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APRIL 1985

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EXPLORING COMPUTER GRAPHICS

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Electronics Today INTERNATIONAL

APRIL 1985

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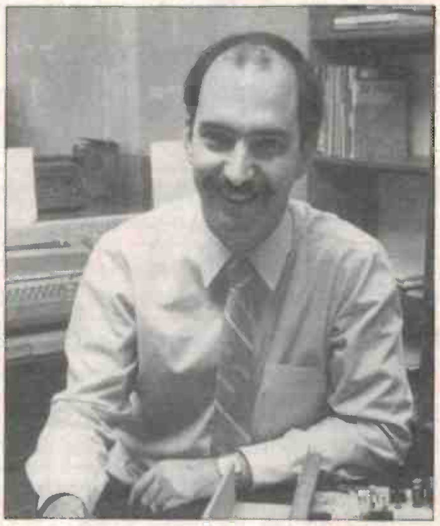
COVER: Fibre optics graphic was designed by John Burch and produced at XYZAP, 24 Carlotta Street, Artarmon, NSW 2064, (02)438-4333, on the Evans and Sutherland P300 graphics machine.

EDITORIAL



WHAT A STUNNING FRONT COVER! It is an artist's impression of a printed circuit board and combines two important features of your April issue of Electronics Today. The cover was inspired by the low-cost fibre optics experiments described in this issue by Peter Ihnat — when you have built up an experiment you should notice the resemblance.

The graphic was produced by a specialist graphics company called XYZAP. Its work is covered in our computer graphics feature in this issue and has been seen on just about every television station in Australia.

You'll find our April issue is packed with interesting features, projects and reviews . . . hope you enjoy reading it.

☆ ☆ ☆

THE MINISTER FOR SCIENCE, Barry Jones, has formed the Commission for the Future with a brief to influence the community's attitude toward the role changing technologies will play in its future.

Once I got over the thought that this was a Committee for Tomorrow that didn't have to do anything today, I started to think that the Commission's task will be quite a challenge.

The thing that makes technological change difficult is the change, not the technology. Technology has been changing our life style in a significant fashion for the last two centuries — you'd think by now we would have the problems sorted out, but we haven't!

In any change there are winners and losers. Winners want their rewards without any dilly-dallying and certainly don't want to give any up to compensate the losers.

In technological change the losers are the companies that cannot adapt to compete under new circumstances and those who work for these companies.

These two groups represent a formidable barrier to the whole of the community reaping the benefits of technology. Just look at the miners' strike in Britain and many of the demarcation disputes in Australia.

So there is the conundrum. Do you compensate the losers and ask the winners to pay part of the cost, or not?

If you don't, you will always limit the benefits the community can gain from technological change.

David Kelly
Editor

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

GENERAL INQUIRIES: For all inquiries about back issues, subscriptions ($27.00 for 12 months/12 issues), photocopies of articles, artwork or submitting articles, call (02) 663-9999 or write to: ETI Reader Services, 140 Joynton Avenue (PO Box 227), Waterloo, NSW 2017.

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

ADVERTISERS' INDEX

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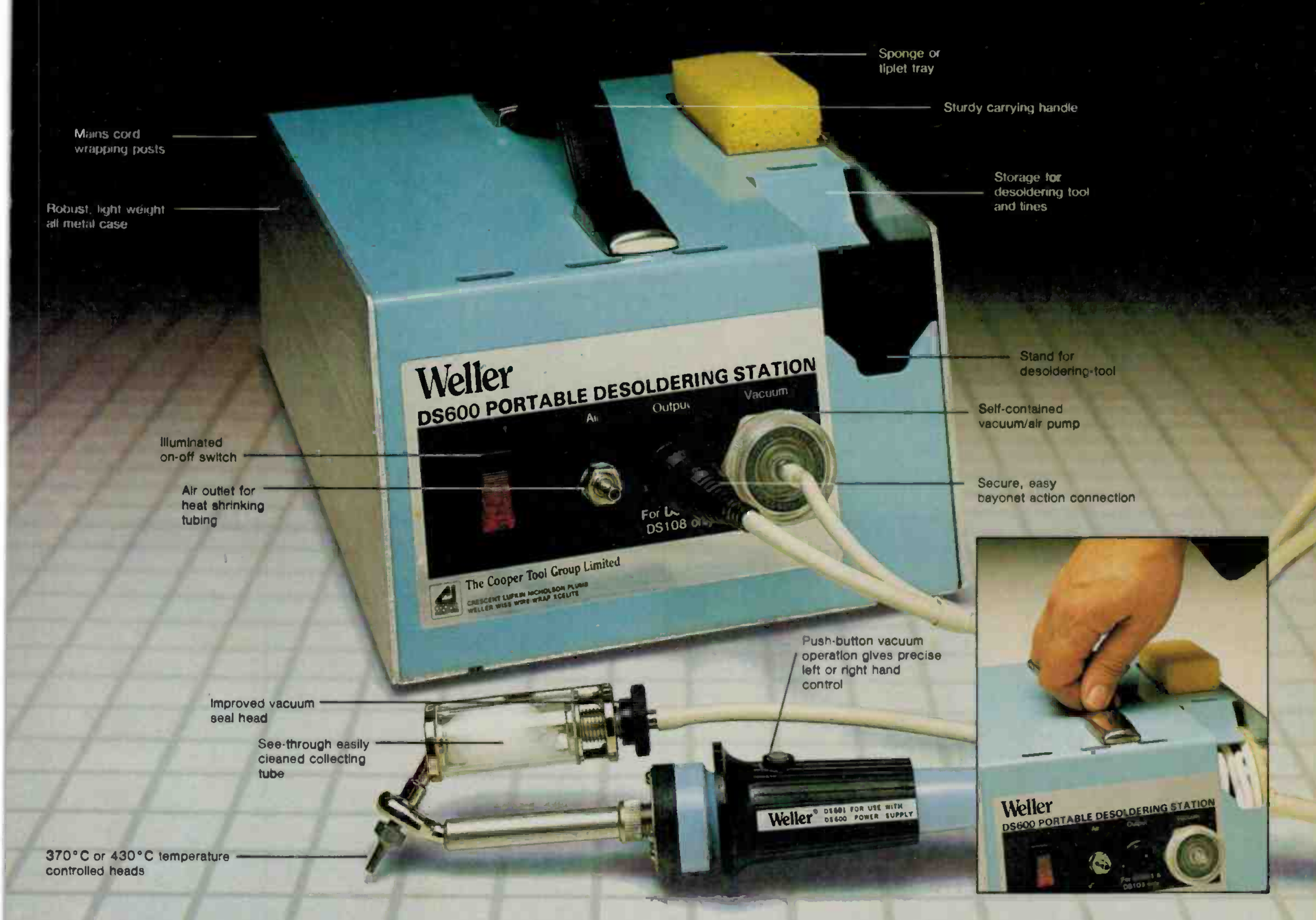
Weller. Desoldering takes off!



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DS111	2.29	.64	12
DS112	1.93	.91	12
DS113	2.49	1.14	12
DS114	3.18	1.80	12
DS115	1.52	.64	19
DS116	2.49	1.14	19
DS117	2.29	.64	19

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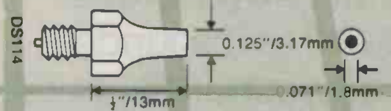

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Australia for the space race?

There is increasing interest within government, the scientific community and industry in Australian participation in space and space related activities.

Evidence of this came from two reports last month. One was an announcement that the CSIRO has set up an office for Space Science and Applications (COSSA).

Head of COSSA, Ken McCracken, hopes to have a budget of $7m rising to $20m by the end of the decade. Major objectives of the unit will be organizing construction of the next generation of communications satellites as well as remote sensing systems.

CSIRO has identified nine projects it should be involved in during the next five to ten years. These include space communications systems, remote sensing, participation with the ESA in meteorological spacecraft projects such as IPOMS and collaboration with NASA on the Spartan reusable spacecraft system.

Meanwhile the West Australian government has commissioned a report from financial researchers Coopers and Lybrand Services on space activities in the state.

The government asked researcher Peter Farr to identify areas where the state could develop industry and employment opportunities using space related technologies.

The report is to be handed to the government in the near future. It is expected to recommend special efforts to secure expertise in the area of remote sensing and satellite construction.

Remote sensing is especially important in Western Australia, which has a large primary sector, large areas of unexplored land, a small population and high wage bills. It is expected the report will recommend WA develop an autonomous ability to retrieve and interpret Landsat and Spot images. Spot is the new French resource sensing satellite. It is reportedly able to resolve ten metre features on the surface of the Earth.

Head of COSSA Dr Ken McCracken.

Another area the report is likely to identify for government interest is domestic downstations for Aussat type satellites. With a large unserviced rural population WA has a greater need than most.

HDVS: Before long or before time?

Broadcasting engineers and technicians (and not a few of the technical press) were treated to a slice of the future recently when Sony showed off its new High Definition Video System (HDVS) for the first time.

The unit consisted of a three gun video projection set-up fed by a one inch video machine. The first indication of things to come was the aspect ratio of the screen: 5:3 rather than 5:4.

The system shows 1125 lines, interlaced 2:1 at 60 Hz. Video bandwidth is 30 MHz. (At present you are watching 625 lines and 7 MHz).

The subjective effect is breathtaking. ETI visited Sony in company with a crowd of hardened ABC engineers, some of whom were moved to "Ooos" and "Aahs" of appreciation. Under the conditions of the Sony demo it seemed much better than 16 mm film, and marginally as good as 35 mm. Rolling off a one inch tape, it seemed little short of miraculous.

It was very much a demonstration model though. Sony has suggested uses for it in small (100 seat) theatres where the 120 inch screen could be used to advantage. It would be significantly cheaper than 35 mm movie film.

At present it has no application in distributed television services. Problems that remain to be solved include the evolution of a standard so that equipment from different manufacturers can be interfaced. This may be solved by a CCIR meeting in December 1985, where the HDVS standard will be discussed.

Another problem is the very large bandwidth required. Apart from problems of redistributing spectrum space, noise will be a major problem with a broadcast signal. Sony spokesmen at the demo claim that by the time broadcasters are ready to use the technology, digital broadcasting techniques will be available to solve this problem.

Smart phone or no phone?

British Telecom has developed an experimental telephone that does away with conventional dials and handsets.

The phone, called ASCOT (for Automatic Speech Controlled Telephone) responds to a library of about 50 stored words. The phone has a processor controlled circuit which compares sounds with preprogrammed sounds, and will respond to words from the owner like "dial" and "home".

ASCOT was developed by engineers at the Martlesham Heath research laboratories in eastern England.

British Telecom believes the first application of ASCOT will be to help disabled people, who may not be able to press buttons or move a telephone dial. It could be available in Britain by 1986, according to BT.

Meanwhile across the Atlantic the US public is starting to reap the benefits of the open telecommunications market. International Resource Developments a US consulting firm, is predicting that it will shortly be impossible to get a domestic telephone installation.

The problem, according to IRD, is that prices are so low that supplying basic telephones is no longer an economic proposition. In the past, regulation demanded that the local telephone companies be 'suppliers of last resort', that is they had an obligation to supply phones, no matter what the economics of the situation.

That situation has changed. With deregulation of the industry there are now no suppliers of last resort, and regular suppliers are dropping out of the market "like flies" according to IRD.

One result of this trend is that consumers might be forced into buying more sophisticated equipment with more add-ons. Many manufacturers are interested in supplying this higher cost product. Whether the public will like buying it, and whether they will have any choice, remains to be seen.

DOC studies communications

The Department of Communications has announced the formation of a high level study group into the future of broadcasting.

Commenting on the study during a recent symposium in Sydney, DOC secretary Bob Lansdowne said that the study was necessary so that policy could be decided before technology forced changes on the community, as had happened in the past.

The main purpose of the study will be to consider the implications of satellite technology, especially post-Aussat, which is expected to be used by around the turn of the century.

Lansdowne pleaded for close co-operation between his department and all sections of the industry. He said that unless an industry consensus on the future of broadcasting emerged, the future would be bleak.

It seems the main issues to be considered are centralization versus regionalism and equalization of services. The latter has been a hobby horse of Communications Minister Duffy for a number of years. It expresses his view that all Australians are entitled to the same quality of service no matter where they live. The existence of satellites makes this possible. The problem is to make it practical in view of the divergent interests of the industry.

At the same time there are real problems with allowing Australian TV to be controlled by only three networks. Foreshadowing this, Duffy said in his speech to the symposium that regional stations might need to develop a more creative approach to the future.

Australian Beginning bounces back

After a halt in operations for most of February, one of the original public data bases, Australian Beginning, was back on line in early March.

Australian Beginning uses a Data General MV/8000 to hold its data base, and it appears this was the source of the trouble. According to a Data General press release issued late in January, DG had made "strenuous attempts to conclude financial arrangements with Australian Beginning". These evidently failed, because Data General reclaimed its computer.

The General was a little premature, however. It seems that the incident was resolved with the return of the computer, and presumably, a happier financial picture. According to the Beginning's David Lutz, the picture now has never been brighter. He said that differences with DG had been resolved and they were continuing as before.

Mr Lutz said that the service was being resumed at the same level as before the hiatus. According to Mr Lutz, there are plans for an expansion of services in the near future.

OOPs

In our February issue we published a news story saying that Irene Pellett and Lino Giambertone had formed a new distribution company to be called Nectronics. After interaction with a certain very large Japanese company Irene and Lino have decided that calling their company NECtronics was a really lousy idea. So, goodbye Nectronics, hullo Itronics. Call on **Itronics** at **27 Lexton Rd, Box Hill, Vic 3128.**

BRIEFS

RF exposure Standards

The Standards Association has published a new standard AS 2772, dealing with exposure of the human body to frequencies between 300 kHz and 300 GHz. The limits are set low enough to avoid radiation hazzards after eight hours of exposure (occupational exposure) or 24 hours of exposure (non-occupational). The SAA will hold seminars in Sydney and Melbourne on the new standard. For more info contact the SAA.

$4m worth of fire protection electronics

Fire Fighting Enterprises has just won another contract to supply the NSW Electricity Commission with fire fighting equipment. The equipment will be installed at the Bayswater power station in the Hunter Valley. FFE has just completed a $2m contract at Eraring power station.

Graphics gabfest

Ausgraph 85, the Australasian conference on computer graphics, will be held in Brisbane between 12-16 August 1985. According to the organizers, speakers will be of the same quality as last year at the highly successful meet in Melbourne. Further details from Barrie Markey on (03)387-9955.

Growing semiconductors

Massachusetts Institute of Technology has announced the creation of a new process for growing polycrystalline semiconductor material. Large grain polycrystalline film can now be formed from amorphous film. The invention can be used with both batch and continuous processes, making it particularly suitable for large scale manufacture. According to MIT current methods of production are too expensive for economic exploitation.

Webster: more of the same and loving it

Melbourne based Webster Computer Corporation has signed an agreement with Sigma Corp of the US under which the US company will build and market a Webster designed Winchester disk controller. Large sales are predicted to the DEC compatible market in the US. This is the second US deal announced recently by Webster. In December Webster announced it had sold distribution rights to its SDVZ11 multiplexer. Webster claims to be doing $100,000 per month business in the US.

ABT decides

The Australian Broadcasting Tribunal should hand down recommendation to the Minister of Communication soon on licences for Remote Communities Television Services (RCTS). RCTS will use downstations and UHF transmitters to relay the HACBSS 2 commercial television services. The four HACBSS 2 services are the commercial stations that will be relayed over Aussat with HACBSS 1 (the ABC).

More Interscan notes

The long and convoluted history of Interscan took a turn for the better recently with the announcement of a $US90m contract in the USA.

Interscan was formed in 1978 to develop a market for a CSIRO designed aircraft landing system called TRSB (for Time Referenced Scanning Beam). It offers significant advantages in air traffic control over the older instrument landing systems presently used around the world.

Because TRSB is a concept rather than a discrete product, it was not possible to protect it by patent, and as a result Interscan has faced massive competition from US giants like Bendix, Raythenon and Hazeltine.

In 1984 government funded development programs ran out and Interscan was forced to go out and look for commercial backers. However, private industry was not overly enthusiastic so the Australian Industry Development Corporation (AIDC) stepped into the breach.

Now, Interscan has sold its first major system in the US to United Technologies Corporation, the fifth largest US manufacturer. UTC includes Pratt and Whitney (aero engines) and Sikorsky (helicopters). TRSB systems are to be installed at both company's manufacturing plants.

According to John Dreggan, managing director of Interscan, the sale is significant, not only because it is the first overseas sale, but because "the presence of Interscan equipment at these locations will be highly visible to UTC worldwide clients, which will help us significantly in our worldwide marketing".

COMPANY NEWS

Elcoma, which forms the Electronics Components and Materials division of Philips, has moved its Sydney office to 11 Waltham Street, Artarmon NSW 2064. Phone (02) 439-3322.

Melbourne based manufacturer, Sites Alive, has advised a name change to Ectron Pty Ltd. The company is heavily involved in selling its voice synthesizers in the US market.

Mayer Kreig and Co, the Adelaide based distributor, has just moved its Sydney office to 4 Brodie Street, Rydalmere.

Promark Electronics has increased its involvement with Teledyne by being appointed factory agent and distributor for the company's relay division. Promark has been distributing Teledyne semis since 1983.

After a period of uncertainty, the aggressive Japanese CRO maker, Kikisui, has settled on Sydney based Emona Instruments to distribute its range of CROs. If Australia follows US trends, Emona can expect to be servicing a significant percentage of the CRO market within a few years.

Sony (Australia) has announced the appointment of Erik Buttars to the position of Deputy National Sales Manager. Buttars has spent the last 10 years in a senior sales position with the General Corporation.

Just twelve months after the opening of its Queensland operation Acme Electronics is moving house. New address is 62 Doggett Street, Fortitude Valley, Qld 4006. Phone (07)854-1911.

WA radio system

The Perth based manufacturer, Radtek Corporation, has announced a contract to supply 200 computerized communications systems to a Sydney courier company.

The unit is known as the DL800. It was developed by Omnitronics in Perth and includes a VDU, a printer, a keyboard and interface equipment for either VHF or UHF radio. It also has four status keys that can be used to send prearranged messages to avoid overloading the voice channel.

The voice channel uses digital encryption with automatic error detection and correction. This increases noise immunity as well as provides greater security against accidental or deliberate bugging.

Current plans call for the DL800 to be marketed overseas by Radtek. The company believes it will find ready acceptance by couriers, statutory authorities and other large fleet users.

New research councils

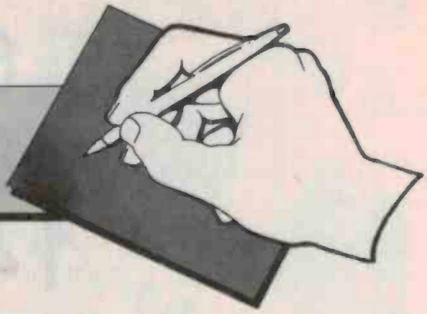
The Australian Science and Technology Council has just completed a report on the funding of basic research in Australia.

It is believed a major recommendation of the report is that two new research councils ought to be established to oversee university research funding. At present this role is carried out by the Australian Research Grants Committee. It is anticipated that one of the new councils would look after applied science and engineering, the other the social sciences and humanities.

The councils would advise the government on areas of excellence that were underfunded and identify new areas of research.

It is not known at this stage whether the creation of the new councils represents a change of fortune for Mr Barry Jones, the Minister for Science. With the Hawke ministry, funding of science research has taken a nose dive. Mr Jones' recent demotion to the outer ministry has reflected this.

Letters to the Editor



Thoughts on ETI

I SEE, from your February editorial, that Roger Harrison has left ETI. As a reader of ETI for some years, I was impressed, particularly, by his articles on amateur radio and I guess that a lot of readers will be sorry to see him go. However, may I welcome the new editor and wish him all the best in this role.

I hope that, as editor, you don't mind a bit of feedback from one of your readers. To me, the most important role of an electronics magazine is to inform, especially about significant electronic and related developments and the state of the art generally. So, news and feature articles rate highly with me, as also do projects which embody novel designs and new devices. Incidently, I rarely build published projects as I much prefer to design my own, but I find them an invaluable source of ideas. The 'Ideas' section is of much interest to me for this reason. I'm also interested in reading the views of other readers but I notice that a 'Letters to the editor' section has been omitted from ETI for some time now.

I was impressed by Ian Thomas' article on CDI (February '85). He not only designed what seemed to be an interesting and novel circuit but went to a lot of trouble to explain all the finer points. CDI systems have seemed to be mostly out of favour for some time now and it will be interesting to see if, with the ETI circuit, they will make a comeback.

Keep up the tradition of a fine magazine, and good luck.

H. Nacinovich,
Gulgong, NSW

VHS bias

AS A REGULAR reader of ETI for more than twelve years, I have always been impressed by your unbiased attitude to all things electronic. But after reading February's review of the JVC GR-C1 Videomovie camcorder, I'm afraid it seems that I may have been mistaken.

With the section "Winners and Losers", you seem to have taken the same direction as your competitor magazine in condemning the Beta video format.

The somewhat brief history of domestic video shows that all major innovations have usually first appeared on a Beta machine, to be followed sometime later by VHS with perhaps one or two refinements (i.e: camcorders and hi-fi). Bearing this in mind, to predict a "lingering" death for Beta seems to me to be a little foolish.

I have always preferred the operation of a Beta machine, as I find the constant threading and unthreading of tape on a VHS VCR more than a little irritating.

I do not believe Beta is destined to the same fate as Sanyo V-cord, Philips 1500 and 1700 (and maybe undeservedly V2000) and Funai CVC formats have succumbed to. Almost a third of all ½-inch video machines are Beta, which probably amounts to quite a few million VCRs. I cannot believe that their owners would abandon them for something that offers little except better advertising.

The reason for the better market penetration of VHS, seems a little unclear. I can only conclude that perhaps JVC was more generous with licensing arrangements than was Sony. While every man and his/her dog seems to have his/her name on a VHS deck, the list for Beta is much shorter i.e: Sony, Sanyo, Aiwa, NEC, General, Toshiba, Nakamichi and Pioneer (some of which now produce VHS as well). This obviously means that the total advertising budget for Beta has always been much less, especially when you take into account that not all Beta licencees produce export market video recorders.

With the acceptance of professional Betacam, and Beta-hi-fi as 'the' hi-fi machine for audiophiles (mainly due to cueing problems in VHS), I can predict that Beta will survive at least as long as VHS.

Mark A. Coursey,
Windsor Gdns, SA

A comment on the tone

MR JON FAIRALL'S article "The Satellite TV Smorgasbord" (Jan '85) was read with great interest, however his statement, "There are literally hundreds of satellites occupying the orbit — many of course, with some dark military purpose. Those that are doing something useful are being squeezed into smaller and smaller slots." invites some comment. It is noted that he is a recent addition to your staff, and some details of his engineering and military qualifications and experience would be appreciated.

It is not a closely guarded secret that military satellites are used for surveillance and communications. The intelligence gleaned from these sources provides both NATO and the Warsaw Pact with vital information on current military postures. The strategic and tactical importance of this information is obvious, and has undoubtedly contributed to the prevention of a World War. Mr Fairall apparently considers this application of satellite technology as useless, and it is therefore recommended that he ponder the relative importance of the collection of military intelligence to the mass dissemination of "Perfect Match".

M. E. Bowden,
West Pennant Hills, NSW

Different CD philosophy

I AM WRITING about some misconceptions your writer, Dennis Lingane has in his article on "Different CD philosophies" ("Sweet home Chicago" Oct. '85).

In statement number two, he says that over sampling can mean slower access time and less accurate tracking.

Oversampling is a method used in the D to A process so as to get 16-bit resolution out of a 14-bit DAC. As oversampling is done after all the servo, user code extraction, error correction and concealment, interpolation, etc; it can not effect the tracking or access time.

We are then warned to be careful in our selection of discs for Sony players and others that use the 44.1 kHz sampling system. Unfortunately, we will all have to be careful as the 44.1 kHz sampling system is an inherent part of the CD system design. Any player not working to 44.1 kHz will not play a CD disc at all.

Peter Williams,
Dandenong, Vic.

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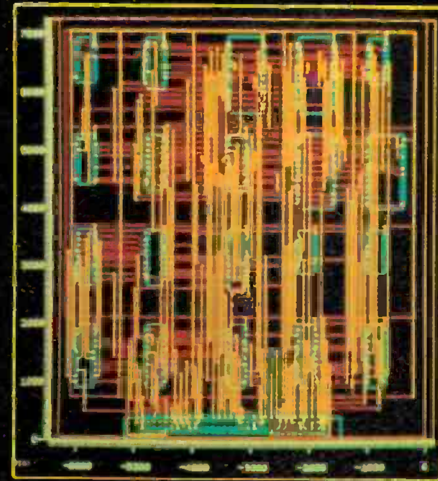


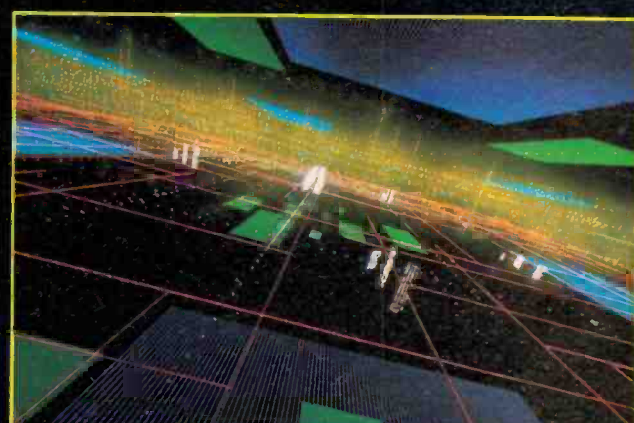
Above. A circuit board laid out by CAD. Courtesy AUSTCAD.

Left. Frame from the opening credits of the ABC's news program 'The National'. Courtesy XYZAP animation and ABC. Animated by Andrew Cunningham.

Right. A frame created on the BOSCH FGS4000. Notice the highlighting and shading which gives clues to the 3D shape of the objects. Courtesy Robert Bosch and Co.

Below. When a computer generated image is not computer generated! This drawing was created on the Quantel paintbox using the touchpad and the amazing palette facility. Courtesy Quantum Electronics.

Right. Title sequence from the Mike Walsh show. Courtesy XYZAP and TCN9. Animator Mike Murray.



Computer Graphics — EXPLORING IN THE DIMENSIONS OF ILLUSION

Jon Fairall

Two landmarks in animation are *Fantasia* and *Tron*, symbols of the past and the future. While there will always be a future for the graphics of *Fantasia*, novelty and excitement lie with *Tron* and with the refinements and sophistication of computer graphics as it explores worlds of space, business and, of course, entertainment.

VIDEO GRAPHICS, the art of putting images on a monitor, is one of the most exciting, and potentially one of the most useful applications of computers to emerge during the last twenty years.

Computer generated images are breaking down the barriers between artists and electrical engineers. In the process some hauntingly beautiful images are being created.

And not only in art. For the first time designers can see the fruits of their labours before anything is built. Doctors can see inside the body without having to cut it. Individual organs can be mapped and studied, their irregularities noted and discussed, all without causing the patient any discomfort at all.

Computer graphics makes it possible to go where no man has gone before. Down the groove of a record, into the silicon layers of an IC. With computer graphics you can fly down the Valley of the Mariners on Mars, or orbit a planet somewhere in the deep reaches of space.

You can shoot aeroplanes out of the sky, or blow up ships, do all the things, in fact that you always wanted to do, but your mother would never let you . . .

Computer graphics is miraculous. Where did it start? How does it work? And what, as they say, is it good for?

In the beginning . . .

Where and when computer graphics began is largely a matter of definition. In the 1950s there were a few people working in the frontier of the new computer technology who foresaw some kind of visual role for the computer. John Whitney of the USA was one of the pioneers in the field. He began work using ex-World War II anti-aircraft guidance predictors to sort out some of the basic theorems of the industry.

Other pioneers included Drs Evans and Sutherland. They went on to found one of the most innovative companies in the graphics market, with systems for applications as diverse as aircraft simulators and planeteria.

By the early 1960s graphics output was being used in some very esoteric scientific applications, but without much effect on most people in electronics or the general public at large.

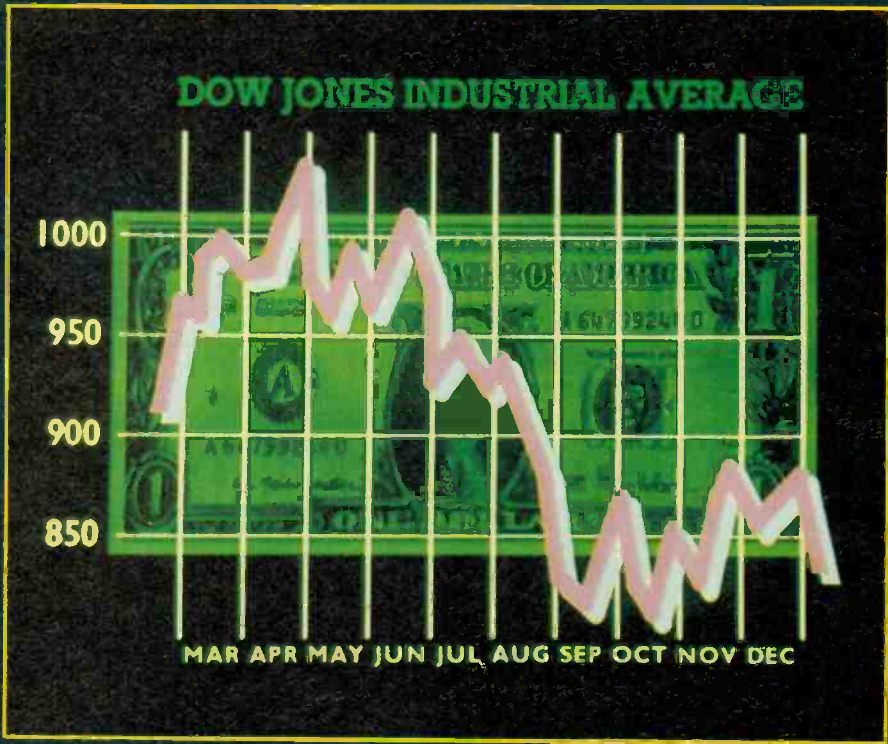
This was probably due to the fact that the growth of video graphics was almost entirely driven by engineers themselves. Unlike computers, satellites, rockets and radio-on-a-chip, computer graphics were never the province of science fiction writers or social seers. The potential of computer generated graphics was beyond imagining.

In the 1960s, the field began to expand. Two engines drove it; one, of course, was the general expansion in computer power that happened about that time. This had an effect on computer graphics as it has on every other part of electronics. The other important influence was the space race, in particular, the imaging needs of NASA.

NASA had two requirements. Firstly they wanted to be able to retrieve images, faint fuzzy images, from deep in space. They wanted to be able to enhance the images they received up to the limits imposed by the resolution of the optical systems they were working with.

The other NASA requirement was more subtle. They wanted to create images of what they expected to see. They wanted the ability to put into a computer a mathematical description of what they thought was there, and so to create from nothing, a vision of what they expected to see.

For the first time, large numbers of computer scientists and buckets of money came together to work on the problem of computer imaging. Looking back the results were a little difficult to get excited about: faint and fuzzy. But at the time they generated enormous excitement, if only because for the first time computer literate people ▶



A typical business graphic produced on the Quantel paintbox. The dollar note is input from a video camera. The grid and graph can be superimposed electronically. Courtesy Quantum Electronics.

began to realise the potential of the tool.

Out of the two needs of NASA has come the modern computer graphics industry; on the one hand imaging systems, on the other graphics. Imaging is an input process, the process, essentially, of teaching a computer to see. The hardware of this problem is reasonably well understood. It is not difficult to take an image from a TV camera and turn it into a series of numbers for digestion by the host computer. To make sense of the same numbers is quite another exercise however.

Graphics, of course, is an output process. It amounts to taking the output of a computer and presenting it in a visual fashion. And it's not easy. It takes lots of computer time, lots and lots of memory, and a considerable amount of expertise.

Pong

The early achievements of NASA were probably the first serious attempt at computer imaging, but not quite the first achievements in computer graphics. That early pioneering was attributable to an arcade game called Pong. Pong consisted of grey and white images of a tennis court, and two bats controlled by paddles. The realistic way in which the ball bounced off the bats and the walls entranced the public. Video games had arrived.

By the early 1970s four or five different versions of Pong were available on a single chip. In fact in 1976 this magazine was putting together kits based on multigame chips.

The next breakthrough in this field was the advent of the space invaders type game, orders of magnitude more complex than Pong. The space invaders generation depended as much on advances in raw computer power as advances in software.

Applications

CAD

Early in the piece, it was realized that graphics had more important functions to perform than generate Pong. One of the first, and still one of the most important applications is Computer Aided Design (CAD).

Originally, CAD was conceived of as an electronic drawing board. To a certain extent it still is. CAD systems allow the user (typically not a computer specialist) to make drawings very rapidly. On most systems one starts by defining a system of coordinates and then selecting points by pressing a touch tablet. The points can then be joined together to form lines.

When the lines enclose an area the computer can be told to define this as a plane. Then the whole drawing can be rotated around any of its three axes so that it can be viewed from any angle.

It does nothing which, in principle, a competent draughtsman couldn't do. However it does it so much faster, and allows so much faster feedback of changes, that it has had a major impact on the design procedure.

For instance in architecture it is commonplace to use the system to turn a plan drawing into a series of perspectives. The viewer can wander at will through the building, viewing interiors and exteriors from any angle.

Modern systems require an even greater integration of the computer into the design process. Software can complete dimension drawings given just a single scale. Calculating the centre of gravity, volume or density are also common procedures.

However, CAD systems have not had much impact in Australia yet. Chris Harris, the managing director of Austcad, a Sydney based CAD company, estimates the potential Australian market at about 250-300 systems a year. Current sales of reasonably sized systems are running at about 50 a year.

The reasons, according to Harris, are complex but probably have a great deal to do with the innate conservatism of businessmen, the recession and ignorance. Since all three will decrease in importance as time goes by, he believes the future is extremely bright.

Simulation

Once a designer or architect has completely specified a system to the computer, the next logical step is to use the computer to simulate the performance of the proposed system before it has actually been built. Indeed the computer can simulate destructive tests even before the prototype has been made.

Many applications spring to mind. The aerodynamic performance of a motorcar can be assessed long before the first car body is sculptured out of wood and plastic. The military can fight all its wars in grown-up versions of arcade games without ever shedding a drop of blood. But undoubtably the most spectacular, and probably the most expensive simulation in everyday use is the aircraft simulator.

The major user in this country is Qantas, which has a number of simulators in its Sydney complex. They are large box-like structures that stand on hydraulic legs. Inside is a perfect recreation of the cockpit of the aircraft, in this case a Boeing 747 or 767. Behind the windows is a video representation of the space through which the aircraft is moving.

The most sophisticated of the simulators is the 767 simulator now being commissioned. It employs a Neoview Sp1 system using six displays. There are two image generation systems each driving three displays to give the pilot a 180 degree angle of vision around the cockpit.

Because of the display technology the visual scene is limited to a dusk/night presentation. Called beam penetration scopes, they can give an exceptionally believable representation of city lights at night, and of course, all the lights associated with the airport such as flarepath and taxiway lights (see box). The texture of land, sea and mountain can be differentiated with 64 different levels of grey.

Programming the visual screen for a flight simulation is a lengthy and complex task. According to Ron Page, the simulator development and maintainance manager it ▶

FLIGHT SIMULATORS

Just how good are flight simulators? Never one to quail in pursuit of a good story, your hack insinuated himself in the left hand seat of a 747 simulator recently, and can tell you that it's very, very good indeed.

Inside, the simulator is an exact recreation of the cockpit of a 747, down to the last little bell and whistle. As I strapped myself in, the lights of Hong Kong glowed brilliantly outside. Ahead of us: New Kowloon and the hills of the New Territories. Twenty nine feet below, the runway stretched off into the distance.

In the captain's seat the acting flight simulator manager, Barry Boyd eased forward the throttles. Outside the four huge turbines began to shriek as our forty ton leviathan rolled down the runway. The acceleration forced us back into the seats. As we passed through 130 knots the nose came up and the vibrations from the wheels ceased. Flying.

Just a simple circuit, I was told. But Hong Kong is a murderous airport to get into and out of. The runway is built out over the sea. Directly ahead Beacon Hill rises 1521 feet above sea level. There is no such thing as a regular circuit here. You take off and swing sharp left. Landing is the reverse procedure. No wonder they practise.

And practise they do. Hundreds of hours in here. Until it's perfect. They call it the sweat box.

As we swing around, Hong Kong island itself comes into view. Underneath all the other Islands that make up the Crown Colony are picked out in the gloom as dark patches of grey.

Turning back towards the runway the lights of the city glimmer in the distance. A line of flashing strobes marks out the approach path across the town. The airport is still invisible behind the hills.

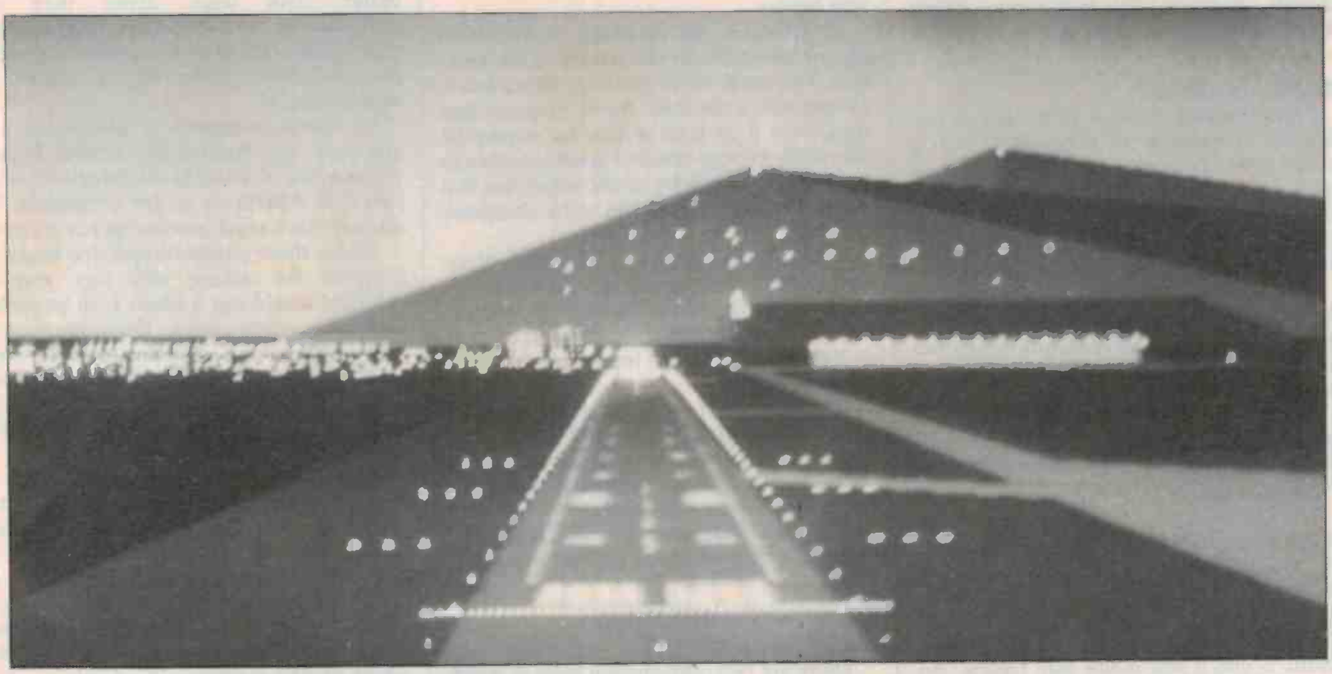
Down to six hundred feet. Cross winds buffet the jet as we wait for the first sighting of the airfield. Flying under these conditions requires concentration, and the casual sightseeing ends as Barry keeps it straight and level.

The runway comes into view 45 degrees away to the right. This is the decision point. Go or no go. A pilot must be able to see the runway from here. If he can't then he must go around and do an instrument approach. The runway lights glitter in the gloom. Not a hint of cloud. Lovely. We turn gently towards home and the runway.

Over the fence. The flarepath disappears past the side windows. The stall light comes on. Bounce. We balloon, moving slightly to the right. Straighten up. Down. Reverse thrust comes on and the seat belts tighten as the plane slows down.

Suddenly the screen, and its illusion flicker, and disappear. The lights come on and Barry grinning at me. "Sorry about the landing — I havn't done that for a while."

"Thanks." What a pity. Arcade games will never be the same again.



Quantel's paintbox from the artists point of view.

takes about 450 manhours to render a complete airport and its environs. This is done by staff in the simulator section, who enter in the details of each light that is to appear in a screen. Position is fixed by a touch tablet. Other details, such as intensity and colour must also be given to the computer to make the approach look as lifelike as possible.

It's all tremendously expensive, but nothing compared to the cost of operating the real thing. You can't crash an aircraft cheaply, or teach pilots how not to. Flight simulators are used for little else.

Business graphics

From the point of view of the computer, simulation amounts to little more than a number crunching exercise. Although complex, the system always responds according to known equations. In many other applications of graphics, it is not the system, but the numbers themselves that are of interest.

In fact, this is rapidly becoming one of the most important applications of graphics. In the USA most people working in the field spend their time turning out slides for business presentations that put figures into a visual context. It's already a major application of graphics in that country, threatening to take over leadership from TV commercials.

The importance of this side of video graphics lies in the fact that computers have the ability to manipulate and output an enormous amount of data. Unfortunately, people can't input nearly as well. It can become impossible to see the significance of results if one is inundated with figures. So artists spend a great deal of their time thinking up new, stimulating ways to display charts, histograms and piegraphs so that their significance can be seen at a glance.

Animation

The most visible manifestation of video graphics is undoubtably the animated sequences seen in TV and film productions. It is also one of the most technically demanding areas of the subject. It's a small industry in Australia, centred in a handful of production houses.

In principle, the demands of animation do not really change the nature of the exercise. The usual way of creating animation is to compose a sequence frame by frame and then store it on tape or film for sequential playback. It does demand great accuracy in terms of the geometry of the scene, but this is usually not a problem with computer drawing.

Within the last few years, the needs of entertainment programming, whether for films (like the Walt Disney production *Tron*) or TV commercials have taken over as one of the driving forces behind computer graphics.

It's mainly this area that demands more realistic rendering, better highlighting and better representations of surface textures. Another software interest being developed is the modelling of living systems. This can be anything from the realistic rendering of a leaf to the movement of a ballet dancer.

So how do graphics machines work?

There are two fundamental ways in which computers can put an image on a screen. One method is to use a vectorscope. The computer defines two points on the screen and the electron beam paints a line between them. It is possible to find vectorscopes with very short persistence screens, which are ideal for animation, but which require a refresh frequently. Vectorscopes with long persistence will hold a record of the trace movement for many seconds and so rarely require refreshing.

Either way, the vectorscope is an exceptionally simple and efficient way of drawing shapes, frugal with memory and processing time. Historically, this method has been favoured whenever there are problems with either memory or time, as when drawing complex shapes or in animation.

The second type of graphics machine uses a raster, that is it works in lines and frames much like a TV screen. It is often referred to as a memory mapped screen because each dot on the screen (pixel) is turned on or off by a specific memory element. In other words there is a one to one correlation between each pixel and a memory location.

Two things must be apparent straight away. One is that the memory mapped screen is horrendously heavy on memory. Another is that resolution will depend to a large degree on how many lines there are on the screen. The more the merrier.

Subjectively, the worst thing about a raster screen is the 'jaggies'. Correctly, this phenomenon is called aliasing. It refers to the fact that on a raster a diagonal line is not actually a line at all, but a staircase.

Naturally aliasing improves with the number of lines. At 625 lines, the (TV standard) it is considered acceptable for monitor reproduction, although not for hard copy. To take decent photographs of a raster screen, suitable for slide reproduction for instance, requires at least 1024 or even better 2048 lines. Even then the reproduction is not perfect. In fact tests have shown that even on systems with 6000 line definition there is still room for improvement.

Of course, monitors of this quality usually have large bandwidths as well. Figures of the order of 40 MHz are common (as opposed to 8 MHz or so for a standard TV screen). Such machines do not come cheap.

Under these circumstances one might be forgiven for asking why any graphics machine would use a raster scan in preference to a vectorscope. Well, the vectorscope suffers two crippling disadvantages when it comes to the reproduction of lifelike graphics. Firstly, it cannot 'paint', that is fill in the screen between two lines. Secondly it cannot work in colour.

This is not to say that one method of working is better than the other. Both have advantages over the other that will ensure a future for either of them. The vectorscope will continue to have a future in high precision, scientific and CAD/CAM type applications. The raster screen, on the other hand, will continue to dominate in fields where lifelike graphics are judged essential.

To a limited extent it is possible to give a vectorscope colour capability with a beam penetration tube. This is a type of vectorscope in which the electron beam makes a coloured point by illuminating a phosphor with a given accelerating potential. Changing the potential changes the colour. All colours can be created in this way except blue.

Machines

Broadly speaking we may once again divide the subject in two. On the one hand we have two dimensional machines like the Fairlight Video Instrument or the Quantel Paintbox. These machines are essentially devices that allow an artist to create an image in a process as analogous to drawing as possible.

The Fairlight CVI is one of the cheapest machines on the market. You can buy one from the manufacturers in Sydney for under $4000. It allows the manipulation of a video image in real time or the creation of images from a touchpad. The Paintbox, on the other hand, is considered by most people in the industry, to be the best of the type available in the world. At a price of $140,000 it should be. It is designed to be used by artists, particularly graphic artists in a commercial or industrial situation.

Using Paintbox is an artist's dream. Without any mess or fuss it can replicate water colour, oilpainting, chalk or airbrushing, all with a choice of brush. Colours can be chosen from a selected range or mixed by the artist on a palette area of the screen. It is also possible to take a colour of any point on the screen and use that colour anywhere else.

The Paintbox can also accept video feeds. This means that any image can be input onto the screen and then treated as any other image. So it becomes possible to retouch or alter an image, or use it for a background to a graphic presentation of some kind.

Machines such as these are designed essentially for the artist, not the programmer. This is not to say that they don't represent a significant technological achievement, or that they don't require a great deal of computer power. They do. The Paintbox comes with a 10M hard disk as standard, and more can be added if necessary.

But from the point of view of the computer buff, the large animation production machines like the Evans and Sutherland P300 used by XYZAP production house in Sydney are far more interesting.

Its machine consists of a vectorscope and control unit for controlling the image, plus a keyboard and VDU for talking to the host computer. Using memory in the host computer it is possible to define a shape for display. With the control unit it is then possible to choreograph the movement of the object, that is to say, move the viewport relative to the object. All the necessary transformations are done by an algorithm in the control unit.

Once the animation has been choreographed it is fed by the host computer to another unit where the vectorscope image is transferred into a series of raster scan frames that are suitable for TV projection. At this stage colour and highlighting are added to beautify the final image. It is also at this time that the memory requirements and processing time of the production start to multiply rapidly. In fact it becomes impossible to store frame information in RAM, and as a result each frame is transferred to tape as it is produced. Managing director of XYZAP, Russel Maehl, reckons on a limit of 10 minutes per frame as the absolute upper limit on processing time.

The accumulating images are stored on either film or video tape for their final transformation into a slice of animation. It then becomes possible to enhance the graphics by editing the film or tape, and also to mix in images from other sources.

The beauty of the Evans and Sutherland machinery is that it is ultimately flexible, limited only by the software created by its users. The problem is that those users are highly skilled and very rare.

A different approach is taken by the FGS4000. This machine comes with stored software, but it is designed to be operated by television artists, who need not have any knowledge of the computer hardware, whether they be directors or videotape editors, or whatever.

On the FGS4000 it is possible to create an object via a set of simple controls, and then choreograph the movement both of the object and the viewing position as required. All the algorithms for transforming an object in size and position are already in the machine.

Storage on the FGS4000 is via a combination of RAM, disk and tape. When RAM is full it downloads into the disk. When the disk is full it downloads into the tape. In this way very fast access to the last few frames can be achieved from the disk, while an entire animated sequence can be preserved on tape.

The significance of machines like this lies with the operator. From being a test machine, with appropriately skilled technologists to operate it, the graphics machine has become a rather mundane device that anyone can fiddle with. This is not to say that the price is mundane, it isn't. You need almost half a million dollars before you can call one your own. So far one New Zealand company has bought one, and two Australian producers are looking at it seriously.

Software

The best way to get some understanding of what is going on inside the software of the computer is to think of the various problems that the software must overcome. The first problem is that the object of any graphics exercise is the description of a scene, which we can think of as the world. The world will be viewed from a particular angle and distance. This is the viewport.

Given a world and a viewport, the next step is to decide how these are to be described to the computer. Typically the world will be broken down into a manageable number of objects.

The most efficient way of describing a three dimensional object to a computer is far from being a generally agreed upon problem. One approach is to describe an object in terms of polygons, with a side, top, bottom etc. The oddest of objects can be tackled in this way.

Another approach is to think in terms of primitives, such as cubes, spheres and cones that the computer can handle. One can then create any shape simply by adding and subtracting primitives of different size together.

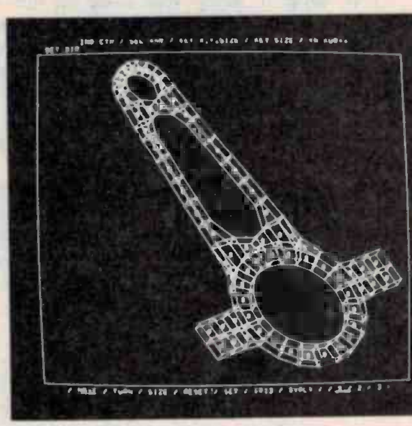
Given a world and a viewport, the next step is to organize these for display. There are a number of problems here too. Of these, the two most important are probably perspective and shading.

Perspective is important because it is the essential clue to locating an object in a 3D space, and shading because it is the essential clue as to the shape of an object. (Of course shading isn't relevant to wire frame drawings, but perspective certainly is.)

There are two fundamental techniques for generating 3D graphics, called ray tracing, and boundary representation. For boundary representation, (B-rep), the computer needs to know the position of every point in the scene. This is usually done via a process of three coordinates for each point, to correspond with X,Y,Z axes.

Given a complete description of its world, the program must firstly decide what to show. This is the process known as clipping, and it defines the viewport. Secondly it must attack the hidden line problem.

The hidden line problem, for a while at least, was one of the Everests of video graphics. Although many efficient algo- ▶



A typical CAD 'wire' drawing. Courtesy AUSTCAD.

rithms now exist to solve it, it still remains a major user of computer power.

Essentially, the problem can be explained thus: when the user describes the world to the computer, the description must consist of complete details of all the objects in it. This the computer will faithfully reproduce. But a moment's thought will show you that in the real world, with real objects, we can't see all the points of a three dimensional object at any one time.

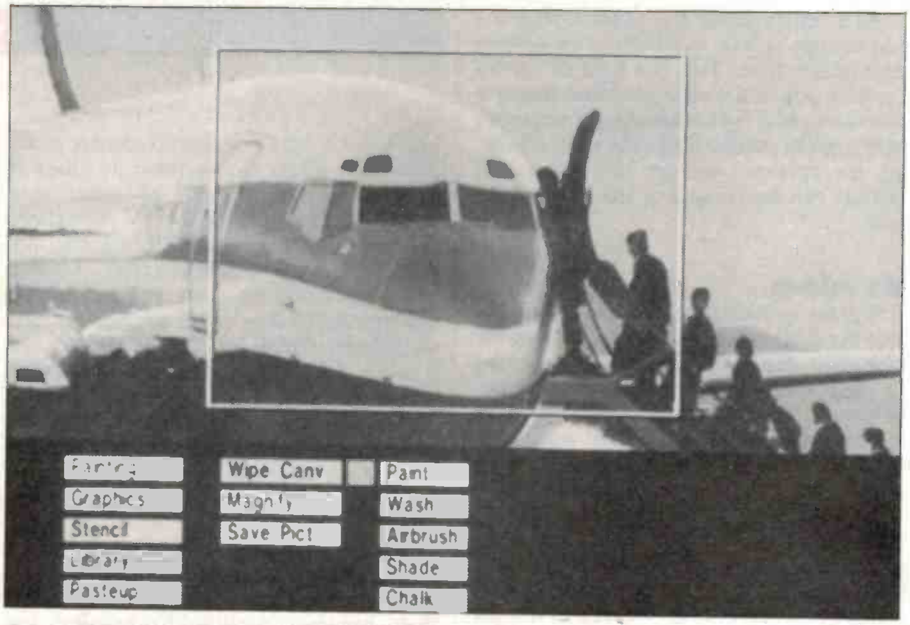
Imagine a cube. Seen from any point, there will always be a minimum of three sides invisible to a given observer. The problem is how to explain that to a computer, which, like Superman, has X-ray vision, but absolutely no understanding.

There also needs to be some provision in the program for determining the brightness of any particular surface in the world. This is determined by the light source, the orientation of the surface and the distances involved.

Historically, B-rep was the first method used for video graphics, if only because it is the most natural way for a computer programmer to think about the problem. A more elegant solution, even if more expensive in terms of memory, is called ray tracing.

Ray tracing is the process of actually calculating the path of every ray of light back from the viewport to the light source. It is thus a far closer analogue of the way in which vision actually works.

It goes backward, not for any conceptual reason, but simply because most of the rays emanating from any source of light will not enter any given viewport. By calculating backward from the viewport, the computing overhead is reduced at least to a consideration of only those rays that can actually be seen.



Freehand drawing on the paintbox. The operator can zoom in on the area inside the border to do fine work. Courtesy Quantum Electronics.

In order to create a ray traced image, the optical properties of each surface in the viewport must be specified. You must be able to specify, not only how light will bounce, but also how it will be changed in the act. The more realistic one makes the equations here, the more realistic the final picture. Certainly the best modern solutions to these problems allow one to show surfaces like glass and plastic, shiny steels like aluminium and matt surfaces like leaves and rubber.

It's also necessary in ray tracing to specify the exact parameters of the light source itself. This includes not only its position in terms of direction and distance, but also the colour of the light and its brightness.

The major advantage of ray tracing is that it is a very natural technique, one that in principle could achieve perfectly life-like results. It automatically takes care of conventional problems like clipping and hidden surface routines.

Its major disadvantage is that it is far more demanding of processor power than B-rep. It requires more and it takes longer. As a result, ray tracing tends not to be used in all except the most exceptional (and expensive) requirements. However, it is also the method of the future.

SOFTWARE TOOLS

Using microcomputers to do graphics is rather like using a gnat to carry an elephant — a crushing experience. On the other hand, we all have to learn to drive somewhere, and a micro can be used to illustrate many of the software techniques that form the foundation of video graphics.

The Apple II, which was used for this exercise, plots points of lines with an HPLOT command. It uses a grid with its origin in the top left-hand corner. The X axis runs to (279,0) in the top right hand corner. The Y axis goes down to (0,190) in the bottom left. So HPLOT 0,0 will put a dot in the top left corner of the screen. HPLOT 279,190 turns on a dot in the bottom right. And HPLOT 0,0, to 279,190 draws a line right across the screen.

Program 1 plots two simple shapes using HPLOT. Line 230 uses the points stored in the subroutine at line 20 to create a U-shaped figure. Another form of the HPLOT is used at line 310 to produce a screen border. The instructions at line 100 are Apple initialization functions that turn on graphics page 1 and set the colour.

Program 1.

```
1  REM : SIMPLE SHAPE
2  GOTO 100
19  REM :SHAPESUB
20 X(1) = 4:Y(1) = 66.25:X(2) = 84:Y(2) = Y(1):X(3) = 100:Y(3) = 140.5:X(
    4) = 180:Y(4) = Y(3):X(5) = 188
21 Y(5) = Y(1):X(6) = 276:Y(6) = Y(1)
22  RETURN
99  REM :MAIN PROGRAMME STARTS HERE
100  HGR : HCOLOR= 3: POKE  - 16302,0
170  GOSUB 20
180  FOR I = 1 TO 5
230  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1)
250  NEXT I
310  HPLOT 0,0 TO 279,0 TO 279,190 TO 0,190 TO 0,0
320  STOP
```

We can increase the flexibility of Program 1 by making the HPLOT points depend on some variables. In Program 2 the X coordinates are dependant on the values of A and C. The Y coordinate depends on B and D. The output looks like Figure 1.

Program 2.

```
1  REM  : SHAPE WITH VARIABLES
2  GOTO 100
19  REM :SHAPESUB
20 X(1) = C - (85 * A):Y(1) = D - (25 * B):X(2) = C - (35 * A):Y(2) = Y(1
    ):X(3) = C - (25 * A):Y(3) = D + (30 * B):X(4) = C + (25 * A):Y(4) =
```

```
     Y(3):X(5) = C + (30 * A)
21 Y(5) = Y(1):X(6) = C + (85 * A):Y(6) = Y(1)
22  RETURN
99  REM :MAIN PROGRAMME STARTS HERE
100  HGR : HCOLOR= 3: POKE  - 16302,0
110 A = 1.6
120 B = 1.35
150 C = 140
160 D = 100
170  GOSUB 20
180  FOR I = 1 TO 5
230  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1)
250  NEXT I
310  HPLOT 0,0 TO 279,0 TO 279,190 TO 0,190 TO 0,0
320  STOP
```

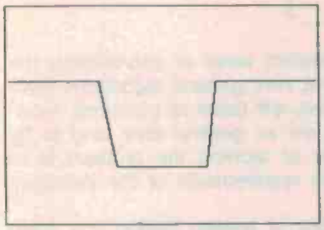


Figure 1.

With these variables in place it's possible to begin some manipulation of the image. The first of these is the process of *scaling*. Scaling an image is the process of changing its size, while keeping the shape constant. This is done in Program 3 using A and B as the scaling variables.

The screen dump from Program 3 appears as Figure 2. This shows forty versions of our shape, all progressively smaller. This is controlled by lines 110, 120 and 270. It is not very difficult to interpret this figure as a series of shapes disappearing into the distance, and in fact one of the biggest uses of scaling is to create perspective.

Program 3.

```
1  REM :SCALING THE IMAGE
2  GOTO 100
19  REM :SHAPESUB
20 X(1) = C - (85 * A):Y(1) = D - (25 * B):X(2) = C - (35 * A):Y(2) = Y(1
    ):X(3) = C - (25 * A):Y(3) = D + (30 * B):X(4) = C + (25 * A):Y(4) =
    Y(3):X(5) = C + (30 * A)
21 Y(5) = Y(1):X(6) = C + (85 * A):Y(6) = Y(1)
22  RETURN
99  REM :MAIN PROGRAMME STARTS HERE
100  HGR : HCOLOR= 3: POKE  - 16302,0
110 A = 1.6
120 B = 1.35
140  FOR J = 1 TO 40
150 C = 140
160 D = 100
170  GOSUB 20
180  FOR I = 1 TO 5
230  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1)
250  NEXT I
270  LET A = A * 0.93:B = B * 0.93
300  NEXT J
310  HPLOT 0,0 TO 279,0 TO 279,190 TO 0,190 TO 0,0
320  STOP
```

Figure 2.

