Dec. 1980
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eti

ELECTRONICS TODAY INTERNATIONAL

GOLD DETECTOR

Can discriminate 'trash' from 'treasure'

BUILD A pH METER

Keep your pool or fish tank healthy; lots of other uses etc.

Voltage Regulators

-circuits and techniques

Learn BASIC

Pot core coil design

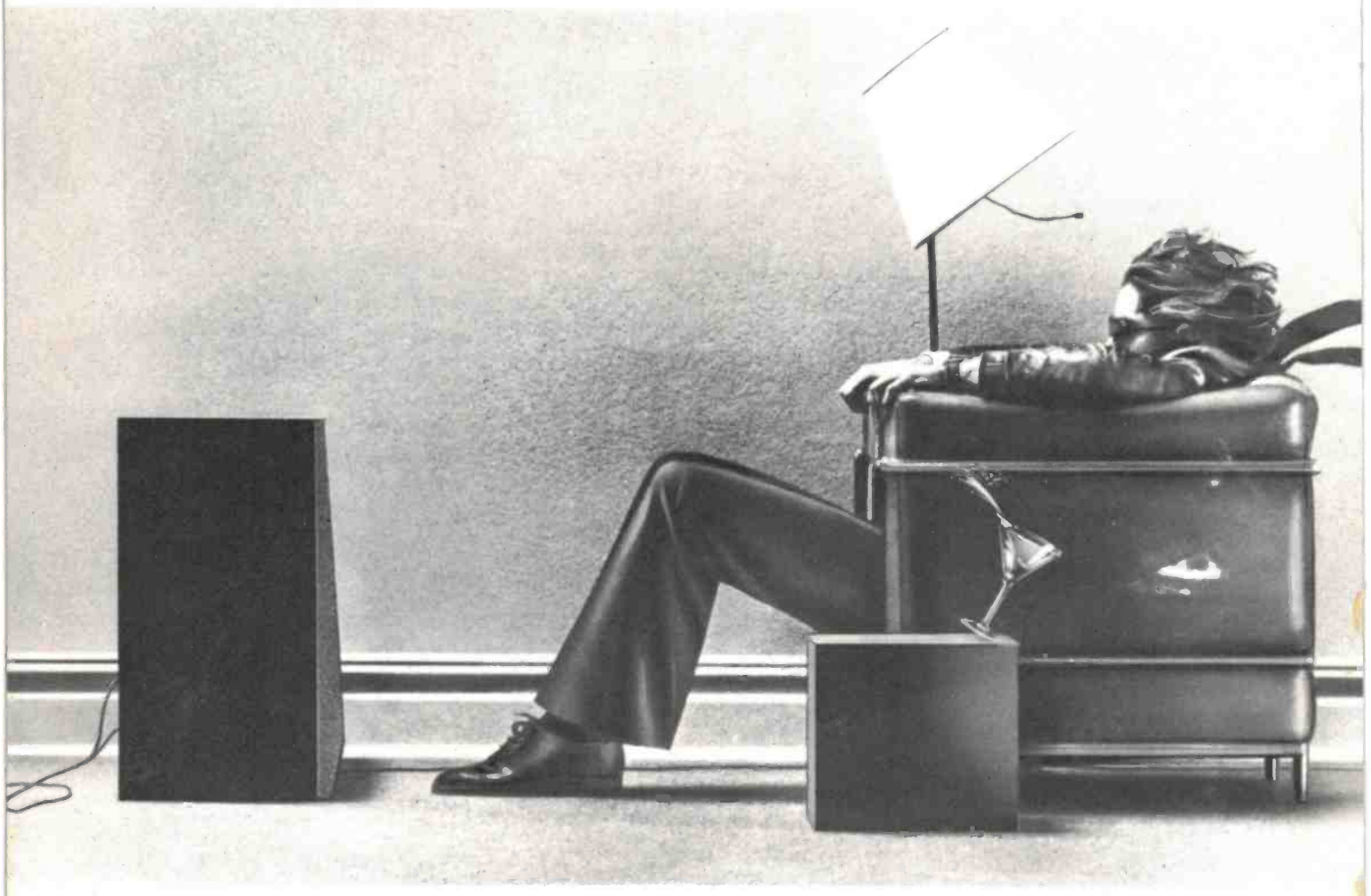
Hi-Fi Reviews:

Marantz ST500 FM/AM tuner

PAS-30 loudspeakers from G.R.D.

Win a ZX80 COMPUTER – WITH SOFTWARE

AFTER 500 PLAYS OUR HIGH FIDELITY TAPE STILL DELIVERS HIGH FIDELITY.



If your old favourites don't sound as good as they used to, the problem could be your recording tape.

Some tapes show their age more than others. And when a tape ages prematurely, the music on it does too.

What can happen is, the oxide particles that are bound onto tape loosen and fall off, taking some of your music with them.

At Maxell, we've developed a binding process that helps to prevent this. When oxide particles are bound onto our tape, they stay put. And so does your music.

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write to Maxell Advisory Service,
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simply excellent

WT191/80

ELECTRONICS TODAY INTERNATIONAL

Registered for posting as a publication – Category B

QUICK INDEX

WE HAVE RECEIVED quite a few enquiries over the past six months or so concerning projects which have appeared in the British edition of ETI, which have not subsequently appeared in the Australian edition of ETI. Indeed, some callers have become quite irate, despite our explanations! Firstly, we should put readers in the picture about our relationship with the overseas editions of ETI.

ETI originated in Australia in 1971 under Modern Magazines and a British edition was started by us a year later. German, Dutch and Canadian editions followed in 1976 and 1977. There was a French edition produced for a while but that was sold and has since been converted to a hi-fi magazine.

Australia's ownership and interests in the overseas editions were sold by the previous owners of Modern Magazines in June 1978. Since that date the overseas editions have been autonomous, although some material is exchanged between the various editions. The majority of projects originated by ETI Australia are re-published in the overseas editions. Almost all the projects in the Canadian edition, for example, are taken from ETI Australia.

The UK edition of ETI is not available in Australia — nor ours in the UK — owing to pre-existing agreements. However, it seems that, by one means or another, some Australian readers have become aware of projects published in the British edition but not published in ETI Australia.

Naturally, we exchange copies of each issue with the overseas editions. *Every* project originated overseas we consider for republication here — and we do that with a great deal of care: we consider the usefulness and possible popularity of the project, whether we have done something similar in the past, are the techniques new and/or interesting, what about component availability? The latter is particularly important. That's generally the reason why we don't (can't!) republish a project from an overseas edition. So many components, particularly ICs, available in Europe are just not available here. Often we consider finding some other way around this problem, but it generally means re-designing the project and in so many cases, because of the special devices used, the re-design is either impossible or the project becomes too expensive to the end user — you. We often go to great lengths, and spend considerable time, trying to find sources of components for would-be popular projects from our overseas editions. Sometimes we're successful, sometimes not.

Those projects we do take from overseas editions we build up in our own laboratory and completely test out. Sometimes we have to modify pc boards to suit locally available components (relays, cases, meters etc) and the text is generally rewritten and additional material included. In fact, we once so changed a project that we'd taken from the UK edition that they accidentally re-published it some months after their original project appeared!

If you come to hear about a project that one of our overseas editions has done, but which has not appeared in ETI Australia, rest assured we've looked at it closely and we're either preparing it for publication or it's been shelved until special components can be obtained.

The best wishes of the season to all our readers and advertisers.

Roger Harrison
Editor

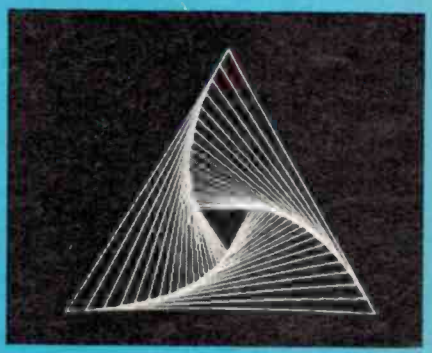
advertisers

eti ELECTRONICS TODAY INTERNATIONAL

COVER

We don't think we're making extravagant claims for our super new metal detector. It really can tell precious metals from old iron! Photo, gold nugget and cover design by the inimitable Ivy Hansen.

features



news

projects

sound

general

next month

PERMOSTAT ANTI-STATIC RECORD CARE KIT

Record care products are legion and many claims are made as to their efficacy. Permostat is claimed to ". . . permanently remove static electricity from a gramophone record". And what's more, without adverse effect. Louis Challis explores this claim and comes up with a surprise!

OIL TEMPERATURE METER FOR YOUR CAR

Featuring a linear LED readout, like most of our recent vehicle projects, this instrument employs a readily available dipstick probe. No car should be without one . . .

VIDEO DISC

What is it, what's inside the machines, where is it all going to end? Your questions answered. A fascinating rundown on this new consumer technology which will be upon us before you can say "National Panasonic, Philips, Pioneer, Kenwood, Magnavox, JVC . . . ".

150W MOSFET POWER AMPLIFIER MODULE

Would you believe less than 0.0008% distortion at 1kHz — and unconditionally stable? And that's conservative! This brilliant design forms the basis of our Series 5000 state-of-the-art stereo hi-fi system. If you've always wanted a really good hi-jfi amp, this is it. Don't miss it!

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.

Quality ★ ★ ★ ★

Price ★

Those who believe that a one star price will invariably dictate a similar result have obviously still to experience the union of Traminer and Rhine Riesling. McWILLIAM'S

STAGE & EFFECTS LIGHTING

ALL YOUR REQUIREMENTS AUSTRALIA WIDE

PAR 56

300w 240V

SEALED BEAM LANTERN

The PAR 56 — we brought this amazing lantern to Australia, and our version is the one that others try to copy. With a 2,000 hour life lamp, what could be more economical?
Look at these features:
- Large lamp rotating knob.
- New "easy glide" rotating assembly.
- Pole focus hook.
- New, hi strength colour runners.

To celebrate the end of the year, our agents are now offering very attractive deals on Par 56 lanterns — go and talk turkey NOW with your local Barratt Lighting Agent. The price will surprise you. Options: 4 door barndoor, colour wheel.

STAGE LIGHTING COURSE

The only intensive stage lighting course that covers all aspects of Stage and Effects Lighting. To be held on Saturday 17th and Sunday 18th January, 1981, at Barratt Lighting in Sydney.
Cost is $25.00 including notes, refreshments, and a night out on the Saturday night. To enrol, contact Barratt Lighting now. Hurry, numbers are limited.

DIMMERS

The new Ceitex Dimmer Rack — 12 channels, 2000 watts per channel in 3 x 4 way modules. This dimmer rack uses Flakey iron toriods for RF suppression — interference with audio systems is virtually non-existant. The Ceitex rack will drive either positive or negative control dimmer control desks — thus almost any dimmer control desk now available, will mate the Ceitex rack.

Top level adjustment is a trim pot on the front of each module, making trimming easy. The rack can be housed in any standard equipment rack, or be free standing. It is of very rugged construction. Power requirement to drive this dimmer rack is 3 phase, 30 amps per phase — into an internal terminal block. Control connection is a 14 pin cannon twist lock — standard on some dimmer desks. A control cable up to 60 metres (more in some situations) can be used to connect this dimmer rack with a control desk.

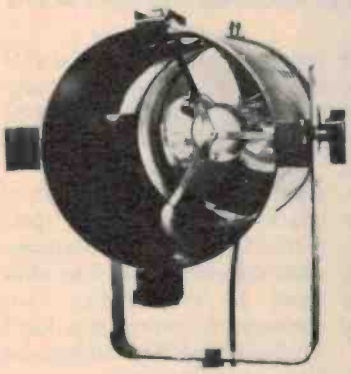
JANDS DIMMER DESKS

These mate the Ceitex Rack.
JL 24/8 • 24 channels, 2 presets • 8 scenemasters on Pin Matrix • 3 channel chaser • Flash buttons.
JL 36/12 • 36 channels • 2 presets • 12 scenemasters on Pin Matrix • 3 channel chaser • Flash buttons.
We also have other 12 and 24 channel desks!

CHRISTMAS SPECIAL OSCILITES $39

Limited Number

The Oslllte — a 3 channel chaser (sequencer).
• Variable rate • 450 watts per channel • Normal or shadow chase. Cheapest chase in Australia.



RAYLIGHT 500 WATT, 240V VERY TIGHT BEAM

Rock Industries think this is the brightest 500 watt lantern on the world market — in fact, we would love to be proven wrong! The Raylight is a fixed beam lantern — used mainly by Rock bands where extremely high intensity is needed.
LAMP: 500 watts, 240V, A1/244.
LANTERN HOUSING: Same can as the PAR 64 sealed beam lantern.
APPLICATION: Where very high intensity, tight-beam lighting is required.

DELTALIGHT IS COMING!

SYDNEY: Ceitex 2/33 College St, Gladesville (02) 896-2900
WOLLONGONG: Trilogy Electronics 40 Princes Hwy, Fairy Meadow (042) 83-1219
NEWCASTLE: Your Move Lighting 37a Beaumont St, Hamilton (049) 69-3560
BRISBANE: Harvey Theatrical Lighting 21 Crosby Rd, Albion (07) 262-4622
BRISBANE: Rave Light & Sound 95 Bridge Rd, Fortitude Valley (07) 52-3310
GOLD COAST: Rave Audio Visual 2388 Gold Coast Hwy, Mermaid Beach (075) 38-3331
MELBOURNE: Clearlight Shows 17 Alex Ave, Moorabbin (03) 553-1446
MELBOURNE: Lighting Corporation 131 Brighton St, Richmond (03) 429-5122
ADELAIDE: Hiwatt Lighting 37 Angus St, Nth Adelaide 5006 (08) 212-2033
ADELAIDE: Hiwatt Lighting 37 Angas St, Adelaide 5000 (08) 212-2033
ACT: Topstage Productions 8/14 Kembla St, Fyshwick ACT 2609 (062) 80-4694
PERTH: Stagecraft 1142 Hay St, West Perth 6005 (09) 321-9363.
PERTH: Kosmic Sound 1074 Albany Hwy, Bentley (09) 361-8981
HOBART: Good Oil Sound 310 Liverpool St, Hobart (002) 23-5151
Also available Australia-wide at Strand Rank Electronic outlets.

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Telex AA25298

NOW OPEN: New One-Stop Lighting Shop Showroom. All products ex-stock.

New Phone No. (02) **698-8499**

NEWS digest

College TV transmissions

A six week experiment in educational TV broadcasting was recently completed by Box Hill Technical College in Melbourne.

The programmes concentrated on teaching electronics, as a service to local amateurs, and were transmitted from the college's amateur repeater on channel 34 of the UHF band.

Transmitter power was only 10 watts and the broadcasts were only meant to cover a small area of east Melbourne, but reception reports indicate that they reached well beyond the target area and were even picked up in Geelong.

The programmes, which covered subjects like Oscilloscope Triggering, Oscillators, Phase Modulation and Frequency Modulation, were broadcast on two evenings each week. A unique feature of the transmissions was that students viewing the programmes could 'talk back' to the programme presenters via a direct telephone line into the studio.

All the work involved in the project, from construction of the transmitter to scripting and production of the programmes, was carried out by members of the college.

At the moment the college is still assessing the effectiveness of the project. They hope to use the experience gained in this six week experiment as the basis for producing a longer and perhaps continuous series of educational transmissions, beginning sometime within the next twelve months.

Many schools in the area watched the transmissions with great interest and have already indicated their desire to become involved in the administration, planning or production of future programmes. Mr Ron Ritchie, the Acting Director of Technical Education, has also been an interested viewer. He sees the experiment as yet another aspect of an enlarging electronic communication and distribution system. As most schools already have television receivers, this must be one of the most cost effective methods of distribution available.

It would also be relatively simple to marry a teletext system into the transmissions. Up to 150 pages of information could be modulated onto the otherwise unused line synch part of the signal to reinforce, recapitulate or extend the programme material. Viewers would be able to go through the main points of a programme they had just watched at their own pace.

Such a facility would obviously improve the effective dissemination of Technical and Further Education (TAFE) programmes. With suitable written backup material, it would even be feasible for people to study TAFE courses at home without having to attend a college regularly.

Programmable answering device

The A-100 telephone answering machine from Answerex can be programmed to accept incoming messages of any length.

Considering how flustered some people get when they speak to an answering machine and how angry they are when cut off in mid-message, this is certainly a desirable feature. Even when their message time is up, callers encountering the A-100 will not be abruptly disconnected — a recorded message warns them when they have run out of time.

The public relations value of these features to a business is obvious, but Answerex are also expecting that the machine, with its competitive (less than $200) price tag, will appeal to a wide range of active individuals who will want to instal it in their homes.

The A-100 comes with a standard cassette, one side of which is professionally prerecorded with forty messages, while the other is blank to allow users to record their own message to callers and leave whatever time they choose for incoming messages.

For more details, contact Answerex Communications Australia, 100 William St, Sydney 2000. (02) 357-2527.

Electronics courses at Newcastle

Newcastle Technical College is planning a wide range of electronics courses in 1981 for residents of Newcastle and the lower Hunter Valley.

In particular they are offering the Electronics Trades Course in block release format for students living anywhere in NSW. This is a three year course covering analogue and digital techniques for apprentices and others.

Post Trade courses include Television Receiver Servicing, Semiconductor Electronics, Industrial Electronics, Post Trade Electronics and Industrial Instruments (conversion).

In addition there are a number of attractive special courses, including Two Way Radio, Microprocessor Principles, Servicing of Electronic Musical Instruments, Television Studio Techniques and others.

Full information on any of these courses for 1981 is available from: **The Senior Head Teacher, School of Applied Electricity — Electronics Division, Newcastle Technical College, Maitland Road, Tighes Hill, NSW 2297. Phone (049) 61 0461 ext. 367.**

Superconductivity at room temperature

A metals researcher at a US Air Force base has accidentally discovered a compound which appears to superconduct at room temperature.

Fred W. Valdiek was experimenting with titanium boride crystals, deforming them under hydrostatic conditions in an effort to improve their ductility. When he finally achieved this aim by making crystals with an unusual and highly symmetrical structure, he set about looking at other properties and the superconductivity "... came along as a gift.", as he put it.

He was using a four point probe to test for electrical resistance and found that in two directions the resistance was normal (titanium boride is usually a good conductor) but in the third direction the resistance was zero. Nor was this an unrepeatable fluke. Valdiek made other crystals using the same growth and deformation techniques and now has about fifteen crystals which all exhibit zero resistance in one direction.

Zero resistance, however, is not the only property of a superconductor. To properly qualify for this description a material must also repel magnetic fields, a property known as the Meissner effect, which is essential for any practical applications of superconductors. Valdiek is setting up a coil to test for the Meissner effect and he claims to have already seen magnetic repulsion caused by the fields in his electron microscope.

At the moment physicists can only speculate about the mode of conduction in the new material. General thermodynamic considerations seem to rule out the possibility that electron Cooper pairs are being formed (as happens in low temperature superconductors), but if conduction is by more exotic means like exciton interaction or electron-hole pairs, then room temperature superconductivity does not violate accepted physical theory.

New National video recorder

National Panasonic have recently released their third generation home video recorder, a lightweight model weighing less than 13 kg and incorporating several unique features.

The model NV-7000 is a VHS recorder with a four hour record and playback ability. The video signal to noise ratio is 43 dB and Double Dolby circuitry gives the machine an audio S/N ratio of 50 dB.

Four direct drive motors are used, the video head cylinder motor being quartz locked to give an accuracy of 99.999%, according to National.

The standard model comes with a cable-linked remote control unit that in addition to the normal functions can also be used to review or cue at nine times normal speed, to play at half or double speed and to display single frames.

Other features claimed to be unique to this model are an antenna signal booster and an auto-edit function which ensures smooth continuity between programmes.

The NV-7000 has a recommended retail price of $1500 and comes with a two year warranty on all parts except the heads, which are guaranteed for twelve months.

New ETI staff members

Pictured here are two new members of our advertising sales staff in Melbourne.

Bill Philpott has just been appointed our Victorian Sales Manager. Bill began his career in the Royal Australian Navy, where he was trained in electronic, electrical and submarine communications theory. On leaving the service in 1976 he worked for four years as a marketing consultant for Computer Technology.

Virginia Salman has also recently been appointed to our Melbourne sales staff. She was formerly secretary to Southern States Executive Manager, Tom Bray, who was so impressed with her abilities that he promoted her to her new position. Virginia, who is tall and athletic, is married with two children. She enjoys playing tennis and riding bicycles, loves music and is very interested in computers.

Laser depth sounder

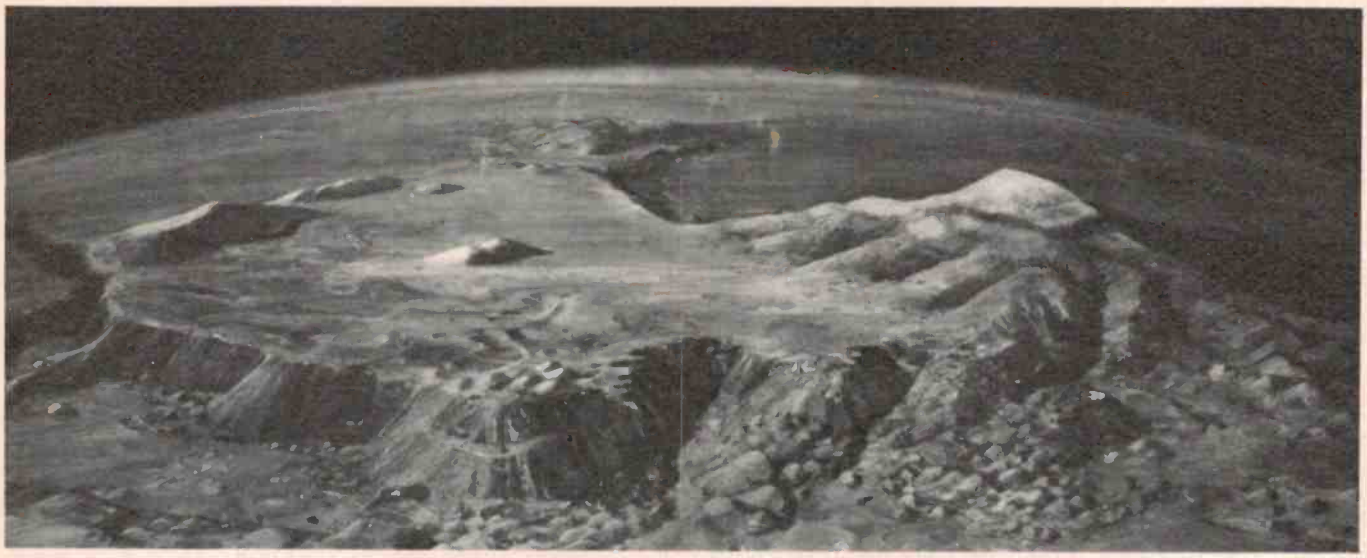
An airborne laser depth sounder will help ease the burden of hydrographic survey work around Australia's coasts.

The equipment, which is believed to be in advance of anything else in the Western world, was developed by the Defence Research Institute at Salisbury, SA. Known as WHELADS II it works by measuring the time interval between the reflection of a laser beam from the sea surface and the bottom. Multiplying this interval by the velocity of light in sea water gives the depth.

Conventional acoustic sounders work on a similar principle, but because they use sound waves they must be carried on surface vessels, which makes the task of surveying Australia's vast continental shelf a long and laborious one.

All measured depths must of course be accompanied by accurate positional information, and the generation of such data (accurate to within a few metres) is an essential part of the system.

Installed in a RAAF Dakota, WHELADS II has been tested over North Queensland waters and is currently on trial off South Australia.



Venusian surface mapped by orbiter radar

The Pioneer Venus craft (see ETI May 1979) has been orbiting the planet since December 1978 during which time its radar has penetrated the thick clouds of the planet to provide information about large surface features.

By May 18th, 1980 the Orbiter had mapped 93% of the Venusian surface from 73° North to 63° South latitude, missing relatively small circular regions around each pole of the planet. The work should continue for a few more years.

Prior to the Pioneer Orbiter work, less than 1% of Venus' surface had been detected by powerful Earth-based radar techniques.

The most prominent features on Venus are the highland regions which are comparable to the continents of the Earth. One of these, Ishtar Terra, in the northern hemisphere is the size of Australia, while another, Aphrodite Terra, is as large as half of Africa.

There is no 'sea level' on Venus, but 60% of the surface consists of relatively flat rolling plains lying at a radial distance of 6050 km from the centre of the planet. This 6050 km radius is used as a reference distance like sea level on the Earth.

The lowlands of Venus may be compared with the oceanic areas of the Earth, but only 16% of the surface lies below the 6050 km radius whereas on Earth nearly two-thirds of the surface is covered by the oceans.

The lowest point is 2.9 km below the reference level.

The highest point, Maxwell Montes, in Ishtar Terra is 10.8 km (35 400 feet) above the reference level and is therefore higher than Mount Everest.

Only about 8% of the planet's surface is true "highlands" which may resemble the corresponding areas of low-density rock on the Earth.

An international group is naming the surface features after mythical goddesses. Ishtar (centred at 65° North) is named after the Babylonian goddess of love and war, daughter of the Moon and sister of the Sun. Aphrodite (centred at 5° South) is another name for Venus itself.

Minor features will be named after other mythical female figures and still smaller features after famous women who are no longer living. However, the names have so far been allocated on a tentative basis.

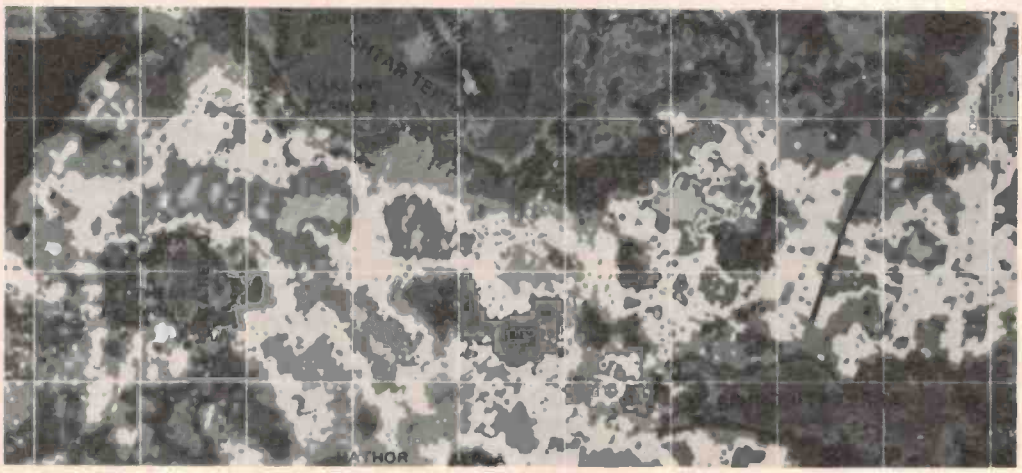
Other major features on Venus include Beta Regio at 30° North which appears to consist of two huge shield-shaped volcanoes larger than the Hawaii-Midway chain on the Earth; it is probably situated on a fault line running from 40° North to 50° South latitude.

There are two huge adjoining mountains (smooth on the surface and shaped like the very wide-based Hawaiian volcanoes) which cover a North-South distance of some 2100 km. The Soviet Venera 9 and 10 craft landed in this region and found radioactivity similar to that of volcanic rocks on the Earth.

These Theia Mons (northerly) and Rhea Mons (Southerly) mountains rise to about 4 km above the reference level. Alpha Regio is a smaller highland region about 25° South of the equator.

When considering the maps of the Venusian surface, readers should remember that it would not have been possible to obtain this information without modern electronics, space-borne radar and a highly efficient inter-planetary communications network. Complex data reduction systems were employed to convert the raw data into acceptable images.

Brian Dance



Small Fridge. Big Deal.

Space age breakthrough creates a new line of Koolatron electronic portable refrigerators and food warmers.

You're nicely away on your long-awaited vacation, camping trip or long weekend with the family. You're comfortably cruising in your car, van or rec. vehicle along a busy interstate with few rest stops or restaurants. You guessed it . . . the kids want to stop for a snack. But your Koolatron P34 or P34A is full of sandwiches, cold drinks, fried chicken . . . home made, fresh and cold. The family helps themselves and you've saved valuable vacation time and another expensive restaurant bill.

You're a commuter, a salesman or a trucker and you spend many hours in your vehicle daily. Now with your amazing Koolatron plugged in beside you, you open the lid and instantly fresh food and drinks are at your fingertips. Just for the price of a good cooler and one or two seasons of buying ice, (or about 10 family restaurant meals), all the marvels of home refrigeration are available electronically. An amazing space-age miracle . . . the thermo-electric solid state module . . . makes these portable refrigerators possible.

These amazing heat pumps have not only gone to the moon, but have provided the breakthrough for Koolatron's portable fridge revolution.

THOUSANDS IN USE

Koolatron now has tens of thousands of electronic fridges in use worldwide using these same powerful solid state modules. Built to take it, two of these electronic modules are encased in tough, plastic insulated chests that are designed to be rugged and trouble-free. Non-rusting hinges and latches prevent corrosion in salt water environments. And with only one moving part (a small 12 volt fan) Koolatron's portables seldom see a service depot. Now you can enjoy Koolatron's whole family of electronic portable refrigerators and food warmers that eliminate costly ice and provide "home refrigeration" convenience at sane and sensible prices.

THE PERFECT RECREATIONAL FRIDGE — **MODEL P34 $219.00**

Holds over 20 kg food or 48 cans or 12 bottles of wine. Refrigerates in air temperatures up to 35°C. Tough ABS case in Sand Beige with non-corroding latches and handle. Large 33 litre capacity. Weighs only 7½ kg when empty. Operates on 12 volts DC with supplied power cord or from optional 240 volt adaptor.

Exterior: 53cm x 41cm x 41cm

Interior: 41cm x 31cm x 31cm

As a travel fridge Koolatron keeps food and drinks fresh and cold wherever you go. Carry frozen food, medical samples, insulin, dietetic food. Photographers use it for films. Boatowners keep your drinks cold and food fresh without going ashore for hard to get and cumbersome ice. Operate Koolatron up to six hours from your battery and still start your engine. With the power off, Koolatron keeps everything cold and fresh for many hours in its well insulated case. Imagine dry dependable refrigeration with the size to match your travelling and camping needs. Fits into any boat, van, truck, camper or back seat of your car. Ideal for aeroplanes. Unaffected by motion or tilting. A natural for drive-in movies, picnics, sporting events. With our optional 240 volt adaptor you'll also find endless uses wherever household current is available . . . at your weekender . . . as a bar fridge . . . in your motel room for a midnight snack or drink . . . as an office fridge . . . or beside your pool. Use as auxiliary fridge at your next party. Dazzle your friends with the latest space age technology.

THE ULTIMATE RECREATIONAL REFRIGERATOR & FOOD WARMER — **MODEL P34A $239.00**

The same size, colour, weight and capacity as the P34 but includes food warming features, fully adjustable temperature control and low battery warning indicator.

The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent applied for) it allows you to dial a complete range of temperatures from very cold to very warm. You wine buffs will find it ideal to keep up to 12 bottles of wine at just the right temperature. In winter take your favourite casserole and hot food for the whole family with you and save on restaurant meals. Mothers can keep baby's formula just right for baby. Low battery indicator warns you when battery needs a recharge and the sensing circuits efficiently control your power consumption to save on battery drain. This is our best of the line recreational fridge and food warmer with all the bells and whistles for the discerning buyer who demands quality, size and versatility.

WHY IS KOOLATRON BETTER VALUE THAN ANY OTHER PORTABLE FRIDGE?

The full size family of Koolatron portables are specially designed for the serious traveller and outdoors man. They will refrigerate more than 3 times the contents of the Sheen and 4 times the contents of the Electrolux Sunnycool. You can fit more drinks (48 small cans or 12 wine bottles) or more food (20 kg) into your Koolatron than into most other portable fridges, yet Koolatron costs a lot less for it's size. At the same time it consumes no more power under full load than other smaller units.

WE MAKE YOU A PROMISE

If you can find any other 12VDC or gas operated portable refrigerator that is lighter, bigger and costs less than Koolatron—we will buy it for you. No questions asked.

ORDER TODAY WITHOUT ANY OBLIGATION AND 21 DAY MONEY BACK GUARANTEE

Simply complete the attached order form or phone collect and we will rush you your Koolatron on our no risk 21 day trial offer. Each unit comes with complete instructions and a written 1 year warranty. In the unlikely event you ever need service we have service centres in all capital cities and overseas. When you receive your Koolatron use it constantly for a full 3 weeks without risk.

If you ordered our optional 240 volt adaptor, plug it in, then use your portable immediately as a bar fridge or around the patio or pool. Next plug your fridge into your car or van. Take your family out for a weekend trip. Enjoy fresh home cooked food as you thumb your nose at expensive restaurants and takeaways. If after you have thoroughly tested it, you don't agree that your Koolatron represents a major breakthrough that will save you time money and bother for years to come, send it back for a full refund. You can't lose . . . we guarantee it.

So be among the thousands to discover that the ice age is over. Don't waste another dollar on ice . . . order your Koolatron without any obligation today.

CREDIT CARD HOLDERS—You can phone your order reverse charge

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Koolatron Industries
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409 Sussex Street Sydney 2000

Or use this handy order coupon.

Koolatron
INDUSTRIES

297 Williamstown Road,
Port Melbourne, 3207 Telex 32571
Send me with full refund privileges:

___Koolatron P34 at $219.00.

___Koolatron P34A at $239.00.

___Koolatron 240V Adaptor at $37.50.

Please add $7.50 for handling and delivery per unit.
No charge for shipping A.C. adaptor if ordered with unit.

I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

I enclose my cheque or money order for

$_____or please charge it to my

☐ Bankcard ☐ Diners Club
☐ American Express

A/c Number _____

Expiry Date _____

Signature _____
(necessary to send merchandise)

NAME _____

ADDRESS _____

CITY _____

CODE _____

ETI 12/80

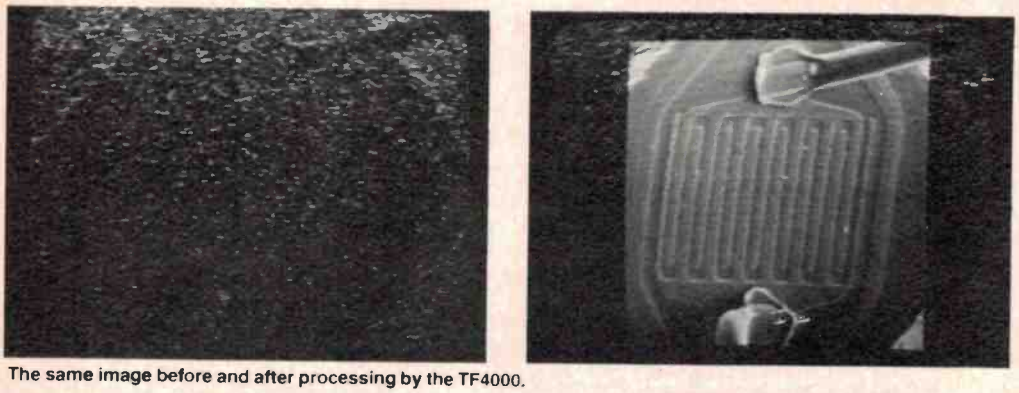
Video image processor reduces noise

The Australian company, Dindima, have announced the development of a new method of processing video images to improve the signal-to-noise ratio by 45 dB.

A patent application has been made for the Arlunya TF4000 digital temporal filter which is expected to have applications in the fields of medicine, astronomy, nuclear physics, and industry.

The instrument stores a video image on a 512 x 512 picture element matrix, applying a noise integration algorithm and 256 grey scale levels on an element by element basis. The processor samples the image at 14.5 MHz over a period selected by the operator, ranging from 0.3 s to 82 s.

The Arlunya TF4000 is unique in that it can effectively eliminate noise on a real time basis. This makes the instrument especially useful in the image processing of X-ray fluoroscopy where it enables the minimum dosage of radiation to be used, for example in the examination of a patient with suspected cancer.



The same image before and after processing by the TF4000.

It is hoped that the instrument will have considerable export potential and although it is new it is already being sold in the UK as an image intensifier and noise reduction system for electron microscopy.

Further information can be obtained from Dindima Group Pty Ltd, P.O. Box 106, Vermont, Vic 3133.

Californian power industry backs solar cells

Westinghouse announce that two of the major Californian electric power companies will fund the development of an automatic solar cell production plant.

The plant will produce single crystal silicon ribbon, known as dendritic web, directly from molten silicon. The process yields a long, smooth and pure ribbon which, unlike ingots, does not need to be sliced, polished and cleaned. This saves time and avoids wasting expensive high purity silicon.

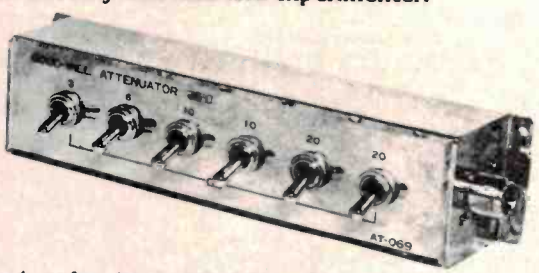
Solar cells made from dendritic web have already achieved conversion efficiencies approaching 16 per cent and Westinghouse expect that improvements currently underway will take this figure over 18 per cent, which in midday sunshine means a power output around 170 watts per square metre.

Phase one of the project, a pilot facility with a capacity of 50 kilowatts per year, will have operating costs of about US$1 million in its first year of production, of which Pacific Gas and Electric and Southern California Edison will each provide $300 000. Under the agreement, the utilities will receive their first cells later this year to use in their own research and development programmes.

Once the first stage is completed, Westinghouse plan to expand to a fully automated 25 000 kilowatt per year production line, which will be the basic module for a full scale production plant.

Attenuate me baby !

RF attenuators are an indispensable instrument in the shack of every true ham and experimenter.



They're often hard to find in the shops, but if you look carefully in Emtronics' George St, Sydney store you'll find two models from the Goodwill company.

Models AT-069 and AT-872 are available in 50 and 75 ohm impedances and are specified to work from dc to 250 MHz.

The AT-069 has a maximum attenuation of 69 dB in six steps — 3, 6, 10, 10, 20 and 20 dB. The AT-872 has eight steps of 1, 2, 3, 6, 10, 10, 20 and 20 dB for a maximum of 72 dB.

Both models can be obtained with N, BNC or S0239 connectors, although the latter are favoured. Both measure 220 mm long by 50 mm square.

Applications include measuring receiver and preamp noise figure, checking or measuring relative antenna gain, reducing front end overload in receivers, providing calibrated steps from a signal generator output, etc.

See Emtronics at 649 George St, Sydney 2000 (P.O. Box K21, Haymarket 2000). (02) 211-0531.

And you thought just for old

1. Not the old school bus, not the blunderbus. This is the Fun Bus, and it's fun all the way. With one of the world's most exciting and beautiful countries at your feet, travelling in the Fun Bus can make your holiday even more memorable.

Mix with people your own age, share their interests, and live the good life as you cover the country from top to bottom. You'll never be in better company.

There's much more to New Zealand than mudholes and geysers.

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2. Go where no man has gone before. Four wheel drive it through/up/across/around/over some of the most unbelievable roads and no roads you're ever likely to meet.

3. Rent a bike. Take it by the hour or the week, in Christchurch, or from there into the country.

There are even tandems for hire if that's your idea of togetherness.

4. Before the wheel came the walk, and the Routeburn Trek is one of the most stunning ways to take one. A four day guided hike through two of New Zealand's greatest National Parks, Mt. Aspiring and Fiordland. This is not exactly a Sunday stroll.

5. Get into training between April and December. Fourteen consecutive days of train, bus and ferry travel to and from almost any part of New Zealand for just $8 a day.

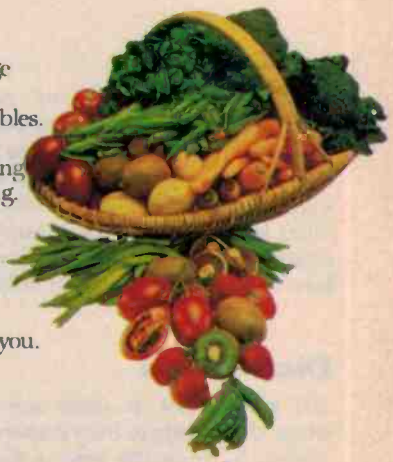
6. Or fly like a bird. New Zealand Air Pass allows you unlimited travel throughout New Zealand.

If you have 14 days, $170 and lots of stamina you can see up to 23 towns and cities.

New Zealand was geysers.

7. One of man's favourite pastimes. You'll find kiwis of all kinds in New Zealand. Some feathered, all friendly. It's said that the after-dark dance rituals are well worth the experiencing.

