SHUTTLE TO HOUSTON VIA HAM RADIO

Australian hams prove amateur radio can provide back-up for space flights

MORE FUNCTIONS FOR THE VZ200
UNDERSTANDING THE 6800-SERIES MICROs
EIGHT JOYSTICKs REVIEWED

ROOM LIGHTS CONTROLLER
MICROBEE ROM READEr
DIGITAL ENLARGING
EXPOSURE METER

SPECIAL OFFER
Cheap 6800 books

HI-FI: ME SOUND AMP/PREAMP REVIEWED (Aust.made)
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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.

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

ETI March 1984 — 3
Price Breakthrough
The Neotronics Model OS620 is a powerful 20MHz dual trace oscilloscope with performance and features normally found on scopes costing $200-$500 more. We sell at lower profit margins and import directly from the manufacturer. You reap the benefit!!

Compare the Features
The Neotronics OS620 is a precision measuring instrument. The tube is 150mm flat screen/internal graticule type with 2kV acceleration potential. The bandwidth is a full 20MHz on both channels. Others offer round faced tubes, plastic graticules, less bandwidth, yet cost more! Intensity modulation is built in. By importing directly we offer you the best value on the Australian market.

Built-in component tester
The component tester allows you to make full use of the OS620. With no additional test gear, you can check resistors, capacitors and zener diodes as well as trouble shoot solid state circuits. Testing signals are available via the COMP. TEST terminals.

<table>
<thead>
<tr>
<th></th>
<th>Neotronics OS620</th>
<th>Hitachi V212</th>
<th>TRIO 1560</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth</td>
<td>20MHz</td>
<td>20MHz</td>
<td>15MHz</td>
</tr>
<tr>
<td>Flat Screen with internal graticule</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Probes</td>
<td>Included</td>
<td>$28 each</td>
<td>$33 each</td>
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<tr>
<td>Component tester</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Price (inc. tax)</td>
<td>$574.50</td>
<td>$699.00</td>
<td>$626.75</td>
</tr>
<tr>
<td>Price with two probes</td>
<td>$574.50</td>
<td>$755.00</td>
<td>$692.75</td>
</tr>
</tbody>
</table>

Probes included in price.

Most users will need a set of probes. These are sold as very expensive 'extras' with some other brands - often costing over $70.00 a pair (we think this is a bit like selling a car and then saying it's extra for the tyres!). The Neotronics OS620 comes complete with a pair of high quality probes.

Phone on the Hotline
(02) 918 8220
Avoid disappointment. Order your OS620 by Bankcard or MasterCard on the phone. Just call up, reverse the charges and we'll take your order. Shipping is only $7.50 anywhere in Australia - including packing and insurance.

Full 12 month warranty. Your OS620 is fully guaranteed for a full year.
THERE HAVE BEEN MASSIVE STRIDES in computer hardware and software development in recent years, powered by a burgeoning market demanding ever more sophistication and power and ever more "user friendliness" (to use the trade's jargon). What the hardware/software designers are aiming at is to reduce, or strip away, the requirement for 'computer knowledge' in users or potential users. An entirely laudable aim. Just as one needn't have a mechanical engineering background to be able to drive a car, one needn't have a computer systems engineering background to be able to use a modern computer.

Standing back a little and looking at where the industry has been, I think that point was reached some time ago and the industry is rushing headlong past the goal, unrealising.

In the main, computers and their software are no longer 'unfriendly' or difficult to use, no programming ability is necessary. What does make many computers difficult to use is their documentation. Some of our staff and correspondents have had things to say on this subject over the years, varying from guarded praise to scathing condemnation. It's unfortunate, but I think that, while the state of the art has moved ahead enormously in hardware and software, it remains static when it comes to documentation. There are some specific exceptions, but all too few. Too much seems to be written in some language other than plain English; though the words are recognisable, the meaning is not.

I think the industry should be now not looking to its laurels, nor the way ahead, but introspectively, focusing on the documentation delivered with their product.

**APPLE'S MACINTOSH — REIGNS SUPREME?**

Apple launched their "third generation" computer on a slightly prepared public late in January. Will it lead Apple and the computer industry behind it into the next computer revolution? Colin Rivers reports.

**PROJECT 340 VEHICLE SECURITY ALARM**

This alarm does not rely on interior lights being activated by a door opening to trip the alarm. It uses 'resonance' sensors to tell the circuitry your vehicle's being tampered with! It features three delays — exit, entry and alarm length before resetting. The alarm is armed in an unusual way so you can still protect the vehicle, even though you've left it in a parking station and the keys with the attendant.

**6802-BASED MICROCONTROLLER**

A microprocessor with a bit of ROM, a bit of RAM and some I/O lines can do all sorts of things. This project, based on the 6802, forms the basis of a whole series of controller projects. Remember the ETI-650 STAC Timer? There's an application, for one.

---

**3D PLOTTING ON THE MICROBEE**

How to plot three-dimensional graphs on-screen and to a printer using your Microbee computer. Simple, but smart! Excellent results, too.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

---

**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 modifications, other than errata or addenda. We try to answer letters as soon as possible. Difficult questions may take some time to answer.

**GENERAL INQUIRIES:** For all inquiries about back issues, subscriptions ($20.00 for 12 months/12 issues), photocopies of articles, artwork or submitting articles, call (02) 663-9999 or write to: ETI Reader Services, 140 Joynton Avenue (PO Box 227), Waterloo, NSW 2017.

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If you wish to attend a university to obtain a degree, why not have the Navy to pay your way. And offer you a career at the same time.

The Navy is seeking university entrants in the fields of Science, Arts, Mechanical or Electrical Engineering to attend the Royal Australian Naval College and the new Australian Defence Force Academy.

If you have matriculated or are currently undertaking your matriculation, are an Australian citizen or eligible to apply for Australian citizenship, are under 20 on the 1st January of your intended year of entry and are able to meet our selection requirements you will be offered excellent pay to obtain the degree of your choice and qualify as an Officer in the Navy. Taking up positions such as Combat Systems Officers, Marine Engineers, Seaman Officers and Supply Officers. Commanding men and playing a key role in the defence of Australia.

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NCM 68 DPS 123
SATELLITE TRIALS FOR ANTARCTICA

A satellite communications Earth station is being set up at the Australian base at Mawson in Antarctica in order to assess the potential of satellite communications to meet future needs of Australian National Antarctic Research Expeditions (ANARE) communications needs.

Trials of the system are to be conducted between Mawson and Australia this year. An investigation recently carried out by the Antarctic Division of the Department of Science has shown that existing communications networks between Australia and Antarctica are inadequate and unreliable (a fact well-known to ex-expeditioners - Ed.).

It is estimated that most of the equipment currently used at the stations will need replacing in two or three years, and an urgent assessment of future demands and systems is required.

At the present time communications between Australia, her Antarctic stations and expedition ships at sea, are carried out using high frequency radio links. These links provide the sole means of radio communication, and are often severely effected by disturbances in the Earth's ionosphere.

In order to evaluate the suitability of satellite communications, the Antarctic Division, which is responsible for ANARE communication links, has decided to purchase an Inmarsat ground station.

The Inmarsat system has three satellites in geostationary orbit 36 000 km above the equator over the Atlantic, Indian and Pacific Oceans.

Mawson tests will use the Indian Ocean satellite, which will be some 13° above the horizon almost due north of the station.

This satellite's permanent control stations are at Eik in Norway and Yamaguchi in southern Japan. There are no Inmarsat control stations in Australia.

Communications traffic from Mawson will travel to the satellite, down to the Japanese station, then on to Australia via either an underwater cable, or the Intelsat satellite system to a ground station in Ceduna, South Australia. On reaching Australia, traffic will be patched into the national communications network.

The Inmarsat facility will provide a single communications channel which can be used at any time day or night for either telephone, telex, facsimile, or data transmission. This will allow an adequate evaluation of satellite communications to be made.

PROGRAMMABLE SECURITY SWITCH

The new Arlec PC700 Security Switch can be programmed to turn lights on and off up to 48 times each day to give a natural 'at home' appearance to a dwelling and act as a deterrent to burglars.

To further confuse and discourage burglars the Arlec Security Switch has a built-in variability feature that automatically turns the lights on and off at slightly different times each day. Furthermore it is possible to simulate the normal 'at home' pattern of light operation by allowing the security switch to program itself according to the way the lights are used in the home over a 24 hour period.

The integral memory stores the information about this normal pattern of light usage and will repeat it continuously whenever the householders are away from home.

The security switch is designed for wall mounting and can replace existing wall mounted switches or be used in new installations. It can also replace architrave switches where the present wiring can be easily diverted into the wall cavity. It will control lamp globes to a total of 500 watts but is unsuitable for fluorescent or other types of gas discharge lamps.

In normal use, the lights can be controlled manually simply by pressing the time dial. This acts as the switch to turn the lights on or off without disturbing the preset time selections stored in the security switch's memory, which will remain effective until they are deliberately changed to another sequence by the owner. The switch has a current back-up feature to provide at least five minutes retention of memory in the event of mains power failures.

It also combines the convenience of automatic lighting control with the ability to make savings in electricity costs. For example, the programmed switch will remember to turn off lights that may have been left on inadvertently and can be made to turn lights on at the right time to greet guests, or welcome the returning household following a night out.

Further information on the PC700 Security Switch is available from Arlec Pty Ltd, 30 Lexton Road, Box Hill Vic 3128. (03)840-1222.

NEW PRESIDENT FOR A.E.I.A.

The Managing Director of Plessey Pacific Pty Ltd, Mr Bruce Goddard has been appointed the new president of the Australian Electronics Industry Association (A.E.I.A.)

He succeeds Mr Allen Deegan, Chairman and Managing Director of Standard Telephones & Cables Pty Limited, who did not seek Presidential re-election but will remain on the Board-of-Directors.

Newly-elected Vice-President of the association is Mr Cornelis Bossers, Managing Director of Philips Industries Holding Ltd.

Other executive appointments made at the Annual General Meeting were: Telecommunications and Defence Division: Chairman, Mr Peter Lane, (Standard Telephones & Cables Pty Ltd); Vice-chairman, Mr Arthur Gabb (Amalgamated Wireless Australasia Ltd). Components Division: Chairman, Mr Bob Gibson (Morris Productions Pty Ltd); Vice-chairman, Mr Chris Tyree (Amtron Tyree Pty Ltd), Mobile Radio Division: Chairman, Mr Terry Stanley (Motorola Electronics Aust Pty Ltd); Vice-chairman, Mr Ian McKenzie (Philips Industries Holdings Ltd).
BRITISH ROBOT CONFERENCE

Industrial robotics experts are invited to submit papers to the British Robot Association (BRA) for its 7th Annual Conference to be held in Cambridge, eastern England from 14-16 May 1984.

The conference contributes to the advancement of robot technology in Britain and overseas by providing an international forum to discuss technological advancement. Presentations dealing with industrial case studies and experience of practical applications are welcome, says BRA.

Topics for discussion include assembly and machine transfer, robot welding and design, programming, economics, human factors, safety, robot handling applications and management.

To date, papers have been received from Britain, the United States, Germany, France, Finland and Bulgaria. These, together with any new contributions will be of benefit to those already involved in the manufacture or use of robots as well as others who wish to increase productivity and efficiency, says BRA.

Authors abstracts — about 100 words — should be sent to The Conference Director, BRA 7, British Robot Association, 28-30 High Street, Kempton, Bedford, England, MK4 7AJ.

NEW STANDARDS

The Standards Association of Australia has published a new standard on fixed capacitors for use in electronic equipment specifically on fixed polystyrene film dielectric dc capacitors with thin metal foil electrodes. It is identical with IEC 384-7 (1978) on that type of capacitor.

The purpose of this standard (AS 1541.2) is to establish preferred ratings and characteristics. Test severities and performance requirements for the type of capacitor are given for appropriate test procedures selected from AS 1541, Part 1, the generic standard for capacitors for use in electronic equipment.

Copies of AS 1541.2 can be purchased from any SAA office at a cost of $11.40 plus $2.40 postage and handling charge.

The SAA is also seeking comment on a proposed standard, DR 83247, for stabilised power supplies having on ac output.

Stabilised power supplies are generally complex units and subject to variables such as temperature, input voltage and load. The variation in performance because of these variables are specified and this should result in the rationalisation of design, construction and performance requirements.

The draft does not cover power supplies for electrical measurement equipment. It includes the electrical performance requirements and nomi-nates the physical dimensions to be listed when specifying a unit.

Test methods covering the stabilised output quantity and electromagnetic interference are included.

Attention is drawn to the fact that this is a draft only and liable to alteration in light of comment received.

For information telephone (02) 29-6022 or any state office.

NOTES & ERRATA

Project 412, October 1983: The linking for dot/bar mode is shown incorrectly on the circuit and component overlay. For a dot mode display, link pins 9 and 11 (as per the photograph of the board); for the bar mode, link pin 9 to the positive supply.

Upgrading the ETI-656 EPROM Programmer, January 1984: Two connections to the 4PDT switch have been interchanged. Looking at the wiring diagram on page 70, the two upper and lower right hand wires have been transposed. The upper one says "PIN 7 PERSONALITY SKT" but should go to R14:15 — SW2b, the lower one says "R14:15 — SW2a" and should go to pin 7 of the personality socket.

Project 676, Microbee RS232er, February 1984: The pinout for the transistors, shown on page 65, is all screwed up. Use the pinout on page 111.

Project 274, Damn Fast NiCad Charger, February 1984: Figure 2 shows the battery negative connected to the heatsink. It should be insulated from it. The BVXX200L diode cathode connects to the collector of Q4/Q5 and R1-LED1 via the heatsink, not the wires shown.

LONDON LAB SHOW

The Department of Trade is seeking companies manufacturing scientific, medical and laboratory equipment to participate in the 1984 London Laboratory Show. Participation in the show, to be held at the Barbican Centre from 4-6 September, will develop Australia's image as a manufacturer of world class high technology equipment.

Australian participation in Fairs covering similar products — Semlab UK 1981 and Mesucor France 1982 — has been very successful with exhibitors receiving initial orders of $200,000 and $938,000 respectively.

The product coverage includes scientific educational, medical and industrial equipment; services and supplies; sensors and back-up systems; medical electronics; analytical and biologic research instruments; electronic measuring and testing equipment; measurement control systems and instrumentation.

The Scientific Instrument Manufacturers' Association will run a major analytical conference concurrently with the Laboratory Show.

Australian laboratory equipment manufacturers seeking information on participation should contact the Promotions Officer, Ian French, Department of Trade, Canberra ACT 2600. (062) 72-25115.

ARLEC'S MINI ELECTRIC TOOL

Designed in Australia, the Arlec Supertool Model No. ET57L is a compact, precision power tool which has a multitude of uses in and around the home, the office, factory, workshop etc. It is described as 'ideal' for miniature and electronic engineering, educational projects and drawing office work.

Particular emphasis has been placed on the design of the casing to ensure optimum balance and ease of handling, with weight kept to a minimum. The on/off switch provides feather-touch stop/start control with a switch lock for continuous running.

The robust 12 watt motor operates at 10,000 revolutions per minute and is powered via an SEC approved plugpack adaptor.

The unit is supplied with eight tools, six eraser sticks and a collet chuck with five collets for a variety of tasks including drilling, shaping, cleaning grinding, and erasing. It can also be used with supplementary bits and cutters for milling, sanding, polishing, cutting and the superior continuous-line system of engraving.

Draughtsmen and graphic artists should find it invaluable as it is excellent for erasing ink and pencil lines quickly and cleanly from drawings, tracings, photocopies and dyeline prints.

Electronics designers and hobbyists use it as a high speed printed-circuit board drill and cutter. Handymen utilise it for small drilling, sanding and polishing jobs including the unit to sharpen cutters too.

Further information is available from Arlec Pty Ltd, 30 Lenton Road, Box Hill Vic. 3128.
Australia's Air Force believes that if you're technically minded and you've put the effort in at school, you deserve the chance to develop those skills. You deserve a future.

The new F18 Hornet will be the most technically advanced aircraft ever to grace the Australian sky. And it needs technically minded young men and women as Electronics Technicians to keep it flying.

If you have successfully completed at least year 10 with passes in English, Maths and Science, you may just turn an interest in electronics into a full time career.

JOIN AUSTRALIA'S AIR FORCE.

If you're an Australian citizen (or eligible to become one), aged 17-34, telephone your nearest Air Force Careers Adviser on:

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or write to Box XYZ in your capital city.

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Here is what you get:
A Parameters Model 7040 or Model 601 digital multimeter, probably the best value instrument of its type in Australia. Instruments that are widely respected for their proven quality, ruggedness, dependability, accuracy and style.

Special Bonus Offer
Order your new Model 7040 or Model 601 now and receive our special bonus offer of a hard vinyl carrying case (normal retail price $12.00) at no extra charge.

Our No-Nonsense Warranty
You have the protection of our no-nonsense warranty for a full 12 months from the date of purchase. Should your instrument develop a fault not attributable to physical abuse, simply return it to us freight paid and we will either repair or replace it at no charge to you. This applies in addition to all warranty requirements you normally receive under the trade practices act.

Hurry — This offer applies only to our current limited stocks.

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**ORDER FORM**

I would like to take advantage of your special digital multimeter offer. Please supply me meter(s) as set out below. I understand that I will receive a carrying case for each meter ordered at no extra charge.

<table>
<thead>
<tr>
<th>QTY</th>
<th>MODEL</th>
<th>PRICE TAX*</th>
<th>PRICE TAX PAID</th>
<th>TOTAL AMOUNT</th>
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<td>601</td>
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<td>7040</td>
<td>$87.75</td>
<td>$99.00</td>
<td></td>
</tr>
</tbody>
</table>

* Tax free orders must include an exemption certificate on an official company order.
** Bankcard users be sure to include your full home address, not a PO box number.

Please allow 7 days for delivery.

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NAME

ADDRESS

☐ I enclose my cheque for $...
☐ Please charge my Bankcard**
  No. 496...
☐ Our Company Order No. is enclosed

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Parameters Pty. Ltd. P.O. Box 573 ARTARMON N.S.W. 2064 Offer closes June 30, 1984

---
ELECTRONICS TO JAPAN?

Sydney designers and manufacturers of computer-based musical instruments, Fairlight Instruments Pty Ltd, was one of 18 firms to win last year's Export Awards for Outstanding Achievement.

The annual awards, sponsored by the Confederation of Australian Industry and the Department of Trade since 1963, are a recognition of significant achievement in skill, enterprise and initiative in the export field.

Presented by the Minister for Industry and Commerce, Senator John Button, the award was accepted for the company by Research and Development Officer, Mr P. Vogel, at a presentation ceremony in Canberra on 2 December.

Fairlight Instruments claims a world first in the marketing of its technologically innovative microcomputer-based, multivoice, sound-producing system, the Fairlight Computer Musical Instrument (CMI).

Accepted by leading international musicians, the CMI has achieved impressive export growth, up from sales of $457,000 in its first year of production (1979-80) to $1.6 million last financial year.

An arrangement with Japan's Matsushita to launch the product there, earned the firm an initial $250,000. Other major sales have been in the USA, Britain and Europe.

World publicity was a significant success factor, much of it generated by trade show participation and advertising and promotional tours assisted by Trade Commissioners and export incentive grants.

The CMI was developed with the aid of an Industrial Research and Development Grant.

TO THE ELECTRONICALLY MINDED. (Professionals, Hobbyists, Students & Enthusiasts.)

We carry a wide range of Multimeters, Calculators, Soldering tools, Transformers, Cables, Instrument boxes, Computer Connectors, TV Aerials, Components and just about anything you may require.

TV CHANNEL SPACING STANDARD CHANGE

The Minister for Communications, Mr Michael Duffy, announced in December that the existing official standard of 8 MHz spacing for the carriage of television signals in the UHF band would be changed to 7 MHz.

Mr Duffy said his decision would allow for more productive use of the spectrum which was a limited physical resource. The decision followed detailed consultation with the broadcasting industry and television receiver manufacturers, according to the minister's office. It would have no detrimental effect on the industry and would not cause any increase in the price of receivers, he claimed.

The existing standard of 8 MHz spacing was created in 1976 by the old Australian Broadcasting Control Board which had initially favoured 8 MHz spacing for UHF television services and 7 MHz for the more traditional VHF band.

This band was becoming congested and as a result, the UHF band would increasing be used in Australia for the future expansion of television services.

Apart from enabling the planners to make more efficient use of UHF, adoption of 7 MHz spacing would also allow development of a national UHF television plan to proceed. The relevant technical standard for Australian television services would be altered in accordance with the decision, Mr Duffy said.
A group of Canberra radio amateurs set out to prove that amateur radio could provide viable backup communications for manned space flights.

Using 144 MHz equipment, they made an historic contact between Owen Garriott, W5LFL, aboard the Space Shuttle Columbia that flew in late November to early December last year, patching him through to the Johnston Space Centre in Houston (USA). This is their story.

MORE AMATEURS IN SPACE?

AMATEUR RADIO may well be welcome aboard future Space Shuttle flights as a direct result of the success of Dr Owen Garriott's operations on the STS-9 mission.

Although reports did not specifically mention the VK10RR operation, its success has undoubtedly had some influence. The general amateur contacts were achieved in Garriott's 'spare time'. At a post-flight press conference on 19 December, Garriott said, "As with most hams on the ground, you have the opportunity to do that kind of work only in your spare time. That's the way we did it on board as well."

"In the hours I managed to find time for it, I talked with some 300 hams in various parts of the world, principally in the US, but also a good many in Europe, and other people scattered all over the face of the globe."

"Most of the contacts were by phone (voice), some on CW (morse code). These were all logged and will be acknowledged now that we are back here on the ground."

Carl Smith, WOBWJ, President of the American Radio Relay League, was on hand at the press conference to congratulate Dr Garriott and he expressed the hope that it will be possible to have more licensed amateur radio operators on board future Space Shuttle missions in order to prove that the amateurs' capability of providing backup and emergency communications is real.

The public relations success of W5LFL's operation cannot be denied. NASA, in need of favourable public exposure, showed that ordinary people can become involved in the space program.

(Item courtesy Westlink Report — Ed.)
WHEN it was announced that Dr. Owen Garriott would operate as W5LFL from the Space Shuttle "Columbia" during the STS-9 mission, a great deal of interest was generated within the amateur fraternity worldwide. W5LFL used a hand-held transceiver in the two metre amateur band (144-148 MHz). This was the first time that an amateur station had been operated from an orbiting manned spacecraft.

The interest in this expansion of VHF amateur radio was shown by an active group working at the Orroral Valley NASA Space Tracking Station, situated in the Gudgenby Nature Reserve in the southern part of the Australian Capital Territory. The Orroral Tracking Station supports the Space Shuttle missions by providing tracking, telemetry and voice contact whenever the orbiter is in range. The amateurs at Orroral Valley are part of the specialist teams established to meet satellite tracking requirements. After discussion, this group decided to investigate the possibility of establishing an amateur station at the Orroral Valley Space Tracking Facility for the purpose of contacting W5LFL on the STS-9 mission.
Will your child grow up to be Chairman of the Board?

Aristotle said ‘give me your child from one to seven and I will give you the man.’ Put simply he was saying people are products of their environment. Research confirms children brought up in an atmosphere of creativity and learning where they are encouraged to compete are the ones who get to the top.

What can a parent do to give their child that special start? To begin with you can turn off the television. And turn on the home computer. But with so many to choose from what home computer should your youngster have?

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Space tracking operations within Australia are supervised by the Department of Science and Technology, who were approached for permission to establish the amateur station. The Department declined permission on the grounds of possible interference to normal Space Shuttle communications. When the Department's decision was learned, they were requested to reconsider.

Because the amateur operations on the Space Shuttle were approved by NASA the NASA representative in Australia, Dr Joe Kerwin, was asked to intercede on behalf of the amateurs. With Dr Kerwin's help, an alternative site was located.

During this pre-mission period, Dr Kerwin was in contact with his ex-Skylab colleague, Owen Garriott, who was flying on the STS-9 mission. When Dr Garriott learned of the interest shown by the amateurs in Australia, he proposed that a special test should be conducted to prove that amateur radio could be used as a viable backup communications link. Dr Kerwin asked the amateur group at Orroral Valley if they would undertake this experiment. This challenge was accepted and the astronauts arranged with the mission planners at Lyndon B. Johnson Space Centre in Houston that one particular orbit would be made available for this historic test. Special frequencies, separate from those used for the normal amateur contacts, were arranged and kept secure by Dr Kerwin until one hour before the experiment took place. Even the orbit to be used was not revealed until after the STS-9 mission had been launched.

Site and setup
Situated in the Canberra inner-southern suburb of Deakin is the switching and communications centre for all NASA space-tracking voice, data and teletype circuits between Australia and the United States. With Dr Kerwin's help it was at this centre that the amateur station was established. To this point, much of the ground-work and liaison with Dr Kerwin had been done by Richard Elliott, VK1ZAH, and Paul Bell, VK1BX, whose unflagging optimism and enthusiasm had brought the results so far.

Because of the number of amateurs involved, the special nature of the station, and the participation of NASA through Dr Kerwin, it was decided that a special call sign should be obtained, if possible. The Department of Communications was contacted and, thanks to their understanding and ready co-operation when the experiment was explained, they issued the special event call sign of VK10RR for the duration of the STS-9 mission. With the preliminary arrangements completed, the site established and the call sign allocated, the equipment and antenna system was selected.

The choice of antenna was not simple because of the conflicting requirements that had to be met. By this time as well, launch day was approaching and not a great deal of time was available to construct special equipment. As this Shuttle mission had a high inclination orbit (57 degrees to the equator) an omnidirectional antenna would have been desirable. Such an antenna should have a low angle of radiation to
Shuttle-to-Houston via amateur radio

cover the low-elevation horizon portions of the pass, and a higher angle for the maximum elevation point.