The other two variables are used for the process of *transformation*. Transformation is the process of moving the shape around the screen, without affecting its shape or size. Inspection of lines 20 and 21 shows that C and D fit the bill nicely.

In Figure 3 the results of both scaling and transformation can be seen. C and D are made to be functions of cos and sin TH (theta). Line 290 increases TH by $\pi/55$ on every iteration. The result of these manoeuvres is that the shape is transformed around a portion of an ellipse. Notice once again the strong impression of depth given by scaling the image.

The problem with moving the object around the screen is that sooner or later one is bound to come up against the screen boundary. In Applesoft, when this happens the program simply crashes. Other micros may have different arrangements. In an event, as soon as you try to translate the image it becomes imperative that you have some means of preventing the program from trying to plot a point outside the screen boundaries.

There are a good many algorithms around that will test every point before it is plotted to see if it lies within the screen boundaries. Some are better than others. The one used in Program 4 begins at line 3, and is the essence of simplicity. If a point is beyond the boundaries it simply makes it equal to the boundary.

Program 4.

```
1  REM :TRANSLATION AND CLIPPING
2  GOTO 100
3  REM :CLIPPING ROUTINE
4  IF X(I) < 0 THEN X(I) = 0
5  IF X(I) > 279 THEN  LET X(I) = 279
6  IF Y(I) < 0 THEN Y(I) = 0
7  IF Y(I) > 190 THEN Y(I) = 190
9  RETURN
19  REM :SHAPESUB
20 X(1) = C - (85 * A):Y(1) = D - (25 * B):X(2) = C - (35 * A):Y(2) = Y(1
    ):X(3) = C - (25 * A):Y(3) = D + (30 * B):X(4) = C + (25 * A):Y(4) =
    Y(3):X(5) = C + (30 * A)
21 Y(5) = Y(1):X(6) = C + (85 * A):Y(6) = Y(1)
22  RETURN
99  REM :MAIN PROGRAMME STARTS HERE
100  HGR : HCOLOR= 3: POKE  - 16302,0
110 A = 1.6
120 B = 1.35
130 TH = 3 * 3.141592654 / 2
140  FOR J = 1 TO 40
150 C = 210 *  COS (TH) + 40
160 D = 80 - 60 *  SIN (TH)
170  GOSUB 20
180  FOR I = 1 TO 5
190  GOSUB 3
200  LET I = I + 1
210  GOSUB 3
220  LET I = I - 1
230  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1)
250  NEXT I
270  LET A = A * 0.93:B = B * 0.93
290 TH = TH + (3.14159 / 55)
300  NEXT J
310  HPLOT 0,0 TO 279,0 TO 279,190 TO 0,190 TO 0,0
320  STOP
```

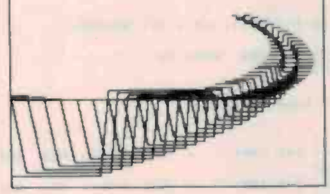


Figure 3.

Obviously there are still problems with this. Diagonal lines will print at the wrong angle if one side happens to fall outside the boundary. When lines are out of the viewport altogether the program will plot a line along the border.

A fully blown clipping routine would have to address both these problems. We would need to find the point of intersection of any line and the screen boundary and substitute that point at one end of the line. Presumably this would be done by a system of simultaneous equations. However, subroutine 3 is extremely simple and appears to give adequate results, as can be seen from Figure 3. You can test it out for yourself by pushing the shape around the screen into the various screen boundaries. This can be achieved by changing the constants in lines 150 and 160.

The fun really starts with Program 5. Let's make some interpretations of Figure 3. Call it a curved trench carved into the earth, or better still, the groove of a record. Whatever it is, there are certain parts of the groove that we would like to see, and others we do not want to see.

With this assumption it's possible to meaningfully say that some portions of the drawing are in front of others. Putting it another way, some parts of the drawing should be hidden. Developing software to tell the computer which is which is the *hidden line* problem.

Program 5 is a development of Program 4 which attempts to do this. Figure 4 is the output. Close inspection of Figure 4 ▶

shows that it is by no means perfect, for reasons that will become apparent in a moment, but it is certainly orders of magnitude better than Figure 3.

Program 5.

```
1   REM  : HIDDEN LINE ROUTINES
2   GOTO 100
3   REM :CLIPPING ROUTINE
4   IF X(I) < 0 THEN X(I) = 0
5   IF X(I) > 279 THEN  LET X(I) = 279
6   IF Y(I) < 0 THEN Y(I) = 0
7   IF Y(I) > 190 THEN Y(I) = 190
9   RETURN
19  REM :SHAPESUB
20 X(1) = C - (85 * A):Y(1) = D - (25 * B):X(2) = C - (35 * A):Y(2) = Y(1
    ):X(3) = C - (25 * A):Y(3) = D + (30 * B):X(4) = C + (25 * A):Y(4) =
    Y(3):X(5) = C + (30 * A)
21 Y(5) = Y(1):X(6) = C + (85 * A):Y(6) = Y(1)
22  RETURN
29  REM :SHAPESAVE
30  FOR K = 1 TO 6
31  FOR G = 1 TO 7
32 M(G,K) = M(G + 1,K)
33 N(G,K) = N(G + 1,K)
34  NEXT G
35 M(8,K) = X(K)
36 N(8,K) = Y(K)
37  NEXT K
38  RETURN
50  REM : HIDDEN LINE ROUTINE
51  IF E > C THEN  GOTO 57
32  IF I = 1 THEN  LET W = 3:X = 2: GOSUB 63
53  IF I = 2 OR I = 3 THEN  LET W = 4:X = 5: GOSUB 63
54  IF I = 4 THEN  LET W = 6:X = 5: GOSUB 63
55  IF I = 5 THEN  HPLOT X(5),Y(5) TO X(6),Y(6)
56  RETURN
57  IF I = 1 THEN  HPLOT X(1),Y(1) TO X(2),Y(2)
58  IF I = 2 THEN  LET X = 1:W = 2: GOSUB 63
59  IF I = 3 OR I = 4 THEN  LET X = 2:W = 3: GOSUB 63
60  IF I = 5 THEN  LET X = 5:W = 4: GOSUB 63
61  RETURN
62  REM :PLANE AND LINE GENERATOR
63 P(2) = X(W):P(1) = X(X):S(2) = Y(W):S(1) = Y(X)
64 Q = 1
65  IF M(Q,W) = O AND Q < 9 THEN Q = Q + 1: GOTO 65
66  IF Q = 9 THEN  RETURN
67 P(4) = M(Q,X):P(3) = M(Q,W):S(4) = N(Q,X):S(3) = N(Q,W)
68  IF X(I) - X(I + 1) = 0 THEN S RETURN
69 ML = (Y(I) - Y(I + 1)) / (X(I) - X(I + 1))
70 P(5) = P(1):S(5) = S(1)
71 RL = Y(I) - (ML * X(I))
72 Z = 0:U = 0
73  REM  :LOOP
74 U = U + 1
75  IF U = 5 THEN  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1): RETURN
76 V = U + 1
77  IF P(U) - P(V) = 0 THEN  LET MP(U) = 1000: GOTO 79
78 MP(U) = (S(U) - S(V)) / (P(U) - P(V))
79 R(U) = S(U) - (MP(U) * P(U))
80  IF ML - MP(U) = 0 THEN  LET XR = 1000: GOTO 82
81 XR = (R(U) - RL) / (ML - MP(U))
82 YR = (ML * XR) + RL
83  IF  INT (P(V)) >  INT (P(U)) AND  INT (XR) > =  INT (P(U)) AND  INT
    (XR) <  INT (P(V)) THEN  GOTO 87
84  IF  INT (P(U)) >  INT (P(V)) AND  INT (XR) < =  INT (P(U)) AND  INT
    (XR) >  INT (P(V)) THEN  GOTO 87
85  GOTO 73
86  REM  :SIMULANEOUS POINT SORTER
87 Z = Z + 1
88  IF Z = 1 THEN XS = XR:YS = YR: GOTO 73
89  IF XR > XS THEN  LET XA = XR:YA = YR:XR = XS:YR = YS:XS = XA:YS = YA
90  REM  : PLOTTING COMMANDS
91  IF X(I + 1) = XR OR X(I + 1) < XR AND X(I) < XR OR XS < X(I) OR XS =
    X(I) THEN  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1): RETURN
92  IF X(I) < XR AND X(I + 1) > XR THEN  HPLOT X(I),Y(I) TO XR,YR: RETURN

93  IF X(I) < XS AND XS < X(I + 1) THEN  HPLOT XS,YS TO X(I + 1),Y(I + 1)
    : RETURN
94  RETURN
99  REM :MAIN PROGRAMME STARTS HERE
100  HGR : HCOLOR= 3: POKE  - 16302,0
110 A = 1.6
120 B = 1.35
130 TH = 3 * 3.141592654 / 2
140  FOR J = 1 TO 40
150 C = 210 *  COS (TH) + 40
160 D = 80 - 60 *  SIN (TH)
170  GOSUB 20
180  FOR I = 1 TO 5
190  GOSUB 3
200  LET I = I + 1
210  GOSUB 3
220  LET I = I - 1
230  IF J = 1 THEN  HPLOT X(I),Y(I) TO X(I + 1),Y(I + 1): GOTO 250
240  GOSUB 50
250  NEXT I
255  GOSUB 50
260  LET E = C
270  LET A = A * 0.93:B = B * 0.93
280  GOSUB 30
290 TH = TH + (3.14159 / 55)
300  NEXT J
310  HPLOT 0,0 TO 279,0 TO 279,190 TO 0,190 TO 0,0
320  STOP
350 TH = TH + (3.14159 / 55)
```

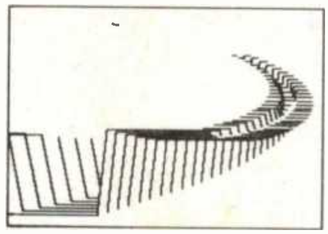


Figure 4.

There are a number of standard ways of approaching the hidden line problem, and some very general algorithms have been written which, it is claimed, will solve all problems. However, precisely because they are so general they tend to be very inefficient. The best way of tackling the problem is to customize the algorithm to the requirements of the individual program.

One of the favoured methods of solving hidden line problems, especially where concave shapes are concerned, is to define a vector at right angles to every plane on the object. If the vector points towards the viewport the plane is visible. If it points away the plane is invisible. This will allow you to treat a cube quite efficiently, but it does nothing in the case where one object is in front of, and thus hiding, another.

One very economical method of tackling that problem is to define a vector from every point in the viewport to every other. In this way it is possible to determine whether a point is in front of another or not.

In the particular case under consideration here neither of these methods seemed to fit the bill. After a good many sleepless nights it seemed to me that I could solve most of the problems by assigning a priority to the planes that make up the trench. It is possible to specify a heirarchy which depends only on the horizontal direction of the transformation.

For the sake of exposition think of each shape as consisting of two surfaces, two walls and a base. Then if the groove is moving left to right we can always see the right hand surface. The right hand wall can be hidden by this surface though. The base and left hand wall can be hidden by the right hand wall. The left hand surface can be hidden by the left hand wall. If the groove is running right to left we need to assign exactly the opposite set of priorities.

In order to make a system like this work we need to save sufficient data from each shape to make up a plane. This is done by the shapesave routine located at line 29. It stores the co-ordinates of the previous eight shapes in an 8 x 6 array. The priorities are then assigned by the hidden line routine at line 50 through to 61. Between line 63 and 89 the program searches the array for the first non-zero coordinates and then creates a plane. Then it examines the four edges of the plane to see if there are any points of intersection with the line. If there are, the coordinates are stored in the variables XR,YR and XS,YR. The plot commands appear between lines 90 and 94.

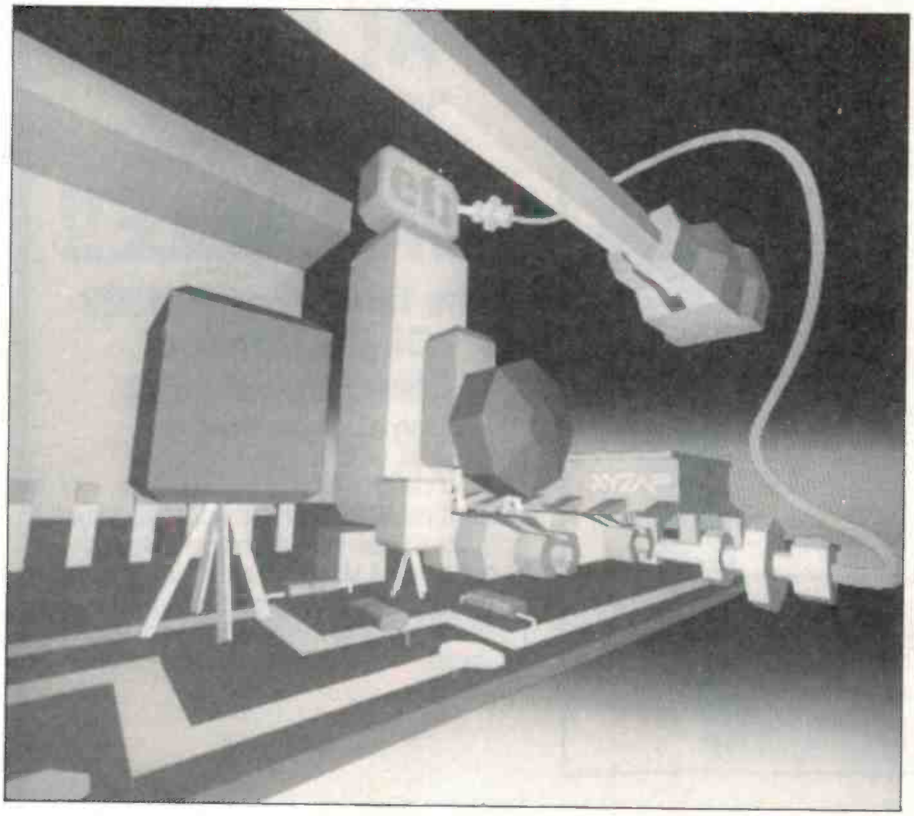
There are a number of difficulties with this, not the least being that since the planes are created out of two points in the current line, and two points from a line printed eight shapes earlier, things get a little out of kilter as we go around corners. A more sophisticated program would make some allowance for this.

Another problem is that in some places a line is obscured by more than one plane. When this happens the program will print regardless.

However, we are already paying a considerable price in computation time for removing the lines. Figure 3 can be executed in a few seconds. Figure 4 takes several minutes. Increasing subtlety will make the problem worse. Apart from anything else this serves a purpose in illustrating two points about graphics. One is that hiding lines is a lot more difficult than printing them. Another is that increasing realism takes computer time, and therefore costs money. Compromise is the nature of the game.

LIGHT ON OPTICAL FIBRES

Jon Fairall



Optical fibre — the glass link, is hardly a fragile thing. It has a long history and is now well established as a communications medium.

OPTICAL FIBRES, the use of light rather than electrons, is the oldest form of communications known to man. Two thousand, six hundred years ago, while sundry heroes were invading Troy in a wooden horse, messages were being sent back to the Greek capital by a series of bonfires. From that time on, numerous methods were devised to convey messages by light, until in the mid-1800s we began our long dalliance with electronic communications.

Now the wheel has turned full circle. Late in 1981 Telecom Australia installed a data link between Sydney University's computer centre in Darlington Road, and the main campus, about a kilometre away. It was optical fibre, and marked the beginning of a new era in communications in Australia.

Today optical fibre has well and truly moved out of the laboratory and into the workplace. Lines are smaller, lighter and more flexible than equivalent metal cables. This means they are easier to install and they occupy less space in cable ducts. A single fibre is only 0.9 mm across, although practical installations usually have three cables with a metal strength member running down the middle.

They have very low losses compared with metal cable. On most routes it is possible to do without repeaters except in exchanges. This contrasts with the present situation where it is often necessary to site repeaters in manholes in the street.

But the biggest advantage of optical fibre is undoubtably its bandwidth. With current technology it is routine for a single fibre to carry a full video signal 10 km, or eight video signals 4 km. Alternatively 1920 telephone channels can be carried 10 km or 7680 carried for 4 km. All on a cable less than a millimetre across.

In terms of miles of cables laid, the biggest users are the world's communications authorities. In some countries, optical fibre now counts for a significant percentage of the total amount of new lines laid. In Brazil for instance, optical fibre now links all the major cities. In countries with highly developed metal networks, optical fibres are being used to increase capacity on congested trunk routes.

In Australia, Telecom has been using optical fibre on main trunk routes since 1983, when the Melbourne exchanges of Dandenong and Exhibition were linked. This 36 km cable carries a 34 Mbit data stream. Various railway authorities are also coming to rely on it for signalling. This is an application where the immunity of the cable to radio interference is particularly relevant.

Melbourne and Sydney will be linked by 1988 (yet anther bicentennial year project) by a 30-fibre cable giving a total capacity for 60,000 voice channels. The existing coaxial cable has a 9000 voice channel capacity.

The Sydney-Melbourne cable will follow the existing cable route, but only use every third repeater installation.

Other uses are also being found for optical fibre as price comes down. Aerospace designers are using it in aircraft. Mechanical engineers use it on assembly lines to control robots.

Optical fibre

So, what is optical fibre? In its simplest form an optical fibre consists of a core surrounded by a cladding. The whole thing is enclosed in a jacket. The light actually propagates only in the core and cladding (see Figure 1).

The principle here is the same as the one that makes a stick appear bent when stuck half in and half out of water. Rays of light bend across the interface of two materials

Figure 1: The structure of an optical fibre.

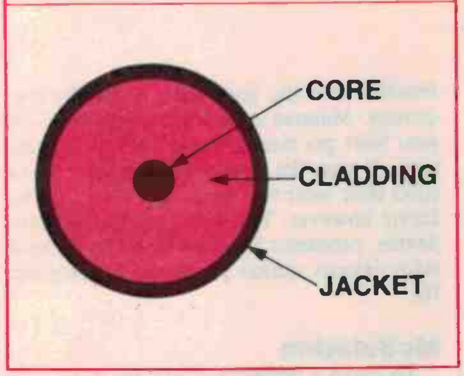


Figure 2: Light crossing an interface. 'n' refers to the index of refraction of the two media. They are linked by $n_1/n_2 = \sin\Phi_1/\sin\Phi_2$.

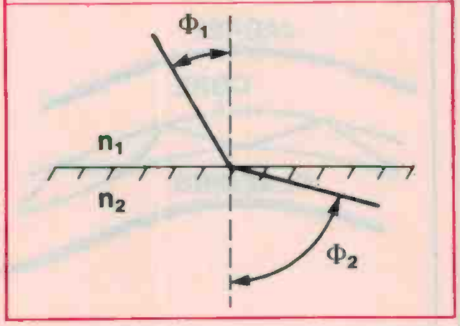
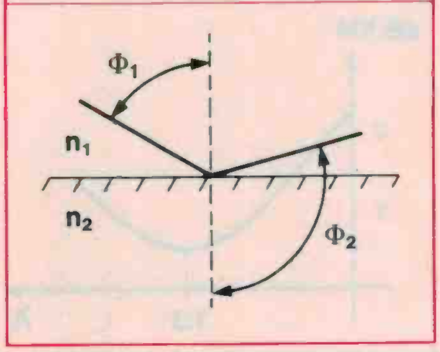


Figure 3: Total internal refraction. Note that n_1/n_2 still equals $\sin\phi_1/\sin\phi_2$.



with different refractive indices. Between air and water is one such boundary. Between air and glass is another. It's also possible to make different types of glass, with different refractive indices.

The mathematical relationship between the light paths is shown in Figure 2. As Φ_1 is increased, Φ_2 increases as well, but by a larger amount, until Φ_2 is greater than 90 degrees. This is the situation (Figure 3) where the light wave will always stay within the medium n_1. It will never enter n_2. It will, in fact, be totally contained within n_1, or, to use the jargon, totally internally reflected.

Things are arranged like this in an optical fibre: light is coupled into the fibre where some of it will be internally refracted. Once started, it will travel the entire length of the pipe, irrespective of twists and turns (within reason, of course). (See Figure 4.)

The basic idea here is not new. Sir Isaac Newton observed that a beam of light could get 'stuck' in a steady stream of water, if it entered at the right angle.

Modern research for a realizable waveguide began in 1954 when Hopkins and Kapay in the USA published a paper outlining the general principles of optical fibre. But they were a long way from a marketable fibre. For a start, glass transparent enough to be a useful transmission medium does not grow on trees.

It is generally accepted that a workable fibre must have an attenuation better than 0.5 dB per kilometre. To see how impressive this constraint is consider that ordinary window glass has an attenuation of about 0.5 dB per centimetre.

Numerous ways of lowering the attenuation of glass were attempted. One suggestion was to have a simple hollow pipe, analogous to a micro-waveguide, with lenses at strategic intervals. It was quickly discovered however, that apart from the manufacturing problems, any changes in the temperature or humidity of the air inside the pipe completely changed the tranmission characteristics.

In 1971 the CSIRO toyed with the idea, à la Newton, of filling a pipe with water, which proved to have excellent absorption characteristics. But these light pipes proved impossibly difficult to handle and manufacture.

In 1975 a technique called chemical vapour deposition had been identified in the USA as holding some promise. In Australia, AWA set up an experimental manufacturing plant in its laboratories in Sydney. Selected materials were heated into a gas and then deposited on the inside of the silica tube. When the tube was completely filled with the material, it was collapsed by heating and then drawn out into a long thin fibre. Using such techniques it has proven possible to develop fibres with absorption figures approaching 0.5 dB per kilometre.

Progress towards a realistic optical fibre was not really as smooth as this account suggests. Inevitably, there were wrong turnings and back alleys.

For instance, early research was dedicated to developing fibres that could work at the highest possible frequency. This logic was that the higher the frequency the faster the rate of data transmission.

This type of fibre is called monomode fibre, because it allows for the propagation of only one frequency down the line.

It turned out that these were the most difficult types of fibre to manufacture. The problem is that high frequency also leads to small cores. Fibres operating at the ultraviolet end of the spectrum have cores in the region of 2 to 8 microns across.

Manufacturing to these sorts of tolerances is extremely expensive for most applications. It's also difficult to handle in the field. Practical cable in a practical communications system has to be readily joined, cut, terminated, buried in mud and most of all, sworn at. No one swears at 8 microns.

If the core diameter is enlarged to 50 microns, manufacturing problems are eased, but the propagation frequency is much reduced. Monomode fibres can carry more than 20 GHz. With a 50 micron core the useful bandwidth is reduced to 50 MHz or less.

Another problem is that other frequencies propagate down the line as well. These follow a different path down the cable, and so arrive at the end at a different time. This phase error restricts the information you can send down the tube to several megahertz.

The solution to the problem was the creation of multimode fibres, especially designed to support a number of different modes of propagation. They work by doing away with a clearly defined core and cladding. Instead the refractive index of the glass is steadily increased towards the centre of the fibre. Since the light radiation travels more slowly as the index is raised, it is possible, by careful design, to make all the frequencies travel at the same rate. Useful bandwidth is about 600 MHz.

Although it appears more complex, fibres like this are actually relatively easy to produce. The first ones produced in Australia were made by AWA in 1978. Currently the North Ryde plant is producing about 200 km a month.

Recently, monomode fibres have come back into the picture. Although still expensive they have come down in price sufficiently to be cost effective in certain high density applications. The proposed Sydney-Melbourne trunk will use monomode fibre operating initially at 140 Mb/s. This will be quickly uprated to 545 Mb/s with an attenuation of about 0.4 dB per kilometre.

Joining such cables is still a problem, in spite of current techniques. Telecom plans to have portable air-conditioned clean rooms that can be placed over manholes on the cable route. The cable will then be hauled up into the room and the linesman, equipped with a microscope and glass welder, will make the join.

Telecom is currently working on a project that will endow the system with a certain amount of intelligence. A signal will be injected into one end of the fibre and received at the other. As the two ends are moved around each other the signal will increase or decrease in strength depending on the misalignment of the cable ends. When the signal is at a maximum the ends will be fused together with a glass welder. Current plans are that such welds will result in a loss of less than 0.1 dB.

Transmission

The medium, however, is only half the message. To take advantage of the optical fibre a whole new generation of transmission equipment has been developed.

Typically in an optical system the transmitter is an LED or a solid state laser. The LED has advantages of cheapness and is easy to modulate. The laser, on the other hand, is difficult to modulate and expen-

Figure 4: Wavelength versus attenuation in a silica tube.

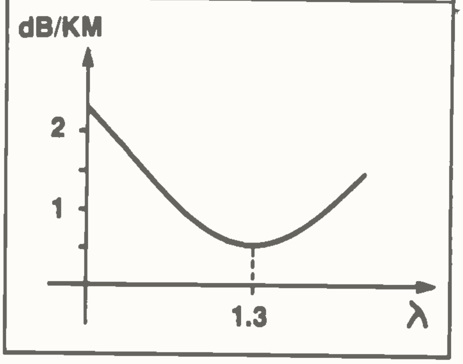
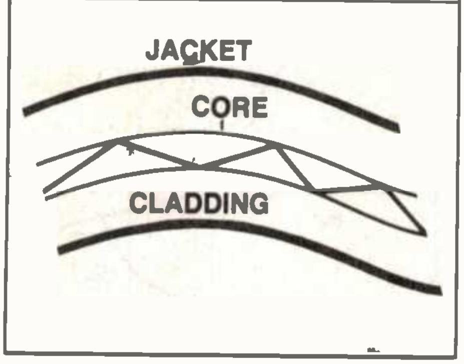


Figure 5: The path of a ray of light within an optical fibre.



sive, but it is bright.

Most telecommunications applications use a solid state laser as the transmission element. It was discovered early in the game that a semiconductor diode made of gallium arsenide radiates between 10-12 and 10-15 Hz. This just so happens to be the frequency of visible light, so it's called a light emitting diode. If the semiconductor junction is made very small, laser action starts to occur.

Laser light is very much more powerful, narrow and coherent than the light from an LED. These are just the qualities we require for an optical communications system, and make the laser a natural choice as a transmitter.

LEDs have been used in Australian communications before. Telecom used them experimentally in a fibre link between Springvale and Clayton in Melbourne in 1980. The link was 8 km long and speeds up to 8 Mb/s were obtained. A semiconductor laser was later installed and the transmission rate upped to 140 Mb/s.

The next problem is to make the laser and the fibre compatible. Figure 4 is a graph of attenuation versus wavelength for a typical silica fibre. It shows immediately that in order to get the best from such a fibre we need a laser that will transmit at about 1.3 microns wavelength.

The characteristic of attenuation in the glass isn't caused by impurities, but by the nature of the interaction of light and matter. In a silica type material, Raleigh scattering, that is, the scattering of light by the constituent molecules, starts to become significant below 1.3 microns. Longer wavelengths are absorbed by the material.

Although the numbers change, the same pattern will be found in many different materials. For instance, it has been suggested that halide materials such as zinc chloride or tellurium bromide could be operated at 4 microns with losses as small as 10^{-3} dB per kilometre (at which stage repeater makers go out of business).

Fortunately, getting a laser to work at the right frequency is not much of a problem. Since its invention by Theodore Maiman, laser action has been observed in many different materials, each with a specific frequency. Maiman's 1960 laser used ruby. A year later gas lasers (NeHe) were in operation. It was the doped neodymium YAG solid state laser that pointed the way to the future however. This was a small solid state device, precursor to a whole family of solid state devices similar in size to the familiar IC.

Modulation

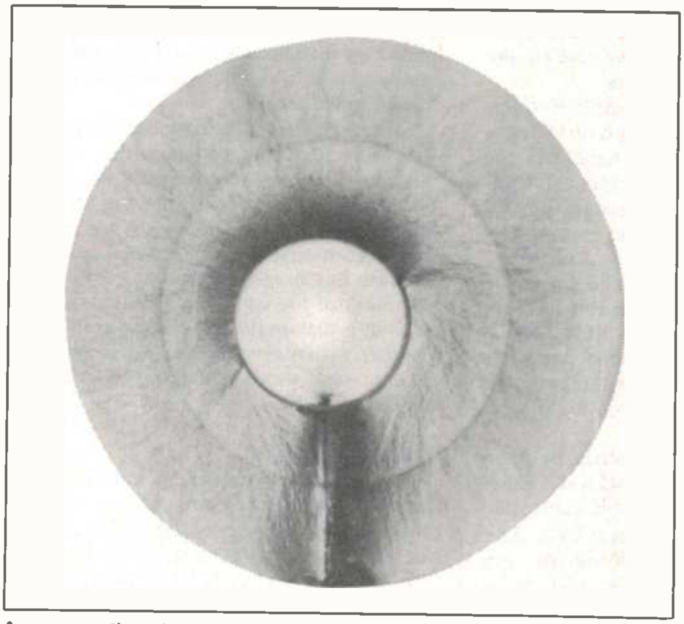
To make a practical communications system it's not sufficient just to have a medium and a transmitter. There has to be some way of modulating the transmitter to carry information.

The simplest technique is just to vary the current supplied to an LED. There is a very linear relationship between the light output and the current supplied. However, an LED is not bright enough for most applications, at least in telecommunications.

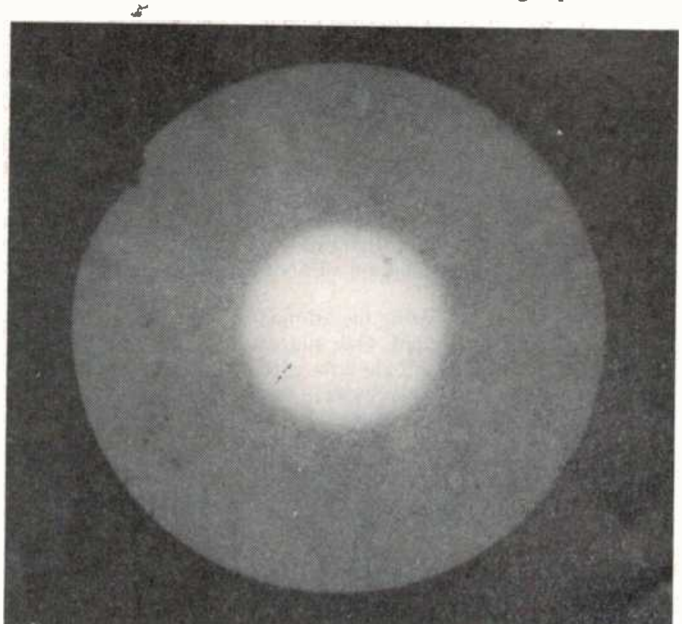
Lasers, on the other hand, are rather difficult to modulate. In fact, in a unique application of Murphy's law, as they get brighter and more efficient as they get harder to modulate.

This has led to the idea that some more indirect methods of modulation might be appropriate. The idea is that an external modulator should be placed in series with the source, so that its frequency can be maintained as stable as possible. In fact a whole range of solid state devices has been created that handle light in the same way the more familiar ICs handle electron flow.

Modulation, for instance, may be achieved using the Pockels effect, in which the refractive index of a light path can be



A cross section of multimode, graded index optical fibre with silicon resin coating. Coating outside diameter 380 μm, fibre 125 μm, core 50 μm. (Courtesy of AWA, Optical Fibre Division.)



Multimode, graded index optical fibre without coating. Fibre outside diameter 125 μm, core 50 μm. (Courtesy of AWA, Optical Fibre Division.)

altered in proportion to the strength of an applied electric field. Other methods include optically stressing the light path to change the index of refraction.

However it's done the end result will be some sort of digital modulation. Except, perhaps, in the earliest years analogue methods have never been seriously considered. The most common method is pulse code modulation (PCM), in which the level of an analogue input is represented by a digital word.

It is a curious thought that the basic idea of PCM, like optical communications itself, was invented by the ancient Greeks. In 200 BC Polybius developed a two bit, five level code and applied it to the Greek alphabet. So far as we know, it was the first example of an ability to communicate completely unarranged messages over a long distance.

Reception

At the receiving end some method of converting the optical energy to electrical energy must be found. The basic theory relating incoming photons to matter (the photo electric effect) was worked out by Albert Einstein in 1905, the same busy year he worked out the theory of relativity.

The photo electric effect had been known (but not understood) for many years before that. In fact the first modern optical communications system was designed in 1850 by Alexander Graham Bell, who modulated sunlight falling on a sellenium photoresistor. He arranged things such that a diaphragm mirror at the focus of a speaking tube concentrated the light onto the resistor. Sound waves in the tube changed the shape of the mirror, and thus the intensity of the light.

Modern requirements for high sensitivity and bandwidth lead at the very least, to silicon photodiodes. When the light strikes the active region of such a device, an electron-hole pair is created in the active region, and a current flows that is directly proportional to the number of photons.

An even greater sophistication is the use of avalanche photodiodes. If one of these is reverse-biased, and a photon hits its junction, an avalanche of carriers occurs, creating considerable current flow.

The future

Optical fibre is undoubtably the medium of the future. Apart from its impressive technological features, it's made from the most commonly occurring element in the Earth's crust: silicon. As copper gets more expensive, techniques for producing optical fibres get more refined and thus cheaper.

But it is unlikely that optical fibre will be run into subscribers homes for many years. The sheer size of the investment in copper cable means that the world's communications will continue to be based on copper. But junction lines between exchanges, data networks, TV links, in short, all the big bandwidth applications, will be on glass in the near future. It will mean a quantum leap in our ability to shunt information around the nation.

In other applications, glass is likely to be increasingly used instead of copper to communicate between devices. As opto-electronic transduction technology becomes cheaper and easier to use applications will multiply. See elsewhere in this issue.

MEGATEST: CHALLENGING THE IC TESTING GIANTS

Not quite 10 years ago, two young computer engineers — one an Australian — set up a small company in California's Silicon Valley to make IC testing equipment. Today Megatest's testing systems are used by almost all of the major US chip manufacturers, and its latest MegaOne system is widely acknowledged as a breakthrough in the testing of highly complex VLSI chips.

Jim Rowe

AS IC CHIPS have become more and more complex, chip manufacturers have been facing an ever-increasing problem: how to test their finished products quickly and economically. The problem has become particularly pressing with the latest VLSI (very large scale integration) devices.

Testing a typical modern VLSI chip like a 64K dynamic RAM involves more than 120 million separate tests. As a result, testing can take more than 30 seconds per chip with traditional equipment. When you have to turn them out by the hundreds of thousands per month, this simply isn't acceptable. The cost of testing a chip can actually exceed the cost of making it.

The number of tests per chip tends to grow exponentially with chip complexity. So unless an answer is found, the cost of chip testing could itself become a serious barrier to the development of still bigger VLSI devices — like 256K and 1 megabit RAMs.

Not surprisingly, the companies that make IC testing systems have been spending a lot of time and money trying to find an answer. And we're talking about some pretty big and experienced firms, like Fairchild, Teradyne and GenRad. But right now a lot of people in the industry are putting their money on a little company in California's Silicon Valley, started only 10 years ago by a couple of enterprising young engineers.

Steve Bisset is an Australian who grew up in Canberra and moved to the USA to study electronics at California Institute of Technology. After graduating he worked at Hewlett-Packard designing ICs, and became friendly with another engineer working on IC and logic testers, Howard Marshall. Bissett then went to Intel, where he too found himself involved in the problems of testing complex chips.

In 1975 the two engineers decided they would start up a company of their own. Rather than choose one of the glamour product areas like super-fast computer chips, they decided to specialize in an area which they felt had been largely ignored. You guessed it, they chose chip testing. It was here they sensed some breakthroughs would be necessary before long, and with their backgrounds and experience they hoped they could make some original and useful contributions. They called the company Megatest Corporation.

In a rented cottage in Santa Clara they designed and put together their first testing system. It cost $20,000, scraped together from their own savings and from loans by friends. By 1978 they had made and sold 120 'Q-8000' testers, and Megatest Corporation was doing $4 million worth of business a year.

A couple of years later they produced a more elaborate family of testers, the Q2 series. This has been a most successful range, which still provides the bulk of Megatest sales revenue. To date over 500 have been produced, and Q2 testers are now part of the production test facilities of most major chip makers.

The Q2 family was designed to test logic, memory and microprocessor chips operating at up to 10 MHz and with up to 40 pins. Based themselves on dedicated 16-bit microprocessors, the various Q2 models are designed to operate in multiples as part of a local-area network (LAN), controlled by a PDP 11/23 minicomputer. For example up to eight Q2/52 memory testers can be clustered around a single PDP 11/23.

The Q2/52 memory tester can accommodate chips with up to 4 million addresses, and with data patterns up to 1 megabit wide. It can check chips with either byte-wide or world-wide organization, and with a variety of chip-select modes. Current models will check the latest 512K EPROMs, and are available with the op-

The MegaOne system. Using a complete tester for each pin, it can test VLSI devices with up to 256 pins. Three independent test heads allow for maximum throughput.

tion of providing bit error mapping on a colour graphics display with 1 megabit resolution.

The Q2/62 microprocessor tester also offers pretty fancy performance. It provides 24 timing generators, with the ability to produce 48 timing edges at data rates up to 10 MHz and with programming anywhere in a 16-cycle window. It also includes a buffer memory capable of storing 174 000 testing parameter values or 'vectors'.

But without a doubt the tester that has made the industry really sit up and take notice of Megatest is its latest and biggest, the MegaOne. This is the one that Steve Bisset believes will lift his company into the big league, with a turnover of more than US$1 billion. And it's the one that seems to have stolen a march from the existing leaders in the automatic testing market: Teradyne, Fairchild, GenRad, Tektronix and Takeda-Riken.

The MegaOne project started in 1980, when Steve Bisset talked his old Aussie school friend Richard Swan into joining Megatest. The two had been at school in Canberra together in the 1960s, and had started a light-show business together when they left. After they drifted apart, Richard went to England and then over to Carnegie-Mellon University in Pittsburgh, where he gained a PhD in Computer Science. Just before he joined his old friend at Megatest in 1980, he was working at Carnegie-Mellon as Assistant Professor in the Department of Computer Science.

As Megatest's Director of Engineering, Swan became chief architect of the MegaOne. With a team of top engineers, he laboured for four years on the project to bring it to fruition. All told MegaOne has taken 140 man-years of effort, and a total investment of about US$15 million. When you consider that 1983 sales turnover for this still relatively small private company was only US$22 million, it was a mighty effort.

Right from the start, the MegaOne was designed to meet the growing need for an automated tester for VLSI chips that would overcome the problems of existing testers. It had to be inherently fast, to cope with ever-faster clock rates. It also had to be able to cope with the growing number of pins per chip. And last but by no means least, it had to provide a way to simplify the writing of testing software, which was fast becoming an expensive nightmare.

Megatest's engineers soon realized that many of these problems stemmed from the ▶

Megatest's Steve Bissett. Proving the Yanks aren't the only ones with entrepreneurial drive — but doing it in Silicon Valley.

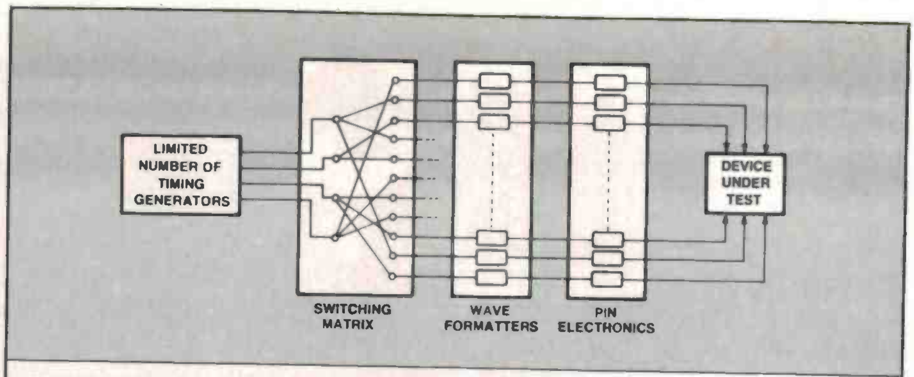


Figure 1. Conventional IC testers use a limited number of timing generators and other resources, connected to the device pins via a switching matrix. This makes programming complicated, introduces timing errors and expansion almost impossible.

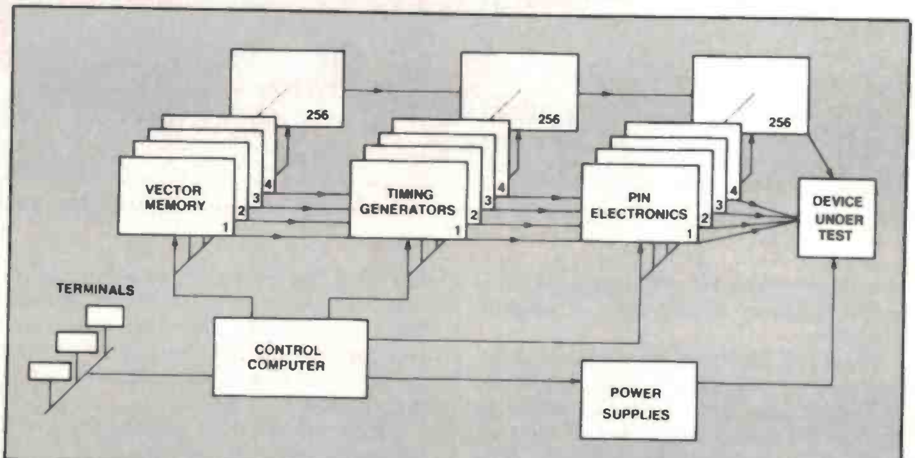


Figure 2. The MegaOne uses a complete programmable tester per device pin. Each identical tester comprises a vector memory, timing generators and pin electronics. To cope with bigger devices, more testing modules are added.

way existing chip testers have used a 'shared resource' architecture. They use a limited number of programmable timing signal and pulse generators, together with a similar small number of edge and logic level detectors. The various generators and detectors are connected to a switching matrix, which enables them to be connected under software control to the various pins of the IC being tested (see Figure 1). So the actual circuit for each test must first be set up by programming the switching matrix, then the test itself performed by triggering the generators, strobing the detectors and storing the data.

One problem with this shared-resource aproach is that the limited number of generators and detectors makes it harder and harder to cope with more complex chips. The larger the number of pins, the more the person writing the test program has to work out how to 'juggle' the tester's resources in order to set up and perform each test.

So VLSI chip testing programs have become more and more complex, and are taking longer and longer to develop. In some cases a program for a new chip can take up to a year to write, and needs to be extensively debugged using the tester itself.

But that's not all. There are timing problems with this approach, because the testing resources are not connected directly to the chip pins, but via the switching matrix — an array of multiplexers. This means a variety of signal paths, each varying in terms of propagation delay. So the signals take different times to reach the chip pins, causing timing or 'skewing' errors.

It is possible to switch in programmable 'de-skewing' delay circuits to remove these errors, but this becomes harder and harder as the number of chip pins increases and the switching matrix grows. In practice the errors tend to grow steadily, imposing their own limits on the chips than can be tested.

The MegaOne gets around these problems by changing to a more basic architecture. Instead of a limited number of test signal generators and detectors, it goes in 'boots and all' with a complete and separate programmable tester for each and every pin of the test device. So for each pin there is a separate timing generator, waveform formatter, dc supply/pin driver, detector and loading circuit — all of which are programmable. There's also a separate memory to store that pin's testing signal and result data, or its 'test vector' information (see Figure 2).

Get the idea? Each pin's tester circuit can be programmed to provide for that pin being an input, an output, a supply pin or whatever. And this can be done dynamically, with signals applied and outputs sensed at set times — all under program control. Every single pin has its own fully programmable and independent tester; the operation of these testers is 'orchestrated' by the master computer under the control of the testing program.

Obviously this involves quite a lot of testing hardware; the MegaOne is designed to cope with devices of up to 256 pins, so it can be fitted with up to 256 testers! Each of these testers has a programmable timing generator board, a pin electronics board and vector memory board.

The timing generator boards are, in a sense, the heart of each tester. These generate real-time signals which are fed to the pin electronics board, both as 'stimulus' signals to be fed to the input pins of the chip under test, and as 'strobe' signals to enable the pin electronics sensing circuitry at the right times to sense expected chip outputs.

In each testing cycle, each timing generator is capable of generating any waveform shape composed of three independent timing edges, with a resolution of 100 ps (picoseconds). It can also be programmed to use the generated waveform to control the pin electronics in any of seven different ways: drive HI, drive LOW, drive OFF (all pin driving), strobe HI, strobe LOW, strobe for Z and strobe OFF (all pin sensing).

The other main board in each tester is the vector memory board. It provides 1 megabyte of storage, used both for storing the testing parameters applied to the timing generators, and the response data from the chip pin concerned.

Each of these three-board testers can drive or sense its device pin at a 40 MHz rate. If this is not fast enough for certain pins of a chip under test, two testers can be connected to a single pin under software control, to achieve an 80 MHz data rate. During a test, no less than 64 unique waveforms can be selected on the fly for a given device pin; a total of 126 sets of waveforms, plus cycle timing, are available per pin. It is also possible to load waveform specifications into all timing generators in parallel from vector memory, giving an effective reloading rate of 2.5 gigabytes per second.

The vector memory and timing generator boards for each tester are housed in the MegaOne's mainframe, while the pin electronics cards for all testers are housed in adjustable-position testing heads. Because the MegaOne's test time per chip (around 200 ms for a typical device) is much shorter than the 700-800 ms needed to change chips via an automatic handler, the MegaOne is provided with three testing heads so that it can achieve maximum chip throughput.

Obviously the MegaOne is a pretty fancy beast, and it's not cheap. Prices start at US$1.3 million for an 80-pin model. But the advantages of this 'brute force' approach are great.

For a start, because each device pin has its own tester, and all testers are identical, there are virtually no timing errors. All tester hardware can be pre-calibrated for every possible testing configuration. So a testing program can specify signals which will arrive at device pins at precisely known times.

More importantly, because there are no restrictions on tester resources, the testing software can be much simpler and more straightforward — and hence cheaper to develop. With the MegaOne, testing programs are written in the high-level language Pascal. These run on the MegaOne's inbuilt 32-bit control computer, which uses six 68010 processor boards and a set of peripherals including up to 1.8 gigabytes of disk storage, a 600-line-per-minute printer, and up to 48 workstation terminals.

A further advantage is that the basic MegaOne can easily be expanded to provide for additional device pins, because with the tester-per-pin architecture there is no interaction between pins. To provide for more pins, it is basically a matter of adding more testers and interfacing to the control computer. Systems for 512 device pins and more are quite feasible, while existing machines can easily be upgraded and expanded.

All in all, the MegaOne is a most impressive system and one that seems set to lift Megatest into the big league after only 10 years. Sounds like a classical Silicon Valley backyard-to-billion dollar success story — a tribute to Yank drive and initiative, doesn't it?

But don't forget that Megetest's founder-President and Director of Engineering aren't Yanks at all. Steve Bisset and Richard Swan are both Aussies. So it's not a matter of where you're born, or even where you grow up. It could be just a matter of your drive and initiative, and also where you try to build up a business ●

Could Megatest have happened in Australia?

In the last year or so we've had a lot of talk in Australia about assisting the so-called "sunrise industries". A few hi-tech firms have actually managed to gain enough momentum to flutter clear of the ground. But somehow it's all been rather half-hearted and hypothetical.

It's a great topic for political speech-making, but when the time comes to dole out public money there are always lots of more urgent claims.

Not that I think this is really a problem when it comes to encouraging hi-tech industry, because I suspect that the real impetus has to come from private investment. It's all very well for a committee of academics and boffins to decide which hi-tech projects should get Government support. The fact is, it's not their own money being invested.

How much more motivated any of us becomes, in working towards a goal, when our own personal money is involved! To me that's why private investment will always prove far more effective than public funding — because a private investor has a strong incentive to make sure the project turns out successfully.

Of course in order to attract private investment for hi-tech industry, you need to have the right financial climate. You need to have investors who are prepared to take reasonable risks, and a tax structure which will encourage them to take those risks.

Even this isn't the whole story. Just having the right financial climate and a boffin with a bright hi-tech idea isn't enough. To attract venture capital, you also need to boil down the complex technical ideas so that the basic business plan can be explained to potential investors. So you need to have technical communicators and marketing people involved in a project from a very early stage, or it'll probably never get off the ground.

The Yanks seem to understand these things well and the right things happen as a result — even if the boffins happen to be from Australia. Stories like Megatest's prove it!

It seems to me that we have a long way to go in Australia before the same thing can start to happen here. So people like Steve Bisset will probably still have to go to Silicon Valley, if they want to turn their dreams into reality. Frustrating, isn't it? (J.R.)

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RELAY AND BASE
Can carry 10A at 28V DC or 5A at 240V AC. Supplies with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.
Normally $8.95
Cat. S14074 NOW $6.95
ULTRASONIC MOTION DETECTOR
A compact design that can be used with virtually any alarm system which has an input for N.C. or N.O. external sensor. Coverage is approximately 110 degree angle and up to 8 metres. Comes with detailed instructions.
Cat. S15033 $39.95
APPLE JOYSTICKS
Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 $27.95
SUPER HORN
Wide dispersion tweeter, handles up to 100W.
Sensitivity: 105dB/0.5m
Frequency Reponse: 3kHz-30kHz
Impedance: 8 OHMS
Size: 145x54mm
Cat. C12102 $12.95
RS232 & 'D' TYPE CONNECTORS
PART DESCRIP. CAT.NO.
1-9 10-25
DE 9P 9 Pin Female P10880
$1.75 $1.60
DE 9S 9 Pin Male P10881
$2.25 $2.45
DE 9C 9 Pin Cover P10992
$2.55 $2.45
DA 15P 15 Pin Male P10894
$2.10 $1.95
DA 15S 15 Pin Female P10895
$2.25 $2.10
DA 15C 15 Pin Cover P10892
$1.15 $1.05
DB 25P 25 Pin Male P10900
$2.95 $2.80
DB 25S 25 Pin Female P10901
$3.45 $3.30
DB 25C 25 Pin Cover P10902
$1.20 $1.10
HORN CRAZY!!
8W, aluminium or plastic.
Normally $9.50
Aluminium Cat. C12015
Plastic Cat. C12010
1-9 10+
$6.50 $5.95
10 only!!
PLASTIC COMPUTER CASING
A stylistic low profile case to give your system the professional look it deserves. Provision for two 5 1/4" slimline drives.
Cat. X11080 $75.00
MOUNTING BRACKET
For above Ultrasonic Alarm and features ball pivot for horizontal and vertical adjustment.
Cat. S15042 $11.95
PIPER MOUSE ROBOT
This is a Super-Sonic robot, controlled by a super-sonic sound sensor and an electronic circuit (1 Channel). By using the whistle included with this Kit, Piper Mouse will obey your commands immediatley turning to the right, stop, advance and stop
Cat. K96680 $34.95
BULK CABLE 100M ROLLS
Cat. W11222 3C2V75 OHM
$22.00
Cat. W11224 5C2V75 OHM
$35.00
Cat. W11219 4 Core Shielded
$49.00
HEX KEY PAD
19 keys, unencoded, 76 x 95mm
Cat. K46804 $42.50
Errors and Omissions Excepted.

CHANGING OF PHONE NUMBER
Please note that in May, our City Stores' phone number will be changing from 347 7917 to 663 6151

DISK STORAGE BOXES
Efficient and practical, these disk storage boxes protect your disks from being damaged or lost.
50's. Features smoked plastic cover with provision for a lock. High impact ABS plastic base.
Cat. C16025 $26.50
50's. Features smoked plastic cover. Divided into 10 sections, each fan elevates the disks for easy identification and access.
Cat. C16050 $34.50

VIDEO SWITCHING BOX
Low loss R.F. switching — allows inputs for: VCR, video, disc, antenna cable TV, home computer and video games.
Cat. A13015 $39.50

MICRON SOLDERING IRON
240V, 30 W general purpose for electrical and electronic soldering.
Cat. T12430 This month $10.95

NEW!!
TELECOMMUNICATION PLUG TO 2 SOCKETS.
Ideal for modem connections.
Cat. Y16014 $12.95

VCR HEAD CLEANERS
VHS and Beta available. A professional head cleaner, employs 'double sided' cleaning action. Just insert the cassette 'play' for 30 seconds and the job's done!
VHS CAT. A11456 $17.50
Beta Cat. A11457 $17.50

SWITCH MODE POWER SUPPLY
DC+5V at 3A, +12V at 1A
DC−5V at 200mA, −12V at 500mA
Dimensions: L250 x W90 x H55mm
Cat. M16680 $89

SWIVEL BASE
Makes life easier, normally $29.50.
Cat. D11100 $25.50

UNIVERSAL SOLDERING IRON STAND
Cat. T11302
$5.95 slashed to $3.95

TELECOMMUNICATION PLUG/SOCKET
Plug Cat. Y1601 $3.95
Socket Cat. Y16018 $4.95

P.A. SPEAKERS
Dual cone, wide range. 200mm (8 in.) 10 W ideal for public address, background music etc.
1-9 10+
Cat. 1200 $9.50 $8.50

PUSH BUTTON DIALLERS
Tired of old fashion dialling and re-dialling engaged numbers? These convenient push button diallers include last number re-dial (up to 16 digits) and instructions for an easy changeover.
Cat. A12030 $19.95

BRAND NEW FANS
Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.
240V 4⅝" Cat. T12461 $10.95
115V 4⅝" Cat. T12463 $10.95
240V 3½" Cat. T12465 $10.95
115V 3½" Cat. T12467 $10.95
10 Fans (mixed) less 10%

VIDEO RF MODULATOR
At an unbelievable price!
Our RF modulators are channel selectable either Channel 0 or Channel 1
1-9 10+
Cat. $16040
$4.95 $3.95

TELECOMMUNICATION EXTENSION LEADS
Cat. Y16010 5m $12.50
Cat. Y16012 10m $14.95

10,000uF 75V ELECTROS
25% more microFarads! Ideal for those who want a more powerful amp!
1-9 10+
Cat. R16587 $10.50 $9.00

COLOUR CAPPED KNOBS
Economy knobs with elevated white pointer.
Cat. H10001 RED
Cat. H10002 BLUE
Cat. H10003 GREEN
Cat. H10004 YELLOW
This month's prices
1-9 10-99 100+
$0.40 $0.35 $0.30

KEY SWITCHES
1-9 10+
Cat. S12500
$3.95 $3.75

BREADBOARD SPECIALS
Why pay more??
Competitors Price / Our Price
Cat. P11000 100 holes $2.95 / $1.50
P11005 640 holes $8.95 / $5.95
P11009 840 holes $14.85 / $10.95
P11012 1680 holes $27.95 / $19.95
P11015 2420 holes $45.00 / $29.95

CAR REPLACEMENT SPEAKERS
Cat. C10757 5x7" Oval $5.95
Cat. C10746 4x6" Oval $4.95
Cat. C10705 5" Round $4.50
Cat. C10706 6" Round $5.95
All are rated at 4 OHM, 5 WATT

BLANK DATA CASSETTES
Brings out the best in any micro!
1-9 10-99 100
$1.10 $1.00 $0.90
Cat. D11141

CRYSTAL SPECIALS
Prime spec's. We just too many in stock!
3.5795 MHz 14.318 MHz
4.00 MHz 18.0 MHz
4.1943 MHz 20.0 MHz
All $2.50 each!
10 or more $2.00!

TAPERED REAMER
Great for enlarging holes that are a bit too small. Enlarges from 5mm to 20mm.
Cat. T12370 $6.95

MINI STEREO HEADPHONE
Low cost hi-fi sound! Light and comfortable, as easy to wear as hair!
Cat. C14000 $4.95

DIGITAL MULTIMETER
YFE YF1100 FEATURES
- Large, easy to read 3½ digit display
- Facilities for transistor and diode testing
- Clearly laid out front panel
- 10A DC AC range
- Priced to undersell the others!

Cat. A16025 $59.50

RELAY AND BASE
Can carry 10A at 28V DC or 5A at 240V AC. Supplied with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts paralleled up to 20A can be switched.
Normally $8.95
Cat. S14074 This month $6.95

2K OHM MULTI METER
11 Ranges, pocket size.
SPECIFICATIONS:
11 RANGES
DC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt
AC VOLTAGE: 0-10-50-250-1000 volts 2000 ohms/volt
DECIBELS: -10 to +22dB in four ranges
OHMETER: 0-10 kohms 0-1 mega ohms
DC CURRENT: 1 100mA
normally $14.95
this month $9.95

FAIRCHILD TTL DATA BOOKS
Just arrived! This book is the same as used in the Victorian Education System. Includes data on new Fast series. Limited stock 500 only.
Cat. B10050 $14.95

TO3 HEATSINK
1-9 10+ 100+
$1.00 $0.90 $0.75

3 ½" MAGNIFYING GLASS
Ideal for close inspections of soldar joins etc.
Cat. T12087 $7.95

$100 PROTOCARDS
SAVE $10 This month only.
Cat. H19125
Horizontal Buss
Cat. H19125 $29.50
Vertical Buss
Cat. H 19130 $29.50
Pad Per Hole
Cat. H 19135 $29.50

POWERFUL MINI DRILL
Featuring a powerful 6000 r.p.m. motor. This lightweight (113gm) drill is ideal for many jobs. Perfect for PCB work! Has a 0.8 to 1.2mm chuck and 1mm drill bit.
Requires 12V 1 AMP fuse with M19010!
Cat. T12302 $11.95

NEGATIVE & POSITIVE CIRCUIT RESIST
Make your own presensitized PC Boards. POSITIVE PHOTO RESIST for using 1 : 1 tapes and pads on clear film for one off or prototypes. Resist 50ml bottle for appox. 1500 sq cm of pcb.
Cat. P85500 $6.95
DEVELOPER: 70 gms of crystals to mix with 2 lt of water, enough to complement 50ml of resist.
Cat. P85504 $3.25
NEGATIVE PHOTO RESIST for using normal negative PCB images.
Resist: 50ml bottle for approx. 1500 sq cm of pcb.
Cat. P85508 $5.45
DEVELOPER: 500ml bottle enough to complement 50ml of resist. No dilution required.
Cat. P85510 $8.50
ETCHANT: 400gms of crystals to mix with 1 to 1½ lts of HOT water.
Cat. P85512 $3.25

PIN VICE
It's infuriating when all you need to do is drill one hole a little big bigger and haven't got a drill that fits in your tool box. Buy one of these for drilling circuit boards. Will hold drill bits, taps, files, etc. up to 3mm.
Cat. T12352 $7.95

QUARTS CRYSTAL CLOCK MOVEMENT
- Very compact and reliable
- Self starting one second stepping motor has strong torque
- Powered by 1.5V AA battery that lasts for a year
- Supplied with two sets of hands, one short and one long
- ±15 seconds/month accuracy
- 56mm square, 15mm deep.

