AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY!

Electronics Today INTERNATIONAL

eti
October 1984
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AM STEREO

DUAL STANDARD DECODER TO BUILD

PROJECTS

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DRUM SYNTHESISER

READY-SET-GO LIGHTS

CHIP 8 FOR THE MICROBEE
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INTRO TO RADIOTELETYPE

TOUCH TYPING IN THE COMPUTER AGE

EXPANDING YOUR VZ200 BASIC

DIGITAL AUDIO ENCODER FOR VCRs REVIEWED

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PAR 485

QUICK INDEX

THE FEDERAL GOVERNMENT'S decision to cut funds to the research and development community, in particular the CSIRO, can only be seen as short-sighted in the extreme. To my view, the decision is tantamount to saying ". . . we're going to invest in the here and now (i.e: an early election) and leave tomorrow fend for itself."

When it comes to government spending on research and development, Australia is right down the bottom of the heap. What little has been spent on our R&D community since world War II has returned phenomenal results. In many areas, Australia has been, and is, right at the forefront of developments, in both 'pure' and 'applied' research. Witness the Interscan aircraft landing system (a practical development) and our standing in radio astronomy. I mention these because developments in radio astronomy in Australia led to the successful development of the Interscan system.

The investment of public revenue in research and development projects is an investment in the future of the nation. Australia has never been, and will never be, a nation built around an industrial/manufacturing economy. Australia was the world's first nation to have a services-based economy. We missed the industrial revolution. Now that the services sector is on the decline we must look to the future. And that means we must encourage the so-called "brain-based" industries.

It seems the Government's expressed intention to focus on long term economic objectives has been swept aside for what they see as a short-term gain. While it's obvious to everyone we have a number of immediate problems to tackle, sacrificing the needs of the future will only exacerbate matters in years to come. And with the rapid pace of technological development occurring throughout the rest of the world, we're swiftly going to "get behind the eight-ball". Care to join the 'technological third world', anyone?

A farewell

ETI's Assistant Editor, Jennie Whyte, has been bitten by the travel bug. Jennie resigned in August and this is the last issue on which she worked. By the time you read this, she will be travelling in the People's Republic of China.

Jennie joined the magazine in mid-1982 and played a significant part in the development and growth of the magazine during a difficult period. Prior to joining ETI, she contributed articles on a freelance basis to Hobby Electronics and some of our other publications. During her time as Assistant Editor, she wrote a number of articles for ETI, as well as other magazines in our group, probably the most memorable being "Hitch-hikers' Guide to the Infrared Galaxy", the cover story in the August '83 issue.

Jennie's dedication to a complex and difficult task, her professionalism and unfailing sense of humour kept us 'on the rails' and significantly contributed to buffering the magazine from the effects of the recession and to our recent growth.

Not wishing to lose her writing talents, Jennie has agreed to submit freelance articles from time to time. This won't be the last we see of her. Bon voyage!

Roger Harrison
EDITOR

SERVICES

TECHNICAL INQUIRIES: We can only answer readers' technical inquiries by telephone after 4.30pm Mondays to Thursdays. The technical inquiry number is (02) 662-4267. Technical inquiries by mail must be accompanied by a stamped, self-addressed envelope. There is no charge. We can only answer queries relating to projects and articles as published. We cannot advise on modifications, other than errata or addenda. We try to answer letters as soon as possible. Difficult questions may take some time to answer.

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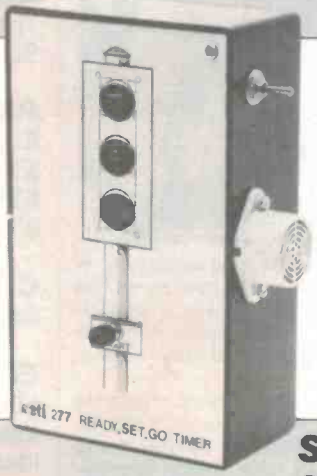
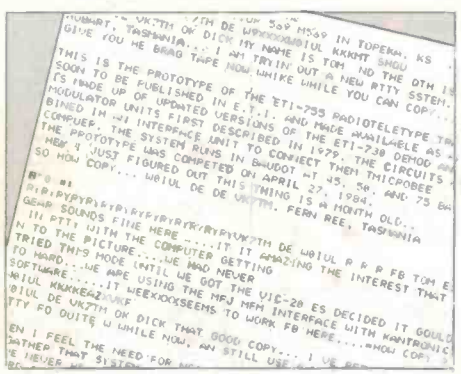
ELECTRONICS TODAY INTERNATIONAL is published monthly by the Electronics Division of the Federal Publishing Company Pty Limited, 140 Joynton Avenue, Waterloo, NSW 2017. Typeset and printed by ESN-The Litho Centre, Sydney. Distributed by Gordon and Gotch Limited, Sydney. Cover price $2.50 (maximum and recommended Australian retail price only; recommended New Zealand price, $2.95). Registered by Australia Post, Publication No NBP0407. ISSN No 0013-5216.

Sansui PC-X1 digital audio adaptor for VCRs p.38

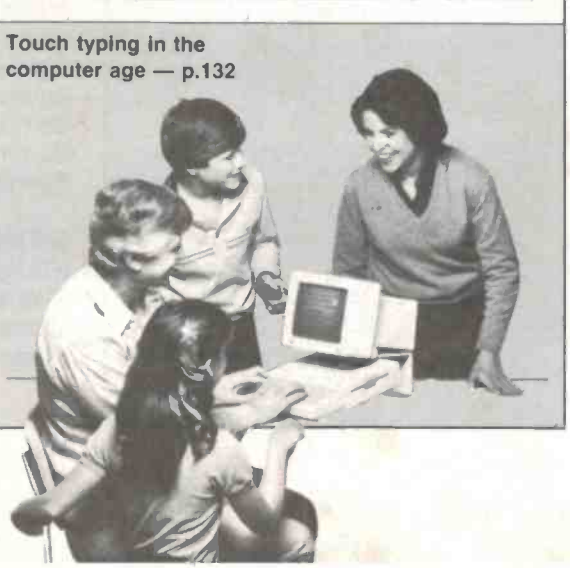


Read, Set, Go! Timer and lights p.70

SPECIAL OFFERS



The magic of RTTY; p.100



Touch typing in the computer age — p.132

NEWS

COLUMNS

DEPARTMENTS

This page is to assist readers in the continual search for components, kits, printed circuit boards and other parts for ETI projects and circuits. If you are looking for a particular item or project and it is not mentioned here, check with our advertisers.

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CONTENTS

FEATURES

PROJECTS

REVIEWS

COVER: design by All White.

NEXT MONTH

RADIOTELETYPE SPECIAL

More and more radio amateurs are getting into RTTY — generally via the computer so many now have in their 'shacks'. As foreshadowed this issue (see page 100), we'll be presenting *two* RTTY transceiver modem projects — one for the Microbee and one for the VZ200.

DIRECTIONAL DOOR MINDER

This simple project employs a twin light beam to sound a buzzer when the beams are broken when passing through them in one direction, but not in the other. So, you can use it to tell when somebody walks into a room, for example, but it won't sound when they walk out.

PROGRAMMABLE LOGIC CONTROLLERS

These devices, known as 'PLCs', are the sort-of "universal multipole switch/relay black box that can do almost anything". Our feature introduces the subject, the equipment and applications.

ADVERTISERS' INDEX

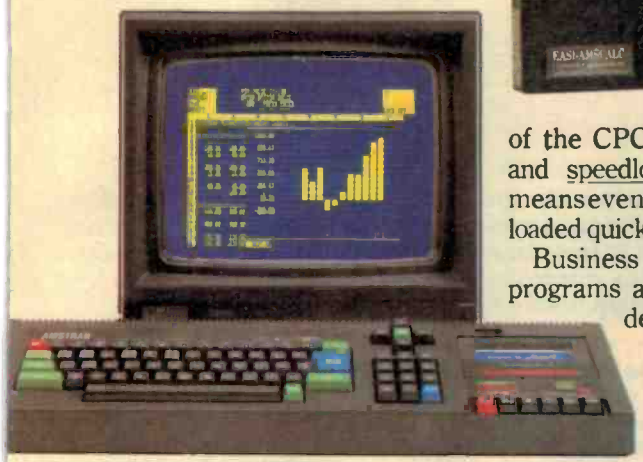
A complete workstation for the price of a home computer.

CPC 464
complete
with
monitor
and
datacorder

It's mouthwatering.

64K of RAM, 32K of ROM, a high resolution green screen VDU, integral cassette data recorder, typewriter style keyboard, numeric keypad and a very fast extended BASIC.

The CPC464 is also available with a colour monitor instead of the green screen VDU.



CPC464 colour monitor (CTM640)

You'd be hard pressed to find a comparable computer for the money let alone the monitor and recorder.

And the CPC464 comes complete and ready-to-go. Just plug it in.

64K RAM (42K available).

The low cost but powerful CPC464 is equally at home in business and educational applications as it is running the household budget or playing games.

With 42K RAM available to BASIC, the opportunities for sophisticated and complex programming are considerable.

80 column text display.

The green screen VDU is purpose designed with a bright, crisp, 80 column text display that compares favourably with systems costing several times as much.

You can program up to 8 text windows and there's a graphics window, too.

The CPC464 has a typewriter style keyboard, large ENTRY key, sensibly positioned cursor keys, numeric keypad for fast data entry and a full 8-bit character set.

If you think that sounds impressive, wait until you hear the 3-voice, 7-octave stereo output through a hi-fi amplifier and speakers.

Amsoft. High quality software.

A wide range of programs is already available and we're expanding it rapidly. The software takes full advantage

of the CPC464's high specification and speedloading capability. Which means even complex programs can be loaded quickly.

Business applications, educational programs and arcade games are all designed to make maximum use of CPC464's impressive graphics, stereo sound and processing abilities.

Amstrad. User Information Service.

Whether you're interested in serious commercial applications or you're a games fanatic you'll want to receive the latest information about your AMSTRAD Computer. Upon request you will be advised about the latest software and its application, special information concerning your CPC464, available peripherals and software reviews. There will also be programs and exercises to try.

In addition to the User Information Service you will be given details of where you may contact your nearest independent user club.

CPC464. Unlimited scope for expansion.

We've thought of everything you're likely to need in the future. That's why there's a built-in parallel printer interface. A low cost optional disk drive system including CP/M* (with the option to access 3000 programs) and LOGO. Joystick port. And the virtually unlimited potential of the Z80 data bus with sideways ROM support.

Finally, a power supply and modulator (MP-1) allows you to connect your CPC464 green screen VDU system to a colour TV.

Optional disk drive DDI-1 including interface CP/M* and LOGO

Optional 80 column dot matrix printer DMP-1 operates at up to 50 characters per second. Combined with the CPC464, it offers a high performance text processing system.

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AWA-THORN AMSTRAD

*Trade mark Digital Research

I'd like to know more about the incredible CPC464 complete computer system and where to see one.
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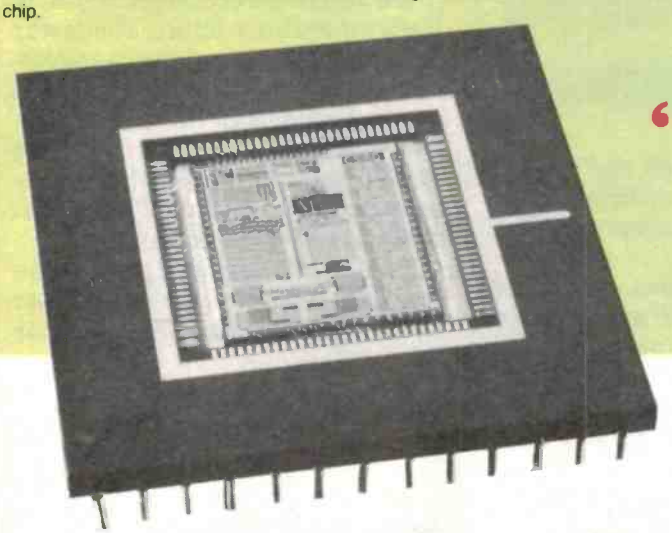
CODE NO: TPB 184

Australia's first "super chip"

In mid-August, Australia joined the 'big league' of silicon chip designers when the CSIRO demonstrated a fingernail-sized VLSI (very large scale integration) logic chip that represented the culmination of an intensive three-year effort by a small group headed by Dr Craig Mudge.

Australia's first. A 102 000-transistor voice recognition VLSI chip.



The 102 000-transistor chip, designed and constructed as a design exercise, is a voice recognition device.

In launching the 'super chip', the Minister for Science and Technology, Mr Barry Jones, said: "It is important to know that it is vastly more difficult to design a 100K logic chip than it is to design one of the 1000K memory chips that have recently been announced in the US and Japan.

"Memory chips are difficult to make but their design is a relatively simple matter. A VLSI logic chip is virtually a whole group of unique chips, each doing different things, linked together in an integrated system that handles a very complex task."

The main effort of the CSIRO group went into developing computer software to simplify the design process so that small components could be designed by a single person and then later assembled into a complete chip. Dr Mudge's group had tested the design system by designing a VLSI chip and had chosen voice recognition as a design exercise because of the known problems of designing a chip powerful enough to recognise the human voice.

"The market is crying out for innovative new electronic products. It is not even necessary for a demand to exist — new products create their own demand, and the manufacturers can enjoy exclusivity," Mr Jones aid.

"Australian manufacturers must exploit VLSI design, because it will give them the ability to make electronic devices as advanced as any in the world. Australians are certainly capable of generating the ideas and we now have the means to realise them."

Mr Jones warned that Australia would not be alone in seeking to capitalise on VLSI design. A US company was already establishing a VLSI design centre in Singapore to service South-east Asian countries and Australia's new VLSI company, Austek Microsystems headed by Dr Mudge, could not ignore the estimated $100 million per year international market for VLSI design expertise.

The fact that much of the new company's work would be done for overseas customers simply emphasised the importance of Australian companies taking up the technology as rapidly as possible.

"What we now need is entrepreneurial companies who are willing to venture into development of VLSI-based products, as well as investors who can weigh the risks against the potentially enormous returns from innovative products."

Chip champion. Dr Craig Mudge.

Mr Jones said Australia could perhaps follow the American pattern, where large corporations had "budded off" small companies to undertake design and development of high-technology devices with considerable success. This was the approach adopted by CSIRO, which three years ago had assembled a small, innovative group of researchers to undertake development of a VLSI design capability in Australia.

Mr Jones said the VLSI project had not only succeeded in its primary objective within three years, but had succeeded in diffusing the results of its work as well as its design expertise, into industry and Australian universities.

Meanwhile, a small Melbourne electronics company has leaped into the fray with what they claim is the first fully-Australian custom integrated gate array circuit to go into commercial production from a design completed outside the fabrication house.

The company, Raywood Electronics Pty Ltd, is now ready to go into production after five months' development and tests.

The work was done by a Principal Lecturer at Swinburne Institute, Jim Lambert, whilst on contract to the CSIRO Division of Manufacturing Technology, using the software facilities and equipment at the Melbourne laboratory of that division.

Mr Lambert has designed a gate array integrated circuit, comprising 2000 transistors, on a small silicon chip. His success helps to bridge the gap between custom microchip research and custom microchips for commercial production, it is claimed.

In the past, detailed design has usually been carried out by the chip fabrication factory. Mr Lambert's design used the largest gate array chip manufactured by AWA, and was successful at the first prototype.

"This approach changes custom chip design from being a black art within the hands of a small group of specialists working for the chip fabricators into something accessible to the general electronic design community," Mr Lambert said.

"It should allow hundreds of small innovative Australian companies to develop outstanding products which can compete strongly on the world market, rather than always relying on standard microchips, which are just as available to overseas manufacturers as they are to our own."

Mr Lambert described his project as a practical demonstration that the new methods can achieve real commercial results.

Raywood team. From left: Ted Fisher (Raywood), Jim Lambert (Swinburne, Dept Elec Eng), Bob Brown (Chief, CSIRO Div Manuf Tech).

"But what is needed is the determination to produce products which reach the market," he said. "This CMOS gate array chip implements a complex phased-shift keyed data encoder, generally used in conjunction with a radio transmitter to provide high quality data signalling," he added.

A no compromise design approach can be used as the custom chip allows exactly the desired function to be implemented, instead of the designer having to modify the function to suit the limitations of standard chips.

Mr Lambert said there had been some criticism during the national microelectronics conference in Adelaide last year about the lack of commercial products to emerge from more than 200 multi-project chip prototype designs undertaken over the past few years.

"This criticism helped stir me up to take on this project and the results give an excellent example of what can be achieved, using existing facilities and appropriate management and skills."

"There is close cooperation between researchers and AWA, the only Australian fabricators for this kind of chip. Several researcher establishments, including unbivesities, advanced colleges and CSIRO, are currently working on full custom CMOS techniques, to be tested later this year.

"The falling costs should help this technology to penetrate our electronics industry with more depth than it has to date."

Mr Lambert, who is a Principal Lecturer in Electrical and Electronic Engineer, said many people now saw custom integrated circuitry as the cornerstone of the future electronics industry in Australia.

"We buy billions of dollars worth of electrical equipment from overseas, when we should be producing and exporting more ourselves," he said. "If we can't handle locally based microelectronics, our electronics industry will not have the strength to compete on the world market."

He said that the leverage effect was enormous. "For every dollar we invest directly into microelectronics, more than 100 dollars flows into the economy."

Task for the Australia Telescope

Australia's Bicentennial Authority has endorsed the Australia Telescope as an official commemorative activity for 1988.

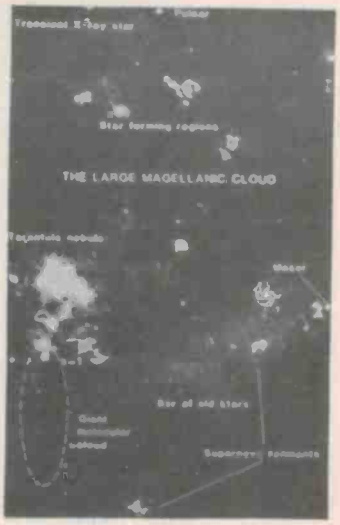
At the same time, the CSIRO has released a photograph of one of the prime targets for the new, synthesis telescope. It's the Large Magellanic Cloud (LMC), an irregular galaxy about 160,000 light years from earth. Because it is so close (by comparison with all other galaxies) astronomers regard it as an object of prime interest.

The photo was taken by the optical telescope as Siding Springs and shows a small part of the LMC. Within the boundaries of this area can be found most of the types of object that interest modern astronomers, and form much of the justification for the construction of the Australian telescope, the large synthesis telescope under construction in New South Wales.

The area is dotted with very young stars and regions where stars are actively forming, such as the Tarantula nebula, and the giant molecular cloud just below it. At the other extreme, a bar of very old stars runs across the bottom right, complete with the exploded remains of some of them, the supernova remnants. Other remnants of massive stars, the pulsars, can be found at the top of the picture.

X-ray sources have also been discovered in the region (Marked x-1). Some models of this phenomena call for the active emitting region to surround a black hole. At top left is one of the most curious objects in the southern skies: a transient x-ray star. There are some suggestions that this might in fact be a remnant of a super massive binary star. One of the pair is a black hole, the other too faint to be seen from earth.

With its ability to 'see' vanishingly faint objects, and also its ability to resolve them extremely finely, it is expected that the Australia telescope will provide new insights into all these objects.



Interactive video

The first example of interactive video most people will see will probably be the video juke box now being installed in some pubs and clubs.

Originally conceived as an alternative to VCRs on the domestic market, the video disk arrived at technical maturity just a few years too late.

The British company Thorn EMI, however, has reconfigured the video disk and linked it to a computer to produce interactive video.

The concept of interactive video is that the disk, with its enormous storage capacity, should be user-accessed in much the same fashion as computer RAM. This means the interactive disk is ideal for video music, where any track can be accessed as required, or for educational videos.

Thorn EMI has developed a motor maintenance manual using interactive video to demonstrate its capacities.

It seems that after a slow start, video disks really are set to go this time. Now that the technology has been made to work the software is being designed that will let people get some benefit from them.

New L & H service

Lawrence & Hanson, the Melbourne based electrical distributor, has recently introduced an obligation free quotation and technical advice service.

The service is available through Lawrence & Hanson's sales centres located all over Australia.

According to the company the new service will save time and thus money by ensuring a prompt, competitive price on all electrical requirements.

For further information or technical advice on all products contact **Lawrence and Hanson, 142 Dorcas St, Sth Melbourne. Vic 3205. (03)697-1599.** ▶

NOTES & ERRATA

May 1984, The role of ionospheric measurements in high frequency communications, by David G. Cole. The panel on pages 146-147, containing information 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 Aeropsace, is by way of illustration, the table of scaled parameters below it contains errors and should not be taken 'as read'.
Roger Harison, Editor ETI.

May 1984; Eprom programmer listing for ETI 662b Timer/Controller.

Location 61C5H should contain 86 not 96.

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.

DUCT go ahead

The South Australian Minister of Education and Technology, Mr Arnold, has signed an agreement allowing Werner Electronics the rights to manufacture and market the DUCT system, devised by the department's Education Technology Centre with the assistance of Werners and Telecom.

The DUCT (Diverse Use of Communications Technology) system enables individuals or groups in two or more locations to be linked by telephone. It involves a terminal which consists of a loudspeaking telephone, pushbutton telephone, microphones and loudspeaker. It allows, for example, a teacher in Adelaide to take a class in Ceduna, or for an expert in a particular field to hold a seminar with students in several country locations.

"This combination will not only promote South Australia as being in the forefront of developing technology-based industries, but provide an example of how this can be achieved through public and private sector co-operation," Mr Arnold said.

"While the system has been used for educational purposes, its commercial and industrial applications are well recognised. However, from the department's viewpoint, the system means individuals and groups can now gain access to resource levels and expertise which otherwise would not be available."

Car instrumentation

High technology dash instruments and on-board vehicle monitoring systems will be commonplace in Australian vehicles within a few years.

According to the instrument manufacturer VDO, future automotive instrument clusters will feature state-of-the-art liquid crystal displays, bar graph displays and computer monitoring of many vehicle functions.

The new technology is the result of a three nation joint venture involving VDO Instruments Australia, VDO AG in West Germany and Yazaki Instruments of Japan.

LCD displays have the advantages of high visibility and readability, even in bright sunlight. They require lower operating voltages and cost less to manufacture than current vacuum fluorescent displays. Typically the displays will feature a digital speedo with an adjacent analogue bar graph tachometer indicating both revs per minute and optimum torque.

Easy to read bar graphs for voltmeter, fuel, water temperature and oil pressure will replace current needle gauges and warning lights. On more sophisticated models a vehicle monitoring system including a picturegram of the car will show door openings, lights function and seat belt status.

Air conditioning can also be more closely monitored with a picturegram display showing internal cabin temperature, air flow travel and proportions of warm/cold air.

Further into the future the joint venture is looking at a vehicle-based navigation system using the earth's magnetic field and bar encoded maps.

For more information contact **VDO, 115 Northern Road, Heidelberg West, Vic 3081. (03)450-3209.**

A typical LCD dashboard being produced by VDO.

The start of the process: Piles of unwanted circuit boards are sorted before being fed into the crusher.

PRECIOUS RUBBISH

The first refinery in the world dedicated exclusively to the recovery of precious metals from electronic scrap has been opened in South-West Britain. The plant uses a combination of processes, equipment and computer technology to recover millions of pounds of precious metals contained in thousands of tonnes of obsolete electronic components and circuitry discarded each year by industry.

The recovery involves two main processes: calcination and melting. The raw material is first sorted, crushed and sampled to determine the precious metal content. It is then fed to a calciner, which burns off the plastics and reduces the raw metallic scrap to an oxidised ash. The ash is reduced to particles of various sizes and sieved, with the larger particles falling past a rotating magnet that separates them into magnetic and non-magnetic fractions for separate refining. Following computer analysis to determine the precise amount and type of flux that needs to be added to ensure an optimum melt. the powdered mixture is sprayed with water and pelletised ready for melting in one of nine induction furnaces.

The resulting hot metal is cast into bars that contain gold, silver and platinum-group metals in a greatly enriched form which are now ready for final processing into their individual base metals.

In its first year alone, the new plant is expected to recover up to one tonne of gold valued at £8-9 million, plus large amounts of silver and smaller amounts of the platinum-based group.

Any old valves required?

Collectors and bower-birds like hoarding away what normal mortals call 'junk'. But beauty is in the eye of the beholder, or so it is said, and 'junk' to some is never so beauteous to 'the believer' as when it *works*.

Collectors of 'antique' radio (*not* electronic) equipment, or radio equipment of some antiquity, are invariably on the lookout for those wondrous things made of metal, glass and bakelite — **valves!** However, sources have tended to dry up over the last decade or so. Pity, but that's a sign of progress we suppose.

For the collecting cogniscenti, we have found a *new source* of those products of the glass-blowers' and metal-workers' art. Try **Sue Coulter, 1000 West Columbus Ave, Bakersfield, California USA 93301.** ●

$1 million available

CSIRO has launched a $1 million research grant scheme to promote the effective application of its new Cyber 205 — Australia's only supercomputer.

The supercomputer is part of CSIRO's nationwide computer network, CSIRONET.

Research in any branch of science which can use the special numerically intensive processing power of the Cyber 205, a vector processor, is eligible for consideration. The exception is research of immediate commercial application or undertaken for a fee.

Grants will be awarded by a small committee of scientists from CSIRO and universities on a competitive basis. They would consist of a notional dollar sum to be used for the cost of computing through CSIRONET. Since the scheme is designed to facilitate large scale scientific computing, the smallest grant request to be considered is $5,000. No formal upper limit applies.

The announcement of the grants scheme follows closely CSIRONET's call for expressions of interest from commercial enterprises to join with it in the development of industrial supercomputer applications.

For further information contact **Mr Charles Denea, CSIRONET's Business Development Manager in Canberra on (062)43-3242.**

Commercial Space Shuttle

A private company could be operating its own space shuttle by the end of the decade.

The US government's wish is to make the business of launching satellites a purely commercial venture. The first step will come when NASA turns over to the US Department of Transportation the responsibility for supervising commercial launches.

Apart from the satellite communications business, which has grown from nothing to $10 million a year since the 1960s, no field of space applications has yet shown anything like a profit.

A firm that believes it can turn the shuttle into a going concern is Astrotech International of Maryland. Its vice-president of operations, Willard F. Rockwell III, managed to evoke a vision of the space business turning into a cross between the Mayflower and Howard Hughes.

Astrotech has been talking to NASA about buying its own shuttle orbiter. Rockwell said parties are currently working on terms and conditions which will lead to a purchase agreement. The venture will operate under the name Space Shuttle of America Corporation.

BRIEFS

The Audio Engineering Society (AES) is having its Australian Regional Convention on September 25-27. It will be held at the Hilton Hotel, Melbourne. For more information contact Graham Haynes, AES, Box 131, South Melbourne Vic. 3205.

AWA has announced that it has handed over a new magnetic ranging facility, valued at more than $2.87M to the Royal Australian Navy. The facility is designed to remove the magnetism that any steel-hulled vessel naturally takes on, thus improving the defense of shipping from mines and other weapons.

Need a hard-copy dump? Glover and Associates, a Sydney technical advertising agency make a business of typesetting word-processor disks. They have recently increased the range of work they can do by including disks created on Apple II computers in their range. For more information contact Glover and Associates at 281 Pacific Highway, North Sydney or 923-1934.

CBS will wind up its videodisk operation after an investment of five years and $500m. The decision follows RCAs announcement in April that it will stop making video disk players this year. This means that RCA is now the only US company making disks. Company spokesmen have promised that production will continue for a few more years.

The new cable laying ship 'Pacific Guardian' has been launched at the Swan Hunter shipyards on the River Tyne, North England, and is due for delivery towards the end of the year. Pacific Guardian will be used to maintain the Anzcan cable that runs between Australia and Canada. It is expected the 6000 ton vessel will be based in Fiji.

David Svendsen has been appointed Sales and Marketing Manager for the Australian operations of Microsoft, the software company. After a four year stint overseas he worked for Kodak Business Systems division in sales and marketing.

Libra Data is marketing a new pcb design package from Datasoft of the US. It is selling for around $2000, but according to the makers will save a great deal of time in the construction of pc boards. For more information the company can be contacted at 7 Chandler Rd, Boronia Vic 3155. (03)762-8387.

SMD boards

Printronics, one of Australia's largest manufacturers of printed circuit boards, can now produce boards for use with surface mounted devices (SMD).

This is the first time that an Australian company has been able to provide this technology. It will offer many advantages to Australian manufacturers who have had to rely on overseas suppliers for SMD boards.

Boards with surface mounted components offer many advantages over conventional boards. The most obvious is the saving of space. A board with SMD can be up to three times smaller than the conventional board. In addition, the board makes possible the use of devices which are vastly superior and more efficient than conventional wired devices.

At present the initial cost is comparable with conventional boards but the long term cost reduces with increased reliability and longer life.

For further information contact **Printronics, Unit 25, 33 College St, Gladesville NSW 2111.**

Robot show

Australian Exhibition Services is organising the International Robot Show which will be staged at Sydney's Centrepoint from 6-10 November 1988.

The show is part of the International Symposium and Exposition on Robots sponsored by the Australian Robot Association and co-sponsored by the Institution of Engineers. The event is an endorsed Australian bicentennial activity.

With Australian industry struggling to compete in a highly competitive world market, the introduction of robots is recognised as an important way of improving productivity, quality control and Australia's international competitiveness. The Commonwealth Government has declared robots to be a sunrise industry worthy of special promotion and support.

The show will stimulate interest in robots and facilitate their introduction for both industrial and non-industrial applications. It will provide Australian industry with a unique opportunity to see and compare the world's latest robot technology. At the same time, it will provide Australian and overseas manufacturers of robots with a base for marketing their products throughout Australia and South-East Asia.

For further information contact **Australian Exhibition Services, Suite 3/2 Illoura Plaza, 424 St Kilda Road, Melbourne Vic. 3004. (03)267-4500.** ●

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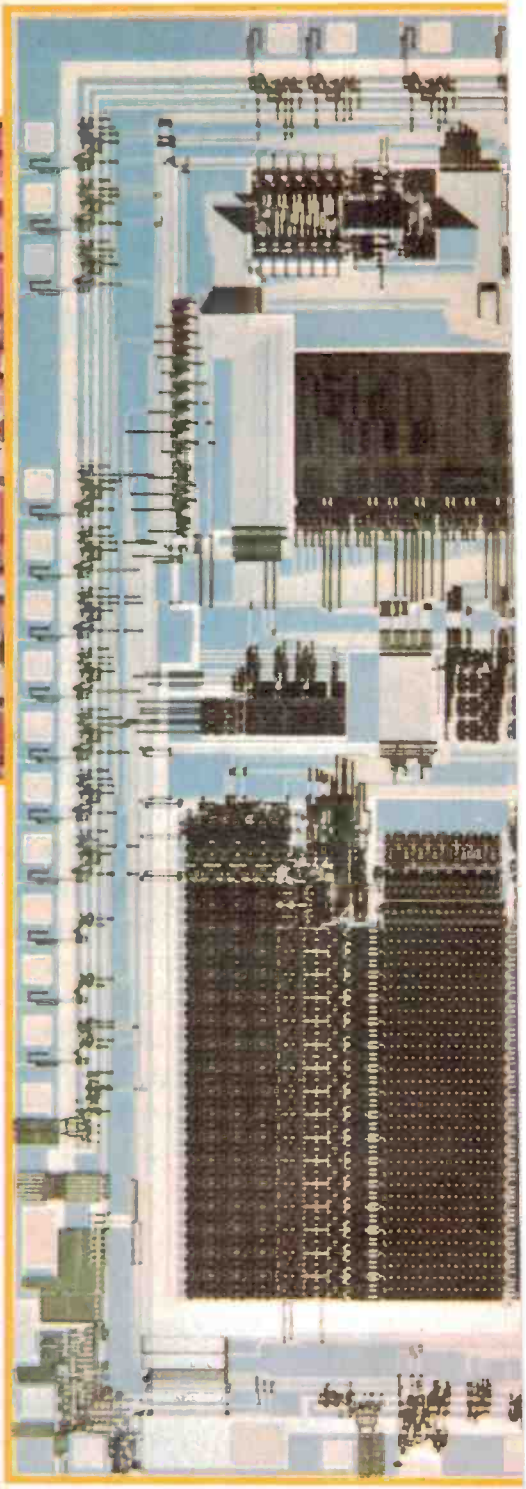
'SILICON COMPILER' Slashes Design Time for Big Chips



Jim Rowe

It's now possible to pack complete functional subsystems into single VLSI chips. The problem facing chip makers has been that using conventional methods, designing such complex chips takes a huge amount of time and money. But now there's a ray of hope — the silicon compiler.

WHEN THE FIRST crude integrated circuits or 'ICs' were produced in the late 1950s, each chip had no more than a dozen or so transistors and perhaps 20 resistors. Once the basic circuit for the IC had been decided upon, there wasn't a great deal of further work to produce a layout for the chip itself and generate the various etching masks needed to make it.

In a sense, an IC isn't all that much different from a printed circuit board — it's rather like a pc board compressed to a few millimetres square. Once you've worked out the transistors, resistors and capacitors you need, and the way they're to be connected together, it's largely just a matter of working out how to arrange them so that you can organise their interconnections. Right?

Well at least, it wasn't *too* hard with those first ICs. But as the technology improved, and it became possible to pack more and more circuitry into a single chip, things changed. Chip makers found that the more components they tried to pack onto their chips, the greater the time and cost needed to design the chips themselves.

In fact, there seemed to be a roughly square-law relationship: for every doubling in the number of components on a chip, the time and cost approximately quadrupled!

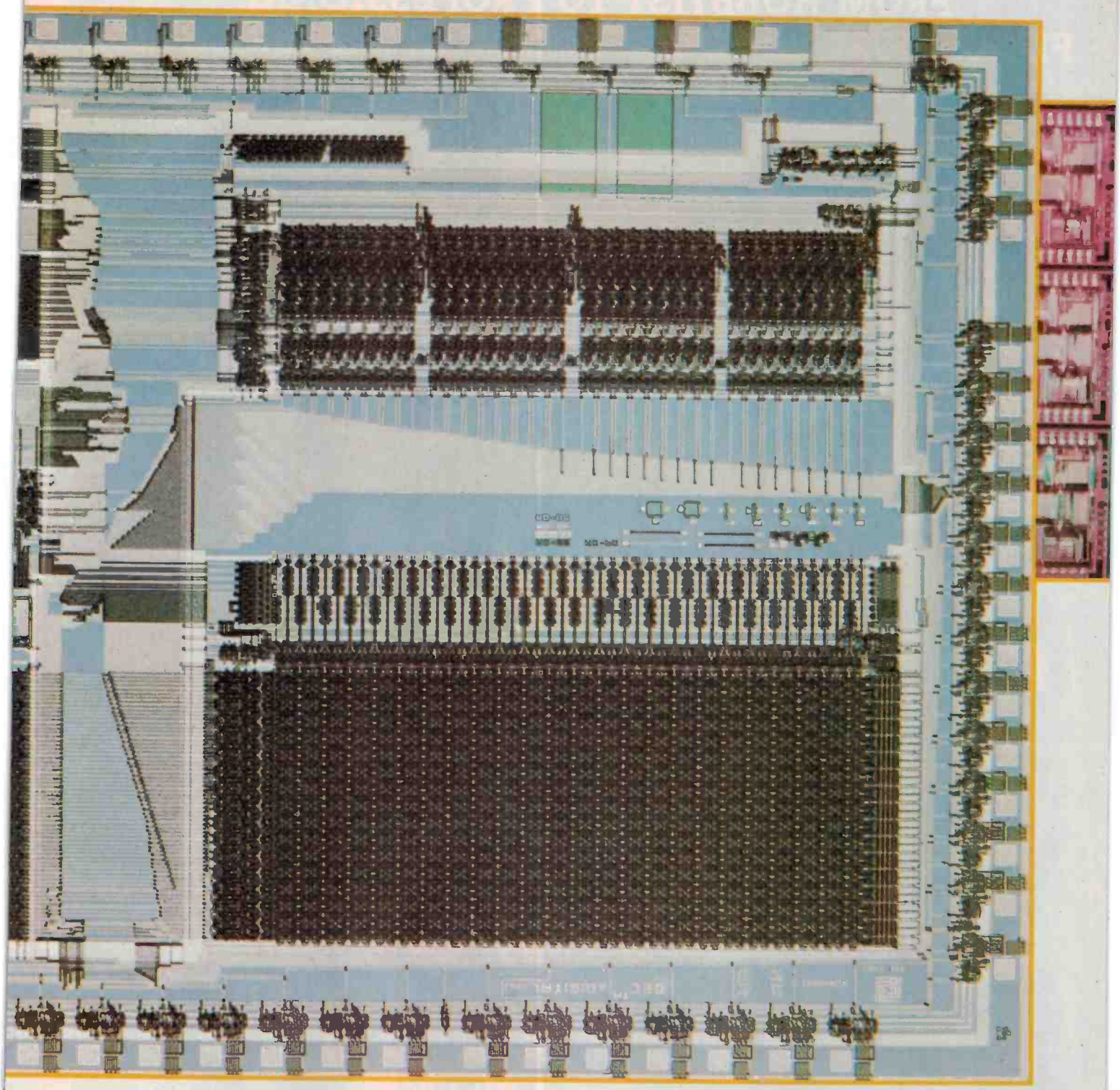
If that doesn't seem too worrying, consider that nowadays a modern VLSI (very large scale integrated) chip may include as many as 50 000 transistors — plus a suitable number of other components. There can be as many as *one million* distinct functional areas or 'geometries' to lay out and interconnect on the chip surface.

To design such chips using the 'conventional' techniques that have been evolved can take as much as 60 man-years. Typically, this effort is spread over two to four actual years, and can cost up to 10 million dollars!

Dr David Johannsen. Inventor of the silicon compiler and co-founder of Silicon Compilers Inc.

The design process

Apart from the sheer amount of work involved, the overall job of designing an IC chip is one which cannot really be split up into separate parts that are capable of being done in 'parallel' to save time. Its various stages must be done in sequential, 'top-



down' order: first the functional design of the system, then design of the logic to perform the required functions, then design of the circuits to perform that logic, and finally the translation of the final circuit into the nitty-gritty geometric patterns and connections etched, diffused and deposited on the chip surface.

Each of these stages of chip design tends to require different specialised skills. So there are system designers, logic designers, circuit designers and finally the chip geometry designers — no one engineer can hope to be really good at more than one of these specialities.

The enormous amount of time, money and expertise required to design a modern VLSI chip can be justified, providing the final chip is one which can be manufactured and sold in huge volumes. Obviously, this means general-purpose chips that will have as many different uses as possible — like ▶

The MicroVAX chip. The latest and most impressive VLSI chip to be designed by Silicon Compilers is this 32-bit data processing chip, which forms the heart of Digital Equipment Corporation's new MicroVAX 1 desktop minicomputer. Containing over 37 000 transistors, the chip measures about 7 x 9 mm. Its design would normally have taken around 32 man-years, but using the silicon compiler it took only 1.2 man-years, a speedup of 27 times.

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7 8060A
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The growing dilemma

Unfortunately as Gordon Moore, one of the founders of Intel pointed out a few years ago, the more complex chips become the more difficult it is to make them 'general purpose'. By the time you get to VLSI chips and beyond, they're no longer small functional 'building blocks' with many possible uses. They've become complete sub-systems or even systems — with fairly specific (even though complex) functions.

Yet from the point of view of firms making today's electronic equipment, the advantages of VLSI technology are needed in order to achieve the ever-tightening goals of miniaturisation, increased reliability and lower manufacturing cost.

So the IC makers are facing a growing dilemma: they have to keep on producing ever more complex chips, but at the same time the chips are becoming more and more specialised. The investment to design each new chip is rising alarmingly, yet the expected manufacturing volume for each is falling — at least in relative terms. By 1990, it is estimated that roughly half of all ICs made will be specific-purpose VLSI chips.

Gate arrays and cells

One approach to solving this dilemma has been to develop what are known as programmable logic arrays (PLAs) or 'gate arrays'. These are VLSI chips made with a large number of general-purpose logic gates (typically from 2000 to 8000), arranged in a grid pattern so that they can be interconnected in a large number of ways using a final metal pattern deposited on the top.

The PLA approach allows the IC maker or 'chip foundry' to produce chips that are basically general-purpose for most of the manufacturing steps, and only 'customised' at the final stage of production. This simplifies and lowers the overall cost and time required for the overall design of a chip, but it has definite limitations.

The most severe limitation is that the PLA approach is really only suitable for one type of IC — random logic circuits. They're not suitable for implementing memories, register banks, timing circuits or analogue processing. They also tend to be fairly wasteful in terms of the area of silicon chip needed, because of the need to allow for a wide variety of interconnections. In fact the larger a PLA becomes, the higher the proportion of total chip area which must be left for the interconnections — so the more wasteful it becomes.

Apart from PLAs, the only other approach to simplifying VLSI design available until very recently has been the 'standard cells' technique. This is a method of using pre-designed and standardised patterns for different functional 'cells', at the chip geometry level — like an 8-bit latch register cell, a decoder cell, a D-to-A converter cell and so on. The patterns for these standard cells may be combined like building blocks to produce the final chip pattern.

Unlike the PLA approach, the standard cells technique is suitable for making a wide variety of chips. However, it too has limitations. Probably the most serious is that the size and performance of the various 'standard cell' patterns must be a compromise in order to make them suitable for a variety of applications. This often makes them either too big, too small, too fast, too slow or otherwise less than ideal, for any *particular* application.

Because of this, a VLSI chip designed using the standard cells technique can be a little like a building designed by a committee. Although each of the elements that make it up may be good in themselves, they may not work well in combination.

A way of getting around this is to develop a big enough 'library' of standard cell patterns, with many different variations on each type of cell. So you may have, say, decoder patterns with different numbers of input bits, in different physical sizes and with different operating speeds.

Needless to say, generating all of these permutations and combinations involves a huge amount of work in itself. So until they are all created and in your cell library, each new chip design may require almost as much cell redesign work as if you were designing the complete chip from scratch.

Enter Johannsen

The standard cells approach does offer some improvement over a full top-down approach to VLSI chip design, particularly in the long term. But it has become increasingly obvious, over the last couple of years that if chips are going to become much more complex, something much more drastic needs to be done to reduce their skyrocketting design costs.

Enter the 'silicon compiler', brainchild of 27-year-old American electronics engineer Dr David Johannsen.

Johannsen had the idea while working for his PhD degree at the California Institute of Technology in Pasadena, about five years ago. He gave it the name 'silicon compiler', because of the analogy with the use of software compilers to simplify dramatically the effort required to write computer programs.

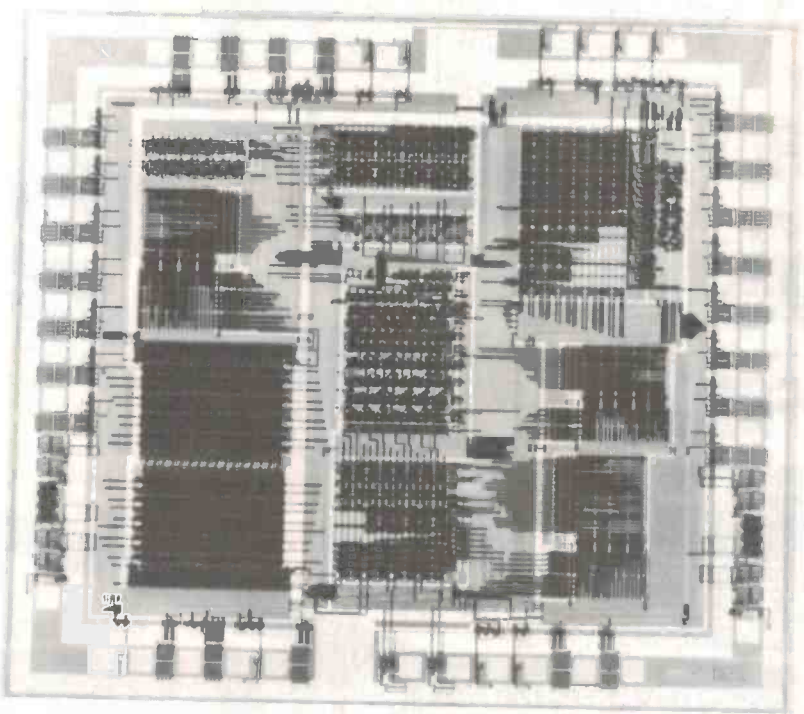
Before the development of software compilers, computer programs generally had to be written in so-called 'machine language': the binary code numbers used by the computer itself. This was not only extremely laborious and time consuming, but also the kind of task where we humans tend to make lots of errors.

With the development of software compilers, this time and effort was cut drastically. Programmers were able to write their programs in an abstract, human-orientated 'high level' language (like FORTRAN, COBOL or BASIC). Then, running under the compiler program, the computer itself was used to *translate* the high-level language 'source program' into its equivalent machine language 'object' form to run later on the computer.

The software compiler saved the computer programmer from having to worry about all of the nitty-gritty fine details of computer operation, freeing them from drudgery and allowing them to think and write at the abstract or 'system' level. This achieved not only a dramatic saving in time and tedium, but avoided many errors as well.

Surely, reasoned Johannsen, it should be possible to develop a computer program or suite of programs which would achieve the same dramatic results in designing silicon chips. Such a 'silicon compiler' would automate all of the tedious steps in designing a chip's logic, circuit and chip-geometry/layout, once the system designer had specified the various functions to be performed.

Working with his professor at Caltech,



Their first. First VLSI chip to be designed by Silicon Compilers was this 8001 Ethernet data-link controller, designed for Seeq Technologies. Although design work began two years after Intel had started on their controller, Seeq was able to begin selling finished chips after only eight months — one year ahead of Intel!

Carver Mead, Johannsen produced the first rather crude silicon compiler and described it in his PhD thesis. He gave it the name 'Bristle Blocks' because it was designed to work out the interconnections for pre-defined functional cells.

Although Bristle Blocks only performed part of the chip design process, the results obtained were sufficiently promising to suggest to Johannsen and Mead that the silicon compiler concept held a lot of promise for VLSI technology. So they left Caltech in 1981 and, together with other people from Caltech and Intel, formed their own company to develop and exploit the idea.

Since 1981, Silicon Compilers Inc has developed the basic concept to the point where they have a complete working VLSI chip compiler. While it still hasn't been fully perfected, the compiler has now been used to design three state-of-the-art VLSI chips, in much shorter times than would normally have been required.

First steps

The first chip designed by Silicon Compilers was the industry's first data-link controller chip for the Ethernet local-area network standard. This was designed for Seeq Technologies, and took a mere eight months to produce working chips from the initial functional specification. Part of this time was actually taken up in completing the silicon compiler program itself.

As a result of this short design time, Seeq was able to release its controller chip almost a year ahead of Intel, even though Intel had nearly *two years'* head start developing its own controller chip! Needless to say, this gave Seeq a big advantage in the Ethernet controller chip market — it still outsells both Intel and two newer competitors.

Silicon Compilers' second chip design was an intelligent colour video graphics controller chip, produced for Sun Microsystems for use in a high performance, high-resolution graphics terminal. The entire design of this 'RasterOp' chip took only five months work by a single design engineer, instead of the 10 or 15 man-years that would normally have been involved.

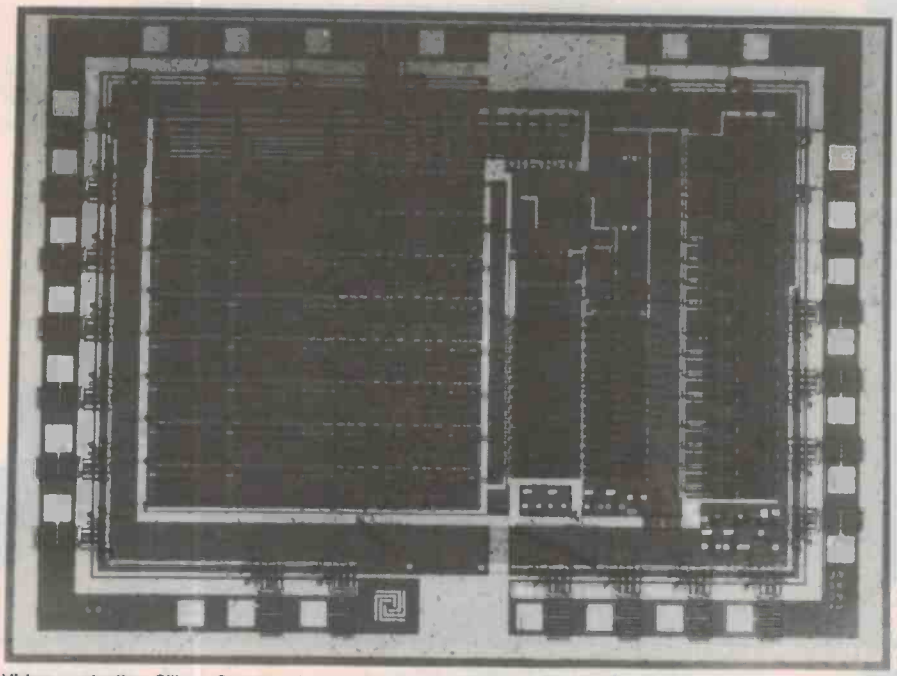
Enter the MicroVAX

But perhaps the most impressive Silicon Compilers' achievement so far is their third VLSI chip design. This is a very complex 32-bit data processor chip which forms the heart of Digital Equipment Corporation's new 'MicroVAX 1' desktop minicomputer.

The new MicroVAX chip was designed to be software compatible with DEC's existing VAX computers, but using a totally new internal architecture. It contains a full 32-bit-wide arithmetic and logic unit, a 64-bit barrel shifter, a dual-port block of 47 data registers, a control decoder, a timer, a 7-level operand-restore stack, a 32-word ROM, and all of the associated logic, data multiplexing and control circuitry.

The chip contains a total of 37 000 transistors, and measures about 7 x 9 mm. Using it, DEC has been able to produce its new MicroVAX 1 computer on only two pc boards measuring 203 x 254 mm, and sell it for roughly half the price of the VAX 11/730 model it outperforms.

Design of the MicroVAX chip by Silicon Compilers took two engineers only seven months, from functional design to working silicon. That is, 1.2 man-years. For a chip of this complexity, the conventional design approach would have taken over two and a half years, and involved as many as 15 specialists in some phases of the work — a total of around 32 man-years!



Video controller. Silicon Compilers' second VLSI chip design was this RasterOp video controller chip, used by Sun Microsystems in a high performance bit-mapped graphics terminal. The entire chip design took a single engineer only five months.

This is an improvement by a factor of *27 times*, showing that the silicon compiler concept really does seem to offer the dramatic improvement in VLSI chip design time that is needed. Presumably this 'design leverage' factor will be improved still further as the silicon compiler is itself refined and improved.

Other advantages

Silicon Compilers' president Phillip Kaufman points out that the silicon compiler technique doesn't just speed up VLSI chip design. It provides a lot of other advantages as well.

Built into the silicon compiler is the ability to synthesise functional models at each of the levels of design complexity: the logic level and the circuit level as well as the chip geometry and layout level. This makes it possible for the designer to carry out functional simulations very easily at any time during the design process, getting 'feedback' on the way the final chips will perform — long before any are actually made.

For example, the designer can call for a timing analysis, to see if the resulting chip will be able to do certain of its tasks fast enough. If the results don't match up well enough to the required performance, the designer can then change the high-level performance parameters and try again.

This allows an 'incremental' or successive-refinement approach to the design of very complex VLSI chips, without involving the huge time delays that this would normally require. So the resulting chips tend to be *better* than the chips produced using the conventional top-down approach, as well as being produced much faster.

It also becomes possible for the designer to try out alternative architectures for a chip, to see which approach results in the best performance and/or the smallest chip area. And with the silicon compiler this kind of exploration takes only hours, whereas with conventional design methods it takes so long that designers virtually never have the opportunity to try it.

The key

So all in all, the silicon compiler seems set to open up a whole new era in integrated circuit technology. An era in which designers of electronic systems will be able to design extremely complicated VLSI chips, without ever needing to get bogged down in the fine details of logic design, circuit design or chip geometry and layout. And an era in which the IC makers will be able to design and produce complex new chips far more quickly and economically than ever before.

In fact, some industry observers believe that without some kind of automated approach to chip design, IC technology will never be able to get past the current VLSI level — the barriers of time, effort and cost would be too great. It may well be that the silicon compiler is the key that will finally make possible the next big quantum leap in IC technology, to ultra-large-scale (ULSI) and super-large-scale (SLSI) chips. ●

The Chicago Consumer Electronics Show demonstrated a vast array of different technologies that are beginning to integrate as they recognise each other's importance. The video industry is acknowledging the audio industry and the audio and computer industries are moving closer together.

The Greatest Show On Earth:

SWEET HOME, CHICAGO

Dennis Lingane

AS THE DUST settled in Chicago after 96 547 electronic industry delegates rode off into the sunset on train, plane and car there is no doubt that this was possibly the most successful show that the EIA (Electronics Industry of America) has staged.

Not because it had the biggest attendance of all time, or because of the vast number of exhibitors. But because all segments of this diverse industry (except the Hollywood brigade) are buoyant and are now all working together rather than pulling against each other. The boundaries between all of the technologies are beginning to blur.

Home computers, the baby of the industry, have reached a new maturity and are now obviously here to stay. And not as a gimmick, status symbol or game centre. There is now a vast array of software for all sorts of applications in the home that will make it attractive to many parts of the community — if not all.

Audio, the star of the industry until five years ago and then blitzed by video to become the depressed area, is now back on its feet, thanks to CD. The tiny disc has breathed a new air of optimism into the industry, and spawned a whole new range of amplifiers and speakers to cater for its demanding and peculiar needs.

Video, until this year fast becoming nothing more than a home appliance, has had a re-birth through video hi-fi and stereo TV. There is increasing interest in portable machines for home video movie making.

Kodak is expected to pour millions of dollars into promoting its 8 mm video system this year. Even if the 8 mm system doesn't gain public acceptance because of price and size it will get the message across to the buying public that video is also for home photography.

Although Sharp and Philips have pulled out of VHS-C format video, JVC has an even higher commitment to it. After all, they argue, it is compatible with VHS and is smaller than the 8 mm system being launched by Kodak. The problem is that people didn't realise it was around and what it was for.

Telephones are booming in the US, and we have only seen the tip of the iceberg in Australia. Clever phones that are quite inexpensive, answering machines, and art-form telephones are all part of the new electronic home.

Coleco launched a telephone for teenage girls that doubles as a private diary and photograph album, and which locks so nobody can pry. It has a secret compartment for her diary, and will store nine telephone numbers for automatic dialling. Next to each button she has a photograph of her boyfriends. So she presses the button next to the boyfield she wants to call and the Coleco telephone does the rest. It retails in the US for around $50, and points to a new market in personal phones.

DIFFERENT CD PHILOSOPHIES

Although CD technology is seen as the lifesaver of the audio industry it came under a lot of close scrutiny at the Chicago Show. There is no doubt that CD is far better than the current LP analogue audio system. But even so it is far from perfect, if the debates that were raised at the show are anything to go by.

The general opinion is that as prices have dropped so has the quality of the product. That was about the most clear-cut answer to a multitude of questions fired around at the many workshops on CD.

It was obvious that most people don't really understand what the technology is all about. Several points were made at the workshop.

1. There are audible differences between players that can be detected by anyone with a good ear.

2. Over-sampling, as done in the Philips and Yamaha players, will compensate for poor production of discs and bad engineering. But it can mean slower access time and less accurate tracking.

3. If you choose to have accurate tracking, as in the Sony players, then the benefit is that a properly engineered record will sound better than on other players. But if the record isn't engineered properly then the disc will have a harsh sound on the top end. It appears that this is the price you will have to pay for faster and more accurate tracking. So careful selection of discs must be the order of the day for Sony owners and other CD players that use the 44.1 kHz sampling system.

4. Then there are the arguments for and against using analogue and digital filters. Quantisation noise has to be filtered out of the circuit during the processing of the audio signal. Some manufacturers filter it out in the digital stage, while others filter it out in the analogue stage.

Theoretically it's better to do the filtering in the digital stage, but some companies feel that the digital filters aren't good enough yet and add distortion to the music. However, while analogue filters are less prone to this problem they can cause phase shift.

Before I left for the US I felt that things weren't all that clear-cut with the new CD technology. But there was no-one in Australia who could answer the questions. The same applies in the US where, as yet, there is little known about the technology outside of the engineers.

ON THE RIGHT TRACK

One of the main questions I was trying to get answered at the show was why some players will track discs that are unable to be tracked by other players. The best answer I was given at the show was that it's probably down to servo systems and sampling frequencies. In cutting prices manufacturers have started to reduce the versatility of servo systems to handle bumps, knocks and even warped discs.

Leading industry critic, Len Feldman, says that one of the best ways to test the quality of CD players these days is to tap them on the side when they are playing a disc. If the disc mistracks it's a fair indication that the unit has an inferior servo system.

But while that is a simple test of tracking ability it may not reveal the whole story. Some machines are designed to be intolerant of any glitches in the disc production. They will reject a disc if they can't track it correctly. Other machines are designed to be able to pass on over the glitch, finding the nearest piece of information to the one it couldn't track and carrying on.

The purists argue that it's better to have an accurate tracking system and live with bad discs, while others say it's better to have a machine that isn't quite as accurate and therefore not as musically good, but will keep on playing. It's here that the major philosophies in manufacturing appear to part company. It's the old hi-fi versus low-fi argument all over again.

Summing it all up was Sony spokesman, Marc Finer, who simply said, "It's an imperfect world. Sony has designed its players for accuracy, while Philips has designed theirs to compensate for poor recordings. So the Philips will sound better than ours with a poor record. But it isn't as accurate.

"Ours will track more accurately, has a faster access time, and sounds better if the record is properly engineered and digitally recorded. We all have a lot to learn, as do the engineers who make the records."

However, while we pick faults in the system, even at its worst it is still a hundred times better than the traditional LP, so we are really nit-picking.

Kenwood's Mr H. Ishi, a leading engineer, put a bit more light on the subject. He said that like the direct-drive turntable, the CD players' servo system can 'hunt' and create a poor sound.

When the laser finds a glitch, or a minute scratch on the disc, it leaps back and forth trying to pick up the next track.

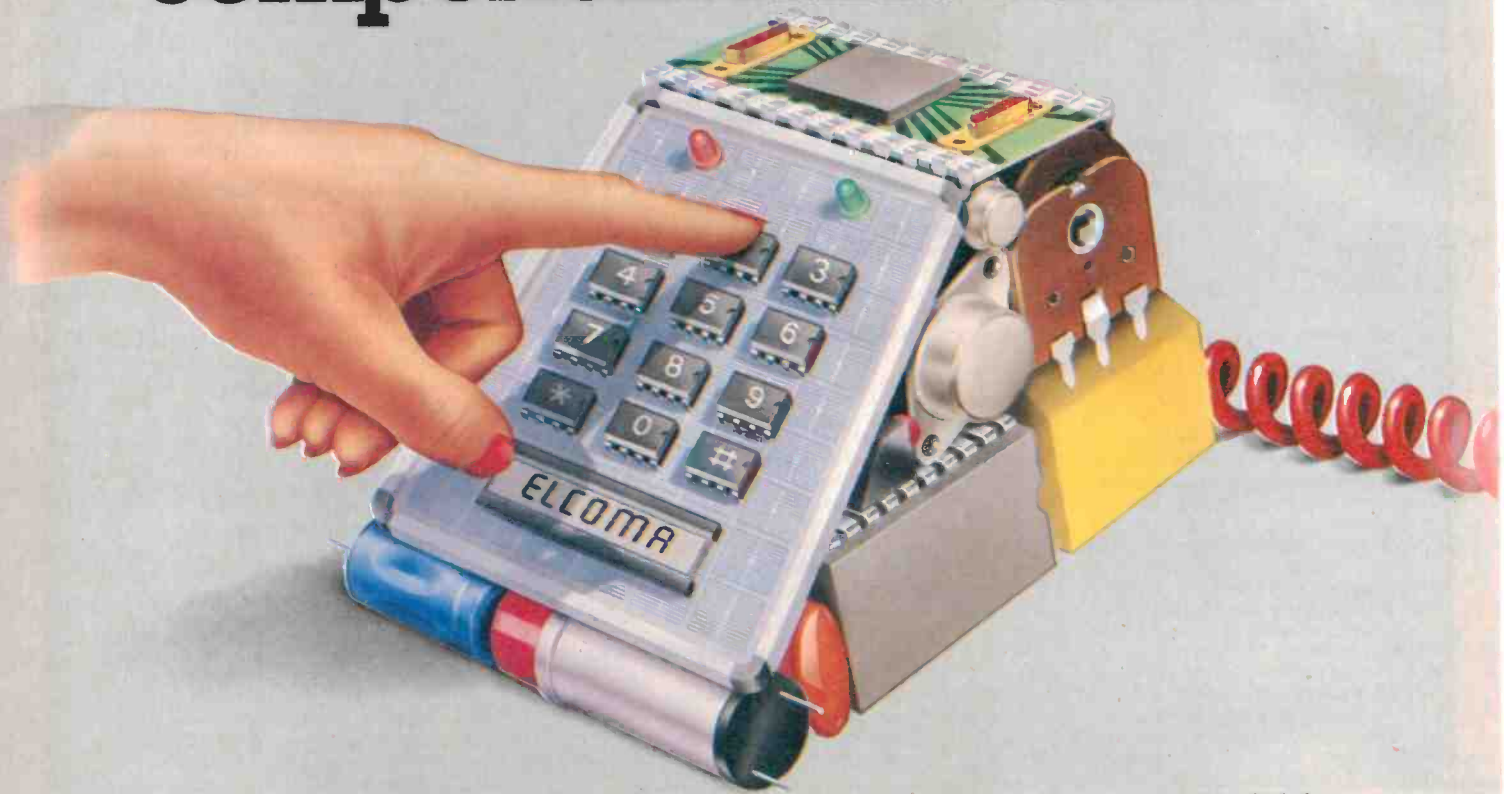
Kenwood has a microprocessor in their 1100 CD player. If the laser finds a minute scratch on its first time round the disc it stores it in memory, and when it approaches that same spot on the disc next time round it automatically mutes so the glitch is lost and the laser tracks on without interruption.

This ensures a much smoother run, says Mr Ishi, and is part of the reason Kenwood's 1100 player rated so highly with audio critics.

It all adds up to the fact that laser players are different and you'll have to learn to listen if you want a good player. When it comes to price you get what you pay for, so tap on the side of the player and have a close look at the features.

Find a disc that is digitally recorded, one that you like, and then start listening to players.

Phone for telecommunications component innovations



Telecommunication equipment manufacturers face constant pressure for more and more user features. These pressures are accompanied by complex technical problems imposed by the highly sophisticated integration of business communications and information systems.

"New" equipment frequently becomes obsolescent, virtually from the first production run.

Elegant technical solutions, design flexibility and inherent reliability stem from the very latest "chip" and component technologies. So the long-term winners will be the companies who employ the most up-to-date and reliable electronic technology right from the start – moving their new designs smoothly into production.

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"Sansui."

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DPS&L VAN 31

The car sound industry is slowing as the car manufacturers install more and more sophisticated sound equipment in cars direct from the factory. But even car sound dealers are optimistic as they shift their interest to new car electronics such as security systems, car phones and car computers.

Integration and promotion

All aspects of the industry are moving forward. But what is even more significant is that they are now recognising each other's importance in the overall market. And they are beginning to integrate.

Even the video indusry has acknowledged the audio industry. The hi-fi videos belong as much in an audio shop as they do in a video store. And while the audio industry will promote this new concept as the best way to record CD, the video industry will need really good audio equipment like efficient speakers and high power amplifiers to handle the wide dynamic range of the video hi-fi.

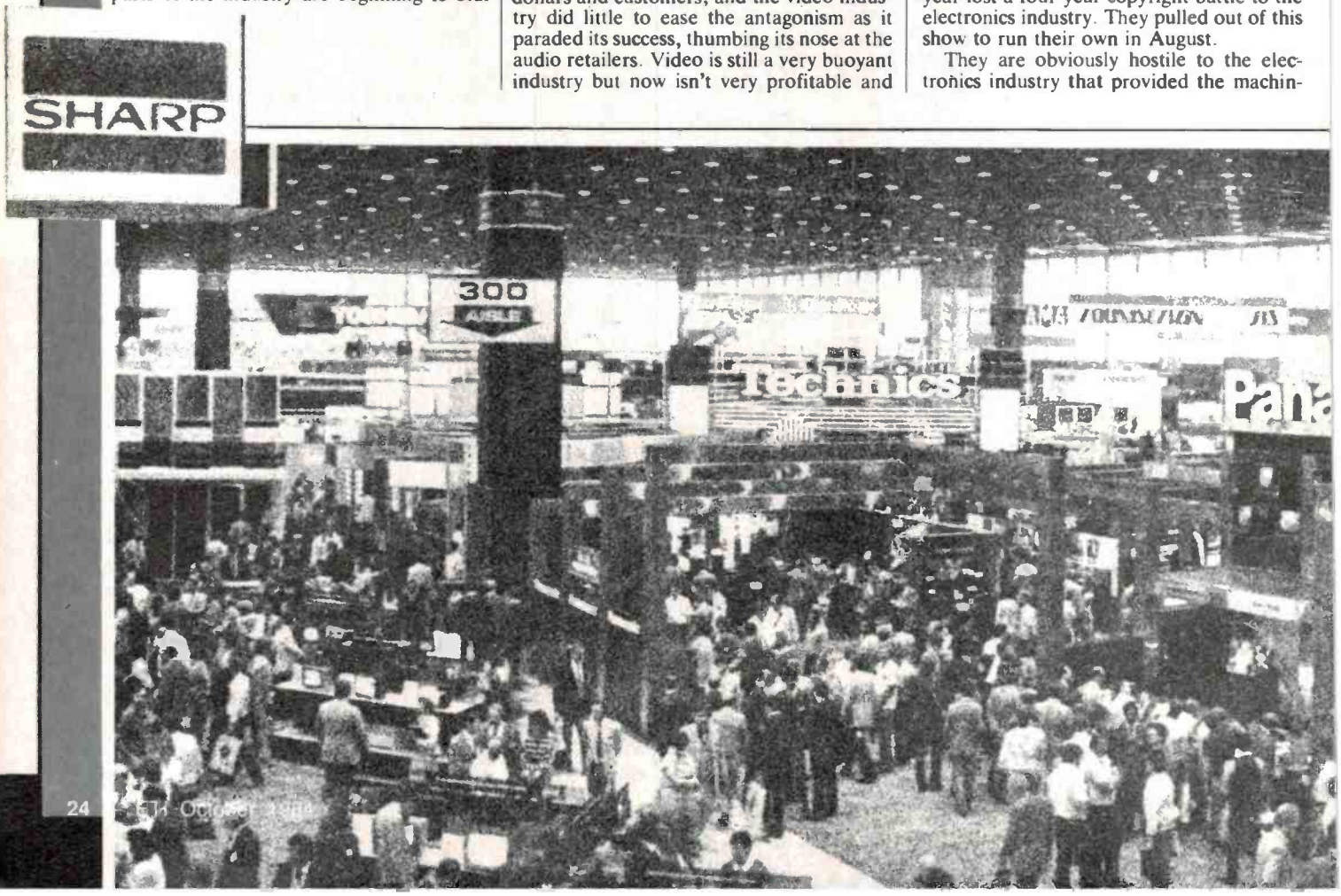
Even the computer and audio industries are moving closer. CD discs are being proposed as a means of selling computer games and computer programs, using the CD players as a hard disk drive system as well as an audio player. And the computer industry is promoting floppy disks as a means of recording digital music off CD.

So the boundaries between the various parts of the industry are beginning to blur together, and each sees the other as an integral part of the industry's complex and unpredictable future.

In the past the audio industry has had no love for the new video industry that took its dollars and customers, and the video industry did little to ease the antagonism as it paraded its success, thumbing its nose at the audio retailers. Video is still a very buoyant industry but now isn't very profitable and needs the audio industry to get it back to profitability. So both audio and video dealers were locked in discussions in workshops.

The only group that wasn't in Chicago in force was the Hollywood moguls who this year lost a four-year copyright battle to the electronics industry. They pulled out of this show to run their own in August.

They are obviously hostile to the electronics industry that provided the machin-



ery and medium (VCRs and tape) to destroy the proven patterns of entertainment distribution i.e: TV and cinema. But while they may be sulking because they didn't get the US government to agree to put royalty taxes on VCRs and blank tape, they can't ignore this industry either.

They make millions of dollars out of it. Paramount say that within two years they expect to be selling movies on video tape for as low as $20, indicating the success. And music video has given the record industry a new lease of life.

In fact, MGM/UA spokesman Bill Gallagher says his company is planning special productions for video. He says it is a new art form and, as such, needs to be treated as a new medium with its own production schedules. So Hollywood is an uneasy bed partner with the electronics industry. They both need each other.

