practical circuit techniques

END SECTION OF DELAY LINE

OUTPUT

BALANCE POT

LOWPASS FILTER

OUTPUT B

1k

FINAL OUTPUT

SW1

MAIN SECTION OF DELAY LINE

OUTPUT = TIME-DELAYED VERSION OF INPUT

CHARGE TRANSFER OR CLOCKED SHIFTING CIRCUITRY

CLK 01

CLK 02

ANALOGUE INPUT

LOWPASS 'ANTI-ALIASING' FILTER

CCD 'BUCKET BRIGADE' DELAY LINE

TWO-PHASE CLOCK GENERATOR

DELAY TIME

INPUT

OUTPUT

HI-FI SCOOP!

Page 92

Sony digital audio disc player - first review

MICRO BEE EPROM PROGRAMMER

simple, low cost Page 45

ELECTRIC FENCE TESTER - beats 'grass roots' methods! Page 33

Six more super programs for the '660 computer Page 82
IF YOU’RE SWITCHED ON, THIS IS PARADISE.

Australia's Hornet. The cockpit contains the latest in the world. Enough electronics to keep any switched on enthusiast happy for years. The Hornet will form the backbone of Australia's Air Force. You can form the backbone of the people who will keep it in the air. Simply phone your Air Force Careers Adviser on Sydney 212 1011, Newcastle 25476, Wollongong 286 492, Parramatta 635 1511, Canberra 82 2333, Melbourne 61 3731, Geelong 21 1588, Brisbane 226 2826, Townsville 72 4566, Adelaide 212 1455, Perth 325 6222, Hobart 34 7077, Launceston 31 1005.

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features

18 Analogue Delay Lines  Electronic audio delay line techniques
51 Rod Irving Zip-Out Mini-Catalogue  Another 'little ripper' from Rod

projects and technical

29 1511: Immersible Temperature Controller  Uses zero-crossing switch
33 1512: Electric Fence Tester  Tells more than a blade of grass!
45 668: MicroBee EPROM Programmer  Simple to build, low cost
18 Circuit File: Analogue Delay Lines  Techniques, practical circuits
59 Ideas for Experimenters  Cheap HV dc-dc inverter, spotlight dimmer etc.
64 Shoparound  Where to buy kits and components for projects

computing today

69 Mattel to Market 4K Home Computer  Micro-Professor II released
77 The MicroBee Column  Lissajous pattern generator, letter from Owen Hill
84 '660 Program Potpourri  Six more super programs for the '660 computer

sight & sound

87 The Vikings are Coming  Sansui's 'smart' compu-receivers
92 Scoop Review: Sony Digital Audio Disc Player  All sound, no noise

news

8 News Digest
11 Equipment News
14 Component News
66 Communication News
71 Printout
88 Sight & Sound News

contests and special offers

15 Special Offer — LCD Multimeter
  8 function, 23 range Univolt DMM
60 Idea of the Month Contest
  $90 Scope 'Work Centre' to win.

general

37-44 Mail Order Books from ETI
80 Mini-Mart
98 Dregs

This month's cover features diagrams from the Circuit File article on Audio Delay Lines, page 18. The inset picture is from our review of the first digital audio disc player to arrive here, page 92.

Cover design: by Ali White

Registered by Australia Post — Publication No. NBP0407
ISSN No. 0013-5216

ETI February 1983 — 3
We increased the range to 100MHz, the channels to 4 and the trace to 8, but you’d never know it from the price.

A Scope that does more and tells more

Here, for the bottom liner, is a scope that really performs! You get your 100MHz with an alternate sweep function in a compact package. You get a 4-channel, 8-trace format so that a large number of signals can be simultaneously observed with ease. And you not only watch 4 different kinds of waveforms at the same time but you also get measurements of phase differences in signals and their timing.

Features galore in a unit you can trust

And that’s not all. Listen to these outstanding features: an Auto-Fix circuit for easy triggering, a National exclusive; bright, clear waveforms on an advanced domed-mesh CRT, a National speciality; 2mV/DIV sensitivity; 2 nSec/DIV maximum sweep rate; ±2% time axis accuracy; a TV sync separation circuit for video signals; variable hold-off function for trigger stabilization; alternate triggering, drift compensation; and more.

Ideal for lab, line or field service

You also get that world renowned National reliability in every National oscilloscope. We have, for example, reduced parts by one-quarter, which means, of course, less wiring and less failures. We have installed glass epoxy circuit boards which have far greater resistance to shock and heat. There is also a 15,000-hour MTBF (Mean Time Between Failures) rate, certainly one of the finest in the industry.

So the next time you’re looking for a reliable scope that’s been fully upgraded in range, channels and trace—everything, in fact, except price—remember the VP-5512A Pana Scope. From National.

PRICE: $2,200-
( & Sales Tax if applicable)
We are entering a new era in sound reproduction technology. The digital audio disc is a commercial reality. Discs and players will be on sale here in six weeks or so (maybe less). It has been a decade in coming and a lot was 'promised' along the way. But, having heard it, I can say the performance certainly lives up to the promises. Where musical performances have been digitally recorded and transferred to digital disc, the lack of background noise is immediately apparent and the dynamic range positively breathtaking. The clarity and imaging has to be heard to be believed.

I can remember, as a boy, my first hearing stereo sound. Two Sydney AM broadcast stations cooperated in Australia's first public stereo broadcast. The family set up two 'wirelesses' to hear it. The stations played all the gimmicks of the time (a ping-pong game, trains rushing at each other fast changing as musical selections). I was spellbound. Some short time later I heard my first stereo microgroove recording on what was then regarded as hi-fi equipment and was even more amazed.

Upon hearing my first digital disc demonstration (courtesy of Technics in Japan last June) I hardly believed what I heard. Then, upon hearing the Sony and Philips systems demonstrated late last year I once again experienced that boyhood amazement.

It will be another decade before there's a DAD player in every home, just as it took a decade or more for the 33⅓ rpm microgroove disc to oust 78s.

The microgroove disc (and stereo) had an impact on every piece of equipment in the sound reproduction chain. I guess we can expect the digital audio disc to do the same for this generation of audio equipment. For audio technology, the next decade should prove interesting indeed.

Roger Harrison
Editor

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**CIRCUIT FILE: SCS, TRIACS & POWER CONTROL**

This article is the first of a two-part Circuit File explaining the basic principles and applications of SCS and Triacs. If these devices are unfamiliar to you, don't miss it!

**NICAD 'FLOAT' CHARGER**

There is more to charging NICad batteries than meets the eye. There are controlled current chargers, trickle chargers and constant chargers. Controlled current and trickle chargers will never damage a NICad but won't bring it to full charge within a reasonable time either. Fast chargers (like the ETI-563) are bulky and cost more money. This NICad Float Charger provides a happy medium. It's cheap, simple to build and will bring a battery to full charge from complete discharge in 12 hours. Keep it there. And your NICads are safe from overcharging damage.

**GENERAL PURPOSE INTERFACE FOR THE APPLE II**

Designed to plug into one of the Apple's slots, this board has one analogue input, one analogue output, eight digital inputs and eight digital outputs. You can use it to connect your Apple to computer peripherals, electronic instruments and science experiments. Applications include: controlling a Tasman Turtle Robot, automatic control of a slot car, driving a printer, reading a DVM or recording a potentiometer connected to a physics experiment. Plug in your Apple to the real world!

**COLOUR CLOCKS FOR TANDBY'S 'COCO'**

Sorry, but we've had to hold this one over from this issue. Making good use of the Tandy Color Computer graphics and powerful extended BASIC commands, two-clock programs are presented. Your grandfather never saw clocks like these!

**CHIP 8 CHARACTER GEN. & VIDEO TYPEWRITER**

Another gem from Frank Rees for CHIP 8 fans, this article explains how to build a 660 or whatever. With a small 'character generator' routine combined with a short 'video typewriter' program, you can write messages on screen by typing in an appropriate set of tokens. Combine this with your own programs and you've got a powerful message generator.

**SHURE V15 TYPE V CARTRIDGE REVIEW**

Facing imminent threat from the digital audio disc, Shure have risen to the task of developing their V15 series cartridge to the utmost of its capabilities and produced a fine product with superior performance. There's lots of life in the microgroove yet!

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.

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**services**

Technical enquiries: We can only answer readers' technical enquiries by telephone after 4.30 pm Mondays to Thursdays. The technical enquiry number is: (02)268-9015.

General enquiries: For enquiries about back issues, photostats or also submitting articles, call (02)268-9015 or write to the address on this page.

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OVER 500 CERAMICS — 5 BUCKS!!
Not your usual rubbish either! Quantity made in the USA, military grade units made by Comair. These devices are basically military style CE-12 devices (DY-103010). They are available in various sizes, and are very stable, long life units that sold in quantities to military. We have up to 60 cents each. This offer represents outstanding value for money. Hey! Ceramics less than 1 cent each! $5

OVER 100 TANTALUMS — 5 BUCKS!!!
Once again, no silly devices. Tiny long life and very high quality made in the USA by Comair. We do not have many (less than forty) Limit of 2 packs per customer. Once again, less than 1 cent each! $5

LIQUID CRYSTAL DISPLAY

LCD’s from less than a dollar each!!! We have over 50 different types of LCD Displays. They range from 10mm high 6 digit displays to 75mm high single alphanumeric in both transmission and reflective styles.

In our January ads we said that we would have a list with each type and a description. Frankly, we did not have the time and space to do this. We are going to offer you an even better deal instead, 200 deals in fact.

DEAL 1 — You send us $3.95 (plus p&p) and we send you THREE LCD Displays. That’s right, made in the USA high quality displays for around $1.30 each. You will get 3 different displays. They could be alphanumeric (up to 3”), dot matrix, or multi-segment numeric or — whatever! The data manual with pin connections for most types will cost you another 50 cents.

DEAL 2 — You send us $2.95 (plus p&p) and we send you TEN (10) LCD Displays. Some will be the same but most will be different. We want to give you as a benefit. You get the connection manual with it.

HIGH QUALITY BARGAIN

MULTIMETER

Incredible value for a high quality Analogue unit. We have secured a small quantity of 4116 of the “STANDARD” ST-100 HNU Multimeter. This very same unit sells ‘trade’ for $72 + tax under a different name. Even if you could get it for $72 including tax you would be doing well. Our Price? Check the specs first.

ONLY ~ $59.95

THE ULTIMATE

6.5mm SOCKET??

4116 RAMs 150nS — GOING CHEAP
We have received a quantity of 4116 (100s) RAM, at a price which means great savings to you — $1 each and don’t forget they can easily be used as memory for your PC. We have other types of memory too, we have 1516 units, and we have 1016 units, and this is the “Logic Number” for them 4116. If you have ever had to buy a new standard replacement part you will know that the “Logic Number” part is a very expensive. We don’t want to sell them at 1516 U.S. we want to sell them at 4116’s — and at a great price. The normal 416 is lower than your price for our 4116. You will get 4116 in a $5.10 deal with a 5016 $5.00 and we will save you $1.95.

For large quantities are below:

1-99 pcs $1.95
10-24 pcs $1.85
25-99 pcs $1.75
100+ $1.65

6.5mm SOCKET??

We cannot win. At one stage we had thousands of these. We slowly sold them off to manufacturers who somehow or other needed a bright panel mount pilot lamp. You know the lamp we mean. It takes a torch globe & has a glass multi-facet lens that looks like a cheap piece of costume jewellery.

It was the sum of 50p. We recently bought a large consignment of manufacturers stock. You guessed it, we got em back! But at least they didn’t cost much. Any redeeming features? Yes, they are a lot made & you can change the globe from the front panel. $2 will get you 10 (mixed colours). No other deals.

UGLY MES LAMP BEZELS

We were dreamed of such a nice piece of costume jewellery. We have several dozen of these. They are normal multi-facet lenses that look like a cheap piece of costume jewellery.

These are normally $1.50. Opening we have them available at a half price for $2, open. We will sell them for $2.00.

TUBING

HEATSHRINK TUBING PACK
Amazing value. A huge bag of lengths of Heatshrink sleeving. At least 6 different colours in sleeving ranging from 3mm Ø to 32mm Ø. You will probably never need to buy heatshrink again. ONLY $3.50

SALE

JUMBO SPAGHETTI PACK
Genuine P.V.C. Spaghetti tubing. Always handy. From 7mm I.D. through to 13mm. Over 20m in all!!! Many colours. ONLY $3.50

THE BEST

9 - 50 VOLT D.C. 50 MILLIAMP
This Combined Ammeter/Multimeter is fantastic value at $22, and has many outstanding features. It includes a DC voltage range of 50 volts, an AC voltage range of 500 volts, a DC current range of 50 milliamps, and an AC current range of 50 milliamps. The meter also has a 20 kilo-ohm resistance range and a 200 kilo-ohm resistance range. The meter is housed in a rugged metal case and is powered by four AA batteries.

The meter is easy to use, with large, easy-to-read displays and clearly marked ranges. The meter is also very accurate, with a maximum error of 2%. The meter is made in the USA and is backed by a one-year warranty. The meter is ideal for use in the home or in the workshop, and is perfect for repairs or for general testing.

We have 250 of these meters, and this is a special offer only for a limited time. Don’t miss out on this fantastic offer, and buy your own 9 - 50 Volt D.C. 50 Milliamp Combined Ammeter/Multimeter today! Only $22!

LIMITED QUANTITY

We have a limited quantity of these meters available, so don’t delay. Order yours today and get the best value for money. We are confident that you will be satisfied with your purchase, and if you are not, we offer a full money-back guarantee. Don’t miss out on this fantastic offer and buy your own 9 - 50 Volt D.C. 50 Milliamp Combined Ammeter/Multimeter today! Only $22!
**28pin IC skt.**

We're stocked to the rafters with 28 pin IC sockets. What to do? Slash the price to clear them of course!

They are quality sockets made by Robinson Nugent of the USA. Each socket features tapered guides for unaligned pins and is a low profile design. The pins are tin plated. Normally we sell 28 pin sockets for 60 cents each, however for FEBRUARY ONLY you pay only 30 cents each! (Minimum 10 sockets) but there's no limit. So Hurry!!

**30¢ each min 10**

---

**NEW**

**STOP**

**Press**

Disco strobes, 240V Mains powered. Not a kit. Built in a woodgrain (walnut) cabinet measuring 150 x 150 x 120mm. High efficiency wide angle reflector. 0 - 12 flashes per second fully variable. But that is no big deal. The big deal is the price.

NORMALLY $36.50

BUT because we get desperate in February ONLY $12.50 each!!!

ALMOST 2/3 OFF!!!

(Goods are brand new but reworked Q.C. controlled stock).

---

**HANIMEX**

PRINTING CALCULATOR

- Quality Hanimex Brand
- Model UC 1500P
- 12 Digits, (12 Digit Print)
- Plus D.P., Comma & Two Symbols
- Selective
- Uses Standard Plain Paper
- Rolls (foot expensive and hard to get Aluminium coated paper)
- Floating or Fixed Decimal Point
- Selectable % Mode & Slash
- Most of the usual features found in machines costing well over $100!!
- A Real Accountant's Special
- Weights over 3Kg!!
- Roll of Paper Supplied - available virtually everywhere.

WE ONLY HAVE A SMALL QUANTITY OF THESE UNITS. STRICTLY ONE PER CUSTOMER

**$59.50**

---

**STAGGERING VALUE**

**$22**

EACH

NORMALLY $26

Motorola twin element, controlled dispersion High Performance Line Source Tweeter.

Model KS11071A

- Designed for flush mounting. No large holes to bore. * Less than 19mm deep will fit behind most grille panels.
- Great in hot cars (Guaranteed unaffected at 99 degrees Centigrade!)* Sensitivity 98dB @ 2.8 volts/4 metre * No need for a crossover network * Response 4 - 40kHz (+3 3dB) * Attractive built-in grille.

---

**Jaycar**

NUMBER 1 FOR KITS

125 YORK STREET, SYDNEY 2000

PHONE: 746 4088 TELEX: 72293

265-267 RIDGEWAY ROAD, PENRITH, NSW

PHONE: 878 1127 ULTRA-TELEGRAPH: JAYCAR

SEALED BOXES $1.00, $1.25, $1.50

PACKAGING CHARGES 80c, 90c, $1.25, $3.00

MAIL ORDER TO: BOX K30, HAYMARKET, SYDNEY 2000

---

**POT PACKS**

Guess what? We've made more of these very popular packs.

In EA and ETI August last year we advertised packs of high quality European manufactured potentiometers. They sold quickly and we asked the question at the time "Will pots ever be this cheap again?" Guess what. We've done it. They are now EVEN CHEAPER than August 1982.

FAR CHEAPER IN FACT!!

PACK No. 1 - Last year you got 50 assorted pots in this pack. This year you get over 75 pots for the same price. That works out at around 13 cents a potentiometer!

COST OF PACK - $9.95

Sorry p&p on this is $2.50

PACK No. 2 - This pack was selling fast when it contained 120 assorted pots. NOW it contains 200 potentiometers.

COST OF PACK - $19.95

WOW! Less than 10 cents per pot!

Sorry, p&p $4.50

NOTE: Each pack contains the same style of pot which includes: Single gang, dual gang, switched, unswitched, in log and linear. All pots have plain shafts to take grub screw knob and most have a flat on the shaft. They have either PCB or solder eyelet terminals. They are brand new stock.

---

GE SMOKE & BURGLAR ALARM

The response rate of these products has been staggering. As a result we have actually run out of stock. If you still want one of these units, ring first, we may still have a few left.
Professional engineering is a career for women

A vocational video program to promote career opportunities for women in professional engineering is now available for use as a part of careers education for young women from Year Nine onwards.

The program, called 'Women in Professional Engineering', features eight women who chose professional engineering as a career. They are working in chemical, acoustical, corrosion, traffic and electrical engineering.

Speaking at the launching of the program in Melbourne the Minister for Employment and Industrial Relations, Mr. Ian Macphee said, "Socially and economically it is unacceptable to modern Australian thinkers to allow segregation of the labour market."

The programme was produced by the Women's Bureau of his Department, with sponsorship from ESSO Australia and Telecom.

"The concentration of women into a relatively narrow range of occupations is one reason why the unemployment rate of young women is higher than that of young men," said Mr. Macphee. He said that the federal government was firmly committed to equal opportunity in employment for all Australians and regarded the segregated labour market as unnecessary and undesirable.

"Equal employment opportunity is not just a matter of social justice. It is a matter of the efficient management of human resources. It is a matter of selecting the best person for the job, a task that will be harder if the pool of possible talent is restricted."

"Any profession is missing out if it is barring fifty percent of the population." Mr. Macphee pointed out that of the 36,000 members of the Institution of Engineers, only 242 were women.

Australia compared unfavourably with some other countries in this respect. In Australia only about 0.5 percent of our engineers are women while in the United Kingdom and the United States the figure is around ten percent, and in some eastern European countries it is 30 percent or more.

New satellite earth station at Moree

A new $11m satellite earth station antenna at Moree in northern NSW was opened on November 3, 1982.

The dish antenna, the second at OTC's Moree satellite earth station, provides telecommunication services via a Pacific Ocean satellite to North America, New Zealand, South East Asia, Japan and other destinations.

Called Moree 2, the antenna was built to cope with the increased demand for overseas telecommunications, which, in Australia, is growing at about 25% a year. Communications received by the new antenna are carried by co-axial cable and microwave links to OTC's international terminals at Paddington and Broadway in Sydney, from where they are distributed throughout Australia.

Moree 2 and Moree 1, by operating to separate INTELSAT satellites, will offer route diversity in the Pacific Ocean region. Further diversity is provided by OTC's cable links across the Pacific.

The new antenna has been designed to accommodate dual polarisation — a method of frequency re-use which makes more efficient use of the frequency spectrum by almost doubling its capacity. The latest INTELSAT satellites use this technology.

Vicom Sydney moves

Vicom's Sydney office is now located at Milsons Point.

The new location is 6th Floor, Eagle House, 118 Alfred Street, Milsons Point NSW 2061. (02)436-2766. Tlx. AA70619.

Voice-controlled robots on the march

A new generation of at least six different types of robots able to respond to spoken orders are expected to be ready in Britain by July.

They will be the product of a major competition launched in London by the British Computer Society. Under its guidance, technicians taking diploma courses at UK colleges and polytechnics have produced plans for a crop of robots which can be both re-programmed and ordered to perform tasks by human voice control.

The design teams, which each consist of up to eight people, have already produced their plans and the six designs said to have the greatest potential have been chosen. These robots will be built and developed in readiness for the final in July.

In the final, to be judged by top experts, the robots will be required to carry out both placing and stacking duties in response to voice commands from their operators. The ability to get a robot to respond to the human voice is proving one of the biggest tests for scientists and engineers. No two voices are the same in pitch or volume and it is much easier to give the robot a voice through a synthesiser than to produce a robot 'brain' able to act on the voice of its operator.
Altec Lansing speakers to orbit

Altec Lansing is providing loudspeaker compression drivers as part of an upcoming NASA space shuttle mission.

The Altec loudspeakers are part of an experiment being conducted by researchers at the Jet Propulsion Laboratory in Pasadena, US. Three Altec Lansing 908-8A high frequency compression drivers will be used in an acoustic containerless processing experiment involving the melting and recoiling of experimental glass under zero-gravity conditions on board the shuttle.

New satellite radio beacon

A new type of life-saver for ships at sea, a radio beacon that automatically beams its message via satellite to shore, is expected to emerge from tests nearing completion in Spain.

Several nations are working towards development of the device, known as a satellite Emergency Position-Indicating Radio Beacon (EPIRB), which would be built to internationally agreed specifications.

Experimenters from the USSR, US, UK, Norway and Federal Republic of Germany have developed satellite EPIRB systems in their own countries. They are now comparing and evaluating them in a demanding series of tests, using a channel simulator developed by the German Aerospace Research Establishment, at the European Space Agency tracking station near Madrid.

Most countries are expected to make it mandatory for all ocean-going vessels to carry such satellite EPIRBs in the 1990s. The radio beacon would send a distress message to the appropriate rescue authorities indicating where the signal orientated, the ship involved and the nature of the distress. Within a few minutes, rescue authorities would have the message processed so that they could direct other ships or aircraft to the vessel in distress.

Electromagnetic interference limits

The Standards Association of Australia has published a standard dealing with electromagnetic interference limits related to motor vehicle ignition.

AS 2557 was requested by the Department of Communications, supported by Telecom and Road Transport Authorities. It covers only spark type ignition and not other sources of interference from motor vehicles and similar equipment.

The reason for the standard is to limit interference to motor vehicle-based communication systems and roadside vehicle control systems and to permit the detection from the roadside of offending vehicles.

The benefit of this standard to the average consumer will be less interference to communication systems such as land mobile radio and public automatic mobile telephone services, from motor vehicles. There will also be less interference to broadcast reception in dwellings and shops adjacent to heavy traffic concentrations.

Copies of AS 2557 can be purchased from any SAA office at a cost of $5.80 plus $1.25 postage and handling charge.

Satellite link for Nepal

The Sagarmatha Intelsat Earth Station near Kathmandu, Nepal, was built by Marconi Communication Systems to allow Nepal to develop its contacts with the outside world which, up to now, have been provided by HF radio through India.

The project took nearly two years to complete under difficult circumstances. Marconi was responsible for provision of the earth station buildings and antenna foundations, manufacture, installation and testing of the communications equipment, both at the earth station and at the International Telephone Exchange in Kathmandu and provision of the antenna and the microwave radio system linking the earth station with Kathmandu.

Marconi also provided a full training programme for the Nepalese engineers and technicians who will be responsible for running the site. A Marconi engineer will provide assistance to the local staff for the first year of the earth station operation.

Nepal now has a facility that can ultimately provide 60 channels for direct communication via telephone and telex and can be expanded to include TV.

Played golf with your watch lately?

I bet sometimes you’ve said to yourself, after an exhausting, frustrating day on the golf course, that life wasn’t meant to be easy.

If the sun was too hot, the golf course too crowded, that new motorised buggy you want to buy is just too expensive and you still aren’t a member of that exclusive club, then give it all up. Throw away that telesopic ball retriever, give up worrying about getting your new wet-weather gear wet, forget about sandy bunkers and wet fairways. And play golf with your own watch!

The watch you can play golf with, the Golf Game Cassio, or GG-9, is now available in Hong Kong, and they say you’ll really feel like you’re on the fairway.

The instructions take a bit of getting into and could be enough to send you back to a real fairway with rain and sandy bunkers and a good wind. When you start the game a display comes up reading ‘9H: P36’ which means the game consists of 9 holes, 36 strokes at par. Then the display changes to the highest score achieved by the previous player and next appears ‘H1: 04’ telling you that you are at the first hole par 4. And then you see ‘350 00’ which means that you are 350 metres away from the first hole and no shot has been made...

And so it goes on. By the time you’ve waded through the instructions you’ll be too exhausted to push the correct buttons. But once you’ve mastered the instructions just think how practical this Golf Watch actually is. You can play it seven days a week, at any time of the day or night, and you will never get it wet... unless you play it in the bath and it doesn’t say whether it is waterproof.

The GG-9 has an alarm and even tells the time so what more could you want for $20.
**ETI 1500 KITSET**

Superb unit featuring:
- Tune and discriminate.
- 4 modes of operation.
- VLF/TR design.
- Ground balance.
- Auto balance push buttons.
- Pre-wound search heads.
- Very professional unit.
- Approximately 1/3 price of many similar commercial built up locators.
- Audio and meter indication.
- Lets you know when to rejoice.