Complete with data sheet, instructions and wall hanger bracket.
Cat. XC0100 $14.95

NEW! U.V. TUBES
Fits into standard 15W flouro holder. Suitable for Scotchcal, Eprom erasing etc. As used in ETI Eprom Erasing Kit.
WARNING: Do not look directly into UV Tubes!!
If ordering by mail please include an extra $2 for "SPECIAL" packing.
Cat. H28600 $24.95

PANEL METER BARGAINS!!
250 ua Sensitivity Panel cut out 36 x 16mm. Mounting hole centres at 49mm.
Cat. Q10400 normally $4.50
this month $2.95
250 ua Sensitivity centre 0, very useful for balanced circuit and applications needing a centre "0" or null indication.
Cat. Q10405 normally $4.95
this month $2.95

TRANSISTOR NIPPERS
Normally $7.95! This Month
Cat. T12070 $6.95

MICRO NIPPERS
Normally $9.95 This Month
Cat. T12050 $6.95

RITRON (ZETA) DATASETTE
For data loading and saving, this Micron Datasette suits most home computers and features tape counter, monitor function for audio verification and slide volume control for output level.
Cat. C14900 $29.95

MAGNETIC BULK ERASER
The best and by far the quickest way to erase tapes, cassettes and computer discs! Reduces noise levels below recorders own erase head level. On/off switch located in handle. 240V AC operation.
Cat. C14950 $29.50

ELECTRET MIC INSERTS
With pins for easy board insertion.
1+ 10+ 100+
$1.25 $1.10 $1.00

Pioneer puts digital compact disc player in car

Pioneer has just announced its release of a small number of CDX-1 compact disc players exclusively designed to operate in conjunction with the 'just-released' Centrate 'flagship' component range of car hi-fi equipment.

Pioneer has packaged the CD player in an attractive DIN-sized in-dash unit which would be compatible with other quality modular car stereo components — particularly Pioneer's Centrate top-end system.

The CDX-1 disc player features two separate modules. An Operations Module fits in the standard dashboard 'slot' of most modern cars. This incorporates the laser pick-up and disc drive mechanism, while the Processing Module houses the electronic functions of the CD player in a 'hideaway' unit for mounting under or behind the dash or under the front seats.

Functions include skip-search, music scan, track-repeat and disc repeat. The system has also been designed to be fail safe. Should a sensor detect any dramatic rise in ambient temperature within Pioneer's heat-proof mechanism, the display indicates that the disc play-back has been automatically disengaged to prevent possible damage to player

The CDX-1 companion Compact Disc Player for Pioneer's Centrate system sells for around $1000. The later CDX-P1 is expected to be similarly priced.

For further information contact **Pioneer Car Stereo, (03)580-9911.**

Super SR video recording cassettes

The new Konica video cassettes make use of a specially formulated cobalt and ferric magnetic material. The extreme fineness and even grading of the material's particle composition produces highly uniform image characteristics, reports Konica.

Konica video tapes are coated by a process which maintains even particle distribution over the surface of the tape, creating a smooth surface for contact with the drum and heads. The improved video signal-to-noise and chroma signal-to-noise radios thus attained result in video recordings that are true to life.

With long-term colour and image stability starting with a stable base film of tensilized polyester, Konica tapes maintain their shape and length even under higher than normal tension.

Other special characteristics of the tapes to reduce wear and tear are low demagnetization and durability against heat and humidity fluctuations.

Magneplanar speakers in Australia

Audio 2000 now distributes Magnepan Magneplanar speakers in Australia.

The Magneplanar drive system uses a large lightweight flat diaphragm of stretched Mylar film. Separate bass and midrange panels are used. The diaphragms carry a 'voice-grid' analagous to the voice-coil of a conventional dynamic drive unit and powerful strip magnets bonded to the panel chassis provide static motive force.

As such, the diaphragms receive a far more evenly distributed motive force, have far lower mass and greater radiating area than ordinary units. Main benefits are lower overall distortion, with greatly reduced intermodulation, rapid response for clearer dynamics especially at low listening levels.

Four Magneplanar models are available. These are the SMG, or small Magneplanar, the MG1 B, the MG2 B and the MG3. The SMG is designed for use in smaller rooms. At the other end of the scale, the 1.83 metre high MG3 is a wide-range, high output 3-way speaker system using, in addition to Magneplanar panels, a vertical ribbon tweeter running almost the entire height of the speaker along one edge.

Information on Magneplanar speaker systems is available from **Audio 2000, PO Box 107, Brookvale, NSW 2100. (02)939-2159.**

Improved open reel decks

The Teac X-2000R, X-2000, X-2000M reel decks are replacements of the X-1000 models. The new models have been developed with features such as CA (Cobalt Amorphous) record and play heads; semi-fixed head mounting; higher bias frequency (150 kHz; 50% higher than usual); and reference recording level raised to 6 dB.

The X-2000R is built with bi-directional record and play, while both the X-200R and X-2000 have four track record and play at 19/9.5 cm/s. The X-2000M model is a two track machine with four track playback and a tape speed of 38/19 cm/s.

Other common features include dbx noise reduction (type I); EE tape compatibility; dual-capstan closed-loop transport; semi-fixed head mounting; bias fine control (±10%); 5/digit multifunction LED tape counter; auto-locator (search to zero, search to cue); block repeat; record mute with auto spacer; and electro-magnetic reel braking.

Recommended retail prices are $1399 for the X-2000, $1699 for the X-2000R and $1642 for the X-2000M.

For more information contact **Teac Aust. Pty Ltd, 115 Whiteman St, South Melbourne, Vic 3205. (03)699-6000.**

Speaking Danish

A new brand of speakers from Danish American Loudspeaker Industry (DALI) were introduced into Australia in March.

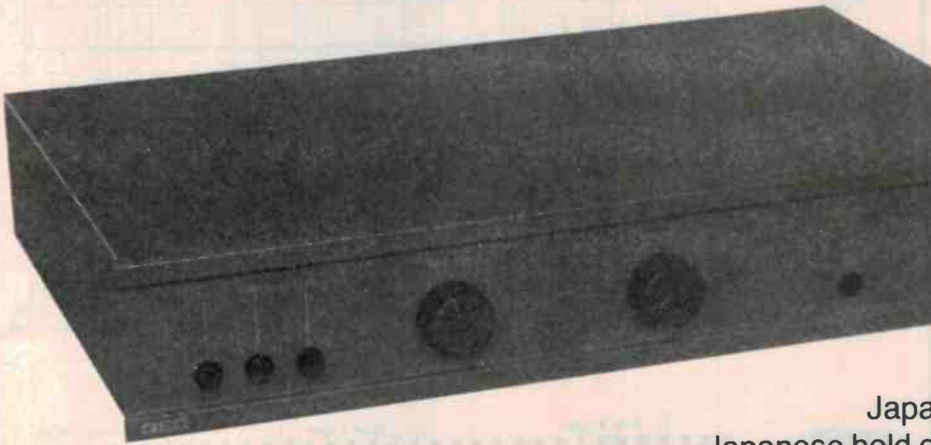
The concept of the DALI speakers is no nonsense, no flashing lights, no unnecessary trim rings around the drivers.

The speakers are all made in genuine wood veneer right down to the 2-way DALI-2 at $395 per pair. All drivers are designed by DALI and manufactured in Denmark by Dynaudio, Scan Speak, Peerless and Vifa. The four models introduced to Australia will be two 2-way bookshelf speakers at $395 and $495 per pair, the floor standing DALI-4 with three drivers at $695 per pair and the top model, DALI-6 at $1195 per pair, a newly developed floor standing speaker.

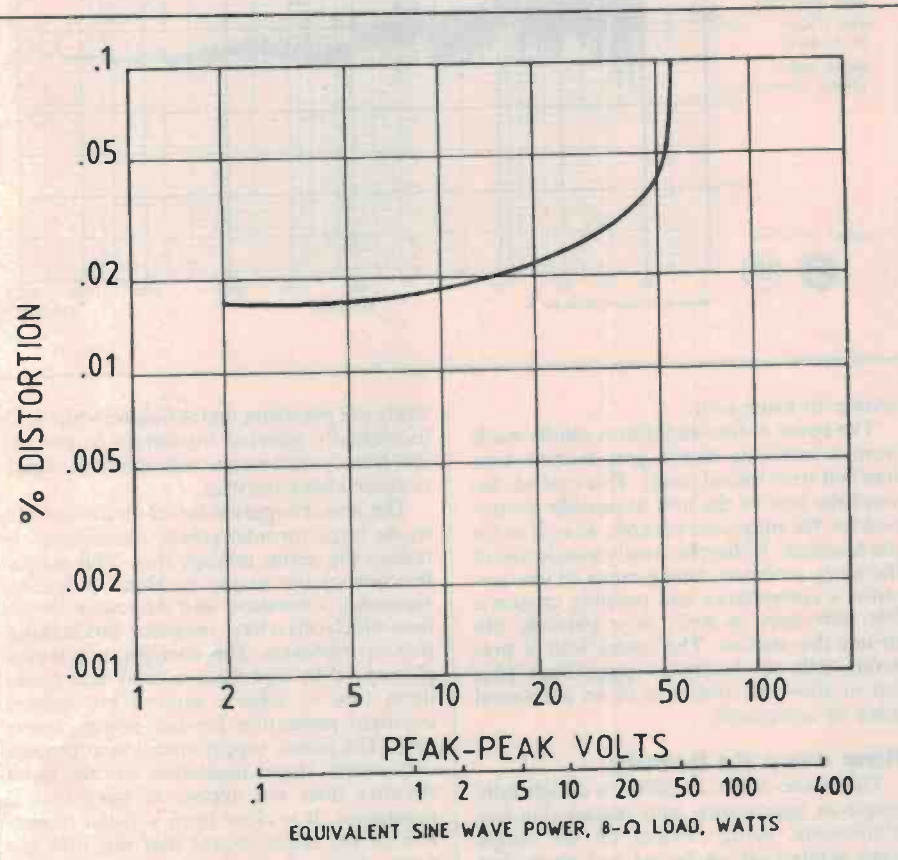
The DALI speakers are efficient with power handling capacity between 60 and 200 watt RMS. They feature very low distortion between 0.5 and 0.6 per-cent 2nd and 3rd harmonic distortion and good stereo image.

For more information please contact **Scan Audio Pty Ltd, PO Box 242, Hawthorn, Vic 3122. (03)819-5352.**

QED FOR MODEST AMP



Makers of hi-fi outside Japan are always keen to break the Japanese hold on the market. Some have begun to simplify their products in attempts to compete with a new look unit. QED has introduced a stereo amplifier of modest design and appearance which has yet to prove itself against the mighty Japanese.



IEC high frequency total different frequency distortion QED model A230 stereo amplifier.

Louis Challis

QED MODEL A230 STEREO AMPLIFIER

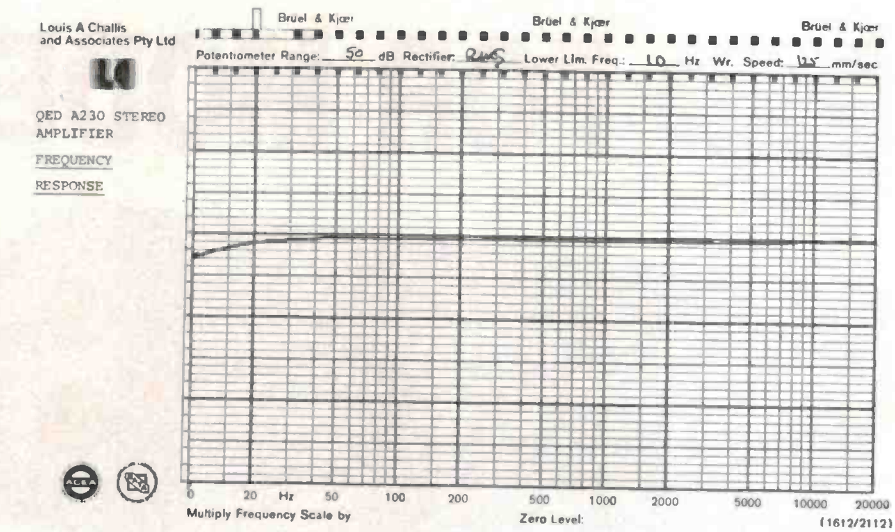
Dimensions:	*355 mm (wide) x 237 mm (deep) x 64 mm (high)*
Weight:	*3.3 kg*
Manufactured:	*QED Audio Products Limited, Ashford, Middlesex, United Kingdom.*
Recommended Retail Price:	*$399*

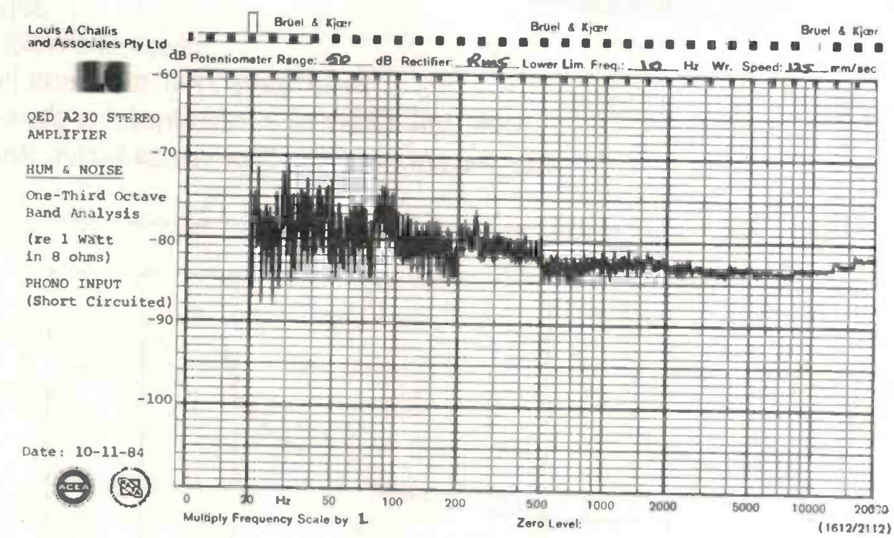
"QED" IS DEFINED by the *Macquarie Dictionary* as "which was to be shown or proved" and is sometimes put into other words with a more contemporary note — "so it follows naturally".

QED consequently is an unusual yet in many respects an apt title for the British firm which produces the A230 amplifier, as well as for the design philosophy underlying its products. The general product information bulletin on the company states: "The objective of QED's Hi-Fi Systems Division is to provide a viable British alternative to the ubiquitious Japanese 'rack' system and to provide a realistic alternative in terms of value for money, ease of use, reliability and domestic acceptability."

Obviously with those expressed philosophies, it appears that the British hi-fi industry feels somewhat threatened and a trifle ▶

Characteristics of the QED A230 Stereo Amplifier as measured.





beleaguered by its inscrutable Japanese competitors. Not surprisingly, QED is projecting a parallel and generally similar design philosophy to NAD and many other new or small manufacturers most of whom realise that not everybody wants shiny, glossy, fancy or expensive front panels. They believe that what really counts is performance, price and reliability.

On the face of it

The A230 amplifier combines a preamplifier and stereo power amplifier into a simple neat package with a performance that belies the simplicity of the visual impression. The front panel has a muted grey hammertone finish with green silkscreen printing which is neatly stencilled over the grey. The neat appearance is accented with matching vertical green lines to point out each of the (limited number of) controls on the front panel.

These controls are in three groupings. On the left side of the panel are three push-buttons for DISC, TUNER and TAPE which can all be selected at the same time although they are really intended to be used with a maximum of two on at any one time. In the centre of the panel is a single volume control with matching balance control beside it. On the right hand side of the panel is a tip-ring and sleeve headphone socket, which is only suitable for high impedance headphones. Last but not least, on the right hand side of the panel is a latching power push-button surmounted by a matching green light emitting diode.

The rear panel of the amplifier, which is fabricated from heavy gauge steel, incorporates three pairs of colour coded speaker terminals designed to accept banana plugs. The red top sockets are labelled "DIRECT Right and Left". The white central sockets are labelled "SWITCHED Right and Left" and are automatically disconnected when headphones are plugged into the front panel. The black bottom sockets are labelled "GROUND Right and Left" and these are centrally grounded to the main earthing terminal inside the amplifier.

In the centre of the back panel is a reasonably small, neatly finned heatsink on the rear of which the four output transistors are mounted. To the right of this is a pair of DIN sockets for tape and tuner respectively as well as a pair of RCA coaxial sockets for connecting the moving magnet cartridge output of a record player. Last, but not least, is a plastic screwed earth terminal, which provides a neat, functional and simple back panel.

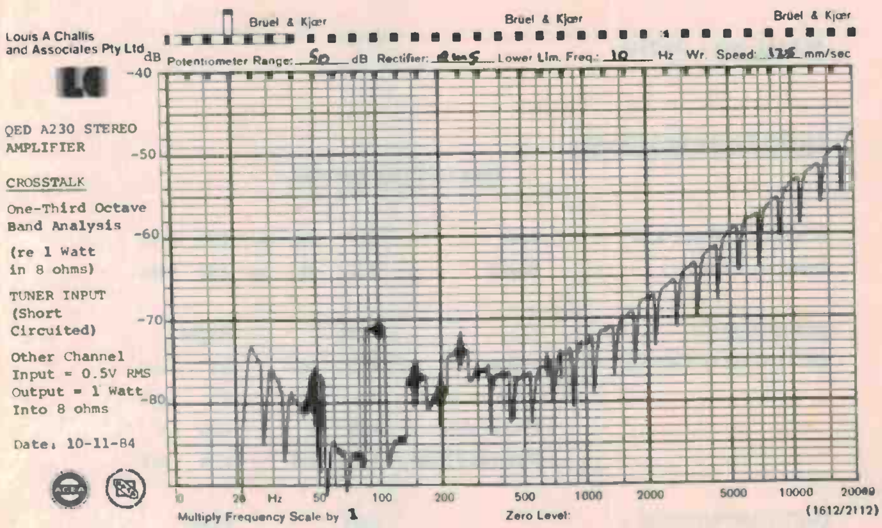
One 'note' caught my eye when I inspected the back panel. This warned the user that the unit contains *no output fuses* or *protection devices* in the output circuit. Thus, if you short your output leads you blow up your amplifier!!! Well deleting the protection circuits is most certainly one way to save money, but it discouraged me more than a trifle during the subsequent objective testing, in which I took special care not to destroy the amplifier before I even had a chance to listen to it.

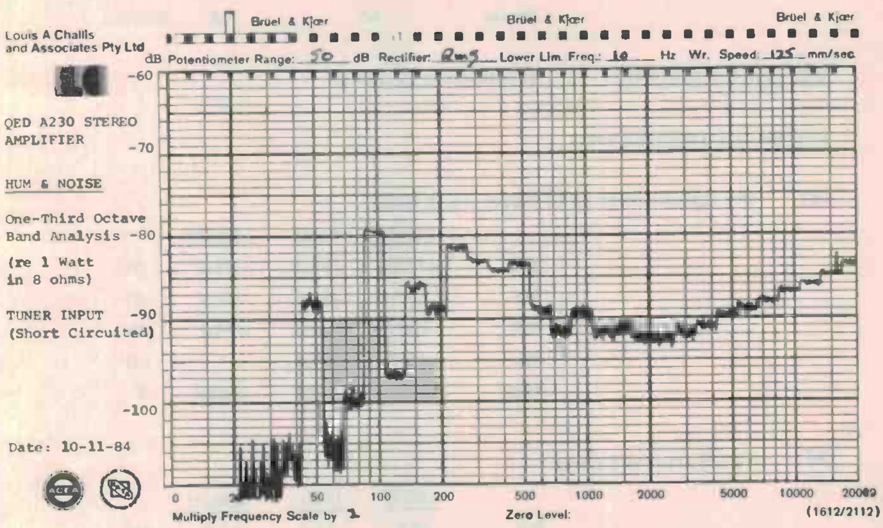
The cover of the amplifier is solidly made from a matching muted grey hammertone finished steel folded panel. This extends beyond the rear of the unit to provide protection for the plugs and sockets, as well as for the heatsink. It thereby neatly avoids one of the nasty problems facing many of this amplifier's competitors and possibly creates a few new ones as well, as it partially obstructs the airflow. The mains lead is prewired with an Australian piggy-back plug top to allow the insertion of an additional piece of equipment.

How deep its beauty

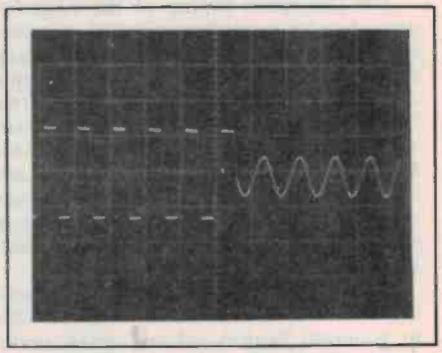
The inside of the amplifier is delightfully simple in appearance with remarkably few components being evident on the single large printed circuit board and most, but not all of these, being clearly labelled to assist the serviceman. Most of the components are precision metal film resistors with individually selected transistors to provide low noise performance and optimum signal-to-noise characteristics.

The power supply is based on the use of a single large toroidal power transformer to reduce the mains leakage flux. This simplifies one of the major problems plagueing Japanese, Taiwanese and American amplifiers which often have magnetic flux leakage pick-up problems. This configuration is supplemented by a protective relay and mains input fuse to achieve modest but limited overload protection for the power supply only. The power supply circuit incorporates very simple ripple regulation and the input circuitry does not appear to have special regulation. It is clear from a visual inspection of the circuit board that this unit has been designed to keep the cost to a minimum and thereby compete with the opposition.

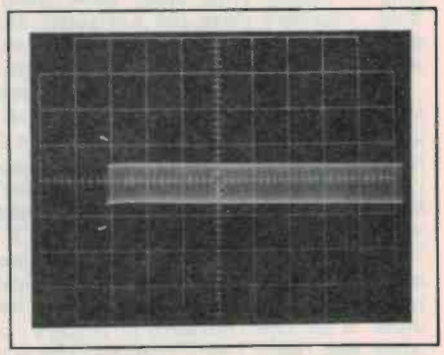




Transient overload recovery test of the QED A230 at 10 dB overload re rated power into 8 ohms both channels driven. Overload duration: 20 ms. Repetition rate: 512 ms. (IHF-A-202)



1 ms/div



50 ms/div

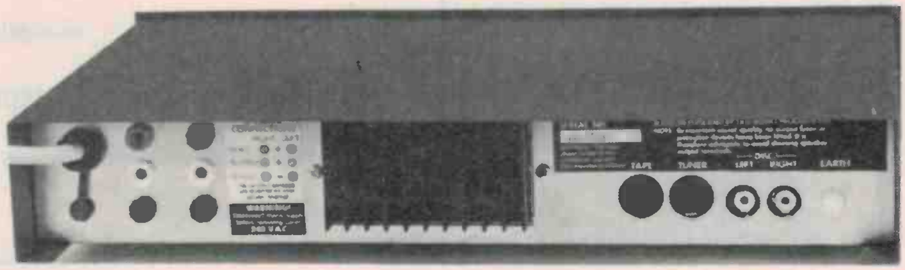
When we first received the amplifier the manufacturer's literature was absent. On the basis of the size of the transistors and the efficiency of the heatsink, we presumed that it had a 40 watt rating and proceeded to evaluate it on that basis. It was only when we neared the completion of the reviewing process, and long after the testing had ceased, we discovered that the manufacturer only quotes a 30 watt rating for the amplifier which I still feel was rather conservative.

Testing it

The manufacturer's claims are all relatively modest and we did not have any problems in evaluating the unit or confirming the performance claims.

The objective testing proved most of the brochures claims with the amplifier exceeding all of the ratings in terms of frequency response, distortion, power output and signal noise for the phono input. The signal-to noise performance of the tuner and auxiliary input was 3 dB(A) below the manufacturer's claim, although it should be noted that our evaluation was performed relative to the 1 watt output level, whilst the manufacturer's claim may well have been referring either to that level or equally likely to full output level. If the manufacturer's data relates to full output level then the amplifier most certainly exceeds the quoted performance figures.

The power output of the amplifier is certainly well up to the manufacturer's expectations for, although we performed our distortion and power output testing at the 40 watt level, the unit still had no difficulty meeting its stated distortion figures and most certainly had a 2.7 dB headroom relative to the 30 watt level.



The IEC high frequency total difference frequency distortion characteristics of the amplifier are reasonably good considering the price and market for the amplifier. They are as good as could be expected in terms of what you can hear and what you require in an amplifier of this general class. The transient overload characteristic of the amplifier was excellent without any trace of jitter, carry over or misbehaviour.

The cross-talk between the channels although not quoted by the manufacturer, is better than 50 dB at all frequencies and thus well up to any of the requirements that the intending user may expect.

The subjective testing of the amplifier proved to be rewarding with the amplifier providing excellent performance with magnetic cartridge input, tape recorder input and CD player connected to the external tuner input. One limitation which discouraged me slightly was the need to provide DIN socket connections for the tape and CD player. Few pieces of equipment come with DIN plugs and leads in the presence of an almost universality of RCA coaxial sockets on consumer equipment.

Once this problem was overcome however, the amplifier proved willing and able to generate healthy, clean signals under almost all conditions excluding straight clipping of course. Even under these conditions, excessive drive did not cause any problems in terms of lost transistors, cooked rectifiers or smoking transformers.

I listened to a number of new classical CD discs including two excellent and exciting new discs with "Mozart's Quintents in C Minor" by Joseph Suk with the Smetana Quartet (Denon 38 C37-7179) and "Mozart's Four Flute Quintets" with Aurele Nicolet with the Mozart String Trio (Denon 38 C37-7157). These revealed that the amplifier has more than adequate output for classical reproduction and is still good enough for music of the type contained in Telarc's exciting *Star Tracks* Disc CD 80094. This is a remarkably good disc with "Star Wars", "Superman" and "Star Trek" music to test your amplifier, speakers and most probably your neighbour's hearing as well.

On reflection

The subjective impression I gained from the QED A230 amplifier is that its performance is very good but not superlative. Its price is generally competitive and it delivers enough power to satisfy the requirements of any user with speakers providing moderate efficiency and a listening room that is not too large.

The basic design philosophy underlying the A230 is generally right for the UK market but not completely right for Australia. My one concern is that if the amplifier is mistreated, through inadequate or faulty termination or even slipshod movement of speaker leads, you could create embarrassing and unintentional damage. Apart from that criticism, this amplifier performs well, looks good and produces excellent sound ●

MEASURED PERFORMANCE OF QED MODEL A230 STEREO AMPLIFIER

SERIAL NO : A02564

FREQUENCY RESPONSE :

Tone Controls Centred

(-3dB re 1 Watt, 0.5V Input to Tuner)	Left	9.5 Hz to 100 kHz
	Right	9.3 Hz to 100 kHz

SENSITIVITY : (for 1 Watt in 8 ohms)

	Left	Right
Tuner	34 mV	33 mV
Tape	34 mV	33 mV
Phono M/M	460 V	460 V
Overload M/M	133 mV	135 mV

INPUT IMPEDANCE :

	Left	Right
Tuner	56	56 Kohms
Tape	120	120 Kohms
Phono	68	68 Kohms

OUTPUT IMPEDANCE : 90 milliohms (@ 1kHz)

HARMONIC DISTORTION :

(A) (At tested power of 40 Watts into 8 ohms

	100Hz	1kHz	6.3kHz	
2nd	-74.6	-73.1	-61.6	dB
3rd	-75.3	-86.1	-81.4	dB
4th	-102.0	-86.0	-73.4	dB
5th	-93.9	-95.5	-	dB
THD	0.025	0.023	0.086	%

(B) At 1 Watt into 8 ohms

	100Hz	1kHz	6.3kHz	
2nd	-78.6	-78.5	-67.0	dB
3rd	-86.1	-90.9	-86.0	dB
4th	-93.5	-88.2	-76.7	dB
5th	-93.8	-	-	dB
THD	0.013	0.013	0.047	%

NOISE AND HUM LEVELS :

(re 1 watt with 8 ohms) with volume control set for 1 watt output with auxiliary input of 0.5 volts RMS on tuner input and 5mV for phono input.

TUNER	-72.0 dB(Lin)	-77.0 dB(A)
PHONO M/M	-66.0 dB(Lin)	-71 dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT :

(IHF-A-202)

(20mS burst repeated at 500mS intervals) = 60 Volts peak to peak

= 56 Watts

∴ Dynamic Headroom = 2.7dB (re 30 Watts)

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Telex AA38897
MAIN WAREHOUSE
56 Renver Rd., CLAYTON 3168
Phone 543 2166

Please find listed below special wholesale pricing for a fraction of the range of products we import and are distributors for. Please feel free to ring Dean Wilson or Peter Jones for competitive quotes on all your components and computer peripheral needs. New price lists and products will now be issued at regular intervals. Please note minimum account orders for these prices is $50 per order. Minimum Cash Sale or Mail Order $20.

Best regards,

Rod Irving

Rod Irving

RESISTORS

1/4 WATT E12 CARBON BULK
PACKED $4.50/1000
TAPED AND BOXED $5.00/1000
$4.75/1000 10K LOTS
1/4 METAL FILM TAPED AND BOXED
$13.00/1000 $12.00/1000/10K LOT
SUPPLY E24 VALUE

MEMORY

	10-99	100+	1000+	10K+
4164-15P	$3.50	$2.95	$2.75	$2.50
41256	$19.00	$14.00	$13.00	$12.00
6116P-3	$6.00	5.90	$5.80	$5.50
2716	$4.90	$4.50	$4.25	$4.00
27128	$16.00	$15.00	$13.50	$13.00
2532	$7.50	$6.50	$6.40	$6.30
2732	$4.50	$4.10	$3.90	$3.50

TRANSFORMERS

Cat No.		1-99	100+
M12851	2851	2.00	1.75
M12155	2155	4.00	3.50
M16672	6672	5.10	4.75

MONITORS

Cat No.		1-3	4+
X14500	Ritron 1 Green	$100.00	$95.00
X14502	Ritron 1 Amber	$105.00	$100.00
X14506	Ritron 2 Amber	$145.00	$135.00
X14510	Ritron 3 Amber	$129.00	$124.00

WHILE STOCKS LAST

75OHM COAX CABLE

Cat No.		100M	500M	1000M
W11222	3C2V	18.00	17.00	16.00
W11224	5C2V	21.00	20.00	19.00

(5C2V WHITE)
100M ROLLS
LINE LOSS PER 100' (33M 200MHz)
W11222 6.2dB (Approx)
W11224 3.9dB (Approx)

COMPUTER CONNECTORS

Cat No.	Description	1-99	100+
P10900	DB25 Plug	1.30	1.20
P10901	DB25 Socket	1.40	1.30
P12210	Centronics Solder	3.50	3.15
P12200	Centronics Crimp	5.00	4.50

NICADS

Cat No.		1-99	100+
S15020	AA	1.60	1.50
S15021	C 1.8AH	3.25	2.90
S15022	D 4.0AH	5.90	5.50

HORN SPEAKERS

Cat No.		1-99	100+
C12010	5" Plastic 8W Max	4.80	4.70
C12015	5" Metal 8W Max	4.70	4.30
C12012	12V Siren	8.50	8.00

SOLDERING IRON STANDS

Cat No.	1-99	100+
T113023	3.25	3.00

VERBATIM DATA LIFE DISKETTES

	10-99	100+	1000+
SS/DD MD525-01	2.50	2.25	2.15
DS/DD MD550-01	3.30	3.00	2.60

XIDEX DISKETTES

SS/DD	2.90	2.70	2.25
DS/DD	3.50	3.25	2.95

FANS

		1-9	10+	100+
240V	4 1/2"	10.50	10.00	8.00
240V	3 1/2"	10.50	10.00	8.00
115V	4 1/2"	10.50	10.00	8.00
115V	3 1/2"	10.50	10.00	8.00

CRYSTALS

Cat No.	Frequency	Can	10+	100+	1000+
Y11000	1MHz	HC33	5.50	4.75	4.50
Y11005	2MHz	HC33	2.25	1.95	1.85
Y11008	2.4576MHz	HC33	2.25	1.95	1.85
Y11015	3.57954MHz	HC18	1.20	.90	.65
Y11020	4.00MHz	HC18	1.30	1.20	.75
Y11022	4.194304MHz	HC18	1.40	1.30	.75
Y11025	4.75MHz	HC18	1.40	1.30	.75
Y11026	4.9152MHz	HC18	1.40	1.30	.75
Y11042	6.144MHz	HC18	1.40	1.30	.75
Y11050	8.00MHz	HC18	1.40	1.30	.75
Y11055	8.867238MHz	HC18	1.40	1.30	.75
Y11070	12.00MHz	HC18	1.40	1.30	.75
Y11072	14.318MHz	HC18	1.40	1.30	.75
Y11080	16.00MHz	HC18	1.40	1.30	.75
Y11085	18.432MHz	HC18	1.40	1.30	.75
Y11090	20.00MHz	HC18	1.40	1.30	.75

FULL RANGE OF CRYSTALS AVAILABLE

POLYESTER 100V "GREENCAP" TYPE

Cat No.		1-99	100+
R15131	.001uF	0.06	0.04
R15137	.0012uF	0.06	0.04
R15138	.0015uF	0.06	0.04
R15140	.0022uF	0.06	0.04
R15142	.0033uF	0.06	0.04
R15143	.0039uF	0.06	0.04
R15145	.0047uF	0.06	0.04
R15146	.0056uF	0.06	0.04
R15147	.0082uF	0.06	0.04
R15148	.01uF	0.07	0.05
R15150	.015uF	0.07	0.05
R15152	.022uF	0.07	0.05
R15154	.033uF	0.07	0.05
R15155	.039uF	0.07	0.05
R15156	.047uF	0.08	0.06
R15157	.056uF	0.08	0.06
R15158	.068uF	0.08	0.06
R15159	.082uF	0.08	0.07
R15160	.1uF	0.09	0.08
R15162	.15uF	0.11	0.10
R15164	.22uF	0.13	0.11
R15165	.27uF	0.14	0.13
R15172	1uF	0.60	0.48
R15176	2.2u	1.10	0.90
R15178	3.3uF	1.50	1.20

DIODES

Cat No.	Desc.	10+	100+	1000+
Z10135	IN4148	0.03	0.02	0.015
Z10105	IN4002	0.04	0.03	0.03
Z10107	IN4004	0.05	0.04	0.02
Z10110	IN4007	0.10	0.06	0.05
Z10115	IN5404	0.18	0.14	0.11
Z10119	IN5408	0.20	0.16	0.13

BRIDGES

	10+	100+	1000+
6A 400V	1.00	0.80	0.75
W02	0.24	0.23	0.20
W04	0.25	0.24	0.21

TRANSISTOR

	1-99	100+
2SJ49	3.50	3.30
2SK134	3.50	3.30

MULTIMETERS

	1-99	100+
YF1100	47.50	45.00

RCA INSULATING SOCKETS

Cat No.	Desc.	1-99	100+
P10232	2 Way	0.25	0.21
P10234	4 Way	0.45	0.40
P10236	6 Way	0.75	0.60

RCA CHASSIS MOUNT METAL

Cat No.	1-99	100+
P10231	0.16	0.13

ELECTROLYTICS

Cat No.	Desc.	10+	100+
R1415	1uF 63V PCB RB	0.05	0.04
R15461	10uF 16V PCB RB	0.05	0.04
R15462	10uF 25V PCB RB	0.05	0.04
R15482	22uF 25V PCB RB	0.06	0.05
R15521	47uF 16V PCB RB	0.07	0.06
R15522	47uF 25V PCB RB	0.08	0.07
R15581	1000uF 16V PCB RB	0.21	0.20
R15582	1000uF 25V PCB RB	0.28	0.25
R15591	2200uF 16V PCB RB	0.39	0.33
R15592	2200uF 25V PCB RB	0.55	0.50
R15904	2200uF 50V AXIAL	1.50	1.00

RG CAN TYPE WITH LUGS

		1-99	100+
R164585	8000uF 75V	6.00	5.80
R16587	10,000uF	7.00	6.50

IDC CONNECTORS

		1-99	100+
P12114	14 Pin Dip Plug	0.60	0.50
P12116	16 Pin Dip Plug	0.65	0.55

GREY FLAT RIBBON CABLE

			PER 100 FT ROLL		
Cat No.	Desc.	Per Mtr	1-3	4+	10+
W12616	16 Way	1.29	19.75	18.50	16.50
W12625	25 Way	1.40	29.50	27.50	23.50
W12626	26 Way	1.60	31.00	29.00	25.00
W12634	34 Way	1.80	40.00	38.00	34.00
W12640	40 Way	2.20	50.00	47.50	42.50
W12650	50 Way	2.75	59.00	57.50	52.50

EX STOCK
LARGER QUANTITIES NEGOTIABLE

PANEL METERS

		1-9	10+
Q10500	MU45 0-1mA	5.95	5.75
Q10502	MU45 50-0-50uA	5.95	5.75
Q10504	MU45 0-100uA	5.95	5.75
Q10505	MU45 0-50uA	5.95	5.75
Q10510	MU45 0-5A	5.95	5.75
Q10518	MU45 0-1A	5.95	5.75
Q10520	MU45 0-20V	5.95	5.75

VOLTAGE REGULATORS

	10+	100+	1000+
7805uC	.45	.44	.43
7805KC	1.50	1.40	1.20
7812uC	.45	.44	.43
7815KC	1.50	1.40	1.20
7818uC	.50	.49	.48
7818KC	1.50	1.40	1.20
7905uC	.50	.46	.44
7912uC	.50	.46	.44
uA323KC	4.50	3.90	3.75
	1-9	10+	100+
78H05	6.50	5.50	4.90
78H12	7.00	6.00	5.90
78HGKC	7.50	6.50	6.00
79HGKC	16.50	16.00	14.00
78P05	11.50	11.00	10.50
78P12	14.00	13.50	13.00

LOW PROFILE IC SOCKETS

	10+	100+	1000+	10K
8 Pin	.08	.07	.06	.05
14 Pin	.10	.09	.08	.07
16 Pin	.11	.10	.09	.08
18 Pin	.12	.11	.10	.09
20 Pin	.13	.12	.11	.10
22 Pin	.14	.13	.12	.11
24 Pin	.15	.14	.13	.12
28 Pin	.19	.17	.15	.14
45 Pin	.25	.24	.22	.20

RING 489 7231 FOR OUR LOW PRICING ON THESE.

Desc	Qty	Desc	Qty	Desc	Qty
7402	3K	74LS02	2K	74LS195	2K
7404	11K	74LS08	2k	74LS245	3K
7405	2K	74LS10	1K	74LS273	3K
7406	12K	74LS14	2K	74LS393	2K
7407	4K	74LS40	1K	UA774	4K
7416	2K	74LS74	12K	UA339	6K
7445	3K	74LS86	2K	1488	7K
7446	2K	74LS123	2K	1489	5K
7447	2K	74LS138	3K	7812UC	4K
7473	1.5K	74LS139	2K	7805UC	5K
7474	1.2K	74LS155	1K	UA555	4K

IC's

	1-9	10+	100+
8035	3.90	3.70	3.50
8085	4.00	3.90	3.50
8088	25.00	23.00	19.00
8155	3.90	3.75	3.50
8156	3.50	3.30	2.90
8212	1.90	1.70	1.50
8224	2.40	2.00	1.90
8226	1.90	1.70	1.50
8253	3.90	3.70	3.50
8255	4.00	3.50	2.90
8257	3.90	3.50	3.00
8259	3.90	3.50	3.30
8279	3.90	3.50	3.30

MITSUBISHI DISK DRIVES

		1-9	10+
4851	5 1/4"	$180.00	$170.00
4853	5 1/4"	$220.00	$205.00
4854	5 1/4"	$280.00	$260.00
2896	8"	$450.00	$420.00

All prices plus sales tax where applicable. Minimum wholesale cash sale purchase $20.

ADDRESS ALL MAIL ORDERS TO:
P.O. Box 235, NORTHCOTE VIC 3070
Minimum P/Pack $3.00
Minimum Account P/Pack $5.00
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Resellers, OEM's, Bulk Users, please write for 100 page Computer Price List.
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VISA

APRIL EASTER

Our specials don't taste as good as Easter Eggs but you'll be enjoying them long after your choccies!

2nd HAND SURPLUS ☆ BARGAINS ☆

Jaycar does not normally sell 2nd hand surplus goods but this purchase was just TOO GOOD to knock back! We have basically purchased an amount of electronic equipment from a large Australian Banking group. We are offering two items for sale, both absolutely astonishing value for money. We defy you to buy more high quality electronics for less. Both items are in outstanding condition and have not been in service for all that long. They are a distinctive orange colour. Because they are so heavy (compared to their low cost) special P&P conditions apply.

ITEM	NSW	VIC	QLD	SA	NT & WA	TAS
XX 5910	$2.90	$4.60	$6.20	$5.80	$8.20	$5.80
XX 5900	$4.15	$8.00	$12.00	$12.00	$12.00	$12.00

PASSBOOK PRINTER UNIT

This is the familiar unit that prints your deposit balance in your passbook savings account. The unit weighing a massive 12.5kg has a one-line matrix printer, with large gearbox reduced stepping motors for carriage head drive and passbook positioning. We estimate that ONE motor alone would be worth at least $70. Apart from this there are 7 (YES 7) main PCB's all crammed with transistors, passives, edge connectors, gold IC sockets, Cannon subminiatures, not to mention LSI & MSI IC's, heatsinks, power transistors etc. AS WELL AS THIS a massive computer grade power supply is included, which is based on two (YES 2) monstrous double C-core transformers! The power supply will provide standard voltages of +5, +12V etc. The equipment is of such recent vintage to use insulation displacement connectors.
We emphasise that the equipment is not new and may not still perform its original function (no problem if you don't own a bank!). We do not have circuit diagrams but they would be meaningless anyway.
They are however, an outstanding opportunity to get hold of hundreds of normally ridiculously expensive components at a fraction of their cost price. We are absolutely convinced that you will be delighted with this purchase.
Size: 345(W) x 310(D) x 215(H)
Cat. XX-5900

ONLY $35.00

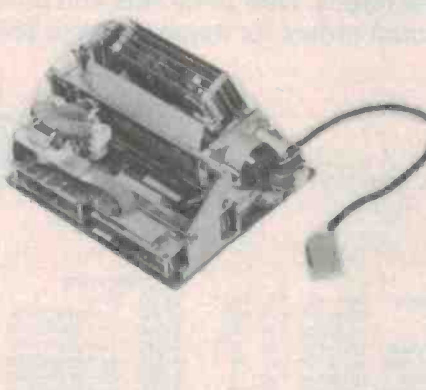
TELLER UNIT

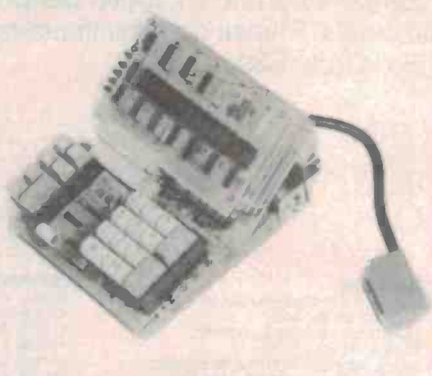
This unit provides numeric display and data entry facility for bank tellers. As a spare parts bargain, this unit has several features:

- ★ A 12-digit (x7 segment) LED display. Display height 8mm. US made LITRONIX displays.
- ★ Two Hall-Effect keypads, one 13-key pad, one 7 key pad.
- ★ Six PCB's crammed with LED's, IC's, IDC edge connectors, tantalum & other capacitors, resistors etc.
- ★ Two TO-3 voltage regulators, one LM323K & one LM320K5

This 3.5kg unit is fitted with a 50 way Cannon 'D' plug as well. Once again we are certain that you will be delighted with this purchase.
Dimensions: 210(W) x 300(D) x 150(H)
Cat. XX-5910

ONLY $15.00





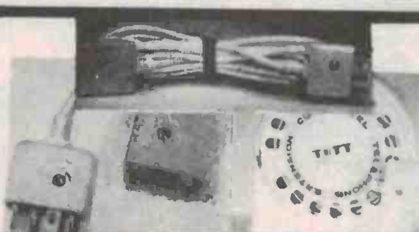
Units shown with covers removed.

TELEPHONE EXTENSION LEADS

Our purchasing guy is a "bunny" and now we've got them coming out of our ears! SAVE HEAPS while we are in this dilemma!

YT-6010 ______ 5m Ext. lead ______ **$9.95 SAVE $5**
YT-6012 ______ 10m Ext. lead **$12.95 SAVE $7**
YT-6013 ______ 15m wind up reel **$12.95 SAVE $7**
YT-6014 ______ 20m wind up reel **$14.95 SAVE $8**

☆ SAVE HEAPS ☆



QUALITY BOXES
with brass threaded inserts

Console box, available in grey, black, and blue
Size: 215(W) x 130(D) x 47(HF) x 73(HR)mm
CATALOGUE PRICE $12.95
Grey - Cat. HB-6211
Black - Cat. HB-6213
Blue - Cat. HB-6212

THIS MONTH
$6.95 ea

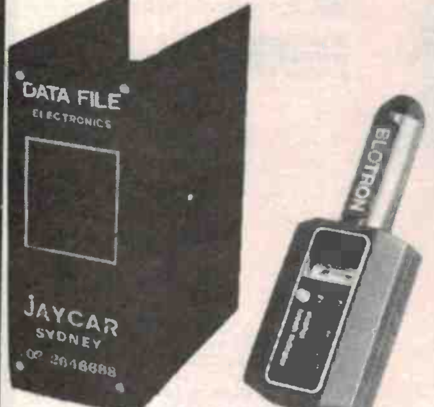
Rectangular box, available in orange, grey and blue.
Size: 150(L) x 80(W) x 50(D)mm
Slightly smaller than a UB1 Jiffy Box.
CATALOGUE PRICE $5.45
Cat. HB-6150 - Orange
Cat. HB-6151 - Grey
Cat. HB-6152 - Blue

THIS MONTH
$3.95 ea

We're in a bind over Binders!

Our magazine binders have never been so cheap!
Are your ETI's and/or EA's (or any other monthly mags) in a mess? Keep them tidy with a Jaycar binder. Buy them this month and SAVE.
Cat. BB-7000

USUALLY $4.95 each
APRIL ONLY $3.95
or 10 up $3.65 each



☆ ALCOHOL CHECKER ☆

Like the Easter Bunny, you too might be out and about over Easter. If so make sure you stay under the "limit" with our "BLOTRON" blood/alcohol checker! SAVE $10 this month to boot!
Simply blow into the mouthpiece to see if you are over the limit. Dual analogue meter and LED go/borderline/no-go readout. Calibrated in Australia. Surprisingly accurate. Can be recalibrated if laws change. Specify 0.05 or 0.08.
Cat. YS-5100

$78 in December - $75 in February
IN APRIL? $65.00
NEGATIVE INFLATION!

IC SOCKET SPECIALS!

You'd be a "Bunny" if you missed out!
We have IC sockets to the rafters! We must clear some to do roof renovations.

Cat. PI-6503 ______ 18 PIN ______ **12¢**
NORMALLY 32¢
Cat. PI-6507 ______ 28 PIN ______ **16¢**
NORMALLY 50¢
Cat. PI-6508 ______ 40 PIN ______ **30¢**
NORMALLY 70¢

These prices are so low that we must stipulate a minimum quantity of 100 each.

HOUSE ALARM KIT
☆ ☆ SAVE ☆ ☆

Since the release of our new house alarm kit, the old faithful ETI582 has fallen by the wayside.
This alarm kit is a very good unit, but doesn't come supplied with a fancy box, Gel battery and all that. If you are after a budget house alarm kit THAT WORKS WELL this is it, and now is the time to buy it.
Cat. KE-4032

USUAL PRICE $59.95
This month ONLY $44.95
☆ SAVE $15.00 ☆

NUMBERED KNOB

Numbered 1 thru 0. Fits standard ¼" shaft, with grub screw. Diameter 37mm.
Cat. HK-7549

APRIL ONLY
40¢ each
NORMALLY 85¢

SMOKE DETECTOR

1 MONTH ONLY
$9.95
Limit of 1 per customer
Cat. LA-5090

MAIL ORDER HOTLINE

To save you time (and therefore money) we have installed a special HOTLINE direct to the inner workings of our mail order dept. This saves you from going through our Head Office switchboard! If you wish to place an order, enquire about an order or simply check for more information, call:

(02) 646 1300

SEE ELECTRONICS AUSTRALIA THIS MONTH FOR MORE JAYCAR SPECIALS - SEE ELECTRONICS AUSTRALIA THIS

BUNNY SPECIALS!

GIANT EASTER SHOWBAG

We are pleased to announce our 1985 SHOWBAG. This year it will not contain a Phantom comic and lolly. (We're worried about your physical and mental health!)
It WILL contain over 1kg of assorted electronic goodies - 'junk' if you like, but all brand new components etc. Like last year we are NOT SAYING exactly what goes into each bag (because each bag is unique). And, like last year we expect to run out SO BE EARLY. Unfortunately because of the massive weight P&P is $2.50. We are pleased to advise though that the price of the bag has not changed from last year!

GIANT EASTER SHOW BAG — BACK AGAIN!

ONLY $5.50!!

WERE $14.95

Has it hit your fan yet?

Failure we mean. Well, buy another - or buy two! Computer grade quality. German made but 110 volt. Standard 3" (75mm) square unit. Use 2 in series for 240V.

Cat. XX-2508 **NOW $7.50**

NEW LOWER PRICE ON QUARTZ CRYSTAL CLOCK MOVEMENT

MOVEMENT - Very compact and reliable ● Self starting one-second stepping motor has strong torque ● Powered by 1.5V AA battery that lasts one year ● Supplied with 1 set of hands ● ±15 second/month accuracy ● 56mm square, 15mm deep ● Complete with data sheet and instructions.

SAVE $5 on 1984 PRICE
ONLY $9.95

Sweep second hand 115mm long

ROTARY DIALLERS

ROTARY DIALLERS - As used in "normal" telephones. Hundreds of uses.
Cat. XT-6900

OTHERS SELL FOR $4.95
JAYCAR NORMAL PRICE $2.95
JAYCAR SUPER SPECIAL PRICE
ONLY $1.00 each

GLOBES - 45 VOLT

A pack of 500 globes, push-in bayonet type with one contact each side. As used in Sylvester switchboards. These would be great for anybody building an electronic scoreboard or for massive wiring of a train set or anything.
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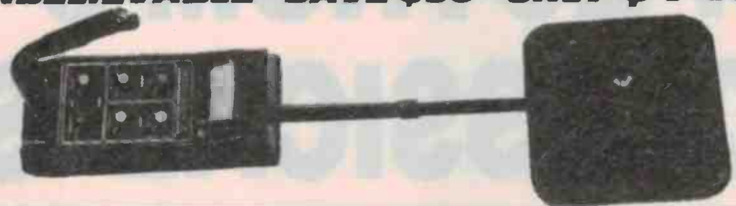

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Program this exciting robot to perform a sequence of complex manuevers. Has multi-speed gearbox, flashing lights & makes robot noises. An ideal learning tool for the young scientist. Battery powered.
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PLUGPACK - Ferguson 240 volt to 12V DC 400mA plugpack - This quality Australian made plug pack used to sell for $16.95. We had them on special for one month last year at $4.95 and we sold a stack of them!
This is your second chance to SAVE and SAVE even more.
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10 or more 12¢ ea	10 or more 16¢ ea

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ELECTROLYTIC PACK - 55 quality RB type supplied. Values range from 1uF to 470uF. Voltages from 16 to 63.
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Cat. RG-5199 **$6.75**

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Cat. RC-5399 **$3.95**

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SPECTRUM'S 'CLASSICAL' SPEAKER

The SP7 is the new loudspeaker from Spectrum. It incorporates some unusual features of design, and perhaps some untried ones, with the seeming result that it is a speaker for the quieter classical music lover.

I NEVER CEASE to be amazed at the wide range of equipment which turns up for review each month. The latest 'load' turned out to be three pairs of boxes containing loudspeakers manufactured in Hong Kong. At first I thought that all six boxes were required to assemble a speaker system, until I discovered that we had been sent three pairs of different sized speakers from the same manufacturer.

Although both the smallest and largest boxes were interesting, unlike Goldie Locks I elected to open the middle sized box first and sighting these particular speakers, which are designated as the SP7 Spectrum series, immediately chose them in preference to the other two.

The first unusual accoutrement of the Spectrum SP7s is the guarantee card which comes complete with a frequency response level recording stapled on the front. Each of these level recordings bears all the signs of having been produced with either a warble tone or a slow 'writing response' which both American and European manufacturers used to achieve smoother looking responses in the 50s and 60s.

I was not impressed by this approach which suggests that the manufacturer is still learning both the marketing procedures and the technical requirements of his products.

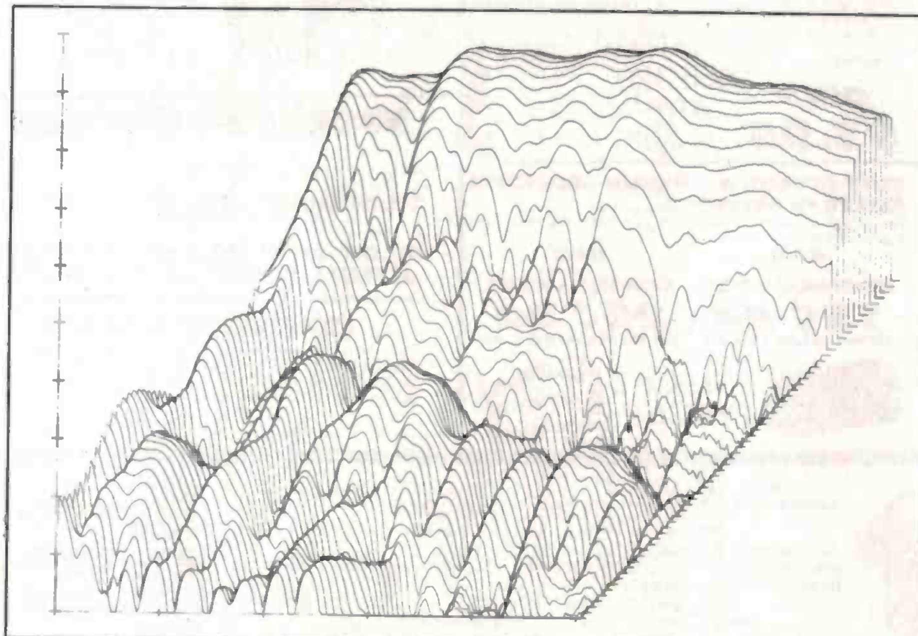
Finally removing all the packing from the Spectrum SP7s, I perceived a tall slender speaker enclosure, strikingly textured, veneered on the three sides and top, and fabricated from 25 mm thick dense particleboard suitably stiffened and solidly braced.

The upper face incorporates a step back in the top of the cabinet on which a 25 mm soft domed tweeter is mounted.

The designers have made the tweeter a visual feature of the system and it is protected by an integral woven wire mesh cover, rather than by a separate decorative cover. The woven wire cover however provides negligible high frequency attenuation and consequently the designers have elected to avoid the problems that the more conventional decorative cover often creates. The low frequency driver and the tweeter are both manufactured by Audax in France and are well proven designs.

The 200 mm diameter woofer is located on the forward face of the cabinet and unlike the tweeter, is covered by a frame and a black open weave grille cloth.

An unusual loading port with an 'L' configuration is located almost immediately below the woofer. This port extends down into the body of the enclosure to increase its effective length and thus reduce the lower cut-off frequency of the ported enclosure combination. Unlike most other ported enclosures which we have seen in recent years, the designers have taken considerable trouble to optimise the design of the porting structure to reduce its airflow resistance. The woofer design is a fairly conventional long throw driver incorporating a rolled



Decay response spectra. Initial decay characteristics are particularly good.

SPECTRUM SP7 LOUDSPEAKER

Dimensions:	*910 mm (height) x 272 mm (width) x 288 mm (depth)*
Weight:	*19 kg*
Manufacturer:	*The Radio People Ltd, Hong Kong*
RRP:	*$1299*

Louis Challis

flexible plastic surround, which laces the speaker diaphragm unusually close to the cloth facing.

The rear of the cabinet incorporates a speaker terminal with sockets for banana plugs and a parallel DIN plug socket recessed near the lower edge of the cabinet.

The overall appearance of the design is a speaker enclosure which "looks technical" — not visually pleasing but with an extremely small footprint quite compatible with the average small Hong Kong, Japanese or Australian apartment designs. These never have quite enough space to accommodate the larger speaker cabinet designs required for good or above average performance and such designs have generally been the norm in recent years.

Objective testing

The speakers arrived with no technical literature which would have indicated their performance ratings and particularly their power handling capacities (except for the guarantee card with the frequency response graph).

The objective testing of the speakers revealed characteristics which I would not have anticipated from an initial cursory examinaton. The first of these differences was that the frequency response measured in our anechoic room was generally smooth and substantially broad. This seems to confirm that the manufacturer's level recordings were produced with a much slower writing response speed that we used in our testing.

At both standard measurement positions, the on-axis frequency response is ±6 dB from 35 Hz to 20 kHz and although there are a couple of small bumps clearly evident on the resulting frequency curve in the region of the main crossover, the result is nonetheless commendable.

At 30° from the main axis, the frequency response is still commendable with the small problem of a loss of output above 16 kHz and a small droop in the response between 2 and 3 kHz. Neither the high frequency droop, nor the small drop in performance in the mid-band region are particularly disturbing. As a consequence, the overall frequency performance is substantially better than I would have expected from a speaker enclosure of this size or from the size of the low frequency driver.

The measurements in close proximity to the low frequency driver and tweeter reveal the cause of the frequency notch. This comes as a result of the interaction of the residual output of the low frequency driver which produces a supplementary peak between 2 kHz and 3 kHz.

The distortion measurements reveal that the low frequency output is affected by the size of the driver and is particularly prone to nonlinear performance at output levels exceeding 96 dB at one metre. As a consequence the enclosure produces 3.3% distortion for 96 dB at one metre and much higher levels of distortion at greater output powers.

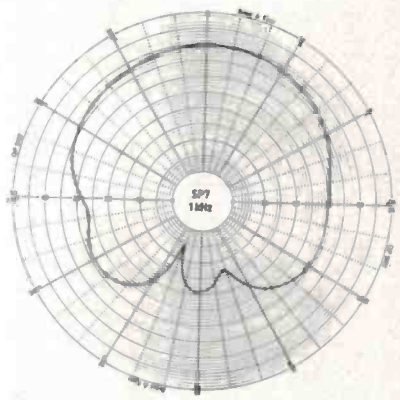
The distortion tends to initially drop at higher frequencies, but starts to climb again at 6.3 kHz and above.

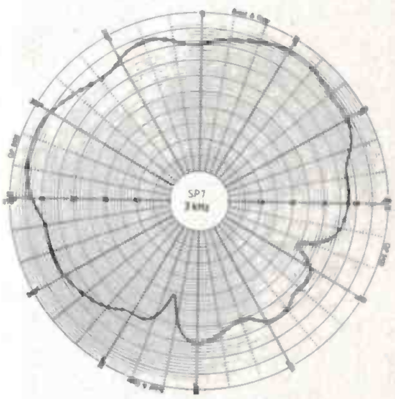
At higher output powers and with levels approaching 100 dB or greater, this distortion becomes much more significant with both the low freqency distortion and, to a lesser extent, the high frequency increasing at an unacceptable rate.