Coming together

When summing up the Chicago Show one has to say that all the functions are finally coming together and this should make it a much stronger entity. It will create a new era of integrated home electronic entertainment and information centres that will suit everyone.

But that's what the Chicago show is all about. It gives everyone worldwide a chance to analyse technologies and trends over a hectic five days. Technologies are displayed and new ideas born in workshops and public debate.

It's a vital ingredient of the future of this industry; it's all so new that everyone is learning as it grows.

CD — FROM JUKE BOXES TO CARS

It was good to see more creative developments in CD technology at the Chicago Show instead of the cheaper and cheaper trend we have been seeing in recent months.

Technics unveiled a new CD auto changer that really should be described as a home juke box. It holds up to 50 discs at a time and you can programme it through its sophisticated microcomputer to play any track of any disc in whatever order you want. The price being quoted in the US for this large, new-era, auto changer is around US$1500.

Not to be out-done, Sharp had a CD juke box that will hold over 100 discs which could be programmed to play any tune in any order. It is a serious commercial machine aimed at radio stations and coffee bars, and retails for around $6000.

There were several demonstrations of CD with pictures, although we still haven't got any information about when they will be commercially available. These visual compact discs have still pictures to illustrate musical passages, or librettos for operas, or even song titles and a picture of a pop star. But so far, although codes have been agreed, there still isn't any indication when we will see them available on the market.

Pioneer was supposed to show a combined laser video disc and CD player at the show. In other words, a player that would play both laser video discs and CD. But it never materialised.

CD WHILE YOU DRIVE

The accolades for CD developments at the show went to Sony who produced a ready-for-the-market car CD player.

Sony managed to squeeze the size of the players down by reducing the laser assembly by about 70%, and by combining four integrated circuits into one tiny chip. Sony says it has also solved the problem of vibration.

One of the main problems with CDs in a car is that they will mistrack when you hit a bump in the road. Sony says it has developed a new servo and suspension system that gets round that problem. They won't say how they did it because they have applied for patents. But the car players certainly stood up to thumps and bumps dished out by the press invited to the low-key release.

There were two models in the Sony range: a straight CD player and a combination AM/FM CD player.

Sony says the units will cost about the same as a top-class cassette deck. Which means anything in the $800 to $1200 price area.

SOLDERING:

Dubious joints and how to cure them

Now you have the basics of how to solder under your belt, it's time to find out what to do when things don't go quite right, or what to do when repairs are necessary.

Roger Harrison

THE SUCCESS of failure of a project can often depend on the quality of just one soldered joint. If it has not been prepared properly, or correctly soldered, then it's quite possible to have a 'no joint'. Identifying a bad joint can save you heaps of time wasted in trying to track down a fault. And there's nothing so frustrating as trying to track down faulty joints.

Bad joints and their cures

In some instances, the solder may not wet the joint evenly. The solder surface is not smooth and continuous, having irregular, round, non-wetted areas exposed. The solder may meet one surface abruptly in places. This condition is illustrated in Figure 13. It can often be remedied by reheating, although desoldering and cleaning may be necessary in some cases.

When a joint is not wetted at all, usually due to tarnish, the solder will not completely cover the surface and appears as droplets or balls (Figure 14). This is a bad joint mechanically and electrically and should be taken apart and properly prepared.

Sometimes during soldering, the molten solder will run along the metal and then withdraw towards the fillet when the iron is removed (Figure 15). This 'dewetting' is another problem caused by tarnish that the flux is unable to remove. The joint has to be desoldered and thoroughly cleaned before resoldering. Applying more heat and excess solder might make the joint look all right but it may conceal a bad joint.

A 'cold' or 'dry' joint is usually caused by movement of the parts during soldering or as the solder is solidifying. It is also caused by the solder running onto surfaces cooler than the soldering temperature. A cold joint has a frosty appearance, as shown in Figure 16, but may otherwise look like a good joint.

The trap with cold joints is that they may perform quite well for a considerable period and then suddenly become intermittent or go open circuit. They are repaired quite simply by reapplying heat or desoldering the joint and then resoldering.

If insufficient heat is applied to a joint, the solder solidifies before adequate wetting occurs, causing the angle of contact between the solder and the parts to be very large. The flux is not properly activated and the joint may tarnish. The solder can usually be pried loose. The surface of the solder may be smooth and continuous but it is not attached to the parts of the joint (Figure 17). Reheat the joint if tarnishing is not evident, otherwise desolder and clean before soldering.

In some cases, a resin bond is formed between the parts of the joint. In this case, the angle of contact of the solder is usually large and a layer of solidified resin forms the bond, as shown in Figure 18. There may be no electrical contact at all, the joint has little strength and may be prised apart. It may be caued by excess flux or solder running onto surfaces cooler than soldering temperature but hot enough to melt the flux. It is usually cured by reheating the joint, making sure that all parts are brought up to soldering temperature.

When soldering multi-strand hookup wire, excess solder or long soldering time

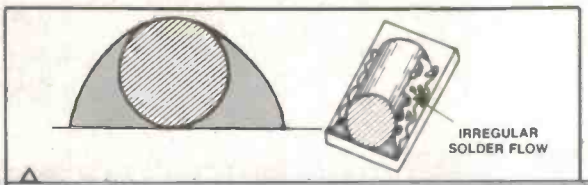


Figure 13. When poor wetting occurs, the solder meets one surface at an abrupt angle and the solder flows irregularly.

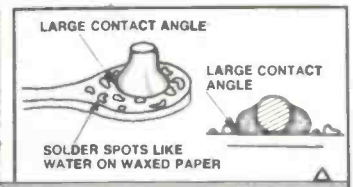


Figure 15. Dewetting. The solder appears to flow properly, then withdraws when the iron is removed from the joint. Reheating with more flux may effect a cure, otherwise start again and clean the joint parts.

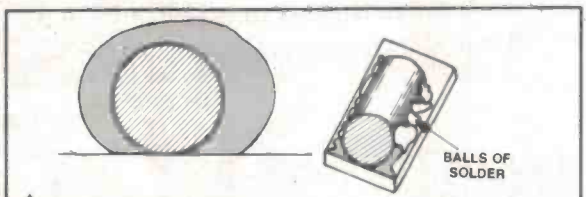


Figure 14. Tarnished surfaces prevent wetting altogether. Balls of solder sit on the surface. More flux and reheating may fix it, otherwise start again and clean the joint parts.

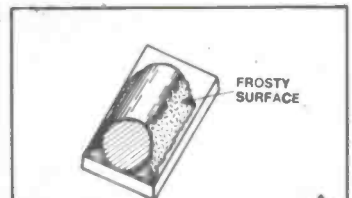
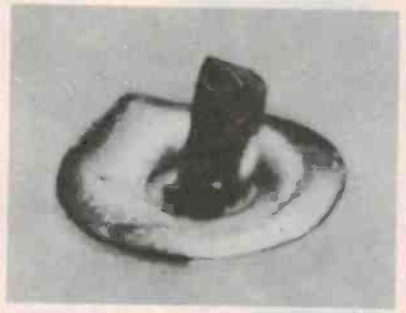
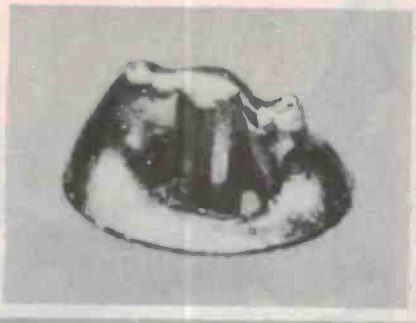


Figure 16. A cold joint can be deceptive. The joint may look good in other respects, but the solder surface will have a frosty appearance (see accompanying picture). Reheating the joint usually fixes it.

Resin joint. Too little heat.



Cold joint 1. Solder beads like water on wax.



Cold joint 2. 'Frosty' surface on the solder.

Disturbed joint. Moved when solder solidifying. Solder looks chalky.

Overheated joint. Don't overdo it, there may be another problem.

(Pictures from Pace Training Manual, courtesy of Coltronics P/L)

RECOGNISING BAD JOINTS

This group of pictures shows the typical appearance of common bad joints. A **resin joint** results when too little heat is applied or an iron tip with insufficient heat capacity is employed. A quantity of resin solidifies between the component lead and the terminal. Flux may sometimes appear on the solder surface itself. **Cold joints** occur when the heat is withdrawn too soon or the joint is otherwise cooled too rapidly. The solder does not properly liquify and may form beads like water drops on a waxed surface. Often, the solder surface has a 'frosty' appearance. A **disturbed joint** may also have a frosty appearance but the solder is generally lumpy or granulated and may show cracks. Movement of the parts during cooling causes the problem. The solder on an **overheated joint** has a dull, chalky or crystalline appearance. It usually results from repeatedly trying to heat a joint that won't wet properly.

can cause solder to run along the strands behind the insulation. This is called 'wicking' (Figure 19) and can be reduced by soldering faster or by using a heatsink on the wire. Wicking makes the wire brittle and liable to break when it is moved.

When the soldering iron is withdrawn from a joint a spike of solder, called an 'icicle', is sometimes left behind, usually pointing in the direction in which the iron was removed (see Figure 20).

Icicles may be caused by a variety of problems, including tarnished joints, too short soldering time, low soldering temperature or excess solder on the iron. Reapplication of the soldering iron usually remedies the problem, but make sure that there is not some other problem with the joint. If the joint is otherwise sound, small icicles are nothing to worry about.

Preparing leads and components

Most modern components have leads which are tin-plated to aid soldering. The tin is readily absorbed into the solder, allowing rapid wetting and reducing soldering time. The plating will tarnish with time and handling. Unplated leads and unprotected printed circuit boards are partic-

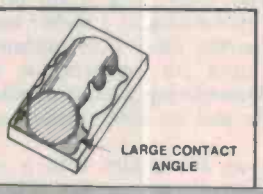


Figure 17. Too little heat. The solder forms a large contact angle with the surface and may be prised loose. Reheat the joint to fix this one.

Figure 19. 'Wicking' is caused by solder running back up the strands of multi-strand hookup wire. This makes the wire brittle at the joint and movement may break it.

Figure 18. A resin bond (see accompanying picture). There may be no electrical contact at all. It can be cured by reheating the joint.

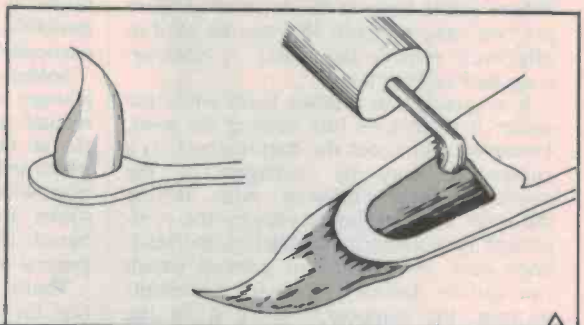


Figure 20. 'Icicles' sometimes form on a joint when you remove the iron. Reheat the joint with a clean iron to get rid of them.

ularly affected as oxidisation is quite rapid.

It is always a good practice to tin the parts of a joint before putting them together. Component leads can be tinned by simply heating them with the iron and then applying a little solder. Only tin that part of the lead that is actually going to make the joint as component leads are usually trimmed after the joint is made.

If the lead is tarnished, it can be cleaned by pulling it through a doubled-over piece of emery cloth or plain steel wool. Printed circuit board tracks do not need tinning. If the tracks are tarnished, clean the board with an abrasive powder cleanser (such as Ajax) and a moist cloth. Wash the board in clean water after cleaning and dry with a tissue or paper towel.

A light spray of clear lacquer, such as "PC lacquer", will prevent tarnishing and can later be soldered through.

Stranded hookup wire is best prepared in the following manner. Strip away about 6-7 mm of insulation from each end. Twist the strands together, apply the hot iron for about one second and then a touch of solder. Don't overheat or apply too much solder. Solid hookup wire is prepared the same way as component leads.

Tarnished tags are best cleaned by rubbing with emery cloth or lightly scraping them with a penknife. Thoroughly heat the tag with the iron before applying a little solder to tin it.

Enamelled coil wire can be prepared by stripping the end back about 6-10 mm using a penknife, cutting blade, emery cloth or steel wool until the bright copper wire shows. Tin it quickly.

Some modern coil winding wire is coated with an enamel that, although very tough, melts at soldering temperatures ('Bicalex' and 'Lewmex' are several trade names). A hot soldering iron is applied to the end to heat it first. Apply some solder to the face of the iron then to form a molten blob to cover the wire. Shortly, the insulation will smoke and burn off, allowing the wire to be tinned. A good hot tip is necessary for this operation.

Desoldering

Where joints have to be desoldered there are two basic methods that can be used to effectively remove the solder — 'soaking' it up and sucking it up.

It is possible to remove leads while the solder is molten by just heating the joint. However, this is not the best method, as a component may be damaged by the amount of heat produced. Also, flexing the leads whilst trying to remove the component may damage the lead or the lead-body seal. A terminal or printed circuit can also be damaged by heat or attempts to prise the component loose while the solder is molten. It is much better to use a desoldering aid.

Desoldering 'wick' can be used to soak up molten solder from a joint. This consists of a copper braid impregnated with resin. When applied to a joint and heated with a soldering iron, molten solder from the joint flows into the fluxed braid by capillary attraction, effectively clearing the joint of solder. Figure 21 shows how it's done.

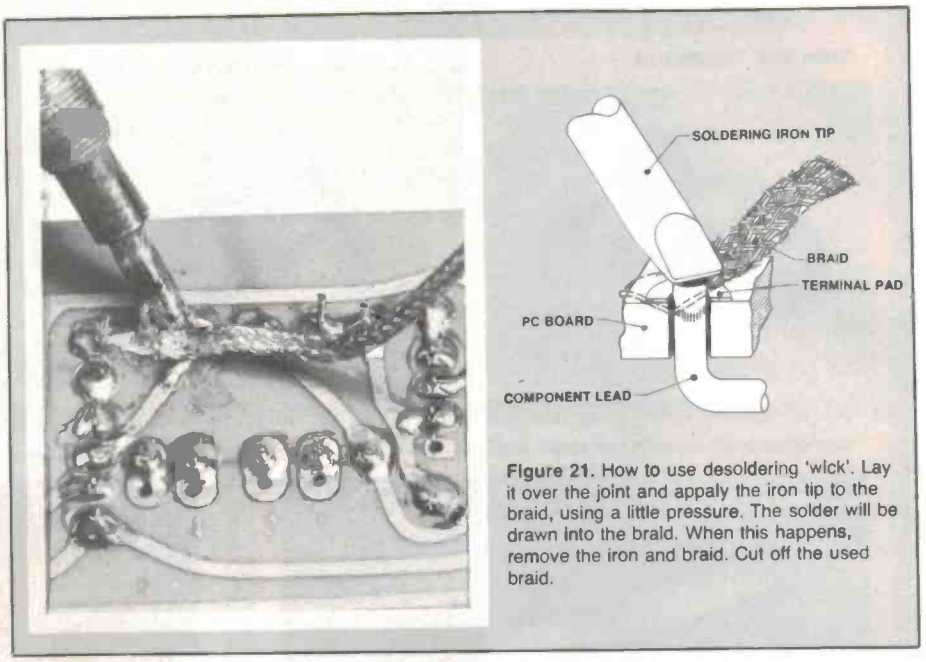


Figure 21. How to use desoldering 'wick'. Lay it over the joint and appaly the iron tip to the braid, using a little pressure. The solder will be drawn into the braid. When this happens, remove the iron and braid. Cut off the used braid.

You lay the wick over the area to be desoldered. The iron is applied to the wick and some pressure applied. As the wick heats up it activates the flux in it, which flows onto the joint, and as the solder on the joint melts it replaces the flux in the wick, flowing into the braid quite quickly. The 'used' wick is cut off afterwards. A tip running at a higher temperature and having more heat capacity than generally used for soldering is recommended. Desoldering wick is excellent for general use and on joints having a large area.

Sucking up the solder with a suitable tool is a very effective method. Hand-held 'solder suckers' are inexpensive and popular but a variety of desoldering irons having a hollow tip through which the molten solder is drawn by a vacuum pump are available (but expensive). These are particularly useful for servicing work.

Solder suckers have a spring-loaded plunger in a barrel with a thumb-operated release mechanism. A heat-resistant nozzle at one end is applied to the joint, which is heated with an ordinary soldering iron. when the plunger is released, molten solder from the joint is drawn into the barrel. (Figure 22). They are excellent for general use with pc boards.

That's the general technique, and it's fine for equipment using bipolar devices, but it can be extremely dangerous for MOS devices. Standard plastic solder suckers have been found to produce a static surge of 5 kV to 10 kV at the tip. This is invariably in contact with the device's leads when the surge occurs and may damage or destroy the device. To obviate the problem, static-free metallised plastic nozzles may be obtained. Otherwise, use desoldering wick or a vacuum-operated desoldering iron.

Practise makes perfect

That should get you started on soldering. Don't expect perfect or consistent results at first. It takes time to get the hang of it. And, as they say, practise makes perfect.

Don't leap into a full-blown computer or hi-fi system as your first project, tackle a few smaller ones at first until your soldering improves and you're able to find your way around electronic components with confidence. Kits are generally supplied with all the required parts, saving you the hassle and confusion of shopping around. Go to it, then! ●

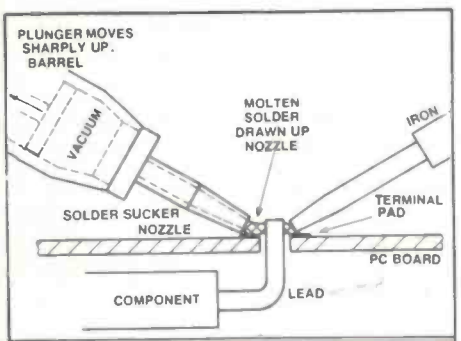


Figure 22. Using a solder sucker. First heat the joint until the solder melts. Then apply the solder sucker nozzle and release the plunger to suck up the molten solder. It is sometimes best to remove the iron before releasing the plunger. The solder sucker's nozzle and barrel has to be cleared of the solid solder 'dags' periodically.

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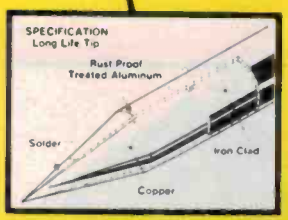

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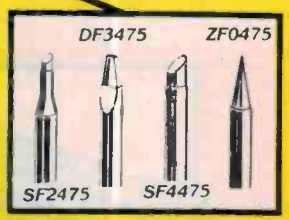

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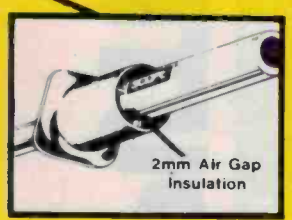

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the COMPUTER VIDEO INSTRUMENT:

Fairlight strikes again

Jon Fairall

Fairlight Instruments, the Sydney-based firm that revolutionised computer-generated music five years ago, is about to do the same thing for the video industry with their Computer Video Instrument (CVI).

ONE OF THE MAJOR trends in 'sight and sound' electronics over recent years has been the gradual amalgamation of audio and video equipment and techniques. The recent advent of hi-fi and stereo video equipment is just one of a range of related movements in the industry. So there's nothing surprising in musical instrument makers jumping on the bandwaggon and producing video equipment.

That, in a nutshell, is the story of Fairlight Instruments, They leapt to worldwide attention with the Computer Musical Instrument (CMI) in the 1970s. It has become standard equipment for some of the biggest and most creative stars in contemporary music. It was a machine that could receive any sound, digitize it, manipulate it in any conceivable way, and then spit it out the other end.

The Computer Video Instrument (CVI) does much the same thing for video. It too, accepts an input, (in this case an image), digitizes it, manipulates it in any way the operator desires, and outputs to a monitor.

Conceptually, the CVI is nothing new. There have been video manipulators on the market for several years. The thing that makes the CVI unique is its price, and therefore the range of people who will be interested in buying it.

At present the bottom of the video machine market starts at about $30 000 and goes on up from there. Big Video graphics animations packages can cost somewhere in the vicinity of $300 000. The CVI costs a fraction of this price, around $5000 depending on packaging, but has features that make it directly competitive with the larger machines.

Advertising houses, video clip production companies, broadcasters like GTV 9 in Melbourne, even government departments and industrial companies are queueing for the right to own one.

There is even talk of a domestic version, aimed at the home video enthusiast. For that to happen the price would have to drop considerably, but given strong demand that is quite possible.

The machine itself is a small package about as big as a typical home computer. It can be operated in two modes; paint and video. The paint mode allows the user to draw (or paint) on the screen. Using a small pad located on the right of the instrument, and a pen, the user can defire any of 4096 colours, plus innumerable combinations of texture, brush shape, screen and stencil wipes.

In the video mode the incoming video from a camera can be manipulated in a number of different ways. The screen geometry may be varied with stretches and compressions in vertical and horizontal directions. It can be colourised, that is, any value of incoming RGB information can be assigned some arbitary value so as to change the colour of the image. Other colour effects such as solarisation or pixelation are also possible.

The CVI also has a frame grab function

that allows the user to seize a single incoming frame for manipulation. This can then be manipulated in any of the ways mentioned above. The frame grab function can be programmed such that a frame is grabbed at preset intervals. In the mode the frames are superimposed on top of each other so that the effect of a moving body is to leave 'trails' behind.

In practice, the only distinction between the two modes of operation is that the functions are selected via different memory subsets. Both sets of effects can be intermixed at will.

Internally, the core of the circuit is a 14 x 64K video refresh memory. This is fed by a 12-bit wide RGB ADC. Four bits are used to encode each of the red, green and blue signals. There is a similar DAC arrangement on the output, from which Fairlight derive their claim of defining 4096 colours. Manipulation of the data store is done under software control stored in 32K of ROM. The ROM plus the 128K of RAM are all controlled by a 6809 processor running at 2 MHz.

Production of the CVI will start in October, with deliveries commencing around the end of the year. There have been strong expressions of interest from overseas, especially in the UK and Germany, where the Fairlight Computer Music Instrument has given the company a very high profile.

For more information, contact **Fairlight Instruments, 17 Boundary St, Rushcutters Bay NSW 2011. (02)331-6333.**

Is the audio slump over?

According to reports from Japanese manufacturers of audio equipment components, the demand for parts has remained so solid this year that they are saying the recovery is 'real', unlike 1983's 'false recovery'.

In March last year, the manufacturers reported orders had lifted to an encouraging level, but they slumped later in the year.

This year, bolstered by record-setting order values over June and July, there is more support for calling it a recovery.

Component orders cover stereo radio-cassettes, cassette decks, car sound equipment and component stereo (mostly bound for the USA).

There are also 'encouraging' rises in orders reported by manufacturers of magnetic heads, tuners, micromotors, speakers, passive components, coils, semiconductors and ICs. TDK reports their speaker-related parts and materials output is running at capacity.

Meanwhile, the boom in compact disc grows apace. Japan is the largest manufacturer and exporter of compact disc players and the USA and West Germany are the largest consumers of them. *But Australia is the third largest consumer of CD players!*

In February this year, nearly 800 CD players were exported from Japan to Australia, placing us ninth in ranking, behind Britain and Hong Kong.

USA was top of the ranking with just under 20 000 units, followed by West Germany with just over 6800 units, according to Japanese Ministry of Finance reports.

In May, Australia jumped to third place with just under 1800 units exported to here from Japan, displacing Canada which held third place in April. Some 23 000 units went to the US that month, but only some 2400 to West Germany, which still retained second ranking.

The total volume of CD players shipped from Japan jumped over two and a half times between February and May, from 65 034 units to 171 718.

— Roger Harrison

Total car audio

Pioneer has expanded the top end of its car stereo range.

New are the nine-band CD9 graphic equaliser, the four-way tilt-axial TS1690 speaker, and the UDM16T speaker spacer.

The CD9 is a graphic equaliser with nine different frequency adjustments covering the range from 60 to 16 000 Hz. The CD9 has a balance control between the front and rear amplifiers as well as separate equalisation for both Amplifiers. Rrp is $199.

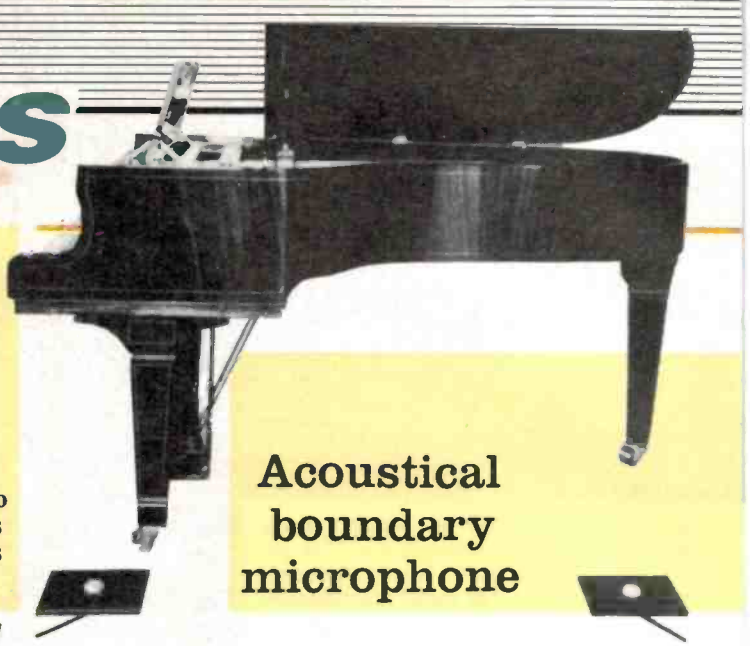
The new TS1690 speaker is a four-way tilt-axial unit with a total power handling capability of 90 W max. The TS1690 has a variable adjustment up to 45 degrees on its mid and high range speakers, allowing these frequencies to be projected straight at the front of the vehicle and the listener.

It has a recommended retail price of $209 a pair.

The UDM16T is a spacer that can help achieve better sound dispersion in vehicles where there are acoustic problems.

The Pioneer UDM16T has a recommended retail price of around $17.50 a pair.

For further information contact **Pioneer Electronics, 178 Boundary Road, Braeside Vic 3195. (03)580-9911.**



Acoustical boundary microphone

The MKE212 acoustical boundary microphone is designed for recording all classical instruments. It can be used for recording film and video soundtracks sound effects and for most recording and sound reinforcement applications.

The MKE212 uses the increase in sound pressure on acoustically live surfaces. Simulating a wall, or an acoustically live surface, with a metal disc or a similar device into which a pressure microphone has been flush mounted creates a microphone which differs from conventional pressure microphones.

There are no parts protruding from the surface which could cause irregularities in frequency response.

The MKE212R has an eight-pin DIN plug and the MKE212-3 has a special coupling device to fit a handgrip/powering module.

For more information contact **R. H. Cunningham, 146 Roden St, West Melbourne Vic. 3003. (03)329-9633.**

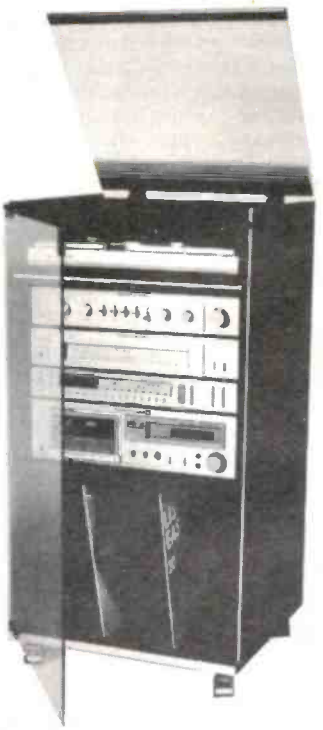
Cabinets for hi-fi buffs

The fullest protection one can give valued hi-fi equipment is to encase it in a well-made, high-quality utility cabinet which combines both functional design and sturdy durability.

Systemline Furniture manufactures a range of products designed around a home entertainment centre. These units incorporate a number of features designed to protect valuable video and audio equipment. Among these are safety glass doors which not only keep the dust out but also, with their fitted magnetic door catches, protect the equipment from children's curious hands.

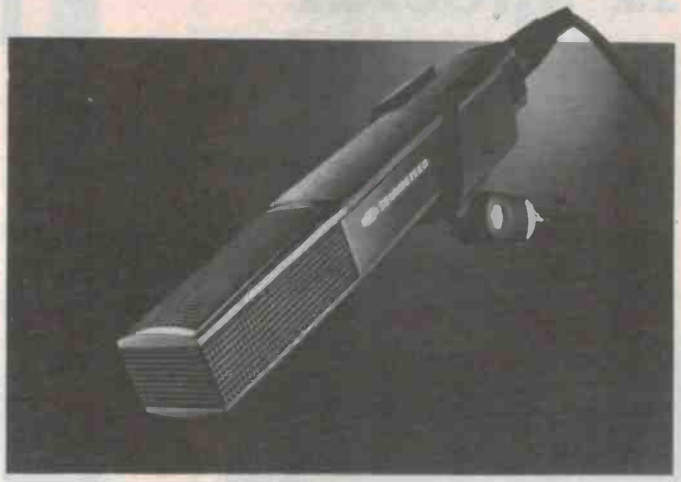
Systemline's products range from vertical glasstop cabinets for audio systems to self-contained units that can hold a TV receiver, video recorder, hi-fi plus records and video cassettes.

For further information contact **Systemline, 24 Enterprise Ave, Padstow NSW 2211. (02)771-3999.**



Systemline's MVG-925 mobile glass-top cabinet.

Sennheiser MD 441 U-3



Increased efforts on the part of Sennheiser in the music market have lead to the modification of the MD 441 dynamic microphone.

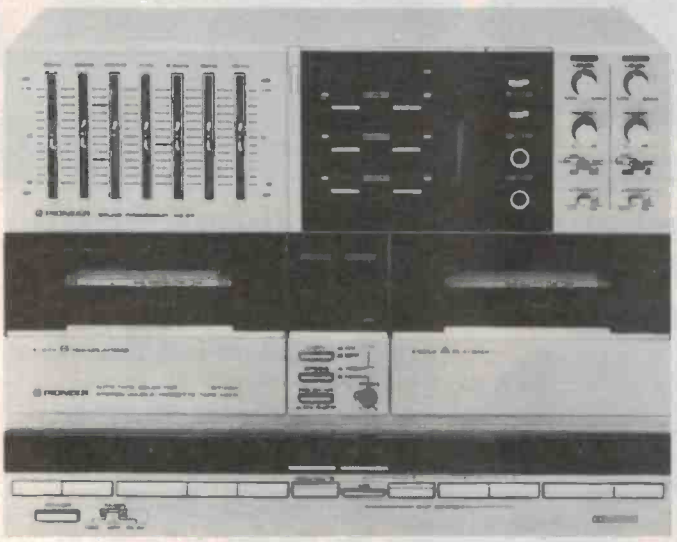
Exhaustive tests carried out with bands using the Sennheiser microphones demonstrated that a bass frequency response can be definitively determined when recording suspended and standing toms, snare drums and high-hat cymbals. The same bass frequency response can also be optimally established for wind instruments. In this way, the MD 441 U-3 has been given an optimally defined bass frequency response.

As with previous versions, the treble range can be boosted via a small switch. Otherwise, it remains linear.

A new mounting stand, the MZQ 441, has been developed which can withstand the rough treatment received, particularly when a band is on tour.

For more information contact **R. H. Cunningham Pty Ltd, P.O. Box 4533, Melbourne Vic. 3003. (03)329.9633.**

Pioneer cassette deck/ sound processor



Pioneer has expanded its range of shelf component hi-fi with the CA-X7 sound processor and the CT-X8W double cassette deck. Pioneer claims that these products will give a sophisticated sound mixing and dubbing facility.

With the sound processor sound quality can be modulated and matched for peak results in any room. This is important with shelf systems which can be required to work in confined spaces. The CA-X7 compensates for the peaks and dips in the top and bottom end of the frequency range through its seven band graphic equaliser section. An in-built echo function operates on a time delay mechanism.

Stereo microphone mixing is possible through the CA-X7 when it is used in conjunction with the double cassette deck. Electronic musical instruments can be plugged into the CA-X7 so that vocal and audio signals can be mixed. Recommended retail price is $339.

The CT-X8W double cassette deck is two interlinked cassette transport systems in one package, making it possible to dub and synchro-record. Other features include skip search, Dolby noise reduction and record muting.

A synchro-record start switch allows co-ordinated dubbing from one tape to another and the relay play switch activates a circuit for continuous playback of two cassettes. The CT-X8W has a minimum wow-and-flutter of 0.05% and a signal-to-noise ratio of 47 dB. It has a recommended retail price of $499.

For more information on these products contact **Pioneer Electronics Australia Pty Ltd, 178 Boundary Rd, Braeside Vic. 3195. (03)580-9911.**

Nakamichi three-head auto-reverse deck

The Nakamichi RX-505 is a discrete three-head unidirectional auto-reverse cassette deck. It features Nakamichi's asymmetrical dual-capstan diffused-resonance transport, claimed to be the only mechanism with such precise tensioning and guidance that neither pressure pad nor intercapstan guide are required. Eliminating them reduces scrape flutter and modulation noise to extremely low levels and improves reproduction.

The makers say that no 'sandwich' head can match the performance of the discrete heads in magnetic azimuth accuracy, response, MOL, and freedom from 'cross-feed'. Furthermore, no rotating-head system can prevent bidirectional azimuth error. Even if azimuth is set separately in the two directions with adjustable stoppers, it changes as the mechanism wears.

Nakamichi's unidirectional auto reverse deck is a totally new approach. Rather than changing tape direction at the end of the side and rotating the magnetic head, the cassette disengages from the mechanism, turns end for end, and reloads. The procedure is exactly the same as performed manually in a 'one-way' deck and so a precision dual-capstan transport can be used. Since tape travels in the *same* direction on both sides, there is no "bidirectional azimuth error" as with conventional auto reverse. The same erase, recording, and playback heads are used on both sides. There is no need for an extra erase head — which increases tape friction and scrape flutter — nor for a head-rotating mechanism which virtually guarantees azimuth error.

The RX-505 has uniform response from 20 Hz to 20 000 Hz and features Dolby-B and C-type noise reduction, independent tape and equalisation selectors, adjustable bias, and the Nakamichi Dual-Speed Master Fader to create professional-quality recordings.

In addition to a defeatable MPX filter for FM-stereo recording, the deck has a defeatable subsonic filter to prevent infrasonic energy from affecting the recording when taping a warped record.

The RX-505 sells for $1400.

For more information contact **Geoff Matthews, Marketing Director, Convoy International 400 Botany Rd, Waterloo NSW 2017. (02)698-7300.**

A special opportunity for readers of Electronics Today

By special arrangement with Teac Australia Pty Ltd, the local representatives for Denon, we are able to offer readers the outstanding new Denon Technical CD Test Disc for only

$19.95 *Plus $2.50 postage and handling*

This important new tool for evaluating CD players and testing audio systems comes from Denon, the Japanese company that has played a leading role in the development of digital audio recording. Here's what Louis Challis, Australia's foremost audio and electronic equipment reviewer, said after testing this exciting new disc in his NATA-registered laboratory:

"I classify this particular CD disc as one of the best bargains of 1984. I believe that almost every recording studio, radio station, television station and serious high fidelity enthusiast will want to buy this particular disc, because it provides just SO MUCH INVALUABLE (testing) INFORMATION."

(Electronics Today, August 1984)

This is an excellent offer for such a professional, state of the art disc! Look at what you get for just $19.95:

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Slave Amp (150 watts per channel into 16 ohms) with stereo to mono switching.

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500 Mosfet Output Stages
250W into 8 ohms

Disco Mixers

CITRONIC SM 330 $695.00
6 Channel Input (2 Mikes + 4 aux)

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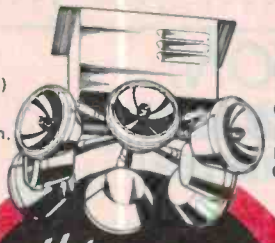

Lamps

DX100-ES, 240v, 100w $3.75
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BONUS!
One FREE TDK 180 Video Tape

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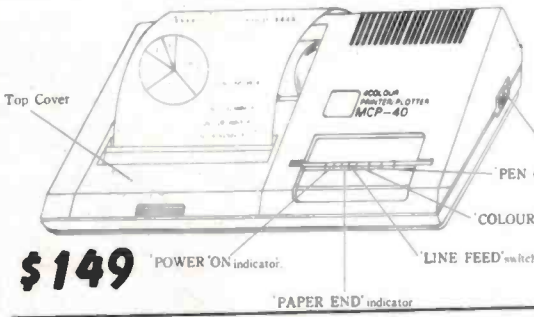

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Cat. XP-4605

SPECIFICATIONS

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(Vertical)	*73mm/sec(3.80ips)*
Printing Speed	*12 characters per second*
Resolution	*0.2mm/step(0.00787 inch)*
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Characters per Line	*80 or 40 (Text Mode) (Determined by Software in Graphics Mode)*
Accuracy (repetition)	*0.2mm max*
(Movement)	*0.3mm max*
(Distance)	*0.5% max (X-axis) 1% (Y-axis)*
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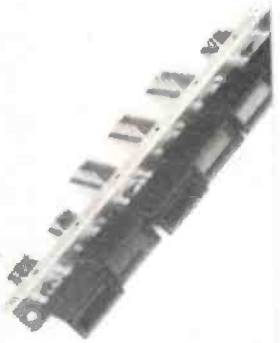

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The MP-3013 is also supplied with a very handy 2.8 metre long cord with twisted wire leads at the end. Now the price! For October only you can grab this fantastic bargain for only **$6.95**! That's right almost ½ normal cost! OCTOBER ONLY - Orders received after October will not be recognised.

Cat. MP-3013 _____ **$6.95**

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The consumer flop that should never have flopped!

One of the greatest consumer flops of the last decade was the ionization-type smoke detector.

Even though it was a brilliant product (see box), is reliable, compact, easy installation, fail safe etc., it just did not sell. Apparently human nature being what it is finds safety-orientated products just not worth the investment however modest. We all know, for example, that accidents and fires never happen to **US!!**

We all know also, that smoke is the greatest killer in a fire. Many fires smoulder for hours before catching allght and causing physical damage.

The US market research gurus thought that a cheap, compact smoke detector would be a mass consumer item. But boy, were they wrong! When they sold for **$49.50** no one wanted them. The price fell to a very reasonable **$29.99** and still they stayed on the supplier's shelves. Jaycar was called in.

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Cat LA-5090

(Were advertised earlier this year at $19.95 each but originally sold for $49.50).

TECHNICAL

For those unfamiliar with the product, a brief description: A minute speck of the rare element Americium 241 is enclosed in a sealed metal chamber within a compact plastic case that contains control electronics, battery and solid state alarm. A very small ionised field is set up within the chamber. When smoke enters the case and then the chamber, the chamber changes electrical state and the external circuit switches on the alarm. The chamber detects down to very low smoke levels. The electronics circuit is run by a 9V battery. When the battery is getting towards the end of its life the circuit automatically gives you up to two weeks warning by emitting distinct beeps.

If the idea of a radioactive device concerns you, don't worry because this device emits less radiation than your average clay-fired housebrick!!

The "Smoke Sentry" is completely self-contained, is round and measures a compact 115mm diameter and 40mm deep. Fixing screws (even masonry plugs!) are provided as well as 9V battery and very comprehensive instruction manual.

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$34.95 - SAVE $5

MEMOCON CRAWLER

This robot is controlled by a keyboard (which is supplie keyboard plugs into the robot. Up to 256 discrete com can be entered into the robots memory (RAM). The ro then move according to programmed instructions. Lig a buzzer can also be programmed to operate as wel

Cat. KJ-6686

$69.95 - SAVE $10

WAREHOUSE MOVING FROM OCT 1st TO 7/9 RAWSON ST. AUBURN 2144

ELECTRONIC BELT DRIVE TURNTABLE BSR QUALITY

Jaycar has made a sensational scoop purchase of B.S.R. belt drive turntables from England at below manufacturers cost!
Two models available AA-0290 works from 9-12V DC and the AA-0292 from 240V AC (includes 12V 400mA adaptor). The DC motor drive is electronically controlled.

SPECIFICATIONS:
- Dimensions 330(W) x 285(D) x 60(H)mm overall
- Platter diameter 280mm
- 2 speed - 33 & 45 rpm (internally adjustable)
- Pick-up arm counterbalanced type with cueing facility
- Pick-up ceramic (stereo) with diamond stylus
- Turntable operation - auto stop, will return to rest automatically. Turntable chassis is sprung on all corners with transit screws & clips ★ Weight 1.5kg
- Output stereo RCA sockets underneath unit

MASSIVE PRICE BREAKTHROUGH!

(Due to the weight of the unit post and packing is $5 NOT $4.50)

Check the price! Cat. AA-0290
(Requires 9-12V DC

ONLY $29.95

240V version -
(includes 12V 400mA adaptor)
Cat. AA-0292

ONLY $39.95

★ SEE OUR OTHER ADS FOR HI FI SYSTEM ★

★ NEW ★ CQAM STEREO DECODER KIT

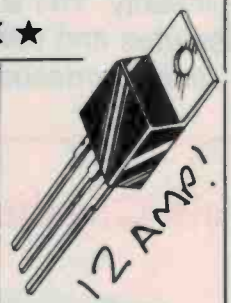
Ref: EA Oct 1984
of parts for this project including PCB, 10uH choke, C13020 IC.

KA-1555 **ONLY $19.95**
(Whistle filter coil extra)
Cat. EE-3814 $19.95

ANOTHER BARGAIN

CHEAPER THAN ELECTRETS

Quality West German made dynamic mic inserts. You can feel the quality by the weight of one in your hand! Not too much in the specification dept. except that we know that they are GOOD!!
Cat AM-4015 **$1.50 ea (1-9)**
10 or more $1.25 ea



BARGAIN OF THE CENTURY!!

How do we do it?
Another BARGAIN!!

Once again, Jaycar has secured a massive below-cost scoop purchase. This time a nifty combination VHF/UHF television tuner assembly! We **dare not mention the famous Japanese brand** of this quality assembly!

- Brand, spanking new
- Separate VHF rotary tuner
- Separate UHF rotary tuner
- All knobs & wiring INCLUDED!
- Attractive front panel fascia included!
- Circuit diagram included!

Be quick to secure one of these as we only have 70 pieces for sale.
Cat DM-9004

ONLY $69.95 HURRY!

400 VOLT TRIAC BARGAIN!!

Yet another Scoop Purchase!!
Genuine 'Motorola' brand 2N6343 12A 400V Triac. TO-220 case. Equivalent to GE SC141D which sells for $1.65. (As used in the Musicolor). Cat. ZX-7140
Only $1.50 each or pack of 10 for $10

SENSATIONAL DEALS ON 3-WAY SPEAKER SYSTEMS!!

8" 3 WAY SYSTEM

Superb 8" woofer with foam surround suspension and heavy magnet assembly with sealed back midrange and tweeter. System impedance 8 ohms. Power handling 40 watts rms. Crossover capacitors and connecting diagram and recommended 8" cabinet detail drawing supplied.
Cat. CS-2453 (2 required for stereo) **$29.95/set**

10" 3 WAY SYSTEM

Once again, a high quality 10" woofer with higher power, sealed back midrange and tweeter. System impedance 8 ohms. In addition a quality Pioneer 3-way crossover is provided at no extra charge. Connection instructions are also provided as well as recommended 10" cabinet plans.
Cat. CS-2454 (2 required for stereo) **$39.95/set**
INCLUDES PIONEER 3-WAY CROSSOVER!!

BELOW MANUFACTURER'S COST!!

ONLY **$125** COMPLETE
MASSIVE SAVING OF $74

ONLY **$29.50**
Cat XC2036

Spare Flow Sensors: Jaycar will be supporting this product for many years to come. To avoid problems changing cars, why not buy a spare fuel flow sensor? They are about the only things that wear out!

FULL 90 DAY WARRANTY

AS REVIEWED
OCT '82
EA (p.26-28)
ETI NOV '82 (p.26)

CAT. XC2010

NEW IMPROVED MODEL!

The Voyager is available from the following dealers at your convenience or by mail order to Jaycar Box 185 Concord 2137

Jaycar Sydney (City)	264 6688/267 1614		
Jaycar Concord	745 3077		
Jaycar Carlingford	872 4444	Rod Irving	
Jaycar Hurstville	570 7000	Melb A'Becket St	(03) 347 9257
Zap Electronics	Parramatta	Northcote	(03) 489 8131
	Hornsby	Altronics Perth	(09) 328 1599

At $199 the Voyager Car Computer represented absolutely outstanding value for money. No one else had such a low priced FULL FUNCTION car computer. The Voyager is the only low-cost unit that will give you full consumption (the most important feature in a car computer) in both metric litres 100km AND good old MILES PER GALLON!

At $195 many many hundreds have been sold NOW you can grab one **absolutely complete** for only $125 — a saving of 37% or $74!

The Voyager comes absolutely complete with all fitting hardware — even down to a roll of insulation tape! Installation generally takes between 4 and 6 hours depending on vehicle

SEE OUR OTHER ADS FOR ADDRESS PANEL AND OTHER INFORMATION

SOUND RECORDING—

The problem with reel-to-reel and compact cassette audio recorders is their limited dynamic range. Even noise reduction systems can't fully compensate and they introduce frequency non-linearity. The solution is to go digital. But digital recorders cost an arm and a leg and offer features and performance not needed by lesser mortals. Sansui's add-on digital audio encoder/decoder for use with a video cassette recorder looks like it might offer the low-cost solution.

Louis Challis

SANSUI TRICODE PC-X1 PCM DIGITAL AUDIO PROCESSOR

Dimensions:	*PC-X1 266 mm wide x 73 mm high x 287 mm deep* *AX-C1 100 mm wide x 71 mm high x 200 mm deep*
Weight:	*PC-X1 — 2.5 kg, AC-X1 — 1.5 kg*
Manufactured:	*In Japan, by Sansui Electric Company Limited, Tokyo.*
Price:	*$1399 (s.r.p.)*

FOR THE LAST thirty years, most professionals and many amateurs have relied on professional reel-to-reel tape recorders like the Nagra III and Nagra IV tape recorders for critical film recordings in the field. These tape recorders have provided exemplary service, often working in conditions where the thermal, humidity, vibration and sometimes dirt and dust conditions are almost unbelievable.

One of the most obvious problems with conventional reel-to-reel recorders, and most of the compact cassette recorders, is that they are effectively limited to a practical dynamic range of about 55-60 dB, unless they incorporate one of the sophisticated noise reduction systems like dBX, Dolby A/B/C or Dolby HX. Whilst each of these noise reduction systems provides worthwhile and sometimes dramatic improvements in the effective signal-to-noise ratio, they do so at the expense of flexibility, and usually frequency linearity. More significantly, they generally introduce some other unwanted audible effects and consequently are regarded as a "pain in the proverbial" by the industry.

What most professionals (and quite a few amateurs) really want, is a recorder with a dynamic range of 90 or, if possible, 100 dB without suffering the distortion, dynamic range and hiss problems of a conventional reel-to-reel or cassette recorder.

In the last few years, digital recorders from Sony, Sound Stream and 3M have taken the professional recording field by storm because of their superlative recording characteristics, which almost completely eclipse the professional multi-track analogue recorder.

The problem with professional digital recorders is their *unbelievable price* as well as various other technical problems like their compatibility with one another. Obviously, not everybody needs a 16, 24 or 32 track professional digital recorder with a price beyond the reach of all but the most wealthy.

Many people would be quite happy with a two-channel digital recorder offering a performance superior to the conventional Nagra or Stellavox, if only it didn't cost "an arm and a leg".

The solution

The Japanese manufacturers realised that it is readily possible to provide such performance by an unusual and yet extremely innovative approach. Instead of building a digital tape recorder from the ground up, they decided that all that they had to do was to develop a suitable pulse code modulation (PCM) processor which would produce a compatible video signal. This could then be directly recorded on a conventional video cassette recorder (VCR) of the type which so many households now utilise for video entertainment. By using this ploy, it is possible to produce a PCM recording system with characteristics just as good as those provided by a studio digital recorder, but for an unbelievably small fraction of the price.

The resulting system becomes a tape recorder with a flat frequency response (±0.2 dB) from 5 Hz to 20 kHz with linear dynamic range of close to 90 dB and with the ability to record a signal (almost any signal) without having to worry unduly about the input attenuator settings being perfectly adjusted for the variations in signal level under a wide range of practical recording conditions.

THE DIGITAL SOLUTION

Using Sansui's PC-X1 PCM digital processor for VCRs

Although all this sounds delightfully simple, nothing could be further from the truth, as there are practical problems with a VCR in the form of tape dropouts due to imperfections in the tape magnetic coating. This is further compounded by the use of a rotating head, spirally tracking over a 12 mm wide magnetic tape. There are also a number of not so obvious problems created by the dropout compensation circuitry incorporated in most VCRs.

The tape drop-out problem is almost solved by the use of one or more of the interleaved modulation PCM standard redundancy codes. These take the original audio signal and divide it up on a frame-by-frame basis, so that if part of the signal is lost there is generally sufficient components of the original data left in adjacent frames for the signal to be reconstituted. This redundancy code manipulation is done in such a way that on record, and subsequently on replay, the loss of a segment of the original signal becomes far less embarrassing and only in the presence of extremely long dropouts do you suffer any audible or detectable loss of signal (See Figure 4).

Sansui have gone one stage further than most other manufacturers of PCM digital processors by incorporating the 'Tricode' circuit. This enables the PC-X1 to "read" very deteriorated PCM signals that are so poor that other machines would most probably fail to cope with them. Their reasons for going to so much trouble are more sensible than the average reader might at first realise, as they have set out to make this signal processor suitable for use with half-speed VCRs. As a result, you can record a signal on an L750 Beta format or an E180 VHS format tape (or longer) to provide up to six (or eight) hours of recording time, which is an extremely long recording time by any standards.

The PC-X1

The performance capability offered by the PC-X1 is undoubtedly exciting. It is designed to provide a two-channel capability claimed to be +0, −0.5 dB from 5 Hz to 20 kHz with an unweighted dynamic range of 84 dB. Whilst the ordinary reel-to-reel recorder has maximum distortion at maximum recording level, the PCM processor/VCR combination theoretically has minimum distortion at the maximum recording levels and conversely, maximum distortion at minimum recording level, not unlike a conventional CD player.

These characteristics result in the capability to produce truly professional recordings, which can not only be played repeatedly, but can be re-recorded digitally from master to copy virtually without any trace fo the type of deterioration that occurs during multiple mixes or mix-downs on a conventional reel-to-reel recorder.

The design of the PC-X1 is rather novel as it contains the main working system together with a battery holder in the relatively small main module. The mains power supply unit is incorporated in a supplementary external plug-in ac power adaptor. As a result, you can either operate the unit for up to an hour on a rechargeable battery pack (which was regrettably not provided for our testing) or you can plug it into a 12 volt supply (e.g: from your car) to obtain extended recording time, or plug it into he mains with the PC-X1 for unlimited recording time.

The main unit is black, with the main controls neatly and functionally integrated on the front panel. These are contained in five main groupings. On the left hand side is the POWER/ON OFF switch, a small rotary volume control for the headphone output level and a tip-ring-sleeve socket for your 8 Ohm stereo headphones.

The second row of controls incorporate a large rocker switch for RECORD or PLAY, below which is a large yellow push-button providing RECORD MUTING. Using this spring-loaded switch, gaps can be provided between recorded sections, so that you can ensure the deletion of an unwanted audible signal.

Mains power supply. The AC-X1 unit is a simple black box with a power switch and indicator on the front panel.

The third column of controls are a series of four horizontal slider switches which are not frequently used. The first of these is labelled COPY which allows you to perform dropout compensated 'digital tape to digital tape' copying (provided you have a similar machine with which to copy).

The next switch is a meter mode switched labelled LEVEL or TRACK/BATTERY. In the normal mode, the LEDs in the central section of the adjacent display act as a conventional level recording meter. When the switch is moved to the track/battery position, the left channel meter is converted into a tape tracking indicator and the right channel meter into a battery status indicator. This function is indispensible as I subsequently discovered.

The third switch, which is designed for MUTING, has two positions labelled AUTO to prevent noise caused by dropouts or other noise faults being audible, and an OFF position in which more dropout noise can be heard but allows the playback to continue without muting interruptions.

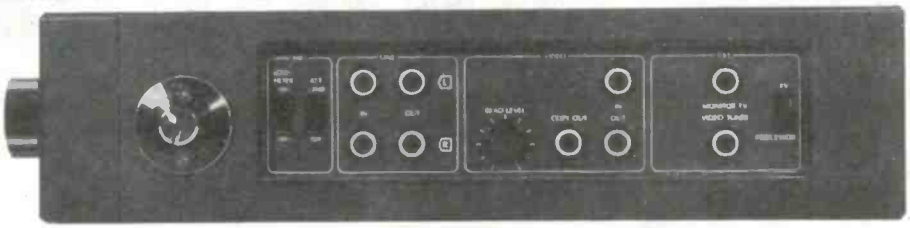
The fourth switch in this group is the INPUT selector switch which chooses the LINE or MICROPHONE signal inputs to the processor.

The central section of the fascia contains the two-channel meter display utilising yellow, orange and red LEDs. This display covers the range −30 dB to 0 dB with yellow light emitting diodes, 0 dB to 15 dB with orange LEDs, and overload with a pair of red LEDs. The display peaks are held for a second which is important to show where the peak signal is for level setting.

The 0 dB on this unit is not 0 dB as it is on a tape recorder and in the range 0 dB to +15 dB one achieves the lowest distortions that the modulation process can provide (based on a 14-bit analogue-to-digital converter). The handbook advises that average recording levels should be centred on 0 dB and that transients should be allowed to extend up into the 0 to +15 dB range.

The recorder incorporates a high frequency pre-emphasis mode so that signals in the 0 dB to +15 dB level range are boosted in the 3 kHz to 20 kHz range during encoding and re-equalised on decoding. ▶

The ins and outs. The audio line and video inputs and ouputs are located on the side along with several controls.



When the central display is switched to TRACK/BATT it provides a clear display on the tracking performance of the VCR and whether the tracking is adequate, as well as the battery condition. In the field you would need to know whether you still have sufficient battery voltage to allow the recording or demodulating process to continue with your available battery charge.

At the bottom of the display are four illuminated display lights for RECORD, PLAY, MUTING, NO COPY and CHARGE. The NO COPY light only illuminates when playing back a tape containing a tape copying prohibition code. On the right hand side of the display there are a pair of dual, concentrically-mounted left and right channel recording level controls. To the right of these are a pair of tip and sleeve microphone input sockets.

Figure 1

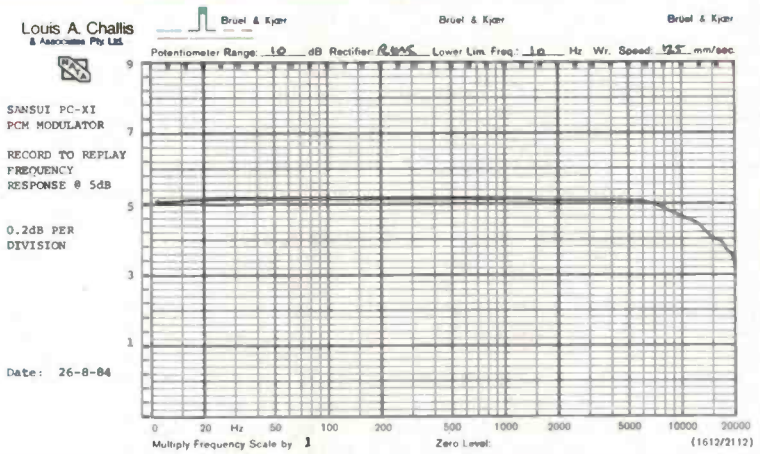
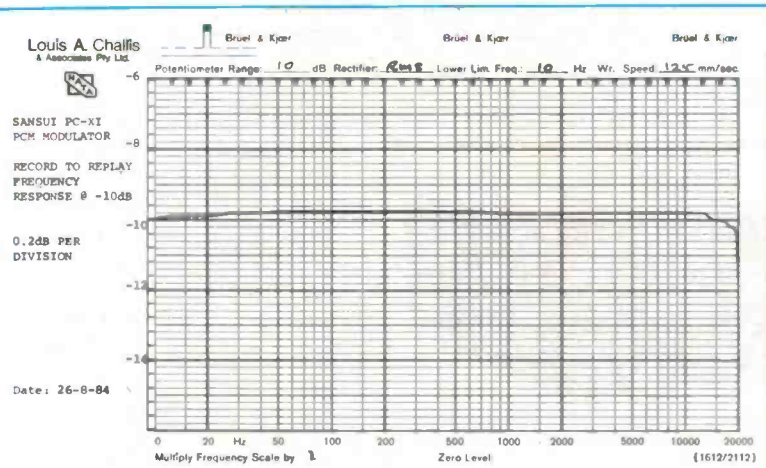


Figure 2



The right hand side of the main module contains the remaining controls and sockets. These include a high-pass ON and OFF filter switch to cut out low frequency or unwanted infrasonic signals which are likely to be picked up by a microphone out of doors or in windy conditions, and a 20 dB microphone attenuator switch.

Conventional RCA-type coaxial sockets are provided for left and right channel line input and output and for video and output (for connecting to the VCR). A copy-out jack is provided for the digital signal for copying from one tape to another. A small rotary control, labelled READ LEVEL, is provided as an additional control if the VCR's tracking control does not provide sufficient flexibility.

There are two additional jacks labelled MONITOR TV and VIDEO TUNER which we supplemented by a TV/processor switch, which enables you to connect up your VCR without having to change your normal system connections. This arrangement also conveniently allows you to watch the digital PCM pattern on your TV screen, to ensure that the modulation process is taking place during the recording phase and that the demodulation signal is being fed to he PCM processor on replay.

On the left hand side of the unit is a battery compartment (which we were unable to use). The power supply is pre-wired for 240 volt operation, is double insulated and incorporates a small LED indicator and mains on/off switch.

On test

During the objective assessment of the unit, I initially attempted to use a two-speed VHS recorder without success and incorrectly believed that the PC-X1 was not working correctly. (I subsequently found the problem was a faulty cable). When I switched to an old, reliable Sanyo Beta recorder, the inexplicable cable problem disappeared and good results were immediately obtained.

The first thing that became clear from the testing was that the dynamic range of the PC-X1 is a little limited by the use of the 14-bit quantization. This means that, in order to produce the best results from the recorder, one really has to try to make effective use of, and optimise the performance, of the PCM processor in the 0 dB to +15 dB range. One cannot record the full frequency response with a +15 dB signal, or even a +5 dB signal, where the distortion is extremely low, but you must do it at a lower level which is typically below +5 dB, or even lower, because of the use of frequency pre-emphasis.

Under these conditions, the measured frequency response is *almost ruler flat* from 10 Hz to 18 kHz, and only 0.4 dB down at 5 Hz and 20 kHz. This performance, you will realise, is substantially better than any

professional analogue recorder can provide and allows this combination to be used for a wide range of professional applications which previously necessitated the use of FM professional recorders. Note that FM recorders can only achieve a 45 dB dynamic range (almost half of the range that the PCM/VCR system offers).

Distortion. What distortion?

It is in the area of distortion that the PC-X1 really shines. The distortion levels at +15 dB are only 0.03% at 1 kHz, and 0.04% at 100 Hz and 6.3 kHz. At +10 dB these figures are, surprisingly, *lower*. At −30 dB distortion rose to 0.029% at 1 kHz and 0.38% at 100 Hz. At very low signal levels. (−50 dB) the distortion levels rise to 3.6% at 1 kHz and 4.7 at 100 Hz in the same way as they do on a compact disc. This is because you have only about three bits of resolution left and obviously cannot expect much less than about 5% distortion.

As soon as you exceed the +15 dB level you cross into a 'no mans land' where you don't really have any more bits of analogue-to-digital resolution left. As a consequence, the moment you exceed the +15 dB level you start to rapidly increase the distortion. By the time you are 2 dB above that figure, you exceed the 3%, third-order harmonic distortion level.

This means that the effective dynamic range of the system is 82 dB unweighted and 84 dB A-weighted, relative to the +15 dB setting, and an actual 84 dB unweighted and 86 dB A-weighted, relative to the +17 dB setting, an area which one would be well advised to avoid.

These figures compare particularly well with the 14-bit resolution theoretical figures of 14 x 6 dB, or 84 dB. Sansui actually claim an 86 dB dynamic range which was achieved (as an A-weighted figure) in the set up evaluated.

Wow

The manufacturer does not state the wow and flutter figures, which we tried to measure by conventional techniques, but could not (in the same way as we couldn't with the CD disc players). We resorted to a stratagem of utilising one of our tried and proven graphical methods with a frequency deviation detector with the results being plotted out on our level recorder.

This provided the unvarying signal you see in Figure 4 which reveals how stable and accurate the speed stability of the system really is (i.e: no measurable trace of wow and flutter, but measurable dropouts do show).

Watching the process

For those so inclined, it is interesting to watch the PCM encoded signal on a video monitor. In the laboratory I viewed this on a green screen Sanyo video monitor which forms part of our computing system. The sinewave signals with varying level produce clearly defined patterns.

At home, I was able to watch the signal on our TV set where you have the benefit of colour as well as shape and form. The video signal actually tells you quite a lot about what's happening during the modulation or demodulation process.

The important thing is not the pattern itself but the number of visible dropouts which test the capabilities of the Tricode circuit to its full capacity. When working beyond the capacity of the Tricode circuit this manifests itself as audible dropouts, not unlike those you would experience on a conventional reel-to-reel, or more likely, a compact cassette recorder. The poorer the tape, the more drop-outs are likely to result.

Test tapes

Given the frequency response, low distor- ▶

Figure 3

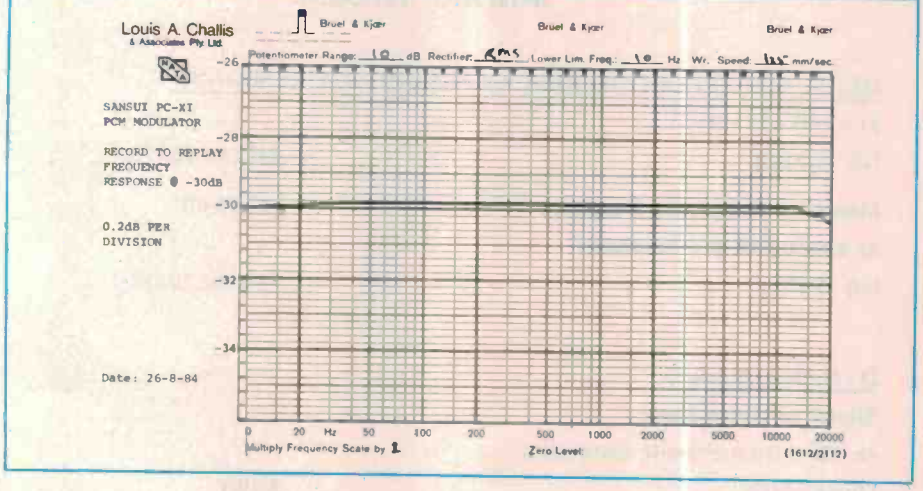
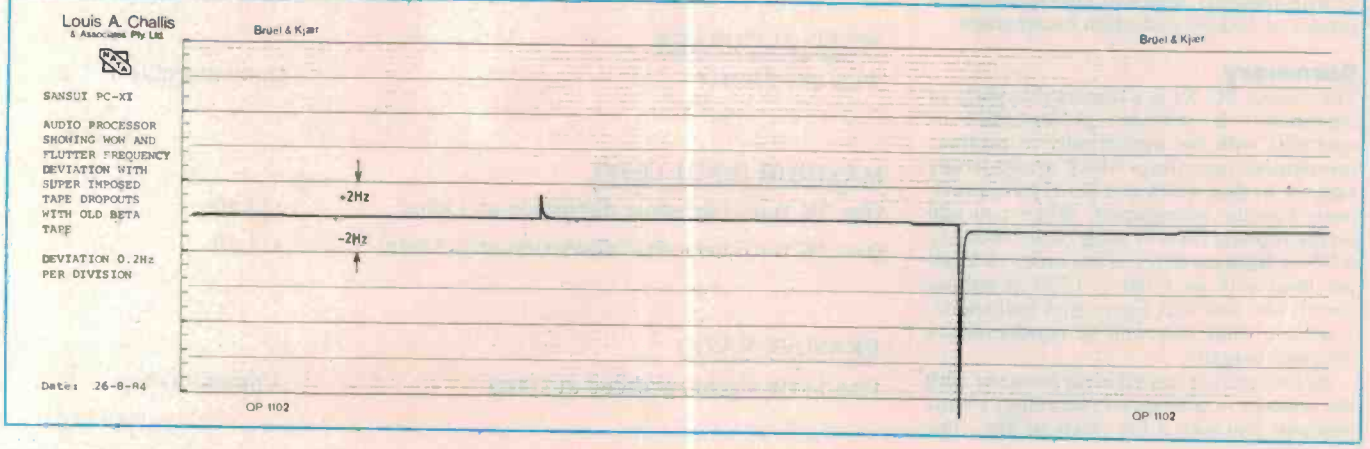
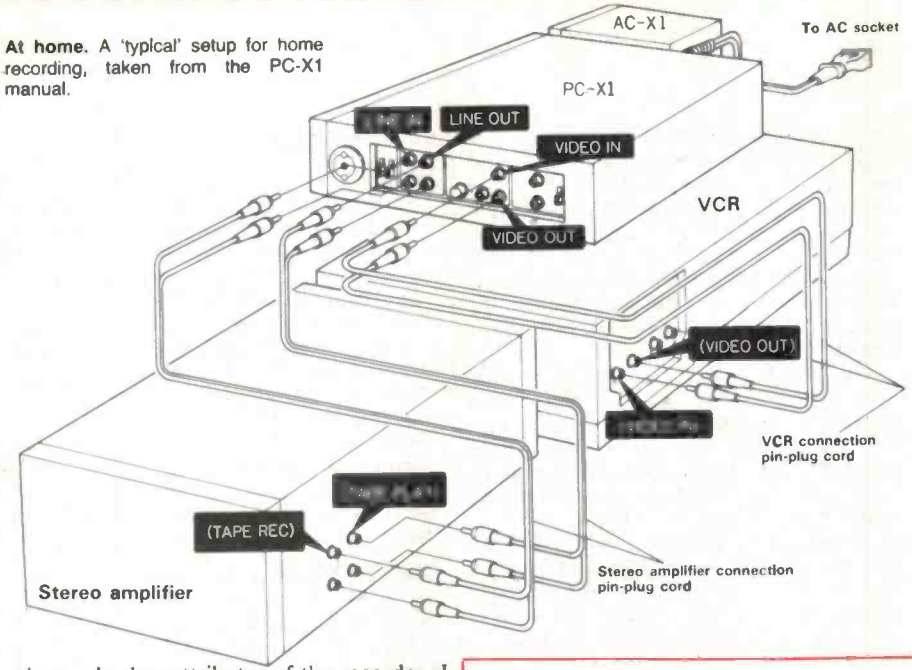


Figure 4





At home. A 'typical' setup for home recording, taken from the PC-X1 manual.

tion and other attributes of the recorder, I produced a series of temporary test tape recordings utilising a Sony CDP101 player and some superlatively digitally-recorded software from Denon, Sony, CBS and Philips.

I arranged the test so that I could conduct an A-B comparison replay of the original recorded content at the same time as the PCM encoded material. These tests were set to precise synchronism (by using the fast/slow setting on the Sony CPD101 player) with both signals running in parallel through the different inputs of the same amplification system.

With this set up being fed to my monitor speakers, I was *unable to detect any trace of audible difference*, even during the quietest passages of music. By contrast, my younger son could just detect traces of quantisation noise during the quietest passages of music at maximum amplification level. These componewnts were in the 10 kHz to 20 kHz region.

What I did notice was how much cleaner the signal was when compared with an ordinary compact cassette player without Dolby or with Dolby B, which at high signal levels produced audible distortion components.

Summary

The Sandui PC-X1 is a remarkable piece of equipment. It provides professionals or amateurs with the opportunity to produce inexpensive recordings which are generally superor to that which you (or I) have previously become accustomed. When you add on the running costs of using either ordinary VHS or Beta cassettes of the order of $5.00 per hour with an E180 or L750 at normal speed, and half that figure with half-speed, you have what may well be considered an absolute bargain!

Before getting carried away however with the concept of half-speed recording, I must acquaint you with a few 'facts of life'. The PCM encoder is producing information at approximately three megabits per second. The VCR operating at half speed has a bandwidth of only about 75% of that required. That the system works is a credit to both the total system redundancy and the Tricode circuit. Any weakness in the system will soon carry you to the point of inadequate performance. With premium video tape, clean, new heads and every thing else going well, the system unquestionably works. Given two to three years of continual usage, dirty heads and more significantly, worn heads, the system would most probably not work.

