott, W5LFL, was the first amateur to operate from space, flying on the Columbia late-November/early-December 1983. Tony England W0ORE, is scheduled to fly on a mission later this year and hopes to operate on several bands (see this column, May '84 ETI).

Dr Parise hopes AMSAT and the ARRL can successfully negotiate an amateur radio experiment for him.

Updated range of low-loss coax

An updated range of low-loss coaxial cables was recently released through GFS Electronic Imports of Melbourne.

Manufactured by Nippon Tushin Densen of Japan, the new range comprises three cables, all of double-shielded, foam dielectric construction and 50 ohms impedance.

The updated cables are claimed to feature attenuation figures not unlike "Heliax-type" cables, but at considerably less cost.

Cable type 5D-FB is 7.3 mm in diameter and has a quoted attenuation of 5.5 dB/100 m at 100 MHz, 12.1 dB/100 m at 400 MHz and 19.8 dB/100 m at 1 GHz. Type 8D-FB is 11.1 mm in diameter with attenuation figures quoted of 3.9 dB/100 m at 100 MHz, 8.5 dB/100 m at 400 MHz adn 13.5 dB/100 m at 1 GHz. Type 10D-FB features attenuation figures quoted of 3.1 dB/100 m at 100 MHz, 6.8 dB/100 m at 400 MHz and 11.0 dB/100 m at 1 GHz.

Types 8D-FB and 10D-FB are suited to UHF applications, the latter particularly where long runs are involved. Type 5D-FB is designed as a general 'workhorse' cable for HF and VHF applications with loss figures better than the common RG-8, even though it is smaller in diameter, the makers claim.

Each cable is constructed with a solid, but flexible, centre conductor and a shield over the foam dielectric of thin aluminium/mylar overlaid by a tinned copper brain. Termination is simple using the braid. GFS stock N-type connectors for the UHF cables and PL-259s for the 5D-FB.

Prices are $2.10/m for the 5D-FB, $3/m for the 8D-FB and $4.60/m for 10D-FB. Contact **GFS Electronic Imports, 17 McKeon Rd, Mitcham Vic. 3132. (03)873-3777.**

New ham software

Ham radio enthusiasts can greatly expand their capabilities with a software package just released for Commodore computers.

The new software has been developed over the last four years by Melbourne-based High Technology Computer Systems. It is the brainchild of well known radio ham, Mike Hamilton (VK3BHM).

Called the RTTY program (pronounced 'ritty'), it handles radio teletype (RTTY), morse code (CW) and slow scan TV (SSTV). It provides translation facilities via Commodore VIC-20, C64 or 8000 series computers.

The program lets you monitor teletype traffic from sources such as worldwide news services, armed forces and emergency services. The program even has 'Mailbox', an automatic answer mode.

It costs $59 and can be obtained from **High Technology Computer Systems, 87 Swanston St, Richmond Vic. 3121. (03)429-1966.**

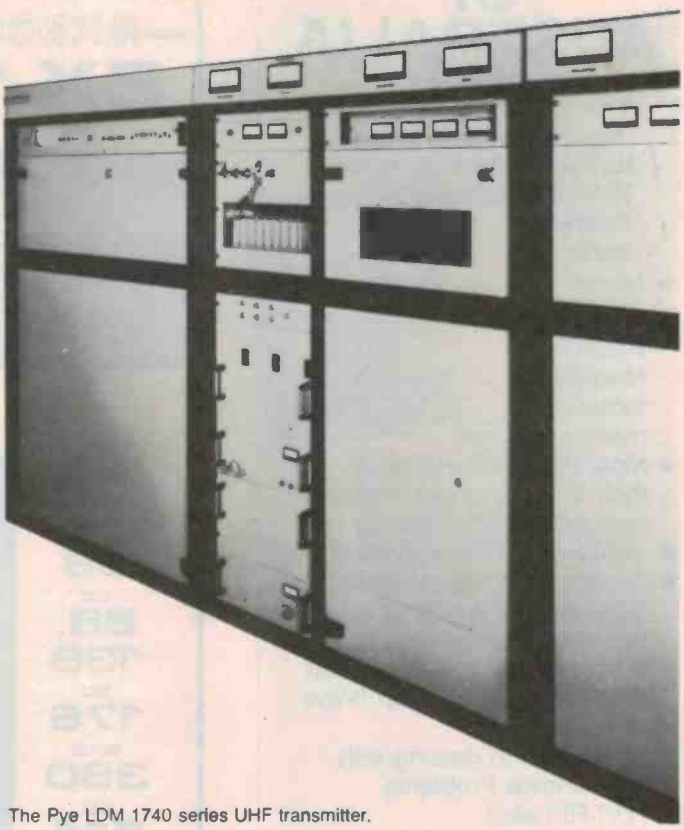
New transmitters for SBS

Telecom Australia has ordered four television transmitters worth $1.88 million to carry programmes produced by the Special Broadcasting Service (SBS). They will be supplied by Pye TVT of Cambridge, England.

The first of them will be delivered this year for installation at Wollongong, Newcastle, Brisbane and Adelaide. The 25 kW LDM 1740/05 transmitters being supplied operate in the automatic multiplex reserve mode. Separate vision and sound amplifiers are provided in each of the transmitters. If vision or sound amplifier should fail, the remaining amplifier handles combined vision and sound at reduced power.

Pye TVT equipment offers considerable savings by increased klystron efficiency at a time when broadcasters are becoming increasingly concerned about the high cost of power required by existing transmitters.

The LDM 1740 is 40% smaller than earlier equipment with the same power output and will fit comfortably into confined spaces in existing buildings.



The Pye LDM 1740 series UHF transmitter.

VOA station reactivated

The Voice of America recently reactivated its relay base at Dixon, California when it commenced transmissions to the Central American area.

The Dixon station was built in 1944 in order to provide a good signal into the South Pacific and keep American servicemen in touch with home during the war years.

The writer visited the site some years ago, and found three new 250 kW transmitters being installed to add to the five lower-powered units then in use.

The Dixon Station was closed some four years ago when a satellite link was put into operation between the VOA Washington studio and the Philippines transmitters.

The transmissions commenced recently carry VOA programmes for morning and evening reception in the Caribbean area.

In a radio broadcast President Reagan praised the VOA for their work in getting information into the USSR. It is expected that the budget to re-equip VOA will receive greater support due to the President's interest.

The VOA plans to modernise many of its overseas stations, some of which have equipment that is forty years old!

The Voice of America has submitted a proposal calling for five new transmitter sites and 19 new programme languages.

The sites would be in the Caribbean, South America, the Middle East, the Arabian Peninsula and the Far East. Additional languages included Hausa, Somali, four more languages spoken in the USSR, Japanese and all major Western European languages.

— **Arthur Cushen**

World's centre

GFS has recently reprinted their popular Great Circle or Zenithal Azimuthal chart.

The Great Circle map gives the true direction and distance to every place in the world from Melbourne and will enable its user to easily ascertain the distance and direction of radio stations worked or heard. It also provides the shortest or 'great circle' distance to these stations from Melbourne. With reduced accuracy the map may be also used from other locations in the central and eastern half of Australia.

At 320 x 420 mm, GFS's Great Circle map is designed to fit under the glass top of an operator's desk or mount on a wall as a poster.

Price of the map is $1.80 plus $2 p&p and is available from **GFS Electronic Imports, 17 McKeon Rd, Mitcham Vic 3132. (03)873-3777.**

CLUB QST

The **Western Suburbs Radio Club** of Melbourne (VK3AWS) has advised a change of venue and postal address. They now hold club meetings in the Ern Rose Memorial Pavilion, Preston Yacht Club, Edwardes Park Lake, Seavergrove, Reservoir on the 1st Friday of the month at 8.00 pm. Their postal address is now PO Box 336 Reservoir 3073 Vic. The 1984 executive comprises President Mark Stephenson VK3PI, Vice President Bruce Pettingill VK3KRS, Secretary Tom Page VK3AGH and Treasurer Neil May VK3VZY.

NOTE: Club Secretaries, PR Officers et al — CLUB QST is for your benefit. Send us details of meeting times, venues, Field Day or Convention dates etc and we'll gladly give you the publicity in this column. Ideally, we'd like copy to reach us eight (8) weeks in advance of the issue date. Special events should be advised 12-16 weeks in advance if possible — that way we can do a standard 'news' item for you (photos also appreciated). We'll also enter your details on our data base (as we do for computer clubs) and publish a grand listing periodically. It's up to you!

COMPUTER PLOTTING TROPOSPHERIC PROPAGATION PATHS

Andrew Boon VK7AW

Point-to-point communications on VHF/UHF depends on propagation through the 'troposphere' immediately above the Earth's surface. Working out how a given path will 'perform' is a tedious process — unless you use this program!

THE PROPAGATION of radio signals in the troposphere, i.e: the first 5 km or so of the atmosphere, is of particular importance to anyone wishing to establish a radio link on a frequency above 30 MHz. In the troposphere, there are no regular layers of ionised gases to bend radio waves back to the surface of the earth, as is the case with HF signals using the ionosphere. Because frequencies greater than 30 MHz are generally above the MUF (Maximum Useable Frequency) for ionospheric propagation, tropospheric propagation must be used. Here the signal power generally diminishes as the square of the distance from the transmitter (inverse square law).

That is not to say that ionospheric propagation does not exist above 30 MHz. Any radio amateur who uses the six metre band can attest to the fact that ionospheric effects enable DX contacts to be made over considerably longer distances than an inverse square law would allow. However such effects are not usually relied upon in the establishment of a fixed link, for example between a commercial user's office and his mobile radio base station on the top of a prominent hill, or between a radio amateur's home and a distance repeater.

In order to assess whether contact can be established between two fixed points on a VHF or UHF frequency, it is useful to be able to calculate the propagation loss, or path attenuation, between the transmit and receive antennas.

This article briefly summarises the different types of loss affecting tropospheric propagation, and describes a computer program which provides a plot of the path profile between transmit and receive antennas, to simplify the path loss calculations.

There are four main types of path propagation losses; free-space loss, Plane-Earth loss and diffraction losses — both smooth-Earth diffraction and knife-edge diffraction. Depending on the topography between the transmit and receive antennas, and on the meteorological conditions prevailing, one or more of these loss types may be involved at any given time. Each of these will now be briefly described.

Free-space loss

Firstly, let us introduce the concept of an *isotropic* antenna. An antenna which radiates power equally in all directions, i.e: one which has no directivity, is called an *isotropic radiator*. If a transmitter has an output power of T watts, and is connected to an isotropic radiator, the power density at a distance d metres from the transmitter is:

$$\frac{T}{4\pi d^2} \text{ watt/m}^2$$

(The power is uniformly distributed over the area of a sphere, of radius d metres.) If another isotropic radiator is connected to a receiver d metres from the transmitter, the power received is given by:

$$R = \frac{AT}{4\pi d^2} \text{ watts,}$$

where A is called the Effective Area of the receiving antenna.

For an isotropic radiator, the effective area is:

$$A = \frac{\lambda^2}{4\pi} \text{m}^2,$$

where 'λ' is the wavelength in metres.

Thus the ratio of received power to transmitted power is:

$$\frac{R}{T} = \left(\frac{\lambda}{4\pi d}\right)^2$$

By substituting 300/f for λ, where f is the frequency in MHz, the ratio becomes:

$$\frac{R}{T} = \left(\frac{300}{4\pi fd}\right)^2$$

The ratio is the proportion of the transmitted power actually received, and is a measure of the path propagation loss. Expressing this in decibels,

Free-space path loss (dB)
$$= 32.4+20\log(d)+20\log(f),$$

where 'f' is the operating frequency in MHz and 'd' is the distance between the two antennas in km.

Plane-Earth loss

Free-space conditions occur when a certain minimum clearance exists between the path of the radio signal (the "ray-line") and the terrain between the two antenna locations. When this clearance does not exist, the ray-line may be obstructed, or reflections may be possible from sections of terrain close to the ray-line.

Figure 1 illustrates the situation where a reflection causes two signals, a direct ray and a reflected ray, to combine at the receive antenna. The direct signal experiences the free-space loss, and if the reflected signal is totally reflected, it experiences an almost identical free-space loss, but may be out of phase with the direct ray, due to the difference in path lengths.

The difference in path lengths can be shown to be 2h1h2/d (by applying some geometry and assuming that the path length is much greater than the antenna heights). This difference in path lengths results in a phase difference between the two signals of $(2h1h2/d)x(2\pi/\lambda)+\pi$ (in radians), allowing for a phase reversal of π radians (i.e: 180°) on reflection. Conse- ▶

quently, the amplitude of the received signal is multiplied by a factor $2\text{Sin}(2\pi h1h2/(\lambda d))$, i.e: the value oscillates about the free-space value as the antenna heights are increased.

In most practical applications, the main interest is in the situation where h1h2 is much less than λd, and using the approximation $\text{Sin}(x) \approx x$ for small values of x, the "Plane-Earth" loss is given by:

$$\left(\frac{2(2\pi h1h2)}{\pi d}\right)^2 \times \text{(free space loss)}$$

$$= \left(\frac{4\pi h1h2}{\lambda d}\right)^2 \times \left(\frac{\lambda}{4\pi d}\right) = \left(\frac{h1h2}{d^2}\right)^2$$

(Terms are squared as we have been considering voltage amplitudes, whereas the free-space ratio was a power ratio.) Thus the Plane-Earth loss (dB) = 40log(d)-20log(h1)-20log(h2), where 'd', 'h1' and 'h2' are measured in the same units, or

Plane-Earth loss (dB)
= 120+40log(d)-20log(h1)-20log(h2),
where 'd' is in km and 'h1', 'h2' are in metres. Note that the Plane-Earth loss is independent of the frequency in use.

Diffraction

When the two antennas are not within sight of each other, signals may be propagated by means of diffraction. Diffraction is the process whereby radio (and light) waves are "bent" around corners. For example, a shadow may have indistinct edges because, as well as the straight ray from a light source past an object to a screen displaying the shadow, other rays are bent, or diffracted, at the edge of the object. Radio waves display diffraction effects to a more noticeable extent than light waves because of their longer wavelength, and also because we are usually dealing with a single RF frequency.

To illustrate diffraction, consider a breakwater stopping a large swell rolling in at regular intervals. Although the wave pattern of the sea-going swell is interrupted by the breakwater, a pattern of smaller waves will radiate from the end of the breakwater into the sheltered waters, i.e: the waves are "bent" around the end of the breakwater, although they are greatly attenuated.

Huygens Principle (from the theory of Optics) states that, "All points on a wavefront can be considered as point sources for the production of spherical secondary wavelets. After a time 't' the new position of the wavefront will be the surface of tangency to these secondary wavelets." (Reference 2.) The part of the wavefront at and beyond the end of the breakwater radiates secondary wavelets, which spread inside the breakwater. In the same way, radio waves will spread into a shadow area.

There are two cases normally considered. The first is diffraction over smooth spherical Earth, including "smooth" hills: this is known as *Smooth-Earth diffraction.* The second is diffraction over a sharp obstacle, e.g: a ridge with steep sides running across the path: this is known as *Knife-edge diffraction.*

Smooth-Earth diffraction is illustrated in Figure 2. The antenna heights above the smooth earth are h1 and h2, and d1, d2 are the distances from each antenna to the "radio horizon". The heights and distances are related by:

$$d = \sqrt{2kah}$$

where 'k' is the "k-factor" (see later) and 'a' is the actual earth radius. (6370 km).

The diffraction loss depends on the total distance between the antennas, the distances d1 and d2, the frequency of operation, the effective earth radius, the polarisation of the signals and the conductivity of the "smooth earth" (be it land or sea). Reference 1 includes a nomogram for the determination of the diffraction loss over a smooth sphere.

Knife-edge diffraction is illustrated in Figure 3. Here, d1 and d2 are the distances from each antenna to the knife edge obstruction, and h is the height of the obstruction above the direct line between the two antennas. Once again, Ref 1 includes a nomogram for the determination of the diffraction loss. Of course, this simple case is not always found on practical paths, but other (similar) techniques exist which enable the diffraction loss to be determined when there are multiple obstructions.

The total propagation loss is found by adding the diffraction loss to either the Free-space loss, or to the Plane-Earth loss, as appropriate.

The path profile

In the discussions about propagation losses, it has been assumed that we knew all about the terrain between the two antennas. Before we can decide whether diffraction losses have to be considered, we must know whether the ray-line is obstructed. In order to find this out, we have to prepare a profile of the topographical variations along the straight line joining the locations of the two antennas. This vertical section is known as a *path profile,* and is prepared as follows:

1. Obtain a good map with detailed contour information (e.g: 1:100 000 series, or a larger scale if available) covering the terrain between the transmit and receive locations. Several map sheets may have to be joined together to cover the whole path.
2. Draw a straight line (in pencil preferably) between transmit and receive locations.
3. Commencing at the transmit antenna location, make up a table of distance along the path (km) versus height above sea level (in metres). Measurements of distance to the nearest 100 m, and height to the nearest contour interval (20 m on the 1:100 000 series maps) are generally adequate.
4. Plot the tabulated values on squared paper, as shown in Figure 4, and "join the dots" to display the profile of the terrain between the two antennas. Reference 5 has a description of this technique.
5. The path of the radio ray-line can then be added. In Figure 4, the line A-B is the path, where A-C and B-D are the heights of the antennas above ground level.

However, there are two further factors which have to be taken into account when plotting a path profile. These are:
(a) The earth is not flat — it's round!
(b) Radio waves do not always travel in straight lines in the troposphere.

On the short path (say less than 15 km), the error involved in assuming a flat earth is usually not significant. But on longer paths, the combination of the curvature of the earth (the "earth bulge") and the bending of radio waves has to be taken into account. This is done by using the concept of an *effective Earth radius* which differs from the actual Earth radius. But first let us look at the reasons for the bending of radio waves in the atmosphere.

Refraction

Electromagnetic waves (be they radio or light) travel at different speeds through media which have different refractive indices. This results in bending of the ray (the "ray" is travelling in a direction at right angles to the wavefront) where the refractive index changes. For example, the common observation of a straight stick appearing bent when part of it is under water is a result of the bending of light rays at the air-water junction, because air and water have different refractive indices.

The refractive index of the atmosphere is dependent on the absolute temperature, atmospheric pressure and water vapour pressure, and consequently varies with height above ground. The refractive index generally varies inversely with height, resulting in radio waves being bent towards the surface of the Earth. Thus, if you are on a mountain-top and you transmit a radio signal with zero degrees elevation, instead of travelling in a straight line into outer space, it will be bent towards the Earth, to a greater or lesser extent depending on the actual variation of the refractive index with height. Figure 5 shows this effect.

Note that the variation in the refractive index of the atmosphere with height is not constant; it is possible for the refractive index to increase with height, causing radio waves to be bent away from the earth. (Reference 4 gives a very good account of meteorological effects on tropospheric propagation.)

Effective Earth radius

In a practical situation it is much easier if we can draw a straight line to represent the radio ray-line, even though we know that the actual path may be curved. To enable this to be done, the surface of the Earth is "distorted", i.e: the curvature of the Earth is changed. Changing the earth bulge amounts to considering the radius of

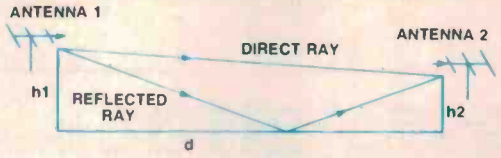


Figure 1. Plane-Earth reflections.

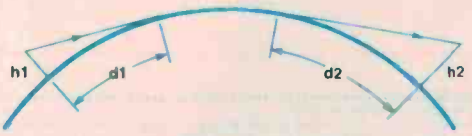


Figure 2. Smooth Earth diffraction.

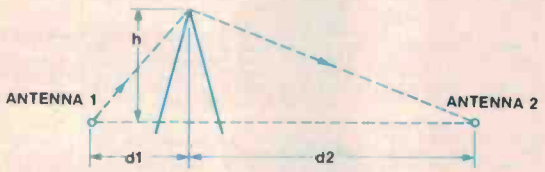


Figure 3. Knife-edge diffraction.

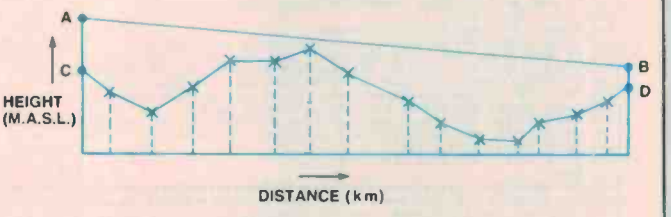


Figure 4. Plotting a path profile.

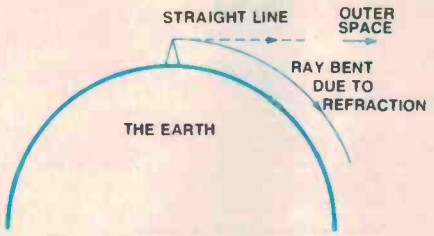


Figure 5. Bending of radio signal due to refraction.

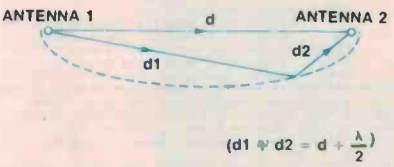


Figure 6. First Fresnel zone.

the earth to have a value different from its nominal 6370 km. An *effective Earth radius* is used to calculate the Earth bulge which allows us to draw a straight ray-line, and the "k-factor" is defined as:

$$k = \frac{\text{Effective Earth radius}}{\text{Actual radius of Earth (6370 km)}}$$

The variation of the atmospheric refractive index with height under "average" conditions is such that a k-factor of 1.33 (4/3) enables us to draw straight ray-lines. However, k will vary from approximately 0.6 to infinity, with k = infinity corresponding to a "flat earth". Reducing the value of k causes the intervening terrain to become higher, and may cause an unobstructed path to become obstructed. Thus the signal level reduces and fading may result.

The actual value of earth bulge to be added to each tabulated profile height can be calculated from:

$$\text{Earth bulge} = 0.0784 d1(d-d1)/k$$

where 'd' is the path length in km, 'd1' is the distance of the profile point along the path in km, and 'k' is the k-factor. The Earth bulge is given in metres.

Fresnel zones

Having drawn a path profile using the effective Earth radius, and drawn a straight ray-line, one more curve is often added to the plot. This is the *First Fresnel zone*, and is the locus of points such that the difference in path length between the direct ray and a ray reflected from the Fresnel zone is one half-wavelength. This means that a signal reflected from a point on the first Fresnel zone will add in phase to the direct signal, allowing for a 180 degree phase shift on reflection. Figure 6 shows the Fresnel zone as plotted on a path profile.

The Fresnel zone is included for two reasons: firstly, as a means of determining the effective antenna heights when using the nomograms of Reference 1 for Plane-Earth loss; secondly, a visual examination can determine whether possible reflections could cause problems. The distance of the first Fresnel zone from the direct ray-line is given by:

$$h = \sqrt{\lambda(d1d2)/(d1+d2)}$$

(Reference 3)

Computer-aided path profiles

Because of the number of calculations involved (Earth bulge and Fresnel zone for each profile point), and the fact that each calculation is identical, the plotting of path profiles is an *ideal* candidate for computerisation. In the computer program to be described below, the path profile data, as read from the map (i.e: distance and height), are input directly into the computer, along with the name of the path, antenna heights, frequency of operation and k-factor. It also allows for the names of profile points to be entered (e.g: prominent hills and river valleys).

The program produces a plot of the topographical profile, with the earth bulge added to the map data. The direct ray-line is drawn, also the first Fresnel zone. As listed, the program runs under TSC Extended BASIC using the FLEX9 operating system for a 6809 processor, and the output is produced by a Toshiba PA7251E printer (also known as an Itoh 8510P, inter alia).

Program description

The main program of PATHPLOT is found between lines 500 and 1200, i.e: 17 lines. The remainder of the program listing consists of REM statements and subroutines by the main program. The main program, and each subroutine called from the main program, are commenced with a descriptive header enclosed by complete lines of asterisks. Subroutines called from within subroutines (e.g: 12000) have headers enclosed by half-lines of asterisks.

The main program first asks whether new or existing profile data is to be used (line 1000). If new data is specified, subroutine 10000 is used to lead the user through the task of inputting data from the keyboard. If existing data is to be used, the subroutine 11000 is called to read data from a disk file, and allow this data to be modified (e.g: to vary the k-factor) before plotting the path. In both cases, the user is asked whether he wishes to save the profile data (new or modified ▶

```
100 REM ********************************************************************
110 REM * PROGRAM "PATHPLOT.BAS".
120 REM * Plots path, including Earth Bulge, Topographical information, Rav
130 REM * line, First Fresnel zone, for a radio wave in the Troposphere.
140 REM * Program written by A.P.Boon, June 1984.
200 REM ********************************************************************
500 DIM DI(50),HI(50),NI$(50),PD%(600,8),VD%(500)
1000 INPUT "New Profile Data (N) or Existing Data File (E) ";AN$: GOSUB 9000
1010 IF AN$()"N" AND AN$()"E" THEN 1000
1020 IF AN$="N" THEN GOSUB 10000 ELSE GOSUB 11000
1030 PRINT "Calculating ..."
1060 GOSUB 12500: REM Find Path Length.
1070 GOSUB 12700: REM Calculate Horizontal Scale for Plotting.
1080 IF HS%=0 THEN GOTO 1200: REM End if path too long (>512 km).
1090 GOSUB 12300: REM Transfer data to Path Data matrix, for plotting.
1100 k=2:GOSUB 13000: REM Interpolate between supplied data points.
1105 MH=0: REM Maximum height of plot, required for vertical scale.
1110 GOSUB 13300: REM Set up Earth Bulge in Path Data.
1120 GOSUB 13500: REM Draw direct ray line and Fresnel zone in Path Data.
1132 GOSUB 14600: REM Calculate Vertical Scale for plotting.
1135 PRINT "Plotting the path"
1140 GOSUB 14000: REM Plot path on Printer.
1200 END
9000 REM ********************************************************************
9010 REM * Subroutine to convert lower case alpha characters to upper case.
9020 REM * for the string AN$ (replies to questions).
9030 REM * Input: AN$ = Upper or Lower case alpha.
9040 REM * Output: AN$ = Upper case alpha.
9050 REM ********************************************************************
9060 IF ASC(AN$)>90 THEN AN$=CHR$(ASC(AN$)-32)
9070 RETURN
10000 REM *******************************************************************
10010 REM * Subroutine to request new data for a path profile calculation.
10020 REM * Input Data is:
10030 REM *          PP$     Name of Path (up to 40 chars.)
10040 REM *          KF      Effective Earth Radius Factor (k-factor).
10050 REM *          F       Frequency of interest (MHz).
10060 REM *          PO$     Polarization ('H' or 'V').
10070 REM *          HT      Height of Tx Antenna above ground (metres).
10080 REM *          HR      Height of Rx Antenna above ground (metres).
10090 REM *          DI(i)   Distance of i-th profile point from Tx (km).
10100 REM *          HI(i)   Height of i-th profile point above sea level  m).
10110 REM *          NI$(i)  Name of i-th profile point (if any), 17 chars. max.
10130 REM *******************************************************************
10200 INPUT "Title of Path Profile (35 chars. maximum) ";PP$
10210 IF LEN (PP$)>35 THEN PRINT "Title Too Long": GOTO 10200
10220 INPUT "Effective Earth Radius Factor (k-value) for this plot ";KF
10230 IF KF(0.4 THEN PRINT "Make K greater than 0.4": GOTO 10220
10240 INPUT "Frequency in MHz ";F
10250 IF F<30 THEN PRINT "VHF or UHF (30-3000 MHz) only.":GOTO 10240
10260 INPUT "Polarization (H or V) ";PO$
10270 IF PO$()"H" AND PO$()"h" AND PO$() V" AND PO$()"v" THEN GOTO 10260
10280 INPUT "Height of Transmit Antenna above ground (m) ";HT
10290 IF HT<=0 THEN PRINT "Must be greater than 0 m.": GOTO 10280
10300 INPUT "Height of Receive Antenna above ground (m) ";HR
10310 IF HR<=0 THEN PRINT "Must be greater than 0 m.":GOTO 10300
10320 PRINT "Topographical Information for the path, in the form:"
10330 PRINT " Distance From Tx, in km; Height above sea level in metres; "
10340 PRINT " Name of the feature, 17 chars. maximum. (Enter  0  if no name.)"
10350 PRINT " Enter '-1' for the distance when all data is entered."
10360 PRINT " (Up to 50 points. If more than 50, change DIM statements.)"
10365 i=1:REM Up to 50 profile points catered for.
10370 INPUT "Distance ";DI(i):IF DI(i)<0 THEN GOTO 10450
10380 INPUT "Height asl ";HI(i): IF HI(i)<0 THEN GOTO 10380
10390 INPUT "Name of Feature ";NI$(i)
10400 IF LEN(NI$(i))>17 THEN NI$(i)=LEFT$(NI$(i),17)
10410 i=i+1: IF i>50 THEN PRINT "Too much data":GOTO 10450
10420 GOTO 10370:REM Get next profile point.
10450 INPUT "Do you wish to save the data ";AN$: GOSUB 9000
10460 IF AN$()"Y" AND AN$()"N" THEN GOTO 10450
10470 IF AN$="Y" THEN GOSUB 12000
10500 RETURN
11000 REM *******************************************************************
11010 REM * Subroutine to Read Data from a Disk File, and allow data to
11020 REM * be modified before being used for calculations.
11030 REM * Data is in the same form as for subroutine at line 10000.
11040 REM *******************************************************************
11100 ON ERROR GOTO 11700
11110 INPUT "Name of Existing Data File ";NF$
11120 OPEN OLD NF$ AS 2
11130 INPUT #2, PP$,KF,F,PO$,HT,HR
11140 i=1: REM Initialize counter for no. of profile points.
11150 INPUT #2,DI(i),HI(i),NI$(i)
11160 i=i+1: GOTO 11150
11170 CLOSE 2: ND=i: REM Number of Profile Data Points.
11200 INPUT "Do You Wish to Alter Any Data (Y/N) ";AN$: GOSUB 9000
11210 IF AN$()"Y" AND AN$()"N" THEN GOTO 11200
11215 IF AN$="N" THEN GOTO 11500
11220 PRINT "For Each Data Item, Type 'A' for Amend, 'N' for No change,"
11230 PRINT "or  R  for no change to Remaining Data."
11240 PRINT PP$: INPUT "Change (A/N/R) ";AN$: GOSUB 9000
11250 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11270
11260 INPUT "New Title ";PP$: IF LEN(PP$)>80 THEN PRINT "Too Long.": GOTO 11260
11270 PRINT "K= ";KF;: INPUT " Change (A/N/R) ";AN$: GOSUB 9000
11280 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11300
11290 INPUT "New Value of K ";KF: IF KF(0.4 THEN PRINT "Make K>0.4":GOTO 11290
11300 PRINT "Frequency ";F;"MHz. ";: INPUT "Change (A/N/R) ";AN$: GOSUB 9000
11310 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11330
11320 INPUT "New Frequency, MHz ";F
11325 IF F<30 THEN PRINT "VHF or UHF Only": GOTO 11320
11330 PRINT "Polarization ";PO$;: INPUT ". Change (A/N/R) ";AN$: GOSUB 9000
11340 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11360
11350 INPUT "New Polarization, H or V ";PO$
11355 IF PO$()"H" AND PO$()"V" THEN GOTO 11350
11360 PRINT "Height of Tx Ant.";HT;"m. ";:INPUT "Change (A/N/R) ";AN$:GOSUB 9000
11370 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11390
11380 INPUT "New Height, metres ";HT:IF HT<=0 THEN PRINT ">0 Only.":GOTO 11380
11390 PRINT "Height of Rx Ant.";HR;"m. ";:INPUT "Change (A/N/R) ";AN$:GOSUB 9000
11400 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11430
11410 INPUT "New Height, metres ";HR:IF HR<=0 THEN PRINT ">0 Only.":GOTO 11410
11430 i=1
11440 IF DI(i)<0 THEN 11500
11450 PRINT "Distance=";DI(i);" Height=";HI(i);" Name=";NI$(i)
11460 INPUT "Change (A/N/R) ";AN$: GOSUB 9000
11470 IF AN$="R" THEN GOTO 11500 ELSE IF AN$="N" THEN GOTO 11490
11480 INPUT "New Distance ";DI(i):INPUT "Height ";HI(i):INPUT "Name ";NI$(i)
11484 IF (DI(i)<0 OR HI(i)<0) THEN GOTO 11480
11488 IF LEN(NI$(i))>17 THEN NI$(i)=LEFT$(NI$(i),17)
11490 i=i+1:IF i<ND THEN GOTO 11440
11500 INPUT "Additional Profile Data (Y/N) ";AN$: GOSUB 9000
11510 IF AN$()"Y" AND AN$()"N" THEN 11500
11520 IF AN$="N" THEN GOTO 11600
11530 REM: REM Point past existing data.
11540 INPUT "Distance ";DI(i):IF DI(i)<0 THEN GOTO 11600
11550 INPUT "Height (m asl) ";HI(i): INPUT "Name (0 if none) ";NI$(i)
11560 i=i+1: GOTO 11530
11600 ON ERROR GOTO
11605 INPUT "Do you wish to save the data (Y/N) ";AN$: GOSUB 9000
11610 IF AN$()"Y" AND AN$()"N" THEN GOTO 11605
11620 IF AN$="Y" THEN GOSUB 12000
11625 ON ERROR GOTO: REM Return error control to BASIC.
11630 RETURN
11700 REM Error Routine - Assumed to be incorrect file specification.
11710 IF ERR=8 AND ERL=11150 THEN RESUME 11170: REM Finds end of file.
11711 IF ERR=4 THEN PRINT "Not found - check file name.":CLOSE 2:GOTO 11713
11712 PRINT "Error No. ";ERR;"at Line ";ERL;"."
11713 INPUT "Give Up (Y/N) ";AN$: GOSUB 9000
11714 IF AN$="N" THEN RESUME 11110 ELSE END
11720 REM RESUME 11110
12000 REM ********************************************
12010 REM * Subroutine to Save Data to a New Disk File.
12020 REM * Data is in same form as that required by subroutine at line 11000.
12040 REM ********************************************
12100 ON ERROR GOTO 12200
12110 INPUT "What is the name of the new file ";NF$
12120 OPEN NEW NF$ AS 3
12130 PRINT #3,PP$;PRINT #3,KF; , ;F;",";PO$;PRINT #3,HT;",";HR
12140 i=1
12150 IF DI(i)<0 THEN GOTO 12180
12160 PRINT #3, DI(i);",";HI(i);",";NI$(i)
12170 i=i+1: GOTO 12150
12180 PRINT #3, DI(i)
12190 CLOSE 3: ON ERROR GOTO: REM Return error control to BASIC.
12195 RETURN
12200 REM Error routine.
12210 PRINT "Error No. ";ERR;" at Line ";ERL
12220 RESUME 12110
12300 REM *******************************************************************
12310 REM * Subroutine to transfer data from input matrices DI(i), HI(i) to
12320 REM * Path Data matrix, PD%(j,k), where j=distance along path (dots),
12325 REM * k=1 for Earth Bulge.          k=2 for Topographical Data,
12330 REM * k=3 for Fresnel zone.         k=4 for Baseline (future),
12330 REM * k=5 for Direct Ray Line.      k=6 for Diffracted ray (future),
12335 REM * k=7 for Text Indicator.       k=8 for Index (i) of input data.
12336 REM * PD%(j,7)=0 if no text for a profile point.
12339 REM * Only k=2, 7 and 8 are set in this subroutine.
12340 REM *******************************************************************
12410 REM First, initialize all topograph cal elements to -1.
12415 LF=LE+HS%+0.5: REM Path length, in dots.
12420 FOR j=1 TO LF%
12430   PD%(j,2)=-1
12435   PD%(j,3)=-1
12440   PD%(j,5)=0: REM Initialize text indicator to "no text".
12440 NEXT j
12460 i=1
12470 IF DI(i)<0 THEN 12490
12472 j%=HS%*DI(i)+0.5: REM Round off when converting to integer.
12475 PD%(j%,2)=HI(i)+0.5
12477 PD%(j%,8)=i: REM Index of input data.
12478 IF NI$(i)<>"0" then PD%(j%,7)=1:REM Text indicator.
```

existing) onto disk before proceeding.