These characteristics are, for all practical purposes, mutually exclusive. In addition, physical size and weight had to be kept within manageable limits as the entire assembly had to be hand-carried onto a roof some 15 metres above ground. The speed of a fast moving spacecraft posed problems for a directional antenna system. Finally, as consideration of all factors, a combination was selected to cover as many possibilities as was reasonable. This combination was a steerable, crossed 10-element yagi with switchable circular polarisation, a 5-element horizontal yagi oriented to maximum elevation of the pass, and a 5/8-wavelength vertical whip. The antennas were mounted on a temporary scaffold erected on the roof of the Deakin Switching Centre. Semi-rigid, low-loss hardline was used to connect the antennas to the equipment. A low noise GaAs FET pre-amplifier was used to improve the receive noise figure.

The equipment used was provided by local amateurs and was configured with two claims to provide redundancy in the event of a failure. Alternative mains and battery power was available to all essential equipment. Three transceivers were used in the final configuration. These were an ICOM IC260A, an FDK 205 and an ICOM IC251A. The two main units used Microwave Modules 100 W linear amplifiers with receiver preamplifiers.

This configuration allowed two 100 W uplink paths and the prime receive path threshold was 140 dBm due to the GaAs FET amplifier. Special delayed transmitter keying was installed to enable the antenna anode GaAs FET amplifier to be disconnected before uplink power was applied to the antenna. Thanks must go to Richard Elliott VK1ZA, Paul Bell VK1BX, Darryl Fallow VK1DF, Bob Heinson VK1RR, and Bob Quick VK1ZOR, for their efforts in construction and installation of the equipment. The officers in charge of the Deakin Switching Centre, Mr Des Terrell and Mr John Warth, provided valuable assistance in making space available and for advice during installation of the station.

Houston phone-patch

For the actual contact, and to prove that the amateur system could provide proper back-up voice capability to the Space Shuttle, a phone-patch was used to interface with the international telephone system. Dr Owen Garrett W5LFL, on board "Columbia", was then able to speak to the Cap-Com (Spacecraft voice communicator) in Houston via amateur radio through VK1ORR and an international phone-patch.

On Monday evening, 5th December 1983, this historic test took place during orbit 110 of the STS-9 mission. The test proved an outstanding success and demonstrated that amateur radio could provide excellent emergency voice communication.

The orbiter was passing from north-west to south-east over Australia, directly over Melbourne. This pass allowed only six minutes for the contact.

During his conversation with controllers in Houston, Owen Garrett said of VK1ORR, "This is one of the best stations we have heard since we have been in orbit!" A compliment indeed and a tribute to the performance of the VK1ORR station!

Also present for this history-making experiment was the US Ambassador to Australia, Robert Nesen, and Senator Jake Garn of Utah, USA, a member of the NASA Appropriations Committee. The ambassador was able to exchange a few words with W5LFL during the contact which was coordinated by Dr Garrett's colleague, Dr Joe Kerwin.

Contact

Here is a partial transcript of the historic two metre band amateur communications test between W5LFL on board the Space Shuttle "Columbia", and VK1ORR in Canberra. (S/C is the Spacecraft "Columbia", W5LFL ORR and JK is the NASA representative, Joe Kerwin).

S/C "Hello victor kilo one ogaren roger, victor kilo one ogaren roger; W five lima foxtrot lima, W five lima foxtrot lima".

ORR "W five lima fox lima here is VK one ogaren roomey roomey. We copy you five by five. I will now hand you over to Joe Kerwin".

S/C "Columbia coming right back (signal fade) is Joe Kerwin at the station this morning"

ORR "Okay Owen, we're copying you OK. We have had a problem with the phone-patch. We're trying to get the phone-patch up and then I'll hand you over to Joe".

S/C "OK, that sounds fine and I've got all your signals here on the tape recording and when we get back on the ground we'll be able to acknowledge them all in proper order and er, hullo there Joe, if you can get on the mic all your friends here in the spacecraft wish you hullo as do your friends back in Houston, and we will of course be looking forward to seeing you back home in a few more days and we also want to send our best wishes and many thanks to the fine crew there at Orroal Valley for all their help in tracking for the last week or so and the other previous missions, and an outstanding job has been done and we appreciate it very much. Go ahead now Joe over".

JK "Alright, sounds like a real science party Owen, it sounds like you're getting a good come up there. I'm ready to turn Cap-Com in Houston right over on the line here? - OK Owen. I'm going to turn you over to Houston to complete the contact right now and then I want to get back with you for a minute. Please finish your transmissions with 'over' as we are simplex and I have to push the button for Houston to talk. Go ahead and call Houston, over".

S/C "Hello Houston Cap-Com, Hello Houston Cap-Com, I expect this is er... Brian on the line. This is W5LFL, Spacecraft Columbia, go ahead, Brian".

(Houston cap-Com uplink is garble on the tape and unintelligible)

S/C "Roger, outstanding. Load and clear. One of the best stations we've heard ever since we've been in orbit. The attitude of the spacecraft is just perfect, of course. We're looking right, straight down over Melbourne at just about this moment, this very moment, and we just wanted to establish the fact that we could maintain a backup comm. here. John is right behind me and he's been looking forward to call you all or having us say hello to you through the backup ham system. - And he's giving us a thumbs up sign right now, Brian, so a fine business; we appreciate the chance to talk with you, go ahead, over"

(Houston Cap-Com transmission is garbled on tape)

S/C "Yeah, John doesn't want to get on the loop here, I would have to change the heading with him Brian, but hello to you also Bill and why don't we go back now to Australia and take a few moments here before we lose contact line-side with Joe Kerwin. Thanks a lot fellas in Houston and back to you Joe, in Australia, over".

JK "OK, thanks very much Owen, I've got the Ambassador, Robert Nesen, here and incidentally, standing behind him is Senator Jake Garn from Utah who says hello to John and he still wants a ride. Here's the ambassador".

S/C "OK, fine Joe. thank you, I just passed along the hello from the senator to John who acknowledges that, and er, I am pleased to have you there also Mr Ambassador so I'm glad to see you all. The spacecraft attitude really makes the comm. system fine here this moment, and we've had a lot of good views of Australia, and er, we want to er as I say a moment ago, wish you all er a lot of many thanks and 75s for all the good work that you've done for us here in the past tracking missions. Go ahead".

(End of partial transcript.)

The performance and success of this experiment was due to the dedication and determination of Dr Owen Garrett W5LFL, Dr Joe Kerwin, and Richard Elliott VK1ZA, who were able to bypass international and bureaucratic boundaries by their personal involvement and interest.
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Phone: (02) 665-8211 Telex: AA20181 BENELC
KODAK ENTERS VIDEO MARKET

Eastman Kodak Company has announced plans to extend its reach in imaging to the worldwide video market. Kodak will market an entirely new 8 mm video camera-recorder system and more than 50 configurations of Kodak and Eastman brand video cassettes and tapes for home entertainment and professional applications.

The products will be manufactured to Kodak specifications in Japan. Video tape will be supplied by TDK and the equipment will be sourced from Matsushita. "Our new Kodavision series 2000 video system marks the beginning of a new level of convenience in home video recording," noted Mr. E.G. Woods, managing director and chief executive officer for Kodak (Australasia).

"The one-piece Kodavision camcorders are highly portable," Mr. Woods added. "When compared with current camera and recorder hookups, their advantages become clear. Current 1/2" two-piece systems usually require the user to shoulder a camera that's wired to a separate recorder unit carried at waist level. The entire outfit may weigh 5 kg or more. But the smaller Kodak 8 mm video cassette (only slightly larger than an audio tape cassette) yields considerable advantages. It makes it possible to design a 2.2 kg cordless model with point-and-shoot convenience.

The new Kodavision series 2000 video system includes two 8 mm video camera-recorders: the Kodavision series 2000 camcorder, model 2200; and the autofocus camcorder, model 2400. The camcorders will accept 8 mm Kodak video cassettes.

The system's visual and audio capability is extremely high says Kodak. Both tapes have the capability of recording digital and/or FM hi-fidelity sound.

The camcorders share several common features. These include a fast f/1.2, 6:2 power zoom lens, a 1/2" Newvicon tube and a fully automatic white balance that adjusts the camera to shifts in colour temperature.

The cameras also feature a fast forward and fast reverse, a 5x visual search, and an electronic viewfinder (actually a miniature black-and-white television screen). A review feature lets the user replay the last four seconds of the most recent recording. Both cameras incorporate an automatic iris for automatic exposure control.

Both camcorders accept cassettes of either MP (metal particle) tape or a higher grade ME (metal evaporated) tape. Both can record for up to 60 minutes on the PAL system, and Kodak anticipates that advances in high density tape technology will result in 8 mm cassettes with even longer playing times.

The Kodavision system's compact playback component, the series 2000 cradle, model 2220, allows users to play back recorded tapes.

The cradle was developed by engineers and designers from Kodak and the manufacturer. It is connected to the user's television. To play a tape, the user inserts the camcorder itself into the cradle. The camera's motor drives the tape. Circuitry within the cradle converts the signals recorded on the tape for television display.

The camcorder's battery is recharged while the camera is in the cradle. The cradle can also recharge a separate battery to extend the time the camcorder can be used.

The cradle is designed to include an optional Kodavision series 2000 tuner/timer, model 2222, a device that allows users to record television broadcasts. The cradle is designed to be compatible with existing 1/2" VCRs to facilitate dubbing 8 mm images onto 1/2" tape and vice versa.

The cable ready tuner/timer has 105-channel capability and offers 12 preset channel positions. It can be programmed to tape up to two programmes over any two-week period.

Kodak video cassettes for the home entertainment market will be sold in 1/2" width (in both Beta and VHS formats) and in various popular lengths, in regular and extra high grades.

Eastman 1/2" professional video cassettes are scheduled to be available around mid year in all popular formats and lengths, in high grade and extra high grade quality versions. Eastman 1/2" cassettes (in both professional and broadcast quality grades) will be available at the same time. Eastman broadcast quality tape will become available later this year.

For further information contact Akai (Australasia) Pty Ltd, PO Box 90, Coburg Vic 3058. (03) 350-1222.

NEW AKAI VIDEO

Akai has announced a new addition to their video range for 1984, the VS-6EA. The VS-6EA will join the VS-3EA and the stereo/Dolby VS-8EA in the Akai model range. Like the VS-8EA, the VS-6EA features two-speed recording and playback doubling the recording time of any video cassette. The long play mode gives up to eight hours recording (from a four hour tape). For improved picture quality at normal speed the VS-6EA has four heads, which produce a superstill picture on freeze frame, says Akai.

Akai claims that along with the VS-3EA and VS-8EA the new model has several exclusive features, including the 'can't miss' interactive monitor. The interactive monitor tells you exactly what to do by displaying operating instructions on your own television set. It tells you what buttons to press for unattended recording and even how much recording time you have left on the tape.

The timer allows you to programme the VS-6EA to record up to four programmes over a 28 day period. In case of power failure, there is an inbuilt battery that provides emergency power for up to three days for the tuner memory.

All of the functions of the video recorder can be operated with the 25 function wireless infrared remote control.

The VS-6EA has a front loading tape transport mechanism that enables it to be easily incorporated in an existing home entertainment setup.

Other features include fast picture search to find a specific point on the video tape, 8-channel preset tuning and an electronic synthesizer tuning system which ensures that tuning is always accurate and stable, says Akai.

Further information can be obtained from Akai Australia Pty Ltd, PO Box 309, North Ryde NSW 2113. (02) 887-2311.
SIMPLE-HIGH PERFORMANCE CD PLAYER FROM NAD

NAD's first digital Compact Disc player, the Model 5200, available from NAD retail dealers from January and priced in the mid-$900 range, is a "second generation" CD player that employs newly developed LSI chips for its tracking and digital decoding functions.

Unlike CD players that are festooned with programming controls to provide automatic playback of recorder tracks in any randomly chosen order, the NAD 5200 is essentially a high-performance "manual turntable" for compact discs.

Its unusually simple, logical controls provide rapid access to any track; two-speed cueing in the slow-sean search mode (with audible output to facilitate precise cueing to any point within a track) and the ability to advance or retard the laser's cue point in the music by increments as small as one second.

In view of its operating simplicity and the discs' near-immunity to fingerprints and handling damage, the 5200 is also an ideal record playing system for children.

The laser tracking and digital error-correction circuits in the NAD 5200 are particularly advanced. The standard CIRC (cross interleave) approach to error correction is augmented in the 5200 by a PLL frame-synchronizing circuit that eliminates data losses caused by timing jitter, NAD says.

It also includes a new logic processing circuit that analyzes bit error patterns, doubling the system's capacity for error-correction both before and after signal de-interleaving. As a result, the 5200 securely tracks flawed discs that are unplayable on other, more costly CD players, claim NAD.

Special attention was paid to the design of the analogue output circuitry of the 5200 to ensure that no added noise, distortion or slew-rate limiting would compromise the purity of the playback sound. With its signal/noise ratio of nearly 100 dB, "...even the smallest details in the musical texture are heard against a background of velvety silence."

NAD equipment is distributed in Australia by Falk Electrosound, Rockdale NSW.

VIDEO/AUDIO ACCESSORIES

GFS Electronic Imports of Mitcham Victoria has just announced the release of two new video/audio-related products from the factory of MFJ Enterprises, Mississippi, USA.

Both units are designed to be used in conjunction with a video recorder and stereo system to provide big theatre quality sound.

First in this new line is the model MFJ-1500 'room expanding audio enhancer'. It makes use of electronic time delay with feedback to simulate the reverberation of reflected sound normally experienced in a theatre.

The room expander connects directly to the audio jack of a VCR or TV. An auxiliary speaker on a stereo system is then connected to its output. Controls provided on the MFJ-1500 are ambience, for reverberation expand, for time delay, volume and input.

To complement the MFJ-1500 is the new MFJ-1501 stereo synthesizer. It produces a simulated stereo from the mono audio output of a TV or VCR.

The MFJ-1501 uses a sophisticated design to create a comb response that puts alternating 1 kHz bands of sound into the left and right channels of your stereo system. This technique is the same used by professional audio engineers to produce simulated stereo LPs for the older mono recordings.

For further details of both the MFJ-1500 room expander and MFJ-1501 stereo synthesizer, contact the Australian distributors, GFS Electronic Imports, 17 McKeon Road, Mitcham 3132 Vic. (03)3873-3777.

DENON CD PLAYER

Denon engineers found that the digital to analogue conversion process was one crucial area when they looked for ways to improve the CD player. More features and functions were built in and it was made easier to operate. The result is the new DCD-1800.

One of the problems of D/A converters has been the generation of a distortion similar to crossover distortion in amplifiers. To remedy this, Denon developed the Super Linear Converter which they say drastically reduces the distortion and adds sweetness to high frequencies.

Tracking performance is improved too by the new Linear Drive Tracer system which uses a single high precision pivot shaft instead of the conventional parallel rod system for greater overall stability. Search time is also reduced.

Denon claim a S/N ratio of 96 dB, dynamic range of 95 dB, distortion of 0.003% and wow and flutter so low it can't be measured.

The Australian distributors of Denon equipment in Australia is Amalgamated Wireless (A/Asia) Ltd, 422 Lane Cove Rd, North Ryde NSW. (02)387-7111.

SANYO CAR SPEAKERS

Sanyo has announced the release of a new car speaker system — the FSP 401.

This compact unit is a single cone system with eight watts maximum power handling. It features a frequency response of 70Hz-10kHz and comes complete with a mounting baffle, wiring and instruments.

The FSP 401 is available from car stereo specialists, electrical retailers and department stores for around $15.95.

For further information contact Mr. Wally Fabiszewski, Sanyo Australia Pty Ltd, 14 Mars Rd, Lane Cove NSW 2066. (02)428-0822.
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DICK SMITH Electronics
See page 93 for full address details.
ME 15 preamplifier
and ME 75 power amplifier

These Australian designed and manufactured amplifiers...
"are very much like the best of the valve amplifiers which I, and
many other audiophiles, grew to admire and accept"

Louis Challis

I was pleased when it was suggested that we review this equipment designed by
ME Sound Pty Ltd because we don't often see Australian manufactured or designed
equipment.

Contrary to the nasty rumours circulating in Canberra, Australian enterprise is still
alive, and ME Sound is probably typical of that enterprise. The firm is young, virile, a
trifle avant-garde, and knows about electronic technology.

Perhaps you may not have heard of ME Sound, or their predecessors, Modular
Electronics. I must admit that, prior to conducting this review, neither had I. Their
equipment is handled by only a very small number of retailers so unless you visited one
of the retailers, or happen to know somebody who bought some of their equipment,
your chances of seeing or hearing it would not be very great.

The trade literature which arrived with the amplifier and preamplifier was a trifle
scanty. Surprisingly, there was no proper handbook or circuit diagram with the equip-
ment. However, the manufacturers did include a price list which will probably frighten all but the most intrepid audiophile into believing that this equipment is beyond
his or her budget.

Each of the pieces of equipment came in its own solidly constructed pineboard pack-
ing case which the transport company had managed to cover with a brown treacle-like
substance. Fortunately, the packing was good enough to ensure that the substance
did not penetrate through to the equipment.

The appearance of the equipment did not provide the awe inspiring glitter and pan-
ache of the Marantz Esoteric range or the functional and very practical characteristics
of the New Zealand Perreaux range, both of which we have recently reviewed. ME
Sound has chosen the stark and businesslike black colour to clothe their equipment
which probably also helps with the thermal dissipation.

While ME Sound believes that 'black is beautiful' the appearance of the equipment
is not in any way avant-garde, even though it looks different.

ME 15 features

The preamplifier, in keeping with the Per-
reaux approach, does not incorporate tone
controls and I must state that, in general
terms, I support the stance of both ME
Sound and Perreaux in this particular mat-
ter. The preamplifier's front panel, which is
designed for rack mounting, has so few con-
trols on it that you could well be forgiven
for wondering why the designer has bothered to put the preamplifier into a separate
package.

The controls consist of a power on/off
switch, with its associated bezel light, a
phone/auxiliary switch and a tape monitor
switch, all located on the left-hand side of
the panel. A balance control and a gain con-
trol are located at the right-hand side of the
panel.

The preamplifier's back panel has a pair

of gold-plated phono input sockets, a pair of sockets for auxiliary inputs, two pairs of sockets for tape input and output and a pair of sockets for the main signal output. The designers have also provided a universal terminal which supplies a 15 V signal to the main amplifier, as well as a DIN socket through which a separate power pack provides the main supply voltages for the preamplifier.

The concept of externally powering a preamplifier is not completely new as it does provide the designers with a possible means of reducing magnetic induction from the power transformer. In theory, this may make it possible to reduce hum and noise to a much lower level but this, regrettably, is achieved at a substantially higher manufacturing cost.

While it is possible that the mains hum leakage component in the voltage supplies may be effectively reduced by this approach, I have measured a sufficient number of competing units from other manufacturers to know that this particular approach is not the only way to achieve that aim.

The 15 V supply terminal on the back of the preamplifier provides a signal which switches the main amplifier from standby to a fully operational condition when the preamplifier is switched on. The power amplifier is claimed to operate in the Class 'AB' mode so it is obviously essential to reduce unnecessary power dissipation and consequently this feature must be included.

The inside of the preamplifier is not quite what I expected as it contains six printed circuit boards, four of which are major and two are minor. The minor ones are associated with the gain and balance controls at the front of the unit and also with the separate large and fancy-looking printed circuit board with large earthing strip for the interconnection of the coaxial connections on the rear panel.

**ME 15 PREAMPLIFIER AND ME 75 POWER AMPLIFIER**

**ME 15**
- Dimensions: 435 mm wide x 56 mm high x 300 mm deep.
- Weight: 7 kg
- Price: $895

**ME 75**
- Dimensions: 435 mm wide x 120 mm high x 370 mm deep.
- Weight: 22 kg
- Price: $1295

Manufacturer and Distributor: ME Sound Pty Ltd, c/o Post Office, Dyers Crossing NSW 2429.

(065)50-2254.

The major printed circuit boards are for the twin balanced power supply, the high current output module and the moving magnet/phono preamplifier, together with its plug-in precision RIAA equalisation circuit. Each of these only occupy a small proportion of the available space inside the cabinet. The sixth printed circuit module is associated with the switching controls for power, phono/auxiliary and tape monitor circuits.

The unit is well made and neatly laid out, however, its cost seems a trifle higher than we would expect in terms of either the circuitry provided or based on the competitive prices from other suppliers.

**ME 75 features**

The main amplifier's appearance is, if anything, more avant-garde than that of the preamplifier. The designer has chosen to place the two large heat sinks on the front panel, instead of the sides or back as other designers do.

These heat sinks flank a pair of operating mode indication lights located at the centre of the panel. A red bezel light indicates that the amplifier is in 'standby mode' while a green one shows that the amplifier is 'on' and operating normally.

Each of the heat sinks has twelve, 50 mm deep cooling fins extending across the full height of the panel. The external corners of the heat sinks are particularly sharp and, like the external corners of the front panel, are likely to leave a nasty scratch or cut if you happen to inadvertently come into contact with them.

I have criticised Jands for this fault, but they have learnt from their mistakes and their latest amplifiers no longer have this problem.

The back panel incorporates a line input socket on each side adjacent to two pairs of large, colour-coded universal output sockets. The panel also incorporates a yellow universal terminal for the amplifier's power activation circuit.

The only visible protection is a 2.5 A slow-blow line fuse which appears to provide the last line of defence for the amplifier protection.

Unlike the majority of amplifiers on the market, this unit features a Class 'AB' power output stage. This is one way to improve the linearity of the amplifier but only at the expense of considerable power dissipation.
The result is lower power output and the need for a good cooling performance.

This is supplemented by a very unusual drive circuit in which the designers have chosen an even more unusual approach to negative feedback (See Figure 1). The stated purpose for this particular choice of circuitry is to reduce dynamic distortion.

As the figure shows they have divided the circuitry into two sections. The front section is the buffer amplifier in which sufficient feedback is provided to set the correct gain and overall sensitivity.

The second section incorporates the driver and output stages and these use the normal feedback of the emitter follower configuration. This has apparently been done to isolate the speaker from the internal feedback stages, particularly the capacitor and inductors normally required for the feedback loop.

These concepts are apparently based on a design feature proposed by Matti Otaala who is renowned for a number of equally topical theories, many of which are currently the subject of heated debate in technical circles. Not surprisingly, some of the most heated debates on these theories have taken place in Australia where the members of the IREE audio group and the associated members of the Standards Association Committee TE/24 have strongly objected to the glaring inconsistencies in Otaala’s theories as well as some of his claims.

At a recent meeting of the Sydney branch of the Audio group of the IREE Professor Cherry provided a series of demonstrations which personally convinced me that some of Otaala’s theories and many other generally held theories are quite specious.

The top panel of the amplifier is well ventilated and when the amplifier is operating (in the class ‘AB’ mode) the heat generated is enough to make you wonder whether a cooling fan might not have been a worthwhile addition.

The amplifier’s internal construction was very different to any other amplifier that I have seen. The first major difference which catches your eye is the array of small electrolytic capacitors mounted on two printed circuit boards with their power rectifiers on each side of the large centrally mounted mains power transformer. The designers claim that this configuration achieves much lower impedances and much more stable rectification than the more conventional single large computer type capacitor which other designers have favoured.

The power amplifier circuit boards are located immediately behind the front external heat sinks and use a novel, but very practical, combination of heat sinks which double as mechanical bracketing. Each of the printed circuit boards uses a pair of side rails onto which the driver transistors are mounted and which enhance the rigidity of the boards and their resistance to external vibration.

The earth wires and signal wires have been designed using very large conductors which ensure minimum impedance over the operating frequency range. The amplifier appears to incorporate an output stage protection circuit although no details are provided as to how it works.
SOUND REVIEW

Objective testing
The claims made in the information supplied with the preamplifier and amplifier are quite exciting. All of the significant measurable and audible parameters including frequency response, total harmonic distortion, slew rate, output impedance, signal-to-noise ratio, audible quality, base response, sound definition as well as overall clarity are claimed to be substantially superior when compared to other amplifiers. Most of the other amplifiers, however, are generally less expensive than this particular unit.

The measured performance of the amplifier was not quite as exciting as I would have expected. The frequency response is exceptionally good extending from below 1 Hz to beyond 100 kHz with no sign of low frequency drooping response. This sounds good on paper, but if you happen to drop your cartridge on the platter the chances are that your speaker diaphragm and its voice coil are likely to jump right out of the speaker basket.

A better approach is to offer the user a variable low frequency cut-off setting which provides the ability to remove the low frequency wow and eccentricity information content on the records, as well as protecting the speaker from unwanted excursions.

At the one watt level with the preamplifier and amplifier both operating, the distortion at the three test frequencies of 100 Hz, 1 kHz and 6.3 kHz is moderately low in the range between 0.023% and 0.026%. At the 78 W level the distortion rises to between 0.06% and 0.13%.

However, before you get carried away and start pounding the table or phoning me to complain about the 'high' level of the distortion, I should point out that this level of performance is still reasonably good when you consider that the amplifier does not incorporate a feedback loop connecting the output stage directly back to the input.

The design has been conceived to specifically avoid that requirement. In the interest of achieving a stated set of audible goals. By the same token, these figures are in no way comparable with the better or best amplifiers that we have reviewed in the last few years whose distortion figures, under similar operating conditions, have been as much as three orders of magnitude better than the figures displayed by this system.

As the manufacturer's literature gives a warning about using suitable mains connections we tested the amplifier twice, the second time using a mains supply which does not come through our normal core balance circuit breakers.