The above comments are most probably less applicable to a VCR operating at normal speed where the greater available handwidth of the recorder provides a large measure of compensation, but not complete compensation for some of those problems. It is important to use premium video tape

TRICODE PC-X1 PCM DIGITAL PROCESSOR

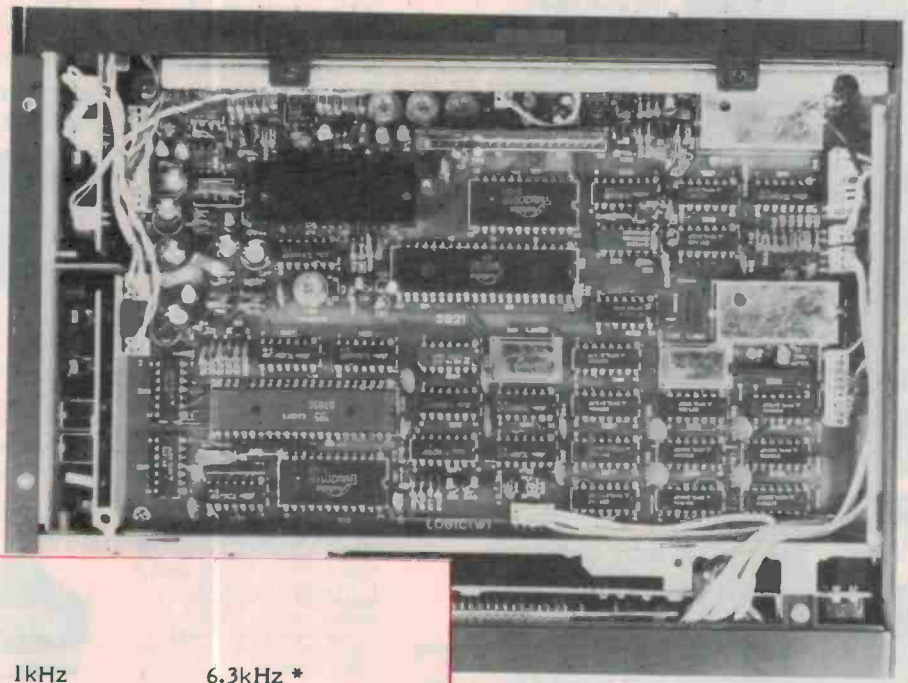
Serial No.: 223050047

MEASURED RECORD TO REPLAY FREQUENCY RESPONSE	
at -5 dB and -30 dB	
(+0 -0.5 dB)	5 Hz to 20 kHz
Measured Frequency Response	at +15 dB
as a result of pre-emphasis	
(+0 -5 dB)	5 Hz to 20 kHz
DYNAMIC RANGE	
Signal to Noise Ratio	
re 3% third harmonic distortion	
Unweighted	84 dB
A-weighted	86 dB
SPEED ACCURACY	
Wow and Flutter	Unmeasurable
MAXIMUM INPUT LEVEL	
(for 3% third harmonic distortion at 1 kHz)	+17 dB
(for 3% third harmonic distortion at 6.3 kHz)	+11 dB
ERASURE RATIO	
(for 1 kHz signal recorded at OVU)	Unmeasurable

(see our review of VCR Head Cleaners, May 1983).

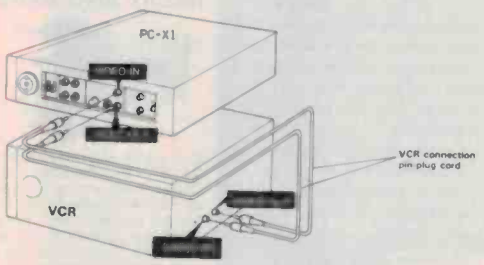
It is also important to note that there are now VCRs available which incorporate switches to disconnect the tape dropout discriminator which would normally feed the previous line of video information to mask a dropout when there is total video signal loss. This is quite visually acceptable but totally audibly unacceptable for feeding into an audio PCM processor.

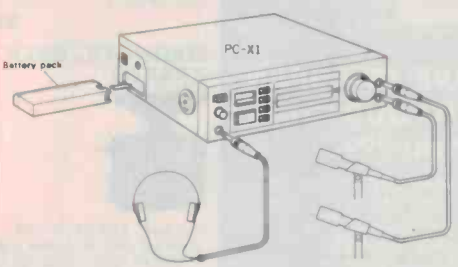
The Sansui PC-X1 offers a performance which is exciting at a capital and running cost which puts it technically in front of most other home recorders currently available. Given the limitations in editing and processing (particularly with the VHS machines, which lifts the tape clear of the heads during a stop cycle), it still provides a wonderfully exciting and in most respects, an inexpensive format for hi-fidelity recording. ●



Above. Inside the PC-X1. Most of the electronics is contained on the main pc board, visible here in the bottom of the case.

Below. Suggested setup for portable operation in the field. (From the PC-X1 manual).





HARMONIC DISTORTION

Level +15 dB Component	100Hz	1kHz	6.3kHz *	
2nd	-81.1	-73.9	-81.1	dB
3rd	-69.2	-73.9	-67.8	dB
4th	-76.8	-83.4	-	dB
5th	-86.3	95.5	-	dB
T.H.D.	0.04	0.03	0.04	%

*The 6.3kHz measured at +10 dB because of pre-emphasis.

Level +10 dB				
2nd	-71.4	71.1	-81.2	dB
3rd	-87.5	85.9	-72.0	dB
4th	-104.0	95.7	-	dB
5th	-96.1	93.6	-	dB
T.H.D.	0.027	0.03	0.026	%

Level 0 dB				
2nd	-83.9	-84.6	-76.1	dB
3rd	-87.8	-87.0	-	dB
4th	-85.8	-89.8	101.5	dB
5th	-85.1	-85.9	-	dB
T.H.D.	0.011	0.0095	0.016	%

Level -30 dB				
2nd	-49.7	-51.4	*	dB
3rd	-55.8	-	*	dB
4th	-62.6	-58.3	*	dB
5th	-60.6	-	*	dB
T.H.D.	0.38	0.029	*	%

* Below noise floor

Level -50 dB				
2nd	-28.8	-33.9	*	dB
3rd	-36.8	-33.4	*	dB
4th	-33.7	-33.7	*	dB
5th	-36.4	-	*	dB
T.H.D.	4.7	3.6	*	%

* Below noise floor

rie

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$1-$9.99	$1.50
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$500 plus	$10.00

Certified Post for orders over $100 included "free"! Registered Post for orders over $200 included "free"! Account orders from schools Govt. Depts., Public Cos., gratefully accepted. Min. order of $20. (or a min. $5 accounting fee will apply.) Comet Road Freight, Airmail etc. are extra.

HAVE YOU BEEN INTO OUR CITY STORE???

Conveniently located on the edge of the city where parking is easy! Over 4,000sq. ft. of an extensive range of products and great "in store" bargains . . for those interested in computers we have a wide range on display upstairs. For good advice and a good price, see Rod Irving Electronics.

CANNON TYPE AUDIO CONNECTIONS

We've sold 1000's because of their great value!!

	1-9	10+
3 Pin line male Cat. P10960	$1.90	$1.60
3 Pin chassis male Cat. P10962	$1.90	$1.60
3 Pin line female Cat. P10964	$2.50	$2.10
3 pin chassis female Cat. P10966	$2.90	$2.20

ELECTRONIC CASSETTE DEMAGNETISER

Save $2. Rec. retail $16.95

Cat. A10006 This month **$14.95!**

DISK STORAGE BOXES

25's or 50's

Efficient and practical! Protects your disks from being damaged or lost. Solves all those hassles of finding "that" disk.
A must at these prices . . .

Cat. C16025 25 Disk Box **$29.50**

Cat. C16050 50 Disk Box **$49.50**

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 parallel up to 20A can be switched.
Normally $8.95

Cat. S14074 This month **$6.95**

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.

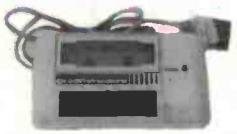
Cat. C14950 **$29.50**

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

MICRON DATASETTE



Suits most computers. Audio and visual output (via piezo element and led). A great help with those difficult to load programs.

Cat. C14900 **$39.50**

BLANK DATA CASSETTES

Brings out the best in any micro! Perfect for the Micron Datasette above!

1-9	10-99	100
$1.10	$1.00	$0.90

Cat. D11141

U.V. TUBES NEW!

Fits into standard 20W 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**

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. (use with M19010)

Cat. T12302 **$10.95**

SUPER HORN

NEW!

Wide dispersion tweeter, handles up to 100W.
Sensitivity: 105dB/0.5m
Frequency Response: 3kHz-30kHz
Impedance: 8 OHMS
Size: 145x54mm

Cat. C12103 **$12.95**

VIDEO GAME COVER

NEW

Keeps dust and grime off the unit while not in use!

Cat. A15033 **$5.95**

COMPUTER PAPER

Top quality at a very affordable price. Blank 11x9½", 2,000 sheet, quality 60gsm bond paper.

Cat. C21001 **$29.50**

"IBM TYPE" COMPUTER CASING

NEW! Give your kit computer a totally professional appearance with one of these "IBM type" casings. Includes room for 2 5¼" Disk Drives and connection ports.

Cat. X111090 **$89.00**

SUPER HORN TWEETER

NEW!

Requires no crossover and handles up to 100W!
Sensitivity: 100dB/0.5m
Frequency Response: 3kHz-30kHz
Impedance: 8 OHMS
Size: 96mm diameter

Cat. C12102

(Rec. Retail $12.95) **$9.95**

VCR COVER

NEW!

Keep the dust and grit out of your expensive VCR. Fits most VCR's and is made of heavy duty vinyl with a clear plastic front. Available in a variety of colours: Black, Beige, Brown and Silver Grey.
Size: 335(W) x 240(D) x 80(H)mm

Cat. A15031 **$7.95**

(Larger size also available)

BULK CABLE 100M ROLLS

300 OHM TV Ribbon
Cat. W11220 **$10.00**

2 Core speaker cable
Cat. W11216 **$10.00**

2 Core shielded
Cat. W11214 **$30.00**

DIGITAL MULTIMETER

NEW!

YFE YF1100 FEATURES!
★ Large easy to read 3½ digit display
★ Facilities for transistor and diode testing
★ Clearly laid out front panel
★ Priced to undersell the others.

Cat. A16025 **$59.50**

BARREL KEY SWITCH

NEW. High security 4 pole 2 position with 2 keys.

Cat. S12503 **$6.95**

BULK 'IC' SPECIALS

	10+	100+	1000+
LM 324	$0.70	$0.65	$0.60
LM339	$0.70	$0.65	$0.60
LM555	$0.40	$0.39	$0.35
LM723	$0.60	$0.55	$0.53
LM741	$0.45	$0.40	$0.37
LM1458	$0.80	$0.70	$0.65
LM1488	$0.60	$0.57	$0.55
LM1489	$0.60	$0.57	$0.55

PHILLIPS SPEAKER SPECIAL

Cat. C12030 AD01610 T8 **$9.95**

Cat. C12040 AD02160 SQ8 **$34.95**

Cat. C12045 AD70620 M8 **$49.00**

Cat. C12050 AD12550 W8 **$79.00**

You don't have to "Imagine" Phillips quality at these prices!

NEW JOINABLE PCB MOUNTING SCREW TERMINALS

Less than half the price of the old ones!

	1-9	10+
2 way Cat. P10542	$0.50	$0.40
3 way Cat. P10543	$0.75	$0.65

APPLE JOYSTICKS

Ideal for games or word processing.
Fits most 6502 "compatable" computers.

Cat. C14200 **$19.50**

S100 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**

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**

We are always searching for new products. If you have any new distressed stock or surplus to your needs, we are always interested.

Errors and Ommissions Excepted

THE COMPLETE 4½ DIGIT DMM...

AVAILABLE EX-STOCK

Compare Yours!	NEW 175	Your DMM
Autoranging	✓	
100 Point Data Logger	✓	
Digital Calibration	✓	
IEEE-488 Option	✓	
Min/Max Reading Hold	✓	
10A Capability	✓	
100kHz TRMS	✓	
10mΩ to 200MΩ	✓	
Display Annunciators	✓	
Relative Reference	✓	
dBm/Relative dB	✓	

KEITHLEY

The new Model 175 Autoranging Bench Digital Multimeter, from Keithley Instruments, Inc., combines the measurement capabilities of much higher-priced system DMMs with several new features to extend its utility, yet retain simplicity of use. It has a field installable battery option, making it fully portable. Fast autoranging (up to 200ms per range change on DCV) enables the user to concentrate on getting the reading without worrying about choosing the appropriate range, and digital calibration, as many users can now calibrate the meter in-house.

With the Model 1753 IEEE-488 (GPIB) option, the 175 is the lowest-priced IEEE-interfaceable DMM available.

Model 175's 100-point data logger monitors drift, determines rates of change, and collects response curve data without a printer, output cables, or complicated hook-ups. The data logger has six different store rates from one reading/400ms to one reading/hour, and data recall is "push-button" easy.

SCIENTIFIC DEVICES AUSTRALIA PTY LTD

2 JACKS ROAD, SOUTH OAKLEIGH,
VICTORIA, 3167 PHONE: 579 3622
31 HALSEY ROAD, ELIZABETH EAST, S.A. 5112 PHONE: 2555 6575
559A WILLOUGHBY RD, WILLOUGHBY 2068. PHONE: 95 2064

Versatile new sweeper from Wavetek

Scientific Devices has announed the release of the Wavetek Model 2005 sweep frequency generator. It features modular design which enables a high degree of customising to suit individual user's requirements. A large number of options are already already available and Wavetek claim further boards will be released at regular intervals.

It covers the 1 MHz to 4.5 GHz range in three bands. Band 1 is covered by a 1 to 1500 MHz heterodyne sweep oscillator. Band 2 is covered by a 1.5 to 2.5 GHz fundamental oscillator. Band 3 is covered by a 2.5 to 4.5 GHz fundamental oscillator. Additionally, all three oscillators may be stacked (sequentially swept) to cover the entire 1 MHz to 4.5 GHz frequency range (band 4).

Each of the four frequency bands may be used in three modes of operation: start/stop, ΔF or CW. It can be swept over any portion of a given band, in either direction, at any rate from 50 sweeps per second to 1 sweep every 100 seconds. Manual, triggered, or recurring sweeps are provided.

The instrument provides crystal-controlled harmonic markers at 1, 10, 50, 100 and 500 MHz intervals as standard equipment. The marker system features dual-amplitude markers for easy identification. In application, the markers may be tilted up to 90° for easy viewing when displayed with steep transition signals.

The 2006 has an optional rear panel auxillary RF output, a pen lift circuit for use with X-Y plotters and a 0 to 70 dB programmable attenuator.

For more information contact **Scientific Devices, 2 Jacks Rd, South Oakleigh, Vic 3167. (03)579-3622.**

Current meter

HEME has announced the release of its new clip-on current meter, the HEME 100. It is designed for heavy-duty applications where surge current values are of paramount importance and where a resolution of 10 mA is required.

There is a hold facility to assist efficient reading of both surge and normal current values on an LCD.

An analogue output socket permits display or monitoring on either a chart recorder or by a cathode ray oscilloscope, thus enabling complex current waveforms to be displayed.

The instrument is autoranging from 0-20 A and 0-100 A and will operate from dc to 1 KHz, indicating polarity.

Accuracy of the HEME 100 is 1% of range and is only minimally affected by the position of the conductor in relation to the jaws, the proximity of the return current and by stray magnetic fields from adjacent components.

For further information Warsash Pty Ltd, P.O. Box 217, Double Bay NSW 2028. (02)30-6815.

Microtelemetry

Email's Relay Division has introduced a new single board telemetry unit, Microtran, to complement its existing telemetry equipment.

Whilst only the size of an A4 page Email claim the Microtran includes all of the features necessary for a complete telemetry station, including microprocessor control, FSK modem, Telecom private line interface, radio transceiver interface, serial output 'test' port and power supply complete with battery charger.

It provides 8 control outputs with 16 status and 8 analogue inputs.

Microtran can be used in all point to point telemetry applications or with the company's Minitran system in larger network applications.

For more information contact **Email, PO Box 160, Oakleigh Vic. 3166. (03)544-8244.**

Electronic soft starters

The Startronic soft start motor controller offers electronic motor control protection to extend motor life and save energy.

Using a current limiting system, the soft start feature significantly reduces mechanical shock and stress to gears, bearings, belts, etc., in almost any ac induction motor application.

The Startronic incorporates integral pushbuttons, contactors, line fuses, electronic motor protection and includes an energy saving facility which functions automatically whenever the motor is operating at less than full capacity.

For more information concerning this equipment, contact the nearest Lawrence & Hanson Sales Centre in your state, or at **142 Dorcas St, Sth Melbourne Vic 3205. (03)697-1599.**

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$200-$499	$7.50
$500 plus	$10.00

Certified Post for orders over $100 included "free"! Registered Post for orders over $200 included "free"! Account orders from schools Govt. Depts., Public Cos., gratefully accepted. Min. order of $20. (or a min. $5 accounting fee will apply.) Comet Road Freight, Airmail etc. are extra.

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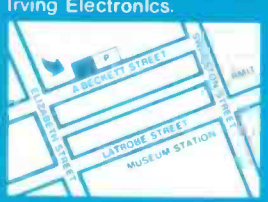

SPOTLIGHT 12V

Quartz halogen spotlight. Hand held with moulded plastic grip. Brilliant beam up to 55 watts, can be seen for miles. Orange lens cover, emergency 'flasher' switch, 3 metre curled cord, cigarette lighter plug and replaceable H3 halogen bulb!

Cat. 15050 **$19.95**

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**

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 approx. 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 reuqired.

Cat. P85510 **$8.50**

ETCHANT: 400gms of crystals to mix with 1 to 1½ lts of HOT water.

Cat. P85512 **$3.25**

ARISTA HOUSE ALARM

House alarm security system. Electronic push button control module with programmable entry/exit code. Supplied with siren module and 4 sets of reed switches. Will allow up to 30 entry/exit points and additinoal siren modules. Complete with instruction book, cable etc. Battery operated.

Cat. M22461 **$69.95**

RCA GOLD PLATED PLUGS AND SOCKETS

For those who want the ultimate in connection.
Essential for Laser disc player to get that fantastic sound quality.

Cat. P10147 PLUG **$1.95**

Cat. P10146 SOCKET **$1.20**

Please note these must be used together.

36 WAY CENTRONICS CRIMP PLUG

Cat. P12200

1-9	10-99	100+
$6.50	$5.95	$5.50

P.S. Discount flat cable is coming!
We've done it again!

MINI STEREO HEADPHONE

Low cost hi-fi sound! Light and comfortable, as easy to wear as hair!

Cat. C14000 **$4.95**

BULK CABLE 100M ROLLS

Cat. W11222 3C2V75 OHM **$25.00**

Cat. W11224 5C2V75 OHM **$39.00**

Cat. W11219 4 Core Shielded **$55.00**

UNIVERSAL SOLDERING IRON STAND

Cat. T11302
$5.95 slashed to **$3.95**

NICAD BATTERIES

Save on carbon batteries with these Appolon Nickel cadmiums. Rechargeable up to 1000 times!

Cat. S150020	AA500 MA
Cat. S15021	C 1.8 AH
Cat. S15022	D 4 AH

1-9	10+
$2.25	$1.95
$4.95	$3.95
$7.95	$6.95

RECHARGEABLE 12V GELL BATTERIES

Leakproof and in 3 convenient sizes, these long service life batteries are ideal for burgular systems, emergency lighting or as a computer backup power supply. Ideal for many power needs.

Cat. S15029	12V 1.2 AH	**$17.95**
Cat. S15031	12V 2.6 AH	**$34.50**
Cat. S15033	12V 4.5 AH	**$44.95**

CRYSTAL SPECIALS

Prime spec's. We just have 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!

PCB SPECIALS

Fibreglass predrilled boards.

Type	Normally	Special Price for Mail Order Customers
79TI11	$ 3.90	$1.90
80RM12	$ 3.90	$1.50
81DC2	$ 3.50	$1.50
81MI11	$ 3.90	$1.50
82 A03A/B	$11.80	$5.00
82A03C	$ 3.90	$1.50
82 VX4	$ 3.90	$1.95
821V5	$ 5.90	$3.50
821V6	$ 9.50	$5.95
82PC8	$ 2.50	$1.00
82AL11	$ 3.90	$1.95
83MS4	$ 4.90	$1.95
83PC3A	$ 3.90	$1.35
83PC3B	$ 2.95	$1.35
83RC12A/B	$ 4.05	$2.95
83PS5	$ 5.95	$3.50
83PS7	$ 2.95	$1.10
83TT8	$ 3.95	$1.25
84MC5	$ 3.95	$1.95
84AU1	$ 2.95	$1.25
84AN3A	$ 3.95	$1.95
84AN3B	$ 3.95	$1.95
84SP3	$ 5.90	$3.10
8484	$ 6.95	$3.10

P & P PCB's ONLY .. $1.00
"FREE" Floura Starter Kit with each order over $50.00.

AUDIO FLANGER

Modulates a delay system and produces delay and pitch variations. Features 4 seperate controls producing an extremely wide range of effects from light chorus to really wild tones. At half the price of comparable units in music stores, these are great value!

Cat. A12044 **$89.00**

AUDIO ANALOG DELAY

Achieves delays ranging from 20-300 milliseconds. Superb reverb, doubling and echo. Perfect when playing in 'DEAD' rooms/halls.

Cat. A12046 **$139.00**

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

BRAND NEW FANS

Not noisy pullouts! Stacks of uses in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

Cat. T12461	240V	4⅝"	**$16.95**
Cat. T12463	115V	4⅝"	**$16.95**
Cat. T12465	240V	3½"	**$16.95**
Cat. T12467	115V	3½"	**$16.95**

10 Fans (mixed) less 10%

INCREASE YOUR MEMORY

	1-9	10+	
Cat. U48116			4116
	$2.95	$2.50	
Cat. U48164			4164
	$7.95	$6.95	
Cat. U48770			27128
	$49.00	$45.00	

★★★ SCOOP ★★★

PRIME SPEC RED LEDS

We bought 100,000 so you can reap the benefits!

1-9	10-99	100+
$0.10	$0.09	$0.08

Cat. Z10150

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

Errors and Ommissions Excepted

Power switching module

Telemecanique (Australia) has launched a new concept in power switching.

The Integral 32 output module with overload protection.

Called the Integral 32, it combines the functions of an isolator, a circuit breaker, a contactor, and a motor protector in a single compact, 120 square cm unit.

The Integral 32 comprises a single set of contacts in an arc chamber which perform the functions of both contactor and circuit breaker.

The overload protection modules fitted to the lower part of the device incorporate adjustable thermal/magnetic or magnetic-only protection. There are eight interchangeable overload sizes to protect motors ranging from 0.37 kW to 15.0 kW.

A master control knob on the front of Integral 32 provides the positive opening isolation function and enables the unit to be placed in a ready state for remote control. It also provides a reset function.

For further information contact **Telemecanique, 175 Gibbs St, Chatswood NSW 2067. (02)406-6666.**

New VOM's

Two new VOMs have just been released by Paton Electronics. They are the Norma Messtechnik A1700 and A1710.

The A1700 and A1710 have a sturdily designed movement which will work accurately and reliably under extreme environmental conditions. The quartz pointer of a mere 0.2 mm thickness is resistant to deformation.

The mirrored linear scale permits accurate readings by supressing any parallax error. Two jacks and a central selector make for clarity in the measuring set-up while permitting a very wide total range.

For more information contact **Paton Electronics, 90 Victoria Street, Ashfield NSW 2131. (02)797-9222.**

SUPER BARGAINS AT MAGRATHS!

SUPER SPECIALS ON SEMI CONDUCTORS

LINEAR

CA3140E	$2.24	LM380N-8	$1.62	LM748N	.58	MN3001N	$18.63
LF347	$2.33	LM380N-14	$1.62	LM1458N	.55	NE571N	$3.73
LF351	.63	LM381N	$2.77	LM1488(75188)	$1.06	NE5534AP	$3.48
LF353	$1.15	LM382N	$1.74	LM1489(75189)	.81	NSM3915N*	$7.13
LF356	$1.06	LM383T	$2.85	LM1496N	$1.10	NSM3916N*	$7.13
LF357	$1.06	LM386N	.75	LM2917N-14	$2.48	NSM3914N*	$8.91
LF13741	.69	LM387N	$1.44	LM3900	.81	NSM39152N	$7.71
LM301AH	.58	LM394CH	$4.02	LM3909N	$1.21	OP37GZ	$9.87
LM301AN	.40	LM555	.35	LM3911N	$1.73	RC4136	$1.61
LM307N	.62	LM556	.92	LM3914N	$3.66	S50240	$8.05
LM308M	.81	LM565	$1.58	LM3915N	$7.13	S50242	$8.05
LM311N	.61	LM566	$2.13	LM3916N	$3.66	TL071	.86
LM316H	$5.92	LM567	$1.50	LM4250N	$1.66	TL072	$1.15
LM318N	$2.65	LM709CH	$1.32	DM2502	$6.56	TL074	$2.42
LM324N	.83	LM709-8	.58	DM350N	$7.02	TL084	$2.16
LM334Z	$1.61	LM709-14	.98	DM8ILS95N	$2.42	TL091	$1.20
LM335Z	$1.85	LM710N	.81	DM8ILS96N	$1.68	TL497	$2.90
LM339N	.58	LM723N	.83	DM8ILS97N	$1.96	ULN2003	$1.61
LM348N	$1.33	LM723CH	.81	DM8ILS98N	$1.93	ULN2209N	$2.70
LM349N	.69	LM739N	$3.06	DS8835	$2.70	80C97	.86
LM361N	$3.51	LM741CH	.81	MM5316	$8.05	80C95	.86
LM376N	.78	LM741CN-8	.37	MM5837	$3.34		
LM377N	$2.99	LM741CN-14	.75	MM5369	$2.65		
LM378N	$3.13	LM747N	.86	MM5865	$9.20		

AMPHENOL FRC2 SERIES PCB HEADERS

FRC2-C16S-13	$2.36	FRC2-C16S-23	$3.14
FRC2-C16L-13	$2.44	FRC2-C16L-23	$3.14
FRC2-C20S-13	$2.82	FRC2-C20S-23	$3.16
FRC2-C20L-13	$3.53	FRC2-C20L-23	$3.01
FRC2-C26S-13	$2.82	FRC2-C26S-23	$3.51
FRC2-C26L-13	$2.98	FRC2-C26L-23	$3.01
FRC2-C34S-13	$3.06	FRC2-C34S-23	$4.17
FRC2-C34L-13	$3.08	FRC2-C34L-23	$3.08
FRC2-C40S-13	$3.36	FRC2-C40S-23	$3.85
FRC2-C40L-13	$3.91	FRC2-C40L-23	$3.48
FRC2-C50S-13	$3.80	FRC2-C50S-23	$4.32
FRC2-C50L-13	$3.77	FRC2-C50L-23	$4.43
FRC2-C60S-13	$4.43	FRC2-C60S-23	$5.27
FRC2-C60L-13	$4.96	FRC2-C60L-23	$5.42

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1602 UART +5volt	$6.07	4164 64K DYNAMIC RAM	$7.76
6508 1K CMOS STATIC RAM	$7.76	4416 16K× DYNAMIC RAM	$17.94
6800 8 BIT CPU	$5.75	6116P-3(8416) 2K×8 CMOS	$8.04
6801L1 8 BIT CPU + RAM, ROM, TIMER	$35.75	8085 8 BIT N CHANNEL CPU	$5.75
68B09 9 BIT CPU	$12.65	8086 16 BIT PARALLEL CPU	$20.14
6810 128×8 ST. READ/WRITE MEMORY	$5.41	8114 1025×4 STATIC RAM	$4.60
6821 P.I.A. 1 MHZ	$2.88	8118 16K×1 DYNAMIC RAM	$4.54
68A21 P.I.A. 5 MHZ	$4.03	8155 256×8 RAM	$4.34
6834 512×8 EPROM	$15.30	8212 8 BIT I/O PORT	$1.70
6850 ACIA 1 MHZ	$5.96	8216 8 BIT PARA-BI-DIR- BUS DRIV	$1.39
6852 SSDA 1 MHZ	$6.30	8224 CLOCK GENERATOR DRIVER	$1.55
68B50 ACIA 2 MHZ	$11.50	8243 MCS48 I/O EXPANDER	$2.31
6854 ADVANCED DATA LINK CONTROL	$16.10	8251 PROG. COMMUNICATION I/F	$2.67
2516 16K EPROM (TI.)	$4.27	8253 PROG. INTERVAL TIMER	$4.24
2532 32K EPROM (TI.)	$8.05	8255 PROG. PERIPHERAL I/F	$3.45
2564 64K EPROM (TI.)	$13.80	8257 PROG. DMA CONTROLLER	$3.94
2732 32K EPROM (FUJITSU)	$7.75	8259 PROG. INTERRUPT CONTROLLER	$3.94
2764 64K EPROM (FUJITSU)	$10.79	8279 PROG. INTERRUPT CONTROLLER	$3.19
27128 128K EPROM (FUJITSU)	$34.50	Z80A-CPU-4 MHZ 4 MHZ CPU	$4.50
4044-30 4K×1 STATIC RAM	$1.73	Z80A-PIO-4 MHZ 4 MHZ PIO	$4.50
4116 16K DYNAMIC RAM	$2.30	Z80A-CTC-4 MHZ 4 MHZ CTC	$5.83

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MEE/T ERASES 12 EPROMS IN 20 MIN	$143.75
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Available in following voltages

2.5 watt 81¢ ea	9.1 VOLT, 11 VOLT, 13 VOLT, 18 VOLT, 20 VOLT, 22 VOLT, 27 VOLT, 30 VOLT, 39 VOLT, 43 VOLT.
5 watt 67¢ ea	4.7 VOLT, 5.1 VOLT, 5.6 VOLT, 6.2 VOLT, 6.8 VOLT, 7.5 VOLT, 8.2 VOLT, 9.1 VOLT, 10 VOLT, 12 VOLT, 15 VOLT, 18 VOLT, 24 VOLT.
400 watt 25¢ ea	2.4 VOLT, 2.7 VOLT, 3.3 VOLT, 3.9 VOLT, 4.3 VOLT, 4.7 VOLT, 5.1 VOLT, 5.6 VOLT, 6.2 VOLT, 6.8 VOLT, 7.5 VOLT, 8.2 VOLT, 9.1 VOLT, 10 VOLT, 11 VOLT, 12 VOLT, 13 VOLT, 15 VOLT, 16 VOLT, 18 VOLT, 20 VOLT, 24 VOLT, 27 VOLT, 30 VOLT, 36 VOLT, 39 VOLT.
1 watt 32¢ ea	3.3 VOLT, 3.6 VOLT, 3.9 VOLT, 4.3 VOLT, 4.7 VOLT, 5.1 VOLT, 5.6 VOLT, 6.2 VOLT, 6.8 VOLT, 7.5 VOLT, 8.2 VOLT, 9.1 VOLT, 10 VOLT, 11 VOLT, 12 VOLT, 13 VOLT, 15 VOLT, 16 VOLT, 18 VOLT, 20 VOLT, 22 VOLT, 24 VOLT, 27 VOLT, 30 VOLT, 33 VOLT.

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RFA-1202EA GREEN SCREEN MONITOR

- Complete with built-in swivel/tilt base.
- Anti-glare screen.
- Suitable for professional or home use.

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SPECIFICATIONS

Picture Tube	: 12", 90° Deflection
Display Format	: 80 character × 24 rows, 9 dots, 10 line/character
Display Area Example	: (H) 210mm (8 9/32 Inches) (V) 150mm (5 29/32 Inches)
Input Signal	: Composite Video/Sync. 1.0 Vp-p (Negative Sync.)
Input Impedance	: 75 ohm
Input Signal Connector	: RCA (female) Pin Jack
Hor. Sync. Frequency	: 15.75±0.3 kHz (Standard 15.75 kHz)
Ver. Sync. Frequency	: 49 – 61Hz (Standard 60Hz)
Video Band Width	: 22 MHz
Resolution	: 720 pixels × 240 lines
Linearity	: Horizontal 8%, Vertical 8%
Geometric Distortion	: ±2%

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1 CORE SHIELDED (BRAID) SAC-1	$15.77
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2 CORE SHIELDED (FIG. 8) SAC-3	$26.21
2 CORE HEAVY DUTY SMC-2	$82.52
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CW10	$15.38

COLOURS AVAIL.: BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE, VIOLET, GREY, WHITE.

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500 GRAM REELS		100 GRAM REELS	
14 B&S	$8.30	16 B&S	$3.39
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18 B&S	$8.42	20 B&S	$3.39
20 B&S	$8.69	22 B&S	$3.39
22 B&S	$9.11	24 B&S	$3.39
24 B&S	$9.32	SOLDER	
25 B&S	$9.70	60/40 RESIN CORE	
26 B&S	$11.83	250 GRAM REELS	
28 B&S	$12.00	0.71mm	$6.50
30 B&S	$15.18	1.25mm	$5.73
32 B&S	$15.18		
25 GRAM REELS		500 GRAM REELS	
26 B&S	$3.39	0.71mm	$12.99
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RCW10	$143.45	34 WAY	$158.61
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9 WAY	$46.51	37 WAY	$172.93
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14 WAY	$65.60	50 WAY	$233.74
15 WAY	$77.52	60 WAY	$280.26
		64 WAY	$299.33
		GREY STANDARD (30M REELS)	
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		20 WAY	$34.50
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		25 WAY	$45.17
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Boost for big chip production

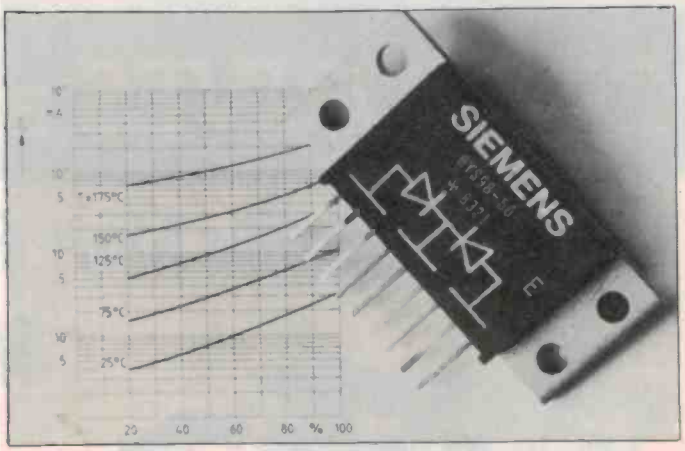
The strengthening demand for ever-larger capacity memory chips has brought about moves by a number of Japanese companies to step up production off-shore and to introduce production plants for 256K dynamic RAMs.

NEC's total production of 64K dynamic RAMs (DRAMs), for example, recently reached 9 million units a month and may exceed 10 million units shortly. However, indications are that 64K DRAM production will slow next year, to be compensated for a comparable demand increase for 256K chips. Hitachi and Fujitsu both say they are likely to begin production of 256K chips next year, while NEC will start sooner.

The US semiconductor plants belonging to NEC, located in Roseville and Mountainview, California, are to be readed for assembly, inspection and other post-processing work for 256K DRAMs, in anticipation of the expansion of demand for them next year. NEC Semiconductors (UK) plant in Scotland will join in, too, but later in the current fiscal year.

Meanwhile, the number of 'steppers', machines used in the production of ICs, from Japanese makers is expected to double this year, indicating the scope of general IC production capacity expansion. There has also been preparation for mass production of 256K DRAMs and other VLSI devices. Another factor, makers say, is a change from the mask-alignment technique to the use of steppers for preparing the pattern to be etched on wafers.

One company producing steppers, Nikon, reports their production this year is expected to be up 70% to 250 units, about 50 of which will be shipped to the US. Nikon is constructing a new stepper production plant at Kumagaya, north of Tokyo, to supplement their Yokohama plant. Completion is being accelerated to ready the new plant for commencement of operation in March.



Dual Schottky: A new package from Siemens with insulated base plate.

Double Schottky

A new dual Schottky diode module from Siemens is now available with an insulated base plate. The unit can be mounted directly on to a pc board or heat sink. This simplifies installation and improves heat dissipation.

Designated 'Isopak', the new Schottky modules are BYS98-50 and BYS98-80 (50 and 80 A rated). Their periodic peak inverse volfages are 40/45/50 V. A guard ring and a junction operating temperature of 175°C are additional features. These components can be ordered now for delivery in approximately six weeks.

For more information contact **Siemens, 544 Church St, Richmond Vic 3121 (03) 429-7111.** ●

Mini power modules

Power supply equipment for electronic systems must have a high degree of reliability, take up little space and be inexpensive. RIFA has utilized its know-how in this field to develop a series of power modules which meet these requirements, and which are intended for mounting on printed boards.

The series comprises eight different dc/dc converters, all having the same mechanical design. Five of the converters are fed with 48 V and the others with 24 V. Each group includes a converter for three output voltages, and the first group also has one for two output voltages. All the remainder provide a single output voltage.

The converters can be connected in parallel, they have transient protection on the supply side, current-limited output, slow start and external start/stop function, and the output voltage is adjustable to within ±10%.

The use of a high conversion frequency ensures small dimension. The size of inductors, transformers and filter capacitors for a given power decreases with increasing frequency. These modules operate at a frequency of 300 kHz as against the 30-40 kHz commonly used in conventional converters.

The conversion frequency has previously been limited to a maximum of 40 kHz because of the difficulty of obtaining high efficiency with high frequency. The properties of the components, such as rectifiers and bipolar switch transistors, have been limited and it has not been possible to design fast control circuits with low power losses.

RIFA has developed monolithic circuits for control and operating functions. They give optimum performance at a conversion frequency of 300 kHz with the minimum number of components.

The converters are produced in two versions, one for mounting on printed boards, and one for individual mounting (chassis version) in order to ensure the widest possible range of applications.

For more information contact **RIFA, 202 Bell St, Preston Vic. 3072.**

RIFA power modules: specially designed for installation on circuit boards.

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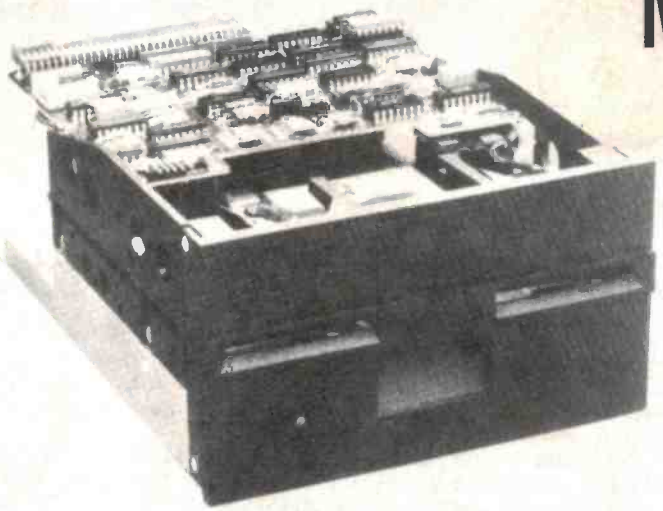

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Full 1 Year Warranty

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MODEL CF301

5¼" plug compatible
250 K-byte capacity, 40 track.
Suit all major processors

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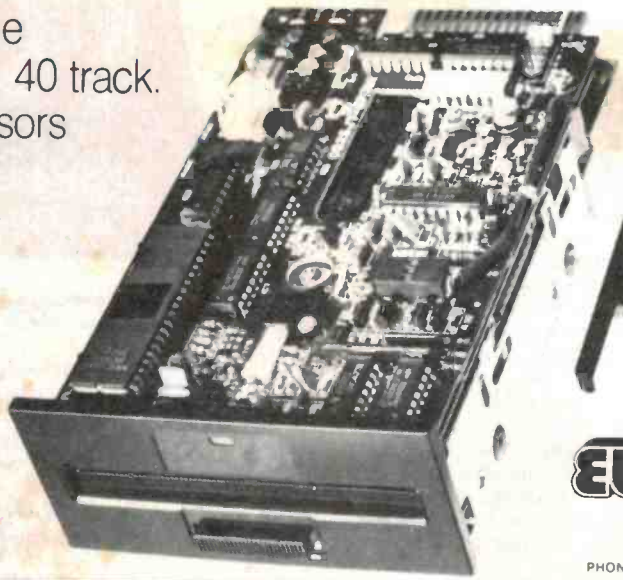

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Computer-grade electrolytics

Elna, Japan's leading manufacturer of electrolytic capacitors has released its new LB series computer-grade electrolytics through their sole Australian agent, Soanar Electronics. These LB series capacitors are particularly suitable as power source filters for computers, inverters, high current power supplies, high output power amplifiers and control equipment.

Despite their small size, these capacitors have exceptionally large capacity and are capable of handling high ripple currents.

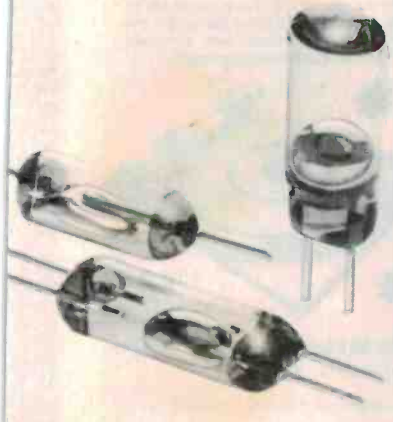
Miniaturisation has been achieved by the use of new electrode foils developed from a technique of high magnification etching.

Construction includes an aluminium can which is sealed with a long life, heat resistant resin and heavy duty screw terminals for handling the high currents involved. Mounting clamps are supplied as standard equipment.

Data sheets, listing current stocks and specifications, are available on request from **Soanar Electronics Pty Ltd, 30 Lexton Rd, Box Hill Vic 3128. (03)840-1222.**

LB series computer grade capacitors from Elna.

Green devils arrive



Little devils! Mercury tilt switches from Email.

The Green Devil line of mercury tilt switches features silent operation, excellent bounce free switching characteristics and small size, according to the distributors.

Due to the fact that they are automatically produced in large volumes, their cost is significantly less than other techniques of tilt angle detection. The mercury switching medium is sealed in an inert atmosphere and has proven its reliability in millions of applications.

Green Devil switches can switch up to 2 A at 240 Vac.

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

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S 5020 AA size	$2.45	$2.00	$1.85
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COMPONENT JOYSTICKS
Standard type (non-centering)

- Resistance 100K ohm
- Lever movement 60°
- Metallic knob
- For TV games, RC units
- Life 500,000 cycles

NOW ½ PRICE
$2.50
K 9680

Self Centering Type

Resistance 5K ohm suit ETI project for microbee Proportional Analogue Joystick Dec 1983

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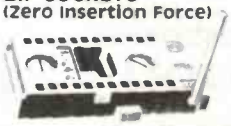

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P 0882 DB 9 Male PCB Mnt	3.75	3.10	2.98
P 0883 DB 9 Female PCB Mount	3.95	3.75	3.60
P 0889 DB 9 Backshell Cvr	2.00	1.80	2.30
P 0890 DB15 Male 15 Pin	2.95	2.90	2.19
P 0891 DB15 Female 15 Pin	3.50	3.00	2.80
P 0892 DB15 Male PCB Mnt	3.25	3.10	2.98
P 0893 DB15 Female PCB Mount	3.95	3.75	3.60
P 0895 DB15 Backshell Cvr	2.85	2.90	2.30
P 0900 DB25 Male 25 Pin	4.50	3.95	3.60
P 0901 DB25 Female 25 Pin	4.95	4.50	3.98
P 0902 DB25 Male PCB Mnt	4.50	4.10	3.85
P 0903 DB25 Female PCB Mount	5.50	5.00	4.70
P 0905 DB25 Backshell Cvr	2.00	2.50	3.98

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P 0864 Female to Male

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ELECTRONIC BELT DRIVE TURNTABLE
BSR QUALITY

Altronics has made a sensational purchase of **Belt Drive Turntables - BELOW** Manufacturers Cost!! Because of our buy we can pass them on to you at a **MASSIVE SAVING.** The Turntables are made in England by B.S.R. They are unmounted and suitable for Disco Consoles, 3-in-1's etc. They are also ideal as replacements for existing 3-in-1 sets. (See Specifications). But there is an aspect that is **really amazing!** You can work the Turntable from 9-12V DC. This means that you can run the unit from a car or truck!! (The A 0612 model can of course run on 240V mains). The Turntable features quality Belt Drive operation, lightweight Transcription type arm. Cueing facility and Stereo Ceramic cartridge with Diamond Stylus. The platter has calibration markings to check speed. A simple neon on 240V will 'strobe' to the markings). Whilst the 33 & 45 rpm speed has been accurately set in the factory, you have the facility to make pitch adjustments underneath the turntable. The DC Motor Drive (as used in the best turntables) is electronically controlled!! Each unit comes with complete instructions. Quantity limited! You will have to hurry to avoid disappointment.

SPECIFICATION

- Dimensions 330 (W) x 285 (D) x 60 (H) mm overall.
- Platter Diameter 280 mm.
- 2 speed 33 and 45 rpm.
- Pick up Arm Counter balanced type with cueing facility.
- Pick-up ceramic stereo with diamond stylus.
- Turntable operation - auto stop, returns to rest automatically. Turntable chassis is sprung on all corners.
- Output stereo RCA sockets provided.
- Weight 1.5KG.

AMAZING LOW PRICE
CAT.A 0612 **$29.95**

240V VERSION (Includes 12V adaptor)
CAT A 0614 **$39.95**

Freight Packing - due to the bulk and weight of this unit - freight is $5.00 per unit.

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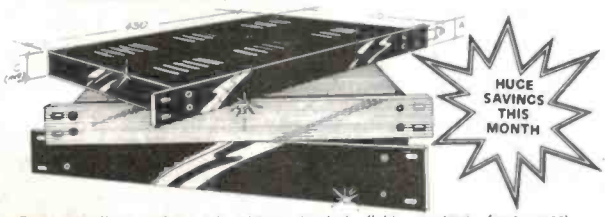
NOW YOUR PREAMPS, AMPS, CONTROL MODULES MONITOR PANELS ETC. CAN LOOK EVERY BIT AS GOOD AS TECHNICS, NAKAMICHI AND OTHER TOP MANUFACTURERS



• These beautifully crafted rack cabinet boxes will give your equipment a real 1st class appearance. • All aluminium construction. • REMOVABLE TOP AND BOTTOM PANELS. • All dimensioning conforms to the International Standard. • Natural or Black finish. • Ventilated lid. • Deluxe brushed finish anodised front panel. • Individually cartoned. • Supplied in Flat Pack Form — Easily assembled in minutes.

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D — 254mm C (Internal Chassis Height)
B (Mounting Bolt Centres)

Cat. No.	Finish	A	B	C	Was	NOW
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H 0402	Natural	88	57	82	55.00	49.00
H 0403	Natural	132	89	126	59.95	54.00
H 0411	Black	44	34	38	45.00	39.00
H 0412	Black	88	57	82	55.00	49.00
H 0413	Black	132	89	126	59.95	54.00

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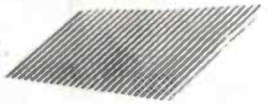

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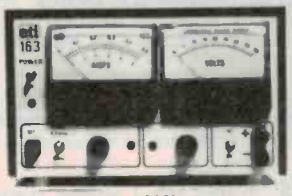

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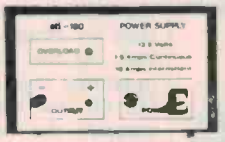

ETI July 1983

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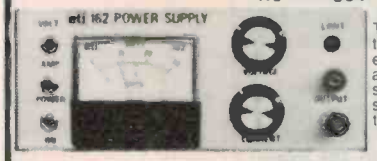

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THE MASTERPLAY Two-way Loudspeakers

These low-cost, two-way 'bookshelf' loudspeakers were designed to team with the ETI-442 Masterplay Stereo Record Player system. While they're simple to build and won't strain the bank account, the finished units look good and sound good.

Geoff Nicholls — **Peter Ihnat**

THESE LOUDSPEAKERS were developed as a low-cost bookshelf system to team with the ETI-442 Masterplay Stereo Amplifier described last month. They can handle the maximum output from the '442. They utilise a 150 mm twin-cone driver with a 60 mm cone tweeter in a "two-way" system, housed in a 13-litre sealed enclosure. The two drivers cost less than $20 and a pair of ETI-463s should cost around $60 to make.

Development

The design of compact loudspeakers presents a challenge: to obtain a compromise between enclosure volume, bass-end response and overall efficiency. The '463s had an overriding parameter — the cost had to be kept in line with the '442 amplifier so driver choice was very restricted.

Consider the problems with the bass driver, or woofer as it is called, in multi-driver systems. At low frequencies the cone will move with the voice coil (which is the 'motor') as a single rigid unit and produce a fairly smooth frequency response.

This band of frequencies is called the "piston range" of the driver and can be roughly predicted from the diameter of the cone — when the sound wavelength approximates the radius of the cone the piston mode starts to falter.

As the frequency is increased above the piston range the cone can no longer follow the movement of the voice coil and vibration 'modes' or waves occur in the cone. This leads to various phase cancellation and reinforcement phenomena which manifest as peaks and troughs in the frequency response — this section of the response is usually called the "wave operating" region.

High quality loudspeaker system divide the frequency range up amongst several drivers so that each is operating in its piston region. This requires complicated (and expensive) 'crossover' networks to roll off each driver's response rapidly.

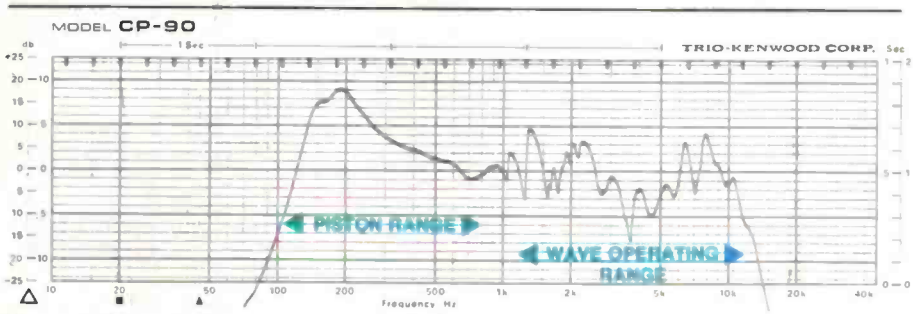
Twin-cone drivers partially overcome the limitations of a single, relatively large, cone by adding a small cone at the voice coil. As the larger cone enters the wave operating region and its response starts to fall off, the smaller cone takes over and extends the response. In practise, the phase cancelling still occurs in the larger cone as well as between the two cones — generally, twin-cone drivers having a single voice coil lean more toward low cost than high quality.

The limitations on the drivers' frequency ranges can be overcome by choosing compatible units (complementary frequency responses) and combining them with an electrical crossover network.

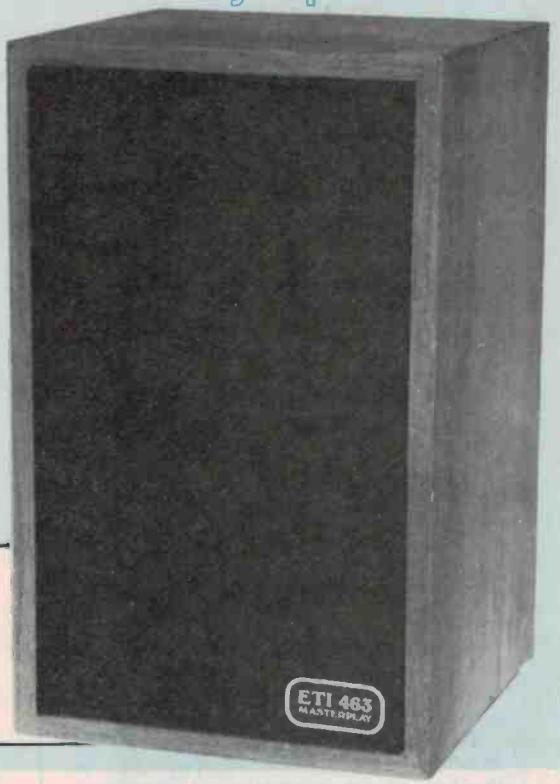
A more difficult problem arises from the nature of the design of the bass driver which causes a phenomena called resonance. This can be understood at a simple level by examining the construction of the driver.

A coil of wire is suspended in a magnetic field in order to convert an electrical signal into an 'equivalent' acoustic signal. The voice coil is attached to the cone and system of supports arranged to make sure the voice coil does not touch the magnet. The moving parts of the speaker have a certain mass, and the suspension system inherently acts like a spring — and that leads to the problem of resonance.

As any physics student should know, a moving mass attached to a spring is the classic example of simple harmonic motion, and when a simple harmonic oscillator is driven by a force there exists a certain frequency where the amplitude of os-



Pistons and waves. Typical response of a low frequency drive unit, showing the piston operating region and the wave operating region.



NOMINAL SPECIFICATIONS ETI-463 2-WAY SPEAKERS
(measured on prototype)

Nominal impedance	8 ohms
Frequency response	60 Hz to 18 kHz (−6 dB), ±7 dB from median
Nominal power handling	10 watts
Box volume	13 litres

cillation is at a maximum. This is the resonant frequency. If the spring and mass was all that was involved, then the oscillation amplitude would increase to infinity. In practise there is always a frictional loss which extracts energy from the system and limits the maximum amplitude for a given input force.

In speaker parlance the 'springiness' is represented as an inverse quantity called *compliance*. The higher the compliance the easier it is to move the cone against the suspension. The resonant frequency is proportional to the (square root of the) inverse of the mass times compliance.

When a driver is mounted in an enclosure, the resonant frequency will be different from that obtained in free air. This is because the air enclosed has mass which must be moved and also has a springiness due to the pressure changing with the volume changes as the speaker cone moves in and out.

For sealed enclosures, the mass increase is small compared to the decrease in total compliance and this results in an increase in resonant frequency from the free air value. The smaller the enclosure the higher the frequency.

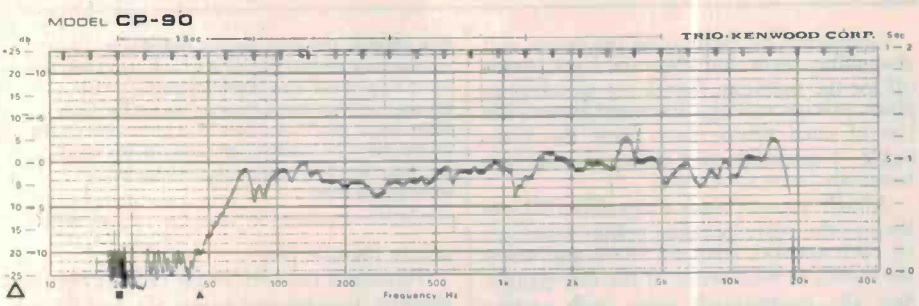
'Reflex' enclosures use a tuned port to add an extra resonant component to the system, a full treatment of the reflex theory is beyond this simplified discussion. Suffice to say that an optimum reflex enclosure can produce a flat response down to almost the free-air resonance of the bass driver, although below that frequency it falls off much more rapidly than for a sealed enclosure (18 dB per octave vs. 12 dB).

Unless the free-air resonance is low enough, this can lead to a sealed enclosure sounding subjectively better than a reflex system with the same driver, even though the reflex system has a lower resonant frequency. A good reflex driver needs to be designed for such usage and we were unable to locate a suitable low-cost unit that would work in a bookshelf system, so the sealed enclosure approach was adopted.

The free-air resonance of the bass driver will have an amplitude several times greater than the mid-band amplitude. When mounted in the enclosure such a response would produce 'one-note' bass and sound 'boomy'. The enclosure should be designed to dampen the resonance.

In sealed systems this is usually done by filling the box with an acoustically absorbent material that will convert some of the energy into heat. The amount of damping required is best determined experimentally. If too much loading is added then the response will roll off from too high a frequency and a loss of bass will result.

This section has presented a simplified description of loudspeaker design — many important points were omitted because of space limitations. For a more comprehensive treatment see David Tilbrook's "Principles and problems in loudspeaker design", originally printed in ETI January and February, 1980.



Frequency response. The speakers have a reasonably smooth frequency response (measured on the tweeter axis) with few significant peaks and dips. The bass response will lift somewhat when they're mounted near the floor.

Speaker selection

With the foregoing in mind, and mindful of the price limitations imposed, we obtained several drivers to evaluate for the '463 project. We would have preferred to use a single wide-range driver, but the available units all fell away around 10 kHz at the top end so a two-way system evolved.

The low frequency driver needed to handle around 10 W RMS and have a resonance in the enclosure of about 100 Hz, which meant a free-air resonance ▶

FINDING THE '+' TERMINAL

For correct operation, the speakers must be 'phased' correctly so that the output of each is in phase at the crossover region, otherwise, cancellation of the output from each driver will occur and you'll get a substantial drop in the level in the crossover region.

Generally, all speakers will have their '+' (positive) terminal marked in some way — usually with a red paint spot or somesuch. If you aren't sure which terminal is which, then there's a simple way to find out.

Take a *single* 1.5 V cell (any size) and briefly connect its terminals to the speaker's terminals. If the cone moves *out*, then then the battery's positive terminal is connected to the speaker's positive terminal. If it moves *in*, reverse the battery leads. Mark the speaker's positive terminal.

of around 60 Hz. The selected unit, a 150 mm (6") twin-cone type made by Pioneer, was obtained from Jaycar (cat. no. CE-2315). This produced a resonance at 125 Hz in the enclosure we decided was about the largest that could be called a bookshelf speaker. This has a volume of 13 litres and is designed to be cut easily from readily available particle board pieces.

The low end response was measured and various amounts of stuffing used in the box to obtain the best compromise. The midrange and high end response was pretty lumpy at first, with a particularly big peak around 3.5 kHz the worst aspect.

After selecting a 60 mm cone tweeter (mainly for its low price), another Pioneer unit from Jaycar (cat. no. CT-2018), various crossover frequencies were tried until a reasonably good response was obtained.

The final crossover uses a 12 dB section for the low frequency driver (mainly to minimise the 3.5 kHz peak) and a 6 dB section with an attenuator for the tweeter. The crossover region is around 2.5 kHz.

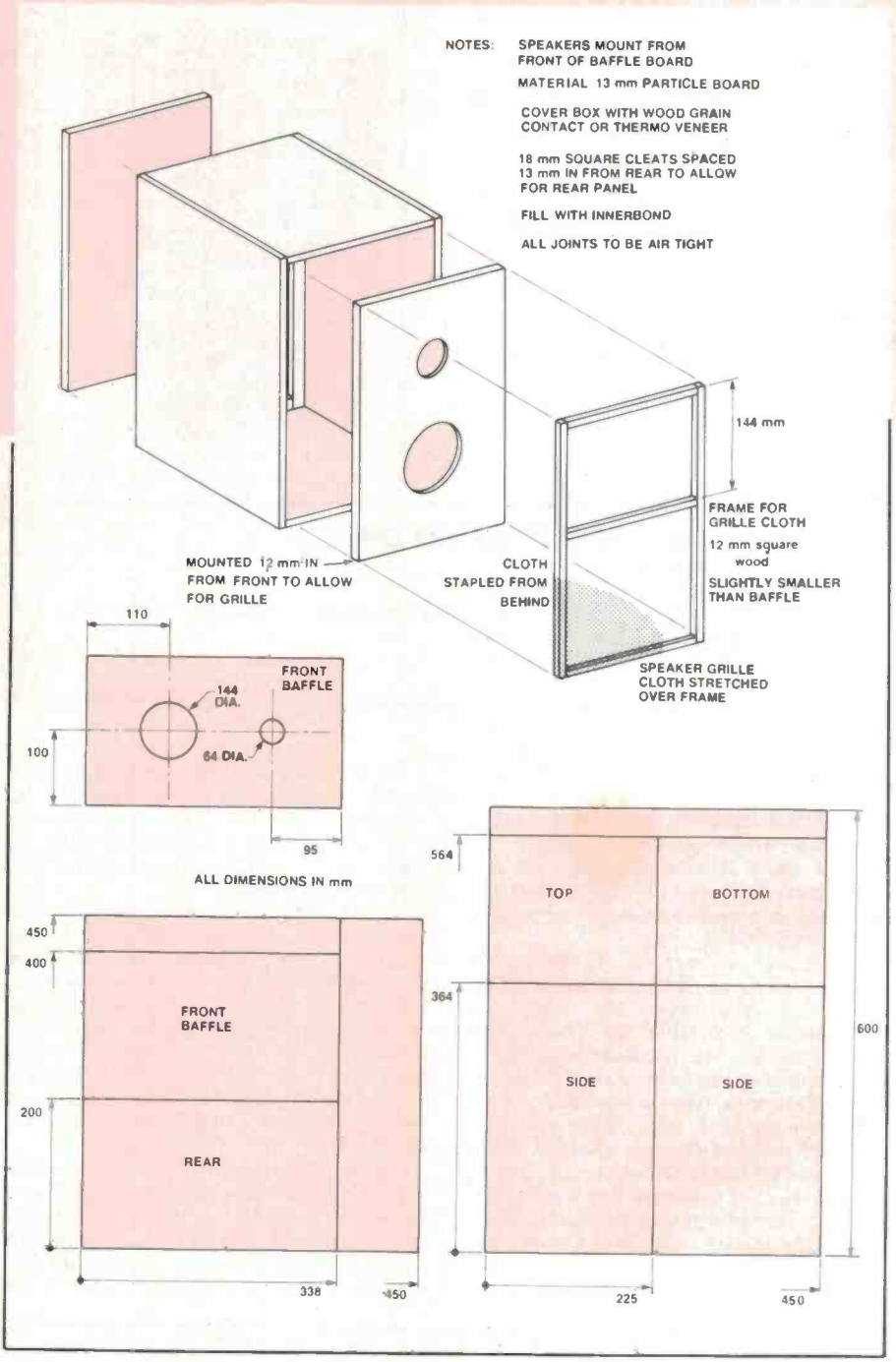
The second cone on the twin-cone driver does not contribute much to the top end, in fact the extra mass it adds to the suspended system probably does more for the bottom end by decreasing the free-air resonance!

Construction

All panels were cut from 13 mm particleboard. To make each enclosure you will need a 450 x 450 mm piece and a 600 x 450 mm piece. The baffle has holes cut for the two speakers. We used a jig saw to do this.

Since our woodworking skills stop at butt joints, we have dimensioned the box for butting the sides against the ends of the top and bottom panels — if you are up to mitred joints you will know how to adjust the dimensions anyway!

The front baffle mounts without cleats since it is glued in place with the speakers mounting from the front. The rear panel mounts against 18 mm cleats all round. It is sealed with a non-hardening sealing compound so that it may be removed to get at the crossover and acoustic stuffing. Such compounds can be obtained from most hardware stores.



Commence by cutting out the boxes and assembling them, but leave the back panels off for the moment. Screw the speakers in place, placing sealing compound around the rim of each where they meet the front baffle. I oriented each driver so that the terminals faced each other.

Attach red and black wires about 80 mm long to the corresponding colour terminals on each speaker terminal block and screw the blocks to the outside of the rear panels. Seal the leadthrough holes with sealing compound. Screw the two five-lug tagstrips in place (see the accompanying photograph). Now wind the two inductors and secure them in place.

Box details. The rear panel is drilled and countersunk around the edge to accommodate two wood screws per side (eight altogether). The speaker terminal block mounts toward the lower edge, about 60-70 mm from the bottom and on the centre line. Drill leadthrough holes for the wires and mounting bolt holes to suit the particular terminal set used.

Terminate the ends of the coils as per the winding diagram and solder R1 and C1 on each tagstrip. Make up a twisted-pair of red and black hookup wire (heavy duty, 24 x 0.2 mm) about 1.6 metres long. Cut it into

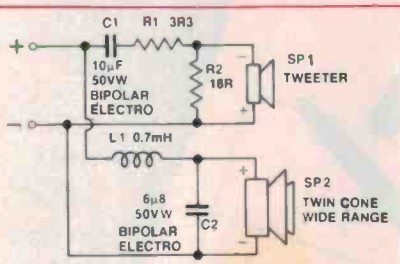
COIL WINDING DETAILS

If you cannot obtain a 0.7 mH inductor (and RFCs are RS in crossovers) then don't fret, wind it yourself! Here's how: Cut a 60 mm length of 50 mm (internal diameter) PVC pipe. Drill two 1.2 mm holes at each end, about 5 mm in from the ends.

Wind a layer of 1 mm enamelled copper wire (18 B&S, 20 swg), pushing the end through one pair of the holes to secure it. The turns should be close-wound, not jumbled. After 40 or so turns you will be near the other end. At this point, wind a layer of tape over the first 40 turns and start the second layer of wire, winding back towards the other end.

After three wire layers wound in this fashion you will have around 120 turns and can terminate the winding through the remaining holes in the other end of the pipe. Leave about 150 mm for leads and scrape the enamel off each end ready for soldering.

I mounted the coil on the inside of the back panel with three nails spaced so the pipe fitted snugly over them. A few blobs of epoxy glued the pipe in place.



Circuit. Simple, isn't it. Note that the tweeter is connected in the opposite phase to the twin-cone to ensure their outputs add in the crossover region.

PARTS LIST — ETI-463

Speakers

SP1 ..... 150 mm twin-cone speaker, 8 ohm 10 W RMS, Pioneer C16EC70-01FW or similar.

SP2 ..... 60 mm cone tweeter, 8 ohm Pioneer H66AP45-01F, or similar — see note below.

Capacitors

C1 ..... 10µ/50 VW bipolar electrolytic

C2 ..... 6µ8/50 VW bipolar electrolytic

Resistors

R1 ..... 3R3, 1/2 W

R2 ..... 18R 1/2 W resistor

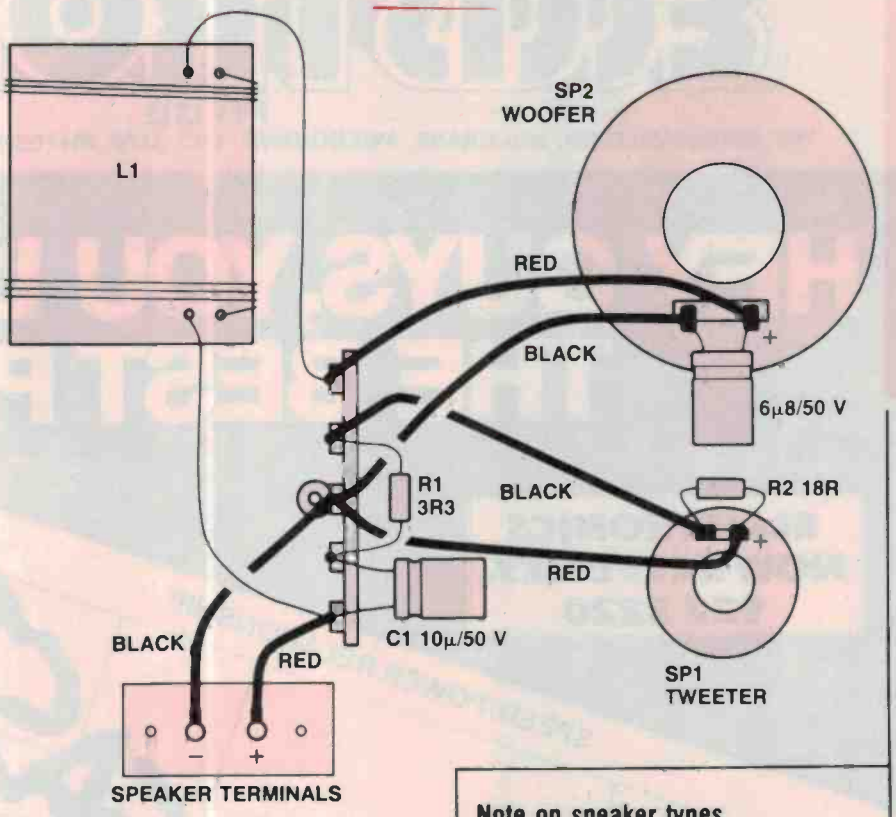
Inductors

L1 ..... 0.7 mH (see winding details)

Miscellaneous

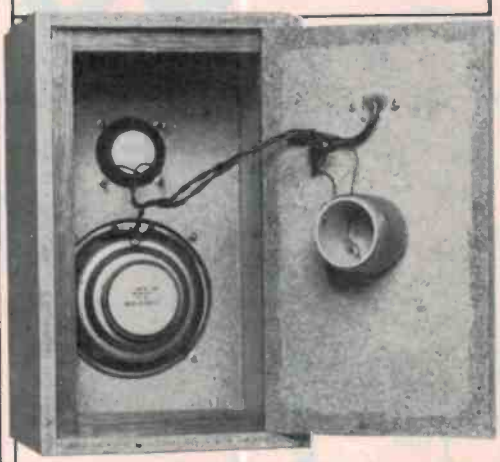
2-way spring terminal block; 1 x 0.5 m length acoustic damping material ("Innerbond"); 24 x 0.2 mm hookup wire; wood glue ("Aquadhere"); non-hardening sealant; 5-way tagstrip; one piece of 450 x 450 x 13 mm particleboard; one piece of 600 x 450 x 13 mm particleboard; 1.25 mm x 12 mm square wooden lath; 1.1 m x 18 mm square wooden lath; 250 x 390 mm of grill cloth; enough woodgrain veneer to cover box (optional); quantity of 30 mm panel pins; quantity of 25 mm woodscrews.