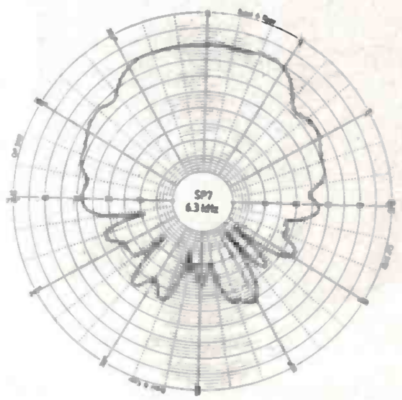
The phase response of the speaker is relatively smooth for the tweeter but there does not appear to be the optimum set back between the tweeter and woofer to achieve ▶

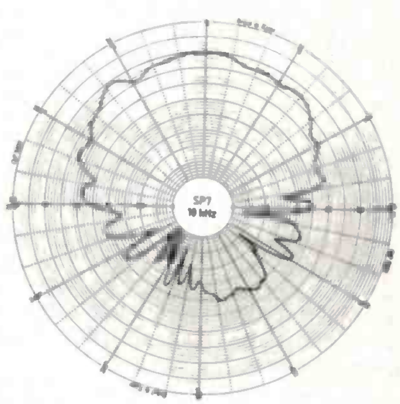
Spectrum SP7. Characteristics as measured.

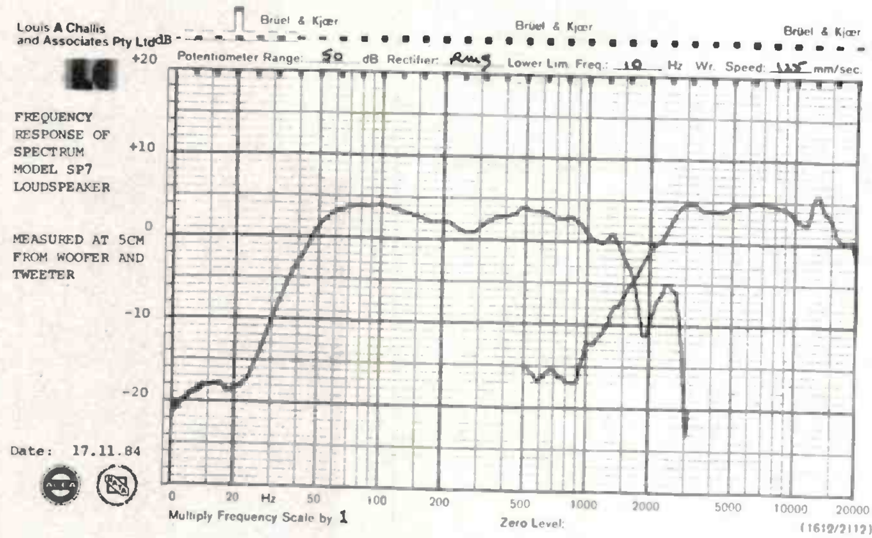
Polar response plots.

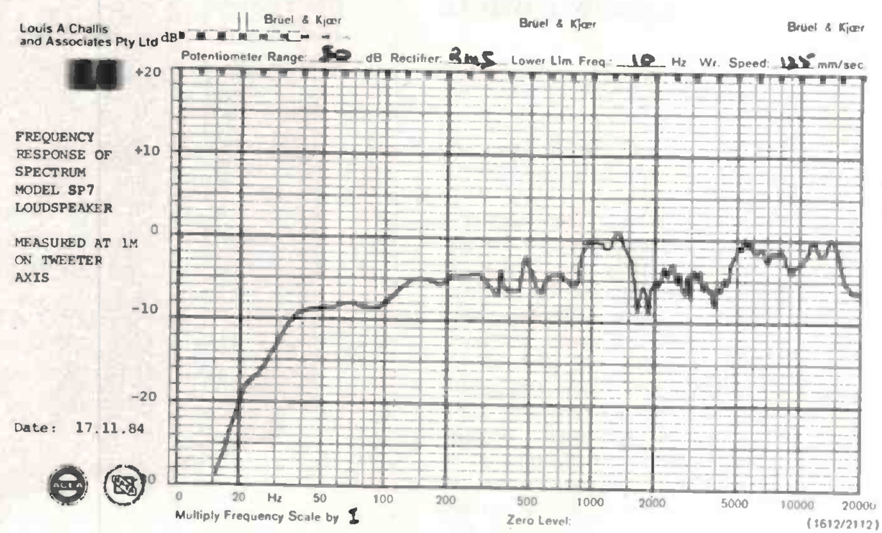


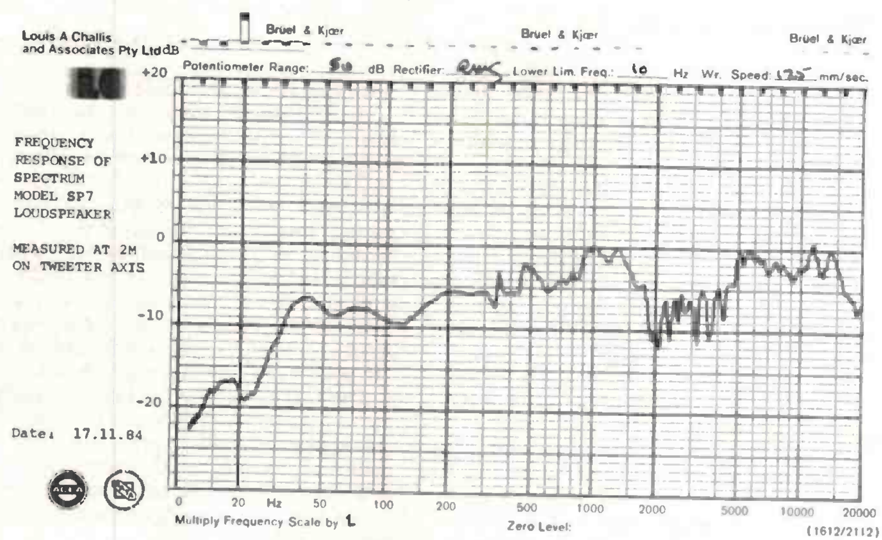












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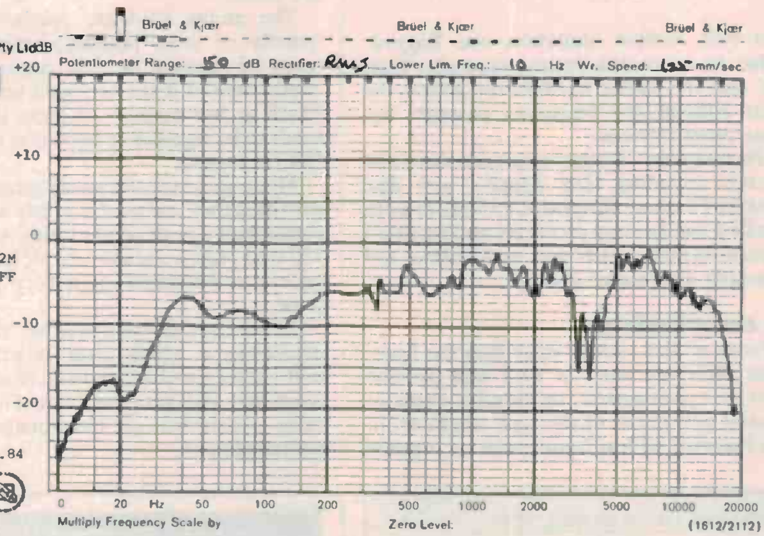

FREQUENCY RESPONSE OF SPECTRUM MODEL SP7 LOUDSPEAKER

MEASURED AT 2M 30 DEGREES OFF TWEETER AXIS

Date: 17.11.84

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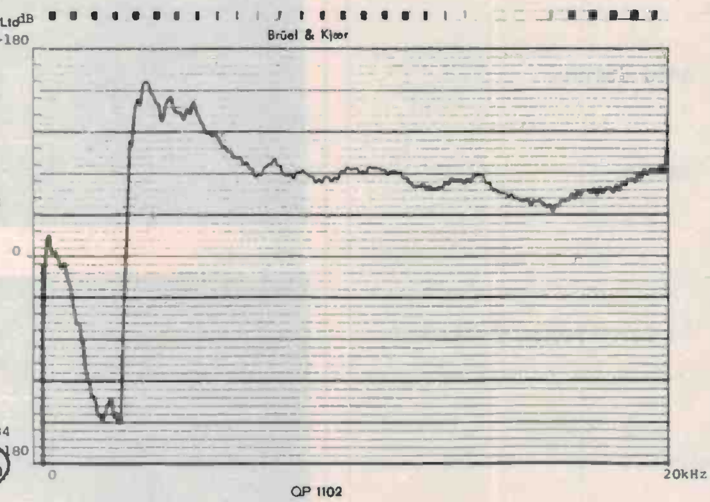

PHASE RESPONSE OF SPECTRUM MODEL SP7 LOUDSPEAKER

MEASURED AT 2M ON TWEETER AXIS

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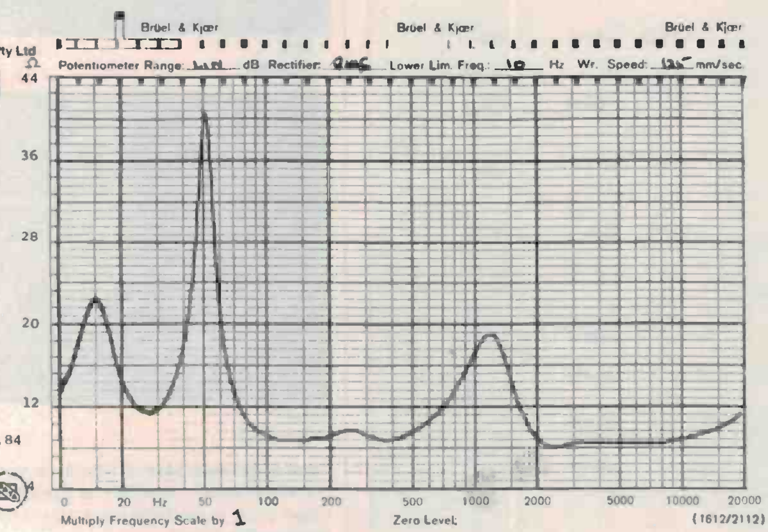


INPUT IMPEDANCE OF SPECTRUM MODEL SP7 LOUDSPEAKER

Date: 17.11.84

perfect group delay.

The impedance curve exhibits a 40 ohm impedance peak at 51 Hz, two minor peaks at 15 Hz and 1.2 kHz and a genuine 8 ohm impedance minimum elsewhere in the response curve. As a consequence the Spectrum SP7 can be conveniently combined with other speakers offering comparable impedance characteristics without risking overloading problems on your amplifier.

The polar plots reveal a much broader dispersion angle at high frequency than any other moderately priced speakers which we have recently reviewed. In particular the bandwidth at 10 kHz is greater than ±50°, which is excellent.

The tone burst evaluations at 100 Hz, 1 kHz and 6.3 kHz also reveal a generally good performance, even though the amount of information available from such testing is relatively limited. By contrast the decay response spectra reveal a particularly smooth response for the initial decay characteristics and the early energy decay characteristics are also substantially better than I would have expected. The secondary decay response peaks in the 200-300 microsecond region are primarily the result of internal reflections from the sides and rear of the cabinet. There are also some traces of reflections from the speaker basket and from the upper sloping face of the cabinet, although these are not pronounced.

When all of the objective test results are considered, it is clear that the designers have achieved remarkably well, particularly when both the price and the size of the enclosures are taken into account.

Subjective testing

The subjective assessment of the Spectrum SP7s soon revealed that these speakers have been primarily designed for classical music, where the peak levels tend to occur primarily in the mid-frequency region rather than at the low frequency end of the spectrum. I listened to a range of new and generally exciting recent releases on CD discs, microgroove recordings and cassette tapes, as well as a limited amount of material sourced from stereo video and FM radio.

The first record I listened to was an Ultragroove record UG9001, *The Digital Fox* on which to my surprise the speakers performed admirably at all listening levels below 100 dB. On Respighi's "Feste Romane" featuring Lorin Maazel (Mobile Fidelity MFSL 1507), the performance of the speakers was exceptionally good and for much of the time indistinguishable from my reference monitors. The only audible difference was a trace of stridency on woodwinds and from the first violins.

The third record I listened to was Kenny Rogers' *Greatest Hits* (Mobile Fidelity Original Master recording MFSL 1-049). This record was handled with a panache which surprised me and revealed that the speakers perform extremely well on speech, as well as for singing at listening levels well ▶

above the normal 90 dB point.

The fourth record was track 10 of the Swedish Hi-Fidelity Institute's Test Record, which is one of the most difficult passages for either a recordplayer or many of the loudspeakers that we have already tested. The performance here was less than satisfactory as the diabolical low frequency components produced speaker resonances which were audible and disturbing.

When playing the first 15 seconds of track 2 on Telarc's *Star Wars* disc (Telarc 80094) I was perturbed by the woofer striking the grille cloth on the drum beats. When I switched in the low pass filter on the preamplifier this problem was minimised but the inability of the speakers to faithfully respond to the bass drum was evident and the first real audible limitation was flagged. Other tracks on this record were also 'testing' and the ability to faithfully follow the most difficult low frequency passages became more obvious.

The majority of other reference discs and records including Earl Klugh's new disc *Wishful Thinking* (Capitol CP35-3121) were handled without any problems and revealed a performance which was scintillating and generally well above average.

In conclusion

From all this, it was clear that the Spectrum SP7s are most at ease and provide their best performance on classical music or general pop music of the type where artificial boosting of low frequencies or unusual low frequency peaks such as those in the *Star Wars*, the Swedish Hi-Fidelity Institute record or Tchaikovsky's "1812 Overture" are absent.

The ability of these speakers to adequately or even faithfully produce some types of classical or rock music is significantly limited if the replayed levels exceed 95 dB at two metres. At these levels there tends to be significant distortion in the 30 to 100 Hz region.

These speakers are worth listening to and provided they are used sensibly with an amplifier with a peak power rating in the 100 to 150 watt region should provide you with excellent performance at a very reasonable price.

Taken overall, the Spectrum SP7s offer a performance which most purchasers will find exciting and which indicates that Hong Kong may well yet pose a threat to the Japanese, American or Continental speaker manufacturers. ●

MEASURED PERFORMANCE OF: SPECTRUM MODEL SP7

SERIAL NO: K10109

FREQUENCY RESPONSE: 35 Hz - 20 kHz

CROSSOVER FREQUENCY: 1600 Hz

SENSITIVITY:

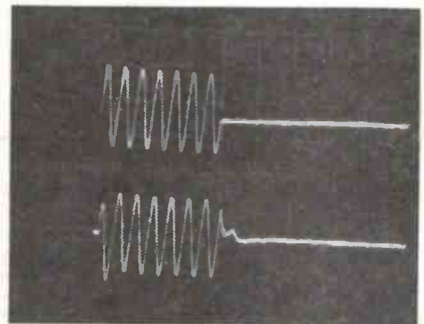
(for 96 dB average at 1m) 7.2 Watts (nominal into 8 Ohms)

HARMONIC DISTORTION: (for 96 dB at 1m)	100Hz (90 dB @ 1m)	1kHz	6.3kHz	
2nd	-32.2	-52.7	-31.8	dB
3rd	-33.4	-53.9	-59.6	dB
4th	-51.2	-	-60.0	dB
5th	-49.8	-	-	dB
THD	3.3	0.31	2.6	%

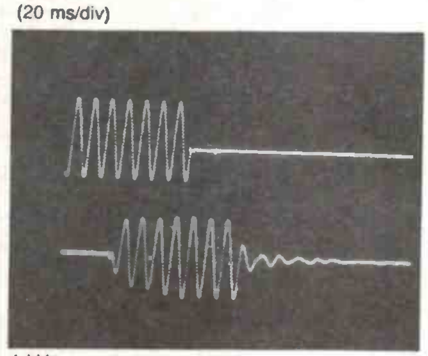
INPUT IMPEDANCE

100Hz	9.0	ohms
1kHz	17.0	ohms
6.3kHz	8.5	ohms
Min at 2.4kHz	8.0	ohms

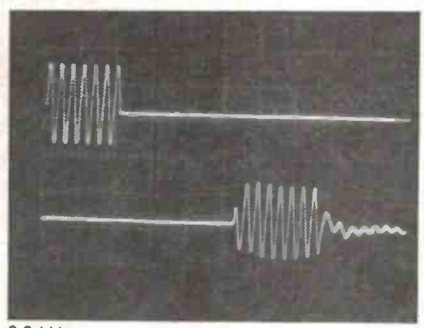
Date: 17.11.84



100 Hz
(20 ms/div)



1 kHz
(2 ms/div)



6.3 kHz
(0.5 ms/div)

Tone burst response of Spectrum model SP7 (for 90 dB steady state SPL at 2 m on axis). Upper trace is electrical input. Lower trace is loudspeaker output.

Fully protected multimeter

The new Topward TDM-104 multimeter is a combination bench/field unit featuring high accuracy and full overload protection on every range.

Twenty eight ranges combine with a basic dc accuracy of 0.1% ±1 digit and 3½ digit resolution to provide a very comprehensive capability. Input impedance is around 1000 M and the unit will tolerate common mode voltages up to 1400 V peak. A 20 A current range is provided for the direct measurement of relatively high currents.

Measuring 233 mm x 80 mm x 300 mm and weighing a mere 1.4 kg, the TDM-104 is ideal for a wide range of laboratory or field applications.

For further information contact **Parameters, PO Box 573, Artarmon NSW 2064. (02)439-3288.**

PA amplifier

Audio Telex Communications has announced the release of a family of public address amplifiers to compliment the existing DI series. The new TX series was designed in Australia and is made by Audio Telex NZ in its New Zealand factory.

Audio Telex has included many changes to the internal construction of the TX series to improve serviceability, such as plug-in edge type connectors on the pre-amp board and plug in ICs.

One feature of the new TX100, 100 watt four mic channel amplifier, is the introduction of a voice operated switching system (VOX) on mic channel four. The VOX input enables any type of microphone to be used for paging, without extra wiring, providing instantaneous muting of both auxiliary inputs such as background music or radio.

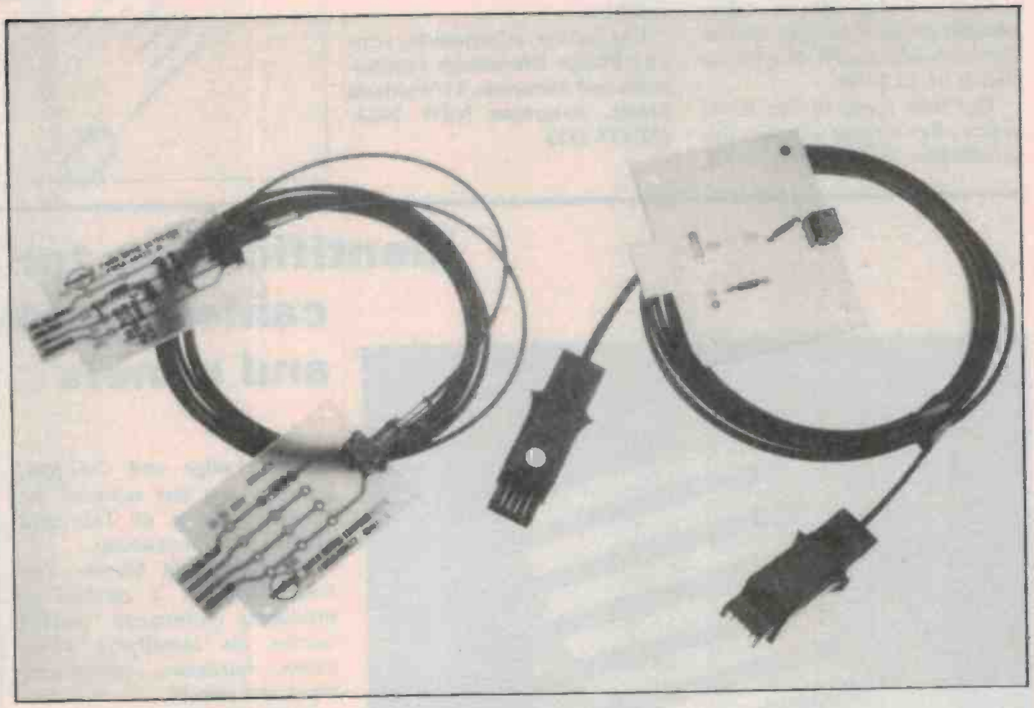
Further information is available from **Audio Telex, 1 Little Street, Parramatta, 2150. (02)633-4344.**

Rental equipment catalogue

Tech-rentals has available on request a catalogue of the electronic equipment for hire. The catalogue has an index of device types. It alphabetically lists product brands and available items, then gives a short description of products under their category heads.

The catalogue also outlines terms and conditions of rental.

For further information contact **Tech-rentals Pty Ltd, PO Box 621, Ringwood, Vic 3134.**



Fibre optic links from Molex

Molex has released a series of fibre optic systems which include a fibre optic transmitter, receiver and cable assembly.

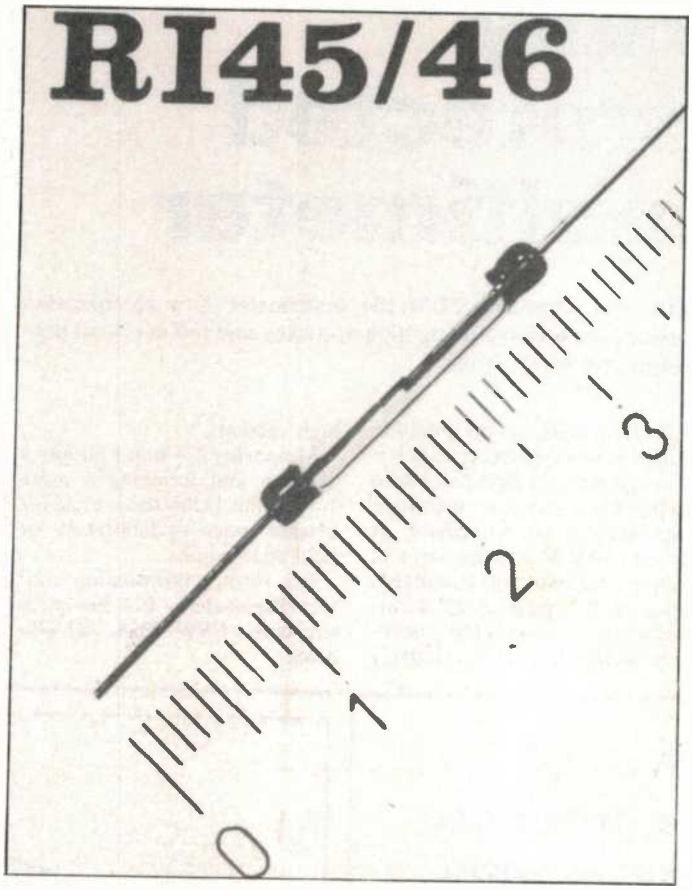
The new transmitter incorporates a 660 nm LED for compatibility with acrylic core fibre optic cable and visible operational checks. It can be interfaced to standard TTL logic.

The receiver has a built-in amplifier, is TTL compatible and can be operated in digital or analogue modes.

Cables for the system have a 1 mm diameter acrylic core and are supplied terminated to specific length.

Electronics engineers and designers are invited to contact **Utilux Pty Ltd, Australian distributors for Molex, 74 Commercial Road, Kingsgrove, NSW 2208. (02)50-0155.**

Dry reeds for power and voltage applications



With the capability to switch 30/40 W combined with high breakdown voltages, Philips' RI-45 and RI-46 micro dry reeds bring the simplicity and reliability of these devices to mains voltage applications.

The hermetically sealed reeds have long lifetimes and can operate in the temperature range −50 to 125°C. The sputtered ruthenium contacts offer a very low and stable contact resistance of typically only 60 ohms.

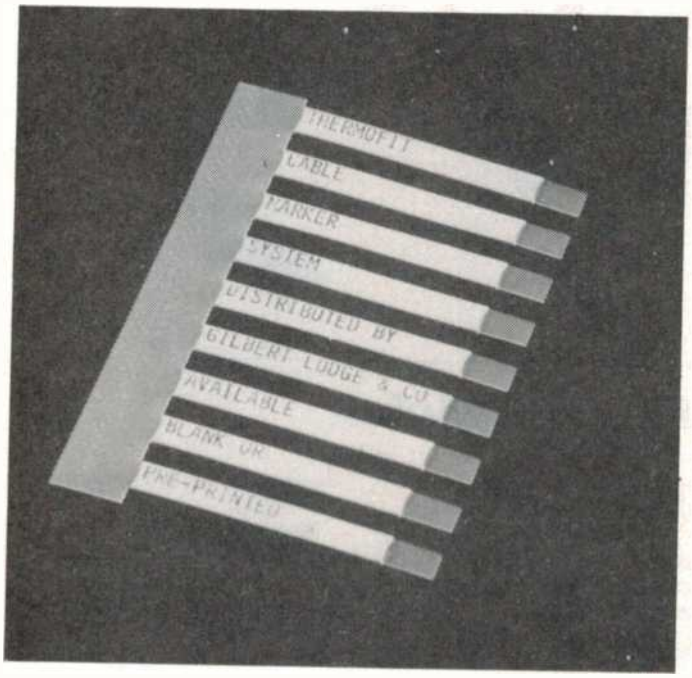
Designed for use in relays switching mains voltages into inductive loads, the RI-45 type can switch up to 40 W.

The four reeds of the RI-46 series offer a range of operative sensitivities from 12 to 77 At, and a range of release sensitivities from 5 to 26, 5 At.

The new devices consist of two magnetically actuated reeds in a robust gas-filled glass capsule. They are single-pole single-throw types with normally open contacts.

For further information, contact **Philips Electronics Components and Materials, 11 Waltham Street, Artarmon NSW 2064. (02)439-3322.**

Identification for cables, pipes and panels



Gilbert Lodge and Company Limited, has just released the Raychem range of Thermofit Marker System products.

The Thermofit Marker System (TMS) is a method of producing permanent marker sleeves for identifying wires, cables, harnesses, connectors, pipes and panels.

TMS heat-shrinkable sleeves are supplied already expanded on reels in bandoliered form for ease of handling. After permatising, the sleeves can be easily removed from the bandolier comb and slipped onto the relevant wire.

For more information contact **Gilbert Lodge & Co Ltd, 1048 Dandenong Rd, Carnegie, Vic 3163.**

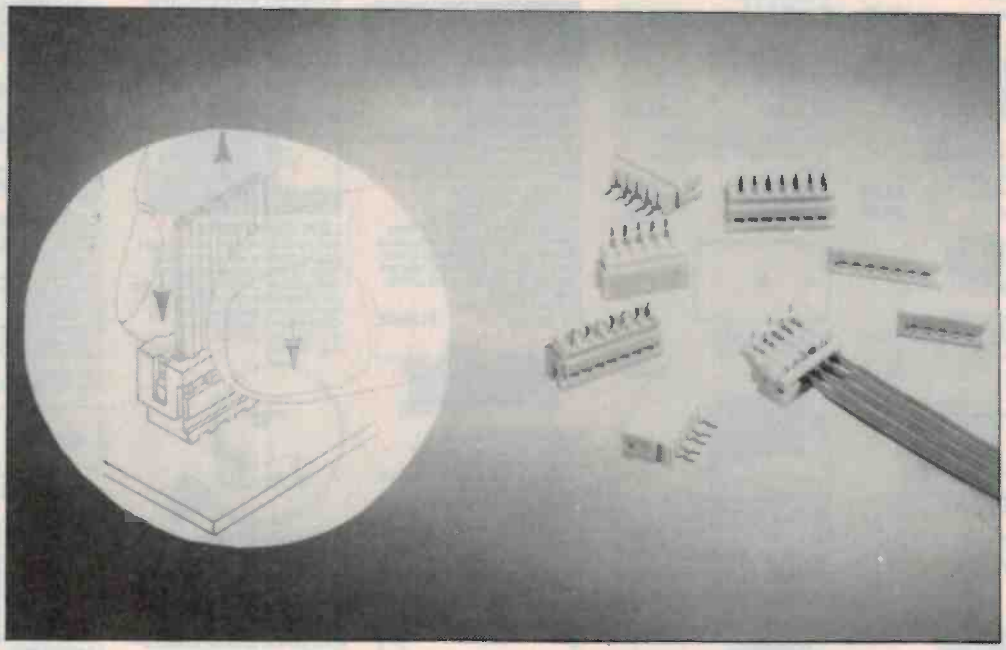
LED lamps loom

Izumi Deni has released a range of super bright solid state LED lamps. These lamps are available fitted with standard bases so that they can directly replace incandescent lamps. The light output of the multi-chip LED is equivalent to incandescent lamps. However, they are more efficient, requiring less current, consuming less power and generating less heat. The LED lamps, being solid state, provide high resistance to shock and vibration and are available in red, green and yellow in voltages from 6 to 24 Vdc.

Also available is a range of round and square pilot lights with the LED lamps fitted.

For further information contact Australian Distributor **Bellco Controls/Email Ltd Relays Division, 15-17 Hume St, Huntingdale, Vic 3166. (03)544-8244.**

The tender wire trap



A new wire trap connector system from Molex available through Utilux is claimed to cut harness assembly costs in interconnection systems.

The glass filled polyester connector has no board hooks to take up valuable board space, its 'kinked' terminal solder tails providing stability and retention to the board during soldering.

After the connector is soldered into place, the stripped cable is inserted in one simple operation, using a good contact wiping action.

Using tin plated, copper alloy terminal material, Molex has achieved a voltage/current rating of 250 V/3 amps, with an insulation resistance of 500 Vdc between adjacent terminals.

Further information can be obtained from **Utilux Pty Ltd, 74 Commercial Road, Kingsgrove, NSW 2208. (02)50-0155.**

Non-volatile RAM requires no interface circuitry

Intel Corp has announced the availability of a non-volatile random-access memory (NVRAM) that requires no interface circuitry.

When used with 8-bit microcontrollers and multiplexed microprocessors, the 2001 NVRAM eliminates the need for interface circuitry by transmitting address and data information on the same lines.

On-chip data-protection circuitry detects when the power supply drops below four volts, at which time the internal erase and write circuitry shuts off. In this way, erroneous command signals generated by other circuits are locked out and cannot affect data stored in the device's memory cells.

For more information contact **Intel Aust. Pty Ltd, Level 6, 200 Pacific Hwy, Crows Nest, NSW 2065. (02)957-2744.**

Pomona test accessories

STC-Cannon Components distributors of Pomona test accessories, has available the 1985 edition of the Pomona electronics test accessories catalogue.

It includes banana plugs, jacks and patch cords, phone tip jacks, plugs and connecting cords, test clips, probes and holders, binding posts, black boxes and sockets.

For more information contact **STC-Cannon Components Pty Ltd, 248 Wickham Road, Moorabbin, Vic 3189.**

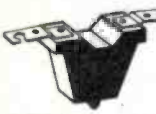
We've got all your T.V. needs covered and at very competitive prices!!

CO-AXIAL CONNECTORS
Socket to socket.
L12260 $0.75
Plug to plug.
L12259 $0.75
Plug to socket.
Cat. L12761 $0.75

METAL CO-AXIAL CONNECTORS
Plug Cat. P10402 $0.95
Socket Cat. $0.95

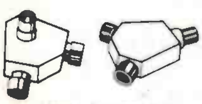
PLASTIC BODY CO-AXIAL CONNECTORS
Plug Cat. P10401 $0.50
Socket Cat. P10408 $0.60

CONNECTOR CORDS
For TV/VTR (using cord 3C-2V) 2.5m long.
Male to Female
Cat. $2.95
Male to Female
Cat. $2.95



UHF/VHF OUTDOOR MATCHING TRANSFORMER
75/300 Ohm, Waterproof type.
Cat. L11020 $3.75

MATCHING TRANSFORMERS
Ohm Type
Cat. L11038 $6.95
Female Type
Cat. L11010 $2.95



CO-AXIAL SOCKETS LOW LOSS SPLITTER
Gives 2 standard co-axial outlets from one input.
Cat. L11036 (left) $4.95
Cat. L11037 (right) $4.95

CABLE CLIPS
Single Cat. $0.06
Dual Cat. $0.06

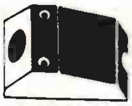
HYBIRD SPLITTERS
2 Way
- Input/Output 75 Ohm
- Splitting loss 3.5dB
- Isolation 25dB
- V.S.W.R. 1.3

Cat. L11310 $3.95
4 Way
- Input/Output 75 Ohm
- Splitting loss 6.8dB
- Isolation 32dB
- V.S.W.R. 1.3

Cat. L11320 $5.95

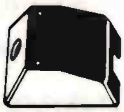
300 OHM COUPLERS
Suitable for UHF, VHF and FM.
2 Set
Cat. L11300 $2.85
4 Set
Cat. L11302 $4.90

WALL PLATES
With directional taps
Cat. L11036 $3.75



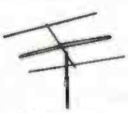
CO-AXIAL SOCKETS SINGLE ENTRY BOX
Cat. L11030 $1.95

CO-AXIAL SOCKETS DOUBLE ENTRY BOX
One in, two out, without low loss arrangement.
Cat. L11035 $3.95



CO-AXIAL SOCKETS SINGLE ENTRY BOX
With isolated capacitors 2KV
Cat. L11031 $2.95

UHF/VHF/FM ANTENNA
Frequency: VHF 48-216 MHz (Ch 1-12) UHF 536-764 Mhz (Ch 25-62)
Impendance: 75/300 (200) Ohm
Element: VHF 4, UHF 9
Gain (dB): VHF 4-6, UHF 4-8
Cat. L11014 $39.50



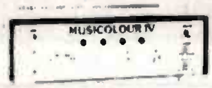
FM ANTENNA
88-108MHz, 75/300 Ohm
Cat. $29.50

PLASTIC BODY CO-AXIAL PANEL SOCKET
Cat. P10406 $0.45

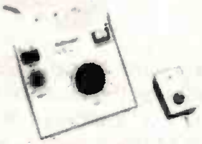
40 W INVERTER
This 12 240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May'82) 82IV5
Cat. K82050 $49.50

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

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



MUSICOLOR IV
Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug.'81) 81MC8
Cat. K81080 $84.00



RAILMASTER PULSE POWER TRAIN CONTROLLER
Here's an up-to-the-minute train controller offering all the most desirable features including inertia, full overload protection, walk-around throttle and excellent low-speed running characters. Probably the best controller available, regardless of the cost!
(EA Sept.'84) 84TC9
Cat. K84091 $79.50

SOUND SIMULATOR FOR MODEL TRAINS
Fancy a diesel sound simulator for your model train layout? This circuit mounts inside the train for added realism and even varies its 'speed' according to the throttle setting.
(EA Nov.'84)
Cat. K84110 $18.00

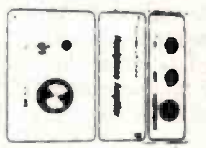
MODEL ENGINE IGNITION SYSTEM
Get sure starts every time and no more glow plug burnouts on your model engines.
(ETI June'83) ETI 1516
Cat. 55160 $49.50

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

LOW OHMS METER
How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov.'81) ETI 158
Cat. K41580 $34.50

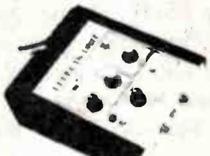
RADIOTELETYPE CONVERTER FOR THE MICROBEE
Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr.'83)
Cat. $20.00

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'83) 83PS5
Cat. K83050 $149

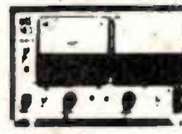


HEADPHONE AMPLIFIER
PRACTICE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument,this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household,or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb.'84) 83MA11
Cat. K83011 $28.00

150W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive 'commercial' ones. It delivers 150 watts into 4-ohms, has a t-band graphic limiter, line out and bi-amp facilities.
(ETI Aug.'84) ETI 1410
Cat. K54100 $299

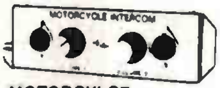


EFFECTS UNIT
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.
(EA June.'83) 83GA6
Cat. K83060 $75.00



LAB SUPPLY
Fully variable 0-40V current limited 0-5A supply with both voltage and current metering (two ranges: 0-0.5A/0-5A). This employs a conventional series-pass regulator, not a switchmode type with its attendant problems, but dissipation is reduced by unique relay switching system switching between taps on the transformer secondary.
(ETI May'83) ETI 163
Cat. K41630 $175.00

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



MOTORCYCLE INTERCOM
OVER 300 SOLD!
Motorcycling is fun, but the conversation between rider and passenger is usually just not possible. But build this intercom and you can converse with your passenger at any time while you are on the move. There are no "push-to-talk" buttons, adjustable volume and it's easy to build!
(EA Feb.'84) 84MC2
Cat. K804020 $45.00

PHONE MINDER
Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function, separately. (EA Feb.'84) 84TP2
Cat. K84021 $24.00

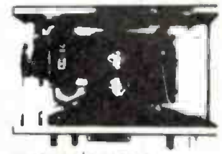
MOSFET POWER AMPLIFIER
Employing Hitachi Mosfets, this power amplifier features a 'no compromise' design, and is rated to deliver 150 1/2 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion.
(ETI Jan.'81) ETI 477
Cat. K44770 $67.50

ZENER TESTER
A simple low cost add-on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.
(ETI May'83) ETI 164
Cat. K41640 $9.50

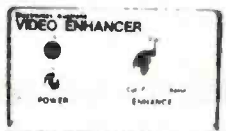
SLIDE CROSS-FADER
Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built varialbe timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder.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

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

PARABOLIC MICROPHONE
Build a low cost paraboia, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds or perhaps even more sinister noises. The current cost of componenets for this project is around $15 including sales tax, but not the cost of batteries or headphones. (EA Nov.'83) 83MA11
Cat. K83110 $15.00

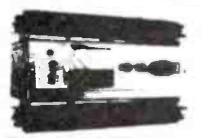


DUAL TRACKING POWER SUPPLY
Built around positive and negative 3-Terminal Regulators, this versatile dual tracking Power Supply can provide voltages up to 2A. In addition the Supply features a fixed +5V 0.9A output and is completely protected against short circuits, overloads and thermal runaway.
(EA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

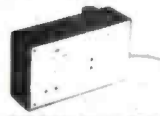


VIDEO ENHANCER
100's SOLD
Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct.'83) 83VE10
Cat. K83100 $35.00

30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limiL Both volatage and current metering is provided. (ETI Dec.'83) ETI 162
Cat. K41620 $49.50



ELECTRIC DUMMY LOAD
With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct.'80) ETI 147
Cat. K41470 $109



DIRECTIONAL DOOR MINDER
Most electronic door minders function by having a beam of light shinning across doorway interrupted, but are incapable of detecting whether the light beam is broken by a person entering or leaving the room. this project overcomes that problem with the aid of digital logic.
(ETI Nov.'84) ETI 278
Cat. K42780 $29.95

CHANGING OF PHONE NUMBER

Please note that in May, our City Stores' phone number will be changing from 347 7917 to 663 6151

50 K LOG POT
Shaft as illustrated
1-9 $0.60
10+ $0.55

WE GOOFED!!

LOG SLIDES POTS
We ordered log instead of linear for the graphic equalizer, so take advantage!
1-9 $0.65
10+ $0.60
100+ $0.50

FIBRE OPTIC LINK

This project allows anyone curious about fibre optics to get hands-on experience without being buried in maths or having to pay a fortune. Simplicity is the key . . . read on for more details.

P. Ihnat

FIBRE OPTIC SYSTEMS have been described in news releases and general articles for many years now. The result however is usually the same — many ideas are presented but how does one get hold of some cable, a transmitter and receiver at reasonable cost to experiment with? Well, Hewlett Packard has provided a solution which is not only cheap (see special offer) but very simple to use. With the addition of a few extra parts your own fibre optic link can become a reality.

For those unsure of what fibre optics is all about, a general article on the topic can be found elsewhere in this issue. Very simply put, a fibre optic link is one in which light is used as the information carrier as opposed to electrons, radio waves, etc. The light after suitable modulation travels through glass or plastic fibre to the receiving end where the original information is extracted. Two major advantages of this system are the extremely wide bandwidth available and the fact that the signal doesn't pick up electrical interference along the way.

In this project I will describe four experiments which can be assembled on the recommended pc boards. If you'd rather not buy or make the boards then any other form of construction is OK (for example, Veroboard). Protoboards (or bimboards) are also ideal but be careful since it's very easy to make a wiring error especially if all your hookup wire is the same colour (like ours in the lab). If you are using the recommended pc boards, you may notice that both transmit and receive circuitry resides on each board! What madness is this, I hear you say — the idea of fibre optic links is to send information some distance away. The answer to this is that during experimentation, both transmit and receive circuitry can be powered from one power supply. Once the circuit operates correctly, the board can be cut in half with a hacksaw blade resulting in a separate transmitter and receiver.

Some applications however require a two way link and so the boards need not be cut. In this case, connect them with either two separate fibre optic cables or buy some duplex cable (duplex fibre optic cable is basically two cables in a figure-8 configuration). Extra single core cable and connectors are available from Hewlett Packard agents under the following part numbers:

- unconnectored cable — HFBR-35xx series;
- grey connector/crimp ring — HFBR-4501;
- blue connector/crimp ring — HFBR-4511.

The HFBR-0500 evaluation kit

This project is based on Hewlett Packard's HFBR-0500 fibre optic evaluation kit, which has been designed for applications requiring a short, low cost fibre optic data link. What I should emphasize here is the world *simple* which HP seems to have left out of its data sheets. The system is so simple to use that anyone from the basic hobbyist to the experienced engineer will be able to experiment with and learn more about fibre optics. Let's now examine the kit in more detail to see how some of the problems normally associated with fibre optics have been solved.

The evaulation kit consists of the following components:

HFBR-1510 transmitter;
HFBR-2501 receiver;
HFBR-3514 5 metres connectored cable;
HFBR-4501 grey connector;
HFBR-4511 blue connector;
HFBR-4595 polishing kit; and literature.

One reason for the reduction in cost for short distance links is due to the type of cable used. The cable is plastic and has a relatively high attenuation of about 0.3 dB per metre. Compare this with cable used

CABLE TERMINATIONS

The following easy procedure describes how to make cable terminations. It is ideal for both field and factory installaiton. If a high volume connectoring technique is required please contact your Hewlett-Packard sales engineer for the recommended procedure and equipment.

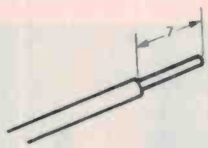
Connectoring the cable is accomplished with the Hewlett-Packard HFBR-4595 Polishing Kit consisting of a Polishing Fixture and 600 grit abrasive paper and 3 micron pink lapping film (3M Company, OC3-14). No adhesive material is needed to secure the cable in the connector, and the connector can be used immediately after polishing.

Connectors may be easily installed on the cable ends with readily available tools. Materials needed for the terminating procedure are:

1) HFBR-35XX/36XX Fiber Optic Cable
2) HFBR-4595 Polishing Kit
3) HFBR-4501 Gray Connector and Crimp Ring
4) HFBR-4511 Blue Connector and Crimp Ring
5) Industrial razor blade or wire cutters
6) 16 gauge latching wire strippers
7) Crimp Tool, AMP 90364-2

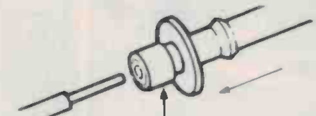
Step 1
The zip cord structure of the HFBR-36XX duplex cable permits easy separation of the channels. The channels should be separated approximately 50 mm (2.0 in.) back from the ends to permit connectoring and polishing.

After cutting the cable to the desired length, strip off approximately 7 mm (0.3 in) of the outer jacket with the 16 gauge wire strippers. Excess webbing on duplex cable may have to be trimmed to allow the connector to slide over the cable.



Step 2
Place the crimp ring and connector over the end of the cable; the fiber should protrude about 3 mm (0.12 in.) through the end of the connector. Carefully position the ring so that it is entirely on the connector and then crimp the ring in place with the crimping tool.

Note: *Place the gray connector on the cable end to be connected to the transmitter and the blue connector on the cable end to be connected to the receiver to maintain the color coding (both connectors are the same mechanically).*



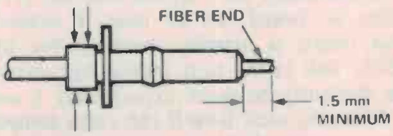
Step 3
Any excess fiber protruding from the connector end may be cut off; however, the trimmed fiber should extend at least 1.5 mm (0.06 in.) from the connector end.

Insert the connector fully into the polishing fixture with the connector end protruding from the bottom of the fixture.

For high volume connectoring use the hardened steel HFBR-4596 polishing fixture.

Note: *The four dots on the bottom of the polishing fixture are wear indicators. Replace the polishing fixture when any dot is no longer visible.*

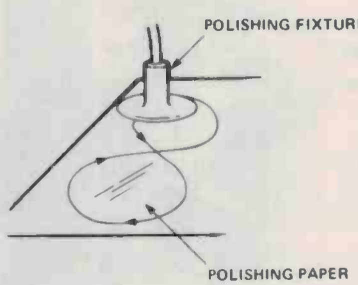
Place the 600 grit abrasive paper on a flat smooth surface. Pressing down on the connector, polish the fiber and the connector until the connector is flush with the end of the polishing fixture. Wipe the connector and fixture with a clean cloth or tissue.



Step 4
Place the flush connector and polishing fixture on the dull side of the 3 micron pink lapping film and continue to polish the fiber and connector for approximately 25 strokes. The fiber end should be flat, smooth and clean.

The cable can now be used.

Note: *Use of the pink lapping film fine polishing step results in approximately a 2 dB improvement in coupling performance of either a transmitter-receiver link or a bulk-head/splice over 600 grit polish alone. This polish is comparable to Hewlett-Packard's factory polish. The fine polishing step may be omitted where an extra 2 dB of optical power is not essential as with short link lengths.*



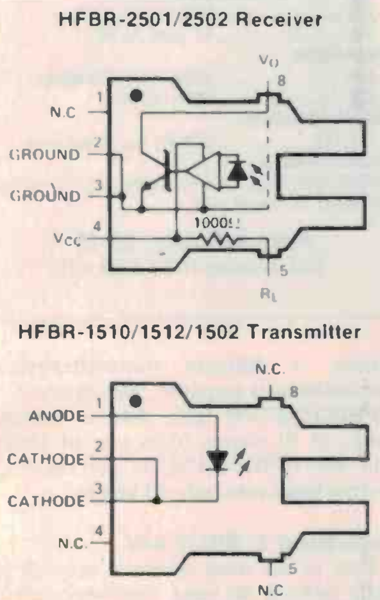


Figure 1a. Top view of fibre optic transmit and receive modules showing pin connections.

for long distance work which needs to have an attenuation of less than 0.5 dB *per kilometre!!* Hence the reduction in cost. Note, however, that by short distance operation I mean a distance of up to 60 metres (with the correct choice of transmitter and receiver modules). The components supplied in the evaluation kit allow a distance of up to 17 metres to be covered with a bandwidth of 5 MHz though 25 metres is possible with reduced bandwidth.

The HFBR-1510 transmitter is basically an LED (as opposed to solid state laser) with an output corresponding to the wavelength at which the optic fibre has an attenuation minimum. It's absolute maximum forward current is 80 mA but, like most LEDs, it can be pulsed with currents up to 1000 mA as long as the average current is below 80 mA. For example, if a 50% duty cycle square wave is used to drive the LED, the current can be set to 160 mA. The 50% duty cycle implies that the LED will only be on half the time and so the average current will be 80 mA. In the experiments which follow, I've kept the average current below 60 mA.

The HFBR-2501 receiver contains a shielded photodetector, which matches the transmitter's wavelength, as well as a wide bandwidth dc amplifier. The output stage is an open collector transistor which allows interfacing with common logic families. An integrated 1k ohm resistor internally connected to Vcc is also provided and can be used as a pull-up resistor when using TTL. The absolute maximum supply voltage is 7 volts and the output voltage should not exceed 18 volts. One requirement however is that a bypass capacitor (any value between 10n and 100n) be connected from pin 3 to pin 4 of the receiver to prevent unwanted oscillations. Figure 1a shows the pin connections for the transmit and receive modules.

Two problems inherent in early fibre optic systems were how to align the cable with the active areas of the transmitter and receiver and how to terminate cables. The Hewlett Packard system uses an innovative snap-in connectoring scheme. The fibre optic cable is terminated by a plastic connector (HFBR-4500 series) which can be fitted in a matter of minutes (see 'Cable Terminations'). The transmitter and receiver modules have jaws which grip the cable connectors to ensure accurate alignment (see Figure 1b).

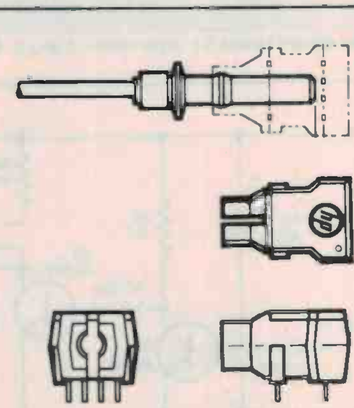


Figure 1b. Details of connector and jaws of transmit module.

Project 1526

Parts List — exp 1 (TTL link)

Resistors	all ¼ W, 5% unless noted
R1	100k
R2	1k
R3	3k9
R4	47 ohm, ½ W
Capacitors	
C1	470µ, 16 V RB electro
C2	100n ceramic
Semiconductors	
Q1, Q2	BC547, 8 or 9 (or sim)

Miscellaneous
HFBR-0500 fibre optic evaluation kit; ETI-1526a pc board; pc board pins.

Price estimate: $5.15
(not including HFBR-0500 Kit)

Experimental applications

Experiment 1: A simple TTL data link for short distances

Figure 2 shows one method of sending TTL data along a fibre optic link. Transistors Q1 and Q2 amplify the TTL signal and drive the transmitter LED. The receiver converts the light beam back to TTL with the help of its internal 1k pull-up resistor.

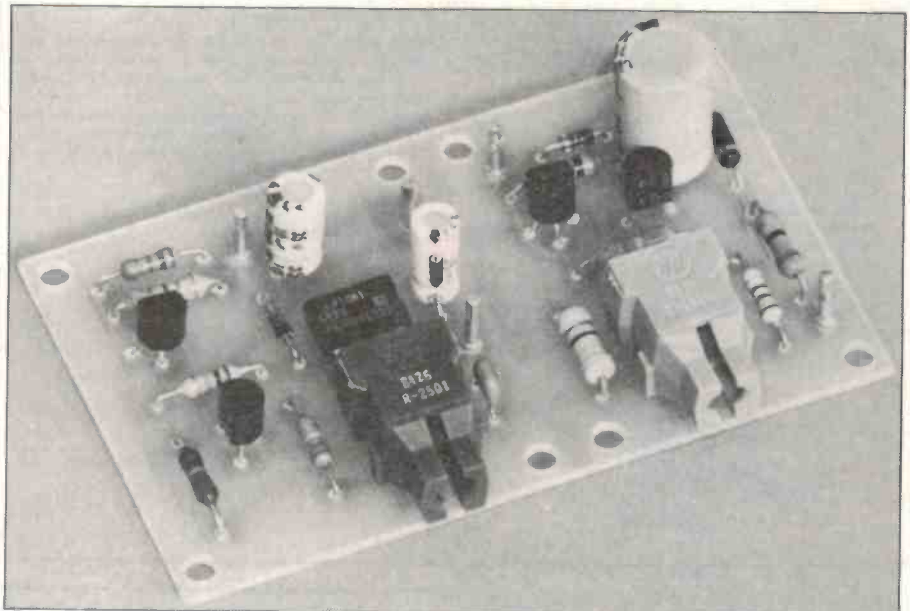
Construction isn't critical but the ETI-1526a pc board can be used if desired. This board is actually designed for the RS232 link in the next section but due to the similarity between experiments 1 and 2, it can be used here if the extra component mounting holes are ignored. Refer to the overlay diagram if there is any confusion.

Start by mounting the resistors, capacitors and transistors in that order. Finally mount the transmit and receive modules.

Take note: 1) When soldering the transmit and receive modules onto pc boards, it is wise to insert connectors into each module to prevent solder flux fumes from coating the optics inside.

2) When the transmitter is operating, take care when looking directly into its opening with no optic cable connected or into the free end of the cable if connected. Under most viewing conditions there is no eye hazard but with high current pulsing for extended distance operation, the optical port of the transmitter may expose the eye beyond its maximum recommended exposure.

Apply power to the circuit and feed a TTL signal into the input. Check the output to see if it matches the input. If OK then the link is ready to use. According to the data sheets, at 25°C the link should operate over a minimum distance of 17 metres with a typical distance of 35 metres (data rate is 5 Mbit/s). For greater distances, a different transmitter/receiver combination is required. For example, the HFBR-1502/2502 pair has a minimum range of 30 metres (data rate of 1Mbit/s) and the HFBR-1512/2503 pair covers 60 metres (data rate only 40 kbit/s).



Printed circuit board for experiments 1 and 2. For experiment 1 ignore extra components and mounting holes.

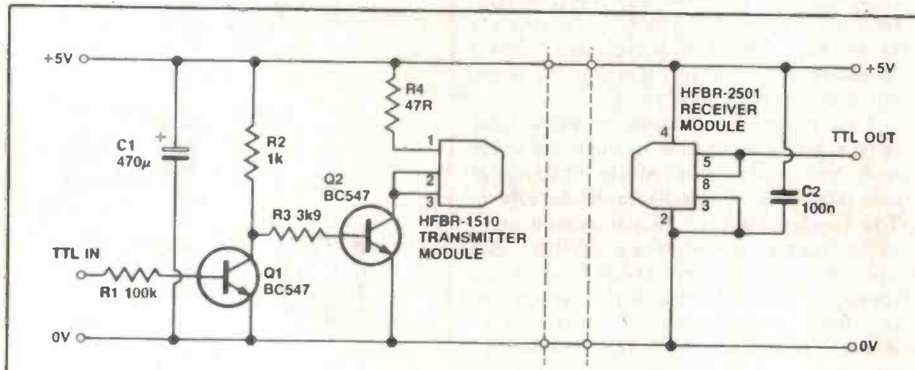


Figure 2. Circuit diagram for TTL link.

Experiment 2: RS232 link

One of the most common uses of fibre optic links is to send computer information to other computers or peripherals. Experiment 1 described a TTL to TTL link which can be used for this application. However, most serial links are either RS232 or RS422 and so a different circuit is required.

Figure 3 shows one way of implementing an RS232 link. The transmitting half is similar to the TTL section except for the following additions. Resistor R1 and zener ZD1 are required to reduce the supply voltage if 5 volts isn't available. This would be the case, if for instance, the circuit was to be used with a Microbee which provides 12 volts on one of the spare RS232 pins. If 5 volts is available, replace R1 with a wire link and omit ZD1.

An RS232 signal swings to more than +3 volts for logic zero and less than −3 volts for logic one. Diode D1 is included to avoid exceeding the reverse breakdown voltage of Q1's base/emitter junction when the input swings negative.

The receiver circuitry is straightforward except perhaps for the section around IC1. With this part removed and the bottom of R9 connected to 0 volts, a simple two transistor stage becomes more apparent — when Q3 is ON, Q4 is ON and the output is 5 volts. When Q3 is OFF, Q4 is OFF and the output is 0 volts. However, to provide a true RS232 signal, the output in the last case should be less than −3 volts. This is provided by IC1, an ICL7660 negative voltage generator. It produces a low current negative version of the voltage fed into pin 8. Since pin 8 has +5 volts on it, the output at the junction of D2 and C4 is −5 volts and the resultant RS232 output swings from +5 to −5 volts.

Construction is straightforward. Mount the resistors first, then capacitors, semiconductors and finally the transmit and re-

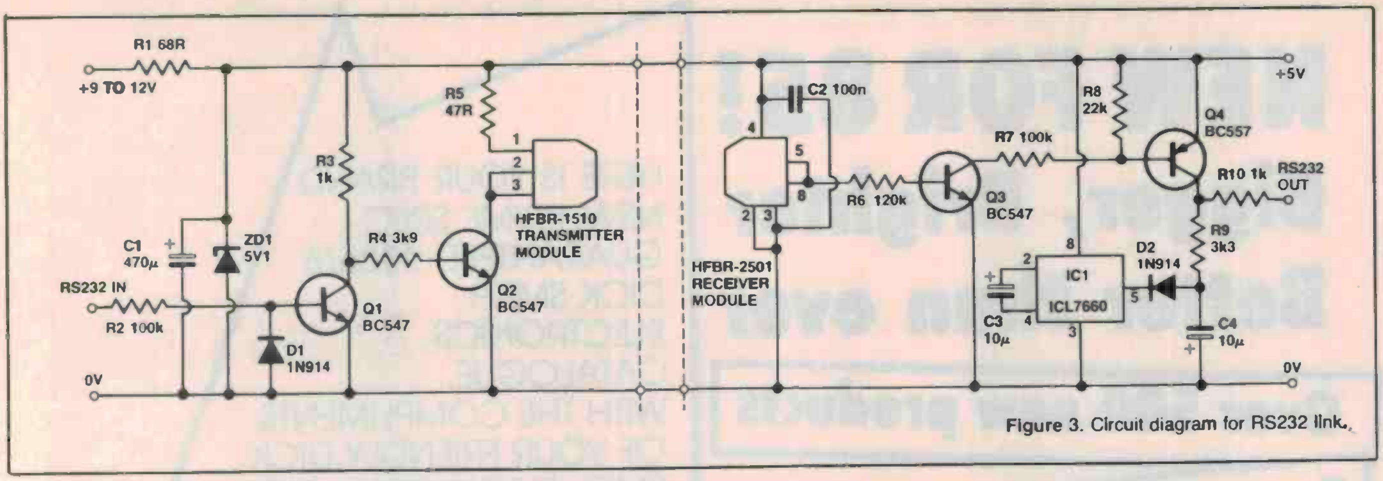


Figure 3. Circuit diagram for RS232 link.

Parts List — exp 2 (RS-232 link)

Resistors	all ¼ W, 5% unless noted
R1	68 ohm, 1 W
R2, 7	100k
R3, 10	1k
R4	3k9
R5	47 ohm, ½ W
R6	120k
R8	22k
R9	3k3
Capacitors	
C1	470μ 16 V RB electro
C2	100n ceramic
C3, 4	10μ 16 V RB electro
Semiconductors	
Q1, 2, 3	BC547, 8 or 9 (or sim)
Q4	BC557, 8 or 9 (or sim)
D1, 2	1N914
ZD1	5V1, 1 W zener
IC1	ICL7660

Miscellaneous
HFBR-0500 fibre optic evaluation kit; ETI-1526a pc board; pc board pins.

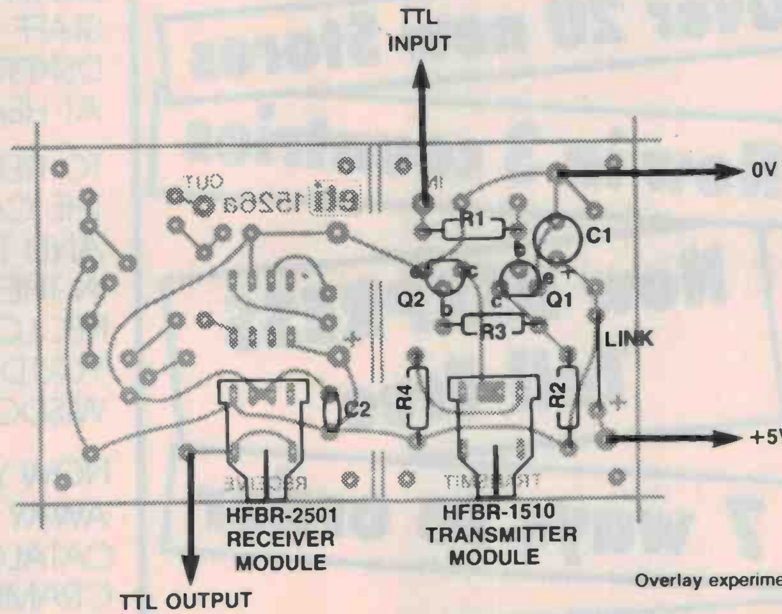
Price estimate: $8.44
(not including HFBR-0500 Kit)

ceive modules. I used pc board pins for input, output and power supply connectors. Connect the power supply and send an RS232 signal through the link. If a problem exists, check all wiring and the orientation of semiconductors.