At line 1060, the path length is found by calling subroutine 12500. This subroutine searches for the maximum value of distance. Based on the path length, the horizontal scale is then calculated (line 1070). Subroutine 12700 selects a scale factor which ensures that a plot will occupy at least half of a 280 mm sheet, regardless of the actual path length. If the path is longer than 512 km, the program terminates.

At this stage, the input data consists of up to 50 triplets of profile points (distance DI(i), height HI(i), text NI$(i)). At line 1090, subroutine 12300 is called to transfer the profile data from DI(i), HI(i) and NI$(i) to the Path Data matrix PD%(j, k). (An integer matrix is used to minimise memory requirements.)

PD% has eight elements per "dot" along the path, where a "dot" is the width of one pin on the printer. The maximum number of dots is 600, which corresponds to a plot of 600/72 = 8.33 inches (212 mm, but the printer has imperial specifications!).

The first six elements of each dot distance, i.e: k = 1 to 6, represent the height on the plot of various data items. These are: 1 – Earth Bulge; 2 — Topography (map data); 3 — Fresnel zone; 4 — (reserved); 5 — Direct ray-line; 6 — (reserved). If any of these elements has a non-zero value, a dot is printed, the position of the dot being given by the value of the element. The last elements are a text indicator, and the index of the input data so that the text can be retrieved.

At line 1100, subroutine 13000 is called to interpolate between supplied and calculated points in PD%(j, k), i.e: straight lines are drawn between profile points, to "fill-in" the gaps. Line 1105 initializes MH, the maximum height to be plotted. During the setting up of the earth bulge (including the adding of earth bulge values to PD%(j, 2)) and the direct ray line (lines 1110, 1120), the maximum height value is updated.

Line 1132 calls subroutine 14600 to cal-

```
12480 i=i+1: GOTO 12470
12490 RETURN
12500 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
12510 REM • Subroutine to find Path Length, i.e. largest element of
12520 REM • the set of DI(i). Path Length is LE.
12530 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
12600 LE=0: i=1 :REM Initialize Length and counter.
12610 IF DI(i)<0 THEN GOTO 12640
12620 IF LE<DI(i) THEN LE=DI(i)
12630 i=i+1: GOTO 12610
12640 RETURN
12700 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
12710 REM • Subroutine to determine the horizontal scale of path profile plot.
12720 REM • Scale ranges from 512 dots/km for a path length of 1 km or less,
12730 REM • to 1 dot/km for a path length of 385-512 km. Maximum path length
12740 REM • is 500 km. HS% = Horizontal Scale, in dots/km.
12750 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
12800 IF LE<2 THEN HS%=300:GOTO 12890
12805 IF LE<3 THEN HS%=200:GOTO 12890
12810 IF LE<4 THEN HS%=150:GOTO 12890
12812 IF LE<6 THEN HS%=100:GOTO 12890
12815 IF LE<8 THEN HS%=75:GOTO 12890
12818 IF LE<12 THEN HS%=50:GOTO 12890
12820 IF LE<20 THEN HS%=30:GOTO 12890
12822 IF LE<30 THEN HS%=20:GOTO 12890
12825 IF LE<40 THEN HS%=15:GOTO 12890
12830 IF LE<60 THEN HS%=10:GOTO 12890
12835 IF LE<100 THEN HS%=6:GOTO 12890
12836 IF LE<150 THEN HS%=4:GOTO 12890
12838 IF LE<200 THEN HS%=3:GOTO 12890
12840 IF LE<300 THEN HS%=2:GOTO 12890
12850 IF LE<512 THEN HS%=1:GOTO 12890
12870 PRINT "Path is Too Long.":HS%=0
12890 RETURN
13000 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13010 REM • Subroutine to interpolate between supplied values in the Matrix
13020 REM • of supplied Topographical data, or between calculated values (e.g.
13030 REM • for the Ray Lines).
13040 REM • Input Data: k  Element of Matrix to be interpolated. PD%(j,k).
13050 REM •             j  Distance variable (0-601).
13060 REM •            PD Matrix of Path Data, as defined in 12300.
13090 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13100 IF PD%(0,k)>=0 THEN GOTO 13120
13110 PRINT "No Topographical Data for Transmitter. Assumed 0 m asl.":PD%(0,k)=0
13120 ST=0: REM STart of Interpolation Interval.
13125 LN%=LE•HS%•0.5: REM Length of path, in dots.
13130 j=1: REM Counts along interval.
13140 IF PD%(j,k)<>-1 THEN GOTO 13170
13150 j=j+1: REM No data - look at next element.
13160 IF j<=LN% THEN GOTO 13140 ELSE GOTO 13250
13170 EN=j: REM ENd of Interpolation Interval, i.e. next data element found.
13180 DF=PD%(EN,k)-PD%(ST,k): REM DiFference between start and end values.
13185 PR=DF/(EN-ST):REM Increment per dot-distance.
13190 z=1: REM Calculate values along interval.
13200 IF ST+z=EN THEN GOTO 13230: REM End of Interval reached.
13210 PD%(ST+z,k)=PD%(ST,k)+PR•z+0.5: REM Straight line approximation.
13220 z=z+1: GOTO 13200: REM Do next point in Interval.
13230 ST=EN: GOTO 13150: REM End becomes start of next interval.
13250 RETURN
13300 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13310 REM • Subroutine to set up Earth Bulge in data matrix, and add Earth
13320 REM • Bulge to topographical data. Also checks max. height of plot (MH).
13330 REM • EB=Earth Bulge at current point, LE=Path LEngth, in Km.
13340 REM • HS%=Horizontal Scale, in dots/km, j=Distance along path, in dots.
13350 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13400 LN%=LE•HS%•0.5
13405 Z=0.0784/HS%/HS%/KF: REM Constant for each point.
13410 FOR j%=0 TO LN%
13420   EB=Z•j%•(LN%-j%): REM Earth Bulge calculation.
13430   PD%(j%,1)=EB+0.5: PD%(j%,2)=PD%(j%,2) + PD%(j%,1)
13435   IF PD%(j%,2)>MH THEN MH=PD%(j%,2): REM Update max. height.
13440 NEXT j%
13460 RETURN
13500 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13510 REM • Subroutine to draw direct ray-line between transmit and receive
13520 REM • antennae, and to draw first Fresnel Zone below ray line.
13530 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
13600 PD%(0,3)=PD%(0,2)+HT-0.5: REM Set up height of Tx antenna asl.
13605 IF PD%(0,3)>MH THEN MH=PD%(0,3)
13610 LN%=LE•HS%•0.5: REM Length of path, in dots.
13615 PD%(LN%,3)=PD%(LN%,2)+HR-0.5: REM Set up height of Rx antenna asl.
13620 IF PD%(LN%,3)>MH THEN MH=PD%(LN%,3)
13625 DF=PD%(LN%,3)-PD%(0,3): REM DiFference in antenna heights.
13630 Z=0.3/F/LE/HS%/HS%: REM Constant for Fresnel calculation.
13632 PR=DF/LN%:REM Change in ray line height per dot-distance.
13635 FOR j=1 TO LN%-1
13640   MJ=PD%(0,3) + PR•j
13645   PD%(j,4)=MJ -(0.5-1000•SQR(Z•j•(LN%-j)/1000)):REM Fresnel Zone.
13650   IF PD%(j,4)<0 THEN PD%(j,4)=0:REM Can't plot below zero.
13655   PD%(j,3)=MJ+0.5:REM Convert direct ray position to integer.
13670 NEXT j
13680 RETURN
14000 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
14005 REM • Subroutine to Plot all Data on an Itoh 8510 Printer. Draws left
14010 REM • and right axes, scale divisions, plots topographical information,
14015 REM • earth bulge, Fresnel zone, ray lines and list feature names.
14025 REM •  Input Data: PD%(601,8) Path Data Matrix
14030 REM •              VS        Vertical Scale (metres/dot)
14035 REM •              HS%       Horizontal Scale (dots/km)
14040 REM •              LE        Path Length, km
14050 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
14060 OPEN "O.PRINT" AS 0:EXEC. "TTYSET,WD=0,EJ=0"
14065 REM Print Title, double width characters.
14070 PRINT #0: PRINT #0,CHR$(14);PP$;CHR$(15)
14072 PRINT #0:PRINT #0,"K=";KF;" F=";F;"MHz ";" Polarization = ";POL$"   ";"Ver
tical Scale = ";40•VS;"m/div. "
14073 PRINT #0,"Path Length=";LE;" km.  Ant. Heights. HT=";HT;" m. HR=";HR;" m.
":DATE$
14075 PRINT #0, CHR$(27);"T16": REM Sets 16/144" LF Pitch.
14077 PRINT #0,CHR$(27);CHR$(62);:REM Unidirectional Printing.
14080 GOSUB 14200: REM Set up left axis and scale.
14085 GOSUB 14250: PRINT #0: REM Plot it.
14088 LN%=LE•HS%•0.5:REM Path length, in dots.
14090 i=0: REM Now plot information.
14095   GOSUB 14300: REM Set up one line for plotting.
14100   GOSUB 14250: REM Now plot it.
14110   i=0: REM Check for text, if present, print first one.
14115     IF i>7 THEN PRINT #0: GOTO 14130
14120     IF PD%(i•8+i,7)<>0 THEN PRINT #0,NI$(PD%(i•8+i,8)): GOTO 14130
14125   i=i+1: GOTO 14115
14130   i=i+1: IF i<=78 AND i•8<=LN% THEN GOTO 14095
14145 GOSUB 14200: REM Set up right axis and scale.
14150 GOSUB 14250: PRINT #0: REM Plot it.
14152 PRINT #0: PRINT #0,CHR$(27);"T24";CHR$(27);CHR$(60): REM 1/8" LF Pitch.
14155 EXEC. "TTYSET,WD=80,EJ=6":REM Restore terminal characteristics.
14160 RETURN
14200 REM ••••••••••••••••••••••••••••••••••••••••
14202 REM • Subroutine to plot vertical axis, with graduations every 40 dots.
14208 REM ••••••••••••••••••••••••••••••••••••••••
14209 VD%(0)=255: REM Set up baseline.
14210 FOR i=1 TO 499: REM Set up axis.
14215   VD%(i)=128
14220 NEXT i
14225 FOR i=1 TO 12: REM Set up scale divisions.
14230   VD%(40•i)=240
14235 NEXT i
14240 RETURN
14250 REM ••••••••••••••••••••••••••••••••••••••••
14255 REM • Subroutine to plot one line of information.
14258 REM ••••••••••••••••••••••••••••••••••••••••
14260 PRINT #0, CHR$(27);CHR$(83);"0500";:REM Here comes 500 graphics bytes.
14265 FOR h=0 TO 499
14270   PRINT #0,CHR$(VD%(h));
14275 NEXT h
14280 RETURN
14300 REM ••••••••••••••••••••••••••••••••••••••••
14302 REM • Subroutine to assemble a line of Bit-Image Graphics
14305 REM • from the Path Data matrix (PD). Printer Data is stored
14310 REM • in Vertical Data matrix, VD(500), modified by Vertical Scale, VS.
14315 REM ••••••••••••••••••••••••••••••••••••••••
14320 VD%(0)=255:REM Draws baseline.
14325 REM Now fill in data from PD%(600,8).
14335 FOR h=1 to 499: REM Set all points across line to blanks.
14340   VD%(h)=0
14345 NEXT h
14347 d%=1
14350 FOR b=0 TO 7
14355   j=i•8+b: REM Line of PD% matrix being examined.
14365   FOR e=1 TO 6: REM Element of PD% matrix.
14368     nu%=PD%(j,e)/VS+0.5
14370     VD%(nu%)=VD%(nu%) OR d%
14373   NEXT e
14375   IF PD%(j,2)=PD%(j,1) THEN GOTO 14378:REM Don't plot below Earth Bulge.
14376   nu%=PD%(j,2)/VS-0.5: REM Plot 2 dots for topography.
14377   VD%(nu%)=VD%(nu%) OR d%
14378   d%=2•d%:REM Mask for plotting bit.
14380 NEXT b
14385 RETURN
14600 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
14610 REM • Subroutine to calculate vertical scale of plot, based on the value
14620 REM • of MH, the maximum height to be plotted. The vertical scale is
14630 REM • VS metres per dot of height. Total available is 500 dots.
14690 REM ••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
14700 IF MH<500 THEN VS=1: GOTO 14760
14710 IF MH<1000 THEN VS=2: GOTO 14760
14720 IF MH<2000 THEN VS=4: GOTO 14760
14730 IF MH<4000 THEN VS=8: GOTO 14760
14740 IF MH<8000 THEN VS=16: GOTO 14760
14750 PRINT "Path is Too High.": VS=0
14760 RETURN
```

culate the vertical scale, based on the value of the maximum height to be plotted. The plot has a maximum height of 500 dots, and the height data is scaled so that the maximum profile height is represented by 500 dot-positions (or less) on the printer. Subroutine 14000 is called at line 1140 to plot the data on the printer.

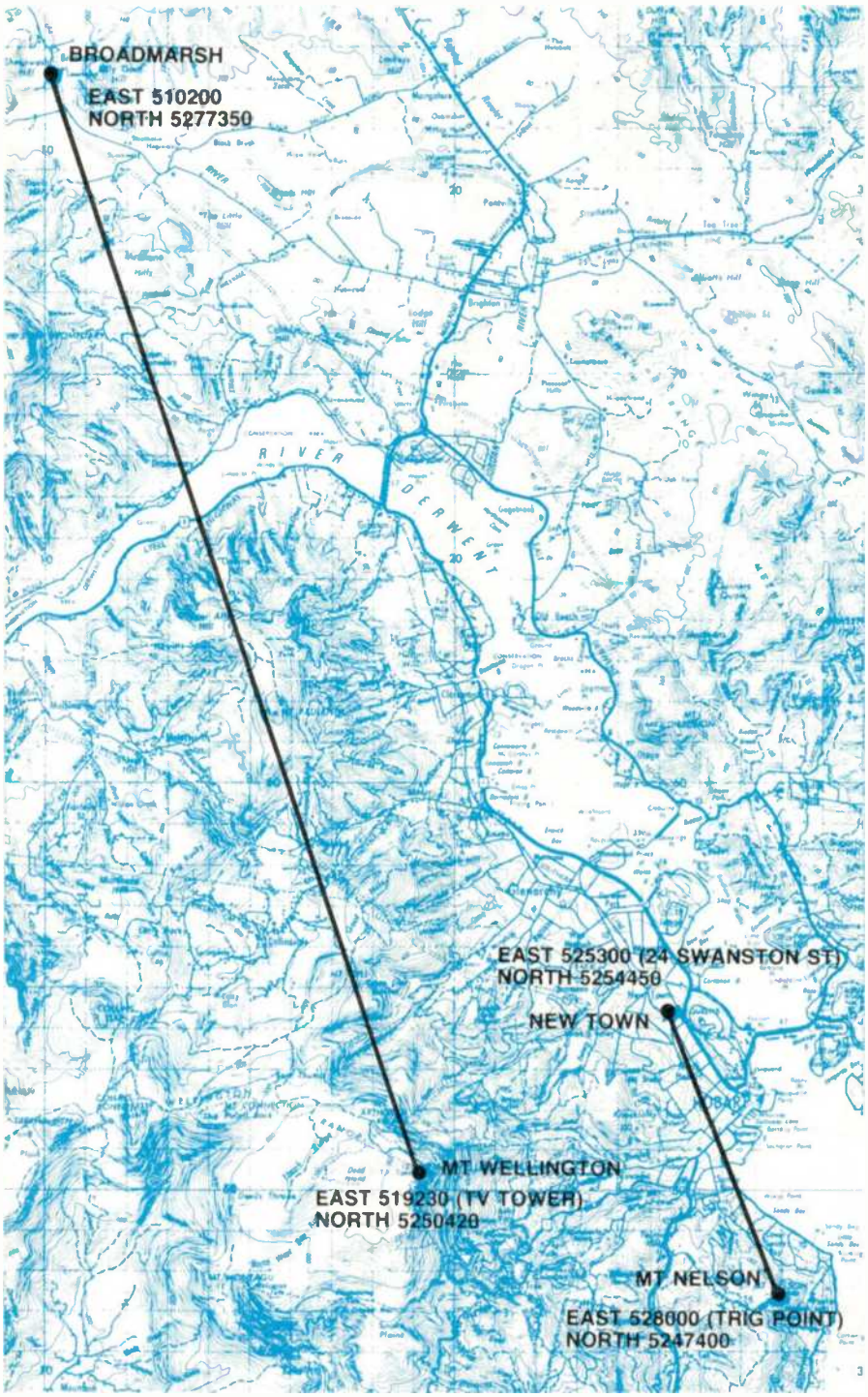
At this stage, the matrix PD%(j, k) contains all the data to be plotted on the printer. Subroutine 1400 prints the title of the path, in double width characters, then prints the parameters associated with the particular profile (data, k-factor, polarisation, vertical scale, antenna heights and path length). The line feed pitch of the printer is then changed to allow the whole of the paper to be used for the plot, without leaving gaps between lines.

The data to be plotted is assembled into the vertical data array, VD%(i), a 500 element integer array, which is used as a binary array with the low order byte (8 bits) representing the information for the eight print head pins. Apart from the left and right axes, the data to be plotted is assembled into VD% by the subroutine 14300, and plotted by subroutine 14250. Lines 14062 and 14155 ensure that the terminal service routines of FLEX9 do not upset the output of graphics characters. The topographical data is plotted by two adjacent dots, to make it stand out from the outer curves.

Using the program

Because PATHPLOT is a relatively long text file (19K characters), and uses large data arrays (PD% and VD%), the program cannot be run as it stands, even on a nominal 64K system. It must first be "compiled" to PATHPLOT.BAC, a process which tokenizes the program and reduces the length to 9K bytes. PATHPLOT.BAC can then be run. If it is desired to run the program using a BASIC interpreter which does not have the "COMPILE" command, removal of all the REM statements might reduce the size sufficiently to enable the program to run.

Once the program is loaded and running, a series of questions leads the user ▶



This map is a section of the Tasmania 1:100 000 topographic map, Sheet 8312, Derwent Tasmania, Edition 3 1978. It is produced by the Survey Branch, Lands Department; published by the Lands Department, Government of Tasmania, Hobart. Reproduced by permission.

Figure 8. Topographical section for a path from Mt Wellington to Broadmarsh, and a path from New Town to Mount Nelson in Tasmania.

through its operation. Answers can be given in upper or lower cases, and an indication is given as to what activity is being undertaken, e.g: "Calculating . . .". A sample of the screen display for a short path is given in Figure 7. User responses are underlined. Do not expect instant response. Apart from the data shuffling, there are a number of arithmetic operations, including a square root, for each dot-distance of the plot. Consequently, a complete plot will take minutes on a 1 MHz system.

To illustrate the applications of PATHPLOT, a number of plots have been reproduced. Figure 8 shows the topographical (map) section for a path from Mt Wellington to Broadmarsh, Tasmania, and Figure 9 is the resulting plot. While this path has good clearance at the Mt Wellington end, it is obstructed by Mt Faulkner in mid-path, and again at the Broadmarsh end.

Figure 8 also shows the map section for a path from New Town to Mount Nelson, Tasmania, and Figure 10 is the corresponding plot. This path has clearance greater than the first Fresnel zone over its entire length, and the free-space formula would be used to calculate the path attenuation.

The last three plots (Figures 11, 12 and 13) are for a fictitious 64 km path between Hobart and Baghdad, and show the effects of variations in the effective Earth radius, or k-factor. Figure 11 is for k = 99, i.e: approximately a flat Earth situation. Figure 12 uses the average value of k = 1.33, and Figure 13 uses k = 0.6, the smallest value normally experienced for any noticeable period of time. What is probably a free-space path at k = 99 becomes a plane-Earth case at k = 1.33, and then is obstructed at k = 0.6.

Depending on the reflectivity of High Ridge, severe fading may be experienced as k decreases towards 0.6, when High Ridge is on the direct ray line. At this time, the signal reflected from High Ridge will be out of phase with the direct ray (due to the 180° phase shift on reflection), and could cancel the direct ray at the receive antenna location. ●

References

1. K. Bullington, *Radio Propagation Fundamentals*, The Bell System Technical Journal Vol 36, No 3, May 1957. (Also printed in the *Antenna Engineering Handbook*, by H. Jasik.)

2. D. Halliday and R. Resnick, *Physics*, 1966, Wiley International Edition.

3. ITT, *Reference Data for Radio Engineers*, 6th Edition, 1975, Howard W. Sams & Co., Inc.

4. D. Evans and G. Jessop, *VHF/UHF Manual*, 3rd Edition, 1976, Radio Society of Great Britain.

5. State Emergency Service, Tasmania, *Map Reading Handbook*, Chapter 5.

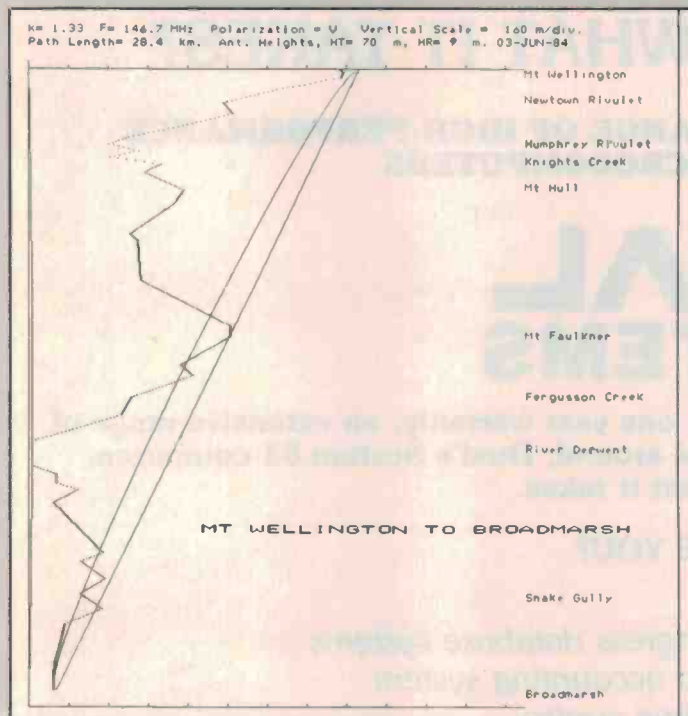


Figure 9. The computer plot for a path from Mt Wellington to Broadmarsh, Tasmania.

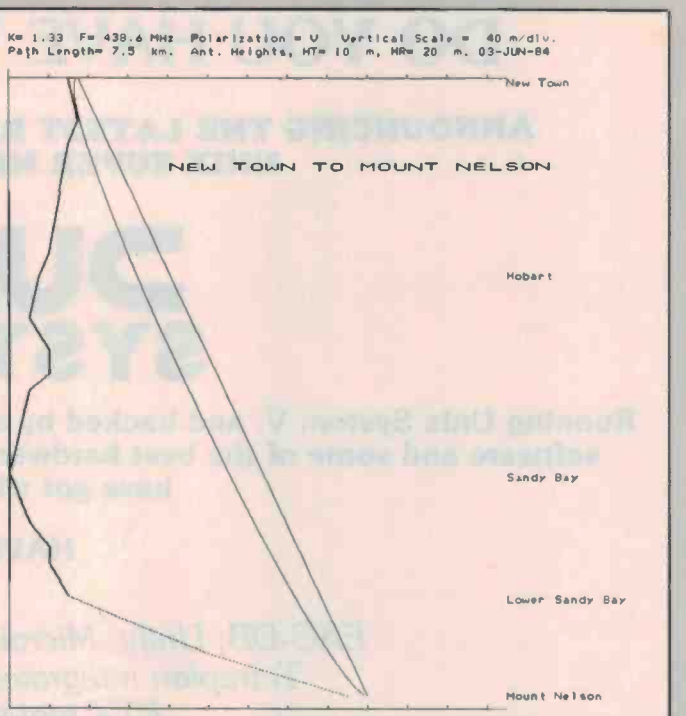


Figure 10. The computer plot for a path from New Town to Mount Nelson, Tasmania.

```
Ready
RUN "PATHPLOT"
New Profile Data (N) or Existing Data File (E) ? N
Title of Path Profile (35 chars. maximum) ? HOBART TO OLD BEACH
Effective Earth Radius Factor (k-value) for this plot ? 2.5
Frequency in MHz ? 146.1
Polarization (H or V) ? V
Height of Transmit Antenna above ground (m) ? 6.5
Height of Receive Antenna above ground (m) ? 11.4
Topographical Information for the path, in the form:
 Distance From Tx, in km; Height above sea level in metres;
 Name of the feature, 17 chars. maximum. (Enter '0' if no name.)
 Enter '-1' for the distance when all data is entered.
 (Up to 50 points. If more than 50, change DIM statements.)
Distance ? 0
Height asl ? 80
Name of Feature ? Home
Distance ? 3
Height asl ? 60
Name of Feature ? 0
Distance ? 35.6
Height asl ? 0
Name of Feature ? Derwent River
Distance ? 46
Height asl ? 40
Name of Feature ? Old Beach
Distance ? 41
Height asl ? 20
Name of Feature ? 0
Distance ? -1
Do you wish to save the data ? y
What is the name of the new file ? NEWPATH
Calculating ...
Plotting the path
Ready
```

Figure 7. A sample of the screen display for a short path with the user responses underlined.

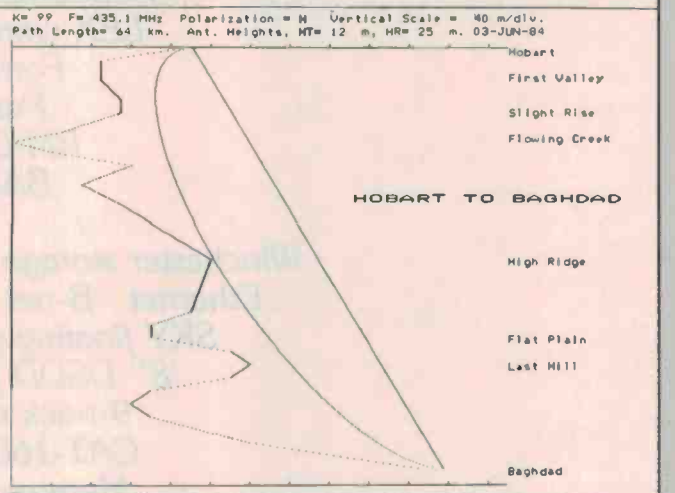


Figure 11. A fictitious path between Hobart and Baghdad for k=99 i.e: approximately a flat earth situation.

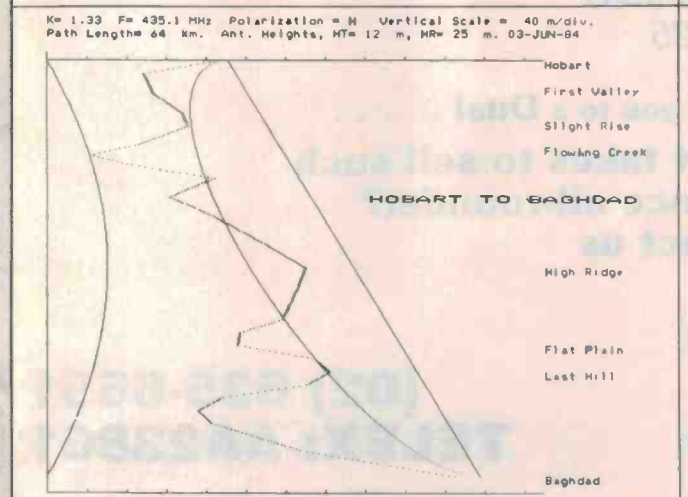


Figure 12. A fictitious path between Hobart and Baghdad for k=1.33.

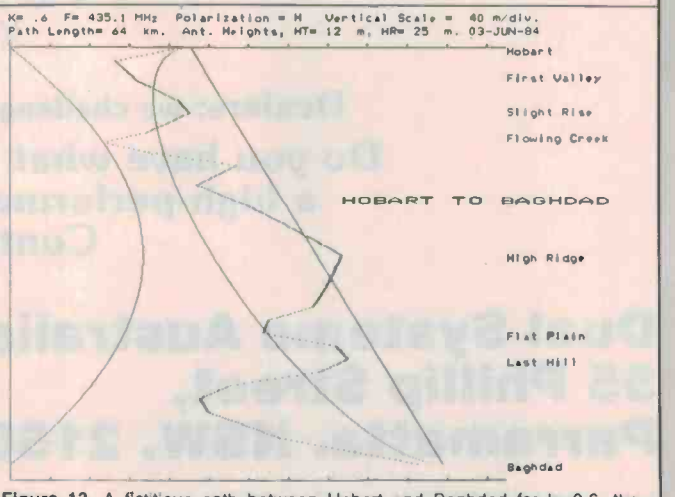


Figure 13. A fictitious path between Hobart and Baghdad for k=0.6, the smallest value normally experienced.

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'PIRATE' BROADCASTERS

Braving the High Seas

Arthur Cushen

After the storm. The pirate broadcasting ship *Tiri* heads out to sea again after sheltering in Tryphena on the North Island of New Zealand.

Unlicensed 'pirate' broadcasters burst on to the medium wave and shortwave broadcast bands in the 1960s. They changed the government monopoly situation that existed then, and broadcasting along with it. They're still at it!

SO-CALLED 'PIRATE' RADIO stations operate off the coast of some European countries where commercial radio programming is banned or the government has a monopoly on broadcasting. In the South Pacific, the story of Radio Hauraki is well known. It broadcast from the 'Tiri' in the Hauraki Gulf off Auckland for 1111 days in the 1960s and broke the monopoly of the New Zealand Broadcasting Service. Subsequently, private commercial stations were granted licences in New Zealand. There are now at least 12 transmitters operating from Auckland down to Invercargill, carrying private commercial programming or non-commecial gospel broadcasting.

The Hauraki created the broadcasting breakthrough and opened the radio broadcasting industry to private enterprise. The story of the difficult life at sea, and the shipwreck of the vessel on Great Barrier is told by those who manned the vessel. In their endeavour to bring private enterprise radio to New Zealand, they battled the hardships of operating 24 hours a day, often in atrocious weather.

In the 1960s off the coast of Britain, 'Radio Caroline', 'Radio London' and many others, broadcast for the first time, commercial programmes to the English audience. They broke the BBC monopoly and created the atmosphere for commercial radio in the United Kingdom. Even today, three vessels are operating off the coast of Britain in the English Channel with programmes for listeners in Western Europe.

Off the Dutch Coast, pirate radio stations also operated, with 'Veronica' having the longest history, but listeners in the South Pacific will better remember 'Radio North Sea' as they broadcast on shortwave as well as mediumwave in English and Dutch, and was verified by many shortwave enthusiasts.

Likewise, shortwave listeners are now able to hear the 'Voice of Peace' operating off the coast of Israel which was first heard by the writer on mediumwave on the frequency of 1540 kHz in 1976. Since last September it has been transmitting on shortwave on a test basis.

A newcomer!

A newcomer to the pirate radio scene commenced operation in August from a vessel anchored in the English Channel with mediumwave and shortwave transmitters on board. During daytime it carries popular music. From 7 pm to 6 am it broadcasts inspirational and gospel music.

The popular music station is known as WRLT, for 'Wonderful Radio London International', while the second programme service will identify as VFG, 'Voice of the Free Gospel'.

The ship is called the 'Four Freedoms' and uses a 50 kW mediumwave transmitter and 10 kW on shortwave.

The new pirate operates on shortwave for its gospel programming so that a wide audience can listen to the night-time broadcasts. The station is installed in a US port and commenced operation on August 14, a date chosen as it commemorates the closing of Radio London some 17 years ago. ●

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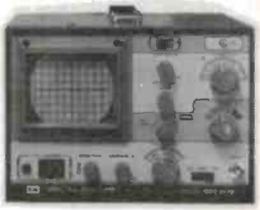

- Sensitivity: 5mV/div - 5V/div. • Bandwidth: DC or 2 Hz - 10 MHz • Trigger Mode: AUTO, NORM, EXT, TV • Trigger Source: INT, EXT • X-Y Operation • CRT: 75 mm

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- Trigger Source: INT, CH2, LINE, EXT
- X-Y Operation; & Z-Axis modulation
- Component Tester: for R, L, C & diodes

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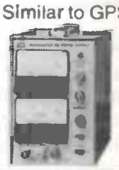

GPC-3020 DUAL POWER SUPPLY

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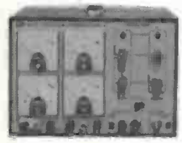

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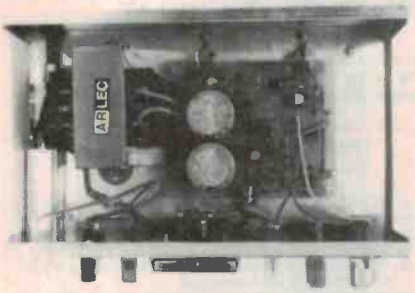

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Use this simple Power Monitor to easily and safely measure the energy consumption of household appliances. You can then calculate running costs and thus minimise your energy bills.