8. A snow job. Take to the skis on some of the world's best snow fields. Places with names as exciting as the fields and the facilities – Tekapo, Mt. Hutt, Mt. Ruapehu, Coronet Peak, etc. And a bribe. It can be cheaper to ski here, including airfare, than in Australia. Speak to Air New Zealand or Qantas.



9. Let Huka Lodge capture you. Home grown vegetables. New Zealand game. Hunting. Trout fishing and horseback riding. It's on the Waikato River and the Queen Mother, General MacArthur and Jack Nicklaus discovered it before you.

10. Get a horse. Take a New Zealand Farm Holiday. (There are three kinds: Children Only, Live-in and Farm 'Cottages'.) On all of them you'll have a good country time. On a lot of them you can take a horse for trekking or hacking. You may even be persuaded to lend a hand on hoof.

11. Where better to be a hell's angel than in an earthly paradise! There are motor bikes for hire in Christchurch and the price for freedom on wheels is really very cheap.

12. Well that's some of the things to do in New Zealand. Now for some of the ways to get there. Air New Zealand and Qantas have about 100 flights a week across the Tasman. They also have a whole lot more detailed information. Contact Air New Zealand or Qantas or your local travel agent. And have a good holiday.

QFA1399LG

pH — the acid test

Many chemical and biological systems depend critically on a parameter known as pH. This article explains what pH means, outlines how it is measured and investigates some areas where it is important.

Elaine Ray & William Fisher

THE IMPORTANCE of acids and alkalis is well known, as is the fact that some acids and alkalis are stronger than others — that is, they react more vigourously with other substances. But what is it that makes sulphuric acid, for example, stronger than acetic acid? And how can we quantify their strengths?

Dissociation

All acids have at least one hydrogen atom that tends to break away from the molecule when the acid is dissolved in water. In doing so it leaves behind an electron and becomes a positively charged hydrogen ion. It is these free hydrogen ions that are responsible for the chemical properties of acids, and their relative numbers determine the strength of the acid in question.

For example, acetic acid (CH_3COOH) dissolved in water tends to partly dissociate into positive hydrogen ions (H^+) and negative acetate residues (CH_3COO^-), thus:

$$CH_3COOH \Leftrightarrow CH_3COO^- + H^+$$

and sulphuric acid dissociates almost completely in water into hydrogen ions and sulphate residues thus:

$$H_2SO_4 \Leftrightarrow 2H^+ + SO_4^{--}$$

Alkalis are extreme examples of a class of substances known as bases. Bases are like converses of acids. When they are dissolved in water they tend to break up into a negatively charged hydroxyl ion (OH^-) and a positively charged residue. For example the strong alkali potassium hydroxide (KOH) breaks up thus:

$$KOH \Leftrightarrow K^+ + OH^-$$

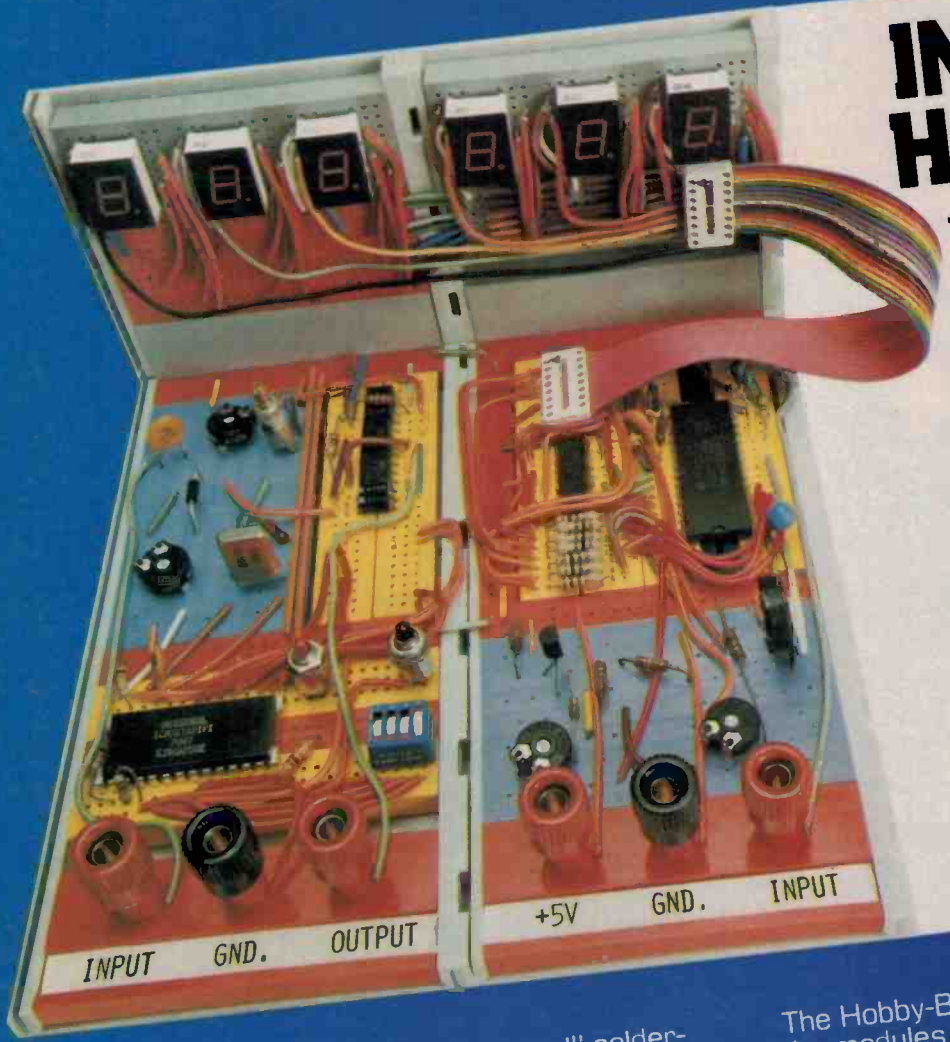
and the weaker base calcium hydroxide (lime) partly breaks up into calcium and

— to page 19 ▶

A high quality portable pH meter with a liquid crystal display that directly indicates the pH of the solution under test.

INTRODUCING HOBBY-BLOX™

The new modular circuit building system designed especially for electronic hobbyists.



Until now, you had to buy "professional" solderless breadboards for your projects and pay "professional" prices. Now there's Hobby-Blox, a totally new circuit-building system that's not only economically priced but offers many more advantages to the hobbyist.

At the core of the system are two expandable starter packs, one for discrete component projects, the other for integrated circuit projects. Each comes with a number of Hobby-Blox modules that fit into a tray and an illustrated project booklet. In addition, the system includes 14 separate component packs you can purchase individually — terminal, distribution and bus strips, speaker panels, binding posts, etc.

The Hobby-Blox system is easy to use because the modules are color-keyed and letter/number indexed. It's time-saving, because they're solderless. It's compatible with DIP's of all sizes and a wide variety of discrete components. And you save money, because the parts can be reused again and again.

How far can you go with the Hobby-Blox system? Take a look at the example above. Then you'll know why we say, "your only limit is your own imagination!"

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Digital IC Probe & Logic Pulser

PRB-1 DIGITAL LOGIC PROBE

Compatible with DTL, TTL CMOS, MOS and Microprocessors using a 4 to 15V power supply. Thresholds automatically programmed. Automatic resetting memory. No adjustment required. Visual indication of logic levels, using LED's to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt pocket portable (protective tip cap and removable coil cord).

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- No switches/no calibration
- Open circuit detection
- DE to > 50 MHZ
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- Automatic pulse stretching to 60 Msec.
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Range extended to 15-25 VDC with optional PA-1 adapter

PLS-1 LOGIC PULSER

The PLS-1 logic pulser will superimpose a dynamic pulse train (20 pps) or a single pulse onto the circuit node under test. There is no need to unsolder pins or cut printed-circuit traces even when these nodes are being clamped by digital outputs.

PLS-1 is a multi-mode, high current pulse generator packaged in a hand-held shirt pocket portable instrument. It can source or sink sufficient current to force saturated output transistors in digital circuits into the opposite logic state.

Signal injection is by means of a pushbutton switch near the probe tip. When the button is depressed, a single high-going or low-going pulse of 2μ sec wide is delivered to the circuit node under test. Pulse polarity is automatic: high nodes are pulsed low and low nodes are pulsed high. Holding the button down delivers a series of pulses of 20 pps to the circuit under test.

- High input impedance (off state) 1 meg ohm
- Low output impedance (active state) 2 ohms
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- Input over voltage protection + 50 volts
- Finger tip push button actuated
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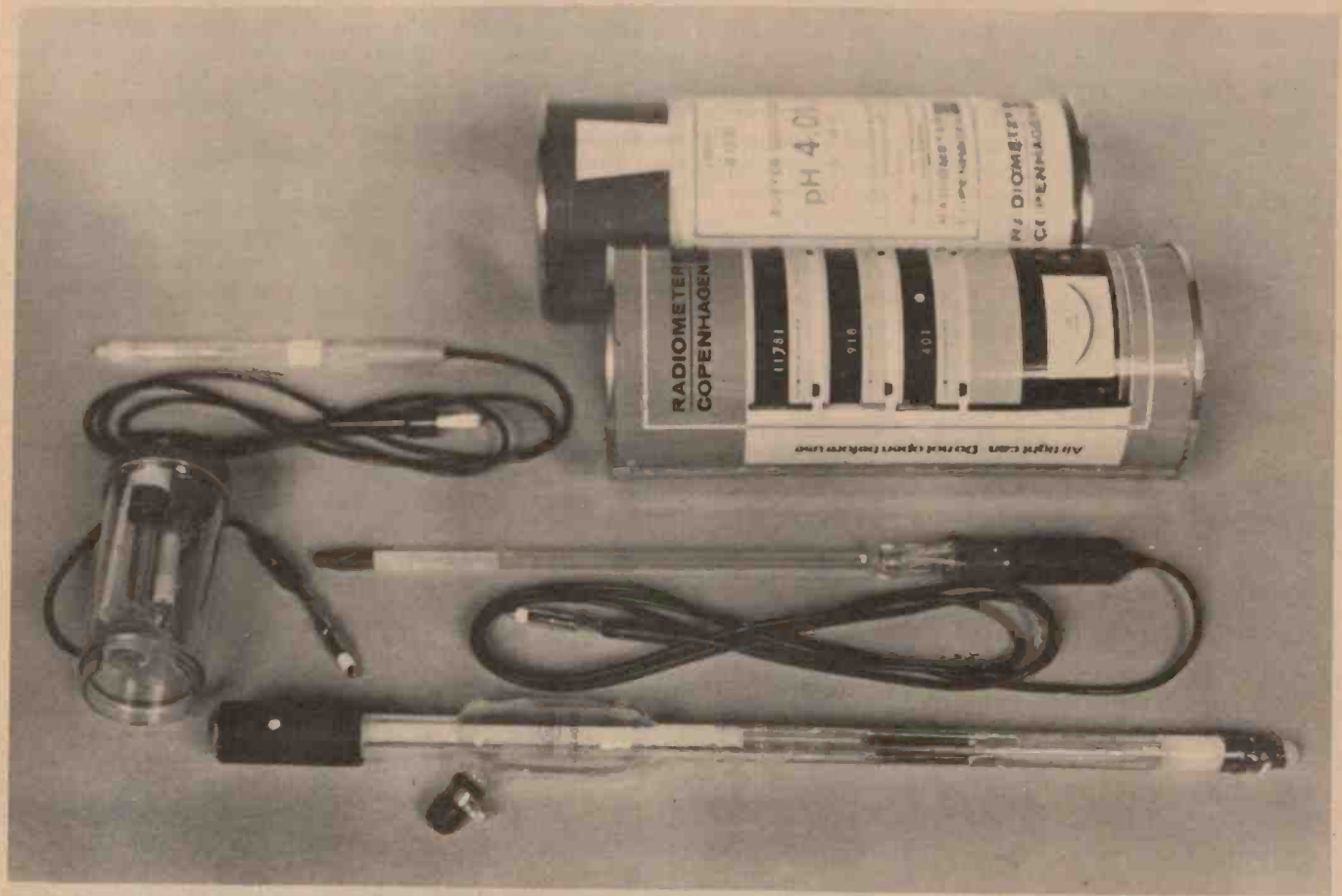


pH electrodes are made in a variety of shapes and sizes to suit different applications. at the rear of the picture are two cans of 'buffer solutions' — liquids whose pH does not change much when they are contaminated. Buffer solutions are used to calibrate pH electrodes.

hydroxyl ions, thus:

$$Ca(OH)_2 \blacklozenge Ca^{++} + 2OH^-$$

Bases and acids in the same solution tend to neutralise each other. The free hydrogen ions from the acid combine with the free hydroxyl ions from the base to form molecules of water, thus:

$$H^+ + OH^- \blacklozenge H_2O$$

Neutrality and activity

The reaction between hydrogen and hydroxyl ions can also proceed in the other direction — that is, water molecules can break up again into free hydrogen and hydroxyl ions. There is only a slight tendency for this to happen, however. In pure water at room temperature only about one water molecule in ten million dissociates into ions. In other words, the concentration of free hydrogen ions in pure water is one part in ten million. This concentration of hydrogen ions is known as a *neutral* solution.

If an acid is dissolved in water, the solution will no longer be neutral — there will be more hydrogen ions because of the dissociation of the acid. Dissolved bases will initially result in a solution that has more hydroxyl ions than neutral water, but these hydroxyl ions will tend to combine with any free hydrogen ions to form H_2O molecules. The net result is that the number of free hydrogen ions in a basic solution is *lower* than in neutral water.

Clearly if we can measure the number of free hydrogen ions in a solution we can find out if it is acidic or basic, and to what extent. Actually what we will be interested in is not the absolute number of hydrogen ions, but their relative numbers, i.e. their concentration.

For reasons of mathematical convenience and logical purity, chemists prefer to work with a quantity known as the *activity* of hydrogen ions. Since the activity is generally proportional to the concentration, the exact distinction between the two terms need not concern us here.

The range of possible values for hydrogen ion activity is very wide, from 10 for the strongest acid solution to 10^{-14} for the strongest alkali. This leads to numbers that are awkward to write and even more awkward to speak (try saying 2.76×10^{-11} quickly!).

The pH notation, which was introduced in 1909 by the Danish chemist S.P.L. Sorensen, makes things a bit easier. It defines pH as the negative logarithm of the hydrogen ion activity, i.e.

pH = − log A (where A is the hydrogen ion activity)

Low values of pH indicate acidity, high values alkalinity. Neutral water is pH7.

pH measurement

The best way to measure the hydrogen ion activity of a solution is to use that solution as part of an electric cell. Before 1937 this was commonly done with a 'hydrogen cell'.

When a platinum electrode is dipped into a solution containing H^+ ions, the positively charged ions tend to attract negatively charges electrons out of the metal. The higher the activity of the ions, the stronger the attraction of the solution for the electrons.

One way to compare the H^+ activities of two different solutions is to put an electrode into each solution and join the electrodes with a wire. The solution with the higher activity will exert a greater pull on the electrons and a current will flow through the wire. If the wire is broken, a voltage will appear ▶

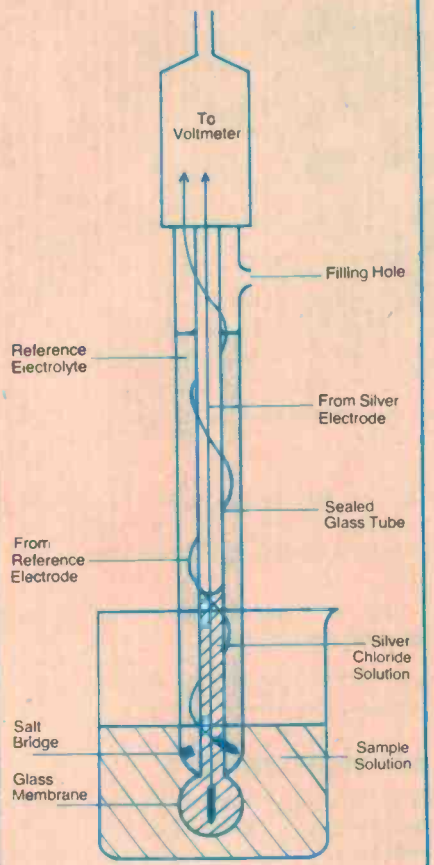
between the two break points. This voltage is a measure of the hydrogen ion activity and hence of the pH.

There are considerable practical and theoretical difficulties involved in the 'hydrogen cell' method of measurement described above. The invention of the 'glass electrode' pH meter in 1937 overcame these difficulties and was a boon to chemists.

A typical glass electrode consists of a porous glass bulb containing a saturated solution of silver chloride (AgCl) in which a silver electrode is immersed. This electrode is connected to one terminal of a voltmeter, whose other terminal is wired to another electrode that sits in a reference solution. Because the silver ions in the silver chloride solution tend to suck electrons from one electrode and the positive ions in the reference solution suck electrodes from the other electrode at fixed but different rates, the voltmeter normally reads some steady voltage.

The glass bulb containing the silver chloride is immersed in the solution whose pH is being measured. The hydrogen ions in the latter solution migrate across the glass membrane of the bulb and alter the activity of the silver chloride solution, thereby altering the attraction of the silver chloride solution for the electrons in the silver electrode dipped into it. Consequently, the reading on the voltmeter will alter.

Careful design can result in a glass electrode pH meter which generates a voltage that is linearly proportional to the pH of the solution being tested. (Sometimes this linearity is achieved by putting the test solution in contact with the reference solution as well, via a 'bridge' of some electrically conducting salt).



A GLASS ELECTRODE

Above is a cross-sectional diagram of a typical pH electrode or 'probe'. It consists of a glass membrane in the shape of a bulb, inside which is a solution of silver chloride and a silver metal electrode. Around the stem of the probe is a refillable reservoir which contains a reference solution and a reference metal electrode.

The two electrodes are connected to the terminals of a voltmeter, which normally reads a steady voltage. When the probe is immersed in the sample solution, some ions from the sample migrate across the glass membrane and alter the activity of the silver chloride, so that the voltmeter reading alters.

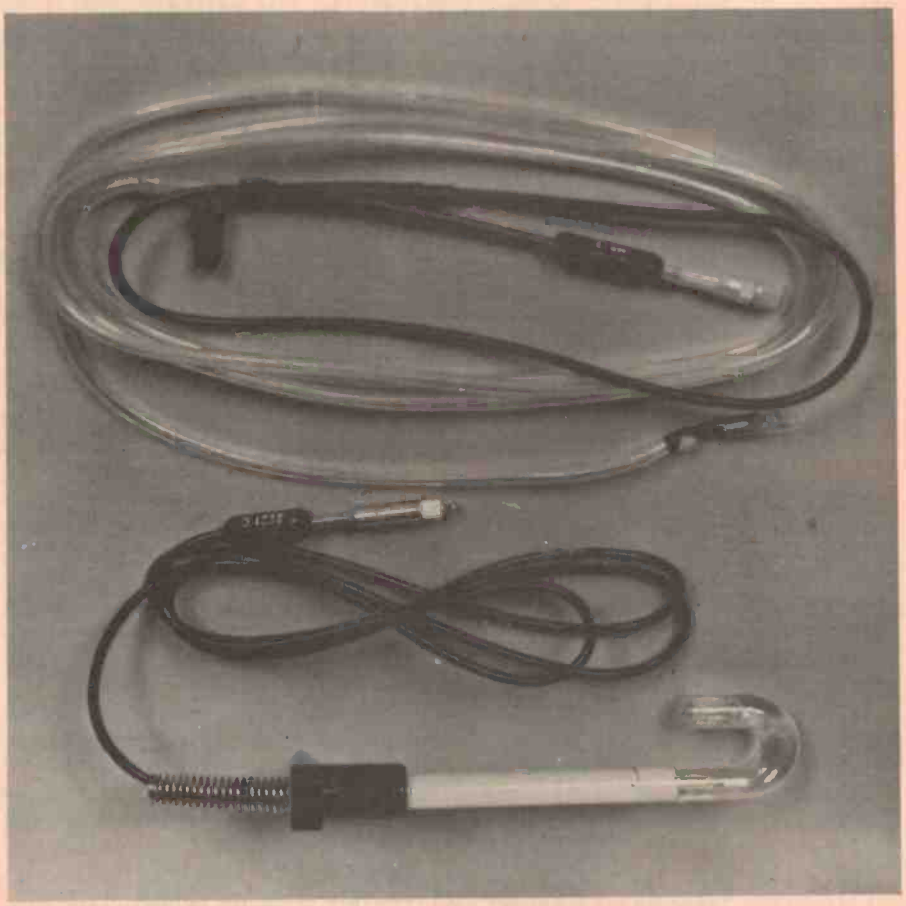
pH in medicine

The complex chemical interactions that take place in the human body are very sensitive to changes in pH so the body is constantly trying to keep the pH of its blood within the narrow range from 7.38 to 7.42.

A complicated feedback system, controlled by the endocrine glands, operates to counteract any abnormal deviations in blood pH, which would otherwise be traumatic. For example, after a heavy intake of alcohol, which makes the blood over-acid, the lungs breathe deeper and faster so as to expel carbon dioxide (which makes carbonic acid when it is dissolved in the blood) and the kidneys extract more carbonic acid from the blood and pass it into the bladder where it can do no harm.

Acidosis and alkalosis, which are the medical terms for abnormally low and abnormally high blood pH, are generally indications of serious diseases like diabetes, kidney or lung failure.

Polio victims and others in artificial respirators sometimes suffer from an excessive build-up of carbon dioxide in the blood (because their lungs cannot excrete it). Fortunately this can easily be detected in time for corrective action to be taken by routinely monitoring the blood pH. The amount of blood required for this purpose is quite small — a few



Two special pH probes for medical applications. The upper one is a gastric pH probe, designed to pass through a patient's nose and the lower probe is used for blood analysis.

millilitres, which must be syringed directly to a gas analyser because exposure to the air would alter its pH.

The pH level in the stomach is quite different to that of the blood. The gastric juices are rich in hydrochloric acid and vary from pH 1.5 to 3.5. A hormonal feedback control system normally keeps the gastric pH within bounds, but this system can be upset by abnormal secretion of adrenaline in times of prolonged nervous tension. This is why people who live under a great deal of stress tend to have ulcers caused by gastric over-acidity.

There are also some people who have little or no free hydrochloric acid in their stomachs. This group run a very high risk of developing stomach cancers. Clearly the measurement of gastric pH levels is of considerable medical importance and over the years physicians have developed various methods of doing this. Perhaps the commonest technique nowadays is to pass an electrode through the nose and down the alimentary canal into the stomach, to give a fast and accurate indication.

Soils

Soil acidity or alkalinity is one of the major factors that affect the growth of plants. The pH of a soil is an indication of the extent to which exchange reactions in the soil are preventing nutrients from reaching the roots of plants.

Roughly what happens is this — the fine particles in a soil aggregate into bodies known as colloids, which have an electrical charge distributed over their surface. The water that permeates the soil contains dissolved ions which plants need and which they normally suck up from the solution by capillary action through their roots. However, some of these ions in solution may change places with less valuable ions on the colloid surfaces. Plants can only absorb ions from the aqueous solution surrounding the colloids; they cannot attract them from the colloid surfaces, so the soil is effectively depleted nutritionally.

Plant nutrient ions are commonly attached to the colloids in exchange for hydrogen ions, which pass into solution. Measuring the soil pH obviously gives an indication of the extent to which this has happened.

Plants vary a great deal in the range of pH they will tolerate. Most will flourish somewhere between pH 6 and 8, but some well known plants grow best outside this range. Potatoes and tomatos, for example, like an acid soil with a pH between 5 and 6, while camellias, azaleas and other hardy flowering plants cannot tolerate any degree of acidity and do best in alkaline conditions with a pH between 8 and 9.

Acid soils can be neutralised by adding lime and over-alkaline ones will benefit from a dressing of bone meal or any other source of phosphates. If you want to measure the pH of your own soil, you should first make a ten per cent aqueous solution (i.e. 10 grams of soil in 100 millilitres of water) and measure the pH of that.

Aquariums

Fish are sensitive creatures and won't flourish unless the pH of their environment is correct. Most freshwater fish do best between pH 6.5 and pH 7.5, but goldfish (whether they are cold or warm water types) like their water a little more alkaline, i.e: pH greater than 7.5.

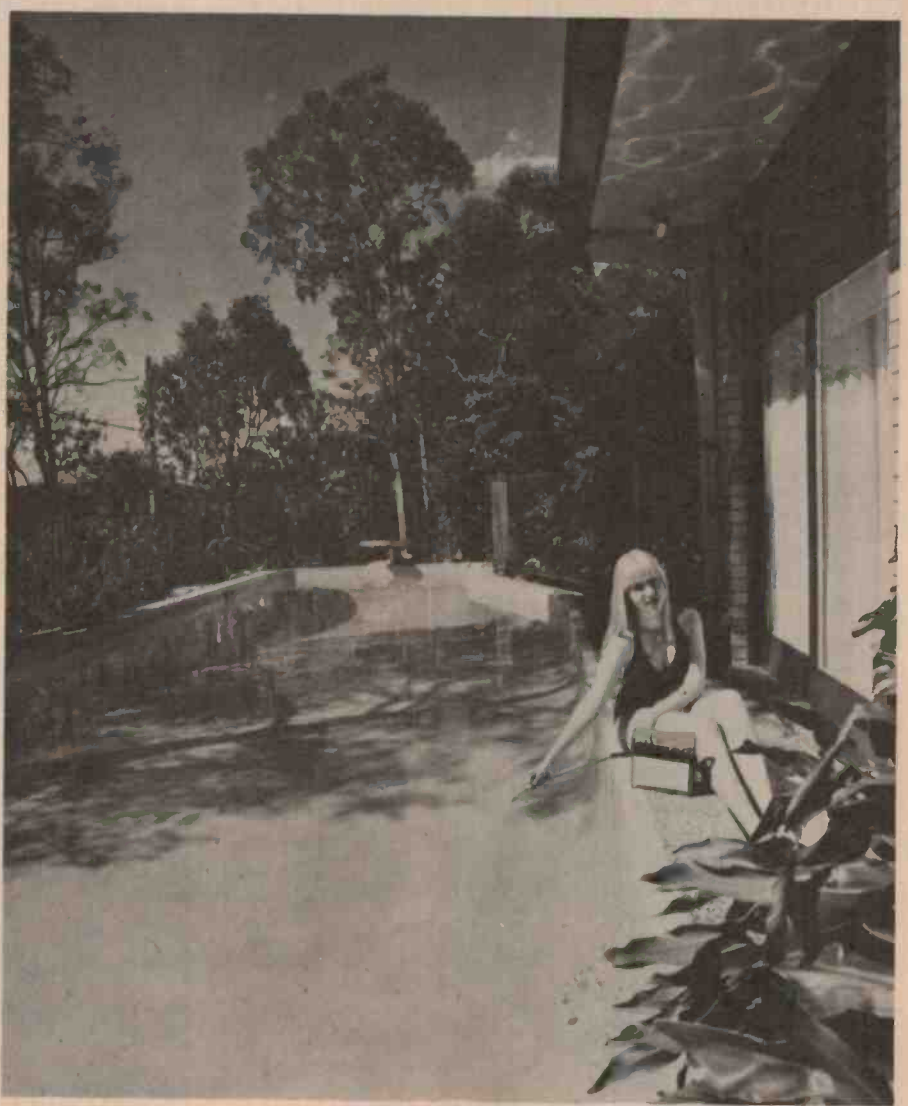
Acidic water in a goldfish tank encourages the growth of fungus and also induces a malady known as 'acid burn', which makes the fish look as if they have had bites taken out of them. It is advisable to measure the pH of goldfish tanks about once a week, preferably when the water is refreshed.

If you don't have a pH meter you can get some idea of the acidity by inspecting the plants growing in the tank. If they are looking unhealthy, the water is too acid.

Swimming pools

The recommended pH for swimming pool water is between 7.2 and 7.6. In the summer months when pools are in frequent use the pH should be tested every second day and chemicals added if necessary to keep it within bounds.

Over-acid pool water enourages the growth of algae, whose colour depends on the degree of acidity. First to form are green algae, in sheltered areas around steps or ladders. Brown algae that stain the tiles are the next stage, followed by black. ●



Chlorinated pools should be maintained at a pH between 7.2 and 7.6. An automatic chlorinator is the best method — see the Pool Magic offer on page 35.

Digital pH meter is simple and accurate

A pH meter has many applications in widely varying fields of interest; in chemical analysis, in soil analysis (gardening!); swimming pool chlorination; care of tropical fish, etc. This project features a 3½-digit liquid crystal display, simple construction and straightforward operation.

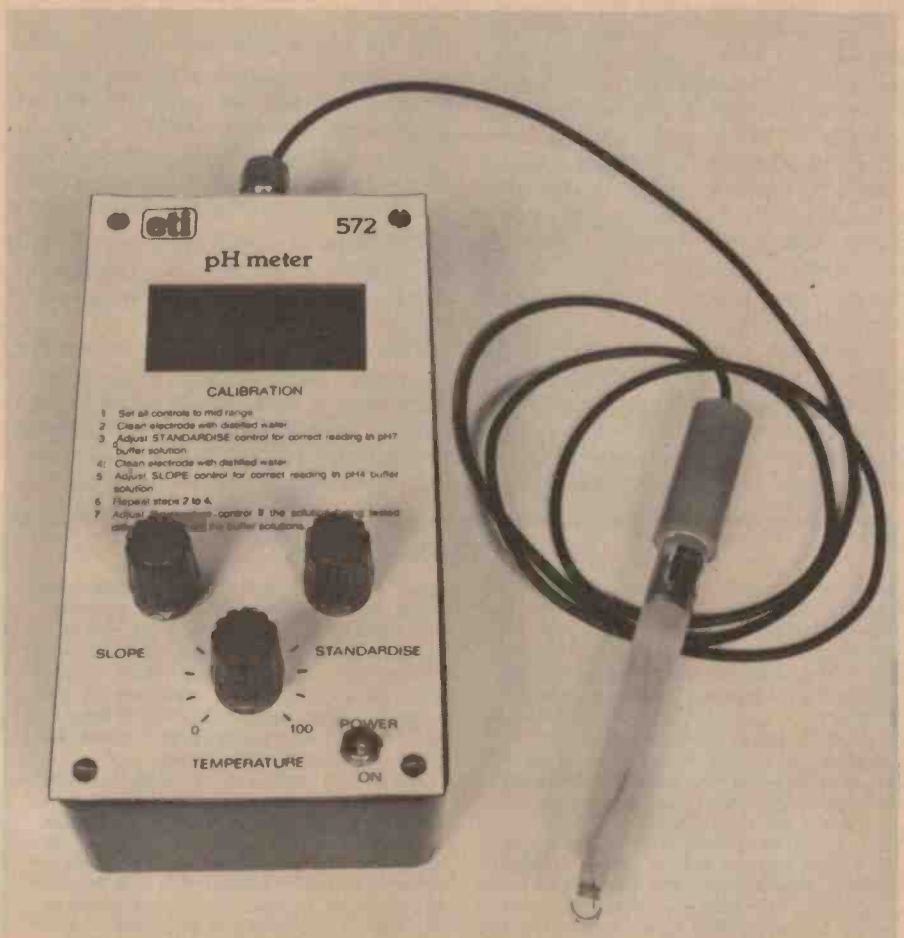
Peter Eliot
Phil Wait

FROM TIME TO TIME readers write or 'phone us with a project suggestion that, at first sight is attractive and practical, but on further investigation runs into what seems insuperable difficulties — generally with the supply (or lack!) of a critical component.

We first looked at this project in response to a spate of reader enquires. They generally pointed out that a pH meter was something we have never done but there were plenty of commercially available models — generally at prices well beyond the hobbyist or student. The electronics for such a project could be designed in several ways and this seemed to present few problems. So, we went looking for a suitable pH electrode.

That's where it all started to come apart at the seams. Our early efforts turned up imported probes costing in the vicinity of $100 for the least expensive model. We figured the electronics for an analogue readout instrument (using a moving coil meter) would cost around $30 or so and for a digital readout instrument around $40 or so. With probes at three times or more the cost of the electronics, a project started to look decidedly unattractive. It almost fell by the wayside.

However, during a conversation one day with Peter Eliot of the Amalgamated Instrument Company, who make and market a range of digital panel meters and portable digital instruments for industrial applications, the editor enquired where he obtained the pH probes for his digital pH instruments, and what did they cost? Peter was using Australian made probes chiefly because they cost less than half the equivalent imported types, and what's more they were readily available. Quick as a flash, we were talking to the man from Starcross Scientific, who distribute the range of 'Ionode' probes made in Queensland. A suitable probe was priced at around $40 so we figured a project would be timely and popular. What's more, having already done much of the required development work, Peter Eliot volunteered to provide us with a circuit and some material to suit our requirements. With some pc board and packaging work from the project staff, this project is the result.



Principles

An article elsewhere in this issue explains the theory behind the pH index as well as detailing applications of pH ▶

measurement in various fields. This discussion is confined to the principles of operation behind this particular instrument.

The pH electrode or probe consists basically of an electric cell which, when immersed in a solution, will generate a voltage proportional to the hydrogen ion activity of that solution. The voltage generated is a measure of the pH of the solution. Measure the voltage generated by the electrode, display it, and you've got a pH meter. Simple enough, but there are a few difficulties.

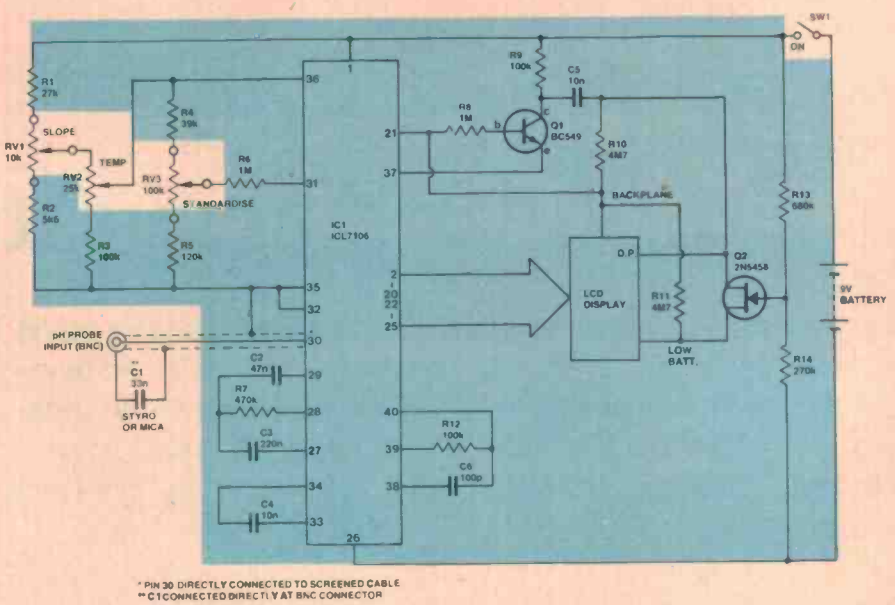
First problem is the internal (or source) impedance of the pH probe. It is generally around 10^9 to 10^{10} ohms! This means that whatever instrument you use to measure the voltage output of the pH probe needs to have an input impedance at least an order of magnitude (i.e: 10 times) higher.

The second problem that has to be tackled has to do with the "slope" variation with temperature of the pH electrode. The output of an electrode is typically 60 mV per pH unit,i.e: for a change in pH of a solution from, say, 7.5 to 8.5, the probe's output voltage will vary 60 mV. The electrode generates a *positive* voltage for pH values less than pH 7 and a *negative* voltage for pH values greater than pH 7. The electrode output is zero at pH 7.

If you plot a graph of probe output versus pH, where pH is represented on a log scale, you get a straight line as illustrated by the unbroken line in Figure 1. However, that line is only correct for one temperature. At another temperature, a line having a different "slope", indicating that the probe's nominal "mV per pH unit" output has varied, results as illustrated by the broken line in Figure 1. In general, a probe's sensitivity (mV per pH unit) increases with increasing temperature and vice versa.

The slope of a probe also varies with the age of the unit. Regular calibration checks remove any error that this may bring to the reading.

There are two general ways to correct for slope variations with temperature: by means of a manual control in the circuit, or automatically. For obvious reasons, the first method is the simplest and that's what we've elected to do.



* PIN 30 DIRECTLY CONNECTED TO SCREENED CABLE
** C1 CONNECTED DIRECTLY AT BNC CONNECTOR

Fortuitously, the input impedance of an ICL7106 analogue-to-digital conversion IC is around 10^{11} to 10^{12} ohms which is just what we need, apart from providing an appropriately scaled digital output to drive a display. Consequently, most of the circuitry for the pH meter is contained within two ICs; the ICL7106 and an LAD204 LCD display. The external circuitry is used to provide the appropriate scaling (so that the display reads directly in pH units) as well as slope and temperature compensation controls.

As this is a battery operated instrument, we thought it would be convenient to have some indication of when the battery was getting low. Surprise, surprise — the LCD display we chose incorporates a little "low batt." warning display in the top left hand corner. This is activated with a little extra circuitry once the battery voltage falls below 8.5 volts.

The pH probe

The pH probe we obtained for our instrument comes from Starcross Scien-

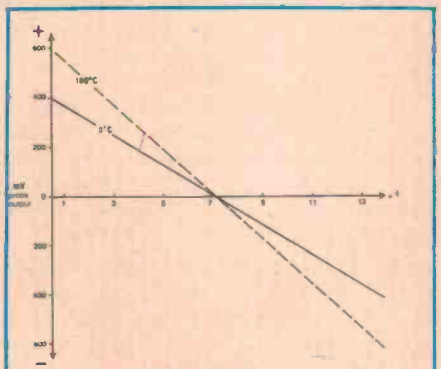


Figure 1. Illustrating how the "slope" of a pH electrode's sensitivity varies with temperature.

HOW IT WORKS — ETI 572

The instrument employs a single-chip analogue-to-digital (A/D) converter IC, type ICL7106, driving a liquid crystal display. Virtually all of the instrument is contained within the A/D converter chip and display. Operation of the 7106 is explained in a separate box. The reference voltage for the A/D converter is varied by three controls to provide the appropriate 'scaling' of the input so that the instrument reads directly in pH units, corrected for "slope" and temperature variations.

Input to the 7106 is applied between the IN LO pin (30) and COMMON pin (32) as the input is negative-going and we require a display which reads positive. The IN HI pin (31) has a portion of the reference voltage applied to it via a resistive divider involving R4, RV3 and R5. This sets the display to read (positive) 7.00 when the input is zero i.e: when the probe is in a pH 7.00 solution.

The A/D converter reference is developed between pins 35 and 36, derived from a resistive divider pick-off between the positive supply rail and the COMMON pin (32).

Varying the reference voltage by a small amount is used to provide temperature and "slope" compensation. The SLOPE control is part of the reference voltage divider and provides a 'vernier' control over a reasonable range, so making the control easy to adjust. The TEMPERATURE control forms part of a resistive divider from the wiper of the SLOPE control, RV1. Again, this provides a vernier adjustment. The voltage appearing on the wiper of RV2 is applied to the REF HI input of the 7106. The whole arrangement minimises interaction between the controls.

The internal clock of the 7106 is run at 50 kHz for maximum mains hum rejection, as explained elsewhere. The LCD display is driven by a square wave signal between the backplane and the numeral segments. This is provided by the 7106 from pin 21. The decimal point requires a drive signal in anti-phase to this and Q1 is arranged as an inverter to provide the appropriate drive to the decimal point.

The LOW BATT. indicator is activated by Q2. The gate of this FET is biased by a voltage divider using R13 and R14. When the battery voltage falls below about 8.5 V, Q2 turns on and applies the anti-phase backplane signal (from the decimal point drive) to the LOW BATT. pin on the display.

Hum filtering at the input is provided by a 33n capacitor connected directly across the input socket.

tific, P.O.Box 151, Frenchs Forest, NSW 2086. They are available mail order for $45.70 which includes sales tax and delivery. The probe, designated G101NFE, comes complete with a plastic protector cap, a wetting cap for storage and a comprehensive booklet plus two 200 ml containers of buffer solution, one of pH 6.88, the other pH 4.00. A BNC plug is fitted to the coaxial cable connection. The probe is a "non-flow" or sealed type and will have a long life without needing replenishment of the internal electrolyte.

In addition, Starcross have available accessories such as 100 ml plastic beakers and plastic wash bottles. They can also supply spear point electrodes suitable for soil analysis.