NOTE: Two of everything needed for stereo pair.



Note on speaker types

The speakers used in the prototype were from Jaycar in Sydney (at nos. CE-2315 and CT-2018). Other speakers may be used, but the crossover may require modification to produce a balanced response. The attenuator at the tweeter compensates for different sensitivities between the drivers. The amount of acoustic damping material used may also need adjusting to dampen the bass driver resonance.



On the inside. Showing the mounting of the crossover components. Note that the back panel is upside down in the picture.

Badge. Full-size artwork of the badge we made up from Scotchcal and stuck on the grille cloth.

four equal lengths and wire up the speakers to the tagstrips as per the wiring diagram. Take care with the phasing of the speakers! Solder the two C2s and R2s in place.

Give it all a thorough check. If, or when, all's well, stuff the acoustic wadding into each box and screw the rear panels in place, using sealing compound all around the cleats.

Connect them up and try them out. You should hear good clear sound at reasonable listening levels. Don't be tempted into winding the amplifier volume 'flat out'. This causes the amplifier's output to 'clip'. Under these conditions, the amplifier's output approaches dc and is capable of doing irreparable damage to the speakers. If, for safety's sake, you want to protect your speakers against such problems, or against amplifier faults applying dc to them, then you might like to construct the ETI-494 Signal-Powered Loudspeaker Protector, published in the October 1982 issue.

Happy listening! ●

Project 739

A DUAL-STANDARD AM STEREO DECODER MODULE

Graham Campbell
Roger Harrison

This add-on module for AM tuners will decode both the Motorola and Harris system transmissions. While the technique is complicated it only takes three chips to do the job at the receiver! This project is quite straightforward to build and install.

THERE HAS BEEN mention, from time to time in the technical media in this country, about the 'imminent' introduction of stereo transmission for AM broadcast stations. The last mention we made of it in ETI was in the June 1983 issue (page 12).

In 1983, some broadcast stations here began equipping for tests of the varous systems. Some 14 commercial stations had installed AM stereo transmission equipment up to June 1984. But before we get into the details, let's back-track a little.

Proposals for stereo transmission systems for AM broadcasting on the mediumwave band (530-1650 kHz) first arose in the 1950s. Over the intervening years, some five systems have been proposed by various companies, viz: RCA (Belar system), Magnavox, Kahn, Harris and Motorola.

In the late 1970s, the US Federal Communications Commission (FCC) authorised stations in North America to instal a system or systems of their choice and to conduct tests. Eventually, they authorised the Magnavox system only but later withdrew this following protests. The FCC later took the view "... let the market decide" and authorised US AM broadcasters to use any of the Magnavox, Kahn, Harris or Motorola systems. In July 1982, AM stereo broadcasting began in the US and hundreds of stations there are now on the air.

But this has left the various receiver manufacturers with a problem. How to provide a receiver which will decode all four transmission systems? Well, Sansui and Matsushita (National) have managed it, but it's not easy, especially if automatic decoding of all the systems is required. It seems that they've been able to provide automatic decoding for the Magnavox, Motorola and Harris systems, but decoding Kahn stereo transmissions has to be done by using a switch on the receiver.

The local scene

In Australia, stations are equipped with different systems and all four extant systems have been tested on the air. Some stations have installed more than one system (but only use one at any particular time during tests). The broadcasters only await a decision by the Government on technical and operating standards before they go on the air with full stereo operation.

Department of Communications officers reported the results of engineering tests to a meeting of the Broadcasting Council in mid-June. The results obtained to that date, apparently, show that:

- AM stereo transmissions are feasible here.
- No one system is technically superior to any other.
- Available multi-system receivers can provide automatic decoding of the Magnavox, Motorola and Harris systems, but a switch has to be used to decode Kahn transmissions.

It seems the DOC's final engineering report will encompass a standard common to all four systems.

While the broadcasters, represented by the Federation of Australian Radio Broadcasters (FARB), is in favour of allowing all four systems to prevail and letting the marketplace decide, the receiver industry, under the auspices of the Australian Electrical and Electronics Manufacturers Association (AEEMA), plumps for the selection of a single system.

We haven't the space here to go into the pros and cons of the arguments either way, but the DOC was to make a decision in August or September. At the time this issue went to press (first week of September), no announcement had been made.

Note that the New Zealand authorities went for a single system standard for AM stereo and stations there went on the air earlier this year using the Harris system.

Our decision

Efforts over the past year to secure data on the transmission systems turned up some interesting articles, but not much practical circuitry on which a project could be based. Attempts to obtain a multi-system decoder chip proved fruitless. However, Motorola came to the party with a great deal of information on the various systems, with (fairly naturally) emphasis placed on the advantages of their system and decoder chip. The latter, designated the MC13020P became available locally early in 1984 and we obtained some samples to play with.

However, a single system decoder was clearly pretty limiting. So we kept our eyes peeled on the overseas press, looking for leads to multi-standard decoder systems and devices.

As chances had it, the R&D manager at Dick Smith Electronics, Gary Crapp, came upon some information from the Harris corporation Broadcast Division on using the Motorola MC13020P chip to decode Harris system transmissions. Therein lay the makings of a dual-standard AM stereo decoder.

For the hobbyist, two systems are better than one and *definitely* better than none — which would have been the case if we'd held out for a multi-system decoder.

A Motorola/Harris decoder permits decoding AM stereo stations located in both Australia (Motorola or Harris) and New Zealand (Harris), so we can cater to our readers across the Tasman.

With some re-hashing of the circuit, a prototype was quickly 'lashed up' and put on the air. Success was ours after a few circuit and component adjustments and the project described here is the result.

Project details

The project was designed to 'add on' to an existing hi-fi AM or AM/FM tuner or receiver. It is not suitable for adding to a simple portable or 'mantle' AM radio. They just don't have the required performance. But more of that later.

Decoding of either system is automatic and depends on discriminating between the 25 Hz Motorola system pilot tone and the 55 Hz Harris system pilot tone.

For ease of construction, a fairly open board layout was used. Apart from the Motorola MC13020P decoder chip, all parts are off-the-shelf items. The decoder chip's oscillator can employ either a coil-capacitor combination or a ceramic resonator. Both were tried successfully. The circuit and component overlay show the different methods.

A single-sided pc board was designed and, owing to the circuit complexity, 11 (or 12) links are necessary. But that's not too much of a burden. One capacitor has to be mounted under the board. It's a bypass for the supply rail to the MC13020P and this keeps its leads to an absolute minimum, ensuring effective bypassing. Note that all the ICs face the same way.

The project takes its input from the AM receiver's last IF stage. As the signal level at this point will be different in different receivers, a trimpot has been employed on the input stage. It has to be set 'on the air'. ▶

AM STEREO SYSTEMS — AN OVERVIEW, ENCODING AND DECODING

FIVE techniques have been devised for adding stereo to standard AM broadcast transmissions, known as: Belar (RCA), Magnavox, Kahn, Harris and Motorola.

The fundamental requirement for any AM stereo transmission system is the necessity to retain compatibility with existing receiving systems which employ a simple envelope detector. (The humble crystal set is the basic example). Hence, the two sound channels must be combined in some way on the transmission that permits separation by a special detector system, yet produces simple monoaural sound in a receiver having an envelope detector.

To accomplish this, all systems (with the exception of the Harris) combine the left and right channels into 'left plus right' (L+R) and transmit it as amplitude modulation. This provides the fundamental compatibility. Also, all systems combine the left and right channels in a subtraction process (L−R) which is then used to modulate the transmitter in some frequency, phase or quadrature fashion.

The latter are all forms of *angular* modulation which is not readily demodulated by ordinary AM radios to such a degree that it would bother reception, depending on the method used and the amount of modulation.

Although all the systems use L − R angular modulation to transmit information so that stereo audio can be decoded at the receiver, the precise method of generating the information determines the differences between the systems and their transmission and reception performance. Characteristics important to the broadcaster, licensing authority (DOC), receiver makers and the listener include spectrum occupancy, fidelity, stereo coverage and separation, noise performance, susceptibility to interference and receiver performance under heavy amplitude modulation.

SYSTEM CATEGORIES

The five systems can be categorised in a variety of ways. Taking a lead from Motorola, three categories divide the systems as follows:

Mixed Mode
Belar (RCA)
Magnavox
Phasing SSB
Kahn
Quadrature
Harris
Motorola

The *mixed mode* system employs amplitude modulation (AM) for the L + R signal with frequency or phase modulation of the carrier for the stereo L − R information. Propagation problems and receiver mistuning are said to adversely affect reception, giving rise to unacceptable distortion.

The Magnavox system, though, takes steps to reduce these effects, employing a 5 Hz 'pilot' tone to provide a reference for a wideband phase-locked loop synchronous detector.

The *phasing SSB* system of Kahn's is quite an elegant concept. Here the carrier is phase-modulated with the L−R signal and then amplitude modulated with the L+R signal. Some very sophisticated circuitry is used to produce the resultant carrier which has the left channel signal on one sideband and the right channel signal on the other. The transmitted signal can be received in various ways. A normal mono AM receiver tuned right onto the carrier will receive the normal AM envelope (the L+R signal). Stereo reception is obtained either by using a receiver with phase detection for separating out the L+R and L−R signals, or by using a receiver with two IF circuits, one tuned slightly above the carrier, the other slightly below.

Reception of Kahn signals suffer if the receiver is mistuned, but sophisticated modern circuitry can 'lock' the receiver to the station.

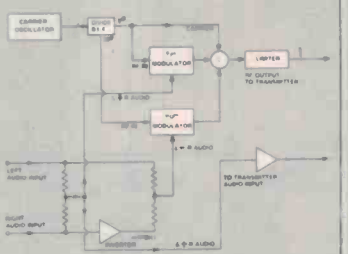
The *quadrature systems* basically comprise two AM transmitters, phase-locked together and with their outputs coupled together but with a phase difference of 90° between the two carriers (hence the term, quadrature). The audio from each transmitter can be separated at the receiving end by using phase-sensitive AM detectors.

However, the problem with quadrature modulation is that it produces distortion in normal AM envelope detectors, so with AM stereo it isn't directly compatible with all the existing receivers.

Motorola and Harris went about solving this problem in slightly different ways.

MOTOROLA 'C-QUAM'

The Motorola compatible quadrature AM stereo system ('C-QUAM') takes the left and right audio channels, combines them and sends them to the AM transmitter's audio input. Thus, the mono (L+R) signal is transmitted and received as AM in the normal way, retaining compatibility. The L+R and L−R (subtraction) audio signals are then used to modulate two carriers which are on the same frequency but 90° out of phase. This signal then supplies the AM transmitter's RF stages.



A block diagram of the Motorola C-QUAM transmitter system is shown in Figure 1. The L+R signal goes to the (0°) "I" quadrature modulator and the L−R signal goes to the (90°) "Q" quadrature modulator. the carrier oscillator is on four times the desired frequency and a digital technique is used to generate the quadrature RF signals.

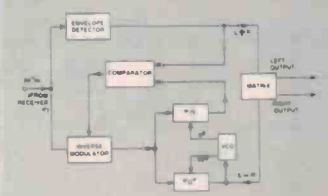
The carrier, the "I" modulator and "Q" modulator outputs are all summed and the result is a pure quadrature AM stereo signal.

Following the summing stage, the signal is passed through a limiter which 'strips' the AM components from it, leaving only the phase modulation "Q" sidebands.

Motorola point out that this is not the same as the simple output of the "Q" modulator because the addition of the "I" and "Q" balanced modulators produce some phase shifting not present in the output of the "Q" modulator alone.

The output of the limiter stage passes to the transmitter's RF drive stages.

Decoding this signal requires splitting the "I" and "Q" signals, generating the original L+R and L−R signals and then 'matrixing' them to produce the left and right stereo audio channels. The basic system block diagram is shown in Figure 2.



The received signal is demodulated two ways — with an envelope detector, giving the L+R signal, and with an "I" detector. The two signals are compared and the resultant 'error' signal used to gain modulate the inputs of the "I" and "Q" demodulators. Motorola's Chris Payne explains the operation as follows: "When the transmitted signal is L+R (monaural, no stereo) the transmitted signal is pure AM or only "I" sidebands. In this case the envelope detector and the "I" demodulator see the same thing. There is no error signal, the input modulator does nothing and the signal passes through without change.

"However, when a left or right only signal is transmitted, both AM and PM is transmitted and the input signal is shifted in phase to the "I" demodulator and loses some of its "I" amplitude.

"The envelope detector sees no difference in the AM because of the phase modulation, and when the envelope detector and the "I" demodulator are compared, there is an error signal.

"The error signal pushes up the input level to the detector. This makes the input signal to the "I" and "Q" demodulators look like a pure quadrature signal and the audio output gives a perfect L−R signal.

"The demodulator output is combined with the envelope detector output in a matrix to give left and right audio out."

A 25 Hz pilot tone is added to the L−R signal at 4% modulation to provide stereo reception by syncronous detection, even under bad signal conditions.

HARRIS

The Harris corporation tried three systems in all, before settling on one. Their first attempt used a +/− 15° phase difference between the "I" and "Q" carriers. The reason being that, the closer the quadrature carriers are to no phase difference, the closer the transmitted signal is to AM. This provides compatibility, but reduces stereo coverage.

Their second attempt employed an audio companding scheme, compressing the amplitude range at the transmitter and expanding it at the receiver.

To control the expansion process in the receiver, Harris employed a variable frequency pilot tone in the L−R channel, varying from 55 Hz to 96 Hz. The frequency was proportional to the required gain control of the receiver expansion circuitry.

Thus, the low frequencies of the stereo audio had to be filtered below 200-300 Hz to allow for the pilot. The receiver decoder system is quite complex for this system and was not favoured for that reason.

The latest Harris system employs a 55 Hz fixed pilot tone. The transmitter encoding system is similar to Motorola's, but the audio is further processed so that the maximum angle of quadrature modulation is limited to obviate AM incompatibility problems under heavy modulation.

As the Harris system is similar to the Motorola system, a similar decoder may be used.

ON THE AIR

The Harris system is employed in New Zealand, but we didn't know which stations were on the air at the time this went to press. New Zealand readers should check with their local stations to see who's running stereo and who isn't.

Some 20 stations throughout all states of Australia (except Tasmania, but they're always last) had been authorised for AM stereo operation when we went to press (early September).

By far the most popular system was the Harris, followed by Motorola. Kahn and Magnavox systems came well behind. Here follows a list of stations either on the air or who will shortly commence transmissions,. categorised by system installed.

Motorola	Harris
2WS	2SM
3AK	2UE
3KZ	2NX
3UZ	2KO
5KA	3XY
Kahn	4BK
2CH	4BH
2UW	5AD
3AW	6IX
Magnavox	6PR
3MP	6PM
2UE	

Note that 2UE is testing both Harris and Magnavox systems.

HOW IT WORKS — ETI-739

Circuit operation hinges around the Motorola MC13020P C-QUAM stereo decoder chip. The general operation of this device is explained in a separate panel. Let's take an overall look at the circuit.

The IF input is buffered and amplified by Q1, a simple wideband common emitter stage. Emitter degeneration feedback is employed via the unbypassed emitter resistor, R10, ensuring stable gain and wide bandwidth. The input is capacitively coupled via C10. RV1 provides input level adjustment as the IF output of different receivers will differ widely.

Dual-system reception necessitates compromising the operation of the decoder, IC2, somewhat, but this is partially corrected by the extra circuitry. The synchronous phase detection function of the MC13020P is employed in receiving both systems, but the Harris system requires extra audio matrixing. The MC13020P is arranged to automatically switch between systems by detecting the presence of the pilot tone, differentiating between the 25 Hz (Motorola) and 55 Hz (Harris) pilot tone frequencies and then altering the operation of the decoder by switching in extra components.

This is accomplished by the Pilot Tone Detector circuitry comprising IC3c and d, diodes, D2, D3 and D4 plus transistors, Q5-6-7 and two CMOS switches, IC3c and d, and the associated circuitry.

So that the audio output still switches to mono when a signal cannot be 'locked' by the decoder, circuitry involving Q2, Q3 and two CMOS switches provides output from the enveloper detector of IC2, passing this to the output matrixing op-amps, IC3a, and b. When a stereo signal is locked by the decoder, this same circuitry provides a matrixing signal to these op-amps from the "I" detector during reception of both Harris and Motorola transmissions.

The VCO in IC2 can be controlled either by an LC circuit (L1-C13) or a ceramic resonator (as shown on the supplementary circuit). Either can be used and the pc board overlays show how to implement them. Resistor R56 "de-Qs" the ceramic resonator, providing a wider pull-in range for the VCO. Capacitor Cx provides temperature compensation for the ceramic resonator. These two items from Murata come as a pair. They are imported and distributed by IRH Components, Sydney, who kindly supplied samples.

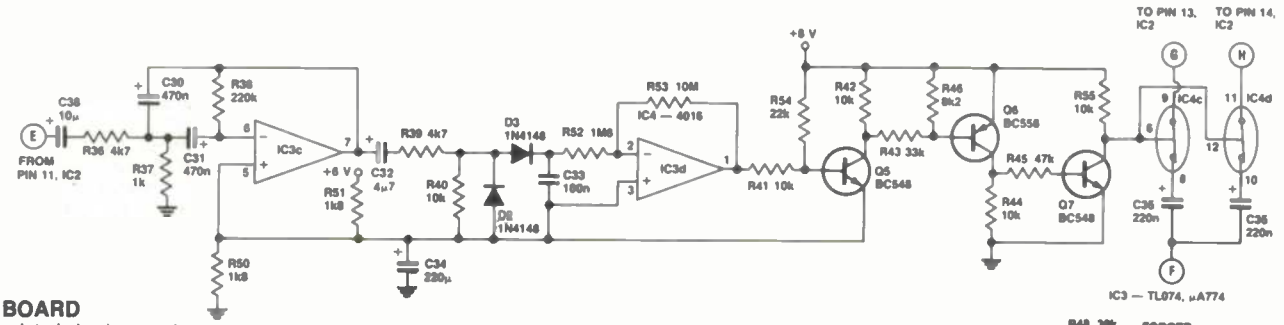
Transistor Q4 buffers the 'force to mono' input of IC2, pin 9. To force mono operation, the base of Q4 should be held high (via the FORCED MONAURAL INPUT).

The LED (LED1) indicates stereo operation.

A three-terminal regulator, IC1, generates an 8 V supply rail and prevents supply input variations from affecting the decoder's performance.

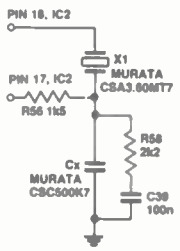
PILOT TONE DETECTOR

The purpose of the pilot tone detector is to place the decoder in the Harris mode when a 55 Hz pilot tone is detected (e.g: from 2SM, 3XY, etc) and in the Motorola mode when a



PC BOARD

The printed circuit artwork was done by Dick Smith Electronics and copyright is held by them. Hence, we have not reproduced the board pattern. Complete kits are available from Dick Smith stores.



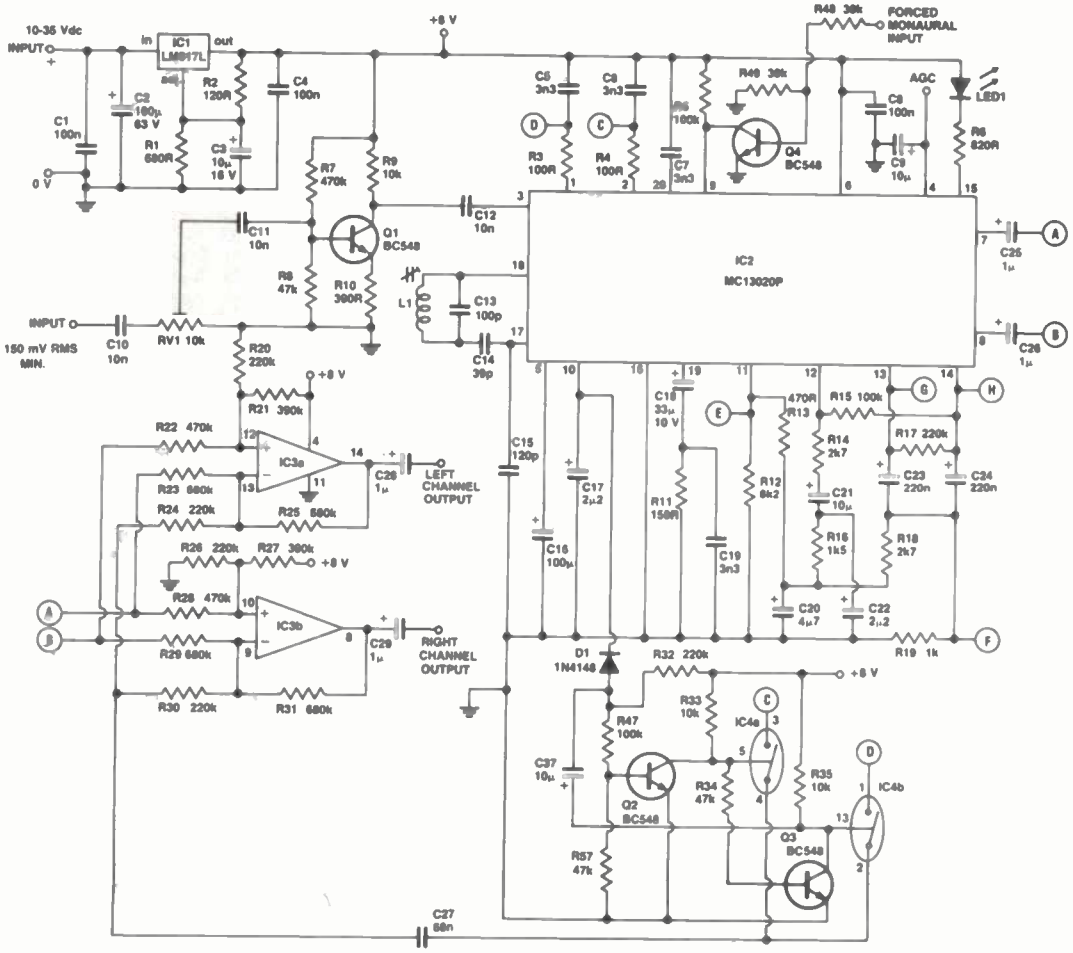
Ceramic resonator
Alternate circuit for using a ceramic resonator.

NOTES

Tantalum capacitors 10 VW) are used for C18, C23, C24, C28-31, C35, C36.

Ceramic capacitors must be used for C8 and C10-15.

CMOS switches IC4c and d are closed when a 25 Hz pilot tone is present, open when a 55 Hz pilot tone is present.



25 Hz pilot tone is detected (e.g: from 2WS, 3 AK etc).

The circuitry consists of a 25 Hz bandpass filter (IC3c and surrounding components), followed by a half-wave voltage-doubler rectifier (D2, D3, C33). Then follows an inverting dc amplifier (IC3d) and a dc switch (Q5, Q6, Q7) to operate two CMOS switches (IC4c and d).

A sample of the pilot tone is derived from the AGCed output of IC2 (pin 11) at 'E'.

When a Motorola station is being received by the tuner/receiver, the 25 Hz pilot tone is passed by IC3c and rectified by D2-D3. This charges C33 and the output of IC3d (pin 1) will go to around −0.7 V (referred to the half-supply rail on pins 3 & 5 of IC3 and emitter of Q5). Resistors R52 and R53 are high values to avoid loading the rectifier.

The output of IC3d turns Q5 off, and thus Q6 and Q7 are off, too. The collector of Q7 goes high, closing the two CMOS switches, IC4c and d. This places C35 and C36 in parallel with pins 13 and 14 of IC2. These are the decoder's pilot filter pins and thus it is set to respond to the 25 Hz pilot tone in order to decode the Motorola signal.

When a Harris station is being received, the 25 Hz bandpass filter will not respond to the 55 Hz pilot tone and thus there will be no output at pin 7 of IC3c. Therefore, the output of IC3d will go to zero (with respect to the half-supply rail) and the base of Q5 will be biased on by R54. This will turn on Q6 and Q7, opening the CMOS switches, IC4c and d. This disconnects C35 and C26 from pins 13 and 14 of IC2, allowing its pilot decoder to respond to the 55 Hz pilot tone so it will decode the Harris signal.

DECODING

The Error Amp in IC2 is disabled by the 100µ capacitor (C16) on pin 5 of the decoder. This change results in the L and R outputs (pins 7 and 8) putting out envelope-plus-Q and envelope-minus-Q signals. The difference between pins 7 and 8 is the Q or L-R channel.

The matrixing op-amps, IC3a and b, perform the differencing. The operation requires a proper L+R signal. Both in-phase (I) and envelope signal are available at 'D' and 'C', respectively. When the decoder is locked, pin 10 goes high. The cathode of D1 is then positive with respective to its anode and the base of Q2 is biased on via R32-R47. Thus, the collector of Q2 goes low and the CMOS switch IC4a is held open. But the base of Q3 will be low and thus its collector will be high (Q4 off). This will turn on the CMOS switch IC4b and the "I" signal on 'D' will be passed via C27 to the matrixing op-amps which will then produce the L and R signals at their outputs.

If the decoder goes out of lock, pin 10 goes low, clamping the base of Q2 low via D1. Thus Q2 turns off and Q3 turns on. Therefore, IC4b will turn off and IC4a will turn on. This will pass the envelope detector output (from 'C') to the matrixing op-amps via C27, producing a monaural output in both channels. When tuning between stations, this prevents annoying whistles being heard.

Operation is similar for Motorola decoding.

PARTS LIST — ETI-739

Resistors ..... all ¼W, 5% unless noted

R1	680R
R2	120R
R3, R4	100R
R5, 15, 47	100k
R6	820R
R7, 22, 28	470k
R8, 34, 45, 57	47k
R9, 33, 35, 40, 41, 42, 44, 55	10k
R10	390R
R11	150R
R12, R46	8k2
R13	470R
R14, R18	2k7
R16, R56 (if X1 used)	1k5
R17, 20, 24, 26, 30, 32, 38	220k
R19, R37	1k
R21, R27	390k
R23, 25, 29, 31	680k
R36, R39	4k7
R43	33k
R48, R49	39k
R50, R51	1k8
R52	1M8
R53	10M
R54	22k
R58(if X1 used)	2k2
RV1	10k vert. trimpot

Capacitors

C1, 4, 33	100n greencaps
C2	100µ/63 V axial electro.
C3, 9, 21, 37, 38	10µ/25 V RB electro.
C5, 6, 7, 19	3n3 greencaps
C8	100n disc ceramic
C10, 11, 12	10n ceramic
C13	100p ceramic
C14	39p ceramic
C15	120p ceramic
C16	100µ/16 V RB electro.
C17, 22	2µ2/25 V RB electro.
C18	33µ/10 V tant.
C20, C32	4µ7/25 V RB electro.
C23, 24, 35, 36	220n/10 V tant.
C25, C26	1µ/50 V RB electro.
C27	68n greencap
C28, C29	1µ/10 V tant.
C30, C31	470n/10 V tant.
C34	220µ/16 V RB electro.
C39	100n (if X1 used)
Cx	CSC500K7, Murata (with X1)

Semiconductors

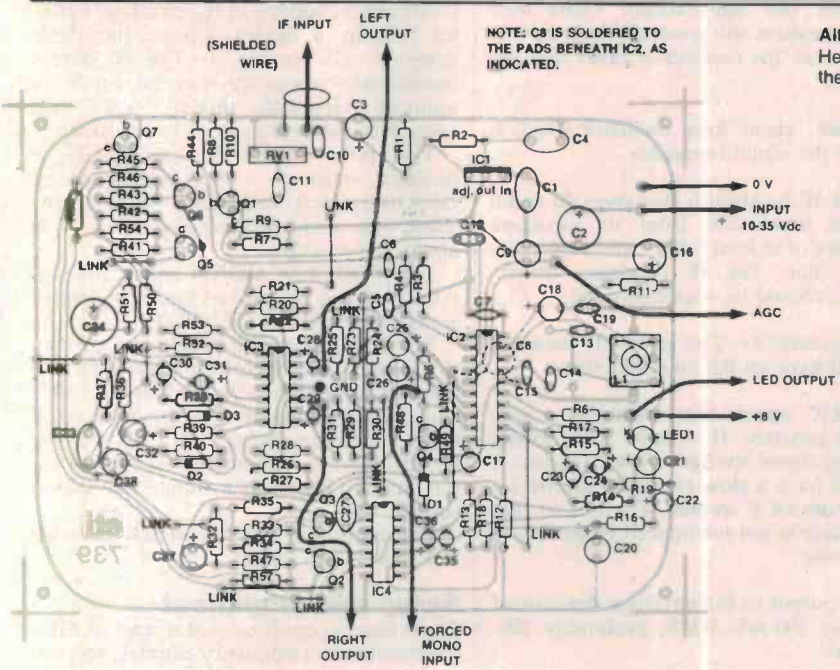
D1, 2, 3	1N4148, 1N914, etc.
Q1-5, Q7	BC548, BC108, etc.
Q6	BC558, etc.
IC1	LM317L
IC2	MC13020P
IC3	TL074, µA774
IC4	4016
LED1	TIL220R, 5 mm red LED

Miscellaneous

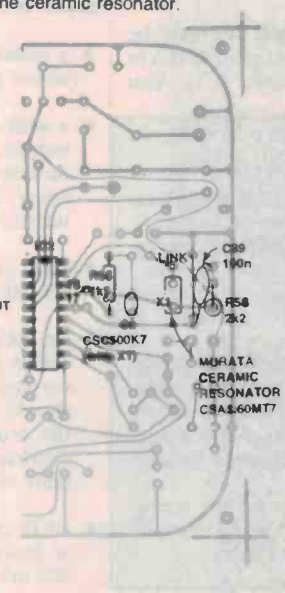
L1	(see text), Neosid 722/1 6.5 mm dia. former, F16 slug plus 7100 shield can.
X1	Murata ceramic resonator (if desired), type CSA3.60MT7 (plus CSC500K7).

ETI-739 pc board (D.S.E. cat. no. ZA 1699); 10 pc stakes; shielded wire and hookup wire to suit; mounting hardware etc.

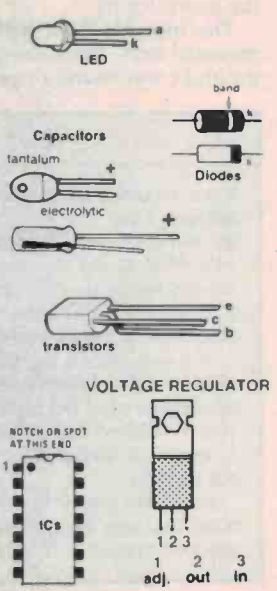
Price estimate: $40-$48



Alternate overlay
Here's the layout if you're using the ceramic resonator.



COMPONENT PINOUTS



For effective stereo reception, the signal level here at the input needs to be above 150 mV RMS, which is generally easily obtainable in most good quality tuners or receivers. The decoder's input impedance is about 5k.

The AGC output has been made available via a pin on the pc board. If your tuner/receiver employs a positive AGC voltage, this output may provide more effective AGC control.

If you require it, you can incorporate a switch to 'force' mono-only reception. All it requires is a switch between the FORCED MONO INPUT and the +8 Vdc supply rail.

An on-board three-terminal regulator provides the appropriate supply voltage and prevents supply variations from affecting the decoder's performance.

An off-board 'stereo' indicator can be incorporated if you wish.

Construction

As always, the first thing to do is check the pc board. See that all the holes are drilled and are the correct diameter. The four mounting holes are the largest. Note that the holes for the three pins on the trimpot, RV1, and the voltage regulator (IC1) pins are slightly larger than the other component holes, as are the two for the coil shield can.

Construction should proceed with reference to the component overlay. Commence with the links. There are 11 of them (12 if you're using the ceramic resonator). Use 22 or 24 gauge tinned copper wire. Three should be sleeved with 'spaghetti' insulation: The one adjacent to R57, the one running past R23 and R29, and the one adjacent to IC2 and R49.

You can solder all the transistors in next. See that they are all correctly oriented. Then you can solder in all the resistors and the three diodes. Follow up with all the capacitors. *Don't forget C8.* It mounts on the copper side of the board, beneath IC2 (between pins 6 and 16; there are pads on the board for it).

The trimpot, RV1, and the ICs may be mounted next. Take care you get the ICs in the right way round (especially IC1). You may need to bend C10 aside a little when fitting RV1.

Now wind L1 according to the coil winding details given here. Glue the former to the board with a quick-set glue like 'Superglue' (take care!). Cut the coil leads to length and tin the ends before soldering them in the pads indicated on the overlay. Place the can over the coil, pushing it right down on the board and, solder the pins to secure it.

If you're using the ceramic resonator, follow the alternate overlay diagram.

Now solder all the pc stakes in place. These provide handy termination for all the off-board connections.

When you think you've got it all finished. Give it a *thorough* check.

COIL WINDING

If you're using the coil L1, it is wound as follows. Take the 722/1 former and wind 38 turns of 36 B&S enamelled copper wire on it, laying the turns close together. Wind it neatly up the former, not jumbled. It doesn't matter whether you wind it clockwise or anti-clockwise.

You can secure the start of the winding with a dab of instant-setting glue, like 'Superglue' (but be careful with it). When you've finished the winding, secure it with a length of sticky tape wrapped around the winding.

Insert the slug in the former and screw it all the way in. Take it gently so that you don't break it. They're fragile.

Tuner requirements

Before you can install your project, perhaps even before you build it, there are a number of matters to consider about the tuner or receiver in which it may be installed.

You can't install an AM stereo decoder in just any AM radio or tuner. Not all types are suitable owing to certain design or construction limitations that adversely affect decoder operation. Obviously, it's impossible for us to list the 'good' ones by make and model number. For a start, we haven't tried them all (. . . nor are we likely to). But we can give you some general hints so you can avoid the 'unlikelies' and, making an informed choice, ensure success.

If your're thinking of converting grandfather's old Radiola three-band *valve* receiver in the gigantic console wood veneer cabinet — forget it. The same goes for 'Little Nipper' valve mantle sets or their ilk. Resign yourself to the fact that his project will have to be solid state all the way.

However, modern pocket transistor sets, clock radios, many portables etc, generally won't meet the requirements either. They generally have poor oscillator stability, narrow IF bandwidths and insufficient sensitivity (for this application). Units with in-built speakers will generally be a no-no.

In general, the receiver or tuner requirements are:

- a stable, 'clean' local oscillator which is *above* the signal frequency.
- a wide IF bandwidth that gives an audio output bandwidth from its envelope detector of at least 5 kHz, and preferably twice that. The IF bandpass characteristic should be reasonably flat.
- good sensitivity. This generally means it should have an RF amplifier stage.
- an AGC system that maintains a generally constant IF output with widely varying signal strengths from stations. It should have a slow enough response (in the order of a second or more) so that distortion is not introduced in the 25 Hz pilot tone.
- an IF output to the envelope detector of at least 100 mV RMS, preferably 200-300 mV.

Many hi-fi tuners and integrated receivers on the market will meet these requirements. Those having synthesiser front ends are far and away the best though their PLL circuitry can sometimes interfere with the decoders. Mechanically tuned receivers can experience microphony on the local oscillator, but not all show the problem. Those with sturdy mechanical construction should not suffer in this regard. Of all the requirements, the local oscillator and IF bandwidth characteristics are the most important.

One way to test the local oscillator of a tuner or receiver is to listen to it on a general coverage ('communications') receiver. Tune the radio intended for conversion to the high frequency end of the broadcast band (around 1600 kHz) and look for the local oscaillator signal on the general coverage receiver around 2050 kHz.

You can generally get a good signal by attaching a few hundred millimetres of wire to the antenna terminal of each receiver and loosely twisting them together.

The audio note you pick up should sound clear and pure, without trace of warbling sounds or pitch variations, especially when you touch or knock the AM tuner's case. A 'rough' note generally means the AM tuner's local oscillator is hum modulated.

Set the AM tuner to a strong local station. Find the local oscillator signal again and see that it does not vary with the station's modulation.

If any of these symptoms show up, the unit's not a candidate for adding-on the stereo decoder.

Unless you can measure the tuner's IF characteristics, you'll have to trust its handbook specifications and 'suck it and see'.

Installation

The first commandment of installation is — 'know thy tuner'. This means, you'll have to locate the tuner's last IF stage. Some have a transistor, some have an IC output at this point. Generally, the last stage has a tuned transformer coupling to the envelope detector (usually a diode). Locate the diode detector and remove it. The IF output transformer secondary may be tuned or untuned. Generally though, you'll find enough signal here to drive the decoder.

This point should be coupled to he decoder board via a short length of low capacitance screened cable. Ground the shield only at the decoder end. Set RV1 at about half rotation.

The FORCED MONO input and the AGC line can be ignored for the moment, along with the LED OUTPUT.

The 0 V lead should be securely earthed to the tuner's chassis or board ground track. Shielded leads should be used for the LEFT and RIGHT outputs. A point marked GND, between these two pads on the board, provides a suitable termination for the shields. Hook-up a suitable dc power supply.

Our prototype was successfully installed in a Teac T-515 tuner.

Setup and alignment

If you have an oscilloscope (at least 15 MHz bandwidth) or a frequency counter, you can

THE MOTOROLA MC13020P C-QUAM AM STEREO DECODER CHIP

This device is a complete one-chip AM stereo decoding and pilot tone detection system. It employs fullwave envelope signal detection at all times for the L + R signal (giving compatible mono AM operation), and decodes L – R signals only when a valid stereo signal is available.

The 25 Hz pilot tone needs to be present to decode the L – R signal. The pilot acquisition time is given as 300 ms for strong signals and this time is extended under noisy conditions to prevent 'falsing'. An internal level detector can be used as an AGC source.

The MC1320P takes the output of the AM tuner's IF amplifier and performs the complete C-QUAM decoding function. In the absence of a good stereo signal, it produces an un-degraded monoaural output from both channels. The L + R mono information delivered to the output always comes from the device's internal envelope detector.

The block diagram of the device here shows what's inside the chip. It first converts the incoming compatible quadrature AM signal to its quadrature components and then decodes these to produce the stereo output channels.

The voltage controlled oscillator (VCO) runs at eight times the input IF frequency. An internal divider provides quadrature (0° and 90°) outputs at the IF frequency for the "I" and "Q" phase detectors. Thus, the VCO works at 3.6 MHz and either a coil-capacitor combination or a low-cost ceramic resonator may be used on the VCO.

The Motorola C-QUAM encoder system multiplies the "I" and "Q" modulating signals by cos Θ. The resulting carrier envelope is 1 + L + R, which is the correct sum signal for mono receivers and for stereo receivers operating in the mono mode.

The quadrature AM conversion is effected in the chip by comparing the output of the envelope detector (Env DET) and the "I" detector (I DET) in the error amp (Err AMP). The provides a 1/cos Θ correction factor, which is then multiplied by the incoming signal in the variable gain block (Var Gain). Thus, the output of the variable gain block is the quadrature AM signal, which can then be synchronously detected.

The "I" and "Q" detectors are held at 0° and 90° relative demodulation angles by reference signals from the divided-down VCO.

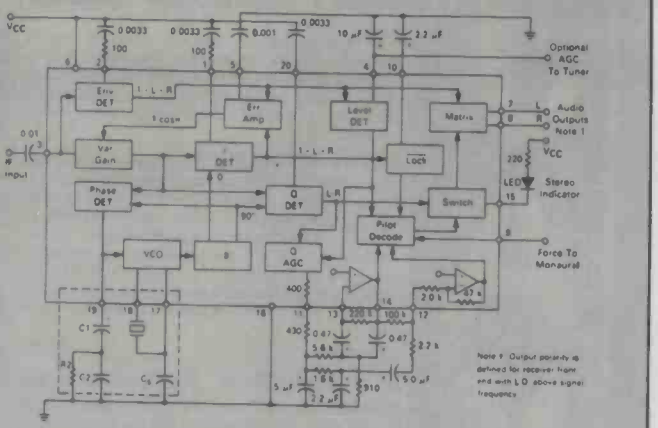
The output of the "I" detectors is 1 + L + R, with the added benefit (over the envelope detector) of being able to produce a negative output on strong co-channel or noise interference. This is used to tell the Lock circuit to go to mono operation. The output from the "Q" detector is the L – R audio and pilot tone.

The internal PLL corner frequency is set at 8-10 Hz (in lock) by the RC filter on pin 19. An internally controlled fast pull-in is provided, R2 providing slight overdamping while C2 prevents HF instability.

The level detector (Level DET) senses carrier level and provides an optional tuner AGC source. It also operates on the "Q" AGC block to provide a constant amplitude 25 Hz pilot at pin 11. It delivers signal strength information to he pilot decoder.

The Q AGC output drives a low pass filter and an active 25 Hz bandpass filter is coupled to the pilot decoder, pin 14, followed by another low pass filter to the co-channel input, pin 12. If there's a 50% reduction in the 25 Hz pilot level, the system will revert to mono operation.

The co-channel input signal contains any low frequency intercarrier beat notes and, at the selected level, prevents the pilot decode circuit



from switching to stereo.

The pilot decoder operates in two modes. Under good signal conditions, the decoder switches to stereo after seven consecutive cycles of the 25 Hz pilot tone (about 300 ms). When signal conditions are bad, the detected interference changes the pilot counter so that 37 consecutive cycles of the pilot are required for stereo operation.

In synthesised tuners, the logic that mutes the audio when tuning can be used to drive pin 9, holding it low. The decoder is forced into mono operation and switches to the short count. When the tuner and the decoder have both locked onto a new station, the pin can be released high, permitting stereo decoding. If no pilot is detected for seven counts, then you're on a mono station and the decoder switches to the long count, reducing the possibility of false stereo triggering ('falsing') due to signal level fluctuation or noise.

If the PLL goes out of lock, or interference is detected by the co-channel circuit before seven cycles are counted, the decoder goes into the long count mode.

The level detector keeps the decoder from going into stereo if the input level drops 10 dB, but will not change the operation of the pilot counter.

Once the decoder's in stereo, it will switch instantly back to mono if either the lock detector on pin 10 goes low or if the carrier level drops below the preset threshold.

In stereo, the co-channel input is disabled and co-channel or other noise is detected by negative excursions of the "I" detector. When these reach 20% co-channel modulation the lock detector puts the system in mono, even though the PLL may be locked. The higher level of co-channel tolerance provides hysteresis to prevent 'chattering' in and out of stereo on a marginal signal.

When all inputs to the Pilot Decode block are correct, and it has completed its count, it turns on the Switch, sending the L – R to the Matrix and dropping pin 15 low (stereo indicator).

set the VCO on frequency quite easily. Just loosely couple into pin 17 of IC2 and set the coil slug, using a plastic aligning tool, to obtain a frequency close to 3.6 MHz (eight times the IF frequency — 3.60 MHz for 450 kHz, 3.64 MHz for 455 kHz).

This is unnecessary if you're using the ceramic resonator.

If you don't have either of these tools, proceed as follows. First lift the cathode end of D1. Switch everything on and tune the receiver to any station (mono or stereo). With a plastic alignment tool, adjust the slug in L1 until you hear a heterodyne note in the tuner (a whistle), Keep adjusting the slug, bringing the heterodyne down in pitch to 'zero beat'. Keep adjusting the slug in the same direction until you hear a second heterodyne.

Best alignment is then achieved by tuning the slug half way between these two 'beat notes'. This can be accomplished by counting the number of turns between beat notes, halving the number and turning the slug black by that amount.

Restore D1.

Tune around the dial and check the decoder's performance on known stereo stations transmitting Harris or Motorola stereo signals. Check that the stereo indicator, LED1, lights when a stereo signal is tuned in.

Problems and pointers

Once alignment is achieved and stereo operation does not seem to be happening, it may be a result of too small an IF signal level to the input of IC2. Try turning up RV1 to increase the signal input. This is best done on a Motorola system station. If you have an RF probe for your multimeter, or a CRO, check the level at pin 3 of IC2 and see that you're getting at least 150-200 mV RMS there. If you've got this signal level there but the stereo indicator still does not light, there could be a pilot tone level problem.

Try increasing the value of C21. You can bump it up to as much as 47µ, if you wish, to lift this level. The same result can be achieved by lowering the value of R14. The pilot tone level at pin 14 of IC2 should be the order of 400 to 600 mV peak-to-peak.

If you want to use the existing stereo indicator LED on your tuner, proceed with caution. Although pin 15 of IC2 is capable of sinking 50 mA, the LED current should be limited to a maximum of 10 mA. Too much current drawn by the indicator causes a loading effect on the IC which creates a phase disturbance that knocks the decoder out of lock. The decoding process starts all over again and when the lock condition brings on the stereo LED the excessive current knocks off the stereo operation once more and the whole process repeats itself.

All you end up with is a flashing LED and mono output.

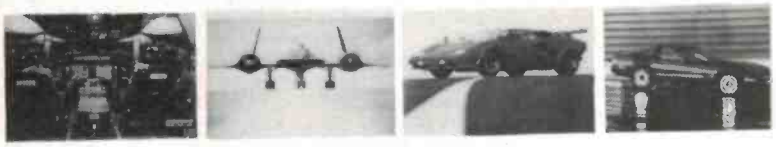
Under noisy conditions, the receiver may be tuned with the FORCED MONO input temporarily held high until the station's tuned in. Upon release, the decoder should find it easier to lock into stereo operation.

Happy stereo listening! ●

JAYCAR

NEW - "HI-TECH" WALL POSTERS

A departure from our area of electronic hardware, but we think that you will be as impressed as we were when you see these magnificent posters. Shown below are descriptions of a small range of posters. We may increase this range depending on the response.



BOEING 767 COCKPIT A magnificent wide-angle view of a new Boeing 767 flight deck on the tarmac at dusk. The photograph is taken from the entrance to the flight deck. In the foreground is a clear view of the new all-electronic instrumentation which is a feature of this aircraft. On the far right is the engineer's console. A typical airport runway can be seen through the pilots windscreen. Full technical specs appear on the bottom edge of the 530(H)x 825(W)mm poster, which is printed in full colour on art paper.

Cat. BP-9210 _____ **$5.95**

SR-71 "BLACKBIRD" Reconnaisance aircraft This is a superb front-on shot of the super-secret SR-71 standing on a remote runway. The photograph clearly illustrates the very low Cd of this aircraft, which can fly higher and faster than virtually any other. A truly remarkable example of High-Tech despite the fact that it was designed many years ago now. Once again, full 530(H)x825(W) colouor. (The aircraft is painted black).

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"LAMBORGHINI" How could you ever be upstaged in a Lambo? Well if you haven't got the $A200 grand that one will cost you here you can have a magnificent poster of a red Countach for $5.95. This 530(H)x825(W)mm poster shows this classic vehicle contemptuously parked across the yellow line of a lonely road.

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"CORVETTE" This is a photograph of the 1984 model Corvette. This model was completely re-engineered and is a major departure from conservative engineering practice. Many European style mechanical features around. It is rumoured that they may arrive in Australia in numbers.... We think that it is the best-looking example of the marque yet. The car is painted in black against a red background. 530(H)x825(W)mm.

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Cat. PT-3010

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$3.95

GRADUATED KNOB WITH SKIRT

Similar knob to illustration except that skirt has aluminium skirt with graduations 0-9 with smaller scale markings in between. The supplier Boo-Boo'ed and we got them! Will take ¼" shaft and has retaining grubscrew. TOYA TYPE TK 167B _____ Cat. HK-7597

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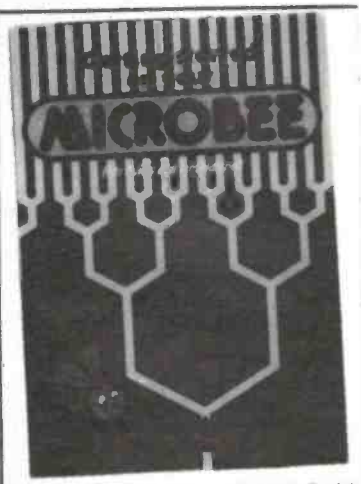
Cat. PS-0628 _____ **$1.95 ea 10+ $1.60 ea**



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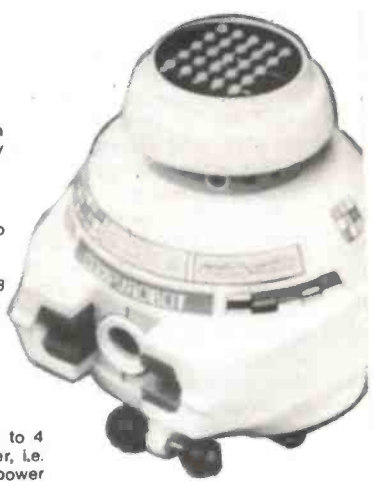

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CHNICAL REVIEW - Most H.T. leads supplied originally with a vehicle consist of a rubberised sheath enclosing a ral conductor of carbon or carbon-reinforced material. The carbon acts as a "distributed resistor" which helps to suppress ion interference. Unfortunately, carbon is a very brittle substance. After a fairly short time the continued shock and vibration e engine envirotment can cause the carbon conductor to break - often in many places. This becomes the weak link in the ion system.

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ou own a Transistor Assisted or Capacitor Discharge ignition and still have the original leads, you could just be kidding rself. Why invest a fortune in an electronic ignition system and still leave a very weak link still there?

leads are made in France and factory terminated. (The factory will not sell us the material in bulk because they feel that we ld not be able to terminate it correctly). Sparkrite of the UK chose them because, in their opinion they are the best in the d. Each lead is fitted with a spark plug cover and rubber boot on the other end. (see list).

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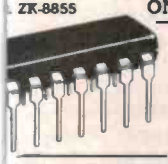

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For technical details see the latest Jaycar catalogue - page 19.
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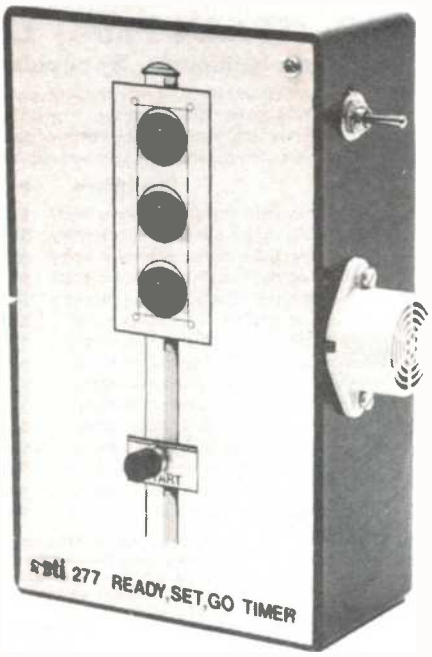
Ready-set-go! lights

No more cries of "cheat, cheat!" during starts on the slot car track or other simultaneous start games. This project will start competitors with the familiar red-amber-green light system which has a random delay between the amber and green indicators.

Robert Irwin



MOST PROJECTS are conceived by the 'suggestive' technique. That is, someone — a staff member, a reader or an advertiser — suggests such-and-such a project would be a good idea. After a little massaging through the office consensus system (rubbish!/ ripper!/might be/ho ho), the idea makes it to the 'breadboard' stage in the lab. or gets discarded along the way.

This project went through a somewhat *different* gestation.

Prologue

One dark and stormy night in an uncharted portion of the ETI lab, strange events were taking place which would have a profound and deep-reaching effect on the lives of many of us here at ETI. It started innocently enough. Peter Ihnat had just finished his electronic Tug'o'War game (ETI, August 1984) and had called in a few of the editorial staff for a quick demonstration. Roger played with the on/-off switch for several seconds and grunted his approval.

"Nice colour!" exclaimed Jennie enthusiastically from the doorway. She was not noted for her wit (thought Robert in his usual dim-witted and humourless fashion).

The games began innocuously enough, with much button pushing from one and all and titters of mirth resounding around the cavernous interior of the lab. The place took on the air of a carnival and there was even talk of abandoning the August issue in favour of a party.

"Hey! This Tug'o'War is really fun," said Jon, who was not known for his wit. "Why don't we keep score?"

And so it came to pass that the great lab staff versus editorial staff Tug'o'War games began. It was soon noted, however, that the scoreline somewhat favoured the lab staff by the margin of ten to nil. This trend may have continued well into the night but, alas, one of the more cerebral of the editorial staff put two and two together (finally getting four with the aid of an HP-15C) and realised that it was also the lab staff who were saying the ubiquitous "Ready, Set, Go".

It was decided that someone, other than the participants, should say the sacred words. David, a member of the elitist Draughting Club, was given the honour. All should have been well, and would have been had not David been caught giving secret signals to the lab staff before reciting his trusted oath (it was later discovered that the lab staff had anticipated the events and had plied David with liberal quantitites of scotch and promises of a free engineering degree to gain his co-operation).

The editorial staff were livid, Roger, his face red and his left eye twitching, mumbled something about placing an ad in the employment section of the Herald. From all round the lab cries of "cheat, cheat" could be heard coming angrily from the advancing mob.

All of the sudden a piercing scream like that of a tortured animal filled the air, Jennie, clutching a live soldering iron (Weller, type WTCPN) and harbouring years of pent-up frustrations over late projects, lunged madly at Geoff's throat and attempted to solder his head to Peter's right leg.

Things could have gotten ugly then had I not been overcome with a blinding vision. "Wait!" I cried, "I have the answer".

Prying the soldering iron out of Jennie's trembling fingers I set furiously to work and, many hours and a myriad of burnt out CMOSs later, I emerged from the lab triumphant, carrying the prototype of what is now the ETI-277 Ready, Set, Go Timer. This secret can now be yours. Read on . . .

Design details

This circuit was beyond my design capabilities and I couldn't find anything similar to copy. I asked Geoff for some advice but he said he didn't know how to do it (he's a bit shy). Anyway, he was too busy to be bothered about electronics as he had to organise the next curry lunch at the Broadway pub. And after that he wouldn't care.

I asked Peter if he could give me a few hints on the circuit — like a complete design and layout of the pc board. Then I could probably manage the 'Parts List'. But Peter had taxed his mental capacities to their limit on a wooden box. One side was a bit shorter than the other (like Roger's arms) and the solder wasn't holding the wood together very well. So I left him to sit on it and I phoned the crisis counselling service (there was no aid from the venereal diseases hotline).

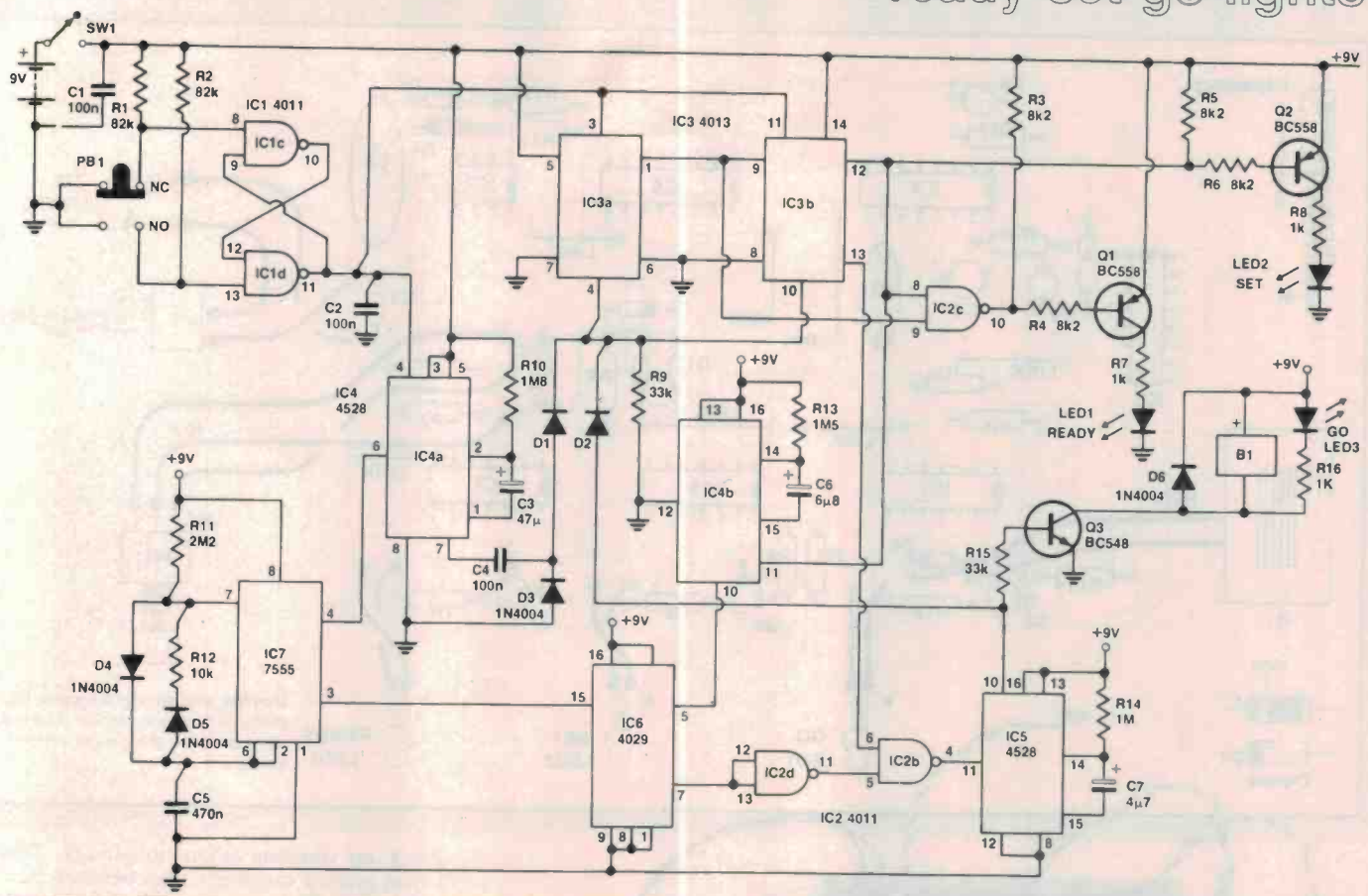
The aim of the exercise was to develop a device which would give some sort of random time period between the press of a pushbutton and the firing of a buzzer or some such thing. This would enable a game, such as the ETI Tug'o'War or a slot car race, to be started fairly without any of the competitors knowing exactly when the gun was going to go off. The final design consists of a four-bit counter, a couple of flip-flops and a handful of monostables.

It was decided to use CMOS chips because of their ability to be run directly off a 9 V battery without any regulation and their low power consumption.

The heart of the circuit is a 4029 four-bit counter. This is configured as a binary-up counter. The counter will count continuously from 0 to 15 and repeat this cycle until it is disabled. At the end of every 0-to-15 count a *terminal count* signal is generated in the form of a low-going pulse.

The terminal count signal is connected through some gating circuitry to the trigger of a monostable which, when fired, lights a green LED and sounds a buzzer. The gating on the trigger is arranged so that the mono will only fire on a terminal count pulse immediately following the press of a pushbutton and will ignore all other terminal count pulses.

Three LEDs are used to indicate the status of the circuit. A red LED indicates



HOW IT WORKS ETI-277

To understand how this circuit works let us look at the sequence of events after each press of the pushbutton. IC1c and IC1d form an RS flip-flop to debounce the pushbutton. Initially the two D-type flip-flops of IC3 are reset i.e: the outputs are low. When the pushbutton is pressed once, two things happen. Firstly, IC3a and IC3b both receive a clock pulse. The input to the first flip-flop IC3a is tied high and the input of the second flip-flop is connected to the output of the first. Therefore, on the first clock pulse the output of flip-flop one goes high and the output of flip-flop two remains low. This causes the output of the NAND gate IC2c to go low which turns on Q1 and lights LED1.

The second thing that happens is that the monostable IC4a is triggered. IC4a is configured as a retriggerable monostable which is triggered on a low to high transition of the trigger input. The output pulse width is set by R10 and C3 and is given, for a 4528 with C >0.01µF and V_{dd} = 9 V, by the formula

$$T_w = 0.32RC$$

In this case a pulse width of around 30 seconds is given. When the mono is triggered a high is given at the output which is connected to the reset pin of the 7555, IC7. The 7555 is connected as an astable multivibrator with a low time of

$$T_L = 1.1R11C5$$

and a high time of

$$T_H = 1.1R12C5$$

This gives a period of

$$T = T_H + T_L$$

With the values given, this gives a period of one second.

A high on the reset pin enables the astable. The output of the astable clocks a four-bit counter IC6. If the pushbutton is not pressed again within 30 seconds then the monostable output will go low disabling the 7555. A positive pulse is also applied to the clear inputs of the flip-flops which resets the outputs to low and turns off the LED1 (the mechanism for obtaining this pulse is discussed later). The circuit is now returned to its 'standby' state.

If, however, the pushbutton is pressed a second time within 30 seconds, then a high is clocked through to the output of the second flip-flop. This turns Q2 on which lights LED2. At the same time the output of the NAND gate IC2c goes high which turns off Q1 and thus LED1. The second press also triggers IC4a.

When the high is clocked through to the output of the flip-flop this triggers a second monostable IC4b which disables the counter for a period given by

$$T_w = 0.32R13C6$$

(about three seconds).

After this time the counter resumes counting up. When a terminal count occurs, i.e: when a four-bit counter reaches 15, a low going pulse occurs on pin 7 of the counter. This is inverted to a high going pulse by IC2d. This drives the NAND gate IC2b which gives a low pulse to trigger a third monostable IC5. This mono gives a pulse which turns on Q3 for a period of 1.5 seconds given by

$$T_w = 0.32\ R14C7$$

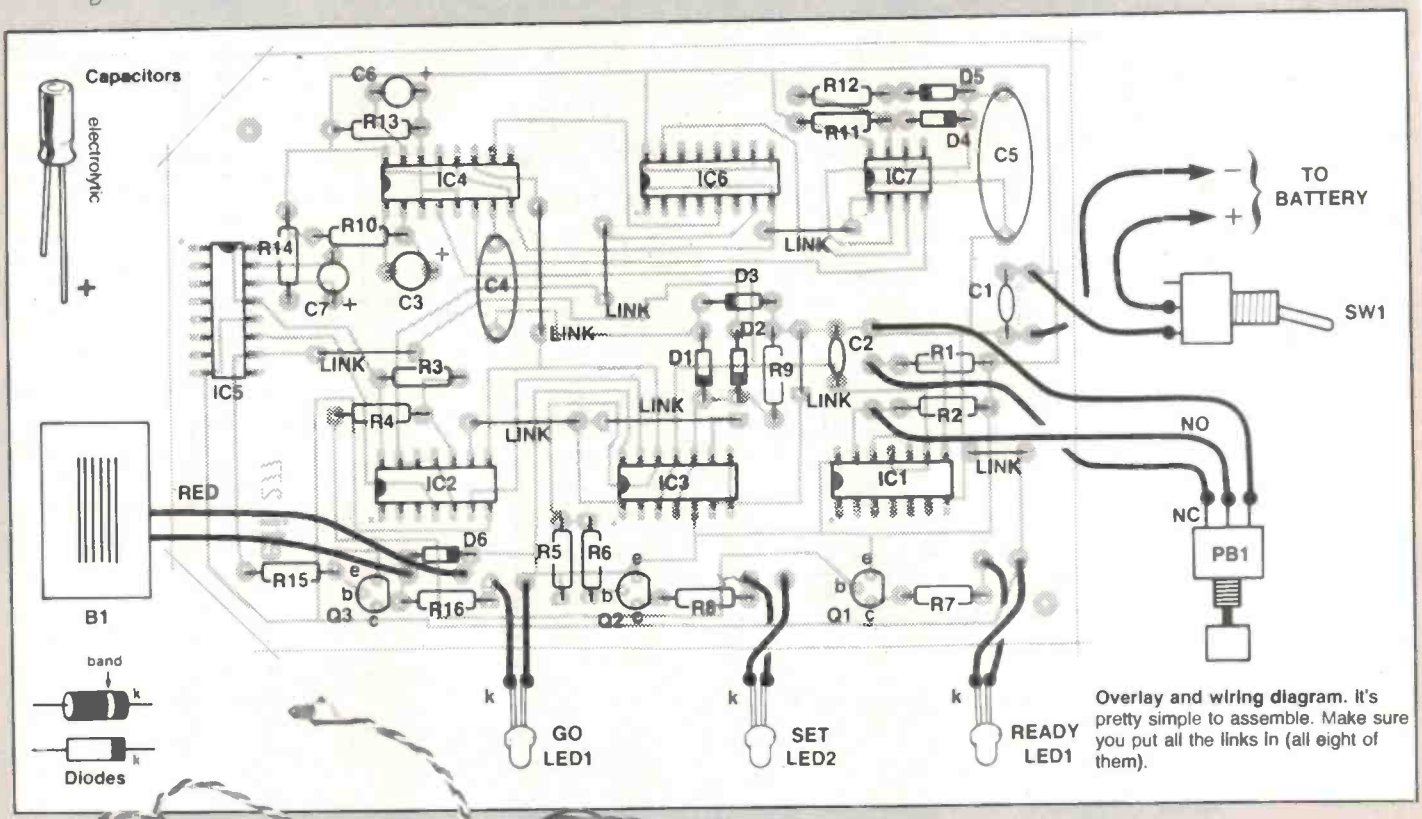
This lights LED3 and turns on the buzzer. The pulse from this third mono also resets the two flip-flops which turns off LED2.

The other input of the NAND gate IC2b is connected to the output of flip-flop two which has the effect of only letting a trigger pulse through to the monostable when LED2 is lit. This prevents the mono from being triggered by a terminal pulse from the counter at some time other than after the second pushbutton press.

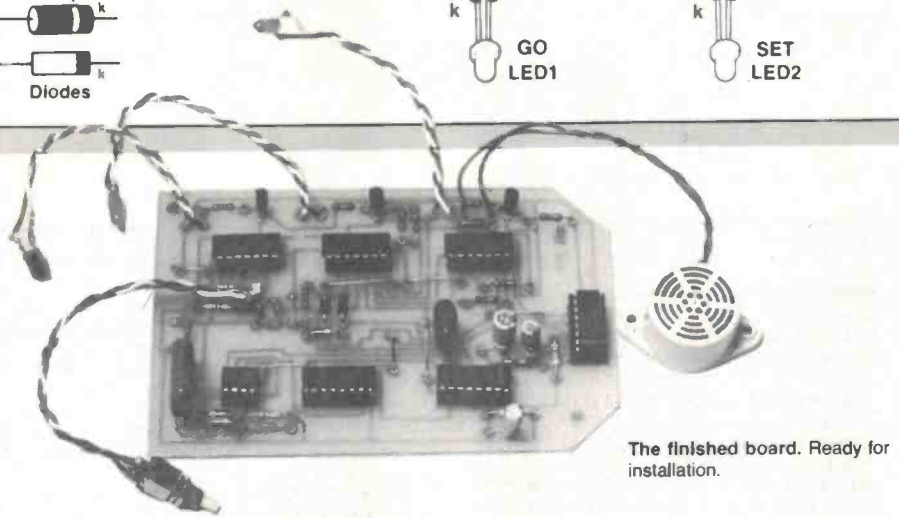
D1, D2 and R9 form a two input OR gate which lets the output from IC4a or IC5b reset the flip-flops. Pin 7 of IC4a is normally high and goes low when the mono is triggered. To prevent this from keeping the flip-flops reset, the pulse is ac coupled to D1 by C4. This provides a short positive pulse on a low to high transition on pin 7 of IC4a. D3 allows C4 to discharge when pin 7 goes low. D6 is put across the buzzer to protect IC5b and Q3 from any back EMF induced because of the inductive load of the buzzer.

C1 filters the supply and C2 filters the clock pulse derived from the pushbutton.

The overall effect is that on the first press of the pushbutton LED1 lights indicating 'ready'. If the button is pressed again within 30 seconds then the 'ready' LED will go out and the 'set' LED will light. Some time later, between three and 18 seconds depending on at which point in the count the button is pressed, the 'set' LED will go out and the 'go' LED and buzzer will turn on for about 1.5 seconds. The circuit will then reset itself. If the button is not pressed a second time within 30 seconds then the circuit will reset itself. ▶



Overlay and wiring diagram. It's pretty simple to assemble. Make sure you put all the links in (all eight of them).



The finished board. Ready for installation.

that the circuit is in the 'ready' mode. This LED is lit after the pushbutton is pressed once. It indicated that the circuit is ready for action.

At this stage the counter is enabled but the gating circuitry on the terminal count output is not yet primed so the mono will not yet fire on a terminal count pulse. The circuit will, in fact, just sit there with the red LED lit and do nothing.

When the pushbutton is pressed a second time and red LED will go out and the yellow LED will light. This indicates that the circuit is in the 'set' mode. At this stage the output monostable will be enabled and will sit and wait for a terminal count pulse to appear. The length of time between the lighting of the yellow LED and the firing of the mono will depend on whereabouts in the count the button was pressed.

If, for instance, the button was pressed when the counter was at five, then the counter would have to count ten more times before giving a terminal count pulse. The counter is clocked once every second, so ten counts is equivalent to ten seconds. If, on the other hand the button is pressed when the counter is at 11, then only four more counts are required.

When the output mono is fired then the yellow LED goes out and the green LED comes on and a buzzer sounds. This means *GO, GO, GO*. At this stage you should be 'going at' whatever you wanted to say 'ready, set, go' for and won't be interested in what the timer is doing which is fine since all the timer will be doing is resetting itself ready for the next round.