±12V RAILS FOR LAB POWER SUPPLY

EA July 1983

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An inexpensive addition to the 50V 5A Lab Power Supply which should prove its worth many times over. It provides additonal fixed ±12V outputs for lower power applications.

PLUG PACK REGULATOR

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Plugpack Extra

INVERTER **40 WATTS**

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MAY EA 1982

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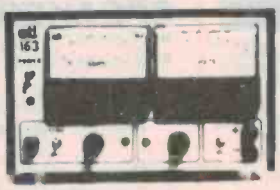

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ETI-163 LAB SUPPLY $175

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

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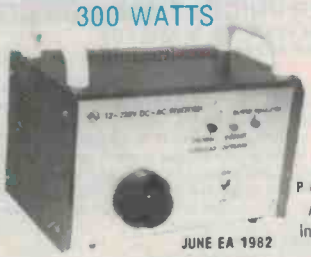

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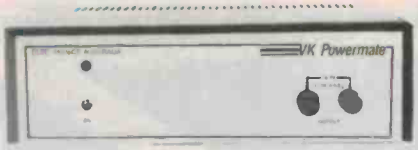
Nominal Supply Voltage	12V DC
Output voltage	see table
Frequency	50Hz ± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

Resistive load W	Output voltage (RMS)	Input current (A)	Efficiency (%)	Battery life 40Ah/20h rate (minutes)
no load	210	1.2	0	–
40	235	4.5	60	240
100	240	11.3	62	80
140	240	15.0	69	60
200	240	20.1	78	50
240	240	24.0	79	32
300	235	29.6	82	28

VK POWERMATE $90



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• 1% Metal Film Resistors are supplied • 14 metres of Low Capacitance Shielded are supplied (a bit extra in case of mistakes) • English "Lorlin" Switches are supplied no substitutes as others supply • We have built and tested this unit and so know what needs to go into every kit • Specially imported black anodised aluminium knobs • Again as with the power amp we are offering this kit A & T at a price which we do not believe there is a commercial unit available that sounds as good. Same delivery as the PA.

PREAMPLIFIER Kit Price $289, P&P $12.00

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ±0.2 dB.
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 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 μV input signal: >71 dB flat >75 dB A-weighted.

On Special at $259
Normally $289

*All parts available separately for both kits.

POWER AMPLIFIER Kit Price $319, P&P $12.00

SPECIFICATIONS 150W RMS into 40hms

Power output:	100W RMS into 8 ohms (±55 V supply).
Frequency response	8 Hz to 20 kHz, +0 0.4 dB 2.8-Hz to 65 kHz, +0 −3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	100dB below full output (flat).
Noise.	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	<0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ±56 V supply rated at 4 A continuous, <0.003% at 10 kHz and 100 W.
3rd harmonic distortion:	<0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	<0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability	Unconditional

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound.

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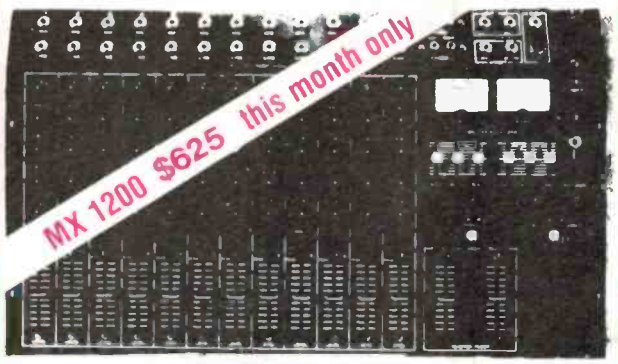
MX-1200 MICROPHONE/AUDIO MIXER



This unit features 12 microphone line inputs with pan, bass, treble, effect and fold back controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc. • complete with carrying case.

SPECIFICATIONS:

INPUTS
Level/Impedance Mic. 46 db/1K
Line 22 db/16K ± 12
Phono 52 db/50K STEREO ± 2 (2mv) at 1KHz
Effect Return (Aux) 20 db/50K ± 1
OUTPUTS
Level/Impedance L & R 0 db/2K
Effect Send 0 db/2K F.B Out 0 db/2K
Head phone Stereo + 10 db 600 (100 1K)
EQUALISATION
Channel
Bass ± 15db
Treble ± 15db
Master
Bass ± 12db
Treble ± 10db
Middle ± 12db

FADER & CONTROLLERS
12 channel fader, Slide, 60mm LOG 25%
2 Master fader, Slide, 60mm LOG 15%
12 F/B Volume, 300, LIN
1 F/B Master level, 300, LIN
12 Effect Send, 300, LIN
1 Effect Return, 300, LOG 15%
2 Phono, 300, LOG 15%
1 Head Phone 300 LOG 15%
S/N. 58DB
FREQUENCY RESPONSE 20-20 KHz
TOTAL HARMONIC DISTORTION Less than 0.1%
METER 2 illuminated VU Meters 0db = 0.775V
PEAK INDICATOR 12 LED Peak indicators
VOLTAGE 240 VAL 50Hz
POWER CONSUMPTION 7.2 watts
DIMENSIONS 620 (W) x 386 (D) x 108 (H) mm
(supplied complete with carrying case)

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS E.T.I. Dec. 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB).
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0. max. 0.01%, sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut:	14 dB

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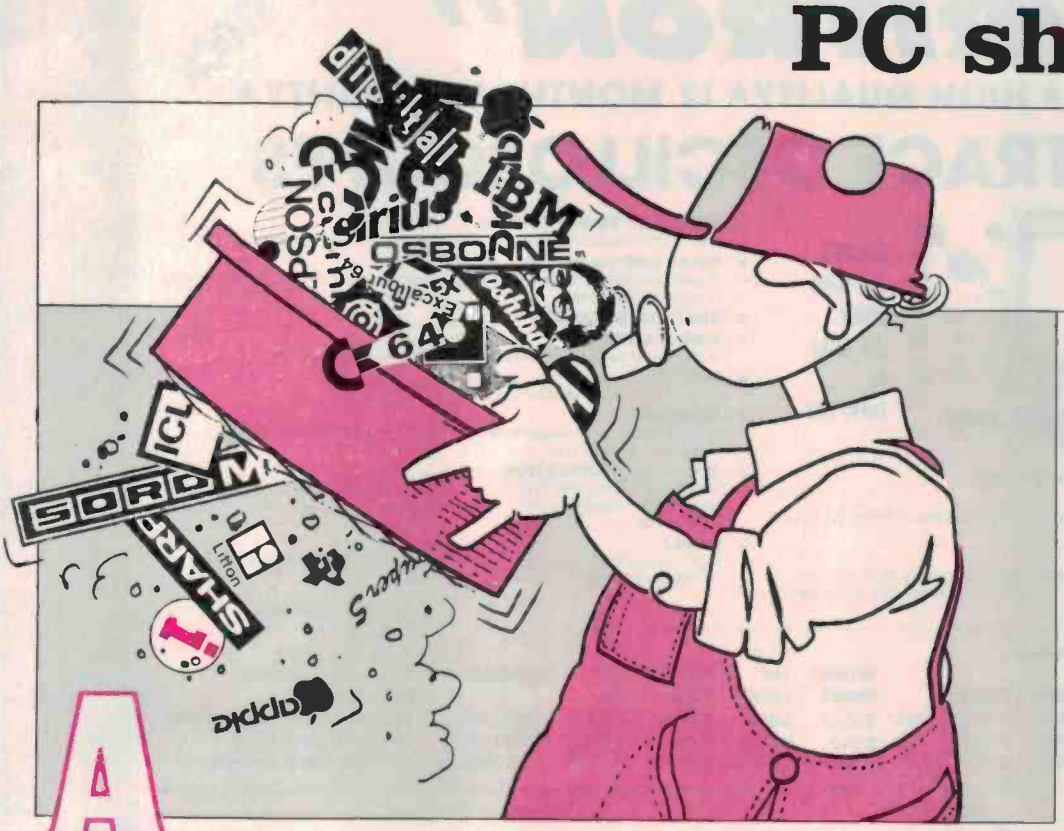
PC shakeout



IBM has cut the price of its personal computers as other computer makers continue to bite the dust.

A year ago it seemed certain that every second home would soon have an inexpensive computer. It was seen to be an indispensable tool for families growing more sophisticated in keeping financial records, planning for the future, playing games and preparing their children for life in a computerised world.

But now, just when the surge in home computer buying was supposed to be well under way, consumers seem to be having serious reservations about the machines.

"Everyone was persuaded that all we had to do was provide the computer and that consumers knew what they would do with them," Mr Philip C. Restaino, senior vice president of Atari Inc, said.

"Clearly, that wasn't the case. There is only so far you can go with intimidation, with telling the public that if you don't buy your kid a computer he'll grow up to be an idiot."

But few consumers have used home computers for more than playing games, he suggested. "Now we have the responsibility to build in the usefulness and appeal. People are starting to work on that, but they only started recently."

IBM Australia has announced more cost-effective versions of the IBM Personal Computer and IBM Personal Computer XT. The new model comes with 256K memory as standard.

Prices have also been lowered on the 64K memory version of the IBM Personal Computer and the 128K memory version of the IBM Personal Computer XT.

The new price for the 64K IBM Personal Computer consisting of a system unit, keyboard, monochrome display and adapter is $3983, a reduction of 13%; and for the 128K IBM Personal Computer XT consisting of a system unit, keyboard, monochrome display and adapter is $7768, a reduction of 14%.

The move is seen as an attempt to step up pressure on competitors in the home and personal computer markets.

It comes as retailers report that IBM Personal Computers, once in such short supply that customers waited months for delivery, are suddenly abundant — a reflection of both tapering demand and of greatly increased production rates.

It also comes as the company's product faces renewed attack from its primary competitor in the personal computer field, Apple.

But Apple may suffer less from the cuts than the raft of IBM-compatible manufacturers, who have stayed alive by offering machines that are only marginally different from IBM models but cost about 20% less.

Analysts said that IBM appeared to be pursuing several separate, but interwoven, strategies in its announcement of price cuts.

"The first, of course is simply a matter of price," said Frank Gens, an analyst with a US consulting concern.

"Outside competitive pressures have increased, and IBM's costs are coming down as the company has stepped up production," he said.

A second aspect concerns the capability of IBM's machines. While a standard model, with 64K of internal memory, looked like a lot in 1981, when the computer was introduced, it is unimpressive now.

Popular business software takes about 180K to run, and many modern programs require much more.

Amid all these problems, the one company that has so far escaped unscathed is Commodore. Its top-selling computer, the Commodore 64, is now one of the least expensive on the market.

It is also, by nearly all accounts, one of the most powerful. That is partly because of its design and partly because Commodore — after falling severely behind demand — is now beginning to ship disk drives and printers in sufficient numbers to meet the demand of those who want to use the machines for serious purposes.

But analysts note that success in the computer industry has a snowballing effect. What makes the Commodore particularly appealing, most experts insist, is the wide range of software available for it — thousands of programs written by hundreds of companies, from one-man ventures to giant book publishers.

Just how long Commodore's success can continue is a subject of some debate. Some say the company, which has grown by leaps and bounds, is a long-term winner, having forced Texas Instruments, Timex and Mattel Inc out of the market.

Others assert that eventually Commodore, too, will be displaced. Its management has turned over almost completely in the past four months. Although officials of the secretive company say everything is going smoothly, many outsiders express doubts.

"My opinion is that consumers now have a better understanding of what they want," said Mr Warren Zorek, who heads the consumer electronics purchasing for a big US chain store.

"They are no longer interested in experimentation but rather with computers that have greater capabilities. That's why the low end has just dried up and disappeared." ●

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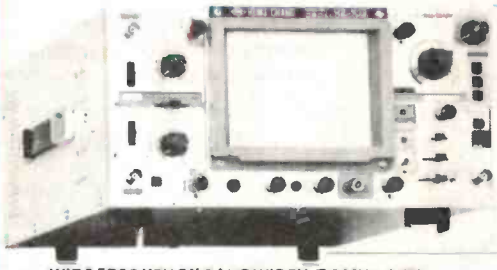

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620	150mm	5mV	N	N	20MHz	0.5uS 0.5Sdiv	$549	$485	$589	012105	(45MHz-6dB)
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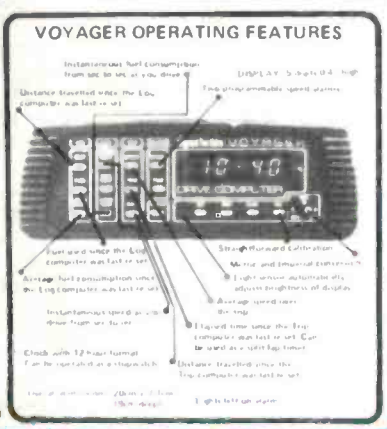

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Switched mode supplies

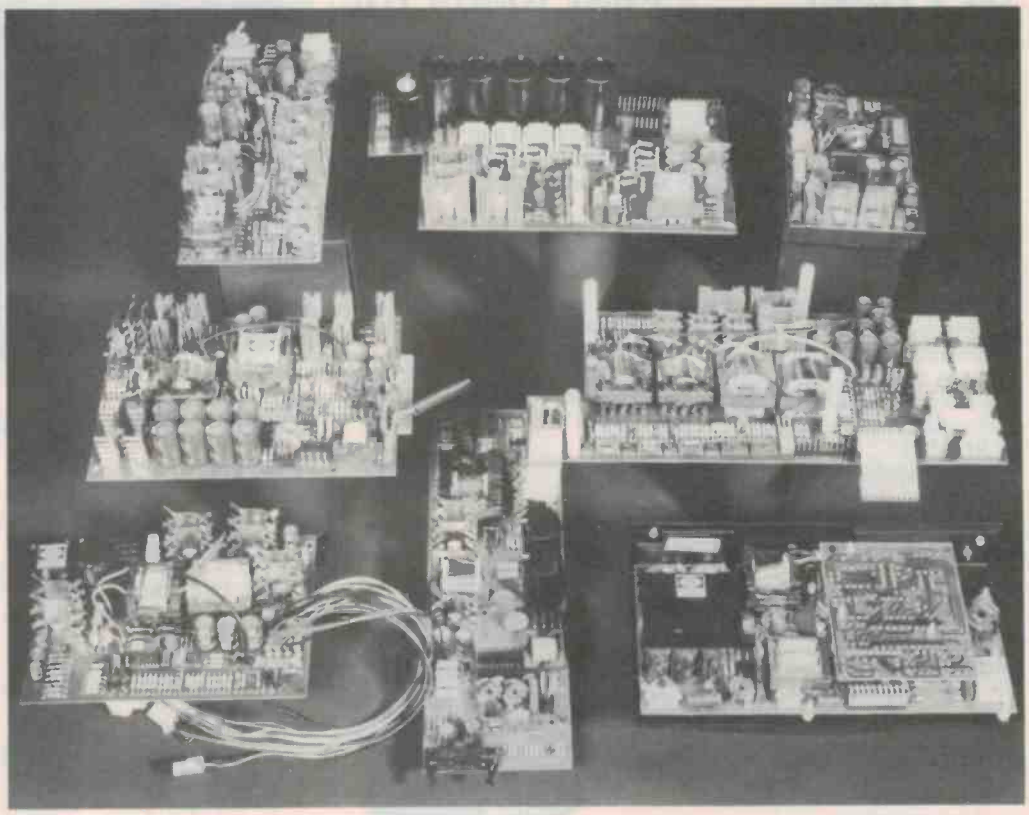
Australian power supply specialist, Scientific Electronics, has released news of a range of switch mode power supplies to the computer industry.

There are now 22 models in the range — from single rail up to five rails and from 3 W to 400 W.

The switch mode technology employed by Scientific Electronics results in a compact, low cost power supply for a wide range of applications in the computer industry from micros, PCs, minis and mainframes to VDUs, printers, drives and computer controlled equipment.

As well as a broad range of standard supplies, Scientific Electronics offers the industry a complete custom design and manufacturing service.

For further information contact **Scientific Electronics, 6 Holloway Drive, Bayswater Vic. 3153. (03)762-5777.**



Switch mode supplies. Part of Scientific Electronics range of power supplies.

Dual advantages

83/80 CPU. A Unix V based system from Dual Systems.

The Dual Systems 83/80 industrial grade computer running Unix System V is now available. From four to 12 people can use it at once.

The 80M disk contains the Unix operating system, on-line manuals, editors, document formatters, C compiler, networking support and programming tools.

Physically the Dual 83/80 is capable of continuous operation at temperatures in excess of 60°C. The rugged industrial grade enclosure offers maximum environmental protection. Inside the CPU cabinet is a 20-slot, multi-layered IEEE-696/S-100 motherboard with Schottky diode terminators.

Main memory starts at 512K and can be expanded to 10M. A 256 simultaneous colour interface provides unparalleled graphics imaging capability.

Unix System V release 2.8 is standard on the Dual 83/80. New enhancements such as error logging, resource accounting, data base operators, Internet network protocol support, shared memory and semaphore handling have been added.

For more information contact **Systems D, 55 Phillip St, Parramatta NSW 2150. (02)635-6651.**

Four-pen plotter

Ampcc Electronics has released a four-pen plotter which can do colour graphs on any paper or OHP transparency up to A3 size.

The four pens are automatically changed and travel at a rate of 280 mm/s. Alphanumeric characters can be drawn at a rate of five per second. Serial and parallel interfaces are standard.

The plotter uses the same software commands as the HP-GL Hewlett Packard plotter. Thus, existing software (such as Lotus 1-2-3) which addresses the HP plotter will operate this new product without modification.

For more information contact **Ampec Electronics, 21 Bibby St, Chiswick NSW 2046. (02)712-2466.**

RFI filter

The newly released computer protector from Edor Electronics has been designed to plug directly into a three-pin 10 A wall socket.

The units incorporate either single or multi-stage power line filters. Special types are available with an earth line choke. Included in all units, as a standard item, is a metal oxide transient suppressor to absorb high energy spikes not completely eliminated by the filter components. A careful EMC construction ensures a good attenuation performance at frequencies up to 300 MHz.

The computer protectors are completely sealed to ensure 100% safety for the user and are available in 1, 3, 6 and 10 A.

For further information **contact Edor Electronics, 8 Bernhardt Avenue, Hoppers Crossing Vic. 3030. (03)749-2605.**

Edor Electronics' new RFI filter for computer applications.

Fast loads for Commodore

Melbourne House has developed a new system to make loading of cassettes onto the Commodore 64 much quicker.

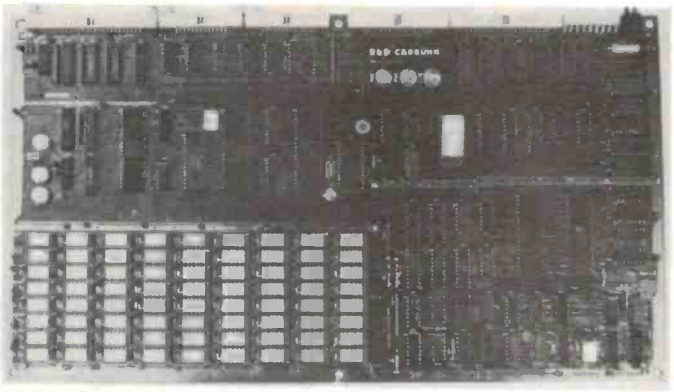
The Pavloda system is a program developed specifically for the Commodore 64 which enables cassette programs to be loaded at the same speed as programs from disk.

For further information **contact Melbourne House, 70 Park St, South Melbourne Vic 3205.**

CLUB CALL

Computer wizzs who are interested in forming a Victorian Wizzard **Users** Group, for owners of Dick Smith Wizzard and Funvision computers, should contact Barry Klein, 24 Russell St, Bulleen Vic. 3105. (03)850-7275 ah.

Oswest, the Osborne Users Group of WA, meets on the first and third Wednesday of each month at 7.30 pm. The venue is the Palmyra Recreation Centre on the first Wednesday and the Subiaco Exhibition Hall on the third Wednesday. For more information contact the secretary, P.O. Box 199, Mundaring WA 6554. (09)295-1449 ah.



A fully built-up disk system from R. and D. Carbuhn.

Fast Z80 system

The R&DC silicon disk system is a single card computer system oriented toward Digital Research's CPM operating system and is constructed on a single 16 x 9 inch card. It incorporates the following major components:

1. 4 MHz Z80A CPU, CTC.
2. 64K of memory, with parity protection.
3. 512K of dynamic RAM, parity protected, interfaced as a disk drive to the system. All the appropriate handlers and tables are provided in the BIOS routines to enable this memory array to act as a pseudo-disk drive as far as CPM is concerned.
4. A PROM resident BIOS for CPM 2.2 (60K), featuring fully buffered, interrupt driven I/O, allowing fast and smooth operation of all peripherals. At least one line of buffering is provided on each device, which also permits adequate 'type-ahead' at the keyboard.

The system is aimed at the more experienced user or professional programmer. It offers speed improvements in excess of 25 times over 5" single density systems, and around 5 times over 8" double density systems.

Programs run at full CPU speed, with disk access times and disk errors eliminated. The silicon disk also provides startling keyboard response times. This is particularly evident with word-processing programs such as Micro-pro's Wordstar, which relies heavily on the system disk for overlays.

To complete the system the user needs to add a VDU of his choice, an 8" flexible disk drive and a suitable dc power supply. The power requirements are +5 V at 2 A, ±12 V at 150 mA.

The silicon disk system is to be offered in kit form from $175 or built-up for $1500 each.

For more information contact **R. and D. Carbuhn, 3 Viscount Way, Forest Hill Vic 3131. (03) 233-3595.**

Troubleshooter

A low-cost, easy-to-use troubleshooting tool for microprocessor board failures has always been desirable but virtually unobtainable. Applied Microsystems has a microprocessor-based, portable instrument, the ET-2000 Microtroubleshooter.

The test market has been growing so rapidly recently that there has been a serious lack of fully qualified people. The ET-2000 goes a long way towards solving this problem by guiding technicians through comprehensive system checks step by step.

Designed for troubleshooting all popular 8-bit and 16-bit microprocessors, the system can be customised to different microprocessors by using an appropriate personality pod. Initially, Applied Microsystems will offer support for the Zilog Z80, Motorola 6502 and 68000 and Intel 8080 and 8086 microprocessors.

For full specification details **contact Warburton Franki, P.O. Box 117, Lidcombe NSW 2141. (02)647-2266.**

Microsystems ET-2000. A sophisticated microprocessor-based troubleshooter.

Readers-only Offer: A Bargain Price for the PB-100 CASIO®

Pocket Computer

Business people, technicians, scientists — and many other people who have to work on the run — know that sometimes, a computer in the hand is worth two on the desk! The people at Casio couldn't agree more . . . and that's why they've come up with the brilliant new **PB-100 Pocket Computer.** It's not a toy! It supplies genuine computing power, plus an excellent range of mathematical functions. Pretty amazing, when you consider that the **PB-100** is not much bigger than your pocket calculator. (In fact, it's a good deal easier to operate than some programmable calculators on the market — because the **PB-100** speaks the easy-to-learn BASIC computer language.)
Because we're dealing directly with Casio, we're able to offer our readers a chance to purchase this great little machine at the very competitive price of **$69.95.** (That's around $10 below the average retail price!) The PB-100 comes with two manuals, lithium batteries and protective case — and postage is included.
Don't miss your chance! Complete and mail the order form today!

It's tiny! At just 165 x 71 x 9.6 mm, the PB-100 is truly pocket-sized. Weight: 116g with batteries.

It speaks your language! the PB-100's program language is BASIC — one of the easiest to learn and use. (And certainly more manageable than the off-beat lingos used by some 'programmable calculators')!

Its programming power is sure to surprise you. At a maximum of 544 steps each, the PB-100 can store up to 10 separate programs! Within your programs, you can utilise 8 levels of subroutine and 4 levels of FOR-NEXT loops.

It supplies super calculating power! As well as the fundamental functions (negative numbers, exponentials, parenthetical addition, subtraction, multiplication and division), built-in features include trigonometry, logarithms, exponentiation, square roots, powers, absolute value, random numbers, and much more!

It's got power to spare! The PB-100 runs on 2 lithium batteries (included in purchase price). Drawing just 0.02W maximum power, it will provide around 360 hours of continuous use. You can't accidentally leave it on, either — about 7 mins after last operation, the PB-100 switches itself off automatically.

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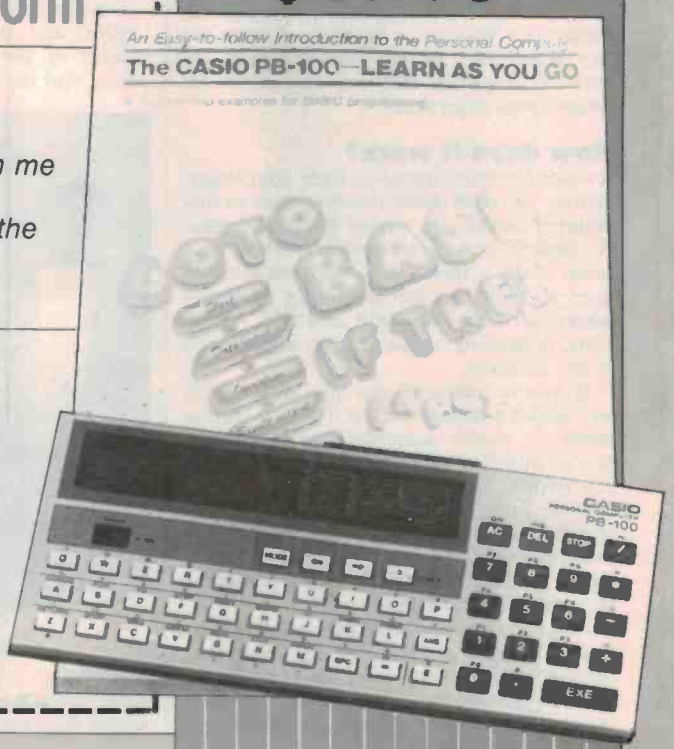


Allow four weeks for delivery

THROW OUT YOUR JOYSTICKS?

Thought control of your computer? Maybe. But Atari's latest innovation for home computers and video games uses 'brain signals' and an infrared link to your joystick port to effect control. Relax — it's only a one-way link, from you to the computer!

Dennis Lingane

YOU CAN FORGET joysticks for playing computer games, now. Atari, 'The King of Games' has announced a revolutionary headband called the "MindLink" for controlling computer games with your mind. Instead of using your joystick, you simply "think" the spaceship, gun, bat or whatever, to where you want it on the screen!

The MindLink is due to be released in the USA in September with three games — one being the old favourite, Breakout.

The headband can be used with any computer taking the Atari paddles, although the game does have to be specially written for the MindLink. Atari's software runs on their VCS games machine and their XL series home computers.

How does it work?

It reads electrical impulses from your brain. Before you dash down this magazine in disbelief, I assure you I tried it and it works. According to Atari's engineers, when your brain sends a message to your muscles, it does so with an electrical pulse of somewhere between one-tenth and fifty microvolts, depending on the urgency and tension of the moment.

If you're relaxed, you produce signals well under a microvolt, but if you're getting ready to punch somebody on the nose, you're pumping out a relatively massive 50 microvolts. Sensors on the headband register the pulses. This is converted to a digital signal and then amplified by a minute amplifier in the headband. This amplified signal is then transmitted to the computer through an infrared link.

There are a number of ways you can teach yourself to control the computer games through a series of tension exercises. I found that the simplest way was to grit my teeth. The harder I gritted, the further and quicker I could move the spaceship across the screen.

Reducing tension

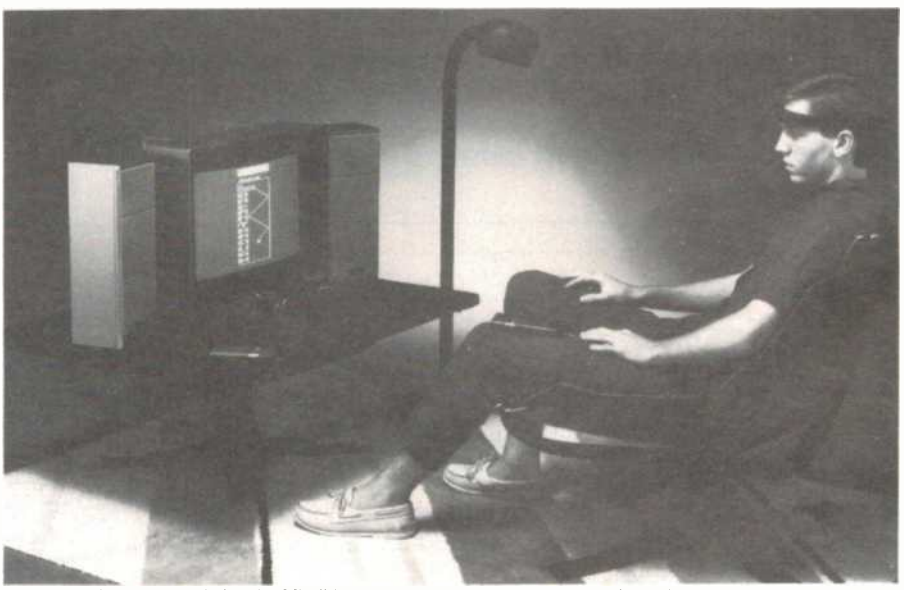
While you have to use tension techniques to control the game, the MindLink can, in fact, also teach you to relax because of its bio-feedback facility. The games are so constructed that, as you learn to use less tension but still maintain control of the cursor, space ship or whatever, then the higher the scores you get.

For example, in Breakout, as you use less tension and still retain full control, the colours of the bricks in the wall change colour and the points earned when the wall is broken are higher.

Using this colour and tension relationship you can also use the headband to learn to relax. You lie back and watch the colour patterns on the screen. Red shows you're uptight, pink shows you're starting to relax and green that you are totally relaxed.

So you have to concentrate on not concentrating to get the green to make sure you are relaxing!

The MindLink will sell in the US for around $99 with one game, possibly more in Australia, and we should see it here in limited quantities before Christmas, says Atari's new English-born President, John Farrand.



Relax, you're in control. Atari's "MindLink" system uses 'brain signals' and an infrared link to replace joystick control. But the software needs to be specially written.

SWIVEL BASE MONITORS FROM $179 THIS MONTH

WHAT'S NEW AT ROD IRVING ELECTRONICS

Ritron 11 Monitors are now available to increase our range of Data Displays. They feature a unique adjustable swivel base that tilts forward or back 30 degrees and swivels right to left 60 degrees. Technical specifications are listed below.

SPECIFICATIONS — CRT SIZE: 12 inches non-glare 90 degree deflection. **INPUT SIGNAL:** 1.0-2.5V p-p composite video signal. **INPUT IMPEDANCE:** Normal 75ohm, high approx 50K ohm. **INPUT TERMINALS:** RCA phono jack. **RISE TIME AND FALL TIME:** Less than 25 ns. **VIDEO BANDWIDTH:** 20 MHz ± 3dB. **SCANNING FREQUENCY:** Horizontal 15.75KHz ±0.5KHz. Vertical: 50Hz/60Hz. Horizontal Retrace Time: Approx 8.5us. Vertical Retrace Time: Approx 800us. **PHOSPHORS AVAILABLE:** Amber, Green. **RESOLUTION:** Centre, 1000 Lines, Corner, 800 Lines. Geometric distortion, 2% or less. Linearity, less than 2%. **CONTROLS:** Front, POWER ON/OFF, brightness, contrast. Rear, V-Hold, H-Hold, V-Line, V-Size.

AVAILABILITY: Green Phosphor in Stock **$179.00**
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SPECIFICATIONS

HIGH-SPEED ACCESS, HIGH ACCURACY POSITIONING instead of plastic CAM positioner or lead screws positioner, a high microprecision metal band positioner is adopted in the mechanism to position the head.
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MOTOR CLOSED LOOP SERVO Hall effect devices are utilized as speed control sensor in DC motor system, so motor can run stably and accurately.
SLIM, HALF-HEIGHT DRIVE The disk drive is only 41mm high. It is only half the size of conventional models.
NO CONTACT WRITE-PROTECTED SENSOR Photo coupler is used as write-protected sensor. It means no damage, long lifetime and good reliability for disk media.

GENERAL SPECIFICATIONS

Capacity (formatted)	163K (20K bytes more than the original)
No. of tracks	40 tracks (5 tracks more)
No. of sectors/track	13 to 16 sectors
Disk rotation speed	300 rpm
Track density	48TPI
Track to track time	Less than 6 msec

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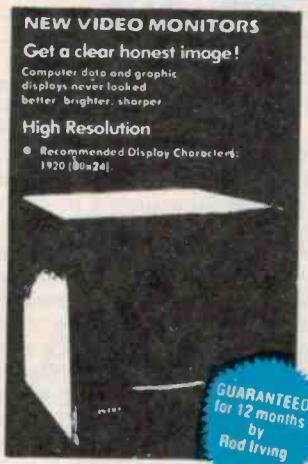

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UNIX

The Evolution of an Operating System

A look at an operating system that, after a decade's gestation in academia, is all set to grasp its share of the action.

Charles Butcher

UNIX FIRST APPEARED in the late 1960s at Bell Laboratories in Murray Hill, New Jersey. It was created by Ken Thompson as a consequence of porting a video game he had developed on Multics — an operating system with which he had been involved previously — to a PDP-7.

Multics was a vast and ambitious project which involved Bell Labs, MIT and GE. Too vast, in fact. Bell became convinced nothing would come from such overdesign and withdrew. This left Ken Thompson with a first-class game and nothing to run it on. In the process of rewriting his game to run on the PDP-7, he started to develop a new type of file system. He soon had a kernel and some utilities running on his machine which together made a rudimentary operating system. Unlike Multics, this system was designed by a single person for the sole purpose of making his software development easier.

The PDP-7 was a very small minicomputer, but it was all that was available to Ken. He had previously requested a PDP-10 mainframe on which to develop his software, but his request was declined. It is interesting to consider what would have become of Unix had his request been granted!