Construction

The pH meter is housed in a plastic box measuring 150 x 80 x 50 mm, although a 'zippy' box of similar size having an ▶

ABOUT THE 7106

The ICL7106 is manufactured by Intersil of the USA and contains all the circuitry for a digital panel meter employing the 'dual-slope integration' technique all housed in a 40-pin dual-in-line package. It is designed to drive any multiplexed 3½-digit liquid crystal display. A companion chip, the ICL 7107 is designed to drive any suitable 3½-digit LED display.

The internal circuitry of the 7106 can be divided into several areas: firstly there's the precision dual-slope integration type analogue-to-digital converter, then display decoder/driving circuitry and display multiplexing.

The precision dual-slope A/D converter is the most important, so let's take a close look at that.

In this method of A/D conversion the analogue input voltage is first converted to a time period which in turn is converted into a binary number by a timer/counting system. Referring to the block diagram here, and the associated timing diagram, the system commences the measurement when the switch connects the analogue signal input to the integrator which commences to 'ramp up'. At the same time the counter begins, from zero, to count the clock pulses. When a predetermined number of pulses, 1000 with the 7106, appear in the counter, the integrator is electronically switched over to the reference voltage. At this point, the integration capacitor, C, has then charged linearly from the input, rising as a ramp voltage to a level decided by the average input signal value over the counter time period (T). As the switch changes to the reference, the counter is reset to zero and commences counting again. The reference, which is of opposite polarity to the input signal, now causes the charged integration capacitor (C) to ramp downward with a fixed slope. When the output of the integrator reaches the zero threshold the counter is stopped and its contents displayed on the digital readout. The count displayed is the ratio of the counts during the 'downward' ramp (over time 't') to the counts during the upward ramp. Thus, for a limit of 1000 counts during the upward ramp, a direct reading of input voltage is obtained if the reference voltage is chosen appropriately.

The absolute value of the integration capacitor and the clock frequency are of little significance provided they are stable for the duration of the conversion period.

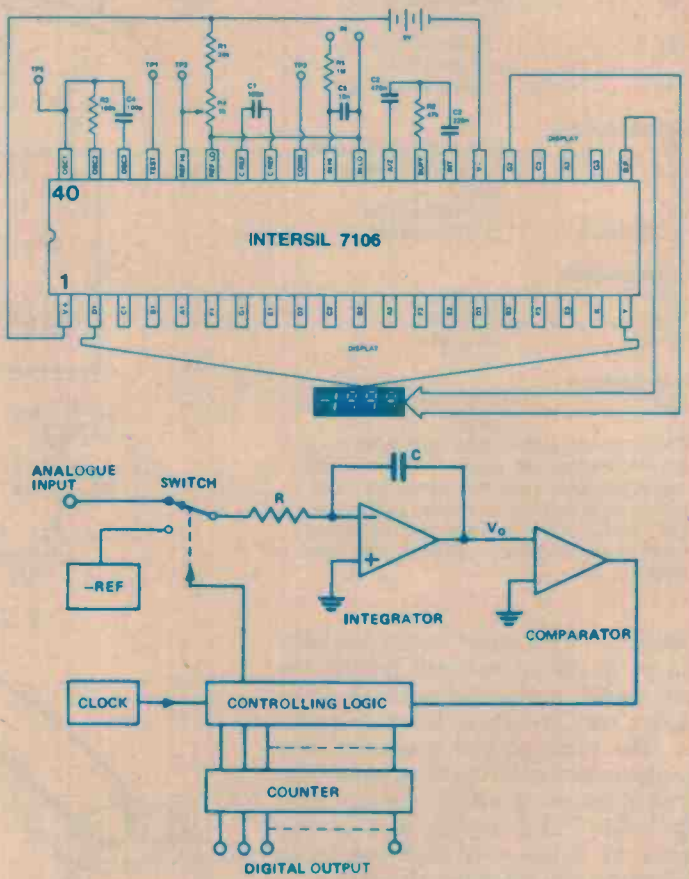
The relatively long analogue-to-digital conversion period has an inherent advantage in that it ignores noise. When noise is integrated over an extended period, its amplitude tends to zero. Thus, dual-slope integration results in excellent accuracy.

The 7106 has an on-board clock oscillator, the frequency of which is determined by external RC components — R3 and C4 in the circuit here, connected between pins 38 and 39. The clock frequency has been set to 50 kHz for the pH meter project. The oscillator frequency is divided by four internally to give a clock period of 80 us. As the integration period is 1000 clock periods long, the analogue input is integrated over a period of 80 ms. This results in pretty nearly optimum mains hum rejection as any 50 Hz ripple on the input will be integrated over four cycles and will thus have a dc value approaching zero.

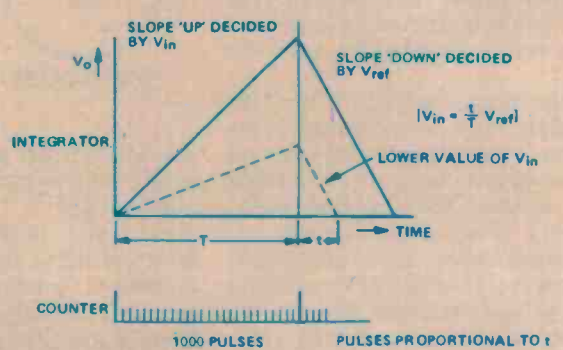
Clock input is to pin 40 (TP5 in the circuit here) and the 7106 may be driven from an external clock if so desired. It requires a square wave drive of 5 V amplitude, positive with respect to the common pin. For external clock drive the clock RC network (R3-C4) is not required.

The A/D converter reference voltage is developed between pins 35 and 36 (REF LO and REF HI respectively). Pin 35 is set internally to be always 2.8 V lower than the positive supply rail applied to pin 1. The full-scale sensitivity of the 7106 can be 'programmed' by setting the value of the voltage between the REF LO and REF HI pins. For 200 mV full-scale sensitivity (reading of 1999 on the display) the voltage between pins 35 and 36 should be set to 100 mV, for 1 V sensitivity it should be 500 mV and so on.

Input current drawn by the 7106 is extremely low, typically one pico-amp (1 pA or 10^{-12} amp as it has an input impedance measured in Giga-ohms (10^9 ohm)! For this reason, the unit can be used to measure voltage sources having a source impedance up to 10^{11} ohms — making it ideal for application in a pH meter. A useful spin-off from the 7106's high input impedance is that only quite small value capacitors are required in parallel with the input to provide good hum rejection. In addition, the input impedance is readily defined by using an appropriate value parallel resistor or simple attenuator on the input.



Block diagram of the 'dual-slope integration' technique of analogue-to-digital conversion commonly used in digital meters.



Timing diagram for the dual-slope A/D conversion technique.

PARTS LIST — ETI 572

Resistors all ½W, 5%

R1	27k
R2	5k6
R3, 9, 12	100k
R4	39k
R5	120k
R6, 8	1M
R7	470k
R10, 11	4M7
R13	680k
R14	270k

Capacitors

C1	33n styroseal or mica
C2	47n greencap or polycarbonate
C3	220n greencap or polycarbonate
C4, 5	10n greencap or polycarbonate
C6	100p ceramic or mica

Semiconductors

Q1	BC549, BC109 or similar
Q2	2N5485, 2N5484 or similar
IC1	ICL7106 see text
LCD Display	LAD204 see text

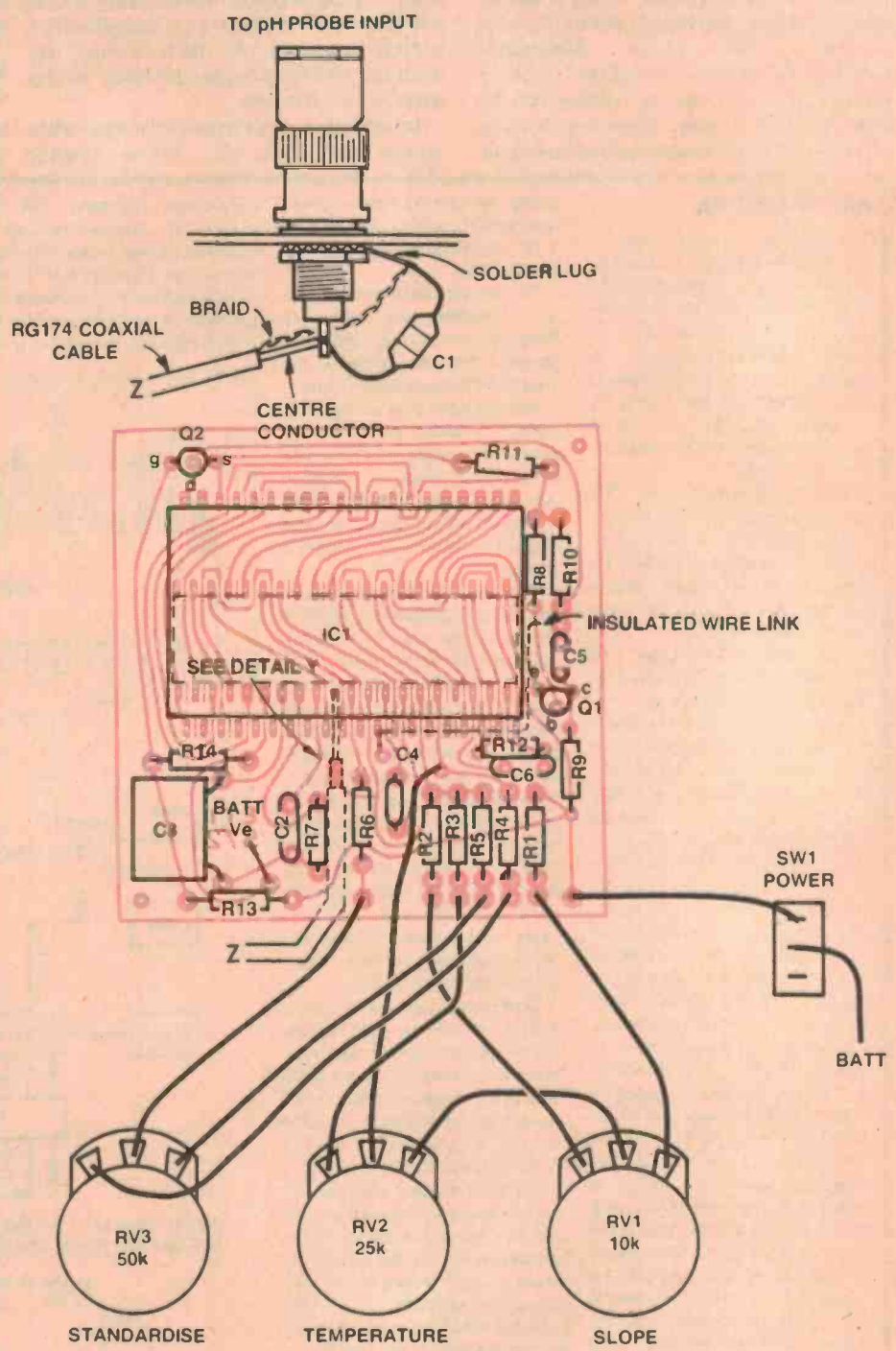
Potentiometers

RV1	10k linear
RV2	25k linear
RV3	50k linear

Miscellaneous

SW1	SPST miniature toggle switch

ETI 572 pc board; plastic box 150 mm x 80 mm x 50 mm; battery clip and No. 216 nine volt battery; length of 4 mm diameter coaxial cable, RG174 or similar — not shielded audio cable; BNC socket (teflon insulated and not second hand); three collett knobs; 40 molex pins; nuts, bolts etc.

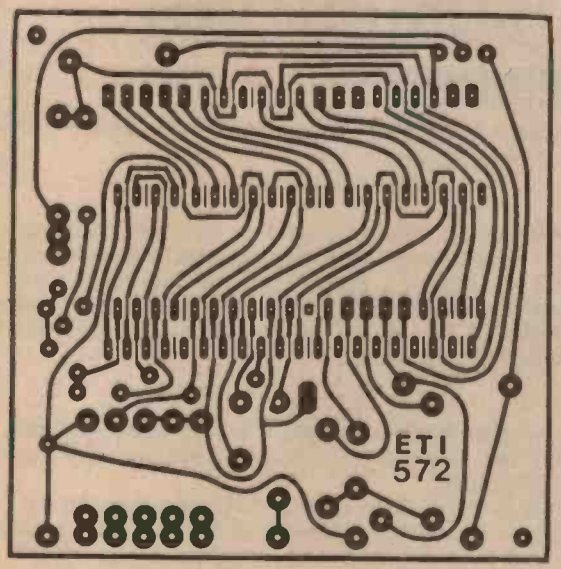


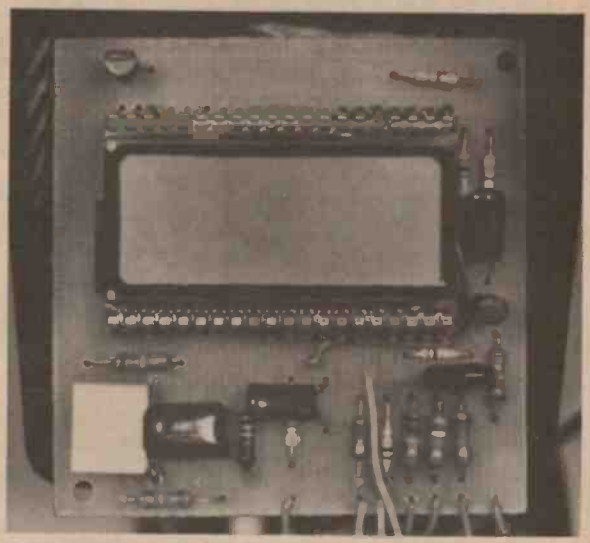
aluminium front panel would also suit. The pc board is mounted behind the front panel, positioned such that the display may be viewed through a cut-out. The three control potentiometers are also mounted on the front panel. The input connector is a BNC coaxial socket which has PTFE insulation. This was chosen as it has very high insulation resistance. We mounted the socket on one end of the case and it is connected via coaxial cable. The battery was mounted on the bottom of the case, held in place with double-sided adhesive tape.

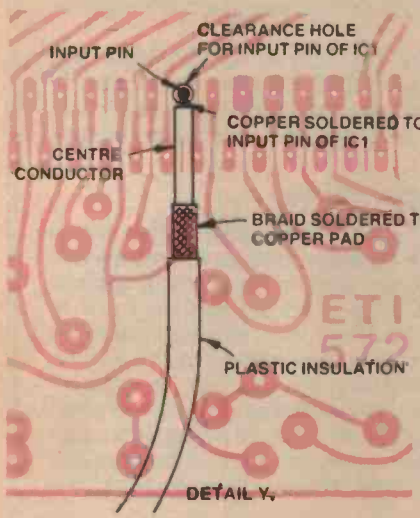
Since the input impedance of the 7106 is extremely high, as explained previously, the input pin (pin 31) must be connected directly to the coaxial cable, without touching the fibreglass board. To do this a 1.5 mm diameter hole was drilled through the pc board immediately beneath pin 31 of the 7106, allowing the pin to pass straight through the board where the cable to the input connector can be terminated directly to it. If you look at the pc board artwork, you will see this drill hole marked by a small square pad with a drill centre marked on it.

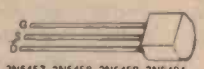
First step in the construction is to drill the lid of the case for the potentiometers, power switch and display cutout. This is best done by using the front panel artwork as a template. Scribe around the inside of the cutout, then mark a parallel line about 2 mm inside this. Drill a series of 3 mm diameter holes using this inside line as the drill centre line, and then pop out the centre of the cutout. Use a flat file to smooth off the edges to the first scribed line.

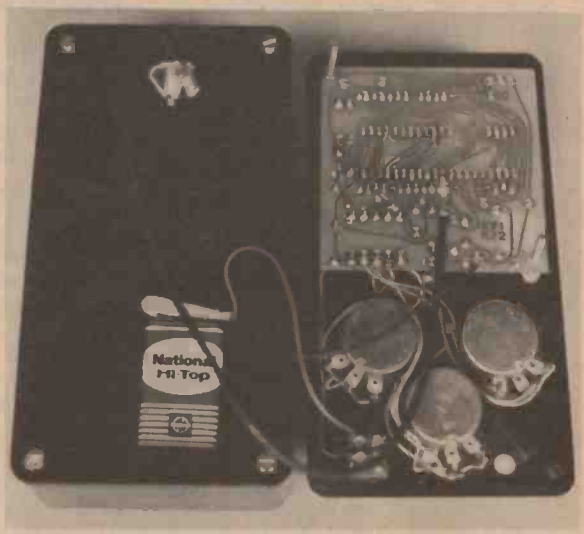
Mark the centres of the potentiometer holes and centre punch them. These holes are drilled to 10 mm diameter. The hole for the power switch should be











Top right: view of the printed circuit board, showing the liquid crystal display.

Right: showing the rear of the pcb, with connections to the probe and potentiometers.

marked in the same way and drilled to 6 mm diameter. Next, mark and drill the hole for the BNC input socket (also 10 mm diameter).

The front panel transfer should not be attached yet. The pc board is mounted behind the front panel using two countersunk-head bolts and nuts either side of the board to position it. Using the unloaded pc board as a template, mark and drill the holes for the bolts that are to hold it. Countersink the holes on the *upper side* of the panel.

The pc board may be tackled next. All the smaller components should be mounted first. The capacitors are bent down onto the board so that they will be lower than the display. Capacitors C2, C3, C4 and C5 can be greencap, polycarbonate or mylar capacitors. If you have bought an Intersil ICL7106EV digital panel meter evaluation kit, some of the components may be used in the project. The clock capacitor, C6, can be either an NPO ceramic type or silver mica. The evaluation kit uses a 100p silver mica type for this capacitor.

Next mount transistor Q1, and the FET Q2, pushing them hard down on the pc board so the tops of their cases will sit below the display (when it is mounted). The FET has an unusual pin-out configuration so be extra careful that you insert it the right way round.

Mount the 7106 IC as shown in the overlay diagram, being careful to orient it correctly. Forty pin ICs are very hard to get out again!

We mounted the display directly above the 7106 on two rows of Molex pins. This permits quite a compact pc board and elevates the display somewhat above the surrounding components on the board. It may also be unplugged, which might be necessary as we explain shortly.

Insert the two rows of Molex pins, but only solder those pins which are actually used. Those pins not having pc board tracks attached are not used. When the pins are in place, bend back the steel connecting strip between the pins with a pair of long-nose pliers until the strip breaks off. The unused pins will come away with it.

Some displays do not have pin 1 designated, but if you turn the display edge-on to the light you should be able to see the numerals faintly. Alternatively, you have a 50-50 chance of getting it right (or wrong — but we're optimists!) if you take a guess

Mount and wire the three potentiometers and the power switch next. Connections are indicated on the wiring diagram. The potentiometer terminals are positioned at odd angles so that they can be fitted in the available space. This necessitates the use of collet knobs so that the pointer can be positioned correctly in relation to the shaft. Some small grub-screw knobs will work, but you may have to shop around. Speaking of Shoparound, see page 85 this issue for details on where to buy suitable collet ▶

knobs. Wire the battery clip and power switch last.

At this stage you can check to see if you have the display inserted the correct way round. Temporarily plug in a battery and turn the unit on. If all is well, you will see numbers come up on the display. If not, no numbers will appear. Unplug the display and reverse it if this is the case.

With all the components mounted, the pc board can now be mounted to the front panel. Adjust the position of the board so that the display sits firmly behind the cutout in the panel, but don't strain the board.

Finally, solder the coaxial cable from the input socket to the pc board as indicated in the accompanying diagram. Make sure that you use good quality coaxial cable such as RG174 (4 mm dia.), not ordinary 'shielded cable' as its insulation resistance is not good enough for this application. Also ensure that the PTFE insulation on the BNC socket is clean and free from flux. If necessary, wash the socket in alcohol.

Terminate one end of the cable on the socket being careful not to leave any flux on the socket's insulation, or heat the coaxial cable insulation too much. Use a good hot iron with a clean tip and solder quickly. Use a large solder lug under the socket's nut for the braid connection or solder the braid to the edge of the nut. Capacitor C1 mounts directly across the input socket and it must be a styroseal or mica type.

Cut the cable to about 150 mm length and terminate the other end to the input pin of the 7106 as shown in the drawing on page 26. Don't let flux flow down onto the hole in the pc board or allow the solder bead at the joint to touch the board.

Now you can plug in the battery and your pH probe and give the unit a try. If all is well, the front panel artwork can be mounted. Scotchcal panels will be available from the usual suppliers (see ETI October 1980, p. 65).

Using the instrument

Before making a measurement, the instrument should always be 'buffered'. Remove the wetting cap from the probe and attach the plastic protective cap — that little bulb on the end is *very* fragile. Set the TEMPERATURE control to room temperature (say, 25) — the scale on this control is marked in degrees centigrade (°C). Clean the electrode with distilled water if you have used it recently.

You will need two buffer solutions, one having a pH near 7 and the other a pH near 4. The two most commonly available have a pH of 6.88 and 4.00. Put the probe in the pH 7 solution and adjust the STANDARDISE control for the correct reading according to the marked pH of the buffer. Allow about two minutes or so for the reading to stabilise before finally adjusting the control. Remove the probe and wash it again in distilled water.

Now put the probe in the pH 4 buffer and allow the reading to stabilise. Then adjust the SLOPE control for the correct reading according to the marked pH of the buffer.

Go through the procedure again to ensure correct adjustment. Only then can you take a reading in the solution or solutions to be tested. Wash the probe before making a measurement and between successive measurements.

If the temperature of the solution, or solutions, to be measured differs substantially from the temperature of the buffers, set the TEMPERATURE control to approximately the temperature of the solution to be measured. This control only has a minor effect and its operation is very 'broad'.

There you have it, your own digital pH meter with an Australian-made probe to boot! ●

THE CARE & FEEDING OF YOUR pH ELECTRODE

To ensure the maximum life and best response from your pH electrode, the following procedures are recommended.

1) When not in use the pH electrode should be stored with its tip soaking in distilled water. It is important that the porous glass membrane and salt bridge are *not allowed to dry out.* If for some foolish reason this does occur the electrode will require soaking in distilled water for 24 hours before it can next be used.

Store the pH electrode with its tip soaking in distilled water, use the protective shield and rinse with distilled water between measurements.

NEVER clean a pH electrode on a rag, or on your sleeve, or under a running tap.

2) For long term storage, cover the glass bulb with a 'wetting cap' containing distilled water. (Note that plastic wetting caps are supplied with the Australian-made Ionode pH electrodes).

3) When in use, the electrode should be rinsed thoroughly with distilled water (preferably applied with a fine-nozzled wash bottle — see the accompanying illustration) between successive readings and between buffer calibrations.

4) If the electrode is used with non-clean or organic solutions the electrode may require extra cleaning from time to time. The most common method used is to soak the electrode for 24 hours in a '0.1 normal' hydrochloric acid solution. Alternatively, simply soaking the electrode in a mild solution of household detergent and distilled water will generally emulsify the contaminants and restore the electrode to normal.

5) *Always be careful not to touch, scratch or damage the porous glass membrane.* It is advisable to use a plastic protector cap as shown in the accompanying illustration. (These are supplied with the Ionode electrode).

6) Generally, a sluggish response from the electrode will indicate that it needs cleaning.

For troubleshooting other problems it is best to consult the instruction booklet supplied with the electrode or the supplier from whom you purchased the electrode.

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N.B. Your Sinclair ZX80 may qualify as a business expense.

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Until now, building your own computer could cost you around $600 — and still leave you with only a bare board for your trouble. The Sinclair ZX80 changes all that. For just $295 you get **everything** you need including leads for direct connection to your own cassette recorder and television. The ZX80 really is a complete, powerful full-facility computer matching or surpassing other personal computers costing much more. The ZX80 is programmed in BASIC and you could use it for anything from chess to running a power station.

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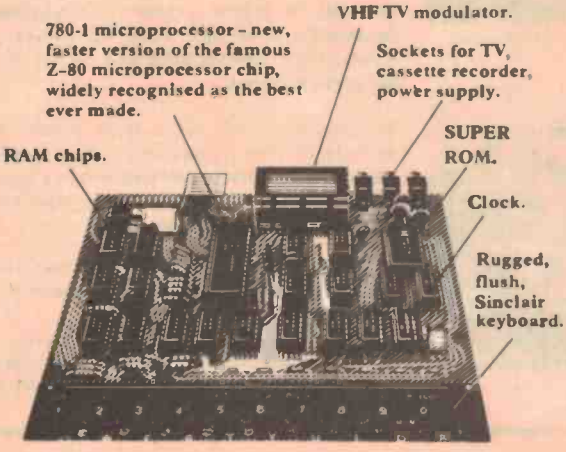

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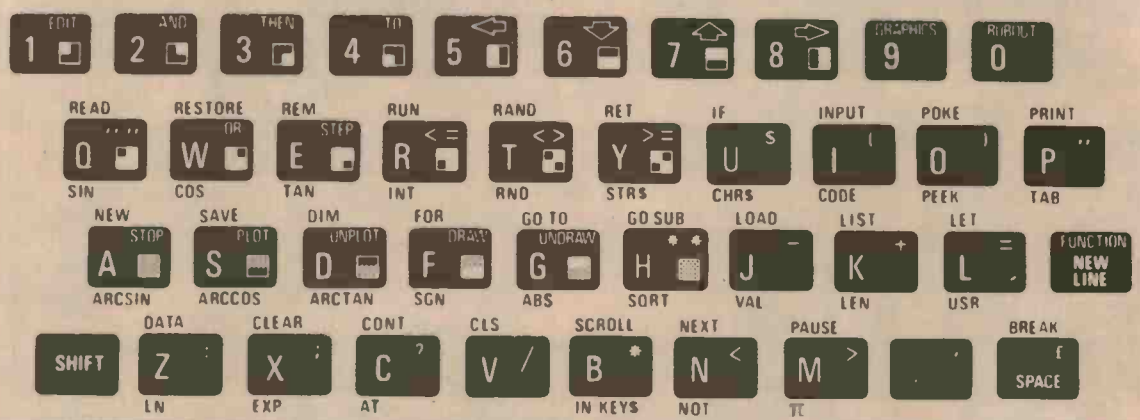
ZX80

8K BASIC ROM

Fantastic new options for sinclair ZX80



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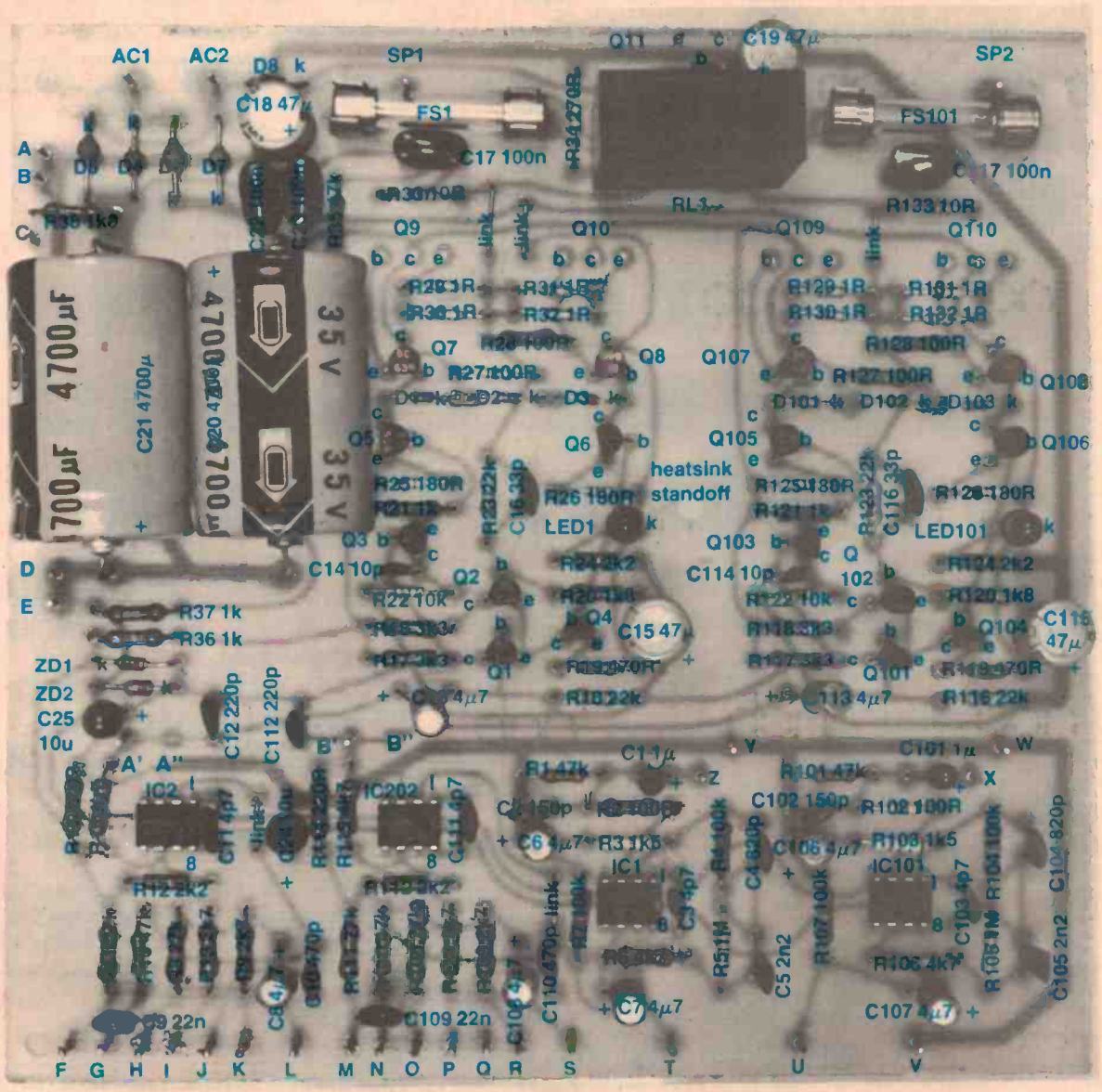
SE3

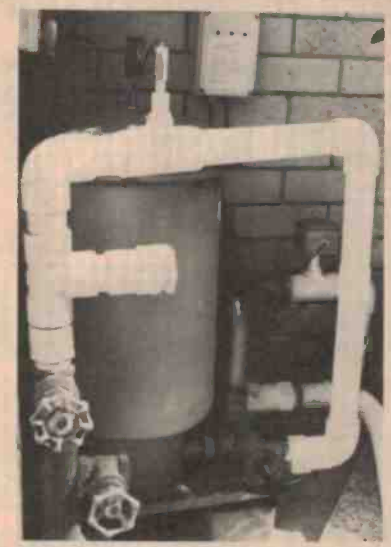
SERIES 3000 COMPACT STEREO AMPLIFIER

reprint of pc board overlay

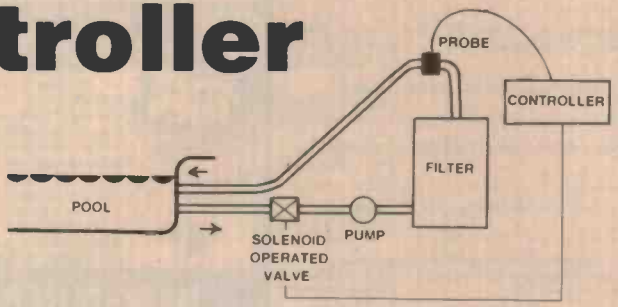
Owing to a printer's error, this overlay was not reproduced correctly in last month's issue. In addition, some artwork came off the overlay and this has been corrected here.



Special reader offer



The POOL MAGIC chlorination controller



For many years municipal swimming pools have used liquid chlorine (sodium hypochlorite) for sanitizing swimming pool water. Liquid chlorine offers many advantages over dry chlorine (calcium hypochlorite) when used in swimming pools. Liquid chlorine is completely soluble and fast-acting. It leaves no residue, eliminating the problem of 'calcium scale' experienced by most pool owners using dry chlorine.

Commercial installations have shown that dosing with chlorine once per day is a very inefficient and uneconomic way of chlorinating a pool. The pool will have a very high chlorine level following dosing. The chlorine level is depleted during the day until virtually no free chlorine exists in the pool when the next day's dose is due.

A much better system is to dose the pool only when it *needs* chlorine — when the free chlorine level falls below the ideal level. The pool is then maintained at the proper chlorine level all the time. Commercial and municipal pools employ this sytem.

Such a system has now been developed for household and commercial installations. POOL MAGIC provides an efficient and reliable way to dispense liquid chlorine. It employs a sensing device and an electronically-controlled valve to dispense chlorine when the chlorine level falls below that required. The POOL MAGIC system eliminates the need for daily dosing and chlorine testing.

POOL MAGIC employs a probe that measures the oxidation-reduction potential of the pool water. This potential is a measure of the ability of the water to kill bacteria and algae and is proportional to the free chlorine level of the pool. There are three components in the system: a sensing probe which is attached to the return-to-pool line, a solid-state controller and a solenoid injector valve. The latter is mounted on the pool suction line.

You can easily install the POOL MAGIC system yourself or, alternatively, installation can be arranged through chlorine distributors located in major cities and towns.

POOL MAGIC has no external controls. The chlorine level is factory preset. All the customer has to do is turn on the power. POOL MAGIC will operate when the filter and pump are operating. POOL MAGIC is fully Australian made and comes complete with a 12 month warranty. The manufacturers of the POOL MAGIC have agreed to offer these units to ETI readers at a special price for a limited period. The POOL MAGIC equipment normally retails for around $320 (not including chemicals or installation charges). The POOL MAGIC is offered to ETI readers for:

$250

(not including chemicals or installation charges) plus $5.00 packing and delivery charges.

CHEMICALS: For your convenience you can have liquid chlorine home delivered and the supplies will include information on where to get chemicals in your area if you tick the appropriate box in the coupon.

INSTALLATION: The POOL MAGIC is supplied complete with installation instructions and any reasonably handy person can install it for themselves. If you don't wish to install it yourself Starcross will include information on where to contact an installation firm in your area if you tick the appropriate box in the coupon. A nominal charge is made for installation.

If you would like more information about the POOL MAGIC equipment, you can 'phone or write Eddy Joseph at Starcross Pty Ltd, P.O. Box 151, Frenchs Forest, NSW 2086. Phone (02) 451-1346. The special price is only available if you order using the coupon on this page.

NOTE: This offer is made by Starcross Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to POOL MAGIC OFFER and sent, together with this coupon (or a photostat of it) to "Pool Magic Offer", ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. We will process our order and pass it on to Starcross Pty Ltd who will send you the goods. Please allow up to four weeks for delivery.

NOTE: Offer closes 31 January 1981

Enclose cheque or money order to total value and mail this coupon to:
POOL MAGIC OFFER
ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011

Please send me the POOL MAGIC swimming pool chlorination controller priced at $250 (does not include chemicals or installation charges) $250.00
Packing and delivery $5.00
Please include nearest contact for chemicals ☐
Please include nearest contact for installation ☐
TOTAL ..... $ .....

Cheque or money order number .....

Signature .....

(Please **print** name and address clearly)

Name .....

Address .....

.....

..... Postcode .....

PARTS FOR NEW KITS

If a kit you want to build is not listed, the parts may be available anyway. Check the Dick Smith Catalogue or call in to your nearest Dick Smith store.

NEW EA MOSFET STEREO AMPLIFIER (See EA December)
Final details for this superb kit are being finalised at the moment. Look for our special adverts in next month's magazines.

SELECTALOT (See EA December)
PCB ..... Cat. H-8384 $3.00
All other components are normal stock lines.

AC MILLIVOLTMETER (See EA December)
PCB ..... Cat. H-8385 $2.25
All other components are normal stock lines.

NEW ETI 5000STEREO AMPLIFIER (See ETI December)
PCB ..... Cat. H-8387 $9.95
(Fibreglass board)

SYSTEM 80/TRS-80 INTERFACE (See EA November)
PCB ..... Cat. H-8383 $1.90
All other components are stock lines.

ELECTRONIC MUSIC GENERATOR (See EA December)
Complete kit, including instructions ..... Cat K-3512 $12.50
PCB only ..... Cat H-8382 $1.90

TRAIN CONTROLLER (See EA November)
PCB ..... Cat H-8381 $1.90
All other components for this kit (including case) are normal stock lines.

'3000' STEREO AMPLIFIER (See ETI November)
PCB ..... Cat H-8631 $7.50
All other components for this project are normal stock lines.

MOISTURE INDICATOR (See ETI November)
PCB ..... Cat H-8632 $1.90
All other components for this project are normal stock lines.

ACOUSTIC COUPLER (See EA September)
Complete kit, including metalwork, etc. ..... Cat K-3605 $75.00
Printed Circuit Board only ..... Cat H-8380 $6.95

EXPANDED SCALE AUTOMOTIVE VOLTMETER (See ETI Sept.)
Printed Circuit Board ..... Cat H-8630 $1.50
LM3914 IC ..... Cat Z-6295 $4.25
Choose round or rectangular, large or small LEDs to suit your particular application.

CHASER (See EA August)
Complete kit, including front panel ..... Cat K-3145 $69.50
PCB only ..... Cat H-8379 $5.95

NASA POWER CHOPPER (See EA August)
Short form kit (All components & PCB) ..... Cat K-3325 $16.50
PCB only ..... Cat H-8378 $3.00

LEDS AND LADDERS GAME (See EA August)
Complete kit inc. printed panel ..... Cat K-3390 $16.75
PCB only ..... Cat H-8378 $3.00

'LED TACHO (see ETI August)
Short Form Kit (includes PCB components etc, but no case – build it into your dash board) ..... Cat K-3240 $24.50

FAST NICAD CHARGER (See ETI August)
PCB only ..... Cat H-8627 $3.00
(All other components in this kit are normal stock lines)

GUITAR/PA PREAMP (See ETI August)
Short form kit PCB & components, no transformer or case) ..... Cat K-3035 $29.50

300 WATT AMPLIFIER (See EA June)
Printed Circuit Board only ..... Cat H-8376 $9.95
(Most other components are normal stock lines).

TV CRO ADAPTOR (See EA May)
Complete Kit ..... Cat K-3060 $29.95
Printed Circuit board ..... Cat H-8375 $3.75

EA's NEW MUSIC GENERATOR

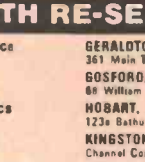
This is a great little kit for the beginner or the experimenter – it uses a very special IC which is pre-programmed with two popular tunes. It plays a complete melody – including chords (not just a few bars as other IC's). It is intended for novelty or alarm applications with a suitable amplifier it could be used as a singing doorbell.

ONLY $12.50
Cat K-3512

OPENING SOON AT SPRINGVALE (VIC)

Yes, another Dick Smith branch will be opening early in the new year at Springvale – to serve Melbourne's Eastern Suburbs. Watch your local papers for the opening date!

CNR DANDENONG ROAD & SPRINGVALE ROAD, SPRINGVALE.



DON'T FORGET: ONLY 3 WEEKS TO CHRISTMAS!!!

Need a few ideas for someone into electronics? Go no further than your nearest Dick Smith store!

CLEAN, HEALTHY AIR: ELECTRONICALLY!

ONLY $85.00
Cat. X-9000

You must have read press reports about the advantages of negative ions: how they help clean stale air, remove cigarette smoke and dust particles, etc etc.

They're very popular – and huge numbers of customers have been asking for them. We were worried by some reports that they also put out significant levels of dangerous ozone – now we've found an Australian made ion generator that does not emit Ozone. A written test from a leading University proves that it is completely safe.

So now you can have all the advantages of negative ions – and not worry about Ozone.

CAUTION! BEWARE OF INFERIOR UNITS WHICH MAY PRODUCE DANGEROUS OZONE.

A GIFT IDEA FOR DAD?

How many times has Dad come home late, because he'd left his lights on and the battery went flat? Here's a gift he'll really appreciate, and it won't break your piggy bank! This light reminder connects easily to his car's electrical system (instructions supplied) and warns him if he leaves the lights on! Have a happy Dad, have a happy Christmas when you give him a Light Reminder! Cat A-8509

$4.50

REMEMBER LAST YEAR . . .

We had a very special special each month . . . an item which was actually BELOW COST? We didn't tell you what it was – you had to find out for yourself (we told you the month after!)

We stopped doing this, but it seems we made a very wrong move. So many people have asked for our below cost special each month that every one of our store managers has demanded they be re instated. As we don't want to lose our store managers en masse (or our customers!) we're going to start our special again . . . next month. So from January call into your nearest Dick Smith store and check out our below cost Special!

LAST MINUTE XMAS ARRIVALS

(SO LAST MINUTE WE DIDN'T EVEN HAVE TIME FOR A PIC!)

LIGHTWEIGHT 'PHONES Just the the shot for amateurs, language students, etc, who have to wear 'phones for a long period. Lightweight, high quality, cord & plug provided. Cat C-4101 A bargain at only $5.95!