We found it interesting that this produced no substantial reduction in the measured level of harmonic distortion; we were convinced that the characteristics of the amplifier are not significantly affected by the choice of mains circuitry.

Obviously, if the amplifier is to achieve the sort of performance that the designers are seeking then the measured 'IEC high frequency total difference frequency distortion' performance should be comparable with the best amplifiers that we have tested.

Surprisingly, this is not the case and the measured performance is not as good as we might have expected. The lowest level of total difference distortion was only 0.08% which is more than 10 times higher than that produced by other amplifiers that we have recently tested.

An equally significant set of parameters is the signal-to-noise ratio. The measured performance for both the auxiliary inputs and the phono inputs only achieves a 60.5 dB signal-to-noise ratio and 67 dB A-weighted performance relative to the one watt level.

An examination of the one third octave band spectrum reveals a very high level of 50 Hz signal; this is hard to justify after all the trouble the designer has taken with external power transformers for the preamplifier and with the fancy power supply.

<table>
<thead>
<tr>
<th>AMPLIFIER DATA SHEET</th>
<th>HARMONIC DISTORTION:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEASURED PERFORMANCE OF ME 17 PREAMPLIFIER NO. 10501IX</strong></td>
<td><strong>(A) (At power of 1 watt into 8 ohms)</strong></td>
</tr>
<tr>
<td><strong>AND ME 13 POWER AMPLIFIER NO. 73001X</strong></td>
<td><strong>100Hz</strong></td>
</tr>
<tr>
<td><strong>FREQUENCY RESPONSE:</strong> &amp; (-3 dB re 1 watt @ 1kHz)</td>
<td>2nd</td>
</tr>
<tr>
<td>No Tone Controls Fitted</td>
<td>-79.8</td>
</tr>
<tr>
<td><strong>SENSITIVITY (for 1 watt in 8 ohms)</strong></td>
<td>2nd</td>
</tr>
<tr>
<td>Left</td>
<td>-79.8</td>
</tr>
<tr>
<td>Right</td>
<td>-79.8</td>
</tr>
<tr>
<td><strong>INPUT IMPEDANCE:</strong> &amp; (at 1kHz)</td>
<td>Left</td>
</tr>
<tr>
<td>AUX</td>
<td>64 k ohm</td>
</tr>
<tr>
<td>TAPE</td>
<td>64 k ohm</td>
</tr>
<tr>
<td>PHONO</td>
<td>67 k ohm</td>
</tr>
<tr>
<td>MAXIMUM OUTPUT POWER AT CLIPPING POINT</td>
<td>Left</td>
</tr>
<tr>
<td>(IHF-A-202 (20mS burst repeated at 300mS intervals))</td>
<td>1/4 V p-p</td>
</tr>
<tr>
<td>Therefore Dynamic Headroom (re 78 watts)</td>
<td>= 110 Watts</td>
</tr>
<tr>
<td>OUTPUT IMPEDANCE: (8 ohm)</td>
<td>= 1.5 dB</td>
</tr>
<tr>
<td>405 millihms</td>
<td></td>
</tr>
<tr>
<td>HUM AND NOISE LEVELS (re 1 watt in 8 ohms)</td>
<td>Left</td>
</tr>
<tr>
<td>INPUT</td>
<td>0.1V AUX.</td>
</tr>
<tr>
<td>INPUT</td>
<td>3.0mV PHONO m/m 60.0 dB (Lin)</td>
</tr>
</tbody>
</table>
We're not suggesting you actually break the law, but aren't you a bit sick of the wimpy sound of most of today's car stereos? You shouldn't need a power booster to let everyone know what great musical taste you have.

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ME Sound Pty Ltd design philosophy

This information, supplied to us at our request, is a precis of Peter Stein’s handwritten notes.

High current output. For the ME 75 power amplifier to effortlessly drive any commercially designed loudspeaker system it must be able to deliver sufficient current to handle the transient and overload conditions demand it. The ME 75 is capable of delivering 40amps, measured at 20% duty cycle pulse, into an appropriate high power load. Power supply. To supply the amplifier modules with the necessary power an unusual array of low inductance capacitors are connected in parallel. The power transformer is designed to supply large instantaneous power levels in excess of that available at the average power outlet. The losses within the transformer are of the same order of magnitude as the IR losses in the normal household wiring system.

The supplies are independent and no crosstalk is possible, other than by modulation of the mains voltage due to excessive power demands and this only manifests itself at 100 Hz with no effect on imaging since directional information occurs above 200 Hz. High temperature performance. Dynamic performance is the prime criteria by which the design of ME products has evolved, rather than steady state or static performance. A significant contributor in the area of ME amplifier dynamics is the new constant operating temperature of the output devices. When a bipolar transistor becomes hot its gain, bandwidth and transient distortion improve markedly, hence the ME 75 has a large constant current heating the output devices to a temperature of 70°C. This current also ensures a low distortion at low levels since the amplifier effectively operates in a Class 'A' mode.

Thermal cycling and its related distortion products are avoided since the transistor junction is already hot, rather than being heated from cold as happens when transistors are intentionally kept as cool as possible. ME Sound has often looked at MOSFETs as possible output devices but they have two serious problems; their distortion products are ten times that of a bipolar device, hence ten times the negative feedback is necessary to equal bipolar amplifier designs, and they have a negative temperature coefficient. As MOSFETs heat up the gain decreases and the dynamic range is compressed. Symmetrical balanced top. ME amplifiers are designed to clip gracefully with a rounded waveform (low order harmonics at the corners), ensuring an inoffensive excursion into overdrive.

It is also important to have a design which does not 'latch up' and here we have utilised a symmetrical topology with equal positive and negative slew rates and settling times. This has another benefit of maintaining very low distortion products by cancelling distortion generated by a 'mirror' effect within the circuitry.

The devices used in the circuitry are hand selected to vanishingly close tolerances; 1% metal film resistors, 0.05% wire wound power resistors, matched sets of semiconductors and hand selected capacitors.

Servo system. In keeping with our philosophy of simple signal processing, a separate error feedback monitors and maintains the dc output level at 0.2±0.001 volts max. rather than overcomplicating the circuit design trying to maintain dc stability.

Remote sensing protection system. This monitors the output of the amplifier and operates once a signal is detected which is likely to damage your loudspeaker.

This style of protection offers a significant advantage as there are no series fuses or relay contacts to detract or interfere with the signal between the circuitry and the loudspeakers. This is the usual practice and these effects increase with age.

The turn-on and turn-off surges which appear at the loudspeaker terminals are inaudible, being less than 0.01% peak.

A significant fact is that the muting relay used in conventional power amplifiers cannot protect against loudspeaker damage. This is due to a common amplifier failure mode, dc at the output terminals, which invariably equals the full internal dc supply voltage (in a 100 W amp 50 Vdc). This causes the relay contacts to weld together, then vapourises the voice coil of the bass driver.

Therefore, the ME protection network removes the ac mains power from the amplifier, making it more reliable. No negative feedback loop for the output, driver and pre-drive transistors, instead, compound emitter degeneration is used with only the front voltage amplifier operating with loop feedback, however, this stage drives the purely resistive power amplifier section.

The system avoids the possibility of loudspeaker effects entering the feedback loop and regenerating throughout the amplifier chain causing 'interference intermodulation distortion', a term used by Matti Otala. The back EMF generated by all dynamic loads can re-enter a conventional amplifier but is isolated by the separate current amplifier embodied in ME amplifiers.

Another advantage of this design is the absence of an output indicator; instability is not a problem and so the circuit can be hard-wired to the loudspeaker, a real benefit when you are talking about esoteric speaker cable of extremely low losses.

Servicing and updating. The modules are easily unplugged and exchanged. This allows the units to be serviced in remote locations while maintaining factory tolerances, as whenever a failure occurs a matched set of factory manufactured modules are fitted.

It also makes it easy to upgrade the old modules to new modules. This system is more economical as you don't have to buy a whole new amplifier.

Peter Stein, Managing Director, ME Sound Pty Ltd

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which incorporates so many capacitors at the back of the amplifier.

The preamplifier sensitivities are, however, relatively good with a 14 µV phono sensitivity and a 210 mV signal required to cause preamplifier overload.

The measurements of maximum output power using the IHF-A-202 test reveals a 110 W peak output into 8 ohms with 1.5 dB headroom. These figures do not match the claims made for the amplifier of 120 W output into 8 ohms. Neither does the peak current match the claimed 40 A peak current capability for single transient peaks.

The test of overload resistance based on our standard overload recovery performance was particularly stable and the unit exhibited no trace of jitter.

The output impedance is relatively high at 405 milliohms but the unit does not appear to exhibit any significant operational vices.

**Subjective testing**

The subjective assessment of the unit revealed characteristics that are a little different from what I would have expected. The audible characteristics are very much like the best of the valve amplifiers which, and many other audiophiles, grew to admire and accept as offering better performance than the first transistorised amplifiers which sounded relatively harsh in comparison.

The quality of the sound is unquestionably different to other high quality amplifiers available at the moment. I found this amplifier particularly pleasant to listen to as it exhibits characteristics which are audibly different, particularly on transient material.

When playing classical music and pop the amplifier works very well, but with recommended retail prices of $695 for the preamplifier and $1295 for the amplifier I can't see too many people hearing a path to the retailers door.

Australian enterprise may not be dead but only rich Australians will ever get to hear this particular equipment.

ETI March 1984 — 29
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Chinon Industries of Japan recently joined the ranks of companies supporting the C/standard. This compact 250KB (500KB in flippy mode) storage unit features low power consumption and 5½" compatible operation. Chinon's CF031 has a 3mS track-to-track access time and uses standard Compact Floppy media. Schools and remote recording applications will benefit from the rigid jacket and dust protection features of Compact Floppy disks.

GENERAL INSTRUMENTS' SPEECH RECOGNITION CHIP SPEAKS FOR ITSELF

Claimed to be the only real-time linear-predictive-coding-analysis chip on the market, this chip, when teamed with a micro-processor, manages both recognition and synthesis with just one reconfigurable filter. Known as the SP1000, the combo chip will work with most micro-processors and will also work with no hardware interface with the 6502 device.

WESTERN DIGITAL CORP. RIDES THE IEEE STD 488 BUS

A general purpose interface bus (GPIB) controller performs the interface function between the micro-processor and the GPIB. Western Digital's WD9914 is a second source for TI's TMS9914A. The chip automatically handles talker, listener and controller operational modes, relieving the micro-processor from bus protocol maintenance. The WD9914 features system controller service request, serial/parallel polling device, clear trigger and DMA facilities. Look for this one early 1984.

IBM® PC STYLE KEYBOARDS TO TRUE DIN PROFILE

Advanced Input Devices' packaged and encoded keyboard features ergonomically designed tactile feel keys and comes complete with curly cord. Measuring a mere 30mm in height to the home row of keys, the Ergokey Tm ED-184-243 also incorporates a two position angle adjuster. This keyboard is the vanguard for the Ergokey Tm series and is predicted to cost less than $200 plus tax in small quantities.
BATTLE FOR DESKTOP REAL ESTATE

The new year saw the beginning of the battle for domination of the desktop — suddenly all the computer manufacturers woke up to the importance of making a machine that any executive would be proud to have on his or her desk. In fact, the companies went further than that; they came out with some wizard little machines calculated to make any executive who doesn't have one look rather warily over the shoulder.

The computers in question all went for compactness combined with power; gone are the days when having a computer on your desk means there's no room to do anything else.

Of the many new releases, five machines stood out as likely to make the grade: the Apple Macintosh; the HP-150 with its touch screen; the Apricot; the Eagle; and the MIC-504 from Multitech.

The Apple Macintosh is possibly Apple's last chance to retain its high position in the marketplace. The Lisa was a revolutionary machine with many useful features, but it was just too expensive for most people, especially in small businesses, to invest in.

While there's no Australian price available for the Macintosh at the time of going to press, its US price is expected to be between $2000 and $3000 which, even when translated into Aussie dollars with a hefty import tax added, works out a lot cheaper than the Lisa.

For this reduction in price, however, you don't lose much power or capability. A Motorola MC68000 processor running at 8 MHz has 64K ROM and 128K RAM, with the memory upgradeable to 512K, and a second microfloppy disk drive may be added.

The Macintosh retains the Lisa's mouse/icon arrangement of operation, which makes it a cinch for even the most ignorant computer novice to work with. For example, when the Macintosh is switched on it displays a floppy disk on the screen as an icon. By clicking the mouse on the icon, the user opens the disk to reveal a window showing more icons for the various files and folders on the disk ('folders' are directories containing other files).

Moving the mouse to one of these folders and clicking twice will open the file and invoke the appropriate applications program to display it — all without the user having to know what is happening in computing terms.

Four applications for the Macintosh will initially be available: MacWrite, a word processor; MacPaint, a drawing program; and MacPlan and MacChart, which are spreadsheet and graphing programs respectively from Microsoft.

The Macintosh is an unusual shape for a personal computer, taking up more space vertically than horizontally, ideal for minimizing the space needed for it on a desktop.

Hewlett-Packard's HP-150 has two things going for it: its incredibly small size and its touch-sensitive screen. Its 305 mm footprint makes sure it won't dominate the desktop, but the basic unit still manages to contain 256K of memory, two serial I/O ports, an HP-IB interface, a screen — and room for an optional printer. To add to this machine's appeal, it uses an 8088 processor and the popular MS-DOS operating system.

The 23 cm screen is a very high-quality green phosphor type, with a resolution of 512 by 390 for graphics and 720 by 378 for alphanumerics. Both can be displayed at the same time, and this is how many of the touch screen graphics work.

The touch-sensitive screen is what it sounds like; the user can make things happen simply by pointing to areas on the screen. 'Touch screen', in fact, is not strictly accurate. HP Touch consists of a grid of infrared light beams just in front of the screen. The 14 horizontal by 21 vertical beams define a 23 by 40 grid on the text screen and set up eight programmable function keys along the bottom of the screen. When you point to and/or touch the screen you break at least one vertical and one horizontal beam, which returns a code to the system indicating what part of the screen is being pointed to.

How this information is used depends on the software, but it means that areas of the screen can be defined in menu form, and the user need only point to the appropriate area of the screen to make a selection.

VisiCalc and WordStar are available for the HP-150, and such popular packages as Lotus 1-2-3, dBase II, Multiplan and Condor are promised for the near future. All the software runs under HP's 'Personal Applications Manager' (PAM), which forms a user-friendly bridge between the operating system and the user.
The Eagle PC Plus is available in configurations with either floppy or hard disks (retailing for $3840 with one floppy drive, $4580 with two, and $7380 with 10M hard disk storage), and is claimed by its distributors, Asia/Pacific Technology marketing Pty Ltd (ATM), to be fully compatible with the IBM-PC and XT.

The Eagle was specifically designed for desktop use, and offers an 'enhanced' IBM keyboard with 84 keys, 10 function keys and a 10-key numeric pad. Powered by a 16-bit Intel 8088 microprocessor, the Eagle has a standard 128K RAM, expandable to 640K on the main CPU board without adding extra pc boards. The design accommodates both 64K and 256K dynamic RAMs, and all models have four IBM-PC compatible option slots. There are also two serial and one parallel ports for printer, modem or mouse connection.

Intricacies of computer operating systems.

The Apricot comes standard with one microfloppy drive, a 23 cm screen monitor and the new 'microscreen' with a liquid crystal display which, with its six associated touch-sensitive keys, provides dynamic choice of operation within each application program, acts as a window on the screen, allowing the system to be used without a monitor if necessary, displays the day, date and time whenever required, and acts as a calculator without necessitating an exit from the main computer system.

A second drive is incorporated in the basic unit, making expansion simple, and the whole package is an extremely compact, elegant desktop design.

The system comes with three operating systems (MS-DOS II, CP/M-86 Plus and Concurrent CP/M-86), a full range of utilities, System Manager, Digital Research's GSX Graphics, asynchronous communications pack, and a printer spooler. It runs three microprocessors: the 8086, the 8089 I/O processor, and optionally the 8087 maths processor. The keyboard can both transmit and receive data.

The Apricot is claimed to run 90% of IBM-PC software with its IBM emulator, and has a recommended retail price of $4444.

Multitech's MIC-504, distributed in Australia by Emona, is a single-board, Z80A-based computer with 4K ROM, 64K RAM and 2M of storage provided by two 5.25 inch floppy drives. It has two full-duplex RS232 serial ports with baud rates programmable from 110 baud to 19.2 kilobaud, as well as one Centronics parallel port.

The Z80A processor provides access to the large library of CP/M 2.2 applications programs, but the MIC-504 comes with a fully documented software pack-

age comprising Word Right, a word processor; Spell Right, a user-expandable 20 000-word dictionary, Magic Worksheet, a spreadsheet program; Qsort, a sorting utility; Analyst, a database management system, and NAD, a name and address file with Word Right merge facilities.

So there are the contenders for the top position on desktops throughout the world. It'll be interesting to look back in a year's time and see which machines have made it to the top.
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EC-80 PRINTER

Energy Control has recently released the EC-80 dot matrix printer available for less than $250 in quantity of 50 units.

The EC-80 is a compact desk top dot matrix impact computer used for hardcopy of data from any microcomputer, personal computer, office computer etc. It will print upper and lower case alpha-numeric characters in both Normal and Italic fonts, in condensed, normal or enlarged sizes and in normal or enhanced modes.

It features both friction and adjustable sprocket feeds as standard; high print quality from carbon film ribbon; logic seeking for faster throughput, high resolution bit-image graphics (640 dots/inch); built-in graphics symbols, self-stacking paper basket; square pin print head for improved character registration.

Further information can be obtained from Energy Control, PO Box 6502, Goonda Qld 4300. (07)788-2455.

CONTROLLER COMBINES HARD AND FLOPPY CONTROL

A multibus-compatible mass storage controller that combines control of both Winchester and floppy disks on the same board is being offered by National Semiconductor. The BLC-8230 and BLC-8232 disk controllers are capable of supporting up to two Winchester and two floppy-disk drives. In particular, the BLC-8230 controls up to two 20 cm Winchesters and two 20 cm floppy-disk drives, while the BLC-8232 controls up to 13 cm Winchesters and either 13 cm or 20 cm floppy-disk drives.

Both products represent a single-board solution to the problem of addressing the two most popular types of peripheral memory. The BLC-8232 provides an SA1000-type 20 cm disk interface, and the BLC-8232 a 13 cm ST506-type interface.

Capable of handling 16, 20 or 24-bit addresses, as well as byte or word-size data transfers, the new disk controllers offer a number of key performance features to users.

These include support of either eight- or 16-bit I/O addressing, programmable error retry with media fault management, comprehensive on-board diagnostics, and the ability to perform direct multisector transfers at the full disk data rate.

For more details, contact National Semiconductor, Cnr Stud Road and Mountain Highway, Bayswater Vic. 3153. (03)729-6333.
NEW INTERFACES FOR IBM PC

3D Digital Design and Development has announced the introduction of two interface systems for the IBM PC. These are the Inlab and Thinklab.

Both systems are modular in design allowing a number of extended Eurocard subunits to be slotted into a 19" industrial rack. These modules include multi-channel analogue to digital converters, digital to analogue converters, instrumentation amplifier, thermocouple conditioning amplifier, intelligent stepper motor controller, programmable shaft encoder etc.

Both interfaces allow up to 128 analogue inputs, 64 analogue outputs, 384 digital input lines, 129 on/off outputs etc. Both analogue inputs and outputs have 12-bit resolution. Digital input and output lines may be opto-isolated from the interface.

Thinklab has been designed specifically for remote data acquisition and control over a serial communication link such as the RS232C or equivalent.

The Inlab Buss controller card may also be used by itself as a 24 line bidirectional input/output device with status bit and interrupt facility.

The company claims that the combination of the IBM PC and 3D interfaces offers a very powerful system with maximum adaptability but without incurring high costs.

3D provides full product support including a detailed manual and suite of demonstration programmes on a diskette. Machine code programming and custom software can be written against specification.

For further information please contact 3D Digital Design and Development, 18/19 Warren Street, London W1P 5DB.
APPLE II MOUSE

Apple Computer has announced a mouse and new software called MousePaint which will offer early next year for its Apple II personal computers.

Apple's Lisa computer, introduced earlier this year, ignited broad interest in the mouse among computer owners, software developers and other computer manufacturers. The Lisa is designed to be almost completely controlled by a mouse, one of the things that makes it much easier to use yet more powerful than conventional computers.

AppleMouse II will be packaged with MousePaint software that uses the mouse to design charts, diagrams, free-hand drawings and other visual aids for reports and presentation. Users can insert text in a drawing and can choose from a variety of character fonts and fill patterns. MousePaint simulates bit-map graphics to support the Apple II family's high resolution capabilities.

Independent software developers are being encouraged to write applications that take advantage of the mouse. Most future Apple software programs for the Apple II family will offer the mouse as an option.

For further information contact Apple Computer Australia Pty Ltd, 37 Waterloo Rd, North Ryde NSW 2113. (02)888-5888.  

MACINTOSH — SOFT WEAR SOFTWARE?

Microsoft has announced a full line of application software for the Apple Macintosh and its intent to announce other programs for the Macintosh as well.

Microsoft claims that their versions of Multiplan, Word, Chart and File programs comprise the first line of software to be announced for the Macintosh by any vendor. In addition, Microsoft BASIC is also available for the Macintosh.

The company says that Macintosh's unique interface, together with the Microsoft programs, provides a powerful and functional environment for increasing a user's productivity. The high resolution graphics screen enables graphics to be applied universally to all modes, whether they be charts and graphs as in Microsoft Chart, columns of figures in Multiplan, or words, sentences, and paragraphs in Microsoft Word. Thus, users can readily combine text with graphics without the usual intermixing problems.

Further details of this software can be obtained from Microsoft Pty Ltd, PO Box 98, Terry Hills NSW 2064. (02)450-2522.  

H-P TOOLS FOR ZILOG

Zilog Corporation and Hewlett-Packard have announced a collaborative effort in which HP will develop support tools for the new Z800 family of microprocessors.

The cooperative project will provide significant benefits for users of Zilog microprocessors and the HP 64000 logic-development system. Such as support tools for the Z800 microprocessor will be available much earlier than otherwise possible.

Otherwise the HP64000 design and development aids will be closely attuned to the Z800 device, allowing designers to take full advantage of the distinctive Z800 CPU features from the very first phases of development.

MICROPROCESSOR FUNDAMENTALS AND APPLICATIONS

A two-part course of microprocessor fundamentals, with a sequel on microprocessor applications, will be offered by radio and cassette as part of the University of New South Wales continuing education program for 1984. The series is being repeated after being widely acclaimed following previous broadcasts.

According to the lecturer, Dr. David Mee, of the University's School of Electrical Engineering and Computer Science, it requires no more than a basic understanding of electronic circuits and simple logic networks, and only general computing experience, to do the courses.

Part 1 of Microprocessor Fundamentals reaches a level where simple programming and application of microprocessors can be understood. Part 2 discusses further hardware and software functions, typical evaluation modules, and demonstrates how to design, develop and debug a simple project on a microprocessor.

The course on Microprocessor Applications will enable the student to use a microprocessor in his own system for measurements, monitoring or control. It covers applications in a variety of common situations, each exemplifying different aspects of microprocessor systems design.

Each part of the microprocessor fundamentals course consists of 10 broadcast lectures, a video program and two attended tutorials at a cost of $42.50. There are 8 radio lectures, backed by a video program and two tutorials on microprocessor applications for $35.

The broadcasts start on 10 April, each lecture being broadcast at 8 pm on Tuesdays and 7 pm on Fridays over the University's educational radio station, Radio University 2UV. Audio cassettes of the lectures are already available, at $80 for each part of Microprocessor Fundamentals, and $64 for Microprocessor Applications. The video programs cost $30 or $50 each, depending on the format chosen.

Transistor radios adjusted to pick up Radio University courses in the Sydney metropolitan area are available for $12, including postage.

Full particulars on this and other continuing education courses by radio and cassette can be obtained from the University of New South Wales by phoning (02)662-2691.
NEW IMPROVED LOW-COST DIRECT MODEM

Dick Smith Electronics has just released a new version of its Dataphone direct-connect data modem. The new Dick Smith Dataphone II offers not only upgraded performance, but also includes a pushbutton type electronic phone. It sells for the same price as the original model: $199.

Besides the added convenience in establishing data calls, the built-in phone brings a further bonus: installing the Dataphone II is now simply a matter of the user plugging it into a standard Telecom phone socket. There’s no delay or installation fee to pay.

The built-in phone also provides a last-number-redial facility, which makes it much easier and faster to re-establish a call following a dropout.

On the performance side, the Dataphone II offers improved demodulator phase stability and significantly greater tolerance of Telecom line impedance variations, claims Dick Smith.

Original Dataphone features still featured in the model II include: full duplex, answer/originate operation for convenience; operates at the standard switched-network data rate of 300 baud; designed and manufactured in Australia and fully authorised by Telecom; uses standard RS232C computer interface and provides ‘carrier detect’ output and LED indication.

Designated as Cat X-3272, the Dick Smith Dataphone II modem is available from all Dick Smith Electronics stores, plus selected resellers.

MODEMS ACT LIKE PERIPHERALS

LSI-based modems from Energy Control designed to link to the microprocessor buss. offer an error rate of 1 in 10^9 claim the company.

The family of highly integrated 1200, 2400 and 9600 baud card-level modems designed to be addressed as microcomputer peripherals is aimed at several lucrative market segments. The models in the line cost $450 in unit quantity for 1200 baud full-duplex units.

The modem family derives from Rockwell-designed very large-scale integrated circuits: two basic signal-processing devices with memory capacities that vary with performance. They might eliminate up to $50 of components previously required to implement modems. More importantly, these chips boost the modems into full-fledged computer peripherals, with control data transferred over the microcomputer bus. explains Dennis Kaliher, general manager for telecommunications products.