If the counter was at 15 when the button was pressed a second time then the green LED and buzzer will come on almost immediately. To overcome this problem a second mono is used to disable the counter for a period of time when the yellow LED is lit.

After the monostable pulse has finished then the counter will be enabled again and pick up counting where it left off. This then gives a minimum time between 'set' and 'go'. With this particular circuit this minimum time is three seconds which should give you enough time to get your hot little hands off the timer and on to your slot car controller or whatever. This time can be lengthened if desired and will be discussed later.

A third monostable is used to shut the whole circuit down after a period of time if it is not re-used. This time is 30 seconds at present but can also be changed if necessary. When the circuit is shut down the clock generator for the counter is disabled and any LED which may be on will be turned off. This is done to save any excessive drain on the battery if you forget to turn the unit off.

Constructional details

The construction is quite straightforward. Begin with the pc board. Check that the tracks on the pc board are all OK and that there are no breaks or shorts. Start by cutting suitable lengths of tinned copper wire to form the eight links on the pc board and solder them in position.

Next locate and solder in all the resistors and capaitors. Take care to get the electrolytics the right way round. The three transistors can be mounted next followed by the six diodes. Make sure you follow the overlay carefully to get the diodes the correct way round.

The only remaining components are the ICs. It is recommended that IC sockets be used with CMOS ICs unless you are an experienced solderer. If you're not using

PARTS LIST — ETI-277

Resistors

R1, R2	82k
R3, R4, R5, R6	8k2
R7, R8, R16	1k
R9, R15	33k
R10	1M8
R11	2M2
R12	10k
R13	1M5
R14	1M

Capacitors

C1, C2	100n ceramic bypass
C3	47µ/25V electro
C4	100n greencap
C5	470n greencap
C6	6µ8/25V electro
C7	4µ7/electro

Semiconductors

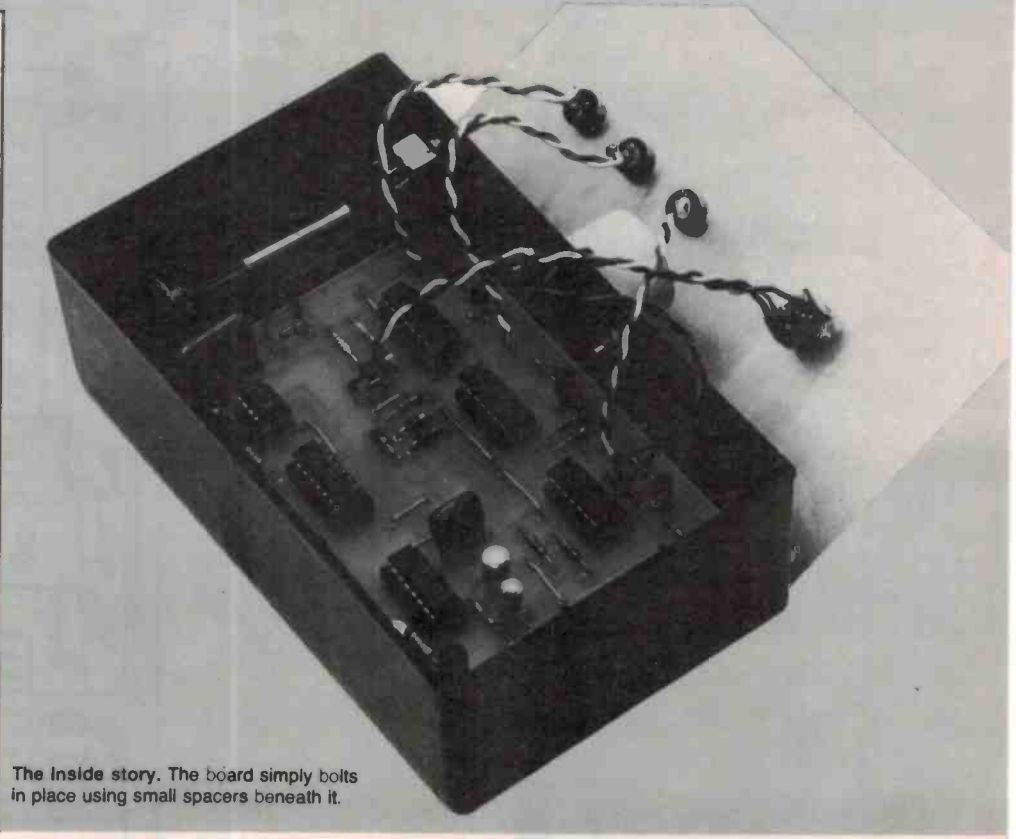
Q1, Q2	BC558
Q3	BC548
IC1, IC2	4011
IC3	4013
IC4, IC5	4528
IC6	4029
IC7	7555
LED1	Red LED 5 mm
LED2	Yellow LED 5 mm
LED3	Green LED 5 mm
D1, D2, D3, D4, D5, D6	1N4002 or similar

Miscellaneous

SW1	SPDT toggle
PB1	SPDT momentary action pushbutton switch
B1	9V buzzer

ETI-277 pc board; Scotchcal front panel; 50 x 90 x 150 jiffy box; No. 216 battery clip; three LED mounting bezels; hookup wire, double-sided tape etc.

Price estimate: $20-$25



The Inside story. The board simply bolts in place using small spacers beneath it.

sockets then solder in the ICs quickly and avoid excessive heat on the IC pins. It is advisable to solder in all the 'earthy' pins first to minimise the risk of destroying the IC with stray voltages induced by the soldering iron. Make sure, with all the ICS that you get the correct orientation.

The only remaining thing to do is to attach lengths of hook-up wire to the connection points of the LEDs, battery terminal and switches. If you make each wire about 100 mm long then you can trim them later. Note that the negative lead from the battery terminal is connected straight to the pc board.

At this stage you should have a fully constructed pc board with a battery terminal and about a dozen wires dangling from it. The next step is to prepare the box to put it in.

The prototype was housed in a 90x50x150 mm Jiffy box. The pc board has been designed to fit snuggly into this box with room for the battery at one end. Two corners of the pc board are chamfered to allow the board to sit between the screw points in the corners of the box.

Firstly unscrew the face plate of the box and mark out the holes for the LEDs and pushbutton using the front panel artwork as a template. Drill ten holes to 6.5 mm. The Scotchcal label can now be attached to the front plate. The easiest way to do this is to prick holes at the centre marks on the Scotchcal with a pin. This will give you something to line up with.

Peel the backing off the Scotchcal carefully and make sure it doesn't stick to itself. Next, wet the sticky side of the Scotchcal by putting it under a running tap. Do the same to the face plate. The Scotchcal can now be placed on the face plate and the water will allow you to move the Scotchcal into position. When you have the Scotchcal lined up press it firmly down and wipe off the excess water with a dry, soft cloth. Work out all the air bubbles beginning at the centre and working outwards. Leave the front panel aside for a couple of hours to dry thoroughly. When it is dry carefully cut out the holes with a sharp knife or scalpel.

The prototype box had small ledges protruding from the sides which allowed the pc board to sit about 10 mm from the bottom of the box. If your box doesn't have these ridges then mounting holes have been provided on the board so that nuts and spacers can be used. Sit the pc board in the box and make sure there is room for the battery at one end.

Locate the ON/OFF switch on the side of the box so tht it will not foul on the pc board or battery. Once you are happy with the position drill a 6.5 mm hole in the side of the box to take the switch. Also locate the buzzer on the side of the box in a convenient position and drill holes to take the mounting bolts for the buzzer.

A small slot should be filed in the top edge of the box just above the buzzer to allow the leads to enter. If necessary the LED leads can be trimmed at this stage. Don't cut them too short or there won't be enough free play to take the lid off without ripping the pc board out.

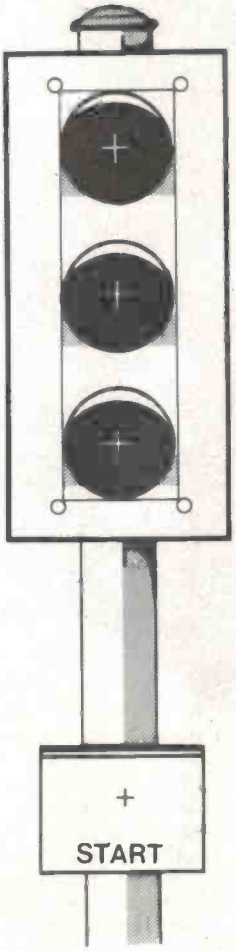
Before permanently mounting the pc board wire up the buzzer ON/OFF switch and battery terminal. The pc board can now be placed in the box. A couple of small blobs of glue will hold it in place (don't use superglue or you'll never be able to get it out again). Mount the ON/OFF switch and buzzer.

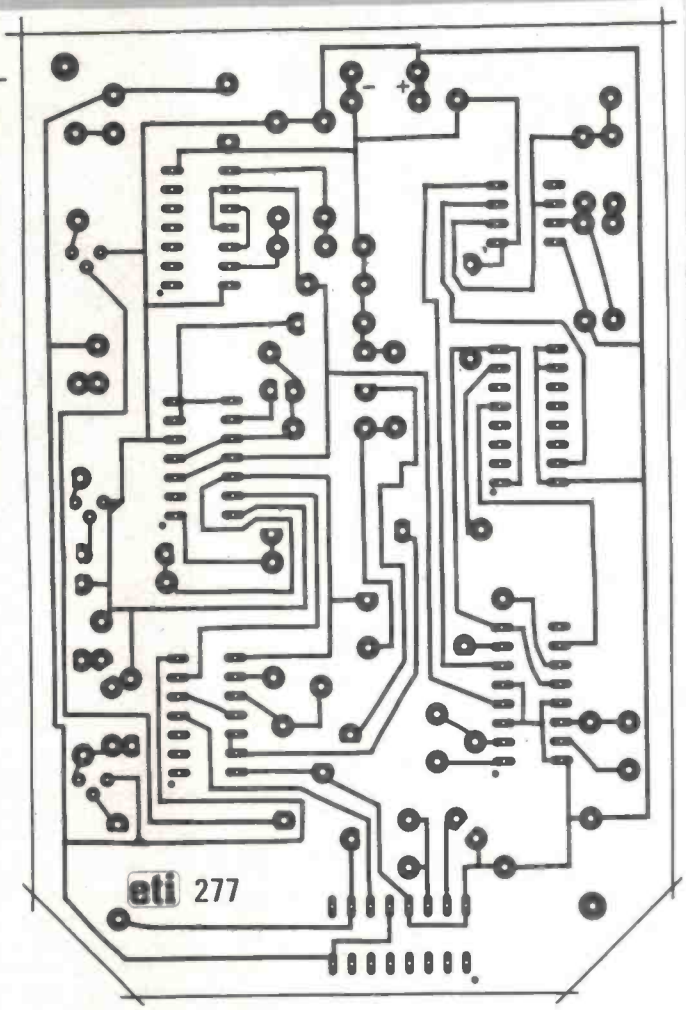
The pushbutton and LEDs can now be attached to the lid (use LED grommets and hacking washers for the LEDs). The only thing left to do is attach a battery and screw on the lid. The battery can be secured to the bottom of the case with a piece of double-sided tape.

Using it

The unit is very easy to use. Simply turn the ON/OFF switch on. The green LED should light and the buzzer will sound for about five seconds. After this all the LEDs should be off. Now all you need to do is press the pushbutton once. The red LED should light. If you do not press the button again the red LED will go out after about 30 seconds.

If you press the button again the yellow LED will light and then, somewhere between three and 18 seconds later, the yellow LED will go out and the green LED and buzzer will turn on for about 1.5 seconds. There is no need to turn the unit off again, unless you are not going to use it ▶





eti 277 READY,SET,GO TIMER

Artwork. Full-size reproductions of the printed circuit board and front panel.

again for a long time, as the unit will automatically go into a standby mode and will draw only tens of microamps from the battery.

A note on time constants

There are three main time constants that may be altered in this circuit. Firstly, the minimum time between 'set' and 'go'. This is set by R13 and C6. The formula for the time delay is:

$$Tw = 0.32 \times R13 \times C6$$

It should be noted, however, that R13 should not be greater than 2M. C6 can be altered to any value to give the desired time.

The second time which can be altered is the period of the 7555 astable. At the moment the counter is being clocked at the rate of one per second. This will give a time of 16 seconds between terminal count pulses. If the period of the clock pulses is decreased to, say, 0.5 seconds then the terminal count pulses will come about every eight seconds. The period is approximately given by:

$$T = 1.1 \times R11 \times C5$$

This is best altered by altering C5. R11 should not be increased past 2M2. If a longer period is required then C5 can be an electrolytic capacitor with the negative pin going to earth.

The third time constant you may wish to alter is that of the automatic reset which puts the circuit into standby when it is not used for a period of time. The monostable that controls this is retriggered on each press of the pushbutton so this time constant must always be set greater than the maximum time between 'set' and 'go'.

At the moment it is set for around 30 seconds. If you increase either of the previous two time constants then you should also increase this one. If the either of the previous time constants are decreased then you don't need to change this one. The formula for this time constant is:

$$Tm = 0.32 \times R10 \times C3$$

Once again R10 should be kept below 2 M but C3 can be as high as practical.

Epilogue

After implementing the Ready, Set, Go timer to start the Tug 'o' War games, editorial/lab staff relations improved remarkably. It should be noted that the lab staff still trounced the opposition regardless of the starting method. This was put down to the exhaustive research in pinball parlours that we were forced to do in order to gain a greater understanding of the state of-the-art technology used in today's sophisticated arcade games.

Jennie has made a remarkable recovery but has been advised that a long sea voyage could do her the world of good, and so leaves on a slow boat to China in the near future. We lose a lot of good assistant editors that way. ●

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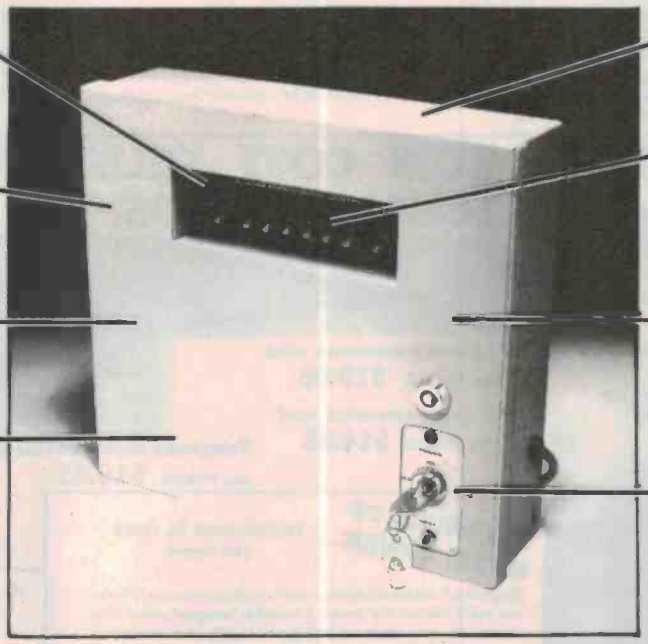

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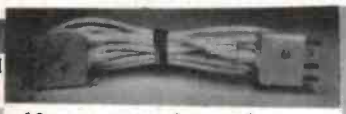

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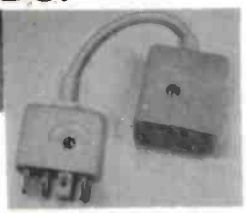

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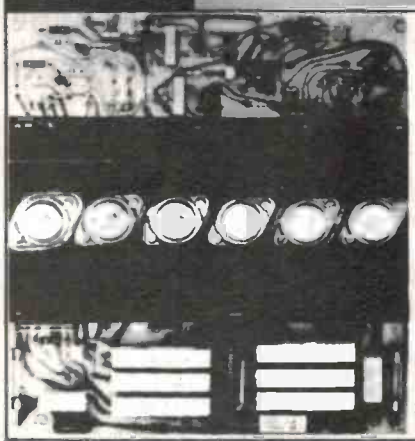

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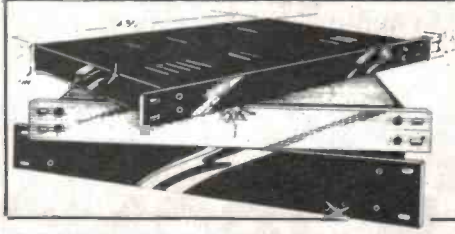

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Ref: ETI September 1984 (ETI 442)

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If you have a car that won't take the Jaycar KJ-6655 Hall Effect Kit (i.e. an Australian six or V8) this could be for you! It is the SIEMENS (German) made Hall Switch. It will operate from −30 to +130°C. A simple soft iron vane cut with appropriate slots will commutate the unit.
Cat HK-2101

$19.95

PCB to suit 84T19 $3.45

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200mCd LEDs Cat ZD-1790
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30° 78mA Solar Cell Cat ZM-9004
$3.25 ea (1-9) $2.95 ea 10 or more
(or $35.40 for the 12 sectors)
"Gates" 2.5 A.H. Gel Batteries Cat SB-2490
ONLY $9.95 each
PCB to suit Cat EE-7085 $4.95
Ref: EA September 1984

ONLY $89.50

TRANSISTOR ASSISTED IGNITION

REF: EA JANUARY 1983

$35

Latest version of this fantastically popular kit! The Jaycar kit comes COMPLETE down to the plastic TO-3 transistor covers, genuine heatsink and diecast box - as used in the original EA unit.
Beware of flimsy kits that use sheetmetal boxes!
This kit is designed to be used with contact breaker points, if you want Hall-Effect breakerless option may we suggest the KA-1505 version of this kit shown elsewhere on this page.
Cat. KA-1506

DUAL TRACKING ±22V POWER SUPPLY

Cat. KA-1410

Ref: EA March 1982

This versatile dual polarity (dual tracking) power supply kit can provide up to ± 22 volts at up to 2 amps. In addition the supply features a fixed +5V at 0.9A output. The supply is completely protected against short circuits, overloads and thermal runaway. The kit comes complete with case, meter and front panel.

TRANSISTOR ASSISTED IGNITION HALL-EFFECT "BREAKERLESS" VERSION $36.95

REF: EA DECEMBER 1983

his kit is virtually identical to the KA-1506 except that it ontains the interface electronics for the KJ-6655 Hall-ffect triggerhead.
Cat. KA-1505

ELECTRIC FENCE

Ref: EA September 1982

Mains or battery powered, this electric fence controller is both inexpensive and versatile. It should prove an adequate deterrent to all manner of livestock. Additionally, its operation conforms to the relevant clauses of Australian standard 3129. (Kit does not include automotive ignition coil which is required).

Cat. KA-1109 **$15.00**

3-50V/5 AMP VARIABLE POWER SUPPLY $149

Ref: EA May/June 1983

A brand new efficient design provides regulated high power. It features state-of-the-art switchmode techniques, dual meters and continuous adjustment. All parts for the kit are provided including specified case, front panel and special meter scales.
Cat. KA-1520

This kit represents a massive saving over equivalent built units! ± 12V add-on kit (refer EA July 1983)

Cat. KA-1521 $14.95

TOUCH LAMP DIMMER

Ref: EA April 1983 Cat. KA-1508 **$19.95**

You can turn lights on and off (AND DIM THEM!) with one touch! Uses high-tech Siemens IC. Features attractive HPM wallplate (supplied). The Jaycar kit contains ALL the necessary components including the small contact spring. Watch out for similar priced kits that don't.

Remote option Cat. KA-1509 **ONLY $14.50**

SEE OUR OTHER ADS FOR ADDRESS PANEL AND OTHER INFORMATION

Project 610

DRUM synthesiser module

This simple, low-cost module operates from a sound pickup or pulse input and can produce a wide variety of sounds.

Jonathan Scott

THE DRUM SYNTHESISER has a lot of those properties that make for a good construction project. It's easy to design some kind of percussion synthesiser because there are lots of different options that can be included or left out. The simplest sort is really not very complicated at all. The commercial units are often not quite what you want for yourself, and are expensive for what you get on account of the relatively small numbers manufactured. Lastly, musicians are often electronic tinkerers of the most compulsive and fanatical type, and are hungry for new sonic experiences. It is not surprising to find that half an hour wading through the indexes of popular construction magazines turns up half a dozen different projects using from one transistor to a handful of ICs. One magazine often has several units of differing complexity.

I have tried to present in this project the most flexible design that could be managed within a modest budget. It centres on a single-chip function generator IC, the Exar 2206 (second-sourced by Teledyne). This offers a waveform source with amplitude and frequency modulation facilities built in. This IC, along with a cheap quad op-amp, allows the incorporation of most of the features found on the most complicated models, and a few extras, for about $8 worth of silicon, and little else beyond the pots (which are many and thus the most expensive bit).

I cannot see a sensible way of circumventing the need for one pot per adjustable function, so I figure that this represents a pretty cost-effective design. It can be built in a box, if you like, or incorporated in a drum practice pad as I did. This latter option has the advantage that this unit's vibration pickup function, described fully later, is used to the full, and there is no need for further encapsulation, unless the unit graduates to non-practice use and must be hauled around by roadies. In addition, the pots can be trimpots, reducing the cost by several dollars.

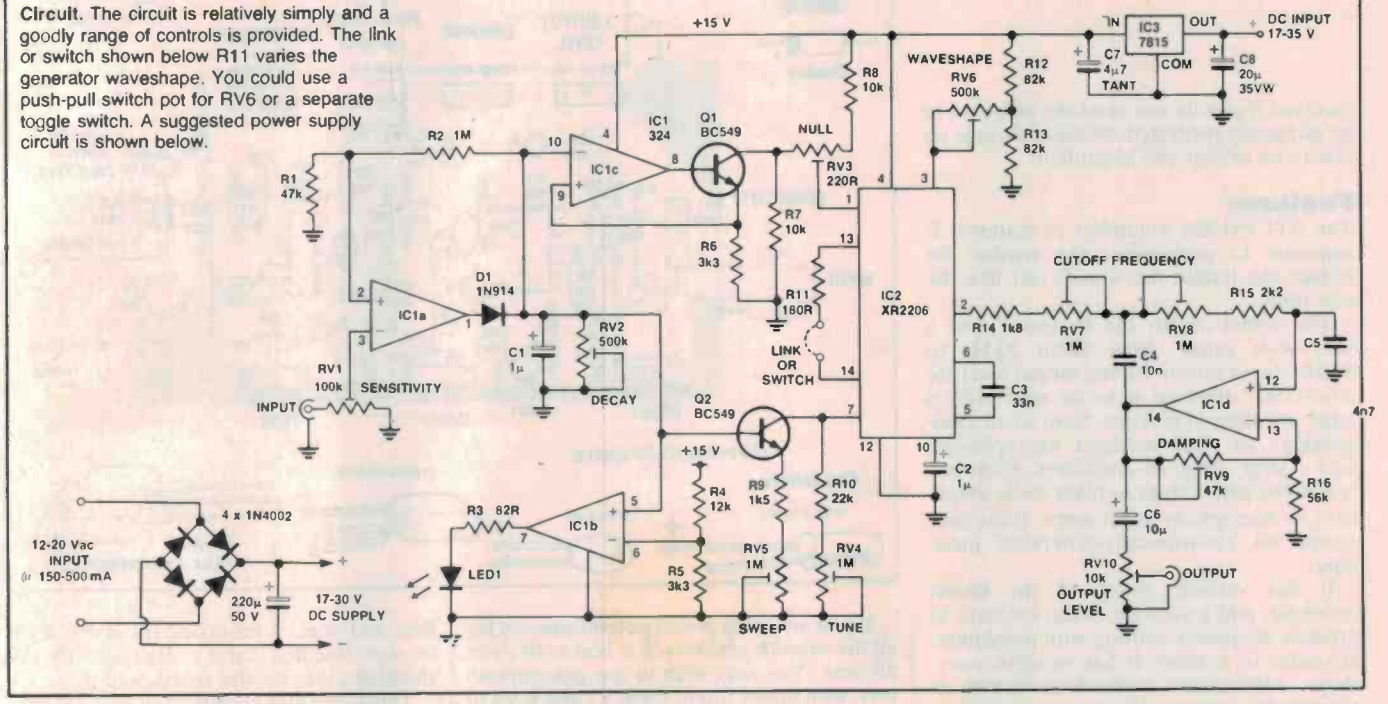
What is a drum synth?

What normally constitutes a drum synth? Well, early units were built in a small box containing a battery. They had one input and one output. When a set of contacts were made, or some signal received, a tone with some of its properties set by knobs was sent to an amplifier, such as a home audio amplifier or a stage amp, etc. Some units appeared with an input circuit which responded to human touch and possibly a tap from an implement such as a drumstick or other 'proper' implement. The number of variables set by the user of the synth could be from one to about ten, depending basically on what you felt it worth paying for.

This project can be built up just like this if you wish. It is, however, intended for a rather more imaginative situation. The availability in recent times of the piezo vibration pickup, such as used in the ETI-340 car burglar alarm, makes it easy to incorporate the synthesiser in a drum practice pad mount or similar, and have it respond as would a true drum, but electronically. This has the advantages that you play it just like a normal percussion instrument (you belt it with a suitable club!) yet you can put its sound into headphones. In addition, the resultant sound can be tuned and altered.

It is envisaged that you might want to get a whole host of the beasties, each with its own practice pad and stand, to form a fully electronic practice/performance kit. Each stand would have its own set of trimpots for setting up the sound desired. Little effort is

Circuit. The circuit is relatively simply and a goodly range of controls is provided. The link or switch shown below R11 varies the generator waveshape. You could use a push-pull switch pot for RV6 or a separate toggle switch. A suggested power supply circuit is shown below.



HOW IT WORKS — ETI-610

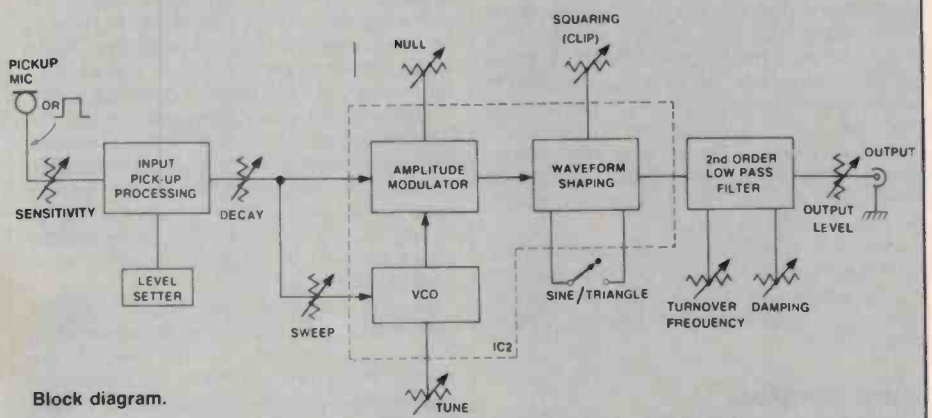
To explain the circuit operation I will initially refer to the block diagram. The pickup processor produces a decaying pulse, proportional to the intensity of the stroke, each time the input microphone is stimulated. This pulse is used to both amplitude and frequency modulate the oscillator waveform. The amplitude modulation is accomplished linearly by a multiplier cell inside the XR2206, while the frequency modulation is achieved by the Voltage Controlled Oscillator in the IC. The waveform, currently triangular, is then shaped by a circuit which can deliver sine or clipped waves, as required. These are filtered before being fed out to an external amplifier. The level-setter allows easy alignment of the input sensitivity control, to correct for changes of pad or strength of drummer, etc.

Referring now to the circuit diagram, RV1 is the input sensitivity control, serving to attenuate the output from the pickup. The first op-amp is a rectifier with gain, which charges up C1 to the peak value of the input waveform. C1 then discharges via RV2, which thus sets the decay rate of the envelope. This envelope control signal appearing on C1 is fed to three places.

Firstly, it is compared to a fixed level by IC1b. If it exceeds the preset level of about 3 V, set by R4 and R5, LED1 is flashed on. This indicates that the signal is too high to be handled, and that the sensitivity should be reduced.

Secondly, the signal is sent to IC1c, which is connected to Q1 and R6 to form a proportional current sink. A voltage of precisely half rail is fixed on pin 1 of IC2 by RV3. This sets the output amplitude to zero for quiescent conditions. When a signal arrives the voltage on pin 1 of IC2, the output amplitude increases proportionally to the signal. Thus the input signal defines the waveform envelope.

Thirdly, the envelope signal is fed to the base of Q2. When the input signal exceeds one Vbe drop (about 0.6 V), corresponding to a beat of medium force, Q2 sinks current from pin 7 of IC2. The current drawn out of pin 7 defines the frequency of oscillation of the VCO, so this has the effect of 'sweeping' the tone when the drum is struck in any but the gentlest manner. RV5 allows the degree of sweeping to be set; RV4 clearly sets some basic amount of current out of pin 7, so it has the effect of 'tuning' the drum.

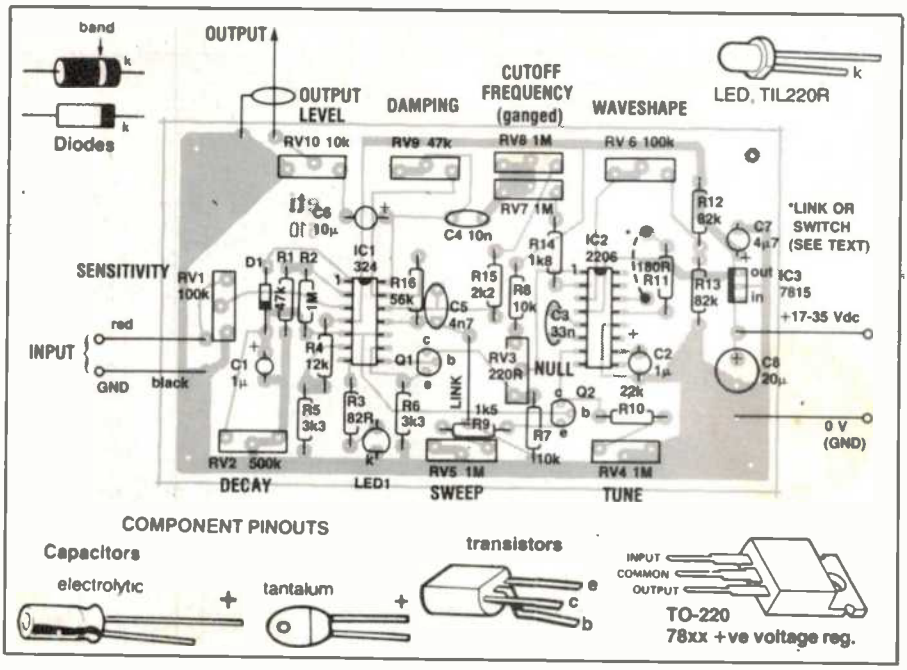


Block diagram.

Once modulated, the signal is fed to a waveshaper. This consists of an amplifier and an optional sine converter. With the 180 ohm resistor R11 connected (via a switch as link), the sine converter is turned on. This gives a choice of 'timbre' of the drum sound. Further, if the amplifier gain is adjusted by means of RV6, the waveshape can be made either to clip on peaks, giving a further enhancement only on loud notes, or to clip heavily, giving a richer, sharper tone. When clipping, many harmonics are generated allowing the filter to further alter tone.

IC1d, the op-amp along with its surrounding components, is connected as a second-order filter with variable cutoff frequency and variable damping. The pots RV7 and RV8, which should always be adjusted together (by means of a double gang pot if non-preset pots are used) set the cutoff or turnover frequency, while RV9 sets the damping factor. This is adjustable from 1 to 0, giving smooth rolloff for RV0 = 0, to very peaky response and possibly oscillation for RV9 = maximum resistance. C6 and RV10 feed the filter output to the external amplifier.

IC3 merely provides a regulated 15 V rail which is necessary for stability. The external input voltage must therefore exceed about 17 volts. Up to 35 V may be applied, so that the supply rail from an external amplifier could be used.



involved if you do not need the pc board to be physically protected, because there is no box to be drilled and beautified.

Features

The ETI-160 has a number of features. It responds to percussion; the harder the impact the louder the sound, just like the real thing.

The sound output can be tuned over a very wide range, from about 20 Hz to 3 kHz. Input sensitivity and output level are adjustable, allowing it to be used with a large selection of pickups, from small loudspeakers to piezo-resonant microphones, and a large range of amplifiers, from low sensitivity guitar amps to plain audio amplifiers, to microphone mixer amps. It can also accept an electronically-generated pulse input.

It has variable decay of the sound envelope, and a variable sweep function to produce frequency shifting with amplitude, as occurs in a drum. It has variable waveshape, continuously shiftable from sine or triangle to square, giving a range of harmonic combinations.

Finally, it has a second-order filter incorporated for further altering the harmonic distribution (the 'tone' of the sound). This filter can be varied from critically damped in the frequency domain to completely undamped, allowing further modification of the tone. (This last function is sometimes called variation of Q, because underdamping produces a tuned-circuit like response at the filter's nominal cutoff frequency, boosting the final harmonics.)

It will clearly require some understanding of what the different fucntions do in order to be competent at adjusting the various pots. The section entitled 'Using it' covers this subject.

Construction

Constructing the electronics of this project is extremely simple. First tackle the pc board. No matter whether you've made it yourself or purchased it, first check the copper tracks to ensure there are none missing (rare) and that there are no minute cracks or small copper 'fingers' bridging closely-spaced tracks (especially between IC pins). Also check that all the holes are drilled and of the right size. This is particularly important if you are using trimpots as their tags are generally wider than component leads. The trimpot tag holes should be drilled to 1.2 mm diameter.

If, or when, all's well with the pc board, you can commence fitting all the resistors and capacitors (but leave the trimpots till later, if you're using them). Be sure to observe the usual precautions as to correct orientation of components according to the overlay. Transistors, ICs, LEDs, diodes and electrolytic capacitors all require correct orientation for correct operation.

If you are using preset potentiometers for all the variable resistors, it is best to fit them all next. You may wish to use potentiometers, with knobs fitted, for RV2 and RV4 to 10. If so, leave these for the moment.

For flying leads to the power supply and amplifier, as well as off-board pots if you are using them, it is probably convenient to fit small connection posts or stakes. These make final connections easier, not to mention repairs, should these ever be necessary.

If you use them, fit them next. If not, solder hookup wire to each of the connections, leaving enough slack to reach the required distance. If using posts, solder the hookup wire to the posts after you mount the pc board, as this will make the whole process easier because you will not need to reach underneath the board.

Having completed the board assembly you should turn your attention to mounting it as you prefer. I cut a circle of wood, and stained it suitably, to make a mount for a conventional practise pad or piece of rubber mat. The disc of wood can be mounted on small feet or a tripod or stand of some kind — whatever you prefer for normal practising.

The pc board and acoustic pickup can be fixed to the underside, as shown in the photograph. I used a small piezo vibration pickup from Creative Electronics in Marrickville, Sydney (see 'Shoparound' this issue) as the pickup (type VPU-1). A 50 mm diameter loudspeaker will do just as well, as will the resonance microphones used in the ETI-340 car burglar alarm.

I even tested a small piezo buzzer obtained from Tandy Electronics, which also worked well.

The pickup element should be attached flush, according to its maker's instructions, while the pc board should be raised on small brass spacers or similar. I used self-tapping screws and 6 mm-long spacers. When it's mounted, connect the pickup. then run appropriate cables to the power and amplifier, and pots, if off-board (twist the leads or use shielded cable). Be sure to use shielded cable for the signal output.

This completes construction and you may proceed to the alignment.

Alignment

Firstly, move all the pots to centre position, connect up the amplifier and power supply, and slowly advance the volume control on the amplifier until something is heard. The first step will be to adjust the null pot, RV3, to produce minimum output. It is possible that you will be close to this already, so move RV2 about and check that you get some sound, then move it to minimise the sound. Once set, this pot will not require further adjustment.

You will notice that two of the pots are mounted at right angles to all the others. These two are preset when aligning the synth, while the others are 'user adjustable'.

The next step is to adjust the input sensitivity, using RV1. This is facilitated by the inbuilt level checker. When the pad is hit hard, LED1 may flash. If it does, the sensitivity pot must be adjusted *down*. If it does not, then you should adjust the sensitivity *up* until it does, then back off just a little until the hardest strike barely misses overloading, as indicated by LED1.

It is possible, although the greatest care has been taken to give a wide range of tolerable inputs, that some pickups may either never deliver overload level or require RV1 to be set so low as to be inconvenient. In such cases, the input gain may be altered by varying R1. Increasing R1 will reduce sensitivity, while decreasing it will increase sensitivity. The value may be altered by a factor of ten at least, though no pickup I tried required any alteration.

Finally, the output pot may be set to deliver a comfortable level to the amplifier. The output impedance is less than 10k.

Adjustment of other pots comes under the heading of 'artistry', and so is not really

PARTS LIST — ETI-610

Resistors

R1	47k
R2	1M
R3	82R
R4	12k
R5, R6	3k3
R7, R8	10k
R9	1k5
R10	22k
R11	180R
R12, R13	82k
R14	1k8
R15	2k2
R16	56k
RV1	100k trim
RV2, RV6	500k trim*
RV3	220R trim
RV4, RV5, RV7, RV8	1M trim*
RV9	47k trim*
RV10	10k trim*

Capacitors

C1, C2	1µ/16 V electro
C3	33n
C4	10n
C5	4n7
C6	10µ/16 V electro
C7	4µ7/35 V tant
C8	20µ/35 VW electro

Semiconductors

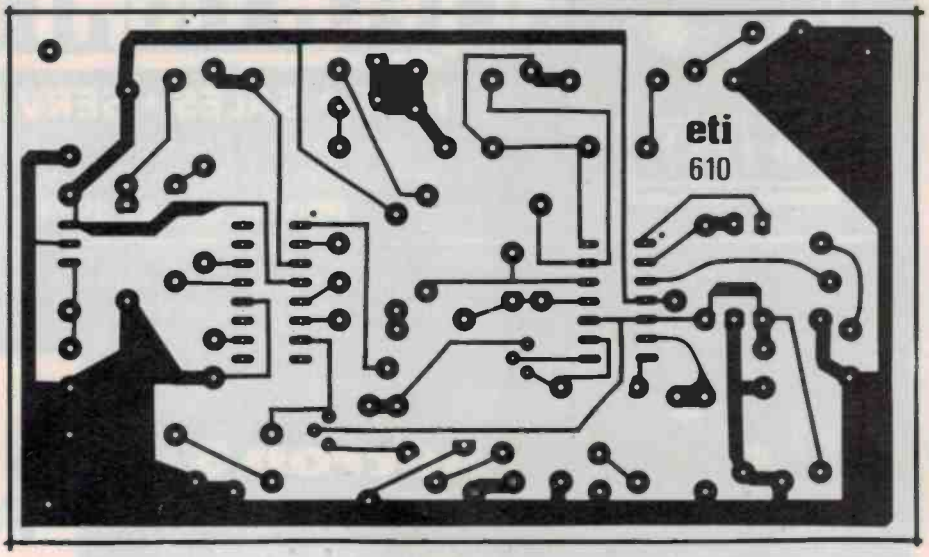
Q1, Q2	BC549, BC109
IC1	LM324 quad op-amp
IC2	XR2206, TSC2206
IC3	7815

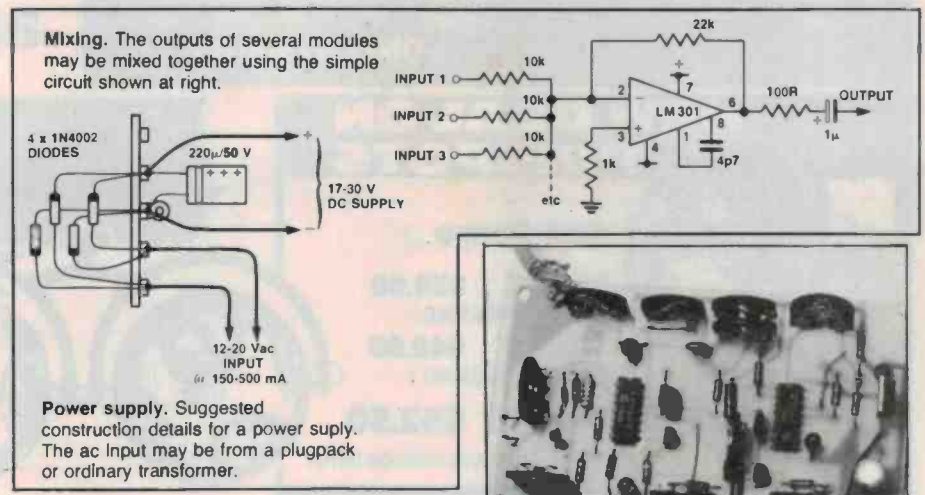
Miscellaneous

Practice pad (if necessary); ETI-610 pc board, hookup wire; standoffs; 1 x VPU-1 piezo vibration pickup (or equivalent); 50 mm loudspeaker; nuts and bolts; wood to suit, etc.

* These trimpots may be replaced by standard pots. RV7 and RV8 should be a dual-ganged type; RV10 should be a log (1c) type.

Price estimate: $18-$24





Completed module. Not much to it. The link visible near RV9 is replaced by a track on the pc board above.

the province of this magazine; nevertheless, you will find a description of the different pots' functions in the next section to help you on your way.

Using it

There are six variable functions. They are labelled Tuning, Sweep, Decay, Waveshape (a switch and a pot), Cutoff Frequency and Damping.

You will probably need little introduction to Tune and Decay. These occur on most drum synth units. *Tune* sets the fundamental frequency, and hence performs the commonsense function of tuning the drum sound, though with a much wider range than is possible with a normal drum. *Decay* sets the length that the 'drum' sounds for. A short decay gives a quick note, while a long decay gives a sustained sound. It is important to set 'tune' and 'decay' to the desired level first, before proceeding to set the other controls.

Sweep sets the degree of frequency shift in the note. This is hard to describe to anyone not familiar with drum synths already. Many drums exhibit a momentary tendency to deliver a sort-of 'gliding' sound (a 'boink', rather than a boom) just after being hit, especially when hit hard. For this reason we have the sweep function. It may be reduced to negligible proportions by the adjustment of the sweep pot to maximum resistance. It has no effect on soft notes, but comes into play on medium notes, and becomes more pronounced with hard hitting.

Waveshape is set by a pot and a switch or link. You could use a pot with an integral push-pull switch. When closed, the switch causes pure (sinusoidal) notes to be produced. When open, triangular, slightly more crisp sounding notes are produced. When the pot is set mid-scale, the notes acquire more harmonics the harder the pad's hit, because of progressive squaring of the waveform. This gives louder notes more treble, and allows the following filter to be put to good use.

When set to minimum resistance the waveshape pot keeps the notes pure for all input strengths. When set to maximum, continuous, 'hard', fuzzy sounds result. This control is set in conjunction with the filter controls, as they affect the harmonics introduced with non-pure waveshapes.

The filter has *cutoff frequency* and *damping* controls. When the damping pot is set for zero resistance, the filter acts just like a normal filter. The pair of pots RV7 and RV8 (which should always be set together, or comprise a jumped pot) define the cutoff frequency of this flat filter. It can be used to eliminate or limit the harmonics present in the signal, reducing high frequency components.

When the damping control is moved away from minimum resistance it introduces a response peak at the cutoff frequency. This has the effect of greatly amplifying harmonics at that frequency. The result is that the sound acquires a higher-pitched quality, almost metallic in some cases.

It is possible that the damping pot will take the filter all the way to oscillation, so be careful to adjust it with this in mind. Also note that the damping system will be of little use if the waveshape has no harmonics, so a pure tone will not permit it to do anything useful to the sound.

Happy drumming! ●

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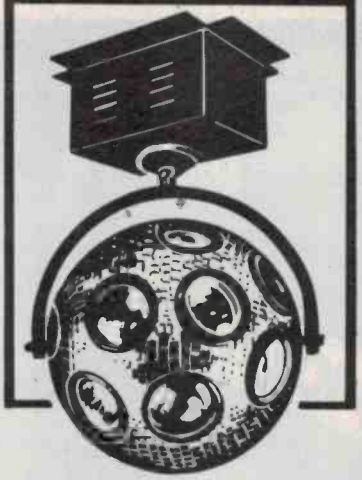

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Proportional ANALOGUE JOYSTICK for the ETI-660

Another peripheral for our learner's micro, the ETI-660. This article uses the ETI-674 joystick to add a new dimension to the computer.

Ian Bishop

ANY 660 owner that read the article in ETI, December 1983, on the proportional joystick for the Microbee will be happy to know that with a bit of programming it will work on the ETI-660.

In this article I will explain how to connect it and program it for the ETI-660.

Programming the joystick

This has to be done in machine code, in four separate routines. The first is at location 0700. This initialises the 6821 PIA for communication with the joystick. It sets up PB1-PB7 as outputs to the joystick and PB0 as an input.

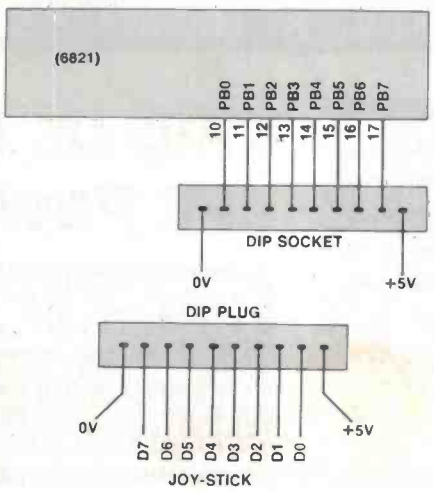
The second routine is at 0716. This is for the Y co-ordinate of the joystick. Upon returning from the subroutine the Y co-ordinate is at location 0402. An F065 instruction will get it out for you.

The third routine is at 0731. This is for the X co-ordinate of the joystick. Upon returning from this routine the co-ordinate is also stored at location 0402. Since the X co-ordinate must not overwrite the Y co-ordinate it is necessary to transfer the contents of 0402 to another location *before* running 0731. Use an F065 again and set another variable to the contents of 0402.

The last routine is at 074F. This is called by the other machine code routines. It simply masks out any rubbish.

Connecting the joystick

There is only one thing to remember here. The data connections from the joystick are connected to the PIA in reverse order. So D0 goes to PB7 and D7 goes to PB0. This is due to the fact that the data buss connections to the 6821 are reversed with respect to the 1802. A 16-pin dip socket can be fitted to the board just in front of the 6821 and a 16-pin dip plug can be fitted to the joystick, so that its not necessary to take up the user port. ●



Machine code routines

Initialise PIA.

```
0700  F804   Initialise X.
      BF
      F803
      AF
      EF
      F800   Access DDRB.
      5F
      62     Control reg B.
      2F
      2F
      F87F   Data direction reg B
      5F
      62     Set up port in/out.
      D4     Return to CHIP-8.
```

Y co-ordinate

```
0716  F82F   RE. 0=2F
      AE
      F804   Init X
      BF
      F802
      AF
      EF
      8E     RE. 0 — D
      5F
      62     Output data to port.
      1F
      1F
      1F
      6A     Get answer from joystick
      FA80
      322F   Joystick found branch.
      2E
      8E
      3A19   Joystick not found, try again.
      304F   Branch to mask out rubbish
```

X Co-ordinate

```
0731  F800   RE.0 = 00
      AE
      F804   Int X
      BF
      F802
      AF
      EF
      8E
      F940   Or 40 with count
      5F     This sets bit 6 of joystick
      62     Output data to joystick
      1F
      1F
      1F
      6A     Get answer from joysick
      FA80
      3A4F   Joystick found branch.
      1E
      8E
      FA3F   Mask out bit 6.
      AE
      3034   Joystick not found branch.
```

Noise rejection

```
074F  F804
      BF
      F802
      AF     RF = 0402.
      OF
      FA3F   Mask out rubbish.
      5F
      D4     Return to CHIP-8.
```

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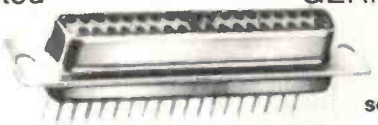

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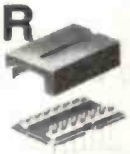
PIN HEADER



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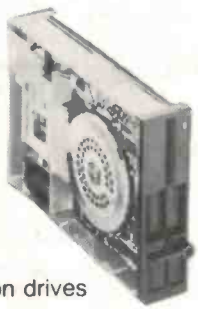

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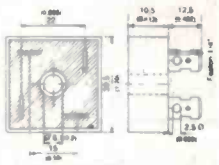

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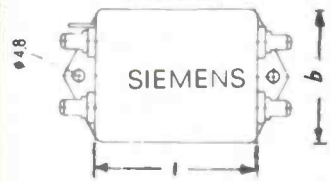

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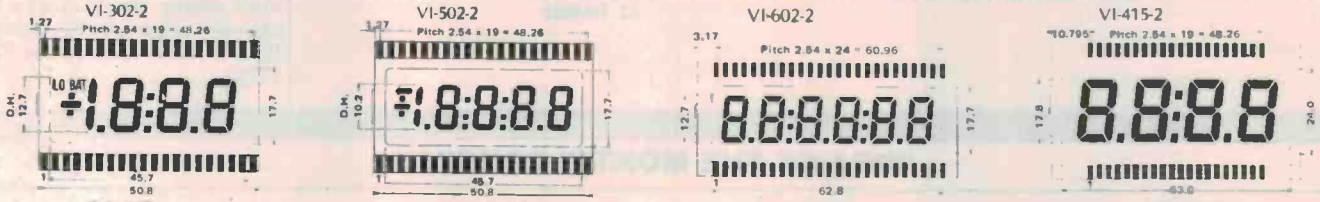

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IDEA OF THE MONTH

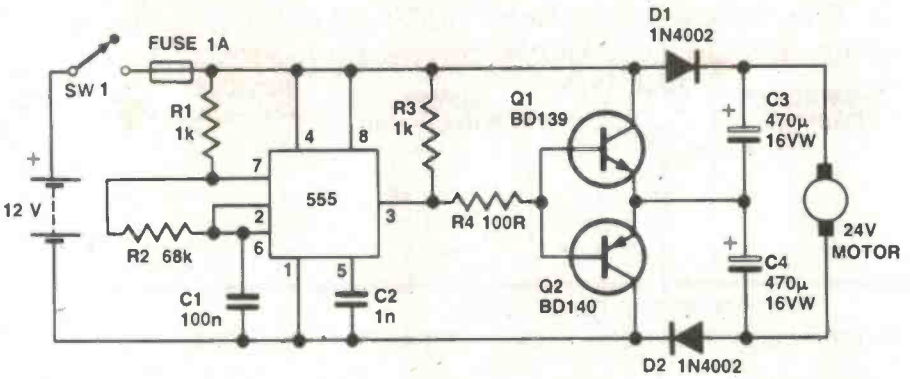
Transformerless voltage doubler

Michael Beaudoin, Hornsby NSW

This circuit shows a convenient method of supplying a 24 V motor from a 12 V battery.

The 555 timer operates in astable mode to produce a square wave at about 1 kHz. When pin 3 of the 555 goes high Q1 conducts and charges C4 to just under 12 V, whilst D1 prevents C3 from discharging. When pin 3 goes low Q2 conducts and similarly charges C3, while D2 prevents the discharge of C4.

The resultant voltage across C3 and C4 supplies the motor. Output is around 22 V with no load, dropping to about 20 V with a motor drawing its maximum of 200 mA. The transistors should be heat sinked.



ETI 265 Modification

The relay can be fitted into the existing holes if you drill out two new ones in the middle of the mains land. You will need to scrape away a portion of the land to insulate the new pins from the 240 V.

Then replace PB1 with a DPDT such as the DSE 1220. One pole can be left to perform its normal function. The other is wired across the extra pole on the relay. When the switch is depressed it applies power to the transformer primary and thus allows power up.

The ETI-265 power down mains appliance timer was designed to switch off equipment attached to it after a predetermined period. It uses a DSE 2851 transformer for its control circuitry. **T. Hollyhead of Liverpool NSW 2170** made a few tests on this transformer and discovered that even when the secondary is open circuited it still draws 10mA. Over a year this amounts to 20 KWhrs.

The solution is to disconnect the mains from the transformer itself during power down. This can be achieved by using a DPDT relay, such as the DSE 57130.

'IDEA OF THE MONTH' CONTEST

COUPON

Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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

PRIZE WORTH $123!

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month we will be giving away a pc board Work Centre consisting of the Model 315 adjustable pc board holder with capacity to accept 300 mm boards, Model 300 180° swivel and lock base which can be attached to the Model 312 tray base with wet sponge receptacle, Model 371 solder spool holder and Model STS 3 soldering iron safety stand. Please note prize does not include solder or scope TC60 temperature controlled iron shown above. The prize is worth $123!

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

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

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

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

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

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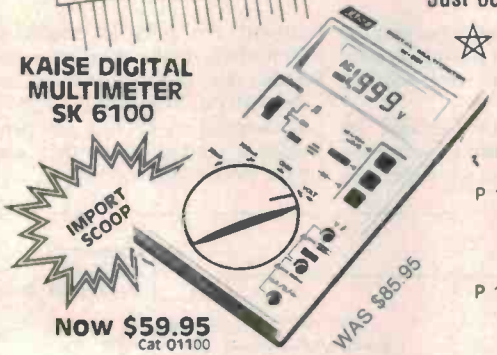

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IDEAS FOR EXPERIMENTERS

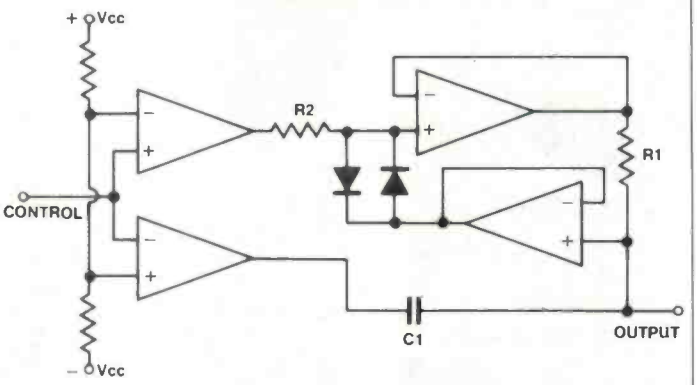
Ramp generator

R. E. Morton of **Carlton NSW** sent us this idea for a ramp generator.

A low voltage level on the control input causes the output to ramp down to −Vcc, while a high input causes the positive equivalent. Feeding in a square wave, of course, will yield a triangular output.

Mr Morton claims the particular advantage of his circuit is that long time constants can be used, with the linear section of the ramp extending over almost the entire voltage range.

This happens because there is a constant current flowing out of, or into, C1. This current is constant because the voltage potential across R1 is maintained by the voltage drop across the diodes.

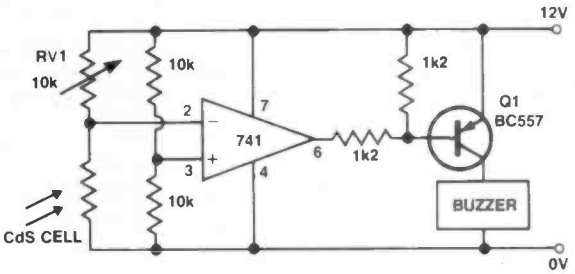


Fridge Watcher

Ron Klein of **Walgett NSW** sent us this article. It's a cunning adaptation of a standard op-amp circuit, and is used to monitor the operation of a kerosine refrigerator.

The core of the circuit is a Cadmium Sulphide cell which has a sharply defined sensitivity to radiation of about 5700 Angstroms i.e: yellow light.

The CdS cell is aimed at the kerosine flame of the 'fridge, via a suitable piece of tubing. When the 'fridge is operating normally, this flame will have a strong yellow colour. However, if it either flares up, or drops low, the colour changes, and with it the resistance of the CdS cell. This change of resistance is detected by the op-amp, and the buzzer triggered via the BC557.



Circuit construction method

Here is an interesting method of building experimental and prototype circuits from **J. Drinda** of **Villawood, NSW**. It's quick, cheap and easy to troubleshoot.

Select a firm piece of cardboard or plastic, and glue all the components you require to it, with their connectors sticking up in the air. Then use thin wire to connect the various pins as required. The wire must be insulated, thin and flexible, and ideally, you should be able to solder it without having to strip it (ie, "Leumex" coil winding wire).

The connections should be made by a mixture of wrapping and soldering, i.e: wrap the wire around the pins as required, then when you have finished one node, go around and solder them all on. This ensures a good mechanical connection and provides a second check that you have everything correct.

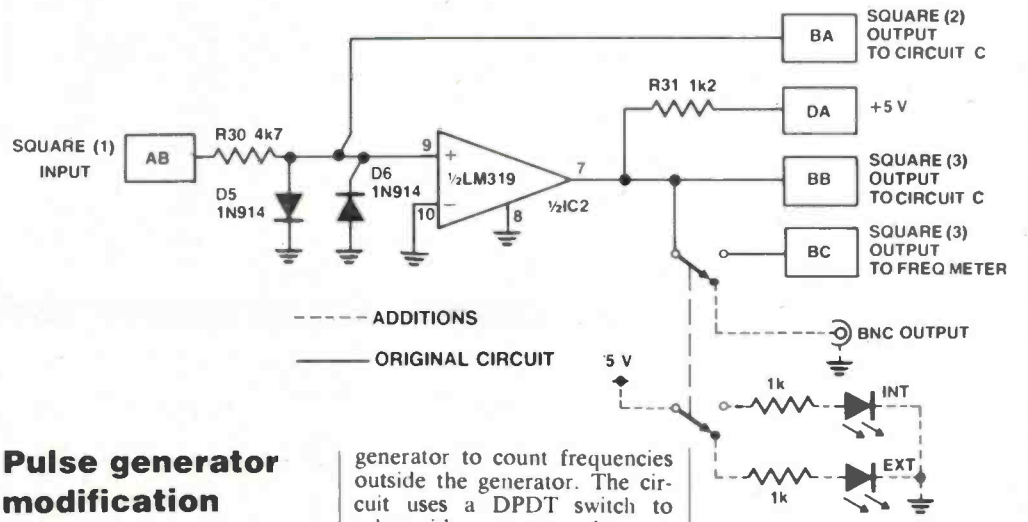
Cassette tips

Eric Eulenstein of **Albury NSW** sent us some ideas on using cassettes.

The worst thing about using cassettes as a storage medium is that they take such an enormous amount of time to load and save. There are a number of techniques you can use to make things go a little faster though.

When loading a program from the cassette start, there is about ten seconds of dead time as the tape spools through the leader. Most of this wasted time can be eliminated by the physical removal of the leader. Of course, this can only be done with cassettes that have been assembled with screws.

Another technique that is very useful is to press RETURN before operating the RECORD key on the recorder. Remember there is a few seconds pause between the time the return key is operated and the time when the program issues forth.



Pulse generator modification

Arthur Barrett of **Cartwright NSW** suggested this handy addendum to our ETI-166 function/pulse generator project.

His circuit allows the frequency counter in the pulse generator to count frequencies outside the generator. The circuit uses a DPDT switch to select either an external source or the on-board frequency as the input.

The BNC output and the select switch can be mounted on the side of the cabinet. If you wish, the other side of the DPDT can be used to select between two LEDs to indicate the position of the switch.

This simple circuit should save you approximately $70 on the price of a good frequency meter.

SWIVEL BASE MONITORS FROM $189 THIS MONTH

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SPECIFICATIONS — CRT SIZE: 12 inches non-glare 90 degree deflection. **INPUT SIGNAL:** 1.0-2.5V p-p composite video signal. **INPUT IMPEDANCE:** Normal 75ohm, high approx 50K ohm. **INPUT TERMINALS:** RCA phone jack. **RISE TIME AND FALL TIME:** Less than 25 us. **VIDEO BANDWIDTH:** 20 MHz ± 3dB. **SCANNING FREQUENCY:** Horizontal, 15.75KHz ±0.5KHz; Vertical, 50Hz-60Hz; Horizontal Retrace Time, Approx 8.5us; Vertical Retrace Time, Approx 800us. **PHOSPHORS AVAILABLE:** Amber, Green. **RESOLUTION:** Centre, 1000 Lines; Corner, 800 Lines; Geometric distortion, 2% or less; Linearity, less than 2%. **CONTROLS:** Front, POWER ON/OFF, brightness contrast; Rear, V-Hold, H-Hold, V-Line, V-Size.

AVAILABILITY: Green Phosphor $189
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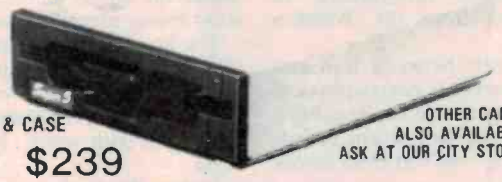

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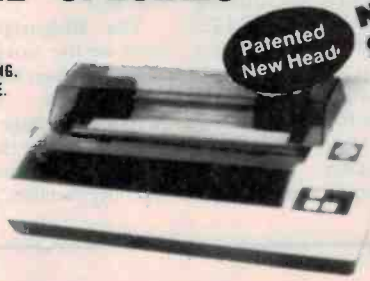

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CP-80/I, 80-COLUMN IMPACT PRINTER

SPECIFICATIONS
Functional Specifications
Printing method — Serial impact dot matrix. Printing format — Alpha-numeric — 7 x 8 in 8 x 9 dot matrix field. Semi-graphic (character graphic) — 7 x 8 dot matrix. Bit image graphic — Vertical 8 dots parallel horizontal 640 dots serial line.
Character size — 2.1mm (0.083")-W x 2.4mm (0.09")-H 7 x 8 dot matrix.
Character set — 228 ASCII characters. Normal and italic alpha-numeric fonts, symbols and semi-graphics.
Printing speed — 80 CPS 640 dots/lines per second.
Line feed time — approximately 200 msec at 4.23mm (1/6") line feed.
Printing direction — Normal — Bidirectional logic seeking. Superscript and bit image graphics — Unidirectional left to right.
Dot graphic intensity — Normal — 640 dots 190.5mm (7.5") line horizontal. Compressed characters — 1,280 dots 190.5mm (7.5in) line horizontal. Line spacing — Normal — 4.23mm (1/6"). Programmable in increments of 0.35mm (1/72") and 0.118mm (1/216").
Columns/line — Normal size — 80 columns. Double width — 40 columns. Compressed print — 142 columns. Compressed double width — 71 columns. The above can be mixed in a line.
Paper feed — Adjustable sprocket feed and friction feed.
Paper type — Fanfold Single sheet. Thickness — 0.05mm (0.002") to 0.25mm (0.01"). Paper width — 101.6mm (4") to 254mm (10").
Number of copies — Original plus 3 copies by normal thickness paper.
Mechanical Specifications
Ribbon — Cartridge ribbon (exclusive use), black.
MTBF — 5 million lines (excluding print head life)
Print head life — Approximately 30 million characters (replaceable).
Dimensions — 377mm (14.8")—W x 295mm (11.6")-D 125mm (4.9")-H incl sprocket cover.

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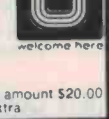


SW jamming increases

Jamming of shortwave broadcasts originated in the late 1930s and today it is switched on and off as political tensions increase or decrease in the trouble spots of the world.

Since World War II, jamming has increased, and in recent months the crises in Poland and Afghanistan have been reasons for renewed interference to broadcasts from the Western World.

The battle between Iran and Iraq has not only been a physical one, but jamming has also been used by Iraq to prevent broadcasts being received from across the border.

The jammer not only hinders reception of the broadcast at which it is directed, but ruins worldwide reception of stations operating on nearby frequencies which have no part of any controversy.

In New Zealand recently I have observed jamming on the mediumwave band for the first time for many years. The frequency of 1350 kHz has suffered so severely that reception of 1ZC Rotorua at 1800 UTC has not been possible at my location.

It is suspected that the jamming originates from Iraq and it is beamed at a station in Iran on the same frequency.

A comparison to a shortwave jammer heard at the same time and blocking the new Iran station on 4990 kHz shows a similar pattern of interference, and unlike the Soviet jammers there is no morse identification.

The Soviet Union is intensifying its extensive jamming according to a recent American report, in a propaganda war waged not with words, but with noise.

Today, the Soviets are blocking American, British, West German, Chinese, South Korean and Israeli broadcasts.

The United Stated is the main target of jammers in the Soviet Union and Eastern Europe: 14 of the 16 languages broadcast by Radio Free Europe and Radio Liberty are blocked, 12 of the Voice of America's 21 foreign language broadcasts are blocked.

The Bulgarians are second only to the Soviets as a major jammer, even blotting out Vatican Radio. The jamming, involving huge transmitting stations across the Soviet Union and smaller transmitters ringing the larger cities, is costing the Soviets an estimated $200M a year.

This battle for the Soviet ear is causing havoc in the airwaves. Many broadcasters around the world are finding it difficult to use clear radio channels because of the spillover of Soviet jamming noise to other frequencies.

Moscow residents continually outwit the ring of about 50 jamming stations around the city.

Many people take their radios to the outskirts of the city, where the jamming is less intense, and those who have country homes have almost no difficulty in getting clear reception.

Some Moscow residents tell of 'pockets' in the city where a tall building, for example, will act as a shield against the jamming.

Some Russians find profits in jamming by modifying radio sets so that they can receive shortwave frequencies not normally found on Russian-made receivers. There is also a thriving black market in tapes of shortwave broadcasts.

My own monitoring of the various bands, which is conducted for Radio Canada International, agrees with the worldwide opinion that shortwave broadcasting is suffering a deterrent in growth and acceptability by listeners, because of this deliberate interference spoiling enjoyable listening.

In a monitoring survey of the 31 metre band, of the 55 channels available between 9500 and 9775 kHz, 106 stations were heard. Sixteen channels were heavily jammed, and 14 suffered rather severe side splatter, which meant that nearly 60% of the band was subject to deliberate interference during the period 0200-0430 UTC.

This particular time period is one in which the major European broadcasters have transmissions in Russian, and these originate from the BBC, Radio Canada and Deutsche Welle.

At the same time, all other bands surveyed have varying degrees of jamming, but the 19, 25 and 31 metre bands show the greatest impact.

— **Arthur Cushen**

Antenna matcher for SWL's

Most SWL's have a common problem with antennas which restricts the performance of their often very expensive communications receivers. Due to the limitations of space an SWL antenna usually consists of a random length of wire strung up where it best fits. Because such an antenna is not resonant its match to the receiver is poor and its performance even poorer.

GFS Electronic Imports are marketing an Antenna Tuner/Pre-amplifier designed specially for SWL applications, the MFJ-959. It is designed to match a random wire or coax fed antenna down to 50 ohms and then introduce gain, thus overcoming the loss presented by a non-resonant antenna.

The built in tuner uses a low noise high gain transistor to provide a maximum of 20 dB gain which may be varied by the user. Switching is provided for selection of two antennas as well as two receivers. Additionally switching is included to allow complete bypassing of the MFJ-959, attenuation with the tuner, tuner only and tuner with amplifier.

In tests recently made on the MFJ-959 using a random wire, as much as 8 S-points increase in signal strength was achieved when compared with the wire on its own. The MFJ-959 requires a power source of nine to 18 volts and sells for $205 plus $12 P&P.

For further information contact the Australian distributors: **GFS Electronic Imports, P.O. Box 97, Mitcham Vic. 3132. (03)873-3777.**

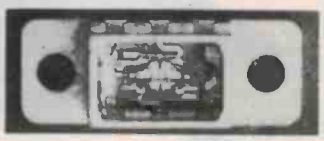
MFJ-959 antenna matcher and preamp, manufactured by MFJ Enterprises of the US.

Wideband FET amp

Electronic Development Sales has just announced a transistor-sized power amp with a bandwidth stretching from 8 to 18 GHz.

The amp, designed by Fujitsu of Japan, is designed to be cascaded without the use of any external circuitry.

Despite its small size, gain is quoted at 15 dBm and the manufacturers claim this is constant over the whole bandwidth to better than 0.5 dB.



Circuit construction includes a sapphire substrate, metal-oxide-metal capacitors, spiral inductors and thin film resistors.

More information can be had from **EDS, 92 Chandos St, St Leonards, NSW 2065.**

More for mobile radio

At the end of this year the mobile radio industry in Britain will get two large chunks of the radio spectrum currently being wasted on 405-line TV.

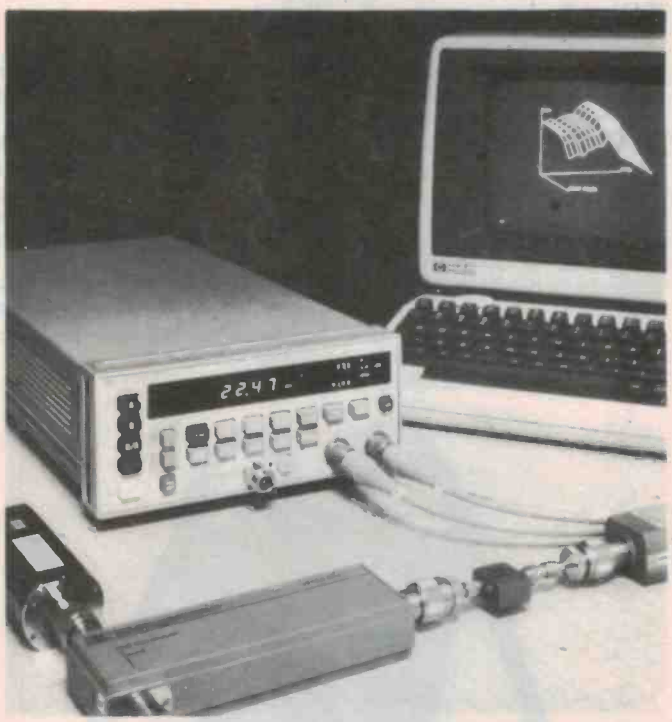
The government plans to use the freed wavelengths, Band I (41-68 MHz) and Band III (174-225 MHz), to generate competition and create jobs. But it recognises that the wavelength release is a once in a lifetime chance which could easily turn sour if the wrong technical moves are made.