**PRICE $193.50 plus $9.50 P&P Reg. Post**

All AEC KITSETS contain only top quality prime specification components by recognised manufacturers. Don't be misled by other so called "KITS" which do not meet ETI and EA standards.

*Give yourself and your Kitset every chance of success.*

**ALL PARTS COVERED BY MANUFACTURERS WARRANTY**

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**PHILLIPS SPEAKER SPECIALS**

<table>
<thead>
<tr>
<th>4 WAY (100W)</th>
<th>3 WAY (60W)</th>
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<td>ADO 12250 W8</td>
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**P&P for speakers**
- Allow 10% for order value up to $100
- Allow 5% for order value over $100

*(NOTE *MIN. P&P CHARGE $2.28)*
Tech-Sales to distribute Solartron products

Tech-Sales Pty Ltd, a fully owned subsidiary of Tech-Rentals, was recently formed to represent both Solartron and Weston products exclusively in Australia. Solartron, a UK based company, and Weston, based in the USA, are part of the Schlumberger Organisation.

Tech-Sales, with a team of specialist engineers, has a range of products which includes instrumentation for measurement in the fields of dynamic analysis, data logging, precision voltage measurement, logic test and spectrum analysis. It also has digital and analogue power meters and analogue temperature gauges.

The Solartron 7045 DMM offers 4½-digit measurements. It is a portable unit featuring ac voltage and current, dc voltage and current, resistance, temperature and range hold and display hold facilities.

The Solartron 7150, a 6½-digit systems voltmeter, is capable of measuring dc and ac volts, dc and ac current and two or four terminal resistance. It also features automatic null and selectable digital filter with an accuracy for dc volts of 0.002% and for ac volts of 0.004%. It retails at around $1600.

The Solartron 7201, a digital fault locator, offers signature and trace analysis, event/transition counting, period width and relative timing, frequency measurement and digital multimeter functions.

For further information on the products available contact Nigel Gamlin, Applications Engineer, Tech-Sales, 83-87 Wellington St, Windsor Vic. 3181. (03)51-1308.

Portable spectrum analyser display

New from Hewlett-Packard is the Model 853A spectrum analyser display. It is a robust, portable mainframe incorporating a digital display system for use with HP's series of spectrum analyser plug-ins covering from 10 kHz to 21 GHz.

The HP 853A provides two independent 480- by 800-point resolution traces offering the user flexibility to store trace data yet still monitor signal changes. It also includes 'Maximum Hold', which facilitates measurements such as signal drift, and 'Digital Averaging' to extract low-level signals from noise without sacrificing sweep speed.

'Normalisation' (or 'Trace Arithmetic') simplifies observation of signal changes within a crowded spectrum or removes system frequency response when using a tracking generator to make stimulus/response measurements. 'Direct Plotter Dump' capability permits both trace and graticule information to be plotted directly on an HP-IB digital plotter via push buttons on the HP 853A front panel.

Should a permanent record of many displays or a comparison and tabulation of data be required, the HP 853A's HP-IB port can be connected to a controller. In addition to trace data recording, other possibilities in this mode include drawing test limits and providing operator prompts on the analyser CRT.

HP offers three RF plug-ins for the HP 853A mainframe: HP 8557A, 10 kHz — 350 MHz; HP 8558B, 100 kHz — 1500 MHz; HP 8559A, 10 MHz — 21 GHz. Existing HP 8557/8558/8559 plug-ins require only a simple, field-installable modification for full compatibility with the new HP 853A mainframe.

For further information contact Hewlett-Packard Australia Ltd, 31-41 Joseph St, Blackburn Vic. 3130. (03)9890-6351.

Fully automatic distortion analyser from 5 Hz — 1 MHz

The new Krohn-Hite Model 6900 provides automatic frequency nulling and auto level setting that lets you make fast and error free measurement of distortion or ac voltage over a frequency of 5 Hz to 1 MHz.

Total harmonic distortion (THD) is displayed on an auto-ranging digital display. THD measurements from 0.005% to 19.9% with resolution of 0.001% and input levels from 100 mV to 100 V RMS are as simple as connecting the signal to the input terminal.

A distortion output is provided for visual inspection of the input signal after the fundamental frequency has been filtered out. An analogue output provides a dc voltage proportional to the percent distortion displayed. An ultra-low distortion sine wave (0.003%) output is provided for use as a standard to test linearity of components or system distortion characteristics.

Warburton Franki Ltd can be contacted at 372 Eastern Valley Way, Chatswood NSW 2067. (02)407-3261.

OFFER!

8-Function, 23-Range LCD digital multimeter
UNDER $100!

SEE PAGE 15
MORE SCAN FOR YOUR DOLLAR!
The brilliant Dick Smith PRO 40 SCANNER

Compare this superb Scanner with others of similar performance elsewhere, at nearly twice the price! The new PRO 40 Scanner from Dick Smith represents the state-of-the-art in computerized scanning receiver! Completely solid state computer controlled circuitry - no expensive crystals to buy - complete with backup battery for stored frequencies.

YOU CAN HEAR . . .
Just about everything from harbour control nudging a supertanker into its berth, to telephone conversations from cars speeding along city streets. All the emergency service, authorities and forces - and of course there are thousands of business radio stations, amateur and CB radio operators. Plus the thousands of stations in the band that we don't know about yet (we're waiting for you to tell us about them). Cat D-2805

FOR ONLY
$399

$0.27 per week for 12 months

SAVES
$200

& it's years ahead!
Yes - an absolutely up-to-date design. Most of the TV game consoles around were designed at least 2 years ago. And in electronics, that's an eternity.

Compare the quality
Amazing picture quality with over 49,000 dots - over twice as good as the largest selling TV game! You'll be amazed at the clarity, the detail - just like the scanning NASA use in the space shuttle!

Space-Age Controllers
Not just simple sticks, full space-age guidance devices with 48 keys, as well! Slide-In overlays so you can see exactly what to do. When the controllers are in the console, they form a standard typewriter style keyboard - that's versatility!

the one with the inbuilt personal computer . . .
Just plug in the optional BASIC cartridge! Cat Y-1605 $69.95 and the WIZZARD becomes a powerful personal computer, complete with 1K of memory. That's more than you get with many personal computers!

Compare the price
The best part of all: the Dick Smith WIZZARD is around $200 cheaper than the closest comparable compute! For less, you get an extra $40. Dick Smith WIZZARD - you get much greater flexibility and enjoyment!

Cat Y-1600

$295

$6.85 weekly over 12 months to approved customers

Great range of game Cartridges
NOW AVAILABLE
Cassette Storage Module

$39.95 ea

Easy one plug connection to your Wizzard! At last - now you can store your programs and replay them without re-keyboarding! Quality cassette unit connects to side of Wizzard, one plug supplies power and signal lines.

AND ONLY
Cat Y-1607

$89.00

COMING SOON
MOVING KEYBOARD

One piece replacement typewriter style keyboard.
The Incredible

Mosfet Amp Kit

This 'Top of the Line' amplifier features up to the minute circuitry as well as the new MOSFET output stage. With a huge 50W/channel output, it's got everything you'll ever need in an amplifier. All components fit a single PCB, which makes construction very easy. All parts are supplied right down to the last nut and bolt! What a bargain! Cat K-3515 See EA Jan '81.

$175 WHY PAY MORE?

Experience the thrill of building your own speaker system & SAVE!

with the New Playmaster speaker kits.

Dick Smith brings you two superbly styled speaker systems to suit your room, your decor - and your pocket! Both are acoustically designed by Neville Williams, MIEEE (Aust), Editor In Chief of Electronics Australia Magazine, and are manufactured under meticulous quality control to meet the exacting standards of the original EA specifications.

See how easy they are to build!

All it takes is a couple of hours and you save a fortune. They're so good looking as any speakers you'll find in the hi-fi showrooms.

250mm SYSTEM

Enclosure plus Speaker & Grille Kits incl: Baffle boards, deluxe grilles, association, hardware, 250mm woofer, midrange, tweeter, crossovers, wiring harness & full instructions. Cat C-2634, C-2044 plus C-2658.

ONLY

$329 PR.

300mm SYSTEM

Simsas to lower except for 300mm woofer plus deluxe 250mm midrange & tweeters. Cat C-2632, C-2042 plus C-2612.

ONLY

$360 PR.

Dick Smith Electronics


MAIL ORDER CENTRE: PO Box 321, North Ryde, NSW 2113. Phone: (02) 888 3200
Just cool it

For applications where forced cooling is necessary, but an airconditioner is impractical, a new cooling unit is now available from Alfatron.

Designed to be used for cooling electronic equipment, it features Peltier effect modules sandwiched between two blowers; its only moving parts are the fan blades.

These cooling units will find application where it is necessary to contain electronic or electrical equipment in dust or flame proof cabinets. As most such equipment will generate significant amounts of heat, this must be removed by heat exchangers or the use of overly large cabinets. The SL series thermo-coolers can be very useful in these situations to keep equipment cool.

Many new industrial control systems incorporate floppy disk or cassette drives as part of their data storage and gathering methods. These are usually at risk in industrial environments, but the SL thermo-coolers can help overcome this problem.

It is also claimed that by using a thermistor and temperature control circuit, these devices can be used to give highly precise temperature control suitable for laboratory situations.

Two models are currently available with 30 Kcal/h and 120 Kcal/h cooling capacity. They are powered from 12 Vdc and 24 Vdc respectively and can cool down to −15°C.

For more information contact Alfatron Pty Ltd, 1761 Ferntree Gully Rd, Ferntree Gully Vic. 3156. (03)758-9551.

Molex C-Grid range of connectors

Molex C-grid is a high density interconnection system which includes connectors, headers, 0.64 mm square pins, shunts and application tooling.

Serving as a switch, the 7859 shunt provides a very low resistance electrical path due to its two points of contact with each pin. One version has a closed top to prevent upside down mating. Shunts pressfit onto two 0.64 mm pins on 2.54 mm center spacing. No soldering is required. These fully stackable shunts utilise less board space than DIP switches and are not subject to accidental actuation or deactivation during board handling.

The 8876 connector mates with 0.64 mm square pins and all Molex dual row headers. The 8876 accepts discrete wire (1.2 mm max OD) or 2.54 mm center notched round conductor ribbon cable, 28 through 22 AWG, solid or stranded. It is end-to-end stackable for users dense packaging needs.

The Molex 7990 dual row female connector is designed to mate with 0.64 mm square pins on a 2.54 mm x 2.54 mm grid for mother-daughter board applications. The connector which is stackable end-to-end, is available in circuit sizes 4 through 130.

The unique 8878 Modular Socket consists of a shrouded carrier, designed to protect fragile IC chip leads, and a polarised socket with double cantilever terminals. This product provides a cost-efficient method for interchanging ICs, memory devices, PROMS, EPROMS and microprocessors.

The Molex 8624 header, with 0.64 mm selectively plated square pins, has a segmented body that can be cut into smaller circuit sizes to meet customer needs. Available in 4 through 80 circuits, the header mates with female connectors on a 2.54 mm x 2.54 mm grid and is stackable end-to-end.

These products are available from Utilux Pty Ltd, 14 Commercial Rd, Kingsgrove NSW 2208. (02)50-0155.
3½-DIGIT LCD
DIGITAL MULTIMETER
by Univolt

- 8 FUNCTIONS 23 RANGES
- PUSHBUTTON OPERATION
- DC VOLTS TO 1 kV, AC VOLTS TO 750 V
- RESISTANCE FROM 200 OHMS TO 20M
- AUTO-RANGING ON AC/DC VOLTS
& RESISTANCE
- AC & DC CURRENT TO TEN AMPS
- FINGER-GUARDS ON PROBES & SHROUDED PLUGS FOR MAXIMUM SAFETY
- TRANSISTOR GAIN MEASUREMENT
- TRANSISTOR CLIP LEAD INCLUDED
- PROTECTIVE CARRY CASE INCLUDED

Here is an opportunity to buy a versatile, top-line multimeter at a very good price, complete with carry case, special probes, leads and spare fuse.

OFFER PRICE
$97.50 tax paid
$84.38 tax exempt

This instrument would normally sell for about $130 retail.

This is an entirely new multimeter from Univolt and this offer is being made as a special promotion for the Model DT-860 which has only just been released here. It is a 3½-digit liquid crystal display instrument featuring 23 ranges in eight functions, three functions being auto-ranging. It is a handheld instrument but comes with a tilt stand to prop it up from the bench. The display features 12 mm high digits, plus value and function indicators (volts, ohms, ac, low battery, -ve, etc). The front panel is functional and well laid out. The test probes supplied have shrouded plugs to prevent accidental finger contact for safety when using the instrument on high voltage circuits, plus the probes have finger guards for further safety and convenience. A strong, synthetic leather carry case is included. The instrument is powered by two 1.5 V AA cells. We have tested a sample DT-860 in the ETI Lab and found it met specifications, functioned well and was generally easy to use. It appears to be a robust, well-made device. Any technician, engineer, serviceman or hobbyist would find it a very useful instrument.

This offer is made by BENELEC PTY LTD (incorporated in NSW). ETI is acting as a clearing house for orders. All mail orders will be despatched by certified post. Please allow up to four weeks for delivery. Offer closes 31 March 1983.

INSPECTION
You can inspect one of these multimeters during office hours at ETI's Sydney and Melbourne offices:

Sydney: 4th Floor, 15 Boundary St
Melbourne: 23rd Floor, 150 Lonsdale St
Flinders St

HOW TO ORDER YOUR MULTIMETER
Fill out the coupon below and enclose a cheque, bank cheque or money order for the amount required made out to BENELEC PTY LTD. If you are not paying sales tax, please quote your sales tax number on the coupon, where indicated, or for schools, colleges or other educational institutions, enclose a sales tax declaration on your letterhead.

SEND completed coupon to:

UNIVOLT MULTIMETER OFFER
c/o ETI MAGAZINE, 140 Joyce St, Waterloo NSW 1983.

STOP PRESS
We will be moving premises sometime in February. Please phone 662-8888 if you want to inspect a DT-860 in Sydney to check which address we'll be at.

DT-860 UNIVOLT LCD
DIGITAL MULTIMETER

SPECIFICATIONS
- 3½-digit liquid crystal display; 12 mm high digits.
- dc volts: 200 mV-1000 V (max) auto-ranging; resolution: 0.1 mV @ 200 mV, 10 mV @ 200 V
- ac volts: 2 V-750 V (max) auto-ranging; resolution: 1 mV @ 2 V, 10 mV @ 200 V
- resistance: 200 ohms; 20 M auto-ranging; resolution: 1 kΩ @ 200 M, 10k @ 20 M.
- ac/dc current: 2000 μA/200 mA/10 A; overload protected; resolution: 1 μA/100 μA/10 mA.
- fF: 0-1999 (±10%) with VDC = 1.2 V, IY = 1 μA.
- continuity: buzzer sounds at resistances under 20 ohms (±10%)
- diode check: reads forward drop in millivolts at 0.8 mA test current; 1 mV resolution.
- warranty: three months normal parts and labour warranty.
- miscellaneous: input impedance 10M minimum; input capacitance less than 50 pF; polarity: – indicated automatically; overrange indicated by 1 of –; size: 145x60x22 (1½x¾x¾) mm; weight: 180 g excluding batteries; protection provided by 0.2 A, 250 V fast blow fuse.

ACCURACY
- dc volts: 200 mV; ±(0.5% of rdg + 2)
  2 V/20 V; ±(0.5% of rdg + 1)
  200 V/1 kV; ±(0.7% of rdg + 1)
- ac volts: 2 V/20 V; ±(0.5% of rdg + 5)
  200 V/750 V; ±(1.0% of rdg + 5)
- dc current: 2 mA/200 μA; ±(1.0% of rdg + 1)
  10 A; ±(1.2% of rdg + 1)
- ac current: 2 mA/200 μA; ±(1.2% of rdg + 5)
  10 A; ±(2.0% of rdg + 5)
- ohms: 200R; ±(0.7% of rdg + 2)
  2 V/20 V; ±(0.5% of rdg + 2)
  2 M; ±(1.0% of rdg + 2)
  20 M; ±(2.0% of rdg + 2)

max. open circuit voltage – 1.5 V on 200 R range
max. open circuit voltage on other ranges – 0.85 V

PLEASE SEND ME...... Univolt Model DT-860 multimeter(s) @ $84.38 each, excl. tax or $97.50 each, inc. tax.
Post and handling $2.50 Sales Tax No........................................ (if applicable) Offer closes 31 March 1983
Enclose S, total Cheque or Money Order No...................................... Signature

Name........................................................................ Postcode.........
The ETI 5000 System. Pristine. Pure. Cocaine for the ears. And to think that they are Australian made and designed. They can stand comparison with any kit - or ready-built units - anywhere. In fact we still think that they are the world's best amplifiers. We should be justifiably proud of this achievement in audio.

The ultimate Hi-Fi power amplifier. We call our model the "Black Monolith" because we feel that the name symbolizes the intelligence that went into the design. The Juranet "Black Monolith" is without doubt the best kit of all the project available. If you have doubts ring our Managing Director, Gary Johnson and he will tell you (He is pressed for a long conversation.)

Several kits suppliers now have 'versions' of the original $500 P.A. which claim to be similar to this. This is simply not the case. Square does not allow us to show EVERY refinement that has been made to the 500 P.A. but possible ones are...

EXCLUSIVE FEATURES:

- Rear panel mains transformer.
- 1% METAL FILM resistors used.
- Flux-shunting strip on power transformers.
- Original chassis bar design.
- Gold-plated output phono sockets (NOT filled Mica).
- Jig drilled and excluded heavy gauge, anodised heatsink bracket.
- SUPERFINISH front panel. STILL THE BEST now with blind tapped holes.
- New heavy-duty heatsink to the output transistors. 100% extra heatsink area and black anodised for greater efficiency (INOT in original design).
- Ventilation holes in top of chassis (NOT in original design).
- Extra 3 pin DIN socket on rear panel (for 25% power new 500 P.A. components)
- Extra 3 pin DIN socket on rear panel, flush (to power new 500 P.A. components).
- If YOU Think THAT YOU CAN SAVE MONEY ON THESE KITS ASK YOUR SUPPLIER IF HE WILL GIVE YOU ALL OF THESE FEATURES. MAKE SURE THAT YOU GET IT IN WRITING!!!

"Black Monolith" SPECIFICATIONS:

Power Output: 100W RMS into 8 ohms.
Frequency Response: 8kHz to 20kHz.
Noise: <0.005%.
Distortion: <0.003% at 1kHz and 100W.
Harmonic Distortion: >98.8%.
Intermodulation Distortion: <0.003% at 1kHz and 100W.
Stability: Unconditional.

"Black Monolith" $399

5000 SERIES GRAPHIC EQUALISERS

Latest addition to the sought-after 5000 Series stable! David Tillys has once again produced a 'No Compromise' design. This new component, a 1/3 octave equaliser, gives you absolute control over the acoustics of your particular listening environment. You get 3 SEPARATE CONTROLS for every octave of your bandwidth to virtually eliminating the subtle nuances that are particular to your listening area. 1/3 octave equalizers have been used by professional engineers in Recording Studios and Live Concerts for over a decade now. It is no accident that the advent of the 1/3 octave equalizer and studio quality live sound has gone hand in hand. BUT THERE'S A CATCH. One of these equalizers is not enough. You will have to buy 2 for stereo. Quite a lot of money - but worth it if you want the best. The 5000 kit includes a full pre-punched plated chassis, pre-punched heavy gauge front panel with silk-screened front panel to match the other 5000 components. It is absolutely original. You can purchase the kits one at a time for $199 each or, for two, $398 - a $10 saving. If you are one of the hundreds of happy 5000 users we are convinced that you will be just delighted with this unit.

5000 SERIES $179

"Bluesprint" $299

SPECIFICATIONS:

Signal-to-Noise: -102dB
Frequency Response: 12Hz - 10kHz - 1dB
Distortion: 0.007%
Input Sensitivity: 46dB
Harmonic Distortion: <0.005%
S/N Ratio: 75dB

"Bluesprint" $299

SPECIFICATIONS:

Frequency Response: 15kHz - 12kHz - 25kHz.
Distortion: <0.005%
Input Sensitivity: 46dB
Harmonic Distortion: <0.005%
S/N Ratio: 75dB

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Input Sensitivity: 46dB
Harmonic Distortion: <0.005%
S/N Ratio: 75dB

"Bluesprint" $299
THE BEST
CAR
COMPUTER
BELOW $200

Never before has such a comprehensive car performance computer been offered at such a low price! Once again innovative microprocessor technology has enabled us to pass enormous savings on to you!

But don’t let the low cost fool you. The “Voyager” car computer IS THE MOST COMPREHENSIVE PRODUCT THAT WE HAVE SEEN. No other car computer matches this one AT EVEN TWICE THE PRICE! You could buy a $2,000 Holden and not get a better car computer!!

Just check the features. We are sure that you will calculate that the "Voyager" represents outstanding value!

FEATURES

- INSTANT FUEL CONSUMPTION IN LITRES/100KM AND MPG!! (MOST OTHERS HAVE ONLY ONE OF THE ABOVE)
- JUST SWITCH FROM ONE TO THE OTHER AS YOU DRIVE ALONG.
- INSTANT SPEED, TIME AND OTHER FUEL DATA.
- VISUAL AND AUDIBLE EXCESS SPEED ALARM.

INSTALLATION

The "Voyager" computer comes complete with an unbelievable array of mounting configurations, dash, under dash or stalk mounts. ALL installation hardware is supplied (even a roll of insulation tape as well, of course), as is the wiring harness and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual.

AVAILABLE FROM:
ROD IRVING MELBOURNE, ALTRONICS PERTH,
TOMORROW'S ELECTRONICS GOSFORD 247246

8 CHANNEL MIXER KIT

The Jaycar 8002 Mixer was originally conceived to be the successor to the very popular E1014 Master Mixer. The 414 was basically configured as a single channel and suffered from a number of serious structural limitations - notably poor signal-to-noise figures. Enormous advances in Audio IC’s have occurred since the 414 was de- signed. Jaycar engineers have taken advantage of this. The incredibly low mass and distortion figures of the 8002 are a testimony to the sound basic design of the mixer coupled with the performance capability of these IC’s. Whilst the 8002 is a 4 channel compact stage mixer, applications have been kept to basic.

A "STUDIO" MIXER. The presence requirement of a studio mixer is that it must be quiet - i.e. have good S/N. Due to the fact that the "8002" IC’s are used in the 8002 audio applications are entirely capable.

In addition to this, metal foil resistors are used in critical signal areas.

AS A DISCO MIXER. The balanced input feature of the 8002 is not really necessary for disco use. This section can easily be bypassed with either a moving magnet (Neumann Cartridge) preamp, or a moving air gap type. The mixer format of the 8002 and tremendous equalization facilities should make this more popular for disco use.

STERO Synthesiser

One of the most effective projects that we have seen. Creates an extremely realistic stereo affect from any line level mono signal! The effect on your signal is staggering. The audio track on your VCR comes to life! Just like the movies! You can convert your T.V., AM tuner or anything now to wall-to-wall stereo sound. Jaycar has two versions of this kit; a short form which enables you to build the synthesiser inside one box and the full free standing unit.

SHORT FORM kit contains PCB and all electronics associated with board but not power transformer or case $39.50

FULL KIT contains everything including power transformer and case $49.50

Ref: EA September 1982

THE BEST CAR COMPUTER BELOW $200

GREAT VALUE FOR MONEY

- Balanced (600 Ohm) Mic., Inputs/Line Inputs.
- Cannon Connectors included in the price.
- Bass, Mid & Treble Equalization on each Input.
- “Effects” (i.e. Echo etc.) capability.
- Foldback and Stereo Pan on ALL 8 Inputs.
- 60mm Slide Faders used throughout.
- 19" Rack Mount capability (or Console Mount).
- Professional Black Front Panel with Format borders & multi-coloured knobs to assist function identification.
- VU Metering.

Jaycar

125 YORK STREET, SYDNEY 2000
PHONE: 02 945 0197, TELEX: 72295
"NEVILLE'S CORNER"
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Mail Order Code: 2124 K-33 (PLUS POSTAGE)

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PORT AND PARCEL CHARGES:

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S 4.50 - 24.99
S 6.50 - 49.99
S 8.50 - 99.99

Mail Order by Bankcard
Via Your Phone
Analogue delay lines

Analogue delay lines can be used to produce special audio effects such as echo, reverb, phasing, flanging, room expansion and predictive switching etc.

Ray Marston

SOLID STATE DELAY LINES are widely used in modern music and audio systems. They can be used to produce popular effects such as echo, reverb, chorus, phasing, flanging etc. in music systems, 'rare' effects such as ambience synthesis or 'room expansion' in expensive hi-fi systems and 'predictive' effects such as click/scratch elimination in record players or auto-switching in tape recorders etc.

Two basic types of solid state delay systems are available, analogue and digital. Digital delay systems tend to be more expensive and complex than analogue types, except where delay times are in excess of 250 ms, so we'll confine our present discussion to analogue systems only.

Delay line basics

Modern solid state analogue delay lines come in integrated circuit form and are almost universally known as CCD (Charge Coupled Device) or 'Bucket-Brigade' delay lines. In essence, these devices contain a stack of analogue memory (sample-and-hold) cells or 'buckets' (usually 512, 1024 or 4096), all wired in series. Analogue input signals are applied at the front of the bucket 'chain' and the delayed output is taken from the main's end.