Rockwell International is represented in Australia by Energy Control, PO Box 6502, Goodna Qld 4300. (07)288-2455.

APPLE AND FRANKLIN TERMINATE LITIGATION

Apple Computer and Franklin Computer Corporation have announced that they have agreed to terminate the litigation commenced by Apple against Franklin in the Federal Court in the Eastern District of Pennsylvania by the entry of a judgement of U$2.5 million against Franklin and Franklin’s agreement not to infringe on Apple’s copyrights.

In its complaint, Apple asserted that Franklin had copied fourteen of Apple’s computer operating system programs. Franklin had challenged the validity of Apple’s copyrights and also asserted that Apple was guilty of anti-trust violations and unfair competition.

A decision by the third circuit court of appeals held that Apple’s operating system could be protected by copyrights. The consent judgement, when entered, will settle Apple’s copyright claims in Apple’s favour and dismiss Franklin’s pertinent counterclaims.

The settlement agreement between Apple and Franklin sets up an arbitration procedure for any future copyright infringement disputes between the companies relating to any substitute Apple-compatible computer program.

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LOCK UP YOUR DATA

The JED DataSafe is a new Australian-designed way to hold 64K of data safely and securely in any data gathering, machine monitoring or recipe holding application. The data is locked away in a box full of lithium battery powered CMOS RAM against mains power supply drops, shock, vibration, humidity, temperature extremes and passing time.

The DataSafe is designed to replace cassette tapes, punched tape or EEPROMs with their high voltage requirements. The DataSafe does away with the need for cassette and floppy drives with their motors, or the complexities and power requirements of bubble memory with its fancy pulses and ramps. It offers an easily loaded and unloaded data store which is then easily transported.

It is a 30 x 60 x 115 mm diecast box and connects via a 15-way D-type connector to a data reading or writing system. During reading and writing, the box draws a few microamps at 5 V. If the DataSafe is then disconnected, or the main system power goes down, the data is stored for years in the RAM.

The DataSafe is available in 8, 16, 32 and 64 kilobyte capacities and a version is also available with two sockets to make the box a safe way to hold and transport 16 kilobytes of PROM data in 2764s. Full details from JED Microprocessors Pty Ltd, PO Box 30, Boronia Vic 3155. (03) 762-3308.

SEVEN-USER NETWORKING SYSTEM FOR THE DESKTOP

The Discovery 500, a desktop networking computer for business, science and industry, has been released in Australia by Archives Computers. The Discovery 500 is an S-100 desktop single- or multi-user system offering both eight- and 16-bit microprocessors and up to 26 megabytes of inbuilt hard-disk storage.

The basic system is just under $9000.

A feature of the Discovery 500 is the 8087/8087 16-bit processor option and its ability to expand disk storage to 128 megabytes.

With the aid of the 8087 numeric data processor, the Discovery 500 can execute 'number crunching' programs at speeds previously only attainable on mainframes.

The Discovery 500 user has a choice of four operating systems, including CP/M, CP/M 86, CP/M Plus and DPC/OS.

Available with the system is a series of Dataflex-based programs, which enable up to seven users to be able to inquire on or update the same database at the same time.

File- and record-locking is managed by the system so that full database integrity is maintained without noticeable delays in response.

With database files, all data needs to be entered into the system only once, and each user can call on this information under various applications programs.

The Discovery 500 complements the Discovery Multi-processor 16-user system released late last year.

For more details, contact Archives Computers, 183 Clarendon Street, South Melbourne Vic. 3205. (03) 699-8377.

8-BIT MICRO WITH 12K ROM

The first 8-bit, single-chip microcomputer with 12K bytes of on-chip ROM has been announced by Texas Instruments.

The new TMS70120 can store a complete, 12K applications program without the need for any external ROMs, buffers and latches. By reducing the chip count for applications in the 4K-12K program range, the TMS70120 allows OEMs to lower the cost, power consumption, weight, and space requirements of many 8-bit applications.

The TMS70120's large, on-chip memory frees up the twenty or more general-purpose I/O lines usually required to interface a microcomputer with off-chip ROMs. This gives designers much greater flexibility to enhance an application by interfacing the TMS70120 to various peripherals.

These capabilities make the TMS70120 well suited for 8-bit applications with moderate memory requirements. Possible uses range from point-of-sale terminals and test equipment to 'smart' appliances and auto dashboard controls.

Fabricated using NMOS technology, the TMS70120 operates from a single 5 V supply. Nominal operating frequency for the device is 5 MHz, with a typical power dissipation of 550 mW. The TMS70120 is provided in a standard 40-pin, 600-mil dual in-line plastic package.

For further information, contact Texas Instruments Australia, SemiConductor Group, 6-10 Talavera Road, North Ryde NSW 2113. (02)887-1122.

NEW DOS FOR APPLE II

Apple software developers are being supplied with a new disk-operating system for the Apple II family of personal computers.

Distributed by Apple Computer Australia for applications development, the Prodos system provides increased compatibility between Apple II and Apple III environments and the higher performance required for more sophisticated Apple II applications.

Prodos uses the hierarchical file structure, file-naming conventions and file formats of the Apple III sophisticated operating system. As a result, Prodos data files and data media are interchangeable on the Apple II or Apple III.

Prodos' design frees the Apple II from the physical limitations of the 143K Apple disk II drive. Using Prodos, the Apple II can handle larger files, such as those often required by the word-processing and database applications. It can also recognise any storage device, either floppy or hard disk, that uses Apple's protocols.

In addition, Prodos' hierarchical, Unix-like structure provides the Apple II user with an organised method for managing larger numbers of files on larger storage devices.

Prodos does not make the Apple DOS 3.3, SOS or Pascal operating environments obsolete, and all will continue to be available as licensed products from Apple. Users will be able to convert DOS 3.3 data files, so that they work with Prodos-based application programs, to take advantage of the advanced capabilities that Prodos provides.

For further details, contact Apple Computer Australia, 37 Waterloo Road, North Ryde NSW 2113. (02)888-5888.
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- Graphic mode on/off
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- Display unit: 12-inch, non-glare, slow cursor
- Display refresh rate: 50/60 Hz
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AN INTELLIGENT TERMINAL

March 1984

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BARSON PLANS COMPUTER MANUFACTURE IN WA

Following an offer of a package of incentives by the West Australian Government, Barson Computers plans to begin manufacturing in Australia this year.

The Melbourne-based company imports BBC microcomputers from Britain and Sirius business computers from the US.

Mr Barson expressed disappointment that the Victorian Government had not offered any incentives but he did not see manufacturing based in Perth as any disadvantage, although 70% of BBC sales would be in the eastern states.

Barson Computers began selling BBC computers in Australia 18 months ago and they now claim to be selling 1000 a month. They also forecast sales of the Sirius machine to double in the second year that the company has had the agency.

Barson has drawn up manufacturing plans for the BBC micros that call for 88% Australian content.

Studies conducted by the company indicated that the cost of manufacturing in Australia would be up to 15% more than it would be in Hong Kong or other South East Asian countries because of the higher wages. However, government support, the stable political situation and the high quality of the Australian workforce would outweigh the advantages of cheaper labour.

Mr Barson believes that electronic manufacturing resources in Australia are considerably under-utilised — in some cases manufacturing equipment was only being used one or two days a month.

For further information contact Barson Computers Pty Ltd, 335 Johnston St, Abbotsford Vic. 3067. (03)419-3033.

TEXT EDITOR FOR HANDHELD COMPUTERS

Text-File is a text editor program for the Sharp PC-1500 or Tandy PC-2 handheld computers and is the first software release from Razor-Soft. The program requires a computer with at least a 4K RAM expansion module installed. For the most common 8K RAM expansion, the program allows up to 85 lines of text, each 79 characters long, to be handled.

Text-File has been designed to make full use of the features of the PC-1500/PC-2 computer. The 26 character single line display is used as a window through which text is viewed. Full cursor controls allow this window to be shifted around easily.

Other review functions include requesting the display of a specific line, and a scroll function which scrolls through the whole entered text.

Two print functions are provided for use with the computer's printer.

Text-File is supplied on cassette and comes with a comprehensive instruction manual. The recommended retail price is $25. For further information contact Razor-Soft, 1 Lantana Court, Frankston Vic 3199.

H-P WORKSTATIONS SUIT IBM SYSTEMS?

Two new terminals from Hewlett-Packard Company provide individual workstation capabilities for office-automation applications.

The HP 2625A dual-display terminal can communicate with both H-P and IBM systems simultaneously. On the IBM system, the terminal emulates the IBM 3276/78 display station.

By pressing a single function key, the user selects either the H-P or IBM feature set. Word-processing and graphics capabilities are available as options. The HP 2628A word-processing workstation operates as a dedicated word processor under control of HP 3000 Word software. Graphics capabilities are available as an option. The HP 2628A terminal is priced 40% below previous comparable models from H-P.

Both workstations come standard with H-P VPLUS compatible data entry feature sets. They store up to six pages of text. Math, line drawing and 11 national-language character sets all come standard with both terminals.

Ergonomic design features include high-quality lettering on a low-glare, flicker-free display, smooth scrolling and an optional tilt-and-swivel base.

VMEBUSS CAPABILITIES EXPANDED

Projecting a market size of $750 million for VMEbuss compatible products by 1988, executives of Mostek, Motorola and Signetics/Philips have announced technical agreement on additional key elements of the total VMEsystem architecture.

The newly-defined supporting bus structures include a high-speed memory expansion bus, VMXbuss, and a self-arbitrating high-speed serial buss, VMSbuss, which may be optionally employed in systems based on the existing VMEbuss standard.

The VMEbuss and its extension bus structures form the basis of a total VMESystem architecture which simplifies integration of complete systems from high-performance 8-, 16-

and 32-bit board level system components. The existing VMEbuss interconnect standard provides the basic data transfer bus between major system components, while the VMXbuss facilitates expansion of local processor memory.

For rapid communication of brief messages between system modules, the VMSbuss uses only two conductors (clock and data) to provide an efficient party line between system components.

Mostek and Signetics/Philips both produce the 16/32-bit M68000 MPU originally developed by Motorola. While not limited in application to 68000-based systems, the VMEsystem architecture has been designed to provide a set of system-level features desirable for microcomputer systems where the M68000 MPU family will be used most frequently.

Additional buss-support IC designs in the M68000 family have also been announced to facilitate development of VMESystem-compatible boards and the companies project that samples of these new chips will be available in the second half of 1984.

Continuing technical discussions among the three companies are expected to result in the definition of additional buss support chips to complement the overall VMESystem architecture.

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One of the simplest solutions is to use a four-way control system, with the lights controlled by a normally open (N.O.) switch in the basement of the house. This then allows a remote control to be mounted in any convenient location on any wall and sends 'on' and 'off' signals to the control switch. To achieve this, the single control switch will either need to be adapted or replaced with a normally open switch, or you can use an interface unit that is simply plugged into the control switch to adapt it to this system. Such an interface unit is also available for use with two-wire pairs.

There are various manufacturers of interface units, but the one chosen for this project is the ETI-1232 CONTROL, which is available in kit form or fully assembled. It is a simple and easy to build unit, and the kit comes complete with all the parts and instructions needed to complete the project.

The kit comprises a PCB with all the necessary components mounted on it, and a simple interface is provided. The interface is connected to the control switch using a standard two-wire pair, and the remote control is connected using a suitable cable. The kit also includes a simple relay circuit to switch the lights on and off, and a simple LED indicator to show the status of the lights.

The interface is designed to be used with any single-pole, single-throw switch, and it can be used with a range of different switch types. The kit comes with all the necessary documentation and instructions, and includes a simple relay circuit to switch the lights on and off, and a simple LED indicator to show the status of the lights.

The kit is available at a cost of $20.00, and includes all the necessary components and instructions to complete the project. It is suitable for use with any single-pole, single-throw switch, and can be used with a range of different switch types. The kit comes with all the necessary documentation and instructions, and includes a simple relay circuit to switch the lights on and off, and a simple LED indicator to show the status of the lights.
The 6800 microprocessor series

With these versatile devices in the M6800 series it is possible to design and build a minimum component system for dedicated applications.

Peter Ihnat

Part 1

THE M6800 FAMILY of LSI devices has been around for some time. Now with the release of several updated chips it is possible to design and build a system for a dedicated application with a minimum amount of time, effort and sometimes more importantly, with the minimum number of components.

This stems from the fact that there is compatibility between the different members of a family; once a particular microprocessor has been purchased almost any number of chips within the family of that microprocessor can be added to obtain the required system.

If care is taken it is also possible to use chips from other families in the same system. It seems that each new device introduced into a family by the manufacturer either performs some new function or is an existing chip which has had 'something extra' added.

The latter is the case with the MC6802 microprocessor. Basically, it is the 6800 microprocessor with two 'added extras'. Firstly, an external clock is no longer required since the oscillator is built-in. All one needs to do is to connect a crystal and two capacitors to the chip and it works.

Secondly, the designers have placed 128 bytes of user RAM on the chip (the lower 32 bytes can be placed in standby mode when the microprocessor is powered down).

Not very much RAM you say? Well, in certain applications you’re right. But let’s imagine that a system is required to control some specific device, e.g. a pushbutton combination lock. Ah, you say. My Apple IIe will do that. Yes, OK. But isn’t that a bit of an overkill?

What would be nice is to have a small single-board microprocessor which can be configured to do the job required for tens of dollars rather than hundreds. This single board microprocessor could then be mounted in the device and left there to run it. One advantage of this method is that the microprocessor unit could be programmed to be a lot more 'intelligent' than a controller made up from discrete components.

As you probably know, large amounts of RAM may not be required in many applications. The combination lock would only need RAM to store the correct combination, entries from the keyboard and other ‘housekeeping’ data. The 128 bytes available in the 6802 would probably be more than enough!

Figure 1 shows one possible minimum system (keyboard and display hardware is not shown). Note that this system would not be flexible enough for the home constructor since the ROM part of the MC6846 needs to be mask-programmed during manufacture.

A more flexible system would use a PIA for I/O and an EPROM to hold the control program.

There are two other versions of the MC6802, the MC6808 is identical but does not have the internal RAM whereas the MC6802NS does have RAM but not the standby feature. They are all available at speeds of 1 MHz, 1.5 MHz and 2 MHz.
The 6800 microprocessor series

Microprocessor description
From the hardware point of view the 6800 and 6802 are both available as 40-pin packages. Figure 2 shows the pinouts of the two low, Read/Write (R/W) and data lines will be tri-stated and address lines will be tri-stated in the 6800 or will display the address of the next instruction in the 6802.

<table>
<thead>
<tr>
<th>Pin no.</th>
<th>6800 signal description</th>
<th>6802 signal description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ground (GND)</td>
<td>ground (GND)</td>
</tr>
<tr>
<td>2</td>
<td>halt (HALT)</td>
<td>halt (HALT)</td>
</tr>
<tr>
<td>3</td>
<td>phase 1 (P1)</td>
<td>memory ready (MR)</td>
</tr>
<tr>
<td>4</td>
<td>interrupt request (IRQ)</td>
<td>interrupt request (IRQ)</td>
</tr>
<tr>
<td>5</td>
<td>valid memory access (VMA)</td>
<td>valid memory access (VMA)</td>
</tr>
<tr>
<td>6</td>
<td>nonmaskable interrupt (NMI)</td>
<td>nonmaskable interrupt (NMI)</td>
</tr>
<tr>
<td>7</td>
<td>buss available (BA)</td>
<td>buss available (BA)</td>
</tr>
<tr>
<td>8</td>
<td>power (Vcc)</td>
<td>power (Vcc)</td>
</tr>
<tr>
<td>9-20</td>
<td>address lines (A0-A11)</td>
<td>address lines (A0-A11)</td>
</tr>
<tr>
<td>21</td>
<td>ground (GND)</td>
<td>ground (GND)</td>
</tr>
<tr>
<td>22-25</td>
<td>address lines (A12-A15)</td>
<td>address lines (A12-A15)</td>
</tr>
<tr>
<td>26-33</td>
<td>data lines (D0-D7)</td>
<td>data lines (D0-D7)</td>
</tr>
<tr>
<td>34</td>
<td>read/write line (R/W)</td>
<td>read/write line (R/W)</td>
</tr>
<tr>
<td>35</td>
<td>not used</td>
<td>Vcc standby</td>
</tr>
<tr>
<td>36</td>
<td>data bus enable (DBE)</td>
<td>RAM enable (RE)</td>
</tr>
<tr>
<td>37</td>
<td>phase 2 (P2)</td>
<td>enable (E)</td>
</tr>
<tr>
<td>38</td>
<td>not used</td>
<td>xtal</td>
</tr>
<tr>
<td>39</td>
<td>three state control (TSC)</td>
<td>extal</td>
</tr>
<tr>
<td>40</td>
<td>reset (RES)</td>
<td>reset (RES)</td>
</tr>
</tbody>
</table>

Table 1. M6800 and MC6802 pin summary.

devices. Notice that they are almost pin for pin equivalent; the differences are due to the 6802 having a clock oscillator and 128 bytes of RAM on the same chip.

It is important to note that the two devices are fully software compatible. Let’s examine the function of each of the 40 pins so that differences between the 6800 and 6802 signals can be noted and explained.

PINS 1 and 21 — ground. These are the ground connections and should be connected to 0 V from the power supply.

PIN 2 — HALT
During normal operation of the microprocessor this input should be tied high. When pulsed low the microprocessor will complete execution of the current instruction and then stop. While in this halted mode the various control lines will be set to the following states: Buss Available (BA) line set high. Valid Memory Access (VMA) line set high, Read/Write (R/W) and data lines will be tri-stated and address lines will be tri-stated in the 6800 or will display the address of the next instruction in the 6802.

PIN 3 — phase 1 clock on the 6800; Memory Ready (MR) on the 6802.
The 6800 needs an external two-phase non-overlapping clock as shown in Figure 3. The two waveforms are called phase 1 and phase 2 and are fed in via pins 3 and 37 respectively. Since the 6802 has a built-in clock the input for phase 1 clock is not necessary, whereas pin 37 is used as a clock output for synchronising data transfers with peripheral devices.

Pin 3 on the 6802 is used as an input which controls the ‘stretching’ of the clock output (E) signal. When MR is low E will be stretched integral numbers of half periods which allows interfacing with slow memories. For normal operation, MR should be tied high (it can be connected directly to Vcc).

PIN 4 — Interrupt Request (IRQ).
A low level of this input requests that the microprocessor jump to an interrupt servicing routine upon completion of the current instruction if, and only if, the interrupt mask bit in the condition code register is not set (see discussion on interrupts).

PIN 5 — Valid Memory Access (VMA).
This does not have tri-state capabilities but when high it indicates that there is a valid address on the address bus. It is usually used in combination with an address decoder to enable peripheral devices.

PIN 6 — Non Maskable Interrupt (NMI).
Similar to IRQ except that the interrupt cannot be masked (see discussion on interrupts).

PIN 7 — Buss Available (BA).
This output signal is normally low but when high it indicates that the microprocessor has stopped and the signal lines are no longer under its control (those which have tri-state capability are placed in the high impedance state). This usually means that either the HALT line is low or the machine is in WAIT mode as a result of executing a WAIT instruction.

PIN 8 — Vcc.
This is connected to +5 V from the power supply.

PINS 9 to 20, 22 to 25 — address lines.
These sixteen address lines give the microprocessor an addressing capability of 64K. The lines have tri-state capability only on the 6800.

PINS 26 to 33 — data lines.
Eight bidirectional lines which transfer data to and from peripherals. These lines have tri-state capability.

PIN 34 — Read/Write (R/W) line.
The microprocessor uses this line to indicate to the peripheral devices whether it wants to perform a read or write operation. It has tri-state capability and is high when the microprocessor is performing a read operation and low during a write. It’s normal standby state is read (high).

Figure 3. Two phase non-overlapping clock required for the M6800 microprocessor showing how certain operations are based around it.
**PIN 35 — Vcc, standby.**

This line is only available on the 6802 (not used on the 6800) and applies the supply voltage to the first 32 bytes of the internal RAM as well as the RAM Enable (RE) logic. By ensuring that +5 V is applied to this pin when the microprocessor is powered down, data will be retained in this portion of memory.

**PIN 36 — Data Bus Enable (DBE) on 6800; RAM Enable (RE) on 6802.**

With the 6800, a high on the DBE input line permits data to be outputted during the microprocessor write cycle. This is replaced by the RAM Enable (RE) function on the 6802.

A high on this line enables the internal RAM which is fully decoded from $0000 to $007F. If external RAM or ROM exists at these addresses, a low should be applied to RE to disable the internal RAM.

**PIN 37 — phase 2 clock on 6800; Enable (E) on 6802.**

These two signals are equivalent and supply the clock signal to the microprocessor and the rest of the system. Note that this pin is an input on the 6800 and an output on the 6802.

**PIN 38 — not used on 6800; XTAL on 6802.**

This input connects one side of an external crystal to the internal oscillator. It is used in conjunction with pin 39.

**PIN 39 — Three-State-Control (TSC) on 6800; EXTAL on 6802.**

Applying a high to this pin on the 6800 places the microprocessor's tri-state lines into the high impedance state. On the 6802, the line is used as the other input from the external crystal (see pin 38) and is connected as shown in Figure 4.

Note also that the oscillator can be driven externally with a TTL input signal running at four times the required clock frequency. It should be fed into pin 39 and pin 38 should be grounded in this case.

**PIN 40 — Reset (RES).**

A low placed on this input resets the microprocessor. All information stored in the registers will be lost during this period. When the line is brought up to a high again, the microprocessor performs the restart sequence which includes setting the interrupt mask bit and loading the program counter with the contents of address location $FFFE and $FFFF. Execution then begins at this specified address.

**Operation of interrupts**

The 6800 and 6802 microprocessors allow for three types of interrupts: maskable, nonmaskable and software (note that reset could be treated as a nonmaskable over-riding interrupt since it is serviced in a similar manner to the other types). Two of the interrupts are initiated by signals applied to external connections on the chip. The software interrupt is different since it is initiated by the program. Otherwise the servicing of each of the interrupts is very similar.

When an interrupt occurs, the microprocessor will first complete the current instruction. Next the contents of the internal registers are pushed onto the stack, i.e.: condition codes, accumulators A and B, index and program counter.

The only exception here is the maskable interrupt where the mask bit in the condition code register is first tested to see if the interrupt is allowed. If it is allowed then the interrupt will be serviced by the method to be described, otherwise program execution proceeds as normal.

After saving the registers, the IRQ mask bit is set to inhibit any other interrupts. Then the program counter is loaded with the address of the appropriate interrupt service routine. These addresses are found in the eight highest locations in memory and are listed in Table 2. Program execution jumps to the specified location where hopefully the programmer has placed an appropriate service routine.

The interrupt service routine usually ends with the Return From Interrupt (RFI) command which tells the microprocessor that servicing is complete and that it can restore all the registers to the same status as before the interrupt. Execution then continues with the instruction that would have been executed if the interrupt hadn't occurred.

**The insides**

As already stated, the MC6802 is software compatible with the M6800. This implies that the internal structure is similar. Both microprocessors have six internal user registers:

- accumulator A (8-bit)
- accumulator B (8-bit)
- index register (16-bit)
- program counter (16-bit)
- stack pointer (16-bit)
- condition code reg (8-bit)

Both accumulators are used as temporary storage registers for results from logical and arithmetic operations and for data manipulation. Depending on the results of many of the operations, any of six condition codes can be set or cleared to indicate various conditions. These codes form the lower six bits of a special register and they indicate the status of these conditions: half carry, interrupt mask, negative, zero result, two's complement overflow and carry/borrow.

The program counter contains the address of the next byte to be fetched and is incremented automatically. The stack pointer is a register that contains an address where the state of the microprocessor registers can be stored when some other function needs to be performed. Bytes can be 'pushed' onto the stack (data actually stored at the address pointed to and the pointer is then decremented) or 'pulled' off the stack (the pointer is incremented and the data is read).

<table>
<thead>
<tr>
<th>address (hex)</th>
<th>contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>$FFFF</td>
<td>LSB of restart address</td>
</tr>
<tr>
<td>$FFFE</td>
<td>MSB of restart address</td>
</tr>
<tr>
<td>$FFFD</td>
<td>LSB of start address of NMI service routine</td>
</tr>
<tr>
<td>$FFFC</td>
<td>MSB of start address of NMI service routine</td>
</tr>
<tr>
<td>$FFFB</td>
<td>LSB of start address of software interrupt service routine</td>
</tr>
<tr>
<td>$FFFA</td>
<td>MSB of start address of software interrupt service routine</td>
</tr>
<tr>
<td>$FFF9</td>
<td>LSB of start address of IRQ service routine</td>
</tr>
<tr>
<td>$FFF8</td>
<td>MSB of start address of IRQ service routine</td>
</tr>
</tbody>
</table>

Table 2. Location of the interrupt vector addresses.

From the software point of view, the 6800 and 6802 have seven addressing modes which can be used by the programmer. They are: accumulator, implied, immediate, direct, extended, indexed and relative addressing modes.

These will not be discussed here but are explained quite well in the two books which are on special offer this month.

So as you can see, the MC6802 is a more versatile device than the M6800 and is well suited to forming the CPU of a minimum component system for dedicated applications. Next month we'll look at such a system.

**References**

2. Staugaard, Andrew C. *How to Program and Interface the 6800*, Indiana, Howard W. Sams & Co., Inc.

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Eight joysticks and a trackball reviewed

So you want to buy a joystick for your micro, but don't know which one to purchase (for the kids, of course)! This review should help you come to grips with the problem.