Before long, Unix had attracted the attention of other programmers at Bell, including Dennis Ritchie. Thompson and Ritchie started to refine Unix, adding word-processing utilities in response to another department's need for a wordprocessor. Through this, they obtained a PDP-11 on which they continued to develop their new operating system. When other departments bought new PDP-11s, they chose Unix rather than DEC's operating system; Unix probably owes part of its early success to the poor nature of the DEC operating systems available at that time.

At this stage, Unix was still written in PDP-11 assembler, and the time had come to rewrite it in a higher-level language. Thompson felt that none of the current languages were good enough to do this and he began to develop B which was a simplification of BCPL (Basic Combined Programming Language) which was, in turn, descended from Algol 60. Dennis Richie then took B, refined the best parts of it, added data structures and called the result C.

C quickly established itself as the preferred systems programming language at Bell; it was high-level enough to allow programs to be independent of machine architecture, yet low-level enough to ensure sufficient speed to remove the need for systems programming in machine language.

It was soon realised that C was a sufficiently high-level language to enable compilers to be written for almost any machine. Unix was subsequently rewritten in C during the summer of 1973, and it then followed that Unix too could operate on practically any machine. Trials soon proved this correct. Unix was ported to the Interdata 8/32 at the University of Wollongong, and to the IBM/370 in quick succession and with a minimum of reconfiguration. Thus the notion that operating systems have to be written in machine code was forever dispelled; the world's first truly portable programming language and operating system were born.

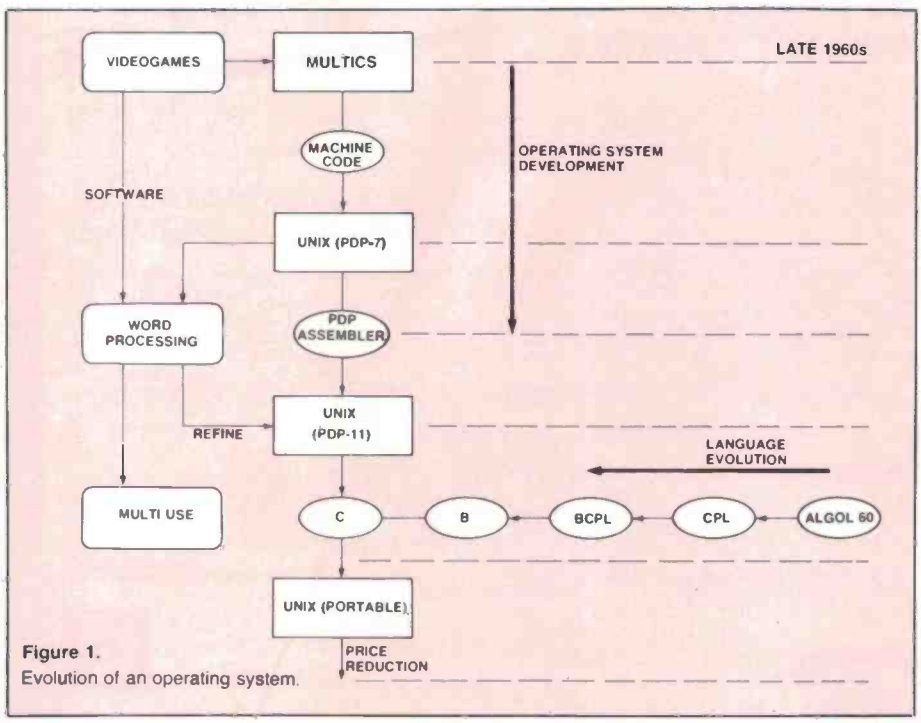


Figure 1.
Evolution of an operating system.

The shell

The Unix command interpreter is called *sh* which is short for 'shell'. *Sh* handles the interfacing between Unix and the user. Commands to *sh* consist of one or more words, separated by blanks. The first word is taken as the name of a file to be run as a program. Subsequent words are given to the program by *sh* as arguments for interpretation by it. For example, the Unix utility *cat* lists files on the user's terminal. Thus *cat file name* will list the contents of the file called *filename* on the terminal.

The shell also accepts a variety of conditional constructs which enable the user to write programs which *sh* can interpret; so it is also a programming language in itself. Repetitive tasks are simplified by its ability to loop.

The following is a trivial example of a shell program.

```
while true
do
echo "hello"
done
```

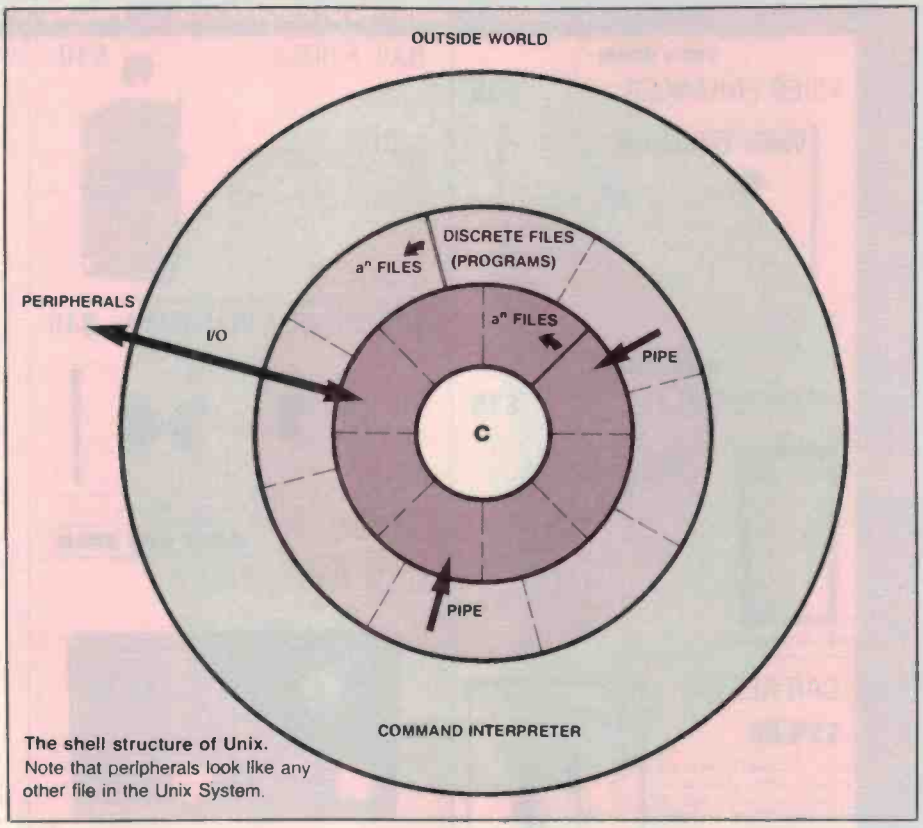
This program will simply keep echoing (printing) "hello" on the terminal until it is stopped (usually by typing DEL). Naturally, a whole series of conditional tests can be performed to make useful programs. The shell also accepts 'if-then-else' and 'if-then-else-if' constructs as well as 'for' loops. One thing worth noting here is that these shell programs are not compiled and executed — they are interpreted by the shell in the same sense that BASIC programs are interpreted. Shell programs may be typed at the terminal interactively or stored in files.

Input/Output redirection

Probably the most powerful feature of the shell is its ability to redirect I/O with the greatest of ease and consistency. Under normal conditions the shell uses as its input and output channels the terminal keyboard and screen, known respectively as standard input and standard output. Under Unix these channels look just like files (more on this later), so it becomes a trivial matter to redirect output or input to or from other files.

The I/O redirection symbols are < and >. To send the output of a command to a file other than the standard output (terminal screen), the command would look like: *command > filename*. So *ls > listfile* would send the output of *ls* to a file called *listfile*, creating or overwriting it as required (*ls* is the Unix command for listing the names of the files contained in the current directory). One way to make a copy of a file would be: *cat file > copy*. To append to a file without destroying the old contents the symbol is >>. Similarly, the shell will take its input from the file following the < symbol e.g: *programname < commandfile*.

Another form of I/O redirection allows output from one command to be used as input to another command. This process is known as piping, and will be described in the section on software tools.



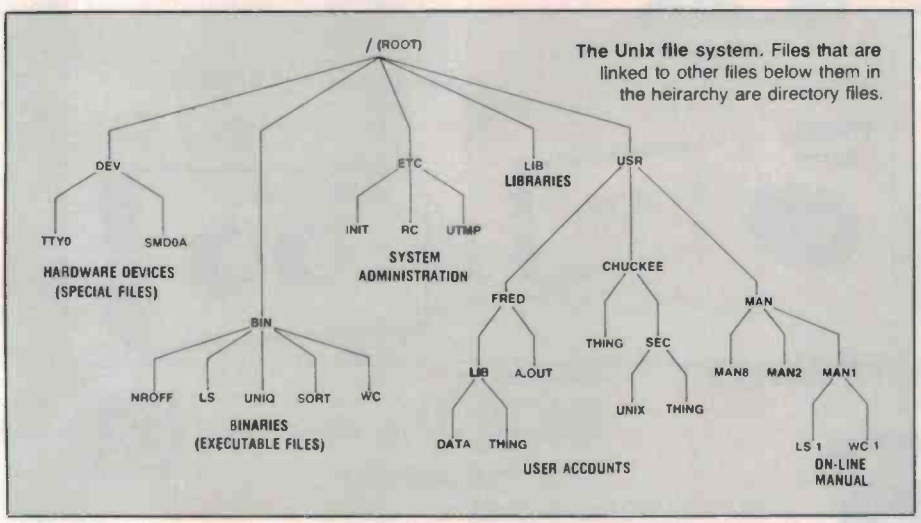
The shell structure of Unix. Note that peripherals look like any other file in the Unix System.

Asynchronous processes

Since Unix is a multi-user multi-tasking system, the shell will allow several commands to run simultaneously. This is known as running a command *'in the background'*. When a command is run in the background, the shell does not wait for it to terminate before it resumes reading input from the terminal. This means that other commands can be input and executed while time-consuming, non-interactive commands run in the background.

Typing an ampersand (&) on the line at the end of a command instructs the shell to run that command in the background. The shell will respond by printing a number and then prompting for further commands. The number printed by the shell is a PID (Process Identification) number which is unique to that process. Each process run (including the shell) gets a unique PID for the duration of its life. This PID is used to reference that process in further commands.

The usual use of PIDs from the terminal is to kill (stop) unwanted processes. Background processes cannot be killed by typing DEL, so they must be terminated using *kill*. For example, if you had a background process with PID 23456, you could terminate it by typing *kill 23456*. The shell would then respond with the message *23456: killed*. The command *ps* (Process Status) will list all currently running processes along with their PIDs.



The Unix file system. Files that are linked to other files below them in the heirarchy are directory files.

The Unix file system

Ken Thompson's file system — which was where the whole thing started — is based on a hierarchical structure very much like a tree (see diagram). Files are arranged within directories which are themselves files inside other directories. A tree-like structure emerges, with all branches eventually tracing back to the root directory which is known simply as "/". In addition to this, under the Unix system all hardware and software objects are treated as files and behave like files. The Unix system is composed of three types of files: ordinary, directory and special files.

Ordinary files

The great majority of files under Unix fall into this category. Ordinary files contain ASCII data, which may be text, source or object code, or executable code. Each file ▶

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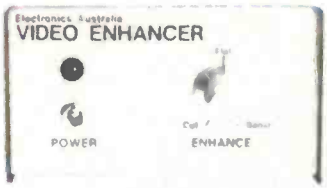

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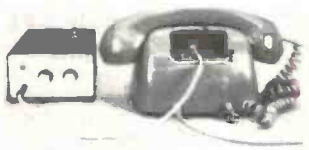

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has associated with it a set of protection bits which allow combinations of read, write and execute access by the file's owner and other users. The owner may also specify permissions relating to a specific subset of users known as a group.

All users have control over which other users are in their group. Every file is contained in a directory, so files with the same name which exist in different directories are separate and unrelated entities.

Directories

To change from one directory to another under Unix, the user types *cd pathname*, where *pathname* is the pathname of the target directory. The directory you are presently in is known as the current directory. When users log in to the system, they start off in their own home directory, which can be reached from anywhere in the file system by typing *cd* with no argument.

Files in the current directory can be accessed by their simple name. Files in other directories are accessed by specifying their full pathname. Any file on the machine is thus instantly accessible simply by specifying its full pathname e.g: */bin/nroff* is the program used to wordprocess documents and this article started its life as */usr/chuckee/sec/unix* on Systems D's Dual 83/80 Unix machine. Note that when it was being written, the author would log in and then move to the directory */usr/chuckee/sec* where the file could be accessed simply as *unix*. Hence to edit it using *vi* he could simply type *vi unix*.

It may at first seem tedious to have to type all those long pathnames all the time, but there are several short-cuts. The current directory pathname can be abbreviated by typing a period, so typing *./filename* is equivalent to typing *filename*.

"So what?" you may say. Consider how one may copy a file in another directory to the current directory. Assuming the current directory is */usr/chuckee/sec*, instead of typing *cp/usr/fred/lib/data/usr/chuckee/sec/data*, one can simply type *cp /usr/fred/lib/data* . (*cp* is the Unix copy command).

The directory directly above the current directory in the file system can be typed as two periods. This directory is known as the *parent* directory of the current directory. All directories except the root directory (/) have a parent. Typing *cat ../thing* when in */usr/chuckee/sec* will list the file */usr/chuckee/thing*

There are various other ways of reducing the amount of typing necessary, but they will not be mentioned here.

Special files

Special files make hardware devices usable like ordinary files. Not only does this allow simple and consistent file manipulation, but it also greatly simplifies input/output and I/O redirection. Thus the output from a program can be sent to the printer in exactly the same way as it is sent to another file or indeed to a terminal.

All I/O ports, the disk drives and the machine's memory are accessed and treated as files. Naturally, these files have extra software (e.g: device drivers) associated with them, but from the outside they look and behave exactly like files.

Software development tools

The Unix system grew up as a software development environment, so it is richly endowed with software development tools. The average Unix system comes with about 180 utility programs (tools) which range from wordprocessors to machine code debuggers. These tools are designed to perform a single, simple task efficiently. They all work in conjunction with each other, and are used as building blocks to perform more complex tasks. This is made possible by Unix's consistent treatment of files and programs and the shell's ability to redirect input/output easily.

For example, the utility *sort* sorts its input lines lexicographically and *uniq* removes any adjacent repeated lines contained in its input. These can be used together by redirecting the output of one program to another; this is known in Unix as piping. So the above utilities can be used together by typing *sort < filename | uniq* where *filename* is the name of the file you wish to strip of repeated lines. the Symbol '|' is the Unix pipe symbol, and causes output from the program on its left to be set as input to the program on its right.

The utility *who* will print out details of all people currently using the system, one per line; *wc* counts words, lines, and characters in its input. If you only want to know the number of people using the system rather than everything about them you could type *who | wc −1* which would print a single number on the terminal, the number of users. Notice the −1 after *wc*. It is known as a flag and is interpreted by *wc*. Flags are given as arguments to programs and are treated by the programs as switches which control the way they function. Most Unix utilities accept a few flags. In the above example the −1 flag instructs *wc* to print only the number of lines in its input (the default is lines, words and characters).

Flags are almost universally of the form −x where x is any character and is usually mnemonically reminiscent of the option it invokes. The '−' at the beginning of a flag enables the program to distinguish it from a filename. As a further example, *uniq* will accept the flag *−d* which causes it to output only a single copy of each of the repeated lines. So the command *cat filename | sort | uniq −d | wc −1* will tell you how many repeated lines there are in a file. Flexibility is the keyword here. A programmer can use these building blocks to tailor-make a more complex utility to perform any desired task.

This modular philosophy is reflected in the Source Code Control System (SCCS) package of programs, which are used to keep track of changes in source code files, and to enable previous versions of any particular file to be retrieved if needed. Contrary to what one may imagine, it does not simply keep a copy of each new version of a file, but stores only the changes made to the file.

SCCS is a suite of 14 programs which all perform specific operations; recording changes made retrieving old versions etc. These programs use, in turn, several other lower-level utilities. To work out what changes were made to a file, *delta* uses *diff* which compares two files and outputs commands which can be understood by *ed*, the standard Unix text editor.

These commands can be sent to *ed* to make the one file out of the other, which is what happens when *get* is invoked. Note that *delta* and *get* are part of the SCCS suite of programs, but *diff* and *ed* are not — they are standard Unix utilities.

The point here is that the writing of the SCCS package was simplified by the availability of tools such as *diff*, and that its authors saved time and code by the use of such tools. It is quite possible that SCCS programs may in the future be used themselves as tools by an even more complex software package.

In the same way that standard library subroutines save time and code in computer programs themselves, so software tools provide the same savings in their development.

Epilogue

Until very recently, Unix was used only by educational and research institutions; prohibitively high licensing costs precluded its use commercially. This has had its advantages; Unix has been given a childhood free of the traumas associated with commercial development. It has been brought up by caring people interested only in its welfare and integrity. Thanks to this, Unix has grown up healthy and strong, and almost totally free of the compatibility diseases which plague its peers.

This is due in no small part to its remarkable portability. But the most important point here is that its development could follow the original guidelines used in its inception, under the watchful eyes of those who created it, without having to succumb to the compromises of production schedules, customer satisfaction and profit-hungry management.

Recently, due to the relaxation of the licensing system, a whole motley crew of software houses have climbed on the Unix bandwagon and immediately begun to undo a lot of the original good by making their own arbitrary changes to the operating system and to the C language itself, thus reintroducing all the portability problems its originators so valiantly fought to solve. Names such as Xenix, P-nix and Idris mushroom overnight and strike terror in the hearts of those who know and love Unix.

The future looks troubled; there are definitely dark times ahead. One thing, however, is certain. Unit has had a great deal of time to build its strength and reputation, and it has without any doubt a greater potential to succeed than any of its imitators, or indeed, its rivals. ●

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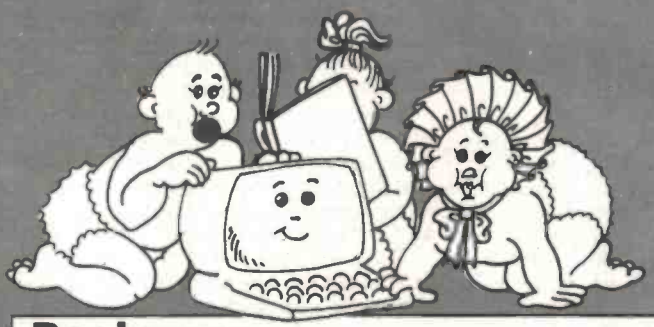

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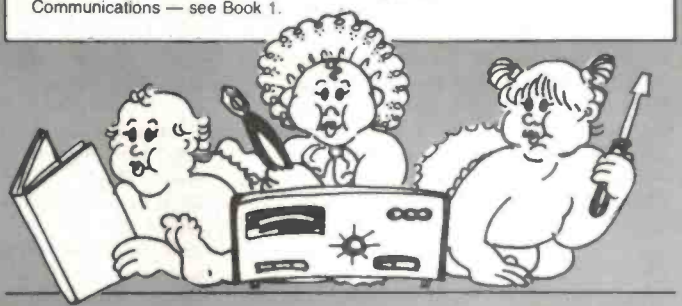

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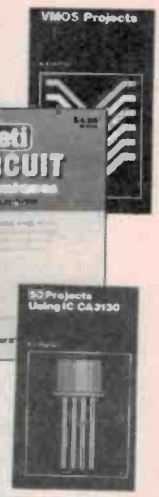

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PROLOG

The wood for the trees

This article looks at the data structures which allow relationships to be graphically expressed in PROLOG. Lists are introduced along with a shorthand to make them more readable.

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IN PART 2, WE LOOKED at the way in which both a family tree and a street map can be represented by listing connections. We represented families with parent-child connections. We represented streets with one way thoroughfares connecting intersections. There is, however, a more picturesque way of representing certain graphical data, but this applies only to the data structures known as 'trees' and 'lists'.

A tree, which we met briefly in the last part, is a graph without cycles (there is no way of getting from a node back to itself) and will thus be implicitly directed (like our one way streets). We talk about trees as being composed of **nodes** — parent, child, root, leaf and interior nodes.

What distinguishes trees from other acyclic directed graphs is that every node has at most one parent, and at most N children, where N is the arity of the tree. Often when people talk about trees they implicitly mean a binary tree — a tree with arity two and thus at most two children to any node. A proper tree has an arity of at least two.

The 'root' node is the granddaddy of them all. It has no parent. Every other node in the tree is a descendant. At the other end of the scale we have the 'leaf' nodes. They are the nodes that have no children. Every other node in the tree is an interior node. Normally we think of trees as being directed from parent to child, from root to leaf.

In the past part we considered the patriarchical tree involving only the males of the family, and we observed that that tree was one of these pure mathematical trees. It was also noted that we normally draw trees upside down — with the root at the top and the branches and leaves hanging below.

Let's restrict our family tree still further. Suppose we are only interested in the successors to the throne of the ancient kingdom of Jindabyne. We can restrict our family to the single line

"Anthony" → "George" → "Richard"

Only the eldest male, heir apparent, in each generation is included. This is a tree in which every node has at most one descendant — the successor. Such a tree is said to be 'degenerate'. In fact a degenerate tree is simply a list, a succession of nodes.

In Sydney 2001, this would correspond to considering, say, just one street. There can really be no corners, twists, bends or turns in a list — it is just a simple sequence of successive items. Suppose we select 'Market' street. Since the street name won't vary, we can omit it again, and our database reduces to:

suc.1)
```
: succ(0,1). succ(1,2). scc(2,3). succ(3,4).
: lt(X,Y) :- succ(X,Y).
: lt(X,Z) :- succ(X,Y), lt(Y,Z).
```

suc.2)
```
: ?- lt(2,X).
:       % What comes after 2?
   X = 3
   X = 4
```

suc.3)
```
: ?- lt(X,2).
:       % What comes before 2?
   X = 1
   X = 0
```

Note that the predicate 'succ' is used to indicate the next (immediately succeeding) set of lights along the street. Also my use of the predicate 'lt' may have stumped you. Can you guess what it stands for? In the context of Sydney 2001, it functions to relate one intersection to any other further along the street, but if you look at the actual numbers which satisfy it, you will see that lt(X,Y) succeeds if X is less than Y. In other words we have succeeded in defining an arithmetic test.

Here are definitions for the other arithmetic comparisons, except for ne (which was introduced in Part 1, in the panel FAMILY TREES — exercises).

```
suc.4)
:       % Define other relations in terms of lt.
:       % N.B. They could have been defined recursively.
: gt(Y,X) :- succ(X,Y).
: gt(Z,X) :- succ(X,Y), lt(Y,Z).
: eq(X,X).
: ge(X,X).
: ge(Y,X) :- lt(X,Y).
: le(X,X).
: le(X,Y) :- lt(X,Y).

suc.5)
: ?- ge(2,X).
:       % What numbers is 2 greater than or equal to?
  X = 2
  X = 1
  X = 0

suc.6)
: ?- gt(X,Y).
:       % What pairs of numbers satisfy greater than?
  X = 1
  Y = 0
  X = 2
  Y = 1
  X = 3
  Y = 2
  X = 4
  Y = 3
  X = 2
  Y = 0
  X = 3
  Y = 0
  X = 4
  Y = 0
  X = 3
  Y = 1
  X = 4
  Y = 1
  X = 4
  Y = 2
```

The 'eq' predicate is applicable in any context — it is not limited to the numbers used here, e.g:

```
equ.1)
: ?- eq(2,2)
:       % Does 2 equal 2?

equ.2)
: ?- eq("Elizabeth",X).
:       % Make X equal Elizabeth.
  X = "Elizabeth"

equ.3)
: ?- eq(father(X,"Tom"),father("Fred",Y)).
:       % Unify two goals.
  X = "Fred"
  Y = "Tom"
```

SUCCESSOR ARITHMETIC — exercises

The ability to use 'succ' to define the relational operations for numbers is only the beginning of what we can do using successor arithmetic. Consider what is involved in adding two numbers together. How could you do that using 'succ'? The 'succ' predicate allows you to find the number after — or before — a given number (for which it is defined). In other words, you can increment or decrement a number.

We can conceive of relations like these

```
sum(X, Y, Z)   % (the) sum (of) X (and) Y (is) Z
prod(X, Y, Z)  % (the) prod(uct of) X (and) Y (is) Z
```

We all know that multiplication of integers can be done by repeated addition — although we seldom do it this way. We can also see that addition is repeated incrementation — although we haven't done it that way since we were counting on our fingers. Thus if we count down from X to 0, we should be able to perform addition by repeatedly incrementing our recursively defined sum using 'succ'. And in exactly the same way, we should be able to do multiplication by repeatedly adding to our recursively defined product using 'sum' as just defined.

Although these seem to be problems which we see in an iterative way, since we are basically repeating a process (increment or add) as we count up or down between two values, the functions can very easily be performed recursively. The recursive PROLOG definitions have a big advantage — it is quite simple to verify the correctness of each rule independently. This is simply a matter of checking whether or not a rule is *always* logically true, i.e: the predicate relationship expressed in the head is *always* true if *all* the goal relationships expressed in the body are true (and of course if any goal is not true the clause is inapplicable and thus perfectly consistent, irrespective of whether or not the head goal is true). Try these problems:

(1) Define 'sum' and 'prod'.
(2) Define 'exp' — exponentiation.
(3) Define 'diff' and 'quot' — subtraction and integer division (exact — no remainder).
(4) Define 'fac' and 'fib' — calculation of the Nth factorial and Fibonacci numbers (use fac(N, Factorial) and fib(N, Fibonacci)).
(5) Define 'quotrem' — division involving both a quotient and a remainder (use quotrem(Dividend, Divisor, Quotient, Remainder)).

Of course, most PROLOG implementations have some sort of built-in arithmetic capabilities. In fact, in some of the implementations the actual predicate names used here will be the names of built-ins — which will mean that different names will need to be used for these examples.

It is more difficult to produce a similarly general 'ne' predicate — though a reasonably general definition can be produced in a way to be revealed in the next part. It is fairly easy to define 'ne' for our 'succ' series of numbers, so you may care to figure that out as an exercise.

NOTE: If we were to find that these functions had been predefined (as built-ins of a particular PROLOG system) we would have to use different names to test these definitions, e.g: 'less', 'greater', etc.

Data structures — nested

So far the trees and graphs which we have considered have been represented in terms of what is connected to what. In fact, there is a somewhat more direct approach to the representation of trees. All the data structures we've used so far have been flat, and thus hardly warrant the title 'structures'. Therefore, we now proceed to examine in more detail the construction of PROLOG data structures.

It will be recalled that the basic data structure of PROLOG is the term, and that each of the arguments of a compound term is itself a term. So far, the only compound terms we have encountered have been goals and head goals. In fact, the arguments of a compound term can themselves be compound terms. Thus our catalogue (in Part 1) could have been represented more flexibly to allow for different types of work, e.g:

```
entry(item(Author,Title),issuer(Pub,Date,book(ISBN))).
entry(item(Author,Title),issuer(Pub,Date,
                                serial (Jnl, Vol, Iss, Page))).
```

With this representation framework we can search an Author, Title, Publisher or Date and expect to find both books and articles as appropriate. In addition, we can discover whether it is a book or an article, and thence either the International Book Number or the Journal reference. Alternatively, we could search for books using ISBN or for articles by the Journal Name.

It is obviously a simple matter to write predicates and goals capable of using nested structures. As an exercise, you may care to rework examples 'cat.1' to 'cat.15' from Part 1 to make use of this new form of catalogue entry.

Trees — representation

In dealing with tree-like domains, we have introduced recursive predicates on the basis that any predicate can quite legitimately be used as a condition in any predicate definition — even its own. We just need to ensure that it gives us a true expression of the relationship, and that the recursive goal is in some respect simpler than the head goal — in order to ensure termination.

In dealing with tree-like data structures, we can introduce recursive terms in a precisely analogous manner. A tree is, in general,

AVAILABLE IMPLEMENTATIONS

This panel lists a selection of the most important, common or available PROLOG implementations. Some parts will be merely informative. Others may be helpful in finding a version of PROLOG which you or your Institution can play around with and learn to program with. As you can see by some of the prices, we aren't just talking fun and games either!

Name and Distributor	Price	CPUs	MHz	LIPS	Syntax	Comments
Marseilles PROLOG	?			?	4	FORTRAN version
Dr Alain Colmerauer, Groupe d'Intelligence Artificielle, Case 901 Faculte des Sciences de Luminy Universite d'Aix-Marseilles II 13288 Marseilles Cedex 9 France	?	6800	2?	~8	4	CANDIDE version
	?	6502	4?	20?	4	PASCAL/APPLE version
DEC-10/DEC-20 PROLOG	$7500	DEC		2400	1	Interpreter
	$15000	2060		43000	1	Compiler (Fastest PROLOG yet)
SILOGIC Inc. Suite 2000, 6420 Wilshire Blvd, Los Angeles CA 90048 USA						
Z-80 PROLOG-1	$290	Z-80	4	300	1	64K address
C-PROLOG	$1750	68000	12.5	875	1	
	$1290	11/60		1000	1	(RSX-11 OS)
	$3750	VAX780		1500	1	VMS or UNIX
etc.						
Micro-PROLOG	£150?	Z-80	4	240	3	Binary only CP/M
Logic Programming Associates 36 Gorst Road London SW11 6JE UK		6502	?	240	3	Binary only Apple
UNSW-PROLOG	$150	11/70		1000	1	UNIX C source 0.5" tape only
		VAX780		1400		
Dr Claude Sammut Dept of Computer Science University of New South Wales Kensington NSW 2033 Australia						
PROLOG-86	$125	8086	6?	~300	1	Binary (UNSW-PROLOG modified for CP/M & MSDOS)
Solution Systems 45-I Accord Park Norwell MA 02061						
YORK PROLOG	£175				1	PASCAL source 0.5" tape only
Mrs Jenny Turner Department of Computer Science University of York Heslington York Y01 5DD UK		80186.	6?	~100	1	from IMPACT ($75 MSDOS)
Innovative MicroProcessor And Computer Technology		IMPACT intends to distribute PROLOG books and a number of the above systems in binary form on floppy disk. Contact me via IMPACT to indicate interest or for current details. Expected price range $50-$150.				
IMPACT Ltd 259A Trafalgar St, Petersham NSW 2049 Australia						

Note
Prices are all in seller's currency and will quickly be out of date. Figures in the syntax column refer to the notations enumerated in the previous panel. The tabled average or estimated Logical Inferences Per Second (LIPS) are for the clock speed indicated. There is little point in contacting YORK or UNSW if you cannot read standard 0.5" computer tape — they are unable to supply PROLOG in any form other than these large source distribution tapes.

COMPARISON OF IMPLEMENTATIONS

A growing number of PROLOG implementations now exist, each with its own unique syntax and predefined functions. The predefined functions are not critical as most capabilities are available in most implementations, but the precise details may vary.

The syntax can vary in ways which can alter quite markedly the appearance of a PROLOG program, and it can require some rather messy modifications to get programs developed on one system running on another. The syntax used in these articles is about as standard as you can get. For comparison here is the way the same clause would be represented in several different PROLOG systems.

1. path(From, To) :- st(St, From, Q), path(Q,To).
2. path(From, To) <– st(St, From, Q), path(Q,To).
3. ((path x1 x2) (st y x1 z) (path z x2))
4. +PATH(*FROM,*TO) –ST(*ST,*FROM,*Q) –PATH(*Q,*TO)

Syntax 1 is, of course, what is used in these articles. The examples in these articles have all been run using UNSW PROLOG which, in common with most current PROLOG systems, has attempted a high degree of compatibility with the Edinburgh DEC 10 PROLOG.

The very first PROLOG system used notation 4. For this form case is not significant — the original Marseilles system was an upper-case only program written in FORTRAN. Variables were thus indicated by an initial asterisk. Some systems use another character to introduce variables, but the most common denotation is the upper case convention used in this series. Perversely enough, there are some implementations using the reverse convention — but I am not listing any of those.

Plus and minus prefixes to the predicates are used in notation 4. This derives from the Predicate Calculus/Resolution Theorem Proving antecedents of PROLOG. In Horne clause logic, a clause is regarded as a disjunction of one positive literal and zero or more negative literals — either the positive one is true or at least one of the negated ones is false. This has the obvious implication that if all the negated literals are true, then the positive one must also be true. Hence the implication notation used in 2 provides a much more intuitive representation of the logical statement to be expressed.

The notation used in 1 is halfway between the forms in 2 and 4. Read in the sense of 4, the colon separates the positive literal from the negated literals, the minus sign indicates that the literals on the right side are negated, and the comma still has the essential meaning 'or'.

Read in the sense of 2, as I have done in these articles, the neck is taken as a backward implication, or 'if', and the comma is interpreted as a logical 'and'. For this reason I find notation 2 the most helpful, although it does require a bit more use of the shift key when typing. The ideal system would accept either notation 1 or notation 2 synonymously.

As far as notation 3 is concerned, I have nothing positive to say about it. If PROLOG has any tendency towards LISP's "Lots of Irritating Single Parentheses", then this notation only aggravates it. It is, I believe, a sop to those in the LISP community who are familiar with LISP and concerned at LISP being ousted by PROLOG — this notation merely succeeds in making PROLOG hard to read.

In addition, the only system which has chosen to use this notation, viz. Micro-PROLOG, has made another dubious concession (to mathematicians this time, I imagine): case is irrelevant and the identification of variables appears to be that anything starting with x, y or z (upper or lower case) is a variable. Having read the Micro-PROLOG primer twice, I still cannot find this stated anywhere, but it is the usage in all the examples.

This only leaves the question of how to get access to one of the many PROLOG systems. Unfortunately, systems for micros are only now becoming available and I do not know of any organisation in Australia who can sell you one — although I have prompted one Australian company to negotiate for distribution rights for a couple of the systems I am listing.

In a separate panel I list the information I have on available implementations. I do know of a dozen or so more others which are suitable only for mainframes, but unfortunately I know of no more for micros. If anyone knows of the availability of others, please let me know and I will try to publish an update in a later part of this series.

WARNING. The Australian customs has a policy of charging duty and sales tax on imports at the highest rates applicable to any part of a shipment. Currently this totals about 67% on magnetic media — disks or tapes. This makes local distribution of software a real plus — well, the duty is designed to protect local industry!

characterised by its root and its subtrees. Each subtree has exactly the same potential form as its parent. A leaf node is a tree consisting of a root and no subtrees. An interior node is a tree consisting of a root and a positive number of subtrees.