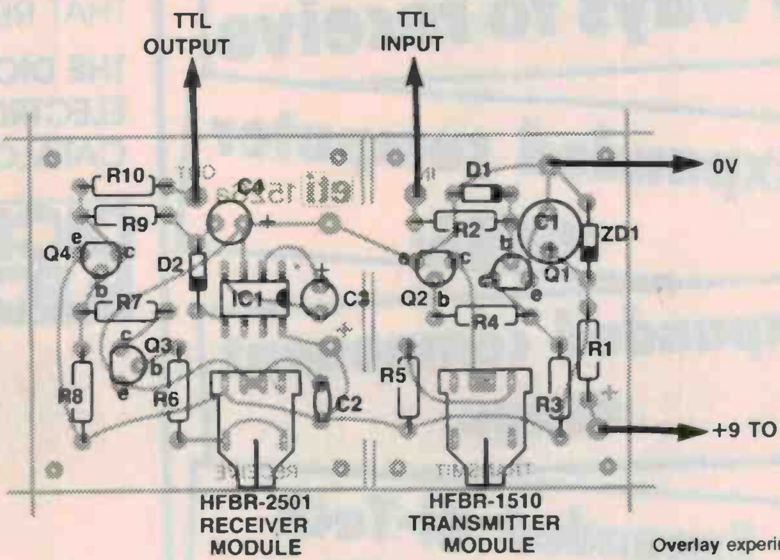
If you need a one way RS232 link, simply cut the pc board in half to separate transmitter and receiver. The two can be separated by up to 25 metres of optic cable without modification. In many cases however a two way link will be required — one for data and the other for handshaking. In this case build two boards and use two cables (or duplex cable).

Experiment 3: Photo interrupter link

There are situations were electromechanical or optoelectronic sensors are required in high voltage, electrically noisy or explosive environments. If the sensor needs to monitor a go/no go or on/off situation then the following fibre optic photo interrupter setup should prove interesting. The following examples illustrate cases where interference-free optics are ideal.



Overlay experiment 1.



Overlay experiment 2.

*For a guide to components and kits for projects, see **SHOPAROUND** this issue.*

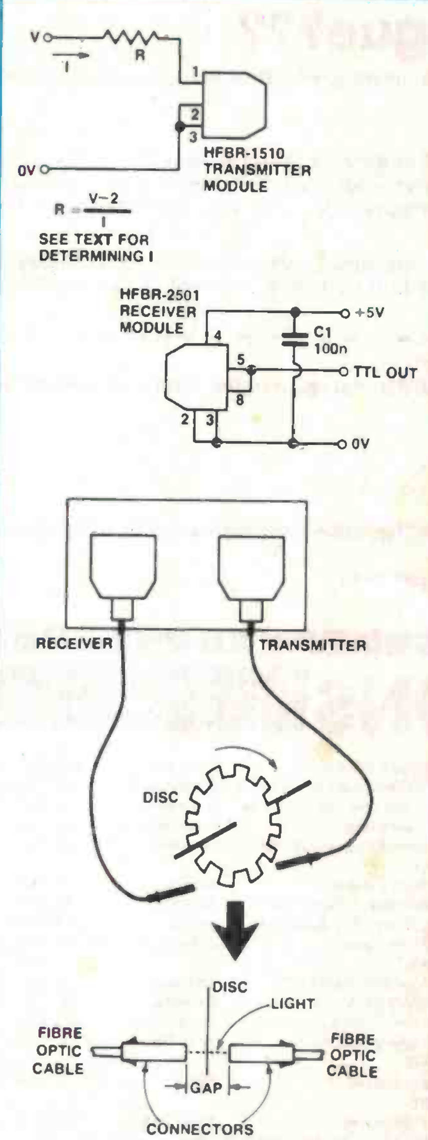


Figure 4a. Photo interrupter.

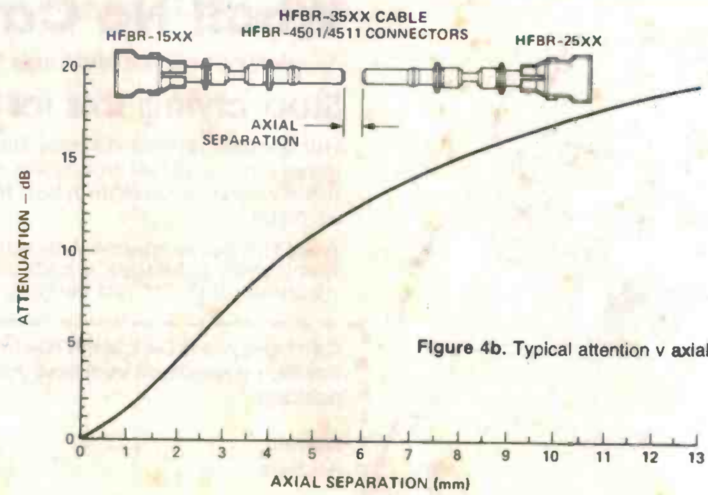


Figure 4b. Typical attention v axial separation.

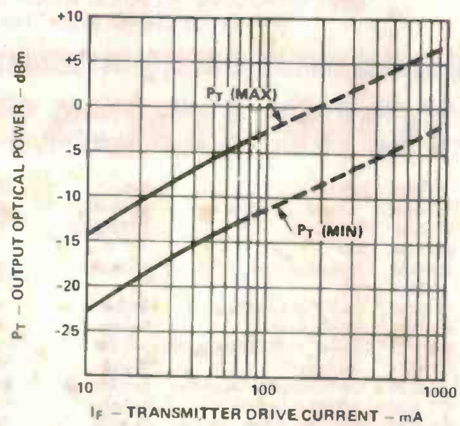


Figure 4c. Typical optical power v transmitter I_F (0-70°C).

Parts List — exp 3 (photo Interrupter)

Resistors
R .... see text

Capacitors
C1 .... 100n ceramic

Miscellaneous
HFBR-0500 fibre optic evaluation kit.

Price Estimate: $0.20
(not including HFBR-0500 Kit)

1) To determine the speed of rotation of a shaft or motor a notched disc can be attached to the required shaft and set up to interrupt a light beam which passes through the notches on to an optical sensor. The number of interruptions to the light beam (per second) can be made in proportion to the speed of rotation. If a fibre optic link carries light to and from the notched disc, electrical interference normally induced by the proximity of the sensor to the motor will be eliminated.

2) Position encoding can be accomplished in a similar manner. Suitable gearing can be set up so that the number of interruptions to the light path will be proportional to the lateral (or angular) movement of the required object. The resolution is determined by the number of notches on the disc.

3) Those who have fitted electronic ignitions to their cars may like to replace the points with an optical sensor. More details of this can be found in a previous ETI electronic ignition project (ETI-316 May 1977). The idea is to place a notched disc on the shaft in the distributor and to mount an LED and photodiode so that the light path will be interrupted at the same rate as the points are opened. Here we have a high voltage, electrically noisy environment ideal for a fibre optic photo interrupter.

Figure 4a shows the photo interrupter circuitry. Construction will vary with the application so no details are given. Since there is a possibility that the receiver may be over or under driven (too much or insufficient light sent down the cable), the value of resistor R needs to be calculated. This is a simple procedure, as follows. First determine the maximum and minimum output levels for the transmitter. The equation is given on page 10 of the HP data sheets but can be simplified to:

Pmax (dBm) ≤ gap attenuation − 9.5; and

Pmin (dBm) ≥ gap attenuation − 18.5.

This assumes that the total length of the fibre optic path is less than two metres. Gap attenuation can be estimated from the graph in Figure 4b. For example, a 1 mm gap produces an attenuation of about 1.5 dB. Plugging this into the above equations, Pmax should be less than −8 dBm and Pmin greater than −17 dBm. The next step is to convert these figures into an equivalent transmitter drive current. The graph in Figure 4c does all the hard work and gives an answer of about 30 mA. The value of R in the circuit is

R = (V−2)/I

which for the example given above and a 12 volt supply gives

R = (12−2)/30 mA
= 330 ohms.

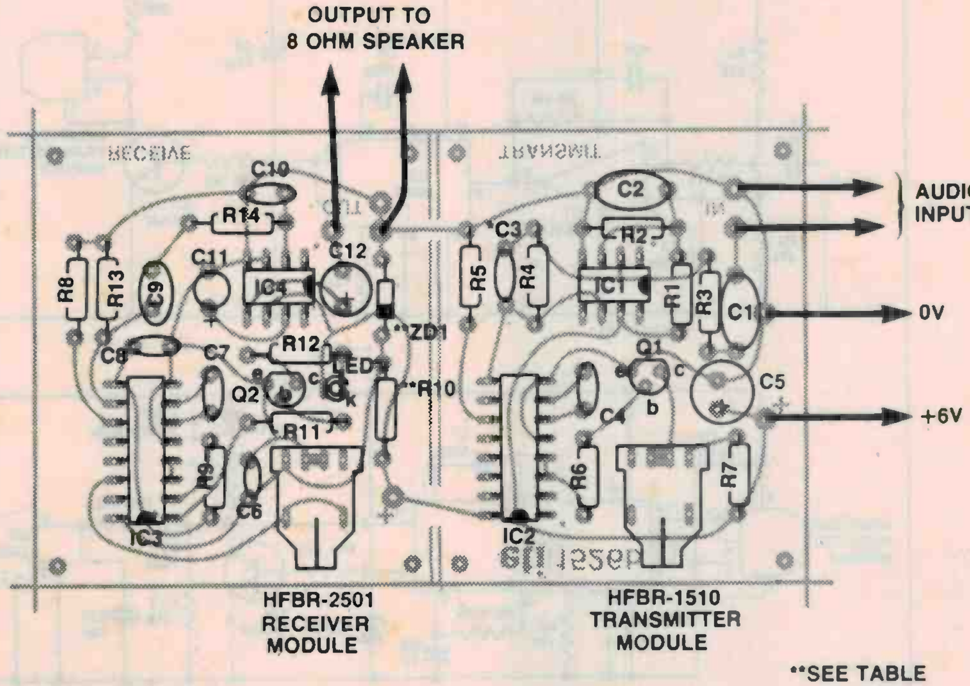
The only catch is not to exceed 80 mA. If higher currents are required, the LED needs to be pulsed to avoid burning it out.

Parts List — exp 4 (audio link)

Resistors	all ¼ W, 5% unless noted
R1, 2, 3, 11	47k
R4	1M
R5, 8	12k
R6, 12	1k2
R7	39 ohm, ½ W
R9, 13	120k
R10	see text
R14	10k
Capacitors	
C1, 2	220n greencap
C3	see text
C4, 7	100p
C5	470µ 16 V RB electro
C6, 9	100n ceramic
C8	1n greencap
C10	10n greencap
C11	10µ 16 V RB electro
C12	100µ 16 V RB electro
Semiconductors	
IC1	CA3140
IC2, 3	4046
IC4	LM386
Q1, 2	BC547, 8 or 9 (or sim)
ZD1	see text
LED1	3 mm red LED

Miscellaneous
HFBR-0500 fibre optic evaluation kit; ETI-1526b pc board; 8 ohm speaker; pc board pins.

Price estimate: $22.25
(not including HFBR-0500 Kit)



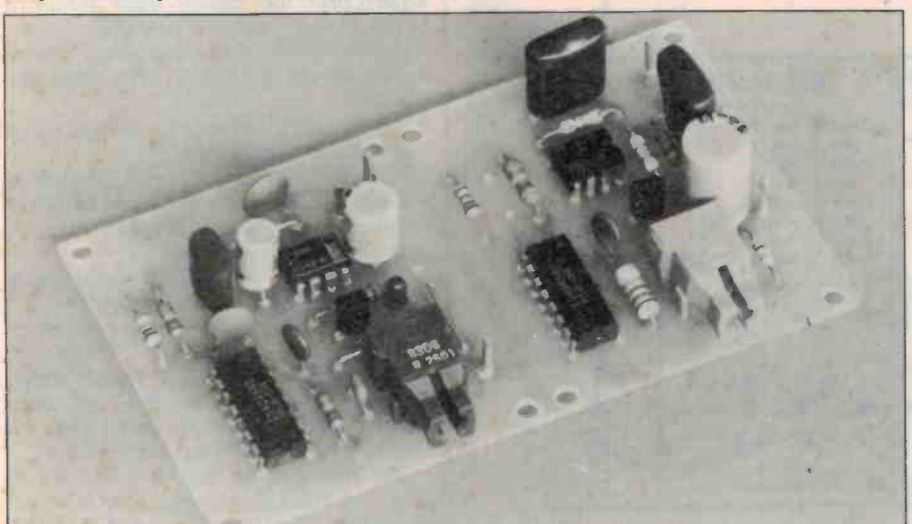
Overlay experiment 4.

Experiment 4: Analogue/audio link

Many times an analogue signal must be sent along a fibre optic link. In terms of miles of cables laid, the largest usage of fibre optics is by the world's communications authorities. The reasons for this are numerous and include size, ease of handling and available bandwidth. To make the most of the available bandwidth, digital techniques are used for encoding and decoding analogue signals. This allows about eight video signals or 7680 telephone channels to travel four kilometres. In this experiment, we will only send a single analogue signal along the link. This will, however, demonstrate one of the simpler techniques for encoding/decoding signals. Other techniques beyond the scope of this project include digitization and multiplexing.

Simple amplitude modulation (changing the intensity of the transmit LED) cannot be used for analogue information transfer with the evaluation kit. This is due to two factors. Firstly, the receiver module is purely a digital device. It's output can be in only one of two states — high or low. Secondly, there is an upper and lower light level limit for the receiver — it won't operate with too little or too much light.

To solve the above problems I frequency modulated a 220 kHz carrier with the analogue signal and demodulated it at the receiver. This involved using a voltage controlled oscillator (VCO) and a phase-locked loop, the operation of which can be looked up in any good text book if you want to experiment further. In operation, the transmitter LED flashes at about 220 kHz with no input signal applied. When an input is applied, its amplitude causes a proportional change in the carrier frequency, that is, the flash rate of the LED. This change in frequency is called frequency modulation. At the receiver, the light pulses are converted back into a frequency modulated square wave. This is compared with an oscillator running at the same frequency as the transmitter (220 kHz) by a phase-locked loop arrangement to produce, after filtering, the original analogue signal.



Printed circuit board for experiment 4.

The circuit diagram is shown in Figure 5. The analogue (or audio) input is amplified by IC1 which is configured as an inverting amplifier. The gain of this stage is

gain = 0-(R4/R3)

and can be set to any value required by changing either resistor. C3 provides some high frequency filtering and can be selected to suit the application.

The output of the op-amp is the control voltage required by the VCO. I chose the 4046 phase-locked loop for this job since it is inexpensive and commonly available. It incorporates a VCO and two phase comparators though it's only the VCO that we're interested in for the transmitter. R5 and C4 set the centre frequency (or carrier in this case) to approximately 220 kHz. The output is a frequency modulated square wave which drives the transmitter LED via Q1. R6 and R7 determine the amount of current flowing through the ▶

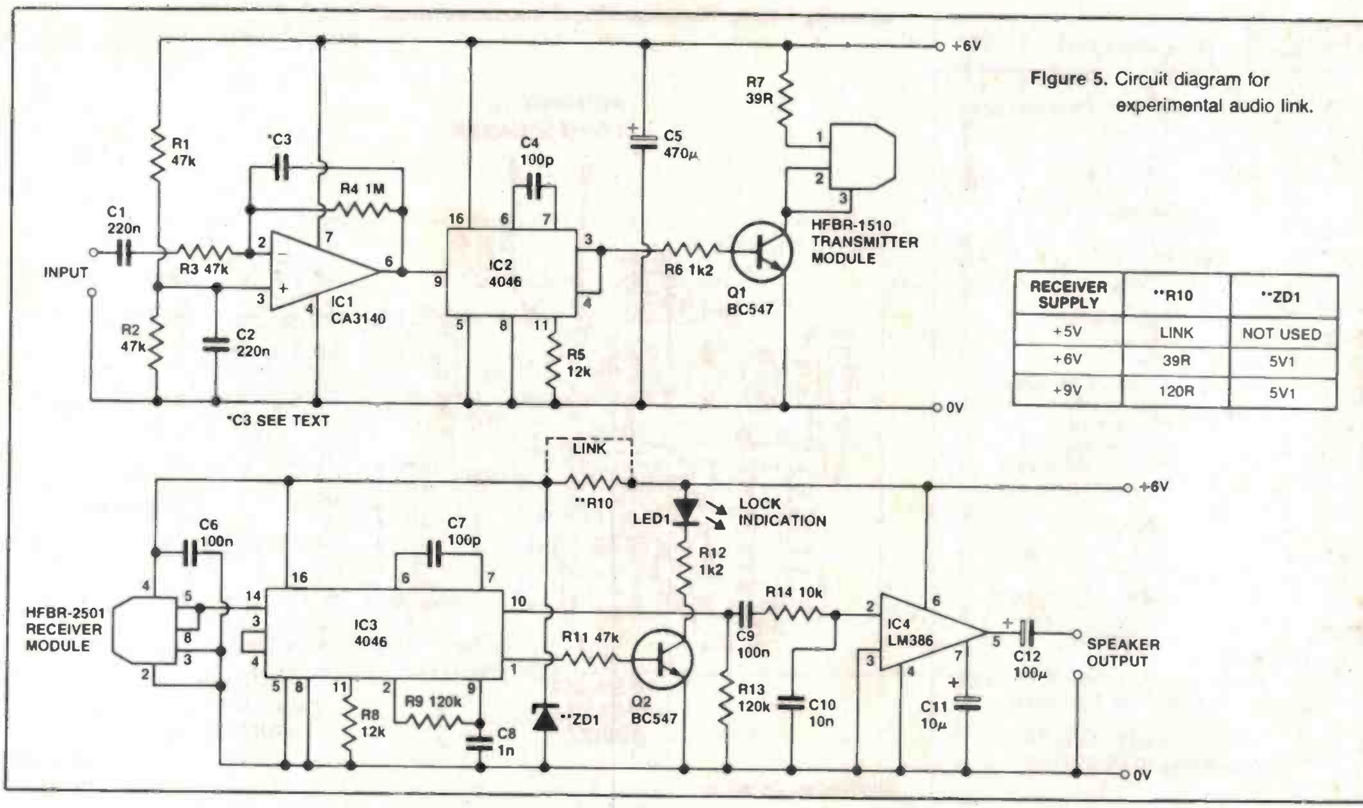
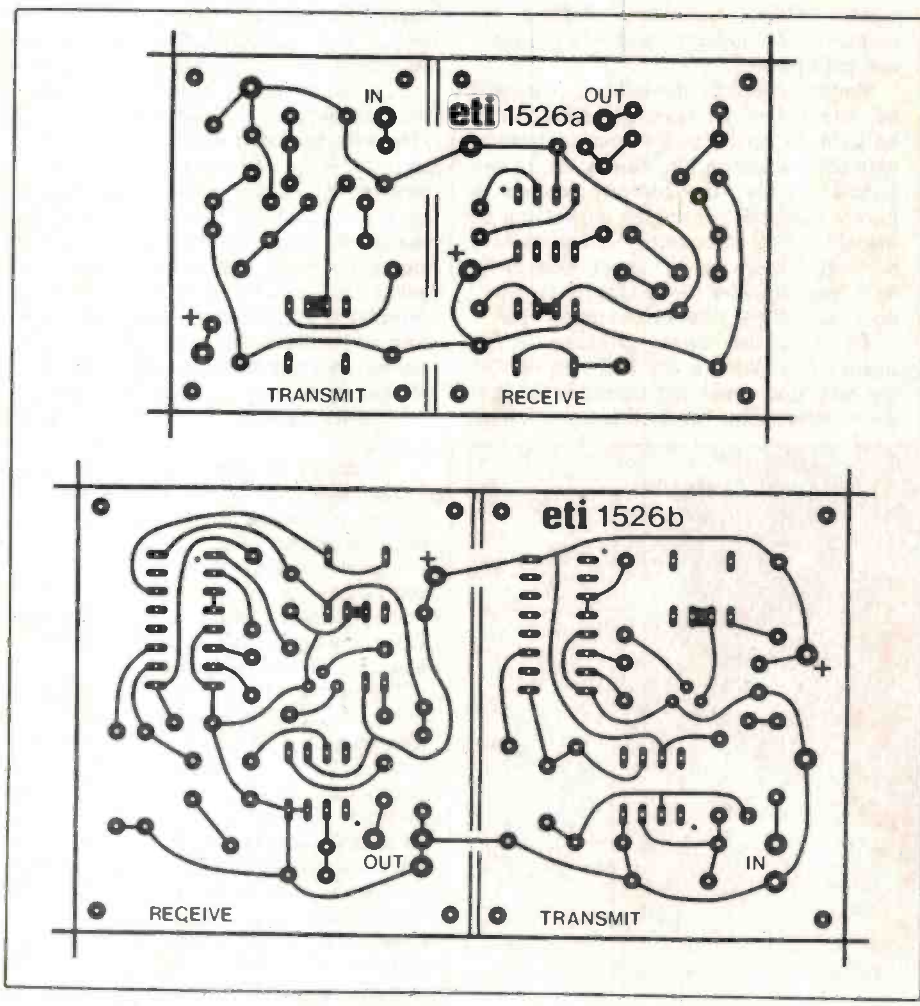


Figure 5. Circuit diagram for experimental audio link.

RECEIVER SUPPLY	**R10	**ZD1
+5V	LINK	NOT USED
+6V	39R	5V1
+9V	120R	5V1



LED which, in turn, depends on the length of optic cable between transmitter and receiver. The values shown in the circuit diagram allow between five and 25 metres of cable to be used with a six volt supply.

At the receiver, another 4046 is used to extract the original information. Capacitors C9, C10 and resistor R14 provide filtering to remove all traces of the carrier frequency which may otherwise produce distortion. C4, R5 and C7, R8 determine the link's operating frequency (about 220 kHz) and can be changed if required. Points to watch however are —

- the carrier frequency should be much higher than the highest input frequency (10 to 20 times higher if possible);
- the oscillators in the transmitter and receiver should be set to the same frequency;
- the maximum operating frequency of the 4046 is around 1 MHz.

LED1 and associated components indicate when the receiver has locked on to the incoming signal. This function can be deleted if not required.

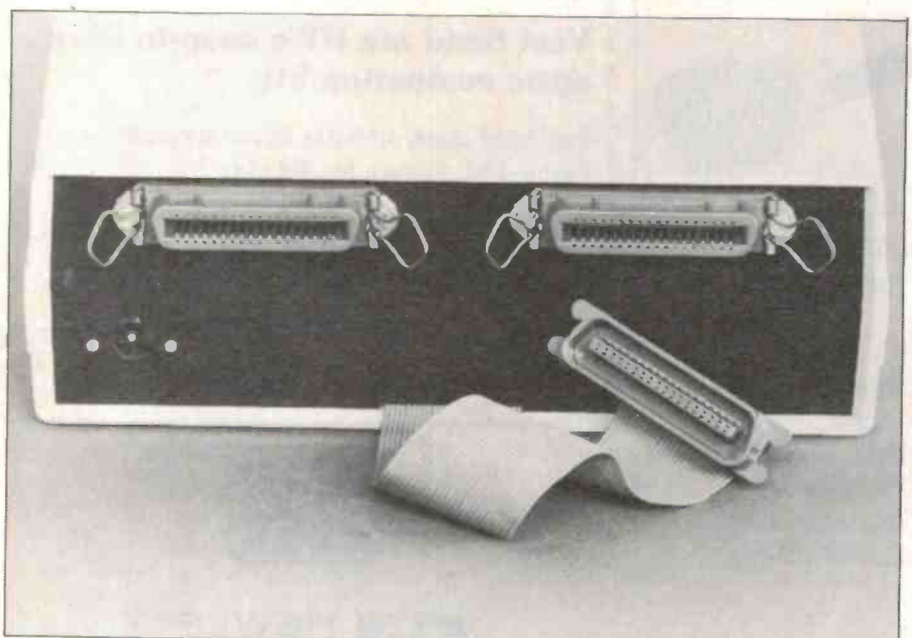
IC4 amplifies the filtered signal and is capable of driving an 8 ohm speaker. If a six volt supply is used, the output volume will be limited due to clipping. For greater volume before clipping, a higher supply voltage can be used but R10 and zener ZD1 should be fitted to ensure that the HBFR-2501 and 4046 receive five volts.

The rest is up to you. If you come up with any interesting applications for your fibre optic link, drop us a line. Other readers may be interested to try them out●

PRINTER SHARER

The end of rummaging around table legs, squeezing fingers to get to inaccessible plugs, or untangling knotted cables to interchange computers with your lonely printer has arrived with the ETI-667. This printer sharer allows two computers to use a single printer without changing connectors, pulling switches, or using special codes.

Geoff Nicholls



Rear panel view. Note ribbon cable with printer plug emerging from slot.

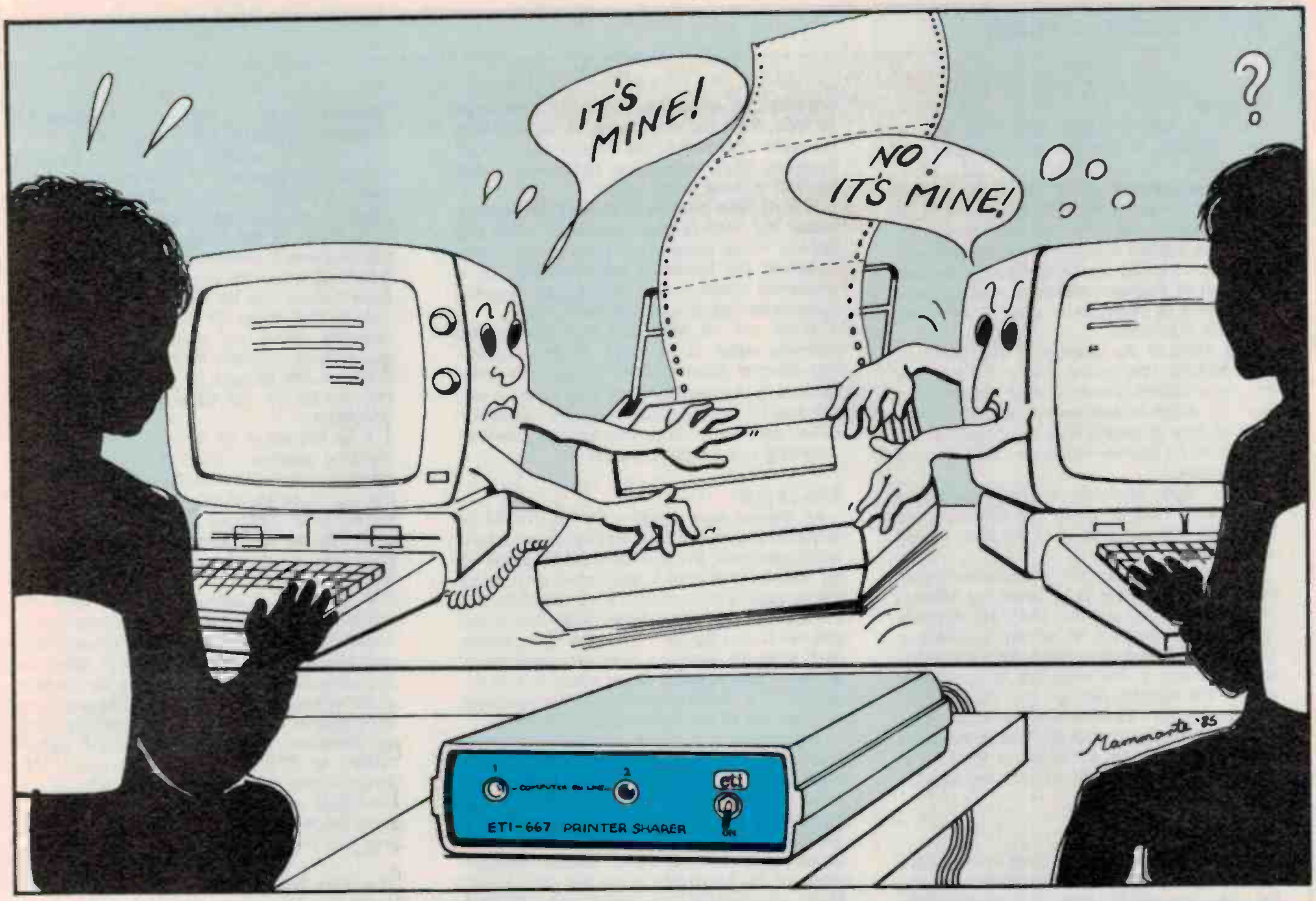
I DESCRIBED the ETI-666 Printer Switch to connect one computer to two printers in ETI, February. This project does the opposite; the printer sharer allows two computers to access a single parallel printer, automatically switching between them as required. There are no switches to operate and no control codes to send, you simply use the normal print commands from each computer.

The sharer supports both BUSY and ACKNOWLEDGE handshaking lines and should therefore be usable with all Centronics printers.

When the printer sharer is in the idle state neither computer is on line to the printer. When one of the computers attempts to output a character, the sharer connects it to the printer and locks out the other computer until printing is finished. A ten second timer in the sharer is used to avoid reverting to the idle state while a long operation such as a form-feed is taking place. The timer is restarted every time a character is received from the comptuer controlling the printer.

The handshaking control logic of the sharer may seem over complicated at first glance, but it is essential if the project is to work with all the different computers around. There are many different ways to implement a parallel printer port on a computer. The de facto standard interface is called 'Centronics' after the name of a leading printer manufacturer who defined the electrical and mechanical specifications of a 36-pin connector for its parallel printers. Nearly all printers made these days use the Centronics connector, but they don't necessarily conform to the electrical specification.

The simplest type of interface uses only



the eight data lines, and the STB-BAR and ACK-BAR signals. The computer outputs to the printer by first placing the character to be printed on the data lines and then generating a negative pulse on the STB-BAR line. The printer inputs the character on the STB-BAR pulse and when it is ready to accept another one it generates an ACK-BAR signal. This is the technique used in the ETI-671 and '675 printer interfaces.

It is also possible to use the BUSY signal to control the data transfer, but BUSY seems to be used in two different ways. A few printers use BUSY on a character by character basis, the signal goes high briefly after every STB-BAR pulse. An interface expecting BUSY to work like this may wait for the positive pulse before outputting another character.

Most printers leave BUSY low until the print buffer is full or printing is taking place, so whenever BUSY is low the printer can accept data. The computer interface should look at BUSY before outputting a character to make sure it will not be lost.

If all computers had printer ports that looked at BUSY before outputting a character then this project would have been a lot simpler. The problems arise when the simplest technique using only ACK-BAR is used. Consider what happens if the printer sharer has connected computer 'A' to the printer and computer 'B' attempts to print. If computer 'B' does not check BUSY first it will simply output the first character on the parallel data lines with a short pulse on the STB-BAR and wait for the ACK-BAR signal to come before continuing. The printer sharer has to store the first character from 'B' and remember to switch over to 'B' when 'A' has finished printing. It also has to send an ACK-BAR to 'B' on changeover so that 'B' doesn't 'hang'. All this has been achieved in the ETI-667.

CENTRONICS SIGNAL TABLE

Signal Pin No.	Return Pin No.	Signal Name	Dir.	Description
1	19	STB-BAR	IN	Active LOW pulse indicating valid data on data pins.
2	20	DATA 0	IN	
3	21	DATA 1	IN	
4	22	DATA 2	IN	
5	23	DATA 3	IN	
6	24	DATA 4	IN	
7	25	DATA 5	IN	
8	26	DATA 6	IN	
9	27	DATA 7	IN	
10	28	ACK-BAR	OUT	Active LOW pulse indicating printer has accepted last data and is ready for more.
11	29	BUSY	OUT	Printer cannot accept data while signal is HIGH.
12	30	PE	OUT	A HIGH indicates printer is out of paper.
13	—	SLCT	OUT	A HIGH indicates printer is selected (on line).

NOTE: The PE signal is not connected in the ETI-667. The remaining 10 Centronics signals are not implemented in the ETI-667.

Construction

Most of the components mount on the pc board, which is double-sided but not plated-through. There are therefore a number of feed-through links to install, and these are best done first. The position of each feed-through is marked by a dot on the overlay diagram. A few of these are actually component leads, and should be done first so you ▶

HOW IT WORKS — ETI-667

General

Within the field of digital logic there are two main classes of circuits: combinational and sequential.

A **combinational** circuit has a set of inputs and outputs connected by logic elements so that there is a one-to-one correspondence between the applied inputs and the resulting outputs. Such a circuit can be completely specified by a set of Boolean equations, one for each output, and its operation is often shown in the form of a truth table.

The state of the outputs at any particular time depends only on the state of the inputs at the same instant; previous input combinations have no effect on subsequent outputs. This is another way of saying that combinational circuits have no internal memory — they are time independent.

(Real logic elements always have finite delays from input to output and this departure from ideal behaviour leads to the aptly named phenonoma of 'hazards'.)

Sequential circuits are characterized by *internal states* that have to be taken into account in determining the outputs. The internal states represent memory — in setting the internal states the previous inputs have stored information in the circuit. The *sequence* of inputs now affects the outputs, not just the inputs themselves, as in combinational circuits. This memory takes the form of flip-flops at the basic level which may be combined to form more complicated circuits such as shift registers or counters.

State diagrams

Mainly two methods are used to represent the operation of sequential circuits. These are the state table and the state diagram. In a state table each line represents an external state and shows the inputs and outputs of that state, together with the outputs of the next state. A state table is like a truth table that has been expanded to show the sequential information as well. Most readers should be familiar with the state tables of simple circuits such as JK flip-flops. State tables are sometimes called function or mode select tables.

A state table becomes unwieldy when many inputs and outputs are involved or when the internal states need to be shown, such as in designing the hardware implementation of a sequential circuit. In this case a state diagram conveys the circuit operation more clearly.

There are no hard and fast rules about choosing states to be shown on the diagram. The designer allocates them to break the problem into a manageable form from which a circuit may be realized. State diagrams can be internal, external or both internal and external, according to the signals chosen.

The circuit

An internal state diagram for the ETI-667 is shown in Figure 1. I have defined seven states which represent the allowable permutations of six memory elements in the circuit, comprising the 10 second monostables IC1a and IC1b, the 25 microsecond monostables IC3a and IC3b, and the D-type flip-flops IC2a and IC2b. Within each state the operation is purely combinational. Transitions between states occur only on receipt of an STB-BAR pulse from either computer or when one of the monostables times out.

The heart of the circuit is the cross-coupled dual retriggerable monostable multivibrator IC1. Each mono has a 10 second period, and the cross coupling ensures that only one can be triggered at any one time. Whenever IC1a is set, computer 2 is on line and computer 1 is suppressed. The two LEDs indicate whether either of the computers is on line. The handshake signals ACK-BAR, BUSY and STB-BAR are gated with the monos in IC1 to pass from the selected computer to the printer via IC5, IC6 and IC7.

State S0 is entered on power up and has neither computer on line. All monostables and flip-flops are reset by C8 at switch-on.

To move to another state, one of the computers must send a STB-BAR pulse. Note that each transition between states represents either an input variable changing (STB$_1$-BAR or STB$_2$-BAR) or the timing out of one of the monostables. If computer 1 begins printing then the circuit moves to state S1. Similarly if computer 2 starts then S4 is the next state.

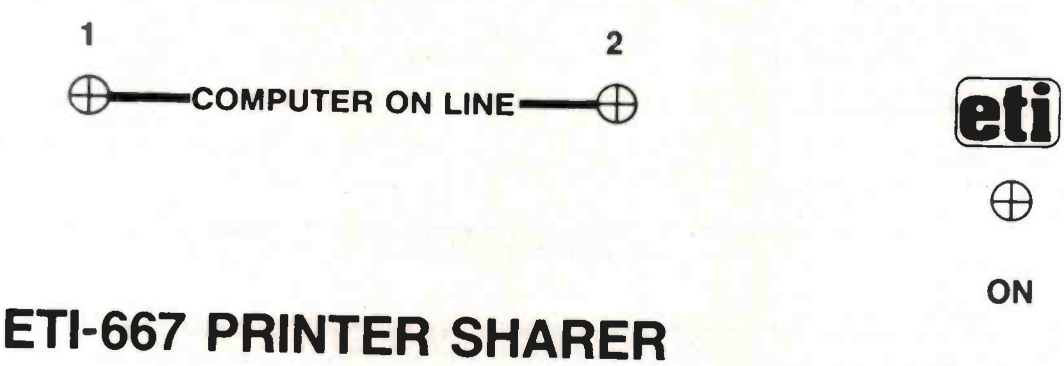
Note that states S1 and S4 can be interchanged merely by swapping the computer designations. Similarly S2 and S3 can be interchanged with S5 and S6. To avoid repetition, only the S0, S1, S2, S3 and S4 states will be discussed.

If an interval of 10 seconds passes without receiving another STB$_1$-BAR pulse while the circuit is in state S1 then IC1b will time out and the next state will be S0. On the other hand, if the computer continues to output to the printer, IC1b will be retriggered at each STB$_1$-BAR pulse and a new 10-second period will begin with each pulse.

If computer 2 attempts to print while the sharer is in S1 then the circuit will move to S2, where flip-flop IC2a is set and will remain there until the 10 second monostable IC1b times out and computer 1 is disconnected. It then moves to S3 where both monostables IC3a and IC1a are triggered, the latter causing computer 2 to be connected to the printer and the former causing an STB-BAR signal to be sent to the printer. When IC3a times out after about 25 μs, the circuit enters the S4 state, which is the same result as if computer 2 had attempted to print from state S0.

The data latches

IC8 and IC9 are tristate 8-bit latches with their data inputs connected separately to the two computers' data lines and their outputs paralleled to drive the printer. The data is latched on the STB-BAR pulse from each com-



puter whether the computer is on line or not. This avoids losing the first byte from the computer if the simple STB-ACK handshaking is used, as explained in the main text.

The tristate output buffers are controlled by the 10 second monostables in IC1, this avoids any output conflicts since the cross-coupling between the two 10 second monos prevents both being set simultaneously.

CENTRONICS compatibility

The Centronics specification for input data timing requires that the parallel data be stable from at least 0.5 μs *before* the STB-BAR pulse begins up to at least 0.5 μs *after* the STB-BAR pulse finishes. The pulse itself should be at least 0.5 μs in duration. The ETI-667 as published does not meet the 'before' specification because the data latches are not enabled until the STB-BAR pulse goes low. The prototype was tested on several printers (all of which had a 0.5 μs *before* spec.) and operation was perfect in all cases. If you have any problems with data input timing and want to conform to the Centronics spec. then I suggest the following modification: insert an RC delay network between the STB-BAR pulse and IC4 on each computer. This will allow the data latch to be enabled before the rest of the sharer receives the STB-BAR pulse. IC4 may need to be changed to a 74LS132 Schmitt NAND to obtain reliable operation. Note that this modification should *not* be necessary with the vast majority of printers.

Power supply

D1 protects against reversed dc inputs, and allows an ac plugpack or a transformer to be used. Capacitors C1 and C2 filter the dc input voltage and IC10 regulates it to the TTL level of 5.0±0.2 V. C3 and C4 to C7 provide distributed bypassing on the printed circuit board.

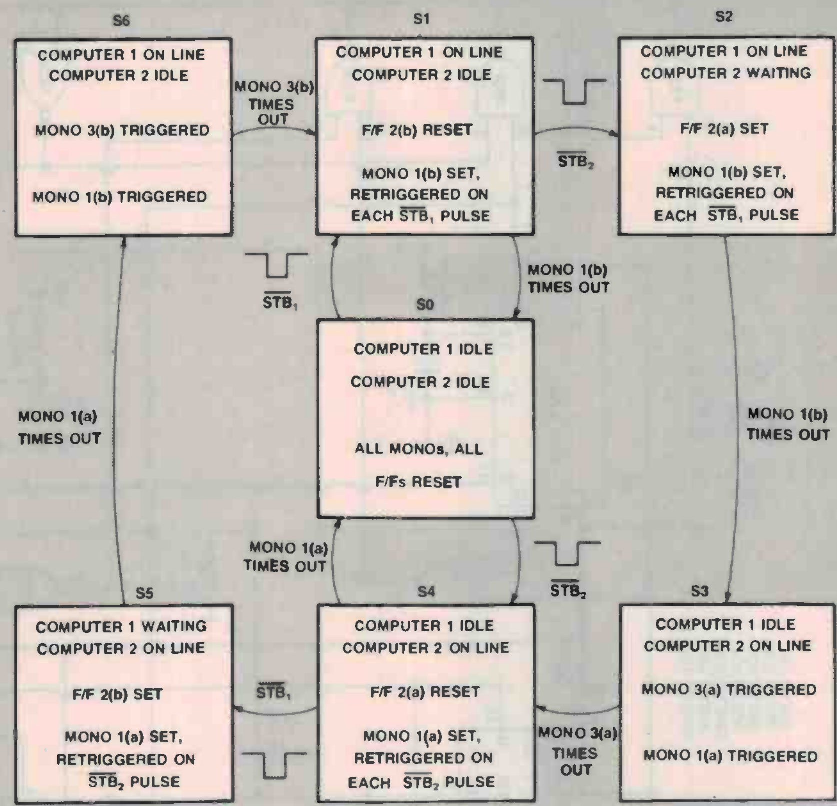


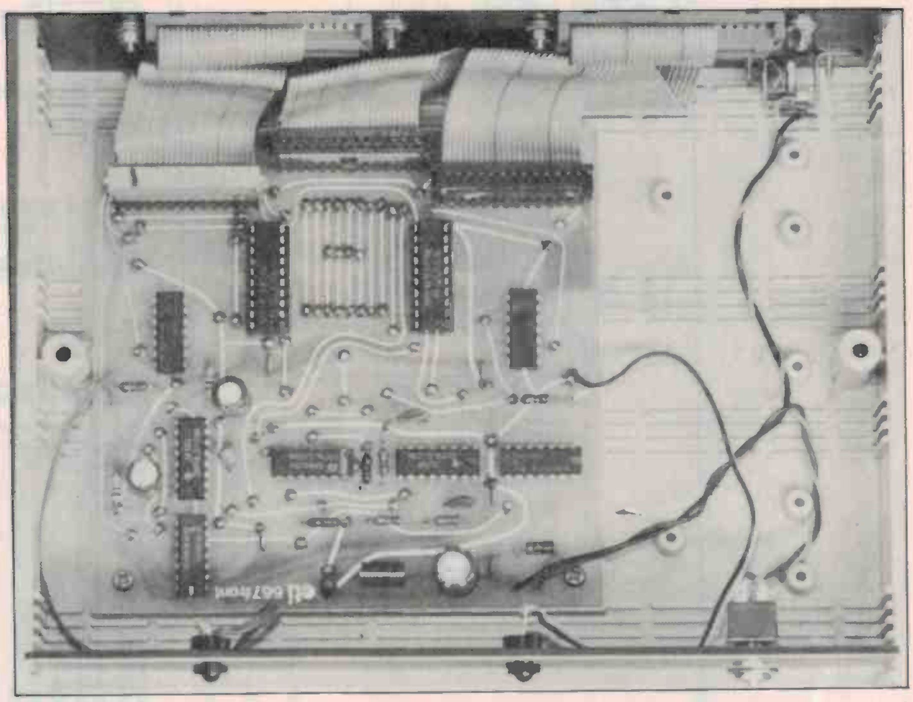
Figure 1. State diagram.

don't solder a wire instead. The components to be soldered on the top side of the pc board are R4, R5, R7, R9, C3 (both leads), C4, C6 and C7.

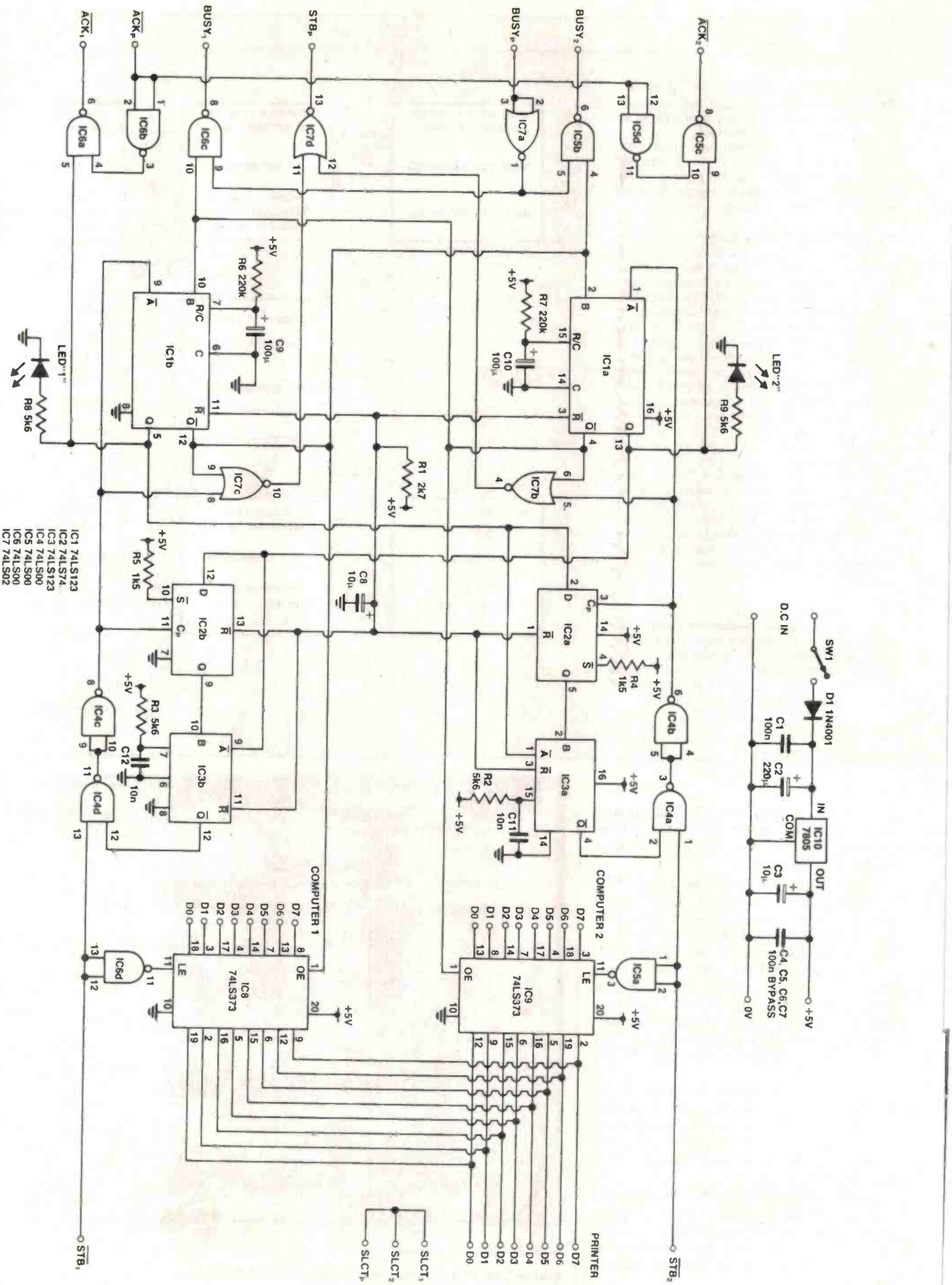
The remaining feed-throughs should be completed with solid tinned copper wire. I found it best to loop the wire through at least two holes then solder the top and bottom before trimming off the excess wire. This method stops the wire from moving around during the soldering. There are around 80 such feed-throughs to install, so get comfortable before tackling the job. Note that there is a feed-through *under* IC7 which must be installed before the ICs are mounted.

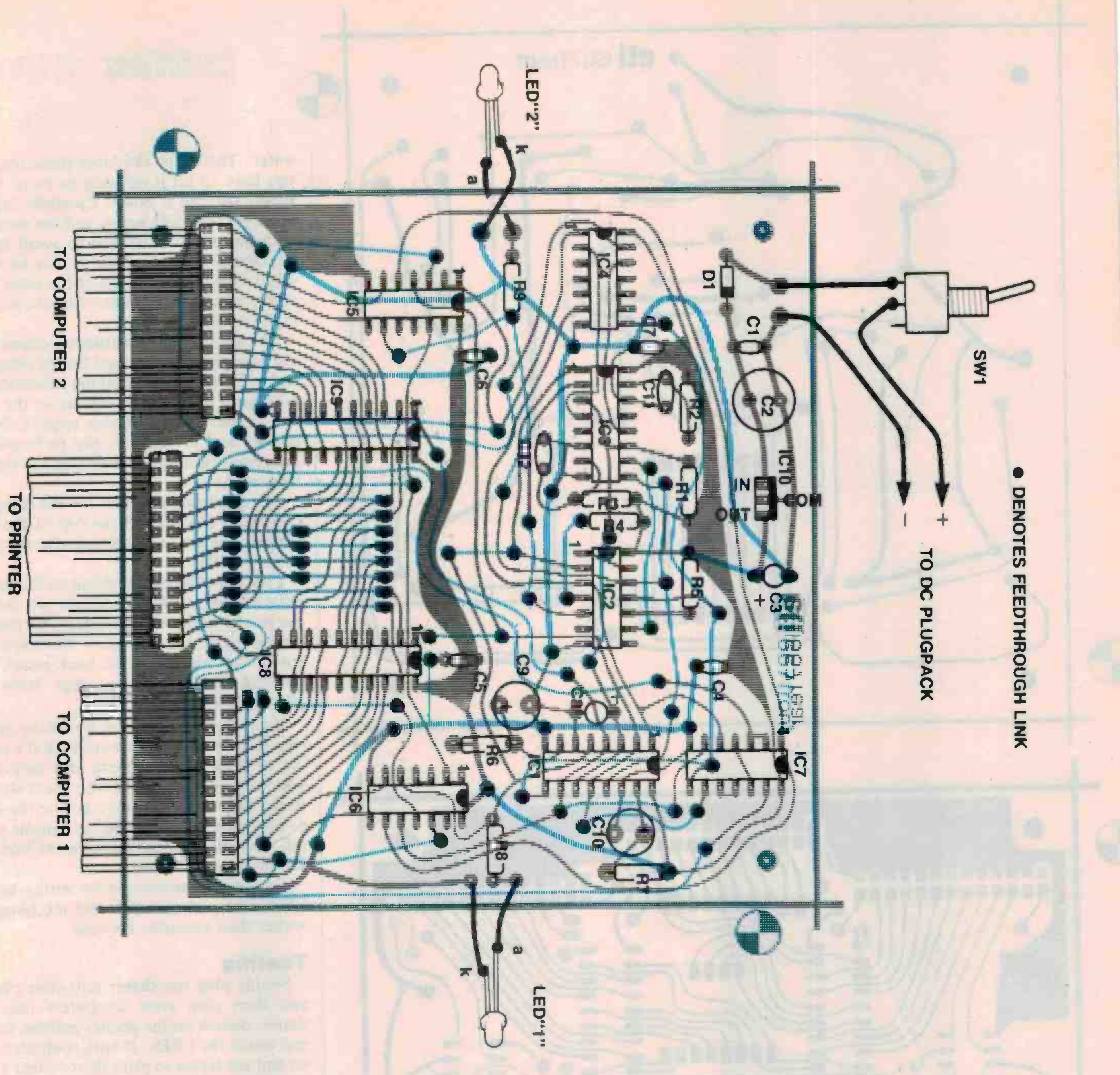
After you have recovered from all the feed-throughs (oh if only plated-through boards were cheaper!) the remaining resistors and capacitors can be put in. Watch the polarity of the electrolytic capacitors C2, C3, C8, C9 and C10.

Install D1 and IC10 (the 5 V regulator) and wire up the power supply from the plugpack. Switch on and check that the voltage across C3 is 5.0±0.2 V. If not, find the trouble before proceeding or you may damage the ICs.



Internal plan view showing connectors and pc board mounting.


IC1 74LS123
IC2 74LS74
IC3 74LS123
IC4 74LS00
IC5 74LS00
IC6 74LS00
IC7 74LS02
D.C IN
SW1
D1 1N4001
C1 100n
C2 220µ
IC10 7805
IN
COM
OUT
C3 10µ
C4, C5, C6, C7 100n BYPASS
+5V
0V
COMPUTER 1
COMPUTER 2
PRINTER
IC8 74LS373
IC9 74LS373
LED "1"
LED "2"
R1 2k7
R2 5k6
R3 5k6
R4 1k5
R5 1k5
R6 220k
R7 220k
R8 5k6
R9 5k6
C8 10µ
C9 100µ
C10 100µ
C11 10n
C12 10n
SLCT₁
SLCT₂
SLCTₚ



PARTS LIST — ETI-667

Resistors
R1 .... 2k7
R2, 3, 8, 9 .... 5k6
R4, 5 .... 1k5
R6, 7 .... 220k

Capacitors
C1, 4, 5, 6, 7 .... 100nF ceramic bypass
C2 .... 220μF 16VW electro
C3, 8 .... 10μF tag tantalum
C9, 10 .... 100μF 16VW electro
C11, 12 .... 10n ceramic

Semiconductors
IC1, 3 .... 74LS123
IC2 .... 74LS74
IC4, 5, 6 .... 74LS00
IC7 .... 74LS02
IC8, 9 .... 74LS373
IC10 7805
LED1, 2 .... 5 mm high efficiency LEDs
D1 .... 1N4001 or equiv.

Miscellaneous
SW1 .... spst miniature toggle switch

ETI-667 pc board and front panel; plastic case 200 x 160 x 70 mm; 9 V dc plugpack with socket to suit; 2 x 5 mm LED bezels; 1 m tinned copper wire (for links); 4 self tapping screws to mount pc board; nuts, bolts and washers to mount sockets.

Connectors
Either insulation displacement types: 3 x 26-way pin headers & ID sockets; 1 Centronics ID plug; 2 Centronics ID sockets; 1 m of 26-way ribbon cable; or solder types: 1 Centronics solder plug: 2 Centronics solder sockets; hookup wire or ribbon.

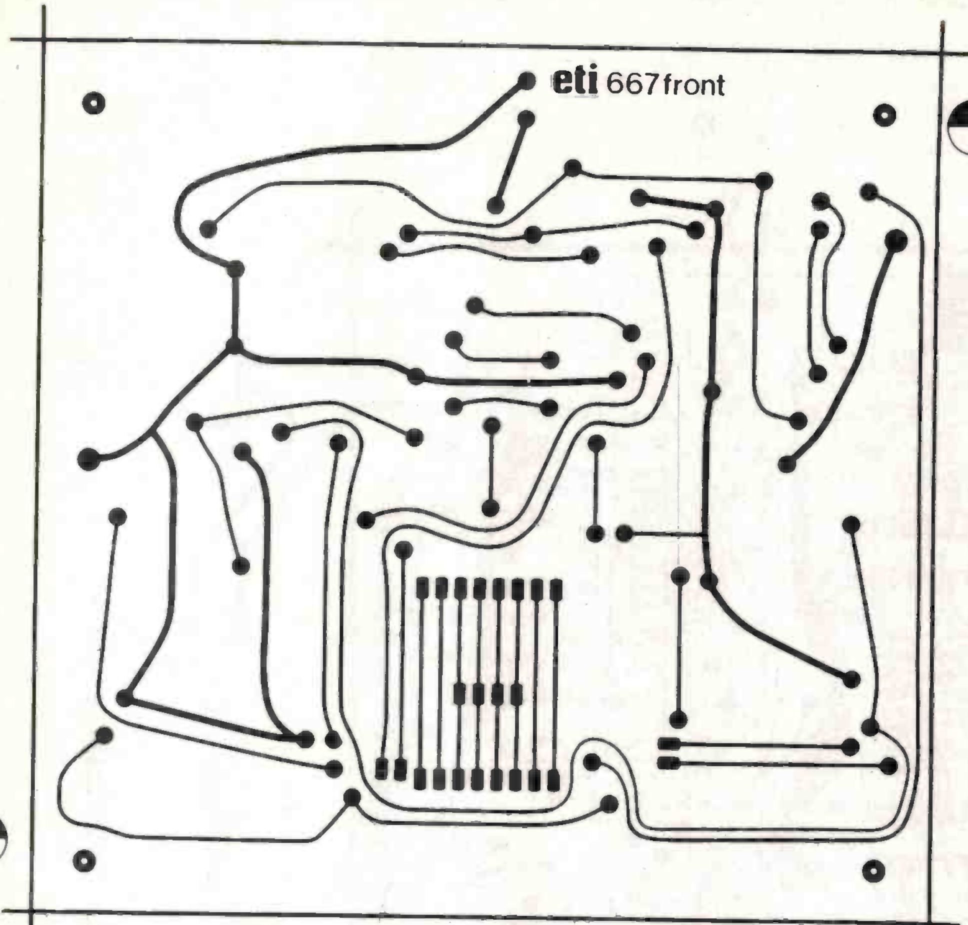
Estimated price: $50
(not including ID parts)
$98 including ID connector system

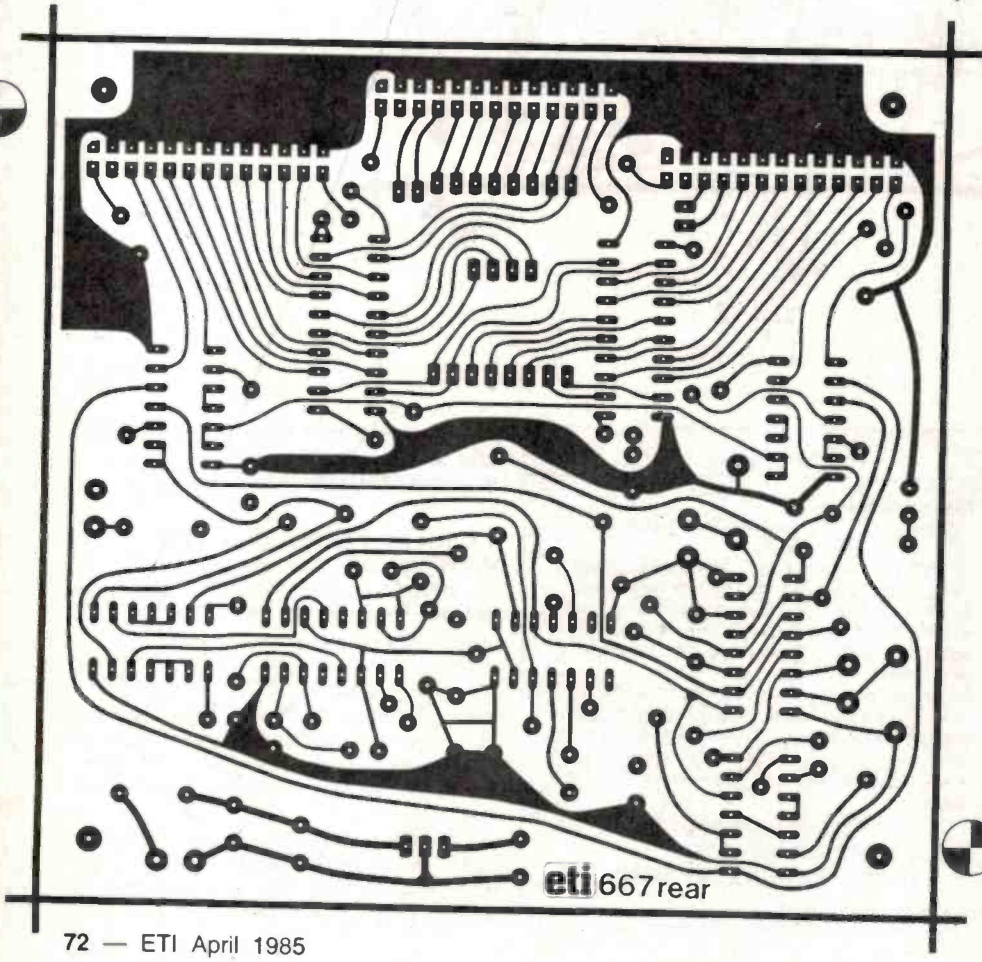
For a guide to components and kits for projects, see SHOPAROUND this issue.