Peter Moxom

THE ATARI-TYPE joystick has undoubtedly become the most popular format for games control on micros and video games machines. It's virtually an industry standard amongst manufacturers. However, there's lots of competition, with many accessory manufacturers getting 'on the bandwagon'. A huge variety of styles and models is now offered. If you're confused enough after choosing a micro or video game, you're going to be just as confused all over again trying to choose a 'better' joystick.

To clear away a fog of confusion, it was suggested to the Editor that a number of joysticks be obtained for review. All in good time, some eight joysticks arrived, along with one 'trackball'. The units reviewed were:

Atari — by Atari (the 'benchmark')
Quickshot — by Spectravideo
Mini Champ — by Championship Electronics
Super Champ — by Championship Electronics
Pointmaster — by Discwasher
The Boss — by Wico
Red Ball — by Wico
Red Stick — by Wico
Trackball — by Wico

Each unit was examined for control accuracy, fire button response, grip, construction and suitability for right and left handers alike. A VIC-20 was used as the review machine with a variety of games kindly supplied by Ramond Bermeister of The Computer Spot, Shop C4, MLC Centre, Martin Place, Sydney.

Firstly, control accuracy would have to be the most important feature of any joystick to its user because, when using a joystick for its designed purpose — games control — you want to get away from those aliens and other nasties and zap, rather than be zapped. To zap effectively, the fire button must have good response or else you're more than likely to be zapped!

Apart from the requirement of good fire button response, it must be well located. The best location for fire buttons is on the stick itself so that the joystick can be placed on a table, or other solid surface, making single-hand operation possible. The stick-located fire buttons are particularly suited to left hand users.

The table here gives a rating out of five for the four parameters, along with other pertinent details about the joysticks.

The trackball was a ring-in, supplied along with the Wico joysticks. Trackballs are relatively rare at present, probably for reasons of cost, but they have certain advantages in some applications although they don't match up to joysticks in general games control. Basically, they consist of a ball sitting on a set of rollers placed at right angles (X and Y axes). Attached to each roller mechanism is a light and detector arrangement that is 'cut' by a perforated disc. The light detector acts as a switch, in a similar manner to the switches on the joysticks.

Joysticks, internally, have four switches activated by the stick, giving eight control directions. The fire button is a separate switch.

Now for the reviews!
The Atari
The Atari only has one fire button, located on the top left of the base. The stick is very stiff in usage and very uncomfortable for long sessions. It's good for a 'benchmark', because every other manufacturer has tried to outdo it — and generally succeeded. But, it's still the cheapest!

The Super Champ
This, too, has a retractable cord that winds up in the base. The cord is a sensible length. The fire buttons are sensibly located — one trigger-style at the top of the hand grip, the other on the very top of the stick. Both have excellent response. The unit is comfortable to use in the hand. The base has suction caps so is best for table use, rather than held in one hand — which I found uncomfortable. Construction is just acceptable, the design covers this up.

The Quickshot
This one was early on the market and 'set the standard' for many others to follow. It has suction caps on the base and a contoured hand grip with fire buttons both on the base and stick. I found it hard to use as an in-hand joystick (which is the Atari's main mode) but it is good for use on a table or floor. Construction seemed flimsy, confirmed by its being prone to breakage. It's no better than the Atari in this regard.

Pointmaster
This joystick is well thought out in design and has excellent response for directional control and the fire buttons. It is also sensibly priced. The stick has more movement in the forward direction than the rearward direction, equal movement left and right, although I don't know that that's much of an advantage. If it is, it's very subtle. In general, stick movement is greater than most of the others reviewed but ensures that you move your 'piece' in the direction intended.

Construction is 'solid', above average, but not as good in this area as the best reviewed. The Pointmaster is ideal for either right or left hand users. It has only one fire button, located on top of the stick. The base is smaller than most and most comfortable to hold in your other hand, I found.

The Mini Champ
Clearly, this one was designed for competition use by under-15s. It fits small hands . . . er, like the proverbial. It has three fire button locations — one on top of the stick, two on the base. Thus, it suits right or left handed use. The cord is retractable and winds up inside the base. I found it hard to hold in my hand at first, but it became easier the more I used it. Response in control is reasonable, construction is average, somewhat better than the Atari and it's competitively priced.

The Boss
Mady by Wico this joystick is distributed by the video games company in Australia — Futuretronics. The grip on this stick is suited not for small hands, but minute hands (obviously aimed at the Irish Leprechaun market). The single fire button, located atop the stick, is hard to get your thumb around as it is tall and square and exhibits no 'feedback'. Control accuracy is good, but maimed by the grip. In all, a very disappointing product from Wico who normally produce an excellent product.
**The Red Stick**

Aptly named, this is another one from Wico. This must be the best joystick I've ever used — it has unbelievable response in directional control and with the fire button. Left handers should have no problems with this one as there is a fire button atop the stick. Movement is very smooth — only hampered by the price! Five marks in all categories.

**The Red Ball**

Brother to the Red Stick, again from Wico. Another 'miracle' joystick, it only lets the side down in the grip. I found it hard to get a good grip, at first, but once perfected it's as good as the Red Stick.

**The Trackball**

Yet another Wico creation. I think this is really a gimmick for games control in that, in general, it's hard to control — particularly at speed, and is only suited to right hand players. I found it over-sensitive, a sneeze will throw your piece right off course. Once the novelty wears off, it's only another one for the toy heap at the bottom of the wardrobe. This is unfortunate because some games are suited to a trackball style of control. If the price weren't so high, it would probably be a big hit, I suspect.

**Conclusion**

In concluding, I would like to say that the Wico Red Stick is leaps and bounds ahead of the rest of the field, but it costs $45, which is a consideration. When considering value for money the Pointmaster, I feel, would definitely be the best. At only $25 (5c change), it is an excellent buy.
5000 POWER AMPLIFIER
REF: E.Ti JAN/MARCH 1981

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- THE CLASSIC POWER FET DESIGN
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CAT KE 4200

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- Jig drilled, extruded, deburred and black anodized heatsink bracket in heavy gauge. All other kits we have seen, a flimsy punched-out piece of aluminium metal is supplied. Not even used! This is one of the most critical components in the kit.
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Intermodulation Distortion

Stability

WRMS 3000W Input 3200W Output 700W Output

All distortion measured at 3200W output and 1KHz sine wave at 3200W output at 1KHz sinc
Infra-Red Movement Detector

The infra-red or IR Detector for short, falls into the Black Magic category. It basically is a high gain passive tuned receiver of a particular IR band. The heart of the unit consists of a high gain lens (antenna?) which has a "Commutated" field of view. Its reception pattern is count-like, but highly tuned to the IR wavelength of human bodies.

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115 PARRAMATTA ROAD PHONE: (02) 745 3077
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121 FOREST ROAD PHONE: (02) 570 7200

For those whose budget does not extend to $389, may we suggest the 2010 MkIIA Octave (10 band) Equaliser. This unit is rack mounted in the same format as the 500 series Equaliser. It is stereo (in one 3½ ″ cabinet) with one slider per octave.

It represents a refinement of the ETI 485 graphic and, as you can see, is no slouch when it comes to performance.

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A ROM reader for the Microbee

So you’ve written your 32K ‘Adventure’ program and you’re impressing all your friends with the graphics and the witty text — but they’re not impressed at how long it takes to load the goldang program from tape! Then again, loading those short, useful utilities from tape takes a frustrating few minutes when you’re hot to get on with the job. This project fixes that — transfer those tape programs to EPROM and load them with the ROM Reader.

Paul Leonardi

This project enables your favourite games or utilities to be loaded into your Microbee very quickly and cheaply. At the moment, if you want to change programs in the Microbee, you must either wait agonising minutes for an 8K program to load from cassette, or if you want it faster, a disk drive and associated software is needed (rather expensive for most of us). The ETI-673 MultiPROM board described in the November 1982 issue is another approach but is limited to a number of programs and the program must be written for a certain area of memory.

The ROM Reader was designed to enable you to read a program previously written for tape storage and then transferred to EPROM. The project plugs into the 15-pin D-socket on the Microbee’s rear apron and requires no external power. The program you wish to read into memory must have previously been put into a 2716, 2732 or a 2764 EPROM. If the ETI-668 Microbee EPROM blower is available, you can quite easily do this by reading the program from tape and copying to EPROM with a few small modifications to the code. This way, a library of EPROMs can be kept, similarly to your library of tapes.

A machine code support program is necessary to read the information into memory quickly. A USR (XXXX) call from BASIC is all that is necessary to read in and execute the program as the first seven locations of the EPROM contain the type and load address information.

Details

The design is very simple, as you can see from the circuit diagram. However, I’ve pulled a few tricks. The Microbee’s parallel I/O port has only eight signal lines. To read eight data lines from the EPROM, select each address location in turn and do whatever else is necessary. I have arranged the Microbee I/O lines to be a 4-in/4-out set, multiplexing the eight EPROM data lines onto the four Microbee input lines set up. Naturally, some ‘driving’ software is needed.

Driving software

The program which enables the EPROM to be read can be ORGed to reside in RAM and thus needs to be loaded from cassette occasionally or reside in the NETWORK EPROM socket.

The software initially sets up the PIO for 4-in and 4-out lines. It then resets the address generator, sets A12 low and selects the least significant nibble (half a byte, four bits). The first location in the EPROM describes the EPROM type: 4 for a 2732 (4K), 8 for a 2764 (8K). If the data is zero then a 2716 is assumed. A11 is connected to Vpp and this must be high to read a 2716, so the address generator is clocked 2048 times to set A11 high. If a 2 is the first data in the EPROM then the next step is carried out, else an error message is displayed.

Construction

Assembling the project is quite easy. First, pins 6, 7 and 9 of the DB10P need to be cut off and discarded so that the socket can be mounted to the pc board. The way tracks had to run on the board made this necessary. Carefully check the pc board to see that all holes are correctly drilled and that there are no breaks in the tracks or hairline

Parts List — ETI-678

<table>
<thead>
<tr>
<th>Resistor Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistors</td>
<td>nil</td>
</tr>
<tr>
<td>Capacitors</td>
<td>nil</td>
</tr>
<tr>
<td>Semiconductors</td>
<td>IC1</td>
</tr>
<tr>
<td></td>
<td>IC2</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>ETI-678 pc board; 28-pin ZIF socket or 28-pin low insertion pressure socket; DA15P right-angle pc mount 15-pin plug; tinned copper wire for links.</td>
</tr>
</tbody>
</table>

Price estimate: $23-$30
TO MICROBEE
PARALLEL PORT
DA-15 PLUG
+5 V
[Image]

The printed circuit board pattern is on page 103.

'bridges', particularly where tracks or pads are closely-spaced. See that you can screw the DB15 plug to the board without straining the pins. Don't mount it just yet, though.

The six links need to be inserted and soldered in place first. Don't forget the one beneath the EPROM socket. While two IC sockets were used on the prototype shown in the photograph, they aren't essential. If you're using them, put them on next, otherwise, mount the EPROM socket. You have three alternatives here: the expensive way, the less expensive way and the cheap way. The expensive way is to buy a 28-pin zero insertion force socket. It's elegant, handy to use and saves your valuable EPROMs from harm. But they cost $15-$20. The less expensive way is to use a low insertion force socket. They're easy to use, the EPROMs slip in and out comfortably, reducing the risk of damaged pins, and they cost under $10. The cheap way is just to use an ordinary IC socket and take care. Use a quality IC socket if you must go for the cheap option.

Fit the DB15 plug next, bolt it to the board before soldering the pins to avoid placing strain on the soldered joints.

Assemble the ICs to the board last of all, taking care with their orientation. The 4040 is a CMOS type, so only handle it by the ends of the package, using your thumb and forefinger, and avoid touching the pins. Better still, use a static-safe IC insertion tool. If you're soldering it in, solder pads 8 and 16 first— in that order. Use a soldering iron with a grounded tip.

---

Testing
Plug the unit into the Port A socket of the Microbee. Insert a pre-programmed EPROM If the driver software resides in the NETWORK socket, a simple MEM command from the BASIC command level will read in and execute the program, else aUSR (XXXX) to where you have assembled the program will be needed.

Swift and happy ROM reading to you!
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Commencing on the 25th day of December, 1983, Scientific Devices Australia Pty. Ltd. was appointed as the new Australian representative for Wavetek Corporation U.S.A.

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Concept — K. N. Developments, W.A. Production — Artype, W.A.
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**It's the and Dick's**

![Image of The March Hare]

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See Page 93 for full address details

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62 — ETI March 1984
More functions for the VZ200

This article details how you can simply add automatic line numbering and TRON and TROFF trace functions to the Dick Smith VZ200 colour computer.

Steve Olney

Why So Simple?

How was I able to add these two functions so easily? Well, on close scrutiny of the VZ200 BASIC in ROM, I discovered that it was fundamentally similar to Level II TRS-80 BASIC. By finding the equivalent control areas in RAM for the VZ200 BASIC, and by experimentation, I was able to get the functions working.

Apparently, the machine code for the execution of the 'AUTO', 'TRON' and 'TROFF' functions is still present in the VZ200 BASIC ROM, but not enabled is a bit strange. Perhaps some functions were dropped in order to implement all functions provided on the multi-function keys.

A word of warning! Like all situations where you are patching software (especially when written by someone else), beware of yet-uncovered gremlins. I take no responsibility for any havoc wreaked by same!

A more elegant and flexible approach would be to intercept the text interpreter and make it recognise the 'AUTO' and trace commands from the immediate command level, and perhaps add a line renumbering command. But that's another story!

ETI March 1984 — 63
Hewlett-Packard IC Troubleshooters to show it like it is:

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ATOM
Miroslav Kostecki, Elizabeth Park SA.

Atom is a Hi RES moving model of electrons orbiting an atom. The model is not meant to be accurate but shows a way of moving objects quickly along complex paths.

A path is first calculated and stored in an array. Then a loop is used to move along the stored points, thus the path is only calculated once before the movement. This greatly speeds the movement since calculation time is removed.

This method can be used where calculation time slows moving objects on a predictable path. Spinning shapes, bouncing balls and many physical simulations can easily use this method to speed up the graphics. The 'Atom' program may be changed to a model of the solar system.

VOLUME CONTROL
Graham Taylor, Fitzroy Victoria.

When playing with the sound possibilities of the Microbee late at night I received a certain amount of abuse. I thought that a volume control would be useful and, after studying the circuit diagram, I came up with this idea.

A cermet trimpot can be mounted just below and to the right of the 'RESET' key where there is a convenient hole in the keyboard's baseplate. Mount the trimpot on a small piece of veroboard and glue it over the hole, then drill a hole of appropriate diameter in the case to allow access.

A cermet trimpot is recommended as it is the ideal height and of sufficient ruggedness to work well. I just happened to have a 2k version but I imagine that any value between 1k and 2k will work.

The circuit diagram for my Microbee, which is now more than one year old, shows a capacitor (10 µF) in series with the speaker drive transistor's base resistor. However, there is a link in the corresponding place on the pc board so a trick may have to be cut on later models.

Remove this link (see diagram) and attach wires from the trimpot to the appropriate places on the pc board. Now I can play 'Asteroids' and other noisy games without incurring the wrath of half the neighbourhood.

A toothpaste tube cap can be used as a knob, however, an appropriately sized screwdriver works better as the trimpot is flush with the top of the case and so it out of the way of the keys.

Another useful idea, when writing machine code sound routines, is to output O42H to port 2 as this will send the noise to the cassette port as well.

AUTOMATIC CASSETTE CONTROL
Tony Clay, Logon Qld

This modification uses only one IC and relay and allows automatic control of the cassette player during SAVEs and LOADs.

To save, type OUT 10.0:SAVE "TEST". The cassette turns on the program saved and the beep from the speaker (which occurs after both SAVE and LOAD) turns the motor off.

The relay resistance should be greater than 100 ohms.

A CAPITAL IDEA
Lindsay Ford, Dreamcards Victoria

As a software publishing firm, we get heaps of good software sent to us for evaluation. But one failing that occurs in about 50% of submitted programs is that programmers persist in using "POKE 257,1" to force the Microbee into only allowing input in upper case (i.e. in CAPITALS).

This is bad technique as it does not eliminate lower case, but simply reverses the operation of the shift lock key, causing all sorts of errors and crashes.

If you're writing software to a commercial (i.e. infalible) standard, then the only acceptable way to input a string (say ADS) in upper case exclusively is with this subroutine.

00100 REM Subroutine to INPUT string ADS in mixed cases, then
00110 REM convert it to entirely upper case. Uses variables
00120 REM ADS, X and Y - Bz OCCASIONS 1983 (Not copyright)
00130 INPUT ADS: ?F:ADS: THEN 130
00140 FOR X=1 TO LEN(ADS): Y=ASC(ADS(X)): IF Y>96 THEN LET
00150 ADS=ADS(X-1)+CHR(Y-22)+ADS(X+1)
00160 NEXT X: RETURN

66 — ETI March 1984
A PREDITOR/PREY SIMULATION

The original program 'Prey', a predator/prey simulation for the Apple II, was written by Phil Cohen and was published in ETI, September 1982.

The program has now been modified for the Microbee. One drawback is that when fed with erratic changes in variables, the Bee sometimes runs out of PCGs.

J. Murfet, Hadspen Tasmania

START AND STOP KEY

A useful keyboard addition would be a RUN/STOP key to start program execution and halt single key operations. This program simply allows the ESC key to be used to run and halt BASIC programs.

It is based on a program written by D.J. Whyatt for the Microbee and published in ETI, December 1983 on page 57. The routine checks the keyboard input and if ESC is pressed then control is passed to ESCKEY. Pressing any key will automatically start the BASIC program currently in memory.

When a program is running ESC will also halt the program temporarily.

Once the BASIC listing has been entered it can be deleted and the ESC key used to start and stop BASIC programs that are subsequently entered.

P. J. Bisset, Benowa Qld.

SOURCE LISTING

LINE  LABEL  MNE   OPERAND
00100  ORG 3498H
00110  CALL OASERH
00120  PUSH AF
00130  CP 1BH
00140  JB, Z, ESCKEY: If ESC pressed then jump.
00150  POP AF
00160  RET
00170  ESCKEY CALL 600AH Wait for key to be pressed.

BASIC LISTING

00100  FOR I = 10 TO 15000: READ D:POKE 3,D:NEXT I
00110  POKE 194,152:POKE 195,58
00120  DATA 205,233,163,245,245,27,40,2,241,201
00130  DATA 241,205,6.128,254,27,200,195,30,128

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P. J. Bisset, Benowa Qld.
Now every microbee can become a personal terminal using TELCOM 1. TELCOM 1 is a ROM based communications program suitable for all ROM based microbee IC and later models. It allows the use of the serial RS232 port at 16 baud rates from 50 to 19200 Baud, provides real time clock with alarm feature, modem control functions such as automatic dialling, BASIC WORDBEE and MACHINE LANGUAGE file transfer via the serial port. Additionally the ROM emulates the ADM 3A and Televideo 912 terminals for connection to other computers. All information can be viewed on the screen and retrieved as a WORDBEE file and even printer-out using the built in screen print utility.

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**ENCOURAGEMENT**

Ozi-Soft, in conjunction with Computer Techniques, is offering to donate a VIC-20 expansion board for the best software item submitted to this column every month. The board is Australian-designed and manufactured and simply plugs into the VIC-20's expansion slot. It features three sockets that can be independently switch-selected, plus an on-board reset switch. Why not plug in to three separate expansion units to your VIC-20 and avoid the hassle of plugging things in and out and turning the computer on and off each time.

It is distributed by Computer Techniques, 123 Clarence Street, Sydney (G.P.O. Box 4936) NSW 2000. (02)29-7244. The board costs $59.95. All submissions must be accompanied by a signed letter from you stating that it's your original work. The winning submission will be judged by the Editor and no correspondence will be entered into. All published submissions will be paid for.

Send entries to The Editor, VIC-20 Column, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.

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**HORSE RACE FORECAST**

Matt Underwood, Box Hill North, Vic.

If you like to have a bet on the horses then this program may help you to make some money. However the predictions of this program as to which horses will win first, second, etc. may not be accurate as there are many factors which affect the result. But with a bit of common sense the punter should show a profit over a number of races.

---

Computer expansion units to your VIC-20
dently switch - selected, slot.

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It tried this program for the Caulfield and Melbourne Cup and I found it very helpful. It picked three of the first five place getters in the Caulfield and the winner of the Melbourne Cup, so I am showing a profit so far.

The program gives the option of having a printout made of the results. Some lines may exceed the allowable 88 characters so some words may have to be abbreviated.

Most of the data needed to feed into this program may be found in any newspaper which has a turf or form guide of the races.

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Peter Skilton of Seaford Vic. is the winner of the VIC-20 expansion board this month. His useful program, Curve Fitter, gives the line-of-best-fit to graphical data.

**CURVE FITTER**

Peter Skilton, Seaford, Vic.

This program proves that the VIC-20 can do more than just play video games. It gives you the line-of-best-fit to graphical data, the procedure being to obtain the graph on the screen and then adjust a simple case we use a CURVE FITTER to adjust parameters. Pictorially, this resembles the graph shown fits the data. The listing shown fits the data, the procedure being

```
30 PRINT "CURVE FITTER"
10 POKE36879:10 PRINT "CURVE FITTER"
20 PRINT "CURVE FITTER PROGRAM FOR ANY DIFFERENTIABLE FUNCTION"
30 PRINT "MINTERM MEAN BE ENTERED" (X,Y) VALUES"15"
40 REM F.P. SKILTON 1/2/83
50 IF =X=4=0=1=X0=0;0;1=XO=0.1=0 REM PERFORM A NON-LINEAR LEAST SQUARES FIT
60 READ (X,Y) FROM X=0 TO X=100:10 REM PERFORM A NON-LINEAR LEAST SQUARES FIT
```

The listing shown fits a cubic equation with its four adjustable parameters. Pictorially, this is searching five-dimensional parameter hyperspace (with a program pointer of length equal to lambda) for the minimum of the well that is present. The parameter values corresponding to the bottom of the well are those of the curve-of-best-fit. By the nature of the cubic power series, if your data is more accurately represented by a parabola or line, then the higher order parameter will approach zero as required.

When the program is running it first fits into the unexpanded VIC and can handle up to 34 input data points. Of course, more can be input with a memory expansion cartridge and by redimensioning the array X in line 70.

Intermediate calculations are displayed on the screen during execution. The time between these iterations will increase with the number of data points. The criterion for convergence of the fit is that the smallest value of chi-square is obtained. This variable is related to the deviation of your data from the calculated curve-of-best-fit. So the larger chi-square, the better the fitted equation matches your data. The final results give the parameters following their respective standard deviation in brackets. A sample printout is shown using the temperature dependence of a resistor. The calculated curve-of-best-fit is shown on the graph. I strongly recommend that you try your data once you have typed in the program as any tug may distort the apparent parameter values obtained.

This is an entirely general routine which can be used to fit any mathematical function. If you wish to change the equation fitted then seven lines need to be altered.

At line 60 set P equal to the number of adjustable parameters in the function and let FS be whatever equation you are fitting. In line 80 set PS to all the adjustable parameters (each must be two characters long) exactly as you gave them in FS.

In line 640 you must give P expressions of the form (01=EXP(2X)) with respect to G1 would be D1=EXP(2X) and with respect to G2 would be D2=EXP(2X). Line 680 is identical to 630 except for using the array P instead of P. Line 700 is simply T=(YJ) which is the expression given in the right-hand side of line 640.

If you are unfortunate enough to get an error message (assuming no typing mistakes), then probably your initial guesses were grossly wrong in order of magnitude or else your derivative expressions in 650 are incorrect.

Remember that the number of data must exceed the number of adjustable parameters by at least one to define chi-square unambiguously give the curve-of-best-fit.
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SPECTRUM ANALYSER
TWINS FROM TEK.

Tektronix is adding a new set of 'twins' to its 490 series spectrum analyser family. The two major new products — the 494 and its programmable compatible counterpart, the 494P — offer many features never before available in a spectrum analyser, the company claims.

The new analysers cover the frequency range from 10 kHz to 325 GHz and offer an exclusive 'help' mode which provides explanations of controls and functions, on the CRT itself, at a push of a button.

The new 494/494P spectrum analysers are similar to the popular 492/492P (50 kHz to 220 GHz) and 496/496P (1 kHz to 1.8 GHz) spectrum analysers in appearance, operation, and rugged environmental specifications.

The 494/494P possesses the first three-year warranty in the history of the spectrum analyser industry, Tektronix claims. The 494 and 494P offer frequency measurement accuracy typical of a counter; ±27 Hz at 21 GHz, a first for portable analysers the company says. Frequency coverage is extended to 325 GHz.

Another significant industry first, according to Tektronix, is the unique 'help' mode that gives the new user operational confidence by displaying control function descriptions with the touch of a button. When you press the help button instructions appear on the CRT. You can then press any pushbutton and a description of its function appears. The help text, plus all other screen messages, are in English with an optional second language of either German, French, or Spanish.

Ten on-board registers for pre-setting instrument control settings saves set-up time and improves measurement repeatability. Measurements made in the field are transported to the laboratory for comparison and analysis. Up to nine displays are stored with front panel control settings.

A data dump-to-plotter facility provides a plotter interface for hard copies without having to hook up a controller. It is compatible with both Tektronix and Hewlett-Packard GPIB plotters.

The 50-75 GHz, 75-110 GHz and 110-170 GHz bands have been included, plus new waveguide mixers for these bands and others that cover from 18 GHz to 325 GHz.

Low-cost frequency counters from H-P

Two new frequency counters from Hewlett-Packard, the HP 5384A and HP 5385A, offer new levels of accuracy and resolution in economy-priced systems counters covering the frequency range of 10 Hz to 1 GHz.