Figure 1 illustrates the basic operating principle of an analogue delay line. Each bucket consists of a small capacitor and a tetrode MOSFET and acts like a sample-and-hold stage. An electronic switch is placed at the front of the chain which is externally biased to a preset voltage. Charges can be shifted down the chain, one step at a time, via an external two-phase clock signal; one phase of the clock is also used to activate the input sampling switch. The operating sequence is as follows.

On the first clock half-cycle, each existing bucket charge is shifted backwards one step to the next bucket in the chain and a sample of the instantaneous input signal is fed to the first bucket via SW1, where it is 'stored' as an analogue charge. On the second half-cycle, each existing charge (including the input one) is transferred backwards another step to the next bucket in the chain, but the input is NOT sampled via SW1. There is thus always an 'empty' bucket between each charged bucket in the chain. This double shifting process repeats on each clock cycle, with input samples repeatedly being taken and then clocked towards the back of the chain.

In the final section of the delay line, a short section of buckets is wired in parallel with, and fed from, the main delay line, but has only one bucket more than the corresponding section of the main line and is clocked in anti-phase. The IC thus has two outputs which, when added together, effectively fill in the 'gaps' in the main delay line bucket chain. The outputs can be 'added' either by shorting them directly together or preferably, by connecting them to a balance pot as shown in the diagram. The final output of the delay line is thus a quantised but time-delayed replica of the original input signal.

Figure 2 shows the essential 'usage' elements of an analogue delay line chip. The delay line MOSFETs use a tetrode structure, so the IC needs two supply lines (V_DD and V_BB) plus a ground or common connection.

The input terminal must be biased into the linear mode by voltage V_bias. The two outputs of the device must be added together, as already described; in Figure 2 we've shown addition by direct-shorting. Finally, the IC must be provided with a two-phase clock
signal, normally consisting of a pair of anti-phase square waves that switch fully between the VDD and GND (or 0 V) potentials.

How much delay?
We've already seen that the buckets of the analogue delay line are alternately 'empty' and 'charged' and that each complete clock cycle shifts a charge two stages along the bucket chain. Thus, the maximum number of samples taken by a line is equal to half the number of bucket stages (a 1024 stage line can take only 512 samples) and the actual time-delay available from a line is given by:

\[ \text{Time Delay} = \frac{S \times p}{2 \times \tau} \]

where \( S \) = number of bucket stages, \( p \) = clock period, and \( \tau \) = clock frequency.

Thus, a 1024-stage line using a 10 kHz (100 us) clock gives a delay of 51.2 ms. A 4096-stage line gives a 204.8 ms delay at the same clock frequency. This seems pretty good, but there are two major snags. The first is that the maximum useful signal frequency of the delay line is equal to one third of the clock frequency, so a delay line clocked at 10 kHz has a useful bandwidth of only 3.3 kHz. The second snag concerns costs. Analogue delay lines are rather expensive. A 512-stage device will set you back around $30!

Figure 3 shows the block diagram of a basic, real-life analogue delay line system. The input signal is applied to the input of the delay line via a low-pass filter which has a cut-off frequency that is one third (or less) of the operating frequency of the clock generator, and is used to overcome 'aliasing' or intermodulation problems. The output of the delay line is passed through a second low-pass filter which also has a cut-off frequency one third (or less) of that of the clock. This serves the multiple purposes of rejecting clock break-through signals and integrating the delay line output pulses so that the final analogue output signal is a faithful (but time-delayed) copy of the original input signal.

We'll take a closer look at some of the elements of the Figure 3 circuit and at some practical delay line chips later in this article. In the meantime, let's digress slightly and look at the subject known as psycho-audios.

Psychoaoustics
Many of the special effects that are obtainable with delay lines depend heavily on the human brain’s idiosyncratic behaviour when interpreting sounds. Basically, the brain does not always perceive sounds as they truly are, but actually 'interprets' them so that they conform to a pre-conceived pattern. The brain can sometimes be tricked into mis-interpreting the sounds. The study of this particular subject is known as psycho-audios. Here are some psycho-audios' 'laws' that are worth knowing:

**APPLICATIONS**

**Simple musical effects**

Figures 4 to 15 illustrate a variety of analogue delay line applications. In these diagrams we have, for the sake of simplicity, ignored the presence of the usual input/output low-pass filters. Let's start by looking at some simple musical effects circuits.

Figure 4 shows how the delay line can be used to apply vibrato (frequency modulation) to any input signal. The low-frequency sinewave generator modulates the clock generator frequency and thus causes the output signals to be similarly time-delay modulated.

Figure 5 shows the delay line used to give a double-tracking effect. The delay time is in the 'perceptible' range 10-25 ms and the delayed and direct signals are added in an audio mixer to give the composite 'two signals' output shown in the diagram. If a solo singer's voice is played through the unit it sounds like a pair of singers in very close proximity.
harmony. Alternative names for this circuit are 'mini-echo' and 'micro-chorus'.

Comb filter circuits

Figure 8 shows a delay line used to make a comb filter. The direct and delayed signals are added together; signal components that are in-phase when added give an increased output signal amplitude and those that are in anti-phase tend to self-cancel and give a reduced output level. Consequently, the frequency response shows a series of notches, the notch spacing being the reciprocal of the line delay time (1 kHz spacing at 1 ms delay, 250 Hz spacing at 4 ms delay).

These phase-induced notches are typically only 20-30 dB deep.

The two most popular musical applications of the comb filter are in 'phasers' and 'flangers'. In the phaser (Figure 9) the notches are simply swept slowly up and down the audio band via a slow-scan oscillator, introducing a pleasant acoustic effect on music signals.

Figure 6. Auto-Double-Tracking (ADT) or mini-chorus circuit.

The flanger circuit (Figure 10) differs from the phaser in that the mixer is placed ahead of the delay line and part of the delayed signal is fed back to one input of the mixer so that in-phase signals add together regeneratively. Amplitudes of the peaks depends on the degree of feedback and can be made very steep. These phase-induced peaks introduce very powerful acoustic effects as they are swept up and down through music signals via the slow-scan oscillator.

Figure 7. 'Chorus' generator.

Figure 7 shows how three ADT circuits can be wired together to make a 'chorus' machine. All three lines have slightly different delay times. The original input and the three delay signals are all added together, the net effect being that a solo singer sounds like a quartet, or a duet sounds like an octet, etc.

Echo/reverb circuits

Figure 11 shows the basic circuit of an echo unit. The delay (echo) may vary from 10 ms to 250 ms and is usually adjustable, as is the echo amplitude. Note that this circuit produces only a single echo.
The echo/reverb circuit of Figure 12 produces multiple or repeating echoes (reverberation). It uses two mixers, one ahead of the delay line and the other at the output. Part of the delay output is fed back to the input mixer so that the circuit gives echoes of echoes of echoes, etc. The reverb time is defined as the time taken for the repeating echo to fall by 60 dB relative to the original input signal and depends on the delay time and the overall attenuation of the feedback signals. Each delay time, echo volume and reverb time are all independently variable.

Figure 13 shows the basic circuit of an ambience synthesiser or 'room expander'. Here, the outputs of a conventional stereo hi-fi system are summed to give a mono aural image. The resulting signal is then passed to a pair of semi-independent reverb units which produce repeating echoes but not the original signal. The reverb outputs are then summed and passed to a mono PA system and speaker which is usually placed behind the listener. The system effectively synthesises the echo and reverb characteristics of a chamber of any desired size so that the listener can be given the impression of sitting in a cathedral, concert hall or small club house etc., while in fact sitting in his own living room. Such units produce very impressive results.

There are lots of possible variations on the basic Figure 13 circuit. In some cases the mono signal is derived by differencing (rather than summing) the stereo signals, thereby cancelling centre-stage signals and overcoming a rather disconcerting 'announcer-in-a-cave' effect that occurs in 'summing' systems. The number of delay (reverb) stages may vary from one in the cheapest units to four in the more expensive units.

**Predictive switching circuits**

Delay lines are particularly useful in helping to solve 'predictive' or 'anticipatory' switching problems in which a switching action is required to occur slightly before some random event occurs.

Suppose, for example, that you need to make recordings of random or intermittent sounds (thunder, speech, etc) to have the recorder running continuously would be inefficient and expensive. It would not be practical to try activating the recorder automatically via a sound switch since part of the sound will already have occurred by the time the recorder turns on.

Figure 14 shows the solution to this problem. The sound input activates a sound switch which, because of mechanical inertia, turns the recorder's motor on within 20 ms or so. In the meantime, the sound travels through the 50 ms delay line towards the recorder's audio input terminal, so that the recorder has already been turned on for 30 ms by the time the first part of the sound reaches it. When the original sound ceases the sound switch turns off, but the switch extender maintains the motor drive for another 100 ms or so, enabling the entire 'delayed' signal to be recorded.

Finally, to conclude this 'applications' section, Figure 15 shows how 'predictive' switching can be used to help eliminate the sounds of clicks and scratches from a record player. Such sounds can easily be detected by using stereo phase-comparison techniques.

In Figure 15 the disc signals are fed to the audio amplifier via a 3 ms delay line, a bilateral switch and a track-and-hold circuit. Normally, the bilateral switch is closed and the signal reaching the audio amplifier is a delayed but otherwise unmodified replica of the disc signal. When a click or scratch occurs on the disc the detector/extend circuit opens the bilateral switch for a minimum of 3 ms, momentarily blanking the audio signal to the amplifier. Because of the presence of the delay line, the blanking period effectively straddles the 'click' period, enabling its sound effects to be completely eliminated from the system (see 'Psycho Acoustics').
Figure 16. Basic details of five popular CCD delay lines.

### PRACTICAL CIRCUITS

#### Delay lines

Figure 16 shows basic details of five popular CCD delay lines. The TDA1022 and the SAD512 are general-purpose 512-stage delay lines requiring two-phase clock inputs. They give 12.8 ms delay at 7 kHz bandwidth when driven at 20 kHz clock frequency.

The SAD512D is an 'updated' version of the SAD512 and incorporates built-in output drivers and a clock input divider. It requires a single-phase clock input.

The SAD1024A is a dual version of the SAD512. The two halves can be used independently or can be wired in series to give a delay of 25.6 ms at 7 kHz bandwidth.

The SAD4096 gives a performance equal to eight SAD512s in series. It provides a delay of 102.4 ms at 7 kHz bandwidth or 250 ms at 3 kHz bandwidth. The device requires a low-impedance two-phase clock drive, since its clock terminal input capacitance is about 1000 pF.

Figures 17 and 18 show a couple of practical delay line circuits using TDA1022 and SAD512D devices. Both circuits use a preset to adjust the input dc bias so that symmetrical clipping occurs under overdrive conditions and another preset to balance the two outputs for minimum clock breakthrough.

#### Clock generators

The clock signals to a CCD delay line should be reasonably symmetrical, should have fairly fast rise and fall times and should switch fully between the supply rail voltages. CMOS devices make ideal clock generators and Figures 19 to 21 show three practical circuits.

The general-purpose two-phase generator of Figure 19 is inexpensive and can be used in most applications where a fixed or manually-variable frequency is needed. The frequency can be swept over a 100:1 range via RV1 and the centre frequency can be altered by changing the C1 value.

The high-performance two-phase generator of Figure 20 is based on the VCO section of a
4046B phase-locked loop chip and is useful in applications where the frequency needs to be swept over a very wide range, or needs to be voltage controlled. The frequency is controlled by the voltage on pin 9, being at maximum (minimum delay) when pin 9 is high and minimum (maximum delay) when pin 9 is low. Maximum frequency is determined by the C2-R1 value and minimum frequency by the value of C2 and the series values of R2-RPS1.

The Figures 19 and 20 circuits can be used to directly clock all CCD delay lines except the SAD4096, which has a clock terminal capacitance of 1000 pF (1 nF) and needs low-impedance clock drive. The SAD4096 is best driven by the circuit shown in Figure 21 which uses the two halves of a 4013 wired in parallel to give the required low-impedance two-phase output: the circuit is driven by a single-phase clock signal which can be obtained from either of the Figure 19 or 20 circuits.

**Filter circuits**

In most applications a low-pass filter must be inserted between the actual input signal and the input of the delay line, to prevent aliasing problems. Another must be inserted in series with the output of the line to provide clock-signal rejection and integration of the sample's signals. For maximum bandwidth both filters usually have a cut-off frequency that is one third (or less) of the maximum clock frequency used; the input filter usually has a first-order or better response and the output filter has a second-order or better response.

Figure 22 shows the practical circuit of a 25 kHz second-order low-pass filter with coupled input and output. The non-inverting terminal of the op-amp is biased at half-supply volts, usually by a simple potential divider network. The cut-off frequency can be varied by giving C1 and C2 alternative values, but in the same ratio as shown in the diagram, e.g. cut-off can be reduced to 12.5 kHz by giving C1 and C2 values of 1 nF and 6 nF respectively.

All delay lines suffer from a certain amount of 'insertion' loss. Typically, if 100 mV is put in at the front of the delay line, only 70 mV or so appears at the output. Often the output low-pass filter is given a degree of compensatory gain to give zero overall signal loss. Figure 23 shows such a circuit. This circuit has a nominal cut-off frequency of about 12 kHz, depending on the setting of the GAIN BALANCE control.

Finally, to complete this look at CCD delay line circuits, Figure 24 shows how a two-input unity-gain 'mixer' (adder) can also be made to act as a first-order low-pass filter by simply wiring a roll-off capacitor (C3) between the output and the terminal of the op-amp. This type of circuit is often used at the front end of CCD flanger and reverbation designs.
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<tr>
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Immersible temperature controller features zero-crossing ac control

This simple to construct project has done sterling service as a temperature controller in a common fish tank heater but has wide application. It features a zero-crossing switch type controller to prevent RF interference to other appliances.

At this point, let us stress that the pc board is operating at live mains potential as the IC is designed to run directly on the mains without transformer isolation, so be careful. You should never touch any of the components while the circuit is plugged in, nor try to adjust the setpoint preset pot. Exercise extreme care when installing the circuit and ensure that it is mounted securely in a place where it is sealed away from prying fingers and poking utensils. While no less safe than the ordinary mains connection in whatever appliance you are using it with, it is significantly more tempting to approach this little fellow with a screwdriver or pair of pliers, so do try not to cost ETI any readers, especially yourself or your family.

Jonathan Scott

IF THIS PROJECT did not run directly on 240 volts we would call it a simple project. It contains only one IC, a triac and very little else, yet it is a full zero-crossing switch system capable of controlling up to 1500 watts of heating power that may be employed to regulate the temperature of a room, a fish tank or a bowl of yoghurt-in-the-making. The latter two tasks are those for which it was first dreamed-up, but more ideas come to the mind the longer you think about it. The fact that it is a zero-crossing switch (see the panel on page 31) rather than a proportional phase control means that it will not generate any RF noise — no clicks or pops in the hi-fi, no buzzes or hums in radios. The fact that it is quite small (it requires no heatsink for loads of 200 watts or less) makes it possible to include it in the innards of the heating device. For instance, we built one inside the narrow glass tube of an aquarium heater. It is cheap to build as it requires no transformer or mechanical relay mechanism. It can be adjusted to regulate to any temperature that the sensor can stand. In our case we wanted to regulate to a temperature in the 25-30°C region, but the unit will regulate over quite a wide range of temperatures with the correct resistor values, provided the pc board is not cooked along with the thing you are heating. This means of course, that the pc board and triac must be separated if you want to go over about 50°C or so. Varying things is covered later.
Circuit. Simple, what?

**Parts and construction**

Three of the components in this circuit are worth delving into briefly, so that you know what they do and how the choice of type affects the circuit performance. The first is the triac. This must be of 400 or more volts rating, and it must be of at least 4 A. A current rating as the pcb board is designed to take the type which comes in a bolt-on package, and these start at 4 A. This over-rating, if you are only planning to have around 150 W of heater, as I did, allows you to dispense with a heatsink. There is no reason why you should not have a higher rating still if the thing physically fits in place. With a heatsink, the type we found most common at the suppliers (and used) is rated at 6 A and will thus run up to 1500 watts (6 A x 250 Vols) of load.

The IC we have specified is a type CA3059, from RCA (distributed by AWA Micromenics). There are three ZCS ICs available, one slightly more expensive which offers tighter specifications, of no use to us here. The other one, a CA3079, lacks a facility which is incorporated in the 3059, the device specified. This device has an 'automatic switch-off' facility for the heating element in the event that the temperature sensing thermistor goes either open circuit or short circuit. This means that if the connections to the thermistor or the sensor itself fail, the system will not turn the heater on and overheat the controlled object. This adds a dollar or two to the price, but is quite worthwhile. The 3079 device must not be used in this circuit.

The thermistor you use will depend upon how much you wish to pay, how robust a component you need, and how you wish to connect it thermally to the load, as well as the temperature you are going for. We used both a cheap bead type, and an ITT G24CW. The latter is a small, but strong, glass bead type with a wide temperature range — but a $10-plus price tag! The G24CW is a professional type, both reliable and predictable. As we pointed out above, a failure of the thermistor is not likely to cause anything but a cooling of the load, so unless you are willing to pay the price and need the reliability, use a cheap type. It is only necessary to have a resistance of 10k to 60k at the regulated temperature. We used a type having a resistance of 47k at 20°C, coating $1 to $2 at a local supplier.

Once you have obtained the thermistor, it is necessary to select R4 and RV1 to suit.

These must together be able to equal the resistance of the thermistor at the temperature you are going for. Now, the G24CW has a resistance of 20k at 20°C and a temperature coefficient of so many ohms-per-degree. As we were going for 20-25 degrees in that model, we chose 8k2 for R4 and 20k for RV1, ensuring that we could reach 20k or a bit less. In general, if the thermistor is a cheap type, you had best measure its resistance while at the temperature most used. If it comes with specifications, say of X ohms at 20 degrees and Y ohms-per-degree, it will have a total resistance of (X+Y (20 - T)) ohms at T degrees.

So, having selected these components, you should assemble them on the pc board in accordance with the overlay diagram. Take care to get the polarity of the IC, capacitor and triac correct. Note that the metal flag of the triac is the A2 (anode 2) connection, and the lead to the load is taken via a lug on the bolt holding it to the pc board.

The final piece of constructional detail is the mounting of the thermistor. It is important to have it in close thermal contact with the item you are trying to heat. In our constructional example we are regulating the temperature of the liquid surrounding the tube within which the controller and the device are placed. Thus, we need to mount the thermistor as close to the device as possible. The two most common thermistors are the NTC (negative temperature coefficient) and the PTC (positive temperature coefficient), but the former is preferable here, and is used.

The CA3058 and CA3059 are used in this project. If the project is used to control a fish tank heater, the half rail potential the comparator activates a circuit which turns the triac on at the next supply zero, and each subsequent zero until the voltage falls below half rail.

Clearly, then, RV1/R4 must be selected so that they add up to the resistance of the sensing thermistor at the temperature for which it is desired to regulate. Thus, when the temperature reaches the preset point, the voltage across TH1 corresponds to half rail potential on pin 13. Pin 14 allows the protection circuit to detect when TH1 goes either open circuit or short circuit by looking at the voltage at the junction of R4 and TH1. If this voltage nears the dc supply rail or the local common (N), there has been a failure, and the firing of the triac is inhibited until the condition is removed.

The supply dropping resistors R1-3 are used instead of a single resistor purely for size considerations. All that is required is that they deliver 10 to 50 milliamps to the IC's rectifier-regulator.

The sensing thermistor must be a negative temperature coefficient type (NTC), as its resistance must drop with increasing temperature. In order to reduce the voltage on pin 13 as the temperature is brought towards the setpoint, there is sufficient excess supply current to allow it to draw at least one milliamp if necessary. Thus, any of the common small bead types with a few kilohms of resistance at the setpoint may be used. The total permissible sensor resistance range is 2k to 100k.

Most of the functions of this temperature controller are contained inside the IC, so let's take a look at the CA3058/3059 zero-voltage switch IC first.

Three zero-voltage switches are made by RCA — the CA3058, CA3059 and CA3079. They are all designed to control a thyristor in a variety of ac power switching applications for ac input voltages of 24, 120, 230 and 77 volts at 50, 60 and 400 Hz. The 3058 is supplied in a 14 lead dual-in-line (DIL) ceramic package and the 3059 and 3079 are supplied in 14 lead DIL plastic packages. Each incorporates four functional blocks as follows (refer to the block diagram here):

1. Limiter-Power Supply — permits operation directly from an ac line.
2. Directional Voltage Sensing Amplifier — tests the condition of external sensors or command signals. Hysteresis or proportional-control capability may easily be implemented in this configuration.
3. Zero-Crossing Detector — synchronises the output pulses of the circuit at the time when the ac cycle is at zero voltage point; thereby eliminating radio-frequency interference (RFI) when used with resistive loads.
4. Triac Gating Circuit — provides high-current pulses to the gate of the power controlling thyristor.

In addition, the CA3058 and CA3059 provide the following important auxiliary functions:

1. A built-in protection circuit that may be actuated to remove drive from the triac if the sensor opens or shorts.
2. Thyristor firing may be inhibited through the action of an internal diode gate connected to Terminal 1.
3. High power dc comparator operation is provided by overriding the action of the zero-crossing detector. This is accomplished by connecting Terminal 12 to Terminal 7. Gate current to the thyristor is continuous when Terminal 13 is positive with respect to Terminal 9.

Because the CA3079 does not incorporate the built-in protection circuit, the CA3058 or CA3059 have been specified for this project. If the project is used to control a fish tank heater,
heater are immersed. It is thus only possible to regulate the tube temperature, as we cannot put the (live) sensor in the liquid. The sensor was pressed against the tube and sealed in a blob of thermal compound of the type used for mounting transistors on their heatsinks. This meant that it was held at the temperature of the outside as much as possible, rather than at the temperature of the heater and controller themselves. In general, the limitation of keeping the sensor in the same container as the rest of the controller is the one responsible for the accuracy of the system. This method, used in small appliances and ordinary aquarium heaters, gives about two degrees accuracy if the liquid is well mixed and convects freely past the tube. Our controller, limited by the same problem, gives little improvement: the only advantage comes from the fact that the sensor is a small piece of solid which can be pressed to the glass firmly, whereas the mechanical (bi-metallic strip) type of temperature sensor cannot be so positioned. In a larger container it can be separated by some distance and placed wherever you need, and it will give fractional degree accuracy.

As the design of the housing is largely up to the individual constructor, there is very little to say about the physical makeup of the project. If you are copying the format shown in the pictures, assembly is rather straightforward. The only point to note is that you will have to take particular care to see that the tube is sealed against the accidental entry of liquid. Here, Silastic or a similar silicone sealant comes in very useful.

It is necessary to set the preset pot before sealing up the immersible tube. This is done by carefully setting the system up with water coming up to the point on the tube above where the sensor is located. Then, allow a couple hours of undisturbed operation and measure the liquid temperature with a thermometer. Adjust the preset pot (mains unplugged!) and repeat. If you measured the thermistor beforehand, while at the correct temperature, you can adjust the pot/R4 combination to give you that resistance straight away and there should be no need to make a second adjustment of the pot. If at some later stage you wish to change the set point, Silastic is easy to peel away and you can reseal the tube when the adjustment is made and checked.

We do not advise you to leave an access hole to permit adjustment of the pot because, firstly, someone might try and do that with the power on (proof?) or more likely the liquid will find a way of invading the tube and quietly ruining the components.

---

**Immersible Temp. Controller**

**Diagram**

**Parts List—ETI-1511**

- **Resistors**
  - all 1/8 W, 5% unless noted
  - R1, 2, 3: 68k, 1 W
  - R4: 8k (see text)
  - RV1: 20k, 10-turn trimpot

- **Capacitors**
  - C1: 100uF/16 V tarih.

- **Semiconductors**
  - CA3059
  - SCR1: 6A/400 V triac, e.g: T1C226D or similar

- **Miscellaneous**
  - TH1: thermistor to suit application, e.g: ITT G24C glass bead type (see text)
  - ETI-1511 pc board; solder lug; hookup wire; heating element, etc.

**Price estimate**

- $14 - $16 (less element)

---

**The Zero Crossing Switch (ZCS) Technique**

In normal phase control switching the switching element, an SCR or Triac, is triggered into conduction at some time during each half cycle. The moment of switching is varied, so that the duration of the applied voltage pulse, which corresponds to the fraction of the cycle left at the point of triggering, is varied. This is a simple and direct method which does vary the applied power fairly smoothly (see Figure 1). Unfortunately, the sudden application of voltage tends to produce a lot of electromagnetic radiation due to the sudden current change in the load circuit. This is responsible for a lot of radio frequency interference, or RFI.

In ZCS the switching element is only allowed to change the conducting state when the supply voltage is crossing the zero-voltage point—hence the name. This means that there are no sharp voltage transitions across the load, and so no RFI. The penalty paid is that only half of the load cycles are applied to the load. The system is thus not readily applicable to lighting applications as the lights flicker badly due to the relatively long periods between conduction and isolation (see Figure 2).

For applications where the system has sufficient inertia, such as heating, this system is by far the superior technique. As the required functions are available within a single, relatively cheap, IC it is practicable to build a ZCS system with almost the same ease as a proportional system.

---

**Figure 1.**

**Figure 2.**

ETI February 1983 – 31
You may have wondered why Jaycar did not (until now) sell home computers. We had many reasons but our main one was that we were not entirely "happy" with any of the units currently on the market. The closest we came to what we thought was a pretty good computer was the Apple. We thought that it was, quite frankly expensive. However it was sold and serviced throughout Australia by a reputable sales network — so there was no need for Jaycar!