If you are experienced at soldering, and Murphy doesn't scare you then solder the ICs straight in. Everyone else should use sockets. Solder in the two wires for each LED, each around 15 cm.

The pc board is designed to fit a plastic instrument style box which measures 200 x 160 x 70 mm, with moulded mounting pillars inside on the bottom panel. The pc board mounts neatly with small self tappers. The prototype case came from Altronics in Perth.

The front panel carries the label, the two LEDs and the power switch. To mount the label first remove the adhesive backing from it and moisten the sticky side with ▶





water. This stops the label from tearing if you have to lift it off once or twice before finally sticking it down. Carefully drill the holes for the LED bezels and the switch. A very sharp drill is needed to avoid ripping the label around the hole. It may be necessary to file the back edge of the front panel all the way round so that it fits into the slots in the moulded case.

The rest of the construction depends on the type of connector used for the computer and printer wiring. I used the insulation displacement type connectors as in the ETI-666 Printer Switch. These require 26-way pin headers to solder in the pc board and matching transition connectors for the ribbon cable.

The Centronics sockets for the computer cables are mounted at the top of the back panel of the box. Each is bolted to the panel with two 6BA screws.

I left about 40 cm of ribbon on the printer plug ribbon so that the sharer sits next to the printer and plugs straight in. To pass the ribbon cable out, a shallow slot should be cut in the bottom of the back panel. The construction should be clear from the photographs.

If you don't want to pay for all the expensive ID connector hardware then it's possible to dispense with them and simply cut your existing cables and wire them straight to the pc board. This may not be the most elegant approach, but you can console yourself with ample liquid refreshment from the $30 odd you will save.

Complete construction by wiring up the LEDs, the power switch and the plugpack socket then assemble the case.

Testing

Simply plug the sharer into your printer and then plug your computers into the sharer. Switch on the printer and the sharer and watch the LEDs. If both computers are on and not trying to print then neither LED should come on at this stage. Then try printing first from one computer, then the other. While printing, one of the LEDs should light. Then try printing from one while the other is printing and vice versa. You should get error free printouts in each case.

I have only noticed one minor thing to watch for in operation — if the printer is deselected in the middle of a printout and not reselected within 10 seconds then the sharer will revert to the idle state, causing the computer to 'hang' if it does not look at the SLCT. (We had a 50% success [failure?] with the office computers. The MicroBee + ETI-672 interface 'hung' while the Apple IIe with Automatic Ice Co. interface said 'PRINTER' and waited for the SLCT to go high.) If this is troublesome a possible way out is to increase the C9/C10 electros to give more than ten seconds to get the printer back on line.

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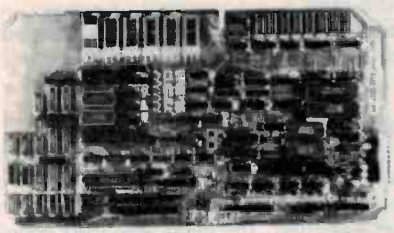

BIG BOARD II

OVER 1,000 SOLD!

Jim Ferguson, designer of the "Big Board" distributed by Digital Research Computers, produced this stunning computer "Big Board II".

FEATURES ...
- ★ **4 MHz Z80 CPU AND PERIPHERALS CHIPS:** The Ferguson computer runs at 4MHz, its monitor code is lean, uses Mode 2 interrupts, and makes good use of the Z80-A DMA chip.
- ★ **64K RAM + 4K STATIC CRT RAM 24K (E)PROM OR STATIC RAM:** "Big Board II" has the three memory banks: the first memory bank has eight 4164 RAM's that provide 60K of user space and 4K of monitor space. The second memory bank has two 2K and 8 SRAMs for the memory-mapped CRT display and space for six 2732s or 2K x 8 static RAMS, or pin compatible (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 "Big Board II" computer has a multiple density disk controller, it can use 1793 or 8877 controller chips. The board has two connectors for disk signal with 34 pins for 5¼" drives the other with 50 pins for 8" drives.
- ★ **VASTLY IMPROVED CRT DISPLAY:** The "Big Board II" computer uses a 6845S CRT controller and 8002 Video Attributes 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 a 7 x 9 dot matrix on 15.75 KHz monitors. The display is user programmable with the default display 24 lines of 80 characters.
- ★ **STD BUS CONNECTOR:** "Big Board II" brings its bus signals to a convenient place on the PC board where users can solder a STD socket, 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 Z80A CTCs = EIGHT PROGRAMMABLE COUNTERS/TIMERS:** The "Big Board II" has two Z80-A CTCs. One is used to clock data into and out of the 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 "Big Board" computer has circuitry and drivers for programming 2716s, 2732(A)s, or pin-compatible (E)PROMS. (Software $25 extra).
- ★ **CP/M CAPABILITY:** CP/M with Russell Smith's CBIOS for the "BIG BOARD II" is available .... (plus tax) $230

The CBIOS 5" or 8" is avail. separately .... (plus tax) $65

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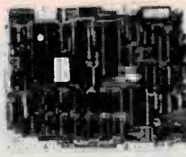

THE LITTLE BIG BOARD

FEATURES:
- ★ Z80A CPU (4 MHZ)
- ★ 65,536 bytes of RAM.
- ★ Two RS232C I/O ports.
- ★ Battery back up realtime clock and calendar.
- ★ Up to four, 8 inch or 5.25 inch double sided, double density or single density floppy disk drives.
- ★ Full STD. Bus
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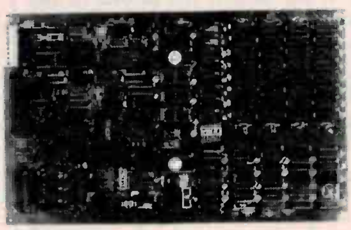

THE ORIGINAL

BIG BOARD 1 COMPUTER KIT!

FEATURING:
- ★ **64K RAM:** Uses industry standard 4116 RAM's. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.
- ★ **Z-80 CPU:** Running at 2.5 MHz. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffeted and runs 8080 software.
- ★ **BASIC I/O:** Consists of separate parallel port (Z80 P10) for use with an ASCII encoded Keyboard for input. Output would be on the 80 x 24 Video Display.
- ★ **24 x 80 CHARACTER VIDEO:** With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix, upper and lower case.
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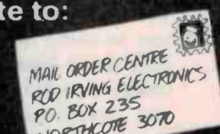

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OP-AMP TESTER

The ETI-183 is a simple op-amp tester which could save your future projects hours in agonizing over using that old op-amp that's been lying in the drawer for the last year.

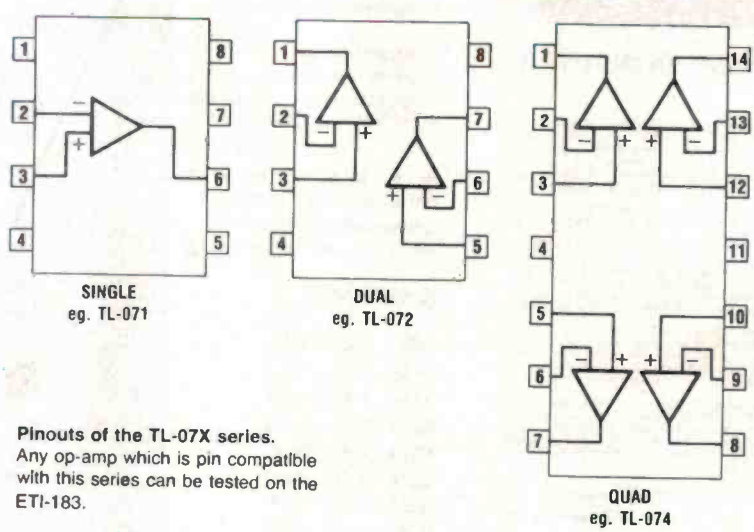
Robert Irwin

TEN YEARS AGO it was a must for anyone working in electronics to be equipped with some kind of device, (simple or hideously complex), that could test a transistor and determine its questionable state of health. The transistor tester is still a favourite workhorse but with the increase in the use of the op-amp as a basic building block it became essential for the analogue artisan to have a quick and easy means of checking ICs. This project is designed to be a simple stand-alone unit which will tell you, in terms of a few LEDs, whether your op-amp belongs in your next project or on the scrapheap with the vegetable peelings.

Design Details

The tester was designed to accommodate single, dual and quad packages with equivalent pinouts to those of the TL08x series. This includes most of the popular general purpose op-amps such as the μA741, LM301 and LF347. Three tests are provided on the tester. Firstly, an excessive power supply current indication tells you that there is a short circuit on the op-amp power supply pins. The other two tests find out whether the op-amp is, in fact, amplifying properly. For both of these tests the op-amp is configured as a non-inverting, dc amplifier with a gain of 20. A dc test can be performed which grounds the input of the op-amp and indicates any excessive dc offset on the output. If the output sits at one of the rails in this situation then it is probably deceased. To make sure the op-amp is in fact amplifying, a square wave is connected to the input. The output is monitored by a window comparator which turns on two LEDs to indicate that the signal is being amplified up to the correct level on both the positive and negative sides.

When dual or quad packages are being tested, each op-amp in the package is tested individually. The appropriate op-amp is selected by a four position rotary switch and the ac and dc tests are then applied to this op-amp only. For op-amps that require compensation, such as the LM301, a 10 pF capacitor can be switched in across pins 1 and 8. This is only necessary for single op-amp packages as all the dual and quad packages that can be used with this tester are internally compensated.



Pinouts of the TL-07X series.
Any op-amp which is pin compatible with this series can be tested on the ETI-183.

Construction

Construction should begin by carefully checking the pc board for broken or shorted tracks. If the pc board checks out OK then start soldering. The eight wire links should be located and soldered in first. These are made up of pieces of tinned copper wire cut to the appropriate length. Resistors and trimpot can go in next. Note that the resistors in the feedback circuit of the test op-amps are of 1% tolerance. Solder in the capacitors making sure that you get the polarity correct on the two electrolytics. The bipolar electrolytic has no polarity and can be put in either way round. The next step is to solder in the ICs, zeners and transistor. It is vitally important to get these components the right way round. If you wish you can use sockets with the ICs.

Now comes the hard bit! The prototype was mounted on the front panel of a jiffy box so the trick comes in getting all the LEDs, test sockets and switches the correct height. The four position rotary switch can be mounted and soldered in flush with the board. If you do not have a pc board mount type switch you will have to trim the pins on the back with a pair of side cutters so that they will fit through the holes.

Next mount the three wirewrap IC sockets that are to be used for the test ICs. The pins on these should all be the same length so mount the sockets to stand up off the pc board about 14 mm making sure that they are all the same height and level. They can be 'tacked' in by soldering just two pins on each socket rather than soldering all pins at this stage. This will make any height adjustments a lot easier.

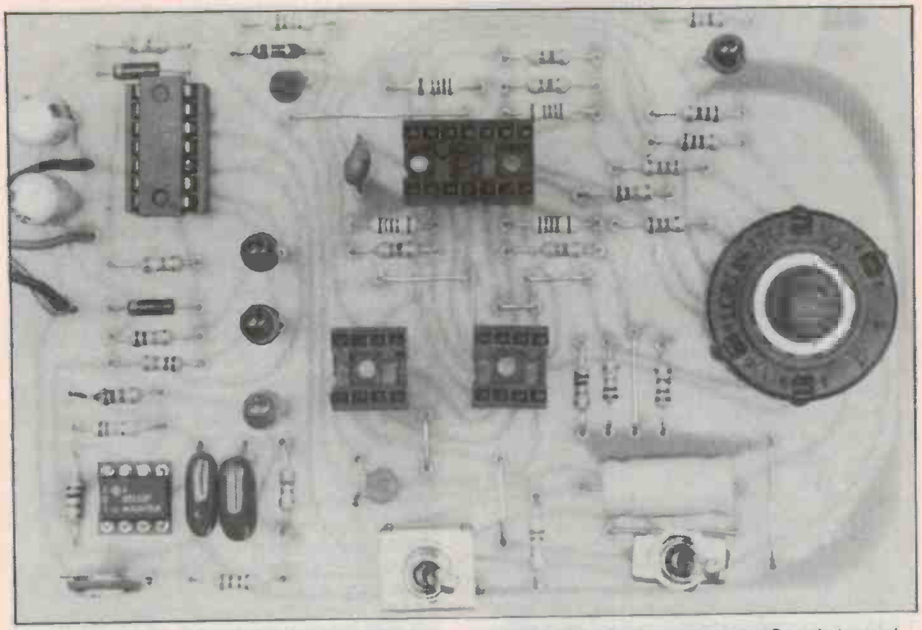
The INPUT and COMPENSATION toggle switches can be mounted in one of two ways. Small lengths of hookup wire (about 20 mm) can be attached to the lugs of the switches and then soldered into place on the pc board or the lengths of tinned copper wire (such as the type used for wire links) can be soldered on to the switch lugs to form 'legs' for the switch to stand on. If you use the latter method then do not, at this stage, solder the switches to the pc board but merely poke the wire legs through the holes on the board and leave them. The height can be adjusted when you mount the board and the switches soldered in then. The four LEDs should also be just pushed into the holes on the pc board and left, then soldered in later.

Finally, the battery terminals and power switch should be wired up with hookup wire according to the wiring diagram and overlay. Take careful note of the polarities of the terminals and leads. There has been provision made on the pc board for a BNC socket to allow a CRO to monitor the output from the DUT (Device Under Test). If you want this the socket should be wired in with hookup wire at this stage. This completes the pc board for now and you can turn your attention to the box.

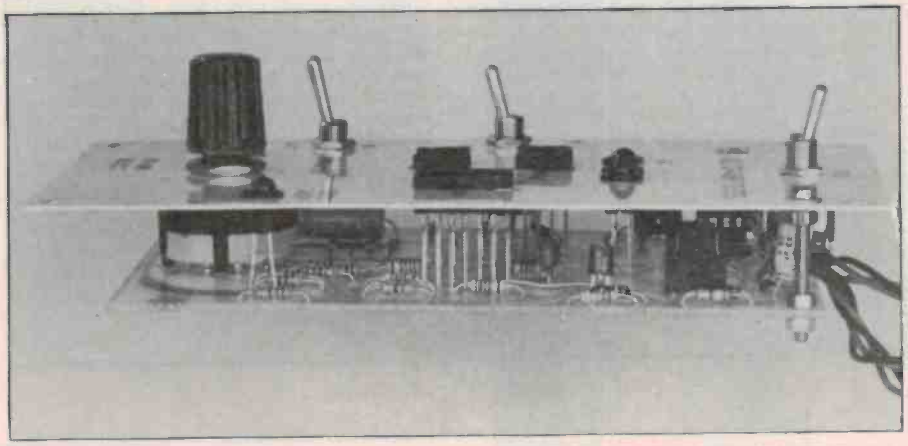
The prototype was housed in a 150 x 90 x 50 mm jiffy box. The pc board mounts on the aluminium lid. The front panel can be marked using the front panel artwork as a template. Mark the positions of all the holes to be drilled and the corner points of the three holes for the IC sockets. The holes for the LEDs and toggles can be drilled using a 6.5 mm drill and the hole for the rotary switch can be drilled using a 9.5 mm one.

Unless you have a suitable square punch set, the easiest way of cutting out the holes for the IC sockets is to drill a hole in the centre of each socket position and file it out to size with a small square file. Be careful not to file too big a hole. If you are including a BNC socket for a CRO output then a suitable hole should be drilled in the side of the box.

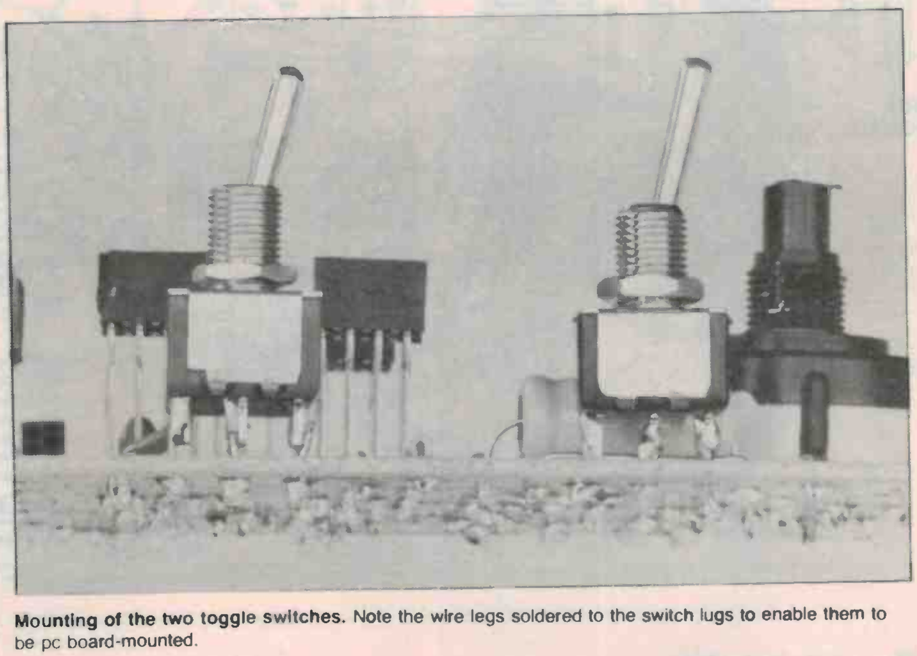
Once you have cut all the holes, do a trial fit to make sure everything lines up OK. Once everything fits, the Scotchcal front panel can be stuck on. If you have a blue on white plastic Scotchcal label it would be advisable to spray the aluminium front panel with white paint before applying the Scotchcal. When it is dry the Scotchcal can be carefully applied. Line it up accurately the first time because once it has stuck you'll have a hard time getting it off again. Trim out the holes in the Scotchcal with a sharp knife or scalpel but be careful not to tear it.



Top view of the pc board showing the position of components. Note the three wirewrap IC sockets used for the test op-amps.



How it all fits together. The board is mounted on the front panel by way of the rotary switch and two mounting bolts. The height of the LEDs should be adjusted after mounting of the board.



Mounting of the two toggle switches. Note the wire legs soldered to the switch lugs to enable them to be pc board-mounted.

HOW IT WORKS — ETI-183

The circuitry for the tester is fairly simple. IC1 is an LM555 timer which, in this case, is configured as a free running astable multivibrator. The frequency of the multivibrator is given by the formula:

$$f = 1.49/(R1+R2)C3.$$

With the values given this gives a frequency of approximately 1 kHz. The output of the LM555 forms the ac signal that is used to drive the DUT (Device Under Test). A green LED, LED1, is used to indicate an output from the LM555 with R7 limiting the current to about 4 mA. The output from the LM555 is divided down by the resistive divider network formed by R6, R8 and RV1. RV1 controls the level of signal being fed to the DUT. The input can be switched from ac to ground by SW2 and the appropriate op-amp input is selected by the B pole of SW3.

The device test sockets are wired up so that the single package, op-amp 1 of the dual package, and op-amp 1 of the quad package are all wired up in parallel. Op-amp 2 of the dual and op-amp 2 of the quad package are wired in parallel. All test op-amps are configured as non-inverting stages. The feedback network is the same for all op-amps and comprises a 100k feedback resistor with a 4k7 resistor to ground. Op-amp 1 has the addition of a 100p capacitor (C6) across the feedback resistor. This is for extra stability at high frequencies for some single op-amps such as the NE5534 which are prone to oscillations. Capacitor C7 can be switched in between pins 1 and 8 of the op-amp 1 test position to take into account op-amps such as the LM301 which need compensation between these pins for stable operation.

A 100R resistor is included on the output of each op-amp to provide some load isolation and enhance stability, and a 47k resistor is connected from each input to ground to provide a dc path to ground when the op-amp is not selected.

The appropriate output is selected by the C pole of SW3. The output from the op-amp is selected by the other pole of SW2 to be either dc coupled or ac coupled via C5 and R9.

The output is fed to the input of a window comparator formed by IC2a and IC2b. The positive input of IC2a is biased to 3.3 V by ZD1 and the negative input of IC2b is biased to −3.3 V by ZD2. The two spare inputs are connected to the output of the op-amp. When the voltage from the op-amp is between +3.3 and −3.3 V both comparator outputs are high therefore LED2 and LED3 are off. If the op-amp output goes above +3.3 V the output of IC2a swings low and turns on LED2. If the output goes below −3.3 V then the output of IC2b goes low turning on LED3. Therefore, if the output is a symmetrical square-wave, as it should be, each LED will be turned on and off in turn as the output swings positive and negative with the overall effect of both LEDs appearing lit.

If the op-amp is only amplifying one side then only one LED will light. In the dc mode, if the output is sitting at one of the rails then the appropriate LED will light. The outputs of the comparators are open collector and can sink a few milliamps. The current is limited by R12 and R13 to about 1.5 mA.

The power is supplied by two 9 V batteries connected to give a split 9-0-9 V supply. This is filtered by C1 and C2. The positive rail to the op-amp test sockets is monitored by an overcurrent indicator formed by Q1, LED4 and associated resistors. R3 is in series with the supply. Q1 is connected across this resistor in such a way that, as the current being drawn from the supply increases, the voltage across R3 increases. When this voltage reaches 0.6 V the transistor, Q1, starts to turn on which turns on LED4 indicating that excessive current is being drawn from the supply. This occurs at about 10 mA. To increase the current that can be drawn before the LED turns on simply decrease R3.

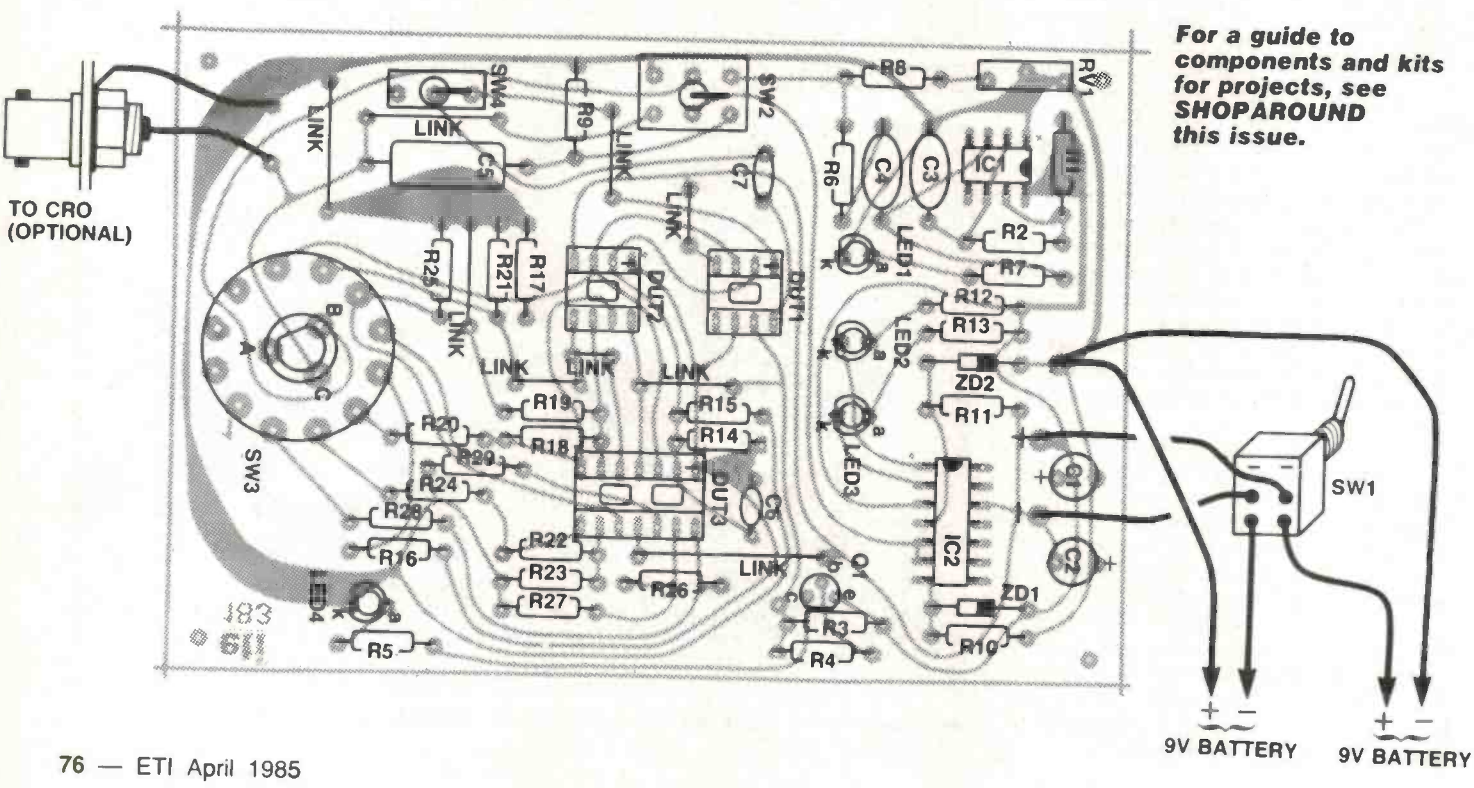
PARTS LIST — ETI-183

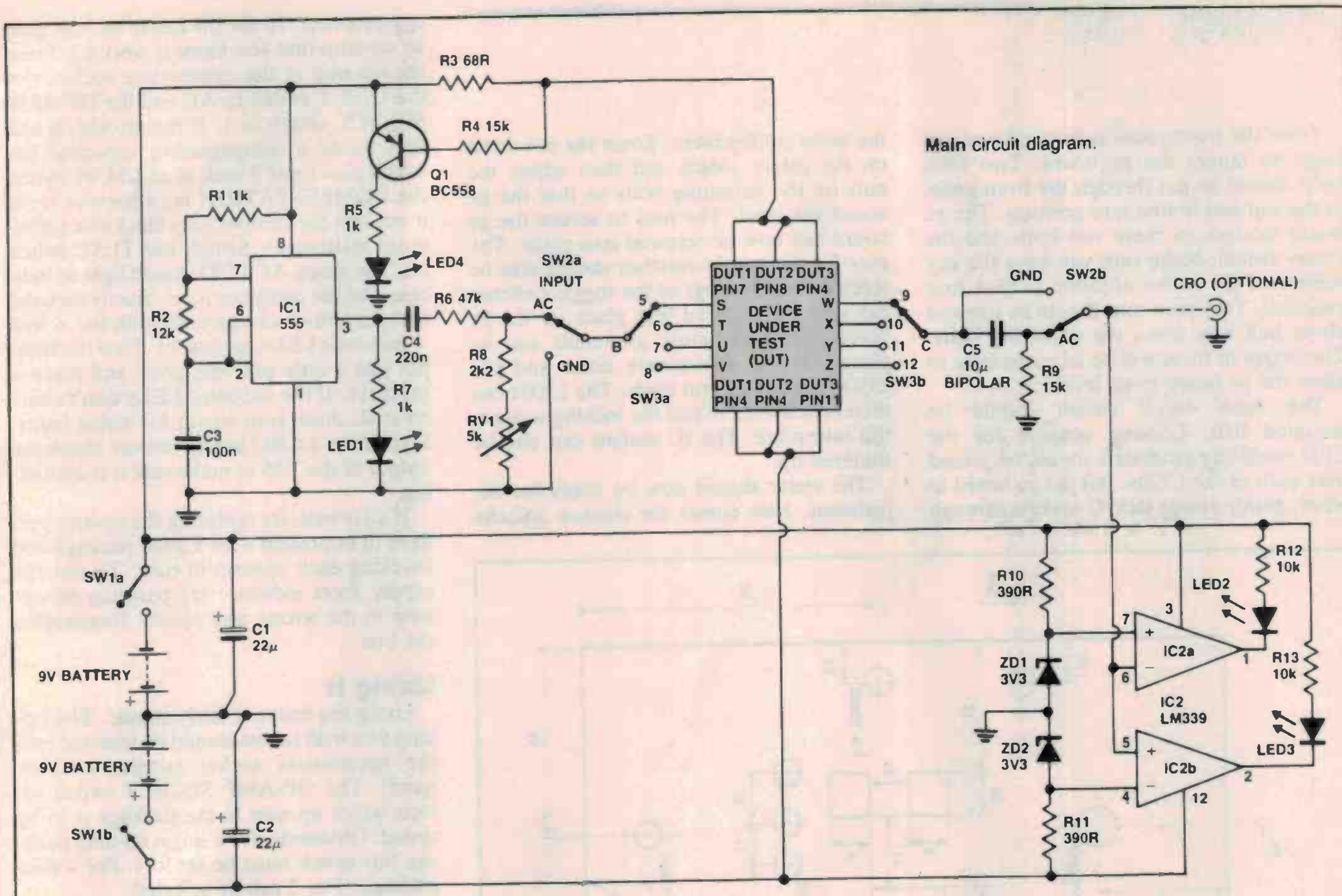
Resistors	all ¼ W 5% unless noted
R1, 5, 7	12k
R2	33k
R3	68R
R4,9	15k
R6	47k
R8	2k2
R10, 11	390R
R12, 13	10k
R14, 18, 22, 26	100k 1%
R15, 19, 23, 27	4k7 1%
R16, 20, 24, 28	100R
R17, 21, 25, 29	47k
RV1	5k trim.
Capacitors	
C1, 2	22µ 25 V RB electro.
C3	100n greencap
C4	220n greencap
C5	10µ 25 V bipolar electro. axial mount
C6	100p ceramic
C7	10p ceramic
Semiconductors	
IC1	LM555
IC2	LM339
ZD1, 2	3V3 400 mW zener
LED1	green 5 mm LED
LED2, 3, 4	red 5 mm LED
Q1	BC558 or similar
Miscellaneous	
SW1	DPST momentary action toggle
SW2	DPDT toggle
SW3	3 pole, four position rotary switch
SW4	SPDT toggle

ETI-183 pc board; 2 x 216 battery terminals; 2 x 8 pin wirewrap IC sockets; 14 pin wirewrap IC socket; 150 x 90 x 50 mm jiffy box; 2 x 6BA 25 mm bolts; 6 x 6BA nuts; 30 cm length tinned copper wire; 4 x LED mounting grommets and washers; hookup wire.

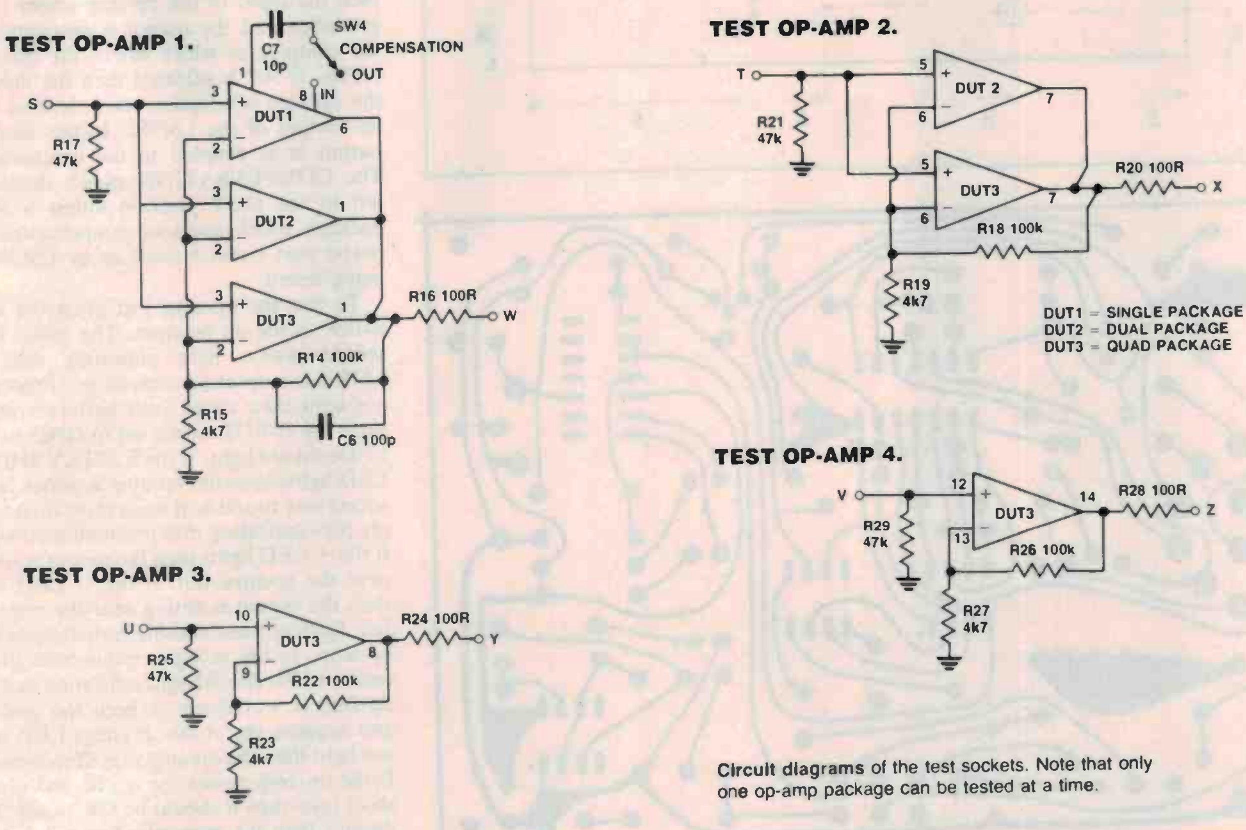
Estimated price: $25

For a guide to components and kits for projects, see SHOPAROUND this issue.





Main circuit diagram.



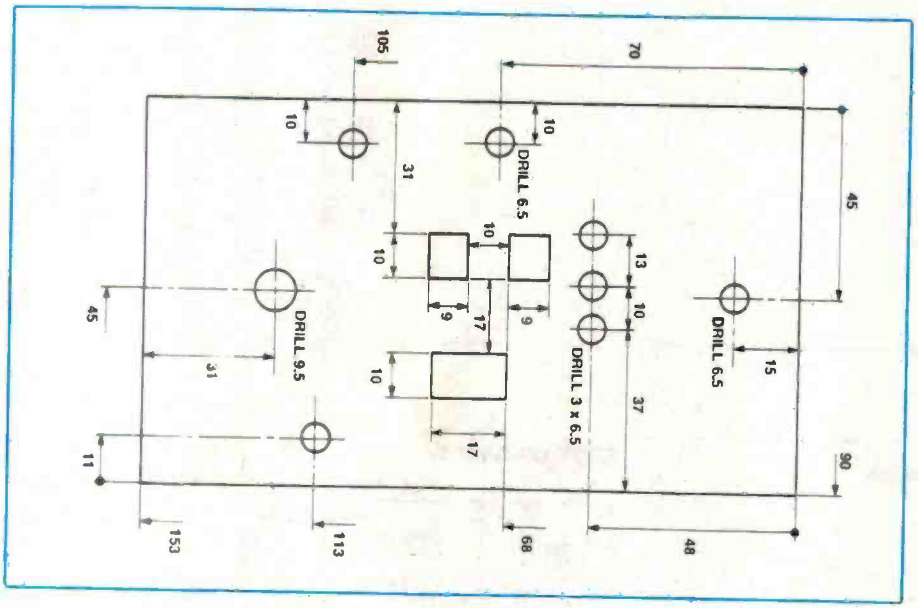
Circuit diagrams of the test sockets. Note that only one op-amp package can be tested at a time.

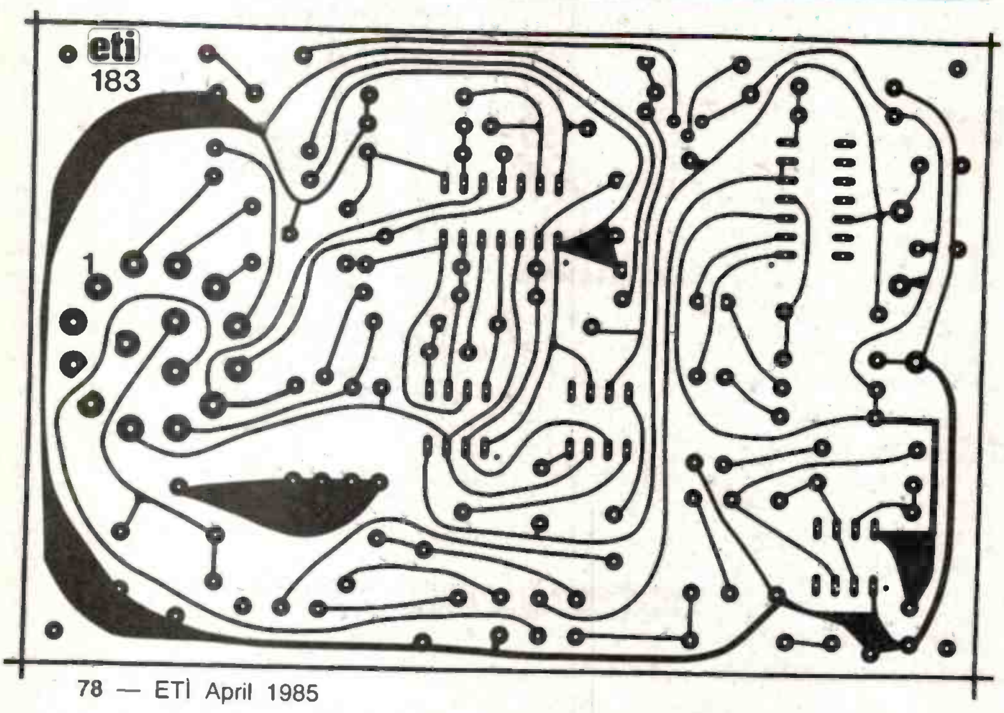
Once the front panel is finished you can begin to mount the pc board. Two 6BA bolts should be put through the front panel at the top and bolted into position. The pc board mounts on these two bolts and the rotary switch. Make sure you have the key washer of the switch adjusted to give four positions. Two more nuts should be screwed about half way down the mounting bolts. The height of these will be adjusted later to allow the pc board to sit level.

The main on/off switch should be mounted first. Locking washers for the LED mounting grommets should be placed over each of the LEDs. Put the pc board in place, gently easing the IC sockets through the holes cut for them. Screw the nut down on the rotary switch and then adjust the nuts on the mounting bolts so that the pc board sits level. The nuts to secure the pc board can now be screwed into place. The nuts for the toggle switches should also be screwed on. The legs of the toggle switches can now be soldered into place on the pc board. LED mounting grommets can be placed in the appropriate holes and the LEDs pushed up into them. The LEDs can then be soldered in and the locking washers slid into place. The IC sockets can also be soldered up.

The tester should now be ready for adjustment. Now comes the chicken and the egg problem. To set the tester up you need an op-amp that you know is working. Place the op-amp in the appropriate socket. Set the INPUT switch to AC and the OP-AMP SELECT switch to 1. If the op-amp is one that needs a compensation capacitor between pins 1 and 8 such as an LM301 switch the COMPENSATION in, otherwise leave it out. Set the trimpot fully clockwise (minimum resistance). Switch the TEST switch on. The green AC LED should light to indicate that the oscillator is on. Slowly turn the trimpot anti-clockwise until both the + and – indicator LEDs are just lit. Turn the trimpot just a little past this point and leave it set there. If the indicator LEDs don't come on at all check your circuit for wiring faults. If you have a CRO handy you can check the output of the '555 to make sure it is oscillating.

If all is well, try replacing the op-amp you have in at present with a quad package and checking each op-amp in turn. To test the supply short indicator try plugging an op-amp in the wrong way round! Reassemble the box.





Using It

Using the tester is fairly simple. The op-amp you wish to test should be inserted into the appropriate socket (single, dual or quad). The OP-AMP SELECT switch selects which op-amp in the package is to be tested. Obviously, for a single op-amp package this switch must be set to 1. For a dual package, 1 or 2 can be selected.

The INPUT switch should be set for the test you wish to perform. If GND is selected then the input to the op-amp under test is grounded and the output is dc coupled to the comparator which drives the indicator LEDs. If AC is selected then the input to the op-amp is a square wave derived from the output of the LM555. In this case the output is ac coupled to the comparators. The COMPENSATION switch should be left in the OUT position unless a single package which requires compensation between pins 1 and 8 (such as an LM301) is being tested.

To test the op-amp just press the main switch to the on position. The green LED should always light indicating that the LM555 is outputting something. If this does not light then check your battery voltage. With the INPUT switch set to GND *no* red LEDs should light. If the SUPPLY SHORT LED lights then the op-amp is either in the wrong way round or it has a short on its supply pins indicating that it is malfunctioning. If the + LED lights then the output is sitting near the positive rail. If the – LED is lit then the output is sitting near the negative rail. Both of these conditions indicate a dud op-amp. In the ac input mode both the + and – LEDs should light indicating that the op-amp is amplifying in both the positive and negative directions. If either LED does not light then the op-amp is malfunctioning. If the op-amp passes the ac, dc and supply short tests then it should be OK to use. If it doesn't then it's probably destined for the dustbin. ●

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DC Current	
Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 100nA, 1uA, 10uA, 100uA, 1mA
Accuracy	• 2mA – 200mA ± (0.3%rdg + 3dgt) 2A-10A ± (0.75%rdg + 3dgt)
AC Current: (True RMS, AC coupled 10% to 100% of range)	
Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 100nA, 1uA, 10uA, 100uA, 1mA
Accuracy	• 2mA @45Hz – 400Hz ± (2.5%rdg + 20dgt) 20mA – 200mA @45Hz 400Hz ± (0.75%rdg + 20dgt) @400Hz – 1KHz ± (0.75%rdg + 30dgt) 2A-10A @45Hz – 500Hz ± (1.2%rdg + 20dgt)
Resistance	
Range	• 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ
Resolution	• 0.01Ω, 0.1Ω, 1Ω, 10Ω, 100Ω, 1KΩ
Accuracy	• 200Ω ± (0.2%rdg + 5dgt + 0.04Ω) 2KΩ – 200KΩ ± (0.1%rdg + 3dgt) 2MΩ ± (0.15%rdg + 3dgt) 20MΩ ± (0.5%rdg + 3dgt)

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Resolution	• 100uV, 1mV, 10mV, 100mV, 1V
Accuracy	• 200mV – 1000V ± (0.8%rdg + 1dgt)
AC Voltage	
Range	• 200mV, 2V, 20V, 200V, 750V
Resolution	• 100uV, 1mV, 10mV, 100mV, 1V
Accuracy	• 200mV – 750V @45Hz – 500Hz ± (1.5%rdg + 4dgt)
DC Current	
Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 1uA, 10uA, 100uA, 1mA, 10mA
Accuracy	• 2mA – 200mA ± (1.25%rdg + 1dgt) 2A-10A ± (2.5%rdg + 3dgt)
AC Current	
Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 1uA, 10uA, 100uA, 1mA, 10mA
Accuracy	• 2mA @45Hz – 400Hz ± (4.0%rdg + 2dgt) 20mA – 200mA @45Hz – 400Hz ± (2.0%rdg + 3dgt) 2A – 10A @45Hz – 400Hz ± (3.0%rdg + 4dgt)
Resistance	
Range	• 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ
Resolution	• 0.1Ω, 1Ω, 10Ω, 100Ω, 1KΩ, 10KΩ
Accuracy	• 200Ω ± (1.0%rdg + 4dgt) 2KΩ – 2MΩ ± (1.0%rdg + 1dgt) 20MΩ ± (3.0%rdg + 5dgt)

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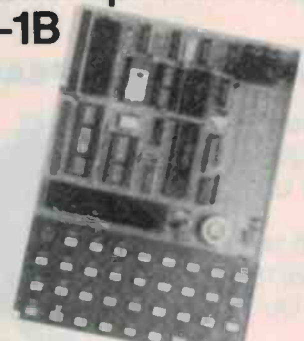

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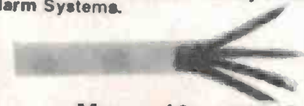

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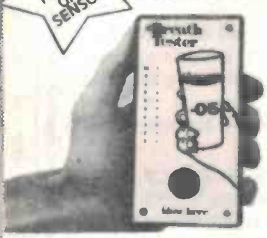

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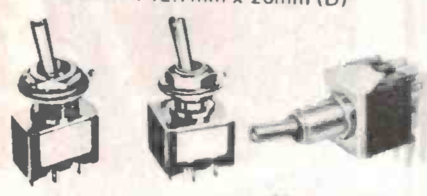

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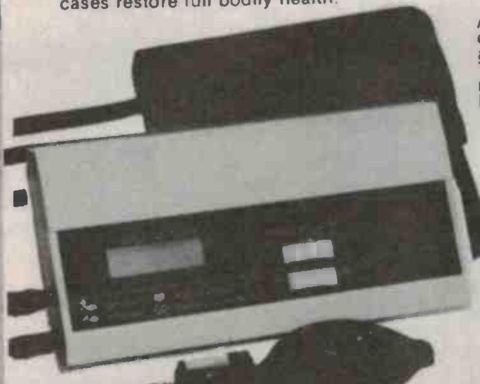

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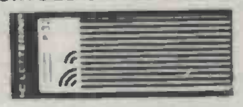

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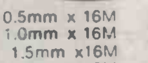
NUMERIC	
2.7mm/H	H 8658
ALPHA	
3.2mm/H	H 8673
3.8mm/H	H 8659

CREPE DESIGN TAPES

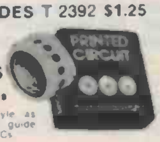


H 8702	0.5mm x 16M	$2.95
H 8703	1.0mm x 16M	$2.95
H 8704	1.5mm x16M	$2.95
H 8705	2.0mm x16M	$2.95
H 8710	Pack of any 4	$10.00

ART TAPE CUTTING KNIFE

SPARE	T 2390	$4.95
PACK OF 6 BLADES	T 2392	$1.25

ROLL PACKS



Ideal for Trade Users

Contents vary each style as dimensions differ. As a guide doughnuts contents 250 PCs

DOUGHNUTS			
2mm	H 8802	$3.50	$3.25
3mm	H 8803	3.50	3.25
4mm	H 8804	3.50	3.25
TEAR DROPS			
3mm	H 8830	$4.95	$4.50
4mm	H 8840	4.95	4.50
T-CONNECTORS			
1.6mm	H 8816	$5.75	$5.50
2.5mm	H 8825	5.75	5.50
IC PADS			
4 x 2.8mm	H 8841	$3.50	$3.25
4 x 2.5mm	H 8842	3.50	3.25

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$3.00 Delivery Australia Wide - We process your order the day received and despatch via. Australia Post. Allow approx. 7 days from day you post order to when you recieve goods. Weight limited 10kgs.

$5.00 Overnight Jetservice - We process your order the day received and despatch via overnight jetservice Courier for delivery next day Country areas please allow additional 24-48 hours. Weight limit 3kgs.

$10.00 Heavy Heavy Service - All orders of 10kgs or more must travel express Road - Please allow 7 days for delivery.

Insurance - As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add 1% to order value (minimum charge $1) When phone ordering please request "Insurance".

Toll Free Phone Order - Bankcard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

ALTRONICS RESELLERS

Wanted in all Areas of Australia—Phone Steve Wroblewski on (09) 381 7233 for Details.

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Jaycar 264 6688
Radio Despatch 211 0191
SUBURBAN
CARLINGFORD
Jaycar 745 3077
DEE WHY
David Ryall Electronics 982 7500
HURSTVILLE
Jaycar 570 7000
LEWISHAM
PrePak Electronics 569 9770
MATTRAVILLE
Creative Electronics 666 4000
COUNTRY
ALBURY
Webb's Electronics 25 4066
BATHURST
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BROKEN HILL
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COFFS HARBOUR
Coffs Habour Electronics 52 5684
GOSFORD
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Kurri Electronics 37 2141
NEWCASTLE
D.G.E.Systems .. 69 1625
George Brown & Company 69 6399
NOWRA
Southern Communications 21 4011
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MW Electronics .. 626 491
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Acorn Electronics 21 2409
PORT MACQUARIE
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Alback Electronics 87 3419
RICHMOND
Vector Electronics 78 4277
TAMWORTH
Landlink Communications 65 4622
TENTERFIELD
Nathan Ross 36 2204
TOUKLEY
TES Electronics . 96 4144
WINDANG
Madjenk Electronics 96 5066
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Vimcom Electronics 28 4400

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Australis 47 5172

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FORTITUDE VALLEY
McGraths Electronics 832 3944
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St.Lucia Electronics 523547
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David Hall Electronics 2088808
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4 Channel 4 track mixer

This circuit was sent to us by **R. Jager** of **North Geelong**.

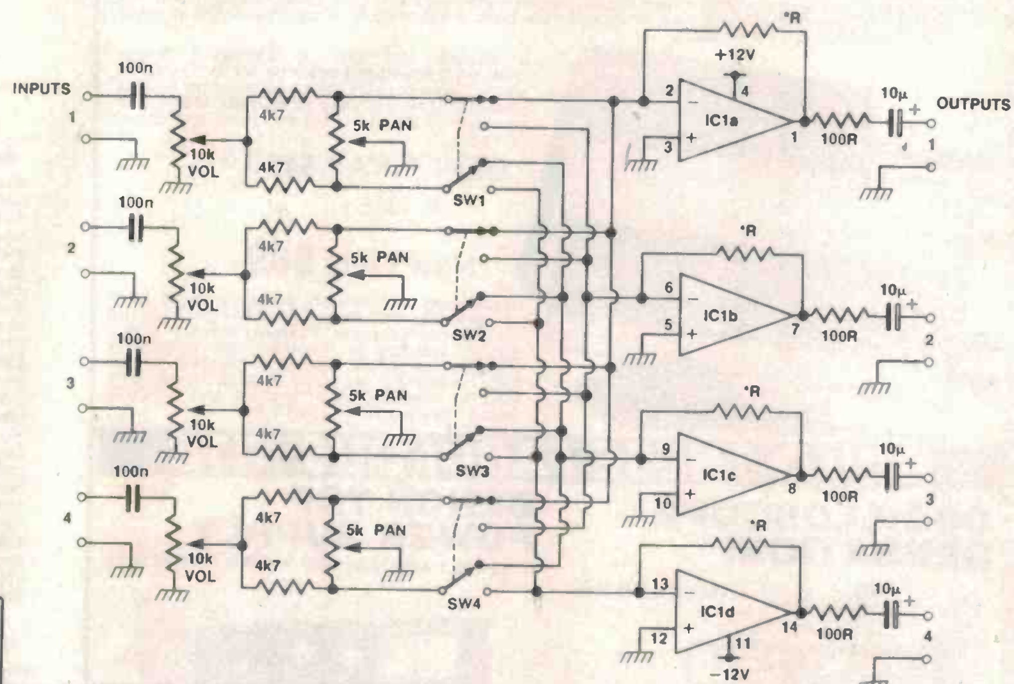
It features a four channel mixer with a 4 track output. This can be used as a stereo mixer as well as a four track. The heart of the circuit is a quad op-amp IC which gives you a little bit of gain for each track.

The pan control lets you pan between tracks one and two with the switch in the up position and with the switch in the down position it lets you pan between tracks three and four.

Extra channels may be added.

A suitable op-amp for IC1 is TL074 or similar.

We have received headlight delay circuits to fill pages of 'ideas for experimenters'. So in the interests of variety please no more, they run little chance of being printed.



*Note: Choose R to give appropriate gain.

'IDEA OF THE MONTH' CONTEST

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month we will be giving away a 60 W Portable Cordless Soldering Iron, a 240 Volt Charging Adaptor together with a Holder Bracket. The prize is worth approx. $100.

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each person will be paid $20 for an item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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

* Breach of copyright is now a criminal offence.

Title of Idea ....

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

Name ....

Address ....

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

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

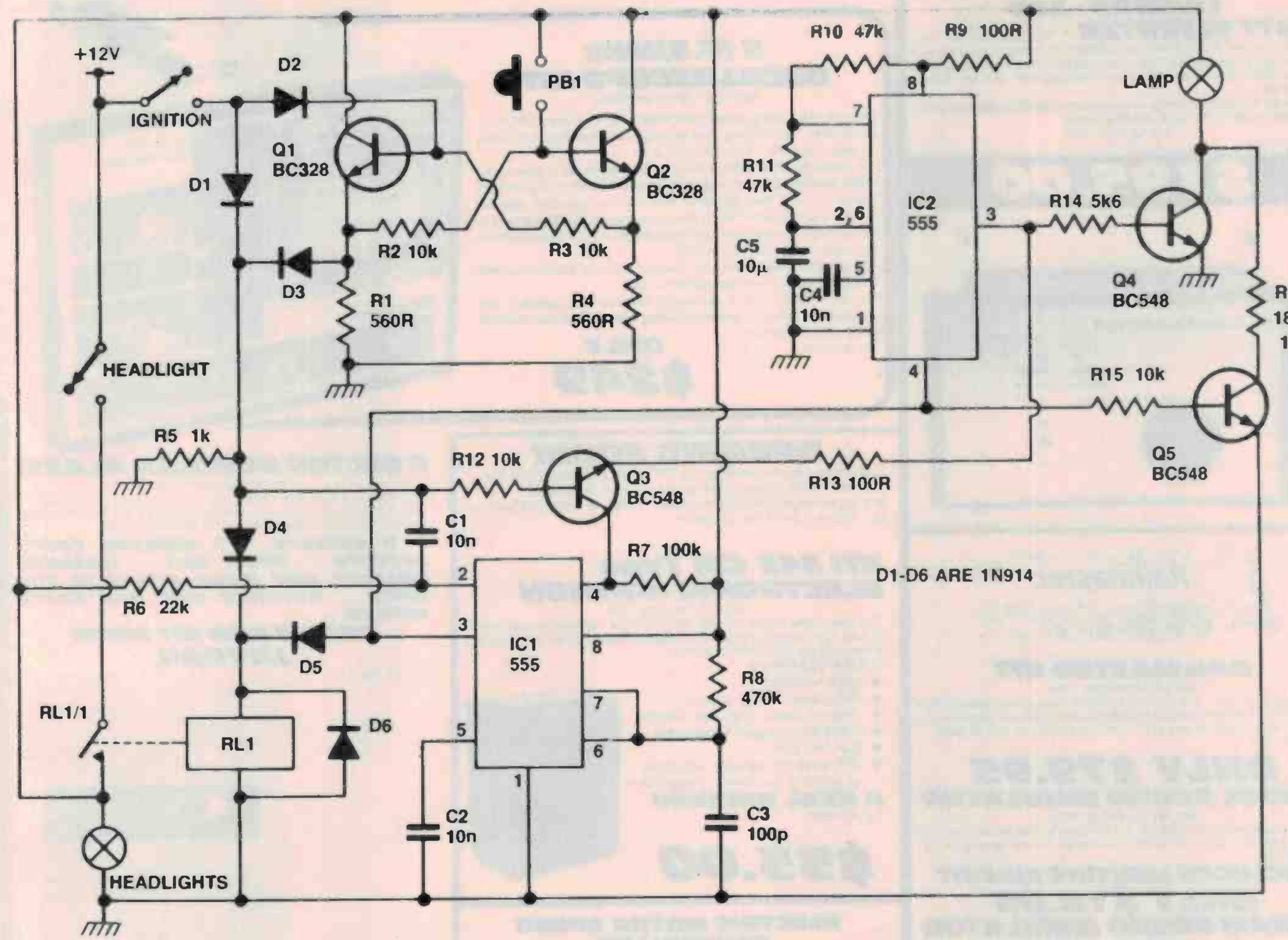
Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked to and including the date of the last day of the month.

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

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

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

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



Motor car light controller

Peter Hill, Cardiff NSW

This circuit reminds you if you have left the headlights on after turning of the ignition. It will automatically turn the lights off if you do not deactivate the circuit.

The first thing to note about the circuit is that power is supplied via the headlight switch, so if the lights are off no power is supplied to the unit.

However this is not sufficient to turn on the lights, owing to the position of RLY 1. This is held up via the ignition switch, via D1 and D4. So both switches must be made to allow the lights to be turned on.

Now look at the latch comprising Q1 and Q2. In its initial state Q2 is on and Q1 off. Consider what happens when the ignition switch is opened. A spike will be induced onto pin 2 of IC1 by the capacitor C1, which has 0 V across it. This starts the timer, IC1. Q2 stays on, and Q1 off, but note that only Q2 base emitter current flows in D3.

IC1 is a fifty second monostable. Its pin 3 will go high, providing 12 V for the relay and pulling up pin 4 on IC2. It also turns on Q5. IC2 is a 1 Hz bistable, so as long as IC1 stays on it will oscillate, driving Q4 and thus the light L1. At the end of fifty seconds pin 3 goes low, the relay drops out and circuit operation ceases.

However, if PB1 is operated during this time the latch changes state. The collector of Q1 goes up to 12 V, supplying sufficient current to operate the relay via D4. The circuit can remain in this position indefinitely, unless supply is interrupted by operating the headlight switch, or the latch is toggled by turning on the ignition again.

Lastly, consider the effect of Q3. If this transistor is on it connects IC1 and IC2 in a loop that prevents either from running. IC1 pin 3 is connected to IC2 pin 4, and IC2 pin 3 is effectively connected to IC1 pin 4. This means that the timer section of the circuit cannot run if power is supplied via either D1 (i.e. ignition is on) or D3 (i.e. PB1 operated). Apart from its effect on circuit control, this has the added advantage of making the timing independent of noise in the motor car supply.

GREAT KITS FOR '85

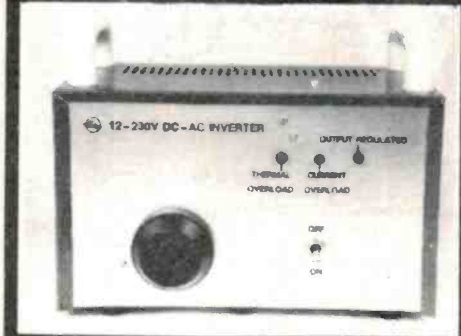
12/230V · 300 WATT INVERTER

This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output voltage is regulated and gives a precise 50Hz. The kit also has current limiting with ultimate thermal shutdown.
The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.