The main headache is how best to allocate the frequencies. Although there now seems to be plenty of bandwidth available in Britain, this is not so. Band III is still used for TV broadcasting in France and Ireland. There will be mutual interference unless the new British users slot their transmissions into carefully chosen parts of the band, where there is the least audio and video energy from TV signals.

Thge DTI's engineers admit that they do not yet know how many channels will be usable for mobile radio. Some frequencies may be suitable only for low-power gadgets like radio microphones, burglar alarms and remote controls.

But even this will not be enough when firms learn how much time, effort and fuel they can save by keeping in touch with employees out on the road. So the DTI wants to adopt a trunking system which relies on a pool of frequencies shared by a pool of users.

There must also be room left in the spectrum for new technology, such as digital coding and single sideband modulation, which takes up less bandwidth.



The new HP438A dual power meter in operation.

Power meter

Combining two power sensors with the new HP 438A microprocessor-based power meter provides more than just two channels of RF and microwave power measurement. The user can compute the ratios A/B or B/A to display gain, gain compression or attenuation in dB or percent.

With a dual coupler the HP 438A will indicate return loss in dB or power-reflection coefficient in percent.

It uses any pair of HP's family of nine HP 8480 power sensors, which range from 100 kHz to 26.5 GHz and from −70 to +44 dBm. To calibrate these thermocouple and diode sensors, the one milliwatt, 50 MHz reference oscillator port on the front panel supplies 1.2% accuracy. Instrument accuracy itself is typically +/−0.02 dB.

The internal microprocessor simplifies operation and programming so complex measurements can be made with only one or two programming codes.

The dual-channel capability makes possible a high dynamic range with a novel setup. One Model 8484A (−70 to −20 dBm) sensor and one Model 8481A (−30 to +20 dBm) connected to a broadband power splitter yield a total dynamic range of greater than 80 dB of true square-law response.

For more information contact **H-P Australia, 31-41 Joseph Street, Blackburn Vic 3130. (03)895-2895.**

COMPACT KLYSTRON

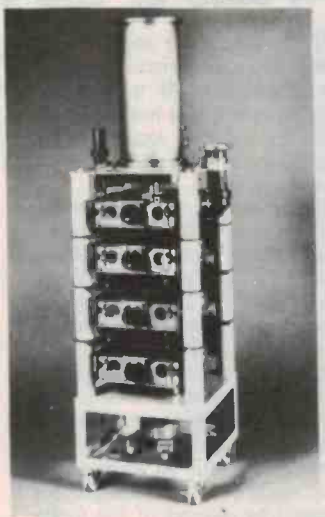
The Philips YK1263 is a compact, highly efficient 58 kW UHF klystron that covers the complete 470-860 MHz frequency range for which three conventional tubes were needed.

The compact design of the tube and its accessories means that the complete assembly occupies an area of only 550 x 550 mm (instead of the 800 x 800 mm of a single conventional tube). The air-cooled body design allows quick, easy installation and maintenance.

The YK1263 has a gain of 40 dB and is part of a new range of energy-saving klystrons with Annular Beam Control. In these tubes, a non-intercepting electrode is used to control the beam current. This ensures an adequate (but never excessive) current over the complete modulation range. ABC klystrons can operate at efficiencies of up to 65%, depending on the modulation circuits.

The YK1263 has four external cavities, electromagnetic focusing and a high stability dispenser-type cathode. Beam data range from 23 kV/6 A for the lowest channel to 26 kV/4.85 A for the highest channel.

For further information contact **Philips, 67 Mars Rd, Lane Cove NSW. (02)427-0888.**



The YK1263. A new compact 58 kW klystron from Philips that covers the 470-860 MHz range.

High power balun

GFS Electronic Imports has released a new high power balun which is manufactured in Japan by Diamond Antenna Company.

The balun, known as the DP-BU5, is a 1:1 type and covers a frequency range 2-40 MHz at an impedance of 50 ohms. It is designed to handle 1.5 kW PEP over its entire operating range.

The DP-BU5 is housed in a high impact resistant plastic moulding which is designed to be either mounted on the boom of an HF beam or used as the centre insulator of a dipole. Connections to the antenna are made through two flying leads while a SO-239 socket is mounted on the bottom of the balun for coupling to the coax feeder cable.

For further information contact **GFS Electronic Imports, 17 McKeon Rd, Mitcham 3132 Vic. (03)873-3777.**

DP-BU5; A new balun for antenna installation. Made by Diamond Antenna of Japan and distributed here by GFS.

MFJ-1224: RTTY/CW computer interface.

RTTY interface

MFJ Enterprises of Mississippi USA recently released a new RTTY/CW computer interface, the MFJ-1224. It is designed to interface to a wide range of personal computers including the VIC-20, Apple, TRS-80C, Atari, TI-99 and Commodore 64.

The MFJ1224 is suitable for operation over a wide range of shifts including 850 Hz, 425 Hz, 170 Hz as well as all shifts between and beyond. A sharp 8-pole active filter is included for 170 Hz shift and CW. It will also operate 5 to 100 WPM on RTTY/CW and up to 300 baud on ASCII. A convenient normal/reverse switch eliminates retuning when stepping through various shifts and a built in automatic noise limiter helps improve copy under noisy conditions.

Tuning is made relatively easy by a two LED tuning indicator which provides for fast positive tuning. RTTY signals are copied on both the Mark and Space tones, not mark only or space only. If either the mark or space are lost the MFJ-1224 maintains copy on the remaining tone.

A range of transmitter keying outputs are provided including AFSK, FSK with PTT. High voltage grid block and direct keying are also included for CW. There is also an external hand key or electronic keyer input socket for convenience.

Price of this MFJ-1224 is $240 plus $12 P&P.

For further information contact the distributors, **GFS Electronic Imports, 17 McKeon Road, Mitcham Vic. 3132.**

New aerials for 'Voice of the Andes'

HCJB, Quito, Ecuador, should be received with a much stronger signal on 6130 kHz from November, when a new aerial system is put into operation. The new antenna will be bi-directional or switchable, meaning that it has the capacity to beam programmes to Europe and the South Pacific separately or simultaneously. It will also operate at 500 kW, a first for HCJB on this frequency.

The transmitters of the Voice of the Andes are not assigned to only one antenna each. A switching system is employed to direct a particular transmitter to a given antenna. In the next few months five new switching units will be added to the existing semi-automatic switching system for HCJB's 500 kW transmitter. This will be a geat improvement over the existing control which has been in operation for the past three years.

The eventual 500 kW switching system will take several years to complete. The switcher control will also be updated, converting it to a fully automatic computerized system. Should a particular switch fail, the signal will be re-routed immediately, so that little or no airtime is lost. Better still, there will be no need, as with the existing system, to call out an engineer in the middle of the night for manual by-passing of the faulty switch. He will be able to get his 'beauty sleep' and correct the fault the next day. Eventually, the new system will contain as many as 30 switches controlling up to six transmitters and as many as ten antennas.

Radio HCJB has been receiving an increase in mail in the past year which could be attributed to the higher power of 500 kW and the better reception which listeners are enjoying from the broadcast from this South American Gospel station.

Last year HCJB received a total of 75,204 letters from 126 different countries. The language services receiving the highest number of listeners' letters were Spanish (21,558), English (12,855), and German (10,108), followed by the Nordic (8,746), Portuguese (7,681), and Japanese (5,575) language services.

HCJB broadcasts to the South Pacific daily, from 0700 to 1030 UTC using three frequencies, 6130, 9745 and 11925 kHz with the first frequency giving the best reception. The transmission on Monday and Saturday 0930-1000 UTC includes 'DX Party Line' which is compered by John Beck and includes reports from listeners on what has been heard on the shortwave bands and is the programme of HCJB's own Club 'Andex'.

— **Arthur Cushen**

RADIOTELETYPE:

The VK7TM shack.

Radioteletype, or RTTY to the cogniscenti (Italian for smart-aleck), is a popular mode of transmission amongst government agencies, companies, news services and radio amateurs, to name a few. Thinking about dabbling your digits in this delightful digital discipline? Start here!

Tom Moffat VK7TM
39 Pillinger Drive, Fern Tree 7101 Tas.

INVENTION OF THE TELETYPE

Frederick George Creed (1871-1957), a native of Nova Scotia, is credited with being the pioneer of the teleprinter. He adapted the machine from a Barlock typewriter, producing his first prototype in a shed he rented for 5s in Glasgow in 1897. He retained this as a mascot for the rest of his life.

Creed's first instruments actually put Morse Code on a punched paper tape but this new technology was not accepted as it was much quicker than existing Morse-encoding machines and threatened to replace the many trained operators of the day.

One Charles Krumm produced a teletype machine in 1907, but it was the UK Morkrum Company who successfully developed one independently and introduced it in the early 1920s. The German Siemens-Halske company also developed a machine at this time.

These machines employed a then-new encoding system developed by Jeran Maurice Baudot and Donald Murray (a New Zealand farmer). The Baudot code, as it is now known, is a five-unit code and requires synchronous transmission and reception.

Creed was a strongly religious man and resigned the chairmanship of his own company in 1930 at the age of 59 because his employees insisted on playing sport on the Sabbath. He continued his interest in inventions, however. A more colourful one being his permanent hair dye, only ever applied once, on his own beard, which turned an indelible rainbow pattern!

WELCOME to the fascinating world of Radioteletype! Today you may be a casual reader, but tomorrow, you could be well and truly hooked. RTTY is a blend of all the best in electronics . . . communications, computers, digital techniques, with some history and some good old mechanical fiddling thrown in.

Everything seems to be going digital these days . . . recorded music (as compact disc), television and video, and even the lowly typewriter (as the word processor). There's a definite advantage in this trend, as digital signals are easier to capture, easier to store and easier to reproduce than their analogue counterparts. And, with the advent of microprocessor technology, you get much more peformance for your digital dollar than you ever did with analogue.

Teletype could almost claim to have started the digital trend, had it not been for Morse code. A century ago somebody figured out that you could transmit data along electrical wires by tapping two contacts together, and binary communication was born. Electrical voice communication soon followed, to eventually evolve into that noxious curse upon mankind, the telephone. One reason we now take holidays is to escape the far-reaching tentacles of the telephone.

Voice communication was, and still is, sometimes plagued with difficult reception, as evidenced by occasional bellows of "WHAT'D YA SAY?? REPEAT IT AGAIN!". Communications experts, especially among the military, eventually discovered that digital (binary, on/off) communication was inherently more reliable for a given amount of power pumped down the line. First there was further improvement on the Morse system; then the development of a machine that could open and close the electrical contacts in a pre-arranged fashion. Voila — teletype!

Teletype transmission

It's really quite easy to understand how teletype transmission works. It's just a stripped-down version of the "serial data transmission" used by personal computers to communicate among themselves and with mainframes. The computer version usually takes place at 300 to 9600 bauds, or so (bits-per-second). The bits that represent a data byte or a character are sent one at a time.

It's finger-flickin' good

First there's a start bit, to tell the receiving end that something is coming. Then come eight data bits (usually), and last but not least, a stop bit which is really just a pause in transmission to ensure that the receiving end has finished receiving. The stop pulse can be one or two bit times long, which means that the whole byte or character occupies 10 or 11 bit times, representing around 110 characters a second at 1200 bauds.

As for teletype, at least that using the standard "Baudot" code, there are five data bits instead of eight, and the stop pulse lasts one-and-a-half bit times. The baud rate can be anything from 45 on up; 50 bauds is very common.

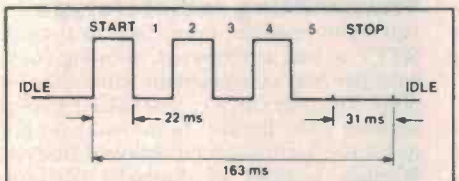


Figure 1. How the teletype signal is made up. For 45.45 baud speed standard, the first five pulses are 22 ms long, followed by a 31 ms 'stop' pulse giving 163 ms per character, while a 50 baud system uses 20 ms pulses with a 30 ms 'stop' pulse, giving 130 ms per character.

Transmission of teletype by radio instead of wires was the next major development step, and radioteletype as we know it was born. Further development that continues to this day has brought forth such goodies as higher and higher transmission speeds, and even error correction systems that produce "what'd ya say — repeat it again" automatically if needed.

Getting into the act

Radio amateurs and enthusiasts go into the act when some of the earlier teletype machines were declared "surplus to requiremenets". Not that they were worn out (they never seem to wear out), they were just made obsolete by newer models. The original fate of such surplus machines was the axe, literally. I will always remember, when I worked for an American telephone company, the time I was told to "dispose" of eight teletype machines. I was handed a large axe, and despite my howls of protest I was forced to smash each one. It was like smashing in the heads of small children.

Nowadays, following submissions by amateur radio groups, owners of teletype machines dispose of them in a more humane way. They are sold to experimenters for small sums, on the understanding that they will never again be placed into commercial service. this system now exists all over the world, and Telecom has certainly played its part, releasing machines of beautiful quality to Australian experimenters for prices as low as $30.

Machinery

One of the first, and possibly best machines, was the Model 15, made by the original Teletype Corporation of the USA. These weighed in at about 130 pounds (they didn't have kilograms back then) and were made entirely of diecast and machined parts. They would have cost the price of a good car when new. They shook the whole table when they were running, they made a terrible noise, and they smelled of oil, ozone, paper, and printer's ink. And they were *lovely*.

A more recent Telecom release has been the Siemens Model 100. If the Model 15 was the *Cadillac*, the Model 100 is the *Mercedes*. Again, made of diecast and machined parts, but more tightly engineered. You can even pick one up without giving yourself a hernia, and when typing it goes tap-tap-tap. (The Model 15 goes **band-bang-bang!**)

Although the Model 100 is officially "kaput" in the eyes of Telecom, the machines are still being used in commercial service. I saw them at both Casey and Mawson stations in the Antarctic, lined up in rows happily tapping away. And their operators had nothing but praise for their reliability.

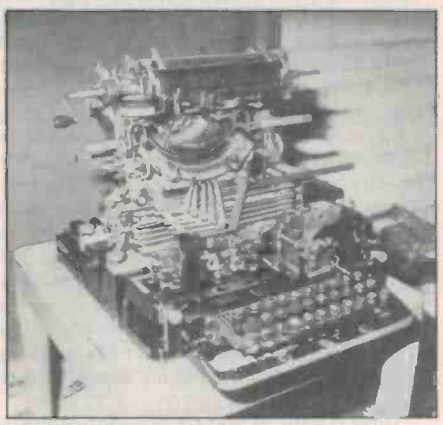
Modern times

Waiting in the wings at Telecom is another Siemens machine, bigger than the Model 100 and blue in colour. These don't seem to be quite as nice as the earlier models somehow, they've got a "modern" four-row keyboard that's harder to type on than the earlier three-row keyboard. But they're certain to be accepted with glee by enthusiasts when they're released.

The latest Telecom machine is the French-designed Sagem. This little beauty has a dot-matrix print mechanism controlled by a 6800 microprocessor. Within its EPROMs are at least two character sets, upright and italic, and it should be possible to provide other fonts with other EPROMS (French letters . . .?) The Sagems are terribly current at the moment but one day they MUST come out as surplus . . . please, Telecom?

The Sagem machine, then, isn't a

The Model 15. The popular workhorse, to date.



Lovely! Inside the Model 15.

Seimens Model 100. A Mercedes to the Model 15's Cadillac. ▶

machine any more. It's a computer, with a keyboard, and a built-in printer instead of a video screen. It's really a hard copy computer terminal that's been programmed to look like a Telex machine. It's doing something that experimenters have been doing for some time: programming their home computers to look like Telex machines.

Computer teletype

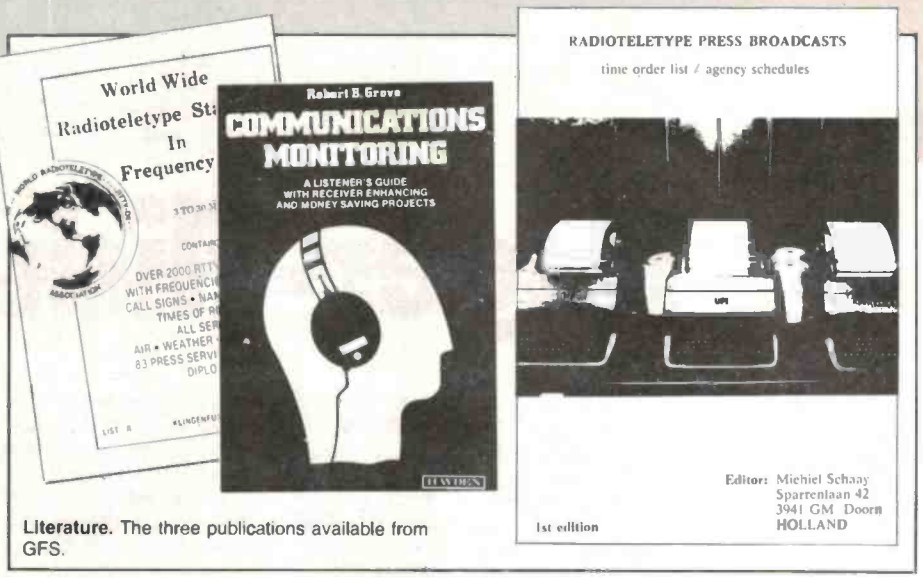
Electronics Today's first venture into computer teletype was the ETI-733 project, published in April last year. It marries a Microbee computer with a simple phase-locked loop AFSK decoder to provide a most addictive eavesdropping facility.

The '733 can tap into radio channels carrying news and propaganda broadcasts from many countries. It can also print upon the Microbee's screen, material from other radio channels that the sender would prefer you didn't see! Radioteletype is sometimes used in preference to voice to provide a measure of security, but with home computers so popular, nothing is really secure any more.

Literature

There are even books published especially for the RTTY addict that take the chance out of the chase and make "pay dirt" much more likely during a given listening session. One book, called "World Wide Radioteletype Stations in Frequency Order" is simply a series of lists that have taken someone an awful lot of time and trouble to put together. The book takes its title from the first list: page after page of entries that look like a shortwave monitor's log. A frequency is given (between 3 and 30 MHz), then a callsign, the location of the observed station, and then abbreviated information about the type of traffic carried and the time observed. This comprehensive list takes up 43 pages of the book, and it's in pretty small print.

Next is a list of marine services, followed by press transmissions, listed by country. Another list arranges the press stations in order of the time observed. The idea is that you note the time you are listening, and then look up the callsigns, locations, and frequencies of press stations you are likely to copy at that time. Finally comes a list of meteorological stations. These aren't too interesting to the casual observer because most of the information is transmitted as five-figure code groups. There's nothing secret, it's just done to save time.



Literature. The three publications available from GFS.

A second book for the RTTY addict is "Radioteletype Press Broadcasts". As its name implies it is aimed at the budding spy who wants to concentrate on press and propaganda transmissions. Press material is particularly interesting, especially when there's a big stoush like the Falklands war going on. Each country's press transmission seems to have its own version of the "truth".

"RTTY Press Broadcasts" includes profiles of the various press agencies, giving a rundown on how they're organized, an example of their logo (good for identification if you're lucky enough to find one of them on facsimile), and sometimes a picture of the agency's "newsroom". Unfortunately some of the station profiles are coloured by the political beliefs of the book's author. But this is of little consequence; you can intercept the stations yourself and make up your own mind.

Both the above books would be good companions for someone who likes to snoop on RTTY. A third book called "Communications Monitoring" is a general guide for people who want to listen in on point-to-point communications, as opposed to shortwave broadcast DXing. Most of it covers VHF transmissions in America, although the book ventures into projects like a VLF converter and a shortwave receiver soup-up job. Unfortunately most of the gear mentioned is American, not available in Australia, so the book is of dubious value here. Just keep reading ETI and you'll learn as much, anyhow.

All three of the books are available by post from GFS Electronic Imports of Mitcham, Victoria.

Transmitting radioteletype

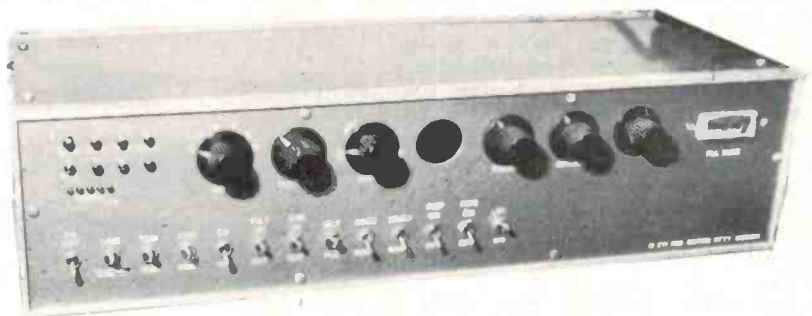
It is quite possible, even easy, to transmit RTTY as well as receive it, allowing you to have two-way conversations with other stations. The only catch is, you MUST hold an amateur radio licence. Information on how to get the licence can be obtained from the Wireless Institute of Australia (divisions operate in each state capital), or from the Department of Communications in your state.

The beauty of RTTY amateur radio communication is that you can chat back and forth over vast distances using very little power (the same applies to Morse code, or CW). This means two things: you can build your own transmitter quite easily, and you save big bucks. The trend in voice communication nowadays is to use the highest power allowed, with big linear amplifiers driven by commercially made transceivers costing well over $1000. If you don't have that sort of gear it's sometimes hard to compete on the crowded bands.

My own RTTY station uses a valve transceiver made back in 1964 (horrors!) running a gigantic 30 watts to a somewhat modest aerial system. This system conducts regular Teletype communication with just about anywhere in the world, and its seems that many of the stations contacted use similar power levels.

As to the RTTY gear at VK7TM, there are now two choices: a Siemens Model 100 connected to an ETI-730 system from 1979, and a Microbee computer working with an ETI-755 RTTY transceiver. Haven't heard of that one? Just wait until next month, when all will be revealed. In the meantime, read and digest the information presented in this special RTTY issue of Electronics Today. It may open up a whole new world of interest for you and your computer. ▶

The analogue modem. My 'old' ETI-730/731 analogue RTTY system.



△ **VZ200 RTTY transceiver project.** Next month we have not one but *two* RTTY projects for you. Apart from the ETI-755 Microbee RTTY transceiver mentioned elsewhere, we have one for the VZ200, dubbed the ETI-756, naturally! It features split-screen display with the received text at the bottom and your reply text at the top plus a 'command' line indicating system status at the top of screen. The project is relatively simple to assemble and set up. It is constructed on two boards which fit neatly inside a VZ200 cartridge case which plugs into the computer's memory expansion connector. All the necessary software comes in EPROM.

Project 755 on the air! This shows a contact in progress on the 14 MHz band between VK7TM and W0IUL in Topeka, Kansas USA. The latter was running 30 watts, while my old rig runs 15 watts! Note that the path length is 14 829 km, giving a km/watt rating of 494 for the W0 station and 988 for me. It shows what RTTY can do when you've got good gear like the ETI-755 (brag, brag . . .). Errors during the transmit period are a result of RF getting into the tape recorder. ▽

```
   FB OM ES URPSIGS OUT OF THE
NOISE AT THIS TIME ....UR 569 M569 IN TOPEKA, KS  .... NAME IS DICK
BICK ...#2 ,2 =(7TM DE W9XXXXW0IUL KKKMT SHQU
W0IUL DE VK7TM OK DICK MY NAME IS TOM  ND THE QTH IS HOBART, TAS
HOBART, TASMANIA... I AM TRYIN OUT A NEW RTTY SSTEM... ILL
GIVE YOU HE BRAG TAPE NOW WHIKE WHILE YOU CAN COPY...

THIS IS THE PROTOTYPE OF THE ETI-755 RADIOTELETYPE TRANSCEIVER
SOON TO BE PUBLISHED IN E.T.I. AND MADE AVAILABLE AS A KIT. IT
IS MADE UP OF UPDATED VERSIONS OF THE ETI-730 DEMOD AND ETI-731
MODULATOR UNITS FIRST DESCRIBED IN 1979. THE CIRCUITS ARE COM-
BINED IH AN INTERFACE UNIT TO CONNECT THEM TMICROBEE
COMPUER. THE SYSTEM RUNS IN BAUDOT AT 45, 50, AND 75 BAUDS.
THE PROTOTYPE WAS COMPETED ON APRIL 27, 1984.
 HEY I JUST FIGURED OUT THIS THING IS A MONTH OLD..
SO HOW COPY... W0IUL DE DE VK7TM, FERN REE, TASMANIA

B^0/#$
RYRYRYRYRYRYRYRYRYRYRYRYVK7TM DE W0IUL R R R FB TOM ES THE NEW
GEAR SOUNDS FINE HERE ....IT IT AMAZING THE INTEREST THAT HAS
 DEVELOPED IN RTTY WITH THE COMPUTER GETTING
N TO THE PICTURE....WE HAD NEVER
TRIED THIS MODE UNTIL WE GOT THE VIC-20 ES DECIDED IT GOULDNT BE
TO HARD...WE ARE USING THE MFJ MFM INTERFACE WITH KANTRONICS HAMSOFT
SOFTWARE.....IT WEEXXXXSEEMS TO WORK FB HERE....=HOW COPY ? VK7TM DE
W0IUL KKKKEA2XVKF
V0IUL DE VK7TM OK DICK THAT GOOD COPY... I'VE BEEN FIDDLING WITH
RTTY FO QUITE W WHILE NOW, AN STILL USE A MECHANICAL MACHINE

WHEN I FEEL THE NEED FOR NOISEAND OIL SMELLS...
I GATHER THAT SYSTEM OF YOURS IS ASED ON VIC 20 BUT I MUST ADMIT
I'VE NEVER HEARD OF THE OTHER GEAR.. OF COURSE YOU'VE PROBABLY NEVER
HEARD OF MINE, WITHER.. EITHER...
THE SOFTWARE IS ONE OF THESE FANCY SPLIT SCREEN THINGS.. OOPS
THE BUFFER JUST CAUFGHT UP WITH ME... ANYHOW THE COMPUTER
IS AN AUSTRALIN MADE Z-80 MACHINE... QUITE OPULAR AMONG
PI NUTS  POPULAR AMONG HAMS HERE, AS ARE VIC-20'S.
SO BACK TO YOU DICK AND HOW ARE THINGS IN TOPEKA?
W0IUXXX W0IEU DE VK7TM KKK
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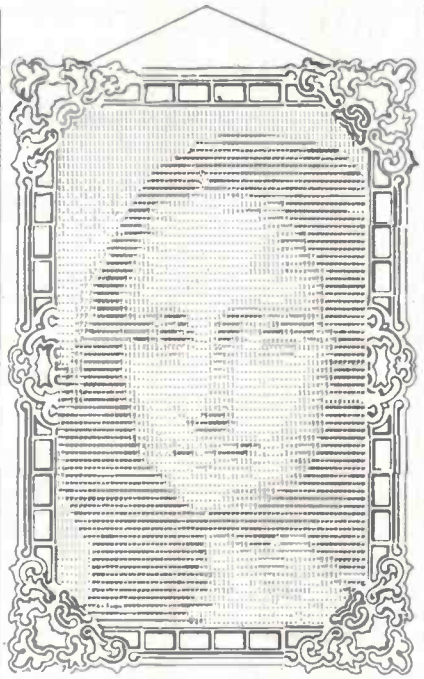

Art, even! An example of RTTY 'art'. Other examples include the obligatory nudes from Playboy/Penthouse, cartoon characters, etc.

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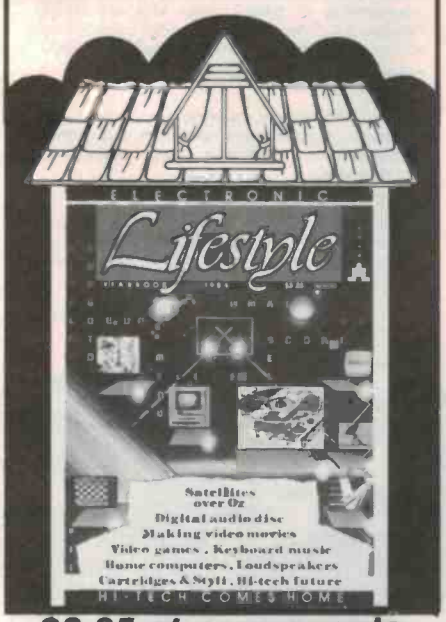

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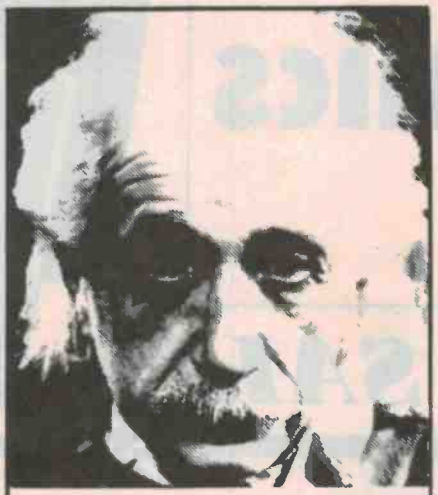

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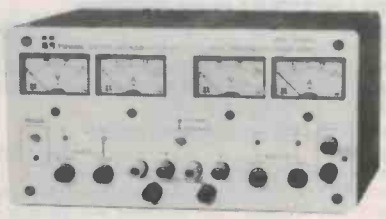

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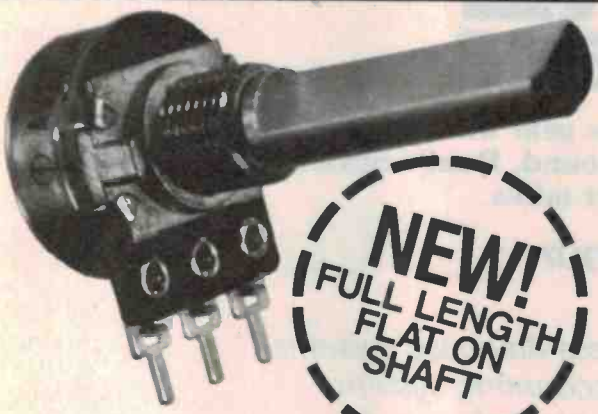

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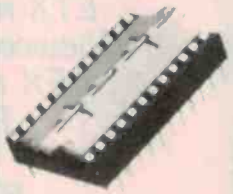

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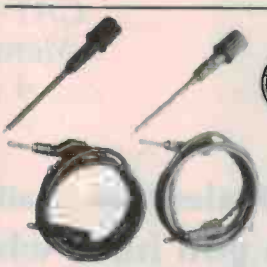

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TELEX: AA23861

Unix is a trademark of Bell Labs.

High hopes for AWA-Thorn with Amstrad home computer package

Next month, AWA-Thorn will launch the Amstrad CPC464 home computer, a much-heralded British-designed package that includes many features sold as extras on other popular home computers, and priced to compete directly against marketplace leaders such as Commodore and Atari.

The Amstrad CPC464 features a Z80 processor, 64K of RAM, a powerful 32K BASIC in ROM, a 74-key typewriter-style keyboard with separate numeric keypad and cross format cursor control keys, plus high resolution video providing 80-column text and 640 x 200 pixel addressable graphics with up to eight text windows.

But the big drawcard is the standard inclusions: the basic machine comes with an inbuilt data cassette that operates under software control at either 1K or 2K bauds. The *System One* comes with a hi-resolution green screen video monitor and will cost around $500, while the *System Two* comes with a colour monitor for around $750.

There are three screen modes and both 40-column and 80-column text is possible. In colour, a 'palette' of 27 colours is offered. You can select up to eight text windows into which characters may be written, plus a graphics window for plotting.

The sound facilities of the CPC464 provides three channels (voices) over a seven-octave range. Each of the channels can be independently set for tone and amplitude and they appear as left, right and centre outputs using the stereo extension jack socket. An internal speaker provides mixed mono output. The sound level and 'envelope' can be varied under software control.

An industry-standard Centronics compatible parallel printer port is provided. This uses the 'busy' signal line for handshaking. Two joysticks can be plugged in for games/graphics manipulation.

The system can be expanded to incorporate disks for which you get the popular and widespread CP/M operating system which gives you access to thousands of programs.

All ROMs occupy the top 16K of memory and there are facilities in the firmware to call up to 240 additional add-on ROMs, according to the Amstrad literature.

The BASIC, according to Amstrad, is an industry standard 'locomotive' language with many extensions for graphics and sound programming.

The CPC464 includes facilities for re-defining up to 32 keys, including the ability to program the numeric keys to contain command strings.

A full 8-bit character set is provided, including symbols and graphics accessible via the keyboard and the CHR$(n) function. There are 256 predefined characters and all are redefinable! All the block shapes you might ever need have been implemented, according to the literature. You also get a Greek character set, games symbols (e.g: bombs, explosions, etc) and an assortment of arrows, crosses, faces, ticks etc. And you can print them all!

Joysticks are available as an option, along with dot-matrix printer and a TV modulator/power supply. AWA-Thorn say there will be "... an abundance" of software available at launch — around 60-70 titles ranging across games, utilities, financial spreadsheats, educational items, etc.

We have arranged for a sample to review at an early date, so keep reading! ●

Colour graphics board

The new Matrox STD-800 is a high resolution colour graphics system on a single STD buss board.

The card contains 128K of on-board RAM which can be configured for a variety of resolutions. Either interlaced (60 Hz) or non-interlaced (30 Hz) operation can be selected.

The STD-800 uses a 7220 GDC VLSI video controller which provides a high level software interface. The card also supports several advanced features including split screen smooth scroll and pan, hardware vector and circle generation, high speed characters and patterned area fills, hardware blink and a light pen interface. The board also contains a large colour look-up table that allows the user to select 16 colours from a palette of 4096.

The intelligence provided by the GDC-7220 allows the user to program the STD-800 using high level graphics commands. Additionally, Matrox provides a comprehensive manual with program listings, allowing the user to be up and running in under an hour.

For more information contact **Measuring and Control Equipment, 2A Chester St, Epping NSW 2121. (02)86-4060.**

Macsoftware

Microsoft BASIC and Multiplan for the Apple Macintosh, the first in a range of Microsoft Macintosh software, is now available in Australia.

Microsoft Multiplan on the Macintosh provides all the features of other versions of Multiplan, with additional enhancements. An 'undo' command allows reversal of the last change to the spreadsheet. Recalculation is faster on the Macintosh, and 'smarter'.

Microsoft BASIC on the Macintosh takes full advantage of the large direct addressing capability of the Macintosh's Motorola 68000 microprocessor, including a decimal maths pack with 14-digit precision, and string variables and string expressions of up to 32 767 characters each. It is source code compatible with all standard versions of Microsoft BASIC, allowing easy migration of programs written in Microsoft BASIC to the Macintosh.

Microsoft BASIC fully incorporates the Macintosh interface and gives the user three kinds of windows — one for command entry when in direct mode or editing a listing, one for viewing the programs listing, and one for the output of the running program. BASIC also provides many of the extended graphics capabilities of Microsoft's GW BASIC, as well as support for Macintosh's font manager and call access to Macintosh's quickdraw routines.

For more information contact **Microsoft, P.O. Box 98, Terrey Hill NSW 2064. (02)450-2522.**

Disk controller

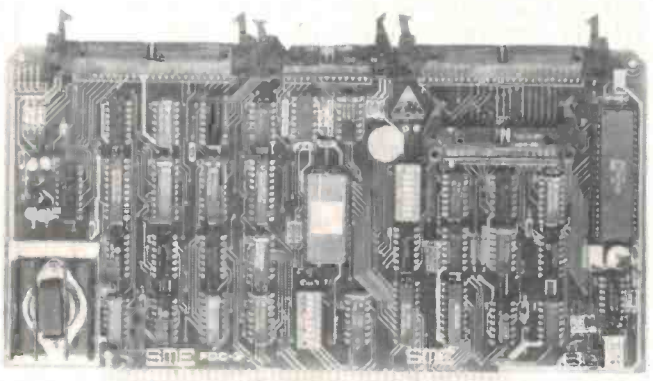
SME Systems has announced its most powerful and flexible S100 controller card to date, the FDC-3. The card controls both five and eight inch floppy disk drives as well as SASI interfaced hard disk drives. An RS-232 serial interface is also provided on the card for special applications.

The floppy disk section can control up to four single or double density, single or double sided, five or eight inch disk drives.

The SASI interface connects to any of the standard hard disk compatible controllers and will control up to four SASI controllers. This interface is intended to be ready to be connected to a drive controller so that getting a hard disk up and running is very easy.

The serial interface is provided for use as either a main system communications channel or as a secondary serial link. The baud rate is switch selectable and is serviced from the on-board crystal oscillator. Two connectors and a large variety of line options are provided for this interface so as to make it highly configurable to suit many applications.

For more information contact **SME Systems, 22 Queen St, Mitcham Vic 3132. (03)874-3666.**



HP data sheet

A new data sheet for the HP 1630-series logic analysers is now available from Hewlett Packard.

The data sheet contains many application descriptions describing the use of performance analysis. It discusses how to use histograms to find software bottlenecks and inefficiencies, and how to optimise system performance.

It provides information on using a logic analyser throughout the design cycle of a digital product. It also covers automatic data acquisition using a logic analyser under computer control.

To obtain this data sheet (HP No. 5953-3939) contact any local Hewlett Packard sales office.

Floppy drive

Ampec Electronics has released a new 3.3M floppy disc drive.

This half height 5¼ inch drive operates on 192 tracks per inch, double-sided, and is therefore able to read (not write) all 96 and 48 tpi diskettes. (Conventional disk entry is automatically sensed by the drive).

Features of the drive include its provision of accurate, repeatable diskette registration and a brushless dc drive motor.

The bit transfer rate is 500 K bit/sec which makes the unit very suitable for Winchester backup.

For more information contact **Ampec Electronics, 24 Bibby St, Chiswick NSW 2046. (02)712-2466.**

IBM encryptor board

Australian computer manufacturer and data security specialist, Eracom, has announced a data encryptor board designed for the IBM PC and XT, and suitable for many PC compatible machines.

Manufactured by Okiok Data of Quebec, Canada, the Data Encryption Board (DEB) uses a private key encryption system based on the DES algorithm with a 56-bit key chosen by the user. The high degree of security is based on the extremely large number of possible distinct keys.

Any file can be encypted by calling up a utility program which replaces the file with its encoded image. The process can also be performed on-line. The DEB provides encryption/decryption from programs in any language. Encryption operation is automatically verified.

For more information contact **6/26 Greg Chappell Drive, Burleigh Gardens Industrial Park, Burleigh Heads Qld 4220. (075) 56-0911.**

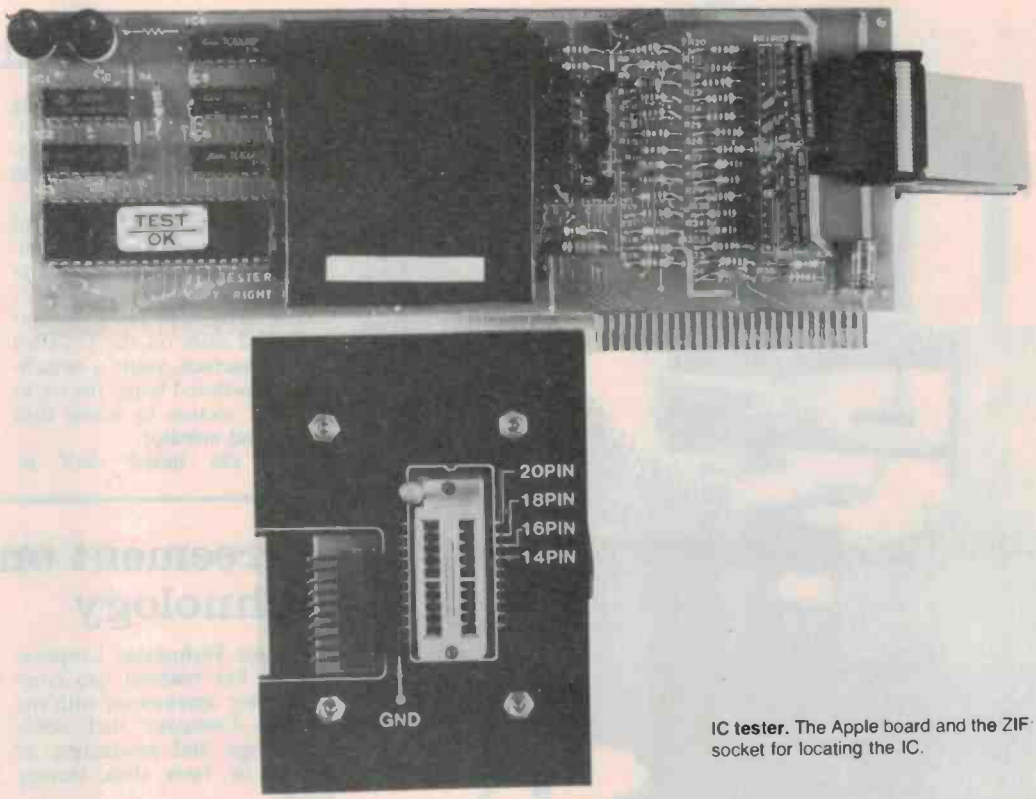
Chip checker

Designed as a peripheral card for the Apple, the chip checker can check and identify all TTL ICs. It is connected via a ribbon cable to a zero insertion force socket placed outside the computer.

Used in conjunction with the software provided, the Chip Checker will test standard TTL (54/7400 Series), low power Schottky TTL (54/74LS Series) Schottky clamped TTL (54/74S Series), low power TTL (54/74L Series), high speed TTL (54/74H Series) and TTL equivalent CMOS devices (54/74C Series).

The Chip Checker will also test for chip instability and respond accordingly. Misplaced or short circuited ICs will not damage it. Recommended retail price is $300.

For more information contact **Australian Video Presentations, 325 Bank St, South Melbourne Vic 3205. (03)699-4177.**



IC tester. The Apple board and the ZIF socket for locating the IC.

CLUB CALL

Spectravideo retailers, Computers for People, at 85 Irving St, Footscray, Vic, would like to see a **Spectravideo users' group** started in the western suburbs/Melbourne area.

Computers for People is willing to provide a venue for the initial meeting of the group and to notify owners of the meeting. Anyone interested in a Spectravideo users' group should contact Computers for People on (03) 689-7644.

The Forth Interest Group in Victoria meets at the rear of 102 Bowen St, Camberwell South, in the Bowen Street Neighbourhood Centre (near the corner of Toorak Rd). The meetings are held on the first Friday of the month at 8 pm.

BBS for TRS-80 fans

That doyen of TRS-80+ clones magazines, *80 Micro*, has established a bulletin board for readers, TRS-80 etc enthusiasts.

The BBS was created by the magazine's technical editor Bradford Dixon, You can access a database of over 20 applications, games, graphics and utility programs at present, updated monthly.

Special sections of the BBS are devoted to answering technical questions and you can 'chat' to *80 Micro* editorial staff (if you're lucky — remember the time zone difference).

If you've got a TRS-80, or maybe something very similar, then wait till after 6 pm local time and dial ISD to Peterborough, New Hampshire, USA. **The number is (603)924-6985.** It can be accessed (we believe) 24 hours a day. ▶

Computer courses

Think Computers has just announced details of its instructional courses.

The company has specialised in networking IBM personal computers and IBM look-a-likes. It has now established a training school where people who wish to learn about computer software applications can receive full instruction.

The courses are aimed at bridging the gap between the professional computer user and the businessman. There are a number of different levels depending on the prior knowledge of the student.

Level 1 courses are designed for people with little or no knowledge of computers. Level 2 concentrates on particular software packages available for IBM personl computers, such as word processing and spreadsheets. Level 3 is intended to impart knowledge of the features and applications of some higher level software like Lotus 1-2-3 and dBase 2.

For more information on the courses contact **Think Computers, 602 Maroondah Highway, Mitcham Vic 2132. (03)873-1122.**

Careful!

Microsoft has issued a warning to users and potential customers to look carefully when buying Microsoft software to ensure it is authentic and not an illegal copy.

Managing Director of Microsoft in Australia, Linda Graham, said that only authentic Microsoft software can be supported by Microsoft dealers and the Microsoft hotline services.

"Upgrades, carried out on an average of every six months, are also only available to authorised software users, making illegally copied software out of date basically six months following purchase," she said.

Graham said an obvious way to spot illegal software is by looking for the official Microsoft green and cream label. "Also, Microsoft packages have diskettes which only ever have data on one side."

For further information contact **Microsoft, P.O. Box 98, Terrey Hills NSW 2064. (02)450-2522.**

The Systemline HCD-530. A compact way of storing your computer.

Storage and display

Taking note of the growing popularity of home computers, Systemline Furniture has introduced the Model HCD-530 computer desktop cabinet.

This compact stand will accept most home and business computers, in particular the popular Apple II and Commodore VIC-20 and 64 models. The computer keyboard rests on the polished flat-top surface, while a detachable, two-tiered ledge fits on to the rear section to house disk drives and monitor.

When the tiered shelf is detached, the unit becomes a student's writing table. Hidden castors give it mobility and convenience; when the computer is not in use, the entire unit can be simply wheeled aside and put away.

The HCD-530 computer desktop cabinet is finished in black and walnut wood grain vinyl. Price is around $99.

For further information contact **Systemline Furniture, 24 Enterprise Ave, Padstow NSW 2211. (02)771-3999.**

Agreement on optical technology

Storage Technology Corporation has reached two comprehensive agreements with the Dupont Company that cover technology and production of optical or laser data storage media.

One of the agreements is a technology agreement under which Storage Technology, in exchange for a fee and royalties, has licensed Dupont to utilise its process and formulation in the manufacture of optical media. This agreement also calls for the exchange of information and know-how in the optical media area.

Under a second agreement Storage Technology has agreed to purchase a significant portion of its optical media requirements from Dupont during the next few years.

Storage Technology will begin limited production of its optical data storage subsystem later this year, with full-scale production commencing in early 1985. Initial quantities of the optical media for use in this subsystem will be produced by the Company at its Longmont, Colorado, facility.

Videopak

Interfaceware has released the Video Pak 80, an integrated system that features a word processor, spread sheet and 80 column screen adapter cartridge for the Commodore 64.

The word processor is an 80 column version of the word manager that includes features such as a screen presentation of the document, search and replace, block move and block copy, a close paragraph operation, right justify, and merging with a mailing list. The word manager comes with a self adhesive feature strip which provides a quick reference of all the functions.

The spread sheet, called the Plan Manager can handle up to 63 columns and 254 rows. These rows may contain numbers, titles and formulas without restriction.

The 80 column adaptor cartridge provides a high quality monochrome display, and contains software on ROM to handle the ASCII conversions and communications operations necessary to allow the Commodore 64 to act as an 80 column terminal for time sharing services and in-house mainframes. In addition, the Video Pak 80 provides full 80 column support of the Commodore BASIC built into the Commodore 64.

For more information contact **Interfaceware, 1/303 Pacific Highway, Lindfield 2070 NSW. (02)46-4374.**

Frame grabber

Imaging Technology has introduced their PCvision frame grabber, a real-time video image acquisition and display module for the IBM PC and PC XT.

The PCvision frame grabber converts a standard analogue video signal from a camera to digital data at a rate of 10 Mhz and then stores the resulting 6-bit pixel data in a 512 x 512 frame memory.

The architecture of the PCvision frame grabber enables it to simultaneously acquire and display 30 frames per second. Programmable look-up tables on the output signal allow any arbitrary transformation of pixel intensity prior to display on an external monitor.

Each location in the on-board frame memory is eight bits deep and stores six bits of digital data (one of 64 gray scale intensities) with the remaining bits enabling two planes of graphics overlays. These graphic overlay planes can be used for generating and positioning text or graphics anywhere on the image without disturbing the stored video data. The frame memory is mapped into the IBM PC address space, enabling direct access to the stored image and facilitating image processing by the IBM PC.

For further information, contact **The Dindima Group, P.O. Box 106, Vermont Vic 3133. (03)873-4455.**

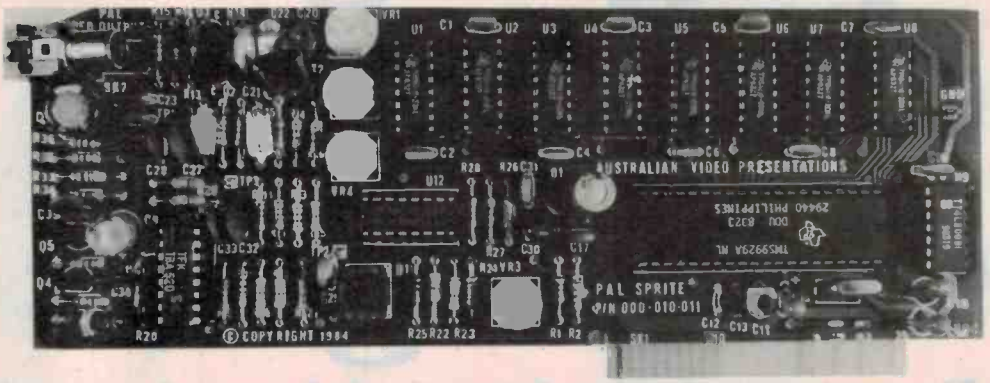
HP emulators

Hewlett Packard has released news of three new logic emulators in the 64 000 series. The HP64264S is designed to emulate the Intel 8051 microcomputer, while the HP64224S and the 64225S mimic the Intel 80186/80188 processors.

These devices are additions to an already extensive range of emulators manufactured by HP for Intel products. They are designed to be imbedded in a larger, modular system where they can take advantage of additional software development tools. All the functions of the processor that are normally transparent are visible to the user, allowing a programmer to optimise software development.

The HP64000 logic development system offers an extensive set of processor specific support tools. There are emulators, assemblers, compilers for various languages and software interfaces.

For more information contact **Hewlett Packard, 31 Joseph St, Blackburn Vic. 3130. (03)895-2895.**



Apple Sprite. A high density colour replacement board for the Apple.

Apple Sprite

The Sprite Graphics Card is a peripheral for the Apple computer. It disregards the Apple's video circuitry and generates sixteen brilliant colours of its own, in thirty two planes.

These Sprite planes can best be envisaged as 32 pictures sandwiched together, the front picture having priority over the second and so on. This priority structure automatically creates three dimensional graphics.

Behind the Sprite planes is the pattern plane which is used for text or graphic images. Behind this is the backdrop plane which is larger in area than the other planes and can be used to form a border around the other planes in any of the sixteen available colours.

Included with the hardware is 'Sprite-soft'. This software contains all the routines needed to create, convert, view, sort, save, merge and move the sprites. Also included is a patch routine enabling the Sprite Card to be located in any slot, a machine code routine to initialise a data disc and two demonstration programs.

The Sprite Card is available in either of the three main video standards, these being PAL, RGB and NTSC. It costs $280.

For more information contact **Australian Video Presentations, 327 Bank St, South Melbourne, Vic 3205. (03)699-4177.** ●

End of EDP?

Networking of microcomputers may soon become as commonplace as linking telephones to each other. Software Corporation of Australia (SCA) said that the emergence of a new kind of network product meant that clusters of desk-top computers will quickly displace EDP departments and larger computers in many environments.

SCA are distributing a networking system based on the IBM personal computer. 10/Net allows desk top computers to share valuable resources like printers and hard-disk storage devices.

10-Net works over ordinary twisted pair wiring. Each participant in the network can gain access to data files, application software and add-on equipment (like printers) at every other participant's workstation.

Each work station requires one 10-Net processor board, the 10-Net networking software and a 10-Net function box — all included in the 10-Net package. The user has only to supply the twisted pair wiring and the computers.

For more information contact **SCA, 449 Swanston St, Melbourne Vic. 3000. (03)347-7011.**

Axiss 5200 colour terminal

The Axiss 5200 is a microprocessor-based colour video display terminal which is capable of displaying alphanumeric characters and medium or high resolution graphics.

The standard screen format consists of eight pre-programmed modes, ranging from 24 lines by 40 characters (which is not coincidental with the Teletex format) to 24 lines by 80 characters.

The software is based on look-up tables and thus allows emulation of most other terminals, by the simple means of changing the contents of the relevant tables. Three terminals are currently emulated and more will follow in the near future.

The 5200 has been especially optimised for use with small computer kits such as the ETI-690 Little Big Board.

For more information contact **ATB Electronics, 34 Forwood St, Monash ACT 2904. (062)91-0134.**

Printer marriage

Printronix, manufacturers of computer line printers, has announced the acquisition of Anadex, a Californian-based designer, manufacturer and retailer of matrix computer printers.

According to Datascope, Australian distributor of Anadex, the parties contemplated completion of the transaction in late August, 1984.

The resultant company will be one of the world's largest printer manufacturers.

For more information contact **Datascope, 44 Avenue Rd, Mosman NSW 2088. (02)969-2699.**

LEARNING SOFTWARE FOR TOTS

Atari has developed a series of computer 'learning' games for children aged between 12 months and three years — when their mobility and fine motor coordination is not sufficiently developed that they can't usually operate computers.

Designed by child psychologist Dr Lee Salk, the games use a cat called Seymour to educate the youngsters.

The first game is called 'Peek-a-boo". The child plays a game of hide-and-seek with the cat Seymour. The game gets progressively more difficult as the child develops.

The parent has to work with the child to learn to control the game, so it's not a situation where the TV set takes over the job of baby minder.

Dr Salk says he has worked with children for 35 years and approached Atari to design this type of game because he was concerned at the pointless games that were being produced instead of educational software to help children learn.

Release of this software in Australia was not known at press time.

— Dennis Lingane

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microbee Educator boasts high quality graphics and sound effects capability, exceptional performance at a realistic price plus powerful software designed for Australian curriculum needs.

32K Personal Communicator $499

microbee's top selling portable computer now features:

Telcom 1 firmware WORDBEE, Microworld BASIC, machine code MONITOR, ADM-3A terminal emulation, self-test in 28K of ROM with 32K of CMOS battery backed user memory, high resolution PCG GRAPHICS, SERIAL AND PARALLEL I/O ports, programmable cassette interface and direct monochrome video output.

A vast library of educational, entertainment and utility software is now widely available. Microworld BASIC supports full high resolution graphics, colour if required, music, I/O data can be directed at will and best of all, MW BASIC is a breeze to program yourself.

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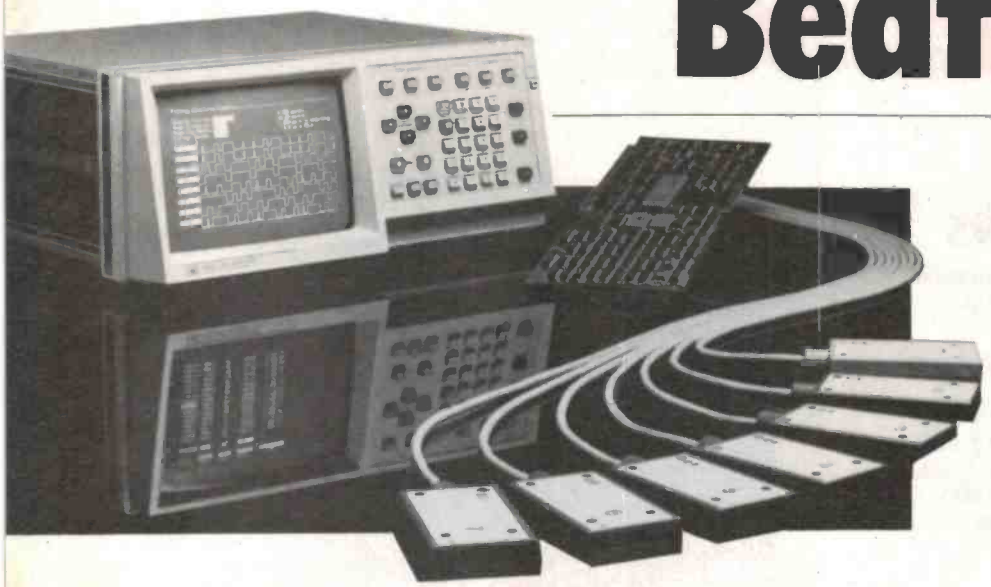


Tom Ryan

Hewlett-Packard

The growing complexity of microprocessor system software has necessitated the development of inexpensive measurement tools. In the past, microprocessor development systems have been used for the task, but they're expensive in both hardware and man-hours. A logic analyser that can display performance histograms and time tags, techniques that will assume more importance in coming years, provides much more rapid solutions to software bottlenecks, according to Hewlett-Packard.

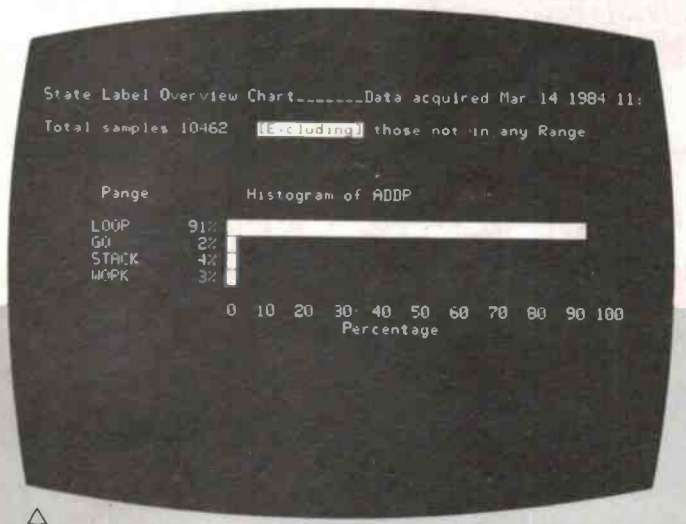
LOGIC ANALYSERS are usually purchased as hardware troubleshooting tools for research and development (R&D) tasks, although they often have sophisticated state analysis capabilities. Instead, a more expensive microprocessor development system (MDS) with software and logic analysis features is usually used to troubleshoot and verify software. The new Hewlett-Packard 1630G logic analyser with powerful software-oriented features offers the designer a cost-effective solution to many problems relegated to the MDS. This article discusses the use of two of these features, software performance histograms and time tags, and how they can be teamed to provide powerful measurements.

Histograms and time tags

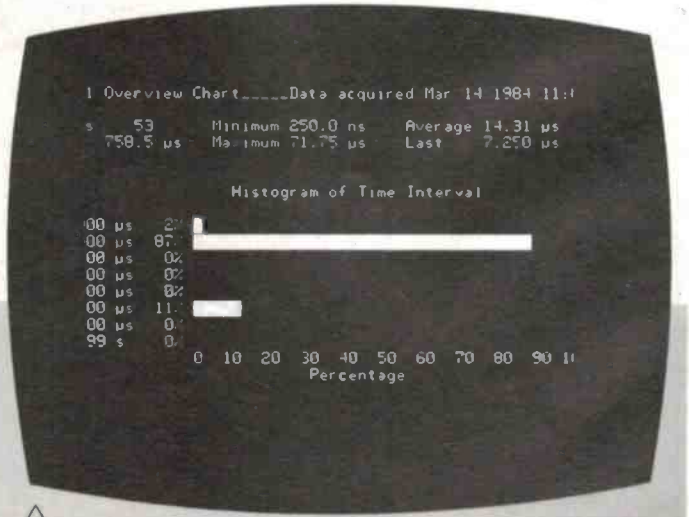
Performance histograms give an overview of system software, which helps a designer identify bottlenecks that slow down execution. The HP-1630G analyser offers histograms in two formats: *state overview* and *time interval*.

In the state overview format, addresses are sampled randomly in time and compared against user-specified address ranges. This gives a statistical view of where the system is spending its time. Up to eight address ranges can be defined, each of which may correspond to a particular software module. Ranges are displayed in bargraph form, with each representing the percentage of system activity in that software module (Figure 1).

Modules where the system spends most of its time are generally where improve-



△ **Figure 1.** State overview histogram.



△ **Figure 2.** Time-interval histogram.

SOFTWARE BOTTLENECK BUGS

ments will most likely yield the greatest increase in performance. Large improvements in frequently-called routines can significantly increase overall system performance. Hence, state overview histograms are important tools for increasing productivity, allowing the designer to identify and place a quantitative measure on the effectiveness of efforts to remedy execution bottlenecks.

After the offending module is identified, it is usually helpful to determine the actual average executive time of the module. This is accomplished using the time-interval histogram. By defining the entrance of the module as the "start timer" event and the exit as the "stop timer" event, you can determine the average execution time of the module and thus have an independent standard against which to measure performance improvements (Figure 2).

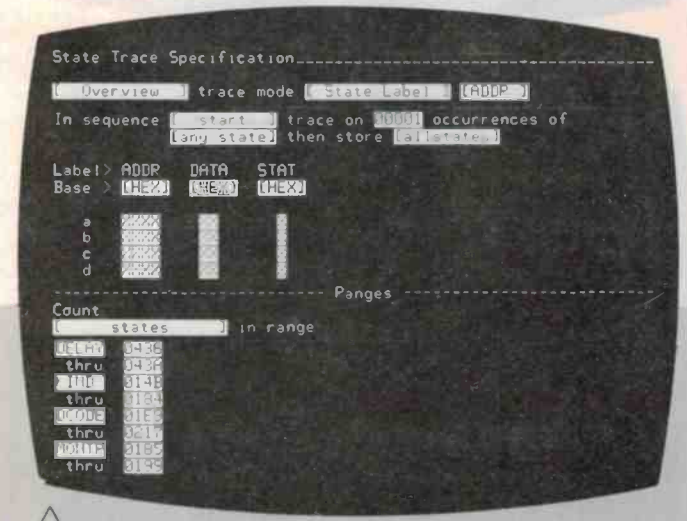
Combining state overview and time-interval histograms, you can track down many performance problems. However, in many cases you may need to know the actual execution time between instructions in a module rather than the average provided by the time-interval histogram. This is especially important when you suspect that a time problem indicated by the histograms may be caused by a few instructions within the software module.

The HP-1630G provides a time tagging feature that addresses this problem. Time tags show the elapsed time between instructions in relative format (i.e: relative to the previous instruction) or absolute format (i.e: relative to the trigger point). Such information provides a microscopic view of system activity. When combined with state overview or time-interval histograms, time tags yield information about system software that goes from a general overview of subroutines down to individual assembly instruction level. This capability helps funnel a problem down from the general to specific in a short time.

Measurement example

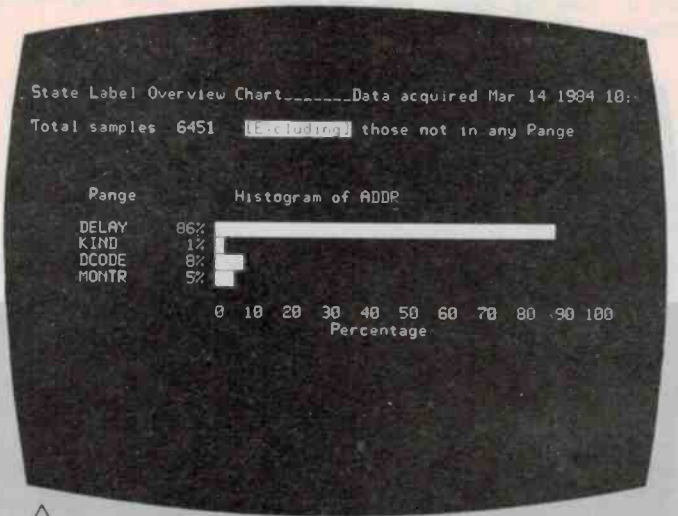
To illustrate the point, a simple example measurement can be made to optimize a module of system software. Figure 3 is a flowchart of the example software. The hardware associated with this flowchart is a keyboard and LED display panel that are, in turn, a portion of a larger microprocessor-based system.

When a key is pressed, the associated alphanumeric should appear on the LED display. The microprocessor scans the keyboard to determine whether a key has been pressed. If not, it refreshes the LED display panel with previous information. ▶



△

Figure 4. Trace specification for tracing state activity of monitor, decode and display modules.



△

Figure 5. Overview histogram of state activity in monitor, decode, and display modules.

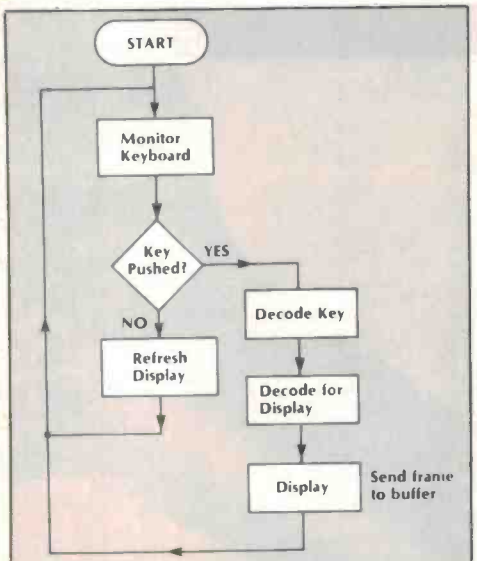


Figure 3. Simplified flowchart of example software subsystem.

Should a key be pressed, the microprocessor decodes the key and updates the display panel with the new information from the keyboard. The system contains a number of LED display characters, and in a multiplexing scheme, each should be kept on for a specified period of time (in this case 1 ms) before moving to the next character. This example shows in which submodule the system spends most of its time and why.

A state overview measurement is set up using four subroutines consisting of the monitor, decode, and display functions (Figure 4). Labels that correspond to the subroutine names are given address ranges of the memory locations occupied by each. The trace specification starts the trace at any state then stores only states that occur within the given address ranges.

Executing the trace measurement in Figure 5 shows that 86% of the activity occurs in subroutine DELAY, which keeps each LED digit on for 1 ms. The amount of program activity then might be expected to be high, but is the delay actually 1 ms?

By setting a single trace mode and viewing the time tag display, you can quickly find out. The trace specification is set to find the start of the routine and then trigger the analyzer when the 1 ms counter is finished.

Figure 6 shows that the time between the start of DELAY and the end of the count is indeed 1 ms.

The amount of time used by the DELAY routine is necessary because shortening the time results in a dimmer display. Thus, no change is to be made in subroutine DELAY.

If another state overview measurement is made using only the remaining three subroutines (excluding delay), the next most likely candidate for optimisation is subroutine DECODE (Figure 7). DECODE takes the data from the keyboard input routine (KIND) and changes it into the form necessary to drive the LEDs.

A time interval histogram of DECODE shows its average execution time. Before beginning to optimize the subroutine, a state/time tag listing of the relative elapsed time between instructions shows whether execution time is evenly spread among states or is concentrated in one area. The listing in Figure 8 shows that the former is the case.

A next step might then be to determine whether certain keys take longer to decode than others. By triggering the 1630G on individual occurrences of each key, the programmer can see whether the decoding routine has time differences that must be resolved.

Conclusion

Verifying software peformance is often a difficult and yet necessary task to ensure that the total system operates efficiently. Tools have long been available for verifying hardware, while software verification has lagged except in the case of microprocessor development systems. Considering the growing complexity of system software, inexpensive measurement tools for such software are of growing importance to the designer and hardware/software integrator alike.

Such features as state overview histograms and time tags, as in the Hewlett-Packard 1630G logic analyser, make it an attractive tool for identifying software bottlenecks. ●

Figure 6. Time tags displaying elapsed time between two start and end of delay counters. ▷

Figure 7. Overview histogram of modules excluding LED DELAY routine. ▽

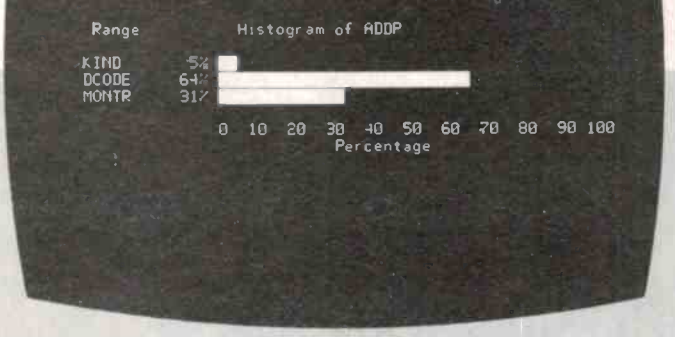
Figure 8. Display of DECODE execution period using time tags. ▽

State Listing_____Data acquired Mar 15 1984 11:

Label> Base >	ADDR [PEL+HEX]		8085 Mnemonic [ASM]		STAT [HEX]	Time [Relative]
[Mark]	[abs]	XXXX	[Instructions]		X	
+0000*	DELAY	+0000	DCR	D	3	0.0 s
+0001*	A	+0000	DCR	B	3	978.6 µs
+0002*	A	+0000	DCR	B	3	1.089 ms
+0003*	A	+0000	DCR	B	3	1.089 ms
+0004*	A	+0000	DCR	B	3	1.089 ms
+0005*	A	+0000	DCR	B	3	1.089 ms
+0006*	A	+0000	DCR	B	3	1.089 ms
+0007*	A	+0000	DCR	B	3	1.894 ms
+0008*	A	+0000	DCR	B	3	1.089 ms
+0009*	A	+0000	DCR	B	3	1.089 ms
+0010*	A	+0000	DCR	B	3	1.089 ms
+0011*	A	+0000	DCR	B	3	1.089 ms
+0012*	A	+0000	DCR	B	3	1.089 ms
+0013*	A	+0000	DCR	B	3	1.894 ms
+0014*	A	+0000	DCR	B	3	1.089 ms
+0015*	A	+0000	DCR	B	3	1.089 ms

State Label Overview Chart_____Data acquired Mar 14 1984 10:

Total samples 594 [Excluding] those not in any Range



State Listing_____Data acquired Mar 15 1984 11:

Label> Base >	ADDR [PEL+HEX]		8085 Mnemonic [ASM]		STAT [USP]	Time [Relative]
[Mark]	[abs]	0006	[Instructions]		[XXXXX]	
-0001	DCODE	+0000	PUSH	PSW	opfch	0.0 s
+0000	C	+09AE	FF	memory write	memwr	3.000 µs
+0001	C	+09AD	54	memory write	memwr	1.520 µs
+0002	DCODE	+0001	PUSH	B	opfch	1.480 µs
+0003	C	+09AC	7F	memory write	memwr	3.000 µs
+0004	C	+09AB	06	memory write	memwr	1.520 µs
+0005	DCODE	+0002	PUSH	D	opfch	1.480 µs
+0006	C	+09AA	02	memory write	memwr	3.000 µs
+0007	C	+09A9	97	memory write	memwr	1.520 µs
+0008	DCODE	+0003	PUSH	H	opfch	1.480 µs
+0009	C	+09A8	0B	memory write	memwr	3.000 µs
+0010	C	+09A7	F0	memory write	memwr	1.520 µs
+0011	DCODE	+0004	LXI	B,0BFA	opfch	1.480 µs
+0012	DCODE	+0005	FA	memory read	memrd	2.000 µs
+0013	DCODE	+0006	0B	memory read	memrd	1.520 µs
+0014	DCODE	+0007	LXI	D,0BF0	opfch	1.480 µs

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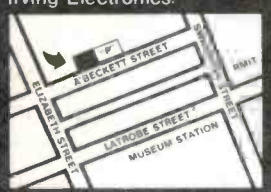


MASTERPLAY 2 WAY SPEAKERS

A low-cost pair of bookshelf speakers to suit the Masterplay stereo unit. (ETI Oct. '84)

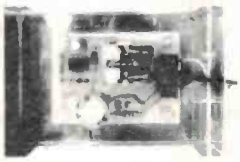
ETI-463

APPLE II ANALOGUE/ DIGITAL INTERFACE

This project will give your Apple a set of 8-bit digital inputs and outputs plus one analogue imput and one analogue output. Applications include: driving a robot, recording science experiment results, etc. (digital only shown). (ETI Mar. '83).

ETI-654 **$159.00**

CAR IGNITION KILLER



Most car burglar 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 **$16.95**

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 **$55.00**

BIPOLAR PROM PROGRAMMER

Every digital workshop should have one! Can be used to program the popular fusible-link PROMS like the 74S188/288, 82S23 and 82S123 etc. (ETI June '83).

ETI-688 **$47.50**

DUAL STANDARD AM STEREO DECODER

This add-on Module for AM tuners and receivers provides decoding for the Motorola and Harris stereo transmission systems. (ETI Oct. '84).

ETI-739

VIDEO AMPLIFIER

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

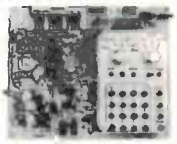
83VA8 **$15.00**

DRIVEWAY SENTRY

Activated by your car's headlights, the "Driveway Sentry" will turn on a driveway or garage light so that you can make a safe exit from your car on the darkest of nights. At the end of 5 minutes, it will automatically turn the light off again. (EA Dec. '82).

82PC11 **$32.00**

EPROM PROGRAMMER EP1



No need for a Micro with EA's great Eprom Programmer suitable for 2716/2758 Eproms. (EA Jan. '82).

82EP1 **$43.00**

With Textool Sockets **$55.00**

CAR ANTENNA CONTROLLER

Automatic whip up/down when you turn your radio/cassette player on or off. Simple to build, adjustments for extension and retraction are provided. (ETI Aug. '84).

ETI-337 ... Please ring for prices and availability of new kits on (03) 481 1436. (Also for PCB Boards for this kit).

DRUM SYNTH. MODULE

A simple, low-cost Module that will generate a wide variety of drum-like sounds from a pulse input provided from a sound pick up or electronically. (ETI Oct. '84).

ETI-610

ETI STEREO

A low cost stereo amp suitable for teaming with a stereo record player with a ceramic cartridge. Over 30W peak output per channel, phono, tape and tuner inputs, full tone controls, single-board constructions. (ETI Aug. '84).

ETI-442 ... Please ring for prices and availability of new kits on (03) 481 1436.

VIDEO ENHANCER

100's SOLD

Like tone controls in a hi-fi amplifier, touch up the signal with this Video Enhancer. (EA Oct. '83).

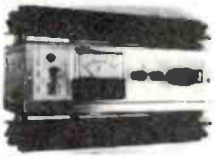
83VE10 **$35.00**

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 **$34.50**

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 **$99.00**

READY-SET-GO LIGHTS

A simple project for starting slot car races, etc. It provides the traditional Red/Amber/Green lights with a random delay between the amber and green. (ETI Oct. '84).

ETI-277

HEADPHONE AMPLIFIER

PRACTISE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practise 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 **$28.00**

GENERAL PURPOSE BALANCED INPUT PREAMP

This project can be used as a balanced mic amp. with low impedance input, a low or high impedance input differential amplifier or a balanced input instrumentation amplifier. (ETI Dec. '83).

ETI-461 **$20.00**

AUTO TESTER

Just the thing to keep in the glovebox or toolkit to find those nasty electrical 'bugaboos' that occur at awkward times. Simple to build, simple to use. (ETI Jan. '83).

ETI-334 **$17.00**

EA SUPER SIREN

Ever wanted to build an ear-splitting alarm which would be compact and not draw much current? This is just the circuit for you. It uses a piezo electric tweeter in a pulsed mode to form an arresting and very efficient alarm. (EA Nov. '82).

82AL17 **$21.00** (battery extra)

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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 **$24.00**

DUAL TRACKING POWER SUPPLY

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

(EA March '82) **$87.50**

MODEL ENGINE IGNITION SYSTEM

Get sure starts every time and no more glow plug burnouts on your model engines. (ETI June '83)

ETI-1516 **$41.50**

TEMP PROBE

Can measure temperature from −50° to +150°C. It simply plugs into your multimeter — great for digital multimeters. Accuracy of 0.1°C resolution of 0.1°C. (ETI June '83).

ETI-153 **$19.95**

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 **$9.50**

PUSHBUTTON-PROGRAMMABLE WIPER CONTROLLER

No more fiddling with knobs and not getting the delay between wipes that you want — this windscreen wiper controller is simply programmed with two pushbuttons to provide the wiping delay you need. (ETI Mar. '83).

ETI-335 **$28.50**

RADIOTELETYPE CONVERTER FOR THE MICROBEE

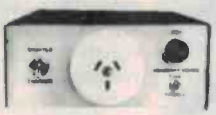
Have your computer print the latest news from the international shortwave news service. Just hook up this project between your shortwave receiver's audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too.

(ETI Apr. '83) **$20.00**

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 limit. Both voltage and current metering is provided. (ETI Dec. '83).

ETI-162 **$47.50**



INVERTER

This 12 240V inverter can be used to power mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on.

(EA May '82) **$49.50**

PARABOLIC MICROPHONE

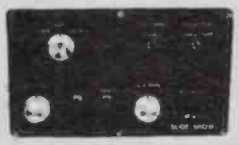
Build a low cost parabola, along with a high gain headphone amplifier to help when listening to those natural activities such as babbling brooks, singing birds of perhaps even more sinister noises. The current cost of components for this project is around $15 including sales tax, but not the cost of batteries or headphones.

(EA Nov. '83) **$15.00**

FUNCTION GENERATOR

This Function Generator with digital readout produces Sine, Triangle and Square waves over a frequency range from below 20Hz to above 160Hz with low distortion and good envelope stability. It has an inbuilt four-digit frequency counter for ease and accuracy of frequency setting.

(EA April '82) **$79.50**



SLIDE CROSS-FADER

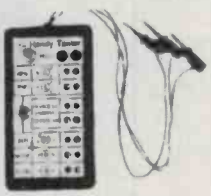
Want to put on a really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at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

81SS11 **$85.00**

TV PATTERN GENERATOR

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

$67.50

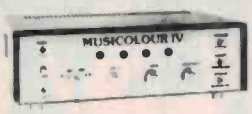


TRANSISTOR TESTER

1000's SOLD

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

(EA Sept. '83) **$15.00**



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 **$84.00**

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 adequate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Standard 3129.

(EA Sept. '82) **$19.50**

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).

84CM5 **$40.00**

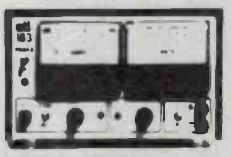
12-230V DC-AC INVERTER

INCLUDING TRANSFORMER 300 WATTS

This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '87).

Nominal Supply Voltage	12V DC
Output Voltage	see table
Frequency	50Hz± .005%
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

P & P $10.00. Anywhere in Australia. **$195.00**



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 a unique relay switching system switching between taps on the transformer secondary. (ETI May '83).

ETI-163 **$175.00**

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) **$140.00**

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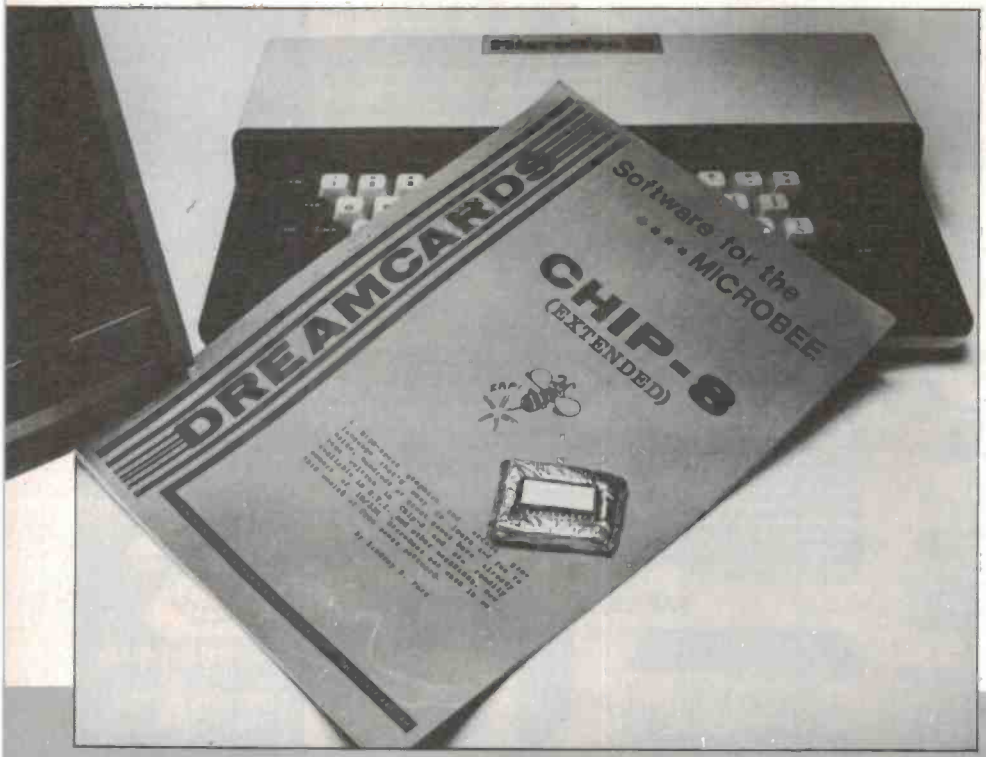

The versatile Microbee can now run the CHIP-8 language, making a huge range of high-speed arcade games available to the enthusiast for no more cost than the time it takes to key them in. And the graphics potential it gives the machine is staggering.

Lindsay R. Ford

Microbee CHIP-8:

Towards the Ultimate GRAPHICS/GAMES Machine

Lindsay Ford is the proprietor of Dreamcards, a software/hardware firm that grew from a hobby — supplying computing hobbyists. Lindsay began supplying software for Michael Bauer's 'Dream' microcomputer then, latterly, for the Microbee. Dreamcard's motto is: "Software That Thinks".

THE RECENTLY RELEASED Dreamcards Extended CHIP-8 V2.0 interpreter/compiler has given the Microbee a capacity for high speed graphics and games support features that will make it hard to beat as a games/graphics machine. This easy-to-use language was introduced into Australia a few years ago, **ETI** being one of its pioneers with the ETI-660 Learners' Microcomputer (see, May, June, October & November '81 issues).

Since then, ETI has dedicated regular monthly columns to CHIP-8, allowing a large software base to become available in back issues. The advent of a fully compatible CHIP-8 interpreter for the Microbee means that this software base will be immediately available to 'Bee users. This will no doubt be a major factor in the spread and further development of the language.

What is CHIP-8?

The language was originally developed in the US for use in video games (see Byte magazine, December 1978). It is a no frills, high speed, display-oriented language that uses 4-digit hex commands to carry out its various functions. Because of its execution speed, it is ideally suited to writing graphic sequences where animation is required or for fast "shoot-em-down" type games. CHIP-8 is a "higher level" interpreted language, so it is also considerably easier to write than machine code or assembler (the usual languages in which arcade games are written). This has resulted in it being adopted in many small computer projects as an ideal language for beginners to learn the fundamentals of

programming. The original versions employed a 64x32 screen, but this was subsequently extended in the ETI-660 to 64 x 48 and later (when various modifications were suggested to the '660 in the Feb. '84 issue of ETI) to 64x64.

Unfortunately, this resulted in software incompatibility between machines, a factor that is of no consequence in the Microbee version as a simple 'reformat screen' instruction allows it to run software written for any of the three screen layouts.

The actual display pattern is created on the screen by the simple expedient of taking from one to 16 bytes of memory (pointed at by the 'Index' register) and transferring them to the screen at co-ordinates specified by two variables (see Figure 1). The resultant binary pattern can be used to create a multitude of shapes and has the advantage of being extremely fast. The display instruction also aids animation by allowing selective erasure of existing displays and can detect when two displayed objects overlap (for instance, allowing the program to detect when the 'laser' hits the 'alien'.)

Other features supported by the versions of the language now in use in Australia (which we shall refer to as the 'core language') include a simple tone generator, a random number generator and commands to carry out arithmetic and logic operations. Figure 2 lists the 'core' language instructions.

Extended CHIP-8

The new version of CHIP-8 fully implements the core language, but its 'user selectable' screen format means that the bulk of software written for earlier machines can be run with little or no modification. An added advantage for the Microbee owner is that the interpreter extends several of the language subsets to take advantage of some of the 'Bee's more sophisticated features (and even a few it didn't originally have!! — see Figure 3). This will allow programmers to avoid the complexities of assembly language, yet still have virtually unlimited scope to write fast action games. The new instructions cover;

Hi-res Graphics: One of the most consistent requests of CHIP-8 users over the years has been for some method of obtaining high resolution graphics. Several people have tried to implement this by introducing changed screen formats (eg: 128x64), but this always results in reduced speed and the loss of the useful high speed 'chunky graphics' that were the main feature of the language in its original form. The new Microbee interpreter side-steps these difficulties by retaining standard graphics in the three main screen formats, but supplements them with 112 cursors (the standard Microbee PCG graphics cursors) that can be loaded with data and displayed using two simple commands. This allows graphics with a fantastic 512x256 resolution to be mixed with any of the other standard and non-standard graphic styles available with this interpreter.

CODE	FUNCTION
0000	NOP (No Operation — ETI-660 uses "00FF")
00E0	Clear the screen
00EE	Return (from subroutine)
0MMM	Do machine code subroutine at $MMM
1MMM	Goto $MMM
2MMM	Gosub $MMM
3XKK	Skip next instruction if VX=KK
4XKK	Skip next instruction if VX=KK
5XY0	Skip next instruction if VX=VY
6XKK	Set VX=KK
7XKK	Set VX=VX+KK
8XY0	Set VX=VY
8XY1	Set VX=VX OR VY (logical OR)
8XY2	Set VX=VX AND VY (logical AND)
8XY4	Set VX=VX+VY (VF=1 if carry)
8XY5	Set VX=VX−VY (VF=1 if no carry)
9XY0	Skip next instruction if VX=VY
AMMM	Set index = $MMM
BMMM	Goto $MMM + V0
CXKK	Set VX = (random number) AND KK
DXYN	Display N bytes at VX/VY
EX9E	Skip next instruction if VX=KEYDOWN
EXA1	Skip next instruction if VX=KEYDOWN
F000	Stop (ETI-660 uses "0000")
FX07	Set VX = current timer value
FX0A	Get key in VX (wait for KEYDOWN)
FX15	Set timer = VX x 20 millisec.
FX18	Beep for VX x 20 millisec.
FX1E	Set index = index + VX
FX29	Set index to display LSD of VX
FX33	Store decimal equiv. VX at index
FX55	Store V0 to VX at index
FX65	Load V0 to VX from index

Figure 2. The CHIP-8 Core Language. Instructions supported by current CHIP-8 machines.

NOTE: **X & Y** refer to Chip-8 variables X & Y (VX & VY)
KK refers to a hex number 00 to FF
N refers to a hex number 0 to F
MMM refers to a 3-digit hex address

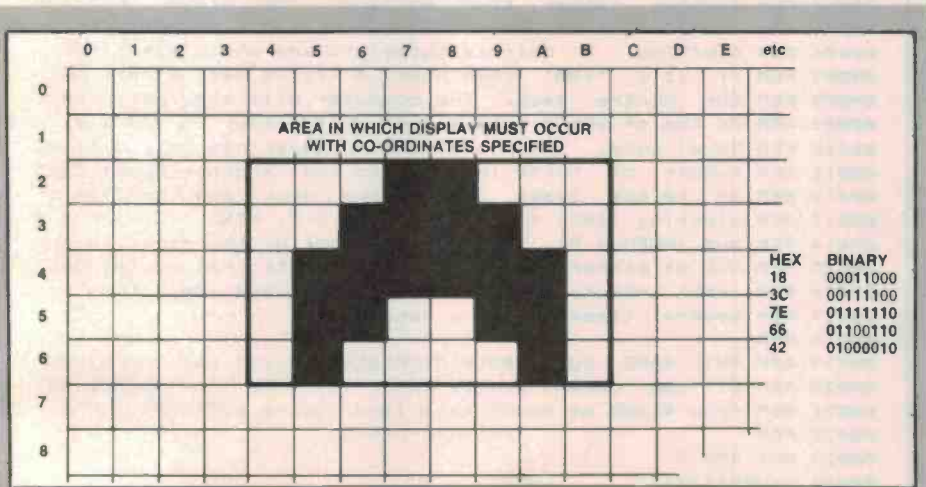

Figure 1. Creating a CHIP-8 display.

CODE	FUNCTION
8XY3	VX=VX XOR VY
8XY6	VX=VY/2 (VF = remainder)
8XY7	Output VX on Port VY
8XY8	Input VX from Port VY
F001	Toggle CHIP-8 cursor (full half-tone)
F002	Toggle display switch
F003	Change screen format
FX05	Set language execution speed = VX
FX25	Set tone frequency = VF (0 to F)
FX35	Set SYNTHA = VX (tone synthesizer function)
FX45	Set SYNTHB = VX (tone synthesizer function)
FX75	Load custom cursor VX from index
FX85	Replace cursor with custom cursor VX
FX95	Store V0 to VX in imaginary CHIP-8 screen
FXY4	Set program page ±X, data page ±Y
FXY6	Set VX/VY to display coincidence co-ordinates
FXYB	Limit joystick range to VX/VY
FXYC	Read joystick into VX/VY
FXYD	Display ASCII string at index at VX/VY

Figure 3. Extended CHIP-8 instructions. Instructions supported only by the Dreamcards interpreters.

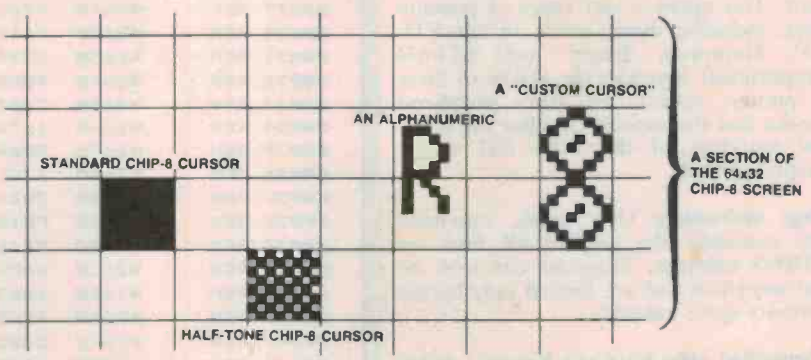

Figure 4. Cursor types available with Dreamcards' CHIP-8

Alphanumerics: Standard CHIP-8 is not a language in which you'd choose to write a wordprocessor program — its best character resolution is 16x6!!! The new interpreter makes it a good deal easier to incorporate text (such as operating instructions for a game or utility) into programs by including an instruction that will display a 'string' of standard ASCII characters in 64x16 format as if they were CHIP-8 cursors. The command even has an 'auto-repeat' facility that allows up to a whole line of any one character to be displayed using only three bytes of data.

Half-tone cursors: One difficulty with the original 'chunky' graphics was to portray contrasting tones. This can now be achieved with a simple 'switch' instruction that allows access to a 'half-tone' CHIP-8 cursor (see Figure 4) that can be used with ordinary full-tone graphics, alphanumerics and hi-res graphics. The possibilities with all these graphics combinations are limitless.

Sound effects: The Microbee tone generator is a fairly simple affair, but the new interpreter extends it to a point where it is a match for many hardware sound units. A wide range of 'buzzes', 'zaps' and 'boings' are available by manipulation of three sound commands, or they can be ignored in favour of the traditional CHIP-8 'beep'. The manual includes a listing of a routine that allows you to step through the various sound effects options — a useful feature as the number of sound effects available totals *over one million*.

Joystick: Two new instructions allow you to operate a standard Microbee joystick and to limit the range over which it is permitted to move. These functions will be invaluable to anyone who is serious about arcade games.

Extended maths and I/O: The additional exclusive-OR (XOR) and the new 'divide by 2' instructions are useful (if not Earth — shattering), but where creative programmers will really benefit is from the two new commands that allow a variable to be output to or input from a selected port. This opens a vast range of possibilities, including direct access to the ETI-673 Multiprom Board and ETI-674 Proportional Joystick, the ability to drive a printer, cassette or other peripheral device and the capacity to alter the internal workings of the PCG and colour graphics board.

Page addressing: One simple command has overcome the original 4K limit on CHIP-8 software. Programs can now be put anywhere and are limited only by the memory space available.

Conversion aids: First and foremost under this category has to be the 'switch' command that alternates between 64x32, 64x48 and 64x64 screen formats. This one command makes the *whole range* of CHIP-8 software immediately accessible to the Microbee user. In addition to this, there is an execution rate control and an instruction that writes binary data to an 'imaginary' CHIP-8 screen, both of which will greatly aid conversion of programs written for other machines in the unlikely event that difficulties are encountered. The execution rate control is also a very useful command in its own right and can be used (for instance) to simulate acceleration in a moving display.

The operating system

Without doubt the most important feature of the package is the ability of this CHIP-8 to co-exist with BASIC. A compiler converts the CHIP-8 hex code created by the programmer into BASIC 'REM' lines that can stand alone or be added to any BASIC program (see Figure 5). These can

Figure 5. A sample of compiled CHIP-8.

This is a BASIC listing created from CHIP-8 code by the Dreamcards Compiler. None of the lines were entered by hand — the *whole listing* is compiled automatically.

On typing "RUN <CR>" a decompiler converts the ASCII CHIP-8 code in lines 5 and 6 back to proper hex code at the address specified by the "header" (line 4).

Line 1 selects the ETI-673 Multiprom Board, NET#2 socket (if fitted).

Line 2 calls the "decompiler" routine in the interpreter, then executes the decompiled CHIP-8 code.

Note the checksum bytes at the end of line 4. These greatly assist program debugging.