In representing a tree, the recursion is natural. Again, all we have to ensure is that it gives us a true expression of the relationship required, and that each subtree is simpler than its parent — for example, we would get into trouble if we tried to make a tree a subtree of itself or of one of its descendants. (Theoretically PROLOG checks that it doesn't create such a monstrosity. There are known methods, simple but expensive, to do this 'occur' check, but because of the expense no system known to me actually performs it.)

The family tree used in Part 1, and illustrated in the first section of Part 2, can be reduced to a pure tree representing the male progeny of Anthony. Using a compound term of the form

ftree(Head, Son1 Family, Son2 Family)

we get

```
ftree("Anthony",ftree("George",ftree("Richard",nil,
                                      nil
                                     ),
                               ftree("Michael",nil,
                                      nil
                                     )
                              ),
                 nil
)
```

Even for a small tree like this it can be seen that this representation can become very cluttered and very difficult to follow. For this reason various conventions are used when writing out trees to make them as readable as possible. This includes putting sibling subtree terms under each other — so that all terms at the same depth are in a column. Also it is helpful to place closing brackets underneath the corresponding opening bracket.

FAMILY TREES — exercises

Consider the 'ftree' representation of the male members of Anthony's family. How would you put this into the database? How would you express the rules for 'father', 'son', 'grandfather' and 'descendant' using this representation?

Hints: Do not try to use 'ftree' as a predicate or put it into the database as is (making it a predicate). It may be helpful to define a general subpredicate 'intree' to tell you whether Person is in FTree (and perhaps give you some information about him).

Trees will be considered more extensively later on in this series. They are very important data structures in computer science, and in PROLOG are something of a work horse. It is important to understand how they work.

This can actually be abbreviated a little when there is a series of lines containing only brackets (and perhaps commas). What you do is coalesce all these lines so that the brackets are in the same physical position (viz: in the same column), and the commas are in the same logical position (viz: follow the same sequence of brackets and commas). This convention will mean that brackets aren't necessarily lined up with their own partners but, on the other hand, it is still easy to see that there are the right number of pairs.

The bracket problem we are seeing here is actually a taste of a problem which is not normally serious in PROLOG, but is a characteristic for which the AI language LISP is notorious. (Wags have reinterpreted the name LISP as 'Lots of Irritating Single Parentheses'.) In PROLOG there is not the same need for vast nested data structures, but in LISP even the program representation introduces myriads of brackets.

In the above 'ftree' representation I have included a number of 'nil' atoms which you may have been wondering about. They are included for a very good reason. ▶

The tree could have been represented with exactly the right number of arguments at each level, omitting all the 'nil's. But in this case you would have to know the number of arguments in advance in order to be able to match anything. The use of 'nil' allows us to represent empty subtrees, and thus to use a fixed arity for 'ftree'. In this case 'ftree' has arity 3, and the tree is binary. The use of 'nil' also gives a uniform condition for an empty tree — which is different from a tree with a root and no descendants.

Lists — representation

A tree with only one successor to each node (except the last which must have none) could be called a unary tree. As we have seen earlier, such a tree (when viewed as a tree) is said to be degenerate. On the other hand, it is actually a rather useful structure, and a unary tree goes by the special name list.

We could represent the line of Anthony's heirs, of eldest sons, with a list:

```
flist("Anthony",flist("George",flist("Richard",nil))).
```

In this case we don't have the same problem with brackets, although we still have to count them. However, we still need the nil.

Lists are an extraordinarily common data structure in PROLOG, and for this reason they are usually blessed with a special notation. Such a list has exactly the same internal structure as the above form of list. In this notation Anthony's dynasty is represented as follows:

```
["Anthony","George","Richard"]
```

One has to admit that this is a lot simpler and neater. I emphasise, however, that this does not embellish the semantics of PROLOG; it does not increase the power of PROLOG. It is merely 'syntactic sugaring', that is, it is a nice alternative syntax for lists which sweetens their use.

A list has a head and a tail, as can clearly be seen from the structured representation. Since a list is recursive, the tail of a list is also a list. For this reason the atom 'nil' is also regarded as a list. (Note that the terminating 'nil' is implicit in this special list notation).

This observation demonstrates the need for a representation which allows access to the head of the list, in general a term, and the tail of the list, in general a list. The following are two alternative forms of list notation used to allow such access.

```
[Head, . .Tail]
[Head | Tail]
```

If either of these is matched against the list representing Anthony's dynasty, Head will be bound to "Anthony", and Tail to ["George","Richard"]. As a further dubious convenience the following would usually be equivalent to the earlier list representing Anthony's dynasty (and will match it, 'nil's and all).

```
["Anthony", . .["George", . .["Richard", . .nil]]]
["Anthony" | ["George" | ["Richard" | nil]]]
```

In this form the underlying structure and the correspondence with the 'flist' representation is clearly seen.

As an illustration of the usage of lists, here is a very basic predicate to check membership of a list, or return all members of a list:

mem.1)

```
%
%       % member(X,L) — X is a member of L
%
%
%  member(X, [X, . .Tail]). % if X is the Head of L
%  member(X, [Head, . .Tail]) :-
%       member(X, Tail). % if X is in the Tail of L.
```

mem.2)

```
%  ?- member(b, [b, c, d]).
%       % Is b a member of [b, c, d]?
   ** yes
```

mem.3)

```
%  ?- member(B, [b, c, d]).
%       % What B are members of [b, c, d]?
   B = b
   B = c
   B = d
```

As a further example, here is another very useful list predicate to append one list with a second to produce a third:

app.1)

```
%
%       % append(A,B,C) — A appended with B is C
%
%  append([], C, C). % if A is nil, B is C
%  append([X, . .ATail], B, [X, . .CTail]):-
%                                % Head of A is Head of C
%          append(ATail, B, CTail).
%                          % ATail appended with B is CTail
```

app.2)

```
%  ?- append([a,b], [c,d], X).
%       % What is [a,b] + [c,d]?
   X = [a,b,c,d]
```

app.3)

```
%  ?- append([a,b], X, [a,b,c,d]).
%       % [a,b] + what is [a,b,c,d]?
   X = [c, d]
```

app.4)

```
%  ?- append(First, [Y, Z], [a,b,c,d]).
%       % What are the last two elements of [a,b,c,d],
%                                       % & what's left?
   First = [a, b]
   Y = c
   Z = d
```

LISTS — exercises

Try writing predicates

(1) to delete a member of one list to get a second list (just the first occurence will do).
(2) to reverse a list.
(3) to check equality of two lists.
(4) to check whether a list is ordered.
(5) to merge two sorted lists into a third sorted list.
(6) to find the smallest element of a list.
(7) to check that one list is a permutation of a second (or to produce all permutations of a list).
(8) to sort a list to get a second sorted list (or to do the corresponding check).

Hints: The predicates which address ordering or sorting will need to make use of 'lt' (if duplicates are excluded) or 'le' (if equality of two members is allowed). Don't forget about 'member' and 'append'. Some of these problems are quite tricky. They are not necessarily graded easier to harder, but some of the later ones will be easier for having done the earlier ones — and could even make use of them or emulate them. There are a great many sorting techniques that can be implemented in PROLOG, one is very obvious, very simple and very inefficient, but a couple of the more standard ones can be implemented using the other predicates described.

You could also implement the 'father', 'heir', 'grandfather' and 'successor' predicates for the list of Anthony's dynasty.

It will be found as you start to use PROLOG that lists, and these two predicates in particular, become a fundamental tool and will be employed in the majority of your programs. We will be returning to them frequently in this sequence of articles. ●

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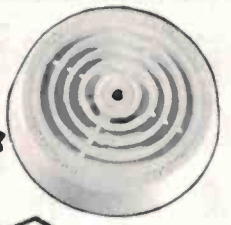

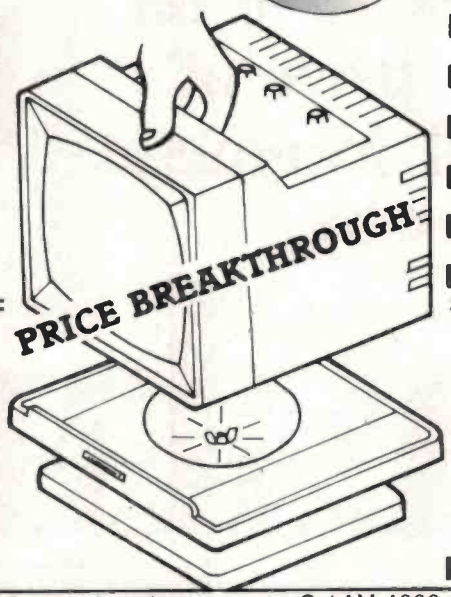

(Were advertised earlier this year at $19.95 each but originally sold for $49.50).

TECHNICAL

For those unfamiliar with the product, a brief description: A minute speck of the rare element Americium 241 is enclosed in a sealed metal chamber within a compact plastic case that contains control electronics, battery and solid state alarm. A very small ionised field is set up within the chamber. When smoke enters the case and then the chamber, the chamber changes electrical state and the external circuit switches on the alarm. The chamber detects down to very low smoke levels. The electronics circuit is run by a 9V battery. When the battery is getting towards the end of its life the circuit automatically gives you up to two weeks warning by emitting distinct beeps.

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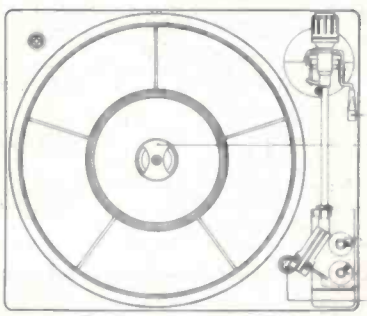

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Jaycar has made a sensational scoop purchase of B.S.R. belt drive turntables from England at below manufacturers cost!

Two models available AA-0290 works from 9-12V DC and the AA-0292 from 240V AC (Includes 12V 500mA adaptor). The DC motor drive is electronically controlled.

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- ★ Dimensions 330(W) x 285(D) x 60(H)mm overall
- ★ Platter diameter 280mm
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START YOUR OWN CACOPHONY!!
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Flux Density	8,300 Gauss
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BANISH THAT 'BAD LOAD'!

BAD LOAD! How many times have we seen that message? These cassette systems are so unreliable! Must get a disk! But is that bad load the fault of the cassette system, or just the way you're using it? Perhaps this small discussion on cassette data recording will clear the air.

Tom Moffat

THE IDEA for this article started brewing some time ago when I joined the local Microbee User's Group and began comparing notes with other people. Lots of them were having trouble getting good recordings. Some were OK at 300 bauds, but bit the dust at 1200 bauds. Some wouldn't work at all. Those were early days, and there was a lot of mystery about Microbees in general, and their cassette recording system in particular.

Then, just recently, the problem reared its head again. First I got a cassette through the post from a Microbee user who wanted to know why it wouldn't load. A few days later a computer shop asked me to investigate a Microbee that was making bad recordings. Some careful listening soon provided the answer.

The trouble was just good old fashioned audio distortion caused by extremely high recording levels. It seems that the Microbee was designed to feed into a cassette recorder's "AUX" jack, which expects an audio level of around one volt or so. There's no quibble with this design, it's a valid one. Trouble is, most recorders being used with Microbees don't have an "AUX" jack, only a "MIC" jack, which expects an audio level of a few thousandths of a volt maximum.

Many Microbee users aren't aware of the difference, after all, they're not expected to be. They're computerists, not electronic technicians. Many who are aware know that the "modern" recorders have automatic volume controls which should turn down the incoming audio level if it's too high. But the Microbee level could be high by a factor of a thousand times, and the AVC circuits just can't take it. The result . . . the AVC gives up and the cassette's recording circuit is swamped.

The 'golden ear' method

You can use your own ears to find out if a high recording level is causing your cassette reliability problems. Get out a program tape that you have recorded, along with a blank tape on which you can make some tests. First, just listen to the start of your program tape. You should hear a short "BRRR . . ." followed by some quickly warbling tones. We will concentrate on the "BRRR" so remember how it sounds.

Put your test cassette in the recorder and prepare to record. On the computer, type "POKE 233,0: USR(43781)". Now roll the tape and hit ‹RETURN›. The recording you are making will take three minutes. What you are doing is writing the "BRRR", a leader, onto the tape in slow motion. To be exact, at 4.69 bauds instead of the usual 300.

When the recording finishes, rewind the tape, play it, and listen carefully. You should hear a 1200 Hz tone, punctuated by bursts of 2400 Hz tone, with some little "tick-tick-ticks" going on in the background. The tones should be good and clear, and similar in volume to a recorded voice. If they sound loud, raspy, and distorted, you will need to apply "the fix".

The fix

Figure 1 shows a circuit called a "voltage divider" consisting of two resistors. You, or a technician friend, can build it right into the Microbee's MIC plug (it will be tight, but it fits). The circuit cuts the audio level to the recorder by a factor of 800 or so, and should just about right. With the job done you can run the slow motion test again, and I'll be you'll be surprised at the difference in sound quality. You'll wonder how the thing ever worked at all. If the tones sound softer than a voice recording, you'll have to reduce the value of the 270k resistor and try again.

The recorder & tape

With that little problem sorted out, let's look at some other cassette questions that have been asked many times:

"WHAT KIND OF RECORDER SHOULD I BE USING?"

The answer to this is, *not a very fancy one*. You don't need it, and super-high performance could be downright harmful. You want to record and replay two tones . . . 1200 and 2400 Hz . . . and hopefully little else. A voice grade recorder is ideal because it provides a kind of natural filtering. People who have used their $2000-metal-stereo-Dolby-modular tape decks have sometimes found they don't work as well as a "cheapie".

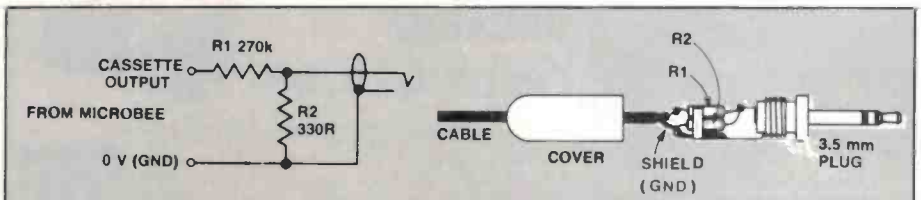
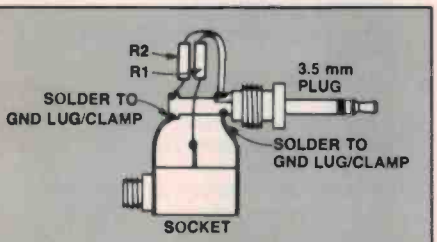
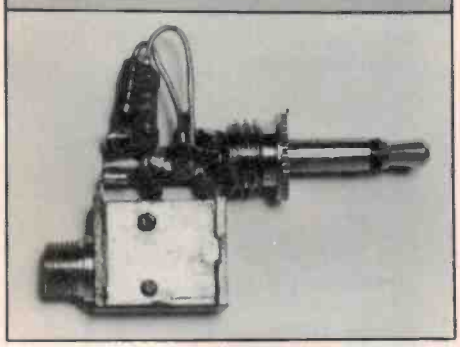


Figure 1. Reducing the signal level out of the computer will reduce the bad load problem. This is how you do it. The two resistors can be soldered inside the Microbee's MIC plug.



An adaptor. An alternative method for reducing the signal is to build a socket/plug adaptor as shown here.



The most effective data recorder for many people has proved to be a small portable dictation-style machine. There are lots of these on the market from all the well-known Japanese manufacturers, and they don't cost an arm and a leg. I've been using a Sony TCM-3, and it's seen so much service now that the paint is starting to wear off. When it finally goes bung I'll be getting another just like it; it's never produced a 'Bad Load', other than the ones that were my fault (like forgetting to plug the MIC cord in).

Recently, a new type of cassette recorder has surfaced, known as a "computer data recorder" or something similar. They cost about half as much again as the dictation-style machines. The one I tested performed much like its cheaper brother, no better and no worse. It would be interesting to hear from someone in the know, why these machines are especially suitable for computer data.

"WHAT ABOUT COMPUTER CASSETTES?"

Well . . . what can you say? They're shorter than normal, and sometimes they don't have leaders. They're often sold in computer shops at absolutely disgusting prices. I've seen one brand of cassette priced at $2.50 in a computer shop, and the same thing for a dollar in an electronics shop. Once you get past the sales hype there's nothing wrong with computer cassettes, they're no better or worse than other cassettes.

Audio cassettes make perfectly good data cassettes, and the same general principles apply that apply to recorders. Many people feel that if you pay big bucks for sooper-dooper ultra low noise cassettes, they must be better for data. That's not necessarily the case; a good "lower grade" cassette will work just as well, if the tape and the cassette case are well made. I've been using the Sony CHF tape, which is the bottom of the Sony range. I've also tried brands like Hitachi and Toshiba and they're all great for data storage. Sony won out for me because it's easier to get them in the 30 minute size.

Beware of "bargain" cassettes. There were recently some selling around Hobart for seven dollars for ten cassettes, including a nice plastic box to store them in. Many people found this too good to resist. Later I borrowed an assembler source listing, recorded on one of these cassettes. When I played it, it "Bad Loaded" not far from the end. When I tried again it bombed, this time not so far along. Each time it got worse as more and more oxide fell off the tape. I eventually gave up, only to be faced with a half-hour of scrubbing the brown guck out of my recorder.

"I EVEN GET BAD LOADS ON STORE-BOUGHT PROGRAMS. I WOULD HAVE THOUGHT THEY'D BE PERFECT."

No, just the opposite. The quality of some of the "commercial" software recordings is absolutely foul. Next time you cop a "Bad Load" just have a listen to the tape. It may have loud mains hum, it may sound muffled, a recording might start, stop, and then start again. I've found all these defects in commercial tapes we're expected to fork out good money for.

The computer shops will always replace bad tapes, but you're still up for another trip to town, another potential parking ticket, another hassle. I find it astounding that the things are put on the market in the first place. Don't the manufacturers even just listen to the occasional cassette, or do the occasional test load? The most interesting crook tape I've yet found didn't even have any oxide on it! The tape was there,shiny on both sides, the oxide had never been applied to it. At least they could claim it was "low noise". I wonder how many like that went out . . .

What this all boils down to is that the cassette storage system, as used in the Microbee, is good and reliable. That's providing it's properly set up in the first place, and your "raw materials", your recorder and your tapes, are of good quality. People have written asking for projects to optimize audio recorders as "data" recorders, but what's the use? you couldn't really improve on what's already there. If it works, don't fix it! ●

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803/Left/Little

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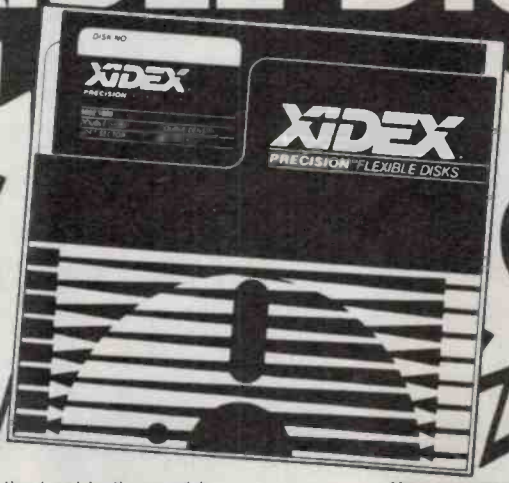

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at the leading edge

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A long awaited lightweight, bright, flat screen display is now in volume production at **Sharp Corporation.** Four units make up a series of various sized low voltage, high resolution readouts the largest of which will display 25 lines of 80 characters on a **640 x 200** dot matrix.

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WANGTEK STREAMING TA[illegible] DRIVES BA[illegible] UP 60MBYTE

Does BASIC Have to be so Basic?

Alan Ford

Although BASIC started out as a beginners language, modern versions are highly sophisticated, with many advantages over more 'professional' languages. The reason BASIC programs seem so poor is that they are often just badly written. A better approach to program writing can result in much more efficient programs.

JUST WHAT IS IT that makes the EDP professional groan when he sees another listing of a BASIC program? Is it part of the siege mentality? After all, what was once his sacrosanct preserve, unchallenged by mere mortals (such as the Chairman and Board of Directors), is now trodden through freely by the fourteen-year-old next door. The mystery is over — computers are everyday and commonplace and with them the once secret world of subroutines, compilers, RS232 handshakes and all the rest.

But wait, groans are emanating from even those professionals sensible enough to welcome the micro — it's not a computer revolution, they say, more a computer revulsion. The fact is that the vast majority of programs written in BASIC are plain awful. They lack structure, they use wasteful techniques, they are illogical, they are hard to read, hard to type in, hard to debug, and hard to use.

They bear all the hallmarks of the programmer who leaps at the keyboard and starts "hitting" (ugh!) keys before he's even decided what he's writing, who hasn't used a pen or pencil in years, and has no use for any paper not churned out of his printer.

So bad are these cobbled together lumps of coding that the average professional condemns BASIC altogether.

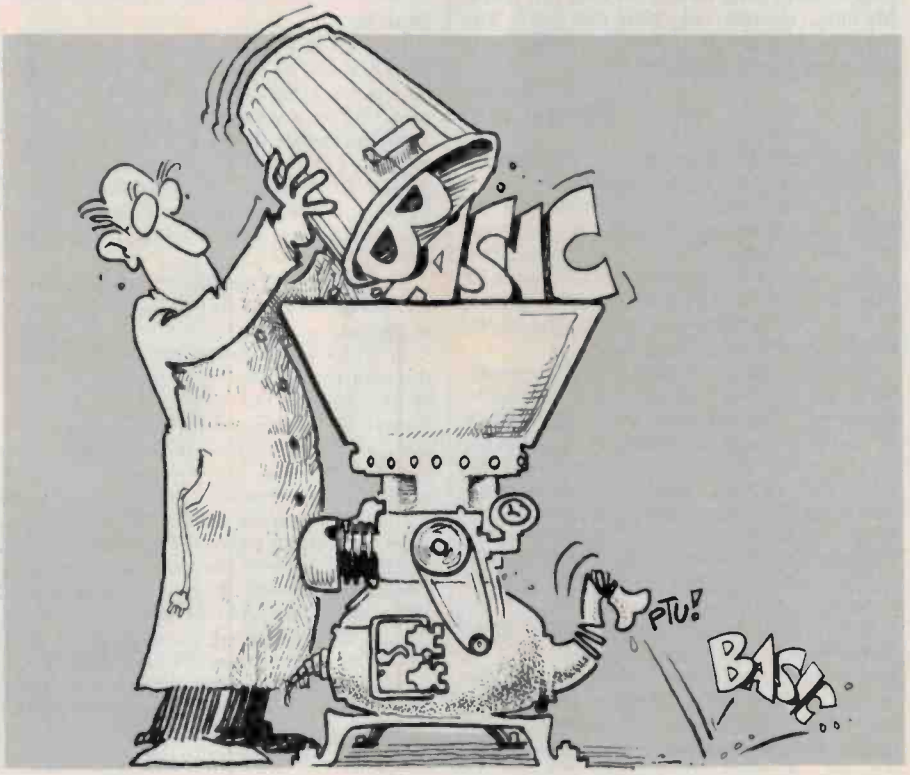
Quite unfair to the poor language! Developed originally as a teaching tool, BASIC has grown to sophisticated and polished heights. It has a great beauty and structure of its own. It is interactive: as an interpreter it translates each command into machine code (the only code the CPU can understand) as it runs. It can be stopped easily in mid run, variables can be read, it can be debugged or modified *in situ* and rerun. Contrast this with COBOL, the industry standard. This is a compiler language. The coding is first keyed in as a source file, and is then processed to create an object file, in machine code. This object program can then be run, all the translation already having been done. Sure, it is faster, but debugging and modification are tedious, involving a change to the source code, rerunning the compiler, and finally the live run.

BASIC allows such luxury as the programmer (with the operator's help) debugging successfully by telephone. It is adequate for the vast majority of business applications, convenient to write and debug. You'll notice I didn't add the usual "easy to learn"! All that rubbish which passes for programs is written by people who found it easy to learn — they learned the keywords and their uses — but not how to write!

A treatise on writing structured BASIC would probably fill a book. In the meantime, here are a few points:

Stay away from the keyboard until the last possible moment. Define the problem on paper, in detail. Think about it conceptually, walking on the beach or sipping orange juice or whatever. Then think about it in detail at the desk (yes, move the computer off). Write out the steps required for the solution. Consider the output first — what do we want from the program? Then consider the necessary data — the inputs required.

In designing the processing, choose ▶



LETTERS

Dear Sir,

I read an advertisement which claimed that if the 6502 chip is replaced with a 65C02A the benefits will be that it uses 99% less energy, has 27 additional new instructions and is 100% compatible with existing software.

If these claims are true then it must be worthwhile replacing the 6502 chip with the 65C02A in any computer which uses a 6502 chip. However, I don't know if the 65C02A is a drop-in replacement or if some modifications are necessary.

Also, while on the subject of chip replacement, is the 6522 chip as used in the VIC-20 a Commodore chip, or is the 6522 chip the same as advertised by at least one of your advertisers? I have also read that the 6522 with the suffix 'A' causes less load errors with disks than when the standard chip is used.

The VIC-20 cassette interface project (ETI-659), published in May 1984, is excellent and, in my opinion, is more reliable than the Commodore datasette. Now my friends and I can exchange our programs without any hassles. We had problems before as there definitely appears to be large incompatibility problems between the Commodore datasettes.

Thanks for a great monthly magazine which I have been buying for over ten years. My initial interest was audio, and still is, but my new interest is computers. And your magazine caters for both.

P. Meehan
Yagoona, NSW

I'm glad that you found the VIC-20 cassette interface suitable for your application.

We have only preliminary data on the 65C02A. It specifies that it is "plug compatible with NMOS 6502", consumes approximately 1/20 of the power and implements 27 new instructions. The obvious conclusion is that it seems worthwhile replacing the standard 6502 with the updated device.

However, 'plug compatible' doesn't necessarily mean 'direct replacement for'. Some instruction changes exist and it all depends on whether your microcomputer's software can cope with them. For example, the JUMP INDIRECT across page boundaries will increment the page address in the 65C02 instead of wrapping around as in the 6502. Obviously, 6502 software that assumes wrap around will run amuck if the instruction is implemented differently.

65C02 decimal operations involving addition and subtraction assume that the Z, N and V flags are valid whereas they are invalid in the 6502. Transitions of the RDY input are allowed only during 6502 read cycles but are allowed also during write operations by the 65C02. As you can see, there is a chance that simply replacing the 6502 with a 65C02 may not necessarily work.

The 6522 Versatile Interface Adaptor is a Synertek device which is second-sourced by other manufacturers. All the chips with this number perform the same basic function but may have their own peculiarities which are sometimes used to advantage by designers of microcomputers. This is why a CMOS, TTL or even audio integrated circuit from a certain manufacturer may work in a circuit whereas others won't. However, in the majority of cases direct substitution should be OK.

The 'A' suffix (also B and C) when applied to microprocessor components indicates that the device is capable of operating faster than the standard device. In the present case, the 6522 can operate at 1 MHz and the 6522A at 2 MHz. This implies that errors are less likely during high speed setup times, e.g: address setup time, data buss setup time, etc are reduced. This may explain why less disk load errors occur if the 6522A is used rather than the standard device.

Peter Ihnat
Project Engineer, ETI

Dear Sir,

I have made a discovery which may be of use to some of your readers. For the last five years I have had a stereo amplifier, powered by a version of your 1974 100 W amplifier power supply inverter, installed in my car. The amplifier uses two Sanken SI-1010G 10 W hybrid IC amplifier modules (and the latest preamp. is my version based on your Series 3000 amplifier, November 1980).

To digress still further, the car uses your electronic ignition from the same 1974 issue as the power supply.

A faulty 12 V lead to the inverter made some horrendous noises occur and blew one of the ICs in the amplifier. I promptly rushed off to buy another and was pleasantly surprised to find the price had only doubled to $17 in over five years. In place again, the system works beautifully.

I pulled the cover off the IC module and found the output transistors to be dead (this had to be done with the aid of a data sheet). These NPN transistors were each mounted on a separate metal block glued to the main case of the module. I removed them with the aid of a fine screwdriver as a chisel.

Wanting to save some money, I used the circuit diagram on the data sheet and substituted a pair of TIP31Cs. BD139s would fit better but don't have the same current rating (the current rating for these ICs needs to be 890 mA RMS which is a bit marginal).

The results were good; there was no audible or CRO-visible distortion, even at 9.5 WRMS into a speaker. So I was lucky and the output transistors were the only faults. The substitutes were Araldited into place and the cover replaced — for future use? Maybe not, but it's as good as the original, if needed.

So anyone who has blown one of these modules, or the higher powered units, might invest in a pair of transistors and a little time before rushing off to buy a replacement that might not be really needed. Epoxying the replacements to the inside of the module is a messy job that is probably better left until a low-power test proves promising, but is essential if the unit works.

T. J. Threlfall Shenton Park WA

Dear Sir,

I am in the sound reinforcement business and I recently constructed your project, ETI-494, the signal powered loudspeaker protector. When it was finished the unit worked as described in the article.

The final test was a blown-up Crown dc 300 A amplifier that I had lying around awaiting repair, with an output of 60 V dc. I also had a slightly 'singed' voice coil which still measured eight ohms.

When I connected these up and switched on the amplifier, the relay pulled in as expected. What I didn't expect was an arc across the relay which continued until the amplifier was switched off. The voice coil was quite warm after only a few seconds and the contacts on the relay were burnt. I used a Fjuitsu FRL611 D012 SPDT relay as specified.

I redesigned the pc board so that it would take a DPDT relay to switch both the positive and negative rails. It now stops all dc and works well.

Alan Westacott Spring Hill, Qld

Subsequent to publication of this project (Oct. '82) we had sporadic reports of the nature you describe. A note was issued to known project kit suppliers, the gist of which was also published in our book *Audio Projects from ETI*, published in December 1982.

A loudspeaker protector such as this is basically meant for a *once-only* operation. It is not meant for successive cut-in, drop-out operation, particularly in the case of a dc fault. This project should not be used if you're trying to trace an intermittent dc fault. If the relay operates, it's time to switch off the amplifier, disconnect the load and find the fault — preferably using a dummy load.

For amplifiers having supply rails in excess of about 50 V, it is advisable to add dc-quenching across the relay contacts. A series RC network is all that's necessary. Use a 100 ohm, 1 W resistor and a 630 V rated capacitor of about 100n or greater value.

For really high power amplifiers having supply rails of 100 V or more, it is probably best to use two relays with their coils connected in parallel and their contacts (with dc-quenching) connected in series, or a DPST relay with the contacts in series and dc-quenching added.

Roger Harrison Editor

meaningful variables, like NM$ for name, CB for closing balance, and list them. Never, never use I or O as variables — they are too easy to confuse with 1 and 0 when keying, reading, typesetting, and debugging. Yes, I know all the books, magazines and articles use FOR I = 1 to N etc, etc, but this is purely an historical convention which has no relevance to BASIC whatsoever, so please don't perpetuate it!

If using files, allocate buffer variables in the same way (but distinct from ordinary variables). Tabulate the fields, allowing spare bytes at the end, and totalling for record lengths.

Look for repetitive processes and plan subroutines. Why, oh why, does everyone put subroutines at the *end*?? BASIC searches from the beginning, so the nearer to the top you place your subroutines, the faster they are accessed — very important when they are accessed repetitively in a loop. And talking of loops, *do* follow the historical convention of identing loops — I know it uses some memory space but the trade-off in clarity is worth it. And note that many dialects of BASIC do not require a variable with NEXT — in fact a loop may run much faster without it; the identation will compensate for any lack of clarity.

Draw an outline flowchart (in pencil) (yes, use a template, we aren't *trying* to waste time).

All inputs should be error trapped. It is not good enough to expose an operator to nonsense like "OV error in 440" or "redo from start" or "DJD error (disc just destroyed!) in 1500". Errors should be detected and announced by your code, and not the language or the operating system!! For example, "Figures only" or "Not a valid date".

Use INKEY$ for single key entries like Y/N. But where an action is drastic, like deleting a record, guard against accidents — check "ARE YOU SURE YOU WISH TO DELETE?", or require a two-key entry like CTRL D.

Plan to segment the program into logical modules. These will be started at lines 1000, 2000, 3000 etc. The program will start at line 10 which will be a GOTO 1000 (No, I don't agree that *all* GOTO's are evil!). So the space from 20 to 990 is available for subroutines, say in blocks at 100, 200, 300 etc., those where speed is critical coming first. Actually coding starts with line 1 GOTO 10. Why another GOTO? This is to jump over line 5 in operation. Line 5 reads 5 SAVE "filename". During the coding stage, assuming you are using disk, you can frequently type GOTO 5 and the latest version of your work will be saved reliably under the correct file name. Beginners are allowed to lose six hours work because the plug fell out — but only once!! After that you appreciate the value of "going to five"!!

Having done all this prior planning, NOW you may start keying in. Notice I am not advocating writing out the actual code by hand first; clearly this would be ludicrous. But with all your variables, files, and subroutines defined *and documented*, your outline flowchart clearly finalised, and the skeleton of your numbering known, you stand a much better chance of writing good, structured code. Despite all your preparation, you will still find yourself making changes and allocating new variables as you code, so have a pad handy and document what you are doing.

Whether or not you use spaces in your code depends largely on the available memory. Every space is a byte, just like any other character, so if space is at a premium, write densely, eg, ONINSTR("AEPFB", CH$)GOTO1000,2000,3000,4000 whereas if readability is of paramount importance, as in a listing for a magazine article, by all means use spaces.

When you've finished, test, test, and test again. Have someone else test too. Walk a friend through the program, trying each option. Make tempting comments like "Put in a stupid entry, and see if it is rejected, like this . . .". With luck, Murphy will rise to the bait and most of your errors will pop up.