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Electric fence tester

This project was developed to take some of the guesswork out of testing or checking an electric fence. Many factors can influence the operation of an electric fence energiser and fence, reducing its effectiveness. A common method of testing a fence is to hold a blade of grass near the wire and get the ‘feel’. Get it wrong and you’ll find yourself dusting off the seat of your pants!

ELECTRIC FENCES are now a common ‘tool’ of farm management. Cattle which escape from an enclosure can cause considerable injury to themselves and other property. An electric fence is an effective, non-injurious barrier when properly erected and maintained. But they have to be maintained! Checking if an electric fence is operating by grabbing it is one method to prove it’s working — but few relish the substantial ‘jolt’ delivered. Another method is to hold a blade of grass near the fence wire. At a few centimetres distant, you should feel a ‘tickle’. But, that’s dependent on the moisture in the grass, your contact with the ground, etc. If you fail to feel the tickle and approach more closely, you’re liable to receive quite a jolt! None of these methods is quantitative, nor can results be compared day-to-day or along the length of a fence.

This project was devised to provide a more quantitative indication of fence/energiser operation and avoid the pitfalls of the ‘grass roots’ methods.

The unit indicates the presence of each pulse from the energiser and shows when the pulse voltage on the fence wire exceeds an amplitude of 2 kV, 3 kV and 5 kV, once calibrated. If used in an uncalibrated mode, the unit will indicate pulse amplitudes on the fence of 40%, 60% and 100% of energiser output.

The electronics for this project has been deliberately kept simple, so that the cost is low and reliability good. Construction, too, is simplified. Only two ICs, a handful of resistors and capacitors, four LEDs and very little else is used. The LEDs are used as indicators. So that they can be readily seen in sunlight, we recommend you use the common yellow LEDs or the recently introduced ‘high brightness’ types.

Our tester was housed in an all-plastic case — so that you can’t possibly come in contact with anything carrying the high voltage pulses! The case is held in one hand and the probe protruding from the end touched on the live wire from the fence after the ‘ground’ probe or lead is literally ‘earthed’. Pressing the pushbutton on the front panel turns the unit on. One LED indicates the presence of a pulse. The ‘2 kV’ LED lights to indicate the unit is on and goes out when a voltage pulse exceeding 2 kV is present. When the voltage pulse exceeds 5 kV, the 2 kV LED goes out and the ‘3 kV’ and ‘5 kV’ LEDs flash on. If there is a problem with the fence or the energiser, and the voltage does not exceed 2 kV, the ‘pulse’ LED only will flash, indicating that the energiser is working but that the voltage is low. More details on checking out a fence are given later.

Construction

For ease of assembly and reliability, it is recommended you use our PCB board design. This board will fit in a standard, commonly stocked plastic case measuring at least 60 mm wide by 30 mm deep by 110 mm long. A number of models have been made, but the one shown in the photograph measured 65 x 36 x 121 mm (w-d-l). The front panel was dressed up with a plastic Scotchcal label. Don’t use a metal type as pulses from the fence probe may ‘track’ across the case to the panel and you may receive a little surprise. You can make your own PCB board using our artwork or buy one ready made, that’s up to you.
When you’ve gathered all the components together, first thing to do is check the pc board. See that all the holes are drilled the correct size and that there are no broken tracks or shorts between tracks — particularly between the IC pins. Commercially made boards don’t suffer such problems in general, but do check the hole sizes. If you mount the pushbutton switch on the pc board, like I did, then see that the holes where it mounts are of the right diameter. Leads on the LEDs on the trimpot are usually of greater thickness than most other components and their mounting holes should be checked too.

At the ‘top’ of the case, mark out and drill two holes for the fence and ground probes. The fence probe shown on the model in the photographs was a 50 mm long 2 BA bolt. The ground probe was plugged into a standard ‘banana’ socket.

If, or when, all’s well with the pc board, mark out and drill the case. Tackle the front panel first. You can use the Scotchcal artwork as a template to mark out the front panel, pricking through the artwork with a sharp-pointed instrument such as a scriber. Drill the holes carefully. It’s easier to use the lid of the plastic case as the front panel. No clip holders for the LEDs were used as they’re unnecessary, really. Just drill the LED holes slightly larger than the diameter of the body of the LED — 5 mm will do nicely. The pushbutton will require a 6.35 mm (¼”) hole.

Now you can put the Scotchcal on the front panel. Position it carefully, having peeled away the backing. When you’ve got it in position, smooth it down rubbing from the middle toward the edges, taking care to avoid getting bubbles under it. If you do get some bubbles or small wrinkles, these can be smoothed out by rubbing them away towards the nearest edge. Using a modeller’s scalpel or other sharp blade, carefully cut out the holes in the Scotchcal.

With the case prepared, you can tackle the pc board assembly. Refer to the accompanying overlay. Solder all the resistors and capacitors in place first, including RV1. Then solder all the diodes in place, making sure you get them the right way round. Note that D1 is an IN4007 and D2, D3 are IN914s or IN4148s. Solder the two ICs in place next, taking care to orient them correctly. Solder the pushbutton to the board next, making sure it sits perpendicular to the board. Last of all come the LEDs. Place them in their positions, making sure you get them the right way round, but don’t solder the leads yet. Temporarily mount the board to the panel using the pushbutton. Then, pushing each LED into place in turn, solder their leads to the board. Disassemble the board from the front panel and solder flying leads of adequate length from the fence probe and ground probe pads on the board and attach the battery clip lead. Use heavily insulated wire for the probe leads and space them well away from each other.

Assemble the board to the panel once again and terminate the two probe leads from the board. Plug in a No. 216 9 V battery and you’re ready to test and calibrate the unit.

Testing it
This method is guaranteed non-dangerous as you don’t get anywhere near an electric fence or fence energiser! For this test you will need one 470 ohm resistor. Solder one lead to the battery positive pad on the board. Set RV1 so that its wiper is at the R10 end of its travel (toward IC1). Press the pushbutton. The ‘2 kV’ LED should come on. Now touch the other end of the 470 ohm resistor to the junction of R10 and RV1. The ‘2 kV’ LED should go out, the ‘3 kV’ and ‘5 kV’ LEDs should light and the ‘pulse’ LED should give a flash. When you disconnect the 470 ohm resistor, the ‘3 kV’ and ‘5 kV’ LEDs should go out in reverse order (5 kV LED first) and the 2 kV LED light briefly. If you don’t get these indications, look for an error in component orientation or placement. Check that you’re getting the supply to the circuit when you press the pushbutton, too.

Correct any errors and try again.

Calibration
You can go about this in several ways. The display can be calibrated to read fence voltage as a percentage of energiser voltage output or it can be calibrated to read directly in volts. If you’re going to calibrate the display to show percentage of energiser output then this should be done with the energiser connected to either a ‘known good’ fence or to a

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**PARTS LIST — ETI-1512**

**Resistors**
- 0.5W 5% unless noted
- R1-6 1k, 1K
- R7, R12 1K
- R8, R15 3K3
- R9 10k
- R10 39k 1 W
- R11 2M2
- R13 10k
- R14, 20, 21, 22 220R
- R16 4k7
- R17, R19 2k2
- R18 1k2
- RV1 500R min, vertical mount trimpot.

**Capacitors**
- C1, C3 100n green cap
- C2 33pF ceramic

**Semiconductors**
- D1-4 IN4007
- D2, D3 IN914, IN4148
- IC1 CA3140
- IC2 LM324, uA324
- LED1-4 TIL220Y yellow LEDs

**Miscellaneous**
- PB1 pushbutton

ETI-1512 pc board; all plastic zippy box 121 x 65 x 36 mm or similar; No. 216 9 V battery and clip lead; Scotchcal front panel; wire, alligator clip etc.

**Price estimate**
$18 — $22
The circuit can be divided into four sections: the input divider, the peak voltage detector, the display and the pulse indicator.

**INPUT DIVIDER**

The input divider comprises R1 to R6, plus R10 and RV1. Diode D1 is for protection, and I'll get around to that shortly. Assuming a positive-going input pulse of 5 kV peak, the voltage appearing across R6 will be about 830 V. This will be conducted to R10/RV1 via D1 and a pulse of about 10 V peak will appear across RV1. When calibrated to indicate voltage on the display LEDs, RV1 will be set to about mid-travel and a pulse of about 5 V peak will appear on the wiper of RV1. What happens to that, I'll get around to in a minute, but first, what's the reason for D1?

Should the input pulse on the fence probe be negative-going, as it sometimes is, then D1 will not conduct as it will be reverse-biased. This prevents a large negative-going pulse being conducted to the rest of the circuit. If the peak pulse voltage developed across R6 in this situation should be greater than 1000 volts, D1, which is rated at 1 kV PIV, will likely go into reverse, or 'zener', breakdown the current passed through it being limited by R10. The voltage across RV1 will be very low, thus ensuring the rest of the circuit is still protected.

**PEAK VOLTAGE DETECTOR**

IC1 and D3 are arranged as a peak voltage detector. The positive-going input pulse from RV1 is applied to the non-inverting input of IC1, pin 3, via R13. As the input impedance of IC1 is very high, R13 does not drop the input voltage and simply provides input current limiting. The output of IC1 will be driven toward the positive supply rail and D3 will conduct. Negative feedback from the cathode of D3 to the inverting input of IC1, pin 2, ensures that IC1 has only unity gain (±1). The output of IC1 charges C3 to the same value as the peak voltage applied to the input. If the peak pulse voltage on the fence probe is 5 kV, and the voltage on the wiper of RV1, when calibrated, is 5 V then C3 will be charged to 5 V.

When the input pulse falls to zero, C3 will discharge slowly via R15 and the combined input impedance of op-amps IC2a, b and c.

**THE DISPLAY**

The display circuitry consists of IC2a, b and c arranged as voltage comparators, LEDs 2, 3 and 4 and resistors R16 to R22.

The resistive divider formed by R16, 17, 18 and 19 provides three fixed voltage points. The junction of R16-17 will be at 5 V (with respect to the common rail), the junction of R17-18 will be at 3 V and the junction of R18-19 will be at 2 V. Thus the Inverting input of IC2c will be held at 5 V, the Inverting Input of IC2b will be held at 3 V, but the non-Inverting Input of IC2a will be held at 2 V.

With the non-inverting input of IC2a (pin 3) held at 2 V, the output, pin 1, will be driven high (toward +9 V) and LED4 will light, the current through it being limited by R22. That is, assuming PB1 is pressed, LED4 thus acts as an 'ON' indicator, one part of its dual role.

If the voltage on C3 reaches a little over 2 V, the inverting input (pin 2) of IC2a will cause the output to go low and LED4 will go out, indicating that the peak pulse voltage on the fence probe has reached 2 kV.

As the inverting inputs of IC2b and c are held at a lower voltage than their non-inverting inputs, the outputs of these two op-amps will be low and LEDs 3 and 4 will be off.

When the voltage on C3 reaches a little over 3 V, the non-inverting input of IC2b will be at a higher voltage than its inverting input and its output, pin 7, will be driven high, lighting LED3.

Note that LED4 will remain off. Thus, LED3 lighting indicates that the peak pulse voltage on the fence probe has reached 3 kV.

When the voltage on C3 reaches a little over 5 V, the non-inverting input of IC2c will be higher than its inverting input and LED2 will be turned on, in the same way as LED3 was turned on. Thus, when LED2 lights, you know the peak pulse voltage on the fence is at least 5 kV.

Note that, in this case, LED4 will be out and LEDs 2 and 3 will be lit.

**THE PULSE INDICATOR**

This circuit comprises IC2d, LED1 and associated components. The input pulse is used to trigger IC2d which is connected as a one-shot multivibrator. The output of IC2d drives LED1 which will flash, indicating the presence of a pulse, regardless of the amplitude, so that if the pulse has insufficient amplitude to drive LED4 off, you can still check that the energiser is supplying pulses to the fence.

In the absence of an input pulse, resistor R8 keeps the output of IC2d in a low state (0 V) as it holds the inverting input (pin 13) at a higher voltage than its non-inverting input (pin 12). Thus, LED1 will be off.

When an input pulse arrives, it is coupled to the one-shot via C2, and R9. The positive-going pulse drives the non-inverting Input of IC2d (pin 13) more positive than its Inverting input (pin 12), driving the output (pin 14) high. LED1 will turn on and positive feedback via R11 will cause IC2d to 'latch' in this state. At this time, C1 will charge from virtually zero volts toward the supply rail, via R7-R8. When the voltage across C1 reaches the value on pin 12, the op-amp will switch back to its previous state with the output low. LED1 will then go out. This action takes a few hundred milliseconds, time enough for you to see LED1 light.

So that the one-shot reacts to rapid pulses, diode D2 is included to discharge C1 quickly, so that IC2d rapidly resets to its quiescent state, ready to receive the next incoming pulse.

If the energiser provides a negative-going pulse to the fence, reverse the energiser connections, NOT the Fence Tester connections or you'll be applying the fence pulse to the common rail of the Tester and you might get a wee surprise via PB1 when you try to test the fence.
Shock. Horror. Probel Gentleman about to receive shock from incorrectly connected Fence Tester (note: ground lead going to live fence wire) dummy fence. A dummy fence can be made up quite simply. You'll need two 10n/3 kV ceramic capacitors, which are widely available. These should be connected in series and then connected directly across the energiser output along with the Fence Tester, thus placing a load of about 5 nF on the energiser. Nothing else should be connected across the energiser output. Make sure all the connections are well above the bench top, or whatever. Set the energiser going, then press the pushbutton on the Fence Tester. Adjust RV1 back until the '5 kV/1000' LED just goes out, then advance it until it comes on again with each pulse. This doesn't necessarily indicate that the energiser is delivering 5 kV. Some energisers will only provide an output around 4 kV on load. This procedure assumes your energiser is working correctly in the first place, so you'd better be pretty sure of that!

By far the best method is to calibrate the Fence Tester so that it actually indicates voltage. For this you'll need an oscilloscope with a x10 or x100 probe. Set the Y-input attenuator to read 200 volts/div. i.e. 2 V/div. or 20 V/div., depending on what range the input attenuator covers. Connect the CRO input across R6 and set the sweep to a low rate. Set the Y-amp input to 'dc'.

Again, your energiser should be connected either to a known good fence or a dummy fence. Connect the Fence Tester to the energiser's output, set the energiser going, and measure the pulse amplitude directly from the oscilloscope's face. At 200 V/div., multiply by six to give the energiser's output directly in volts. Say you get a pulse amplitude of 4½ divisions on the CRO. The energiser's output is 4.5 x 200 x 6 = 5400 volts.

Note the polarity of the pulse. Generally, it will be positive-going. However, some energisers give a negative-going pulse. If such is the case, you'll need to reverse the energiser output leads for the next step.

This time, connect the oscilloscope across C3. (Don't use a x1 probe or you'll upset the C3-R15 time constant.) Set the Y-input to read, say, 1 V/div. on the screen (taking the probe division into account). Turn on the energiser and adjust RV1 so that the peak pulse voltage on the screen is 1000th that previously determined. If the energiser output was determined to be 5400 volts, then the peak pulse amplitude across C3 should be 5.4 volts when RV1 is correctly adjusted.

The unit is now calibrated and ready to use.

In use

When using the Fence Tester, always remember to connect the ground probe first. You can use a pointed metal stake to drive into the ground or a large, strong alligator clip to get a good 'bite' on the star pickets often used to support electric fences. Touch the fence probe on one of the 'live' fence wires and then press the pushbutton. Keep your hands and the Tester dry and keep your big fat pinkies away from the top end of the box.

You will find that the voltage on the fence will be highest closest to the energiser, decreasing the further down the fence you move from the energiser end. If the fence is 'shorting to ground' somewhere, then the voltage will fall off rapidly as you approach the fault. If the live wire is open (i.e. broken) at some point, the voltage will remain high within the vicinity of the break, but disappear on the side of the break away from the energiser.

To be effective, the fence voltage should be generally no lower than 3 kV at its distant end.

BATTERY CHOICE

As this project will probably experience considerable periods of idleness, a battery having a long shelf life is recommended. Alkaline batteries have by far the longest shelf life, being about 10 years, and are thus recommended. Standard carbon-zinc batteries have a shelf life somewhat less than half that of Alkaline types and would need replacing at six to eight month intervals — if you could remember!
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Post and handling

I enclose TOTAL $

Name:
Address:
Postcode:
Signature:

Please debit my [ ] Bankcard [ ] American Express Card
Expiry Date

Number

February 1983 ETI
An EPROM programmer for the MicroBee

This simple, low cost EPROM programmer just plugs into the MicroBee's I/O port and enables you to save programs in any of five different common EPROMs which can then be used in your MicroBee or any other microprocessor-based system. As the MicroBee I/O port is effected with a Z80 PIO chip, this programmer can be used with any other system employing the same I/O.

SICK OF loading tapes? Well here's a way to avoid much of the drudgery, at least for your favourite machine code programs. EPROMs — Erasable Programmable Read Only Memories — are a storage medium often overlooked by keen computerists intent on blowing big dough on such things as disk drives. Information in EPROMs is the same as in any other read only memory — it's always there, and instantly available when you switch on the computer.

It would be fair to say that probably 99% of all EPROMs are programmed once and then forgotten. Manufacturers of computers in small production runs, that is by thousands instead of millions, find it convenient to put their firmware in EPROMs, instead of mask-programmable ROMs. It's cheaper in small quantities, and they can do the programming themselves, instead of having a chip manufacturer make up a special (and expensive) mask.

The standard MicroBee has four EPROMs containing its 16K BASIC, and there are two more if the Editor/Assembler is fitted. There's another blank position meant for a future networking EPROM which can be put to use for other purposes with the help of this project.

A version of this programmer has been in use for over two years, connected to a 6800-based computer that I built. Giving credit where credit is due, what was laughed at by some as a 'toy computer' has turned into a highly useful tool especially since an upgrading in the EPROM department.

It started out with a 1K byte EPROM which was exchanged for a 2K 2716 and then a 4K 2732, a change which required only two jumpers to be moved. The original 1K of machine code now resides in the bottom quarter of the 2732. Within the other three-quarters of the EPROM are a debugging routine, a branch offset calculator, a branch address calculator, a disassembler, hex memory dump to teletype, and teletype printing programs for the Tandy/Sharp pocket computer and the MicroBee. And there's nearly 1K still free!

All this software started off small and just grew until most of it is now interlinked, with some programs accessing subroutines in maybe two or three others.

The point of all this is that there's an empty EPROM slot in the MicroBee that's just begging to be filled with a 2532. And Z80 versions of the above mentioned software...
could very well fill the EPROM. The same goes for any machine code. (Your favourite game?) It is also claimed that 2716s are pin compatible with the MicroBee’s 6116 RAMs, and if yours is a 16K MicroBee there are eight 6116 slots empty. This hasn’t yet been tried and should be approached with caution as it could be disastrous to the 6116 battery backup system.

The hardware

EPROM programmers seem to come in two different types — complicated, and with the arrival of the ETI-668, not so complicated. You could simply go out and buy one, paying hundreds of dollars. Computer-driven home-brew models usually require all 16 address and eight data lines to be brought out, or lots of parallel in/out ports. The MicroBee only has one parallel port. The ETI-668 does the job with one port, an on-board address generator, an on-board programming pulse generator, and a ‘trigger pulse.’

The computer first presents a byte of data to the EPROM via the parallel port’s eight data lines and then supplies the trigger pulse via the port’s handshake lines. The trigger pulse sets off a 50 ms single-shot multivibrator to form the programming pulse, and as the programming pulse finishes it increments the address generator.

The trigger pulse is officially meant to tell a printer to print or a punch to punch, so it applies only to data leaving the computer. But what happens when you want to read material from the EPROM into the computer? If you believed the data books you’d give up at this stage, but now comes the incredible story of the illegal trigger pulse.

My 6800 machine uses Motorola’s 6821 parallel port chip which can be programmed to provide a trigger pulse via its CB2 handshake line whenever data is sent out. But, wonder of wonders, the pulse occurs even when the port is configured as an input. Data written to it doesn’t go anywhere but the act of writing does fire the trigger pulse. So, the trick is to read the port to get a byte out of the EPROM, and then write a dummy value back to it to increment the address generator.

Discovering that bit of undocumented information was an unexpected stroke of good luck, but you haven’t yet heard the best of it. The MicroBee uses the 280 PIO chip for its parallel port, a device as different from Motorola’s 6821 as night is from day. Would the same trick work again? The gods must have really been smiling.

The PIO data sheet shows that when the chip is configured for output, and with the handshake lines ‘ready’ and ‘strobe’ tied together, a half-microsecond positive-going pulse comes from them after an ‘OUT’ instruction to the port. Once again, outputs only. So what would happen with the port set up as an input? Yep — one undocumented, illegal trigger pulse! How can this happen to me. I’ve never even won a miserable 50 cent sweep? Perhaps we should shut up and be thankful to that great chip-designer in the sky.
With that handy trigger pulse available it's now an easy matter to program and read EPROMs with a simple circuit.

Now a few words about the quirks of EPROMs from someone who blew up several during the development of this project.

Each bit in an unprogrammed EPROM is high, so all bytes read 'FF'. During programming each bit required to be low is hit with what amounts to a miniature lightning bolt. It the bit is too long, too powerful, Ka-boom — one blown EPROM.

The supply for properly 'burning' an EPROM comes from a 'high voltage' regulated source, usually 21 or 25 volts. With normal programming, an EPROM draws less than 30 mA from this supply. When something goes wrong, it draws much more, usually resulting in the absolute destruction of the EPROM. With that in mind, the 'programming' supply for this project has a current limit protection of 30 mA designed in.

Many programmer designs let the computer develop the 50 ms programming pulse in software. The ETI-668 does it with a hardware single-shot, nice and foolproof, even if the computer program crashes for some reason. A characteristic of EPROMs often ignored is the specification that the data lines must settle down for at least four microseconds before the programming pulse begins, and another four microseconds must be allowed between the end of the programming pulse and any changes on the address lines. This design provides 50 microsecond delays — much longer than necessary, but easy to see on an oscilloscope when setting up the programmer board.

The barber shop blues

EPROMs are erased by exposure to ultra-violet light. You can go out and buy a special EPROM eraser for many dollars. A UV tube costs about $20. But, if you know a friend or barber your outlay will be nothing more than an occasional haircut. Most barber shops have a device called a 'Servex Ultraviolet Sterilizer' for getting the nasties out of combs and brushes. A half hour in the old Servex will erase an EPROM nicely, and give you and the barber something to talk about besides cricket or football.

Construction

Before we start, a couple of things need to be pointed out. Firstly, for the majority of hobbyist applications the expense of a zero insertion force socket seems unjustified. A better choice would be one of the better quality 'normal' IC sockets, such as the ones with gold-plated pins. I have used one of these in my programmer board and in the spare EPROM position in my MicroBee and both will have EPROMs plugged in and out fairly frequently. (However, the ETI-built version, shown in the photographs, has a ZIF socket soldered in place as we plan to use the programmer rather more frequently than most hobbyists — Ed.)

Secondly, if your MicroBee isn't equipped with a port socket (DB15 female, pc mount style), now's the time to install it. (Editor's note: our MicroBee 64 had the DB15 port socket shown back on the pc board silk screened overlay — just check this if you're installing your own socket.)

Assembling the pc board is fairly straightforward. Before commencing assembly, have a good look at the pc board and make sure that no tracks are broken or shorted together. This applies especially if you are making your own pc board. If the visual check is OK, start by soldering the five links in place. These have been included despite the fact that they're often considered 'bad form'. But the few links are preferable to a more expensive double-sided board, just for the sake of a few connections.

Mount all the resistors and capacitors next, with the exception of the three power supply electrolytes, C4, C8 and C9. These can be mounted either on top of the board or, as in the ETI prototype, under the board. The latter course of action enables you to mount the board beneath the front panel of a jiffy box, or other suitable enclosure. If you just intend to have the unit 'hanging around on a shelf or in a drawer', then the electrolytes may be mounted on the top (non-copper) side of the board. For the sake of convenient handling, leave the mounting of the electrolytics till last.

The diodes and ICs can be mounted now. Take care with the orientation of the diodes ICs 1, 2, and 3 are CMOS types and the usual handling and soldering precautions should be observed. Only handle them between thumb and forefinger, avoid touching the pins, and solder the supply pins first. IC4 is a conventional bipolar IC and no special precautions need be observed. Note that ICs 1 to 4, the personality I/O socket and the EPROM socket are all aligned so that they face the same direction. IC5 is a three-terminal regulator. This mounts with the metal tab facing toward the board. Now you can mount the 16-pin personality socket (an ordinary IC socket) and the 24-pin or 28-pin socket for the EPROM.

Attach suitable lengths of hookup wire to the board and wire up the reset button, SW1, and the read/program switch, SW2. Check it when you've finished. Now strip a short length of ribbon cable so that you have ten wires. Peel back the wires individually at each end, strip and tin the ends, then wire one end to the pc board and the other end to the DB15 plug as shown in the overlay. Carefully check that you have the plug correctly wired.

PERSONALITY PLUGS

<table>
<thead>
<tr>
<th>2716</th>
<th>2532</th>
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<tbody>
<tr>
<td>2732</td>
<td>2722A</td>
</tr>
<tr>
<td>2764</td>
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</table>

ETI February 1983 — 47
This project is designed to be used with one port of a Z80 PIO (Parallel Input/Output chip) as one is used on the MicroBee for the parallel port. Any other microcomputer employing a similar scheme could use this project. This port supplies the data to the EPROM inserted in the programmer board through resistors R1 to R8 which prevent damage in the event of write conflicts. The READY and STROBE lines of the port are fed together to produce a half-microsecond positive-going pulse whenever a read or write operation is performed. This pulse, after a 50 μs delay through MONO 1 (from IC1) is used to clock the program pulse generator, which is MONO 2 from IC1. IC1 is a 74C221, a CMOS dual monostable IC. The program pulse should be 45 to 55 milliseconds long and is determined principally by R10 and C2.