40 CHANNEL AM/SSB CB Rushed into our stores – just in time. Top quality 40 channel rig with LED disp... all hardware. (40ch sets not licensable in Aust). D-1712 INCREDIBLE ONLY $199.00

A NEW BOOK: YOUR FIRST COMPUTER A comprehensive guide to business and personal computing. What it is, how they do it etc etc. Cat B-2366 GREAT IDEA: JUST $8.95!

METRIC CONVERSION CALCULATOR. What a great idea! LCD caculator also gives you instant conversions from metric to imperial (and vice versa!). Cat Q-3025 MUM'D LOVE ONE! $19.95

THE LATEST SYSTEM 80 PROG: RESCUE AT RIGEL What an adventure! You've really got to have your wits about you for this one. Really great for mind training! (Suits TRS-80 16K level II also) X-3649 INC MANUAL ONLY $22.50

IT'S CUTE!

It's called a 'Cutie Phone'!

You've probably seen phones like this one in the movies. Here it is – in Australia! It gives push-button dialling, last number re-dial and folds down when not in use. Great for a bed-side phone, etc.

NOTE: Although this phone connects directly to standard Australian telephone lines, current regulations do not permit them to be used for this purpose.

Cat X-1179
$69.50

Don't try to remember it – TAPE IT!

When it's important, don't rely on your memory. Tape those important conferences, sales meetings, interviews, etc for later reference. This budget-priced recorder takes standard cassettes, and operates from its own batteries or external plug-pack adaptor. It features a review button for instant checking of recording. Also has fast forward and pause controls, too. Comes with inbuilt electret microphone, case & earphone.

$45.00
Cat A-4050

OR A MICRO CASSETTE

Here's another superb recorder: a palm-sized unit you can fit anywhere. And it has a 2 speed motor for extra recording time (standard 15 min/side micro cassettes give either 15 or 30 minutes/side). Tiny size doesn't mean tiny quality: use it anywhere (internal batteries or external supply). Compare our price: single speed equivalents sell for $79 and more elsewhere!

Cat A-4040

Cassettes to suit: Tiny micro cassettes to suit this recorder (up to 30 mins/side). Cat C-3360 $2.95

$47.50

$139 DIGITAL DISPLAY BONUS WITH EVERY YAESU FT-101Z!!

ADD-ON DIGITAL DISPLAY KIT IS ALSO AVAILABLE FOR EXISTING FT-101Z CONVERSIONS: Cat D-2861 $139.00

YES! With every FT101Z, we're including a digital frequency display kit, normally worth $139.00, at no extra charge! It's a simple 'drop-in' replacement display, any ham can install it in an hour or so. Full installation instructions are included. You know how good the FT-101Z is; now it is even better, it becomes an FT-101ZD for the same price! Offer is open strictly while current stocks last: be quick for this bargain.

ONLY WHILE STOCKS LAST!

FT-101Z (Cat D-2862): $775.00
Digital Disp. (D-2861): $139.00
YOU PAY: $775.00

DON'T GET CAUGHT!

(at about 6AM on Thursday, 25 December – as the kids unwrap their Christmas presents . . .)

Imagine! All those battery operated toys and no batteries to run them. Wouldn't you be popular!

Stock up now with budget Hi-watt batteries from Dick Smith. Far cheaper than most brands, yet they're fresh and ready to go to work immediately. All popular sizes:

UM-1 ('D') size	Cat S-3001	30¢ ea
UM-2 ('C') size	Cat S-3002	25¢ ea
UM-3 ('AA') size	Cat S-3003	22¢ ea
UM-10 ('AAA') size	Cat S-3004	25¢ ea
216 size (9V)	Cat S-3006	45¢ ea

ALKALINE BATTERY PACKS:
If you prefer, we have famous brand Alkaline extra-long-life (or extra-heavy-duty!) batteries available (Two per pack except 9V type).

AA size	Cat S-3280	$1.39 pack 2
C size	Cat S-3282	$1.69 pack 2
'D' size	Cat S-3284	$1.69 pack 2
9V size	Cat S-3286	$2.25 each

GREAT FOR CHRISTMAS CAMPING!

Who'd be without a torch? But why limit yourself to a plain, ordinary torch! This is a beauty, it's got:

- A powerful outdoor spotlight
- A bright, but soft fluorescent light
- An emergency orange flasher

$14.95
Cat X-1084
(Requires 6 'D' cells: Cat S-3001 @ 30¢ each – not supplied)

SPACE INVADERS™!!

Hand-held version of the popular game. Works just like the big ones, but doesn't cost a fortune to use! Amazing micro-computer technology makes hand-held space invaders a reality!

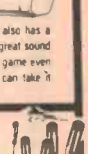
Cat X-1150

$24.50

$29.95

A more elaborate version – and this one also has a second game, Blockbuster! Easy to play, great sound effects, with various options to make the game even more exciting. Battery operated, so they can take it anywhere. Cat X-1152

SCREWDRIVER BARGAINS!



What a bargain! 10 pieces for less than $4!! Flat blade, Phillips, range of lengths, all for only

$3.90
Cat T-4000

LOOKING FOR SOMETHING A LITTLE DIFFERENT THIS YEAR . . .

Something that will challenge them to use their brains? Try this: 'CODEMASTER'. It's a game of intelligence. Using logic and deduction, you have to solve the hidden puzzle. It's different – and it's challenging.

Cat X-1140

$29.50

MAJOR DICK SMITH RE-SELLERS:

Listed below are re-sellers who stock a large proportion of our range. However, we cannot guarantee that they will have any or all of the items, or at the same prices, as those advertised on these pages.

ATHERTON, QLD: Tableland Radio Service
2 Jack Street. Phone 912 017

BENDIGO, Vic: Sumner Electronics
95 Mitchell Street. Phone 431 977

BLACKHEATH, NSW: Goodwin Electronics
123 Station Street. Phone 878 379

BROKEN HILL, NSW: Crystal TV Rentals
66 Crystal Street. Phone 6887

CAIRNS, QLD: Thompson Instrument Services
78–81 McLeod Street. Phone 512 404

COFFS HARBOUR, NSW: Coffs Harbour Electronics
3 Coffs Harbour Plaza, Park Ave. Phone 525 684

DARWIN, NT: Kent Electronics
42 Stuart Highway. Phone 814 749

DUBBO, NSW: Selekta Sound.
31 Talbragar Street. 826 979

EAST MAITLAND, NSW: East Maitland Electronics.
Cnr Lawes & High Streets. 337 327

FAIRY MEADOW, NSW: Trilogy Wholesale Elect.
40 Princes Hwy. Phone 831 219

GERALDTON, WA: KB Electronics & Marine
361 Main Terrace. Phone 212 176

GOSFORD, NSW: Tomorrow's Electronics & Hi Fi
88 William Street. Phone 247 246

HOBART, TAS: Aero Electronics
123a Bathurst Street. Phone 348 232

KINGSTON, TAS: Kingston Electronics & Records
Channel Court. Phone 296 802

LAUNCESTON, TAS: Advanced Electronics
5a The Quadrant. Phone 317 075

LISMORE, NSW: Decro Electric
Magellan St & Bruxner Hwy. Phone 214 137

MACKAY, QLD: Stevens Electronics
42 Victoria Street. Phone 511 723

MARYBOROUGH, QLD: Keller Electronics
218 Adelaide Street. Phone 214 559

MORUYA, NSW: Coastal Electronics
43 Vulcan Street. Phone 742 545

MT GAMBIER, SA: Hutchesson's Communications
5 Elizabeth Street. Phone 258 404

MUSWELLBROOK, NSW: Silicon Chip Electronics
Suite 3, 98 Bridge Street. Phone 43 1096

NAMBOUR, QLD: Nambour Electronic Shop
Shop 4, Lowan House, Ann St. Phone 411 604

NEWCASTLE, NSW: Elektron 2000
181 Wharf Road. Phone 262 644

ORANGE, NSW: M&W Electronics
48 McNamara Street. Phone 626 491

ROCKHAMPTON, QLD: Purely Electronics
15 East Street. Phone 21 058

SOUTHPORT, QLD: Amateur's Paradise
121 Nerang Street. Phone 322 644

TAMWORTH, NSW: Sound Components
78 Brisbane Street. Phone 661 363

TOOWOOMBA, QLD: Hunts Electronics
18 Neil Street. Phone 326 944

TRARALGON, VIC: Power'N'Sound
15 Franklin Street. Phone 743 638

VINCENT, QLD: Tropical TV
249 Fulham Road. Phone 781 421

WAGGA, NSW: Wagga Wholesale Electronics
82 Forsyth Street.

WINDSOR, NSW: Hawkesbury Electronic Centre
111 George Street. Phone 773 411

WOONONGA, VIC: A & M Electronics
78a High Street. Phone 244 588

WHYALLA NORRIE, SA: Mellor Enterprises
Shop 2, Forsythe Street. Phone 454 764

WOULD YOU LIKE TO BE A DICK SMITH RE-SELLER?

How would you like to join the hundreds of successful Dick Smith re-sellers, spread right across Australia?

If you're interested, why not give our wholesale division a call – Sydney (02) 888 3200, 9AM – 5.30PM weekdays.

It could be the start of something big . . .

LOOKS LIKE A NORMAL LED—RIGHT?

IT'S NOT!

THIS ONE FLASHES!

Incredible! Inside this normal size LED package is not only the LED, but a tiny IC chip which makes the LED flash! Just think of the millions of applications for flashing LEDs already; until now you needed external circuitry! Just hook this one up and away it goes!

$1.50 Cat Z-4000

SPECIAL PRICES AVAILABLE TO LARGE QUANTITY BUYERS!

MICROPROCESSOR CONTROLLED MINI ORGAN!

GREAT GIFT IDEA!

Amazing microcomputer technology! This is much, much more than a 'take-anywhere' organ'. Inside this remarkable device is a microcircuit memory which makes this an incredibly versatile instrument. Look what it does:

- Plays any one of 8 tunes permanently stored in memory.
- 'Remembers' up to 96 notes and spaces — so you can 'compose' your own music and play it back again later!
- Or you can use it as an organ and play a merry tune!

It is battery operated, so you can take it anywhere!

Liberace, eat your heart out . . .

Batteries extra

X-1158 **$29.50**

Seasons Greetings

Dick Smith and staff wish all our customers and friends the compliments of the season — and hope to be of service to you again in 1981.

JOIN THE 'IN' SET. . . NEW CORDLESS PHONE!

REMOTE UNIT (IN CHARGING POSITION) PUSH BUTTON KEYPAD

'MASTER' UNIT

You must have seen these around and thought 'Wow! I imagine: a portable 'phone' you can carry around with you and take calls up to a few hundred feet away from your main phone! Not only that, you can make calls — even re-dial automatically! It would have to be the handiest thing since sliced bread, for the home, office, etc . . . price! Save with Dick Smith bargain imports.

It works by radio: the 'master' unit plugs into the phone lines and the power. If a phone call is received, it transmits the call to the pocket-sized 'remote' unit. The master also contains a battery charger for the Ni-cad batteries in the remote unit. You can also 'ring' from the remote unit: push button dialling with last-number re-call.

Note: even though this unit works perfectly with the Australian 'phone system, at present there are no regulations to allow for the testing or approval of these units. Users could, therefore, be prosecuted for connection or use of this unit.

DON'T PAY $400 OR MORE . . .

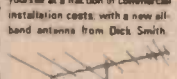
OURS IS **$199.00**

Cat X-1178

ALL-CHANNEL TV ANTENNAS

With the new channels in Sydney & Melbourne, you're probably finding the old antenna just isn't up to scratch. Fix the problem yourself at a fraction of commercial installation costs; with a new all-band antenna from Dick Smith.

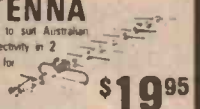
Our biggest seller for good 0-2-7-9-10 reception in metro & near fringe areas. Cat L-4022 **$34.50**



The big gun for more difficult areas. 75 ohm. Use co-ax or twinlead. Cat L-4030 **$54.50**

UHF ANTENNA

Specially made for Dick to suit Australian standards. Adjustable directivity in 2 directions, very important for good UHF reception. Uses standard 300 ohm ribbon, too. Cat L-4028



$19.95

A 600 MHz DFM UNDER $200?

Cat D-3000

YES! ONLY $199!

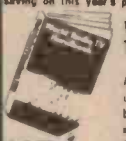
Sounds almost impossible to believe? Yes, a beautifully made, 7 digit 600MHz digital frequency meter for less than you paid for your 100MHz version last year! Battery operated, (use Nicads if you like), highly accurate, and tiny: fits into one hand! Hurry, strictly limited stock of this item — don't say you weren't warned!

Ni-cad batteries (4 req) Cat S-3300 $2.05 ea

Power supp. charger Cat M-9525 $9.50

1980 'ANNUALS' BARGAINS!

Because they're dated 1980 doesn't mean the information is out of date! Buy these annuals now at a big saving on this year's prices; and HUGE savings on next year's!



WORLD RADIO TV HANDBOOK

Almost 600 pages! This is universally regarded as "the bible" to ANYONE interested in radio and television — ANYWHERE in the world. Lists all stations, their frequencies, etc, reviews year . . . it's got the lot! And it's available right now at a very special price!

~~$17.95~~ **$11.95** Cat B-2081

AMATEUR RADIO CALLBOOKS: ALL AREAS.

If you're an amateur (or even an SWL) who's really interested in chasing DX stations, you cannot afford to be without these two. Between them, they list ALL known amateur radio operators IN THE WORLD!

BOOK 1: US CALLS (Cat B-2260)
WAS $21.95 **$15.95**

2: FOREIGN CALLS (Cat B-2262)
WAS $20.95 **$14.95**

SCOOP PURCHASE

1978 ARRL'S

We made a scoop buy of all remaining stocks of the 1978 ARRL HANDBOOK at below cost price! Buy now and save current (1980) cost is near $16!! Hurry they're selling fast! Cat B-2218

ONLY $2.50

A CCTV SYSTEM FOR UNDER $400!

- SECURITY
- SURVEILLANCE
- MONITORING
- HOME, OFFICE
- INDUSTRY

Think of the applications! Extremely simple to set up, light weight and portable (240V operated). Compare the price of this system with others; and you can still watch TV when it's not being used as a monitor!

TV Camera: Cat X-1195
12" TV Monitor: Cat X-1198

BOTH FOR $398

(Items available separately: Camera $298, TV $99)

Dear Customers . . .

Quite often, the products we advertise are so popular they run out within a few days. Or unforeseen circumstances might hold up goods so that advertised lines are not in the stores by the time the advert appears. Please don't blame the store manager or staff: they cannot solve a dock strike on the other side of the world, or even locate a shipment that has gone astray.

What we are trying to say is that, if you're about to drive across town to pick up a particular line at a Dick Smith store, why not give the store a ring first (addresses & phone numbers below) . . . just in case! Thanks.

Dick Smith and Staff

HERE IT IS!

At long last, Dick has his own laboratory oscilloscope. Check it out — feature for feature it compares favourably with others being offered. Dollar for dollar there is simply no comparison! Save with Dick Smith quality products for the hobbyist and professional!

Vertical Sensitivity 10mV division
Horizontal Sensitivity 500mV division
Timebase 10Hz — 100kHz in 4 ranges
Sync External or Internal
Bandwidth DC to 5MHz

Cat Q-1280

$199.00

WOULD YOU LIKE TO WORK WITH US?

Dick Smith Electronics is expanding — if you've been watching your local press you'll probably have noticed this already!

Opening new stores requires new staff. Good staff. Electronics enthusiasts who can be trained to become professional sales people and managers.

If you're talented and enthusiastic, we offer good wages and conditions. If you're above average, promotion can be very rapid. (One of our salesmen became general manager three years later!)

No matter what area you live in, if you'd like to work with us, drop us a line. When we open a store in your area, we'll be in touch . . .

Send your application to:
The Personnel Manager,
Dick Smith Electronics Pty Ltd
PO Box 321,
North Ryde, NSW 2113

SUMMER TIME IS PROJECT BUILDING TIME.

BIG SAVINGS ON DICK'S GENUINE SLOTTED ZIPPY BOXES.

More projects have been built in genuine Dick Smith Zippy Boxes than in any other case!!! And since Dick introduced the slotted Zippy box, constructors have really been happy! No more drilling: just make the project board the right size and it simply slots in place! What could be easier?

And now Dick has ordered massive price cuts — for December only — on the three most popular Zippy Boxes. Grab some now and save: you'll never know when you'll need them!

Size	Cat No	Was	Now
150x90x50	H-2751	$2.50	$1.98
130x68x41	H-2753	$1.95	$1.59
83x54x28	H-2755	$1.50	$1.19

LOOK FOR THE SLOTS!

BE SURE YOU ASK FOR GENUINE DICK SMITH ZIPPY BOXES — THEY'RE THE ONES THE MAGS BUILD PROJECTS IN!

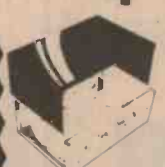
In the past, many customers have wanted to buy a particular project case to build other projects in — maybe to match up with an existing project, or simply because the case was so versatile. We normally couldn't do this, but, once again, we've seen the error of our ways — and released three of our most-asked-for cases to be normal stock lines. While they're intended for specific projects (holes and all!) a simple dress panel on them and they will suit just about anything!

FOR SMALL

A neat folded aluminium case at a bargain price. Originally intended for CDI's, it measures 172 x 125 x 55mm. If you're building a project with any 2N3055's in it, lucky you! The holes are there already! Cat H-3107 **$4.95**

FOR MEDIUM PROJECTS

Here's a bargain! This passivated steel case with vinyl covered lid was selling for almost $11! Suits variety of projects; holes suits 'Musicolor' but add your own dress panel and it suits anything! Size is 250 x 200 x 80mm Cat H-3160 **$7.95**



FOR LARGE PROJECTS

Or this one made for the 'Playmaster' amplifiers, size is a whooping 270 x 250 x 80mm. Holes for pots, switches, terminals etc. Was $12.50 Cat H-3110 **$9.95**

DICK SMITH ELECTRONICS

NSW	145 Parramatta Rd	AUBURN	648 0558
	613 Princes Hwy	BLAKEHURST	546 7744
	818 George St	BROADWAY	211 3777
	531 Pittwater Rd	BROOKVALE	93 0441
	147 Hume Hwy	CHULLORA	642 8922
	162 Pacific Hwy	GORE HILL	439 5311
	30 Grose Street	PARRAMATTA	683 1133
	125 York Street	SYDNEY	290 3377
	263 Keira Street	WOLLONGONG	28 3800
ACT	96 Gladstone St	FYSHWICK	80 4944
QLD	166 Logan Road	BURANDA	391 6233
	824 Gympie Rd	CHERMSIDE	59 6255
SA	60 Wright Street	ADELAIDE	212 1962
VIC	399 Lonsdale St	MELBOURNE	67 9834
	656 Bridge Road	RICHMOND	428 1614
	Dandenong Rd	SPRINGVALE	Open soon
WA	414 William St	PERTH	328 6944

DICK SMITH MAIL ORDER CENTRE:

PO Box 321, North Ryde NSW 2113. Phone (02) 888 3200

SERVICE CENTRE: LANE COVE & WATERLOO RDS, NORTH RYDE NSW 2113. PHONE (02) 888 3200. HOURS 9AM TO 5PM, MONDAY TO FRIDAY ONLY.

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BANKCARD VISA

A 'discriminating' metal detector

This metal detector operates just like the 'bought ones' but costs only one-third to one-half as much to build it yourself. It features three 'discriminate' ranges plus VLF operation and includes an 'auto-tune' button.

design: **Lee Allen, Altek Instruments, UK**
article: **Phil Wait**

"GOLD FEVER," shrieked the news headlines following the finding of the 27 kg Hand of Faith nugget at Wedderburn in Victoria recently. It was unearthed by a couple of amateur fossickers using a metal detector, just about the most sophisticated tool ever brought to bear in the hunt for gold.

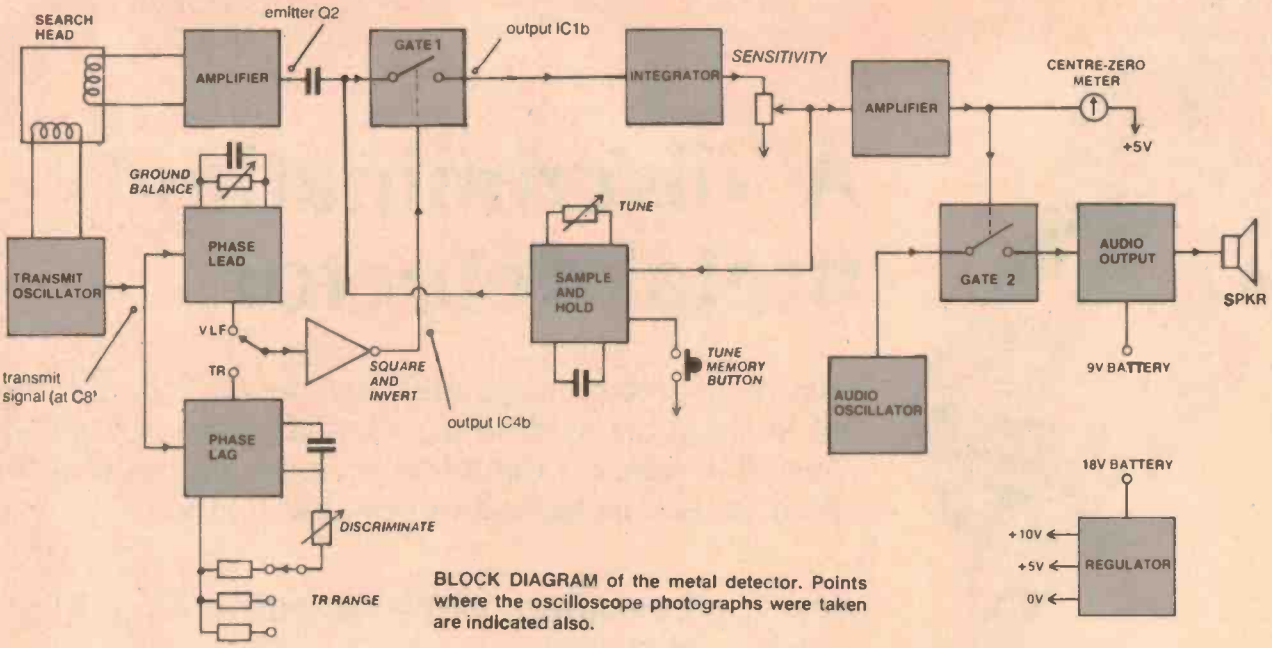
Designs for metal detectors genuinely able to discriminate between 'trash' and 'treasure' have generally been well kept trade secrets. Even the general principles of operation have been veiled in mystery. However, we are indebted to Lee Allen of Altek Instruments of the UK for providing us with the circuit design of this metal detector project via our British edition. The design incorporates all the features and refinements of modern commercially-made instruments and features performance equivalent to units costing two to three times as much.

Principles of operation

This detector employs the basically well-known *induction balance* technique to detect the presence of a metallic 'target' in the ground, but includes a number of refinements which respond to certain characteristics of the target. The 'search head' contains two coils: an outer coil which is connected to a low frequency oscillator operating somewhere in the range 15 - 20 kHz, and an inner coil which is placed so that it is only very loosely coupled to the outer coil. The latter is connected to the 'receiver' input of the instrument. Being only very loosely coupled, the signal induced in the receiver (inner) coil from the transmit (outer) coil is very small when a target is not in the vicinity of the search head.

When the search head approaches a metallic target, the target will have a number of influences on the two coils. Firstly, the magnetic field pattern of the transmit coil will be disturbed, and thus the coupling between the transmit and receive coils will be increased. This generally produces an increase in the signal from the receive coil. In simple induction balance detectors, such as the ETI-549 (May 1977), this signal increase is detected and used to gate an audio oscillator on so that a tone is passed to a speaker or headphones.

That's all quite straightforward, but there are other influences to be taken into account. The ground in which a target is buried can have quite a profound effect on the coils in the search head. Firstly, if the ground is basically non-conducting, then it will have a permeability considerably different to that ▶



BLOCK DIAGRAM of the metal detector. Points where the oscilloscope photographs were taken are indicated also.

of air. This will affect the coupling between the two coils in the search head, increasing the coupling if the transmit and receive coils are initially set up away from the influence of the ground. You can compensate for this effect by physically varying the position of one coil in relation to the other when the search head is near the ground. However, different soils will have different compositions and thus have different values of permeability — even within quite a small area. The best way to compensate is by electronic means and we'll go into that shortly.

If the soil contains an appreciable amount of iron minerals (maghemite, hematite etc ... often referred to as "iron stone soils"), or mineral salts of one type or another, then it will be partly conducting.

Such soils will have a permeability often greater than basically non-conducting soils, affecting the coupling between the coils in the search head in a similar way to that just explained. Again, as the composition of the soils varies, so will the coupling. Another effect is that of 'eddy currents' induced in the conductive soil. The ac magnetic field of the transmit coil will induce a current in the ground beneath the search head and the eddy current has an effect opposing the permeability effect of the soil — and the whole effect varies in a complex and unpredictable way as you sweep the search head over the ground.

The only way to compensate for these varying, and generally unpredictable effects, is to devise circuitry that 'recognises' the effect.

Permeability effects will vary the phase as well as the amplitude of the signal coupled into the receive coil from the transmit coil while eddy current effects vary the amplitude. Knowing that, one can devise appropriate circuitry to take the effects into account.

However, we need to know how a metallic target affects the phase and amplitude of the receive signal. If the target is ferrous, it will have a much greater effect on the magnetic field of the transmit coil than will the surrounding soil as its permeability is greater and it will 'bend' or concentrate the field lines to a much greater degree. If the target is non-ferrous it will have a permeability effect opposite to that of ferrous targets, deflecting the field lines, but eddy currents also have some influence.

The eddy current effect in a target depends on the electrical and physical characteristics of the target. Metals which are good conductors will have greater induced eddy currents than metals which have a higher resistivity. It is a fortunate accident of nature that gold and silver are good conductors (low resistivity) while iron (especially if it's oxidised or rusty) is not so good a conductor.

If the target is ring-shaped then the eddy current effect is enhanced, whereas if it's a broken ring or just a peculiarly-shaped mass, the eddy current effect is less pronounced. The 'attitude' or orientation of the target will also affect the eddy current effects. If the main plane of the target object is aligned such that the field lines from the transmit coil cut it at right angles, then the eddy currents induced will be at a maximum. If the main plane of the target is aligned parallel to the transmit field then the eddy currents induced will be at a minimum. Obviously, the attitude of the target with respect to the transmit coil's field will vary as the head passes over it and the eddy current effect will vary accordingly — it may not be maximum beneath the centre of the search head.

The permeability and eddy current effects combine in the receive coil and the signal varies in phase and amplitude in characteristic ways.

The instrument

The best way to understand how this instrument operates is to look at it in block diagram form. The accompanying diagram shows the basic circuit blocks employed. The transmit oscillator drives the transmit coil in the search head and supplies a signal to two phase control circuit blocks. The signal from the receive head is first amplified and then ac-coupled to the input of a gate (gate 1). This gate is controlled by the output from one or other of the phase control circuits via a block which 'squares up' and inverts the signal. The output gate consists of an ac signal superimposed on a dc level. This passes to an integrator which obtains the *average* dc level of the composite signal. This is then passed to both a dc amplifier which drives a centre-zero meter, and to a 'sample and hold' circuit. The output of this block provides a dc level to the input of gate 1 which is a measure of the average dc level of the composite signal. The initial dc level applied to the

input of gate 1 is actually established by the *tune* control. Thus, a dc negative feedback path is provided.

In addition to meter indication, an audio indication is provided. The output of the dc amplifier driving the meter controls a gate which switches on or off the output of an audio oscillator. This is applied to an audio amplifier and an on-board loudspeaker or headphones.

Power for the audio amplifier is provided by two 9 V batteries in parallel. The rest of the circuitry requires two supply rails at +10 V and +5 V with respect to the common rail (0 V). This is supplied by a regulator from an 18 V source consisting of two 9 V batteries connected in series.

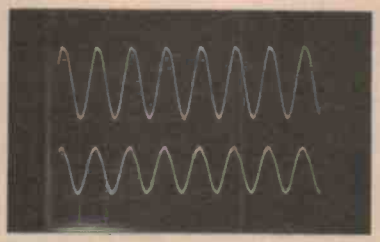
Initially, the instrument is set up in the 'VLF' mode. The search head is held in the air and the *tune* control adjusted to bring the meter to centre zero. This is done with the *tune memory* button depressed. This activates the sample and hold circuit, storing the dc level set by the feedback loop in the capacitor of the sample and hold block. Thus, a particular dc level at the output of the integrator corresponding to meter centre zero is set up.

The search head is then lowered to the ground. Naturally, this will upset the coupling between the transmit and receive coils and the output at gate 1 will change. This will change the dc level at the output of the integrator. The *ground balance* control is then adjusted to bring the meter back to centre zero. What the ground balance circuit does is to provide a signal which leads the phase of the transmit signal and thus leads the phase of the signal induced in the receive coil without the presence of ground. The ground balance control varies the phase of this signal over a range of about four to one. Thus, when you vary the ground balance control, this varies the phase of the signal controlling gate 1, thus varying the average level of the signal passed to the integrator.

The process is then repeated until no change occurs when the search head is lowered to the ground. This establishes a 'normal' condition for the output of the integrator and the sample and hold circuit maintains the appropriate dc level at the input to gate 1 such that the meter remains at centre zero.

If the search head then approaches a metallic object, the amplitude of the signal in the receive coil will vary as the coupling between the coils and the phase of the signal will be altered by the target. This will change the average level of the composite signal out of gate ▶

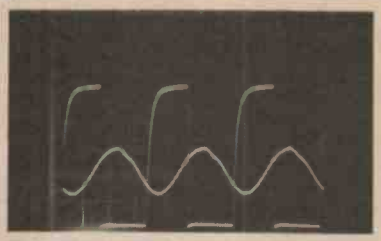
OSCILLOSCOPE PHOTOGRAPHS



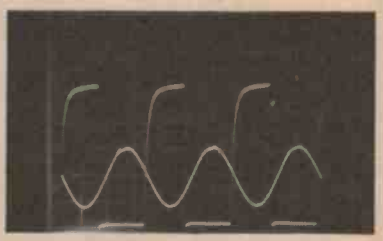
NOTE: As the effect induced by different targets is very, very small, we have had to use fairly large sample targets to show gross effects in order to demonstrate the operation of the instrument.

A) Top trace: transmit signal on C8 (Y-amp 5 V/div, ac-coupled)
Bottom trace: received signal on emitter of Q2 (Y-amp 5 V/div ac-coupled). Time base: 50 us/div.

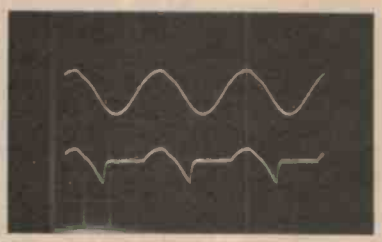
VLF MODE



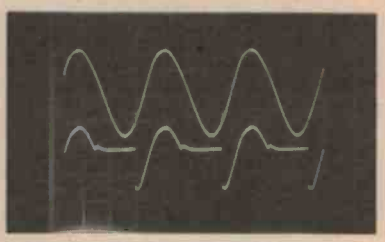
B) Received signal on emitter of Q2 (sine wave) superimposed on output of IC4b. (Both traces 2 V/div, ac-coupled; time base 20 us/div).



C) As per pic (B) but with aluminium target held near search head. Note the phase delay and change in amplitude of the received signal.

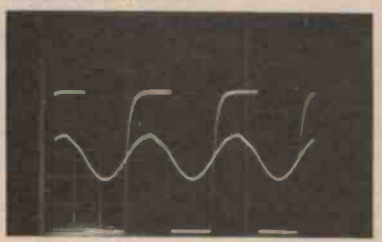


D) Top trace: received signal on emitter of Q2.
Bottom trace: output of IC1b showing composite waveform of received signal 'mixed' with a dc level. (Both traces 2 V/div, ac-coupled; time base 20 us/div).

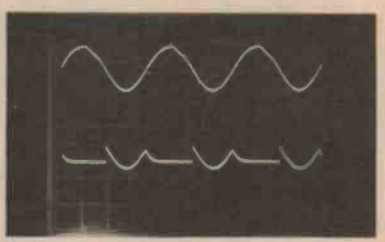


E) Same as pic (D) but with metal target near the search head. Note the increase in average dc level from the output of IC1b. The change in this signal is much larger for non-ferrous than for ferrous metals.

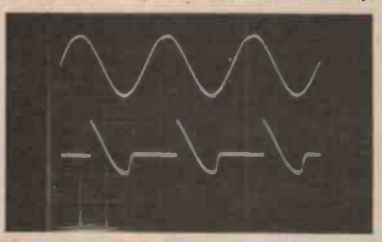
DISCRIMINATE MODE



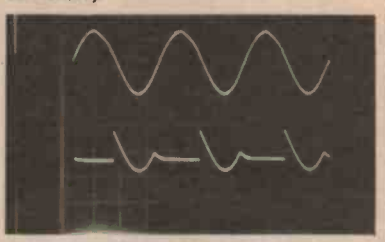
F) Received signal on emitter of Q2 (sine wave) superimposed on the output of IC4b. The phase difference between the two signals is adjustable through 180° by use of the course (TR1, TR2, TR3) and fine 'discriminate' controls. (Both traces 2 V/div, ac-coupled; time base 20 us/div).



G) Top trace: received signal on emitter of Q2. Bottom trace: output of IC1b showing composite waveform of received signal 'mixed' with a dc level. Detector set to TR1 mode, discriminate control to 9. (Both traces 2 V/div, ac-coupled; time base 20 us/div).

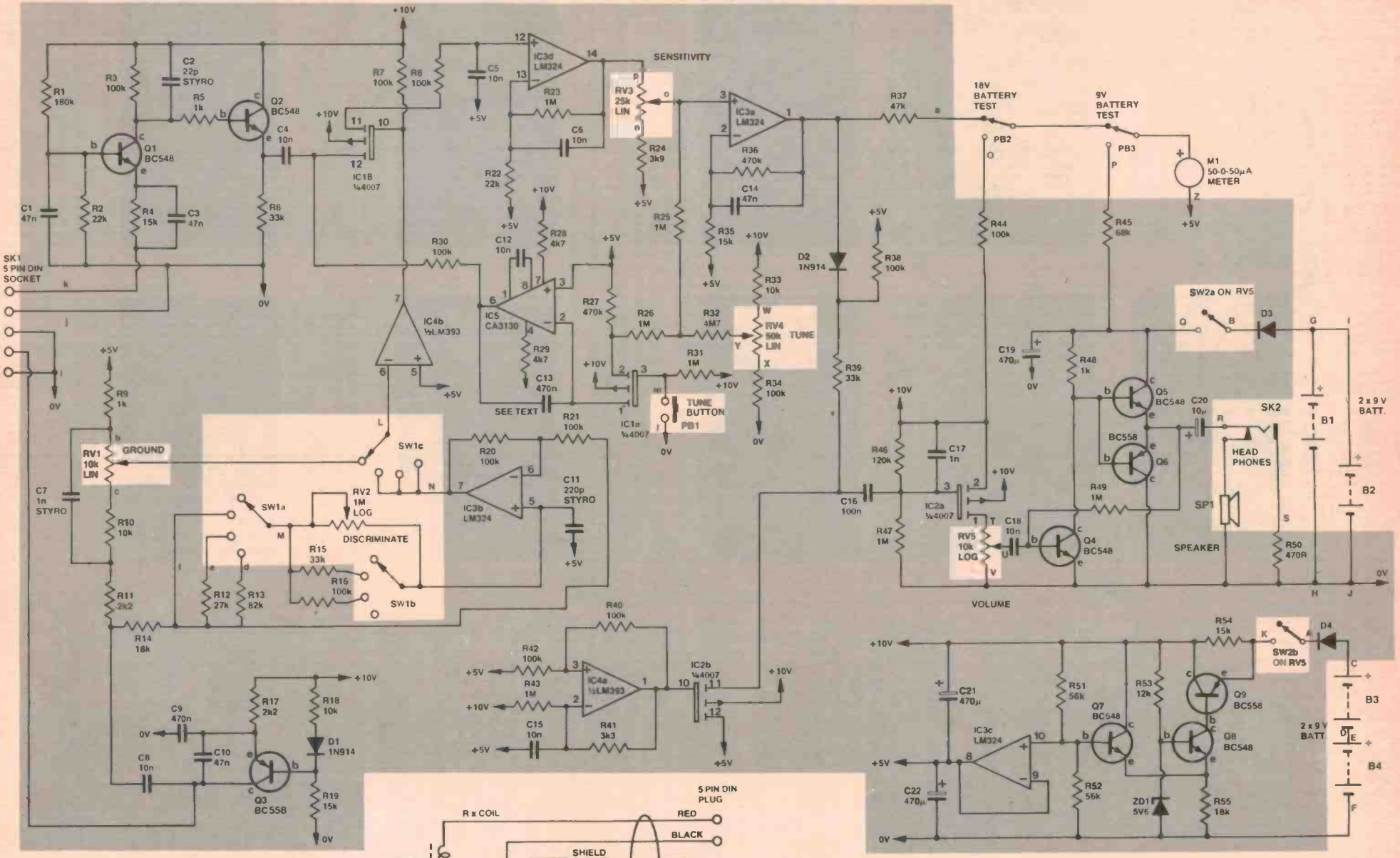


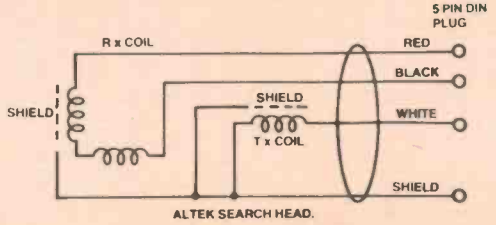
(H As per pic (G) but brass target held near search head. Note the increase in the average dc level of the signal at the output of IC1b.



I) As per pic (G) but steel target held near search head. Note the decrease in average dc level of the signal at the output of IC1b, illustrating discrimination.

Project 1500 super metal detector





NOTES: SW1 shown in 'VLF' position. External connections via pc board pins are marked 'A, B . . .' and 'a, b . . .'. Do not confuse transistor emitter/base/collector designations with them.

LM 324	pin 4	+10V
	pin 11	0V
LM393	pin 14	+10V
	pin 4	0V
4007	pin 14	+10V
	pin 7	0V

OSCILLOSCOPE PICTURES taken at the following points:-
(A) collector of Q3 and emitter of Q2. (B) emitter of Q2 and pin 7, IC4. (C) same. (D) emitter of Q2 and pin 11, IC1b. (E) same. (F) emitter of Q2 and pin 7, IC4. (G) emitter of Q2 and pin 11 IC1b. (H) same. (J) same.

FEATURES

- VLF and T/R operation
- Three ranges of 'discriminate' (T/R) operation
- Can tune out aluminium ring-pull tabs
- Ground balance circuitry included
- Tune memory ('auto-tune') button
- High sensitivity (will detect 20¢ piece at depths over 250 mm)
- Pre-wound and aligned waterproof search head
- Straightforward construction, no alignment necessary
- Low battery drain
- Uses common No. 216 transistor radio batteries
- Costs around $200 in kit form

HOW IT WORKS — ETI 1500

As the general principles of operation have been discussed with regard to the block diagram in the text, this description is confined to the circuit alone.

Commencing with the transmitter, Q3 is configured as a Colpitts oscillator, the transmit coil in the search head forming the inductance which resonates with the combination C9 and C10. Bias is applied to Q3 via R18, D1 and R19. Emitter bias is provided by R17. The transmit signal to the phase-lead and phase-lag circuitry (ground and discriminate controls) is tapped off the collector of Q3 via C8 to the junction of R11 and R14. The ground control circuitry connects via R11 while the discriminate circuitry connects via R14.

The signal from the receive coil is amplified by Q1 and applied to gate 1 (see block diagram), one CMOS gate in IC1 (IC1b), via an emitter-following buffer stage, Q2. Note that Q1 is operated as a grounded-base amplifier. The phase of the received signal through Q1 and Q2 is not altered. Output from the emitter of Q2 is applied to the drain of IC1b.

The base of IC1b is driven by a square wave derived from the transmit signal, the phase of which can be varied by either the ground or discriminate controls.

In the VLF mode, the phase of the transmit signal tapped off from Q3 can be varied using RV1. This provides a phase-advanced signal that can be varied over the range from about $+10^{o}$ to $+40^{o}$. A leading phase RC network is formed by R10 and RV1 in conjunction with C7. This signal is applied to the inverting input of an op-amp, IC4b. As this is operated at maximum gain with a high signal level at the input, it will 'square up' the signal at its output (pin 7), which drives the gate of IC1b.