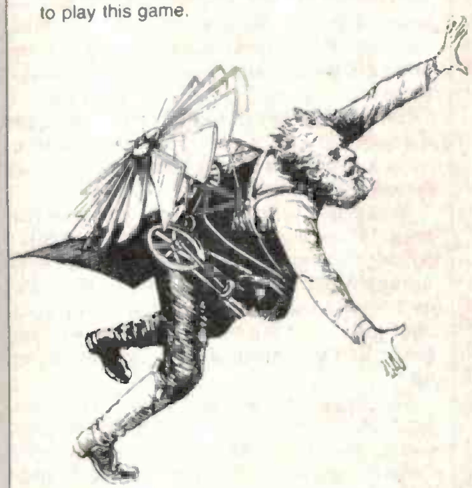
Finally, gather together your documentation and a printout of the latest version, dated, together with a machine-generated variable reference list, and file away carefully. Hopefully, one day in the future you will open that file and with the wisdom of added hours, yourself groan at the code (as I do at everything I've written so far) — then you're on the way to becoming a programmer of sorts, and the hacking days are far behind! Good luck! ●

COMMODORE COLUMN

CHOPPER PILOT

Ric Kube, Waikerie, SA

This program works with any memory capacity in the VIC-20. It fits the unexpanded VIC but it has a routine (lines 110, 260-280) that changes the configuration for different memories. You need to have a joystick to play this game.



```
10 REM*CHOPPER PILOT
20 GOTO660
30 DATA254,16,124,71,68,124,16,124
40 DATA127,8,62,226,34,62,8,62
50 DATA0,0,0,0,127,63,31,15
60 DATA28,28,28,29,255,255,255,255
70 DATA127,103,195,219,195,219,219,255
80 DATA128,192,224,224,254,252,248,240
90 REM**SET UP SCREEN
100 IFPEEK(648)=30THENPOKE52,28:POKE56,28
110 IFPEEK(648)=16THENGOSUB260
120 DD=37154:P1=37151:P2=37152:R=36877:T=36878:X=7680+INT(RND(1)*273):B=8120
130 K=7168:F=7432:E=7424:S=INT(RND(1)*18)
140 FORI=ETOE+7:POKEI,0:NEXT
150 FORI=KTOK+15:READD:POKEI,D:NEXT
160 FORJ=FTOF+31:READQ:POKEJ,Q:NEXT
170 POKE36869,255:POKE36879,110:PRINT"♥E"
180 TI$="000000"
190 FORQ=STO18:POKEB+Q,33:POKEB+1+Q,34:POKEB+2+Q,35:POKEB+3+Q,36
200 GOSUB320:FORO=1TO200:NEXT
210 S=0:POKEB+Q,32:POKEB+1+Q,32:POKEB+2+Q,32:POKEB+3+Q,32:NEXT
220 FORQ=18TO0STEP-1:POKEB+Q,33:POKEB+1+Q,34:POKEB+2+Q,35:POKEB+3+Q,36
230 GOSUB320:FORD=1TO200:NEXT
240 POKEB+Q,32:POKEB+1+Q,32:POKEB+2+Q,32:POKEB+3+Q,32:NEXT:GOTO190
250 REM**EXPANDER RESET**
260 POKE36866,150:POKE36869,240:POKE648,30
270 FORWA=217TO228:POKEWA,158:NEXT:FORWA=229TO250:POKEWA,159:NEXT
280 RETURN
290 POKET,6:POKER,128:FORM=1TO5:NEXT:POKET,0
300 RETURN
310 END
320 POKEDD,127:P=PEEK(P2)AND128:J0=-(P=0)
330 POKEDD,255:P=PEEK(P1)
340 J1=-((PAND8)=0):J2=-((PAND16)=0):J3=-((PAND4)=0)=FB=-((PAND32)=0)
350 IFJ3THENPOKEX,32:X=X-22:POKEX,1:GOSUB290
360 IFJ1THENPOKEX,32:X=X+22:POKEX,1:GOSUB290
370 IFJ2THENPOKEX,32:X=X-1:POKEX,0:GOSUB290
380 IFJ0THENPOKEX,32:X=X+1:POKEX,1:GOSUB290
390 IFTI$="000015"THEN580
```

▶

MEECHER MATCH

P. Stanhope, Figtree NSW

This is a graphic version for the VIC-20 of the old stick or match game 'Nim'. After the first game the algorithm causes the program to 'learn', and the computer then plays an almost faultless game.

```
1 S=36879:L=7680:U=38400
2 PRINT"♥E":FORA=0TO21:POKEL+A,160:POKEU+A,(AAND7):NEXT
3 FORA=22TO484STEP22:POKEL+A,160:POKEU+A,((A/22)AND7):NEXT
4 FORA=22TO484STEP22:POKEL-1+A,160:POKE38421+A,((A/22)AND7):NEXT
5 FORA=0TO21:POKE8164+A,160:POKE38884+A,(AAND7):NEXT
7 PRINT"QQQQ]]]R MEECHER MATCH ■"
9 PRINT"QQQQQQ]]]]]RP. STANHOPE■"
10 PRINT"Q]]]]]]]R 1983 ■C"
11 GOSUB300:PRINT"J":POKES,252
13 PRINT"E WE■ ARE GOING TO PLAY":PRINT"Q]]]]THE MATCH GAME."
14 PRINT"QREMEMBER- ONLY TAKE R 1,2,OR 3 MATCHES"
15 PRINT"QFROM THE RPILE■ EACH GO."
16 PRINT"QQ R HIT A KEY TO GO ON ":GOSUB400
17 GETA$:IFA$=""THEN17
18 PRINT"♥":POKES,57:PRINT"QQQQQQ]]WATCH OUT,BECAUSE   I'M  NOT A BAD PLAYER!"
19 PRINT"QQQQQ R HIT A KEY TO GO ON ":GOSUB499
20 GETA$:IFA$=""THEN20
21 X=0:Y=0:DIMF(21):DIMQ(21)
22 FORI=1TO21:F(I)=0:NEXTI
23 F(1)=100
24 PRINT"♥":POKES,29:PRINT"S$    R   MATCHES   ■"
25 FORA=0TO20:POKE7724+A,108:POKE38444+A,2:NEXT
26 FORA=0TO20:POKE7746+A,113:POKE38466+A,7:NEXT
27 FORA=0TO20:POKE7768+A,118:POKE38488+A,7:POKE7790+A,118:POKE38510+A,7:NEXT
28 PRINT"SQQQQQQ] ____________________"
29 GOSUB499
30 B$="
       "
31 PRINT"SQQQQQQQQQ WE START WITH 21":PRINT"Q]]]]MATCHES"
32 FORT=1TO2000:NEXTT:PRINT"SQQQQQQQQQQ"B$;
33 FORI=1TO21:Q(I)=0:NEXTI:M=21
34 PRINT"SQQQQQQQQQQQQQQQQQQQQ ■ R YOU GO FIRST ■"
35 GOSUB499:PRINT"SQQQQQQQQQQQHOW MANY DO YOU TAKE ■ (HIT RRETURN■ EACH GO)"
36 INPUT Z:P=INT(Z):IFP>3ORP<1THEN37
37 IFP>3ORP<1THENPRINT"R]]TAKE 1,2,OR 3■":FORT=1TO999:NEXT:GOTO35
38 M=M-P:GOSUB350:PRINT"SQQQQQQQQQQ";B$:FORT=1TO400:NEXT:GOSUB499
39 PRINT"SQQQQQQQQQ MATCHES LEFT: "M:FORT=1TO1000:NEXTT
40 IFM=1THENGOTO90
41 IFMK =0THEN100
42 Q(M)=-1
43 IFM=1THEN90
44 IFM=2THEN55
45 IFM=3THEN50
46 IFF(M-3)<F(M-2)THEN50
47 IF F(M-3)<F(M-1)THEN55
48 C=3
49 GOTO56
50 IFF(M-2)<F(M-1)THENGOTO55
51 C=2:GOTO56
55 C=1
56 PRINT"SQQQQQQQQQQ"B$:PRINT"SQQQQQQQQQ I TAKE"C:FORT=1TO900:NEXT
57 M=M-C
58 GOSUB350
59 FORT=1TO1000:NEXT
60 Q(M)=1
```

▶

C64 PROGRAM HINTS

C. Morris, Smithfield Plains SA

The following hints might be useful for Commodore users.

To recover a program after typing NEW, try POKE 2050,1 and then type in a dummy line number greater than the last line of the program. Then LIST. You should get your program back.

Another useful hint is that a reset button can be fitted to the C64 by wiring a momentary 'on' switch between the reset and ground pins of the user port. This makes it possible to reset without turning the power off. Refer to page 143 of the user manual for the correct pin numbers.

```
400 IFX=(B+2+Q)-22THEN450
410 IFX=(B+Q)-22ORX=(B+1+Q)-22ORX=(B+3+Q)-22THEN POKEX,4:GOTO550
420 IFX)=B+22THEN530
430 RETURN
440 REM WIN
450 PRINT"CONGRATULATIONS!YOU HAVE SAFELY LANDED"
460 PRINT"IT TOOK YOU "RIGHT$(TI$,2)" SECONDS"
470 REM PLAY AGAIN
480 PRINT"ANOTHER GAME? (Y-N)"
490 GETA$:IFA$=""THEN490
500 IFA$<>"Y"THENPOKE36869,240:POKE36879,27:PRINT"":GOTO760
510 RESTORE:RUN30
520 REM MISS
530 PRINT"TOO BAD - YOU SUNK!":GOTO480
540 REM CRASH
550 PRINT"OOPS! YOU CRASHED!"
560 POKER,220:FORL=15TO0STEP-1:POKET,L:FORM=1TO75:NEXTM,L:POKER,0:POKET,0
570 GOTO480
580 POKEB+Q,14:POKEB+1+Q,14:POKEB+2+Q,14:POKEB+3+Q,14
590 POKER,220:FORL=15TO0STEP-1:POKET,L:FORM=1TO50:NEXTM,L:POKER,0:POKET,0
600 PRINT"YOU FAILED TO LAND IN";
610 PRINT"15 SECONDS      ";
620 PRINT"  THE SHIP HAS BLOWN UP"
630 GOTO480
640 PRINT"THE SHIP HAS BLOWN UP"
650 REM**INSTRUCTIONS
660 POKE36879,1:PRINT"    INSTRUCTIONS"
670 PRINT"YOU ARE A HELICOPTER":PRINT" PILOT.":PRINT
680 PRINT"YOU HAVE 15 SECONDS TO LAND ON YOUR SHIP"
690 PRINT"AND SAVE IT FROM EX-  PLODING."
700 PRINT"YOU HAVE TO LAND ON   THE PAD ABOVE THE  ON THE SHIP."
710 PRINT"USE YOUR JOYSTICK TO  MOVE THE 'CHOPPER."
720 PRINT"READY TO BEGIN? (Y-N)"
730 GETA$:IFA$=""THEN730
740 IFA$<>"Y"THEN730
750 GOTO30
760 END

READY.
```

```
61 PRINT""B$:GOSUB499
62 IFM=1THEN100
63 PRINT" MATCHES LEFT!"M:FORT=1TO2000:NEXT
64 IFM=1THEN100
65 PRINT""B$
66 GOTO35
90 PRINT"":POKES,223
91 PRINT"YOU WON..."
92 PRINT"BUT I THINK YOU WERE"
93 PRINT" BIT LUCKY!! "
94 POKE36878,15:FORL=1TO10:FORM=180TO235STEP2:POKE36876,M
95 FORN=1TO10:NEXTN:NEXTM:POKE36876,0:FORM=1TO100:NEXTM:NEXTL
96 POKE36878,0
97 Y=Y+1
98 FORI=1TO21:F(I)=F(I)-Q(I):NEXTI
99 GOTO110
100 PRINT"":POKES,252
101 PRINT:PRINT:PRINT""
102 PRINT""
103 PRINT""
104 PRINT""
105 POKES-1,15:FORL=130TO254:POKES-3,L
106 FORM=1TO40:NEXTM:NEXTL:POKES-1,0:POKES-3,0
107 X=X+1
110 PRINT"ANOTHER GAME?":PRINT:PRINT"(Y/N)"
111 GETA$:IFA$=""THEN111
112 IFA$="Y"THENPOKES,29:PRINT"":GOTO24
113 PRINT"":POKES,27:PRINT"ELL,O.K."
114 PRINT"YOU KNOW WHEN YOU'RE   LICKED!!"
115 PRINT" BY THE WAY, THE SCORE   WAS...."
116 PRINT" HUMAN"Y;"  VIC"X
120 END
300 POKES-1,15:FORL=1TO100:POKES-3,INT(RND(1)*128)+128
301 FORM=1TO15:NEXTM:NEXTL:POKES-3,0:POKES-1,0
302 RETURN
350 R=20 M:FORW=0TOR:POKE7724+W,160:POKE38444+W,1:NEXT:POKES-1,13:POKES-3,(240-4
*R)
351 FORT=1TO100:NEXT:POKES-1,0
352 FORW=0TOR:POKE7746+W,160:POKE38466+W,1:NEXT:POKES-1,15
353 FORT=1TO100:NEXT:POKES-1,0
354 FORW=0TOR:POKE7768+W,160:POKE38488+W,1:NEXT:POKES-1,15:FORT=1TO100:NEXT:POKE
S-1,0
355 FORW=0TOR:POKE7790+W,160:POKE38510+W,1:NEXT:POKES-1,15:FORT=1TO100:NEXT:POKE
S-1,0
357 POKES-3,0:RETURN
400 POKES-1,15:FORL=1TO20:FORM=220-LTO160-LSTEP-4:POKES-3,M
401 NEXTM:FORM=160-LTO220-LSTEP4:POKES-3,M
402 NEXTM:NEXTL:POKES-1,0:POKES-3,0
403 RETURN
439 FORV=1TO2
500 POKES-1,15:POKES-3,175:POKES-4,195:FORT=1TO200:NEXT
501 POKES-3,191:POKES-4,175:FORT=1TO200:NEXT
502 POKES-1,0:POKES-3,0:POKES-4,0:NEXTV
503 RETURN
READY.
```

Big screamers!

Know what a crook hates most? Noise! Scare the pants off them with this high efficiency horn speaker. Connects to alarm speaker output. Really loud.
Cat C-2705

ONLY **$10.25**

Larger (127 x 200mm) horn with huge 15 watts rating. For the installations where a loud alarm is a must.
Cat C-2718

Also ideal for PA use

ONLY **$27.50**

Alarmed by the cost of security?

It's so easy with these superb security system components from Dick Smith Electronics. Everything from the very latest in integrated circuit control units right through to the sensors you use to stop thieves **before** they get in!

Don't know what to do? No worries: our exclusive booklet 'How to intall your own burglar alarm' will tell you how easy it is! Yes, YOU can put in your own fully professional quality alarm system at a tiny fraction of the cost of professional installation.

Give em the gong!

Ultra Loud Bell. A great new addition to our range. Huge 8 inch fire bell with massive gonger, 12 volts operate at 300mA. Suitable for most alarm systems.
Cat L-5280

$34.95

Piezo Piercer!

What an amazing sound from such a little gizmo! Piezo alarm unit features inbuilt driving circuit so it operates direct from 12 volt supply. Unbelievable 120dB @ 1m output

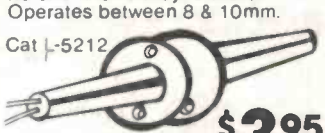
Cat L-7025

$14.95

Magnetic Switch

100% Hidden Magnetic (Reed) Door & Window Switches. What a great idea! Ideal for all alarm systems — usable in wood, aluminium & other doors/windows. They are covered by window/door when closed — no one knows they're there! Operates between 8 & 10mm.

Cat L-5212



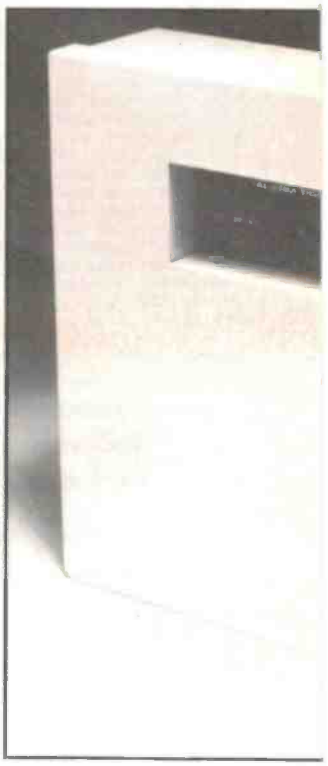
ONLY **$3.95**

Deterrent Sticker

Bright silk-screened inside adhesive sticker for your home. Great for warning off intruders: they're more likely to go to easier pickings! They don't know you haven't even got an alarm . . . or have you?

only **$2.00** Cat L-5311

Professional Quality Security Centre



This is it! The most professional alarm system we've ever seen – and it's suitable for homes, offices, factories . . . you name it! With six individual sectors all full controllable for instant or delayed alarm, each able to isolate and each triggerable by a huge range of sensors: the type of alarm used by banks, etc where security is paramount.

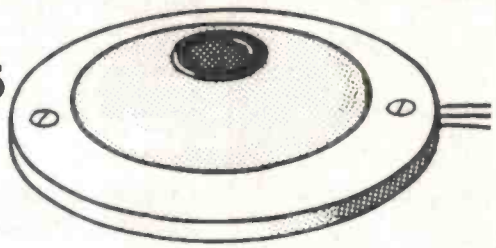
Imagine how it would protect your home!

The type of alarm system the professionals charge $1000 or more to install!

Protect against fire!

Most alarms have provision for a fire sensor. Take advantage of it and protect your home and property! Use any number of sensors in likely 'hot spots'.
Cat L-5254

$7.95



One step — and they're gone . . .

Hide a pressure mat under the carpet, a rug — even the lightweight Bill Sykes can't get past this one! Put one in front of your safe! Normally open contacts.

Cat L-5270

ONLY **$19.50**

Plus! Everything you need for no-fuss installation of your alarm system . . . such as

Wire

Thin hook-up wire for easy concealment. Range of colours available. 10¢/metre or only $8.00 per 100m roll.

Light-weight 'figure 8' twin conductor cable. One cable marked with tracer for instant recognition. Cat W-2010, 20¢/metre or only $15.00 per 100 roll.

Tools

Standard Flat Blade or Philips Blade Screwdrivers at bargain prices: **Mini Size** – Flat Cat T-4010 @ 55¢. Philips Cat T-4020 @ 65¢. **Stubby Size** – Flat Cat T-4060 Philips Cat T-4065 Each $1.75. **Popular Size** – Flat Cat T-4085 @ 85¢ Philips Cat T-4030 @ 75¢. **Heavy Size** – Flat only, Cat T-4100 @ $1.95 each.

Soldering Irons:

240V 30W general purpose iron Cat T-1330 $9.95. 12V 25W general purpose iron T-1920 $9.95.
Solder to suit 1.25mm hobby pack Cat N-1638 $1.20.

Do it yourself and save a fortune!

★ ★ ★ ★ **EXCLUSIVE** ★ ★ ★ ★ ★

Our step-by-step guide makes it so easy to install your own alarm system to fully professional standards! Everything you need to know – and it's only $1.95 or FREE with any alarm system from Dick Smith Electronics.

Features:

- Heavy duty steel case with security key lock and tamper protection.
- Internal mains power supply plus charger for (optional) back-up battery: room inside the case for battery.
- Latest 'wire-out-proof' sensor circuitry – suits both n/o and n/c sensors!
- Use with any type of intruder detection sensors.
- Isolate any sector(s) you wish: you can have alarm on in rest of house while you're asleep at night.
- Comprehensive installation manual supplied!

Cat L-5100

$239

Top quality Swiss made infra-red people sensor

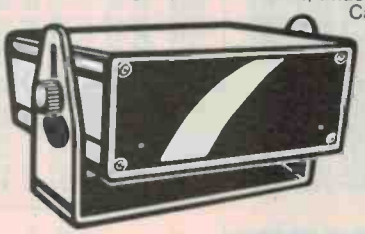
The very latest: Swiss made quality detector actually senses human radiation — even from across a room! Virtually no false triggering, ultra reliable. Simple connection to our Security Centre (L-5100) and Bookshelf Control Module (L-5102).
Cat L-5010

Two other models also available.

ONLY **$119**

Microwave Sensor

Want to catch them in the act? Silent, invisible microwaves detect any movement in the target area and trigger the alarm device. 12V operated. Range up to 15 metres, attaches to any alarm system!
Cat L-5000

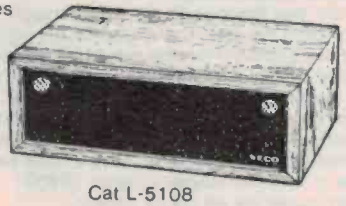


Latest technology!

$95

Ultrasonic Blaster!

The 'Claytons' alarm: the ideal alarm for those who don't want to put in alarms! This one is fully self contained, including siren speaker. Just place it on the shelf and its invisible ultrasonic rays detect movement. Fantastic for single room protection; can also be used as a sensor on a master alarm console. Includes sensitivity control, operates from external 12V battery, from mains via optional plug-pack with internal battery back-up. Has provision for external speaker, sensors, etc.

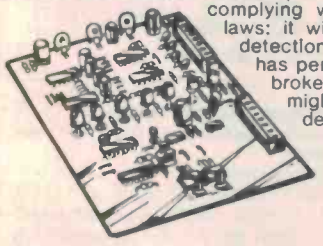


Cat L-5108

$99

4 Sector Control Module

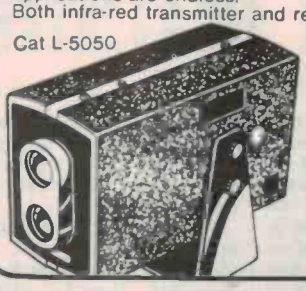
The 'bare bones' alarm controller – for the do-it-yourselfer who wants to install a top quality system without paying a fortune. You can protect four different sectors, and this alarm features circuitry complying with the latest noise pollution laws: it will re-arm itself after an alarm detection, but will isolate a sector which has permanently tripped detectors (eg broken window foil). The intruder might think that the system has been defeated – but will be caught by the other three sectors still armed!
Cat L-5056



ONLY **$69.50**

Infra-red Beam

Burglar Alarms ... Door Minders ... People Counters ... the applications are endless!
Both infra-red transmitter and receiver are in the same unit, with a reflector supplied to send the beam back. A sensitivity control allows 'fine tuning' to suit the location. Mains (240V) powered, with a 12V DC @ 1A output each time the beam is broken. The unit can be set for two modes: 'instant' (output while beam is broken) and 'intermittent' (outputs for five seconds after beam is broken).
Cat L-5050



ONLY **$99**

Stainless Steel Pliers/Nippers
Transistor Nipper Cat T-3205
Mini Flat Nose Cat T-3325
Mini Needle Nose Cat T-3570
Mini Long Nose Cat T-3565
And they're only $8.50 a pair!

See insert for address details

DICK SMITH ELECTRONICS
PTY. LTD.

AMAZING

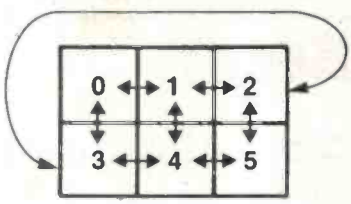
M. Crozier, Auckland NZ

```
0600  afd0 6a00 6000 f055 7a01 3a0a 1606 6820
0610  6914 afe0 d893 6a12 ce05 afd6 f365 2780
0620  27be afd0 f565 4e00 164e 4e01 1656 4e02
0630  165e 4e03 1666 4e04 166e ae80 3501 1674
0640  27a2 27d4 f565 a67a 6b01 280c 1692 a840
0650  3001 1674 1640 a980 3101 1674 1640 aac0
0660  3201 1674 1640 ac00 3301 1674 1640 ad40
0670  4401 1640 27a2 a67a 27ee 8060 8170 27ee
0680  8260 8370 27ee 8460 8570 6b00 280c 27d4
0690  f555 afd6 f365 2780 7001 300a 16b6 6000
06a0  7101 310a 16b6 6100 7201 320a 16b6 6200
06b0  7301 330a 1778 2780 6600 6700 6b01 eba1
06c0  67ff 6b06 eba1 6601 6b09 eba1 6701 6b04
06d0  eba1 66ff afa0 d893 8864 8974 d893 f900
06e0  fb18 3f01 1742 27d4 f565 a67a d011 4f00
06f0  171c d011 d231 4f00 1732 d231 d451 4f00
0700  173a d451 afc0 d893 4601 78ff 4701 79ff
0710  46ff 7801 47ff 7901 d893 1692 6019 612d
0720  d011 27d4 f555 27be 7aff 27be 4a00 1778
0730  1692 621b 632d d231 1722 641d 652d d451
0740  1722 4800 175a 483d 1762 4900 176a 3925
0750  1692 281e 7e03 6901 1770 281e 7eff 683c
0760  1770 281e 7e01 6801 1770 281e 7efd 6924
0770  00e0 afc0 d893 161a f800 f818 78cf 1778
0780  6a30 6d2b 8b30 279a 8b20 279a 8b10 279a
0790  8b00 279a afd6 f355 00ee fb29 dcd5 7c04
07a0  00ee 6d00 6b01 6c00 dcd1 fb1e fa00 fd18
07b0  7c08 3c40 17a8 7d01 3d28 17a6 00ee 6c01
07c0  6d2b afcd fa33 f265 f129 dcd5 f229 7e04
07d0  dcd5 00ee 4e00 afda 4e01 afe0 4e02 afe6
07e0  4e03 afec 4e04 aff2 4e05 aff8 00ee 6d19
07f0  a63f c73f 3600 4700 17f0 87d5 3f00 463f
0800  17f0 d671 3f01 00ee d671 17f0 fb00 fe18
0810  d011 d231 d451 7b01 3b80 180c 00ee afd0
0820  f565 4e00 6001 4e01 6101 4e02 6201 4e03
0830  6301 4e04 6401 4e05 6501 afd0 f555 00ee
```

This game consists of six mazes which the player must traverse to obtain all the 1β dots the computer displays in random positions. When the game begins, the computer will display a cross 'x' in the middle of the screen. It will then randomly select a maze and display it. Three dots are randomly selected and will flash for about three seconds so that you can see where they are (although if you forget where the dots are, colliding into a wall will make the dots flash occasionally).

You can then manoeuvre the cross through the maze to obtain the dots. The counter on the bottom right will count from the time the dots first finish flashing through to the end of the game. The lower the counter number at the end of the game the better, as this game is a race against time. The score on the left counts down the number of dots as you obtain them. The game ends when either all 18 dots have been obtained or when the counter reaches 10 000.

The six mazes are set out as follows:



The above diagram shows, for example, that from maze 0, you can, through gates, exit and enter maze 1 from the right or maze 3 from the bottom, but you can't enter any maze from the left or the top. You can also enter maze 2 from the left of maze 3 and visa versa, even though by the diagram they are quite far apart. Once you have passed through a gate and are in the next maze, your 'x' will be on the opposite side of the screen. For example, if you go out a gate on the right of maze 4, you will end up on the left of maze 5.

You may find it necessary to exit a maze and approach it from another direction to obtain all the dots in the maze.

There are a few traps included in the program. Usually if you exit a maze through a gate you would expect to be able to get back through the same gate to the previous maze. But some gates are 'one-way' gates in which you may, for example, get from maze 1 to maze 0 to maze 1 through the same gate. In one of the mazes there is a 'dead loop' in which once you enter, you can't exit and your game has more or less ended.

MAZE 0

```
0840  ff ff ff ff ff ff ff ff
0848  80 00 40 40 00 40 00 43
0850  80 00 40 40 00 40 00 41
0858  80 00 40 40 00 40 00 41
0860  8f fc 44 47 fc 47 fc 41
0868  80 80 44 44 04 44 04 71
0870  80 c0 44 44 04 44 04 41
0878  80 80 44 44 04 44 04 41
0880  88 ff e4 44 44 44 44 41
0888  88 00 04 44 44 44 44 47
0890  88 00 04 44 44 44 44 41
0898  88 00 04 44 44 44 44 41
08a0  8f f8 04 04 44 44 44 41
08a8  80 08 04 04 44 44 44 71
08b0  80 08 04 04 44 44 44 01
08b8  80 08 ff fc 44 04 44 01
08c0  ff 88 80 80 44 04 44 01
08c8  80 88 80 80 44 7e 47 c1
08d0  80 88 80 80 44 40 40 41
08d8  80 88 88 8f c4 40 40 41
08e0  8a 88 88 88 04 40 40 55
08e8  8f 80 88 88 04 47 fc 7f
08f0  80 08 88 88 04 04 04 0b
08f8  80 00 88 88 fc 04 04 01
0900  80 00 88 88 7c 04 04 03
0908  ff 88 88 88 af fe 47 81
0910  80 08 08 08 00 00 40 83
0918  80 08 08 08 00 00 40 81
0920  80 08 08 08 00 00 40 ab
0928  8f ff ff ff c7 ff f8 ff
0930  88 00 00 00 00 00 08 00
0938  8c 00 00 00 00 00 18 00
0940  88 00 00 00 00 00 08 00
0948  8f 88 f8 f8 f8 f8 f8 81
0950  80 aa aa aa aa aa aa a1
0958  88 f8 8f 8f 8f 8f 8f 81
0960  80 00 00 00 00 00 00 01
0968  80 00 00 00 00 00 04 02 01
0970  80 00 00 00 00 00 00 01
0978  ff ff ff ff f1 ff 1f ff
```

MAZE 1

```
0980  ff ff ff ff ff ff ff ff
0988  80 80 80 08 00 00 00 21
0990  80 80 80 08 08 08 00 03
0998  80 80 80 08 00 00 00 01
09a0  08 88 88 88 88 80 e2 01
09a8  00 88 88 80 00 08 0a 83
09b0  08 88 88 80 80 80 00 01
09b8  80 88 85 80 00 00 80 81
09c0  f0 80 88 ff d2 80 00 8b
09c8  80 88 88 80 00 0a 08 00
09d0  80 80 88 80 00 40 08 80
09d8  80 88 88 80 00 40 00 00
09e0  8f 88 88 8f fc 40 08 01
09e8  80 08 88 8a ac 7f f0 01
09f0  80 08 88 08 00 0f e1
09f8  80 08 88 08 0c 00 00 11
0a00  ff f8 88 08 04 00 00 15
0a08  80 00 88 08 0f ff 80 11
0a10  80 00 8f ff 00 05 7e 11
0a18  80 00 80 aa 04 04 01 11
0a20  8f ff 80 00 00 04 01 10
0a28  80 00 00 00 0c 44 01 10
0a30  80 00 08 00 04 47 e1 10
0a38  80 00 08 42 ac 40 11 11
0a40  ff ff ff ff fc 40 11 11
0a48  80 85 28 58 10 40 11 11
0a50  80 0c 04 00 10 3e 11 11
0a58  80 80 00 08 10 01 01 11
0a60  88 04 04 01 10 01 01 11
0a68  80 00 43 00 11 01 01 11
0a70  00 80 00 80 11 11 83 11
0a78  08 00 40 40 11 10 fe 01
0a80  00 05 80 01 01 10 00 01
0a88  80 00 40 04 01 10 00 01
0a90  88 40 24 00 01 18 00 01
0a98  84 00 02 11 fe 0f ff ff
0aa0  80 04 00 00 00 00 00 00
0aa8  80 42 01 01 00 00 00 00
0ab0  80 04 20 00 00 00 00 00
0ab8  ff ff f1 ff 1f ff ff f1
```

MAZE 2

```
0ac0  ff ff ff ff ff ff ff ff
0ac8  80 00 06 82 08 42 08 01
0ad0  80 00 04 21 04 21 08 01
0ad8  80 00 02 00 08 00 08 01
0ae0  87 ff 84 01 04 21 88 f1
0ae8  88 00 40 20 18 10 08 81
0af0  88 00 40 10 04 01 08 81
0af8  88 00 40 21 08 10 00 81
0b00  88 04 46 00 01 00 00 8f
0b08  88 e0 40 00 00 00 80 81
0b10  88 80 40 02 00 08 08 81
0b18  88 60 46 14 11 00 08 80
0b20  88 10 40 01 00 00 88 f0
0b28  88 0c 44 00 00 10 08 80
0b30  88 08 46 00 10 00 80 81
0b38  87 07 e6 20 00 00 88 81
0b40  80 80 00 35 42 00 00 8f
0b48  81 80 04 16 a0 10 08 81
0b50  80 80 00 40 20 80 0a 81
0b58  ff ff fc 46 00 00 b8 81
0b60  00 00 00 40 00 01 00 f1
0b68  00 00 00 00 10 08 08 01
0b70  00 00 00 00 04 a0 00 01
0b78  f8 ff fe 02 00 00 08 01
0b80  80 80 04 40 40 00 ff ff
0b88  80 80 04 04 00 00 00 00
0b90  80 80 04 00 0c 08 00 00
0b98  85 07 e4 20 04 08 00 00
0ba0  8c 00 46 00 04 7f ff ff
0ba8  88 04 44 02 84 40 80 01
0bb0  84 40 44 20 04 40 00 01
0bb8  80 44 44 02 0c 40 00 01
0bc0  80 40 44 00 04 45 09 11
0bc8  80 40 46 02 04 40 08 01
0bd0  fc 40 44 05 44 40 00 01
0bd8  84 3f 84 21 04 44 40 11
0be0  84 00 04 00 04 40 00 01
0be8  84 00 04 00 04 40 00 81
0bf0  84 00 04 00 04 40 00 01
0bf8  8f f8 ff fe 7c 7e 7f ff
```

MAZE 3

```
0c00  ff ff ff ff ff ff 1f 8f
0c08  80 00 00 00 01 00 10 0b
0c10  80 00 00 00 01 00 10 01
0c18  80 00 00 00 01 00 10 03
0c20  8f fa 4a 92 5e 0f f1 01
0c28  80 20 01 00 00 10 11 43
0c30  80 20 01 00 00 10 10 eb
0c38  80 20 00 00 00 10 10 01
0c40  fe 21 e0 0f ff e1 10 01
0c48  e0 02 10 10 10 01 10 01
0c50  80 02 1f f0 00 01 0a 41
0c58  00 02 10 10 10 01 00 11
0c60  06 1e 00 01 00 ff 00 11
0c68  08 20 00 00 01 01 00 11
0c70  f0 20 01 01 01 01 ff 11
0c78  80 20 1f ff f1 01 00 00
0c80  80 41 eb 00 01 11 00 00
0c88  80 82 00 01 01 11 00 00
0c90  8f 03 01 00 01 11 09 14
0c98  80 02 00 11 1f 10 10 00
0ca0  80 07 10 00 01 10 10 00
0ca8  80 08 11 00 01 10 10 00
0cb0  fa 58 10 10 01 1f e1 11
0cb8  d0 10 11 0a 10 15 01 11
0cc0  80 10 f0 01 10 11 01 11
0cc8  00 10 10 01 10 11 01 11
0cd0  01 11 10 01 0f e1 0e 11
0cd8  03 10 0a 10 00 00 18 11
0ce0  81 11 01 10 00 00 10 11
0ce8  c3 11 01 10 00 00 10 11
0cf0  eb 11 01 0d 25 2f e1 11
0cf8  c3 11 11 00 00 00 00 11
0d00  81 01 11 00 00 00 00 11
0d08  03 01 11 00 00 00 00 11
0d10  01 01 10 fa b5 54 a9 51
0d18  03 fe 10 04 ba 55 4a a1
0d20  c0 00 10 00 00 00 00 01
0d28  80 00 10 00 00 00 00 01
0d30  e0 00 10 00 00 00 00 01
0d38  ff ff ff ff ff ff ff ff
```