The READ/PROGRAM switch, SW2a, is gated with the program pulse to produce the various signals required by different types of UV-erasable EPROMs.

The signals available at the 16-pin 'personality' socket are routed via a programming (or personality) plug to suit the EPROM being programmed. The plug wiring details for five types of common EPROM are shown elsewhere in the article.

IC2, a 4040, generates the address lines for EPROMs up to 4k bytes. It is clocked by the falling edge of the program pulse. To program an 8k-byte EPROM an extra switch is required to develop the A12 address line. The switch wiper should be connected to pin 2 of the 28-pin socket and should switch to +5 V or 0 V to select the upper or lower 4k bank, respectively. Closing SW1 effects a RESET of the address generator.

The power supply combines a fullwave rectifier and a voltage tripler to develop the two supplies necessary. Transformer T1 has a 15 V centre-tapped secondary. A fullwave rectifier, consisting of D1, D4 and C4 provides around 10 V for a 7805 three-terminal regulator which derives a +5 V rail for the ICs. A programming voltage of either 21 V or 25 V is required by some EPROMs. A voltage tripler, involving the addition of diodes D2 and D3 and capacitors C8 and C9, develops a nominal 30 V. A 723 precision regulator, IC4, regulates the required programming voltage (Vpp) of either 21 V or 25 V. Output from the 723 is from pin 10 via R14, which limits the short circuit output current to 30 mA. The voltage divider comprising R15, R16 and R18 establishes an output of 21 V when R11 is properly set. If pins 11 and 12 of the personality socket are shorted together, R13 is placed across R11-R16, raising the 723's output to 25 V. Switch SW2b selects the voltages applied to the Vpp input of the EPROM inserted in the programmer. Note that 2732s and 2732As require 0 V during read while other EPROMs require +5 V.

between 45 and 55 ms wide. If not, change the value of either R10 or C2 to bring the pulse width within these limits. Note that the value of R10 should not be greater than 330k. While you're at it, just check that the pulses on pin 13 of IC1 are around 50 μs or so. This pulse width can have considerable latitude as the minimum requires is 4 μs.

The fudge method requires a ready-programmed EPROM. Set up the programmer and software to read the EPROM. If the pulse from Mono 2 (IC1) is too long, the first byte will be read correctly, the next byte will read the same as the first byte, the third byte will be read correctly, the fourth byte will read the same as the third ..., etc. Change C2 or R10 down by one standard value (i.e. C2 to 82n or R10 to 270k) and try again.

If you read the EPROM correctly first go, vary the byte at OECF in the control program, reducing it from 10 to 0E, then 0D etc., until the result of a read is the same as if the pulse from Mono 2 were too long (every second byte reads the same as the previous byte). If the pulse from Mono 2 is within limits, you should get a correct read from the EPROM when the byte at 0ECF is between 0D (lower limit) and 12 (upper limit). Increase the value of C2 by one standard value (to 120n) and try again if it's outside these limits.

Software and programming

Although the control program looks long and involved, the actual machine code used by the computer is only 422 bytes long, small
enough to be typed in by hand. Most of the code is involved with the screen display. The EPROM routines themselves are very short.

A feature of the program is its ability to partially program an EPROM, step over existing material and then add new stuff. This avoids lots of unnecessary erasures. It would have been simple to arrange the program so that stepping, programming and verifying happened automatically following a set of predetermined instructions. But, following past experience, it was decided to allow manual operation only - you specify each action as it happens.

The purpose is to make you think. Are the addresses right? Do you really want to program, or just step? The screen display has been organized to make this quite easy. When run, the program will show a title and then ask for a 'start address'. You must enter four hexadecimal (hex) digits, including any leading zeroes. You put the MicroBee keyboard into alpha lock for entering hex code. When you've done that, the program then asks for a 'finish address'. You enter more hex digits and the program then asks for a 'command'. You now double-check the addresses to ensure they point to the material you want to work on. If there's a mistake, you hit 'break' and the computer asks you for the addresses again. If all is OK, you now enter your command, using two hands to prevent mistakes. One for the control key, and one for a letter, as follows:

P = program from memory into EPROM
R = read from the EPROM into memory
S = step to a new address
T = test that the EPROM area is erased
V = verify that it all worked.

PERSONALITY SOCKET PIN DESIGNATIONS

A white bar now appears on the screen, showing you what you're doing and in what area of memory. The memory locations roll along like a digital speedo in a car. In the event of an error, either from the ensure test or the verify routine, an appropriate message is displayed, telling you your EPROM has just earned a trip to the barber shop!

There are a few other manual operations involved. Before attempting to program an EPROM, make sure the programmer is turned on. If it isn't, you could damage an EPROM if you then attempt to program it. There are two good tricks to ensure you've done the right thing here. Install a 'piggy back' plug on the mains power lead to the programmer. When using the programmer, plug it into the power socket in the wall then plug the MicroBee's plugpack into the piggy back plug. You could also wire a 12 V bezel lamp across the 10 V supply. With the programmer plugged in and turned on, the first thing you must do is operate the RESET pushbutton, SW1, to initialise the EPROM address generator, setting the EPROM address to zero. Before issuing a program instruction, the read/program switch, SW2, must be in the WRITE position. You must return SW2 to the READ position after programming.

To ensure you don't make a mess of your EPROM it's best to get a pencil and paper and write down, step by step, exactly what you intend to do. As an exercise, let's say we want to put a program called 'Crash' into our EPROM that lives at the spare location E000. (This and all further addresses will be in hexadecimal notation.) There is already a debugging routine in the EPROM at E000-E0FF. We will assume the rest of the EPROM is empty. Here's how we do it:

We must first assemble the program to run in its eventual destination, but we'll have to physically put it somewhere else so it can be programmed into the EPROM. The MicroBee assembler has an 'offset' feature which allows us to do this. 'Crash' must start at E100, the next byte up from the end of 'Debug'. The normal place to put freshly assembled code is at 0400. so we'll assemble with an offset of 2300. After assembly we find that the last byte of 'Crash' will be at E2FF. Note that, the 'finish address' has to be one byte more than the last byte of the program to be entered. Thus, when loading, 'Crash', the finish address is E300.

Turn on your MicroBee and programmer and put SW2 at READ. Then plug the DB15 connector into the MicroBee port. Load the EPROM program and insert the EPROM to be 'burned' into the socket on the ETI-668. Now we go to our pencil and paper:

1) Press SW1 to reset the EPROM address counter. (Is SW2 at READ?)
2) Step E000-E100. (Steps over 'Debug'.)
3) Test E100-E300. (Erased?)
4) Press SW1 again. (RESET address counter.)
5) Step E000-E100.
6) Switch SW2 to PROGRAM.
7) Program 0400-0600. (Have faith, dear fellows...)
8) Switch SW2 to READ, again.
9) Press SW1 again.
10) Verify E000-E100. (Is 'Debug' still OK?)
11) Verify 0400-0600. (Is 'Crash'? OK?)

Did the white bar stop at 0600? Good. Error message? The number on the white bar will say where the error occurred, if you set one, a fact of academic interest really, as there's nothing you can do to fix it, other than erase the EPROM and start again. Perhaps it would be a good idea to have a second, blank EPROM on hand in case you boo-boo with the first.

What could have gone wrong? Maybe you forgot to reset the EPROM address counter. Maybe you forgot to switch the read/program switch correctly. Maybe it's just not your day for programming EPROMs. In that case relax, and go get a haircut!

Undoubtedly there will be those who want to assemble a program from the beginning of MicroBee memory (i.e. 0000). If you do this, remember that the control program starts at 0E00 and hence only 32K bytes may reside from 0000 to 0FFF. To avoid this restriction, assemble programs above the control program, i.e. starting at 1000. For example, if you have a 4K program temporarily residing at 1000 to 1FFF, then the steps to transfer it into EPROM are as follows (you must have a 2372 etc in the ETI-668):

1) Reset the ETI-668 (press SW1), set SW2 to READ
2) Enter start address (= 1000)
3) Enter finish address (= 2000; note, not 0FFF)
4) Switch SW2 to PROGRAM
5) Type 'Control P' to program the EPROM
Then go through the verify routine.

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**Signals/Voltages Required by the Five EPROM Types**

<table>
<thead>
<tr>
<th>24-pin Package Pin Nos.</th>
<th>Read</th>
<th>2716 Prog.</th>
<th>Read</th>
<th>2732 Prog.</th>
<th>Read</th>
<th>2532 Prog.</th>
<th>Read</th>
<th>2732A Prog.</th>
<th>Read</th>
<th>2764 Prog.</th>
<th>(28-pin) Prog.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>VIL</td>
<td>V1H</td>
<td>VIL</td>
<td>A11</td>
<td>VIL</td>
<td>A11</td>
<td>V1L</td>
<td>V1L</td>
<td>+5 V</td>
<td>+25 V</td>
<td>A11</td>
</tr>
<tr>
<td>20</td>
<td>V1L</td>
<td>V1H</td>
<td>V1L</td>
<td>A11</td>
<td>V1L</td>
<td>A11</td>
<td>V1L</td>
<td>+21 V</td>
<td>+5 V</td>
<td>+25 V</td>
<td>A11</td>
</tr>
</tbody>
</table>

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According to the data sheets, no two of the five EPROM types that can be programmed by the ETI-668 may be programmed with the same pin connections. Thus, the 6-pin personality socket is used to customise the programmer for the EPROM in use. The above table shows the signals/voltages required for the five different EPROM types that can be programmed by the ETI-668.
IDEAS FOR EXPERIMENTERS

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.

Cheap high voltage, low current dc-to-dc inverter

Alec Phillips of Myrtleford Victoria designed this circuit, without a special inverter transformer, when he needed a high dc voltage from a low dc voltage supply. It cost him about $7.

The 555 IC drives Q1 and Q2 alternately, Q1 charging via the transformer and Q2 discharging C4 into the transformer. C5 reduces power consumption and increases the output voltage. The output is fed into a voltage doubler and, with a 15 Vdc supply, the output can exceed 600 V. D1 and D2 must be 1 kV, 1 A diodes.

The transformer is a 12.6-0-12.6 V, 150 mA type. The oscillator drives the centre tap of the primary low voltage winding and the output is from the 240 V end. Q1 and Q2 must be on a heatsink of moderate size.

If higher output voltages are required, just add more voltage doublers, but obviously it will handle a smaller load on the output. The circuit will operate at input voltages ranging from 5 to 16 volts.

Spotlamp dimmer

If you're a hunter or a farmer and you've been out walking at night then you'll understand the problem that Alec Phillips of Myrtleford Victoria had.

I use a 12 V motorcycle battery and a 100 W spotlight when I'm out hunting at night but it's often happened that the light starts to fade just when I'm sighting up on the last target. The battery doesn't have enough storage capacity to let me shoot that rabbit or fox, skin them, clean them and find my way home. I didn't want to carry a larger battery so I found the answer with this simple circuit which costs about $12 to set up.

The 555 oscillator has a variable mark/space ratio by means of the 100k linear pot RV1. R4 limits the load on the oscillator and the base current to Q2. D3 is for reverse battery protection of the oscillator. The DPDT switch must be rated at 10A, 12 Vdc.

Q1 and Q2 are mounted and insulated on a 10.2 mm x 7.6 mm (4" x 3") finned black aluminium heatsink which I bolted on to the circuit control box. As Q2 gets hotter than Q1 I found it best to mount Q1 at the top and Q2 at the bottom of the heatsink.

Operation is simple once R3 is chosen to suit your light requirement for walking. When the target is seen, turn the control to full on or switch to direct battery which is brightest, then the lamp may be dimmed again for walking or skimming.

Positive-negative probe

This circuit, which acts as a simple substitute for a voltmeter, was designed by David Pye of Happy Valley SA.

I've found in many cases that all I wanted to know was whether the reading was positive or negative. This is particularly useful in car or motorcycle electrical repairs and, as the unit can be made extremely small, it will fit in any tool kit.

It will fit in a small plastic pill container, operate on any voltage between 5 V and 15 V and is quite cheap as it only requires a few components.

When the positive and negative clips are connected to the circuit both LEDs will light. Then when the probe touches a positive point the green LED is extinguished, leaving the red LED on, signifying positive. Touching the probe to a negative point extinguishes the red, leaving the green LED on. The 1N4002 is a protective diode for reverse polarity.
IDEA OF THE MONTH

Blown fuse indicator

John Beaver, Concord NSW.

Fuses are probably the handiest tool in electronics in that for an outlay of cents they can save hundreds of dollars worth of equipment. When a fuse blows it is usually obvious as the equipment it supplies stops working, sometimes however this is not always the case. If the fuse supplies, for example, power to brake lights in a vehicle or even long delay timer circuits it may not be noticed for days. This circuit will give immediate indication of a blown fuse whether there is a load on the circuit or not as long as there is power.

On a nominal 12 volt supply there is about a 1.7 volt drop across the LED leaving a potential of about 10.3 V on the emitter of Q1. With the fuse intact there is a potential at the base (via fuse and D1) of about 11 V which holds Q1 off. If, however, the fuse blows, power is removed from the anode of D1 therefore allowing current to flow from the base of Q1 through R2 turning on the LED.

The advantage of this circuit is that in the standby mode it draws only 255 microamps, which makes it particularly useful in battery operated circuits. It may be adapted for different voltages by simply changing the values of R1 and R2 using the following formula:

\[ R_1 = \frac{(V_s-V_T) \times 100}{0.2} \]
\[ R_2 = \left(\frac{V_s-V_T}{10000}\right) \times 0.2 \]

(A flashing LED, which is more of an attention-getter, could be used for LED1.)

Touch motor control

L.W. Brown of Burwood Vic. designed this circuit of a touch switch suitable for operating 12 Vdc motors. He says that an excellent use for it would be to mount the touch switch on a shop window, allowing the movement of a display via a car electric fan motor.

An oscillator drives a touch plate stuck to the inside of a glass window. Anything capacitively grounding the 50 mm diameter touch plate causes the Schmitt trigger to turn on the SCR. The 10nF capacitor provides several seconds extra operation once the touch plate has been released. As the SCR will latch on with a dc supply, an unregulated, unfiltered supply should be used. A suitable supply would be the A&R Chargette which is double insulated and very safe.

For intermittent operation no heatsink is required and because of this the entire circuit will be smaller than the touch plate. The small size allows the whole switch to be mounted in a sealed plastic box for protection from environmental humidity. The double insulated power supply could enable the system to operate in hazardous locations.

IDEA OF THE MONTH CONTEST

COUPON

Cut out and send to: Scope/ETI 'Idea of the Month' Contest, ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011.

I agree to the above terms and grant Electronics Today International all rights to publish my idea in ETI Magazine or other publications produced by them. I declare that the attached idea is my own original material that it has not previously been published and that its publication does not violate any other copyright.*

*Breach of copyright is a criminal offence.

Title of idea

Signature

Name

Date

Address

Postcode

NEW PRIZE! WORTH $30!

Scope Laboratories, who manufacture and distribute soldering irons and accessory tools, have offered to sponsor a contest with a prize to be given away every month for the best idea submitted for publication. In ideas for Experimenters column — one of the most consistently popular features in ETI. Each month we will be giving away a Scope Panavise Multi-purpose Work Centre, Model 376/300/312, comprising a self-centring head (376), standard base (300) and tiny base mount (312), all worth about $90! Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the idea published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Scope Laboratories, Murray Publishing, Offset Alpine, Australian Consolidated Press and/or associated companies.

Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI, whose decision will be final. No correspondence can be entered into regarding the decision.

Winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI.

Contestants must enter their names and address where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries.

Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.

60 — February 1983 ETI
THE EVENING'S JUST BEGUN...

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2. What street.
3. Are you in a hollow or on the wrong side of a hill.
4. Have you any trees or tall buildings around your home.
5. How many outlets do you require.
6. What channels do you expect to receive.
7. Do you require F.M.

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The one-chip microprocessor started it almost 10 years ago. The concept of the low-cost micro has affected the world profoundly since then. It arrived a year early. Now, in 1983 — a year early some might say we have the mechanical equivalent to the microprocessor — the low cost micro-robot.

"Robots" have been around for quite a while now (so were computers before the micro), but they will change in '83. Jaycar Cybernetics Division has secured Australian marketing rights for robots manufactured by Powerman of the U.K. Powerman's engineering staff have made a prodigious effort to produce robots at a cost which brings them into the R&D scope of CAE's, Universities, commercial organisations and even the dedicated Hobby Robotics individual.

The entire range of Powerman Robotic equipment will be sold and serviced by Jaycar Cybernetics division in Australia. Watch this space next month for further details of this extremely exciting development.
FABULOUS 'CLEF' MICROSYNTH

AT LAST ~ THE BAND BOX
THE DATA BASE DREAM

The 50 Mbyte Lark Hard Drive system fulfills the dream for data base users. With 25 Mbytes on fixed disk, and 25 Mbytes on removable sealed cartridge - backing up is a Lark. Standard back-up time for a full 25 Mbytes is 5 minutes. It’s built-in back up and other features give the Lark a reliability unparalleled by any cartridge drive. And the power/price ratio will not spoil your dream.

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Telex: SMELECAA37213

SME 390

ETI-1511 temperature controller

This simple project uses very few parts, most of which are commonly stocked items. Kits will be available from Rod Irving Electronics. Fish tank heaters, just like the one we used, cost a dozen dollars or so from aquarium suppliers and pet shops. If you’re doing it all from scratch, pc boards are available from the suppliers listed on page 64 of the January issue. The CA3059/3089 is distributed by AWA Microelectronics, Rydalmere NSW. Stockists we know are: Rod Irving Electronics in Melbourne, Radio Despatch Service in Sydney and Tasman Electronics (P.O. Box 110, Preston Vic. 3072).

Suitable thermistors are widely available. Try Radio Despatch and David Reid in Sydney, Magraths and Radio Parts in Melbourne.

ETI-1512 electric fence tester

Kits for this project will be stocked by Electronic Agencies in Sydney and Rod Irving Electronics in Melbourne. All the parts are generally available from electronic component suppliers. Printed circuit boards and the Scotch seal front panel for this project will be obtainable from the suppliers listed on page 64 of the January issue.

ETI-668 EPROM burner

This project’s bound to be popular amongst the thousands of MicroBee owners. Most parts are widely stocked by electronic component suppliers, except perhaps for the 74C221. To date, we have found the following firms stocking this IC: Altronics (Perth), Data Parts (Shepparton, Vic.), Ellistronics (Melb.), Radio Despatch Service (Sydney), Rod Irving Electronics (Melb.).

Kits should be available from Altronics (Perth), Electronic Agencies (Sydney), Jaycar (Sydney) and Rod Irving Electronics (Melb.).

Bucket brigade delay lines

For those readers wishing to experiment with audio delay lines as detailed in Ray Marston’s Circuit File this month, we have found sources of bucket brigade delay line chips. Tandy stores stock the SAD1024, catalogue number 276-1761, for $19.95.

In Sydney, Jaycar stocks the TDA1022 but we couldn’t find another single soul with SAD or TDA bucket brigade delay lines in stock.

SHOPAROUND

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

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6551 ACIA with SW prog. baud rate $6.42

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Can you imagine a 200mCd LED? (at 20mA)
Well if you can't - buy one and find out.
They are ideal for panel illumination or very low current work. (They will still give useful light at 1mA).

**Video Enhancer**

*Unbelievable but true. This unit enables you to actually IMPROVE a copy of a recorded video tape. How? By amplifying the top end of the video signal by a small amount. This sharpens up the detail of the picture. Dubs can actually look better than the original. Works as a video distribution amplifier as well. Will drive up to 4 VCR's from one VCR input.*

**NEW EA Wide-band AM Tuner**

Australia is one of the few countries in the world where wideband AM is transmitted. In fact a good quality AM signal can be much better than its FM counterpart! Anyone who has suffered from FM multi-path distortion will know what I mean. The Playmaster AM tuner is a true broadband superhet design. Once again, the Jaycar kit is a high quality approach. The Jaycar kit provides all components to complete the project INCLUDING a completely pre-punched cabinet.

**E.T.I. February 1983 - 65**
Communications test instrument does just about everything

The IFR model FM/AM-500 'Micro-Monitor' is a portable communications test instrument that can perform the wide variety of performance measurements required on communications equipment, whether it be AM, SSB or FM, anywhere between 100 kHz and 1 GHz!

The unit essentially comprises a sensitive multimode receiver and RF signal generator. Also included is an audio signal generator which can be used to modulate the RF signal generator in both AM and FM modes as well as provide an audio signal for testing.

Using this instrument you can perform transmitter tests such as deviation and percentage modulation, transmit frequency and frequency error. You can perform receiver performance tests such as sensitivity (SINAD), bandwidth and squelch threshold and differential.

The RF and AF signal generators are both set with thumbwheel switch controls. The RF signal generator output has a calibrated attenuator, which control dominates the centre of the front panel. Frequency accuracy is quoted as ±0.05 ppm but optional 0.2 ppm or ±0.05 ppm master oscillators can be incorporated. Frequency can be set in 100 Hz increments. The audio oscillator can generate a fixed 1 kHz tone with the same accuracy as the master oscillator or you can set the frequency between 10 Hz and 9999.9 Hz in 0.1 Hz increments.

RF generator output is from -127 dBm to -20 dBm in 10 dB increments. An 11 dB range continuous vernier is included. AF generator output is variable from 0 to 2.5 V RMS into a 150 ohm load.

The receiver (or receiver/monitor) has a sensitivity of 2 μV from 1 MHz to 1 GHz, quoted (FM, narrow) and you get a selection of six bandwidths: FM wide — 200 kHz, 80 kHz audio bandwidth, FM mid — 200 kHz, 8 kHz audio (as for the rest); FM narrow — 15 kHz, SSB — 6 kHz, AM narrow — 6 kHz, AM normal — 15 kHz.

The demodulated receiver output is available on a front panel socket for further processing or viewing on a CRO. It is possible to use the unit as a spectrum analyser. Output impedance is 600 ohms and levels are: FM — 60 mV RMS, AM — 5 mV RMS. The receiver antenna is protected and will withstand 0.25 W damage.

The frequency error meter has a quoted accuracy of ±0.1% of scale. The scale is marked to give readout direct in kHz in three ranges of ±10 kHz, ±3 kHz and ±1 kHz. A high resolution option is available. The modulation meter indicates maximum of positive or negative peak modulation (AM and FM) and shows FM deviation in three ranges of 2 kHz, 6 kHz and 20 kHz. Accuracy is quoted as ±5% of reading, ±3% of full scale. On AM modulation you can read frequency deviation in three ranges: 20%, 60% and 200% full scale. An optional amplifier is available to boost the RF signal generator output to +10 dBm on FM/CW or +4 dBm on AM, right across the 100 kHz to 1 GHz range. You can also get a microphone, so the unit becomes a complete transceiver!

The Micro-Monitor can be used to test and fault find equipment like AM and FM tuners/ receivers, communications receivers, scanners, MF/HF/VHF/ UHF transceivers, regardless of whether it be marine, land mobile, amateur or whatever. And its portability is a great asset.

A truly remarkable instrument. Such versatility doesn't come cheaply, however, but it's way ahead of the next best thing in terms of both price and versatility.

Enquiries to Vicom International, 57 City Rd, South Melbourne Vic. 3205. (03) 62-6931.

Full range of 'UHF-series' coaxial connectors

Over 20 PL259/SO239 UHF-series plugs, sockets and adaptors to suit the widely used RG6, RG58 and RG59 50 and 75 ohm coaxial cables are available from Benelec Pty Ltd.

Standard PL259 plugs to suit RG58 and RG59 are available, as well as a PL259 that fits the larger diameter coax and takes reducing adaptors for RG58 and RG59 (reducers are available, too).

A standard PL259 with push-on ferrule, rather than a conventional-screw-on ferrule, is also stocked along with crimp termination PL259s to suit RG58 and RG59.

Apart from the standard four-flange mount SO239 socket, Benelec stock a two-point flange type and two no-flange screw-on types. Of the latter, one is front mounting, the other a rear-mount type. In addition, a double female, 50 mm long feedthrough socket is available.

Benelec carry nine different UHF-series adaptors. The range comprises a double female adaptor, a double male type, a female-to-male right angle adaptor, a three-female T-connector, a two-female/single-male connector, a UHF-to-RCA adaptor, a UHF-to-3.5 mm plug adaptor, a UHF female-to-BNC male adaptor and a UHF male-to-BNC female adaptor. A UHF female-to-male lighting/static arrestor completes the range.

Apart from the UHF-series connectors, Benelec stock a range of type-N and BNC connectors and adaptors.

Enquiries should be directed to Benelec Pty Ltd, P.O. Box 21, Bondi Beach NSW 2026. (02) 665-8211.
More HF spectrum for hams!

On 16 December 1982 the 18 and 24 MHz bands, allocated at the 1979 World Administrative Radio Conference, were released for use by Australian amateurs, and more space on the 1.8 MHz, 3.5 MHz and 7 MHz bands was announced by the Minister for Communications, Mr. N.A. Brown MPQC.

From that date, the 18 068-18 168 MHz and 24 490-24 995 MHz bands will be available to Australian amateurs on a secondary basis. Existing fixed and mobile services remain the prime service in these bands until relocated.

The following frequencies should be kept clear within ±4 kHz: 18 075 kHz, then 105, 125, 128, 130, 145, 147 and 160 kHz as well as 24 900 and 24 901.4 kHz.