High input sensitivity coupled with extensive input-signal conditioning result in enhanced performance in R&D testing. Additionally, low-priced systems capability is available in either HP-IB (standard) or HP-1L (Hewlett-Packard Interface Loop), which is optional.

Frequency range for the HP 5384A is 10 Hz to 225 MHz. For the HP 5385A, it is 10 Hz to 1 GHz. Key specifications common to both units include: measurement resolution is nine digits per second minimum, four to 11-digit display resolution is front-panel selectable to simplify readings; input sensitivity is a high 10 mV RMS (typical); and three gate time selections (0.1, 1.0 and 10 seconds) are provided.

Options enhance operation in the lab or the field. They are: HP-1L for low-priced bench or field automation, a battery pack for portable operation and an oven timebase for laboratory accuracy in the field. The remote display feature allows measurement displays in engineering units, such as RPM, % drift, IF, etc., as well as message and prompts, when the counters are used in conjunction with a handheld or desktop computer.

Contact your local H-P office for more details. Tell them "ETI sent me"! 

ETI March 1984 — 73
EPSON HX-20 PORTABLE COMPUTER FROM MAGRATHS

The HX-20 portable computer package--you get a computer, a printer and a display unit--all in one, go anywhere, self-contained system.

LOOK AT THE FEATURES:
- FULL FUNCTION PORTABLE COMPUTER--NOT A CALCULATOR
- STANDARD 16 KB RAM EXPANDS UP TO 32 KB OR THE 32 KB ROM MEMORY TO 72 KB
- ABLE TO COMMUNICATE WITH FULL SIZE ASCII+1 KEYBOARD
- BUILT-IN PRINTER
- LCD SCREEN
- MUSIC GENERATOR VIA PIEZO--ELECTRIC SPEAKER
- MICROSOFT BASIC
- TIME AND DATE FUNCTIONS.

For fixed location use you can also add on the following options--display controller for monitoring on large screens (every home TV), floppy disk drive for expanded memory, and acoustic coupler for two-way Information transfer.

SPECIFICATIONS:

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard Type</td>
<td>detachable, capacitive, typewriter-style keyboard.</td>
</tr>
<tr>
<td>Display Type</td>
<td>14-key roller with auto repeat capability.</td>
</tr>
<tr>
<td>LED Indicators</td>
<td>4 LED indicators for caps lock, on-line, block mode and keyboard lock/prot.</td>
</tr>
<tr>
<td>Power Supply</td>
<td>+12V, 1.5A.</td>
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<tr>
<td>Recharge</td>
<td>Full charge within 8 hours.</td>
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<tr>
<td>Physical Char.</td>
<td>21.5 x 29 x 4.4 in.</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 7.2 kg (15 lb)</td>
</tr>
<tr>
<td>Expansion</td>
<td>32 KB expandable RAM.</td>
</tr>
<tr>
<td>Expansion Kit</td>
<td>Included.</td>
</tr>
</tbody>
</table>

**VIDEO TAPE SPECIALS**

- **TDK 3 HOUR VHS** $15.45
- **TDK 3 HOUR Beta** $15.45

**SPEHERE COMPUTERS PRESENTS**

**SPECIFICATIONS:**
- **Keyboard:**
  - Detachable, capacitive, typewriter-style keyboard.
  - 14-key roller with auto repeat capability.
- **LED Indicators:**
  - 4 LED indicators for caps lock, on-line, block mode and keyboard lock/prot.
- **Power Supply:**
  - +12V, 1.5A.
- **Recharge:**
  - Full charge within 8 hours.
- **Physical Char.:**
  - 21.5 x 29 x 4.4 in.
- **Weight:**
  - Approx. 7.2 kg (15 lb).
- **Expansion:**
  - 32 KB expandable RAM.
- **Expansion Kit:**
  - Included.

**INSTRUMENT CASES**

**BETACOM**

<table>
<thead>
<tr>
<th>MODEL</th>
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**EDDYSTONE DIECAST BOXES**

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**HORWOOD**

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</tr>
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</table>

**ARISTA ELECTRONICS TV-VIDEO ACCESSORIES**

**THE LITTLE BIG BOARD**

- Kit includes:
  - Users Manual
  - Printed Circuit Board
  - Monitor LED
  - Component Set
  - Set-up Sheet

- $494.50

**ARISTA ELECTRONICSALARMS--SECURITY ACCESSORIES**

**MAGNETIC REED SWITCH**

- $3.22

**NASHUA DATA DISKS**

<table>
<thead>
<tr>
<th>MODEL</th>
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<td>FD-2D</td>
<td>8  &quot;</td>
<td>5.25&quot;</td>
<td>$13.37</td>
</tr>
</tbody>
</table>

**FANTASTIC VALUE**

- Backtab, column tab, column back tab, block mode on/off, protect mode on/off, graphic mode on/off, clear unpressed.
- External Control
  - Power on/off.
  - Contrast adjustment.
  - Baud rate.
  - Parity and data format.
  - End of message.
  - Emulation mode.
  - Refresh rate.
- Half duplex or null duplex.
- Auto line feed.
- Auto new line.
- EIA RS-232-C Current Loop.
- Reverse video or standard video.

**SPHERE COMPUTERS PRESENTS**

AN INTELLIGENT TERMINAL

- **Emulation:**
  - 1801/1562/DELTACOM.
- **Character Set:**
  - 96 ASCII, 51 graphic symbols, 32 control characters.
- **Screen Attributes:**
  - Blank, underline, reverse, dual intensity.
- **Cursor type:**
  - Selectable slow, fast blinking or steady cursor, block underline, invisible cursor.
- **Editing Function:**
  - Cursor: up, down, left, right, home.
  - Insert character, delete character, insert line, delete line, erase to end of line, page feed, field tab, field.

**WAS** $1,029.25
**NOW** $994.25

---

Mail or phone orders add $2.00 above 1 kg pack post. Special rates for heavy items on request.
ARLUNYA PATTERN GENERATORS

The Arlunya PG100Z series of pattern generators produce video signals for testing VCRs, VTRs, monitors, TV receivers and CCTV systems operating to PAL standards. All versions give eight monochrome and ten colour patterns with override controls providing superimposed variable size circle, spot, porthole, chroma level, burst level and interface or non interface selection.

Patterns include: crosshatch, dots, checkerboard, vertical bars, horizontal bars, multi burst, resolution bars, linear gray scale, standard colour bars, white, green, cyan and plain rasters, chroma decoder pattern, chroma staircase, chroma resolution and 'colour black'.

Outputs are video, RF (switched and variable for most VHF and UHF TV channels) and trigger.

The PG100X model provides slaving from any colour SPG generating subcarrier and standard pulses thus enabling broadcast format signal generation in combination with a broadcast station SPG. A rear internal/external switch determines operating mode.

PG100XP provides slaving facilities from the Arlunya VPS210 video processor with which it is mainframe compatible.

Versions are available with separate RGB outputs for testing monitors that require such signals. Other versions can be supplied with multiple outputs with or without superimposed number character identification.

For further information, contact: The Dindima Group Pty Ltd, PO Box 106, Vermont, Vic 3133. (03) 873-4455.

NEW LOW VOLTAGE HEXFET

International Rectifier, whose products are distributed in Australia by Warburton Franki, has introduced a new low RD $\text{(on)}$ 60 V HEXFET.

Designated the IRFZ32, the FET has a maximum RD $\text{(on)}$ of 100 milliohm and incorporates the quality and reliability benefits of HEXFETs including a duration AQL, the company claims.

They say that this is due, in large part, to product design factors such as wire bonding pads, solder die attach, epoxy package, passivated die and proven device structure.

Particular features of the IRFZ32 include, extremely low RD $\text{(on)}$, compact plastic package, fast switching, low drive current, ease of paralleling, no second breakdown, excellent temperature stability and excellent parts per million quality.

For full specification details on this latest addition to the HEXFET range, contact Warburton Franki, 199 Parramatta Rd, Auburn NSW 2144.

1 GHz FREQUENCY COUNTER FROM AWA

The LDC-825 from AWA is a digital frequency counter made by Leader capable of measuring frequency over the wide range 10 Hz to 1 GHz and period 100 mS to 1 µS.

Featuring bright 7-segment fluorescent displays the 8-digit readout provides resolution of 0.1 Hz up to 80 MHz and 10 Hz up to 1 GHz. The high sensitivity of 20 mV up to 80 MHz and 50 mV, via the 50 ohms input of the pre-scaler, combine with the accurate time base of ±3 in $10^6$ to make the LDC-825 suitable for many applications in production testing and service of radio-communications systems.

The counter is small and lightweight and can be used over the temperature range 0 to 40°C. It is mains operated and supplied with two input cables and comprehensive operating instructions.

Further information is available from Amalgamated Wireless (Australia) Ltd, North Ryde Division, Cool Talafera & Lane Cove Roads, Macquarie Park, North Ryde NSW 2113. (02) 887-7111.

WAVETEK FOR SCIENTIFIC DEVICES

COMMENCING on the 25th day of December, 1983, Scientific Devices Australia Pty Ltd was appointed the new Australian representative for Wave-tek Corporation USA.

Wave-tek, with the addition of two new divisions to their structure, namely Nicolet Scientific Corporation and Pacific Measurements, is one of the largest instrumentation suppliers in the USA.

Their products include FFT analysers, synthesisers, programmable filters, RF signal generators, RF components, RF sweep generators, microwave generators, instrumentation controllers, pulse/function generators, arbitrary programmable generators, instrumentation controllers, network analysers and power meters.

Scientific Devices offer marketing and support for Wave-tek products with full service facilities. Contact Scientific Devices Australia Pty Ltd for further information on this appointment at any one of the offices in Melbourne, Sydney or Adelaide.

H-P's RF SIG GEN FAMILY

Hewlett-Packard describes its family of RF signal generators in a new eight-page, four-colour product brochure providing key features and benefits of each instrument.

Included in the brochure are selection guides based on both applications and specifications for each of the programmable and manually-tuned generators and a spectral-purity-compari-

son graph. The literature number is 3953-3833. Enquire at your local H-P office.
FOR QUALITY, PERFORMANCE & VALUE, AARON MUST BE YOUR FIRST 'SCOPE CHOICE
(and for after sales service too!)

1. BS601 - 20MHz/5mV with Built-In Component Tester
   $535 ex tax
   - Check components on screen
   - 19 range timebase • Triggers to over 30MHz • 17ns risetime

2. BS510 - 100MHz/1mV with 4 Channels and 8 Traces
   $2295 ex tax
   - 2ns/div max sweep time
   - Alternate time base with B ends
   - Variable trigger hold-off
   - Independent position controls
   - Signal delay

3. BS625 - 45MHz/1mV with Signal and Timebase Delay
   $1095 ex tax
   - Single sweep • Trigger delay
   - 7.7ns risetime • X, Y, Dual, Chop, Add, Subtract etc

4. BS310S - 15MHz/2mV Battery Portable
   $795 ex tax
   - Ideal for field service use
   - 2 hour operation from built-in NiCads • Automatic re-charging
   - Auto trigger free run • TV sync

5. BS320 - 15MHz/2mV with Digital Storage and DMM
   $2295 ex tax
   - 2708.10 tax paid
   - Built-in 3½ digit digitimeter
   - Digital storage mode • Trigger delay • X-Y mode component tester • 3 channel operation for 3-phase measurements

6. BS635 - 35MHz/1mV with Alternate and Delayed Timebase
   $875 ex tax
   - $1015.00 tax paid
   - 21 range timebase • 100mS-1μS
   - 15MHz/2mV Battery
   - Trigger delay • Front panel trace rotate • Multi-mode display
   - Optional carrying cases available for all 'scopes.

Colinear Probes
A comprehensive range of probes and accessories is available. Modular types have pencil slim leads and detachable earth leads. They offer excellent pulse responses and very wide bandwidths. A comprehensive catalogue is available on request.

SP100 - 100MHz Probe
$28 ex tax
$29.20 tax paid
With x1, ref, x10 positions. 1.5m lead, BNC connector and selection of tips in heavy duty pouch.

All prices are plus sales tax & applicable and subject to change without notice.

N.S.W. Ames Agency 695 4124 • George Brown 519 5655 (09) 69 6369 • Daverd 267 1365 • DGE Systems (09) 69 1625 • Maclean (042) 29 1405 • Radio Components 211 0191 • Sheridan Electronics 595 6122 N.T. Thew & McCann (08) 84-4959 A.C.T. George Brown (02) 81 4300 VIC. Briontronics 419 3986
- G.S. Telephones 328 4311 QLD. Colourview Wholesalers 275 3388 • St. Lucia Electronics 52 7469 • Electronic Shop (07) 32 4652 • W.G. Watson (07) 27 1292
- Nortel (07) 79 8600 • ECO Electronics 376 5677 • Northern Circuits (07) 51 9063 • Fred Hoe & Sons 277 4311 • Redarc Electronics 278 7488 • Trio Electrics 5 6716 • Protronics 252 3111 W.A. Allen Carvery 321 0181 TAS. GHE Electronics (03) 34 2253 & (03) 31 8530.
TEXTOOL ZERO INSERTION FORCE SOCKETS

ZIP DIP II Sockets
TEXTOOL’S versatile ZIP DIP II socket features a flat top plate for easy insertion and extraction. Contacts are on 1" increments for standard sizes, thus mating with standard layouts. All standard sizes from 14 to 40 pin are available from stock at realistic prices.

<table>
<thead>
<tr>
<th>Pins</th>
<th>Stock Number</th>
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ECONO-ZIP Sockets
For applications requiring low cost for not so often used sockets the ECONO-ZIP is the answer. A simple mechanism is used with contacts and body of standard TEXTOOL materials. Ideal for use on P.C.B.’s within equipment for PROMS or EPROMS. Available immediately in 16, 24, 28 and 40 pin, others to follow.

<table>
<thead>
<tr>
<th>Pins</th>
<th>Stock Number</th>
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</tbody>
</table>

ZIP-STRIPS
Combine all the usual TEXTOOL features into a useful socket for testing non-standard packages or pinched board assemblies. The ZIP-STRIP handles may be ganged for ease of use.

<table>
<thead>
<tr>
<th>Pins</th>
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<td>32</td>
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<td>17.01</td>
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</table>

All above prices plus 20% sales tax

Stewart Electronics
44 Stafford St., Huntingtondale 3166. Phone: (03) 543 3733 Telex: 369013
437 City Rd., Sth. Melbourne. Phone: (03) 690 8333

Whatever your needs!

Sawtron 990
For Superior Communications

For all your Electronic needs

- KITS
- COMPONENTS
- TOOLS ETC.

Resellers of Dick Smith, Alltronics
Call in and browse around

Cnr. Bayswater & Eastfield
South Croydon
Phone 723 3860

Ian J. Truscotts
ELECTRONICS WORLD

78 — ETI March 1984
HIGH SPEED DIVIDERS REACH 3 GHz

Plessey semiconductors of Swindon, southern England, has announced availability of prototype samples of an emitter-coupled logic (ECL) divide-by-four device for operation above 2 GHz.

Known as the SP8712 EXP, it is the first fully production specified divider of its type. Full production will start shortly, the company say.

Operation is guaranteed at input frequencies up to 2.4 GHz, and under ideal conditions a typical device will achieve almost 3 GHz which, say Plessey Semiconductors, represents an improvement in frequency performance of 50 per cent in less than two years and is indicative of major advances in silicon ECL technology.

An important feature of the SP8712 is that it is supplied in a conventional dual-in-line package so that it can be mounted on a printed circuit board, along with accompanying components. It had been thought that DIL packages were unsuitable for operation above 1.5 GHz because of the length of bond wires between the chip and the package leadouts. However, experience gained from manufacture of the SP8612 has shown otherwise.

The design of the SP8712 EXP features a carefully designed chip layout which matches the input stage with the self-inductive of bond wires. This means that the SP8712 EXP can be operated in a conventional manner using conventional board assembly techniques.

Like other Plessey SP8000 series high speed dividers, the SP8712 EXP is guaranteed to operate over a defined temperature, supply voltage, input voltage and frequency range with no compromise in performance.

As well as the applications in professional test and measurement equipment, the SP8712 EXP is ideal for use in direct broadcast satellite (DBS) systems, says Plessey. Present DBS systems used in the USA require a divider to perform at 2 GHz with a typical IF frequency.

The ability to divide at higher frequencies will now allow the user of higher IF frequencies, with a resulting improvement in performance. European systems are planned to operate at even higher frequencies and the introduction of the SP8712 EXP now makes this possible.

For further information contact Plessey Semiconductors Limited, Cheney Manor, Swindon, Wiltshire, England SN2 2QW. Telephone (079)3-6251.

UHF POWER TRANSISTORS

Motorola has announced the new MRF652 and MRF841, cost-effective, high gain UHF and 800 MHz mobile radio RF power transistors.

The devices provide 8.5 to 10 dB minimum gain and 65% typical efficiency specified at 5.0 W output power and 512 or 870 MHz.

These new transistors also feature improved ruggedness, which is 100% tested at high supply, over drive and 30:1 VSWR. Both the MRF652 and MRF841 are designed primarily for driver and output stages in land mobile and hand held radios operating in the UHF and 800 MHz frequency bands.

These devices provide at least 1 dB more gain than previously existing RF power transistors, thereby significantly reducing the cost of driver stages, claim Motorola.

These devices are available from Motorola Semiconductor Products, 250 Pacific Hwy, Crows Nest NSW 2065. (02)438-1955.

IMPROVED CONVERGENCE FOR 30AX TV SYSTEM

Improved convergence for their 30AX TV tube deflection system is announced by Philips. Convergence improvement over previous data is 10-20% for the three new deflection units, type numbers AT1850 (20°), AT1860 (22°) and AT1870 (26°).

Several improvements have been made in the deflection units, including a new winding technique, which gives better control of tolerances during production. The 22° coil also now includes field shapers.

Samples of the 22° and 26° deflection units are available now; samples of the 20° unit will be available by the end of the year.

For further information contact Philips Electronic Components & Materials, 67 Mars Road, Lane Cove NSW 2066. (02) 427-0888.

TRW SECOND-SOURCE OPTOCOUPLEDERS

TRW Electronics Components Group, Optoelectronics Div., has unveiled alternative sources for the 6N Series of optocouplers. The five-member series is available off the shelf in eight-pin DIPs with temperature compensation over the 0° to 70° Celsius range and 3000 Vdc isolation.

The high speed 6N135 and 6N136 have open-collector outputs for use as line receivers and isolators in applications having data rates of up to one megabit.

The high-gain 6N138 and 6N139 devices are said to provide high sensitivity for EIA RS232C line receiver and telephone-ringing detection.

The ultra-high speed 6N137 device is an optically-coupled logic gate designed for digital-interfacing applications and usable for 10 megabits.

For further information contact Total Electronics, 9 Harker St, Burwood 3125 Vic. (03)288-4044.
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The Multiprom board is a complete and convenient tool for anyone wanting to expand their Microbee's memory and includes a plug-in board plus all components to make the exciting project. There is also provision on the board to change the address of the ports used for eprom selection and I/O.

Little BIG Board

SEE ETI OCTOBER 1983 FOR FULL DETAILS

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Control up to four room lights over a twin-wire cable

Ian Thomas

It is probably a not-uncommon problem to want to replace the single ceiling light in a room with a more exotic dimmable arrangement only to find that the twin-wire switch cable is concreted in, or otherwise hard to get at without spoiling the room decoration. This project allows you to control up to four room lights — two dimmable and two switched — over the existing twin-wire cable. No need to spoil the wall and ruin the room decor.

The controls. I modified a standard, commonly available, HPM light fitting (made in Australia) to take the controls. This provided a neat and convenient solution, the switches and dimmer pots snap into the panel, the encoder pc board mounts behind them. The end result is only distinguishable from an 'ordinary' light fitting by the two pc board mounting screws visible here (which should be earthed or covered). If the pc mountings are epoxied in place — who'd know the difference?

It is probably a not-uncommon problem to want to replace the single overhead light fitting with a more exotic dimmable arrangement only to find that the control wires to the switch are concreted in. Also, in keeping with Murphy's Law, the walls have only been re-papered a year or so ago and the wallpaper is now totally unavailable and to string more wires to the switch would involve a major redecoration of the whole room, so the idea is scrapped.

This project is intended to solve such problems by replacing the single wall switch with the required multiple switch-control pot combination and a very compact printed circuit board. A matching electronics box in the ceiling feeds power to the control board and also recovers the control information to operate triacs to drive the multiple lights.

It was considered essential that the replaced wall controls look exactly like normal 'bought' controls and avoid that 'home made' look so, normal, purchased, wall fittings were used for the controller. The unit in the ceiling merely had to work reliably and could be any size or shape at all.

The design
The first problem to be dealt with in the design was how many controls and what type were wanted. Also, it had to be decided how to multiplex the switch/control pot information onto the single wire pair available. A survey of the many types of controller integrated circuits available (what we were trying to do is not dissimilar to the remote control of a TV or VCR) showed that while there were dozens (literally!) manufactured, precisely none (zip! zero! zilch!) were to be had in Australia unless you wanted to buy 1000 or so.

The only ray of light to be found was from National Semiconductor, and a perfectly satisfactory ray it turned out to be too. National make the LM1871 Radio Control Encoder/Transmitter and its companion LM1872 Radio Control Receiver/Decoder, which are intended to be used as remote controllers for toy cars or model aeroplanes. They provide, in their simplest configuration, two linear analogue control
channels plus two separate on-off channels. The encoder/transmitter also contains a moderate power high-f transistor to be used as an RF transmitter and the receiver/decoder has all the circuitry to construct a (simple) RF receiver so, as I could actually go out and buy some over the counter (good marketing National!) this integrated circuit pair seemed to be the way to go. They would give two completely linear, dimmable lights plus two simple on-off lights which should cover most rooms adequately.

The LM1871/LM1872 integrated circuits operate on a rather peculiar combination of pulse-width modulation plus (once again in their simplest configuration) pulse counting to transmit the analogue and digital information. The receiver/decoder half of the pair contains no memory so the encoder/transmitter must send the information continuously to keep the system 'alive'.

The encoder section of the LM1871 generates a series of up to six pulses in each data frame with each pulse separated by a fixed off time. At the end of the up-to-six pulses a much longer synchronisation pulse is sent so the receiver/decoder can lock on correctly. The first two pulses in each data frame are of variable width to convey the analogue information of the two channels and the other, up-to-four, fixed width pulses give the status of the two on-off switches. Figure 1 shows a typical encoder output and indicates how the width of the first two pulses gives the analogue data.

As Figure 1 shows, the analogue information is contained in a series of pulses repeated at the frame rate whose width varies. The values recommended by National give a frame rate of 50 Hz. However, as the analogue information derived from this repetition rate data is to be used to control triacs running from 50 Hz mains the two similar frequencies would be sure to give rise to all sorts of unwanted slow beat effects (you would be amazed how sensitive the eye is to slow beats in, say, light intensity). For this reason I opted to have a frame rate of 75 Hz so any beats would be at 25 Hz and thus unnoticeable.

Also, the National design data is based on bandwidth restrictions and no such restraints exist for us. I also opted to shorten the fixed off time between all pulses to 0.4 ms from the National-recommended 0.5. The analogue channel limits were left the same as in the recommendations at 1 ms minimum and 2 ms maximum. The digital information pulses were left at 0.5 ms to finish defining all the times in the frame sent from the encoder.

The LM1871 is intended to be used as a very low power 27 MHz or 46 MHz (or, by straining and a bit of extra circuitry, 72 MHz) radio transmitter. This seemed like a good idea except that I had no desire to further crud up the ether with lighting control information. Instead, I chose to use the wires carrying power to the controller to carry switched low frequency RF data in the.

The works! This is the receiver and triac driver board which mounts away in the ceiling cavity, or somewhere else.

---

**Figure 1.**

Typical encoder output waveform. The width of the first two pulses gives the analogue data.

**Typical application**

- **ETI-1522A**
- **TWIN-PAIR CABLE**
- **ETI-1522B**
- **DUAL DIMMER SWITCH WALL PLATE**
- **SWITCH WALL PLATE**
- **LIGHT CORNER LIGHT**
- **WALL FIXTURE**
- **SPOT**
- **CHANDELIER**

**A)** Encoder Output (Pin 13)
**B)** Transmitted RF Carrier Envelope
**C)** Typical Receiver Channel 1 Output
**D)** Typical Receiver Channel 2 Output
HOW IT WORKS - ETI-1522

The light controller can be divided into two major sections: the transmitter and the receiver and itself can be divided into several sections which are the RF receiver, analogue filtering, mains synchronisation and triac drive. First, consider the transmitter.

The transmitter sends its information as to potentiometer position and switch status by sending a series of between three and six data pulses and requires much longer pulse to synchronise the system (see Figure 1). All the pulses are separated by an off period of exactly the same time. The first two pulses are individually pulse-width modulated to encode the two analogue channels and the next one-to-four pulses contain the switches, encoded by a simple counting system. As the width of the first two pulses and also the analogue channel and also, the LM1871 contains actual time taken for data transmission varies as the input controls are varied. However, the LM1871 allows for this by varying the length of the system pulse so the length of every data frame is the same.

While it is interesting to go into details of the internal operation of the LM1871 the essential thing to understand how the external components affect the operation of the integrated circuit. The IC consists of several separate RC timing circuits and some combining logic and voltage reference generators to give both stable timing and stable RF output level. Overall data frame timing is set by R8 and C10 and this time constant sets the frequency of the system pulse. The time between each individual pulse of the data and the duration of each data pulse is set by capacitor C11, together with different resistors for the inter-pulse time and the actual pulse durations.