MAZE 4

```
0d40  ff ff f1 ff 1f ff ff f1
0d48  80 00 e1 01 0f 0b c0 11
0d50  80 01 c1 01 07 81 80 11
0d58  80 00 81 01 03 03 00 11
0d60  88 0f 02 10 80 81 07 1f
0d68  82 10 04 10 40 40 08 0b
0d70  87 e0 08 10 20 20 10 01
0d78  82 00 10 38 18 10 10 01
0d80  86 01 e0 54 04 08 60 81
0d88  84 02 00 82 02 0a 81 c1
0d90  88 3c 01 01 01 07 01 e0
0d98  88 20 02 00 e0 82 02 10
0da0  88 40 3e 00 20 80 0c 00
0da8  88 80 40 10 10 40 14 01
0db0  88 83 c0 38 08 20 20 01
0db8  00 04 00 56 08 1f c1 03
0dc0  00 08 07 81 04 10 00 07
0dc8  00 08 04 03 82 10 00 0f
0dd0  28 f0 78 01 87 10 00 15
0dd8  00 00 80 0f 02 11 ff e1
0de0  00 00 e0 04 04 11 00 01
0de8  00 01 80 80 08 11 00 01
0df0  88 ff ff 80 10 21 00 03
0df8  88 78 40 40 60 41 10 e1
0e00  88 3c 00 20 80 81 05 40
0e08  88 08 00 15 01 02 1e 00
0e10  84 04 04 0e 02 04 08 10
0e18  82 03 06 07 0c 08 10 0f
0e20  81 80 81 02 00 10 20 01
0e28  c0 40 43 81 00 20 40 11
0e30  e0 20 41 c0 80 40 81 01
0e38  d0 78 22 a0 7f 81 02 11
0e40  80 04 00 10 00 02 04 01
0e48  80 44 00 38 00 04 08 10
0e50  80 02 00 1c 00 08 10 20
0e58  8f c3 ff ff ff f0 20 40
0e60  80 00 00 00 00 00 40 01
0e68  80 00 00 00 00 00 e0 03
0e70  80 00 00 00 00 01 c0 07
0e78  ff ff ff ff ff ff ff ff
```

MAZE 5

```
0e80  8f ff ff fc 7c 7c 7f ff
0e88  0d 40 10 84 00 00 40 01
0e90  08 00 40 44 40 04 40 03
0e98  0c 00 00 04 00 00 40 01
0ea0  f3 04 00 04 7f fc 44 41
0ea8  d4 00 04 04 00 00 40 03
0eb0  60 40 00 04 00 00 42 81
0eb8  c0 04 92 00 00 00 40 05
0ec0  80 00 00 03 ff ff c0 01
0ec8  c0 20 00 60 00 00 04 01
0ed0  82 00 00 20 00 00 01 01
0ed8  80 02 48 00 00 00 01 d1
0ee0  81 80 00 08 12 5a 40 81
0ee8  a0 08 02 00 00 00 10 01
0ef0  c1 00 00 00 80 00 00 81
0ef8  80 00 a0 84 00 00 00 05
0f00  80 10 00 00 02 49 08 01
0f08  81 01 08 00 00 00 80 81
0f10  8a 00 00 40 81 00 00 01
0f18  84 10 84 00 00 00 08 a1
0f20  81 00 00 04 10 08 80 81
0f28  80 08 40 40 00 80 08 01
0f30  80 00 04 00 08 08 88 81
0f38  90 82 80 00 00 80 80 21
0f40  00 00 00 40 80 00 08 81
0f48  00 20 08 00 08 08 80 81
0f50  08 00 00 84 00 80 08 01
0f58  80 09 20 00 00 00 80 85
0f60  82 00 00 08 50 08 00 01
0f68  80 00 02 00 01 00 88 01
0f70  e0 80 00 20 80 00 80 81
0f78  80 24 90 00 01 10 08 21
0f80  f8 00 00 20 08 01 00 01
0f88  88 00 00 00 00 00 00 81
0f90  8c 00 01 00 08 10 01 01
0f98  8a 94 a4 12 40 80 95 05
0fa0  80 00 00 00 00 00 00 01
0fa8  80 00 00 00 00 00 00 01
0fb0  80 00 00 00 00 00 00 01
0fb8  ff ff ff ff ff ff ff ff
0fc0  a0 40 80
```

The following is a guide to the program's construction:

0600-060d	Set counter to zero.
060e-0619	Draw X in middle of the screen. Pick a maze. Set score to 18.
061a-0621	Show score and counter.
0622-0639	Which maze has been picked?
063a-0673	Has maze been done before? (Hence have dots already been randomised?)
0640-064d	If it has then draw maze and dots. Flash dots.
0674-0691	If it hasn't then draw maze and randomise dots. Flash dots.
0692-06b7	Increase counter number by 1. If counter reaches 10 000 then end game.
06b8-06e1	Key pounding.
06e2-06e5	Has X collided with anything?
06e6-0741	If it has then has it collided with a dot? — which dot! Put dot between score and counter and decrease score by 1. If score reaches zero then end game. Go back to 0692.
0704-071b	If it has but not with a dot, then it must be a wall — so reverse out of wall. Go back to 0692.
0742-0751	If it hasn't then has it gone through a gate — which one? If not then go back to 0692.
0752-0777	This maze has already been done. Decide which maze the gate leads to.

▶	Erase previous maze. Put X in new position. Go back to 061a.
0778-077F	End game by continuous sound effects.
0780-07a1	Subroutine for displaying counter.
07a2-07bd	Subroutine for displaying maze.
07be-07d3	Subroutine for displaying score.
07d4-07ed	Subroutine for deciding which part of memory contains data for each maze.
07ee-080b	Subroutine for randomising dots.
080c-081d	Subroutine for flashing dots.
081e-083f	Subroutine for deciding which mazes have already been done.

THIS COLUMN is for those readers who own a microcomputer system that runs the "CHIP-8" language. This was developed for 8-chip 'trainer' micro systems, such as the RCA VIP (VP-111) system, Michael Bauer's 'Dream' and the ETI-660 Learner's Microcomputer (published in 1981). The CHIP-8 language is now also available for the popular MICROBEE, developed and distributed by Dreamcards of Melbourne.

A useful little newsletter for hobbyists running a CHIP-8 system is compiled, published and distributed by Frank Rees, 27 King St, Boort Vic 3537. For subscription details, send Frank a stamped, self-addressed envelope. Each issue contains software and hardware tips, games and utilities listings, etc.

ERRATA

The '3D Maze' program by Peter Easdown, published in the July 1984 issue, contained an error in the first paragraph of the text. The program does *NOT* require Bill Kreykes' high resolution modification to the '660 to work.

CHIP-8 CHARACTER GENERATOR

Peter Ball, Auckland NZ

Here is a routine for a character generator. It makes letters in a 5x7 matrix. The method used is to point the 'I' pointer at the data and then display it. This way of doing things uses up a lot of memory but it's easy to make changes and to add to or subtract from the character set.

Variables 3 and 4 point to the data while V5 and V6 are co-ordinates for the characters. If V3 is 00 it will point at 0722 and if it equals 01 then it will point to 0825. V4 sets the exact position of the data. This implies thatto print A, V3 should equal 00, so should V4. To print B V3=0, V4=07, and so.

```
Display Set
0600  650C 660C 630C 640C 270C 7407 3403 1614
 610  7301 6400 3423 161c 4301 161a 7506 353c
 620  1626 7608 6500 1608
Character Generator
0700  00ff 00ff 430C a722 4301 a825 00ff 00ff
 710  00ff 00ff 00ff 00ff 00ff 00ff f41e d567
 720  00ee 2050 8888 f888 88f0 8886 f088 c8f0
 730  7088 808c 8088 70f0 8888 8888 88f0 f880
 740  80f0 8080 f8f8 8080 f080 8080 7088 8080
 750  9888 7088 8088 f888 8888 f820 2020 2020
 760  f8f8 2020 2020 a0e0 8890 a0c0 a090 8880
 770  8080 8080 80f8 f8a8 a8a8 8888 8888 c8a8
 780  a898 8888 7088 8888 8888 70f0 8888 f020
 790  8080 7086 8838 8898 78f0 8886 f0a0 9088
 7a0  7088 8070 0888 70f8 2020 2020 2020 8888
 7b0  8888 8388 7088 8588 8888 5020 8888 88a8
 7c0  a8a8 f888 6850 2050 8883 8888 8850 2020
 7d0  60f8 0810 2040 80f8 e020 2020 2020 f870
 7e0  8810 2040 80f8 7085 0830 0888 7080 8c80
 7f0  8090 f810 f880 80f0 0808 f070 8880 f088
0800  8870 f808 1020 2020 2070 8888 7088 8870
 810  7888 8878 0808 0870 8898 a8c8 8870 7088
 820  0810 2000 2020 2020 2020 0020 e080 8080
 830  8080 e038 0808 0808 0838 0000 0000 0000
 840  2000 0000 0000 0000 ---------- ----
```

MASTERMIND

Peter Ball, Auckland NZ

The object of this game is to guess the secret code in the least amount of tries possible. First you have to press 'E' four times slowly. Then you should hear a beep. Any combination of six digits between 0 and 5 may then be keyed in. If you are not satisfied with your code, press any key apart from F and it will be erased. Pressing 'F' will tell the computer to accept the code. It will reply with two numbers beside yours. These tell you how many numbers you have correct in the right place, and how many you have correct in the wrong place.

```
0600  17aa 00ff 00ff 00ff 6500 6414 f60a f629
 610  d455 f70a f729 7404 d455 f80a f829 7404
 620  d455 f90a f929 7404 d455 fa0a 3a0f 1632
 630  164e 00ff 6414 f629 d455 f729 7404 d455
 640  f829 7404 d455 f929 7404 d455 160a a900
 650  f955 6b01 560c 6b00 3b01 1660 6006 6606
 660  6c01 5710 6c00 3c01 166e 6107 6707 6d01
 670  5820 6d00 3d01 167c 6208 6808 6e01 5930
 680  6e00 3e01 168a 6309 6909 8bc4 8bd4 8be4
 690  6a00 fb29 da55 84b0 6b01 5610 6b00 3b01
 6a0  16a8 6606 6107 16c8 6b01 5620 6b00 3b01
 6b0  16b8 6606 6208 16c8 6b01 5630 6b00 3b01
 6c0  16c8 6606 6309 00ff 6c01 570c 6c00 3c01
 6d0  16d8 6707 6006 16f8 6c01 5720 6c00 3c01
 6e0  16e8 6707 6208 16f8 6e01 5730 6c00 3c01
 6f0  16f8 6707 6309 16f8 6d01 5800 6d00 3d01
0700  1708 6808 6006 1728 6d01 5810 6d00 3d01
 710  1718 6808 6107 1728 6d01 5830 6d00 3d01
 720  1728 6808 6309 1728 6e01 5900 6e00 3e01
 730  1738 6909 6006 1758 6e01 5910 6e00 3e01
 740  1748 6909 6107 1758 6e01 5920 6e0c 3e01
 750  1758 6909 6208 1758 8bc4 8bd4 8be4 fb29
 760  7a06 da55 8f40 a900 f965 7506 3f04 160a
 770  6428 6520 f029 d455 f129 7404 d455 f229
 780  7404 d455 f329 7404 d455 6200 00ff 6101
 790  17a0 f200 f115 f118 f307 3300 1798 178c
 7a0  00ff 42ff 178a 7201 1792 650e 6000 00ff
 7b0  e5a1 17bc 7001 3006 17ae 17ac 6f20 ff15
 7c0  fe07 3e00 17c0 00ff 6100 00ff e5a1 17d8
 7d0  7101 3106 17ca 17c8 6f20 ff15 fe07 3e00
 7e0  17dc 00ff 6200 00ff e5a1 17f4 7201 3206
 7f0  17e6 17e4 6f20 ff15 fe07 3e00 17f8 00ff
0800  6300 00ff e5a1 1810 7301 3306 1802 1800
 810  6f20 ff15 fe07 3e00 1814 6f30 00ff 00ff
 820  ff18 00ff 00ff 00ff 00ff 1602 ---- ----
```

WORDS GAME

J. Murfet, Hadspen Tas.

This game is a development of a game sold in novelty stores in booklet form. Short stories are written with the key words missing. Without first seeing the story, you are to think up some interesting adverbs, nouns, adjectives etc. in the order asked and have them written in by a second person. The resulting completed stories can make hilarious reading.

This game is ideal for conversion to a computer program and I've done it like this. Firstly an array is set up from data to print examples of verbs, nouns etc. Then several subroutines are accessed by the program: ones clears a line after an input, one print a line across the screen, and one looks for a keypress. We then have the introduction followed by requests for the words, then the stories themselves with the variables in place ready for those words. After the required number of inputs is satisfied for each story it's printed, before going on to the next one. Finally in line 2230 there is a loop back to the start.

If you have a printer and want to use it on this game then add line 50 out#1 and change the print commands in the list to lprint.

FILE PROGRAM

M. Anderson, Doubleview WA

Here is a handy means of keeping track of programs or files stored on cassette tape.

The 'auto' line numbering facility usually causes most programs to start at line 100, thus enabling a short 'index' to be read from cassette without destroying the resident program. BASIC readily accepts the cassette as an interactive input medium (IN#3), so by using REM statements one can easily create an index file at the start of each side of every cassette, thus saving a great deal of frustration, wondering where to dump your new program! The heart of the program is line 12, which lists lines 1-12, and leaves a cntrl-Z at the end to redirect input back to the keyboard when the index is read back from cassette.

```
)1 REM TAPE NUMBER TWO
 - SIDE TWO (2)
)2 REM FILE :0
)3 REM FILE :1
 BOOT 5 TO 9 BOOT OPTIONS
)4 REM FILE :2
 BANNER 10 TO 20 PRINT BANNER
)5 REM FILE :3
)6 REM FILE :4
)7 REM FILE :5
)8 REM FILE :6
)9 REM FILE :7
)10 REM FILE :8
)11 REM FILE :9
)12 OUT #3:LIST,
 12:PRINT "END"↖CHR$(26):
 OUT #0:PRINT "↖G":END
)LIST

 INDEX     0 TO  4
```

WORDS GAME

```
00120 DIM Y1$(13):STR$(1000)
00130 FOR I=1 TO 13:READ Y1$(I):NEXT I
00140 GOTO 270
00150 FOR I=1 TO 13:PRINT Y1$(I):NEXT I
00160 RETURN
00170 FOR I=1 TO 63:CURS I,15:PRINT" ":NEXT I
00180 RETURN
00190 CURS 1,10
00200 FOR I=1 TO 64:PRINT"-";
00210 NEXT I
00220 RETURN
00230 CURS 1,1:Z1$=KEY:IFZ1$="" THEN 230
00240 CLS
00250 INVERSE:CURS 25,1:PRINT"DEAR ANALYST":NORMAL
00260 RETURN
00270 CLS:CURS 27,1:UNDERLINE:PRINT"WORDS GAME":NORMAL
00280 PRINT:PRINT"WORDS GAME (or HOW TO GET THE WIFE INTERESTED IN COMPUTERS) is
 "
00285 PRINT"the sort of game played by people who don't like to play games."
00300 PRINT:PRINT"You are asked to input a NOUN, ADJECTIVE, Etc. Then a story is
 "
00310 PRINT"printed containing your words."
00320 PRINT:PRINT"IF YOU WANT EXAMPLES OF WORDS ON THE SCREEN, PRESS 'Y' IF NO '
N'"
00330 Z1$=KEY:IFZ1$="" THEN 330
00340 IF Z1$="Y" OR Z1$="y" THEN LET A=1
00350 REM *** SET UP INPUTS FOR FIRST STORY ***
00360 CLS
00370 IF A=1 THEN GOSUB 150
00380 CURS 1,15:INPUT"ADJECTIVE";A1$
00390 GOSUB 170
00400 CURS 1,15:INPUT"NAME OF PERSON IN ROOM  ";C1$
00410 GOSUB 170
00420 CURS 1,15:INPUT"ADJECTIVE   ";A2$
00430 GOSUB 170
00440 CURS 1,15:INPUT"ADJECTIVE   ";A3$
00450 GOSUB 170
00460 CURS 1,15:INPUT"A COLOUR   ";V1$
00470 GOSUB 170
00480 CURS 1,15:INPUT"EXCLAMATION   ";H1$
00490 GOSUB 170
00500 CURS 1,15:INPUT"CLOTHING (PLURAL)   ";J1$
00510 GOSUB 170
00520 CURS 1,15:INPUT"NAME OF FEMALE   ";D1$
00530 GOSUB 170
00540 CURS 1,15:INPUT"PLURAL NOUN   ";F2$
00550 GOSUB 170
00560 CURS 1,15:INPUT"PART OF BODY   ";G1$
00570 GOSUB 170
00580 CURS 1,15:INPUT"ADJECTIVE   ";A4$
00590 GOSUB 170
00600 CURS 1,15:INPUT"PLURAL NOUN   ";F3$
00610 GOSUB 170
00620 CLS:REM *** PRINT STORY ***
00630 INVERSE:CURS 20,1:PRINT"GRUNYUN BEACH NUDIST CAMP":NORMAL
00640 PRINT:PRINT"How would you like good "A1$" holiday fun? Come to Grunyun Be
ach,hosted by that famous nudist "C1$" ."
00650 PRINT"You will be invited to take off your "A2$" clothes and join in the
"A3$" games with other "V1$" nudists."
00660 PRINT"'"H1$"'' you will say,'I'll never wear "J1$" again.'"
00670 PRINT"At Grunyun Beach you will meet "D1$" who will let you examine her "
F2$
00680 PRINT"You need have no fear of getting sand in your "G1$" as the camp has
 "A4$" showering facilities"
00690 PRINT"and after a few days you can brag about your golden brown "F3$"."
00700 CURS 1,1:REM *** TO STOP CURSOR REMAINING ON SCREEN ***
00710 Z1$=KEY:IF Z1$="" THEN 710
00720 CLS:IF A=1 THEN GOSUB 150
00730 REM *** SECOND STORY ***
00740 CURS 1,15:INPUT"A COMPASS DIRECTION     ";X1$
00750 GOSUB 170
00760 CURS 1,15:INPUT"NAME OF BOY IN ROOM   ";K1$
00770 GOSUB 170
00780 CURS 1,15:INPUT"NAME OF GIRL IN ROOM   ";L1$
00790 GOSUB 170
00800 CURS 1,15:INPUT"ROOM IN HOUSE   ";M1$
00810 GOSUB 170
00820 CURS 1,15:INPUT"PART OF BODY   ";G1$
00830 GOSUB 170
00840 CURS 1,15:INPUT"ADJECTIVE   ";A1$
00850 GOSUB 170
00860 CURS 1,15:INPUT"A LIQUID   ";N1$
00870 GOSUB 170
00880 CURS 1,15:INPUT"A COLOUR   ";V1$
00890 GOSUB 170
00900 CURS 1,15:INPUT"PART OF BODY   ";G2$
00910 GOSUB 170
00920 CURS 1,15:INPUT"PART OF CLOTHING   ";J1$
00930 GOSUB 170
00940 CURS 1,15:INPUT"PART OF BODY   ";G3$
00950 GOSUB 170
00960 CURS 1,15:INPUT"NOUN   ";E1$
00970 GOSUB 170
00980 CURS 1,15:INPUT"VERB  ";O1$
00990 GOSUB 170
01000 CURS 1,15:INPUT"VERB (PRESENT TENSE)   ";O2$
01010 GOSUB 170
01020 CURS 1,15:INPUT"PART OF CLOTHING   ";J2$
01030 GOSUB 170
```

WORDS GAME continued

```
01040 CURS 1,15:INPUT"NOUN      ";E2$
01050 GOSUB 170
01060 CLS:CURS 23,1:INVERSE:PRINT"A LOVE SCENE FROM THE MOVIE"
01070 CURS 26,2:PRINT"FAR "X1$:NORMAL
01080 PRINT"TO BE READ BY "K1$;" AND "L1$
01090 PRINT K1$;" - Why don't you come into my "M1$". I'll allow you to sit on my "G1$"?"
01100 PRINT L1$;" - All right if you pour me a "A1$" drink first. I'd prefer "N1
$
01110 PRINT K1$;" - Well, maybe later. Here let me kiss your beautiful "V1$" "G2
$
01120 PRINT L1$;" - No you'll only press my "J1$" with your "G3$
01130 PRINT K1$;" - But all I want to do is blow on your pink little "E1$" and "
O1$" you."
01140 PRINT L1$;" - Okay. If you don't "O2$". I'll take off my "J2$
01150 PRINT K1$;" - But you'll be perfectly safe. I'll wear a "E2$"."
01160 CURS 1,1
01170 Z1$=KEY:IFZ1$="" THEN 1170
01610 REM *** FOURTH SECTION, IN FOUR PARTS ***
01620 CLS
01630 IF A=1 THEN GOSUB 150
01640 CURS 1,15:INPUT"ADJECTIVE   ";A1$
01650 GOSUB 170
01660 CURS 1,15:INPUT"VERB (PRESENT TENSE)   ";O1$
01670 GOSUB 170
01680 CURS 1,15:INPUT"A NUMBER   ";T1$
01690 GOSUB 170
01700 CURS 1,15:INPUT"NOUN   ";E1$
01710 GOSUB 170
01720 CURS 1,15:INPUT"VERB ENDING IN 'ING'   ";U1$
01730 GOSUB 170
01740 CURS 1,15:INPUT"NOUN   ";E2$
01750 GOSUB 170
01760 CURS 1,15:INPUT"A LIQUID   ";N1$
01770 GOSUB 170
01780 CURS 1,15:INPUT"A COLOUR   ";V1$
01790 GOSUB 170
01800 CURS 1,15:INPUT"VERB ENDING IN 'ING'   ";U2$
01810 GOSUB 170
01820 CURS 1,15:INPUT"ADJECTIVE   ";A2$
01830 GOSUB 170
01840 CURS 1,15:INPUT"NOUN   ";E3$
01850 GOSUB 170
01860 CURS 1,15:INPUT"ADJECTIVE   ";A3$
01870 GOSUB 170
01880 CURS 1,15:INPUT"ADJECTIVE   ";A4$
01890 GOSUB 170
01900 CURS 1,15:INPUT"VERB ENDING IN 'ING'   ";U3$
01910 GOSUB 170
01920 CURS 1,15:INPUT"NOUN   ";E4$
01930 GOSUB 170
01940 CURS 1,15:INPUT"PART OF BODY   ";G1$
01950 GOSUB 170
01960 CLS:GOSUB 250
01970 CURS 1,5:PRINT"QUESTION"
01980 CURS 1,7:PRINT"How many times a week should a "A1$" couple "O1$"?"
01990 GOSUB 190
02000 CURS 1,11:PRINT"ANSWER"
02010 CURS 1,13:PRINT T1$" times."
02020 GOSUB 230
02030 CURS 1,5:PRINT"QUESTION"
02040 CURS 1,7:PRINT"If a man gets a rash on his "E1$", should he stop "U1$"?"
02050 GOSUB 190
02060 CURS 1,11:PRINT"ANSWER"
02070 CURS 1,13:PRINT"No. He should soak his "E2$" in warm "N1$" until it turns
"V1$
02080 GOSUB 230
02090 CURS 1,5:PRINT"QUESTION"
02100 CURS 1,7:PRINT"If a wife sleeps with her husband while "U2$", will she get
 a "A2$" "E3$"?"
02110 GOSUB 190
02120 CURS 1,11:PRINT"ANSWER"
02130 CURS 1,13:PRINT"Of course!"
02140 GOSUB 230
02150 CURS 1,5:PRINT"QUESTION"
02160 CURS 1,7:PRINT"My husband likes to eat "A3$" food."
02170 PRINT"I like "A4$" food. What should we do?"
02180 GOSUB 190
02190 CURS 1,11:PRINT"ANSWER"
02200 CURS 1,13:PRINT"Try "U3$" his "E4$" with your "G1$
02210 GOSUB 230
02220 CLS:CURS 25,7:UNDERLINE:PRINT"END OF PROGRAM"
02230 CURS 4,9:PRINT"DO YOU WISH TO PLAY AGAIN? TYPE 'Y' FOR YES, 'N' FOR NO":ND
RMAL
02240 Z1$=KEY:IF Z1$="" THEN 2240
02250 IF Z1$="Y" OR Z1$="y" THEN 350
02260 END
02270 DATA "ADJECTIVES - JUICY. HEAVY. THICK. PINK. ROUGH. ENORMOUS. RANCID"
02280 DATA "ADVERBS - SLOWLY. GREEDILY. LOVINGLY. SMACKINGLY. SUMPTUOUSLY."
02290 DATA "NOUNS - ORGAN. POCKET. STRAP. BOTTLE. THIGH. THONG. DONKEY."
02300 DATA "PART OF BODY - NAVEL. KIDNEY. ARM-PIT. BUTTOCK. NIPPLE."
02310 DATA "EXCLAMATION - DRAT. BALDERDASH. HIMMEL. "
02320 DATA "CLOTHING - COAT-TAIL. SPOD-COLLAR. NICKERS. COD-PIECE. SHOE."
02330 DATA "A LIQUID - POND-WATER. GRUEL. CUSTARD. SYRUP OF IPEKAC."
02340 DATA "A SILLY WORD - GROMMET. FUTTOCKS. BILIOUS. FROND."
02350 DATA "A BIRD - EMU. DODO. MALLARD-DUCK. VULTURE."
02360 DATA "A VEGETABLE - BRUSSELL-SPROUT. PEA. ARTICHOKE."
02370 DATA "AN INSECT - TSETSE-FLY. MAGGOT. DRAGON-FLY."
02380 DATA "VERB - SALIVATE. PROD. WRITHE. SPANK. SUCK."
02390 DATA "SOMETHING STICKY - BOIL-OINTMENT. MOLASSES. FLY-PAPER."
```

DUAL WINDOWS

D. J. Whyatt, Sth Plympton SA

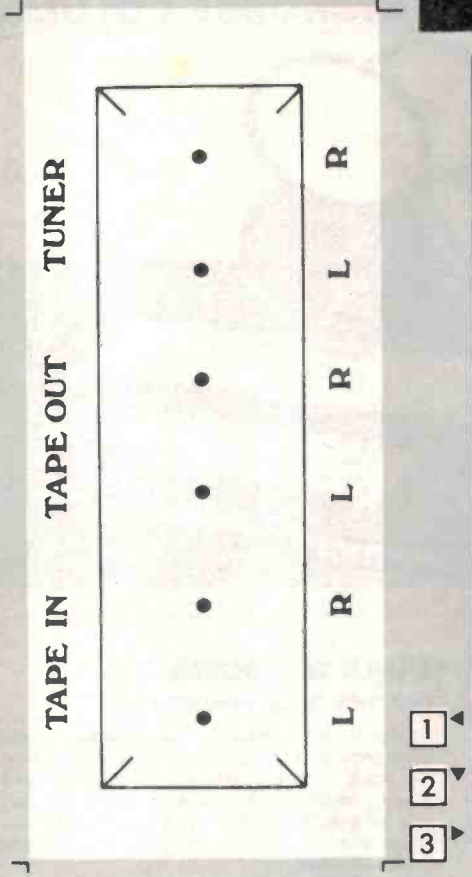
No doubt many readers have seen examples of the latest generation of multi-screen computers such as the Apple Lisa and Macintosh. For those who haven't, these computers allow the user to view several 'windows' from different programs on the screen at one time. This effect can be simulated to a degree on the Microbee.

The program listed here will place the normal BASIC 64x16 window in the top half of the screen. The bottom half then displays the contents of the presently unused portion of the screen RAM. This is another 64x16 window.

The alternate screen is obtained by POKEing 75 in location 218 of the video 6545 register table (normally 72) and RESETing to allow the video chip to read the new values. Line 110 of the listing does this by testing PEEK(218)=72, and if true, POKEing the RESET jump address to RUN on a warm start and replacing 72 with 75. The USR(32768) then performs a RESET and the program reRUNs. This time, PEEK(218)=72 is false, so the program continues. The altered locations are restored, and another call to USR(32768) will END the program and return the screen to normal.

Writing in this window is simply a matter of POKEing ASCII character codes directly into the screen RAM. Line 130 does this to clear the screen. To print "String" at position 20,7 a call is made to the subroutine at 240 with parameters [20,7,"String"]. This screen format can be used to allow on-screen program instructions, help files or any relatively static display.

```
00090 rem       DUAL WINDOWS
00100 cls
00110 if peek(218)=72 then poke 162,30:poke 163,128:poke 218,75:
usr(32768)
00120 poke 162,33:poke 163,128:poke 218,72
00130 for I=62464 to 63488:poke I,32:next I
00140 for I=1 to 64:gosub [I,1,"*"] 240:next I
00150 for I=2 to 15:gosub [64,I,"*"] 240:next I
00160 for I=64 to 1 step -1:gosub [I,16,"*"] 240:next I
00170 for I=15 to 2 step -1:gosub [1,I,"*"] 240:next I
00180 gosub [18,7,"This is the fixed window."] 240
00190 gosub [18,12,"Press any key to exit ..."] 240
00200 speed 20
00210 print "|"tab(16)"This is the scrolling window."tab(64)"|"
00220 K1$=key$:if K1$="" then 210
00230 speed 0:usr(32768)
00240 rem
00250 rem * * * String Printer * * *
00260 rem
00270 var(X,Y,Z1$)
00280 if X<1 or X>64 or Y<1 or Y>16 or Z1$="" then return
00290 X=(Y-1)*64+(X-1)+62464
00300 for Y=1 to len(Z1$):poke Y-1+X,asc(Z1$(1,Y)):next Y
00310 return
```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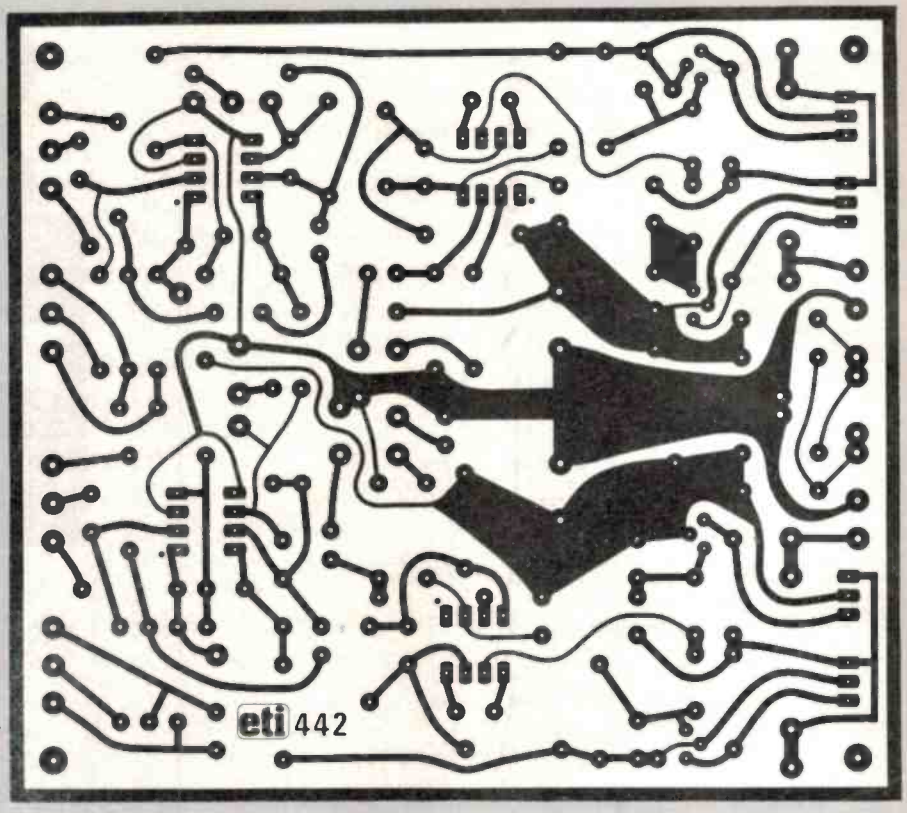
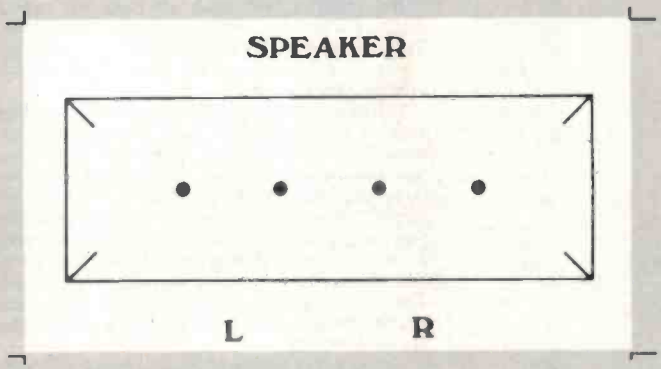
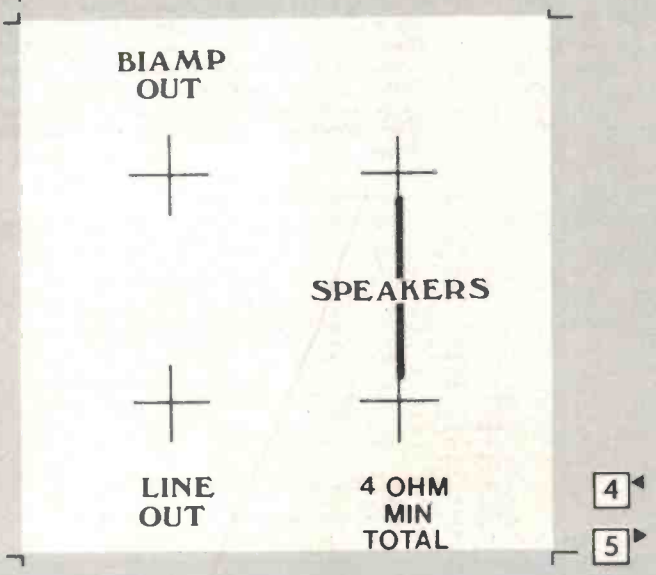
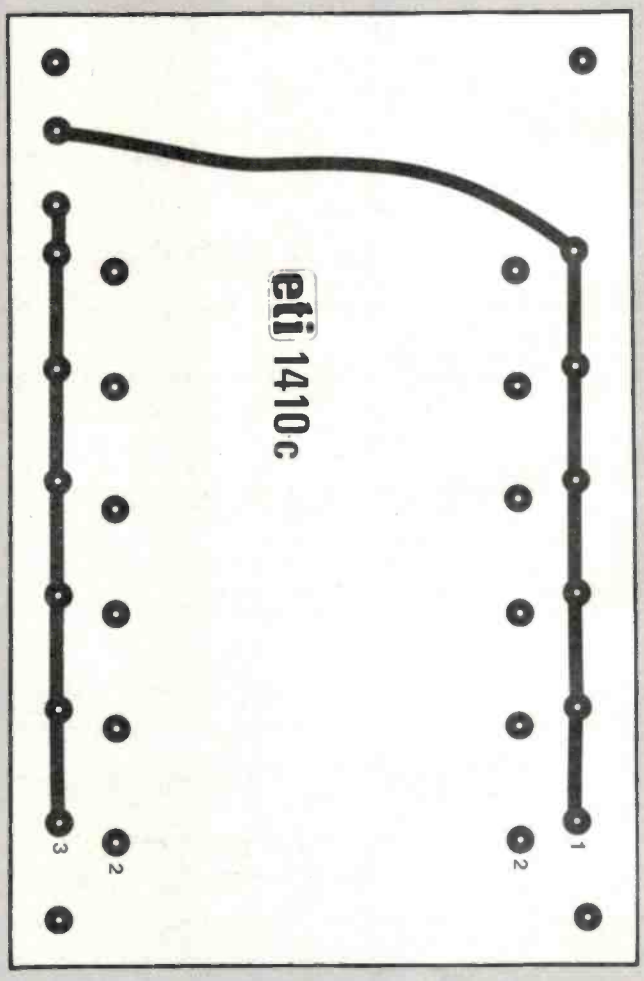
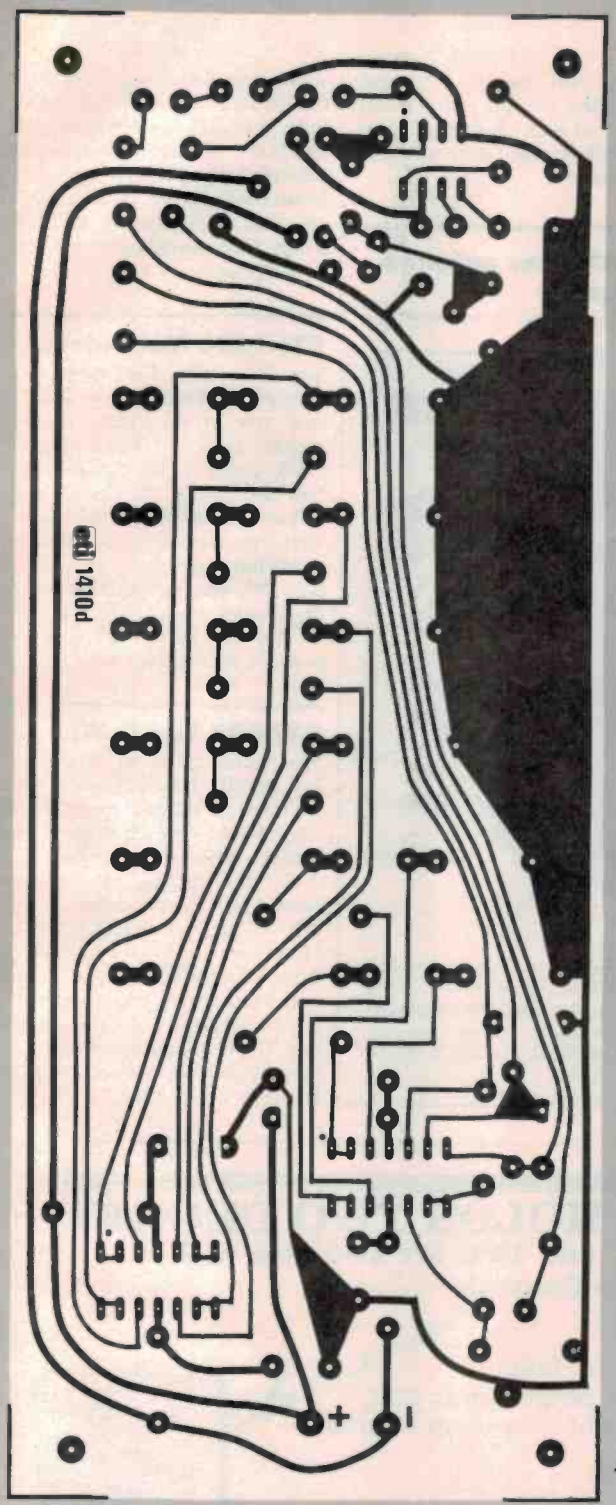
TAPE OUT
TUNER
L R L R L R
1
2
3