On the 1.8 MHz MF band, Australian amateurs have the first 25 kHz on a primary service basis and 1825 to 1875 kHz on a secondary basis. On the 80 metre band, 3794 to 3800 kHz is allocated on a secondary basis (but keep 1 kHz away from 3794 kHz). On 40 metres, 7100 to 7200 kHz (an extra 50 kHz) is allocated on a secondary basis, the primary service being broadcasting.

These new allocations are only available to amateurs holding the 'full' ticket.

Hope is still held by the Wireless Institute of Australia that 50-50.1 MHz operation can be approved (five years too late to be of significant value — Ed.).

Go to Gosford!

Do not pass go, but take $200 with you to the Central Coast Amateur Radio Club Field Day, the largest annual amateur event in Australia, to be held on Sunday, 20th February.

You'll need the $200 to buy up all those goodies on display or to splash on the 'disposals'.

The 'Gosford Field Day' attracts 600 — 800 attendees every year. What's to amuse them? Well, there's always the all-band open scramble where contestants attempt to contact as many other stations as possible within a short space of time. There are the direction-finding transmitter hunts — foxhunts — plus quiz competitions, etc.

Then there's all the 'eyeballs'. The Field Day is the chance to make face-to-face contact with those voices at the other end or renew old acquaintances.

The commerical displays are popular for ogling the latest equipment, the disposals stall is popular for getting rid of your junk and buying someone else's.

The action starts at 8 am. You can take your own picnic lunch or buy food from the take-away stands at the venue. Talking of venue, it's at the Gosford Showground, Showground Rd, Gosford NSW, on the western side of the railway line. Registration is a few dollars, and this includes free morning and afternoon tea.

Go to Gosford!
1983 ALTRONICS ELECTRONIC COMPONENTS CATALOGUE

YOURS FREE with this month's Electronics Australia Magazine
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EXAMPLES

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Here are some incredible bargains on 1st quality NON catalogue lines — to clear.
(We suggest you phone orders now to reserve yours).

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See ETI April '82 for full details

1. Superb Sigea Case Included.
2. Simulates drums, cymbals, snare, bongos and lots of other weird sounds.
3. Play manually like a seat of drums.
4. Provision for programming (plays automatically). ETI advise sequencer to follow.
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Mattel to market
4K home computer
and new Intellivision keyboard unit

Mattel Electronics will shortly begin distributing an expandable 4K home computer, dubbed the 'Aquarius', and will replace their Intellivision video game computer keyboard add-on with a lower-priced unit later this year.

The Aquarius keyboard console will retail in the States for less than US$200. It will run a CP/M operating system and 8K Microsoft BASIC in ROM. The 4K RAM is expandable to 52K through the addition of 16K add-on cards.

Video display, either direct to a monitor or via RF output to a TV set, is 24 lines of 40 characters with a resolution of 320 x 192 pixels and it can generate 16 colours.

Mattel will offer Logo in educational software, as well as entertainment (read 'games'), home management and self improvement packages.

Peripherals for the Aquarius will include a 40-column thermal printer, a data recorder and two hand controllers for games.

Following a marked lack of success with their Intellivision video games centre computer keyboard add-on, Mattel are planning to introduce a remake of this unit to retail for US$150 or less. Mattel conceded last year that they had overpriced the Intellivision keyboard unit which was on the market for around US$600.

It seems that Radofin Far East of Hong Kong will be making both the Aquarius keyboard console and the new Intellivision keyboard unit. At present, Radofin are mainly known for their marketing and brand-name manufacturing of Teletext decoders.

New generation miniature ▲
personal computer

Emona Enterprises Pty Ltd has been appointed exclusive distributor for the MPF-II 'Micro-Professor' personal computer, manufactured by Multitech Industrial Corporation.

The MPF-II is not an Apple II copy, although it has most of its features and more, such as 64K RAM, 16K ROM, PAL colour and printer interface incorporated. BASIC commands are available both in standard multikey entry and in single key entry.

With the addition of several optional software cartridges, the MPF-II also operates in Assembly, Pascal and FORTH. The MPF-II, which is compatible to the Apple II BASIC, can also use most of the existing programs for the Apple II.

This home computer can be used for education, home and business management, entertainment and learning programming languages. It can be connected to colour home TV sets and the display can be in either text or low or high resolution graphics.

Options include video display, printer, software cassettes and cartridges, remote control pad, RS232C network interface board, floppy disk drive and Chinese Character Controller.

For further details contact Emona Enterprises Pty Ltd, CBC Bank Building, 661 George St, Haymarket, Sydney NSW 2000. (02)212-4815.

S100 colour video board

What seems to be the first locally available S100 colour video board has only recently been released by Queensland-based manufacturer, Technitron, and for the host of features it provides, the makers have dubbed it the 'Provida'.

The board provides a memory-mapped colour video display giving seven colour RGB output and features either an 80 x 24 or a 64 x 16 screen format.

Not only that, but you get 128 programmable characters or 128 x 256 high resolution graphics. The board includes a 2K RAM page buffer, a 2K RAM function block and separate 2K RAM for the 128 programmable characters. The dual character set is generated by an 8K PROM.

The board can generate flashing and inverse characters, half-intensity characters and can do underlining as well as mirror reverse characters.

Technitron claim the board provides jitter-free video and with programmable TV sync it is suitable for use on other video standards (i.e. overseas).

The Provida is constructed on a quality fibreglass through-hole plated board and costs just $220 (plus tax). Further details from Technitron, 84 Targo St, Bundaberg Qld 4670. (071) 72-5606.
**Test Instrument Showcase**

Below are illustrated just some of the extensive range of test and measuring instruments available from Emona Enterprises. All are quality instruments and are priced very reasonably. You are invited to contact us for full details on our range.

### TRIGGERING OSCILLOSCOPE

**GDS-3100**

- Sensitivity: 5mV to 5mV/div
- Bandwidth: DC or 2Hz to 10MHz
- Sweep Rate: 10ms to 0.1µs/div
- Trigger Mode: Auto, Norm, EXT.
- C.R.T.: 75 mm

### DIGITAL LCR METER LCR-2430

- 5-DIGIT FOR RLC 4-DIGIT FOR D & Q
- Test Range
  - R: 1m OHM — 9.999M OHM
  - L: 0.2mH — 9999.9H
  - C: 0.1pF — 9999.9uF
- Accuracy:
  - ±0.2% (RLC)
  - ±0.01% (D)
- Display system: 6 digit LED display

### UNIVERSAL COUNTER GUCZ1010

- Frequency range: 0 to 100MHz (CHA)
- Period range: 5Hz to 25MHz (CHA)
- Count capacity: 99999999 (CHA)
- Ratio range: R1: 5Hz to 100MHz (CHA)
- f2: 5Hz to 25MHz (HZ)
- Time Interval Range: 0.1ns to 10s
- Sensitivity: ±35mV

### DIGITAL MULTIMETERS (TRUE R.M.S.) GCMD8035T

- Functions: DCV, ACV, DCA, ACA, DCA
- Range:
  - DCA 200mV, 2/20/200/1200/1200V
  - 0.1% ±10%
  - ACV 200mV, 2/20/200/1200V
  - 0.5% ±10% (TRUE RMS)
  - DCA 200µA/20/200mA/2A
  - 0.2% ±10%
- Accuracy:
  - ±0.01mV
- Display system: 8 digit LED display

### FREQUENCY COUNTER GFC-8055F

- Frequency Range: 1Hz — 550MHz
- Sensitivity: A: 1Hz — 60MHz ±10mV
  - 60MHz — 100MHz ±20mV
  - B: 50MHz — 250MHz ±30mV
  - 250MHz — 500MHz ±100mV
  - 500MHz — 550MHz ±150mV
- Display system: 8 digit LED display

### HAND HELD, DIGITAL AND ANALOGUE MULTIMETERS

**Akiyama L224**

- **SPECIFICATIONS**
  - Measuring Range: ACV: 0 — 10, 50, 250, 1000 (V)
  - DCV: 0 — 0.25, 2.5, 10, 50, 250, 1000 (V)
  - DCA: 0 — 5µA, 1m, 25m, 250mA (A), 10A at extra jack
  - ACA: 0 — 1m, 25mA, 250mA (A), 10A at extra jack
  - Sensitivity:
    - OHM: Rx1, Rx10, Rx100, Rx1K (0.5 — 2M ohms)
    - dB: — 20 — +62 dBm
  - Battery Test: 1.5V (10mA), 9V (10mA)
  - Temperature Range: +20°C — +60°C
  - Sensitivity: ACV: 8000 ohm/V
    - DCV: 20,000 ohm/V

**Akiyama L380B**

- **SPECIFICATIONS**
  - Measuring Range:
    - AC Voltage (AVC): 0 — 12, 60, 300, 1200 (V)
    - DC Voltage (DCV): 0 — 0.3, 3, 12, 60, 300, 1200 (V)
  - AC Current (DCA): 0 — 60µA, 6mA, 12mA, 120mA (A), 400mA
  - DC Current (DCA): 0 — 4µA (R x 1), 40µA (R x 10), 400mA
  - Resistance (DCA): 0 — 4K (R x 1), 40K (R x 10)
  - Load Current (DCL): 0 — 75µA, 750µA, 7.5mA, 75mA
  - Temperature (TEMP): 30°C — 250°C
  - Continuity (CONT): Continuity test by built-in buzzer
  - Battery Test: BATT/GOOD (B) Indication for 1.5V & 9V cells

**Model AT-101**

- **Special Features:**
  - Voltage Meter: 30V Full Scale
  - Current Meter: 10mA full scale
  - Potentiometer: 1KΩ 1pc.
  - A/D Conversion: 1pc.

**A-TEK**

- **SPECIFICATIONS**
  - Measuring Range: DC Voltage (DCV): 0 — 60, 300, 1200 (V)
  - Sensitivity: ±2% ±10µA
  - DC Current (DCA): 0 — 60µA, 6mA, 12mA, 120mA (A), 400mA
  - DC Voltage (DCV): 0 — 0.3, 3, 12, 60, 300, 1200 (V)
  - DC Current (DCA): 0 — 4µA (R x 1), 40µA (R x 10), 400mA
  - DC Voltage (DCV): 0 — 0.3, 3, 12, 60, 300, 1200 (V)
  - Resistance (DCA): 0 — 4K (R x 1), 40K (R x 10)
  - Load Current (DCL): 0 — 75µA, 750µA, 7.5mA, 75mA
  - Temperature (TEMP): 30°C — 250°C
  - Continuity (CONT): Continuity test by built-in buzzer
  - Battery Test: BATT/GOOD (B) Indication for 1.5V & 9V cells

**Model AT-102**

- **Special Features:**
  - Voltage Meter: 30V Full Scale
  - Current Meter: 10mA full scale
  - Potentiometer: 1KΩ 1pc.
  - A/D Conversion: 1pc.
HP-IL peripherals

Three new HP-IL peripherals, an 80-column impact printer, a video interface and a general-purpose input/output interface, bring added capabilities to Hewlett-Packard Interface Loop (HP-IL) systems.

Not only do they enhance the versatility of HP handheld computers, but they provide a more complete peripheral base for HP-IL instruments and future Hewlett-Packard portable computers.

HP's first full-size impact printer, the HP 82065B, produces dot-mode graphics and retails for $1017 (tax free). It features 80 characters per second bidirectional operation, variable column width, five user-selectable print modes, self-diagnostics and will accept single- or multi-part paper forms.

The HP 82163B video interface, which plugs into a television or monitor, displays any combination of 96 different characters and symbols in a 32-column by 16-line format. It retails for $395.50 (tax free).

The HP 82165A HP-IL/GPIO interface links devices that contain parallel-interface ports with HP-IL systems, permitting communication between the devices and other HP-IL system components. With a recommended retail price of $395.50 (tax free), the GPIO interface is suited for connecting low-cost portable systems to mainstream computers with parallel ports.

More information can be obtained from Hewlett-Packard, 31-41 Joseph St, Blackburn Vic. 3130. (03) 232-1581.

TRS-80 Model III upgrade

A new series of low-cost hardware/firmware upgrades offers users of the Tandy TRS-80 Model III access to CP/M software, increased RAM, full video processing and 4 MHz clock options.

DeForest Computers of Nunawading have announced a range of upgrades which give this micro all the power of a conventional CP/M computer at a fraction of the cost. There are three stages of upgrade, Compacon I, II and IV priced at $550, $945 and $995 respectively.

The Compactor units, which were developed by Hurricane Laboratories in the US, together increase the onboard RAM of the TRS-80 Model III to 12K and give the facility for full video processing with a 24 x 80 character display.

Both the Compactor I and IV systems add a resident diagnostic debug monitor, repeating keys, beeper support and auto debugging operations for the best of two worlds. Incorporating full support for the TRSDOS system, the Compactor I gives all of the attendant virtues of the original CP/M 2.2 written by Digital Research Corporation. It will also run the new CP/M Version 3.

The Memory Module of the Compactor I plugs into the Z80-A CPU socket of the TRS-80 Model III. Once it has been installed the user can insert either a TRSDOS or CP/M disk and the Compactor I Detect Routine automatically determines which it is, and Boots-up the appropriate operating system.

The Compactor II replaces the CPU in the Model III with a Z80-A CPU. The replacement CPU adds 64K of dynamic RAM which can be totally addressed without recourse to bank switching. The two CPU clock rates of 2 MHz for the standard Model III and the 4 MHz given with Compactor II are software selectable.

The Compactor IV is a full feature video processor and serial interface and is simply installed within the cabinet of the Model III. Compactor IV will allow you to operate under TRSDOS or CP/M on the built-in TRS BASIC ROM. The versatility of the Compactor IV’s video processor, which contains RAM, character generator ROM and video signal circuitry is extended even further with a software selectable video switch.

The range of Compactor upgrades are available from deForest Computers, 26 Station St, Nunawading Vic. 3131. (03) 877-7846.

32K BYTES FOR THE ZX81

SPECIAL RAM PACK FOR THE ZX81

This board uses dynamic RAM chips for lower cost and lower power consumption. Simply plugs into the ZX 81 expansion port offering 32K BYTES for basic programmes and data handling. No extra PSU required. Extra memory to help you build your ZX81 into a powerful microprocessor system at an affordable price. Compare the price with other RAM PACKS available on the market!

Price for 32K Ram Pack (RP32)
only: $165.00 incl. P&P (Aust)
Free cases available soon.

Please send order and S A E for further information to:
VENDALE PTY. LTD., Dept T7, Box 456,
Glen Waverley, Victoria 3150.
36 Plymouth St., Glen Waverley,
(03) 232 0444.

ZX80/81 PROGRAMMABLE CHARACTER GENERATOR

Using simple BASIC programs you can create your own unique character sets and graphic symbols for games, high resolution graphics and charts and interesting patterns. Program symbols normally available only on more expensive microprocessors and you are not limited to preprogrammed graphic sets.

Fully assembled price $95.00 incl. P & P (Australia)
Uses the 8K ROM from Sinclair (not incl.).

UPGRADE YOUR ZX80 GRAPHICS

Now you can upgrade your ZX80 to the full animated graphics of the ZX81. Your ZX80 will now run in SLOW mode.

Fully assembled price only $58.50 incl. P & P (Australia)
Works only in conjunction with 8K ROM from Sinclair (not incl.).
'Win a Microprofessor' Contest Results

There's no doubt about it, plenty of people want to learn about microprocessing and then apply that knowledge to solving practical problems, according to many of the entries we received for this contest that ran in the September '82 issue.

Some entrants wanted to learn how to use a microprocessor to control hothouse gardens, others wanted to manage home heating/cooling systems using the Microprofessor. Many said they just wanted to learn and that the Microprofessor covered many facets of microprocessing, not just programming, that it filled their needs nicely.

However, our winner, Lindsay Swadling of Surry Hills NSW, wanted the Microprofessor for a unique application. Here's his entry:

I would like to win the Microprofessor to try to develop programs to teach my young cousin, Jim, to talk. He is seven years old, with Down's Syndrome, and lives on a property 30 miles from Gunnedah. He has no access to speech therapy, which he badly needs.

A computer is possibly the only 'voice' which has the patience to repeat the same word over and over long enough for him to learn to pronounce it. The speech synthesiser in the Microprofessor would therefore be extremely helpful in teaching him good articulation, and possibly later to write and spell.

Congratulations Lindsay! We'd like to know how it turns out.

Many thanks to all those who entered the contest and to Emcna Enterprises for providing a Microprofessor, speech synthesiser and printer for the prize.

Emulogic microprocessor development system

Scientific Devices Australia has been appointed sole Australian representative for Emulogic Incorporated and has released their premier product, the ECL-3211 microprocessor development system, in Australia.

The ECL-3211 features the ability to transparently emulate any chip, any word length and any family at full speed with no reservations as to wait states, shortened stack space or lost interrupt vectors. It will not degrade target performance or require compromise or interpretation of any results obtained during emulation.

The system is based around a DEC PDP II running RTII and RSX-11M operating systems. A VT101 terminal is used so that features such as full screen based editing are provided as standard. Emulogic has added a high speed universal emulator, high speed emulation memory and complete software support from cross- assembler to symbolic debugging.

Further details are available from Scientific Devices, 21 Jacks Rd, South Oakleigh Vic. 3167, (03)579-3622.

THE VERY LATEST

This great new book from ETI is so 'hot off the press' that the cover literally glows red!

TOP PROJECTS VOL. 8

Our 'Top Projects' series have always been very popular with hobbyists, containing as they do a collection of the best projects from the past year or so's issues of ETI Magazine. Here we have 25 projects, ranging from the ETI-1501 Negative Ion Generator, to the ETI-499 General Purpose 150 W MOSFET Power Amp Module, from the ETI-574 Disco Strobe to the ETI-469 Percussion Synthesiser, from the ETI-735 UHF TV Converter to the ETI-563 NiCad Fast Charger. Also included are the ETI-599 Infrared Remote Control Unit, the ETI-567 Core Balance Relay, the ETI-259 Incremental Timer, the ETI-156 100 MHz High Impedance Instrument Probe, the ETI-328 LED Oil Temperature Meter for cars, the ETI-257 Universal Relay Driver Board, the ETI-492 Sound Bender, the ETI-1503 Intelligent Battery Charger, the ETI-725 UHF Masthead Amp & more, & more.

Top Projects Vol. 8 is available at newsagents, selected electronic suppliers or directly, by mail order, from ETI Book Sales, 15 Boundary St, Rushcutters Bay NSW 2011, for $4.95 plus 90c post and handling.
MicroBee — Australia's own educational and personal computer!

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- Over 7,000 sold
- Over 2,500 in Australian schools.

MicroBee the fully expandable, cost effective computer you have come to know and love is moving ahead with COLOUR — soon to be announced.

See us at the Australian Personal Computer Show Centrepoint, Sydney, March 1983.

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NEW ‘PLUS’ SERIES WITH EXTRA FEATURES

16K PLUS
The 16K PLUS with features such as built in music generation, high and low resolution graphics, with a screen display of 16 lines each containing 64 upper and lower case characters. When you also consider all of the standard extras like continuous memory, built in printer and input/output interfaces and parallel port, 4.5 volt battery back-up and self testing BASIC in ROM, the MicroBee 16K PLUS is unbeatable in its class.

32K PLUS
All of the standard features of the 16K PLUS with twice as much usable RAM. When you add the new Word Bee ROM Pack, you have a powerful word processing capability which does a lot more than play the many games available for the MicroBee. Add a printer and maybe even the Tasman Turtle and just see what you and your family can now do with your home computer.

A better Bee for ‘83
Now with
- BATTERY BACK-UP
- PARALLEL INTERFACE
- SELECTED CONTINUOUS MEMORY

64K PLUS
The MicroBee 64K is equipped with 56K of user RAM with Battery backed continuous memory and has built-in 80 x 24 screen format as well as 64 x 16 line. All characters are upper and lower case and powerful graphics are readily available. A value packed exclusive feature of the MicroBee 64K PLUS is that it can double as an ADM3A Terminal operating in serial mode at either 300 or 1200 baud (full or half duplex). You can add a modem and use your MicroBee 64 as your personal information window to the world.

Coming Soon
Colour Bee Conversion (for any MicroBee)
Bee Modem/Network
ROM PACKS

WORDBEE — a full featured Wordprocessor.
Convert your MicroBee into a professional quality wordprocessor.
Suitable for any 16K or 32K MicroBee.
Enables the user to select either BASIC or WORDBEE/MONITOR as required.
WORDBEE is friendly and easy to use, and has extensive HELP files built into the ROM.
It uses the familiar control key and dot commands from WORDSTAR, the on-line help from WORDMASTER and the on-screen formatting from ELECTRIC PENCIL.

EDASM — MicroBee monitor and Z80 Editor Assembler.
This ROM pack converts your MicroBee into a combined BASIC/MACHINE CODE/ASSEMBLY LANGUAGE unit and is ideal for those who need to develop programs in machine code. Built in commands include EXAMINE and MODIFY memory, BLOCK MOVE and FILL memory, EXECUTE a program, READ and WRITE to cassette tape, SEARCH and COMPARE code and RETURN to BASIC.

NETWORK 1
By popular demand we are making this ROM available for networking to other computers over the telephone lines. Contains the software to convert any 16K/32K MicroBee into a 'DUMB TERMINAL'.

"MICROSPACE INVADERS"
Yes the arcade favourite! This fast-moving version was written especially for the MicroBee by Tim Morris-Yates and has become one of the most popular programs yet released.

"MISSILE WARS"
Equipped with radar and ray cannons your mission is to defend your city against the attacking alien invaders. This game is fast moving and very exciting. The graphics and synchronized sound effects will really involve you in the game.

FAMILY GAMES

"CHESS"
Match your skills against the MicroBee chess master. You can select from 1 to 6 ply and also analyse any position. A built-in 'HELP' feature enables the computer to play YOUR current move.

"CONCENTRATION"
A real family favourite for 1 to 4 players to test your memory skills. If you call one player MERLIN, the computer will play that turn so watch out!

"HOUSE OF FRANKENSTEIN"
A New Release
The first adventure game for the MicroBee. Needs a 32K machine and can take weeks to resolve. Has built-in game save facility to re-load the game and resume play from your last session.

"BIORHYTHM/CALENDAR MAKER"
Ideal for parties or carnivals.
Requires a serial printer. You can print BIORHYTHMS for anyone — just enter their name and birthday!

EDUCATIONAL SOFTWARE
Because the MicroBee is a recommended computer in Australian schools, considerable software is currently being written at all levels. Here are details of just a few.

EDPAK 1
This tape demonstrates the capabilities of the MicroBee in such areas as music, French vocabulary, primary mathematics, geometry, typing drill and infants exercises. All programs are readily modified to suit various teaching applications.

EDPAK 11
Produced by popular demand, EDPAK 11 is a continuation of EDPAK 1. Subjects include drawing, Infant maths, spelling drill various maths approaches and general demonstrations.

PILOT
PILOT is a very easy programming language to learn and ideal for preparing CAI (computer-aided-instruction). MicroBee PILOT supports several enhancements including full integer arithmetic.

ARCADE GAMES
Ideal for parties, these action games make full use of the superb graphics and sound effects of the MicroBee. Your friends and family are set for hours of fun and excitement!

"ROBOT MAN" —
A New Release.
You must move about the maze eating up the red fruit. Watch out for the Robot Men as they are programmed to destroy you before you complete your mission!

COMPUTER UTILITIES
These programs are included as enhancements of the MicroBee computer itself.