```
00001 REM           <<<<< STRIP JACK NAKED >>>>>
00002 REM                                        by Lindsay R. Ford
00003 REM This is the famous card game in which you lose
00004 REM clothes rather than dollars. The player and the
00005 REM computer each have 27 cards and 10 articles of
00006 REM clothing.  A coin is tossed to see who plays first -
00007 REM if it's "YOU" then press a key to deal a card onto
00008 REM the centre deck. The computer will then put a card
00009 REM on top of yours (and so on).  If either of you play a
00010 REM Royal card, then the other player has only a fixed
00011 REM number of turns in which to deal another Royal card
00012 REM or he/she loses the centre deck and an item of
00013 REM clothing (JACK = 1 turn, QUEEN = 2, KING = 3, ACE = 4
00014 REM and JOKER = 5). The game is lost by the first to run
00015 REM out of either clothes or cards. Note that as the deck
00016 REM isn't memory-mapped, the same card may turn up
00017 REM several times during a game.
00018 REM                    --------------
00019 REM THIS GAME  SUITS BOTH MICROBEE AND ETI 660 COMPUTERS.
00020 REM ETI 660  owners simply enter the code from $0600, not
00021 REM from $2600 as shown here (and ignore $25FE/F).
00022 REM                    --------------
00023 OUT 255,2
00024 X=USR(57347)
00025 END
00026 REM     Dreamcards Chip-8   $25F0 to 2A2F   Check 46/08
00027 REM     $25F0  0000 0000 0000 0000  0000 0000 0000 F002
00028 REM     $2600  620A 630A 641B 651B  C701 26F4 2800 00E0
00029 REM     $2610  4200 17DC 4300 17CE  6600 6C00 6A00 2700
00030 REM     $2620  7A19 3ACB 161E 26BE  26CE 26DA 26D4 26C6
00031 REM     $2630  3700 1676 8DC0 7D01  26F4 4400 17DC 27BE
00032 REM     $2640  F00A 27BE 6E19 26F6  26CE 74FF 26CE 26DA
00033 REM     $2650  7601 26DA 3601 2730  2716 3C00 1676 4D01
00034 REM     $2660  1676 3D00 1636 6E19  FE18 26BE 72FF 26BE
00035 REM     $2670  8564 6701 160A 8DC0  7D01 6E19 26F6 4500
00036 REM     $2680  17CE 27C6 26F4 27C6  6E19 26F6 26D4 75FF
00037 REM     $2690  26D4 26DA 7601 26DA  3601 2730 2716 6E04
00038 REM     $26A0  FE18 3C00 1634 4D01  1634 3D00 1678 6E19
00039 REM     $26B0  FE18 26C6 73FF 26C6  8464 6700 160A 8020
00040 REM     $26C0  6A03 6B0B 16E0 8030  6A35 6B0B 16E0 8040
00041 REM     $26D0  6A03 16DE 8050 6A35  16DE 8060 6A1C 6B1B
00042 REM     $26E0  A9B0 F033 A9B1 F165  F029 DAB5 7A04 F129
00043 REM     $26F0  DAB5 00EE 6E32 FE15  FE07 3E00 16F8 00EE
00044 REM     $2700  6B07 A9B9 DAB9 7A08  A9C2 DAB9 7A38 7B09
00045 REM     $2710  3B19 1702 00EE C001  A9B3 F055 C003 A9B4
00046 REM     $2720  F055 C00F 400F 1722  400E 1722 A9B5 F055
00047 REM     $2730  A9B5 F065 8900 A9B3  F065 4000 1742 4900
```

be EDITed, PRINTed, LOADed or SAVed exactly as if they were BASIC, but when the 'RUN' command is issued they will automatically be decompiled into CHIP-8 hex code and executed in that language.

This facility allows novice programmers to use CHIP-8 with little knowledge of how it works, whilst experts can take advantage of the combined benefits of the fast display speed of CHIP-8 and the powerful string processing and maths of BASIC within the one program.

The interpreter can be accessed from several points (detailed fully in the operating manual) that make it simple for control or data to be passed backwards and forwards between BASIC AND CHIP-8. This means that CHIP-8 subroutines can be called from BASIC programs and vice versa, a unique feature that has enormous potential for development of the language.

```
00001 OUT 255,2
00002 X=USR(57347)
00003 END
00004 REM  Dreamcards Chip-8   $2200 to 221F   Check BD/8D
00005 REM  $2200  00E0 601F 611B 6204  CA17 A21E DAB1 FA29
00006 REM  $2210  D015 F215 F207 3200  1214 D015 1206 8000
```

```
00048 REM    $2740  17AA 4900 1722 6B09  4901 1790 490D 1796
00049 REM    $2750  490C 179C 490B 17A2  A9B6 F933 A9B7 F165
00050 REM    $2760  390A 176E 6A1C F029  DAB5 7A04 1770 6A1E
00051 REM    $2770  6C00 F129 DAB5 A9B4  F065 A9E2 4001 A9E8
00052 REM    $2780  4002 A9F4 4003 A9EE  6A1C 6B10 DAB7 00EE
00053 REM    $2790  A9CB 6CFC 17A6 A9CE  6CFD 17A6 A9D3 6CFE
00054 REM    $27A0  17A6 A9D8 6CFF 6A1E  1774 A9D8 6A1A 6B08
00055 REM    $27B0  DABA 7A08 7B0A A9CE  DAB5 6CFB 00EE 6A01
00056 REM    $27C0  A9FB 2A1E 00EE 6A34  AA09 2A1E 00EE 26F4
00057 REM    $27D0  00E0 6A10 6B0C A9FB  2A20 17E8 26F4 00E0
00058 REM    $27E0  6A14 6B0C AA04 2A28  AA13 2A20 6000 6E03
00059 REM    $27F0  FE18 6E03 26F6 7001  3010 17EE 2804 1600
00060 REM    $2800  3700 00EE 00E0 2862  26F4 4500 183C 4300
00061 REM    $2810  288A 4301 289C 4302  28A6 4303 28B0 4304
00062 REM    $2820  28BA 4305 28C6 4306  28CE 4307 28D6 4308
00063 REM    $2830  28DE 4309 28E6 6E96  26F6 00EE 288A 1836
00064 REM    $2840  6002 DAB2 185C 6003  DAB3 185C 6005 DAB5
00065 REM    $2850  185C 6009 DAB9 185C  600F DABF 7A08 F01E
00066 REM    $2860  00EE 6A18 6B00 A8F2  2840 2840 6A10 6B09
00067 REM    $2870  284C 6B02 2858 2858  6B09 284C 6A10 6B1E
00068 REM    $2880  2840 6B11 2858 2858  00EE A93E 6A10 6B09
00069 REM    $2890  284C 6B0A 2858 2858  6B09 284C A966 6A1B
00070 REM    $28A0  6B0D 2846 2846 A96C  6A18 6B12 2852 2852
00071 REM    $28B0  A97E 6A1B 6B0B 2852  2840 A989 6A13 6B0A
00072 REM    $28C0  2840 2852 2840 A996  6A18 6B1D 2846 A999
00073 REM    $28D0  6A22 6B1D 2846 A99C  6A12 6B0B 2840 A99C
00074 REM    $28E0  6A2B 6B0B 2840 A99E  6A18 6B00 2840 2840
00075 REM    $28F0  00EE 0F3C E078 207F  F77F 2008 0A08 090C
00076 REM    $2900  1E0E 04FC FEFF 3E3F  3E3F 20A0 2020 60F0
00077 REM    $2910  E040 7FFF FFF8 F8F8  F808 FCDE FC08 0101
00078 REM    $2920  1E11 3F7F 7F7F 7F7F  7F7F 2424 FCFC F4F0
00079 REM    $2930  10F8 FCFC FCFC FCFC  FC48 487E 7F5F 207F
00080 REM    $2940  C07F 2080 40B0 7070  7060 4040 3413 1008
00081 REM    $2950  0100 0304 1B1C 1C1C  0C04 0458 9010 2000
00082 REM    $2960  0008 FC06 FC08 EBAA  E380 8080 162F 5F40
00083 REM    $2970  505C 5B5B 5BD0 E8F4  0414 74B4 B4B4 41E3
00084 REM    $2980  0000 081C 7F00 0000  8000 3F22 B61C 0000
00085 REM    $2990  0800 0877 00FE 38F8  08E0 F880 C000 0830
00086 REM    $29A0  2018 0000 0000 0000  0000 0000 0000 0000
00087 REM    $29B0  0000 0501 0309 0000  09FF FFFF FFFF FFFF
00088 REM    $29C0  FFFF F8F8 F8F8 F8F8  F8F8 F8E0 A0E0 A0A0
00089 REM    $29D0  C0A0 A0E0 A0A0 E040  2020 20A0 E00E 0A0A
00090 REM    $29E0  0A0E 44EE FE7C 7C38  1038 7CFE 7C38 1038
00091 REM    $29F0  7CFE FED6 3838 FEFE  FE10 38AE AAEA 4A4E
00092 REM    $2A00  A0A0 A0A0 E040 4040  E0FB AAAB AAAB 8000
00093 REM    $2A10  0000 80AB A9A9 A9FB  B929 2928 A900 6B00
00094 REM    $2A20  6005 DAB5 7A08 F01E  DAB5 7A08 00EE 0000
```

Presentation

The language and operating system comes in a 4K EPROM that fits into the 'NET' or 'Terminal' socket of the Microbee coreboard or in the 'NET#2' socket of the ETI-673 Multiprom Board. A standard 2532 type EPROM is used, meaning that owners of 'Bees purchased after April 1984 should check that their unit isn't fitted with a 2732 EPROM in the 'Telcom' ('NET') socket. If so, a free changeover ROM is available 'priority paid' from Dreamcards (details on what to look for and how to swap over are contained in a broadsheet included with the operating manual).

The operating manual itself is very detailed and contains a wealth of material that takes you from the very fundamentals of 'memory', 'hex' and 'logic' up to the use of the operating system and the extended language subsets in an easy 'tutorial' style. This wealth of information makes it about the most comprehensive manual available for CHIP-8 and a very valuable reference for the experienced programmer.

At the other end of the scale, the newcomer to CHIP-8 will rapidly become familiar with the language by sitting down at the keyboard and carrying out the program examples.

In addition to a large number of demonstration programs designed to illustrate important features of the various instructions, the manual also contains source listings of two very useful machine code utilities and a full disassembler program. ●

THE CHIP-8 INTERPRETER/ COMPILER EPROM

is available from:

Dreamcards
8 Highland Court
Eltham North 3095 Vic.

It is only available by mail order from this address. It may also be obtainable from your local Dreamcards software dealer. It costs $49.95 (rrp) plus $1 post and handling.

CHIP-8 USERS' NEWSLETTER

An informative CHIP-8 user group newsletter, called "Dreamer", is published by **Frank Rees of 27 King St, Boort 3537 Vic.** You can get a 10-month sub. (September '84 to June '85) for $15, or 16 months (to December '85) for $24. Each issue contains articles on hardware additions and modifications to CHIP-8 computers plus software, tutorials, etc.

PICTURE SHIFTER SUBROUTINE

Peter Ball, Henderson, Auckland, NZ

This program is intended for use as a subroutine in games programs where sophisticated graphic manipulation is required.

It uses a machine code routine to move each dot on the screen one pixel each time it is run. It can move 255 bytes at a time, which amounts to about half the screen. The area affected by the routine can be specified from within the main program, and everything within this area will shift across the screen. It takes approximately 5 seconds to shift the image from one side to the other.

The data that defines the area of the screen affected by the subroutine is contained between 0704 and 0736. It is important to note that the sum of 0704, 0707 and 0736 must not be equal to more than 05FF. If it does you'll destroy the program.

Another point to watch is that the subroutine moves everything within 1B-2F, i.e: 0558-05FF, so anything that is supposed to stay still in this area will wind up moving backwards. To eliminate this problem, the stationary objects must be erased.

A control program has been included with the listing for demonstration purposes. ●

SUBROUTINE

```
0700 F8 00AE; 00→D→R(E).0
 703 F8 05 BF F8 58 AF; 0558→R(F)
 709 F8 06 BD F8 FE AD; 06FE→R(D)
 70F F8 07 BC F8 19 AC; 0719→R(C)
 715 0D; M(R(D))→D
 716 5C; D→M(R(C))
 717 8F; R(F).0→D
 718 FC --; M(R(P))+D→D,DF
 71A AF; D→R(F).0
 71B 0F; M(R(F))→D
 71C F6; SHIFT D RIGHT,LSB(D)→DF,0→MSB
 71D 5F; D→M(R(F))
 71E 1F.1E; R(F)+1→R(F),R(E)+1→R(E)
 720 0F; M(R(F))→D
 721 33 26; IF DF=1,M(R(P))→R(P).0
 723 F6; SAME AS 071C
 724 30 29; M(R(P))→R(P).0
 726 76; SHIFT D RIGHT,LSB(D)→DF,DF→MSB
 727 F9 80; M(R(P))OR D→D; R(P)+1→R(P)
 729 5F; D→M(R(F))
 72A 1F 1E; SAME AS 071E
 72C 8E; R(E)..0→D
 72D FB 08; M(R(P))XOR D→D; R(P)+1→R(P)
 72F 3A 20; 1FD<>0,M(R(P))→R(P).0
 731 0D; M(R(P))→D
 732 FC 08; M(R(P))+D→D,DF; R(P)+1→R(P)
 734 5D; D→M(R(D))
 735 FD A8; M(R(P))−D→D,DF; R(P)+1→R(P)
 737 3A 00; SAME AS 072F
 739 D4; 4→P (RETURN)
```

CONTROL PROGRAM

```
0600 1650
0650 6A00 6B2F C0FF C1FF C2FF 8014 8024
     6380
0660 8035 4F00 166C 3B1B 7BFF 1670 3B2F
     7B01
0670 A67E DAB1 6000 A6FE F055 0700 1654
     80--
```

SUBMARINE DEFENCE

Tim Parish, Myrtle Bank SA

In this game you are the commander of three submarines and your task is to defend them, and the islands on the surface, from the descending missiles. Each submarine has a store of five rockets — the ones remaining at any time are visible inside the subs. To knock out the missiles, just position the cross-shaped cursor (key 5, 6, 7, & E) where you want to explode a rocket, and hit a fire key (1, 2 or 3 — one for each sub). A rocket from the specified sub will then home-in on the designated spot and explode. In the meantime, the cursor can be moved elsewhere. Note that the rockets are restricted to an area 45 degrees each way from the vertical, starting from the launch point.

The missiles are of the multi-warhead type, splitting into three at random altitudes. Depending on where a missile hits, it may destroy an island, knock out a sub or explode harmlessly over the ocean.

There are four levels of play (blue, green, red and black, in that order) and you face two waves of missiles in each. Both the number and speed of the missiles increase with each level.

After every missile in a particular wave has either exploded or been hit, the score is updated and displayed. 50 points are added for each missile hit, 100 points for each remaining island and 200 points for each remaining submarine, which should give you some ideas for obtaining a high score (1500+).

```
0600 00ff 261e 262c 2a44 9ce0 2742 2922 4700
0610 2954 4701 2a24 4a01 1604 7c01 1608 6b00
0620 6d00 277e 6202 2b56 290a 00ee 6700 4b00
0630 163e acf7 f165 6201 2b56 60f0 2994 6400
0640 6000 a7b4 7401 f055 3410 1644 00ff acf6
0650 6005 f055 6e0a 290a 7b01 6a00 278a 2792
0660 6301 ac26 f355 278a 2792 ac32 f355 27c4
0670 2792 6300 ac3e f355 27cc 2792 63ff ac4a
0680 f355 27cc 2792 ac56 f355 4b01 1704 4b02
0690 1704 acf6 6006 f055 6e08 00ff 00ff 00ff
06A0 00ff 00ff 27c4 2792 6300 ac62 f355 3b03
06B0 16b8 0ce9 0ce9 1704 4b04 1704 acf6 6007
06C0 f055 6e06 27c4 2792 6300 ac6e f355 3b05
06D0 16d6 0ce9 1704 4b06 1704 0ce9 0ce9 4b08
06E0 0ce9 4b08 0ce9 27c4 2792 6300 ac7a f355
06F0 acf6 6008 f055 6e04 6e04 00ff 00ff 00ff
0700 00ff 00ff 00ff 3b09 170e 0ce9 0000 00e0
0710 ac92 681f 6917 d893 acf3 600c 6122 6238
0720 f255 a958 60e0 619e f155 a96c f155 a980
0730 f155 6000 6100 6200 acf9 f255 6c00 277e
0740 00ee 6400 7d01 4d03 6d00 6c00 ac26 f365
0750 40ff 1776 9120 62fe 32fe 1760 4d01 27d4
0760 ac24 d011 7101 4d00 8034 d011 412a 2800
0770 ac26 f41e f355 7404 3460 174e 00ee 00ff
0780 6004 61b0 acf7 f155 00ee 00ff c01f 7008
0790 00ee 00ff 8400 c10f a7b4 f11e f065 3000
07A0 1796 6001 a7b4 f11e f055 8040 71f0 c20f
07B0 7208 00ee ---- ---- ---- ---- ---- ----
07C0 ---- ---- 00ff c01f 7010 00ee 00ff c01f
07D0 7017 00ee 00ff 62ff 63ff 70ff f355 6301
07E0 7002 f355 6300 ac24 d011 70fe d011 7001
07F0 8f00 acf6 f065 7002 acf6 f055 80f0 00ee
0800 00ff d011 6200 70fd 71fb acc9 7205 f21e
0810 d015 6f00 7f01 3f15 1814 d015 4205 262a
0820 3219 180e 2b24 60ff 00ee 00ff a8a2 f355
0830 6304 6248 f200 f318 8235 3210 1834 f200
0840 f318 7204 3274 183e a8a8 f01e f065 ac24
0850 612a 4040 189c 4005 187a 401b 187a 4031
0860 187a d011 3f00 186c d011 189c d011 ac86
0870 6128 d013 6064 28ea 189c ace7 612c d012
0880 3f01 189a 4005 acf9 401b acfa 4031 acfb
0890 6001 f055 60c8 28ea 189c d012 a8a2 f365
08A0 00ee ---- ---- 00ff 0101 4040 4005 0505
08B0 0505 400f 0f0f 0f0f 4040 4017 1717 1717
08C0 4040 401b 1b1b 1b1b 4025 2525 2525 4040
08D0 402d 2d2d 2d2d 4040 4031 3131 3131 403b
08E0 3b3b 3b3b 4040 4040 00ff 00ff a906 f255
08F0 8200 acf7 f165 8125 4f00 70ff acf7 f155
0900 a906 f233 00ee ---- ---- 00ff 6400 ac26
0910 60ff 6100 6200 6300 f355 7401 3418 1918
0920 00ee 00ff ac92 d893 6f05 ef9e 1932 3803
0930 78fe 6f06 ef9e 193c 3903 79fe 6f07 ef9e
0940 1946 3839 7802 6f0e ef9e 1950 3923 7902
0950 d893 00ee 00ff 6001 e09e 196a acf9 f065
0960 4001 196a 6008 29ea 199e 6002 e09e 197e
0970 acfa f065 4001 197e 601e 29ea 19ae 6003
0980 e09e 00ee acfb f065 4001 00ee 6034 29ea
0990 29be 00ee f015 f007 3000 1996 00ee 00ff
09A0 acf3 6207 6300 29ce acf3 f055 00ee 00ff
09B0 acf4 621d 6314 29ce acf4 f055 00ee 00ff
09C0 acf5 6233 6328 29ce acf5 f055 00ee 00ff
09D0 f065 612e ac24 d011 70ff 5020 00ee 6000
09E0 61ff a958 f31e f155 00ee 00ff 6701 8290
09F0 7201 6302 8180 8105 64ff 3f00 1a04 8143
0A00 71ff 63fe 8214 8490 7401 612c acee f455
0A10 6283 6302 f200 f318 8235 324d 1a14 ac24
0A20 d011 00ee 00ff acee f465 ac24 d011 71fe
0A30 8f10 8f25 3f01 8034 9140 2a90 d011 acee
0A40 f455 00ee 00ff ac25 6000 612a d011 7008
0A50 3040 1a4c ac8a 6005 612c d014 601b d014
0A60 6031 d014 ac8e 600d d014 6023 d014 6039
0A70 d014 ac86 6001 6128 d013 600f d013 6017
0A80 d013 6025 d013 602d d013 603b d013 00ee
0A90 00ff 6700 62f9 70fd 71fd ac98 7207 f21e
0AA0 d017 420e 2ab8 6f00 7f01 3f10 1aa8 d017
0AB0 322a 1a9a aa93 00ee 00ff ab22 f155 6f02
0AC0 6010 f000 ff18 7004 30c4 1ac2 64fc ac92
0AD0 d893 ac26 7404 f41e 3460 1aea ac92 d893
0AE0 ab22 f165 ac98 f21e 00ee f165 40ff 1ad2
0AF0 ac24 d011 d011 3f01 1ad2 ac26 f41e 8310
0B00 6ff0 83f5 3f00 1ad2 8300 60ff f055 ac24
0B10 d311 6060 6f01 f000 ff18 2b24 6032 2b36
0B20 1ad2 ---- 00ff acf6 f065 70ff acf6 f055
0B30 4000 6a01 00ee 00ff ab52 f255 8200 acf7
0B40 f165 8124 4f01 7001 acf7 f155 ab52 f265
0B50 00ee ---- ---- 00ff abba f555 4202 1baa
0B60 8300 8410 6515 6600 abb8 f165 3201 1b7a
0B70 8034 8144 4f01 7001 1b82 8035 8145 4f00
0B80 70ff abb8 f155 2bc0 ac16 f465 f029 d565
0B90 7504 f129 d565 7504 f229 d565 7504 f329
0BA0 d565 7504 f429 d565 1bb2 6000 6100 abb8
0BB0 f155 abba f565 00ee ---- ---- ---- ----
0BC0 ac1b f655 8200 6327 6410 ac16 2be8 6303
0BD0 64e8 2be8 6300 6464 2be8 640a 2be8 8010
0BE0 f055 ac1b f665 00ee 65ff 7501 6600 8145
0BF0 4f00 72ff 4f00 6601 32ff 1c02 6200 8144
0C00 1c10 8235 3f00 1bee 8144 8234 4601 7201
0C10 8050 f055 00ee ---- ---- ---- ---- ----
0C20 ---- 00ff 80aa                  missile data
0C30 0C40 0C50 0C60 0C70 storage
0C80                 40e0 a000 037f df7f 00c0
0C90 60c0 40e0 4000 00ff 0000 0010 0000 0000
0CA0 0038 3838 0000 0038 7c7c 7c38 0054 aa54
0CB0 aa54 aa54 4220 8842 1420 8882 1088 2042
0CC0 0840 2004 8002 1000 2000 0000 3838 0000
0CD0 387c 7c38 7cfe fefe 3854 aad6 aa28 00aa
0CE0 10aa 1044 1082 1003 3fe9 61d4
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Rod Irving Electronics

SERIES 5000

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PREAMPLIFIER Kit Price $289, P&P $12.00

SPECIFICATIONS

Frequency response:	High-level input: 15Hz-130 kHz, +0, −1 db Low-level input — conforms to RIAA equalisation, ± 0.2 dB
Distortion:	1kHz < 0.003% on all inputs (limit of resolution on measuring equipment due to noise limitation).
S/N noise:	High-level input, master full, with respect to 300 mV input signal at full output (1.2V): >92 dB flat >100 dB A-weighted. MM input, master full, with respect to full output (1.2V) at 5 mV input, 50 ohm source resistance connected: >86 dB flat >92 dB A-weighted. MC input, master full, with respect to full output (1.2V) and 200 µV input signal: >71 dB flat >75 dB A-weighted.

On Special at $259
Normally $289

**All parts available separately for both kits.*

POWER AMPLIFIER Kit Price $319, P&P $12.00

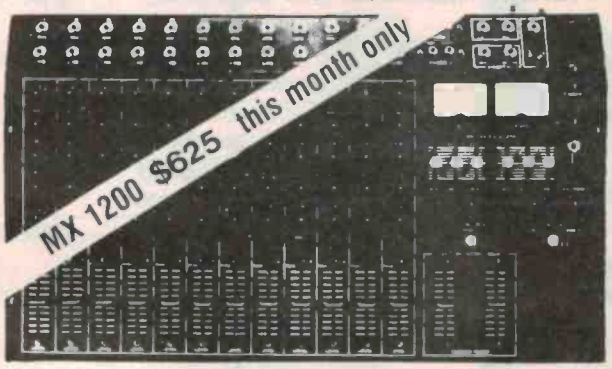
SPECIFICATIONS 150W RMS into 40hms

Power output:	100W RMS into 8 ohms (± 55 V supply).
Frequency response:	8 Hz to 20 kHz, +0 −0.4 dB 2.8 Hz to 65 kHz, +0 −3 dB. NOTE: These figures are determined solely by passive filters.
Input sensitivity:	1V RMS for 100W output.
Hum:	−100dB below full output (flat).
Noise:	−116 dB below full output (flat, 20 kHz bandwidth).
2nd harmonic distortion:	< 0.001% at 1 kHz (0.0007% on prototypes) at 100 W output using a ± 56 V supply rated at 4 A continuous < 0.003% at 10 kHz and 100 W.
3rd harmonic distortion.	< 0.0003% for all frequencies less than 10 kHz and all powers below clipping.
Total harmonic distortion:	Determined by 2nd harmonic distortion (see above).
Intermodulation distortion:	< 0.003% at 100 W. (50 Hz and 7 kHz mixed 4:1).
Stability:	Unconditional

Please note that the "Superb Quality" Heatsink for the power amp was designed and developed by Rod Irving Electronics and is being supplied to other kit suppliers. This product cost $1,200 to develop so that your amplifier kit would have a professional finish as well as sound.

On Special at $299
Normally $319

MX-1200 MICROPHONE/AUDIO MIXER



This unit features: 12 microphone line inputs with pan, bass, treble, effect and fold back controls for each channel • LED peak indicators for each channel • 2 turntable inputs with cross-fade and individual output controls • master equaliser for bass, midrange and treble • variable headphone output etc. etc • complete with carrying case.

SPECIFICATIONS:

INPUTS
Level-Impedance Mic 46 db/1K
Line 22 db/16K x 12
Phono 52 db/50K STEREO x 2 (2mv) at 1KHz
Effect Return (Aux) 20 db/50K x 1
OUTPUTS
Level-Impedance L & R 0 db/2K
Effect Send 0 db/2K F/B Out 0 db/2K
Head phone Stereo +10 db/600 (100 9K)
EQUALISATION
Channel
Bass ±15db
Treble ±15db
Master
Bass ±12db
Treble ±10db
Middle ±12db

FADER & CONTROLLERS
12 channel fader, Slide, 60mm, LOG 25%
2 Master fader, Slide, 60mm, LOG 15%
12 F/B Volume 300, LIN
1 F/B Master level, 300, LIN
12 Effect Send, 300, LIN
1 Effect Return, 300, LOG 15%
2 Phono, 300, LOG 15%
1 Head Phone 300, LOG 15%
S/N, 58DB
FREQUENCY RESPONSE 20-20 KHz
TOTAL HARMONIC DISTORTION Less than 0.1%
METER 2 Illuminated VU Meters 0db = 0.775V
PEAK INDICATOR 12 LED Peak Indicators
VOLTAGE 240 VAL 50Hz
POWER CONSUMPTION 7.2 watts
DIMENSIONS 620 (W) x 386 (D) x 108 (H) mm (supplied complete with carrying case)

THIRD OCTAVE GRAPHIC EQUALIZER

SPECIFICATIONS E.T.I. Dec. 1982

Bands:	28 Bands from 31.5 Hz to 16 kHz
Noise: 20 kHz bandwidth	<0.008 mV, sliders at 0, gain at 0 (−102 dB).
Distortion:	0.007% at 300 mV signal, sliders at 0, gain at 0: max 0.01% sliders at minimum.
Frequency Response:	12 Hz-105 kHz, +0, −1 dB, all controls flat.
Boost & Cut	14 dB

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$379.00 2 Units

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$50-$99.99	$3.50
$100-$199	$5.00
$200-$499	$7.50
$500 plus	$10.00

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Jazz up that OLD '80 BASIC

Jim Rowe

Don't feel you have to flog off that old TRS-80 or System 80 computer, just because its BASIC doesn't have some of the modern bells and whistles. The Custom BASIC treatment will give it a whole new life.

BACK IN February 1978 I previewed the first sample TRS-80 to land in Australia. The model 1 TRS-80 seemed an incredible breakthrough, offering so much computing power in such a low cost package. But now, thanks to galloping technology, both the TRS-80 and its Hong Kong step-brother the System 80 do seem a little puny compared with their ever-expanding tribe of successors.

With a mere 8-bit processor, memory expansion to only 48K, and disk drives sporting a paltry 100K of storage, they already seem eons behind the latest 32-bit, multi-megabyte marvels with their high-powered operating systems, mice and windows.

Yet the fact is that well over 30 000 of these 'first generation' personal computers were sold in Australia alone. And although they're obsolete in the strict technical sense, like last year's cameras, they're still capable of doing a lot of useful computing.

All the same, the Microsoft Level II BASIC in the ROMs of these old '80 machines does lack a few of the nice 'bells and whistles' that you get with the latest models. Wouldn't it be great if there was a low cost way to jazz up the old Level II ROM BASIC, and give your '80 computer a new lease of life?

Tarrah! Enter Custom BASIC, a software product marketed by a chap called Warwick Sands, up in sunny Mackay, Queensland.

Custom BASIC comes in either cassette tape or floppy disk versions, and what it does is allow you to expand your '80 ROM BASIC by adding a swag of extra functions, features and utilities. The machine language routines to handle these add-ons load into RAM and transparently 'patch into' the ROM BASIC, so that they effectively become a part of it.

The interesting thing about Custom BASIC is that it lets you select just the extras you want. So if you have a few extras like a flashing cursor routine and a lower-case driver already built into your particular machine, you can leave these out.

It works like this. On the tape or disk supplied, there are sixteen chained BASIC program mocules. When you load in the first module and fire it up, this starts a sequence of operations. The first modules let you select the functions and features you want; the later modules are loaded in as required to compile the machine language routines which provide those functions.

The final module lets you print out a summary of *your* version of Custom BASIC and dump it as either a 'SYSTEM' program on tape, or as a /CMD file on disk. Then you can run your custom expanded BASIC at any time, simply by loading this machine language program.

Just what features and functions does Custom BASIC provide? I've listed them in Table 1. As you can see, there's quite a lot of useful goodies.

Mr Sands sent me the disk version of Custom BASIC to check it out for myself. This version is compatible with most of the popular '80 operating systems, including TRS-DOS and NEWDOS-80. Like the tape version it comes with an informative 86-page manual, most of which is needed to explain what the various add-on functions do, and how they're used — syntax, etc.

Although the installation program mod- ▶

Keyboard features	Auto repeat; flashing cursor (choice of cursors); single key entry of commands; dump screen to printer; echo to printer; sound output with key depression; lower case driver
General functions	BEEP; BUZZ; DEF FN; DEF USR; #GOTO; &H, &D (hex-decimal-hex); #MOV; #RESTORE; #SWP; WPOKE
Tape utilities (tape version only)	LOAD; LOAD SYSTEM; MERGE; PRINT*; SAVE; SAVE SYSTEM
String functions	CVI, CVS and CVD; #DO; FIELD @; INPUT TO — USING; INSTR; LINE INPUT; LSET and RSET; enhanced MID$; MKI$, MKS$ and MKD$; $SORT
Screen graphics functions	#DRAW; #PLOT
Programming utilities	LMOV; RENUMBER; RENEW; VAR and VARL
Printer utilities	Ability to use <BREAK> key; dump screen to printer; serial printer driver; echo data to printer; spooler; set printer margins

Table 1. Features and functions offered by Custom BASIC.

Table 1

```
YOU HAVE SELECTED THE FOLLOWING ROUTINES:
=========================================
&%                                  CHR$64
BOOT                                #GOTO
#RESTORE                            A FAST STRING SORT
LPRINT SET                          LPRINT LENGTH=
BEEP                                BUZZ
#DO                                 #MOV
#DRAW                               #SWP
DUMP                                LIST VARIABLES
RENUMBER                            LINE MOVE
#PLOT                               WPOKE
FLASHING CURSOR                     RENEW
INSTR                               LINEINPUT
MID$=                               HEX-DECIMAL
<SHIFT CNTRL> E(DIT)                INPUT TO
<SHFT CNTRL> L(PRINTER)             LSET
RSET                                LOWER CASE VIDEO DRIVER
LOWER CASE KB DRIVER                SPOOLER



LOCATIONS OF INTEREST
CURSOR CHARACTER                                -2970
#SET CHANGES FLASH RATE
SYSTEM ENTRY POINT FOR 'RENEW' ROUTINE IS       63400

ENTRY POINT                                     61747

START OF DUMP IS                                61747
THE END OF THE DUMP IS                          65535


THE NAME OF THE COMMAND FILE IS  <<CBASIC/CMD:1>>
```

Features and functions. Illustrating what you can get in the Custom BASIC.

ules are fairly self-explanatory when they're running, you really need to read the manual before you start. If nothing else, this at least lets you see what the various functions and other add-ons do, so that you can decide which ones you want.

First, boot-up

Once I'd gone through the manual and worked out which ones I wanted, I fired up my trusty System 80 and booted up with NEWDOS-80. Then, following instructions, I called BASIC and told it to run the first installation module on the CBASIC disk, EBASIC/A. Up it came, and away we went. I told it which functions I wanted, and it chugged quietly away for about 20 minutes pulling in modules from the disk and dovetailing them together (it shows you its progress on the screen, to reassure you that it's all happening).

Finally, it asked me if I wanted to print out a list of the functions I had selected. So I replied with the requested 'Y', and received the listing shown. As you can see, it also shows the size and location of the final Custom BASIC machine language program, and various other points of interest.

Then it asked if I wanted it to dump the program (it had previously asked what filespec to use). When I replied 'Y', it whirred away for a few seconds and promptly crashed — because there wasn't any room for the file on the CBASIC disk.

My own fault, of course. I had read in the manual that the disk supplied was virtually filled to the brim with the installation modules. But I'd forgotten to replace the disk with another before I gave it the go-ahead to dump the file.

Although Mr Sands has built recovery routines for quite a few errors into the installation modules, this particular error didn't seem to be among them. So there was no alternative but to get NEWDOS-80 to format a new disk, ready for the final dump, and start the whole 20-minute procedure all over again.

This time I did remember to swap disks, and the file was dumped out without a hitch. Whew! Then it was simply a matter of booting up again, loading in my custom CBASIC file, and exploring the extra features of my suddenly-more-powerful BASIC.

How powerful?

And much more powerful it is. For example, I can now use the INPUT TO statement to bring in either numeric or string data from the keyboard and plunk it into a specified field on the screen. This is much faster than the old way of using a slow and messy set of nested subroutines.

I can now do much faster sorting of string arrays, too. All you need to do is call the $SORT function. That most useful of string functions, MID$, can now be used on the left-hand side of an assignment statement too — very handy.

Screen graphics are now much easier, and faster, with functions like #DRAW and #PLOT. And there's a set of new commands to manipulate data in memory, like WPOKE (which pokes two bytes at once), #MOV (which is a block move) and #SWP (a block swap).

Along with these goodies are a lot of the things you normally only get with disk BASIC. Things like hex-to-decimal conversion, extended USR functions, LSET and RSET, and the numeric-string conversion functions CVI,CVS,CVD,MKI$,MKS$ and MKD$. Plus things that some of us have in EPROM, like flashing cursor and lower case drivers.

The only problem I found in using Custom BASIC's lower case drivers with my System 80 was that they somehow didn't seem to work properly with the printer. Lower case got through to the printer when the 'echo' function was in operation, but not when I tried to use the new screen dump or normal LPRINT functions. A minor point perhaps, but it'd be nice if Mr Sands can fix it.

By the way, Custom BASIC also has a spooler function to speed up program operation when things have to be printed. And the initialisation modules allow you to decide how much of your main RAM is set aside as the spooler buffer.

Frankly, I'm still exploring the extra goodies that Custom BASIC brings. But hopefully by now you get the idea. It's quite a neat package, and shows evidence of a lot of 'fine tuning'. I gather from Warwick Sands that early versions have been in use for around 2½ years.

All in all, it seems a nice package and excellent value for money at the quoted price of only $49.95 for either the tape or disk version, including packing and postage anywhere in Australia.

Where do you get it? Direct from **Warwick Sands, Flat 1, 19 Gable Street, Mackay Qld. 4740.** ●

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TOUCH

◁ Out with the old.
In with the new! ▽

A lad asks; a lass shall; a glad lass has salad. Why did the glad lass finish off her night's enjoyment with a bowl of salad? Breep! The Microbee's touch typing course sure gets results. The Commodore's program is more polite, the BBC's is gentle on the beginner and the Apple's blasts you off in a spaceship.

Tom Moffat
39 Pillinger Drive, Fern Tree, Tas 7101

ALMOST EVERY COMPUTER on the market today offers a course in touch typing in its software library. There's a good reason for it — they've all got nice flashy keyboards out front, but most owners wouldn't have a clue how to use them properly.

Although two-fingered typing is the general rule, it's becoming more and more obvious that most of us are going to have to acquire 'keyboard skills' sooner or later; that is, we'll have to learn to touch type. type.

If the experts are right, conducting business in the next generation will be just about impossible without personal computers, and their attendant keyboards. Today's newest business computers use 'mice' to get around the typing problem. Mice may be nice, but try entering text with one. It's just not on.

Today you might dictate your letters. But with the cost of labour going up all the time, you'll most likely be doing it yourself tomorrow, with the help of your trusty word processor.

"She only works in the typing pool . . ." — a disparaging remark from the past. But now I know what 'she' went through to get there. A long, hard slog to learn a skill that looks like magic to the uninitiated.

In my own case, 15 years as a journalist had left me with a two-fingered typing method that was fairly fast, but required constant staring at the keyboard instead of the material being typed. I had to un-learn the old method while learning the new. But looking back on it the effort was certainly worthwhile, even though I'm now stumbling through a keyboard I used to know by heart. Maybe with practice . . .

In this article we'll look at four typing courses, for the Commodore, the Apple, the BBC, and the Microbee. The Microbee program will get the most attention, since that's the one I've been learning on, for at least two hours a day for the past month.

Microbee's growls

Mytek's "Touch Type Tutor" takes an absolutely traditional approach to the subject. The blurb that comes with the program says it's based on the Pitman method. I got the Pitman book out of the library to see how closely the program follows it. The first printing of the book was in 1947. But the computer's use of the method shows that it's stood the test of time.

From my high school days I remember a classroom full of girls (only girls typed then). Most days there were big blackout curtains on the windows, and an old Bell and Howell 16 mm projector throwing an image of a typewriter keyboard up on a screen. (I volunteered to run the projector, as I was partial to darkened rooms full of girls.) On the screen a bouncing spot of light danced from key to key, and the girls followed on the typewriters in front of them . . . *clack-clack-clack-clack* . . . all in unison. The Pitman method in action.

TYPING IN THE COMPUTER AGE

Mytek's program is almost identical, except you've got a Microbee screen instead of a movie screen. The spot of light is there, dancing along on a picture of the keyboard. Below that, the line of characters that is your exercise, with a little arrow that points out which letter to type. And lower still, the text as you type it in.

The computer starts you off on the 'home' keys, with some exercises to train your fingers to find them. From time to time you get a screen of instruction, introducing some more fingerings. But the fingerings given for the lowest row of keys are different from those in the Pitman book — they're all shifted one key to the right. The other programs agree with the Microbee version, so perhaps they're taking into account the extra keys found at the right of computer keyboards.

The Microbee program has one slip-up in it. When it introduces the last two keys for the centre fingers on the bottom row, the program gives V and B, instead of the expected B and N. So V has been introduced twice and N never gets a mention. But the associated exercises stress B and N.

As each exercise is completed you are shown a score card with the number of characters typed, the speed, and the accuracy. You must be 100% accurate before you're allowed to progress to the next exercise. If you make one mistake you must do it all again.

Mytek's blurb says "learn touch typing in hours." Would you believe 65 hours? That's what it took me. The instructions say you will find the course boring at times, and they aren't wrong. It's just lots of rote practice, like playing scales on a piano, but you've got to do it if you want to learn to type.

The program's authors have put a lot of thought into relieving the boredom. Where Pitman's book uses such exercise phrases as "the guard said the the lads had paid their fare," Mytek comes up with such gems as "a lad asks; a lass shall; a glad lass has salad;". One can then ponder why the lass in question finished off her night's enjoyment with a bowl of salad.

The real kicker, though, comes when you score a perfect run through an exercise at a speed of at least 30 words a minute. The computer then speaks to you: *"VERRY GOOOD!"* it says, in the tone of voice Barbara Woodhouse would use if one of her dogs had just done walkies for the first time. It's a digitised voice send-up; but jolly good fun. You really work to get a "very good" out of the computer and, of course, that's the object of the program.

Still, learning to type is damn hard work, even with the light diversions. You type away, knowing you have to get something like 300 consecutive characters absolutely correct, and if you blow it you've got to do it all again.

Every time you make a mistake the computer delivers a raucus *"breep!"* and things flash on the screen. If this happens say five characters from the end, you tend to emit certain unsavoury words. My wife says when I learned to type, my kids learned a whole new vocabulary.

The Microbee's keyboard sometimes gives you two characters for one hit of a key — an undeserved error. One time I very nearly brought a fist down on top of it. But smashing the computer won't help things.

On another occasion I'd worked for about two days on one hard exercise, and I'd just about cracked it. I was terribly tense, and my hands were shaking something awful. Then, during the last few characters I started getting chest pains, and I thought I was going to be the first person in history to score a heart attack from a computer. But it was a false alarm, quickly cured with a belch, followed by a *"breep"* and more swearing.

Then came the day I was working my way through an exercise when I suddenly realized that the text was just appearing on the screen, without conscious effort from me. I was touch typing! All those hours of growling and grizzling had finally come to something. So despite my harsh thoughts and rude comments about Touch Type Tutor, I should point out that it does in fact work. It taught me to touch type.

Mytek tell me that they've had some complaints about Touch Type Tutor, especially the difficulty of the exercises, and now they're changing it. But I wonder if that's really wise — the program in its present form might be bloody hard going, but it certainly gets results! Its current price is $22. (Note: Between the time this was written and prepared for publication, Mytek has ceased trading. Rod Irving Electronics has taken up the software rights.)

Commodore's politeness

The Commodore 64 typing tutor from Ozi-Soft does make things softer for the budding typist. Visually it's much like the Microbee program. There is an image of the keyboard on the screen, this time in colour, and you're given an exercise to follow.

When the program first signs on it says "Hi there. My name is John. What's yours?". You enter "TOM" or whatever. Then, when an exercise is completed, it says something like "Well, TOM, you didn't do too well that time, did you. Better try it again." After you've done better, you're allowed to progress to the next lesson. Note that your result doesn't have to be perfect, just acceptable. Much lower blood pressure in this program.

I can't help imagining how the Microbee would have put it. "Well, TOM, you really stuffed it didn't you. Go stand in the corner for an hour, slit your throat, and then come back and try to get it right, you incompetent, useless fool!"

The Commodore, by the way, has a lovely keyboard for touch typing, though some of the key positions are non-standard.

BBC's gentleness

Now to the BBC offering, which you've probably seen advertised on ABC television. Again, a picture of the keyboard on the screen, only this time, the exercise for you to type is above instead of below the keyboard image. And again, the program is based on the Pitman method.

Like the Commodore the BBC is gentle with you when you mess up an exercise. When I scored 88% on one, which is quite disgusting, it simply said "take more care". Very civilised.

The graphics in the program step along very smartly, even though the program is written in BASIC; which must say something for BBC BASIC. I must admit I've always admired the way it handles graphics.

The keyboard is a pleasure to type on, with no bad habits like double-hitting. But it isn't quite as nice as the Commodore. You don't touch Commodore keys, you fondle them. The BBC program's biggest downfall is its price — at $75 for one cassette it's more than three times as costly as the Microbee or Commodore equivalents. ▶

Apple's blasts

"Mastertype" is one of the many typing programs written for the Apple, and it's as different from the others as night is from day. Mastertype is an arcade style game, with every attempt made to kill the boredom of rote typing practice.

There are 17 lessons, with instruction screens interspersed with ever harder versions of the 'game'. In Mastertype the trainee typist is in a spaceship in the centre of the screen. Four evil spinning objects approach from the corners of the screen intent on colliding with your ship. In the extreme corners are groups of letters, or complete words, that form your typing exercise.