Ref: EA June 1982

Cat. KA-1574

$195.00



RAILMASTER KIT

Ref. EA September 1984

This is the most up-to-date train controller kit that we have seen. It offers all of the most wanted features including inertia, full overload protection etc. The kit includes front panel, correct console box and all parts.
Cat. KA-1560

ONLY $79.95

DIESEL SOUND SIMULATOR

Ref. EA November 1984

You'll be amazed how authentic this kit sounds. The kit includes PCB and all parts as well as all of the components for the lighting circuit.
Cat. KA-1561

INCLUDES LIGHTING CIRCUIT

ONLY $19.95

STEAM SOUND SIMULATOR

Ref. EA December 1984

This kit will make your model steam train sound like the real thing! Includes infra red optical switch to synchronise the "chuffs" to the wheel rotation. Includes all parts plus 32 ohm headphone type transducer.
Cat. KA-1562

ONLY $15.95

MOTORCYCLE INTERCOM

Ref. EA February 1984

What a great kit! This full duplex unit enables you to talk to your pinion passenger whilst driving with your helmets on! Powered by the bikes battery - you can both talk at the same time if you wish as there are no switches to activate. The Jaycar kit includes the special headphone inserts and all parts.
Cat. KA-1533

ONLY $39.95

UTILITY AMPLIFIER · 20 WATT

Ref. EA November 1984

A great low-cost, easy to build amplifier that gives HI FI performance. All components mount on the PCB which is supplied.
Frequency response is from 45Hz to 68kHz and this unit can be used with speakers from 4 ohms up, on voltages from 20 to 35. A great kit for the person who requires low cost HI FI.
Cat. KA-1567

ONLY $17.50

5 (6.5)MHz OSCILLOSCOPE KIT

Ref: EA October 1984

Over the years many people have asked, "Do you have a CRO kit?" Our answer - up until now - has been that built and tested units were no dearer than kits, if you get a kit at all.
The Jaycar KJ-7050 Cathode Ray Oscilloscope kit has a guaranteed 5MHz bandwidth but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz 'scope is usually adequate to troubleshoot most microprocessor and other digital circuitry as well!
This is a wonderful opportunity to learn electronics AND end up with a valuable piece of test equipment as well.
The Jaycar KJ-7050 kit is absolutely complete. The chassis is pre-punched and every component including nuts and bolts are provided, along with instructions.
Cat. KJ-7050

ONLY $249

☆ OPENING SOON! ☆

Call in to our brand new store at 188 Pacific Highway GORE HILL. You can't miss it, just a few doors up from Dick Smith.
We hope that all JAYCAR patrons on the North Shore will look us up. You're more than welcome!

ETI 342 CDI Type ELECTRONIC IGNITION

Ref. ETI February 1985

This brand new design virtually eliminates the controversial problems of past CDI designs. Probably its biggest feature is that it has all but eliminated the CROSSFIRE problem.
OTHER FEATURES:

- High reliability
- Runs from 2-25V supply
- Doesn't create high coil current
- Hall-Effect Trigger compatible
- Die cast box
- Will work on virtually any type of ignition (i.e. boats, planes etc)

A REAL WINNER!!

Cat. KE-4690

$55.00

ELECTRIC MOTOR SPEED CONTROLLER · new improved circuit

Ref. EA December 1984

Control a series wound or "universal" brush type motor with this superb kit. Now you can control the speed of your electric drill, lawn edger or domestic appliances etc. The Jaycar kit is supplied complete.
Cat. KA-1558

VALUE AT $24.95

AUSTRALIAN STANDARD STEREO AM DECODER

Ref. EA October 1984

This kit uses the Australian standard Motorola CQUAM decoder chip - why pay more for units that include non-standard emphasis! This kit will decode the new AM stereo transmissions (with suitable AM tuner).
Cat. KA-1555

ONLY $19.95 COMPLETE

(Whistle filter coil extra - Cat. EE-3814 $19.95)

MAIL ORDER HOTLINE

To save you time (and therefore money) we have installed a special HOTLINE direct to the inner workings of our Mail Order dept. This saves you from going through our Head Office switchboard! If you wish to place an order, enquire about an order or simply check for more information, call:

(02) 646 1300

8 SECTOR BURGLAR ALARM

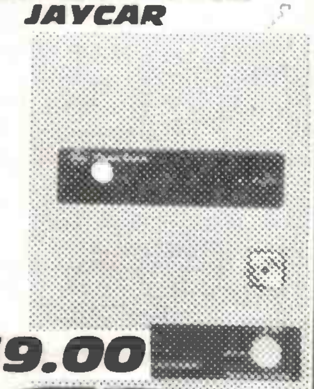
Ref. EA Jan/Feb 1985

Why buy a commercially made up unit for more when you can buy this kit and SAVE money! A unique feature of this kit is the fact that you can wire N/O and N/C alarm sensors ON THE SAME LINE.

☆ 8 sectors ☆ 2 delayed entry sectors ☆ Steel box ☆ Includes battery and siren driver in the price ☆ Variable exit and entry delays.

BRAND NEW KIT FROM JAYCAR

Cat. KA-1580



$139.00

BUSKER AMPLIFIER

Ref. EA February 1985

Fantastic, portable amplifier kit for low-level P.A., Buskers or for practice.

☆ Battery or mains operation ☆ Full control · bass, treble and volume ☆ 2 inputs (low and high) ☆ 17 WATTS RMS output ☆ Gel battery automatically recharged when mains used.

☆ INTRODUCTORY PRICE ☆

All electronics including GEL battery, 8" speaker, metal chassis etc.
Cat. KA-1592

ONLY $125

PRE-CUT WOODEN CABINET to suite Cat. KA-1593

ONLY $30.00

BUY BOTH AND PAY ONLY

$149.00

A FURTHER SAVING

- as you would expect from JAYCAR

PLAYMASTER SERIES II MOSFET STEREO AMP

Ref EA Jan/Feb/March 1985

"...a stereo amplifier that will equal or better just about any integrated commercial amplifier, regardless of price".

– Leo Simpson, Editor of EA, Feb. '85.

MAIN FEATURES OF THE NEW PLAYMASTER

- Switchable phono inputs for MM and MC cartridges
- Electronic signal switching
- Full facilities for dubbing between two cassette decks
- Monitor loop for either of two cassette decks or a signal processor
- Click action pushbutton switches for selection of sources, dubbing and tape monitor with LED status indicators
- Centre detents on bass, treble and balance controls, multiple detents on volume control
- Heavy duty heatsinks
- Power transformer for low hum and noise
- Easy to build construction – all parts except power supply mount directly on the two printed circuit boards; wiring has been kept to an absolute minimum
- 100 watts RMS per channel into 8 ohm loads
- Less than .01% total harmonic distortion.

Jaycar has spent considerable time with EA in development of the project. Central to the design are several key components not used in local amplifier designs before. Jaycar has sourced all of these components (samples from Jaycar were used in the prototypes). Other selected kit suppliers will have these components as well. BEWARE of kits that may be available that may not comply to the original design. Some aspects of the design are very critical & it is important that the project is assembled as per the original design.
Needless to say the Jaycar kit for the project is 100.00% ORIGINAL.
Finally, we are now in a position to advise that the cost of this kit amplifier down to the last nut & bolt is $399. Thats right! A pittance compared to the performance & facilities that you get.

EXCLUSIVE! JAYCAR AMP REPAIR GUARANTEE

We cannot imagine an amplifier of this magnitude being easier to make. Provided you can insert components into the PCB the right way around & not solder dry joints you should have no problems!
If however, you do have hassles getting the amp going, no problems!
Jaycar will provide a fixed price repair facility for this amp. This means, no matter what happens, you will get a great working amp. at a great price!
The price? $39.95 which includes service, all main board parts (up to $30 value). (Transformer & filter caps extra). It is highly unlikely that any damage over $50 would ever occur.
See the kit instructions with the amp. for further details.

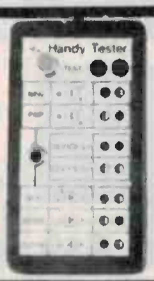
IN-CIRCUIT TRANSISTOR CHECKER

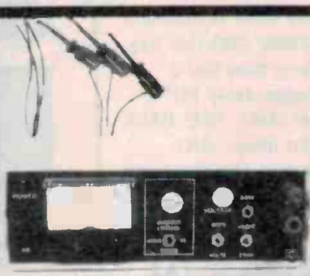
Ref EA December 1983

Don't desolder that transistor! Check it in circuit. This kit will save you a lot of time and hassles and will even check diodes and SCR's too! The Jaycar kit includes all components PLUS Jiffy box and Scotchcal panel with full truth table for device checking
Cat KA 1119

PEACE OF MIND FOR

$15.00





30 VOLT · 1 AMP BENCHTOP POWER SUPPLY ·

A brand new design that features a modern moulded plastic bench top type case

☆ ***Short circuit protection*** ☆ ***3-30V variable output*** ☆ ***0·1 amp with variable current limit*** ☆ ***load switching*** ☆ ***less than 2mV RMS ripple.***

Cat KA 1574

VALUE $64.50

Mycroft products available from TeleCorp

TeleCorp, Australian manufacturers of telecommunication and teletext equipment, have been appointed the sole Australian agency for Mycroft Labs Inc in Australasia.

Mycroft is known for its MITE data communications software packages which allow the computer user access to virtually any asynchronous ASCII database, electronic mail service or microcomputer, directly or via the telephone. It runs on CP/M-80, CP/M-86, concurrent CP/M-86, MS-DOS and recently received notice at the Comdex/Fall '84 when an updated version was launched making it compatible with the Apple Macintosh.

Additional Mycroft products which will now be available in Australia for the first time include Compat, a direct disk interchange utility for CP/M-80, which allows the user to modify disk drives, initialize blank diskettes to desired formats, and prepare directories, transfer or erase files and check for space on any of the four most common MS-DOS formats.

The Myhost package now available through TeleCorp allows the computer to become a host/online system for others to dial into. Once the phoneline has been automatically answered the remote user can issue commands to operate the host.

This new range of products joins the Tulpi intelligent modem developed by TeleCorp in Australia.

CLUB CALL

A New Zealand **Multitech MPF II** users group is looking for contact with other users. The group is desperate for information on memory expansion and software exchange/conversion. Anyone interested should contact Chris Van Lint, 14 Stanhope Grove, Koroko New Zealand.

The **Hawkesbury Microbee Computer Club** advises the following changes: Meetings are to be held in the Microbee Network room, Library Building, Richmond High School, Cnr Penrith Rd and Lennox St, Richmond, NSW 2753. General meetings are held at 7.30 pm, 1st Friday monthly; workshops at 7.00 pm, 3rd Friday monthly. Contact Bruce Rennie (president), 6 Warks Rd, Kurrajong Heights, NSW 2758. (045)77-2344 or (045)67-7329 ah; Garry Holloway (secretary) 55 Fisher Rd, Maraylya, NSW 2765. (045)77-3168 or (045)67-6239 ah.

Future contacts with **Spectravideo Users Group** should be made through Mitch on (03) 438-2687.

The **ZX81 Software Exchange** user group ceased operating July/August 1984.

If you wish to notify Australasia at large of the existence of your group, or advertise changes or forthcoming events in Club Call, send the details to us at ETI, 140 Joynton Ave, Waterloo, NSW 2017.

Macro assembler for the 16-bit Intel micros

Microsoft has announced a new release of Microsoft Macro Assembler that supports the entire Intel family of 16-bit microprocessors. The new release works with 80186, 80286, and 80287 instruction sets, as well as with the 8086, 8087 and 8088 microprocessors supported by the previous version.

The assembler is accompanied by an extensive set of development utilities, including a symbolic debug utility that allows programmers to examine and step through their source code as well as their object code. This utility provides a controlled testing environment for programs, significantly speeding development time.

The programming development tools that accompany the new Microsoft Macro Assembler release include an object linker, a library manager, a cross-reference utility, and a program maintenance utility, in addition to the symbolic debug utility.

New protocols aim at network standardization

Intel Corp recently announced that it has jointly developed, with Microsoft Corp, of Bellevue Washington, network software protocols that allow files to be shared concurrently by multiple users on a local-area network (LAN).

The new network protocols are fully compatible with IBM's PC network. The protocols will be made available to the public by Microsoft and can be implemented with various operating systems to allow networking of dissimilar microcomputers. The protocols will be available through Intel for its own customers.

The protocols are the basis of Microsoft's new networking product, called Microsoft Networks. Microsoft Networks is software that allows network file access among various microcomputers using the MS-DOS operating system and is available from Microsoft.

From 1985, Intel intends to provide networking products for its key operating systems based on the new network protocols. The first implementations will be under iRMX and Xenix. (iRMX is Intel's real-time, multitasking microcomputer operating system; Xenix is Microsoft's version of the Unix multiuser operating system.)

"These network protocols eliminate hardware and operating-system barriers to networking dissimilar computers," said Bill Lattin, Vice President and General Manager for Intel's Systems Group. "We expect the protocols to become an industry standard for local networks."

The protocols come at a time when the local-networking market has been fragmented by a variety of proprietary network protocols. A number of vendors offer LANs that work with a restricted range of equipment, but until now there have been no network protocols that were 'open' — that is, available for use by multiple manufacturers. Computers on such networks will have complete access to all shared files, which can be processed as though they resided locally on each workstation.

Printer with a difference

A new electronic daisywheel printer/typewriter, the Juki 2200, manufactured by Juki, Japan is being distributed in Australia by Stott & Underwood Ltd.

The Juki 2000 is primarily designed as a portable electronic typewriter.

The built-in serial (RS232C) or parallel (Centonics) interface will make this model very popular in the small business and home computer market suggested George Ennis, Stott & Underwood's National Marketing Manager.

It features daisywheel letter quality printing and typewriter features which are normally found only in larger office models, as well as a bidirectional printer.

The Juki 2200 sells for under $600 recommended retail. The first two shipments have already been sold to department stores, computer shops and office equipment dealers throughout Australia.

For further information contact **Stott & Underwood Ltd. (02)929-0566.**

Wordstar design

Wordstar users are often frustrated by its lack of printer control functions. However a new program called Flashprint allows them to print anything the printer can handle — from simple changes of type to complex graphics — without modifying Wordstar.

Flashprint can be customized by the user for any printer. One or two characters in a Wordstar document can send hundreds of bytes (including text) to the printer. Any character can be assigned to a Flashprint function and print anything.

Also included is Flashkey which allows any character (including control characters) to be defined as a function key.

Flashprint/Flashkey costs $49.95 and requires Wordstar V2.26, V3.0 or V3.3. It runs on 8-bit (Z80 CPU) computers and is available in several disk formats which include Microbee, Osborne and Apple.

For more information contact **JRT Software, 42 Turners Avenue, Coromandel Valley, SA 5051.**

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Math Blaster, a mathematics training program just released for the Commodore 64, contains 600 problems in basic maths operations designed for children aged six to 11 years. Children are guided through the learning stages, and according to Commodore each 'problem' becomes an invitation to have fun.

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For further information contact **Commodore, 5 Orion Road, Lane Cove, NSW 2066. (02) 427 4888.**

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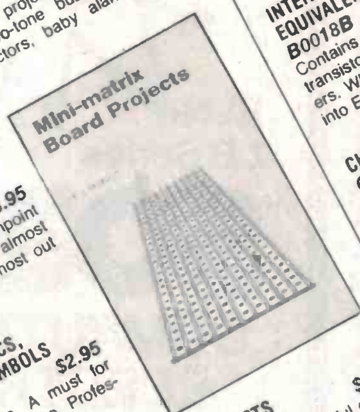

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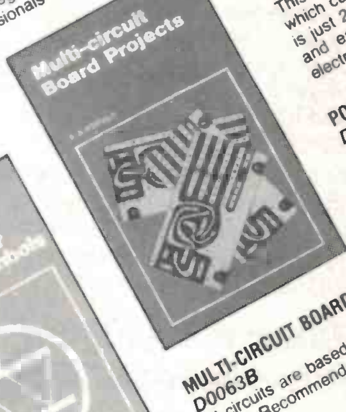

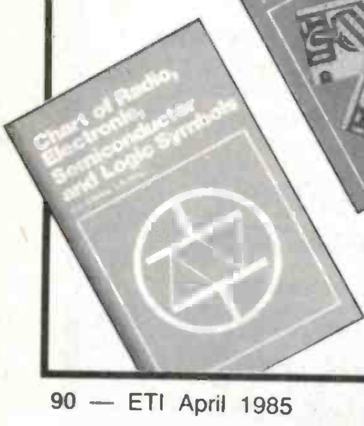

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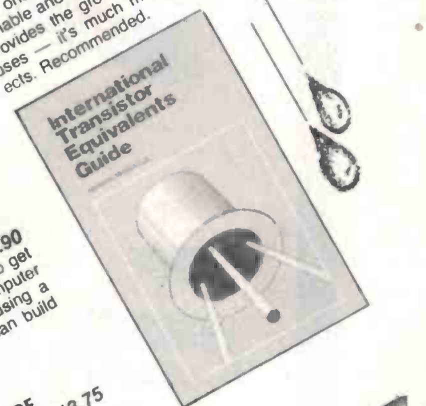

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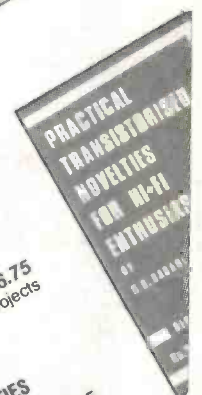
H0275J
In clear, non-technical language, the authors explain what micros are, what they can do and what to expect in the future.



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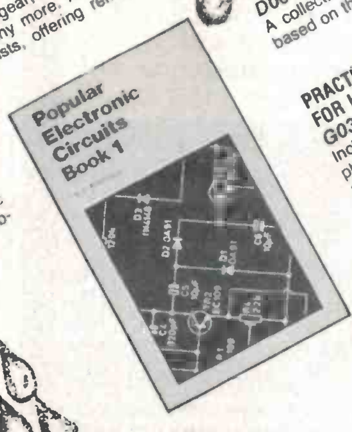

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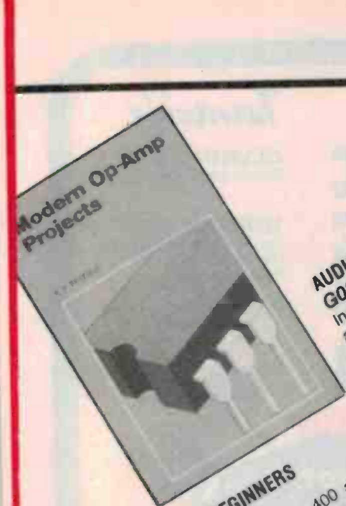

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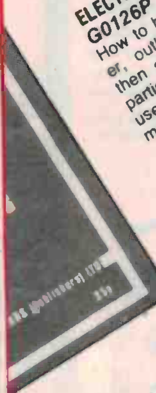

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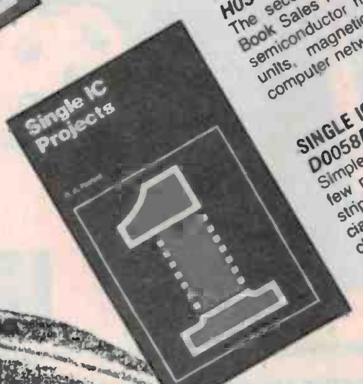

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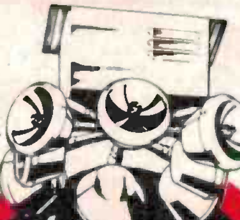

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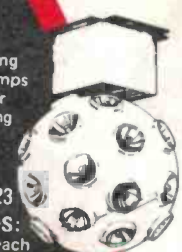

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'Dynamic generator' was written originally by our indefatigueable Chip-8 contributor Lindsay, naturally for the Chip-8 column. But we were so impressed by this program we decided to break the code, so it can be run on the Microbee and Apple as well.

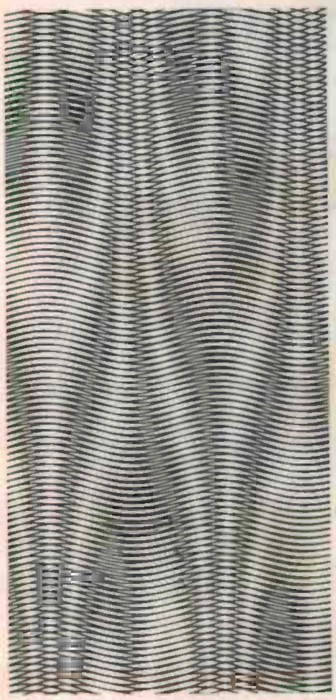
The Microbee and Apple programs use BASIC to POKE machine code into memory to increase operating speed.

Dynachromics generator

Lindsay R. Ford, 8 Highland Ct, Eltham North, Vic 3095

'Dynachromics' is the fascinating science of simulating colour by the rapid periodic movement of monochrome objects. Most readers will be familiar with the classic Dynachromic experiment in which a black and white segmented disc is rapidly rotated to produce an illusion of rainbow colours, but this has always been difficult to simulate with a computer owing to the low speed of BASIC graphics. Not so with CHIP-8. This program illustrates the technique, producing a simple Dynachromic display that oscillates at an increasing frequency through the full colour spectrum, appearing first red, then yellow, green, blue and finally violet. The principles are simple and hopefully will be implemented in future CHIP-8 games so that even those of us tied down to monochrome monitors will find a little colour in our lives!

ETI 660 owners can get a slightly less graphic (but equally colourful) view of the technique by locating the program at $0600 and substituting 'NOP' ('00FF') for all underlined instructions.



CHIP-8

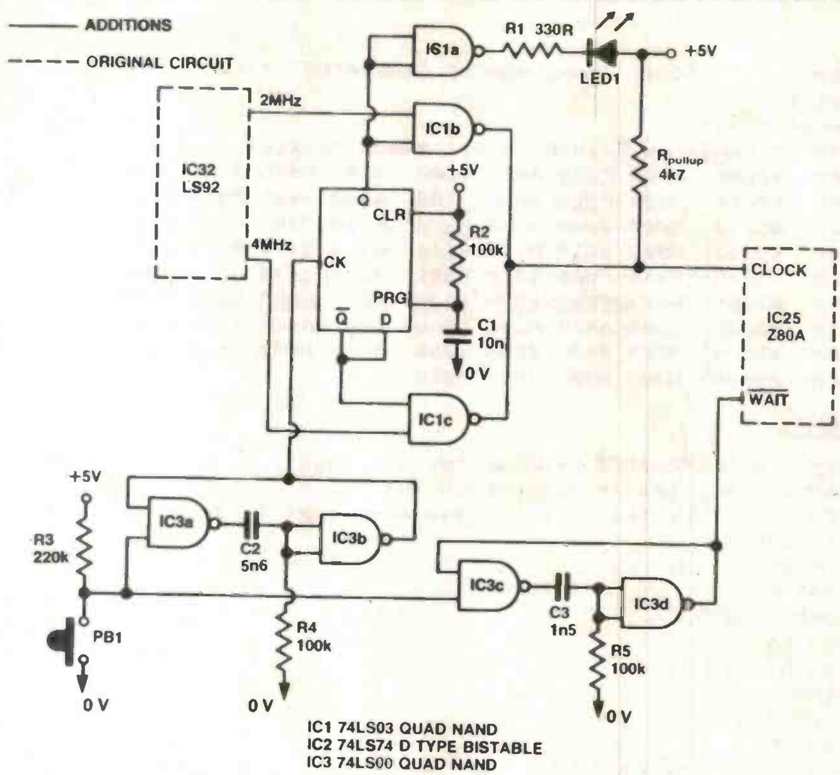
```
00100 REM        <<<<<< DYNACHROMICS GENERATOR >>>>>>
00110 OUT 255,2
00120 X=USR(57347)
00130 REM  Dreamcards Chip-8 v2.2:  $2600 to 2687  (73/14)
00140 REM  $2600  00E0 F2F4 A800 6000  6100 F055 7101 31FF
00150 REM  $2610  160A F224 600A 6208  A660 610B D018 F21E
00160 REM  $2620  7008 303A 161A F2F4  A810 C3FF F31E 6101
00170 REM  $2630  C00E B634 8114 8114  8114 8114 8114 8114
00180 REM  $2640  8114 F065 8210 8202  3200 1628 A810 F31E
00190 REM  $2650  8014 F055 6040 6102  8017 6000 8017 1628
00200 REM  $2660  EEAA AAEE A8A8 A8A8  EAAA AAEA EACA 8AAB
00210 REM  $2670  0E08 080C 0808 0888  EEAA AAAA AAAA AAEE
00220 REM  $2680  8585 8585 8580 80E5
```

MICROBEE

```
00100 REM ..DYNACHROMICS Program for MicroBee..
00110 REM ....written in MICROWORLD BASIC....
00120 REM.... NOTE: the colours take some time to appear.
00130 CLS:LORES
00140 FOR N=1 TO 31
00150 READ A
00160 POKE N-3519,A
00170 NEXT N
00180 FOR N=1 TO 31
00190 READ A
00200 POKE N-3455,A
00210 NEXT N
00220 FOR X=255 TO 129 STEP -1
00230 FOR N=1 TO 31
00240 A=PEEK(N-3519)
00250 POKE N-3519,A-1
00260 NEXT N
00270 FOR N=1 TO 31
00280 A=PEEK(N-3455)
00290 POKE N-3455,A-1
00300 NEXT N
00310 NEXT X
00320 STOP
00330 GOTO 330
00340 DATA 23,2,35,63,22,2,19,41,2,40,63,41,63,20,63,63,63,63,63,54,
50,0,21,2,19,21,2,19,20,63
00350 DATA 63,22,2,42,63,22,2,63,41,2,36,63,41,63,52,47,63,63,63,63,
20,63,63,36,47,4,36,47,4,52,47,15
```

APPLE

```
10  REM  "DYNACHROMICS" EXPERIMENT
20  REM  FOR ALL APPLE COMPUTERS
30  FOR I = 1024 TO 2047: POKE I,32: NEXT I
40 S = 1069
50  FOR A = 1 TO 5
60 F = S + 10
70  FOR B = 1 TO 2
80  READ J
90  FOR K = S TO F
100  POKE K,J:J = J + 1
110  NEXT K
120 S = F:F = S + 10: NEXT B
130 S = S + 110: NEXT A
140  FOR I = 1024 TO 2047
150  IF I - 10 *  INT (I / 10) <  > 0 THEN  POKE I,32
160  NEXT I
170  END
180  REM  DATA FOR MACHINE CODE
200  DATA 64,69,79,78,81,78,72,75,75,96
```



Speed changer

G. Taylor, Fitzroy Vic 3065

So, you've modded your Microbee to operate on both 2 and 4 MHz and you decide that Space Invaders is running too fast (or too slow) so you flip the speed button . . . Damn! forgot to hit the WAIT button first and the program crashes. Oh well, load it in again . . . pity about that high score that nobody will believe.

If this is a problem that you've been experiencing, then I can assure you that you're not Robinson Crusoe. The little beastie outlined left ought to solve the problem once and for all.

When the button is hit, both monostables are triggered, sending their outputs low. Monostable 2 will hold the WAIT pin of the Z80A low whilst monostable 1 will go high after about 25 ms, triggering the 74LS74 and toggling the clock rate. About 70 ms after this, monostable two will go high, allowing the Z80A to go on its merry way. The R/C network on the 74LS74 will ensure a 2 MHz clock on power-up and the LED indicates 4 MHz. This LED is not strictly necessary, but it does fill up the extra hole in the Microbee.

Home alarm control

Tony Blackburn, Niagara Park, NSW 2250

This interface and program have been designed for either microwave or passive infrared intrusion detectors. These detectors reset themselves when there is no longer movement.

The program could easily be modified for reed switches or other detection devices.

The detectors are catered for, up to six individual detectors are possible on the interface. The program would have to be modified slightly for more than two.

How it works

Bits 0, 1, 2 and 7 of the parallel port are used. Bit 7 is used to operate the relay. Bits 0, 1 and 2 are all tied high to +5 V via 5k6 resistors. Bit 2 is used to indicate that the interface is plugged into the parallel port. Bits 0 and 1 are connected across the normally made alarm contacts of the detectors, which pull them low. These two bits are then polled in turn. If any of these bits go high then the detector has operated.

When this happens a relay operates which activates the siren. The relay releases after 15 s and the detector contacts are then polled again. There is also an indication on the screen of which detector has operated. If both are operated, the detector that is connected to the lowest numbered bit is displayed.

The siren and relay are both operated from a separate 12 V power supply. By doing this the alarm is totally isolated from the computer power supply by the opto-coupler.

I would also recommend using a separate 12V 6aH gelcel rechargeable battery as backup for the alarm and Microbee in the event of power failure or anyone trying to disable the alarm by turning the main power off.

```
00100 CLS
00110 SPEED 0
00120 REM ****  PRINT  HEADER  ****
00130 POKE 162,30:POKE 163,128
00140 AI$="HOME ALARM CONTROL"
00150 CURS 16,1:PRINT [A32 42]
00160 CURS 16,2:PRINT"*":CURS 23,2:PRINT AI$:CURS 47,2:PRINT"*"
00170 CURS 16,3:PRINT"*":CURS 47,3:PRINT"*"
00180 CURS 16,4:PRINT"*":CURS 24,4:PRINT"written for the":CURS 47,4:PRINT"*"
00190 CURS 16,5:PRINT"*":CURS 27,5:PRINT"Micro-bee":CURS 47,5:PRINT"*"
00200 CURS 16,6:PRINT"*":CURS 31,6:PRINT"by":CURS 47,6:PRINT"*"
00210 CURS 16,7:PRINT"*":CURS 24,7:PRINT"Tony Blackburn":CURS 47,7:PRINT"*"
00220 CURS 16,8:PRINT"*":CURS 27,8:PRINT"17/08/84":CURS 47,8:PRINT"*"
00230 CURS 16,9:PRINT [A32 42]
00240 PLAY0,40
00250 SPEED 100
00260 CLS
00270 OUT1,255:                 REM initialize port
00280 A=IN(0):                  REM set port 0 (parallel port) for input
00290 IF T=1 THEN 310
00300 IF A)3  THEN 450:         REM  see if bit 2 is high
00310 IF A=0 THEN 440:          REM check port for all bits low
00320 A=3-(A AND 3):    @       REM convert bit 0 and 1 to positive logic
00330 B=-(A AND 1) :IF B THEN  370
00340 PRINT TAB(35) "ALARM IN CIRCUIT 1.":S=1
00350 GOSUB 410
00360 GOTO 270
00370 B=-(A AND 2):IF B THEN  540
00380 PR         NT TAB (35) "ALARM IN CIRCUIT 2.":S=2
00390 GOSUB 410
00400 GOTO 270
00410 OUT1,15:OUT 0,128:        REM initialize port then set bit 7 of parellel port
 high to operate relay
00420 PLAY 0,120:               REM operate relay for 15 sec.
00430 OUT0,3:RETURN:            REM release relay then check alarm status again
00440 PRINT "Alarm unit not connected":PRINT:GOTO 270
00450 CLS:PRINT "Alarm unit connected .":PRINT\
00460 PRINT"Hit 'reset' to restart program"
00470 CURS 6,14:PRINT"hit space bar to continue"
00480 B0$=KEY:IF B0$="" THEN 480
00490 IF B0$=" " THEN CLS
00500 CURS 4,5:PRINT"YOU HAVE 60 sec. TO GET OUT"
00510 CURS 8,14:PRINT" TURN OFF SCREEN":T=1
00520 PLAY 0,240;0,240
00530 GOTO 320
00540  PRINTTAB(35)  "ALARMS O.K.":GOTO 270
00550 PLAY 0,255:T=0:GOTO 430
```

Life

A. Taylor, Fitzroy Vic 3065.

This is an implementation of the well-known 'Life' simulation, originally proposed by John Conway of Caius College, University of Cambridge. This version makes use of the Microbee's graphics capabilities to achieve a grid of 45 x 125 'cells' for the simulation.

The program will run on both 16k and 32k Microbees.

Originally I wrote it in BASIC but due to the number of checks required (45 000) it was taking about a ¼ hour to work out what had to happen in each generation and three minutes to do the drawing. This ruined the effect somewhat, so I rewrote the main routines in Assembler. This brought the time down to around two seconds on a standard 'Bee making the simulation a bit more watchable.

Perhaps I should explain the criteria involved in this implementation of the program:

a) Any live cell which has less than two neighbours dies in the next generation (i.e: it is erased).

b) Any cell with four or more neighbours dies through overpopulation (it is also erased).

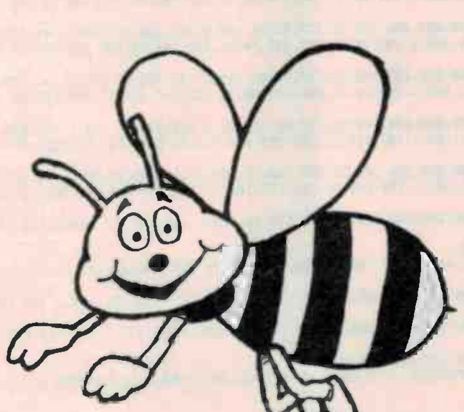
c) Any empty cell with three and only three neighbours becomes a 'birth cell' (i.e: it is set for the next generation).

d) All other cells are left unchanged. It should be noted that all of the above changes occur simultaneously and together make one 'generation'.

Operation of the program is quite simple. On initialisation, you will be greeted with the message 'Enter your array' and a flashing cursor appearing. To set a point hit the B key. To move the cursor use the A,<,>, or Z keys. To reset a point, use the Y key. When you are satisfied with your array, press P and your 'bacteria culture' will be on its way. To quit the program press the Q key. If you want to change the current show pattern, simply press C and the cursor will re-appear, allowing you to edit your array. Press P again to continue after changes. Pressing 'R' will restart the program if you want a completely different pattern.

A word of warning is required: if you alter the BASIC program, DON'T make it much longer or use many extra variables, as the machine code routines sit after the BASIC program in order to fit into a 16k 'Bee. The same thing goes for the machine code routines themselves, which have the arrays directly above them.

```
00010 FNØ=#+47*T+S
00020 LORES:A=10288:B=4400:GOSUB150
00030 S=21:T=61:U=USR(4096):CLS:PRINT"Input your array"
00040 PLOT Ø,ØTO123,ØTO123,44TOØ,44TOØ,Ø
00050 KØ$=KEY:SETT,S:IFPEEK(FNØ(A))=Ø:RESETT,S
00060 RESETT,S:IFPEEK(FNØ(A))=1:SETT,S
00070 IFKØ$="B":SETT,S:POKEFNØ(A),1:POKEFNØ(B),1
00080 IFKØ$="A":S=S+1ELSEIFKØ$="Z":S=S-1
00090 IFKØ$=",":T=T-1ELSEIFKØ$=".":T=T+1
00100 IFKØ$="Y":RESETT,S:POKEFNØ(A),Ø:POKEFNØ(B),Ø
00110 IFKØ$<>"P"THEN5Ø
00120 CURSØ:PRINT"Generation"TAB5Ø"Population"
00130 KØ$=KEY:IFKØ$="R"THEN3ØELSEIFKØ$="C"THEN5Ø
00140 IFKØ$="Q":ENDELSELETU=USR(4155):GOTO130
00150 FORT=4096TO4350:READD:POKET,D:NEXTT:RETURN
00160 DATA 33,Ø,Ø,34,2,Ø,33,Ø,-8,203,134,203,166,35
00170 DATA 124,181,32,-9,221,33,Ø,-8,6,64,17,16,Ø,175
00180 DATA 221,119,Ø,221,119,5,221,119,1Ø,221,119,15,221,25
00190 DATA 16,24Ø,33,Ø,17,1,Ø,46,54,Ø,35,11,12Ø,177
00200 DATA 32,-8,2Ø1,33,46,17,221,33,48,4Ø,14,125,6,45
00210 DATA 175,221,134,2Ø8,221,134,2Ø9,221,134,21Ø,221,134,-1,221
00220 DATA 134,1,221,134,46,221,134,47,221,134,48,-2,3,32
00230 DATA 4,54,1,24,6,-2,2,4Ø,2,54,Ø,35,221,35
00240 DATA 16,212,35,221,35,35,221,35,13,32,2Ø1,17,Ø,4Ø
00250 DATA 33,Ø,17,1,Ø,23,237,176,221,33,48,4Ø,33,Ø
00260 DATA Ø,14,125,6,45,17,Ø,Ø,229,213,221,126,Ø,61
00270 DATA 32,5,2Ø5,48,128,24,3,2Ø5,51,128,2Ø9,225,19,221
00280 DATA 35,16,233,221,35,221,35,35,13,32,22Ø,17,Ø,17
00290 DATA 1,Ø,23,33,Ø,Ø,34,Ø,Ø,26,2Ø5,244,16,19
00300 DATA 11,12Ø,177,32,246,17,63,24Ø,33,Ø,Ø,2Ø5,223,16
00310 DATA 17,14,24Ø,35,62,1,2Ø5,244,16,2Ø5,223,16,2Ø1,62
00320 DATA 48,2Ø5,233,16,35,2Ø5,233,16,2Ø1,237,1Ø3,18,27,237
00330 DATA 1Ø3,18,237,1Ø3,27,2Ø1,134,39,119,35,62,Ø,142,39
00340 DATA 119,43,2Ø1
```



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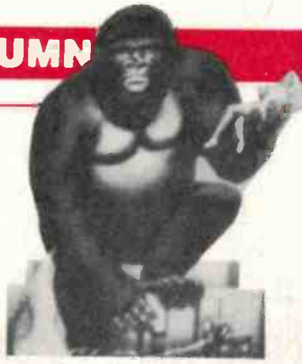

VIC-20

GAMES, GAMES, GAMES!

Here are two games programs that will run on a VIC-20 with a 3K expansion.

The first is a version of the well known Scramble and the second, a version of Donkey Kong. Both use small machine code routines to help speed them up. The games also use the standard multi-load system in order to load the characters and machine code, and should be saved after each other on tape.

The first game, Scramble, provides the player with five different landscapes to bomb in order to complete one mission. The object of the game is to reach the last landscape and destroy a small blue alien.

All the time your fuel level will be lowering and in order to replenish it you will have to bomb fuel dumps along the way. The obstacles you will meet along the way include missiles, meteors, a tunnel, and an alien city.

Movement is controlled by the 'R' and 'M' keys for up and down, while the 'S' key when pressed will unload a bomb. Scoring is as follows, missile — 5 pts; fuel — 10 pts; meteor — 1 pt; alien — 50 pts.

My version of Donkey Kong only uses the first screen because of memory, or rather a lack of it. Five barrels at the most are thrown at you; the hero must make his way to the top of the building under construction and rescue his friend.

When you reach the top you are given an amount of bonus points according to how long it has taken to get there. Along the way there are objects which can be collected for more bonus points.

To make things hard you can only move in the following directions: up by using 'O', left by using 'K', right by using '[', and jump by pressing the space bar.

Getting killed is quite easy, and can happen in a number of ways: by being hit by a barrel, by a barrel falling on you, by walking off girders or ladders, by jumping off girders, and by having your fingers crushed by the barrel while using a ladder. If the bonus points at the top of the screen reach zero your time will also be up and you will thus meet an ugly fate.

Duncan Morrison, Clayton Vic

Scramble

```
5 POKE51,255:POKE52,19:POKE55,255:POKE56,19:CLR
30 FORI=0TO143
40 READA
50 POKE5120+I,A
60 NEXT
70 POKE36866,PEEK(36866)OR128
80 DATA24,60,36,60,102,255,255,153
90 DATA36,60,24,44,44,60,44,24
100 DATA192,160,160,192,0,54,42,34
110 DATA146,84,40,214,40,84,146,0
120 DATA24,126,255,255,126,36,66,255
130 DATA0,128,192,224,255,127,12,24
140 DATA0,0,0,96,144,248,0,0
150 DATA1,2,4,8,8,16,96,128
160 DATA0,128,96,16,8,8,6,1
170 DATA0,60,66,129,129,66,60,0
180 DATA151,104,0,0,0,0,0,0
190 DATA0,0,0,0,0,0,145,110
200 DATA0,0,0,0,0,0,0,0
210 DATA0,0,0,0,0,0,0,255
220 DATA255,129,129,129,129,129,129,255
230 DATA24,126,153,153,255,90,66,129
240 DATA0,0,126,126,126,0,0,0
250 DATA1,2,2,1,2,2,2,1
260 FORI=5264TO5390:POKEI,0:NEXT
270 READA:IFA=-1THEN690
280 POKE5392+Z,A
290 Z=Z+1
300 GOTO270
310 DATA160,21,162,1,189,44,30,202,157,44,30,232,189,44,150,202,157,44,150,232,2
32,136
320 DATA208,236,202,169,32,157,44,30,169,2,141,235,31,169,1,141,235,151
330 DATA160,21,162,1,189,66,30,202,157,66,30,232,189,66,150,202,157,66,150,232,2
32,136
340 DATA208,236,202,169,32,157,66,30,169,2,141,235,31,169,1,141,235,151
350 DATA160,21,162,1,189,88,30,202,157,88,30,232,189,88,150,202,157,88,150,232,2
32,136
340 DATA208,236,202,169,32,157,66,30,169,2,141,235,31,169,1,141,235,151
350 DATA160,21,162,1,189,88,30,202,157,88,30,232,189,88,150,202,157,88,150,232,2
32,136
360 DATA208,236,202,169,32,157,88,30,169,2,141,235,31,169,1,141,235,151
370 DATA160,21,162,1,189,110,30,202,157,110,30,232,189,110,150,202,157,110,150,2
32,232
380 DATA136,208,236,202,169,32,157,110,30,169,2,141,235,31,169,1,141,235,151
390 DATA160,21,162,1,189,132,30,202,157,132,30,232,189,132,150,202,157,132,150,2
32,232
400 DATA136,208,236,202,169,32,157,132,30,169,2,141,235,31,169,1,141,235,151
410 DATA160,21,162,1,189,154,30,202,157,154,30,232,189,154,150,202,157,154,150,2
32,232
420 DATA136,208,236,202,169,32,157,154,30,169,2,141,235,31,169,1,141,235,151
430 DATA160,21,162,1,189,176,30,202,157,176,30,232,189,176,150,202,157,176,150,2
32,232
440 DATA136,208,236,202,169,32,157,176,30,169,2,141,235,31,169,1,141,235,151
450 DATA160,21,162,1,189,198,30,202,157,198,30,232,189,198,150,202,157,198,150,2
32,232
460 DATA136,208,236,202,169,32,157,198,30,169,2,141,235,31,169,1,141,235,151
470 DATA160,21,162,1,189,220,30,202,157,220,30,232,189,220,150,202,157,220,150,2
32,232
480 DATA136,208,236,202,169,32,157,220,30,169,2,141,235,31,169,1,141,235,151
490 DATA160,21,162,1,189,242,30,202,157,242,30,232,189,242,150,202,157,242,150,2
32,232
500 DATA136,208,236,202,169,32,157,242,30,169,2,141,235,31,169,1,141,235,151
510 DATA160,21,162,1,189,8,31,202,157,8,31,232,189,8,151,202,157,8,151,232,232
520 DATA136,208,236,202,169,32,157,8,31,169,2,141,235,31,169,1,141,235,151
530 DATA160,21,162,1,189,30,31,202,157,30,31,232,189,30,151,202,157,30,151,232,2
32
540 DATA136,208,236,202,169,32,157,30,31,169,2,141,235,31,169,1,141,235,151
550 DATA160,21,162,1,189,52,31,202,157,52,31,232,189,52,151,202,157,52,151,232,2
32
560 DATA136,208,236,202,169,32,157,52,31,169,2,141,235,31,169,1,141,235,151
570 DATA160,21,162,1,189,74,31,202,157,74,31,232,189,74,151,202,157,74,151,232,2
32
580 DATA136,208,236,202,169,32,157,74,31,169,2,141,235,31,169,1,141,235,151
590 DATA160,21,162,1,189,96,31,202,157,96,31,232,189,96,151,202,157,96,151,232,2
32
600 DATA136,208,236,202,169,32,157,96,31,169,2,141,235,31,169,1,141,235,151
610 DATA160,21,162,1,189,118,31,202,157,118,31,232,189,118,151,202,157,118,151,2
32,232
620 DATA136,208,236,202,169,32,157,118,31,169,2,141,235,31,169,1,141,235,151
630 DATA160,21,162,1,189,140,31,202,157,140,31,232,189,140,151,202,157,140,151,2
32,232
640 DATA136,208,236,202,169,32,157,140,31,169,1,157,140,151,169,2,141,235,31,169
,1,141
645 DATA235,151
650 DATA160,21,162,1,189,162,31,202,157,162,31,232,189,162,151,202,157,162,151,2
32,232
660 DATA136,208,236,202,169,32,157,162,31,169,1,157,162,151,169,2,141,235,31,169
,1,141
670 DATA235,151,96,160,8,162,22,169,14,157,7,31,169,2,157,7,151,152,160,22,232,1
36,208
680 DATA252,168,136,208,235,96,-1
700 POKE198,5:POKE631,78:POKE632,69:POKE633,87:POKE634,13:POKE635,131:END
```

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Donkey Kong Part 1

```
10 POKE51,120:POKE52,29:POKE55,0:POKE56,16
55 DATA4096
60 REM BARREL 1
100 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,A9,20,8D,FD,10,20,F0,10
101 DATAAD,87,11,8D,01,10,AD,88,11,8D,06,10,AD,74,11,8D,0B,10,AD,FD,10,8D,10,10,
60
102 REM BARREL 2
103 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,A9,20,8D,FD,10,20,F0,10
104 DATAAD,87,11,8D,31,10,AD,88,11,8D,36,10,AD,74,11,8D,3B,10,AD,FD,10,8D,40,10,
60
105 REM BARREL 3
106 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,A9,20,8D,FD,10,20,F0,10
107 DATAAD,87,11,8D,61,10,AD,88,11,8D,66,10,AD,74,11,8D,6B,10,AD,FD,10,8D,70,10,
60
108 REM BARREL 4
109 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,A9,20,8D,FD,10,20,F0,10
110 DATAAD,87,11,8D,91,10,AD,88,11,8D,96,10,AD,74,11,8D,9B,10,AD,FD,10,8D,A0,10,
60
111 REM BARREL 5
112 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,A9,20,8D,FD,10,20,F0,10
113 DATAAD,87,11,8D,C1,10,AD,88,11,8D,C6,10,AD,74,11,8D,CB,10,AD,FD,10,8D,D0,10,
60
114 REM ERASE BARREL
115 DATAAD,87,11,8D,FF,10,AD,88,11,8D,00,11,A9,20,8D,00,1E
116 REM BARREL+22
117 DATA18,D8,AD,87,11,69,16,8D,14,11,AD,88,11,69,00,8D,15,11
118 REM WHAT IS BARREL DOING?
119 DATAAD,16,1E,C9,20,F0,31,AD,74,11,C9,00,F0,15
120 REM MOVING RIGHT
121 DATA18,D8,AD,87,11,69,01,8D,87,11,AD,88,11,69,00,8D,88,11,4C,86,11
122 REM MOVING LEFT
123 DATAD8,38,AD,87,11,E9,01,8D,87,11,AD,88,11,E9,00,8D,88,11,4C,86,11
124 REM BARREL FALLING
125 DATAAD,14,11,8D,87,11,AD,15,11,8D,88,11,18,D8,AD,87,11,69,16,8D,6A,11,AD,88,
11
126 DATA69,00,8D,6B,11,AD,2C,1E,C9,00,F0,03,4C,86,11
127 REM CHANGING DIRECTION
128 DATAA9,FF,C9,00,F0,08,A9,00,8D,74,11,4C,86,11,A9,FF,8D,74,11
129 REM PRINT+CHECK
130 DATAAD,00,1E,C9,04,F0,15,8D,FD,10,AD,87,11,8D,9F,11,AD,88,11,8D,A0,11,A9,02
131 DATA8D,00,1E,60
132 REM RESET BARREL
133 DATAA9,8C,8D,87,11,A9,1E,8D,88,11,A9,FF,8D,74,11,4C,86,11
199 DATA*
200 READL
210 READA$
220 C=LEN(A$)
230 IFA$="*"THEN330
240 IFC<1ORC>2THEN320
250 A=ASC(A$)-48
260 B=ASC(RIGHT$(A$,1))-48
270 N=B+7*(B>9)-(C=2)*(16*(A+7*(A>9)))
280 IFN<0ORN>255THEN320
290 POKEL,N
300 L=L+1
310 GOTO210
320 PRINT"BYTE"L"=["A$"] ????":END
330 POKE198,5:POKE631,78:POKE632,69:POKE633,87:POKE634,13:POKE635,131:END
```

Donkey Kong Part 2

```
10 A=5120
15 READX
20 IFX=-1THEN40
25 POKEA,X
30 A=A+1
35 GOTO15
40 POKE36866,PEEK(36866)OR128
50 POKE198,5:POKE631,78:POKE632,69:POKE633,87
52 POKE634,13:POKE635,131:END
60 DATA255,136,85,34,255,0,0,0
65 DATA129,255,129,255,129,255,129,255
70 DATA56,68,146,170,146,68,56,0
75 DATA192,160,160,219,21,21,17,0
80 DATA126,44,44,44,60,44,60,126
85 DATA206,170,170,202,170,170,206,0
90 DATA234,170,170,170,170,170,174,0
95 DATA16,56,124,84,16,24,0,0
100 DATA56,40,124,124,124,0,0,0
105 DATA0,40,108,124,124,56,16,0
110 DATA0,68,230,206,198,100,8,0
115 DATA0,0,238,138,234,42,238,0
120 DATA0,0,238,40,238,130,238,0
125 DATA28,93,73,62,28,28,20,54
130 DATA28,28,8,95,125,28,18,54
135 DATA56,56,16,250,190,56,72,108
140 DATA56,56,16,254,186,56,68,130
145 DATA16,56,16,16,0,0,187,255
150 DATA153,153,203,255,153,165,165,231
155 DATA238,138,136,232,40,42,238,0
160 DATA238,170,170,172,170,170,234,0
165 DATA224,132,128,192,128,132,224,0
170 DATA224,132,128,224,32,36,224,0
175 DATA0,0,0,0,1,2,2,1
180 DATA0,0,0,7,159,127,71,215
185 DATA0,0,0,192,243,252,196,215
190 DATA0,0,0,0,0,128,128,0
195 DATA0,0,0,0,1,3,3,3
200 DATA64,66,88,199,224,255,224,192
205 DATA4,132,52,198,7,255,7,7
210 DATA0,0,0,0,0,128,128,128
215 DATA3,3,3,3,3,3,7,7
220 DATA0,0,0,0,0,0,0,0
225 DATA200,194,188,160,160,160,240,255
230 DATA39,135,123,11,11,11,31,255
235 DATA128,128,128,128,128,128,192,192
240 DATA3,0,0,0,0,0,0,0
245 DATA191,127,127,124,124,252,252,124
250 DATA251,252,252,124,124,126,126,124
255 DATA128,0,0,0,0,0,0,0
260 DATA0,0,0,0,0,3,7,15
265 DATA124,126,126,126,252,252,252,248
270 DATA124,252,252,252,126,127,127,63
275 DATA0,0,0,0,0,0,128,192
280 DATA238,138,138,142,170,170,234,0
285 DATA174,232,166,172,168,168,174,0
290 DATA234,170,170,170,170,164,228,0
292 DATA238,138,138,204,138,138,234,0
295 DATA60,36,36,36,36,36,60,0
300 DATA8,8,8,8,6,8,8,0
305 DATA60,4,4,60,32,32,60,0
310 DATA60,4,4,60,4,4,60,0
315 DATA32,32,40,40,60,8,8,0
320 DATA60,32,32,60,4,4,60,0
325 DATA32,32,32,60,36,36,60,0
330 DATA60,4,4,4,4,4,4,0
335 DATA60,36,36,60,36,36,60,0
340 DATA60,36,36,60,4,4,4,0
345 DATA28,28,8,62,93,93,20,54
350 DATA-1
```

Donkey Kong Part 3

```
0 PRINT"J";:W=4:FORI=0TO2:POKE7741+I,58:NEXT
1 M=8143:E=32:A=58:P=254:GOTO5
2 POKEM,E
3 RETURN
5 POKE36869,253:POKE36879,8:B=301:D=-21:F=23:G=-1
10 PRINT"STU 0 EFV 300"
15 PRINT"WXYZ [£] ←| %&' ()*+ BB":POKE7771,34
17 PRINT"M A@@ A@ A A A"
20 PRINT"@@@@@@@@@@@@@@@@@ A@ A A"
25 PRINT"@ A@@@@@ A@@@@@@@@"
27 FORI=1TO2:PRINTTAB(4)"A A":NEXT
30 PRINT"@@@@@@@@@@@@@@ A@@@ A A"
35 PRINT"@ A@@@@ A@@@@@@@@@"
37 FORI=1TO2:PRINTTAB(5)"A A":NEXT
38 PRINT"@@@@@@@@@@@@@@@@@@ A@ A A"
40 PRINT"@@@@@@@@@@@@@@@@@@@@@@";:POKE8185,0:POKE38905,5
42 POKE7995,7:POKE7939,0
45 IFU=0THENGOSUB500
50 POKE4097,152:POKE4102,31:POKE4107,255:POKE4112,32
52 POKE4145,92:POKE4150,31:POKE4155,0:POKE4160,32
54 POKE4193,16:POKE4198,31:POKE4203,255:POKE4208,32
56 POKE4241,207:POKE4246,30:POKE4251,0:POKE4256,32
58 POKE4289,149:POKE4294,30:POKE4299,255:POKE4304,32
60 SYS4096:SYS4144:SYS4192:SYS4240:SYS4288
62 IFJ=5THENGOSUB2:M=M+F:E=PEEK(M):A=16+G:J=0
63 IFPEEK(M)=2ORPEEK(M-22)=2ORE=2THEN570
64 IFJ>0THENJ=J+1:GOTO84
65 POKEM,A
70 B=B-1:PRINT" "TAB(3)S;TAB(16)B;"  "
71 IFB=0THEN570
72 K=PEEK(197)
74 IFK=44THENGOSUB2:M=M-1:A=14:E=PEEK(M):D=-23:F=21:G=-2
75 IFK=45THENGOSUB2:M=M+1:A=15:E=PEEK(M):D=-21:F=23:G=-1
76 IFK=52ANDE=1THENPOKEM,1:M=M-22:A=58:E=PEEK(M)
80 IFK=32ANDJ=0ANDE=32THENGOSUB2:M=M+D:E=PEEK(M):A=16:J=1
84 IFPEEK(M)=2ORE=2THEN570
85 IFPEEK(M+22)=32ANDJ=0THEN800
86 IFE=7ORE=8THENGOSUB610
88 IFM=7755ORM=7759THEN700
98 POKEM,A
99 GOTO60
100 PRINT"J"
105 PRINT"          "TAB(9)",- ./"
110 FORI=1TO400:NEXT
112 POKE649,1
115 PRINT"          "TAB(9)"
120 FORN=1TO100:GETA$:IFA$="S"THENRUN
127 NEXT
130 GOTO105
500 V=36878:POKEV,15:RESTORE
510 FORX=1TO51:READO:POKEV-2,O:READO:FORY=1TO70*O:NEXT:NEXT
520 DATA195,3,207,1,215,2,225,2,231,2,228,2,225,2,219,2,212,2,215,4,0,2,195,3,20
7,1,215
530 DATA2,225,2,231,2,228,2,225,2,219,2,215,4,0,2,215,2,228,4,0,1,228,3,221,1,22
3,2,215
540 DATA4,0,1,215,2,225,4,0,1,225,4,221,1,225,1,221,1,215,1,209,2,203,2,212,4,0,
1,212,4
550 DATA209,1,212,1,209,1,203,1,195,2,175,2,187,2,195,4,0,2
560 U=1:RETURN
570 POKEV-2,0:POKE7740+W,32
580 POKEM,17:FORI=230TO127STEP-.5:POKEV-4,I:NEXT:W=W-1:PRINT"J";
585 IFW=0THEN100
588 IFW=1THEN600
590 FORI=2TOW:POKE7739+I,58:NEXT
600 GOTO1
610 POKEV-2,0:E=32:POKEM,11:S=S+50:FORI=128TO240:POKEV-2,I:NEXT:POKEV-2,0
620 RETURN
700 POKEM,A:POKE7739,9:FORI=1TO10
705 PRINT"             I
715 FORR=1TO200:NEXT
720 PRINT"              EFV"
725 FORR=1TO200:NEXT
730 NEXT
738 B=B-1:S=S+1:PRINT" "TAB(3)S;TAB(16)B;"    ":POKEV-2,220:FORR=1TO10:NEXT:POK
EV-2,0
740 IFB>0THEN798
742 POKE7739,10:FORR=253TO0STEP-1:POKEV-3,R:NEXT:PRINT"J";:GOTO590
800 POKEM,13:FORR=1TO30:NEXT:POKEV-2,P:POKEM,32:M=M+22:IFPEEK(M)<>32THENM=M-22:G
OTO570
810 P=P-4:GOTO800
```

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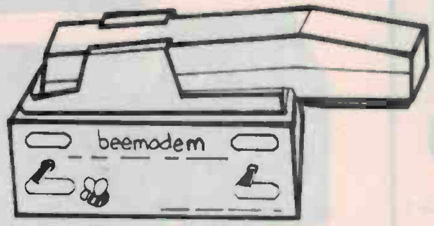

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The **microbee** is designed and manufactured in Australia under strict computer controlled standards, and is backed by a strong national service team, operating from West Gosford and through **microbee** Technology Centres Australia wide.

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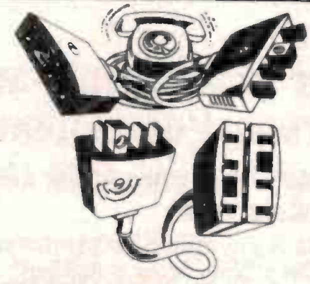

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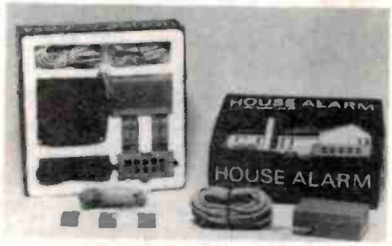

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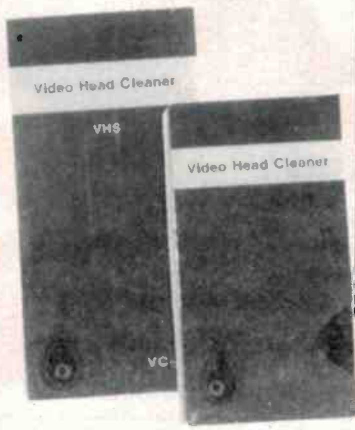

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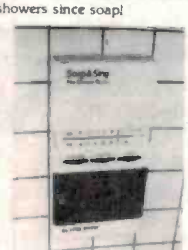

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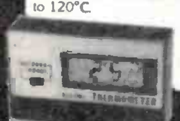

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VOA picks up reduced BBC audience

The British Government has cut the budget of the BBC's External Services by £1 million, while the Voice of America has announced an increase in transmitting and the number of languages making them the number one international broadcaster in the Western World.