PCG TUTORIAL — ESCKEY — and DISSEM are three of them.
## Price List

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
<th>PRICE (Inc. S/T) $</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDWARE:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110.017</td>
<td>MicroBee 16K PLUS</td>
<td>449.00</td>
</tr>
<tr>
<td>110.032</td>
<td>MicroBee 32K PLUS</td>
<td>549.00</td>
</tr>
<tr>
<td>110.064</td>
<td>MicroBee 64K PLUS</td>
<td>699.00</td>
</tr>
<tr>
<td>110.078</td>
<td>S-100 Desk Top Interface</td>
<td>299.00</td>
</tr>
<tr>
<td>110.090</td>
<td>Disk drive with controller &amp; CP/M 2.2</td>
<td>799.00</td>
</tr>
<tr>
<td>110.092</td>
<td>Add on Disk drive</td>
<td>659.00</td>
</tr>
<tr>
<td>110.116</td>
<td>16K-16K PLUS Conversion</td>
<td>29.95</td>
</tr>
<tr>
<td>110.132</td>
<td>16K-32K PLUS Conversion</td>
<td>125.00</td>
</tr>
<tr>
<td>110.164</td>
<td>32K-64K PLUS Conversion</td>
<td>175.00</td>
</tr>
<tr>
<td>110.025</td>
<td>New MicroBee Moulded Case</td>
<td>25.00</td>
</tr>
<tr>
<td>120.580</td>
<td>S-100 Digitaker</td>
<td>155.00</td>
</tr>
<tr>
<td>120.274</td>
<td>S-100 Romblaster</td>
<td>165.00</td>
</tr>
<tr>
<td>110.210</td>
<td>Parallel Port Inc. DB 15 plug &amp; hood</td>
<td>19.95</td>
</tr>
<tr>
<td>250.003</td>
<td>MicroBee Editor/-Assembler ROM</td>
<td>59.50</td>
</tr>
<tr>
<td>MONITORS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150.020</td>
<td>Kaga Denshi Green Phosphorous 30 cm</td>
<td>299.00</td>
</tr>
<tr>
<td>150.025</td>
<td>B &amp; W Monitor (converted T.V.)</td>
<td>149.50</td>
</tr>
<tr>
<td>PERIPHERALS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110.011</td>
<td>Printer/Cable Interface Kit</td>
<td>49.95</td>
</tr>
<tr>
<td>150.030</td>
<td>Audio cassette tape I/O drive</td>
<td>39.50</td>
</tr>
<tr>
<td>110.310</td>
<td>C10 Data Cassette Tape</td>
<td>1.10</td>
</tr>
<tr>
<td>110.311</td>
<td>C20 Data Cassette Tape</td>
<td>1.20</td>
</tr>
<tr>
<td>110.312</td>
<td>C30 Data Cassette Tape</td>
<td>1.30</td>
</tr>
<tr>
<td>SOFTWARE EDUCATIONAL:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250.038</td>
<td>MicroBee PILOT</td>
<td>14.95</td>
</tr>
<tr>
<td>250.033</td>
<td>Ed Pack 1</td>
<td>24.95</td>
</tr>
</tbody>
</table>

### PRINTERS:
- 150.080 Epsom MX 80 111 FIT: 1213.00
- 150.100 Epsom MX 100 111 FIT: 1555.00

### SOFTWARE:
- MicroBee CASSETTES
  - 250.035 Graphic Games: 9.95
  - 250.036 Missle Wars: 9.95
  - 250.037 PCG Tutorials: 9.95
  - 250.020 Space Invaders: 14.95
  - 250.021 Concentration: 9.95
  - 250.022 Chess: 9.95
  - 250.023 Typing / Solitaire: 9.95
  - 250.024 Target: 9.95
  - 250.025 Lunar Lander/Hurkle: 7.95
  - 250.026 Star Strike/Hangman: 7.95
  - 250.027 Blorhymth/Calendar: 9.95
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  - 250.032 Z Trek: 9.95
  - 250.041 "Est" Key: 9.95
  - 250.042 Space Invaders: 14.95
  - 250.045 House Of Frankenstein: 14.95
  - 250.046 Dissem: 9.95

### SOFTWARE IN ROM:
- 250.003 MicroBee Editor/-Assembler: 59.50
- 250.040 MicroBee Word Bee ROMPAK: 89.50
- 250.007 MicroBee 5.1 Basic Upgrade: 20.00
- 250.043 Pascal S +: 299.00
- 250.044 Pilot: P.O.A.
- 250.047 Network 1: 49.50

### SOFTWARE DISK SYSTEM:
- MicroBee CPM 2.2
- MicroBee Disk Basic

**DOCUMENTS**

**WARRANTY**

Applied Technology Pty. Limited warrants that the electrical and mechanical parts of its manufactured products are free from defects in design, materials and workmanship for a period of 3 months from the date of delivery to the buyer. (Freight must be paid by both ways by Sender and is not covered by Warranty.)

**Outlets**

See the exciting new MicroBee 16, 32 and 64 K PLUS Series at your nearest MicroBee Computer Shop.

**SYDNEY:**
- Applied Technology, 1a Pattison Ave, Waitara
  - Phone: 487 2711
- Electronic Agencies, 117 York St, Sydney
  - Phone: 29 2096
- Specialty Enterprises, 6th Floor, 104 Bathurst St, Sydney
  - Phone: 267 7747

**GOSFORD:**
- Applied Technology, 1 Debenham Rd, West Gosford
  - Phone: (043) 24 1022

**CANBERRA:**
- MicroBee Computer Shop, Level 1, Coolonan Court, Weston, ACT.

**MELBOURNE:**
- Computerland Sth, Melbourne, 19 - 37 Albert Road, (Cnr Kingsway & Albert Rd), Melbourne
  - Phone: 26 6647
- Specialty Enterprises, 1st Floor, 305 Latrobe Street, Melbourne
  - Phone: 67 8811

**BRISBANE:**
- Specialty Enterprises, 6th Floor, 246 Queen Street, Brisbane
  - Phone: 229 2450

**PERTH:**
- Altronics 19 Stirling St, Perth
  - Phone: 328 1599

**NEW ZEALAND:**
- Checkpoint Computers, 36 Main Road, Tawa
  - New Zealand
  - Phone: (4) 32 6988

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(02) 487 2711
Lissajous pattern generator

Tom Moffat
Fern Tree, Tasmania

Back in the days before frequency counters, electronics enthusiasts thought up some clever ways to measure frequency. One of the classics is 'Lissajous patterns', produced on an oscilloscope. Ever heard of them? Well you can't even pronounce the word. I can't!

The technique works like this: a sinewave of known frequency is applied to the horizontal plates of an oscilloscope (the usual sawtooth timebase being disconnected), perhaps via an amplifier. The unknown frequency (sinewave) is then applied to the vertical deflection plates (perhaps via the Y amplifier). When the two frequencies have a direct integral relationship, a stable pattern will appear on the screen. If both frequencies are the same (i.e. \( f_x = f_y \)) and the amplitudes are equal, the figure will be a circle. If the amplitudes are different, the figure will be an ellipse.

Determining the ratio of the two frequencies from the pattern is a simple matter. Count the number of maxima on one edge of the pattern in the vertical direction, then the number of maxima on one edge of the pattern in the horizontal direction. The ratio of the two frequencies is then given by:

\[
\frac{f_x}{f_y} = \frac{\text{vertical maxima}}{\text{horizontal maxima}}
\]

For example, take a figure 8 pattern:-

\[
\frac{f_x}{f_y} = \frac{2}{1}
\]

Thus, \( f_x \) is twice \( f_y \).

\[
\begin{align*}
00100 & \text{REM Lissajous Patterns 23/8/82} \\
00110 & \text{INPUT "X-Cycles" A1} \\
00120 & \text{INPUT "Y-Cycles" B1} \\
00130 & \text{C1=186/SQR(A1+B1)}; \text{ D1=142/SQR(A1+B1)} \\
00140 & \text{HIRES: P=255; Q=INT(D1+127)}; \text{ SD 4} \\
00150 & \text{FOR R=0 TO 360} \\
00160 & \text{R1=FLT(R)/57.2} \\
00170 & \text{X1=Sin(R1*A1)}; \text{ Y1=Cos(R1*B1)} \\
00180 & \text{X=INT(X1*C1+255)}; \text{ Y=INT(Y1*D1+127)} \\
00190 & \text{PLOT} \text{ P,Q TO X,Y} \\
00200 & \text{P=X;Q=Y} \\
00210 & \text{NEXT R} \\
00220 & \text{CURS 0: GOTO110} \\
00230 & \text{END}
\end{align*}
\]

YES FOLKS!, Tom Moffat now has a real printer. No more listings from the teletype machine where you have to work out what some of those schizoid characters really mean. For those who had trouble with his Bee-O-Rhythm program we'll reproduce a 'proper' listing (with improvements, no less) next month.

A commonly used standard frequency is the 50 Hz mains supply. You can calibrate an audio oscillator over a 10 1 range by tuning it for stable patterns and then counting the loops. If you already have an accurate audio oscillator you can determine an unknown frequency by tuning for a circle, the pattern developed when the frequency ratio is 1/1.

Well, where does the MicroBee come into this? This little MicroBee program demonstrates Lissajous patterns. You enter the ratios and the computer makes the pretty pictures.

You'll notice that as they get more complicated, they shrink. This is done to prevent the graphics routine from running out of PCG characters and bombing out of the program.

When run, the program asks for 'X-cycles' and then 'Y-cycles'. The screen then blanks and the fun starts. Try 1 for X-cycles and 3 for Y-cycles and you'll see where ABC Television's symbol came from!

Letter from Owen Hill, Managing Director, Applied Technology.

Mr. Roger Harrison, Editor E.T.I.

SUBJECT: MICROBEE REVIEWS ETI December 1982

Dear Roger,

I am writing in response to the product reviews on the MicroBee computer that appeared in the December 1982 issue of ETI. The purpose of this letter is to correct some false impressions and avoid any misunderstandings in print in the February issue of ETI.

In general, we welcome any independent product reviews because they give the readers an opportunity to gauge the production process of another source other than paid space advertising. The two articles you published in December, while containing material of interest to all readers, are clearly reviewing MicroBees purchased in kit form built by the reviewers themselves and not factory manufactured and tested units. As you may probably realise, the MicroBee was sold in kit form initially, however, all orders since July 1982 have been assembled and tested versions. As there were just over 1000 MicroBees supplied in kit form and almost 6000 fully assembled versions supplied to date, your reviews are not fully relevant for your current readers contemplating the purchase of a MicroBee at this point in time.

Of particular concern to our technical people is the article by Tom Moffat. It appears that Mr. Moffat decided to use a plug pack supplying a lower voltage. Readers should not follow Mr. Moffat's example because the battery backup circuit operates by sensing the incoming voltage and switches over when the voltage falls below a threshold. If the voltage falls below 10 V, this threshold voltage ensures that the 280 has sufficient time to reset reliably and switch off the memory enable circuits.

The 9.5 V selected by Mr. Moffat hardly provides any 'headroom' and hence the unreliable operation reported is most likely a direct result of this substitution by the kit builder and not the fault of the MicroBee design. Another source of Mr. Moffat's problems could be the use of a backup battery less than the 4.5 V recommended in the Microworld Users Reports and in the later versions of the owner manuals.

Incidentally, despite the reviewer's colourful descriptions, it is not uncommon for the plug pack to run warm. The 12 V/1 A of course refers to the rating and the reviewer failed to report that the plug pack is manufactured by Arlec and is approved by the Victorian Energy Authority for operation at the stated ratings.

Tests by both Arlec and Applied Technology engineering staff have been carried out to ensure the performance is suited to the MicroBee. I would have thought that a technical reviewer would have at least measured the current drain and supply voltage to see if the plug pack, even if it was 'too hot to touch', was operating within its stated ratings.

As you correctly appended to Mr. Moffat's article, all MicroBees are now supplied in a professionally designed, injection moulded case. For those who purchased MicroBees in the early days the new case is available for S5 complete with all mounting hardware, decals and rubber feet.

Incidentally, those who own MicroBees with their
MICROBEE COLUMN

Editor/Assembler option who want to clear the memory, or fill it with any known hex byte really do not need to use the program shown on page 97 of the December issue. A suitable command has already been built into the EDASM ROMset. The command is:  
F 0400 8000 11-CR;  
and this will fill memory from 400 to 8000 hex with 11 (or whatever data or addresses are selected).  
The criticism relating to delivery delays is understandable. The fact is that the demand for the MicroBee exceeds the supply. While it would be a relatively easy matter to manufacture the MicroBee overseas, it would hardly rate as an Australian computer. The factory facilities at Gosford, NSW are currently being expanded with an additional 8000 sq ft of production area due for completion in January 1983. Production is currently at 1000 units monthly, hardly a small undertaking for any Australian company. Although delivery from the factory involves a delay, dealers have been appointed around the country to carry stocks for customers. Intending buyers of MicroBees are advised to check availability with the dealer closest to them to ascertain what delay, if any, is involved.  

Self test facility  
All MicroBees fitted with version 5.1 of the Microworld BASIC have a built-in self-test facility. Although this is mainly intended for use at the factory to ensure reliable manufacture of the MicroBee, it may be very useful to owners who would like to test their own MicroBee and ensure it is operating correctly.  
To engage the self-test facility hold down the 'S' key and the 'RESET' key simultaneously for about two seconds. Then, while continuing to hold down 'S', release the 'RESET' key and the screen will display:  
keyboard  
This is now waiting for the operator to manually test the keyboard. Carefully press each key in turn working from left to right and starting at the back row with 'ESC', '1', '2', '3' and so on. When you have completed the test and pressed the 'SPACE BAR' the test will move on to the other steps.  

This stage is automatic, although special shorting plugs are used to test the cassette interface and RS232 port. Without these plugs the test will fail on RS232 and cassette interface but this is no real indication that either is faulty. Other tests performed are checksum tests on the BASIC ROMs and the character generator ROM. All RAM memory is tested using a read and compare test memory test which leaves the contents intact and as such any program in memory is left intact, i.e. the memory testing is non-destructive and the self-test can be applied at any time without damaging a program in memory. Incidentally all tests other than the keyboard check are fully automatic and recycle automatically. Any intermittent fault will latch the 'X' and indicate a failure so the test is very effective at monitoring the performance of the MicroBee throughout a 24 hour burn-in-cycle.

MicroBee in Australian schools  
As readers may be aware, the MicroBee was designed specifically for the education market. It has now been selected as an approved computer for schools by the NSW and WA education departments and is currently under close consideration by other authorities as well. MicroBees have been purchased by schools, technical colleges and universities throughout Australia and New Zealand. As this article goes to press there are almost 2500 MicroBees in Australian schools and the vast majority of these have been purchased within the past six months!

MicroBee overseas  
Considerable interest has been shown in the MicroBee in many countries outside of Australia. During 1983 the MicroBee is expected to be manufactured and distributed in countries such as USA, Canada, Israel, UK, Germany, South Africa, Malaysia, New Zealand and others still being negotiated. An international Microworld Users Group is proposed to promote the efficient generation, collection and distribution of software. Granted we all have a long way to go, but there is a real sporting chance that this little 'Aussie MicroBee' will really find its mark against well established brands worldwide!  

Future developments  
Considerable development has been carried out on the original MicroBee since it was first introduced. A world-class colour board has been developed which provides crisp 512 by 256 bit resolution and 16 lines of 64 characters on a modified domestic TV set (with 26 background and 26 foreground colours to boot). Production prototypes have been demonstrated to education authorities around Australia and New Zealand and it has met with wide acclaim. A public release of the Colour Bee will be at the Australian Personal Computer Show in March.  

Low-cost disk drives are now a reality. A much improved disk version of the MicroBee will also be announced at the Australian Computer Show.  
Many customers have asked about the Networking ROM for the MicroBee. There are really two situations involved here. For personal use a low cost modem is due for release shortly which will convert any MicroBee into a personal on-line, terminal capable of accessing the proposed Microworld users' network or, for that matter, any other facility such as the various university networks, the Source and the various local bulletin boards now available.

A local networking capability has now been developed by the NSW Education Department which enables MicroBees to be interconnected with other computers, disk drives and printers to produce a very effective computer classroom. The real advantage of the MicroBee has now been discovered in that it is cost-effective and yet versatile enough to meet the most demanding requirements. Many Australian schools have five, ten or more MicroBees in a classroom at this present time. An ambitious project has now been approved to interconnect 50 schools in Sydney's western suburbs on a full network of MicroBees during 1983.  

Software developments have not been neglected either. Considerable education software has been developed for the MicroBee over the past year and much more will be released shortly. Pilot has now been released and Pascal and LOGO will be available during 1983 for every MicroBee. We have been very fortunate to engage the services of Dr. Harvey Cohen, who worked on the original LOGO project at MIT with Seymour Papert and is now finalising a very effective version for the MicroBee. The MicroBee running colour and high resolution graphics is an ideal machine for the new approach to educational programs currently represented by LOGO.  

On another exciting software front, a complete word processor in ROM has been released. Wordbee is supplied in 8K of ROM and is no toy. It uses almost the same control commands as the popular Wordstar and is very user friendly. With battery backup it is possible for a user to use the word processor to draft letters at home then take the machine back to the office to print them out! With built-in networking he may soon be able to contact the office via a modem using the MicroBee as a terminal and eliminate the trip to the office as well. The Wordbee is similar to most professional word processors and a number of technical colleges are proposing to use MicroBee/Wordbee units as part of a course designed to expose students to the realities of the electronic office of their destined career path.

SUMMARY  
Granted we Australians are a race of 'knockers', but given the response to and performance of the MicroBee to date, maybe a few other readers would also like to comment on the December reviews as well. I feel Eric Lindsay and Tom Moffat have done a great job in getting the ball rolling. Have any of the other thousands of users anything else to say?

Kind regards,  
Owen Hill  
Managing Director,  
Applied Technology Pty Ltd.

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COMPUTERS

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WANTED: TV field level meter, 'Leader LFC 94AC', David Schell, 38/44 Collins St, Annandale NSW 2038. (02)560-0791.

KRAKO AM/SSB CB transceiver. 24 channel, mains or 13.8 Vdc operated, $200 or any reasonable offer. Carl (02)631-0116. Pendle Hill NSW.

FOR SALE: Teletype Model 15 pageprinter, $70. Tape perforator $70 and tape reader $50 ono. Will separate. (03)793-1672.

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PLAYMASTER GRAPHIC ANALYSER with TEAC ME-50 electret microphone, complete, perfect operation and condition. $120. B. Donaldson, 66 Agnes St, Rockhampton Qld 4700. (07)21760.

MISCELLANEOUS


PRINTER CENTRONICS P 1. As new in carton, manual, three rolls paper, $200. R. Wardrop, P.O. Box 595, Lane Cove NSW 2066. (02)47-6448.


WANTED: ELECTROLYTIC capacitors, 500µ or 1000µ, 450 V or higher. Need approx. 72 but any smaller quantity will do. Ray Creeley, 158 South Rd, Penguin Tas. 7316. (09)3-4971.

WANTED: AVAILABILITY of maths tutor programs in BASIC for elementary grades, any help appreciated. R. Pfotenhausen, 21 Hovea St, O'Connor ACT 2601. (06)49-8960.

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Clip-on Thermalloy “Slip Clip” heat sinks and save assembly time, board space, and heat sinks costs. They require no mounting hardware, PC board drilling, or adhesives, and clamp firmly to the device for maximum heat transfer. “Slip Clips” are available for TO-202, TO-220, TO-126, Motorola case 90 and most other popular case styles.

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New low profile heat sinks save board space

The 6073B is 19 mm square and just 9.5 mm high. It cools SCR’s and transistors in TO-220. Motorola Case 70 and Case 90 packages. Dissipates 21° C/watt in natural convection. Available in Black Anodized and Pre-Black Anodized finish.

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The military coup
When you talk to Geoff Wilson about his 18 months in the Army you can’t help but feel he’s a young man who’s come a long way in a short time.

Already he’s graduated from Officer Cadet School, Portsea, with a commission as a Lieutenant. And already he commands an Infantry Platoon of thirty men.

It’s a tremendous responsibility. Especially for a 20 year old. But as Geoff says, “You get enormous satisfaction from using what you’ve learnt in your training to help bring out the best in your team. And in achieving results together.”

“Obviously situations which I haven’t had experience in crop up all the time. And that’s when I have a real responsibility to myself and my men to make decisions based on sound knowledge rather than guesswork. As a result you constantly find yourself learning and mastering new skills. And that’s a challenge I always enjoy accepting. You really begin to realise your full potential and believe in your ability.”

“I suppose you might say my decision to take on a career as an Army Officer is my personal ‘military coup’.”

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IAGO FOR TWO
Frank Rees, Boort, Vic.

This program is a translation to CHIP 8 of a popular board game program, also known as Reversi or Othello, from an original by Milton Collins of South Australia.

Iago is an old game, similar to draughts. You play on a board divided into a grid. Each player has buttons or pieces. The object is, in placing your pieces on the board grid intersections, you bracket one or more of your opponent's pieces between two of your pieces in a straight line running vertically, horizontally or diagonally. Here, the computer not only provides a board and pieces, but also shows your scores and who goes next. This will run on a minimum '660 — B&W, with 1K of memory.

At the start of the game, each player has two pieces placed on the board. Opponent's pieces are shown on the board, then the right side of the board, flashing, indicating whose turn it is. One of the pieces will be flashing, indicating whose turn it is — the computer randomly chooses which piece will flash at the start of the game.

You can then use keys 0-9. For other keys used, try. If you don't get a beep, just hold your finger on the key until the beep sounds.

To enter a move, you have to look where you want to locate your piece. The spots on the board are numbered in rows (X) and columns (Y). Commencing at the top left hand corner is 0.0(X,Y). The bottom right hand corner is 0.7. You enter the X position first by pressing the appropriate number, then the required Y position. If the move is valid, your piece will appear flashing in the chosen field. Press key F to enter your move or another key, except C, to abort the move and try again.

If you wish to concede a move to your opponent, press C. If you make an invalid move, your piece flashes in the illegal location, you get a beep and have to try again.

Strategy and planning ahead are all-important in this game, but it is possible to come out with equal scores!

When entering your move, the computer will flash, indicating whose turn it is — the computer randomly chooses which piece will flash at the start of the game.

To manipulate your ship and fire the cannon, use the following keys:

<table>
<thead>
<tr>
<th>Key</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Fire</td>
</tr>
<tr>
<td>V</td>
<td>Move left</td>
</tr>
<tr>
<td>T</td>
<td>Move right</td>
</tr>
<tr>
<td>KEY 4</td>
<td>MOVE LEFT</td>
</tr>
<tr>
<td>KEY 5</td>
<td>MOVE RIGHT</td>
</tr>
<tr>
<td>KEY 6</td>
<td>FIRE</td>
</tr>
</tbody>
</table>

The game is translated into a mainline and three loops.

The program is structured with a mainline and three loops.

The mainline includes the following:

- B machine and FIRE key
- Expand loop

The values used are as follows:

- 0.1 ASTEROID 1
- 2.3 ASTEROID 2
- 4.5 ASTEROID 3
- 6.7 ASTEROID 4
- 8.9 ASTEROID 5
- A, B, C, D, E, F, MISSION

Now, go ash them asteroids!

ASTEROS MOONSHOWER
Peter Easdown, Kew, NSW

Here's another program rather like several you see in the parlour video games. You have a ship with a cannon that can be moved left and right across the bottom of the screen. Up to five asteroids come plummeting towards your ship. You score points by hitting them with missiles fired from your cannon and you stay alive by ducking out of their way as they rush past. Each hit on an asteroid scores you one point. If an asteroid crashes into you, the resultant explosion fills the screen with 'debris', after which your score is displayed and the game ends. Sound effects accompany the explosion. The game will run on a minimum '660 with B&W video and only 1K of RAM.

To the chime of the cannon, use the following keys:

- Move left
- Move right
- Fire

The program is structured with a mainline and three loops.

- 0600-066C MAINLINE
- 0676-0684 FIRING LOOP
- 0684-06C4 END LOOP
- 0714-072E EXPLOSION LOOP

The variables used are as follows:

- 0.1 ASTEROID 1
- 2.3 ASTEROID 2
- 4.5 ASTEROID 3
- 6.7 ASTEROID 4
- 8.9 ASTEROID 5
- A, B, C, D, E, F, MISSION

Now, go ash them asteroids!

NOTES & ERRATA

Traditional Space Invaders, Oct. '82, p.95: There is an error in this program at address 06C0. Instead of 4501, this should read 4F01. Thanks to Peter Easdown for the correction.

Black Jack, Nov. '82, p.90: Bill Keyless suggests the following changes to slow it down and sound events (i.e. return your bet). Change ODE to 10D4, enter 2642 6F10 FF18 10D4. To allow more time to place your bets, change the data at 0793 to 400A or 400B or 400C. You can then use keys 0 to C to place bets and to answer yes.

84 — February 1983 ETI
PATCHES  Bill Kreykes, St Albans, Vic.

For this game, you will need your ETI-660 with colour and full memory complement. The program draws 100 patches on the screen in a series of columns. Beneath the field of patches is your ship which runs left and right along a coloured line. The colour of the patches changes constantly at random, except when you fire a missile, at which time the pattern "freezes" until your missile hits something.

Your ship and colour line change colour every two to four seconds, depending on how much fuel is wasted. You waste fuel if your ship remains stationary, a missile fails to strike a patch when fired, or if you strike a patch with a colour not corresponding to the colour of your ship. The object is to have your missile strike a patch the same colour as your ship. You score points according to the colour of the patch struck: The patch "explodes" when you score a valid strike. Points are deducted if you hit a patch of a colour different to your ship. That patch then goes red. Points are worth the following number of points:

- BLACK: 000
- RED: 100
- BLUE: 200
- VIOLET: 300
- GREEN: 400
- YELLOW: 500
- PALE BLUE: 600
- WHITE: 700

There are two special patches hidden in the field: one bonus patch and one dust patch, each game. They are worth 10 times the score of the corresponding colour — added to your score for the bonus patch. Deducted for the dust patch! You never know where these special patches are until you hit them! As the colour of these special patches changes constantly, the special points added to or deducted from your score can vary between 1000 and 7000.

Your score is displayed in the centre of the screen above the field of patches. You commence with 0000. When you hit a bonus patch, the number of bonus points is displayed at top left. When you hit a dust patch, the points deducted are shown at top right.

660 SOFTWARE

SELECT-A-GAME  Bill Kreykes, St Albans, Vic.

This program, or better, group of programs, is a continuation from Wipeout 860 Style published in ETI, October 82, page 95. Although Wipeout 860 Style will run on its own, when learned with the loading given here you get a selection of one of three games to play: Wipeout 860 Style, Concentration and Block Puzzle. All three are translations from CHIP 6.02. All are in colour and you'll need a 660 with colour and full 3K of memory. Colour instructions for each are at the start of each game so you can change colours if they don't suit your taste. Details later. You can also change them to monochrome only if you wish.

Here are the games:

A) Wipeout' 660 Style

As per ETI, October 82, page 95. Enter program as published, but change data at 0600 (2822) to 158E.

B) CONCENTRATION

Between two players — A and B. Press a key to reveal the hidden shape. Press another key and match the pairs (eight in all). The computer shows whose turn it is and each player's score. The game automatically re-starts when finished. The winner is the player who attains the highest score overall.

C) BLOCK PUZZLE

Another version of the program by the same name that appeared on page 92 of the November 82 issue. The computer shows 16 squares in a 4 x 4 array, each numbered 0 to F. The 0 disappears and the computer shuffles the squares about. You have to put them back in order, 1 to F, in the least number of turns. A short beep sounds when the computer has finished shuffling.