In the discriminate mode, switch SW1 connects the transmit signal to circuitry which provides a lagging phase signal which can be varied over a range set by RV2 (the discriminate control) and a set of 'range' resistors: R12, R13, R15 and R16. These form a lagging phase RC network in conjunction with C11. The signal is then buffered by a non-inverting op-amp, IC3b, and applied to the inverting input of IC4b via SW1c.

The source of IC1b is connected to an integrator stage formed around IC3d. The output of this stage is connected directly to the sensitivity control, RV3. The wiper of this potentiometer goes directly to the input of a dc amplifier, IC3a, to which we shall return shortly. The wiper of RV3 is also connected to the sample and hold circuit, via R25, which involves IC5, IC1a, the tune control RV4 and the tune memory pushbutton, PB1.

The sample and hold circuit works in the following way. The junction of resistors R25, R26 and R32 will be at a dc level determined by the dc level at the wiper of RV3 and the dc level at the wiper of RV4, the tune control potentiometer. The dc level at the wiper of RV3 will depend on the signal level and phase switched through to the integrator by IC1b. When the tune memory pushbutton, PB1, is pressed, IC1a (also a CMOS switch) will apply a dc level to the input of the sample and hold circuit proportional to the dc level at the junctions of R25, R26 and R32. This will charge C13 and the output of IC5 will settle at this value. This dc level is then applied to the drain of IC1b, via R30.

Thus, the received signal and this dc level are 'mixed' at the input to gate 1 (i.e: IC1b), the composite signal being applied to the integrator.

The meter, M1, is driven by a dc amplifier, IC3a. The input to this op-amp comes from the sensitivity control and is applied to the non-inverting input (pin 3). This stage has a gain of about 30 and a little 'smoothing' (integration) of the signal is applied around the feedback by having a capacitor (C14) connected in parallel with the feedback resistor, R36.

Apart from driving the meter, the output of IC3a is fed to the source of IC2b which gates the audio oscillator through to the audio output stage (i.e: gate 2). The dc level from pin 1 of IC3a goes via D2 and R39 to pin 11 of IC2b. A positive bias is applied to the cathode of D2 from the +5 V rail via R38. Only when the dc level at the output of IV3a goes higher than 0.6 V above the bias applied to the cathode of D2, will IC2b be biased on.

The audio oscillator involves IC4a, configured as an astable multivibrator operating at a few hundred Hertz. The output, pin 1, is applied to the gate of IC2b. When IC2b turns on, the signal is applied to the input of the audio output stage.

One gate from IC2 is biased into its linear region and acts as a source-follower buffer at the input of the audio output stage. The volume control, RV5, is the source resistor for this stage and the output is taken from the wiper of RV5 to the base of Q4, capacitively coupled via C18.

The output stage is a simple complementary class-B stage employing a low power NPN/PNP transistor pair. The collector of Q4 drives the output stage, its collector load also providing bias to the output pair (R48). Both dc and ac feedback is applied to the base of Q4 by R49 from the output. Audio output can be from an 8 ohm speaker or headphones, via a dc isolating capacitor, C20. Headphone volume is reduced by a 470 ohm resistor, R50, in series with one lead to the headphone socket, SK2.

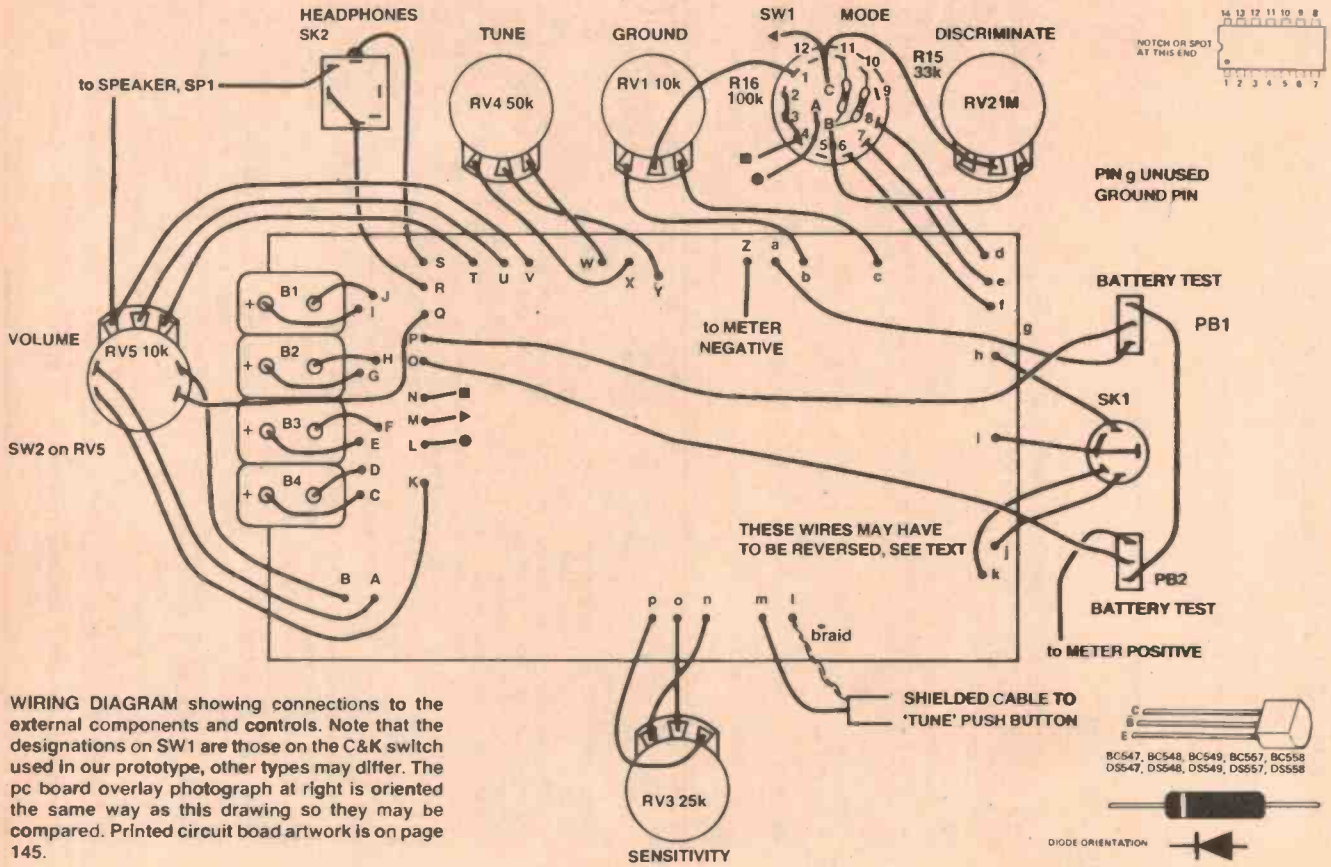
Power supply for the circuitry is split into two parts. The audio output stage is supplied by two 9 V batteries connected in parallel (B1 and B2). These are connected via a reverse-polarity protection diode, D3, and one pole of SW2 which is a switch on RV5.

The rest of the circuitry requires a +10 V and a +5 V rail, with respect to the common rail (0 V). This is derived from two 9 V batteries, B3 and B4, connected in series and applied to a regulator circuit via a reverse-polarity protection diode, D4, and the other pole of SW2. The regulator is basically a conventional series-pass circuit, Q9 being the regulator transistor.

The zener diode ZD1 provides a stable reference voltage for a differential pair, Q7 and Q8, the latter controlling the base current to Q9. Resistor R54 allows a small amount of current to pass to Q7/Q8 at switch-on to ensure the regulator 'starts' correctly. The base of Q7 is biased at half the upper supply rail voltage by R51 and R52. This voltage is buffered by an op-amp, IC3c, configured as a voltage follower, and used to drive the +5 V line. Decoupling is provided by C19, C21 and C22. Note that 'battery test' facilities are provided by R44/PB2 for the 18 V supply and by R45/PB3 for the 9 V supply.

TUNING

During the tuning operation, when the instrument is being initially set up, the circuit works in the following way: With the tune memory pushbutton operated, IC1a is gated on and a dc negative feedback loop is established from the output of the sensitivity control, back to the input of gate 1, the drain of IC1b, via the sample and hold circuitry. A portion of the voltage from the wiper of RV3 is added to the voltage determined by the voltage divider R33, RV4 and R34. This is applied to the source of IC1a. As the tune memory button is pressed, IC1a is conducting and capacitor C13 will charge to the value of the composite voltage applied to the source of IC1a. The op-amp IC5 is a low input current device and the output, pin 6, will settle at a value equal to the composite voltage applied to its non-inverting input (pin 2). This dc level is applied to the source of IC1b and the signal output from the receive coil amplifier is mixed with it. This will bring about a reduction in the dc level of the signal applied to the integrator input, and thus a reduction in the dc level at the input of IC1a and, within a second or two, a new dc condition is established. When the dc level around the loop settles, the meter will read zero (centre) and the tune memory switch is released. The dc level at the output of IC5 (and thus at the drain of IC1b) is maintained by the charge on capacitor C13. In practice, it will drift very slowly, as C13 will be gradually discharged by the input current of IC5 and the capacitor's own leakage. For this reason, the tune memory button is located on the crook of the handle where it can be operated by your thumb every now and then to re-centre the meter.



WIRING DIAGRAM showing connections to the external components and controls. Note that the designations on SW1 are those on the C&K switch used in our prototype, other types may differ. The pc board overlay photograph at right is oriented the same way as this drawing so they may be compared. Printed circuit boad artwork is on page 145.

PARTS LIST — ETI 1500

Resistors all ½W, 5%.

R1	180k
R2, 22	22k
R3, 7, 8, 16, 20, 21, 30, 33, 34, 38, 40, 42, 44	100k
R4, 19, 35, 54	15k
R5, 9, 48	1k
R6, 15, 39	33k
R10, 18	10k
R11, 17	2k2
R12	27k
R13	82k
R14, 55	18k
R23, 25, 26, 31, 43, 47, 49	1M
R24	3k9
R27, 36	470k
R28, 29	4k7
R32	4M7
R37	47k
R41	3k3
R45	68k
R46	120k
R50	470R
R51, 52	56k
R53	12k

Capacitors

C1, 3, 10, 14	47n greencap
C2	22p styroseal
C4, 5, 6, 8, 12, 15, 18	10n greencap
C7	1n styroseal
C9	470n greencap
C11	220p styroseal
C13	470n polycarbonate or styroseal
C16	100n greencap
C17	1n greencap
C19, 21, 22	470µ, 16V electrolytic
C20	10µ, 16V electrolytic

Potentiometers

RV1	10k linear
RV2	1M log.
RV3	25k linear
RV4	50k linear
RV5	10k log pot with DPST switch

Semiconductors

D1, 2, 3, 4	1N914, 1N4148
ZD1	5V6, 400mW zener diode
Q1, 2, 4, 5, 7, 8	BC548, BC108
Q3, 6, 9	BC558, BC178
IC1, 2	4007
IC3	LM324
IC4	LM393N
IC5	CA3130N

Miscellaneous

SW1	three-pole, four position wafer switch;C&K type RA
SW2	on RV5 (DPST switch)
PB1, 2, 3	SPST miniature momentary push buttons, push to make
M1	50-0-50 µA meter,see text
SK1	5-pin DIN socket
SK2	shorting type jack socket
SP1	small eight ohm speaker (75 mm dia.)
B1 - B4	nine volt transistor radio batteries (type 216)

Four battery clips for No. 216 batteries; ETI-1500 pc board; case (see text); handle (see text); search coil (see text); knobs; length of ribbon cable; two metre length of shielded cable; double-sided sticky tape to hold batteries in position, or a suitable clamp.

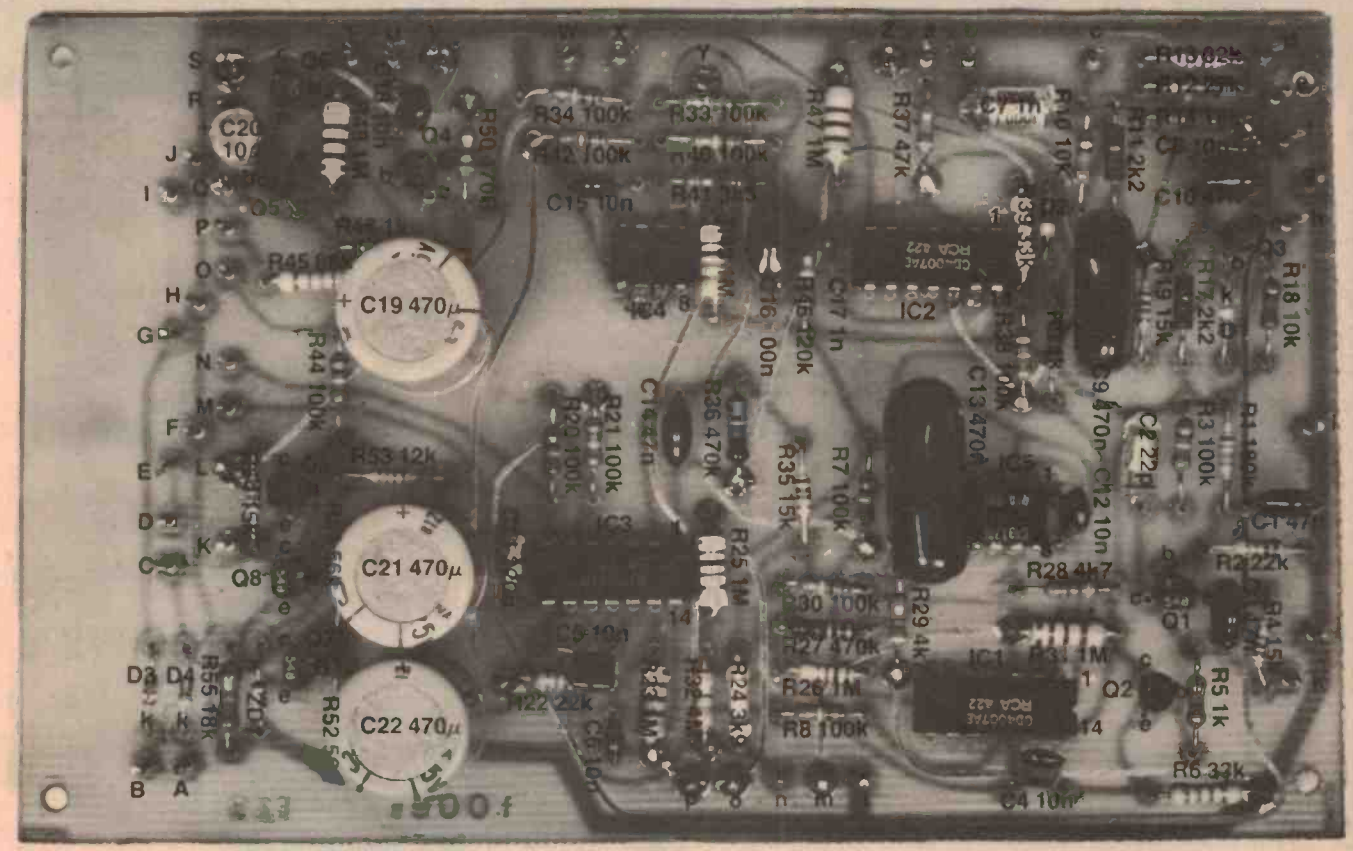
1 and thus the dc level at the output of the integrator will change. This will be amplified and the meter will show an indication. Also, gate 2 will be operated and a tone will be heard in the speaker.

However, this method of operation will not indicate the difference between the characteristics of different targets.

In the discriminate or TR mode, the ground balance control is not used. The instrument is initially set up using the *tune* control to bring the meter to centre-zero. The differne tTR ranges permit varying degrees of control with the *discriminate* potentiometer. The phase-lag circuit block generates a signal which lags the phase of the transmit signal and the discriminate control provides a phase-variable signal to drive gate 1.

When a ferrous target is approached, the combined permeability and eddy current effects tend to reduce the amplitude of the signal picked up by the receive coil. This will cause a reduction in the dc level of the signal out of gate 1 and a reduction in the dc level out of the integrator. Thus, the meter will move to the negative (left hand) side of the scale. This side of the scale is marked "bad", obviously.

When a non-ferrous target is approached, the combined eddy current



and permeability effect tends to increase the amplitude of the signal picked up by the receive coil. This will cause an increase in the dc level of the signal out of gate 1 and an increase in the dc level out of the integrator. The meter will thus move toward the positive (right hand — "good") end of the scale.

The effects we are considering are actually quite small, hence the circuit has a considerable amount of dc gain.

Gate 2 only operates when the output from the dc amp increases (goes positive) and thus the audio output is only heard in the discriminate mode when the meter shows "good".

It is unfortunate that ring-pull tabs from drink cans are aluminium and thus indicate along with other non-ferrous metals. But, the discrimination ability of the instrument can be adjusted to exclude the small effect these targets generate — along with small trinkets, the smaller gold nuggets, etc — but who wants the tiddlers anyway!

If the dc level applied to the input of gate 1 drifts — and it may do for a wide variety of reasons, operating the *tune memory* button will restore the balance of the circuit and re-centre the meter. Quite a cunning arrangement.

Search head

The most important properties of the search head are its size, the relationship between the transmit and receive coils, and the shielding against capacitive effects between the coils and the ground. Surprisingly, the actual inductance of the coils is not of primary importance.

The greater the coil diameter the greater the penetration depth but the less sensitive the detector will be to small objects. Penetration using simple, circular coils is about equal to the search coil diameter for small objects such as coins, while sensitivity is roughly proportional to the cube of the object diameter (expressed as a function of the search coil diameter). Sensitivity is also inversly proportional to the sixth power of the distance between the coil and the object.

All this means that if the object size is halved the sensitivity is reduced to one-eighth. If the depth is doubled the sensitivity is reduced to one sixty-fourth. See why metal detectors designed to pick up small objects use small coils and really only skim the surface? If the search coil is doubled in diameter for greater penetration the sensitivity to small objects falls to one eighth, apart from the coil assembly becoming mechanically less rigid. The law of diminishing returns again or 'you don't get something for nothing'.

Our new detector improves penetration while retaining sensitivity by using a co-planar arrangement of coils in the search head which gives a slightly magnified field pattern downwards, into the ground.

We mentioned earlier that the two coils are only loosely coupled. The positioning of the receiver coil in relation to the transmitter coil is very critical and is the major factor affecting the performance of the instrument. In fact, misplacement by a millimetre or so will markedly affect the performance.

As the search head is moved around, the changing capacitance between the coils and the ground could completely mask the minute changes in the field we are looking for. To avoid this affect the coils are enclosed in a Faraday shield.

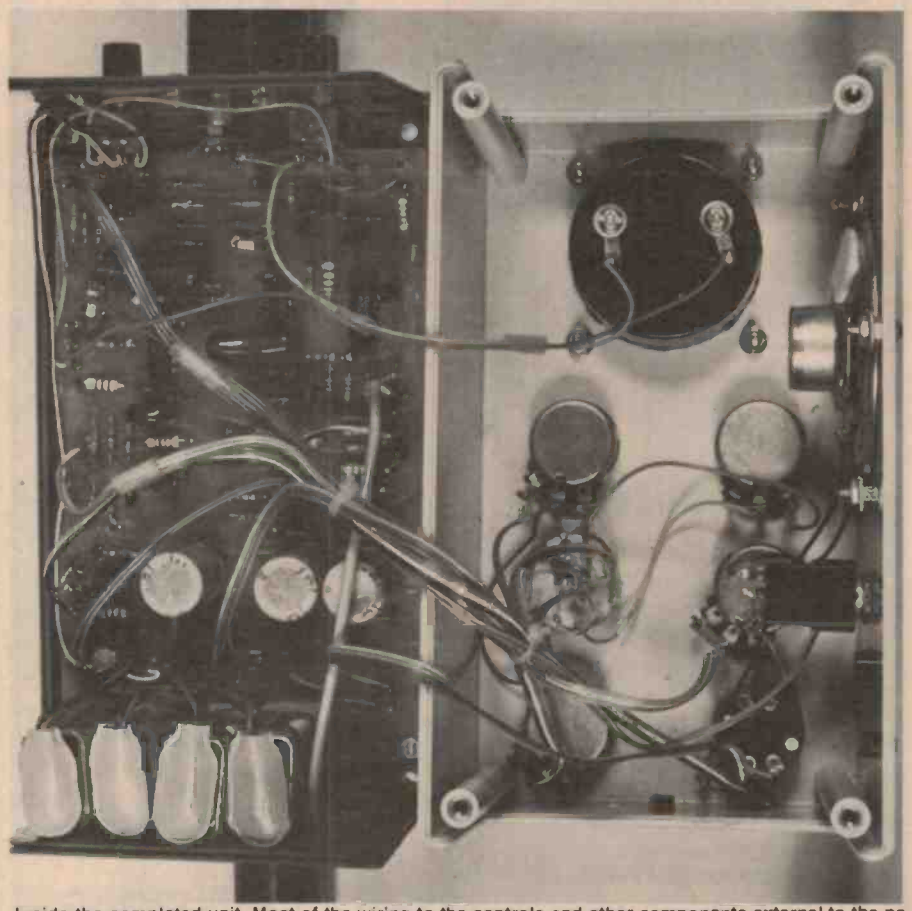
By now it should be obvious that construction of the search head is not a task to be tackled on the kitchen table on a rainy Sunday afternoon. In fact, construction and alignment of the search head would be beyond most readers' resources (anyone who has attempted our earlier induction balance metal detector knows what it's like). With this in mind we chose to use the commercially built, pre-aligned ▶

search head made by Altek Instruments. This will be available in Australia through All Electronic Components in Melbourne who have agreed to make the unit available wholesale to other suppliers, as well as retailing parts themselves, along with hardware — the plastic extendable handle and the case for housing the electronics. See Shoparound for details, p. 85.

Construction

The mechanical components for this project — the search head, handle and case, are available through Altek's Australian agent, All Electronic Components, as mentioned earlier. We recommend you obtain these as your finished instrument will then be a professional looking piece of equipment, with the features and operation of a 'bought one' two to three times the price. However, you can suit yourself and make your own handle if you so desire and we have designed the pc board such that it will also fit in a large jiffy box. You will have to use the search head recommended though, for the reasons we have explained previously.

All the electronics mounts on a single, double-sided pc board. The Altek case has two clamps on the rear enabling it to be clipped on to the handle. The Altek handle has two sections, the lower section sliding inside the upper section enabling the operator to adjust the length of the handle to suit his height. Connection between the search head and the electronics is via a length of shielded cable (supplied with the head) and a five-pin DIN plug/socket arrangement. The *tune memory* pushbutton is mounted in the end of the 'crook' of the handle (see photographs) where it can be easily operated by the thumb. It connects to the electronics via a length of shielded cable passed through the handle.



Inside the completed unit. Most of the wiring to the controls and other components external to the pc board as done using ribbon cable. The colour coding of this cable assists greatly in avoiding confusion. We suggest you place the two units as shown in this photograph to accomplish the wiring. Note how the speaker is mounted. The batteries are held in place by a strip of double-sided sticky tape.

A view of the front panel of the project. The Scotchcal front panel and meter escutcheon will be available from the usual suppliers. See Shoparound. p.85.

Construction should commence with the pc board. As it is a double-sided board (i.e: copper tracks on each side), first identify the 'front' and 'rear' side. These are marked, respectively, ETI 1500f and ETI 1500r. The rear side has the more complicated pattern of tracks. The components are mounted on the *front* of the board, where there is the less complicated set of tracks. Note that some of the resistors, IC pins and pc board pins (used for connecting external wiring to the board) must be soldered to copper tracks on *each* side of the board.

Commence with the resistors. Take care with those that cross tracks that you don't create a short circuit where it's not wanted. Next mount the capacitors. Take care with the orientation of the electrolytics. Note that capacitors C2, C7 and C11 are styroseal types, used for their good temperature stability. Be careful when soldering them in place that you don't overheat the leads as this can cause melting of the capacitor's case, possibly damaging it. The sample and hold capacitor, C13, must be a low leakage type, preferably polycarbonate or mylar. We used a greencap successfully, but whatever you manage to obtain, make sure it's a good quality type from a well-known supplier.

Now mount the semiconductors. Take care with the orientation of these as you can destroy devices if they are incorrectly inserted when power is applied. Finally, solder the pc pins in place and the four battery clips. The latter all go along one edge of the board.

Overall assembly of the pc board is clear from the overlay picture on page 45.

Once you have everything in place on the pc board and you're satisfied that all is OK, you can turn your attention to ▶

the hardware. Start with the case that houses the electronics. If not pre-drilled, you'll need to mark out and drill all the holes in the case lid. The panel artwork can be used as a template. Note that we dressed up the case with a Scotchcal panel. These should be available through the usual suppliers. Centre punch holes before drilling. The cutout for the meter can be made with a hole saw or by drilling a series of 4 mm diameter holes just inside the marked edge of the hole. When you complete the circle, the centre piece can be snapped out and the edge of the hole cleaned up with a half-round file until the meter drops in neatly.

The speaker is mounted on the left hand side of the case lid (as you would normally view the unit in use). It is held in place by large washers placed under the nuts of three bolts spaced around the outer rim of the speaker. Alternatively, you can glue it in place. Be careful not to get any glue on the speaker cone or you might end up with a rather 'strangled' sound!

The pc board mounts in the bottom piece of the case, along with the DIN socket (for the search head connector) and two battery test push buttons. A small hole in the bottom passes the cable to the tune memory button. The case bottom has four integral moulded standoffs to provide support for the pc board which is held in place with screws.

Once all the mechanical work on the case is satisfactory, the Scotchcal panel may be stuck on. Take care when positioning it as it's almost impossible to move if you misalign it. Carefully smooth out all the bubbles toward the edge of the transfer.

The controls, meter etc. may be mounted next. Then you can wire all the external components to the pc board pins. We used lengths of ribbon cable where possible to simplify the wiring. The easiest way to accomplish this part of the assembly is to place the bottom of the box, with the pc board mounted in it, on your left and the lid, with the meter and controls etc. mounted, face down on your right. Follow the wiring diagram on page 44 and complete all the interconnections. You should now appreciate pc board pins!

The tune memory button mounts in a hole in the end of the 'crook' of the handle, as we explained earlier, and the shielded cable connecting to it passes through the handle, emerging through a small hole drilled in the handle near where the cable can enter the hole provided for it in the bottom of the box. This cable is best inserted before you mount the pushbutton. Remove the handgrip. Push the cable through the hole in the handle near the case, until it appears through the end of the handle. Solder the end of the lead to the pushbutton and mount the pushbutton in the hole in the end of the hand grip (easier said than done!). Put the handgrip back and you can pass the business end of the cable into the case and terminate it. If you're lucky, kit suppliers may sell the units with this part already assembled.

Holding the batteries in place is generally left to your ingenuity. We used double-sided sticky tape (ah, that's useful stuff. . .). The battery life is quite good as the circuit has been designed for low current drain. Reverse polarity protection is provided on the pc board to avoid problems should you inadvertently attempt to connect a battery back to front.

When all wiring is complete, push the case onto the handle and drill a small hole through one of the clamps and the stem of the handle. Insert a nail or a bolt and this will prevent the case from rotating on the handle. Mount the search head and adjust the length of the stem to suit yourself. Wrap the cable from the search head around the stem so that it is held quite rigidly and plug it into the DIN socket on the case.

You're ready to roll! . . . once you've tested it.

If you wish to make the search head completely waterproof, seal the hole through which the cable passes with Silastic rubber or some similar caulking compound.

Operation

When construction is complete and you're satisfied all is well, turn the detector on and advance the *volume* control. Set all other controls to mid-

A view of the forward end of the case showing the two battery test pushbuttons and the DIN plug and socket connection to the search head. The Altek cabinet is two-tone grey plastic. The upper section is a lighter hue. Note the "GT" stripes!

to page 158 ▶

MERRY XMAS TO ALL OUR READERS

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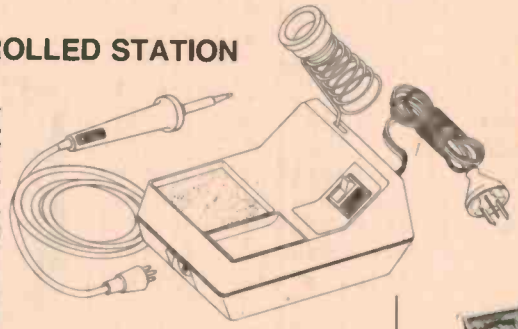

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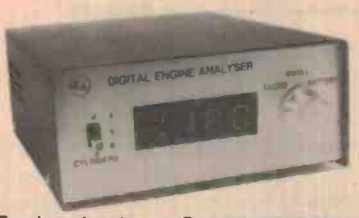

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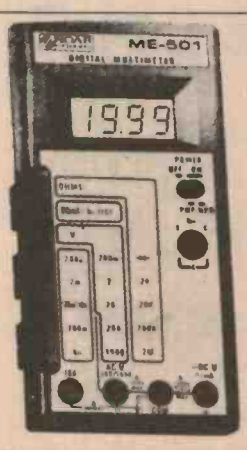

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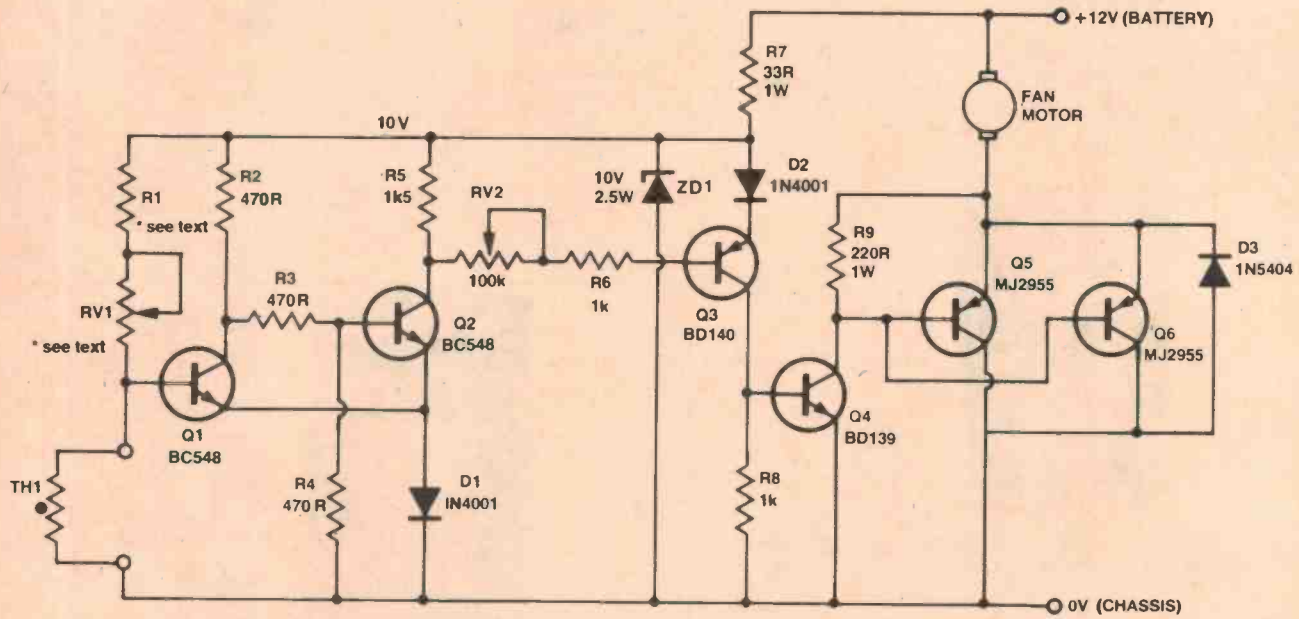

RECENTLY I decided to install a thermatic fan to my car but was dismayed to find that the price was around $80.

This discovery sent me off to the local wreckers where I was able to purchase a fan for $15. Unfortunately, the temperature control for this fan was unsuitable as it was fixed at the wrong temperature and was not adjustable.

I began putting together a few circuits to switch the fan on when the engine reached the desired temperature. Apart from turning the fan on at the right temperature, the circuit would have to turn it off once a predetermined lower temperature had been reached so that the engine would be maintained within its normal operating temperature range. A few circuits I tried had a tendency to 'hang on' past this lower temperature which was definitely an undesirable situation. I eventually solved this problem by using the circuit shown here.

Circuit operation

Engine temperature is sensed by a thermistor, TH1, mounted at a convenient point on the engine block. This thermistor controls a Schmitt trigger (Q1 and Q2) which drives several power transistors (Q5 and Q6), connected in series with the fan motor, via two intermediate stages (Q3 and Q4).

So that the operating points of the Schmitt trigger remain stable despite supply voltage variations (as much as 30% in 12 V systems) the collector supply to Q1 and Q2 is stabilised at 10 V by zener diode ZD1. This also ensures supply line spikes do not cause spurious operation of the fan.

Potentiometer RV1 sets the switch-on temperature while RV2 sets the switch-off temperature.

When the engine is below the required temperature the voltage drop across TH1 should be above 1.2 V. Thus, Q1 will be on and Q2 will be off. As no collector current flows in Q2, Q3 and Q4

SHORT CIRCUITS is a feature that lies somewhere between Ideas for Experimenters and complete Projects. Generally, the items published in Short Circuits will involve tried circuits that have not necessarily been fully developed, but fairly complete details are included as a guide to readers. Unfortunately, owing to the nature of these items, we cannot give further details other than what is provided in the article. Contributions for Short Circuits are always welcome.

will be off and no base drive will be applied to Q5/Q6. Thus, the latter transistors do not conduct and the fan will be idle.

When the engine reaches the required temperature, the voltage drop across TH1 will fall below 1.2 V (preset using RV1) and Q1 will turn off. Q2 then turns on and base current will be supplied to Q3 via D1, Q2, RV2 and R6, turning Q3 on. This turns Q4 on which applies base drive to Q5 and Q6, turning them hard on, operating the fan.

Diode D3 prevents back-emf spikes from destroying the two MJ2955s when the unit turns them off.

There will be a certain amount of hysteresis in the operation of the Schmitt trigger. However, the collector current in Q2 will vary as Q1 will turn on gradually when the temperature drops below the preset switch-on temperature. Thus the base current to Q4 will vary. The point at which insufficient current is supplied to Q3 can be set by varying RV2.

Construction

The whole unit was constructed in a die-cast aluminium box which was bolted to the vehicle chassis inside the engine compartment. The MJ2955s were mounted directly on the case, no insulation is required as the collectors are connected to 0V in any case. General construction is non-critical. However, I used a pc board and supported it by soldering the common connection copper area to the backs of the pots which were mounted on the box.

The thermistor I used had a resistance of 34 ohms at 77°C (170°F). In general, R1 and RV1 are selected such that the voltage across the thermistor TH1 is 1.2 V when the engine is at its recommended operating temperature (or in the middle of its operating temperature range). Whatever thermistor you use, you will need to know its resistance at that temperature. Knowing this, you can calculate R1 and RV1 as follows:

$R1 = 4 \times R_{TH1}$ (at operating temp.)

$RV1 = 6 \times R_{TH1}$ (at operating temp.)

Having calculated these values, use the component nearest in value above that calculated. The correct setting of switch-on temperature should be within the range of RV1. Values used in my unit were, R1 = 150R, RV1 = 250R.

You will need an engine temperature meter of some sort to set the on and off points correctly.

All resistors should be of the rating specified. Those used around Q1 and Q2 (R1 to R5) may be ¼-watt types, but ½-watt or higher rated types may be more reliable. I did not find it necessary to use low value emitter resistors on the MJ2955s to assist current sharing (though it may be a good idea to match a pair for Vbe . . . Ed.). The current through the fan motor when connected directly across the battery was 8.6 amps. In this circuit it draws 7.7 amps but the loss did not noticeably affect the cooling. ●

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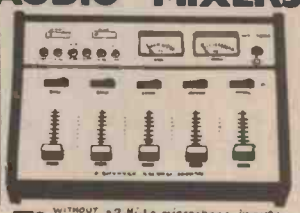

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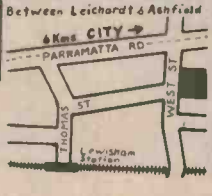

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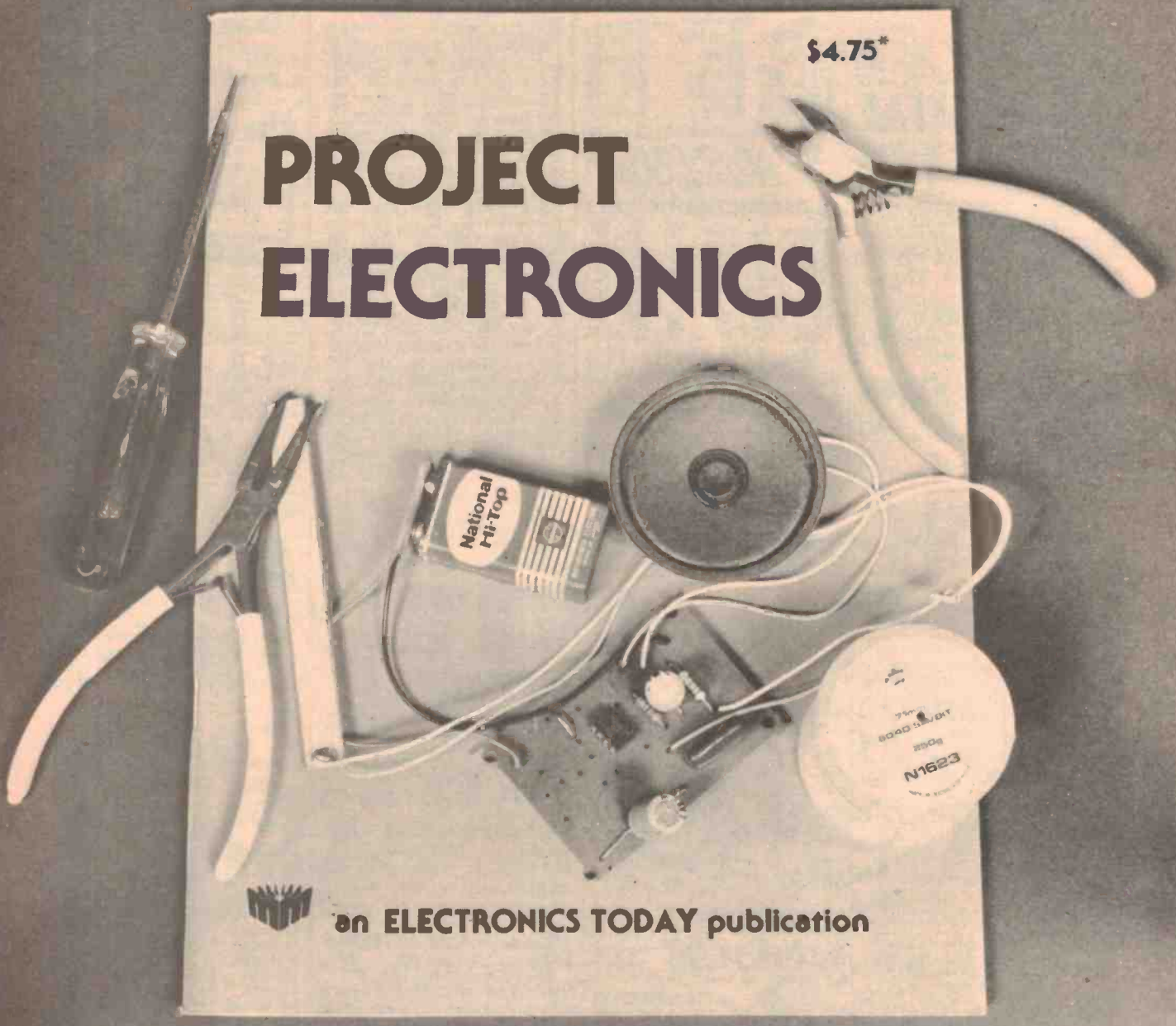


THIS BOOK has been specially designed and produced to meet the needs of newcomers to electronics. Students following the three-segment Industrial Arts syllabus at high school or embarking on the Electronics & Communications or a similar certificate course, will find the projects in this book an eminently practical introduction to the 'works' in electronics. Project Electronics has been a runaway success since it was first published. There are 26 projects included, many are readily available as inexpensive kits, and the book also provides advice on tools, identifying components, troubleshooting, how to solder etc. Available from specialist electronic suppliers or direct from the **ETI Subscription Department, 3rd Floor, 15 Boundary St, Rushcutters Bay NSW 2011** *for $4.75 plus 45 cents post and packing.*

Emergency lighting unit

If the mains power fails, you needn't be left completely in the dark. This unit automatically switches on a battery operated lamp as soon as the power goes off and keeps the battery always fully charged and ready for action.