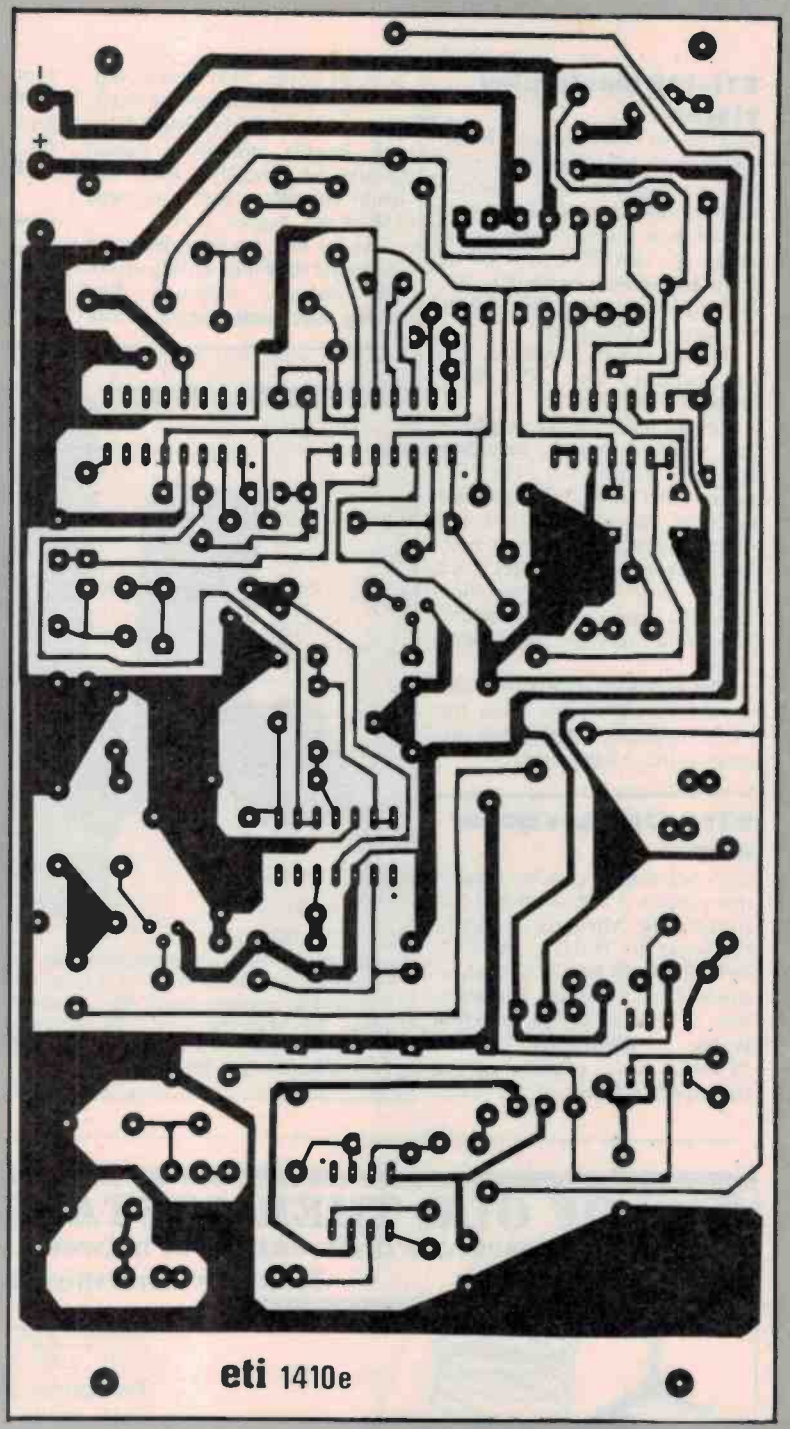

eti 442


SPEAKER
L
R


BIAMP OUT
SPEAKERS
LINE OUT
4 OHM MIN TOTAL
4
5


eti 1410c
3
2
2
1





◄6 7►

Project 442: 'MASTERPLAY' STEREO
page 84

1. 442 rear panel tape in/tape out/tuner
2. 442 rear panel speaker
3. 442 pc board artwork

Project 1410: GUITAR BASS AMP
page 68

4. 1410 rear panel biamp out/line out/speakers
5. 1410c pc board artwork
6. 1410d pc board artwork
7. 1410e pc board artwork

ETI-442 Masterplay stereo

The 'heart' of this project is the BSR turntable with tone arm and ceramic cartridge. Distributed by Jaycar, you can get it in any of their Sydney stores, catalogue no. AA-0290, as well as from **Altronics** in Perth (cat. no. A-0612). You need the 12 Vdc version (it's cheaper).

Jaycar will be kitting up for the project, and it's likely **Altronics** will, too.

All the parts for the amplifier are widely stocked, including the 6672 transformer. The IEC mains cord and socket are not essential, but it's the safest way of getting power into the box. Both **Jaycar** and **Altronics** stock these items as part of their standard range of components. Some other retailers stock them, also.

The pc board and front panel should be obtainable from the usual suppliers, listed in this column in the August issue.

ETI-1410 Bass guitar amp.

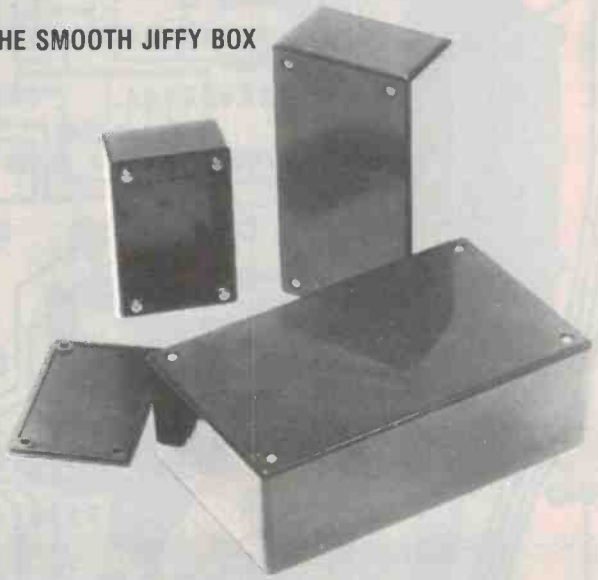
The rack-mount case we used in this project is imported and distributed by **Altronics** in Perth, catalogue no. H-0413. The ETI-499 150 W MOSFET module is stocked as a kit by **Altronics**, too, as well as **Jaycar** and **Rod Irving Electronics**. The PF4361/1 is a popular power transformer (used in the ever-popular Series 5000 stereo amp, amongst other projects of ours). It is stocked widely. Printed circuit boards and front panels should be available from the usual suppliers, listed on page 158 of the August issue.

As for kits, no firms have yet indicated they'll be kitting up for this project, although **Rod Irving Electronics** might. Rock around and pester the man behind the counter, you never know your luck. You might also try **All Electronic Components** in Melbourne.

ETI-337 Car antenna controller

All the parts for this project are what you call 'bog standard'. Constructors should experience little difficulty in obtaining all the parts. It's likely **Dick Smith Electronics** and **Rod Irving Electronics** will kit up for the project. You might also try **All Electronic Components** components in Melbourne.

THE SMOOTH JIFFY BOX



Perth-based importer/distributor/retailer extraordinaire, Altronics, has recently improved its range of popular ABS plastic jiffy boxes with these 'smoothies' featuring plastic lids as opposed to the usual thin aluminium ones. They carry the same internal board guides and the snap-in ledges as the other types. Full details from **Altronics, Box 8280, Stirling St, Perth WA 6000.** Dress up that messy project!

ETI-1524 Mousetrap

Yes, it works, but we're not divulging the score! It went for a trial run in the midst of the plague belt at Glenn Innes, NSW, recently. We made a boo-boo describing the dump capacitor, though we got the manufacturers correct. It is in fact a **metal foil** type, not a metallised type. We understand **Dick Smith Electronics** are offering a kit for it. Try **All Electronic Components** in Melbourne, too.

ETI-807 Tug-O-War

We should have made it clear last month, but simply because we knew, it escaped us, that you don't have to use LS chips in this project. The 'ordinary' 74 series TTL will work fine. As we mentioned last month, some of the devices are not widely stocked. However, several suppliers pride themselves on the depth and breadth of their semiconductor stocks — notably **Jaycar** and **Geoff Wood Electronics** in Sydney and **Ellistronics** and **Rod Irving** in Melbourne.

CONNECTORS

Banana plugs

Banana plugs are one of the most well regarded options for temporary connectors. These consist of a pin with spring metal sides (the banana) which fits into a metal socket called the binding post. The binding post has a screw bottom to secure the post and a plastic thumb nut on top. Often the post has a lateral hole in it to facilitate the connection of probes. Flying leads can be connected under the thumb nut.

To increase their flexibility even further it is possible to buy banana plugs in which the plug has a socket on its back, so that plugs can be stacked ('piggybacked') one on top of the other to make multiple connections.

While banana plugs are an enormously flexible connection system, they do have the disadvantage that the quality of the contact depends on the force of the spring contact in the barrel. When this wears the force diminishes and intermittent contact, or miscontact is the result.

A variation of the plug is the 'GR' plug, designed by the US General Radio corporation. It consists of a rectangular insulating body holding two banana plugs spaced 0.75" (19 mm) apart. Like the piggyback banana plugs, integral sockets behind the plug pins permit stacking of GR connectors. The cable is secured by the plug body and grub screws in the side of the pins at the body provide termination of the wire.

SUPPLIER'S INDEX

This list is intended as a guide to suppliers of connectors and is based on information supplied from the companies listed. We make no claims that this is a 'definitive' list.

Altronics, 105 Stirling St, Perth, WA 6000. (02)328-1599 and toll-free (008)999-007. A mail-order wholesaler and distributor with one retail store in Perth and a huge number of widely distributed re-sellers. Offers a huge range of components particularly for the hobbyist market. Has most of the common types of connector available covering RF, audio, ac and dc power, pc board and computer types (stocks a range of useful IDC connectors).

Amtron Tyres, 176 Cope St, Waterloo NSW 2015. (02)698-9666. Manufactures a range of edge connectors and distributors for Amphenol of the US. Huge variety of types available under the Amphenol name.

Audio Telex Communications, PO Box 421, Parramatta NSW 2150. (02)633-4344. Audio Telex is the Australian distributor for Switchcraft connectors of the US, a well-known and respected name in the audio and sound reinforcement industries. Switchcraft manufacture a range of XLRs, DIN and general audio type connectors.

AVH Electrical Engineering, PO Box 102, Prahran Vic 3181. (03)51-6844. AVH handle a range of German manufactured printed circuit board mounting blocks — the Wieland Bamberg range. These are available in banks with between one and twenty terminals.

Benelec, PO Box 21, Bondi Beach 2021 NSW. (02)665-8211. Electronic and electrical component and equipment distributors. They stock a range of over 200 connectors from RF types (UHF, N, BNC, PAL) to audio (XLR, tip-ring-sleeve, multipin) to DIN types and power connectors. Offer a consulting service on connector problems and applications. They are not tied to a single manufacturer but are prepared to source product to suit customer's needs, they claim.

C&K Electronics, 15 Cowper St, Parramatta NSW 2150. (02)635-0799. Distributors of Lorlin subminiature connectors from the UK, IMO screw terminals as well as range of electronics hardware.

Coltronics, 8 Gipps Road, Greystanes NSW 2145. (02)636-7111. A distribution house that specialises in connectors and soldering irons. They also run instruction courses for the RAAF. Their main contribution to the connector stakes is the Teradyne range. Teradyne is a US-based manufacturer who specialise in connection systems for printed circuit assemblies.

Connect Electronics, 22 Punch St, Artarmon NSW 2064. (02)437-6224. As well as being a supplier of a large range of connectors, Connect also has a custom cable assembly facility. This allows a customer to specify a particular cable and connector, which is then supplied as a single unit.

Dick Smith Electronics, PO Box 321, North Ryde NSW 2113. (02)888-3200. One of the largest retail hobby stores in the country and a very large importer and wholesaler. DSE carries a huge range of components including quite a wide selection of connectors covering audio, RF, multipin, ac/dc power, pc board and computer types.

East West Electronics, 16/20 Henley Rd, Homebush NSW 2140. (02)763-1588. East West commenced operation in 1981 as AMP connectors in Melbourne. The company has grown significantly since then, although they still specialise in off-the-shelf supplies of AMP connectors.

STC-Cannon, 248 Wickham Rd, Moorabbin Vic 3189. (03)555-1566. Cannon, the original manufacturer of XLR-type connectors and still going strong, is now a subsidiary of the giant multi-national ITT company who own STC here. STC-Canon is one of a small number of domestic manufacturers in this country. STC-Cannon stock a huge variety of connectors for all sorts of applications from a variety of manufacturers, apart from Cannon, including pc board types, MS types, multipin types in multifarious configurations, pc board (IL) types, computer connectors (lots of ICDs) etc, etc.

Jaycar, PO Box 185, Concord NSW 2137. (02)745-3077. A Sydney-based importer/wholesaler/distributor with four retail stores in the Sydney area catering for the hobby and professional markets. Jaycar stocks a large range of connectors for audio, computer, RF, ac/dc power and pc board applications.

John Barry Group, 27 Hotham Parade, Artarmon NSW 2064. (02)439-6955. A large and rapidly expanding electronics importer. For the last few years they have been distributing LEMO connectors from Switzerland. Their major customers are Telecom and L.M. Ericsson. LEMO connectors can be obtained to meet special requirements in size and configuration and can be made to customer's specifications, ordered through the John Barry Group.

Lawrence and Hansen, 142 Dorcas St, Melbourne Vic 3000. (03)697-1599. Distributors of a wide range of electrical and electronic parts and equipment. They have recently begun distributing Krone connection systems throughout the country.

Pegasus Components, 59 Malvern St, Bayswater Vic 3153. (03)720-2711. Pegasus are distributors for the AB range of components. These include the AB-MS circular connectors which conform to the environmental requirements of MIL C 5015, the AB-05 minuature bayonet type, as well as a complete range of D-type subminiature connectors. Included in this category is a locally made, low-cost universal Junction shell.

Promark Electronics, 366 Whitehorse Rd, Nunawading Vic 3131. (03)878-1255. Distributes Siemens and Assmann connectors for computer, audio and printec circuit board applications.

Pandult, PO Box 153, Mordialloc, Vic 3195. (03)587-1033. Panduit is marketing half-sized Euro connectors in Australia. These are DIL types that meet appropriate DIN, IEC and MIL specifications. They come with terminals designed for save soldering, hand soldering or wire wrapping.

R. H. Cunningham, 146 Roden St, West Melbourne Vic 3003. (03)329-9633. Distributors of the Swiss Neutrik connectors, including the XLR-compatible NC3MX and FX 3-pin connectors.

Rod Irving Electronics, 425 High St, Northcote Vic 3070. (03)489-8131. A large Melbourne-based importer, distributor and retailer. He has a very large selection of components in stock including a wide variety of connectors for most applications. Specialises in IDC and pc board connectors.

RS Components, 30 Northwood St, West Leederville WA 6007. (09)381-4799. Radiospares is a West Australian-based mail order distributor with a very large range of components for professional and amateur use. Its range of connectors is also very extensive, with all the major classifications listed in this article available. A branch has been set up in Sydney for the convenience of east coast customers.

Swann Electronics, 151 Forster Road, Mt Waverley Vic 3149. (03)544-3033. Swann supply a wide ragne of automotive, edge and in-line connectors. They can supply 16, 24, or 32-way low insertion and withdrawal force connectors. Other types by Swann include slimline, strip pin, Q range and Con range connectors.

Technico Electronics, 67 Mars Road, Lane Cove NSW 2066. (02)427-3444. Distributors of a wide range of electronic goods. They're part of the Philips group of companies. Their main connector products come from Belling-Lee in the UK. As well as the 75 ohm TV coax connectors, Belling-Lee make a wide range of other types including DIN, BNC, SMA pin headers and edge connectors of all types.

Warburton Franki, PO Box 117, Lidcombe NSW 2141. (02)647-2266. Warburton Franki are well known as distributors of a wide range of products of an electrical/electronic nature. Their entry into the connector market is the Phonix connector system. It is intended primarily for connections in motor control, switchboards and control desks. The screw connections are designed according to the Reakdyn Princple, so that when the screws are tightened the extra force exerted pulls the sides of the terminal in instead of out. This makes it impossible to strip the thread or the locating plate. ●

MINI-MART

For Sale/Wanted/ Swap/Join

MISCELLANEOUS

WANTED: SERVICE MANUAL for Technics M228X cassette deck. Also any non-working KAGA PAL monitors or circuit boards for spare parts. B. Connors, 4 Jensen St, Gunnedah NSW 2380. (067)42-2398.

FOR SALE: SWL REPORT FORMS designed for maximum information at your listening post. Give real meaning to your DX reports. Details from Derek Rout, 3/137 Champion St, Christchurch New Zealand.

REPAIRS, modifications or building of ETI, EA projects. Even custom designs. Andrew Newcombe (062) 47-7601. 66 Gellibrand St, Campbell ACT 2601.

WANTED: DATA SHEETS and any info for the Western Digital WD2793PL-02 FDC IC as used in the Microbee. T. Shaw, 4 Clunie St, Lindisfarne Tas 7015.

WANTED: CIRCUIT DIAGRAM or other service data for Mu Fong MF504 logic probe. Will refund costs C. Fletcher, 46 Toongabbie Rd, Toongabbie NSW 2146. (02)631-5037.

EMPLOYMENT: Student looking for part time work in Western suburbs or Melbourne city in electronics or computers. Enthusiastic. Please write to W. Wilson, 25 Curlew Avenue, Altona 3018.

VIDEO

VIDEO GEAR. To be sold as one lot or individual items. Sony video recorder AV3670CE (red), Sony video camera AVC3250CE with viewfinder (needs new tube?), Gijinon zoom lens (1:2, F = 14-70 mm), Slik Professional Design II tripod dolly, two camera cables CCF-25; National video recorder NV3020E; Sony-matic portable video recorder AV3420CE, Sony video camera AVC3420CE (needs tube?) with one standard lens and two others (inc. zoom 1:1.8, F = 12.5-75 mm), extension camera cable; Sony camera adaptor CMA-3CE, Sony video camera switcher CMS110CE, Sony ac power adaptor AC3420CE, three Sony monitors CVM110VZ (11"). Say, $900 the lot ONO. Phone Roy Zimmerman, bh (02)560-5355, ah (02)560-5647.

COMPUTERS

FOR SALE: SORCERER Disk drives for FDS/ Micropolis systems $499 and $525. WordPac $139, DevPac $99, DIGITRIO Controller $499. (02)452-4014.

FOR SALE: SOLUTION to 'Voodoo castle' send $5 to Terry Wilkinson, 154 Dalgarno St, Coonabarrabran NSW 2357.

FOR SALE: TANDY MC-10 computer, brand new, $750 ono. ETI-660 colour 3K computer, all programs $60. Tiny BASIC compiler cassette for C-64 $20. Ben Begg, (08)31-0310.

FOR SALE: VIC-20 program library. High quality games, utilities, educational and miscellaneous programs available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson ACT 2602 for list.

FOR SALE: SS-50 56K 2MM computer $500. 5/5 MB hard disk and eight inch floppy with flex O/S for above $600. Telerap 3300 VDU $250. Teletype ASR33 $75. Keyboard and VDU card $120. Best offers or $1200 the lot. J. Delforno, Lot 2, McGeorge Road, Gisbourne South Vic 3437.

FOR SALE: MICROBEE SOFTWARE. Ms Packman. Excellent graphics, three different mazes, floating fruits. Send $15 plus postage to Khanh Doan, 718 Beauford St, Mr Lawley WA 6050.

AUDIO

HEADPHONES: Sennheiser HD30 stereo. Finest quality sound reproduction. Comfortable wearing. Cost $119, sacrifice at $60. Test welcome. Brian Proctor (02) 579-6867 after 7pm.

MICROPHONE: Realistic switchable wide/narrow angle stereo electret, mounted on desktop base. Cost $78, sacrifice at $40. Test welcome. Brian Proctor (02)579-6867 after 7pm.

COMMUNICATIONS

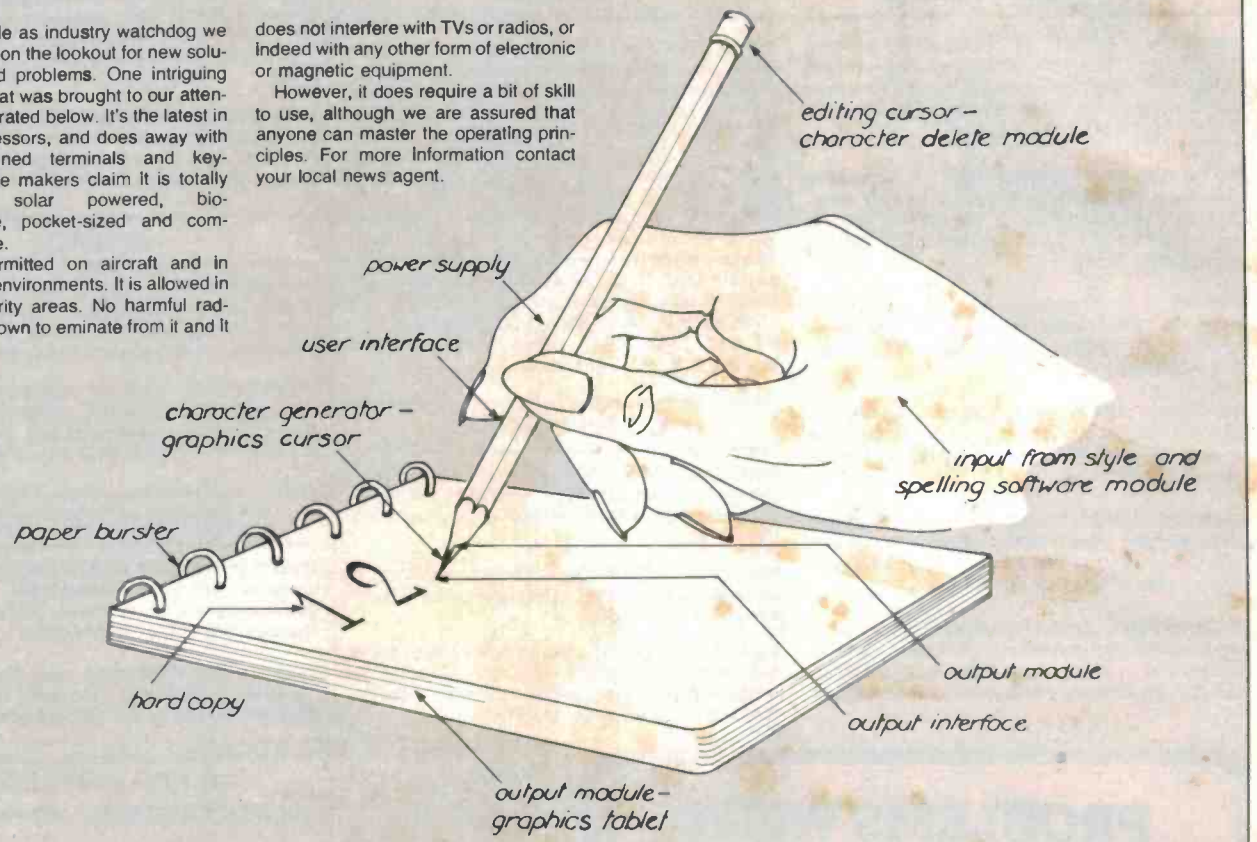
WANTED: QUALITY OLDER COMS RX Trio 9R preferred but others considered. Must be in good condition. Kerry Power, 93 Beryl St, Coffs Harbour NSW 2450. (066)52-7497.

WANTED: AM/FM TUNER with broadband AM. Typically Audiosound T751 John Vasar, 4 Alice St, Padstow NSW 2211. (02)477-6444.

In our role as industry watchdog we are always on the lookout for new solutions to old problems. One intriguing example that was brought to our attention is illustrated below. It's the latest in word processors, and does away with old fashioned terminals and keyboards. The makers claim it is totally portable, solar powered, biodegradable, pocket-sized and completely safe.

It is permitted on aircraft and in explosive environments. It is allowed in most security areas. No harmful radiation is known to eminate from it and it does not interfere with TVs or radios, or indeed with any other form of electronic or magnetic equipment.

However, it does require a bit of skill to use, although we are assured that anyone can master the operating principles. For more information contact your local news agent.



Off the rails

From time to time in this column, we have a little dig at the computer industry's penchant for word contractions and acronyms, not to mention the industry's other foibles. Just to show that (a) we're not biased (against them, that is), and (b) we do look at literature other than that about electronics/computing, etc, this month we've got a story that emanates from the Victorian State Public Service.

Premier Cain's new Government got stuck into 'responsible economic management' pretty shortly after they got into power. An early priority was the public transport system. Following a searching review, the lumbering state railways, known for years as "Vicrail", was split into two separate divisions: *Metropolitan* and *Country*.

As the Victorian State Government Railways was earlier shortened to "Vicrail", why not apply the same marketing strategy to the two new divisions? After all, trying to fit "Victorian Metropolitan Railways" onto the sides of carriages, advertising signs etc, presents some difficulties. Shorter words are more economical, too. Hence, the metropolitan railways are called "Metrail".

The public servants have yet to announce a title for their country rail division.

Never give a sucker a break

Those of us who observe the industry know that it runs on a small number of fundamental rules. The most basic of all is: never give a sucker an even break. Its refreshing to know that its the same all over the capitalist world. But things are a little different in China, where they have all kinds of silly notions about honesty being the best policy.

These thoughts were provoked by the story we found in Businessweek magazine. It seems that the Chinese have been trying to get a foothold in the capitalist markets of Hong Kong, pending their takeover in 1997. Electronics companies, with their technological expertise are highly regarded possessions, so it came as no surprise to anyone when two of Hong Kong's most prominent Peking-backed companies spent US$22.8 million to buy a 34.8% interest in Conic Ltd, makers of TV sets and fancy telephones.

There were a number of motivations for the sale. One was that the Chinese wanted to prove to an increasingly jittery Hong Kong business class that they could manage a capitalist industry efficiently. The other closely related reason was to try and prevent the steady erosion of the Hong Kong economy as 1997 and communist take-over approach.

But the poor old Chinese had reasoned without Mr Au. Alex Au was the chairman of Conix, and what we in Australia would refer too as a 'prominent racing identity'. When trading in Conix was suspended in May, it was revealed that Alex had managed to sell his Conix stock to the commies for US$10m, and had then done a bunk with loans from the Conix company worth US$27.8m.

The Chinese were understandably surprised by this development. They accused the now dissapeared Mr Au of overstating the earnings of Conix, poor financial control and ineffective management. The company actually lost US$48m last year on sales of US$157m. Doesn't this sound familiar?

The story from Businessweek doesn't say where Mr Au was heading, but we can take a few guesses. If you see a dapper looking gent walking down the street with two heavy suitcases, take him seriously.

ERRATA

Printers feature (July 1984 issue): In the list of distributors given at the end of this feature, Polykit Electronics was shown correctly as distributors of CP-80 and Juki 6100 printers. However, Polykit Electronics has advised that it has no direct connection with Rod Irving Electronics or C-Tech, which are separate companies.

If they started the FM revolution without you, make sure you don't miss out this time when AM goes stereo.

It's on its way. All your favourite AM stations, in true stereo. AM Stereo.

And to make sure you're there for the revolution, Sansui introduces the CX990.

Australia's first FM/AM Stereo Cassette Tuner.

With Sansui's unique Intro Scan that samples about ten seconds of each track. One right after the other. Just so you can find a particular track easily.

There's also a computer circuit-control for velvety-smooth operation changes.

- Dual-amp balancer.
- Dolby C and B noise reduction.
- New high-tech heads.
- And continuous auto repeat.

All of which adds up to another first for Sansui.

As well as another revolutionary first for you.

Sansui

How to invest in Yamaha, without living beyond your means.

Yamaha's new top-of-the-range Cassette decks, the K-1000 and K-2000, incorporate the most advanced, state-of-the-art studio component technology at prices $200 to $300 less than comparable equipment.

Indeed, they compare favourably in significant performance areas with any cassette decks at any price.

Both decks have been painstakingly designed and uncompromisingly engineered for optimum functionality and reproduction performance.

Each employs a specially designed two-motor, direct drive transport mechanism for smooth, silent precision, and three low-impedance heads which features a unique Sendust formulation to ensure superb, long lasting reproduction quality. Plus the heads have a lifetime warranty.

The two decks utilise Yamaha's unique Linear Electromagnetic Transduction system which extends linearity to the point where the signal is transferred from the head to the tape–a previously uncontrollable area in the recording chain.

High performance features on both decks also include dbx and Dolby-B* noise reduction, ORBiT (Optimum Record Bias Tuning), a microcomputer controlled Linear Counter, expanded range level meters and a number of auto memory functions.

For Yamaha the K-1000 and K-2000 cassette decks are a natural progression in 95 years of outstanding accomplishments in musical instruments and audio componentry.

For you they represent the finest natural sound recording and reproduction at a surprisingly affordable cost.

Your Yamaha dealer can show you the full range of Yamaha Cassette decks starting at around $200. If you'd like further information just complete and post the coupon below.

K-1000

K-2000

*Dolby is the registered trade mark of Dolby Laboratories

I'd like further technical information on the new K-1000 and K-2000 cassette decks.

Name_____

Address_____

_____

_____ Postcode_____

Send to: Yamaha Hi-Fi Division,
Rose Music Pty. Ltd.,
17-33 Market Street, South Melbourne,
Victoria 3205.