Here are the keys for moving and firing:

LEFT: KEY A
RIGHT: KEY D
FIRE: KEY 8

For lefthanders, you can change the data at 068C to 6801 and use Key 1 to fire. The program as written gives a black background. However, if this is a bit hard on the old eyes (or your TV can't handle it) here are details of how to change the background colour and patch colour selection:

LOCATION  AFFECTS  BLUE GREEN
0660  background  00FF  0911
0666  bonus points  0604  0602
060C  score  0603  0605
0612  minus points  0601  0600
061A  fuel line  0601  0600
081A  wrong hit  0601  0600
0842 & 0894  bypass black  4002  4002

The program can be lengthened or shortened by increasing or decreasing VB at 0698.

The game automatically restarts at the end of each game (when you run out of fuel). Sound effects are used throughout.

You get a high-pitched beep if you make an invalid move.

You get a high-pitched beep if you make an invalid move.
The Vikings are coming

Jamo loudspeakers are designed and manufactured in Denmark and have been in production for twelve years. And now Australia is getting a chance to hear them.

Scan Audio, a new name to the Australian scene, has recently been set up by Michael Henriksen who used to work for the distributors of Jamo loudspeakers in Denmark. Scan Audio will be importing three of the Jamo ranges of loudspeakers, the Professional, Power and Popular ranges, plus accessories such as pedestals.

Four models in the Professional range and three models in the Power range are designed around the CBR (Centre Bass Reflex) system. Jamo's patented bass reproduction system. On the reverse of the front panel of the loudspeaker, an outer bass-reflex tube has been cast, enclosing an inner bass-reflex tube which is mounted on the bass loudspeaker itself. The space between these two tubes forms a circular bass-reflex port providing symmetrical loading of the bass diaphragm and lowering distortion, claim the Jamo manufacturers.

The bass speaker, together with the inner bass-reflex tube, is suspended in the middle of the circular bass reflex port by means of four vibration absorbing rubber blocks. It is claimed that this technique prevents uncontrolled vibration of the front panel and resulting coloration of the sound field.

On all models of the Professional range, the area of the front panel around the treble and mid-range units is faced with neoprene rubber to avoid edge reflections.

The top model in the Professional range, the CBR-1703, is a four-way system and has a rated power of 170 watts RMS and is priced at $1528 per pair (including pedestal).

For more information about Jamo loudspeakers contact Scan Audio, P.O. Box 741, Dandenong Vic. 3175. (03)793-5670.

Acoustat electrostatic loudspeakers

Acoustat Corporation of Florida USA claim that all their loudspeakers utilise full-range-element electrostatic panels to reproduce all the frequencies in the audible spectrum.

And this is achieved without splitting the frequency spectrum with separate woofers, mid-range and tweeter drivers and without crossovers and phase distortion.

The Model Two has a frequency response of 35 Hz to 20 kHz with a sound pressure level of 105 dB at 5 m in a 4 m x 6 m room. The Model Three has a sound pressure level of 110 dB at 6 m in a 4.5 m x 7 m room. The frequency response of the Model Four is 28 Hz to 20 kHz with a sound pressure level of 115 dB at 7 m in a 5 m x 8 m room.

At the top of the range are the Model Six and Model Eight which double the radiating area of the Three and Four without an increase in panel width. In the Six and Eight the additional panels are stacked above rather than next to the original three or four panels, adding three dB of conversion efficiency and about a third-octave of low-frequency range. Acoustat claim that the large radiating area is the reason for the better acoustic impedance match to air, particularly in the difficult low-frequency range. The Model Eight has a frequency response of 24 Hz to 20 kHz with a sound pressure level of 125 dB at 8 m in a 6 m x 9 m room.

And that's not all; there's also the Acoustat Trans-Nova Twin-200 power amplifier which has a power output of 200 W per channel into eight ohms, both channels driven, from 20 Hz to 20 kHz, at no more than 0.09% THD.

If you want to find out more about the Acoustat range of products contact Allen Wright Electronics at 13 Wentworth Ave, Surrey Hills NSW 2010. (02)264-8084.

Sight and Sound NEWS

ETI February 1983 – 87

Sansui compu-receivers

Sansui claim that their two new compu-receivers, models Z-9000 and Z-7000, are the easiest to use receivers they have ever offered.

Both receivers have multi-programmable timers that are capable of turning the receiver (and two connected units) on and off at any preset times. The Sansui Super Feedforward System is incorporated into the dc power amplifiers of the receivers which, it is claimed, significantly reduces every known type of distortion.

The FM tuner sections of the receivers incorporate quartz-PLL frequency synthesizers and provide presets for eight FM and eight AM stations, with a preset scan facility.

The Z-9000 features a seven-band graphic equaliser and the level of each frequency range may be boosted or cut by up to 10 dB. The Z-9000 also has a built in reverberation amp.

For more information on these products contact Vanfi (Aust) Pty Ltd, 297 City Rd, Sth Melbourne Vic. 3205. (03)690-6200.

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For more information on these products contact Vanfi (Aust) Pty Ltd, 297 City Rd, Sth Melbourne Vic. 3205. (03)690-6200.
JBL automotive loudspeakers

JBL have introduced a range of automotive loudspeakers which, they say, are built to the same criteria as professional systems.

Designed to fit standard rear deck mounting holes, the T540 and T845 each have a 152 mm x 229 mm woofer and a 64 mm dynamic tweeter, giving a frequency range of 40 Hz to 18 kHz. They have a flat wire voice coil, 38 mm in diameter which is claimed to increase both efficiency and power handling. The three-way design has a power capacity of 100 W and both can be bi-amplified for further improvements.

The T420 is suitable for either door or rear deck mounting and has been designed so that it will fit in the standard 133 mm cut outs. The tweeter is angled 15° relative to the woofer, the frequency range is 70 Hz to 18 kHz and the power capacity is 75 W. JBL has designed the T205 speakers for smaller cars with limited space for speakers. This 114 mm model will fit into shallow doors and other tight spaces. It has a frequency range of 90 Hz to 18 kHz with a 60 W power capacity.

Harman Australian Pty Ltd stock JBL speakers and can be contacted at Unit A2, 64 Byfield St, Nth Ryde NSW 2113. (02) 887-6333.

Arista Electronics has PA amplifiers

Arista Electronics has a range of PA amplifiers. The Japanese suppliers have changed the model numbers, so to avoid confusion use the Arista equivalent numbers.

Top of the range is the Model J-8 (Arista PS104L) priced at $245.50. This has an ac and dc power supply and a power rating of 100 W. Two microphones can be used with individual volume controls, input impedance is 200-50k adaptable. It has a chime and fog horn switch, siren and siren lock switch, an output impedance selector of 4, 8 and 16 ohm switchable and an output line voltage of 25, 70 or 100 V.

Model J2 (Arista PS103L) has an ac/dc power supply. J3 (Arista PS101M) and J4 (Arista PS102M) are priced at $179.99 and $149.99 respectively and are both for marine use.

Wharfedale finished

Wharfedale is another casualty of the slump in hi-fi.

Despite putting a lot of money into R&D using the latest laser vibrational analysis techniques, Rank have decided to close down the factory after two years of losses. Wharfedale started up in 1982 and became an extremely innovative and successful UK business but now it has gone the way of many of the other hi-fi manufacturing businesses in England.

This seems to have happened because of the failure of the more recent designs to capture the favour of the fickle hi-fi press. Wharfedale did not even have a prospect of an acquisition by a Japanese manufacturer, where do you go from there.

AROUND THE V15 TYPE V:

"Our tests show that the Shure V15 Type V not only lives up to the claims made for it, but in virtually every respect OUTPERFORMS the best cartridges we have previously tested... It is hard to imagine how the V15 Type V could be improved significantly. It offers the MOST PERFORMANCE in the most areas, plus the most convenience and safety in installation and operation." - Julian Hirsch, Stereo Review, June, 1982.

"... (The V15 Type V) is definitely the FINEST pickup Shure has ever made, which makes it one of the finest ever made, period." - High Fidelity, July, 1982.

"... in a world of audiophile discs with demanding tracking requirements, the Shure V15 Type V KEEPS AHEAD of the times." - Rich Warren, Chicago Sun-Times, June 4, 1982.

"(The V15 Type V) REDEFINES its maker as a pioneer in cartridge design not only from the beginnings of microgroove technology but well into the future of the LP disc." - FM Guide (Canada), June, 1982.

"... It may be safe to say that this cartridge's excellent tracking ability is NUMBER ONE in the world. Provides exquisite and elaborate sound." Swing Journal (Japan), May, 1982.
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• PAS 60 10" 3-way 90W (60L)
• PAS 25 8½" 2-way 60W (25L)

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Louis Challis

Louis is completely entranced with the compact disc player. Its performance far exceeds that of conventional systems. Regardless of dust, static or dirty fingers on these digital discs, there's a total absence of surface noise.

I was surprised to find an unusual piece of high fidelity equipment waiting for me in my office when I returned from a trip to Brisbane. Lo and behold, the Editor had received one of only two new Sony Compact Disc players in the country and instead of playing with it, 'Himself' had decided to be magnanimous and let me play with it first. But I soon discovered that he didn't really want me to play with it. What he wanted me to do was to evaluate its technical performance in a similar way to our evaluations with conventional equipment.

Newspapers, journals, television programmes and technical press have been extolling the virtues of the Compact Disc digital audio system and raving about its potential in the market for well over a year now.

The system is basically a technical offshoot from the video discs developed and marketed by Magnavox in the USA some five years ago and redeveloped by Philips of Eindhoven in conjunction with Sony of Japan.

The Philips system is quite revolutionary, but not a surprise, based on our knowledge of the work they have done between 1970 and 1980. During those critical ten years Philips developed the VLP, the Video Long Playing disc, and made a wise decision in the interest of international standardisation. This was to work with Sony in a joint research program as they realised that only with the assistance and full support of the Japanese would they have any chance of repeating what they had already done with the 'compact cassette'. We are all aware of the failure of the Elcassettes and various other systems which have suffered the fate of oblivion, primarily as a result of a lack of standardisation and consequent market-place rejection.

It is clear to me, as it will soon be to you, that the Compact Disc will undoubtedly replace the conventional analogue microgroove disc with its stylus, cartridge and pivot arm paralleled by the ubiquitous slide rule has been replaced by digital calculators. The replacement of the microgroove record by the compact disc will however, be much slower than was the demise of the slide rule, and I expect the two systems to live harmoniously together for many years (if only because both will be produced by the same people).

So what's it all about?

The Compact Disc system replaces the stylus, cartridge and indented spiral track with a laser light emitter, a photo-diode and signal detector and a specially formulated disc containing the program material. This laser disc incorporates the digital signals, which constitute the software or program material, in millions of minute indentations within the active surface of a metallic substrate. This metal layer is covered by a clear plastic which has been designed to pro-
tect the substrate from physical abuse and is simultaneously claimed to be immune to dirt, dust, finger marks and the problems faced by conventional microgroove discs. The data capabilities of the disc are quite outstanding and we have calculated that the typical disc will contain up to 200 megabytes of information. For those of you who are unfamiliar with other data storage systems, this is quite fantastic and greatly exceeds the capacity of a 200 mm diameter floppy disk or a Winchester disk drive of the type currently used in the majority of small computers.

It is this tremendous digital information capacity of the compact disc which makes the whole concept viable and provides the dramatic improvements in dynamic range, information content and playing time which are the main features of this new system.

Features

The Sony CDP-101 disc player features a shiny black molded escutcheon with the left hand side devoted to the disc loading system while the right hand side has the digital display panel and associated touch switch controls.

At the extreme left hand end is a pushbutton power switch and below it is a time on/off selector. At the bottom left hand corner is a standard tip, ring and sleeve headphone socket with its own miniature volume control so that you can listen to the discs without recourse to a separate power amplifier.

To the right of these controls is the compact disc loading tray. You touch a small switch to open the tray, which whirs as it slowly slides out and whirs as it shuts after you touch the switch to close it again. When the disc 'receptor tray' comes out all you have to do is to gently place the disc in the bottomless tray and then return it to its playing position. The internal mechanical system loads the disc onto its precision spindle and then all you do is select the operational function that you then require.

The display panel to the right then lights a red LED to indicate that the disc is correctly set and it also indicates the track number that has been selected. The 'time display' shows the elapsed time of that particular track or alternatively the time left to the end of the disc, as selected. This is a new and exciting facility which has only previously been offered on professional tape recorders and it revolutionises the information and scope of control available to the user.

At the upper right of the display panel is an optical sensor for the remote control unit and next to it is a little green LED to indicate that it has responded to or received a signal.

Immediately below the display panel are six pushbutton controls that allow one to reset the special controls. On the left is a full reset button and the next three to the right provide a complex repeat function sequence. The first of these buttons provides a repeat of the track just played, the second provides a replay of all tracks and the third labelled 'A-B' allows you to select the start point and finish point anywhere during the programme to cycle over and over again. This sequence may be as short as a second or as long as the whole disc. This 'A-B' repeat function facilitates some of the test results which were used to compare the compact digital disc performance with conventional high quality microgroove recordings.

The next button, labelled 'clear', provides a reset for the A-B function. One other button at the extreme right hand end of the facia is labelled 'time' and converts the normal elapsed minute and second time display to one in which the remaining time till the end of the disc is displayed. This is both unusual and ingenious and is a byproduct of the microprocessor technology which makes it all possible. This feature tells you exactly how long you have left on the disc so that you can time your meal, your departure and most particularly your entertainment accordingly.

The main function controls are located in the bottom right quadrant and, not surprisingly, these are different to the conventional cassette or tape recorder controls. On the extreme left hand side of this section is a play button and a smaller pause button. Each of these incorporates a LED so that the activation of the function is clearly indicated.

To the right of these controls are three controls for forward activation and three for reverse. The two largest controls are for forward and reverse, automatically stopping at the beginning of a programme section. The other controls provide three times and ten times normal cueing speeds which is something that you cannot do with a conventional cassette player or record player. These controls are unquestionably a delight to use and provide a flexibility which you miss once you go back to using a conventional compact cassette recorder.
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Arm & cartridge not included
Record clamp optional extra
On the rear of the unit is an 'auto-pause' switch which makes the unit pause at the end of each track necessitating a restart function to play the next number. This would not be used very often, but could prove to be of some special use, particularly for disc jockeys at radio stations. The next control on the rear is labelled 'anti-shock' which would be used in locations where the level of structural vibration is high and mistracking or malfunction might otherwise occur. We did not evaluate this function but when we get the unit back again we intend to subject it to various spectral vibration levels on our shaker table to determine how efficient it really is. The third switch on the rear of the unit is labelled 'beep'. When this particular switch is used the remote control will emit a little 'beep' each time a function is executed.

The rear of the unit features a large heatsink for the servoamplifier and an external mains transformer which has obviously been positioned there to either minimise magnetic flux leakage or because of the lack of space in a jam packed unit.

**Inside the CDP-101**

The inside of the unit is filled with printed circuits, miniature servo drive motors and large scale integrated circuitry which is constructed to standards applicable to the best communication circuitry. The disc drive mechanism is supported by an intricate die casting which features two perpendicular sets of parallel slides to facilitate a primary translation motion of only 33 mm which is constructed. Inside the CDP-101 player. The drive mechanism for the disc and the drawer can be seen on the right.

The width of the digital tracks, as well as a secondary longitudinal motion which the tracking mechanism has to provide to cover the disc surface. The circuitry is designed with a series of stacked arrays of PCB boards located below and to the side of the drive mechanism which is on one side of the unit. It would be interesting to compare this Sony unit with the Philips unit which we feel sure will be a 'little bit different' in the physical details and possibly in a number of other respects.

**Testing difficulties**

It wasn't possible for us to test the unit as we would have liked to. And, no doubt, you would have liked us to test it in the manner you have come to expect. The device can be considered as being a 'black box' which means that in order to evaluate it one needs very special facilities. Neither Sony nor Philips have yet provided or released such facilities, even to their own people in Australia, although we feel sure they have them in both Japan and Holland. In the absence of such special software we have utilised our existing facilities and have innovated to make up for the deficiency.

The obvious parameters that we would normally evaluate are:

- The dynamic range in terms of either unweighted or A-weighted performance.
- The frequency response generally in terms of +0 to -3 dB points.
- The distortion generated by the unit is of particular importance and requires special software, together with our existing distortion measurement facilities, for proper evaluation.
- The speed stability and the wow and flutter characteristics of the unit are particularly important and also require special software.
- The channel separation and phase linearity of the unit should normally be evaluated to confirm the overall performance.
Considering the lack of software we have made reasonable strides in evaluating the characteristics of this unit. For a start, we have confirmed that the dynamic range of the software provided by the manufacturer exceeds 80 dB. We have good reason to believe that a realistic figure of 86 dB would be appropriate for programmes provided using the full dynamic range of the system. We were able to confirm that the frequency response of the system, compared with a similar content recorded on conventional half-speed mastered records which is ±2 dB from 20 Hz to 16 kHz, is at least as good and possibly extends to 20 kHz.

We were unable to evaluate distortion by normal methods. A comparison was made between single transients taken off a half-speed mastered Sony CBS analogue record (Hiroko Nakamura playing Grieg's 'Piano Concerto' in A Minor) and the Sony CBS CD disc number 28AC703 by Grieg playing the same piece of music from the same digital master recording. It clearly showed that the distortion levels on the digital disc were at least one order of magnitude lower than those found on the conventional analogue recording.

The speed stability of the system was even more difficult to assess than the distortion characteristics. All were able to ascertain was that the digital disc is significantly lower in terms of audible wow and flutter than the conventional recording played on a transcription turntable.

Subjectively

The subjective assessment of the unit was limited to the five compact discs provided by Sony. These included two sampler 'pot-pourri' discs, Simon and Garfunkel's 'Bridge Over Troubled Waters', Grieg's 'Piano Concerto' played by the Hiroko Nakamura and one jazz record by a group which I had not previously heard. Surprisingly the 'Bridge Over Troubled Waters' record and the half-speed mastered digitally recorded Sony CBS pressing of the 'Grieg Piano Concerto' 28AC703, which is a 45 rpm digitally mastered recording, are in my collection. They are, and hopefully will continue to be, two of the better records which I own and I have used them for reviewing record playing equipment in the last few years. More significantly, they provided me with the opportunity to undertake a direct assessment of the relative dynamic range, signal-to-noise characteristics, wow and flutter, distortion and over-all quality of the two media.

It soon became clear that just as the 'Bridge Over Troubled Waters' recording was surpassed by the technology of a digitally recorded half-speed mastered microgroove record, so too was the digital compact disc at least the same order of magnitude better than the half-speed mastered microgroove record. In more objective terms 'Bridge Over Troubled Waters', even when new, only had a dynamic range of less than 60 dB A scale. The half-speed mastered 'Grieg Concerto' record has a dynamic range approaching 68 dB A scale, while the digital disc has a dynamic range of better than 86 dB.

If this were all that the digital disc offered by way of improvement, then one would be hard pressed to justify the new medium. But this is far from being true, for the most impressive feature of the digital disc is the total absence of surface noise which is a continual and everpresent problem with the normal microgroove record. Irrespective of the use of surface sprays, careful cleaning, anti-static compounds and brushes, dust proof rooms or whatever else you may choose to use, you will have the same problems that I and every one else has in avoiding dust, dirt and regrettable damage to your precious records.

The fact that dirty fingers and these other irritating problems just do not affect the performance of the compact disc will endear the system to a new generation of audiophiles.

I took Sony and Philips at their word and placed dirt, dust and debris on the active surface of one of the discs to determine whether the manufacturer's claims of immunity to signal drop out, with a dirty disc, would be supported in practice. With some relief I found that barring the situation of total obscuration of the disc surface, which is easy to do deliberately, but hard to do inadvertently, those claims were fully substantiated.

I was completely entranced by the new compact disc and I believe you will be too. The approximate recommended retail price is $800 to $1000 per unit (depending on import duty) and the disc price is around $18. I can see queues forming outside the shops to buy both the players and the discs when they finally arrive about April. Obviously there may not be as many people around with that sort of money as the marketing people might like, but this situation will hopefully be short lived so that all of us can enjoy the refinements and pleasures that this new medium can provide.

In case you hadn't guessed I am going to place my order as soon as I finish this review!

---

**Figure 1**

**Comparison of Single Transient Spectra for Same Program on LP Disc & Compact Disc (Displaced for Clarity)**

[Graph showing spectral analysis of transient response for LP and compact disc versions of Grieg's Piano Concerto.

ETI February 1983 - 97
AS ELECTRONICS pervades music more and more, it will undoubtedly begin to have a great deal more influence on the names of bands. Readers will no doubt be familiar with the German band Kraftwerk whose music is entirely electronic. The lyrics of their songs reflect solid state technology, too. (When will we hear "16 bytes and what do you get ..."?)

Let us speculate for a moment on what would happen to bands' names should they decide to change them to reflect this ever-increasing trend. Perhaps the Hitmen would change to 'The Bitmen', or Love Mum & The Urgent Ring-Mes would change their name to 'Love Mum & The Modem Auto-Diallers'! Instead of the Sex Pistols maybe we'd have 'The One-Shot Multivibrator'. Perhaps AC/DC would change to 'PNP/NPN'!

Then, too, we'll see new bands emerging, all with 'electronic' names right from the down beat. A few imaginative (?) examples might serve to illustrate my theme: like 'R1D1 and the solid state astables', 'Laser Luke and the angry angstroms' (a ferocious punk band), 'Red LED and the brothel boys' (straight from Sydney's Darlinghurst and the flesh pots of King Cross).

We might even get a few out-of-work analogue electronics engineers (digital having taken over completely) forming bands with names like 'Moto Roller and his Texas Instruments' or 'Cath Ode and her Rectifiers' (we're not sexist here, you know!), or even 'Tip 31 and the three-oh double fives'.

**Watch where you're going!**

Now that 'hip stereo', otherwise known as 'stereo to go', is all but all-pervading, we're starting to see the tragic effects this marvel of modern technology can have on our society. A recent newspaper report told of a young man who was killed by a train while crossing a railway line because he was paying more attention to the music on his hip stereo headphones than he was to his surroundings. "Death by misadventure" read the coroner's report.

There are plenty of examples of less tragic, but nonetheless socially deleterious, effects of hip stereos on individuals. Parents write to newspapers wailing that teenagers of today are becoming antisocial (...a familiar theme) through the use of hip stereos and wearing headphones to "...shut out the world". Then there are the train passengers who while away long boring journeys through the suburbs playing their favourite music on hip stereos. Many become so totally engrossed in the microcosmic world so created that they miss their station and have to pay an extra fare to return to their rightful destination, arriving home considerably later than usual to the righteous indignation of their families, too sheepish to give a coherent explanation of where they've been and what they've been doing.

But, I warn you — things are going to get worse! Now they've introduced the dreaded wristwatch TV. Well, the screen (LCD — of course) is strapped to your wrist and the receiver is carried in a pocket on your hip — a la hip stereo. Headphones (a la hip stereo!) convey the sound to your aural consciousness.

Heaven knows how the makers expect you to watch the ball in a World Series Cricket match on a 30 mm screen. People are obviously going to be walking around, totally mesmerised by the wristwatch screen, not looking where they're going. Pedestrian deaths will rocket! Apart from that, thousands of wrist TV equipped commuters will be missing their stops, stumbling up/down railway station stairs, walking into electric light poles, parked cars, buildings and other people. Teenagers (unable to afford a wristwatch TV) will be writing into the newspapers wailing that today's parents have become antisocial through watching their wrist TV almost every waking hour!

However, some good might come of it. The wristwatch TV may well catch on so thoroughly with the adult world that talk-back radio will die.
Sony's new TA-AX5 amplifier with memory is a high fidelity feast.

Its multiple memory lets you create your own acoustic "flavours." Bass and treble tone settings, turnover frequencies, high and low filter are all programmable.

At a touch you can instantly recall the recipe for bittersweet country, hot 'n' spicy rock, or a well-seasoned Stravinsky. And electronic displays graphically show you everything the amp is cooking up.

Sony's Audio Signal Processor means that every function is touch controlled. This knifes through the usual maze of audio circuitry for a streamlined design of the future. Pure and simple, it sounds delicious.

The ideal companion for this tasty new amplifier is Sony's ST-JX4 synthesizer tuner. Why not make a reservation for two?
This remarkable amplifier was developed over 95 years from a primitive reed organ.

The reed organs that Mr. Yamaha designed and built would be considered primitive by today’s standards.

But in 1887 they were hailed as the world’s finest. Since then, Yamaha has become the world’s largest maker of high quality musical instruments; from flutes to flügel horns, from clarinets to concert grands.

But our audio equipment is perhaps our proudest achievement.

The pyramid-shaped B-6 amplifier illustrated above for instance, is just as much 'state-of-the-art' now as Mr. Yamaha’s reed organs were 95 years ago. And though technology has changed, the Yamaha principle hasn’t.

All of our audio equipment, just like our fine musical instruments, is designed, crafted and ruthlessly tested by musicians. Just like our reed organs almost a century ago.

Indeed, the trained ear rather than a computer will always be the final arbiter of perfection.

And naturally the perfection that our musicians require and that our heritage demands, cannot be achieved by cutting corners or trimming costs.

Which may explain Yamaha’s premium pricing and the full five year warranty we give all our audio equipment.

Simply, Yamaha precision audio equipment will reward those whose passion for perfection matches their means with a lifetime of the finest, most natural sound reproduction.