IF YOU LIVE in an isolated country area where the mains supply is erratic, or if your local electricity authority is not too good at labour relations and its workers are always going on strike, then you'll know what it's like to be suddenly and completely without any electric power.

Being deprived of the TV and hi-fi for a while could well be good for the imagination and improve your conversational skills no end, but trying to find the toothpaste in a pitch black bathroom is simply infuriating!

In these circumstances, even a low intensity light is infinitely better than none at all. With this in mind we've designed this project, which switches on a 12 volt lamp of up to 24 watts as soon as the mains power fails. It could also be used of course to power any other 12 volt appliance with the same power rating.

The emergency lamp runs on current supplied by a 12 volt battery, which is kept fully charged when not in use by a trickle of current from the mains. We used a NiCad battery for our prototype, but there is no reason why you shouldn't use a lead/acid accumulator instead, because the charging current is kept so low there is no risk of overcharging and damaging the cells. The charging current is determined by a current limiting resistor, which must be chosen to suit the capacity and charge characteristics of the battery you are using. On page 58 is a table which lists the necessary values of this resistor for different batteries.

We've also included a red LED on the front panel of the unit, to show when it is operating (i.e. when the battery is discharging). This may seem superfluous, because after all you can see for yourself whether a lamp is lit or not, but if you are using the unit to run a fish tank heater or suchlike, then an indication that the unit is operating will be reassuring. ▶

PARTS LIST — ETI 597

Resistors

R1	1k, ½W, 5%
R2	100R, ½W, 5%
R3	Current limiting resistor, see table
R4	1k, ½W, 5%

Capacitor

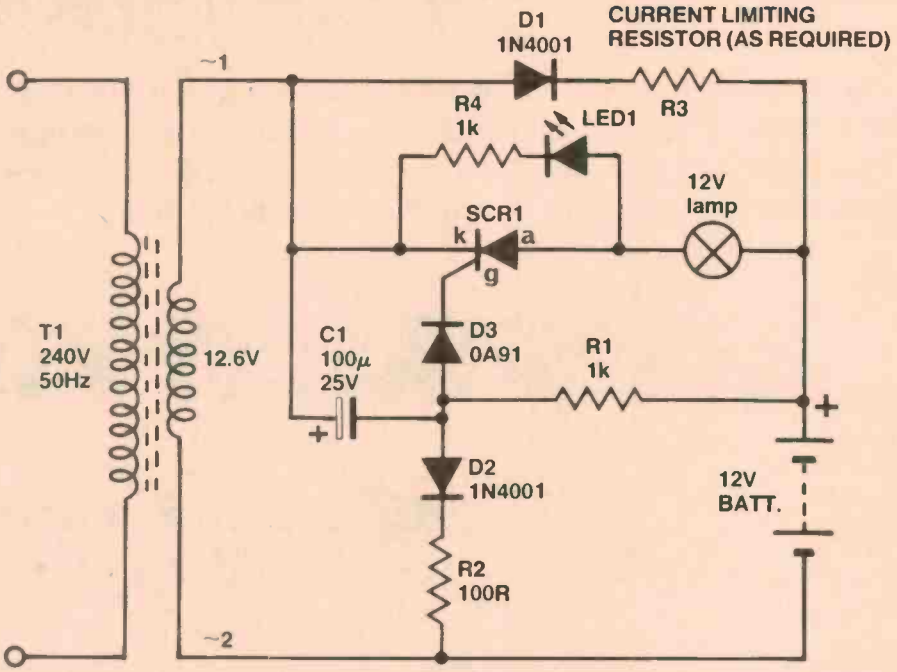
C1	100μ electrolytic, 25V

Semiconductors

D1, D2	EM401, 1N4001, A14A or similar silicon diode
D3	0A91, 0A95 or similar germanium diode
LED1	TIL220R or similar red LED
SCR1	C106Y or similar

Miscellaneous

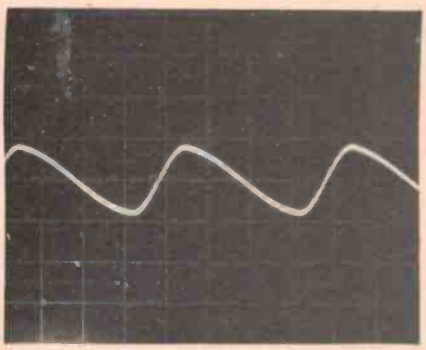
Ferguson PL24/20VA or similar transformer with 240V primary and 12V secondary rated at 1.5A; 12V NiCad battery; plastic box to suit (155mm x 95mm x 50mm); four screw terminals, two red, two black; 12V light bulb and socket.



HOW IT WORKS — ETI 597

When the mains power is on, the circuit float charges a NiCad battery from a transformer and rectifier. When the mains fails, a control circuit switches the battery through to the emergency light and the LED on the front panel.

WHEN POWER IS ON the NiCad battery is trickle charged through a rectifier diode D1, which supplies half wave rectified current pulses to the battery. Capacitor C1 smooths out these pulses by charging to the peak voltage from the transformer secondary through D2 and R2 and discharging through R1 and the battery when the output from the transformer falls. The discharge time constant of C1 is much longer than its charge time constant, so that it does not have time to discharge fully during the transformer negative half cycle. So C1 stays at a high positive voltage, with some ripple, as can be seen from the oscilloscope photograph.



Waveform at the positive lead of C1, showing the 50 Hz ripple.

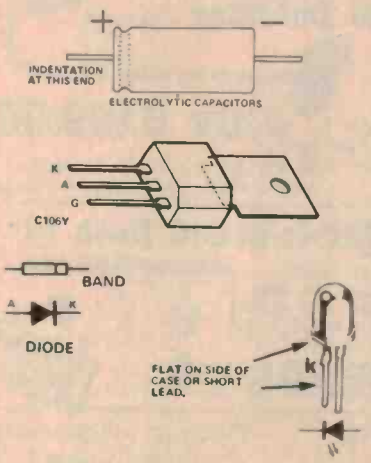
As C1 remains charged, the voltage on the gate of SCR1 is always lower than the voltage on its cathode and SCR1 is therefore reverse biased, so that the emergency lamp is switched off. LED1 is also reverse biased and not illuminated.

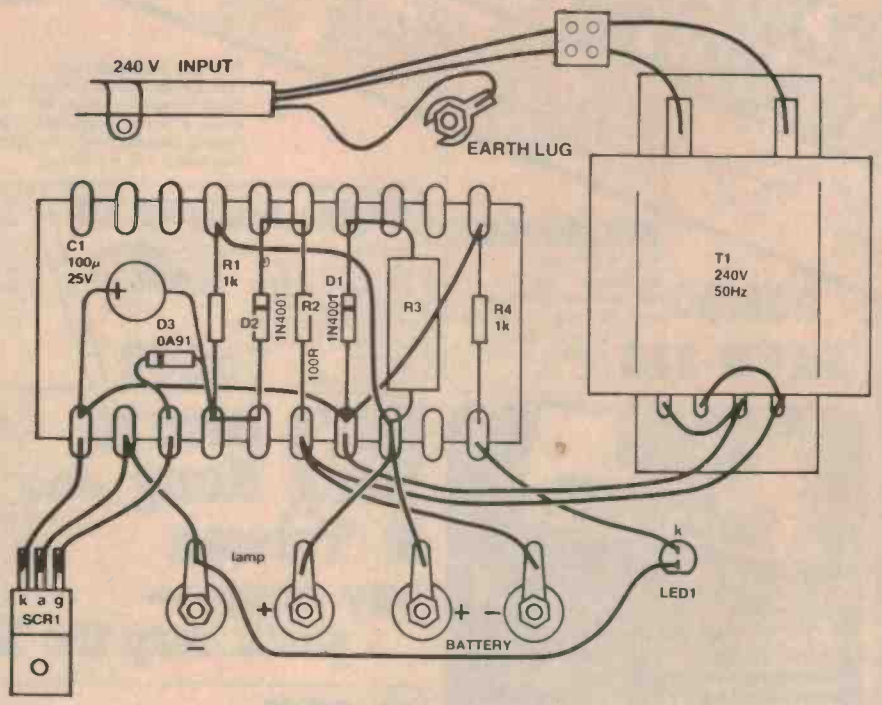
WHEN THE POWER FAILS the output from the transformer falls to zero and C1 starts to discharge through R1 and the battery. Once C1 is fully discharged it begins to charge in the reverse direction from the battery until the voltage on the gate of SCR1 is about 0.6 volts higher than the voltage on its cathode. SCR1 then switches on, lighting the emergency lamp. LED1 is now forward biased and illuminated. The voltage on C1 does not rise any further and the capacitor is not damaged by the reverse polarity because the voltage across it is less than the forming voltage of the electrolyte.

When the power returns, C1 charges again through D2 and R2, turning off SCR1 and resetting the circuit.

NiCad batteries may be used with this project and they can be obtained in ratings from 500 mAh up to 2 Ah capacity. Sealed lead-acid batteries can be obtained in higher capacities (see page 61).

BATTERY CAPACITY	VALUE OF R3 (5W, 5%)
500 mAh	82R
1.2 Ah	33R
2 Ah	22R
4 Ah	10R
6 Ah	6R8





Construction

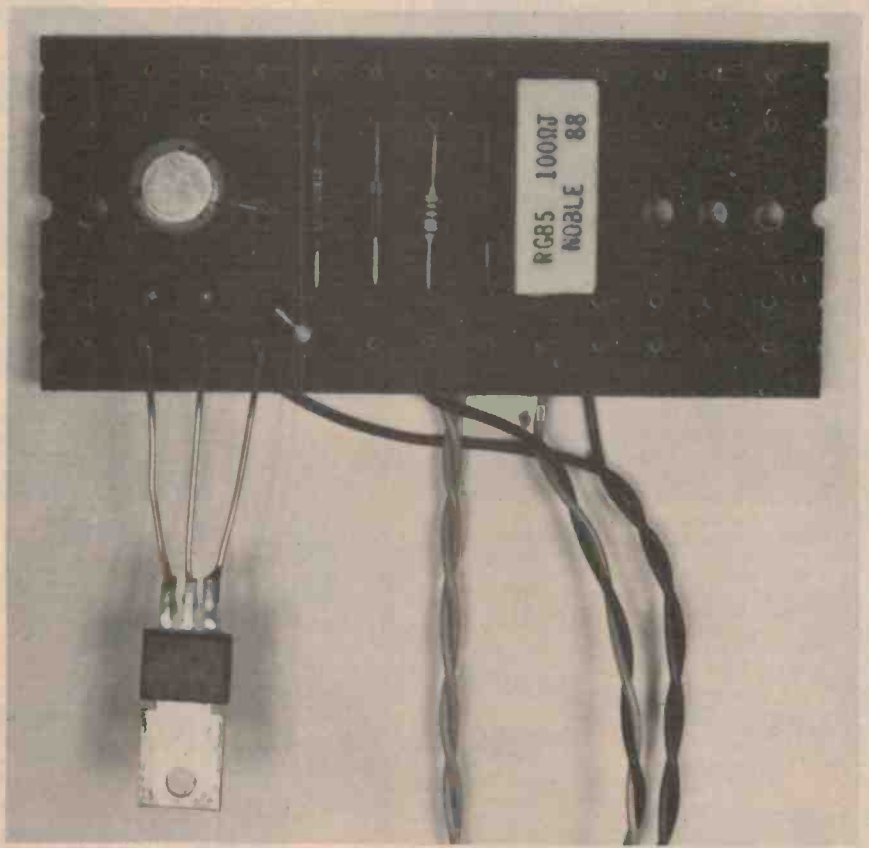
All the components are housed in a plastic case with an aluminium front panel that has terminals for the battery and lamp connections. The LED which indicates power failure is set in the panel above the lamp terminals.

As the circuit is very simple, we decided to mount the electronics on a length of twin tag strip. Mount the components as shown in the diagram on this page, being careful with the orientation of the diodes and the electrolytic capacitor.

The current limiting resistor R3 sets the charging current to the batteries and must be selected to suit the voltage and capacity of the battery. Consult the table on page 58 for the correct value. This resistor may run quite warm, so it should be mounted so that it is spaced about 5mm above the tag board for adequate ventilation.

If the emergency lamp draws 1 A or less, the SCR does not need a heatsink; if the lamp draws between 1 A and 2 A, the SCR can be mounted on the aluminium front panel with an insulating mica strip between it and the metal. For load currents over 2 A a heavier SCR with its own heatsink would have to be used, but we do not recommend drawing this much current because this is an emergency lamp and you won't want to discharge the battery too quickly.

Next wire the connections from the tag board to the LED, the terminals and the transformer. Be extra careful with all of these connections and use insulated hookup wire for all wiring, including connections across the tags on the tag board. The transformer is mounted in the top right corner of the box, leaving enough room for the terminals and the tag board. ▶



Showing the components mounted on the tagstrip.

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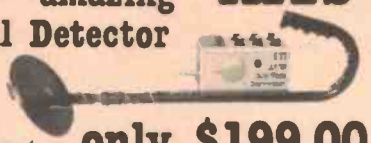

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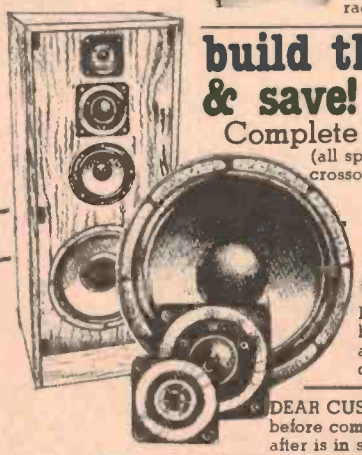

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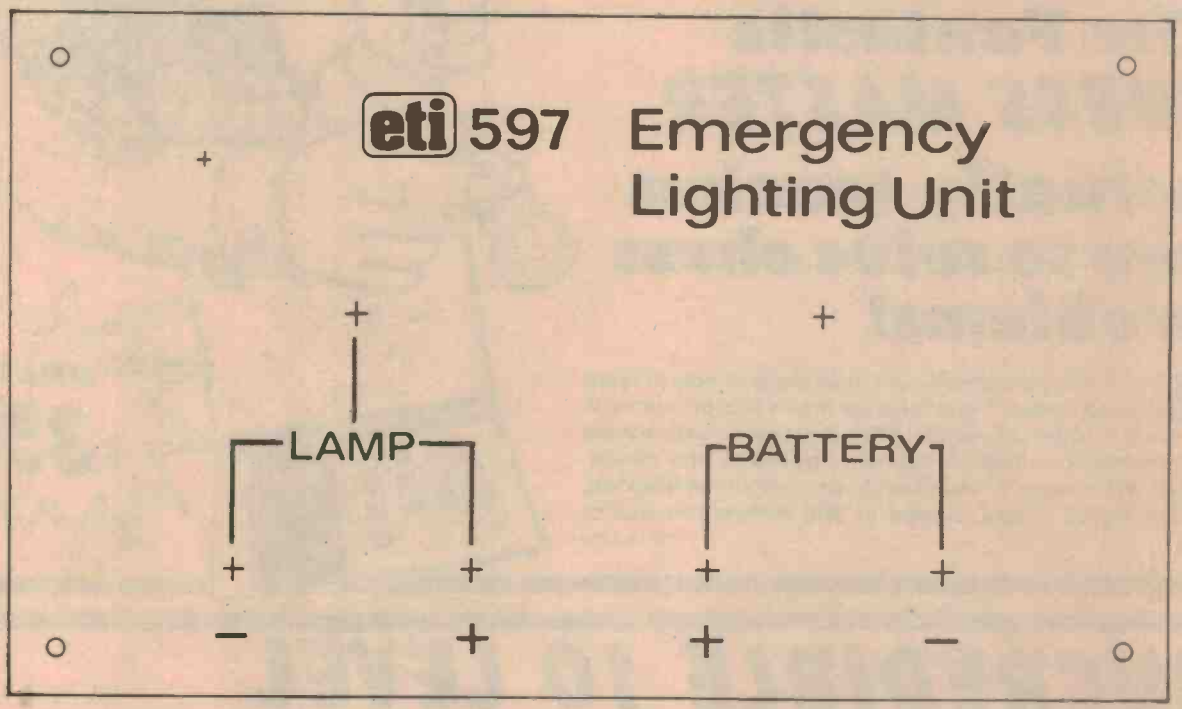
emergency lighting unit

Secure the mains power lead by passing it into the box through a clamping type grommet. Connect the earth wire of the mains lead to the solder lugs on the transformer case and to the front panel. Make sure that these connections are well made and that there is slack left on the mains earth wire, so that if the cable is pulled out of the grommet the earth wire will be the last to break off. ●

Lead-acid storage batteries, such as these sealed, gel electrolyte types are ideal for use with this project and can be obtained in ratings up to 6 Ah. The two batteries on the left are 6 V types rated at 4 Ah, while the 12 V type on the right is rated at 6 Ah.



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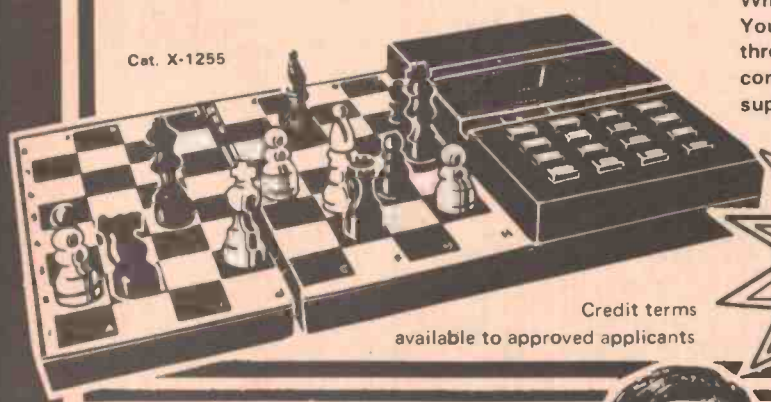

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Lab Notes

Voltage regulators

— circuits and techniques

Here's a 'cookbooklet' of voltage regulator circuits and techniques covering everything from simple zeners to three-terminal regulators from UK correspondent **Ray Marston**, with additional material from staff.

ONE OF THE most common and mundane tasks facing the electronics enthusiast is that of designing voltage regulator circuits, ie: circuits that produce a stable and well defined dc output voltage over a wide range of load current variations. These circuits may vary from simple zener networks, designed to provide load currents up to only a few milliamps, to fixed-voltage high current units for powering logic boards, etc, or to variable-voltage high current units designed to act as general purpose pieces of test gear.

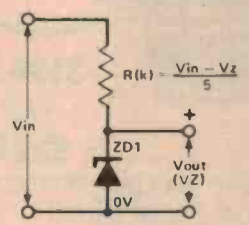

Figure 1. The simplest regulator. The zener regulator is often used to provide a fixed voltage 'reference' and supplies little or no load current. In such case a 400 mW zener of appropriate voltage is used and biased at about 5 mA. The value of R, in kilo ohms, can be calculated from the formula.

Zener based circuits

A zener diode can be used to produce a fixed reference voltage as shown in Figure 1. Often, the supply voltage (Vin) may be subject to fairly wide variations, causing the zener current to vary over a similarly large range. As long as Vin is always more than a few volts greater than the zener voltage and provided that the zener power rating is not exceeded this variation has only a moderate influence on the output voltage of the zener, which typically has an effective output impedance of a few tens of ohms.

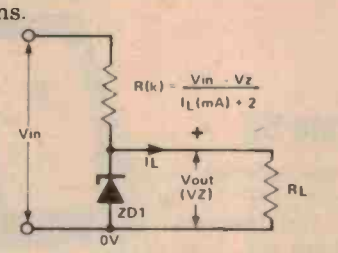

Figure 2. The basic zener regulator can be designed to supply a load current of a few milliamps to hundreds of milliamps depending on the zener power rating. Knowing the required load current, the value of R can be calculated from the formula.

A zener can be used as a very simple voltage regulator, providing load currents up to a few mA, by determining the value of 'R' as shown in Figure 2.

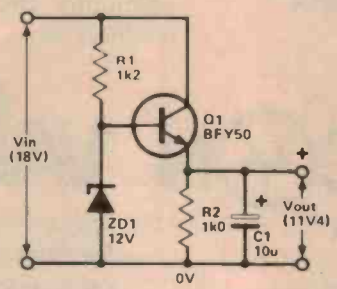

Figure 3. The basic 'series pass' fixed voltage regulator using a zener reference. This circuit can deliver up to about 100 mA at 11.4 volts. Q1 is basically an emitter follower, the base being 'clamped' at 12 V by the zener. C1 reduces the circuit's ac impedance.

In most practical voltage regulator applications the zener is simply used to apply a 'reference' voltage to a high-gain non-inverting buffer amplifier, which then supplies the required output power. The simplest example of this type of circuit is shown in the series-pass regulator circuit of Figure 3.

Op-amp regulators

One way of improving the regulation of the Figure 3 circuit would be to use a Darlington or super-alpha pair of transistors in place of Q1. An even better solution is to use the op-amp plus transistor buffer stage shown in Figure 4. Choice of circuit would perhaps depend on component availability and the application. ▶

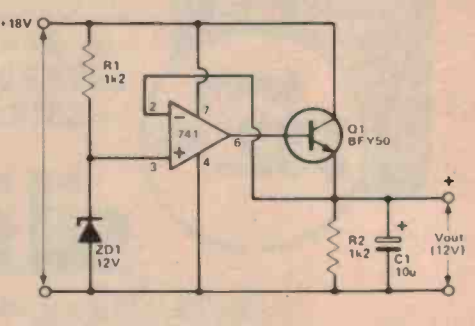

Figure 4. A considerable improvement in regulation is achieved by employing a high gain op-amp to drive the series pass transistor plus negative feedback from the dc output. This circuit will deliver up to about 100 mA and the output voltage stays within a few millivolts of the zener reference for output current variation from zero to maximum.

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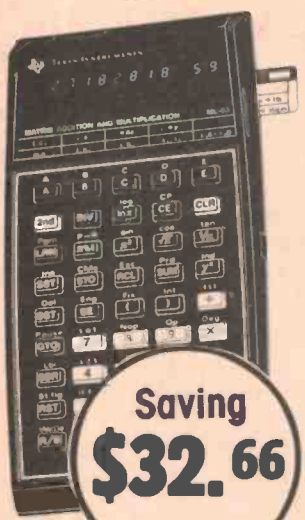

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Lab Notes

The op-amp based regulator of Figure 4 supplies 12V at currents up to 100 mA and gives excellent regulation, despite its simplicity. The op-amp and transistor (Q1) are interconnected as a unity voltage gain non-inverting dc amplifier that has an overall current gain of about one million! The output voltage will be within a few millivolts of the zener reference value and the output impedance is less than one milliohm. The safe output current driving capacity of the circuit is limited to about 100 mA by the power rating of Q1, which should have a small 'flag' or push-on heatsink attached.

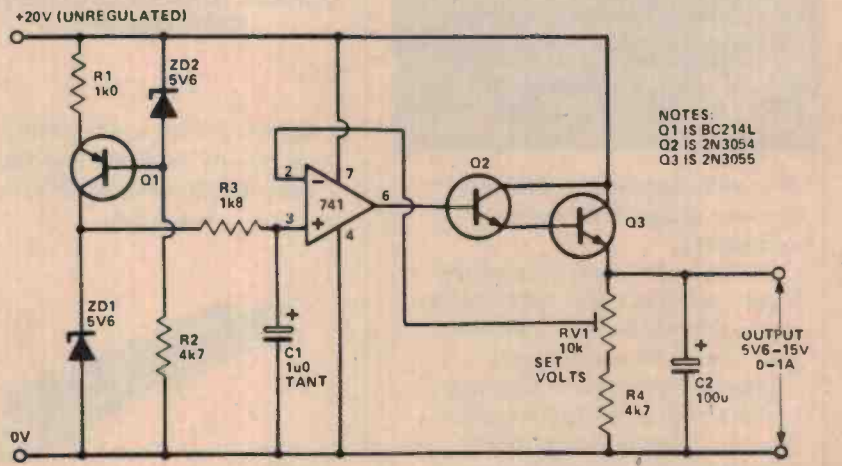


Figure 5. This circuit is a little more sophisticated and performs better than the Figure 4 circuit. This circuit will deliver up to 1 A output current, output voltage being variable between 5.6 V and 15 V. Thermal drift is near zero.

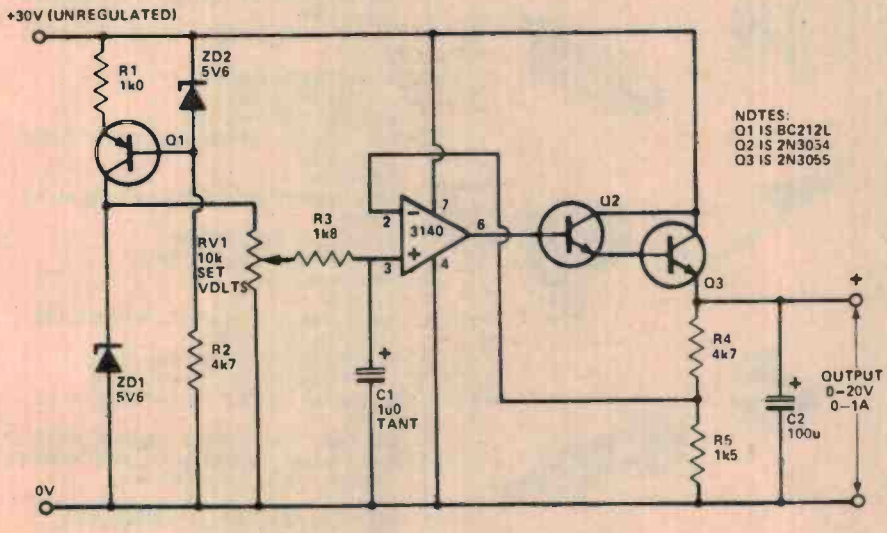


Figure 6. This variation on the Figure 5 circuit permits the output voltage to be varied between 0 V and 20 V. The 3140 op-amp has a fixed voltage gain of about four, fixed by R4/R5.

This circuit can be modified to provide greater current output by replacing Q1 with a power Darlington transistor such as the BDV65B. A suitable heatsink should be used.

The performance of the basic op-amp circuit of Figure 4 can be improved in a variety of ways, some of which are shown in Figure 5. The first improvement that can be made is to make the zener reference voltage (ZD1) independent of supply voltage variations by powering ZD1 from the output of constant-current generator Q1-R1-ZD2-R2. Next, the zener noise can be eliminated by feeding the reference voltage to the op-amp via low-pass filter R3-C1. Thermal drift effects can be eliminated by making ZD1 a 5V6 type, with near-zero (actually about −0.2 mV/°C) temperature coefficient; the op-amp output voltage can then be set to the desired value (greater than 5V6) by using feedback components RV1-R4 to set the op-amp's voltage gain at some appropriate value.

Finally, the load current capacity of the circuit can be set to a fairly high value by using a Darlington-connected power transistor in the series pass output stage. Note that Q2 and Q3 could be replaced by a BDV65B Darlington device. ▶

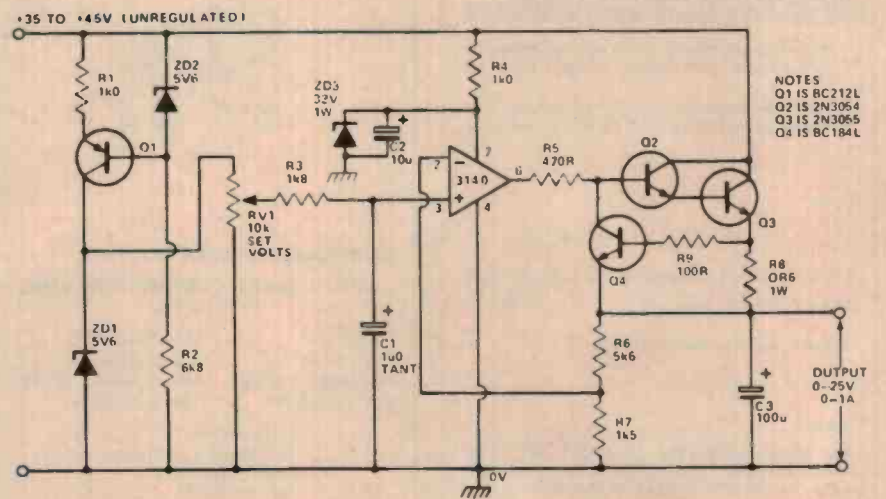


Figure 7. A further refinement is the addition of current limiting and overload protection. Q4 senses the voltage across R8 which is in series with the output. When the current exceeds 1 A, Q4 will be biased on and rob current from the base of Q2, preventing further increase in output current. The op-amp is protected against excessive supply rail voltage via R4 and ZD3.

Lab Notes

Three terminal regulators

Three terminal regulators are remarkably easy to use, as shown in the basic circuits of Figures 8 to 10, which show the connections for making positive, negative and dual regulator circuits respectively; the ICs shown in these examples are 12 V units with current ratings of one amp. Note that a 270n or greater value disc ceramic capacitor should be connected close to the input terminal of the IC and a 10μ or greater electrolytic to the output.

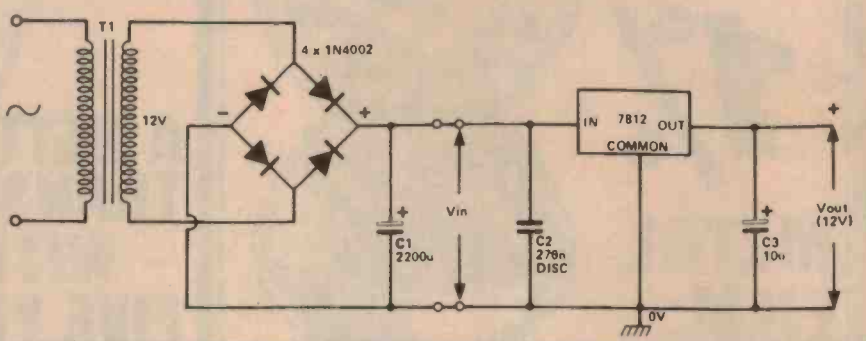


Figure 8. Circuit for the common-or-garden three-terminal fixed voltage positive regulator. Note that C2 and C3 should be mounted as close to the regulator's terminals as is physically possible.

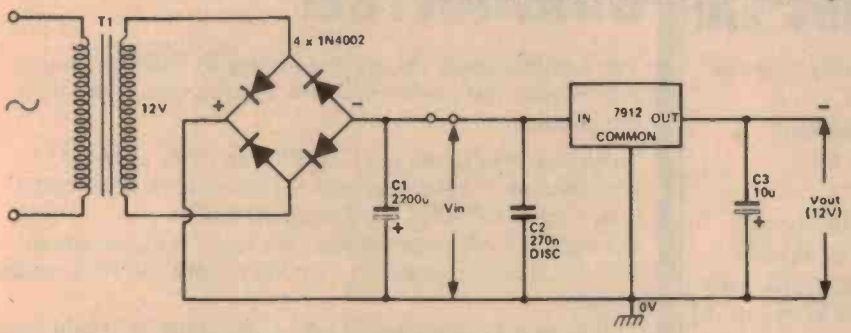


Figure 9. The negative voltage rail counterpart of Figure 8. Don't forget heatsinks.

These capacitors should be connected as close to the device's terminals as is physically possible. They can be quite good RF oscillators if this is not done correctly!

The output voltage of a three terminal regulator is referenced to the 'common' terminal of the IC, which is normally grounded. Most regulator ICs draw quiescent currents of a few mA, which flow to ground via the common terminal. The regulator output voltage can thus be 'jacked up' from the designed value by simply biasing the 'common' terminal with a suitable voltage.

There are two simple ways to do this. The first is shown in Figure 11. The required extra voltage is obtained by passing the IC's quiescent current through a trimpot (RV1). The trimpot is then set to provide the required output voltage. Quiescent current is typically 7 mA to 11 mA. This technique is adequate in most applications, although the output voltage obviously shifts slightly with changes in the IC's quiescent current and thus regulation is degraded a little.

The output voltage of a three terminal regulator can be increased by a fixed amount by connecting a suitable value zener in series with the common terminal as shown in Figure 12. Output voltage is then the regulator voltage plus the zener voltage, in this case, 17.6 volts. Note that the quiescent current from the common terminal of the IC may not be sufficient to drive the zener and extra bias current is best provided. Here, R1 serves that purpose. ▶

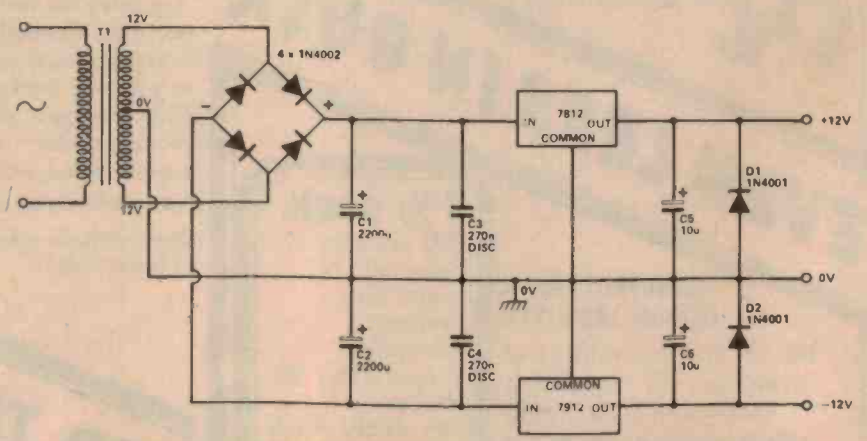


Figure 10. Circuit of a dual positive/negative power supply employing 1 A three-terminal regulators.

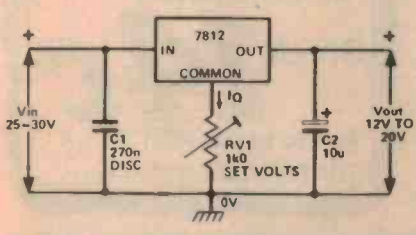


Figure 11. A very simple method of varying the output voltage of a three-terminal regulator. Regulation is slightly affected.

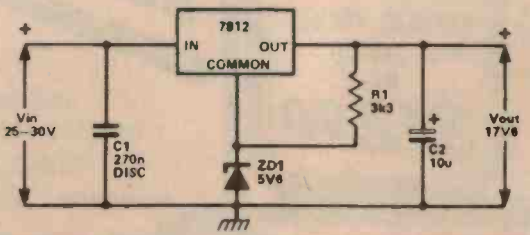
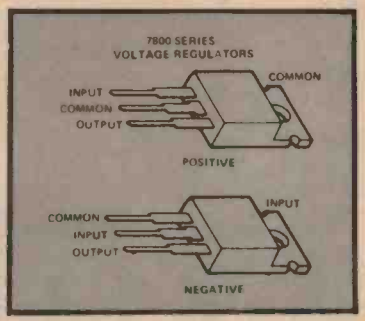


Figure 12. The output voltage can be 'jacked up' by inserting an appropriate zener in series with the regulator's common lead.



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Lab Notes

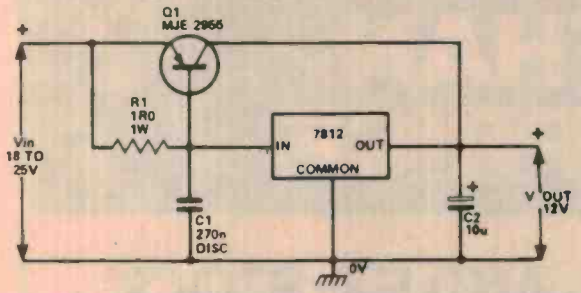

Figure 13. The output current capability of a three-terminal regulator can be boosted by using an external series pass transistor as illustrated. This circuit can deliver up to 5 A.

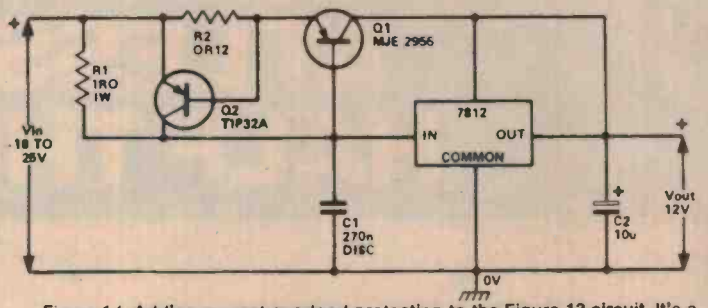

Figure 14. Adding current overload protection to the Figure 13 circuit. It's a wise idea, even though three-terminal regulators generally incorporate thermal shutdown protection.

More current

The output current capacity of a three-terminal regulator can readily be boosted via an external transistor as shown in Figure 13. This circuit, although it looks familiar, is a little unusual. At low load currents, less than 0.6 volts is developed across R1 and Q1 will not turn on. Thus, all the load current will be supplied by the 7812 regulator. When the load current is greater than about 600 mA, the voltage developed across R1 will be sufficient to turn Q1 on and Q1 will commence delivering current to the load.

This circuit can supply up to 5 A. Note that Q1 will need to be mounted on a substantial heatsink, capable of dissipating 60W.

Protection

Overcurrent or overvoltage protection for three terminal regulators can be provided relatively easily. Overcurrent protection for the Figure 13 circuit is illustrated in Figure 14. All it needs is a transistor and a resistor. When the current through R2 (a 0.12 ohm resistor) exceeds 5 A, the voltage across it will turn on Q2, robbing base current from Q1, thus current limiting the output. The 7812 will go into its switch-on/switch-off protection mode.

To protect a three terminal regulator from damage that may result from excessive supply line voltage, a 'pre-regulator' circuit is added. This is illustrated in Figure 15. You will recognise components Q1, R1, C1 and ZD1 as a simple zener-based series pass regulator (as in Figure 3).

Three terminal regulators can withstand no more than 40 V maximum between the input and common terminals, so this circuit limits the voltage applied to about 27 V. Note that Q1 should be mounted on a heatsink capable of dissipating 25 W.

The LED as a regulator

A low noise regulator can be made using a LED as the reference element. David Tilbrook used this technique in the Series 4000 moving-coil preamp (ETI-473, Oct '79).

The usual reference element for discrete voltage regulators is a zener. As these devices operate in the reverse-biased mode, they are inherently noisy and will put noise on the regulated supply rail. This is likely to degrade the performance of low noise, low level circuits supplied by the regulator.

The circuit of the ±6 V regulated supply for the ETI-473 moving-coil preamp is reproduced here. A red LED operated in the forward-biased mode drops a constant 1.65 V and generates very little noise. The reference LEDs in the circuit here are LED1 and LED2. Series regulators Q13 and Q14 regulate the incoming ±12 V. The potential dividers R21/R23 and R22/R24 divide the voltage present at the output of the regulators and drive transistors Q15 and Q16, and the LEDs. The base-emitter junction in series with each LED will drop 0.6 V; to this is added the LED forward drop of 1.65 V. Thus, whenever the voltage present at the junction of the voltage divider resistors tries to increase above 2.3 V, Q15 and Q16 will increasingly conduct, decreasing drive to the bases of Q13 and Q14 respectively.

Noise on the regulated supply rails is further reduced by the C-R networks, C12/R19 and C13/R20. ●

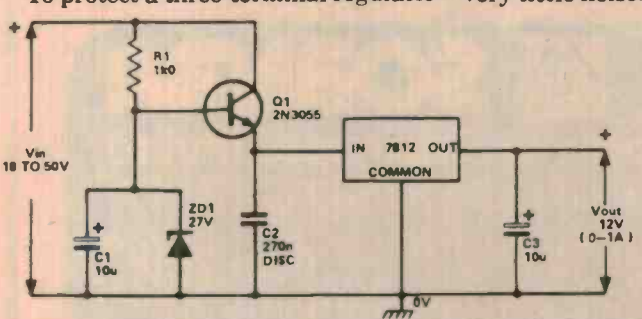

Figure 15. Three-terminal regulators generally have a maximum input voltage rating of 40 V. Where the input may vary widely, at times exceeding the device's limit, this circuit provides protection by using a 'pre-regulator'.