When the LM1871 is measuring the time between the pulses it is charging C11 from 0.33 Vdc to 0.67 Vdc, by switching in R1. When the LM1871 determines an actual pulse it discharges C11 through the resistor associated with that pulse. For example, when it sets the length of the data frame, it switches in the resistance connected to pin 3, which is R7 and RV2. Thus, R7 sets the minimum pulse width of the first analogue channel and RV2 varies the pulse width for that channel. The same cycle is repeated for the second analogue channel, charging C11 through R1 and then selecting the second discharge resistance, R6 and RV1.

If designing pulse-width modulated channels can be generated by connecting four more variable resistors to pins 1, 16, 17 and 16 but we don’t want six analogue channels and also, the LM1871 contains extra circuitry to convert these potential extra channels to two digital channels and at the same time make the receiver much simpler. If pins 1, 16, 17 and 16 are all connected together (as they are here) then for pulses three to six, the same resistor will be used and the last four pulses will have the same length.

Internal logic exists in the LM1871 to operate on information provided on pins 5 and 6 and vary the outputs that are channel dependent according to that information. For example, if both pins 5 and 6 are left open (the IC has internal pullup resistors) then only one fixed duration pulse is sent after the two analogue pulses and the rest of the time is up with the synchronising pulse. If both pins 5 and 6 are shorted to ground then a further four fixed duration pulses are sent and the synchronising pulse is immediately shorter. This is clearly illustrated in Figure 2.

This takes care of the encoding and timing but leaves the problem of the actual transmission. For this purpose, the LM1871 provides a single transistor with its emitter internally connected to ground (which removes a few design options but I think they ran out of places to put these unnecessary resistors). A modulated channel requires how much of the frequency was stable but didn’t want to spend money on a crystal I chose to use a ceramic resonator as the major frequency generator. Thus, the base drive is heavily attenuated for all frequencies except the resonant frequency of the ceramic resonator which controls the frequency of oscillation.

The oscillator is driven from a secondary winding and one end is tied to earth via C5. The other side of the winding has a current limiting (and impedance defining) resistor R3, which connects to the +12 volt supply line. Thus, the oscillator signal is coupled at low level to the transmitter supply. R2, C1 and C2 protect the logic circuitry from interference from the transmitter output.

Capacitors C3 and C7 are used to wave shape the data pulses out of the digital section so the RF spectrum of the transmitter output does not give rise to intermodulation products. The output of the oscillator is taken from a second winding and one end is tied to earth via C5. The other side of the winding has a current limiting (and impedance defining) resistor R3, which connects to the +12 volt supply line. Thus, the oscillator signal is coupled at low level to the transmitter supply. R2, C1 and C2 protect the logic circuitry from interference from the transmitter output.

The receiver is an analog phase detector which sets the error for the main controller to achieve the right by adjusting the duty cycle of the main controller's signal. The LM1872 is designed as a superheterodyne receiver, but for this application all that was necessary was a tuned amplifier at 455 kHz with adequate acg as it is indeterminant what attenuation from the transmitter can be expected. For this reason, the local oscillator section of the LM1872 was disabled by grounding its crystal inputs, pins 1 and 2. This makes the mix of the LM1872 into a simple amplifier (the local oscillator modulates the emitter current of a differential pair and grounding pins 1 and 2 sets a constant emitter current). Thus, what would normally be the RF input becomes an "IF" port and accepts the input from the line.

The actual input signal is coupled in by TR1, and TR3 is a 1.500W 120R 0.4W 0.33Vf transistor. The primary is a single turn and the secondary is 20 turns wound around a Philips 3MH 9mm toroid. This gives a secondary inductance of about 3200, which is lower than the crystal resonator at 455 kHz. Thus, the high input impedance as seen at pin 5 of the LM1872 is transformed down by 20 to present a few tens of ohms to the 12 volt supply line of 555 kHz and almost no impedance for other frequencies.

The next two stages in the IC provide more than adequate gain for our needs. TR1 couple up to the base of the differential pair and TR2 is connected to the collector of the opposite side. The secondary of TR2 couples via diode biasing to the lower section of a cascaded pair which is also part of the agc system. TR3 acts as a simple resonator in the collector of the upper transistor of the cascade pair. This collector also drives the agc system and rf detector. Thus, the agc system has high gain itself, the rf level seen at pin 15 doesn’t vary and it is necessary to monitor the dc agc voltage when tuning the receiver.

Once the detector has recovered a binary signal from the RF data bursts the LM1872 must separate the two analogue channels and, by pulse counting, determine the state of two transmitters. This is not always easy as the LM1871, like the LM1871, has one master timer which is used to recover frame rate. This is set by R1 and C5. Whenever the LM1872 sees no incoming RF it resets the timer R1C5 and while a continuous carrier is being received the timer is allowed to exponentially rise (see Figure 3).

If the carrier is present for long enough, such as for a synchronising pulse from the LM1871, then a comparator in the LM1872 fires and its decoding cycle is started. The next ON-TO-OFF transition then initiates the first analogue pulse and the next ON-TO-OFF transition is the end of the first channel pulse and the start of the second. The third transition terminates the second analogue channel pulse and from on then the LM1872 merely counts ON-TO-OFF transitions to determine the status of the transmitter switches.

The two digital outputs from the LM1872 are used to drive the cathodes of two optocouplers directly and the anodes are pulsed on zero crossings of the mains as the two analogue channels the processing necessary is more complicated. The outputs from the IC are set as open collectors and R2 and R3 act as pullups to 5 V. All the crystals used in the LM1871 is set so that the two analogue channels have pulse widths of between 1 ms and 2 ms (with an allowance for tolerancing — it is less than one and more than two).

As the 75 Hz frame rate gives a pulse repetition rate of 13.33 ms then the two pulse-width modulated outputs have dc components of between 5(1/13.33) and 5(9/13.33) or approximately between 0.4 and 0.8 volts. Superimposed on this is a very strong signal at 75 Hz, plus harmonics. Therefore, the dc component must be shifted and amplified to give an output of between 0 V and +3 V. The two active filters achieve this and provide an attenuation of about 60 dB for the 75 Hz. They are equlipple group delay filters with a phase ripple of 0.5°, which provide an optimum transient and frequency response for this application (see text).

As the dc output is being used to fire triacs, the dc must be related to mains 50 Hz to be of use. IC7, and principally transistors pins 9-10 labelled Q1, a labelled Q1, and labelled Q2, are used as a mains zero cross-
... How It Works, continued:

sing detector. The base of Q1 and the emitter of Q2 are both grounded and the emitter of Q1 is connected to the base of Q2 and, via R27 and R28, to the actual 240 volts 50 Hz mains (one of the resistors is connected to the active and the other is connected to neutral so that if active and neutral are reversed, then everything still works). When the mains is at greater than one Vbe above ground Q2 is turned on. Also, when the mains voltage is greater than one Vbe below ground then Q1 is turned on (in fact it must be less than -5 V before Q1 saturates completely). Only for mains voltages between ±0.8 volts are both transistors completely off and their common collectors, pins 11 and 14, at ±6 volts. Thus, the two commoned collectors have a positive-going pulse every time the mains voltage passes through zero. This pulse is buffered and cleaned up by two gates in IC6.

The buffered, positive-going pulse is impedance transformed by the rest of the transistors in IC7 acting as a Darlington emitter follower and used to reset a ramp generator formed by Q3 and its associated resistors and capacitors. C18 is forcibly charged to 2.6 volts through D1 on a mains zero crossing (the other side of C18 is held at 0.7 V by Q3's base). C18 is then charged through R20 and the current is mirrored by collector current through R21. This produces a linear negative-going ramp at the node of C18, D1 and R21. This ramp is applied to the non-inverting inputs of the two analogue channel comparators while the dc signals derived from the filters are applied to the inverting inputs. The two gates of IC6 following the comparators ensure that even when the comparators are always low, which corresponds to lights full on, there is still a pulse on zero crossing to fire the triacs. The gate outputs are CR differentiated and buffered, then used to drive the MCG3021 optocoupler Input anodes directly.

The four triacs have one terminal connected permanently to the active mains input, the other is connected to the load. This means that when the triacs are off, the driven light fittings are in their off state and, much smaller, triac in the optocoupler is used to trigger the main one on for each circuit. A resistor-capacitor combination protects the optocoupler triacs from excessively high di/dt and hence accidental triggering from mains transients. The two triacs that are driven from the dimmer controls have simple C1 and C2 filters in their outputs to suppress radio frequency interference. The off-triacs have no need for this as they are always fired on zero crossings.

opposite direction. The coil used to operate the transistor in the IC provided as an oscillator also gave an easy way of injecting the oscillator output onto the line. Oscillator frequency stability was provided by using a 455 kHz ceramic resonator (readily available from Tandy, and others) as part of the feedback.

As the LM1871 provides all the necessary circuitry to modulate and waveshape the oscillator output from the encoder output, a complete and compact controller was easy to construct.

The actual controls feeding the LM1871 were made from modified light fitting controls purchased for the purpose. I chose to use two dimmers as these were readily available from Tandy, and convenient arrangement where a panel is purchased with the required number of holes as there are to be controls and then the controls (switches or dimmers) are snapped into the panel.

In order to keep things looking exactly like ordinary light fittings I bought two light dimmers and removed all the works from them except the 50k pots, which are the dimmer control elements (see How It Works). The end result can only be desiguated by the two mounting screws for the electronics printed circuit board. In order to save space in the controller all capacitors are the smaller 5 mm pin spacing, 63 V metallised film type which are increasingly becoming an industry standard and are available from many manufacturers.

When the controller/encoder/decorder transmitter had been designed and modelled, the next problem was to design a modified receiver/decoder which would recover the 455 kHz bursts and regenerate the analogue and digital information. The LM1872 contains all the circuitry for a complete superheterodyne receiver which was somewhat more than was strictly necessary for this application. The on-chip local oscillator was therefore disabled and only the IF amplifier section used. Two of the IF transformers from a set carried by Dick Smith Electronics (L-0260) were used and gave satisfactory performance.

The 455 kHz was coupled from the power supply line with a toroidal transformer whose output was approximately resonated with C1, a 390pF capacitor. This means that the input impedance of the RF section is accurately transformed down to about 200 ohms from the mains line. The age for normal applications is filtered with a 100 nF capacitor on pin 16. In this application, where there is no variation in input signal level, the filter capacitor can be increased to 1 µF, or even greater, with no problems and in fact helps by preventing the range following the input pulses.

The LM1872 IF and detector sections recover the pulses generated by the LM1871 encoder and pass them onto the decoder section whose operation is shown in Figure 2. It can be seen that the decoder simply counts negative-going edges after the synch pulse to determine the status of the two switches in the LM1871 circuit. The timing diagram also illustrates just how the LM1872 derives timing information from the first two pulses after the synch pulse for the analogue channels.

Figure 3 shows how different numbers of pulses are sent from the LM1871 to convey switch status. As the frame timing in the LM1871 is set by a separate resistor and capacitor from the data RC circuit, as the number of data pulses is reduced the synchronising pulse gets longer so the frame rate remains constant at 75 Hz.

In the decoder circuit used, both the analogue and digital outputs were configured as open-collector transistors (the LM1872 offers a choice of open-collector or open-emitter drivers for the digital outputs). Processing of the digital outputs, was no problem and the collectors switched the triac drivers directly (see "How It Works").

However, the analogue channels needed a lot of processing before they could be used to operate triac drives. As the whole of the LM1872 had a maximum operating voltage of 7 V the whole of the receiver and triac drive circuitry was operated from a regulated 5 V rail. (I'm sure National had a good reason for the voltage restriction but it escapes me).

When resistors R2 and R3 are connected to the output collectors the resultant output is a pulse-width modulated signal with the pulses swinging between about 40 mV (the transistor Vce sat) and 5 V. This signal has a dc component and a somewhat larger ac signal. In order to recover and amplify the dc, and at the same time remove the ac, several methods were considered but finally the simple and straightforward way was chosen; namely — a low pass filter to preserve and amplify the dc and at the same time provide about 60 dB attenuation of the 75 Hz fundamental (and appropriately more for the higher harmonics of the ac signal).

When it comes to filters there must be about as many different types and class of filter as there are applications; and there are an equally large number of realisations for
Figure 2(a). Receiver timing waveforms.

Figure 2(b). Digital channel encoding and decoding via pulse-count modulation.

Room lights controller

each class. Filter types vary from ye olde Butterworth (whose chief merit lies in the simplicity and regularity of its transfer polynomial) up to the more exotic Cauer-Chyshev filters which give optimum cutoff response but fierce group delay distortion (and hence ring like a bell).

For this application we really need optimum step response, as if the filter rang then, when the lighting intensity was suddenly changed, it would brighten and fade several times before settling down. This would suggest a Bessel filter which has an optimised step response (it doesn’t overshoot or ring at all) but a rather slow and soggy frequency response. However, we can do a little better than Bessel’s filter by accepting a tiny amount of overshoot (only a few per cent) and using an equi-ripple group delay filter where the filter phase response is allowed to vary a small amount around the ideal linear (Bessel) response and a slight improvement in frequency performance obtained.

The filter actually used is a 5th-order, 0.5° equi-ripple group delay filter which sounds all gosh! gee! wow! fantastic!! but nonetheless actually works just fine. (Linear phase or equi-ripple phase filters also have the advantage that they don’t have any very high Q sections and so are a bit more forgiving on component tolerances).

The first section of the filter is a 3rd-order block with the capacitor values shifted to preferred values and the resistor values varied accordingly (this involves fun things like solving a hectic equation (you beat it to death with a calculator!!!), but it means you can buy the components in this country. The second section is only a 2nd-order block but it has all the gain necessary to bring the pulse-width modulated dc up to about 0-3 volts.

At this stage in the circuit the fact that the information was transmitted at 75 Hz has been removed and all that remains is to relate the dc signals to the mains 50 Hz. In order to do this, IC7, a transistor array, is used to generate pulses on zero crossings of the mains and these pulses are used to generate a ramp which is compared with the dc from the filters (once again, see “How It Works”). After suitable gating to ensure the triac trigger pulses occur when wanted and don’t when not (for a pot fully anti-clockwise it is essential that the lights be completely out and when fully clockwise they should be full on — care was taken here with end-limit tolerances) the processed analogue outputs are fed to the triac drives.

All four triacs are triggered through opto-isolators to ensure that all the electronics is safe to work on but beware!! there is 240 volts on the board!! The two triacs that are switched from digital outputs have no output filtering as they are triggered on zero crossings, but the two dimmer triacs are filtered to suppress RFI.

... to be continued, next month.

ETI March 1984 — 91
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See Page 93 for full address details
Tamura Miniature Pulse

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O.E.M. Enquiries welcomed

Tamura Green Chip Series

Miniature transformers designed for transistor circuitry.

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All 7 VA Series. Insulated to AS 3126. P.C.B. mounting pins compatible with other current models and provision for additional anchorage to P.C.B.s 240V, 50Hz PRIMARY.

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Two equal secondaries for Series - Centre Tap or Parallel Connection.

P.C.B. Transformers

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Low and Extra Low Voltage

240V, 50Hz PRIMARY

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<td>2.5</td>
<td></td>
</tr>
<tr>
<td>60007</td>
<td>24</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>5503</td>
<td>11.5, 17</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>7243</td>
<td>19, 33, 40, 50CT</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>7311</td>
<td>24</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>5663</td>
<td>10, 15, 15, 24, 27.5, 30CT</td>
<td>4.7, 0.87 +2</td>
<td></td>
</tr>
</tbody>
</table>

Two secondaries can be series or parallel connected.

Type No. | VOLTS | Details |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>66022</td>
<td>25.2CT</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Thyristor (SCR) Trigger Transformer

For power supplies, lamp dimmers, motor speed controls

Type No. | VOLTS | Details |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>XT1165</td>
<td>415</td>
<td>Max voltage between windings</td>
</tr>
</tbody>
</table>

HEAD OFFICE: VICTORIA 3032 Linton Road, East Hawthorn, N.S.W. 3126
Ph: (03) 840 1222 Telex 32286
NEW SOUTH WALES 2724 Summer St, Belmore, N.S.W. 2192 Ph: (02) 769 6773 Telex 22874
WAAGA P. J. Warden (Agencies) Pty. Ltd. 7 Norton St, Woogoo, N.S.W. 2650 Ph: (069) 21 2735 Telex 96660
Multi Tap

General purpose transformers for special projects and experimental work provide a wide choice of output voltages. 240V, 50Hz, PRIMARY.

<table>
<thead>
<tr>
<th>SECONdARY AMPs</th>
<th>Details</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Centre tapped 5V, 24V, 30V.</td>
<td></td>
</tr>
<tr>
<td>2 Amp Series</td>
<td>Centre tapped 10, 20, 30, 40, 50 and 60V.</td>
<td></td>
</tr>
<tr>
<td>4 Amp parallel</td>
<td>Centre topped 2,12.6 and 15V.</td>
<td></td>
</tr>
</tbody>
</table>

Enclosed Stepdown Transformers

240V, 50 Hz PRIMARY

Ideal for garden lamps, pond lights and water pumps, automatic trouble lamps, safety lights, pool lighting etc.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>VOLTS</th>
<th>SECONDARY AMPs</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>60269</td>
<td>32</td>
<td>2.25</td>
<td>Type No. 60280, 60426, and 60480 have two fusible in the secondary output for pool lighting applications.</td>
</tr>
<tr>
<td>60279</td>
<td>32</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>60280</td>
<td>32</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>60425</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>60426</td>
<td>3</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>60483</td>
<td>12</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>60480</td>
<td>12</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Portable Stepdown Transformers

<table>
<thead>
<tr>
<th>Type No.</th>
<th>VOLTS</th>
<th>SECONDARY AMPs</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT5578</td>
<td>115</td>
<td>0.35</td>
<td>For shavers, radios, tape recorders, heating, blankets, TV receivers, appliances and instruments. 2 Pin socket.</td>
</tr>
<tr>
<td>PT2164</td>
<td>32</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>PT2184</td>
<td>32</td>
<td>2.17</td>
<td></td>
</tr>
<tr>
<td>PT2168</td>
<td>185</td>
<td>4.35</td>
<td></td>
</tr>
<tr>
<td>PT2170</td>
<td>115</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>PT9565</td>
<td>240</td>
<td>1</td>
<td>For T.V. servicing, electronic workshops etc. 3 Pin socket.</td>
</tr>
<tr>
<td>PT9769</td>
<td>240</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Constant Voltage

Isolated constant RMS Voltage output.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>INPUT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV9024</td>
<td>190-260 RMS</td>
<td>240V-1A</td>
</tr>
<tr>
<td>CV9027</td>
<td>190-260 RMS</td>
<td>240V-4/17A</td>
</tr>
</tbody>
</table>

Audio

<table>
<thead>
<tr>
<th>Type No.</th>
<th>PRIMARY IMPEDANCE</th>
<th>POWER</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>45012</td>
<td>70-1000V Line 4-8.16 Ohm</td>
<td>1-4 WATTS</td>
<td>Line to speaker Impedance</td>
</tr>
<tr>
<td>45034</td>
<td>600 ohm</td>
<td>0dbm</td>
<td>PCB Mounting. Telecom approved.</td>
</tr>
<tr>
<td>45065</td>
<td>600 ohm</td>
<td>-20dbm</td>
<td>Line Isolation to Telecom 1053, 1054.</td>
</tr>
</tbody>
</table>

Control Circuit

For switchboards, PRIMARY 240V 50 Hz. Insulation to AS 3126.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>IMPEDANCE</th>
<th>POWER</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT9169</td>
<td>32.24</td>
<td>1.88</td>
<td>SEC approved</td>
</tr>
<tr>
<td>PT9170</td>
<td>32.24</td>
<td>3.12</td>
<td></td>
</tr>
<tr>
<td>PT9171</td>
<td>32.24</td>
<td>6.25</td>
<td></td>
</tr>
</tbody>
</table>

Soldering Iron

For low voltage soldering irons or similar applications. PRIMARY 240V 50 Hz.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>VOLTS</th>
<th>SECONDARY AMPs</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>60158</td>
<td>3.3</td>
<td>30 int</td>
<td>SEC approved</td>
</tr>
</tbody>
</table>

Bell and Chime Transformer

PRIMARY 240V, 50 Hz.

<table>
<thead>
<tr>
<th>Type No.</th>
<th>VOLTS</th>
<th>SECONDARY AMPs</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>60999</td>
<td>Choice of 5, 8, 12, and 16 Volts</td>
<td>1</td>
<td>Specially designed to power door bells and chimes. Double insulated and short circuit protected.</td>
</tr>
</tbody>
</table>
An enlarging exposure meter with digital readout

With this project you'll get a higher yield of decent exposures from your darkroom. It includes a sensor that compensates for 'cosine error'.

NUMEROUS photographers develop their own films and prints in anything from well-equipped darkrooms to bathrooms and laundries made light-tight with blanket-covered windows. Rapidly rising costs of 'commercial' production, coupled with the fact that the photographer has complete control over the finished product, are some of the reasons for photographers "rolling their own". Fortunately, there is a surprisingly small number of electronic gadgets necessary in the darkroom to produce good quality black and white and colour prints. Even so, darkroom oriented projects in electronic magazines are few and far between.

One electronic gadget which is a must in the darkroom is an exposure meter — a device which quickly and accurately indicates exposure time and ends up paying for itself in terms of time and photographic paper saved. The current project evolved when I decided to buy a commercial exposure meter and soon realised a digital one could be built for the same cost as a simple commercial "two-LED comparative" type. The device described here is very simple to operate since it consists of a remote probe (light detector), three-digit display (which indicates exposure time in seconds) and a "calibration" control on the front panel. One simply puts the sensor on the brightest area of the enlarger baseboard and the meter will indicate the correct exposure time. But more of this later. Let's look at the design details and construction.

**Circuit description**

The basic idea behind the unit's operation is to produce a digital output inversely proportional to the intensity of light falling on a sensor. Why inversely proportional, you might ask? Well, for a given type of photographic paper, the light intensity times the required exposure time is a constant (which takes into account the speed of the paper and the spectral "colour" of the enlarging lamp). Mathematically:

\[ I \times E = C \]  \hspace{1cm} [i]

where \( I \) = light intensity, \( E \) = exposure time and \( C \) = a constant.

Since we need the output from the meter to be \( E \), the equation can be rearranged as follows:

\[ E = C/I \]  \hspace{1cm} [ii]

Notice that the exposure is inversely proportional to light intensity — the more light you have the less exposure is necessary. How is \( C \) handled by this meter? It's the "calibration" control on the front panel!

Figure 1 shows the block diagram of the meter. Originally, I used a phototransistor as the light sensor and it worked well at high light levels. Unfortunately, at the low light levels typically encountered in darkrooms (0.001 — 10 foot candelas) the response was highly non-linear. The alternative was to use a photodiode as a light-to-current converter — the current then being
**Circuit diagram.**

**How it works**

The meter simply provides gating pulses whose period is inversely proportional to the intensity of the incident light. The pulses gate counts for a master oscillator into a four-digit counter which then displays the reading obtained.

Light falling on photodiode D1 produces a proportional current which is converted to a negative voltage by op-amp IC1/1. Resistor R1 affects the sensitivity and C1 is used to filter out any stray ac signals (HF and LF) picked up by the remote probe and connecting cable. IC1/2 is set up as a low pass filter with a gain of approximately 1.5 (= R4/(R3 + 1)) and a cutoff frequency of approximately 3 Hz (= 1/(2πRC2)). A first order filter is sufficient here since at 100 Hz the gain is approximately five octaves by -6 dB/octave = -30 dB.

IC2 and IC3 together form a voltage-to-frequency converter. IC3 is a 7555 timer set up as a Schmitt trigger with trigger levels set at 1/3 and 2/3 of the supply, i.e: 1.6 V and 3.3 V. IC2 is connected as an integrator and Q1 is used as a resetting switch. Operation is as follows — assume Q1 is initially off. A constant negative voltage applied to the input of the integrator causes the output voltage to increase linearly while charging C3.

When the output voltage exceeds the upper trigger level of the Schmitt (3.3 V), its output goes LOW which switches on Q1, discharging the integrator capacitor. The output of the integrator falls until it equals the Schmitt's lower trigger level (1.6 V). This sets the Schmitt's output HIGH again switching off Q1, allowing the cycle to repeat. The length of the cycle is inversely proportional to the magnitude of the voltage applied to the integrator.

The integrator reset pulse (from the Schmitt trigger) is used to trigger monostable IC4/2 which in turn triggers monostable IC4/1. The two respective outputs put active-high pulses on the latch enable (LE) and reset (R) inputs of the counter IC6 (refer to Figure 3 for relevant timing information) to latch the current count and reset the counter. IC6 is basically a four-digit counter with latches, decoders and multiplexer (to drive four displays) all in the one package. This has the advantage of low component count and low power dissipation.

Note that resistors R14-R20 control the brightness of the displays and can be varied to suit. The least significant digit of the counter seems not to be used but is actually used as a divide-by-ten stage to reduce jitter in the final display. IC5 is the master oscillator whose frequency is controlled by RV1. It is a typical astable oscillator based on the 7555 timer.

Power for the meter is derived from a 7.5 V plugpack. The positive supply (+5 V) is produced by a 7805 voltage regulator. Since a split supply is required for the op-amps, I used the Intersil ICL7660 CMOS voltage converter to produce -5 V directly from the +5 V supply. This IC, plus two other components (C7 and C8), produce a very simple and effective negative supply generator. Refer to ETI July 1982, page 51 for a technical description of the IC.
The trickiest part of the construction is the mounting of the molex pins which hold the 7-segment display on the copper side of the pc board.