Pat Gate, presenter of the Voice of America morning program, heard from Washington at weekends.

A member of the frequency and monitoring staff of Voice of America, Washington, Bill Whitacre, spent some time with me recently looking at the Voice of America service to Australia and New Zealand, especially the timing of the transmissions in relation to New Zealand and Australian daylight time. In New Zealand the local time of evening transmission is midnight, and morning transmission is 11.00 am. Regard was also taken to the fact that some Australian states do not move to daylight time, so that schedule information in local time has to be altered in VOA publications.

The Voice of America has a major expansion programme under way including nine new relay stations (three in Morocco, Thailand and Sri Lanka, and six elsewhere still under negotiation), one hundred new 500 kW shortwave transmitters, an increase in languages from 42 to 60 (adding for the first time Western European languages like French, German and Italian), two parallel services to the USSR to serve different time zones, and a 50 per cent increase in broadcasting hours from 1000 to 1500 hours a week.

Transmitters throughout the world will be standardised at 500 kW. At present VOA operates transmitters with powers of 8-250 kW entailing maintenance, spares and production problems.

Bill Whitacre, who works in the field of frequency allocation and transmitter supervision of times and frequencies, is also convinced that the shortwave listener would be better served without jamming. In fact the whole future of shortwave depends very much on the decrease of this type of interference, which in parts of Europe covers 80 per cent of a given shortwave band. It not only destroys the intended signal, but as jamming is a spreading signal, it also interferes with adjacent stations. The increase in transmitters to serve Eastern Europe also results in an increase in jamming, so that the problem is not being overcome by this means.

A Voice of America transmission to Cuba has been under discussion for many months, with the projected Radio Marti station on 1180 kHz. It is also felt that as well as mediumwave coverage, effective FM coverage to Cuba could be obtained from Key West or the area in the Florida Keys but it would be necessary to mount a huge aerial system to effectively serve an FM audience in Havana.

— Arthur Cushen

Morse course from High-Tech Tasmania

High-Tech Tasmania has met the problem of teaching Morse code with the release of Morse Course, a teaching package for the Microbee computer. The student is taught to recognize Morse characters by their sound alone, through a computer's speaker or a set of earphones. There are none of the old style references to dots and dashes.

Morse Course breaks the learning process down into six levels of instruction. The learner is started on the easiest letters, and then progresses up through more difficult stages until the most obscure punctuations are tackled at level 6. Only the first four levels are required for amateur examinations. The two highest levels are included for commercial exam candidates.

Morse Course can also be used in conjunction with Wordbee, the word processor supplied with all Microbee computers.

In the 'level' teaching mode, the student is sent randomly generated groups of five characters. The characters are also stored in Wordbee so the student can refer back to them later to confirm what was sent. As well, Morse Course can send plain language Morse code, generated from any document file that can be written or stored under Wordbee.

While Morse code is being sent, its sound can be recorded directly onto a cassette recorder, allowing the production of Morse practice tapes. The material stored in the word processor can be printed on any serial or parallel printer. The program can be stopped at any time and the code speed set to any value between three and 60 words per minute. The program then resumes where it left off, at the new speed.

Morse Course is available by mail. The cost, for a cassette and full instructions, is $18.50 post paid.

Orders to **High-Tech Tasmania, 39 Pillinger Drive, Fern Tree, Tasmania 7101.**

Icom hand-held radio

Icom (Australia) Pty Ltd has announced the release of a new CRS hand-held radio, designated the IC-40.

Thumbwheel switches are used to select any of the 40 channels available, and the synthesizer gives the user full advantage of the many repeaters available in the CRS band with semi-duplex and simplex operation. A power output of 1 watt is standard and 3 watts available with an optional battery. Input sensitivity better than 0.4 µV for 12 dB sinad has been achieved by using the latest low noise semiconductor technology.

Several battery packs are available which provide a range of power and working life.

Log book and Morse course on VZ200

Two programs for CB and ham enthusiasts for the VZ200 microcomputer (unexpanded) have been developed by a new Tasmanian enterprise, Hi-com Programs.

'Log Book' takes advantage of VZ200 command of INPUT# and PRINT#, which enable you to load and retrieve file data from the tape while the program is running.

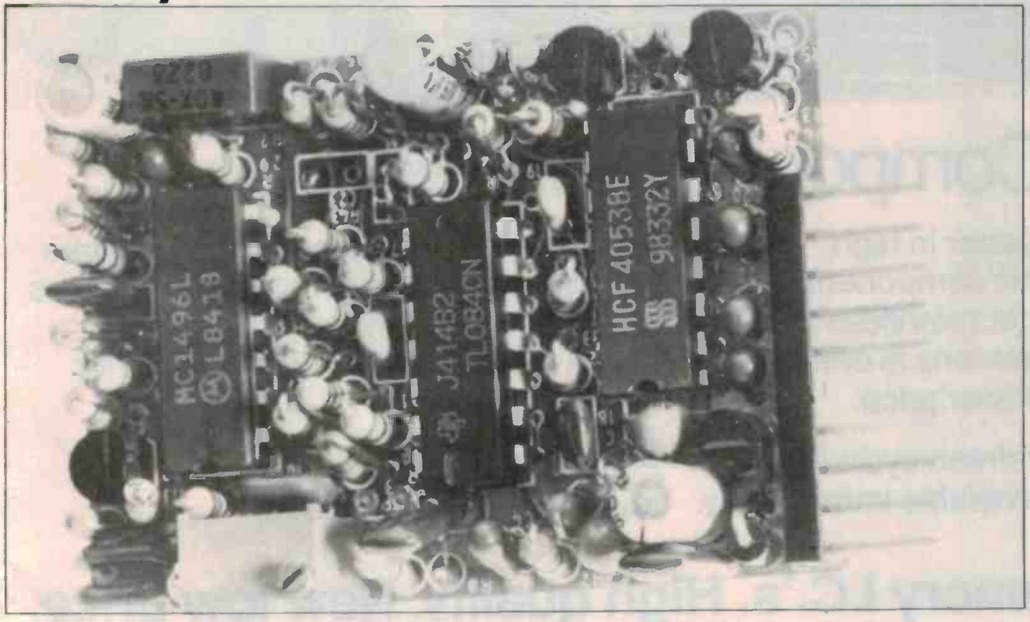
Included in this 'log book' package is a similar program that uses DATA commands to load and retrieve file data.

'Morse Code' is aimed at an operator studying for a novice amateur licence. As well as teaching the Morse code, the operator can be drilled in single letters, single words or full sentences; this can be from letters to code, or vice versa. This program is claimed to be based on sound educational ideas and gives some assistance when errors are made.

Program tapes are available at $6 for the log book package; $6 for the Morse code; $10 for both programs.

For further information contact **J. Hirst, Hi-com Programs, RSD 170, Exeter, Tas 7251. (003)94-4003.**

Locally manufactured radio scrambler



Privacy on shared radio channels and security from eavesdropping scanners are now financially within reach of most two way radio users, with the release by Melbourne based Sepac Industries of a locally designed and manufactured S900 voice scrambler.

The S900 encode/decode scrambler module has been miniaturized so that it can be internally mounted in most radios. It provides selection of clear or coded speech by a simple single switch operation.

No Department of Communications type approval is required for the fitting of the pc board provided it is in an approved radio.

All enquiries should be direct to **Sepac Industries (Australia) Pty Ltd, 134 Beach Street, Frankston, Vic 3199. (03)781-3144. Telex AA38691.**

180,000 Components for Peanuts!

Siemens, a world leader in high technology electronic components is even better known for relentless quality control. And now Siemens is offering memory I.C.'s at a lower price.

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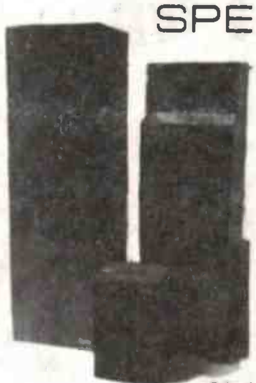

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50 Hz–20 KHz ± 3dB
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88dB SPL, 1W
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Constant monitoring of the optical link together with local and remote loopback testing are all provided on the front panel.

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OPEN DAYS

CSIRO
RADIOPHYSICS

SATURDAY 20th APRIL 1985
10 AM to 5 PM

SUNDAY 21st APRIL 1985
10 AM to 5 PM

Cnr VIMIERA and PEMBROKE ROADS, EPPING NSW 2121

The CSIRO Division of Radiophysics is opening its doors to the public. Some 40 displays and laboratories will be open for inspection and scientists will be presenting informal talks and discussion sessions on aspects of their research work.

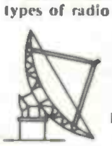
The theme of the displays will be

ASTRONOMY AND TECHNOLOGY

MEETING RESEARCH CHALLENGES FOR THE FUTURE

The Division conducts research in radiophysics in its application to community and industrial problems. New research areas on display will include demonstrations of two new antenna testing ranges, very-large-scale integrated circuit design (VLSI), computer-aided engineering and electronic circuit design, signal processing, image processing and microwave device fabrication. Design and construction details of the new Australia Telescope being built at Narrabri in New South Wales — a Bicentenary project — will be a major feature of the displays.

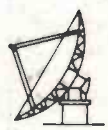
The Parkes 64-metre radio telescope is operated by the Division of Radiophysics. Studies on objects such as quasars, pulsars, neutron stars, black holes, galaxies and the Milky Way are pursued there as part of the Division's astrophysics research program. One of the highlights of the open days will be the provision of a telephone link-up to the telescope which will allow visitors to request the telescope to observe particular types of radio sources.



Light refreshments will be available at cost.

Parking is available on site or nearby.

For further enquiries, telephone (02) 868 0222



PULSAR

Little Big Board

Now reduced from $750 to $450

thousands sold

PULSAR ELECTRONICS PTY. LTD.
19 Catalina Drive, Tullamarine. 3043
Phone 330 2555.

Jaycar in Sydney is selling the ETI-183 op-amp tester for $29.95. It also advises that the CDI we published in February 1985, ETI-342 is available in kit form for $99. This is a lot more expensive than the original cost estimate, but Jaycar has put together a kit employing extremely high grade components. If you are thinking of building this project, it's probably worth the extra money. Remember that automotive electronics do not have an easy life!

Dick Smith Electronics will be supporting the op-amp tester. They are also putting the fibre optic experiment together in kit form. Alternatively the core of the project, the HFBR-0500 fibre optic kit, is available from Federal Marketing through the offer on page 65 in this issue. The rest of the parts in this project are as common as mud so you should be able to get them from the local corner store.

The same can be said for the printer sharer ETI-667. The only problem here is the pc board, which is double-sided.

Artwork

Making your own pc boards? Full-size positive or negative film is available for the prices listed below. Send requests, with payment, to: ***ETI-xxx Artwork, ETI magazine, PO Box 227, Waterloo NSW 2017.*** Make sure you specify positives or negatives, according to the process you use. Make cheques or money orders payable to 'ETI Artwork Sales'. Here are the prices for this month's projects: **ETI-1526a pcb $1.50; ETI-1526b pcb $2.50; ETI-183 pcb $2.70; panel $3.40; ETI-667 pcb $6.90; panel $3.10. (Note ETI-667 uses a double-sided pc board.)**

Boards and panels

Front panels and pc boards for our projects may be obtained from the following suppliers:

All Electronic Components
118 Lonsdale St
Melbourne Vic 3000
(03)662-3506

RCS Radio
651 Forest Rd
Bexley NSW 2207
(02)587-3491

Jemal
PO Box 168
Victoria Park WA 6100
(09)451-8726

Mini Tech
PO Box 9194
Auckland NZ

For pc boards produced in recent years, the following suppliers either keep stocks on hand or can supply to order:

Acetronics
112 Robertson Rd
Bass Hill NSW 2197
(02)645-1241

Jaetronics
58 Appian Drive
St Albans Vic 3021

Jaycar
117 York St
Sydney NSW 2000

Rod Irving Electronics
425 High St
Northcote Vic 3070

MINI MART

AUDIO

FOR SALE: B & W DM70 monitor speakers. 70 W RMS, 20 Hz to 22 kHz, 9 electrostatic panels, and a 12-inch woofer in combination make this one of the finest speakers available. $950 offers. (02)869-1840.

FOR SALE: TRANSCRIPTOR FLUID reference tone arm. Superb precision arm with instructions, only $55. (02)869-1840.

FOR SALE: LOW IMPEDANCE, wide response omnidirectional cassette replacement microphone, suits most recorders. $9 including postage. A. Vennonen, 3 Simpson St, Watson, ACT 2602.

FOR SALE: STAX SR5 electrostatic headphones and SRD-6 driving unit, both in excellent condition. $50 ono. J. Banes, 8/3A Montagu St, Lenah Valley, Tas 7008.

COMPUTERS

FOR SALE: ETI 660 and 760 3K RAM, colour calculator keyboard. No case, with transformer. $70 ono. Ring Geoff Pack (02)427-6304.

WANTED: ANYONE with information of a Light Pen for a Challenger computer. Phone D. Mangelsdorf on (069) 75-3422.

FOR SALE: MICROBEE 32 Plus with 4 MHz mod., EDASM, Kaga Denshi green monitor, $350, contact Ken on (02)498-7270.

WANTED: MYTEK Digitalker for the MicroBee. Best offer taken. Michael Quinn, 69 Eyre St, Broken Hill, NSW 2880.

VZ 200 SOFTWARE, cash book ledger, assembler, utilities, hardware tips etc. Send SAE to Mr J. C. E. D'Alton, 39 Agnes St, Toowong, Qld 4066.

MICROBEE: Series 2 Personal Communicator, TV/monitor, cassette recorder, $250 of software. $550 ono. Ph. Stuart Gibbs (03)583-6497.

VIC-20 PROGRAMME library. High quality games, utilities and miscellaneous programs available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson, ACT 2602 for list.

FOR SALE: TI/994A Computer $180; peripheral expansion box (unused) $190; disk controller card (unused) $99; mini memory module $35 and many other modules, magazines etc. Call Phillip on (02)371-0231 7pm.

WANTED: S100 disk drive card with drive and CP/M suitable for applied tech. DGZ80 CPU card. Phone Tony Eyles (089)27-5539 home, or work (089)81-8499.

FOR SALE: COMMODORE 1520 printer/plotter, hardly used, $125. ETI-659 VIC-20 audio cassette interface kit, $15. Contact P. Gericke, Box 674, Naracoorte, SA 5271. (087)64-4276.

FOR SALE: 32K PERONAL communicator BW TV/monitor, $100 games software, all manuals. Value $700 sell $450. Paul (02)604-7684.

ANYONE IN AUSTRALIA or New Zealand owning a Nascom 1, 2 or 3 microcomputer and wishing to swap information please contact me. Richard Hanrick, 22 Ash St, Kirwan, Qld 4814. (077)73-4344.

FOR SALE: MICROBEE-Chatterbox; plain text (words and numbers) to speech in real-time machine code, cassette $25, details SAE, 37 Nimboya Rd, Marino, SA 5049.

FOR SALE: MICROBEE Micropascal (tape based integer PASCAL) for 32K Microbee. Has all major PASCAL commands plus hires/lores graphics, full error messages, etc. $15 (includes 12 p user manual). R. Moyle, 75 Harborne St, Wembley, Qld 6014. (09)381-4908.

FOR SALE: OSCAR 10 SATELLITE orbital data for your location. 1 month $10, 2 months $18, 3 months $25. Send SASE for sample printout. I. O'Toole, 222 Old Northern Rd, Castle Hill, NSW 2154. (02)680-2112.

FOR SALE: SIEMENS #100 Teleprinter with copy of manual $65. ETI-672 Microbee teletype interface $80. (02)456-2799.

FOR SALE: DOUBLE header tape backup program for the Microbee. Allows speed change, auto etc. $10 post paid from M. Greer, 183 Algester Rd, Algester, Qld 4115.

FOR SALE: 80 MICRO (USA) back issues $4. APC back issues $2. EDTASM plus (tape) $25. WORP 1 W/P (disk) $10. Send SASE for full list. M. Richmond, PO Box 16, Kootingal, NSW 2352.

FOR SALE: VZ200 software 8K 'Teacher Zapper'. Like 'Space Invaders'. Tape includes joystick and keyboard versions plus bonus maths/utilities, manuals. $A5. J. L. Sortland, 1 Mullion Cl, Hornsby Hts, NSW 2077.

FOR SALE: MICROBEE 32K, Editor/Assembler, Wordprocessing in ROM, Wildcards books, manuals and games. Cost $700, sell $400. P. Frankenburg, 'Warrangee' Howlong, NSW 2643. (060)26-5356.

FOR SALE: ACT VIC-20 bimonthly magazine. Many interesting articles and programs. February issue $2. Write to Chris Groenhout, 25 Kerferd St, Watson, ACT 2602.

FOR SALE: COMPLETE chip set for Talking Electronics TEC1A computer kit. Value in excess of $50. Will sell for $20. Ian, 12 Saligna Way, Macquarie Fields, NSW 2564. (02)605-5323, after 4 pm.

FOR SALE: SUPER 80 Disassembler on cassette $9. Siemens teleprinter $40 GC. R. Vowels, 93 Park Drive, Parkville, Vic 3052.

MICROBEE: TENNIS and Squash $5, Hyperspace and Grand Prix $5. Each includes tape and listings. T. B. Knowler, 5 Keane Pl, Fraser, ACT 2615.

COMMUNICATIONS

FOR SALE: YAESU FT107 DMS, FC107, YM38, BASE. Station used 10 hrs TX. Going mobile. $950 ono. Graham VK4VJQ (077) 43-4917.

FOR SALE: YAESU FT-200 complete with power and supply circuits, also trapped vertical antenna complete with groundplane $250. R. W. Buck, 90 Dight St, Richmond, NSW 2753.

MISCELLANEOUS

FOR SALE: TEKTRONIX 524 D oscilloscope, 10 MHz bw, 60 Hz to 5 MHz at 1%, sweep delay, amplitude calibrator, time mark generator, complete with probes, mint condition $450. (02)869-1840.

FOR SALE: FLUKE 8024B digital multimeter with manual and leads as new $250. Brian, 200 Goulburn St, East Sydney, NSW 2000. (02)211-5833.

WANTED: 811A VALVES. L. Sharp VK4NS, 19 Kelso St, Chermside, Qld 4032.

Cruising the Pacific for ANZCAN

Mary Rennie

Being paid to sail the Pacific aboard a comfortable modern cableship may seem the mariner's day off. On the other hand a cable break six kilometres under is a daunting prospect. Cableship Pacific Guardian was in Sydney early this year impressing mariner and engineer with a demonstration to temper both these conceptions.

THERE IS NOT a great deal of choice when it comes to cable repair and maintenance firms but enough to behove the contracted firm to maintain a favourable impression. The loss of a single contract could mean a savage revenue loss for the firm involved which meanwhile has huge investments in ships, crews and research.

The firm contracted to maintain the ANZCAN cable and others in the South Pacific region and which was also responsible for laying most of ANZCAN, is the British firm Cable and Wireless. Cable and Wireless operates a fleet of six ships of which its latest cableship, the Pacific Guardian, serves the South Pacific region. The ship was in Sydney in January to demonstrate its adequacy to 'employer' OTC and impress others who took an interest.

The Pacific Guardian

The Pacific Guardian was built in Britain at the cost of $30 million and launched only last year. From there it sailed to home base in idyllic Suva, where it can lie both idle and well painted: according to an OTC spokesman, there is only a cable fault every two to three years. But when something does go wrong, it can mean long, tedious work for the officers and crew, sifting through mud, dragging the ocean floor, hauling up cable and testing it in all sorts of weather and for days on end.

The Pacific Guardian is powered by four 4,400 kW engines with usually only two running to travel at a speed of up to 16 knots. A speedy manoeuvrable ship is necessary with thousands of kilometres of ocean to patrol above thousands of kilometres of cable.

So it is packed with 'state of the art', gadgets and systems and with far sighted provision for more. Mere run of the mill is the unmanned engine room; more remarkable is the thruster operation by means of which the ship can be manoeuvred in any direction. The thruster works by sucking in water to force down a vertical shaft and out onto a circular grid. The grid can rotate to any position determining the direction into which the ship will be thrust. All this controlled by the modern joystick.

Special attention was paid to balance and the ship has a roll damping tank to enable work to be carried out in heavy seas. Not a painted ocean but striving for it. On board, the clean room has yet to be equipped for repairing repeaters or furnished with its complete computer system. Repairs for now are restricted to damaged cable and replacement of repeaters. Faulty repeaters are returned to their manufacturer for examination.

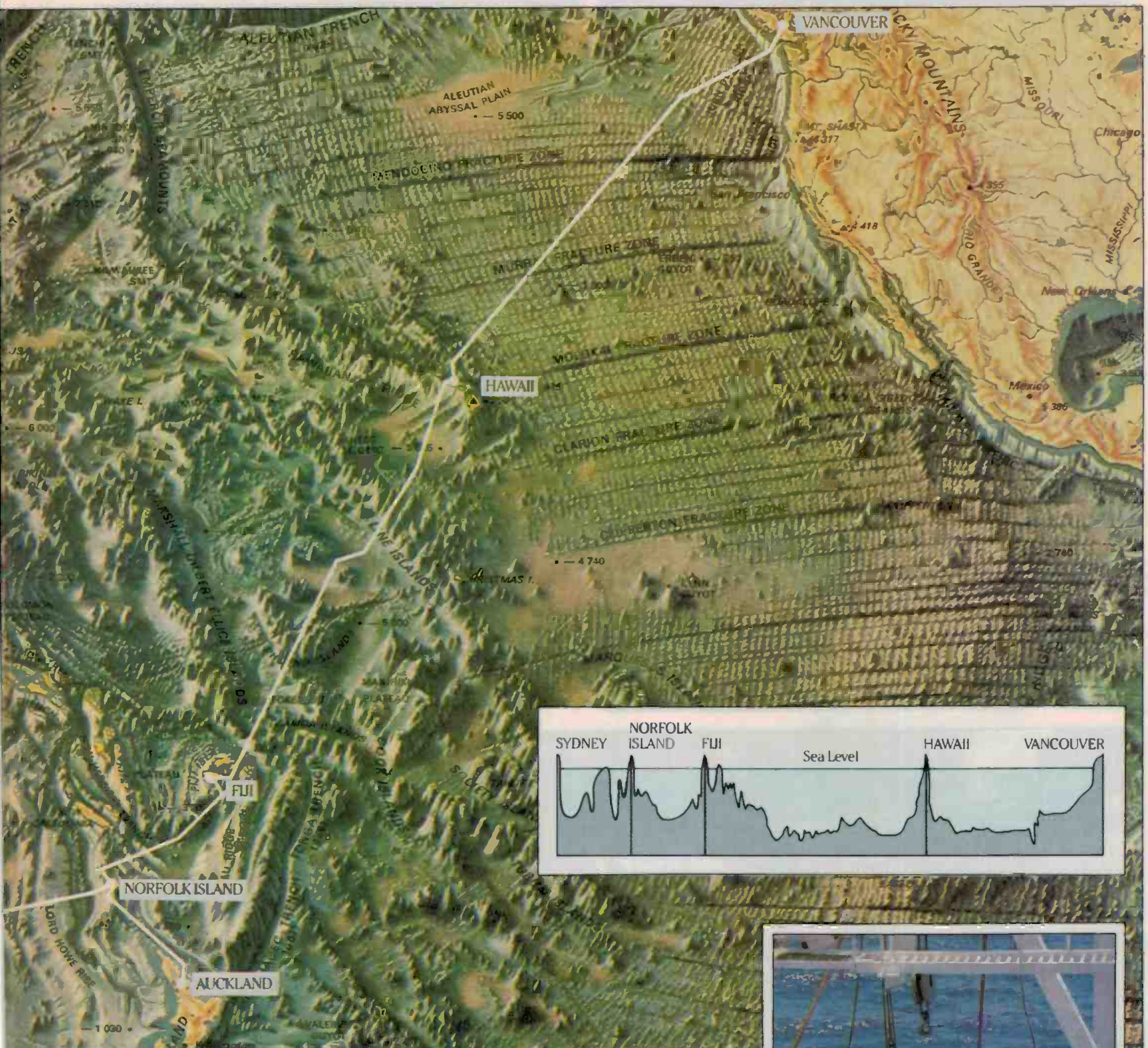
Finding the fault

Most cable faults occur around the coastal area, particularly in the region between Jakarta, Singapore and Hong Kong where fishing trawlers quite often damage cables with their anchors or chafing on rocks occurs. Around the Hawaiian islands, where ANZCAN lies, volcanic activity is likely to cause damage. Faults close to shore are in some sense fortunate because the cable is more accessible and the shore stations can assist the cableship in testing and exactly locating the fault.

Shore stations closely monitor cables for faults by taking daily tone readings from cable repeaters by means of Submerged Repeater Maintenance equipment (SRM tests). Each repeater is fitted with an oscillator circuit which resonates at a vacant frequency on the cable's bandwidth. If a repeater is faulty and fails to amplify the tone, or the cable is damaged the tone fades. Engineers at the shore stations at either cable end note the repeaters from which the signal still comes in clearly — and therefore, from which point a fault has affected tone transmission.

At present, tone from repeaters on the Asian SEACOM cable between Guam and Madang is down about 7 dB. OTC engineers monitoring this have determined between which repeaters the fault lies but expect the cable will be removed from service before the fault becomes too debilitating.

Shore stations carry out a variety of tests to locate cable faults. These depend on the type of fault and its location. A cleanly broken cable where outside sheath and inner core of the coaxial cable are exposed to the salt water, allows the shore station to run what is known as a dc test. The salt



water acts as a conductor short circuiting the cable and a direct current applied to it gives a measurable voltage. Using Ohm's law, resistance can be calculated and compared with the known resistance of the cable and repeaters, to calculate the distance to the fault.

Damage that does not sever a cable to form a short circuit is more difficult to isolate but more common. In such cases the shore station can test the cable for capacitance and similarly calculate comparative distances accurate to five to ten per cent, but quite often it is necessary for a cableship to conduct pulse echo tests at various intervals along the cable.

The pulse echo test requires a pulse to be sent along the cable from either the shore station or from the cableship. The trace of this pulse is monitored on a pulse echo fault locator (PEFL) where it will appear echoed or noisy when the signal encounters any changed cable conditions. The horizontal axis of the PEFL CRT graticule represents distances from the source so a fault echoed on the PEFL is fairly accurately mapped.

Above. Not a sandy bottomed seabed — ANZCAN lies on rugged ocean floor, much of it in volcanic areas. (Map supplied by Cable and Wireless.) **Right.** Going over the bow sheave and drum with a second rope and chain to attach to the raised cable. With the two chains securing it, the cable can be cut then either end hauled on board. (Photos by Greg McBean.)

ANZCAN

Nations may be littering horizons of space with satellites in holiday-like abandon but not entirely at the expense of the submarine cable as a means of communication.

Cables are necessary as a backup to a failed satellite system (notably in the event of star wars) and countries still pay enormous sums for them. Last year the ANZCAN cable was opened to replace the old COMPAC cable, at the staggering cost of $400 million.

For such a small thing as inch and half thick cable everything associated with ANZCAN is in enormous proportions, besides the cost. The cable stretches a long way — from Sydney to Vancouver via Fiji and Hawaii, branching off to New Zealand. Figures vary on cable specifics but according to OTC's published accounts the cable stretches 15,000 km, uses 1,123 repeaters placed at 14 km intervals and provides 1,380 telephone circuits — 18 times as many circuits as that of the 20-year-old COMPAC cable.

OTC is joint owner of the cable in a consortium of 14 nations, and consequent upon it as major shareholder the industry of cable manufacturing has been stimulated in Australia. About 40 per cent of repeaters were manufactured by Standard Cables and Telephones (STC) in its Liverpool NSW factory. According to OTC, industry figures break down to $40.3 million for repeater assembly and $12.4 million for the processing of raw materials in Australia. STC itself spent $10 million on the construction of a clean room for the manufacture of repeaters, which are fortunately guaranteed for 25 years. Most of the cable was laid by British firm Cable and Wireless, except for a small section north of the equator which was laid by a Japanese firm.

The impression of ANZCAN is clearly *big*. Such an investment needs to be maintained well; each moment it is out of operation costs OTC a good deal of income and the consumer inconvenience at least.

Above. Securing an end of cable even more firmly once on board. The cable can then be pulled inside the ship for testing or repairs. **Below.** The cable is hauled across the deck then over large drums to be fed into a series of hydraulic wheels and out to the working area.

The limitation on the pulse echo test is that the pulse can only be monitored up to two to three repeaters away. This means that the shore stations can only test in the first thirty to forty kilometres of cable and the cableship must test at six to eight repeater intervals thereafter. Usually however, the area of fault has been isolated by the SRM test monitoring the repeater tones.

The real cableship goosechase is when a cable develops noise or interference which cannot be associated with any particular repeater or area but which is continually amplified along the cable line. According to OTC, the last time this occurred it entailed the cableship travelling to a halfway point to raise the cable, determine the source direction then periodically raising and testing the cable at intervals until the fault was located. When it can take all day just to raise the cable in deep water, this is no nine to five job.

But, most faults don't occur in deep water and one other test for locating a fault is viable *only* in shallow water between shore and first repeater. A short trip indeed. From the shore station a fairly low frequency signal is sent along the damaged cable. A cableship like the Pacific Guardian equipped with reverse drilled electrodes, traces the signal by weaving a path across the cable at say 45 degrees until it is lost. The ship then returns to its starting point, repeats the exercise but at a finer angle until an exact point at which the signal ceases is determined, indicating the cable break. Beyond the first repeater the water is too deep and the signal too faint for the cableship to detect.

Hook, line and grapnel

Retrieving cable is not always easy business. Cables can be covered in metres of mud impossible to locate with sonar and difficult to hook on to. On top of this, inaccuracies can occur between map and cable owing to differences between one ship's equipment and another — or navigational mistakes.

Once the Pacific Guardian is judged in the vicinity of the cable the position is marked by a buoy as a reference for radar. At a point closer to where the cable is presumed to lie, a length of rope with an attached chain and grapnel is payed out, dropping to the ocean floor. The ship then travels slowly (at 1 knot) at right angles to the cable in an attempt to lock onto the cable.

When the grapnel hooks the cable, a tension meter on board the ship registers a weight. During a shallow water OTC demonstration the cable registered at

50 cwt tension weight and peaked at 800 cwt (20 tons!). Once hooked the cable is raised to the deck level; ropes and chains are attached either side to ease the tension and allow the cable to be cut at the slack middle point.

Either side can then be hauled on board while the other is payed out into the sea still attached to rope aboard the ship.

The enormous strain or tension in raising a cable in deep sea calls for a different approach and there cable is cut on the ocean floor. A special cutting grapnel is lowered to the cable first to cut, then another hooking grapnel is sent down and one side is raised in the normal fashion.

At this stage, the precise point of damage would still be a little indeterminate; in any case engineers don't want to raise the cable at the damaged spot, so the cable must be tested either side for the fault. Assuming that a PEFL test on the raised end indicated no fault, the cable is buoyed and returned to the sea and the ship manoeuvred to pick up the other end.

Cut cable is, of course, still very heavy stuff and hauling it on board requires some secure holding devices. As the Pacific Guardian pulls in the cable, its weight is distributed over various points on the ship starting with large drums between the bow sheaves where it comes on board. Other sets of drums take more weight before the cable is finally pulled through a series of controlled hydraulic wheels. These grip the cable but open wide enough to fit repeaters through.

On board cable work

On board, the Pacific Guardian is equipped with a laboratory to test raised cable, send signals along it, measure capacitance, impedance and resistance. It is also equipped to equalize repeaters after they have been replaced. Most testing done on the cable is carried out in a special working area outside the laboratory where the cable and repeaters are also joined.

Joining the cable involves splicing together the two ends of strengthening metal spine, covering them and the inner copper sheath with a metal casing, then crushing the whole under enormous pressure. Polythene casing is then moulded on to the join and the new whole cable is X-rayed for dirt or air bubbles. If any bubbles have been trapped, the casing must be stripped off and remoulded. The outer conducting copper shield is wrapped around the join and more casing applied and armouring if necessary.

Concluding

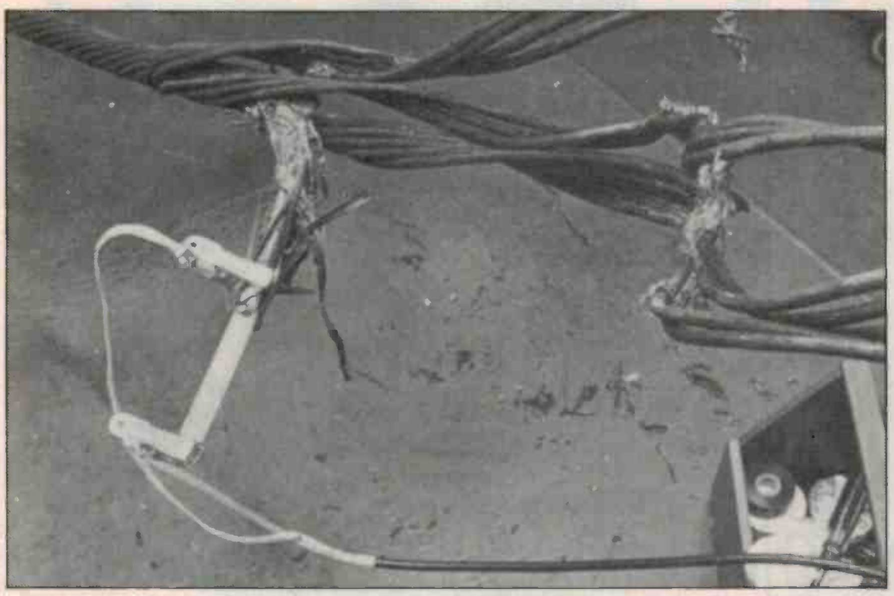
One of the highlights of the Pacific Guardian's relations exercise in Sydney was to take OTC representatives and journalists out for a 'mock cable repair'. The trip involved raising the superseded COMPAC cable, retrieving a repeater and short circuiting the New Zealand end for scientists there. The exercise demonstrated much of the Pacific Guardian's procedure and equipment and gave all a chance to roam the ship investigating at large. The delicacy of raising the cable — first hooking it, attaching ropes and chains while someone dangles vulnerably over the side, then dodging bits of flying armouring — was certainly appreciated. Very little testing was carried out, and no cable joining so most interest lay with the mechanical cable retrieval process. That was enough for most of us.

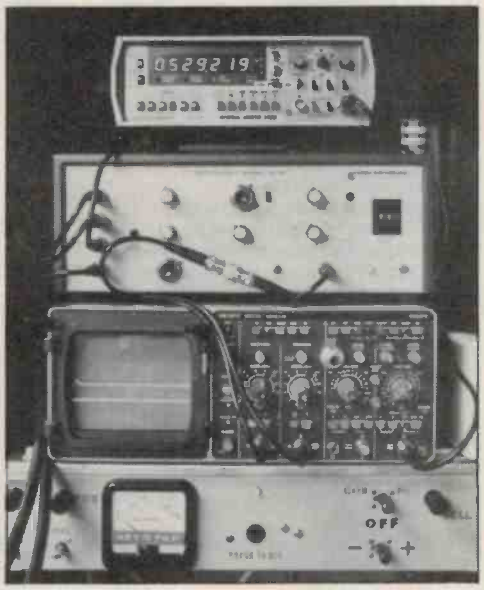
The opening of ANZCAN was an exciting event for OTC and for the geologically interested worldwide: each time a cable is laid it affords a new opportunity of measuring voltage differences between various points on the world's surface. And while scientists in New Zealand looked forward to toying with the short circuited COMPAC cable, OTC representatives arrived back in Sydney sunburnt, impressed, quite full from an absorbing day. The Pacific Guardian looked a little less painted, bearing the gnashes of chains and hooks, and its co-stars, the officers and crew, smiled still full of equanimity; after all, a PR holiday, getting away from the tediousness of work on the big wide Pacific Ocean and the office at tropical Suva . . . ●

SCARAB

One device for working with cables in the water and which has attracted some research is the SCARAB or submersible craft assisting repair and burial (of submarine cable). The SCARAB is a remotely operated vehicle (another likely acronym) which can locate, hook, cut, bury or move the submerged cable. Controlled from the cableship the SCARAB is equipped with sensors through which a video of the cable and environs is transmitted. It consists of a float which forms the main body to which two thrusters are attached; beneath this the claw-like manipulators work, joined to a frame supporting the main body. The sensors are located on the arms of the manipulators. Like some doubtful creature that scratches around in the mud and gnaws cable the SCARAB is aptly named.

The SCARAB has limitations though. It is only specified to dive to a depth of 100 fathoms or one mile, although it has worked as deep as 870 fathoms in tests. So far there are only two SCARABs working — one along the east coast of America and one in the Atlantic. Cable and Wireless has two more on order but there are no promises for the Pacific Guardian.





Above left. Cable is stripped of its armouring and polythene casing to expose the outer copper sheath and inner core to which clips are here attached for testing. **Above right.** The Pulse Echo Fault Locator which traces a signal sent along the cable showing an 'echo' on a screen marked horizontally in distances.

index 1984

PROJECTS

NOTES AND ERRATA 1984

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.

Project 1517, September '83: There are two errors in the wiring diagram of the Video Distributor Amp. On page 148, the two yellow wires from the 2851 transformer are shown going to the top and bottom tags of the tagstrip — this is incorrect. They should both be moved one tag toward the centre of the tagstrip.

Project 166, Part 4, October '83: The following errors crept into the parts list; C17 should be deleted, C18 — 22p ceramic, C19 — 470p ceramic, C20 — 4n7 greencap, C21 — 47n greencap, C22 — 470n greencap, C23 — 4µ7/16 V RBLL, C24 — 47µ/16 V RBLL. C24 shown on the circuit as 100n was not put on the pc board. It may be soldered on the copper side between pins 1 and 14 of IC4. There are two R40s on the overlay. The one next to R54 is actually R58. Some relays may not match the board and it will be necessary to drill extra holes and wire them in with links.

Project 175, Part 2, October '83: Q1 and Q2, shown in the parts list, do not exist.

Project 412, October '83: The linking for dot/bar mode is shown incorrectly on the circuit and component overlay. For a dot mode display, link pins 9 and 11 (as per the photograph of the board); for the bar mode, link pin 9 to the positive supply.

Upgrading the ETI-668 EPROM Programmer, January '84: Two connections to the 4PDT switch have been interchanged. Looking at the wiring diagram on page 70, the two upper and lower right hand wires have been transposed. The upper one says "PIN 7 PERSONALITY SKT" but should go to R14/15 — SW2b, the lower one says "R14/15 — SW2b" and should go to pin 7 of the personality socket.

Project 274, Damn Fast NiCad Charger, February '84: Figure 2 shows the battery negative connected to the heatsink. It should be insulated from it. The BYX/200L diode cathode connects to the collector of Q4/Q5 and R1/LED1 via the heatsink, not the wires shown.

Project 676, Microbee RS232er, February '84: The pinout for the transistors, shown on page 65, is all screwed up. Use the pinout on page 111.

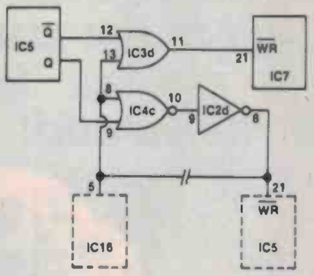
Ideas for Experimenters, February '84: On page 116 the 'electric floor heat earth leakage monitor' normally ticks at about 1 Hz, not 1 kHz as was printed. It was also stated that any small leakage of ten milliohms or less will increase the frequency of the output. The value of the leakage should be ten megohms.

Compost Calculator, February '84: A few errors were discovered in the flow chart on page 76. In the top half of the diagram, second from the left, under the heading 'flowchart compost' step six should be FOR J=1 TO N. On the far right under the heading 'search array and calculate C/N ratio', step four should be IF A(1,4)<−0.125.

In the bottom half of the diagram the steps following '500' should be D=+1, C=1 and H=1. Under '550' it should be D=−1. The third step following '600' should be C=C+D. Under '700' it should be D>0.

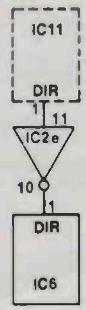
More functions for the VZ200, March '84: There is an error in the second column, just above the listing of the short BASIC program. It should be . . . (Can be done directly by POKE 30945,175.)

Idea of the month, April '84: The following bit of circuitry was left off the circuit diagram:



Notice that the WR lines of IC7 and IC5 should not be joined, but should be connected as shown.

There should be an inverter in the line from pin 1 of IC11 on the Microbee to pin 1 of IC6 as follows:



There is also an error in the program listing that accompanied the article. These should read: ▷

```
1. LD A, 50H            2. LD A, 2
   LD (0D3H), A            OUT (0CH), A
   LD A, 59 H              LD A, 59 H
   LD (0D4H), A            OUT (0DH), A
   LD HL, 0E1 H            LD A, 1
   CALL 85A7 H             OUT (0CH), A
                           LD A, 50 H
                           OUT (0DH), A
```

The role of ionospheric measurements in high frequency communications, by David G. Cole, May '84: The panel on pages 146-147, containing information of 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 Aerospace, is by way of illustration, the table of scaled parameters below it contains errors and should not be taken 'as read'.

Eprom programmer listing for ETI 662b Timer/Controller, May '84: Location 61C5H should contain 86 not 96.

Printers feature, July '84: 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.

Chip 8, July '84: 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.

Project 278, November '84: The overlay and wiring diagram on page 70 contains an error in the caption at the top left corner. The sentence "make sure the green (neutral) mains lead is the longest" should read as follows: "make sure the green/yellow striped earth wire is the longest."

Project 756, November '84: P. 107, last column, there are nine links on the decoder board, not eight. On the circuit diagram, P. 109, C23 should read 470n; Parts List is correct. P. 110, in the table under "Immediate Commands", the second command is SHIFT X. In the text on P. 110, second last paragraph, the last sentence should read: "See that the two polarized capacitors (C21 and C22) are correctly oriented." Note that R7 is actually 2k7, as per Parts List, not 4k7, as per circuit. ●

Special Reader Offer!

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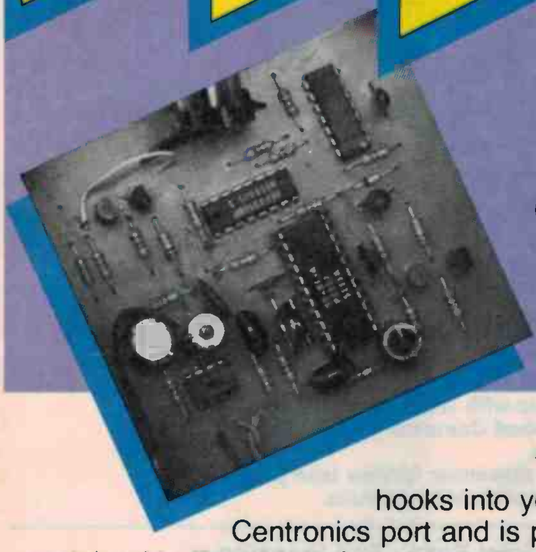

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The ETI-677 CHATTERBOX Voice Synthesiser Project was developed by Tom Moffat, well-known to ETI readers, who is Development Engineer for Flexible Systems, makers of the Tasman Turtle and Turtle Tot educational robots, which they export to Europe and the US. The project was designed around the Votrax SC-01 voice synthesiser chip. But that presented a problem — there was no Australian distributor for it when the project was first mooted. After some considerable footwork on the part of Flexible Systems, they managed to obtain an agreement with the Federal Screw Works (true!), manufacturers of the SC-01 chip. With supply assured the project was ready to roll. But in the past, voice synthesiser projects proved not terribly popular. They were relatively expensive; some gave limited realism, others had limited vocabulary. Perhaps the concept was 'too early'. So, to 'sweeten the deal' and to encourage the inveterate 'hacker' into the ground floor of a computing field that is rapidly burgeoning, ***Electronics Today*** and ***Flexible Systems*** devised this special offer, ***exclusive to ETI readers.*** Flexible Systems would normally sell this product for $90, but for ***the next three months*** they will offer it to readers for the fabulous price of ***just $75!***

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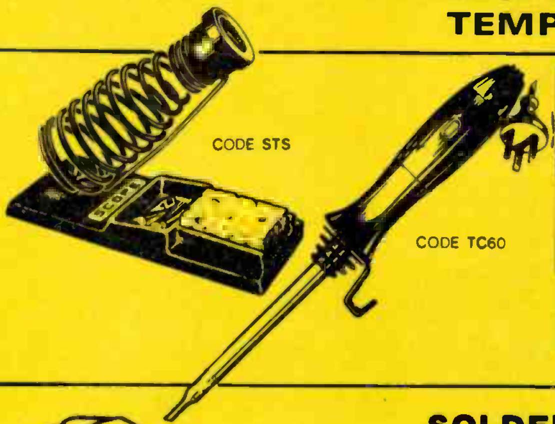

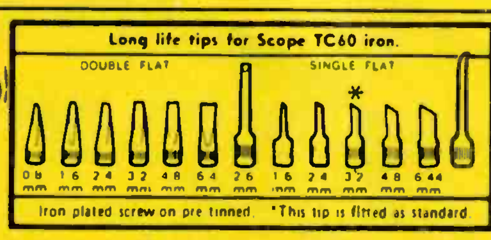

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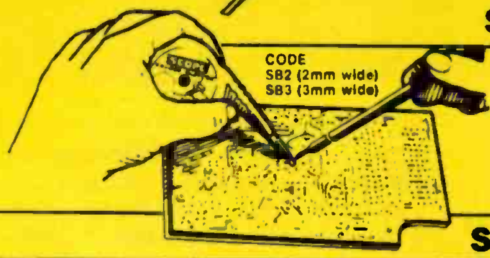
5. Safety Stand available.

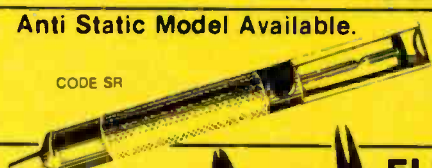
SOLDER BLOTTER That Avoids Burnt Fingers



1. Full 2 metre length/30% more than most brands
2. Avoid Burnt Fingers with Wind Back Dispenser
3. Because Metal Tipped Container keeps Fingers away from Iron Tip.
4. Heat resist nozzle dispenser locates tape positively
5. Plastic dispenser avoids short circuits

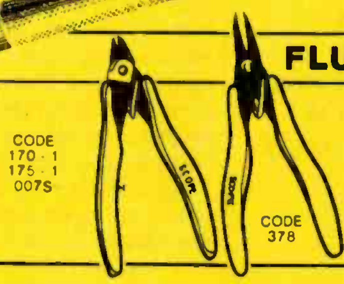
SOLDER REMOVER Metal Body - Self Cleaning

Anti Static Model Available.



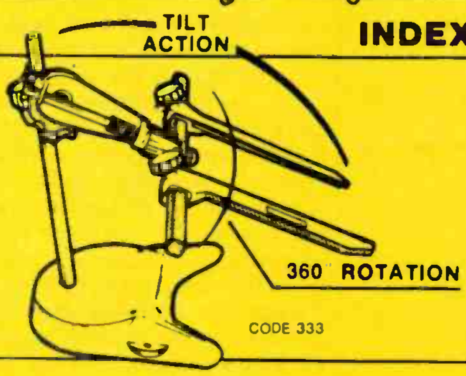
1. Avoids the cost of 'Desolder Braid'.
2. The heat resistent extended nozzle penetrates
3. The solid metal body resists crushing better than the plastic equivalent
4. Self cleaning 5. Safety guard protects faces.

FLUSHCUTTERS Designed for production use.



1. Slice action reduces fatigue
2. Cusion grip spring loaded handles mean real user comfort.
3. Models feature safety catcher which holds offcut till released.
4. Model 378 Long Nose (25mm) plier thin profile — serrated jaws.

INDEXING PCB HOLDER Locks in 32 Positions



1. Rotates and locks in 45° increments
2. Tilts and locks at 4 angles-vertical, 45° - 90° - 120°
3. Offers 200mm of vertical adjustment to the work height
4. Has a heavy cast iron base with bench mounting holes.
5. Retains the quick loading facility of spring mounted arms to hold the PCB
6. Offers cross bars to 750mm for large or multiple board work using extra sets of arms

Magnifier Attachment Available

N.S.W.
Avtek Electronics (02) 427 6688
A E Baker & Co Pty Ltd (02) 621 0044 AA26788
J Boomer & Co Pty Ltd (069) 21 4644
George Brown (02) 519-5855
Sheridan Electronics (02) 699-6912
Martin De Launay Pty Ltd (02) 267 1055 AA26679

S.A.
Bee Jay Electronics (08) 352 5959
Gerard & Goodman Pty Ltd (08) 223 2222 AA 88983

QLD.
Auslec-Austral (07) 262 2811 AA40418
BWD Audiotronics Pty Ltd (07) 44 7566 AA145138
Dunlop IBC (07) 892 0011 AA41561
Elphinstones Ltd (07) 52 0171 AA42503
Haymans Electrical Pty Ltd (07) 369 8400 AA44311
St Lucia Electronics (07) 52 7466 AA42883

W.A.
Atkins Carlyle Ltd (09) 321-0101 AA93750
Letco Trading Company (09) 387 4966 AA94396

VIC.
The Australian School of Electronics Pty Ltd (03) 523 5622 AA30625
Ballarat Electronics Supplies (053) 31 1947 AA37435
Ellistronics Pty Ltd (03) 561 5844 AA37758
Radio Parts Group (03) 329 7888 AA32980
Teleparts Investments Pty Ltd (052) 21 7085
McGraths Electronics (03) 347 1122 AA31001
Middendorp Electric Co Pty Ltd (03) 328 3233 (plus branches)

SCOPE

Having a good product isn't enough!

by Jim Rowe

YES, I KNOW that only a couple of months ago I said good managing editors are supposed to lurk silently in the background and be neither seen nor heard. But I do enjoy a bit of writing — after all, that's why I came back to magazine publishing. I guess it's in my blood. You may have noticed the stories I've written for ETI over the last year.

Anyway, David Kelly and I had a friendly discussion about me writing this column, and he lost. Well not entirely — look where he's decided to put me! Not exactly the most promising place to launch a dramatic return from the journalistic wilderness, but I guess it's better than nothing. Perhaps now and again the odd reader will venture back here to look for signs of life, so here goes . . .

It's funny, since I 'came back' quite a few people have asked me how I adjusted to working in the retail side of the electronics business, after 20 years working on a magazine. Many of those who knew me in my 'BDS' days (right — before Dick Smith!) have obviously been curious to learn how a pretty quiet and unassertive technical writer managed to survive in the rough and tumble world of retailing. Particularly in such a dynamic, energetic company like DSE, and working with you-know-who.

I won't deny it was certainly quite a culture shock, particularly at the start; but at the same time I learnt a lot. DSE happens to be a great place to learn about the dynamics of business. I count myself lucky to have worked there — not just with Dick himself, but with Ike Bain and all of the other people in that most interesting company.

Of course it remains to be seen just how many of the things I had the opportunity to learn have actually lodged permanently in the old grey matter. Hopefully a few, at least.

One thing I did learn was the importance of marketing and sales support. As a technical bloke, I confess I had always tended to look down my nose a bit at marketing and sales people, seeing them as overpaid hangers-on. Surely we engineers did the *real* work, designing the best possible product? Yet marketing and sales people seemed to get a far bigger and unfair slice of the profits, the grasping buggers!

I'm sure a lot of technical people still think this way, but it didn't take me long at DSE to see how wrong it is. Time and again I saw that it was marketing and sales support that could make or break an otherwise great product. With the right marketing and support, it could sell like hot cakes; without them, disaster.

What really drove this lesson home was visiting overseas distributors who were trying to sell the very same products that DSE was selling very successfully here. The differences were often dramatic.

I was reminded of this again only a few weeks ago, when my old friend Owen Hill (Mr Microbee) rang up with an invitation to meet some interesting people out from Sweden. You might recall our news story a couple of months ago, announcing that the Microbee had won a place on the Swedish schools contract (beating some of the multinational biggies, like IBM and Apple).

It turned out that some executives from Applied Tech's Swedish distributor Bergsala were visiting Australia. With them they'd brought a couple of educators and a representative of the arm of Swedish local government responsible for providing their schools with computers. Needless to say I was very interested in meeting them, to find out more about the Microbee coup.

Luckily the Swedish visitors spoke excellent English, which was just as well since my Swedish is non-existent. I was able to have quite a good talk with Jan Bostrom, Bergsala's educational products manager, and also with the local government chap Pierre Bastin. Then later on over lunch I was able to have quite a long discussion with the two educators, Jan Lundgren and Soeren Thornell.

It gradually became clear that without a doubt, the success of Microbee in Sweden is very largely due to the efforts of Applied Tech's distributor Bergsala.

This is not to decry the Microbee as a product; it's a great little computer, and excellent value for money. Nor am I in any way playing down Applied Tech's initiative in developing it right here in Australia and supporting it with a lot of software and peripherals. My hat's off to Owen and his crew; I only wish there were more like them.

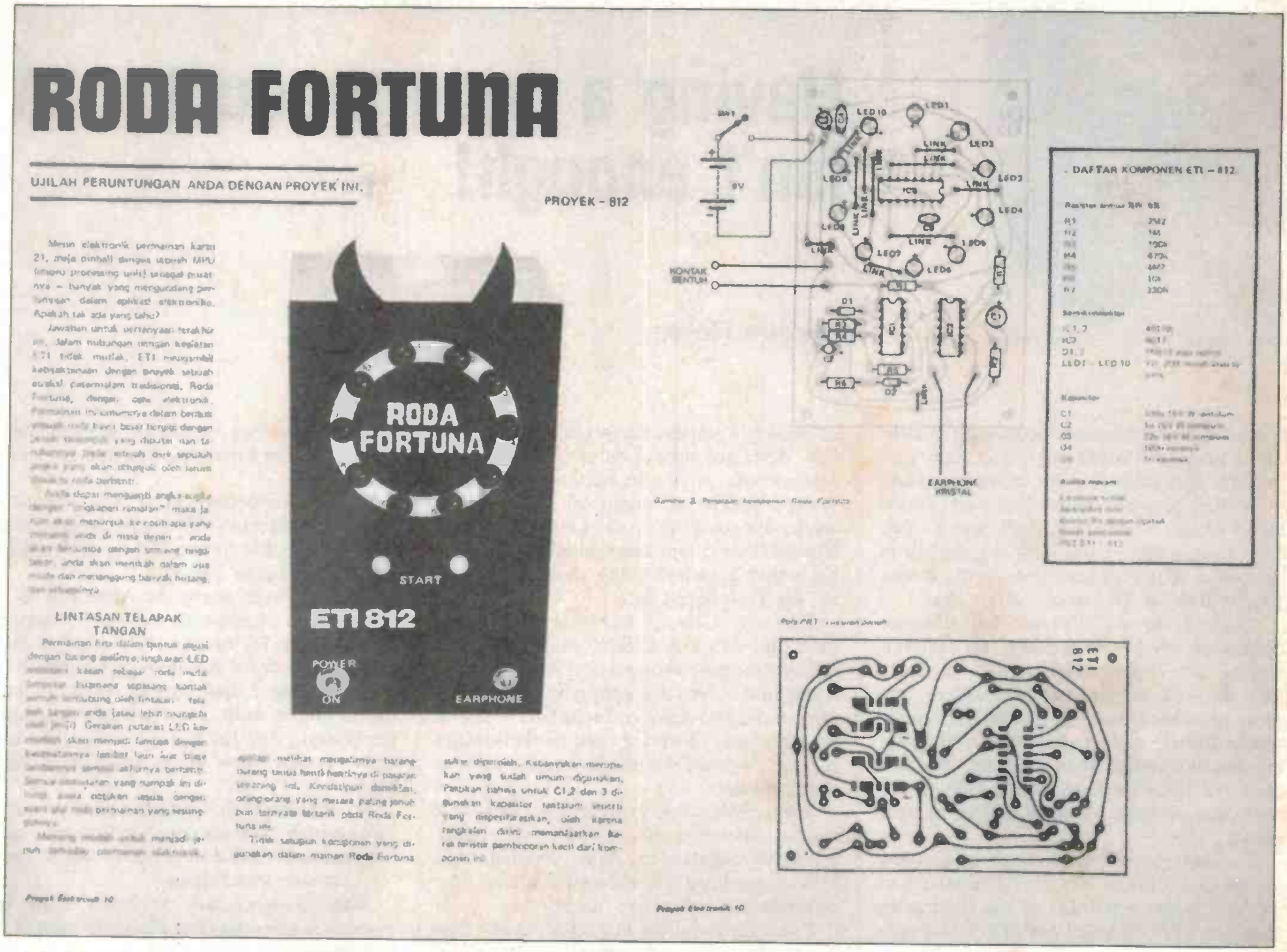
No, it's simply that having a good product isn't enough. You also need to find out what the customers need in order to use it, and then provide those things.

What Bergsala has obviously done in Sweden is take the Microbee and market it with support in this way. They've spent a lot of time and money translating the manuals into Swedish, reconfiguring software to suit the Swedish educational requirements, organising local books and other support items, and so on.

The big American firms don't seem to have done these things. Perhaps they didn't think it was justified, in view of the small size of the Swedish market (only 1.5 million). Perhaps they were planning to, but hadn't got around to it yet. Or perhaps they were complacent and thought their name and reputation would win them the contract without any real effort. Who knows?

It certainly shows the crucial role played by a local distributor when you're exporting to another country. They can make or break the whole enterprise, no matter how good your product may be.

And of course it also shows yet again the importance of marketing and sales support. Perhaps these people aren't overpaid hangers-on after all!



RODA FORTUNA

UJILAH PERUNTUNGAN ANDA DENGAN PROYEK INI.

PROYEK - 812

LINTASAN TELAPAK TANGAN

DAFTAR KOMPONEN ETI - 812

Readers of ETI sometimes wonder why we have the "I" on our masthead. Reason is we have editions published in Canada, UK, Holland, Germany and other countries. Just to make a point, the picture illustrates what the Indonesians did with ETI-812. We get around.

Scarecrows II

As regular readers of this column will no doubt realize, your Dregs hack has never been one to let a fact or two get in the way of a good story. Such is the case with the electronic scarecrow. (See December 1984.)

For his sins, the NSW Dept of Ag tipped neatly typed bundles of agricultural refuse all over the hack's head for suggesting they had the imagination to fund an Australian invention. Of course they didn't!

Sadly, I have to report that it was the dear old Ministry of Industry wot dun it. And it wasn't even a loan, just a loan guarantee to the tune of $200,000, through their small business section.

Apparently, if you are a small business, with a high technology product (i.e. one that uses an IC) the government will give, lend or guarantee you.

In another major development in this fast breaking story it appears that Mr Ron Fry, who, you may remember, was one of the directors of the scarecrow's Queensland distribution company, Agmark Industries, has actually shut down his operation just as things were starting to jump, scarecrow-wise.

In fact, Mr Fry has departed for greener pastures. Just exactly where those greener pastures may be, no one is saying. Ron baby, ring home! Everyone wants to talk to you.

Finally, if you want to find out what an electronic scarecrow really looks like, go to the Australian Design Council, 70 George Street in Sydney's Rocks district. It's on show.

Just don't try and open the box.