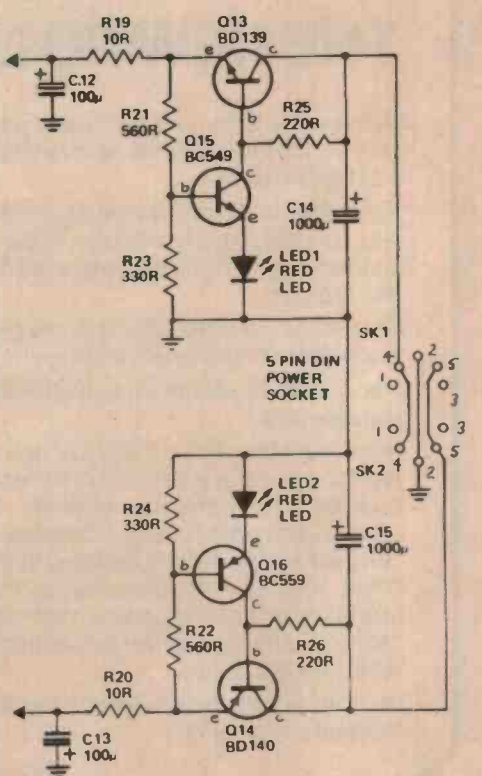

Figure 16. A low noise regulator is necessary in some applications, in which case zeners cannot be used as they generate noise. LEDs can be used as 'quiet' voltage reference sources, as illustrated in the +/– 6 V regulators from David Tilbrook's Series 4000 Moving Coil Preamp project.

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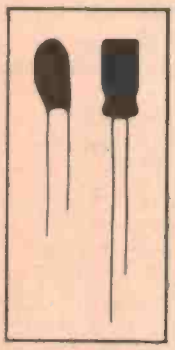

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Designing potcore inductors

Potcores offer many advantages when you need to use an inductor in a circuit. This article details a simplified design method for two common potcore sizes based on a nomograph.

FERRITE POTCORES are widely used in the construction of small inductors and transformers. However very few amateurs know how to choose a core appropriate to their needs, or how to wind a coil of specific inductance.

This article describes a simple method of designing coils for low frequency applications. The design of coils for high frequency applications, and of transformers, is beyond the scope of this article. Design details given apply only to the Philips 'P' series of pot cores and more particularly to the 18 mm (P18/11) and 26 mm (P26/16) diameter cores which are the most commonly available.

Each core size is available in four different ferrite materials (3H1, 3B7, 3D3, 4C6) to cover the frequency range from audio to about 20 MHz. Additionally each material, in each size, is available with a number of permeabilities to cover different inductance, stability and Q factor requirements.

There are two factors commonly used to classify ferrite cores. These are effective permeability (μe) and A_L factor.

The μe factor is primarily determined by the permeability of the material used and its cross sectional area, and secondly by the air gap left between the centres of the two core halves. For example an 18 mm 3B7 core without any air gap (type 0 4000) has a μe of 1750 and a tolerance on inductance of ±25%. The use of increasingly larger air gaps in the same core size and material lowers the μe but increases the stability and reduces the tolerance on inductance.

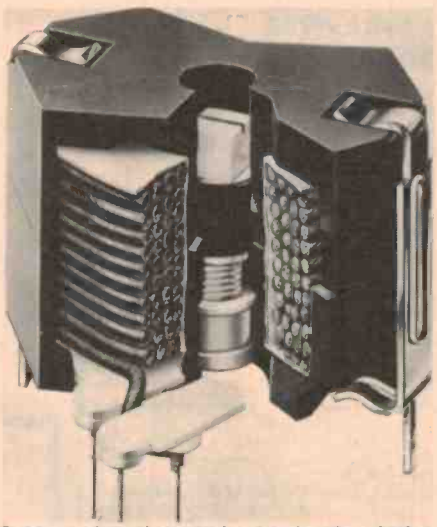
A second factor in common usage is A_L. This factor gives, in nanohenries, the inductance of ONE turn on the core. The inductance of N turns on the core is

$L = N^2 A_L \times 10^{-3}$ millihenries

The selection of a core size, a core material, a permeability value, a wire size and the number of turns depends on all the following factors:-

— inductance, stability of inductance
— frequency range
— Q factor
— unbalanced dc coil current
— level of ac coil current

Choosing the correct core taking *all* these factors into account is a difficult task indeed. However a large number of



Cutaway view of a potcore showing the winding on the internal bobbin and the inductance adjustor in the centre. The ferrite 'pot' comes in two halves, held together with a clip.

core types are eliminated by first selecting in accordance with frequency range and stability.

Frequency range

Firstly select the core material from Table 1 in accordance with the desired frequency range. To choose between 3H1 and 3B7 it is necessary to consider temperature stability.

If the tuning capacitors associated with the coil have small or varying temperature coefficients, a 3B7 core should be used as they have the lowest temperature coefficient in the range 0° - 70°C. Alternatively, if using polystrene capacitors (temp. coeff. −150 ppm/°C) a 3H1 core having an effective permeability (μe) around 150 will give excellent temperature compensation for the temperature coefficient of these capacitors.

Inductance stability

Since the inductance of a coil is proportional to core permeability, the change of effective permeability (μe) with temperature determines the stability of inductance.

The percentage change of inductance with temperature is linearly proportional to μe and hence low μe cores should be used for greatest stability. Stability is therefore obtained at the expense of inductance obtainable with a given core size.

The temperature effect is not large enough to affect any but the most critical of applications and the tolerance on inductance as stated in Tables 2 and 3 will be obtained over the temperature range +15° to +35°C.

TABLE 1

FREQUENCY RANGE	CORE TYPE
0.1 — 200 kHz	3B7, 3H1
200 kHz — 2 MHz	3D3
2 MHz — 20 MHz	4C6

Direct current

A direct current in the winding will change the inductance value of the core and if large enough, could cause saturation. In general, large air gaps, and hence lower permeability (μe), cores should be used where large dc currents are flowing.

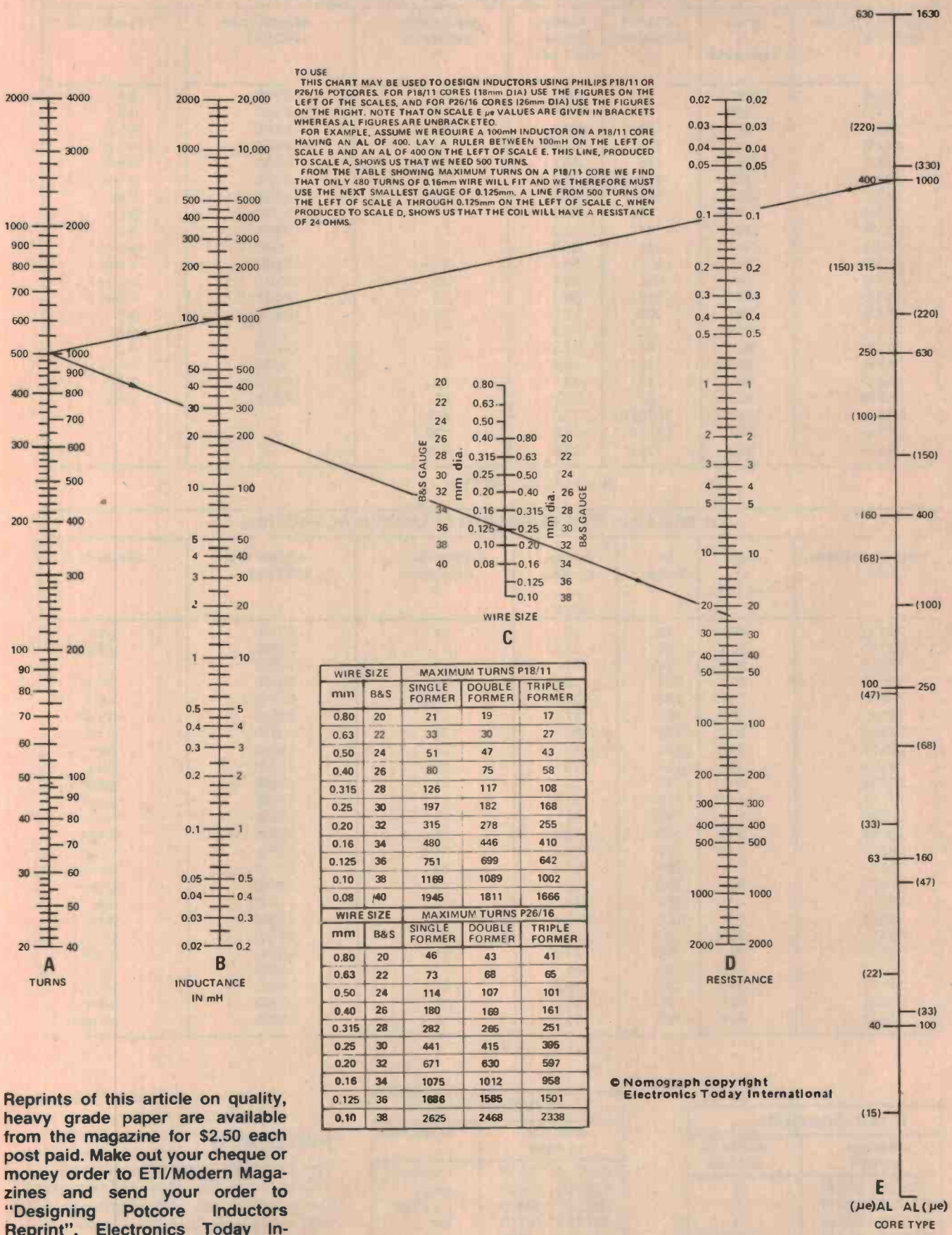
Q factor

The Q of a coil is influenced by different factors at different frequenceis.

At frequencies below 10kHz it is almost completely determined by the dc resistance of the winding. The Q factor of any given coil increases linearly with frequency, and the larger the core, the larger the Q. The highest Q factors are obtainable by using gapless cores of 3H1 or 3B7 material (providing that tolerance and stability are acceptable) eg. 04000 series (P18/11) and 08000 series (P26/16).

Throughout the ultrasonic range core and winding losses affect Q, but Q factors of several hundred may still be obtained by optimum choice of wire and core, such that core and winding losses are equal. For further information, on optimum design, reference should be made to Philips Data Handbook — Components and Materials, Vol. 4.

At higher ultrasonic and lower radio frequencies, additional factors of dielectric and skin-effect losses and parallel winding capacitance, all affect Q, making exact design difficult. Use of Litz wires, split section formers and small cores with low μe values will assist.



TO USE

THIS CHART MAY BE USED TO DESIGN INDUCTORS USING PHILIPS P18/11 OR P26/16 POTCORES. FOR P18/11 CORES (18mm DIA) USE THE FIGURES ON THE LEFT OF THE SCALES, AND FOR P26/16 CORES (26mm DIA) USE THE FIGURES ON THE RIGHT. NOTE THAT ON SCALE E μe VALUES ARE GIVEN IN BRACKETS WHEREAS AL FIGURES ARE UNBRACKETED.

FOR EXAMPLE, ASSUME WE REQUIRE A 100mH INDUCTOR ON A P18/11 CORE HAVING AN AL OF 400. LAY A RULER BETWEEN 100mH ON THE LEFT OF SCALE B AND AN AL OF 400 ON THE LEFT OF SCALE E. THIS LINE, PRODUCED TO SCALE A, SHOWS US THAT WE NEED 500 TURNS.

FROM THE TABLE SHOWING MAXIMUM TURNS ON A P18/11 CORE WE FIND THAT ONLY 480 TURNS OF 0.16mm WIRE WILL FIT AND WE THEREFORE MUST USE THE NEXT SMALLEST GAUGE OF 0.125mm. A LINE FROM 500 TURNS ON THE LEFT OF SCALE A THROUGH 0.125mm ON THE LEFT OF SCALE C, WHEN PRODUCED TO SCALE D, SHOWS US THAT THE COIL WILL HAVE A RESISTANCE OF 24 OHMS.

WIRE SIZE		MAXIMUM TURNS P18/11		
mm	B&S	SINGLE FORMER	DOUBLE FORMER	TRIPLE FORMER
0.80	20	21	19	17
0.63	22	33	30	27
0.50	24	51	47	43
0.40	26	80	75	58
0.315	28	126	117	108
0.25	30	197	182	168
0.20	32	315	278	255
0.16	34	480	446	410
0.125	36	751	699	642
0.10	38	1169	1089	1002
0.08	40	1945	1811	1666
WIRE SIZE		MAXIMUM TURNS P26/16		
mm	B&S	SINGLE FORMER	DOUBLE FORMER	TRIPLE FORMER
0.80	20	46	43	41
0.63	22	73	68	65
0.50	24	114	107	101
0.40	26	180	169	161
0.315	28	282	265	251
0.25	30	441	415	395
0.20	32	671	630	597
0.16	34	1075	1012	958
0.125	36	1686	1585	1501
0.10	38	2625	2468	2338

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Table 2 P18/11 Potcores

A. PRE-ADJUSTED PAIRS WITH STANDARD μ_e VALUES						
catalogue number 4322.022 . . .	grade of ferroxcube	effective permeability (μ_e)	number of turns for 1 mH α	tolerance on inductance %	adjustor type 4322.021	adjustor colour
28030	3B7	33	98.2	±1	30780	green
28040	3B7	47	82.3	±1	30800	red
28050	3B7	68	68.4	±1	30980	white
28060	3B7	100	56.4	±1.5	30980	white
28070	3B7	150	46.1	±2	30810	brown
28080	3B7	220	38.1	±3	30810	brown
28090	3B7	330	31.0	±3	31090	grey
28230	3H1	33	98.2	±1	30780	green
28240	3H1	47	82.3	±1	30800	red
28250	3H1	68	68.4	±1	30980	white
28260	3H1	100	56.4	±1.5	30980	white
28270	3H1	150	46.1	±2	30810	brown
28280	3H1	220	38.1	±3	30810	brown
28290	3H1	330	31.0	±3	31090	grey
28430	3D3	33	98.2	±1	30780	green
28440	3D3	47	82.3	±1	30800	red
28450	3D3	68	68.4	±1	30980	white
28810	4C6	15	146	±1	30780	green
28830	4C6	33	98.2	±1	30790	yellow
08000	3B7	1910.0	12.9	±25	–	–
08200	3H1	1910.0	12.9	±25	–	–
08400	3D3	730.0	20.8	±25	–	–

$N = \alpha\sqrt{L}$ (L in 10^{-3} H)

B. PRE-ADJUSTED PAIRS WITH STANDARD AL FACTORS						
catalogue number 4322.022 . . .	grade of ferroxcube	AL factor	corres-ponding μ_e value	tolerance on inductance %	adjustor type 4322.021	adjustor colour
29030	3B7	63	20	±1	30780	green
29040	3B6	100	31.8	±1	30780	green
29050	3B7	160	51	±1	30800	red
29060	3B7	250	79.5	±1	30980	white
29070	3B7	315	100.2	±1.5	30980	white
29080	3B7	400	127	±2	30810	brown
29100	3B7	630	200	±3	30810	brown
29110	3B7	1000	318	±3	31090	grey
29120	3B7	1600	510	±3	31090	grey
29230	3H1	63	20	±1	30780	green
29240	3H1	100	31.8	±1	30780	green
29280	3H1	160	51	±1	30800	red
29260	3H1	250	79.5	±1	30980	white
29270	3H1	315	100.2	±1.5	30980	white
29280	3H1	400	127	±2	30810	brown
29300	3H1	630	200	±3	30810	brown
29310	3H1	1000	318	±3	31090	grey
29320	3H1	1600	510	±3	31090	grey
29430	3D3	63	20	±1	30780	green
29440	3D3	100	31.8	±1	30780	green
29450	3D3	160	51	±1	30800	red
29460	3D3	250	79.5	±1	30980	white
29830	4C6	63	20	±1	30780	green
29840	4C6	100	31.8	±1	30790	yellow

$L = N^2 AL$ (10^{-9} H)

C. COILFORMERS	
catalogue number	number of sections
4322.021.30330	1
4322.021.30340	2
4322.021.30350	3
4322.021.30130	1 with pins
4302.021.20030	1 with pins

D. MOUNTING PARTS	
catalogue number	description
4322.021.30550	container
4322.021.30660	spring
4322.021.30470	tag plate
4322.021.30710	nut
4322.021.30720	bush
4302.021.20020	clip

Inductance

The tolerance given on inductance, in Tables 2 and 3 is obtained when using the specified core, and a wire size that will completely fill the former close layer wound. Due to slight changes in wire diameter and different methods of winding, the exact number of turns accommodated may vary by ±10%.

Table 3 P26/16 Potcores

A. PRE-ADJUSTED PAIRS WITH STANDARD μ_e VALUES						
catalogue number 4322.022	grade of ferroxcube	effective permeability (μ_e)	number of turns $\propto$	tolerance on inductance %	adjustor type number 4322,021 ...	adjustor colour
24030	3B7	33	120	±1	30760	green
24040	3B7	47	100.5	±1	30770	red
24050	3B7	68	83.6	±1	30960	yellow
24060	3B7	100	68.9	±1.5	30970	white
24070	3B7	150	56.3	±2	30730	brown
24080	3B7	220	46.5	±3	31080	grey
24230	3H1	33	120	±1	30760	green
24240	3H1	100.5	100.5	±1	30770	red
24250	3H1	68	83.6	±1	30960	yellow
24260	3H1	100	68.9	±1.5	30970	white
24270	3H1	150	56.3	±2	30730	brown
24280	3H1	220	46.5	±3	31080	grey
24430	3D3	33	120	±1	30760	green
24440	3D3	47	100.5	±1	30770	red
24450	3D3	68	83.6	±3	30960	yellow
24810	4C6	15	178	±1	30760	green
24820	4C6	22	147	±1	30770	red
24830	4C6	33	120	±1	30970	white
04000	3B7	1750	16.5	±25	–	–
04200	3H1	1750	16.5	±25		
04000	3D3	705	25.9	±25		

$N = \propto \sqrt{L}$ (L in 10^{-3} H)

B. PRE-ADJUSTED PAIRS WITH STANDARD AL FACTORS						
catalogue number 4322.022	grade of ferroxcube	AL factor	corresponding μ_e value	tolerance on inductance $\propto$	adjustor type 4322.021 ...	adjustor colour
25030	3B7	63	30	±1	30760	green
25040	3B7	100	47.5	±1	30770	red
25050	3B7	160	76	±1	30960	yellow
25050	3B7	250	119	±1.5	30970	white
25070	3B7	315	149	±2	30730	brown
25080	3B7	400	190	±2	31080	grey
25100	3B7	630	298	±3	31080	grey
25230	3H1	63	30	±1	30760	green
25240	3H1	100	47.5	±1	30770	red
25250	3H1	160	76	±1	30960	yellow
25260	3H1	250	119	±1.5	30970	white
25270	3H1	315	149	±2	30730	brown
25280	3H1	400	190	±2	31080	grey
25300	3H1	630	298	±3	31080	grey
25420	3D3	40	19.0	±1	30760	green
25430	3D3	63	30	±1	30760	green
25440	3D3	100	47.5	±1	30770	red
25450	3D3	160	76	±1	30960	yellow
25810	4C6	25	11.9	±1	30760	green
25820	4C6	40	19.0	±1	30770	red
25830	4C6	63	30	±1	30970	white

Hence it is safer, when winding experimental coils, to only try and fit 90% of the turns indicated in the maximum number of turns tables.

If the former is only partly filled, errors up to 4% may occur with the lower μe cores. However the use of an adjustor will allow a +10% adjustment range which is generally sufficient to cope with tolerances found in practical circuits.

When optimum stability is required the type of adjustor that matches a certain core should be used. If it is desired to widen the adjustable range, at the possible expense of stability, an adjustor indicated for a potcore with a high μe value may be used with a potcore of low μe value.

C. COIL FORMERS	
catalogue number	number of sections
4322.02130270	1
4322.021.30280	2
4322.021.30290	3
4322.021.30090	1 with pins
4302.021.20010	1 with pins

C. MOUNTING PARTS	
catalogue number	description
4322.021.30530	container
4322.021.30640	spring
4322.021.30450	tag plate
4322.021.30710	nut
4322.021.30720	bush
4302.021.20000	clip

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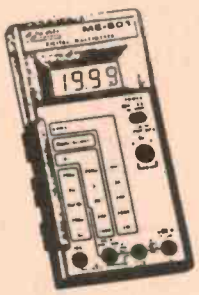

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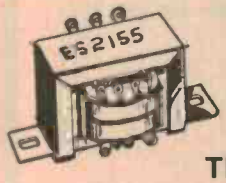

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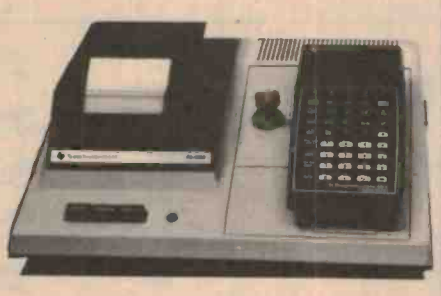

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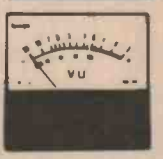

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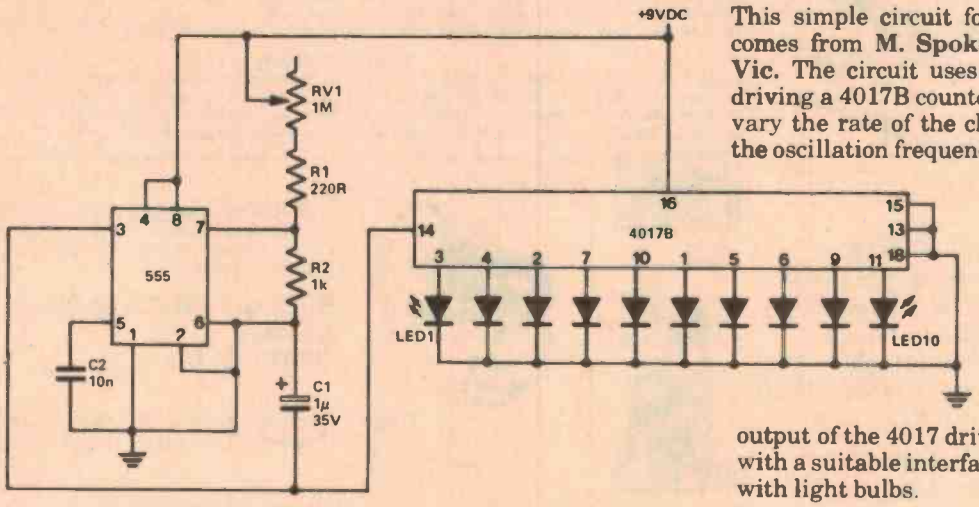
Ideas for Experimenters

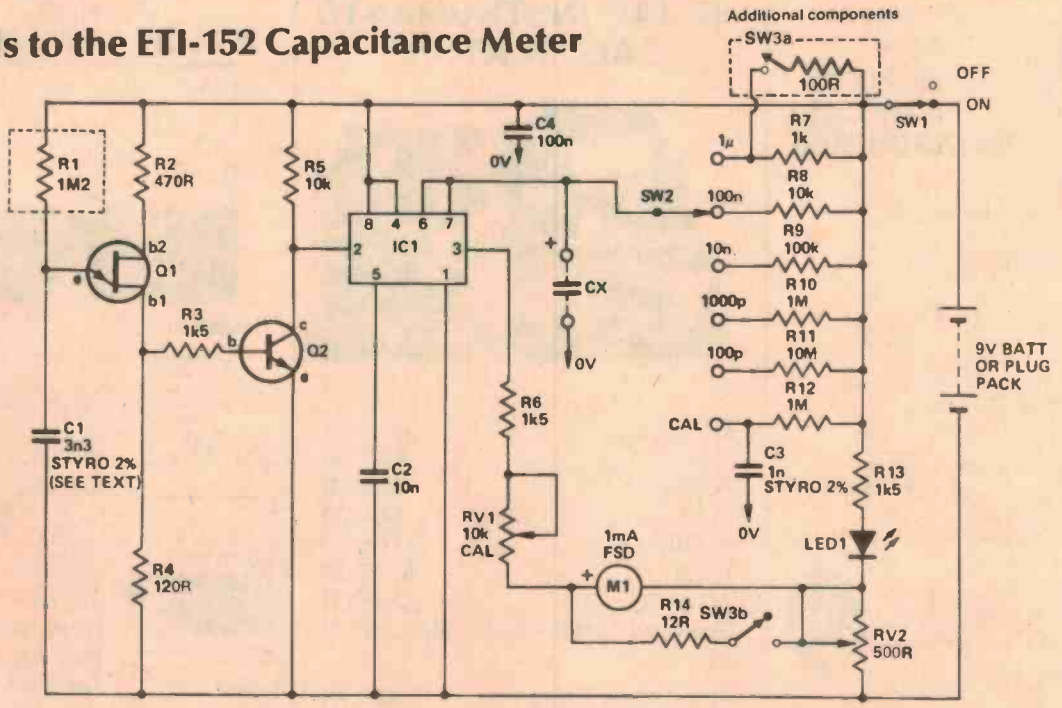
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we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

LED chaser



This simple circuit for a LED chaser comes from **M. Spokes of Glen Iris, Vic.** The circuit uses a 555 oscillator driving a 4017B counter. RV1 is used to vary the rate of the chaser by varying the oscillation frequency of the 555. The output of the 4017 drives ten LEDs, but with a suitable interface it could be used with light bulbs.

Mods to the ETI-152 Capacitance Meter



This project appeared in the February 1980 issue and was part of a short series of look-alike test instruments. Several readers pointed out that the unit did not work properly in the 1µ/x10 mode (i.e: 10µ full scale) as the integration time was not long enough. This problem is cured by a simple modification.

Firstly, SW3 should be changed to a double-pole, single-throw (DPST) type. Secondly, change R1 to 1M2, as shown in the new circuit diagram here. Add a 100 ohm resistor, switched across R7 by the other pole of SW3, as shown in the circuit diagram.

That should correct the problem.

Apart from that, some constructors found that RV2 (zero set control) was very close to one end of its range and difficult to adjust. This is probably brought about by LED1 having a fairly high voltage drop. To cure the problem, reduce R13 to 820 or 680 ohms.

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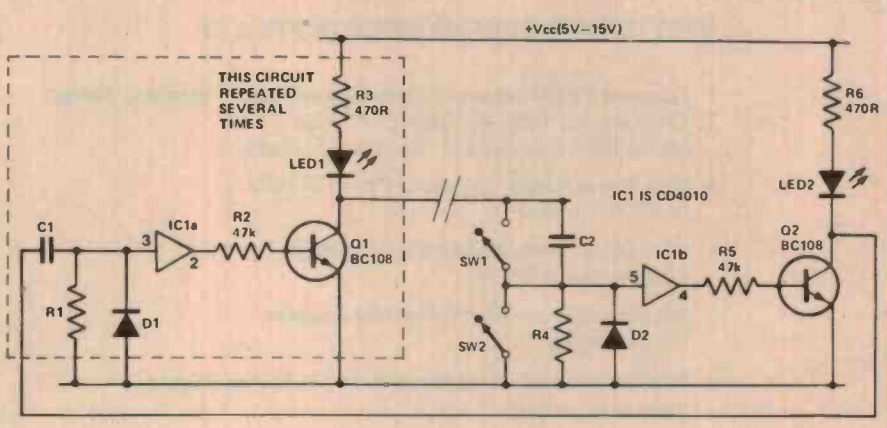
Ideas for Experimenters

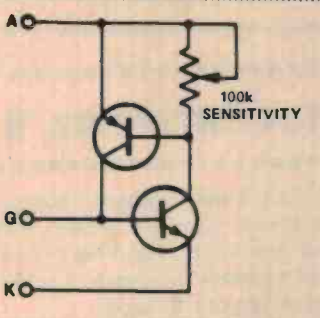
'Endless' LED chaser



This unusual LED or lamp chaser employs a 'chain' of inverter stages connected in a ring. The portion of the circuit inside the dotted box is repeated as many times as you wish, the collector of the transistor in each stage going to the input capacitor of the following stage and so on. Finally, the circuit arrives at SW1 and SW2 and the stage involving IC1b, Q2 etc.

According to **Greg Thamm of Burra North, S.A.,** who submitted it, the whole thing works like this: after applying power, close SW2 until all the LEDs go out. Then, open SW2 and momentarily close SW1 (a pushbutton could be used here). This starts the chaser as the collector of the transistor connected to C2 will be at supply potential, Q2 will turn on and LED2 will light when you close SW1. However, C2 will charge via the LED and dropping resistor of the preceding stage until the input to IC1b goes below its lower threshold. When it does, the output of IC1b will go low and Q2 will turn off. Then, C1 will charge via R6 and LED2, but the initial pulse will turn Q1 on via IC1a and LED1 will light. When C1 charges such that the input of IC1a goes below its lower threshold, Q1 will turn off, triggering the next inverter stage in the chain and so on, right around the chain. The input R-C for each stage (C1, R1 etc) determines the 'on' time. The diodes (D1-D2, etc) discharge C1-C2 etc when the preceding stage transistor turns on.

By using high dissipation transistors and 12 V lamps instead of LEDs, the circuit is suitable for such applications as Christmas tree light displays, etc.

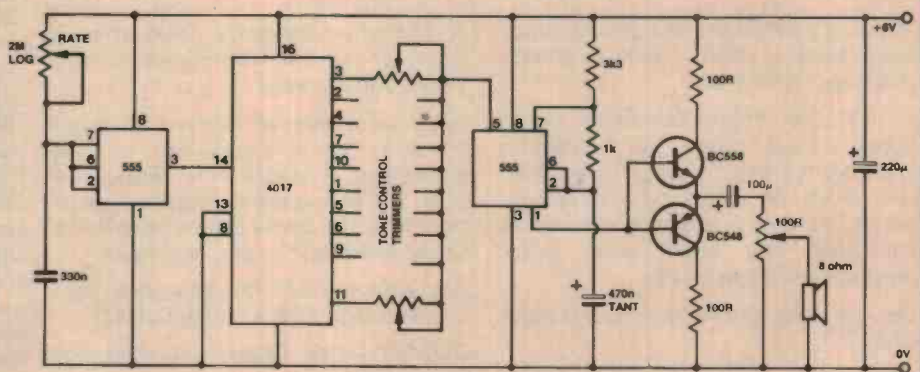


Transistors mimic SCR

This circuit, **from J. da Silva of Croydon, NSW,** simulates an SCR. The 'sensitivity' trimpot is useful to set the triggering voltage and prevents the circuit sefl-triggering from the leakage current of the transistors.

By reversing the polarity of the transistors the circuit becomes a PUT (programmable unijunction transistor) and by replacing the lower transistor with a phototransistor the circuit can be light activated. Any complementary silicon transistor pairs are suitable for this circuit. (Ed. Note: whilst we are aware that this circuit is not really new or original, it is not one that is widely known amongst hobbyists).

A "no hands" organ



This simple organ is really an electronic music box. An idea from **Shane Waye of Victor Harbour, SA,** the circuit steps through a number of preset notes (up to 10) to play a simple tune — music box fashion.

A 555, used as a low frequency oscillator, clocks the 4017 — a decade divider with 10 decoded outputs. The outputs of the 4017 drive trimpots connected to a second 555 arranged as an audio oscillator. Each trimpot sets the frequency or pitch of the audio oscillator. As each output of the 4017 goes high in turn, the audio oscillator changes pitch — and you can play a tune. The output of the audio oscillator is fed to a complementary pair of transistors which drive a speaker for the audio output.

To preset the trimpots, disable the 555 clock and jumper the end of each trimpot connected to the 4017 to the positive supply in turn, then adjust for the required note.

Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here. Also, for a list of suppliers who stock the ETI projects published over the last few years, our "Kits for Projects" page may generally be found on the page immediately before the DREGS page (inside the back cover).

This month's bag of projects are a little unusual and some special components are required. However, we have gone to some trouble to ensure that these components will be available by the time the magazine goes on sale. In fact, we understand they're ready as this is written, a few weeks before publication. Nevertheless, we've got our fingers crossed . . .

The pH meter

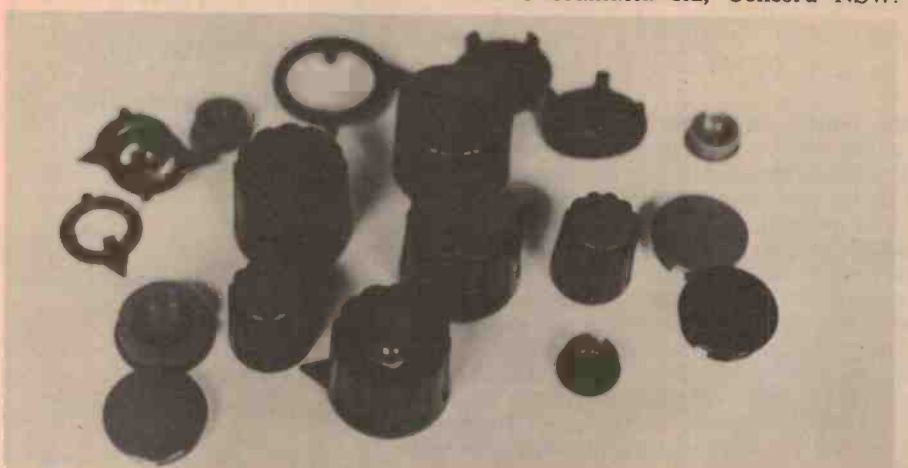
The electronics for this project employ the Intersil ICL7106 and LAD204 3½- digit liquid crystal display. The ICL7106 is distributed in Australia by R & D Electronics. They have a 'kit', known as the RIK6017, containing the 7106 and an LAD204 3½-digit LCD display which they advise will be available to readers for the special price of $28.80 plus 15% sales tax. (Normal price is $35.90 plus tax). This totals $33.12, about 25% below normal price. Readers ordering by mail should include $2.50 post and handling costs. R & D Electronics are located at:

Sydney: 133 Alexander St
CROWS NEST 2065.
Ph: (02)439-5488
Melbourne: 257 Burwood Highway
BURWOOD 3125. Ph: (03)288-3232

Alternatively, many kit and component suppliers stock the Intersil Digital Panel Meter Evaluation Kit employing these ICs. It is known as the ICL7106EV kit and sells at prices varying between about $35 and $45.

If your usual kit or component supplier is not stocking the Ionode pH probes as mentioned in the article (pages 24, 25), they may be obtained from Starcross Scientific, P.O. Box 151 Frenchs Forest, NSW 2086. Available mail order, the G101NFE general purpose pH probes are supplied with a plastic protector cap, a wetting cap for storage and a comprehensive booklet plus two 200 ml containers of buffer solution, one of pH 6.88, the other pH 4.00. The probe itself is a "non-flow" sealed type and has a BNC plug fitted. It will have quite a long life without needing replenishment of the internal electrolyte. Total cost for the package is $45.70, which includes sales tax and delivery. If you need any accessories, such as 100 ml plastic beakers, wash bottles etc., Starcross Scientific can assist. They also have special spear point electrodes for soil analysis.

At the time of going to press, two firms indicated they would be supplying complete kits for this project: All Electronic Components of 118 Lonsdale St, Melbourne and Electronic Agencies of 115 Parramatta Rd, Concord NSW.



Collet knobs will fit where conventional grub-screw knobs will not. They are secured to a control shaft by a split sleeve and nut arrangement. These collett knobs, distributed here by Associated Controls Pty Ltd, headquartered at 55 Fairford Rd, Padstow NSW. They are available in a wide range of colours and sizes and can be fitted with a variety of skirts: pointers, numbered, flange types.

Most components suppliers will be stocking pc boards and Scotchcal panels for this project: Radio Despatch Service, D.R. Electronics and Electronic Agencies in Sydney; Rod Irving Electronics, Ellistronics and All Electronic Components in Melbourne. Possibly Dick Smith stores also. The Ionode pH probes will be available we understand from Radio Despatch Service, Electronic Agencies and D.R. Electronics in Sydney.

The collet knobs we used on our prototype are distributed by Associated Controls Pty Ltd of 55 Fairford Rd Padstow NSW, and 214-224 Wellington Rd, Mulgrave Vic.

ETI-1500 metal detector

This project requires a prewound and aligned search head. This is made by Altek Instruments of the UK and All Electronic Components of Melbourne are acting as their agents in Australia. In addition, AEC will be supplying the handles and case we used to construct our prototype. All these special items are available to other suppliers at wholesale rates from All Electronic Components, as well as complete kits.

At the time of going to press we understand that, apart from All Electronic Components, Electronic Agencies in Sydney will be carrying complete kits for this project. Printed circuit boards, Scotchcal panels etc should be available through most suppliers we have mentioned previously.

Series 3000 compact stereo

Last month's feature project is being stocked as a complete kit by All Electronic Components, Rod Irving Electronics and Tasman Electronics in Melbourne and Radio Despatch Service in Sydney (surprise, surprise!).

ETI-475 AM tuner

Featured in our September issue, this tuner is being stocked as a complete kit by All Electronic Components in Melbourne and Radio Despatch Service in Sydney. If you've gathered all the bits together for yourself, chances are you're still seeking potcores, right? Well, both these firms can supply potcores for this tuner.

Project price estimates

This information is published as a guide and a variety of factors may affect the actual price of a project, whether obtained as separate components, or as a kit.

ETI-572 pH Meter	$80 - $90 (inc. pH probe)
ETI-1500 Metal Detector	$200
ETI-597 Emergency Lighting Unit	$18 - 24 (less batteries)

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Suite 3, 454 St. Kilda Road, Melbourne, 3004. Telephone: (03) 26-5683, 26-6150.

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THE WORLD'S FIRST PORTABLE MICROCOMPUTER
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RAM 48K to 2 megabytes, bubble memory to 2MB, gas plasma display, optional audio, printer, mass storage mini floppys to 800K bytes, hard disk to 195 megabytes, acoustic coupler, S-100 bus, battery optional, CPU with real time clock. For dynamic businessmen on the move. Ideal for real estate agents, insurance brokers and accountants.

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Priced from $4995

OPAL 1000

The OPAL 1000 is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4 MHz CPU card, with 2 RS232c serial and 3x8 bit parallel ports, is used in conjunction with the Delta Products Disk Controller. Memory is provided by a 4MHz 64k dynamic RAM Board by Measurement Systems and Control. The memory board is fully bank selectable and is designed for upgrading to a multi-user system. Disk drives are 2x8" Shugart SA801R running at double density (480k/drive) and fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks by turning off the AC power to the drives 14 seconds after the last drive select and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The software is CP/M version 2.2 with Delta Product's utilities which include DTEST (for testing drives and floppy disks) and M2 (a comphrehensive memory test program). The Delta PROM monitor enables fault finding to be carried out independently) of the Disk Drives. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch.

Dealers for Opal in Victoria.
Sole Distributor for Findex, Victoria and NSW.

SUPPLIERS FOR NDKS S-4000

MATHEMATICS

$$F(w) = aT\frac{\text{Sin } wT/2}{wT/2} e^{-jwT/2}$$

$$e_{rms}^2 = 4KTR(f_2 - f_1)$$

$$L_1 = 10\log\frac{1}{80} \times S_o \text{ (dB)}$$

$$A^2+B^2=C^2$$

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C10 DATA CASSETTES

$1.65 each !

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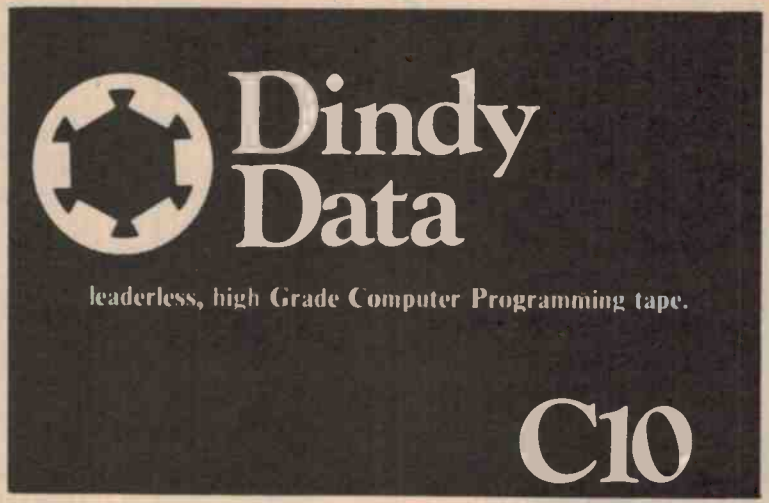
save around 20%



The majority of home and hobby computers employ cassette tapes for mass storage, the most common, and useful, type being the C10 cassette. Dindy Marketing has arranged to make their Dindy Data C10 cassettes available to ETI readers in packs of 20 at a special price — you can save around 20% on the price compared to similar tapes.

Dindy Data Cassettes are manufactured expressly for use in home computers. The cassettes feature 'instant-start', so no data or recording time is lost while waiting for leader tape to pass as in other cassettes. The precision housing and mechanism feature a clamped spring pressure pad to ensure good tape to head contact with no loss of data. The Dindy Data Cassette tape is certified for use on home computers and features a consistent durable coating on a tensilized base ensuring no dropouts or data loss with stretch.

Specification:

Housing — Hi Impact Hi Heat polystyrene shell, five screw type, acetal drive hubs and guide rollers, lubricated stainless steel pins, clamped phosphor bronze spring pressure pad, beryllium shield and graphite polyester slip sheets.