You must type the word in a corner to destroy the enemy ship coming from that corner. Once the game is underway you must keep checking all the corners at once, quickly typing words to prevent your destruction.

All this activity seems to happen blindingly fast, and it's really hard to keep up with it. The program apparently takes note of the words you constantly miss and serves them up more frequently, for more practice. The technique develops an automatic reflex action — see a letter and hit its key, without thinking.

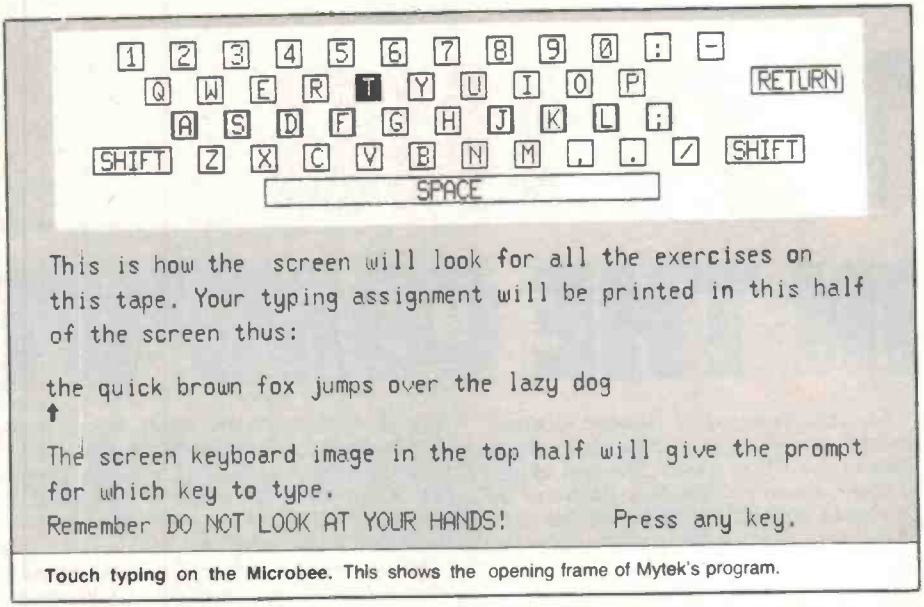
Unfortunately what it doesn't do is let you type in a natural way, working along a line of text. If you think about it, what's really happening is that you are taking note of text several words along from where you're actually typing. So there are no surprises, and your typing flows smoothly along.

In Mastertype you blast a word, and then blast another. What would be nice would be a program that combines the Pitmans and Mastertype methods. If you could get through that lot nothing would stop you.

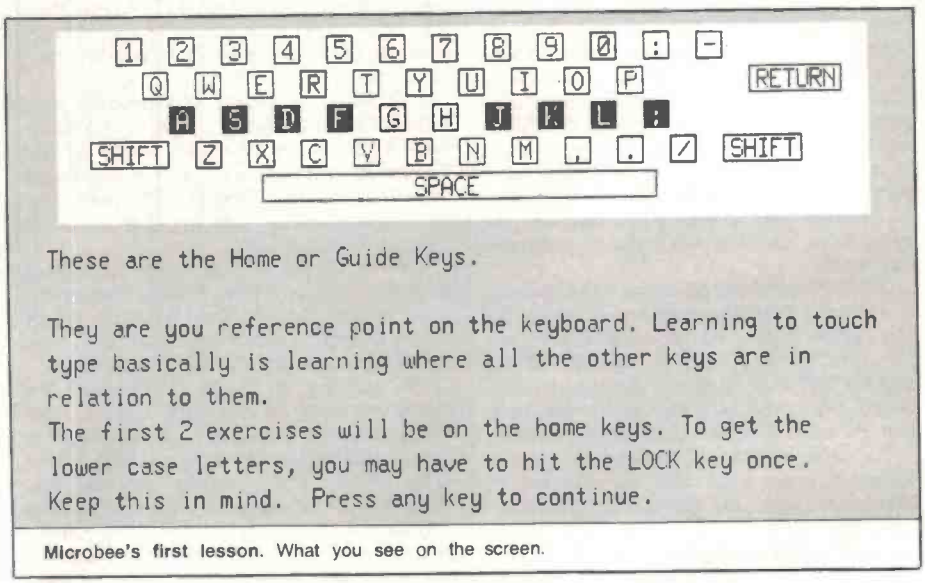
Even though 17 lessons are supplied, Mastertype lets you make up your own exercise words if desired, which later come up as part of the game program. The version of the program I saw had been got at by some mischevious youngster you'd inserted such lovely words as 'maggot' and 'punk'.

Mastertype is priced at $59.95 on disk, which isn't far off the usual price charged for Apple programs. From the looks of it a lot of effort went into Mastertype.

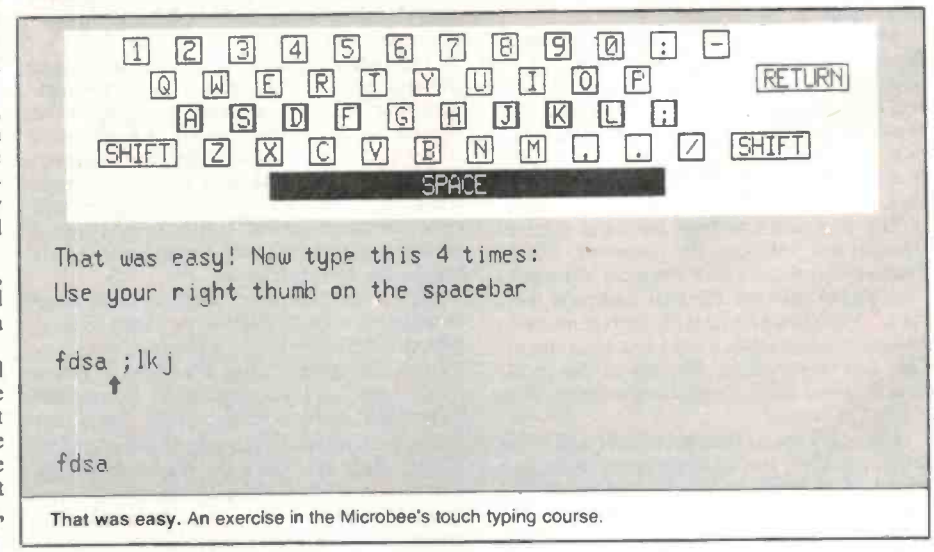
This certainly isn't an exhaustive list of all typing programs available for the above computers, or for other computers. But it might just get you interested in biting the bullet, and finally learning to touch type just like I do. Nowadays, you see, I can just place my fingers on the keys, close my eyes, and skiy je ip ruhhlagh. Oh hell! ●



Touch typing on the Microbee. This shows the opening frame of Mytek's program.



Microbee's first lesson. What you see on the screen.



That was easy. An exercise in the Microbee's touch typing course.

EXTENDING VZ 200 BASIC

Following on from a previous article ("More functions for the VZ200" — ETI March 1984) this article outlines a method of adding commands to the standard VZ200 BASIC.

Steve Olney

THE PREVIOUS article showed how to unlock several 'hidden' functions contained in the VZ200 BASIC ROM by entering the commands indirectly via a BASIC program itself. This approach meant that it was necessary to run the BASIC program each time the function was needed. This is very inconvenient and, as was hinted at in the previous article, a more elegant (and more convenient) approach would be to have the added functions accessed as if they were part of the original command set.

This article gives a method by which this can be done and gives a practical example by making the AUTO command part of the legal VZ200 BASIC command set.

The machine code necessary to achieve this is quite short because, as indicated in the previous article, the code which does the bulk of the work is already resident in the VZ200 BASIC ROM. It is only necessary to get the BASIC interpreter to recognise the auto line-numbering command (AUTO X, Y) as legal and then jump to the relevant code in ROM.

The method outlined here only applies to adding commands to the 'immediate execution mode'. (i.e: typing in commands without line numbers). It does not deal with commands that are to be used within programs.

How it works

Those who are only interested in the end result of adding the AUTO command to the legal commands can skip this section and go straight to the section dealing with entering the program. Those who are interested in how it works — read on!

The reason why it is possible to add commands to the standard VZ200 BASIC command set (thereby extending it) is that, in common with some other BASICs, at various points in the machine code in ROM, calls are made to locations in RAM. This makes it feasible to modify and/or extend the code at a later date. A common example is where a disk system is added later. An extended or enhanced BASIC can be implemented by downloading extra code off disk to the relevant called location. If all the code was executed in ROM then this could not be done.

In a non-disk system (such as the present VZ200) these called locations are usually initialised to '0C9H' (H means hex address of location), which is Z-80 machine code for Ret. So normally, when these RAM locations are jumped to via 'calls' from the BASIC ROM, execution returns immediately to the BASIC ROM via the 'Ret'.

Now, because the Ret's are in RAM, it is possible to change the Ret to a jump to extra code which will be executed before control is returned back to the BASIC ROM.

In the VZ200, all the calls from the BASIC ROM to RAM are to locations between 7952H and 79E2H. One of these exits will be used to add Auto X,Y to the legal command set.

The BASIC interpreter

Leaving the ROM exits for the moment, consider what happens when an 'immediate execution' command is entered. While the text is being typed in, the character codes for each key-press are being entered into a text buffer at around 79E8H. When Return is hit, the interpreter looks at what has been entered into the buffer. Scanning from left to right, it looks for 'reserved words' (words set aside for commands e.g: Print, List etc.). The BASIC ROM contains a list of these reserved words beginning at 1650H and ending at 1820H. This can be revealed by an ASCII dump of this block of memory (the first letter of each reserved word has 80H added to ASCII code which will result in garbage for that letter.)

The interpreter scans the text trying to find one or more of these reserved words. when one of these is found the reserved word text is replaced by a single byte or ▶

'token' (80H to 0FBH). The token is the offset into the list where the reserved word is located and is used as an index into another table which contains the address of the machine code for that command.

If the text cannot be resolved into reserved words or text which belongs to the reserved words, then a Syntax error message is generated. The trick is to intercept control of the interpreter just after the reserved list has been scanned and add code to re-scan the text to see if it contains the new command Auto X,Y.

By good fortune (or good design), immediately after scanning has been done there is a call to RAM (to 79B2H). The Ret (0C9H) at 79B2H is changed to a jump to extra code which will re-scan the text buffer for Auto and if found, will replace the text with the relevant token.

Because only the reserved word list is disabled (by deleting Auto from it), once the Auto command text has been replaced by the correct token (0B7H), the following interpreter code will recognise the token and accept it as legal.

Entering the program

The machine code program is entered via a BASIC program (Listing 1) which POKEs the code into RAM from Data statements. The BASIC program locates the machine code to high memory after resetting the BASIC top-of-memory pointer to below where the code will be POKEd. By this, the machine code program is located out of the way of any BASIC program to be entered later. This action is independent of memory size.

The machine code listing is shown for reference only. All that is necessary is to enter the BASIC Program, save it on tape, and from then on just run it before you start entering your BASIC program. If all is well, control will be returned to the Ready level and, unless the machine code is overwritten by POKEs or the VZ200 is reset, the Auto command is now part of the immediate command set.

Auto command syntax

The form of the Auto command is 'AUTO X,Y' where X is the starting line number and Y is the increment beteen line numbers.

Entering AUTO X will give a starting line number of X and a default increment of 10, while entering AUTO, Y will give a default starting line number of 10 and an increment of Y. AUTO by itself will give both the line number and increment a default of 10.

To exit the Auto mode, hit 'CTRL BREAK'. Entering the Auto mode with line numbers of statements already entered can be a useful single step checking and editing feature (see previous article).

Adding other commands

This method can be used for 'unlocking' other commands 'hidden' in the VZ200 BASIC ROM. As shown in the previous article, the commands TRON and TROFF are also accessible. In the time since that article was submitted it has been found that the code for a delete command (DEL X-Y), with the same syntax as the LIST command, is also present in the VZ200 BASIC ROM.

The listing for a BASIC program that 'unlocks' the 'hidden' code for the AUTO, TRON, TROFF and DEL commands is available from the author. It is of the same form as the program described here.

What next?

The above four extra commands have proved to be very useful and have resulted in significant time-savings in writing BASIC code. Other useful commands would be REN (line re-numbering), MERGE (merging small sub-programs on tape into one program — difficult, because it appears that the VZ200 CLOAD always loads a BASIC program to the location in

memory from which it was CSAVEd), DH and HD (allows decimal to hexa-decimal conversion, and vice-versa). These would be much more difficult to implement as there is no code present in the VZ200 BASIC ROM, so they will have to be written from scratch.

Cautions

Firstly, as this program uses code in the Version 2.0 BASIC ROM, users with other versions (if any) will have to check to see if the program works with their version.

Secondly, you may have already found that during normal program entry, occasionally the cursor will skip a line after you hit Return. This is of no real consequence — until now. Unfortunately the auto line-numbering code doesn't like this and responds by displaying the next line number as it should, but then positions the cursor at the beginning of the next line. Any BASIC statements or text entered on that line will be lost.

Each time Return is hit for a new line number, check to see that the cursor is on the same line as the new line number. If it isn't, hit Return again. This will skip to the next line number. Do this until the cursor is positioned on the same line as the new line number, then it is OK to enter statements. Unless you are fussy the missed line numbers should not be a problem. Of course, you can exit the auto mode (CTRL BREAK) and restart so as not to miss a line number.

A printed listing of a larger program to add the AUTO plus TRON, TROFF, DEL commands to the legal command set can be obtained for $5.00 from the author at: **200 Terrace Rd, North Richmond NSW 2754.** Remember YOUR address! (pref. SAE) ●

```
■ Machine Code Source Listing

;  ***************************************************
;  **                                               **
;  **  BASIC AUTO LINE-NUMBERING UTILITY FOR THE VZ200  **
;  **          COPYRIGHT (C) 1984 BY STEVE OLNEY        **
;  **         200 Terrace Rd. North Richmond 2754       **
;  **                                               **
;  ***************************************************
;
;  MACHINE CODE PROGRAM (POKE'd from the Basic program)
;
;  Actual origin depends on the size of the memory in the
;  VZ200 used.
;
START   ORG     0000H
;
;  Save registers to be used
;
REGSAV  PUSH    AF
        PUSH    BC
        PUSH    DE
        PUSH    HL
        PUSH    IX
;
;  This code scans the text buffer for the 'AUTO' command.
;
AUTOSC  LD      B,03            ;Number of bytes to scan
        LD      IX,AUTTXT       ;Pointer to 'AUTO' text table
SCAN1   INC     HL              ;Adjust to next byte in buffer
        LD      A,(IX+00)       ;Get first byte of table
        CP      (HL)            ;Compare with byte in buffer
        JR      NZ,EXIT-$       ;If not equal then exit
        INC     IX              ;Move to next byte in table
        DJNZ    SCAN1-$         ;Loop back until 3 bytes done
;
;  Execution drops through to here if all 3 bytes match.
;  The 'AUTO' text is replaced with its token (0B7hex) and
;  the rest of the text (operands if any) is closed up behind
;  the token.
;
FNDAUT  PUSH    HL              ;Save end of 'AUTO' in buffer
        DEC     HL              ;Move back to beginning of
        DEC     HL              ;'AUTO' text in buffer
        LD      (HL),0B7H       ;Replace first byte with token
        LD      BC,0000H        ;for 'AUTO'
        POP     DE              ;End of 'AUTO' text in buffer
        EX      DE,HL           ;HL=end of 'AUTO',DE=token
        INC     DE              ;Adjust DE to next byte
SKIP    INC     HL              ;Adjust HL to next byte
NEXT    LD      A,(HL)          ;Get byte from text buffer
        OR      A               ;Is it zero ?
        JR      Z,ENDLIN-$      ;If zero then end of line
        CP      20H             ;Is it a space ?
        JR      Z,SKIP-$        ;Yes ? Then skip to next byte
        LDI                     ;No ? Then transfer byte
        JR      NEXT-$          ;forward and continue
;  Line in text buffer must terminate with three zero bytes
;  and register 'C' must contain the new line length
;
ENDLIN  LD      (DE),A          ;Terminate line with three
        INC     DE              ;zero bytes.
        LD      (DE),A
        INC     DE
        LD      (DE),A
        LD      A,C             ;New text byte count-1, add 6
        CPL                     ;to complemented negative no.
        ADD     A,06            ;to adjust to line length+1
        LD      (LINLEN),A      ;and store it
;
;  Restore registers
;
RESREG  POP     IX
        POP     HL
        POP     DE
        POP     BC              ;Do this just to empty stack
        POP     AF
        LD      BC,(LINLEN)     ;Restore BC with new line
        LD      B,00H           ;length on return to ROM
        RET
;
;  Auto command not found so we return to ROM without
;  altering text or 'C' register.
;
EXIT    POP     IX
        POP     HL
        POP     DE
        POP     BC
        POP     AF
        RET
;  Text table for the 'AUTO' command. Because the 'TO' in
;  'AUTO' is a reserved word, it will have already been token-
;  ised. The token for 'TO' is 0BDH.
;
AUTTXT  DEFB    'A'             ;ASCII "A"
        DEFB    'U'             ;ASCII "U"
        DEFB    0BDH            ;Token for "TO"
LINLEN  DEFS    2
```

LISTING 1

```
0 REM  ***************************************************
10 '   ** USE THE SHORT FORM "'" FOR THE REST OF THE "REM"S **
20 '   **                                               **
30 '   **  BASIC AUTO LINE-NUMBERING UTILITY FOR THE VZ200  **
40 '   **          COPYRIGHT (C) 1984 BY STEVE OLNEY        **
50 '   **         200 TERRACE RD. NORTH RICHMOND 2754       **
60 '   **   "AUTOBAS" TAPE FILE #17-B  9/5/84 VERSION 1.2   **
70 '   **                                               **
80 '   ***************************************************
90 '
100 RB=100:TM=(PEEK(30897)+PEEK(30898)*256)-RB:'GET TOP OF
110 MS=INT(TM/256):LS=TM-MS*256:'                MEMORY AND MOVE
120 POKE30897,LS:POKE30898,MS:'                  DOWN 100 BYTES
200 CLEAR50:'                              RESET BASIC STACK PTR
230 TM=(PEEK(30897)+PEEK(30898)*256):'  NEW TOP OF MEMORY
235 M1=INT((TM+1)/256):L1=TM+1-M1*256:' NEXT LOC'N ABOVE T.O.M.
240 ST=TM:IFST>32767THENST=ST-65536:'   START OF M/C PROG.-1
250 FORI=1TO82:'   LOAD 82 BYTES OF MACHINE CODE INTO RESERVED
255   READD:'      AREA ABOVE BASIC TOP OF MEMORY
260   POKEST+I,D
265   CS=CS+D:'    UPDATE CHECKSUM TOTAL
270 NEXTI
275 IFCS<>9861THENPRINT"-- ERROR IN DATA ENTRY --":END:' CHECKSUM
280 FORI=1TO3:READLB,OS:TS=TM+OS:'  BECAUSE PROGRAM IS RELOCATED
290   MT=INT(TS/256):LT=TS-MT*256:' ABSOLUTE LOCATIONS NEED TO
300   POKEST+LB,LT:POKEST+LB+1,MT:' LOADED
310 NEXTI
365 ' ALTER "RET" AT 7982 HEX TO JUMP TO START OF MACHINE CODE
370 POKE31155,L1:POKE31156,M1:POKE31154,195
380 POKE30862,249:POKE30863,0:' LOAD CALL TO "READY" ROUTINE
390 X=USR(0):'                  AND GO TO IT
395 ' DECIMAL EQUIVALENT OF MACHINE CODE PROGRAM INSTRUCTIONS
400 DATA245,197,213,229,221,229,6,3,221,33,79,0,35,221,126,0
410 DATA190,32,53,221,35,16,245,229,43,43,54,183,1,0,0,209,235
420 DATA19,35,126,183,40,8,254,32,40,247,237,160,24,244,18,19
430 DATA18,19,18,121,47,198,6,50,82,0,221,225,225,209,193
440 DATA241,237,75,82,0,6,0,201,221,225,225,209,193,241,201
450 DATA65,85,189
460 DATA11,80,58,83,68,83
```

ANIMATION

Lindsay Ford, Eltham North Vic

Many Microbee owners won't be aware that their computers contain two VDU RAM areas, not just one. The second screen area is from $F400 to $F7FF. By writing graphics into this RAM then switching between screens, it is possible to achieve very fast animation with BASIC. This short program illustrates how it is done. Note that the transfer of graphics from screen 1 to screen 2 is achieved with a short machine code routine that is POKEd into the 'ABCD . . .' in line 100. So line 100 should be entered exactly as shown here and no lines should be put ahead of it.

```
00100 REM ABCDEFGHIJKL <<<<< Machine Code
   stored here
00110 REM Transfer Machine code routine
   to line 100
00120 FOR X=0 TO 11: READ Y:
   POKE 2310+X,Y: NEXT X
00130 DATA 33,0,240,17,0,244,1,0,4,237,
   176,201
00140 REM Print Screen 1
00150 CLS: FOR X=1 TO 62 STEP 4: CURS X,1:
   PRINT "*": CURS X,16: PRINT "*";:
   NEXT X: FOR X=1 TO 15 STEP 2:
   CURS 64,X: PRINT "**";: NEXT X: CURS
   28,8: PRINT "GETTING"
00160 REM Transfer Screen 1 to Screen 2
00170 X=USR(2310)
00180 REM Print new Screen 1
00190 CLS: FOR X=2 TO 62 STEP 4: CURS X,1:
   PRINT "*": CURS X,16: PRINT "*";:
   NEXT X: FOR X=2 TO 14 STEP 2: CURS
   64,X: PRINT "**";: NEXT X: CURS 29,9:
   PRINT "DIZZY?"
00200 X=0: CURS 0
00210 REM Initialise Screen swop
00220 IN#6 ON: OUT 12,12
00230 OUT 2,64: OUT 2,0: PLAY 0,1: REM
   Make 'click' and delay
00240 REM Next two lines are Screen swop
   routine
00250 IF X=0 THEN OUT 13,4: X=1: GOTO 230
00260 IF X=1 THEN OUT 13,0: X=0: GOTO 230
```

STRING EDITOR

D. J. Whyatt, Sth Plympton SA

In any program using BASIC strings to store text, it is often useful to be able to edit the string while it is being entered, or to re-edit it at some later stage. There are no standard features in BASIC to do this, without re-entering the whole string, or simply adding to the string.

The string to be edited is passed as a parameter to the subroutine, and is returned in A1$. If a null string is passed, then a string will simply be created.

The editor commands are as follows:

BACKSPACE — Non-destructive backspace
LINEFEED — Non-destructive forward
DELETE — Destructive backspace from end of string
I — Insert a space
D — delete character under cursor
B — beginning of line
E — end of line

NOTE: The^ implies that the control key is pressed with other key.

```
01000 rem      STRING EDITOR
01002 rem
01005 rem    VARIABLES USED : L,P,Z,A1$,Z1$
01007 rem
01010 var(A1$)
01020 L=len(A1$):P=1
01030 print A1$;
01040 if L=0 then print" " chr(8);:goto 1060
01050 for Z=1 to L:print chr(8);:next Z
01060 Z1$=key$:if Z1$="" then 1060
01070 Z=asc(Z1$)
01080 if Z=8 and P>1 then print chr(8);:P=P-1:goto 1060
01090 if Z=10 and P<=L then print A1$(;P,P);:P=P+1:goto 1060
01100 if Z=2 and P>1 then for Z=1 to P-1:print chr(8);:next Z:P=
1:goto 1060
01110 if Z=5 and P<=L then print A1$(;P,L);:P=L+1:goto 1060
01120 if Z=9 and P<=L then print" " A1$(;P,L);:for Z=0 to len(A1
$(;P,L)):print chr(8);:next Z:A1$=A1$(;1,P-1)+" "+A1$(;P,L):L=L+
1:goto 1060
01130 if Z=4 and P<=L and L>0 then print A1$(;P+1,L) " ";:for Z=
1 to len(A1$(;P,L)):print chr(8);:next Z:A1$=A1$(;1,P-1)+A1$(;P+
1,L):L=L-1:goto 1060
01140 if Z=127 and P=L+1 and P>1 then print chr(127);:A1$=A1$(;1
,L-1):L=L-1:P=P-1:goto 1060
01150 if Z=127 then 1060
01160 if Z=13 then print:return
01170 if Z<32 then 1060
01180 if P<=L then print Z1$;:A1$=A1$(;1,P-1)+Z1$+A1$(;P+1,L):P=
P+1:goto 1060
01190 print Z1$;:A1$=A1$+Z1$:P=P+1:L=L+1:goto 1060
```

PCG CREATER

Peter Easdown, Kew NSW

I wanted an easy way to draw and create PCG, characters so I wrote this program.

It comes up with a blank screen and the letters A to X across the top and some keys functions at the bottom of the screen.

Looking at the screen, you will notice the 'A' flashing, and a dot flashing near it. These indicate the whereabouts of the cursor. Try moving it by pressing W,A,S, or Z, and you'll notice that the indicators move accordingly. By pressing U,I, or O, you can Set, Invert, or Reset the block at that position. By pressing 'C', you can clear and start again, and by pressing Return, the program will compile the shape into three PCG's, and will display the result and give the data for use in your own program.

Once you have the end result, you can either go back and edit the shape or go back and press 'C' to start again. In this program I used a couple of ideas from other programs. One was the Screen Saver by D. J. Whyatt published in August 1983 ETI, the other, was a couple of lines out of a program called Character Generator by Miroslav Kostecki in the June 1983 issue of ETI.

```
00010DIM A(16),B(16),D(16):GOSUB1100
00020GOSUB1000:X=18:Y=44:CURS1,10:PRINT"'W' - UP,  'A' - LEFT,  'S' - RIGHT,  'Z
' - DOWN.":PRINT"'I' - INVERT,  'U' - SET,  'O' - RESET,  'RETURN' - TEST.":PRINT"
'C' - CLEAR SCREEN."
00025IFR=5THENLETR=0:S=USR(15020,8000)
00030A1$=KEY$:GOSUB1010:IFA1$=""THEN30
00040IFA1$="A"THENLETX=X-4:IFX<18THENLETX=18
00050IFA1$="S"THENLETX=X+4:IFX>110THENLETX=110
00060IFA1$="W"THENLETY=Y+1:IFY>44THENLETY=44
00070IFA1$="Z"THENLETY=Y-1:IFY<29THENLETY=29
00080IFA1$="I"THENFORZ=XTOX+3:INVERT Z,Y:NEXTZ
00090IFA1$="U"THENFORZ=XTOX+3:SET Z,Y:NEXTZ
00100IFA1$="O"THENFORZ=XTOX+3:RESET Z,Y:NEXTZ
00105IFA1$="C"THEN20
00110IFA1$<>CHR$(13)THEN30
00120P=64528:R=64544:U=64560:Z=USR(15000,8000)
00130E=18:FORQ=44TO28STEP-1:GOSUB1020:POKEP+(44-Q),S:A(44-Q)=S:NEXTQ
00140E=50:FORQ=44TO28STEP-1:GOSUB1020:POKER+(44-Q),S:B(44-Q)=S:NEXTQ
00150E=82:FORQ=44TO28STEP-1:GOSUB1020:POKEU+(44-Q),S:D(44-Q)=S:NEXTQ
00160CLS:NORMAL:CURS1,3:PRINT"HERE IS THE RESULTS !"
00170CURS30,4:PCG:PRINT"ABC":NORMAL:CURS1,5:PRINT"FIRST PCG ";:FORK=0TO15:PRINTA
(K);",";:NEXTK
00180PRINT:PRINT"SECOND PCG ";:FORK=0TO15:PRINTB(K);",";:NEXTK
00190PRINT:PRINT"THIRD PCG ";:FORK=0TO15:PRINTD(K);",";:NEXTK
00200CURS1,12:INPUT"COPY THESE DOWN FOR LATER USE THEN PRESS RETURN.";A1$
00210R=5:GOTO20
00999END
01000CLS:LORES:FORX=10TO56STEP2:CURSX,1:C=(X/2)-9:PRINTCHR(69+C);:NEXTX:RETURN
01010C=(X-18)/4:CURS10+(C*2),1:PRINT" ";:SET 15,Y:SET 16,Y:CURS10+(C*2),1:PRINTC
HR(65+C);:RESET 15,Y:RESET 16,Y:RETURN
01020T=128:S=0:FORC=0TO7:IFPOINT(E+(C*4),Q)THENLETS=S+T
01030LETT=T/2:NEXTC:RETURN
01100FORL=15000TO15038:READZ:POKEL,Z:NEXTL:RETURN
01110DATA 89,80,33,0,240,1,0,4,237,176,33,0,248
01120DATA 1,0,8,237,176,201,0,105,96,17,0,240
01130DATA 1,0,4,237,176,17,0,248,1,0,8,237,176,201
```

MACHINE LANGUAGE MONITOR

Noel Bailey, Maryland NSW

The program was written to key hexadecimal data into selected memory locations and then to commence execution of small machine language routines. The format as presented on the VDU is similar to the old 2650 'Pipbug' routine, except that this program uses only the commands 'A' and 'G'. 'A' means 'see or alter' and 'G' means 'goto'.

To use the program first load the BASIC program and then type Run and a prompt '*' will be displayed letting you know that the monitor is waiting for a command, either 'A' or 'G'.

To load hexadecimal data from 0500H onwards:

a. Type A500. The address and its current contents will be displayed.

b. Key in the new hexadecimal byte and press line feed to step on to the next memory location.

c. Each new memory location will display the current contents of that location. Simply type in the new data and press line feed to step onto the following memory location.

d. On completion of loading your program type a carriage return and a prompt will be displayed.

A convenient way to get back to the monitor on completion of your machine language program is to use a Ret instruction C9H as the last instruction of your machine language program. On completion a prompt will be displayed signifying that control has returned to the monitor.

You may use memory locations 0400H to 07FFH and above about 2000H for your machine language routines. This way you should not overwrite the BASIC text file. Although this monitor is useful it does not compare in any way with a good editor-assembler.

```
00100 REM 'PIPBUG' TYPE PROG TO ENTER AND CHECK HEX DATA
00110 REM AND ALSO TO COMMENCE EXECUTION OF A MACHINE
00120 REM LANGUAGE PROGRAM.  WRITTEN BY NOEL BAILEY
00130 REM ON THE 26TH MAY 1983.  COMMANDS A AND G ONLY.
00140 REM CR WILL RETURN TO PROMPT '*' BUT LF WILL STEP
00150 REM ONTO THE NEXT LOCATION.
00160 DIM R(4)
00170 PRINT"":PRINT" *"
00180 INPUT"";A0$
00190 IF ASC(A0$)=65 THEN 210:REM IF COMMAND = 'A'
00200 IF ASC(A0$)=71 THEN 460:REM IF COMMAND = 'G'
00210 N=4:A0$=A0$(;2)
00220 GOSUB 550
00230 Z1=D1
00240 Z2=Z1
00250 Z1=Z2
00260 Z=INT(Z1)
00270 GOSUB 660
00280 PRINT"     ";
00290 N=2:Z1=FLT(PEEK(Z))
00300 GOSUB 660
00310 PRINT"     ";
00320 A0$=KEY$
00330 IF A0$=""THEN 320
00340 IF A0$=CHR$(13) THEN 170
00350 IF A0$=CHR$(10) THEN 510
00360 REM REPLACE DATA BYTE
00370 PRINT A0$;
00380 A5$=KEY$
00390 IF A5$=""THEN 380
00400 PRINT A5$;
00410 A0$=A0$+A5$
00420 GOSUB 550
00430 REM DECIMAL DATA IN D1
00440 POKE Z,INT(D1)
00450 GOTO 320
00460 A0$=A0$(;2)
00470 GOSUB 550
00480 Y=INT(D1)
00490 J=USR(Y,L): REM GO TO MACHINE LANGUAGE ROUTINE
00500 GOTO 170 : REM IF RETURNED PRINT '*'
00510 Z2=Z2+1
00520 N=4
00530 PRINT
00540 GOTO 250
00550 REM CONVERTS HEX STRING IN A0$ INTO DECIMAL IN D1
00560 D1=0
00570 K=LEN(A0$)
00580 FOR I=1 TO K
00590 A2$=A0$(;I,K)
00600 B=ASC(A2$)
00610 IF B<58 THEN LET C=B-48
00620 IF B>64 THEN LET C=B-55
00630 D1=D1*16+FLT(C)
00640 NEXT I
00650 RETURN
00660 REM PRINTS N LETTER HEX FOR Z1 DECIMAL INPUT
00670 REM WHERE N = EITHER 2 OR 4
00680 FOR I=1 TO N
00690 R(I)=INT(FRACT(Z1/16)*16)
00700 Z1=Z1/16-FRACT(Z1/16)
00710 NEXT I
00720 FOR I=N TO 1 STEP -1
00730 D=R(I)
00740 GOSUB 780
00750 PRINT A1$;
00760 NEXT I
00770 RETURN
00780 IF D<10 THEN LET A1$=CHR$(D+48)
00790 IF D>9 THEN LET A1$=CHR$(D+55)
00800 RETURN
```

PROGRAMMING COMPETITION

The Illawarra Microbee Club is running a programming competition open to all people of the NSW South Coast and Tablelands, excluding Canberra (sorry but they have their own Club).

There are two categories in the competition: (1) Educational (2) Games/Miscellaneous.

Prizes are expected to be to the value of $100+ in each category.

The programs will be judged on their content, their appeal and how they are written and will be judged by a sub-committee of the Illawarra Microbee Users Group.

Any programs that are submitted will become the property of the Illawarra Microbee Users and help to boost the Club Library.

For further information contact the club at PO Box 271, Warrawong NSW 2502.

MINI MET

C. Groenhout, Watson ACT 2602

Mini Met is a program for the VIC-20 and super expander which enables you to interpret numerical data in a graphical form on the VDU. The program, originally written for the interpretation of meteorological data such as minimum and maximum temperatures can be adapted for almost any use requiring the insertion of two pieces of numerical data.

When RUN the program asks you to enter the Speed (1-10) with 1 being the fastest. This allows one to slow down the graphical display to look at a particular section with more detail. The program then asks for the Scale Factor (1-5). This allows the user to magnify the display up to five times to increase the accuracy of display. After a second or two the program then comes up with the absolute minimum and maximum temperatures and the X plotting amount for each day as it scales each individual set of data to the screen size in hires.

The data in the program is made up of a minimum temperature and a maximum temperature and two dummy pieces of data (999,999) to show the end of the data for the program. Line 80 and 90 search through the data for these and in the process count the number of pieces of data so that in line 100 the computer can dimension an array to the exact size. The program fills the array with the data which allows quicker and simpler data retrieval than using data statements.

In line 190 the screen changes to high resolution and sets up lines and points on the screen for calibration. Lines 250 to 390 are the main routine which converts raw data into plottable data and at the same time adds in time delays and the daily minimum and maximum temperatures.

When the program has finally graphed your data you have seven options; you can find and graph the minimum temperature, the maximum temperature, the average minimum temperature, the average maximum temperature, add lines for each day plotted, make the program repeat the graph or you can exit the program. ●

VIC-20

```
10 CE=460:TP=58:BO=914
20 PRINTCHR$(147):COLOR0,0,1,0
30 PRINTTAB(9)CHR$(18)"MINI":PRINT:PRINTTAB(5)CHR$(18)"METEOROLOGIST"
40 PRINTSPC(44)"ENTER SPEED (1-10)"
50 INPUTSP:SP=INT(SP):IFSP<1ORSP>10THENPRINT"□□□□";:GOTO40
60 PRINTSPC(44)"SCALING FACTOR (1-5)"
70 INPUTSF:SF=INT(SF):IFSF<1ORSF>5THENPRINT"□□□□";:GOTO60
80 READA,B:IFA=999THEN100
90 D=D+1:GOTO80
100 PRINT:PRINTD"ELEMENTS COUNTED":DIMDA(D):DIMDB(D)
110 RESTORE
120 F=999:G=-999:FORE=1TOD:READA,B:DA(E)=A*SF:DB(E)=B*SF
130 IFA<FTHENF=A:Q=E
140 IFB>GTHENG=B:W=E
150 NEXT
160 PRINT:PRINT"MIN="F:PRINT"MAX="G
170 H=159.8/(D-1):PRINT:PRINT"X PLOTTING="INT(H*100)/100:H=H*6.4
180 PRINT:PRINT"PRESS ANY KEY...":POKE198,0:WAIT198,1:POKE198,0
190 SP=SP*100:GRAPHIC2
200 CA=INT((5/SF)*100)/100:CA$="CAL.="+STR$(CA):CHAR0,10,CA$
210 DRAW2,0,TPTO1023,TP:DRAW2,0,CETO1023,CE:DRAW2,0,BOTO1023,BO
220 FORY=CETOTPSTEP-32:POINT2,0,Y,1023,Y:NEXT
230 FORY=CETOBOSTEP32:POINT2,0,Y,1023,Y:NEXT
240 POINT2,1023,TP+6.4:POINT2,1023,BO-6.4
250 FORE=1TOD
260 FORT=1TOSP:NEXT
270 IFDA(E)<0THENY=CE+ABS(DA(E)*6.4)
280 IFDB(E)<0THENY2=CE+ABS(DB(E)*6.4)
290 IFDA(E)>0THENY=CE-DA(E)*6.4
300 IFDB(E)>0THENY2=CE-DB(E)*6.4
310 X=(E-1)*H
320 IFE=1THEN:POINT2,X,Y:X1=X:Y1=Y:POINT2,X,Y2:Y3=Y2:GOTO360
330 DRAW2,X1,Y1TOX,Y:POINT2,X,TP+6.4,X,BO-6.4
340 DRAW2,X1,Y3TOX,Y2
350 X1=X:Y1=Y:Y3=Y2
360 A$="DAY"+STR$(E):CHAR0,0,A$
370 CHAR18,0,"          ":B$="MIN "+STR$(DA(E)/SF):CHAR18,0,B$
380 CHAR19,0,"          ":C$="MAX "+STR$(DB(E)/SF):CHAR19,0,C$
390 NEXT
400 CHAR18,9,"[ ":CHAR18,13,"]":D$="":GOSUB680
410 IFD$()"MIN"ANDD$()"MAX"ANDD$()"REP"ANDD$()"LIN"ANDD$()"END"ANDD$()
"AV+"ANDD$()"AV-"THEN400
420 IFD$="MIN"THENY=CE+(ABS(F*6.4)*SF):DRAW2,0,YTO1023,Y
430 IFD$="MAX"THEN530
440 IFD$="LIN"THEN580
450 IFD$="REP"THENSP=SP/100:SCNCLR:GOTO190
460 IFD$="END"THEN:GRAPHIC4:COLOR1,3,6,0:END
470 IFD$="AV-"THEN590
480 IFD$="AV+"THEN630
490 C$="DAY"+STR$(Q):CHAR0,0,"          ":CHAR0,0,C$
500 B$="MIN "+STR$(DA(Q)/SF):CHAR18,0,"          ":CHAR18,0,B$
510 C$="MAX "+STR$(DB(Q)/SF):CHAR19,0,"          ":CHAR19,0,C$
520 GOTO400
530 Y=CE-G*6.4*SF:DRAW2,0,YTO1023,Y
540 C$="DAY"+STR$(W):CHAR0,0,"          ":CHAR0,0,C$
550 B$="MIN "+STR$(DA(W)/SF):CHAR18,0,"          ":CHAR18,0,B$
560 C$="MAX "+STR$(DB(W)/SF):CHAR19,0,"          ":CHAR19,0,C$
570 GOTO400
580 FORE=1TOD-2:DRAW2,E*H,TPTOE*H,BO:NEXT:GOTO400
590 FORE=1TOD:AV=AV+DA(E):NEXT:AV=AV/D:AV=INT(AV*100)/100
600 CHAR0,0,"          ":CHAR18,0,"          ":CHAR19,0,"          "
610 B$="AV="+STR$((INT(AV/SF)*100)/100):CHAR18,0,B$
620 Y=CE-AV*6.4:DRAW2,0,YTO1023,Y:AV=0:GOTO400
630 FORE=1TOD:AV=AV+DB(E):NEXT:AV=AV/D:AV=INT(AV*100)/100
640 CHAR0,0,"          ":CHAR18,0,"          ":CHAR19,0,"          "
650 B$="AV="+STR$((INT(AV/SF)*100)/100):CHAR18,0,B$
660 Y=CE-AV*6.4:DRAW2,0,YTO1023,Y:AV=0:GOTO400
680 GETX$:IFX$=""THEN680
690 IFASC(X$)=20ANDLEN(D$)<>0THEND$=LEFT$(D$,LEN(D$)-1):GOTO750
700 IFASC(X$)=13THENRETURN
710 IFASC(X$)=43ORASC(X$)=45THEN730
720 IFASC(X$)<65ORASC(X$)>90THEN680
730 IFLEN(D$)>2THEN680
740 D$=D$+X$
750 CHAR18,10,"  ":CHAR18,10,D$:GOTO680
760 DATA-3,8,-2,7,-4,8,-1,10,-3,11,-2,8,-1,3,-11,5,-12,6,-12,8,-4,5,-3,4,1,
1000 DATA999,999
```

CURSOR-POS

C. Canfield, Bulimba Qld 4171

Cursor-pos is a program to position the cursor anywhere on the screen to assist in screen formatting which is difficult on the Vic.

Type the program making sure the data is entered properly. The program must be saved before it is used as it deletes itself. When the program is run it loads the machine code routine into the top of memory and protects the routine from variables. The program stores the start address of the routine in locations 0,1; the format is [Peek(0)+Peek(1)*256.]

The routine is used by typing [SYS1oc,x,y]. You then simply use a Print or Input and it will appear in the position you specified.

```
10 DATA32,115,0,32,107,201,164,20,32,115,0,32,
   107,201,166,20,24,32,240,255,96
20 A=PEEK(56)*256+PEEK(55)-22
30 FOR B=0 TO 20:READ C:POKE B+A,C:NEXT
40 B=INT(A/256):POKE 56,B:POKE 52,
   B:A=A-B*256
50 POKE 51,A:POKE 55,A
60 POKE 1,A:POKE 2,B
70 NEW
READY.
```

VIC-20

PASSWORD

N. R. Whipp, Fishing Point NSW 2283

This program can be put before a program you want kept confidential.

To operate it you must enter a four letter password. If you do not, or if you get it wrong the Vic will restart and display the message 'bytes free'.

```
PASSWORD
10 DATA 160, 3, 177, 45, 133, 251, 200, 177, 45,
        133, 252, 160, 0, 177, 251, 217, 100, 3,
        208, 17, 200, 192, 4
20 DATA 208, 244, 160, 219, 169, LLL, 145, 43, 200,
        169, HH, 145, 43, 96, 76, 34, 253, PP, PP,
        PP, PP
20 INPUT "PASSWORD"; A$
40 FOR T=1 to 44: READ X: POKE 827+T, X:NEXT
50 SYS 828
60 REM:BEGINNING OF CONFIDENTIAL
PROGRAM
```

COMMODORE HACKERS! We're after well-written, clearly explained programs, hints and tips of a practical or illustrative nature. Length is less important than usefulness and documentation. We pay. Send your 'classics' to: The Editor, ETI, PO Box 227, Waterloo NSW 2017.

8 x 16 CHARACTERS

B. Tadie, Carringbah NSW 2229

This small program was written on the VIC-20 to change characters from the normal 8x8 format to an 8x16 one.

When you run the program it will take about a minute to reprocess all the characters. If you hit the Shift CLR the computer will be ready for use. To go back to normal format use run-stop, Restore.

```
10 FOR N=0 TO 255:POKE 7680+N,N:NEXT

20 POKE 36879,104

30 POKE 36867,26+1

40 POKE 36865,32:POKE 36869,252

50 FOR N=0 TO 1600:P=PEEK(32768+N)

60 POKE 4096+2*N,P:POKE 4096+2*N+1,P

70 NEXT

80 PRINT CHR$(5)
```

VIC-20

MAP PLOTTER

VIC-20

P & R Skitton, Seaford Vic 3198

This program displays a map of Australia centered on the VDU. However, it can be readily adapted to plot any map, shape or object desired to within the resolution of the 3K RAM expander cartridge.

When map drawing there are two types of line that can be constructed. These are line segments, where the two pixels to be connected are widely separated and merely need a straight line between them, and map lines, where the program starts at one pixel and only moves one pixel at a time. The commands for both types are underlined in the print out.

To display a map of your choice, simply trace it onto graph paper. In line 50 set MX and MY to be the total number of map units (say one map unit = 1 mm on the paper). Now encode the map, considering each square mm as a pixel, as shown above in terms of map lines and line segments. These are entered as data statements. To give an idea of the time required it took an hour to digitize the map of Australia presented here.

```
10 REM AUSTRALIA (A GENERAL MAP PLOTTING ROUTINE)
20 REM PETER & ROSALIND SKILTON 5/3/83
30 GRAPHIC 2:COLOR 6,6,1,1
40 REM 200 X 185 MAP COORDINATES ON NORMAL X,Y AXES
50 SU=1022:HU=511:MX=200:MY=185:HW=0.713
60 IY=-SU/MY:REM IY=SCREEN UNITS PER MAP UNIT (Y-AXIS)
70 IX=SU*HW/MX:MX=MX/2:REM IX=SCREEN UNITS PER MAP UNIT (X-AXIS)
80 DIM M(2,8):FORI=1TO8:READM(1,I),M(2,I):NEXT
90 DATA-1,1,0,1,1,1,1,0,1,-1,0,-1,-1,-1,-1,0
100 REM PLOT CONNECTED POINTS
110 FORK=1TO14:READX0,Y0,N:FORJ=1TON:READC$:GOSUB800:X0=X:Y0=Y:NEXT:NEXT
120 REM MAINLAND AUSTRALIA
130 DATA148,176,11,"566664665666666566654435656466656666556666666556554455555"
140 DATA"555665656666565424466666466645465656565656656766666666466667676766"
150 DATA"766767676777777677676767676766668688711887866787877112288732228887"
160 DATA"646878781188881111111222222111112218766782322323222226776777777667"
170 DATA"612121111212211188888818187888888887787878888878878787877667688888"
180 DATA"878888178878768777788788818188812123442221222212211212221212111212"
190 DATA"221111154215543121121221222222222222366532323433433344433444344"
200 DATA"343343432322432322222233456552312245442222244322134344224344455455"
210 DATA"666653234444433182223433343432444443322188444545544444445444543356"
220 DATA"776687766667664565545455445445455455445443333233222232222232222232222"
230 DATA"23323223"
240 REM TASMANIA AND TERRITORIAL ISLANDS
250 DATA148,24,1,"45464454343456666676666817866617821211222221122 3"
260 DATA8,95,1,"224",16,120,1,"4",86,170,1,"12457",87,173,1,"4444477811"
270 DATA119,163,1,"6678233",131,148,1,"7834",191,96,1,"2224667"
280 DATA160,27,1,"668224",144,27,1,"22467",116,50,1,"344445788881"
290 REM STATE BORDERS
300 DATA171,83,1,"33444444656443434443"
310 DATA134,61,1,"445445564456555645444444454534456564555 5"
320 REM PLOT SINGLE LINE SEGMENTS OF BORDERS
330 FORK=1TO7:READX1,Y1,X,Y:GOSUB900:NEXT
340 DATA79,156,79,70,124,148,124,101,136,100,136,61,134,61,133,41
350 DATA80,101,136,100,136,85,154,85,154,85,171,83
360 CHAR 17,1,"AUSTRALIA":STOP
800 REM PLOT THE COMMAND C$ BEGINNING AT MAP COORDINATE (X0,Y0)
810 X=X0:Y=Y0:X1=X:Y1=Y:FORI=1TOLEN(C$):P=VAL(MID$(C$,I,1))
820 X=X+M(1,P):Y=Y+M(2,P):GOSUB900:X1=X:Y1=Y:NEXT:RETURN
900 REM CONVERT MAP COORDS (X1,Y1) & (X,Y) TO SCREEN COORDS AND CONNECT THEM
910 A=INT((X1-MX)*IX+HU):B=INT(Y1*IY+SU):C=INT((X-MX)*IX+HU):D=INT(Y*IY+SU)
920 DRAW 3,A,B TO C,D:RETURN
```

Readers-only Offer: A Bargain Price for the PB-100

CASIO®

Pocket Computer

Business people, technicians, scientists — and many other people who have to work on the run — know that sometimes, a computer in the hand is worth two on the desk! The people at Casio couldn't agree more . . . and that's why they've come up with the brilliant new **PB-100 Pocket Computer.** It's not a toy! It supplies genuine computing power, plus an excellent range of mathematical functions. Pretty amazing, when you consider that the **PB-100** is not much bigger than your pocket calculator. (In fact, it's a good deal easier to operate than some programmable calculators on the market — because the **PB-100** speaks the easy-to-learn BASIC computer language.)

Because we're dealing directly with Casio, we're able to offer our readers a chance to purchase this great little machine at the very competitive price of **$69.95.** (That's around $10 below the average retail price!) The PB-100 comes with two manuals, lithium batteries and protective case — and postage is included.

Don't miss your chance! Complete and mail the order form today!

It's tiny! At just 165 x 71 x 9.6 mm, the PB-100 is truly pocket-sized. Weight: 116g with batteries.

It speaks your language! the PB-100's program language is BASIC — one of the easiest to learn and use. (And certainly more manageable than the off-beat lingos used by some 'programmable calculators')!

Its programming power is sure to surprise you. At a maximum of 544 steps each, the PB-100 can store up to 10 separate programs! Within your programs, you can utilise 8 levels of subroutine and 4 levels of FOR-NEXT loops.

It supplies super calculating power! As well as the fundamental functions (negative numbers, exponentials, parenthetical addition, subtraction, multiplication and division), built-in features include trigonometry, logarithms, exponentiation, square roots, powers, absolute value, random numbers, and much more!

It's got power to spare! The PB-100 runs on 2 lithium batteries (included in purchase price). Drawing just 0.02W maximum power, it will provide around 360 hours of continuous use. You can't accidentally leave it on, either — about 7 mins after last operation, the PB-100 switches itself off automatically.

$69.95

Federal Marketing Mail Order Form

Send completed coupon to:
Federal Marketing. PO Box 227 Waterloo NSW 2017.

Yes! I don't want to miss this opportunity! Please rush me ..... Casio PB-100 Pocket Computer/s — complete with batteries, two manuals and case — at the low price of $69.95 each (postage and handling included).

Name .....

Address .....

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

Signature .....

American Express ☐ **Bankcard** ☐ **Cheque*** ☐

** Please make cheques payable to the Federal Publishing Company Pty Ltd*

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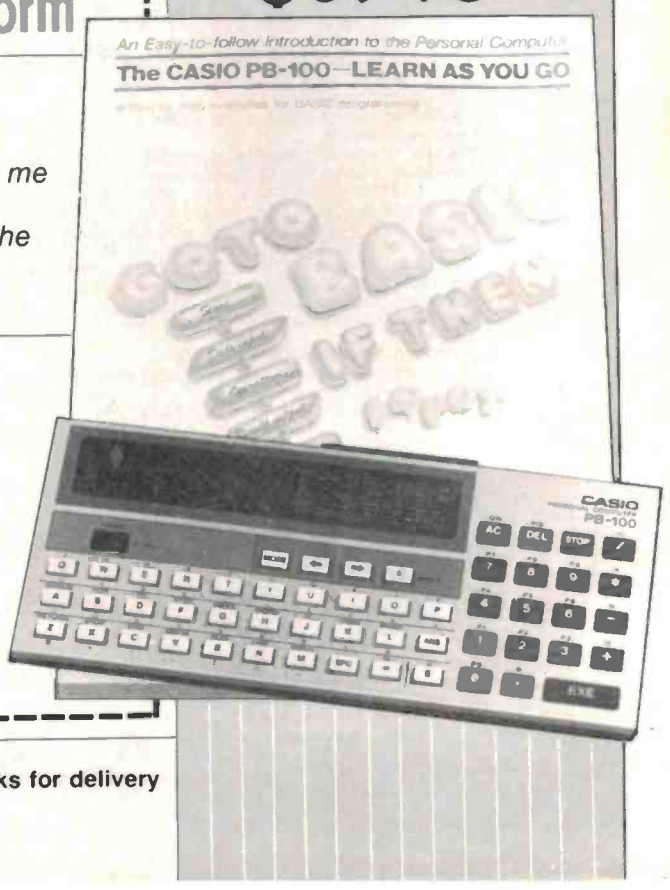


Allow four weeks for delivery

ETI-739 AM stereo decoder

As this project was developed by the Dick Smith organisation, copyright to the board artwork has been retained by them. We understand, however, they are prepared to wholesale them to other suppliers, enabling kits to be available from other sources.

Dick Smith stores will be stocking kits, obviously. Their R&D manager, Gary Crappe, has gone to some trouble to ensure supply sources for the various specialised components used, and constructors should experience little difficulty in obtaining a kit.

ETI-463 Masterplay two-way speakers

Just the thing to go with your Masterplay stereo record player system! We obtained the two drivers specified from *Jaycar*. The twin-cone woofer is a Pioneer driver, as is the tweeter. Jaycar stocks them as cat. nos. CE-2315 and CT-2018 respectively. Altronics may be able to supply them, too. Note that other drivers may be substituted, but the crossover components may need adjusting. (We'll have to leave the details to you, though).

The bipolar (non-polarised electrolytics) are stocked quite widely. Ours were obtained from *Jaycar*, but you'll find them stocked by *Altronics*, *Dick Smith* stores, *Ellistronics* and *Rod Irving Electronics*.

Scotchcal 'badges' may be obtained from *Jemal* in Perth. *All Electronic Components* and *Rod Irving Electronics* in Melbourne. You might also try *RCS Radio* in Sydney and New Zealand readers could try *Mini Tech* in Auckland.

ETI-610 Drum synth

A simple, low-cost, yet versatile module. Components for this are widely available off the shelf from most electronic component retailers.

A variety of sound pickups may be used. The Projects Unlimited VPU-1 used in the prototype came from *Creative Electronics*, PO Box 240, Matraville NSW 2036; (02)666-4000. Common piezo 'beepers' work well, too, as do 50 mm speakers.

For a kit of this project, try *Jaycar* in Sydney, *Altronics* in Perth, *All Electronic Components* and *Rod Irving Electronics* in Melbourne. Printed circuit boards may be obtained from the suppliers listed at the end of the column.

ETI-277 Ready/Set/Go lights

Stop the punchups! Start your games/races with this project instead. As we try to do with the majority of our projects, all the components for this are standard stock items in virtually every electronic components retailer.

If you're after a kit, try *All Electronic Components* and *Rod Irving Electronics* in Melbourne, *Jaycar* in Sydney or *Altronics* in Perth.

Printed circuit boards and front panels should be availble from the suppliers listed at the end of the column.

Artwork

For those constructors willing and able to make their own pc boards and/or front panels, we can supply same-size film transparencies of the artwork, positives or negatives as you require. From the list given below, select what you want and address your request/order to:

'ETI-xxx Artwork'
ETI Magazine
PO Box 227
Waterloo NSW 2017

When ordering, make sure you specify positives or negatives, according to he process you use. Your cheque or money order should be made payable to 'ETI Artwork Sales'. Prices for the artwork for this month's projects are as follows:

ETI-463 (badge)..... $1.00
ETI-610 (pcb) $3.00
ETI-277 (pcb) $3.00
ETI-277 (front panel) . $3.50

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

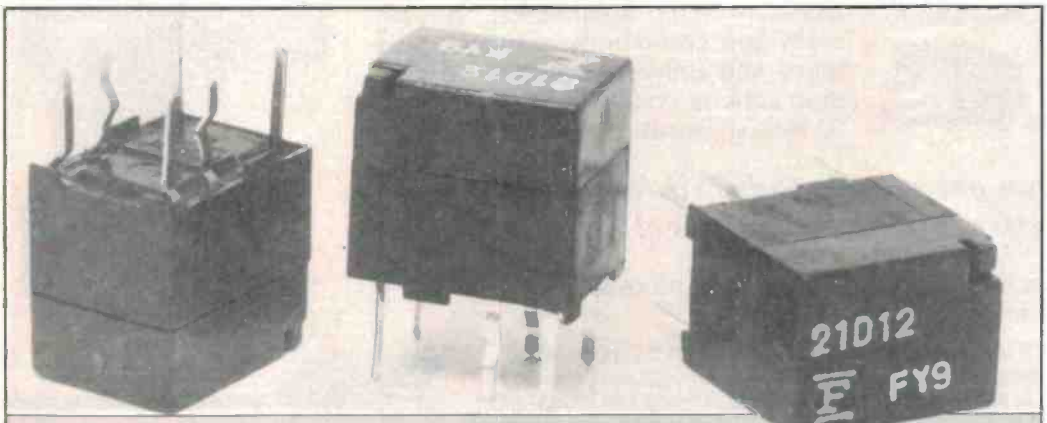
Mini Tech
P.O. Box 9194
Auckland NZ

Rod Irving Electronics
425 High St
Northcote Vic 3070

SPECIAL NOTICE

Owing to printing problems, some issues of the September ETI had poor reproduction on the project overlays on page 71 (ETI-1410 150 W Bass Guitar Amp) and page 91 (ETI-442 Masterplay Stereo). Those readers with poor copies, who wish to construct these projects, can obtain life-size clear prints of these overlay/wiring diagrams by writing to:

ETI-442/1410 Overlay Prints
ETI Magazine
PO Box 227
Waterloo NSW 2017



SIX ON A 50 CENT PIECE!

These new Fujitsu FBR20 series miniature relays are small enough that six will comfortably fit on a 50 cent piece! Despite their miniminiature size, the SPDT contacts are rated at 1 A/24 Vdc (resistive) or 0.5 A/120 Vac (resistive).

Coil dissipation is only 300 mW (at 20 °C) and they can be obtained with coil operating voltages from 1.5 V to 18 V dc. Off-the-shelf models have the popular 5 V and 12 V coils. The relays can be obtained with single or bifurcated contacts with gold overlaying silver contact materials.

The relays measure just 9.8 mm square on the side by 7.4 mm wide. The connection pins are 4 mm deep set out on a 0.1" (2.54 mm) grid. The central pair are preformed so they 'lock in' on a pc board for soldering, particularly when automatic soldering is employed.

The contact-to-coil isolation is rated at 750 Vac for one minute. For further details, contact the distributors, IRH Components, 53 Garema Circuit, Kingsgrove 2208 NSW. (02)750-6444. Currently, David Reid Electronics in York St, Sydney is stocking them.

MINI-MART For Sale/Wanted/ Swap/Join

AUDIO

FOR SALE: COTTER MK2L transformer. Works well with Koestu, supex moving coils. $480. Kenwood L-07C preamp $325. Allan Woodcock, 18 Cambridge Rd, Surfers Paradise, Qld 4217. (075)31-5461.

FOR SALE: TEAC AN60 Dolby unit $30. Infra red alarm beam $20, Car clock $10. A. Wood, Box C294, Clarence St, NSW 2000.

WANTED: OWNERS MANUAL or repair advice for CE Electronics 12" Transcription Turntable. P. Roberts, 24 Walcott St, St Lucia, Qld 4067. (07)371-9255.

FOR SALE: STAX SR5 electrostatic headphones, and SRD 6 driving unit both in excellent condition. $60 ono. J. Barnes, 8/3A Montagu St, Lenah Valley, Tas. 7008.

COMMUNICATIONS

WANTED: QUALITY OLDER COMS RX Trio 9R preferred but others considered. Must be in good condition. Kerry Power, 93 Beryl St, Coffs Harbour NSW 2450. (066)52-7497.

WANTED: VINTAGE radio magazines of 40's and earlier. Books, service manuals, catalogues, etc. B. Baker, Wellington St, Russell, New Zealand 37718.

WANTED: MARCONI transmitter/receiver output test set model TF1065A. J. Spencer (075)36-4333.

WANTED: COMMUNICATIONS RECEIVER. RCA AR88, D. Lewis, 2 Cleland Rd, Artarmon NSW 2064. (02)411-1195.

COMPUTERS

FOR SALE: SYSTEM 80. 48K 3.4 MHz with centronics interface, green phosphor monitor. Over $900 worth of software and all manuals. Complete package $1495. Andrew Rothfield, 9 Orchard St, Pymble NSW 2073. (02)440-8014.

FOR SALE: SYSTEM 80 blue label 48K twin disks, double density, green monitor, Newdos/80 cables, much software. Worth near $4000. Selling $1800. R. Neale, 7 Banyula Place, Killara NSW 2071. (02)498-5617.

TO SELL: MITSUBISHI M4854 1.6M slimline 5¼ inch disk drive and parts needed for Little Big Board kit. Never used. $440 Stuart Gibbs, 19 Peters Drive, Cheltenham Vic 3192.

FOR SALE: DISK DRIVES Siemens 8 inch SS, DD, CW manual and connectors. Brand new Shugart 801R compat $395 each. (02)929-6497.

WANTED: Information about the System 80. Software and anything else of interest. Contact Ray Schatz, P.O. Box 17, Koorawaitha NSW 2807.

FOR SALE: SIGNETICS Instructor 50 2650 microprocessor. Complete with manuals, introductory software and power supply. $100 ono. Tony Ladson, 74 Flenungton Rd, Parkville Vic. 3052. (03)328-2324.

FOR SALE: 32K Microbee with EDASM plus three programs $400. Wayne, 232 Francis Street, Yarraville Vic. 3013. (03)314-5300.

WANTED: Character generator ROM type MM5240 for ADDS 580 terminal. Ed Richardson, 146 York St, Nundah 4012. (07)266-6229.

FOR SALE: VIC-20 program library. High quality games, utilities, educational and miscellaneous programs available. Send SAE to Chris Groenhout, 25 Kerferd St, Watson ACT 2602 for list.

FOR SALE: MICROBEE DISASSEMBLER features serial/parallel printing, address displacement, hex code input, code saving to tape, $9.50. J. Arnold, 36 Victoria St, Rooty Hill NSW 2766.

FOR SALE: MICROBEE 32K with ETI 668 EPROM burner. 50 tapes and six EPROMs. Cassette and Kaga monitor, all manuals, $700, will separate. A. Taylor, 10 Calala St, Duri. NSW 2344. (067)68-0395.

FOR SALE SORCERER MKII. Exidy d/d disk drive. CP/M 2.2 with utilities, 24K extended BASIC. Lots of software, books and documentation. $1900. Impett, 8/28 Ruskin St, Elwood Vic 3184. (03)531-9116.

VIDEO

WANTED: TWO VIDEO head drums in good order for a NV-3020E black and white National VTR. Also a circuit diagram or manual. B. Connors, 4 Jensen St, Gunnedah NSW 2380. (067)422398.

VIDEO GEAR. To be sold as one lot or individual items. Sony video recorder AV3670CE (red), Sony video camera AVC3250CE with viewfinder (needs new tube?), Gijinon zoom lens (1:2, F = 14-70 mm), Slik Professional Design II tripod dolly, two camera cables CCF-25; National video recorder NV3020E; Sony-matic portable video recorder AV3420CE, Sony video camera AVC3420CE (needs tube?) with one standard lens and two others (inc. zoom 1:1.8, F = 12.5-75 mm), extension camera cable; Sony camera adaptor CMA-3CE, Sony video camera switcher CMS110CE, Sony ac power adaptor AC3420CE, three Sony monitors CVM110VZ (11"). Say, $900 the lot ONO. Phone Roy Zimmerman, bh (02)560-5355, ah (02)560-5647.

WANTED: SPARE PARTS for Sharp C206X 20 inch colour television. Send for details B. Connors, 4 Jensen St, Gunnedah NSW 2380.

WANTED: INFORMATION on conversion of S100 Merlin video interface to operate on 50HZ. P. Schoenfeld, P.O. Box 269, Liverpool NSW 2170. (02)602-2000x399 during business hours.

FOR SALE: SERVICE MANUAL NV7000 National Video recorder. $30. A. Cope, 2 Treana Cres. Paradise SA 5075. (08)337-6229.

MISCELLANEOUS

FOR SALE: TRANSISTORS RF, IF, and audio, resistors, capacitors. Bargain prices D. Steele, 8 Kangaroo Place, South Headland WA 6722. (091)73-8303.

WANTED: INFORMATION on Airzone chassis type 513 circa 1931. Contact B. Jones. P.O. Box 2, Manangatang, Vic 3546. (050)35-1444.

WANTED: ANY OLD radios, cassette recorders, etc. D. Manglesdorf, "Corran" West Wyalong NSW 2671 (0697212) 753422.

DREGS

THE LAB. BOYS (sorry, persons) are always on the lookout for fresh, original project ideas. A few readers lately have suggested we do various versions of a digital clock. Well . . . we've done a few in the past and it's generally cheaper these days to buy an all-singing, all-dancing, fully tricked-out digital electronic clock than to build one.

However, Dr Ahmet Bahat, an electrical engineer from Egypt, has developed a computerised, portable "prayer clock" for followers of the Muslim faith. Now *there's* a fresh, original idea for a digital clock, we exclaimed!

This computerised, digital alarm clock tells the followers of Mahomet when, *and in which direction,* they should pray, no matter where they are in the world, according to a recent report in *New Scientist.*

The latitude and longitude of 200 cities are stored in the clock's memory. So the owner just enters the code for a particular city plus the local time and date, and the clock will buzz at the designated times for prayer.

The clock also has a compass which can be set to point toward Mecca. If the user is in an unlisted city, its latitude and longitude are inserted instead of the code.

But what *we,* unbelievers, want to know is, does it show the time in LMT (local mean time) or MMT (Mecca mean time)!

A US company will introduce the first 100 000 of the clocks to Saudi Arabia in the next few months.

Infidels beware!

West Germans . . . 1, Japanese . . . 1

An unscheduled departure at Sydney's domestic air terminal has the audio/video industry buzzing.

But it was not a Boeing or a Douglas that mysteriously took flight overnight.

The winged wonder is a 200 sq. ft. poster erected last February directly above the TAA baggage carousel on behalf of BASF featuring their famous chrome tape and a Time magazine cover.

BASF Australia executives often proudly pointed out the poster to business acquaintances, even journalists, while waiting for their baggage. They were however stunned to find that in their absence from the airport, sometime in June, the poster flew.

Perhaps a keen fan of the chromdioxid tape had a 20 ft. by 10 ft. blank space at home and wanted it as a souvenir. No.

Maybe the contract for the specially-selected site, number 50, had expired. But no. A renewal of BASF's six-month contract with rate protection and first option on the site had been requrested on May 9, then signed and forwarded on May 15 to Airport Advertising International.

After much further investigation, the prodigal poster was discovered. It had taken off and landed at a new less, conspicuous, site near a corner of the terminal.

Bewildered by the mystery and fearing another Amityville — a Mascot Horror — BASF placed a number of calls to Airport Advertising International and Allan Davis Advertising to inquire if any other such cases had been reported. They hadn't.

No satisfactory explanations have so far been forthcoming.

However it has been brought to BASF's attention that a poster two places to the left of TAA terminal site 50 might contain a clue. It reads: "Fly TDK".

(The humble Dregs Editor is always happy to receive "fun" press releases like the above, preferably from a quotable source. As they say, in delicate media matters, sources close to our source suggest that, for further information, you could try Graeme Kemlo on (03)596-4347). ●

COMPACT disc DIGITAL AUDIO

Hear digital perfection.

Introducing the Sony Compact Disc Player.

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

WIRELESS REMOTE CONTROL Full-function remote control.

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

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

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

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

Get even more perfect sound with the Sony Digital Audio Component System, "Precise Series".

It's a Sony

SONY

AUD 0391

How to invest in Yamaha, without living beyond your means.

Yamaha's new top-of-the-range Cassette decks, the K-1000 and K-2000, incorporate the most advanced, state-of-the-art studio component technology at prices $200 to $300 less than comparable equipment.

Indeed, they compare favourably in significant performance areas with any cassette decks at any price.

Both decks have been painstakingly designed and uncompromisingly engineered for optimum functionality and reproduction performance.

Each employs a specially designed two-motor, direct drive transport mechanism for smooth, silent precision, and three low-impedance heads which features a unique Sendust formulation to ensure superb, long lasting reproduction quality. Plus the heads have a lifetime warranty.

The two decks utilise Yamaha's unique Linear Electromagnetic Transduction system which extends linearity to the point where the signal is transferred from the head to the tape–a previously uncontrollable area in the recording chain.

High performance features on both decks also include dbx and Dolby-B* noise reduction, ORBiT (Optimum Record Bias Tuning), a microcomputer controlled Linear Counter, expanded range level meters and a number of auto memory functions.

For Yamaha the K-1000 and K-2000 cassette decks are a natural progression in 95 years of outstanding accomplishments in musical instruments and audio componentry.

For you they represent the finest natural sound recording and reproduction at a surprisingly affordable cost.

Your Yamaha dealer can show you the full range of Yamaha Cassette decks starting at around $200. If you'd like further information just complete and post the coupon below.

*Dolby is the registered trade mark of Dolby Laboratories

I'd like further technical information on the new K-1000 and K-2000 cassette decks.

Name_____

Address_____

_____

_____ Postcode_____

Send to: Yamaha Hi-Fi Division,
Rose Music Pty. Ltd.,
17-33 Market Street, South Melbourne,
Victoria 3205.

YAMAHA