The output voltage from the first stage is proportional to the intensity of the incident light but unless you have an enlarger which operates from a dc power supply, this voltage will have a significant 100 Hz ac component. The signal is then passed through a low pass filter to remove the ac and finally feeds the input of an integrator—a voltage-to-frequency converter. But since we need a signal which is inversely proportional to the light intensity, I have used the period of the waveform produced to gate the output of a master oscillator into the digital counter. The master oscillator essentially runs at some constant frequency which is set by the "calibration" control. The overall timing diagram shown in Figure 3.

Construction
If the project is assembled on the pc board I designed for it, then there should be little trouble with construction. A close visual inspection of the pc board should be done before assembly to see there are no cracks in tracks or bridges between tracks or pads. See that all the holes are correctly drilled. Firstly, insert and solder the three wire...
links, then the resistors (except R11-R13) and capacitors. It is recommended that IC sockets are used and these should be soldered in next followed by the 7805 voltage regulator, IC7.

The trickiest part of the construction is the mounting of the molex pins which hold the 7-segment displays. Note that these and the calibration potentiometer are mounted on the copper side of the PCB. The tracks around the 7-segment display area are very close together and so great care must be taken to avoid solder bridges between tracks or even worse, overheating the tracks causing them to lift. The following procedure should only be attempted with a fine-to-medium tipped iron.

Firstly, break the molex strip into six strips of five pins each. Using emery paper or steel wool, clean the oxide coating off the part which will be soldered. I noticed while constructing the prototype that any rubbish on these pins caused a weak solder joint to be produced and several pins came loose when I attempted to insert the displays. These loose pins are extremely hard to replace without producing solder bridges and so the extra time spent cleaning saves problems later on.

When cleaned, a strip of five pins can then be inserted until the ends just show through the reverse (component) side of the board. The pins should be soldered before continuing with the other strips (if all six are inserted first, it will be almost impossible to solder them). The connecting bridges can then be carefully removed.

The remaining resistors and the transistors can now be mounted along with RV1. As mentioned before, RV1 is mounted on the copper side of the board and since the completed PCB board "hangs off it", a drop of Araldite can be used to hold the two together with greater reliability.

Talking about reliability, a normal carbon pot can be used for RV1 but since these get dusty and end up with "dead" spots, I recommend a cermet, or conductive plastic type, such as the ones made by Bourns. If these are hard to get hold of I have made provision on the board for mounting the standard type. At this stage, the board can be powered up and the supply voltages checked. If all is OK, the ICs and displays can be inserted ensuring that they are all orientated correctly. To aid insertion, the pins on the 7-segment displays should first be straightened with long nose pliers.

Now on to the mechanics. The prototype was mounted in a 158 x 95 x 50 mm zippy box. The PCB board itself is mounted on the lid of the box by means of RV1. I used two nuts on the pot shaft — one below and the other above the lid to position the board at a suitable distance from the lid. The artwork for the Scotthal front panel is reproduced elsewhere in this article. I mounted the on/off switch (optional) and power socket (to suit a plug pack) on the left side of the unit.

Remote probe

The BPW34 photo diode can be mounted in any convenient container to act as a remote probe, e.g: a pill box lid. Note that this container should not be very high since you need to measure the light intensity as close as possible to the base board of your enlarger where the photographic paper will sit. A 50 mm high container may not make much difference to your reading when mak-

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Project 1521

ing big enlargements, but for small prints when the lens may be only 100 mm from the baseboard, there will be a significant error.

For the prototype I cut the end off an unused film container (you know — the black plastic container that 35 mm film comes in) and drilled two holes in it — a 5 mm one in the top to hold the photodiode and a 3 mm one in the side to pass the coax through (see Figure 4(a)). On top I glued a 17 mm diameter aluminium disc with a 3 mm hole drilled in it to let light through to the diode. I painted the disc white to help when positioning under the enlarger. Filling the probe with epoxy completes it's construction and results in a very durable and compact unit.

Note also that the probe is tilted at an angle of 30° to the horizontal. This is to provide some “cosine error” correction. Cosine error is most easily observed when the enlarger is switched on without any film in the carrier. If a light reading is taken directly beneath the lens and another near the edge of the baseboard, there will be a significant difference between the two. In actual fact, the two readings should be identical since the idea of an enlarger is to provide even illumination over the entire area of a negative. The error exists since the light reaching the sensor when at the edge of the baseboard hits it at an angle, whereas directly below the lens the light rays are perpendicular to it. Any sensor experiences a drop in sensitivity as the angle of the incident radiation increases (with respect to the vertical). One easy way of correcting for this is to angle the sensor permanently. Then, when readings are taken beneath the lens, the angled sensor has slightly reduced sensitivity and will give a reading equal to that taken near the edges where the light falls directly onto it (see Figure 4(b)). For consistency, I placed an arrow on the probe and orientate it to point towards the centre of the baseboard when taking all readings.

Operation

The unit itself is very easy to use and needs only one control, the "calibration" control, to be set for each type of paper you use, e.g: Ilfospeed, Bromide, Ektaprint 2 etc. The idea is initially to prepare a test strip of your “standard” negative or slide to determine the correct exposure.

Let’s assume for Ilfospeed grade 3 paper you find that 12 seconds is the correct exposure for your negative. Without changing the lens f-stop or enlarger height, position the probe on the brightest area of the baseboard and adjust the calibration control until the meter reads 12. The exposure meter is now calibrated for this type of paper and the reading from the dial should be written on the outside of it’s packet. The next time you produce prints on this paper you simply set the meter to the setting previously determined, position the probe on the brightest area of the projected image and adjust the lens aperture until the meter gives a reasonable reading, say between five and 60 seconds. Then expose for the indicated time.

Note that a test strip is only necessary when initially setting up the unit and not each time it is used. Also, since the meter is used to measure the intensity of the brightest area of the negative, this corresponds to allowing sufficient light through the lightest area of the negative to just produce black on the paper in this area. The other shades of darkening will then fall in line to produce a correctly exposed print.

Happy exposing!!

Front panel artwork.
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

**Peak level indicator**

David Hamill of The Gap, Queensland designed this peak level indicator which is useful for recording when it is more important to know what the peak level of a signal is, rather than its average level.

VU meters are normally used for this purpose, however, you will find that the LED output of this circuit is easier to interpret and makes the recording more accurate as the distortion will be reduced.

IC1a gauges the positive peaks while IC1b does the same for the negative peaks. Both positive and negative are set by RV1. You can select any threshold from ±1 V. Whenever the input exceeds the positive of the negative level LED1 lights for about 0.1 second.

**Two circuits for the 74LS241**

Brian O’Connor of Box Hill Victoria, has come up with two circuits for use with microprocessor parts. Both of them use the 74LS241 and in each case pin 1 is tied to ground and pin 19 to Vcc.

The first circuit is for a dc motor driver suitable for use with 400 mA/6 V motors like Fisher Technic. Little or no heatsink is required as all transistors are either saturated or off.

The second circuit is for a very simple 8-bit digital to analogue converter which can be built from scrap box components. It will give a linear output of 8 V p-p and the ramp produced by an 8-bit increment is quite smooth.
Microbee write-protected memory ★ ★ ★

Paul Leonardi, Canley Vale NSW

After having inadvertently written over my source code of a BASIC program with an untried program, I decided to put a copy of the program in a switch-selectable write-protected area of RAM, and then run the program.

So then if things went haywire and the source code was written over, the copy in the write-protected memory could be copied back, corrected and tried again.

To protect a 6116 the WXR line must be disconnected (pin 21) and the PWRX line connected to it. Be careful when disconnecting one line that you don’t disconnect other 6116s as the WXR line is often linked from one to the next.

In the Microbee the first and last 2K blocks (6116s) should not be protected; the first is used for a BASIC-EDASM scratch pad and the last for BASIC strings and variable storage (16K and 32K versions of the Microbee).

I suggest protecting the fifth, sixth and seventh RAM chips on the 16K version, and the ninth to the fifteenth on the 32K version. (2000-37FF for 16K, 4000-77FF for 32K).

Care must be exercised with a cold start if the protected memory is selected, as the top of memory pointer will be lower than expected.

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 idea submitted for publication in the ‘Ideas for Experimenters’ column — one of the most consistently popular features in ETI Magazine. Each month, we will be giving away a Scope Panavise Multi-Purpose Work Centre, Model 376/300/312, comprising a self-centering head (376), standard base (300) and tray base mount (312), all worth about $91.

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 issue of ETI Magazine.

Scope laboratories, 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 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 line of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.
Rod Irving Electronics and Magraths in Melbourne. You might also try All Electronic Components.

If you’re making your own pc board and want positive or negative film, you can obtain what you want for just $1.60 post paid from ETI-678 Artwork, ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Make sure you ask for positive or negative film, according to what your photoresist requires.

PCB outlets
Alf Capas of Better PC Boards in Bass Hill, Sydney (02)645-1241, has advised us that you can now purchase ETI project pc boards, made by him, through Sheridan Electronics in Redfern and Geoff Wood Electronics in Rozelle.

Printed circuit boards
Almost every pc board (and most front panels) ever published by ETI may be obtained from:

All Electronic Components
118 Lonsdale St
Melbourne Vic 3000

For pc boards produced in recent years, the following suppliers either keep stocks on hand or can supply to order:

Jenal Products
P.O. Box 168
Victoria Park WA 6100

Jaetronics
58 Appian Drive
St Albans Vic 3021

Better PC Boards
112 Robertson Rd
Bass Hill NSW 2197
(02)645-1241

RCS Radio
651 Forest Rd
Bexley NSW 2207

Mini Tech
P.O. Box 9194
Auckland N.Z.

The following retailers generally keep stocks on-hand of pc boards from recent years’ ETIs:

Rod Irving Electronics
425 High St
Northcote Vic 3070

Bilico Electronics
Shop 2, 31 Pultney St
Dandenong Vic 2175

Jaycar
117 York St
Sydney NSW 2000

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ETI-1521 digital exposure meter
It’s a long time since we did a photographic-type project, so this should please and surprise all the photo-hobbyists who read ETI. If you have any photo-hobbyist friends, show them this project — they might be interested.

Components for this project are all commonly available items, with the exception of the cermet calibration pot — but a little digging will get you one. Jaycar had some (“manufacturer’s surplus”) recently. The 74C926 counter is readily available from many suppliers. The Intersil ICM7225 can also be used. The Intersil ICL7660 supply rail inverter is imported by R&D Electronics and All Electronic Components of 118 Lonsdale St, Melbourne act as their retail distributor.

Kits will likely be supplied by Rod Irving Electronics in Melbourne and maybe All Electronic Components. You could also enquire from Altronics in Perth.

Film of the printed circuit and front panel artwork is obtainable from ETI-1521 Artwork, ETI Magazine, P.O. Box 227, Waterloo NSW 2017. Positive or negative film costs $3.50 each for the pc board or front panel art, post paid ($7.00 the pair).

ETI-678 Microbee ROM reader
This project will be carried in kit form by those firms giving hardware support to the Microbee. Try Altronics in Perth, Jaycar and Avtek in Sydney,
**GREAT NEW PRODUCTS**

**60-KEY COMPUTER KEYBOARD**
- AS USED IN THE FAMOUS MICROBEE!
- SPST CONTACTS
- FRAME MOUNTED - QUALITY UNIT
Cat. KE-3622

**ONLY $29.95**

**MINI BREADBOARD**
Just the right thing for many small projects. This board has the same features as our larger breadboards but measures a compact 80 x 60mm. It has 420 holes, perfect for the occasional project.
Cat. PR-1609

**ONLY $6.95**

**MICROBEE KITS**

<table>
<thead>
<tr>
<th>ETI 733 RTTY CONVERTOR, Ref ETI April 1983</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat. KE-4604</td>
<td>$17.95</td>
<td>Emitter PIN 9</td>
</tr>
<tr>
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</tbody>
</table>

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Ref: EA January 1984

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MELBOURNE READER WINS SCANNER CONTEST

David Paxton of North Ringwood, an outer Melbourne suburb, won the SX-200 Scanner Contest featured in the October issue last year. He correctly answered the five questions and wrote what was judged to be the best 'essay' on what features of the SX-200 attracted him.

RF & COMMUNICATIONS SOFTWARE DESIGN

Technical Imports has released three 'design kit' software packages for the analysis and optimization of RF performance, PLL characteristics and communication-circuit design.

Each design kit comprises several computer programs for electrical engineering applications, available and tested on both the Tektronix 4050 Series of graphics desktop computers and the HP 9800, 200 and 9000 Series.

Each package contains program functions for universal mathematical function plot and frequency selection for minimum IMD products in mixers. The RF design kit contains a program for optimization of noise figure or intercept point of cascaded amplifiers, mixers and filters. The PLL design kit has a program for optimization of type-2, 2nd, 3rd and 5th-order loops and one for general analysis of PLL circuits.

The communications design kit includes program functions for complex impedance of electrically short antennas, digital filter design and antenna spray patterns with driven elements.

The kits are intended to give the designer a better understanding of circuit functions and produces computed results of circuit analysis and optimization in the form of tables and graphical plots.

Prices start from around $2000 per kit, with individual programs available for less than $1000.

For further information, contact Technical Imports Australia, P.O. Box 176, Crows Nest NSW 2065. (02)922-6833.

NOISE FIGURE MEASUREMENTS

Hewlett-Packard's new application note AN/57-1 Principles of RF & Microwave Noise Figure Measurement is now available for all those working on device, component, sub-system and system noise figure. It replaces the long-popular AN/57, Noise Figure Primer.

The 40-page note serves as a comprehensive tutorial on noise figure for the neophyte engineer with detailed material on thermal and shot noise, concepts of noise figure, effective noise temperature, Y-factor, etc.

The experienced engineer also will find plenty of useful information on subtle measurement considerations including single-sideband vs double-sideband, effects of local oscillator noise, second-stage effects and corrections, hot/cold techniques, frequency conversion and image considerations.

An extensive glossary includes common symbols and detailed technical explanations of most terms. Also included is a bibliography of 34 other noise-figure related references. AN/57-1 (Pub. No. 5952-8255) is available at Hewlett-Packard sales offices free of charge.

ETI March 1984 — 107
Communications

ECONOMICAL UNIVERSAL COUNTER

Hewlett-Packard's new HP 5334A universal counter, priced less than $4000, offers new performance and measure-
ment capabilities for a counter in this price class, says the company. A major feature is that it allows users to measure frequency, period, rise time, fall time, pulse width and peak-to-
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Evelyn Bahr, has been honoured with Life Mem-
bership of the Townsville Ama-
teur Radio Club in recognition of "her outstanding services to amateur radio".

Evelyn Bahr (VK4EQ) obtained her Amateur Operator's licence in the mid-1950s and then went on to become the first-ever female member of the Townsville Amateur Radio Club. She has remained an active participant in Club activities ever since.

One of her first official positions was as Club Treasurer during 1974. She became co-editor of the Club magazine 'Backscatter' in March 1975, but soon took over full editorial responsibilities and continued in the position until the present day. She has been net co-ordinator for the Club station VK4WIT for the Sunday evening news broadcasts throughout North Queensland for a number of years and also participates in the activities of the Wireless Institute Civil Emergency Network.

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Transequatorial VHF propagation and equatorial plasma bubbles

Massive depleted zones in the equatorial ionosphere, stretching in field-aligned interhemispherical arcs, have been observed experimentally in recent years. Theoretical explanations of the gross features have been put forward. This paper argues the case for collecting a further round of experimental data and outlines a low-cost way of using VHF trans-equatorial propagation, available to radio amateurs, to study behaviour patterns of individual equatorial plasma bubbles.

1976 WAS A YEAR of good vintage for equatorial aeronomy. It brought with it the first reports of so-called equatorial plasma bubbles, and with them the basis of the new way of thinking about irregularities in the equatorial ionosphere. The classic account was given by Ron Woodman and Cesar La Hoz (1), where they present records showing rising plume-like structures in the equatorial ionosphere recorded on the 50 MHz radar at Jicamarca in Peru. The radar, operating in the conventional mode of power return from a range-gate, receives echoes from ionospheric irregularities having a scale size of three metres. A sketch of one of their records is shown in Figure 1 where the vertical axis has been converted from pulse time-delay into height. The horizontal axis is more complicated. It is like the photo-finish record at the Cludon racetrace (Qld), where the film moves past a slit at the expected speed of galloping horses. Here the moving record assumes that the ionospheric plasma is galloping eastwards at 125 metres/second, which is about average for the early evening. On this basis we have a conversion from a distance of 450 km gives a time lapse of one hour. The plume structures are therefore drifting eastwards at more or less 125 m/s and they rise to higher altitudes as time progresses.

The next significant revelation was the data of McClure, Hanson and Hoffman, working at the University of Texas at Dallas, who published some results in 1977 taken from ion density probes on board the equatorial orbiting satellite AE-C (2). This satellite flew in a near equatorial orbit and showed a wide range of holes, or bubbles, in the ionospheric plasma typically 100 km in width and having plasma density reduced by 10 to 1000 times the background level. The fact that many of these holes rise up engendered the use of the word ‘bubbles’ and indeed the theory has been developed often with the aid of the analogy with air bubbles in water.

Specifically, we need to have observations of the growth and decay of individual bubbles to be able to test the theoretical time histories, and also we need more observations of the ionospheric conditions which allow bubbles to form on some nights but not on others.

One approach which allows a path for interaction between theory and experiment was the numerical modelling by the author and Leo McNamara of the Ionospheric Prediction Service in Sydney (8). The idea was to treat individual bubbles as ducts for radio wave-guiding so that if a transmitter (at VHF) had a line-of-sight access to the end of a bubble then energy may be directed into a certain prescribed geographical region in the other hemisphere. A “best model” for the bubble cross-section, height above the equator, plasma densities and velocities both upwards and downwards was synthesized from the most reliable theories and experiments and a numerical study of the possible transequatorial propagation paths was done on the NOAA CDC-6600 computer in Boulder, Colorado in 1978.

The resulting parameters of frequency dependence, latitude dependence and Doppler shifts agreed well with the published record of transequatorial propagation and gave some confidence to the assertion that VHF transequatorial propagation in the evening is via these bubble waveguides. While relative powers on the TEP link agreed with observations, the absolute power levels predicted by this numerical model were far too high. Clive Winkler of DSE at Salisbury is following this up by applying some concepts of wave-guiding in optical fibres (9).

Where from here?
We have enough accumulated wisdom to be able to take another step. Let’s reiterate:

(i) the plasma bubble phenomenon was discovered experimentally;
(ii) theoretical studies have explained the...
general formation of bubbles but do not agree too well about the growth and movement;
(iii) numerical models relate VHF trans-equatorial propagation to bubbles.

The next step is to use VHF trans-equatorial observations to shed light on the detailed growth and movement of individual bubbles. This will allow the theoreticians to go through another cycle of refinement. Ultimately one would hope that the phenomenon and its ramifications in communications will be understood to the point where it is predictable — at which point we can use it (TEP contacts), abuse it (inter-tropical interference), or avoid it (VHF scintillation on satellite communications) as we see fit.

The role of the amateur
Amateur radio operators on the two metre band have already made a contribution to the development of ideas which form the current knowledge of equatorial plasma bubbles. The trans-equatorial QSO reports, for example, support the banana shape and also indicate the integrity of the bubbles right across the inter-hemispheric connection, as opposed to the idea of unconnected "spread-F" or "scintillation" irregularities. QSO logs have enabled some degree of evaluation of the size of the conjugate region typically available for potential two metre contacts.

On a limited study (we would like more QSO logs) it seems that a receiver within 1000 km of the magnetic conjugate point of a transmitter on two metres has some chance of a contact. The conjugate point needs to be accurately calculated from magnetic field tables rather than from any dipole model.

Jurgen Rottger of the Max-Planck Institut fur Aeronomie in West Germany has produced some graphs of S-meter readings plotted against time every minute by SV1AB in Zimbabwe-Rhodesia and ZE2J in Greece during contacts.

The two metre trans-equatorial openings lasted typically 40 minutes to one hour which agrees reasonably well with the concept of moving ducts. An important implication is that some properties of individual bubble waveguides can usually be observed without interference from nearby bubble structures. Occasionally, a double-peaked power curve suggested closely spaced ducts.

Such power level graphs and even QSO reports alone are useful for basic statistics but the potential for involvement of radio amateurs on two metres now extends further. There is the possibility of using direction-finding techniques to locate the point on the base of the ionosphere where the inter-hemispheric duct terminates. If the bubbles do indeed move eastwards and do rise upwards at the equator whilst remaining field-aligned, then the duct termination should move eastwards and appear higher and higher above the horizon. Observations of azimuth and elevation angle of arrival at one minute intervals are required to check

Figure 1. 20 dB contours of the backscatter power from small scale F region structure on the 50 MHz Jicamarca radar. The broken lines are interpolated sections. After Woodman and La Hoz (1976).

Figure 2. The wave-guide structure of the field-aligned inter-hemispheric equatorial plasma bubbles.
Transequatorial VHF propagation

Figure 3. The type of azimuth, elevation, power and Doppler shift variations which might be observed from a conjugate VHF transmitter. Here we have assumed a bubble growth; in practice we would go from the observed parameters to specifying the bubble development. The time is taken from a zero value when the bubble is at the longitude of the receiver. The frequency for these calculations was 100 MHz and the bubble was assumed to be rising at the equator with an exponentially increasing velocity.

the theory of these movements. The expected variations of angle of arrival are indicated in Figure 3.

A further observation, which is a little more sophisticated, is that of the frequency shift due to the varying path length between a transmitter and conjugate receiver communicating along one of these ducts. At the beginning of a contact the Doppler shift should be small, perhaps a few Hertz positive, and then over 30-40 minutes the Doppler shift should normally go negative to several tens of Hertz, if the theoretical dynamics are anywhere near correct.

The four observations of elevation, azimuth, frequency shift and power, if made accurately, can be interpreted via the numerical models to go a long way towards giving the behaviour patterns of the equatorial plasma bubbles. Unfortunately, many Australians are too far south, magnetically speaking, to be in the action, but the Northern half of the country, and particularly West of the Gulf of Carpentaria, is well placed for Asian conjugate stations. Darwin and Yamagawa are very nearly conjugate.

Epilogue

It is interesting to speculate on two points. One is that this phenomenon was due for a rapid development because of technological moves. If the two metre activity explosion had occurred before the last sunspot maximum then the discovery of the propagation mode may well have been made by radio amateurs. The second point is a challenge. The Jicamarca record shown in Figure 1 clearly shows the bubble phenomenon. It was made in 1974, very near sunspot minimum. Are we kidding ourselves that the two metre path through equatorial plasma bubbles is restricted to high sunspot epochs?

REFERENCES

4. Heron, M. L. and E. B. Dorling (1979) Equatorial ionospheric plasma density bubbles observed by ESRO-4, preprint Mullard Space Science Laboratory, University College London.


This article is reprinted from Proceedings of the 1979 Symposium on Future Amateur Communications Techniques. Despite its age, it remains relevant, especially in view of the huge number of two metre contacts across the equator recorded in the intervening years. Anyone interested in submitting logs for study should contact the Editor of ETI at P.O. Box 227, Waterloo NSW 2017. (02)663-9999.
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WANTED: OSI CP1 disk drive with OS65D and D.T. disk interface board. Also OS65D manual and software. J. Barnes, 8/3A Montagu St, Hobart Tas. 7008. (02)31-0414.

MICROBEE USERS: FREE newsletter with program hints, handy hints etc. available for the asking. To register for your inclusion in our mailing program write to Tom Bonites, P.O. Box 79, Gosnells WA 6110.

WANTED: APPLE BOOKS, especially 'Beneath Apple DOS'; Apple magazines (In-Cider, Softalk, Orchid, etc.), Apple software (games, utilities, etc). Rom (02) 217-2434 ah.

FOR SALE: Z80 DEVELOPMENT system Tec-1, by Talking Electronics $90 ono. complete with manuals and power supply. Mark (02)672-3407.

FOR SALE: S100 boards 16K static RAM $115, 64K dynamic RAM $295, I/O board 25 & 9P $240, disk controller & CP/M $399. (07)203-1949 after 6pm.

FOR SALE: SEKONIC printer plotter S200-GP. As new condition with one roll of paper. Centronics Interface. $550 only. W. Flala, 21 Halloys St, Glen Waverly Vic. 3150. (03)232-0713 ah. (03)758-9000 bh.


COMMUNICATIONS

FOR SALE: PHILIPS FM 320 UHF transceiver and 10 ft co-linear. $280 ono. (062)66-2475.

FOR SALE: DICK SMITH 40 channel UHF transceiver. Built and tested. S meter and repeater options. Selling due to unfortunate geographical location. $225 VK5BCD (085)22-5241.

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GATHERED RECENTLY, in that other Apple Isle across the Big Pond, were a score of technical journalists from around the world — including ETI's correspondent Collyn Rivers. All were there for the pre-release of an exciting new computer.

All went well until Murphy intervened — during a demonstration of the ease with which the machine could access data-bases. Three successive attempts failed — a happening which should neither surprise nor dismay anyone who's ever experienced the sheer inanimate malevolence of computers in mid-sulk.

In retrospect, the hapless demonstrator should have retired wounded (or acquired some more haps), but he pressed on with the demo — which from then on went well.

Until question time.

Then a British journo (arrogant, even for a Pom) asked how come the machine was the ultimate in user-friendliness when even experts couldn't make it work. The demonstrator rose to the bait and asked what on earth the questioner meant.

"Stuffed it three times in a row, didn't you," said our charmer.

"Now we know," observed Collyn upon his return, "what St John really meant in Corinthians 15:33." (For those unaquainted with apostolic aphorisms John 15:33 reads, 'evil communications corrupt good manners'.)
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Examine the unit carefully. You'll find winning features like horizontal slide loading system; soft-push microcomputer controls; 16-selection programmable auto-search system; and synchronous recording to name a few.

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