Tape: 12 micron tensilized base. High density acicular gamma ferric oxide coating dispersed in poly-urethane binder. **These tapes come with a five year unconditional guarantee.**

Money back guarantee: Dindy offer to refund the purchase price in full if you are not completely satisfied and provided you return the goods within 14 days of receipt.

NOTE: This offer is made by Dindy Marketing (Aust) Pty Ltd and ETI is acting as a clearing house only. Cheques or money orders should be made payable to **'DINDY C10 CASSETTE OFFER'** and sent, together with the coupon (or a photostat or clear, handwritten copy of same), to C10 Cassette Offer, ETI Magazine, 15 Boundary St, Rushcutters Bay, NSW 2011. We will then process your order and pass it on to Dindy who will send you the goods. Please allow up to six weeks for delivery.

NOTE: Offer closes 31 January 1981

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Expiry Date ...../...../.....

Signature .....

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General Instrument's* NEW! 'Thinking Cap' Keyboard

General Instrument's Keyboard Division has combined state-of-the-art microprocessor technology with the reliability and simplicity of capacitive keys to create a highly flexible, low cost keyboard for OEM's and hobby projects.

The C70-MGP is chock full of features like 4 level ASCII encoding, serial and parallel outputs, N-Key rollover, provision for RS232 and 20MA loop connection, cursor control and user definable keys and programmable baud rates, all for around $150, plus tax. At a dealer near you.

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You'd have to go a long way to get better value in a computer. It has execution speed that really separates the computers from the toys. We think the Challenger 4 is way ahead of anything you've seen so far, for a wide variety of uses including business, personal, educational and games, as well as a real-time operating system, word processor and a data base management system.

The Challenger 4 has a 2MHz 6502 processor, and if that's not fast enough we can supply the GT option with the 6502C processor, and 120 nanosecond memory which averages over one million instructions per second.

A real time clock and count down timer, a 64 x 32 display in 16 colours, including 8K memory in the cassette version, 24K for the minifloppy. A BUS structure allows easy plug in of extra memory or many more OHIO boards. The BUS means modularity. If you bought your vintage C2-4 in 1977 we can change the boards at a much lower cost than a new computer.

For the best surprise of all ask our opposition if they can provide all these facilities. When they can't, ask us!

For the complete list of dealers, please refer to listing on opposite page.

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Dollars dominate computer congress

The 8th World Computer Congress, held in Melbourne in October by the International Federation for Information Processing (IFIP), was more of a trade fair than the scientific conference it is officially supposed to be.

The avowed aim of the triennial congress is the dissemination and exchange of information processing knowledge and techniques and the advancement of international understanding and cooperation in the field. Some statements from the organisers give the lie to this.

"We have made a substantial profit" said Ashley Goldsworthy, chairman of the organising committee. "The value of equipment on display is over one billion dollars . . . firm sales leads from the exhibition already total one hundred million dollars", commented a spokesman for the organisers.

Nevertheless, behind all the commercial razzamatazz, this was also a meeting of minds. Thirty-five invited papers were presented, along with sixty or so submitted papers (half of which were delivered in Tokyo, the joint venue with Melbourne for the Congress). Most of them were highly technical and well beyond the comprehension of the layman, but one dominant theme that emerged was the 'database problem'.

This problem of how best to organise and manage massive libraries of increasingly distributed and constantly changing information still awaits a satisfactory solution. At a press conference Frank Sumner, chairman of the IFIP programme committee, and Dr Simon Lavington, editor of the Proceedings, agreed that very little progress had been made in this area. They suggested that a totally new approach to data storage and retrieval was needed and that the solutions appeared to lie in the areas of parallel processing and associative memories.

Professor Sumner emphasised that, "We still do not have an adequate method to view the process of access to, and the relationship between, data items. The various database systems — network, relational and hierarchic — all eventually make serial requests to a random access storage device.

Quite divorced from the intellectual discussions at Dallas Brooks Hall was the hard sell of the displays upstairs in the Exhibition Buildings. Some 170 companies were spread over the 16 000 square metres of floor space. The big corporations like IBM and Data General spent hundreds of thousands of dollars on their stands, although Honeywell's stand was remarkable for having virtually no equipment on display, just comfortable armchairs and coffee tables around which visitors were invited to "come in and relax with Honeywell". Rumours that Honeywell had simply forgotten about preparing the stand until the last minute have not been substantiated.

The 'micro sector' of the industry, while spending much less on its exhibits, provided some of the main interest. The 'Computer Concepts' display of Apple micros on Rudi Hoess's stand was perhaps the best attended exhibit in the whole show. The highly regarded North Star Horizon was displayed on a number of stands, as were the Cromenco, Commodore, Compucolor and Findex systems, to name but a few.

ADE displayed the North Star and Compucolor microcomputers.

Mensa's stand featured the Findex portable business micro.

In many ways the exhibition was perfectly timed to suit the distributors and vendors of micro-based business systems. It is only in the past year that some of these systems have matured, in the sense of offering sophisticated and proven business applications software. An example is the evolution of the PET personal computer into the Commodore Business System.

On the two public exhibition days there were still a few people seeking to buy small business systems for under $1000, but by

Mike Pratt of SME is proud of his range of peripherals and expansion boards.

and large the operators who peddled such dreams a year or two ago have disappeared. For the most part the vendors in Melbourne were established suppliers offering hardware, software, maintenance and support at realistic prices. They did excellent business.

A feature of the exhibition was the unprecedented number of companies supplying industrial systems. Microcon, Alfatron and Industrial Micro Systems (IMS) were notable exhibitors in this field.

By and large, however, there was nothing very exciting or particularly new in the whole exhibition. Of course there were systems which had not been displayed and demonstrated before, but one minicomputer looks very much like another.

Prime were displaying their Office Automation System, but although their concept of administrative workstations and management workstations is interesting, one terminal is very much like another unless you can find a salesman to demonstrate the software. Persons like myself, wearing Press badges, found it rather difficult to engage the attention of demonstrators who were much more interested in those with dollars to spend.

For the businessman, the EDP manager, the potential purchaser, the exhibition was a unique opportunity if they had particular needs and specific applications in mind. For the general observer like myself, the vast array of competing products was all a bit too much to take in. In the end I spent more time talking to people in the industry than investigating the greatest collection of computing equipment ever assembled in the Southern Hemisphere.

Perhaps that wasn't such a bad thing. Perhaps the computer world still pays too little attention to the difficulties of integrating computer systems with people. Professor Calvin Gottlieb had this in mind when he remarked that, "The computer technology cannot be regarded as neutral, if experience shows that in reality, whatever its potentialities, the effect of introducing it is almost always to favour large centralised systems and inhibit local autonomy ... What appear to some as opportunities and markets, to others appear as costs and exploitations."

Christopher Speary

Get your hands on our big new PET 3008 keyboard for only $999*

At last it's here: the Commodore PET you've been demanding! It's called the PET 3008. It boasts all the many features of our PET 2001, plus something you've been itching to get your hands on. A new, big, typewriter-style keyboard!

To celebrate the arrival of a strictly limited stock, Commodore offers you a great deal. To begin, the price is slashed to $999*. So straight away you save $196 on the normal price of $1195.

Not bad for a start. And there's more...

FREE, C2N CASSETTE UNIT WITH EVERY PET 3008 SOLD

That's right.

Get your new PET 3008 with the big typewriter-style keyboard now, and we'll throw in, absolutely free, a C2N external cassette unit.

Retail value? $126.50.

So all up on your PET 3008 purchase you save a whopping $322.50. Naturally, it's a strictly limited offer (either that, or we go broke!)

So whatever you do, don't miss out. See your authorised Commodore Dealer very, very soon!

SAME GREAT DEAL ON THE PET 2001

We mustn't leave out the many people who fancy the PET 2001's calculator-style keyboard. So:

COMMODORE PET 2001, normally	$1195
OUR SPECIAL PRICE NOW	$999
YOU SAVE	$196
PLUS FREE C2N CASSETTE UNIT, NORMALLY	$126.50
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For the name of your nearest authorised Commodore Dealer, write or phone;

COMMODORE INFORMATION CENTRE
3 Campbell Street, Artarmon, NSW 2064 Telephone: (02) 437 6296

*Prices and saving may vary slightly from Dealer to Dealer. Offer ends December 30, 1980 or earlier if stocks run out.

MIv1395

Software contest results

A while ago ETI ran a competition in association with Computerland Australia, in which readers were invited to submit original software for microcomputers.

Entries were assessed on the following criteria — the value of the software to the user, its complexity, its 'elegance', the degree of human engineering and the quality and presentation of the documentation.

First place in the contest went to **David Segall** of Canterbury Vic, for his HEX INFORMATION RETRIEVAL SYSTEM. He wins the major prize of a Cromenco ZPU Z-80 CPU card and special prizes for Best Documentation and Most Marketable Software.

Second was **W.R. Hodgson** of Chatswood, NSW, with his program for a NAVIGATION COMPUTER. For this he wins a Vector Graphics 8K RAM kit and the special prize for the Most Original Application.

In third place were **A. Heap and R. Green** of the University of New England, NSW, whose COMPUTER ASSESSMENT OF FARM VIABILITY wins them a Vector Graphics 260 x 260 graphic display generator.

Fourth prize of a Vector Graphics PROM/RAM card goes to **Kenneth Stoke** of Hobart for his game called BUDGET.

All the above prizewinners will also receive free copies of ETI for the next two years.

South Australian software

Peter Hartley, former editor of Micro-80, has established his own software house in Adelaide.

He specialises in small business applications for Z80 based microcomputers and has recently announced major agricultural and small business packages for release early next year. He will also be undertaking custom software development.

The current range of Peter Hartley software includes an interactive typing course called Touchtype, for use with TRS-80 and System 80 micros, and a number of entertaining games.

For more information contact Peter Hartley Software at P.O. Box 132, Eastwood, SA 5063. (08) 79-4061.

. . . and hardware

South Australian based Computer Imports Pty Ltd has announced its diversification into the small business and hobby computer market.

They will concentrate on the supply of peripheral equipment for the most popular micros. Disk drives, memory expansions and printers will be sourced from both overseas and local suppliers, and the company has announced a number of peripheral packages.

Computer Imports will operate in conjunction with Peter Hartley Software to supply composite hardware/software packages especially tailored to users' specifications.

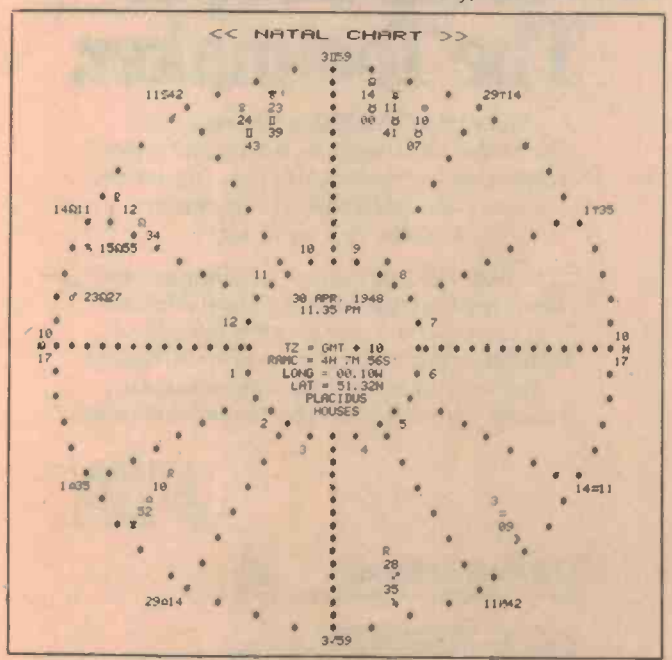
Contact address is P.O. Box 7, Port Adelaide, SA 5015 (08) 268-8065.

Astrology by computer

A Sydney company is using computers to update the ancient and arcane art of astrology.

Preparing astrological charts has always been a tedious and time-consuming business, involving a great deal of calculation and careful plotting of results, so it was a natural candidate for computer automation.

Illustrated on this page is a Natal Chart in the Round Wheel format, prepared for us by Austin Levy,head of Astrosearch Computer Services, who say they are only the second company in the world to offer a computerised chart plotting service.



The chart shows the positions of the sun, moon and planets at the birthtime of sub-editor William Fisher (the only member of staff who could remember exactly when he was born).

Astrosearch's charts are prepared on a 32K Commodore PET with a dual hard disk drive and a programmable printer. The programs, which are written in BASIC, have two major parts. The first part uses the equations of planetary motion to calculate the positions of the planets at the specified times; the second part, which is four times as long, output formatting.

The Round Wheel formatting program uses reflections to generate the complete design from a quarter circle basis. String variables are used in preference to numerics and the planetary symbols are plotted by the programmable character generator. Approximately 1500 bits are used to define the quarter circle pattern in memory.

The complete program uses 24K of memory. As well as Natal Charts like the one illustrated here. It can print out Progressed Charts, which are charts showing the planetary configurations at dates other than the birthdate. Biorhythm printouts are also possible.

Astrosearch are currently working on a high level program which will synthesise interpretations of the astrological data. The idea is to develop a dynamic system rather than a static text file. Other ideas which may yet materialise are computer-made synthesised music and kinetic art displays derived from the astrological data.

For more information contact Astrosearch at P.O. Box 1552, North Sydney, NSW 2060. (02) 913 7559.

The personal micro goes handheld

Well, almost! The Sinclair ZX80 microcomputer is shaped to sit on a desk or table but it's easily small and light enough to hold in your hand if your prefer.

Selling in this country for less than $300, the ZX80 looks like opening up a whole new mass consumer market for personal computers.

People accustomed to using more sophisticated and expensive micros will probably find some of its habits a little disconcerting, but first time users are unlikely to be dismayed by any of its features.

Designed around the 780-1 microprocessor chip (a copy by NEC of the ZX80), the ZX80 contains a keyboard, CPU and I/O interface circuitry in a single module and can be used directly with any cassette recorder and TV set. On board are 4K of ROM (all on one chip) and a 1K RAM which can be expanded to 4K with an optional memory expansion board.

One reason for this computer's light weight is that it is enclosed in a 1mm thick plastic case, metallised on the inside to provide shielding.

The keyboard is made up of touch switches, completely covered by a flexible polymer sheet that protects against contamination by dust or liquids. Key symbols are printed on the underside of this sheet to prevent them rubbing off with use. Despite first impressions, the keys are easy to use. They are laid out in the standard QWERTY arrangement.

Sinclair have developed their own variety of BASIC for use with this machine. This has some features which will definitely make things easy for the novice programmer. Key words like RUN, PRINT and LIST, GOTO, GOSUB, LET and so forth can all be entered with a

The Dick Smith Daisy Wheel

If you just bought any other printer you'll eat your heart out!

When you want letter-quality printing you are usually talking big money. If you've just bought a word processor printer you'll know what we mean.

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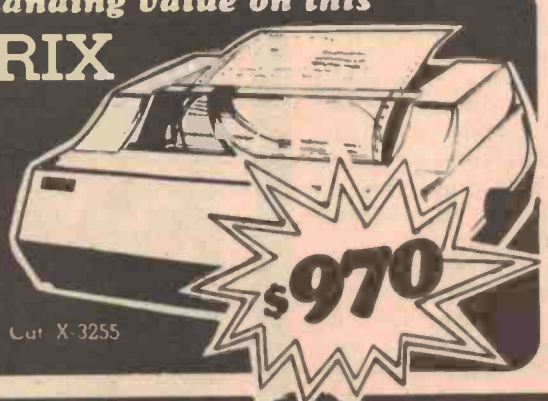

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SYSTEM 80 OWNERS. . .

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single keystroke. The interpreter has a unique syntax checker that prevents entry of program lines with syntax errors, thereby eliminating the frustration of entering a program and only discovering the errors later on when it won't run! And there's a powerful and versatile screen editor that allows modification of existing program lines. However, given the limited capacity of the machine, all these functions have to be provided at the expense of the more powerful BASIC commands.

This deficiency of powerful commands can be eliminated by purchasing the new 8K ROM chip that Sinclair have designed for the ZX80. This is a drop-in replacement for the standard ROM chip, designed for higher level computing, and comes with a new keyboard template and a supplementary operating manual.

As well as a greatly improved range of BASIC commands, the new ROM features full floating point arithmetic with 9-digit accuracy, logarithmic and trigonometric functions and their inverses, a graph plotting capability and a facility for generating animated displays using a 'PAUSE n' command, which sends the display file to the TV screen for n frames or until a key is pressed.

The microprocessor itself, which is clocked at 3.25 MHz, peforms every single function, including the control of the cassette recorder and the TV monitor. As a result, the video display disappears whenever any operation is being carried out, returning when the operation is complete. This is one of the features that practised computer users might find off-putting, but it's doubtful whether novices will find it a nuisance.

When we finally figured out how to prise open the case without completely destroying it, we discovered a single well designed and well finished printed circuit board with all the components mounted directly onto it — the ZX80 is designed to be used with an external power supply.

Closer inspection revealed that Clive Sinclair has obviously shopped around for components in an effort to keep the price as low as possible. Memories from Ireland, video driver from Taiwan, regulator from El Salvador, gates from the UK and a Japanese microprocessor give the machine a truly international flavour. There's one Australian section too, the VHF modulator which replaces the UHF unit fitted to models sold in Europe.

Because this micro does not use the standard ASCII codes, it is not possible to connect a conventional printer, but it is likely that Sinclair will be producing their own compatible printer sometime in the future.

The ZX80 was first publicly shown in Australia at the 8th World Computer Congress in Melbourne.

The ZX80 is distributed in Australia by Sinclair Equipment (Australia) Pty Ltd, 308 High St, Key, Vic 3101. (03) 861 6224.

Local outlets in Victoria are Rod Irving Electronics in Northcote, Myers in Melbourne, Minit Computer Service in Bendigo. NSW suppliers are Emona Enterprises in Sydney, P. Hatcher in Sydney, DGE Systems in Newcastle, South Coast Computing Service in Nowra, Maestro in Kinkumbra.

In Tasmania the ZX80 is available from J. Walch and Son of Hobart, in the Northern Territory from Ascom Electronics of Alice Springs, in the ACT from Computer Business Aids, in Western Australia from WACB Radio Central, Radiotronics and Focus Electronics in Esperance.

Queensland outlets are Computerland in Brisbane and Scotts Audio in Townsville. South Australian residents can obtain the ZX80 from Computerland and from Computer Imports Pty Ltd.

Elaine Ray

For Sorcerer Apprentices

Christmas is just around the corner, so I thought you deserved a few helpful routines which can be interfaced with your BASIC programs. Thanks to Brendan J. Joyce for suggestions in his letter from which I quote:

"The column 'For Sorcerer Apprentices' in ETI is very welcome. It is frustrating as a novice to own what one has been assured is a very powerful micro and not be able to unleash its strength. There are articles in abundance on other better known machines, but there is almost a conspiracy of silence on the Sorcerer . . .

. . . There are three problems bothering me that I would like some information on:

(1) Printing a given number of lines on a page so that a space can be left above and below the perforations.

(2) A keyboard sensing routine that can detect what key has been pressed without the need for the RETURN key . . .

(3) A method of accessing monitor subroutines using BASIC. There must be many powerful subroutines in the monitor, but the identification of these and the method of access to them is a mystery to a non-professional such as myself.

Good luck in your efforts and three cheers for A.P.F.Fry."

Thanks for your letter Brendan. The simplest way of making sure that your printer keeps track of lines per page is to do all your printing through a subroutine. This will allow you to print lines to the screen without losing track of the line count on your printer. Include the lines:

```
0 CLEAR 500:LP=60:CP=6
1 VE=PEEK(-4095)*256+PEEK(-4096)-47
2 IF VE > 32767 THEN VE = VE-65536
```

Then use this to print:

```
10 PR$="HELLO":CR=0
20 GOSUB 1000
```

Where the subroutine is as follows:

```
1000 PP$=PP$+PR$
1010 IF CR THEN RETURN
1020 POKE VE,147:POKE VE+1,233
1030 PRINT PP$:CO=CO+1
1040 IF CO LP-1 THEN FOR CO=CP TO 1
STEP-1:PRINT:NEXT
1050 PP$="":POKE VE,240:RETURN
```

Of course you mustn't use the variables PP$, PR$, CR, CO, LP, CP or VE for any other purpose.

In line 0 you must clear at least enough space to handle the longest line you plan to print. LP is the number of printed lines per page and CP is the number of carriage returns before page end. The total of these two should be the number of lines on your form. CR is a flag to tell the subroutine whether or not to print a carriage return at the end of the line. If CR=1 then the following line will be printed where the last left off. CR=0 terminates the line and prints a carriage return. The subroutine will automatically switch the printer on when it needs it and return with it switched off. You never have to worry about this while the programme is running.

You'll notice that in line 1020 I poked VE + 1 with 233. This is to overcome a bug in the Monitor which may cause problems occasionally. When the Sorcerer is switched on or reset, it sets the SEND vector to E9F0 and the RECEVE vector to EBIC. If you then use the Monitor commands SE 0=V or SE 1=K (ostensibly the same vectors), Exidy programmers see fit to stick in different vectors that do the same thing:

SE 0=V sets the SEND vector to E01B (which jumps to E9F0)

SE 1=K sets the RECEVE vector to E018 (which jumps to EB1C)

The problem is that when you POKE VE,147 or POKE VE,240, you change only the LOW part of the address. If you exit BASIC and set the output, the Monitor will have changed the HIGH part when you return. To be safe, always POKE VE+1,233 when you are switching the printer on and off using this method. One can only hope Exidy takes note of all these bugs — there are lots of 'em!

In answer to Question 2, I have included a simple keyboard scanning routine which uses a modified INP(X) function:

```
10 POKE 318,195:POKE 320,224
20 A=INP(9)
```

Line 20 will load the ASCII number of any key pressed into variable "A". If you want to wait for just any key, include line 30 as follows:

```
30 IF A=0 THEN 20
```

If you want to check for a specific key, (e.g. "."") change line 30 to:

```
30 IF A <> ASC(".") THEN 20
```

Your last question was not so easy, Brendan. I did some asking around and found that Greg Lister of Software Source could provide a solution.

BASIC MONITOR INTERFACE

Copyright (C) November 1980 Greg Lister + Claude Almer

```
ADDR 0  1  2  3   4  5  6  7   8  9  A  B   C  D  E  F
F000:      2A B1  01 2B 7E FE  28 20 FA FD  E5 D1 23 7E
F010: FE AD 20 02  3E 3D 12 13  FE 29 20 F2  1B EB 36 OD
F020: FD E5 E1 CD  25 E2 CA 14  C3 DD21 12  E3 E5 DDE5
F030: 06 02 DD7E  00 BE 20 0E  23 DD23 10  F5 D1 D1 DD
F040: 6E 00 DD66  01 E9 DDE1  E1 DD23 DD  23 DD23 DD
F050: 23 DD7E 00  B7 20 D6 C3  14 C3 FA DF  47 2B 43 31
```

Here's how to use it. Enter the above listing from F002 (HEX) onwards. Claude warns that you shouldn't use it in conjunction with his KEYRP programmne (ETI November 1980)

It is now accessed from BASIC with the USR(X) function as follows:

```
10 POKE 260,2:POKE 261,240:REM initialise USR function.
20 Z=USR(COMMANDLINE)
```

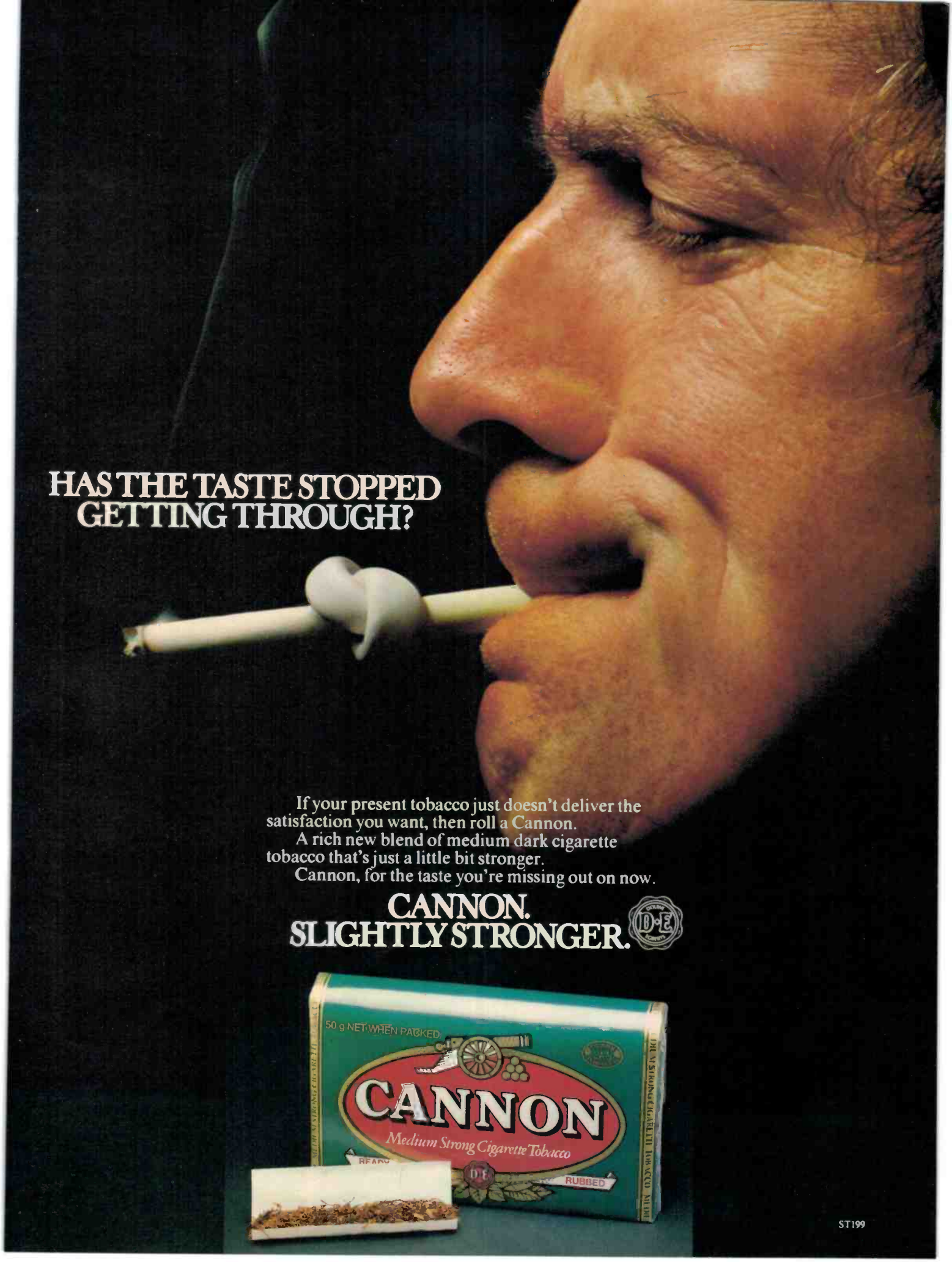
where COMMANDLINE can be any of the standard Exidy Monitor commands, e.g.

Z=USR(DU F002 F05F)	will dump the program you've just keyed in
Z=USR(SE 0=L)	will switch printer on
Z=USR(SE 0=V)	will switch printer off
Z=USR(SE S=10)	will slow the screen down
Z=USR(SA BASMO F002 F05F)	will save the program

An excellent use is to load a tape of predefined graphics directly from Basic.

Finally, there appears to be a lot more backup and worthwhile software than we know of. If readers or programmers would like an appraisal of their software, please send me a copy care of ETI. Of course copyright software will be treated in complete confidence.

A.P.F. Fry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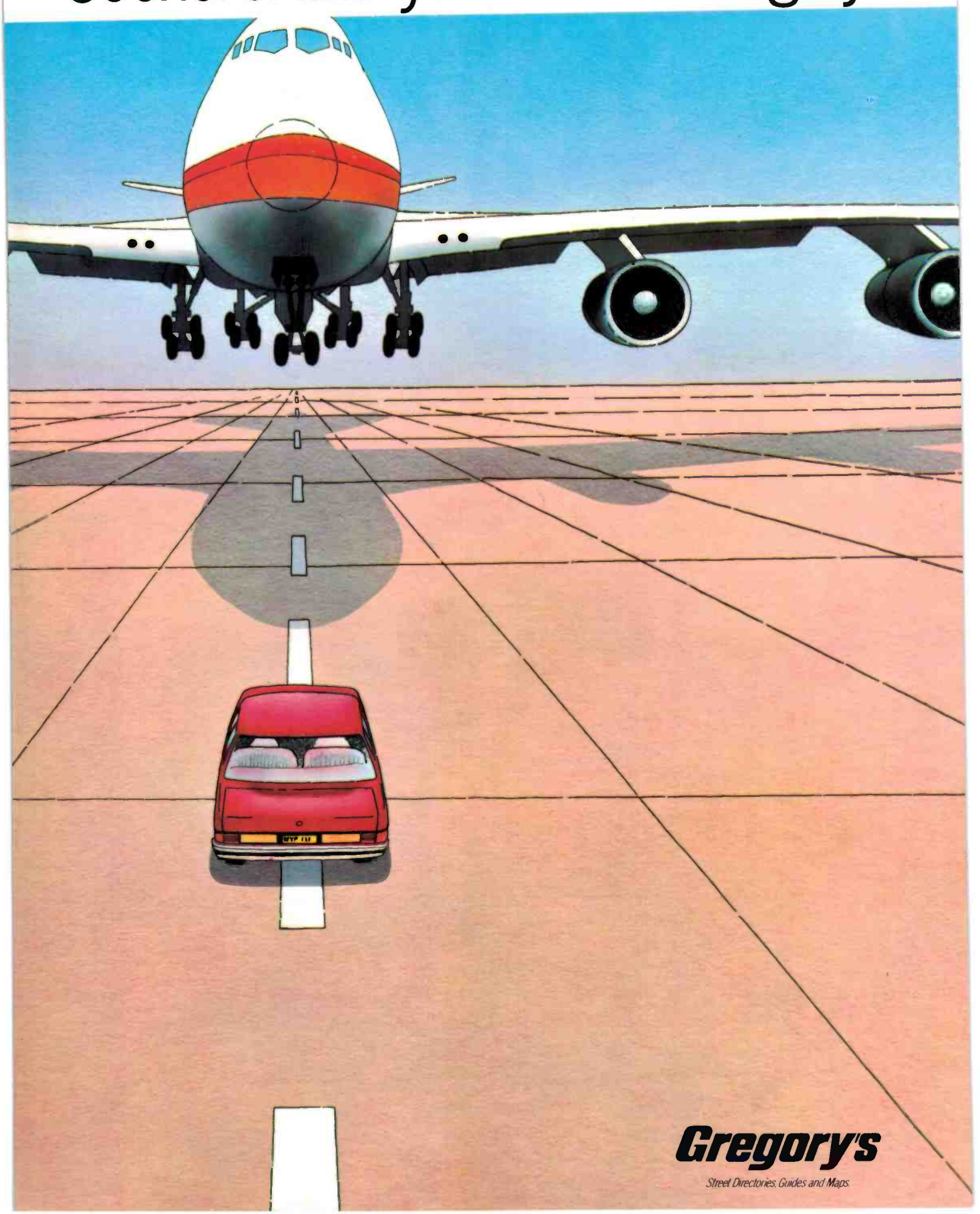

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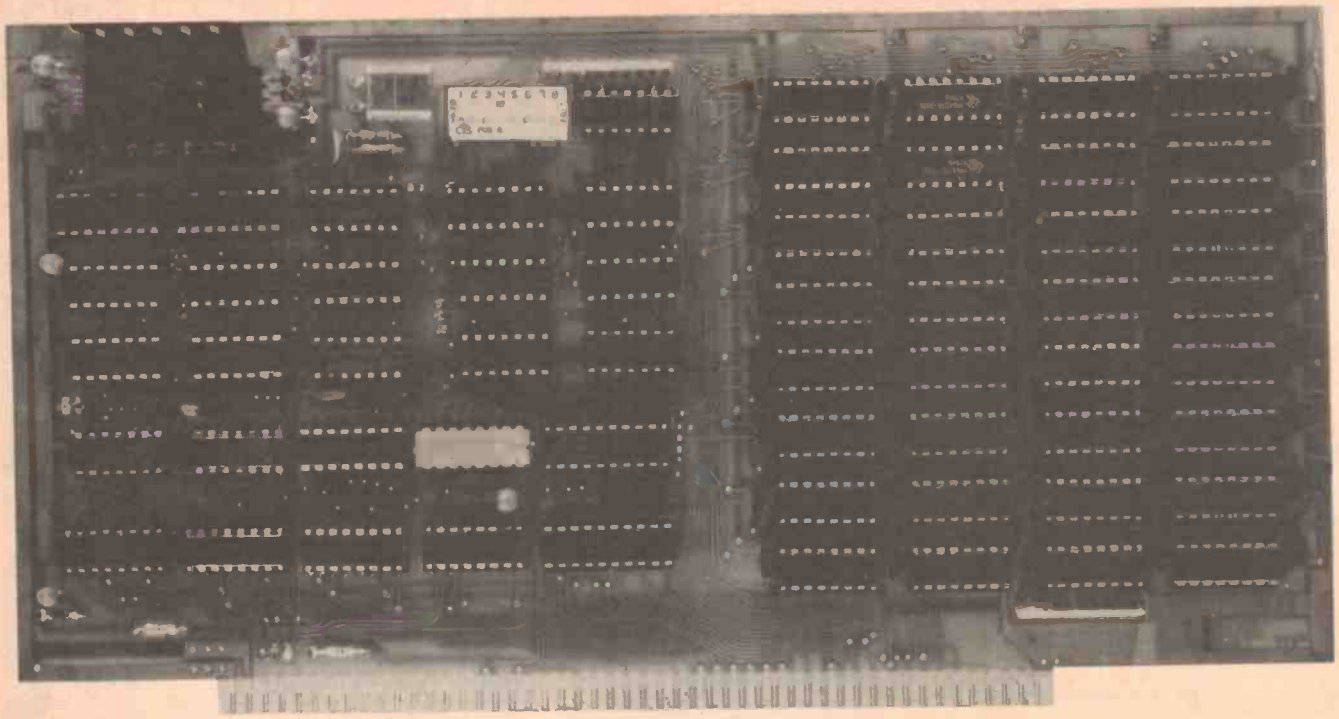

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A SINCLAIR ZX80 COMPUTER

–with software

Only recently released in Australia, the Sinclair ZX80 Personal Computer is being distributed here by Consolidated Marketing at a recommended retail price of $295, including the manual. The ZX80 owes its low price to its remarkable design; the whole system is packed onto fewer, newer, more powerful and advanced LSI chips, the makers claim. The ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer because the design packs the RAM so tightly. You can add to the memory via the expansion port, giving a maximum potential of 16K. The unit includes a cassette interface and output direct to TV antenna input.

You can win one of these remarkable computers by entering this simple contest. Only five questions to answer !

This contest is jointly sponsored by ETI and Consolidated Marketing — who have generously donated the prize.

And as a special bonus the winner will also receive six packs of innovative and imaginative software. This has been designed and donated by Peter Hartley of Peter Hartley Software in Adelaide.

Six runners-up will also win a pack of Peter Hartley software.

RULES

This contest is open to all persons normally resident in Australia with the exception of members of the staff of Consolidated Marketing, Modern Magazines (Holdings) Ltd, K.G.Murray Ltd, Australian Consolidated Press, Wilkes Pty Ltd and/or associated companies.

Entries should be addressed to ETI/Sinclair ZX80 Contest, Electronics Today Int., 15 Boundary St, Rushcutters Bay, NSW 2011.

Closing date for the contest is 31 January 1981. Entries received within seven days of that date will be accepted if postmarked prior to and including 31 January 1981.

The winning entry will be drawn by the Managing 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 answers 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 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, accompanying this contest, that they have read the above rules and agree to abide by their conditions.

You may enter as many times as you wish but you must use a separate entry form for each entry and include the month and page number cut from the bottom right hand portion of this page. You must put your name and address on the entry form and sign it where indicated.

Please read the contest rules carefully, especially if sending multiple entries.

All entries received by the due date will be placed in a barrel. First all-correct entry then drawn is the winner. Next six are the runners-up.

Permit No: TC 80/1261

- What programming language is used in the ZX80 ?

  .....

- How many key entry strokes are required to enter words such as RUN, PRINT, LIST etc. (i.e: how many letters per word) ?

  .....

- How many standard graphic symbols are included ?

  .....

- Can the ZX80 be programmed to play chess ?

  .....

- In which country is the ZX80 made ?

  .....

Name .....

Address .....

.....Postcode .....

I have read the rules of the contest and agree to abide by them

Signed .....

Date .....

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● Printing speed	120CPS bidirectional
● Character size	7 (length) × 9 (width) (Standard)
● Character type	ASCII 128 characters 128 (136E) or 64 (80E) special characters can be added as an optional feature
● Character spacing	10 characters/inch
● Line spacing	6 or 8 lines/inch (switchable)
● Form width	5-15 inches (136E) 5-9 inches (80E)
● Copies	Up to five copies including the original
● Paper feed speed	88m sec/line (6 lines/inch)
● Paper feed mechanism	Tractor feed (continuous form) A slip may also be used
● Data input	8 bit parallel Centronics compatible RS-232C I/F. TTY 20mA current loop I/F. A variety of specifications can be applied by controlling the interface.
● Power	50/60Hz 100V ±10% 160VA
● Inked ribbon	13m/m (width) × 13m (length) (Black cartridge)

Graphic Data RO-136G
The printer can print graphic data by controlling printing on a dot basis of up to 960 dots across the page.
Speed — 80CPS.

New Dot Printer Featuring Low Cost, High Performance, and Versatility

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"Ogura RO Series" aims at dispersion of printers.

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SME can now supply the ES100 Typewriter fitted with RS232C Serial Interface. This unit is known as a ES100P, it can interface to all standard computers via a 25-way 'D' connector.

Please contact SME for more information.
$1950.00

Back door into BASIC

This is the first in a series of four articles that will explain BASIC programming from first principles, using the familiar pocket calculator as a starting point.

Phil Cohen

I GUESS all of you have used a pocket calculator? Well, you'd be surprised how much it has in common with a computer. The only major difference is that a computer is much more flexible — it does the same things, but more of them.

One thing a computer can do that most calculators can't is repeat a sequence of 'key presses' any number of times. Such a sequence is called a program and writing a program is simply the process of deciding what the sequence of key presses is to be.

Calculators

Let's take a closer look at a simple pocket calculator. It has ten keys with numbers on them and others with 'functions' like +, −, x and =. When you press the keys, complicated electronic circuits inside the machine respond by performing certain actions.

Figure 1. **Block diagram of a simple four function calculator.**

Figure 1 is a simplified diagram of how the calculator is organised inside. The block in the middle labelled 'clever bits' represents a lot of sophisticated hardware, but it's not necessary to understand how the hardware works to be able to use the calculator.

This simple kind of calculator has no 'memory' facility where you can store numbers for future use. For example, suppose you have a set of numbers and you want to multiply them all by 0.123949. On this kind of calculator you have to key in 0.123949 for every calculation, which is time-consuming and boring.

Calculators with memory

The next step towards a computer is the calculator with memory, which saves you the tedium of entering the same number over and over again. You can just enter the number once into memory and then pull it out with one keystroke at the relevant part of each calculation.

Figure 2 is a block diagram of a calculator with memory. Its memory can only store one number at a time.

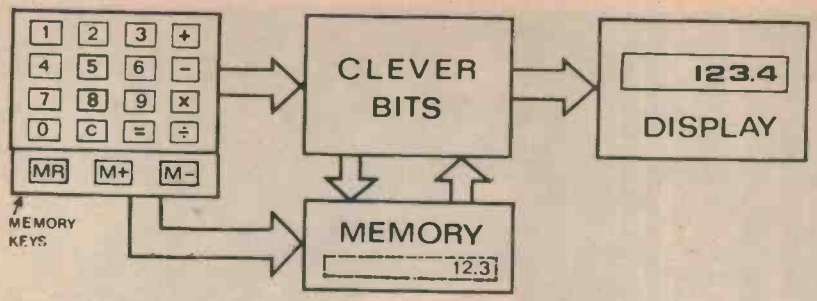


Figure 2. A calculator with memory is a little more complicated.

The memory control keys allow the user to control what the memory does. For example to put the number 0.123949 into memory all you have to do is key in 0.123949 so that it appears on the display, then press the M+ key, which enters the contents of the display in the memory. To 'recall' or 'read' the memory contents at any time during a calculation, you press the MR (Memory Recall) key. This is probably all very familiar to most of you, but it's worth going through it all because it ties in with what I'm going to say later about computer memory.

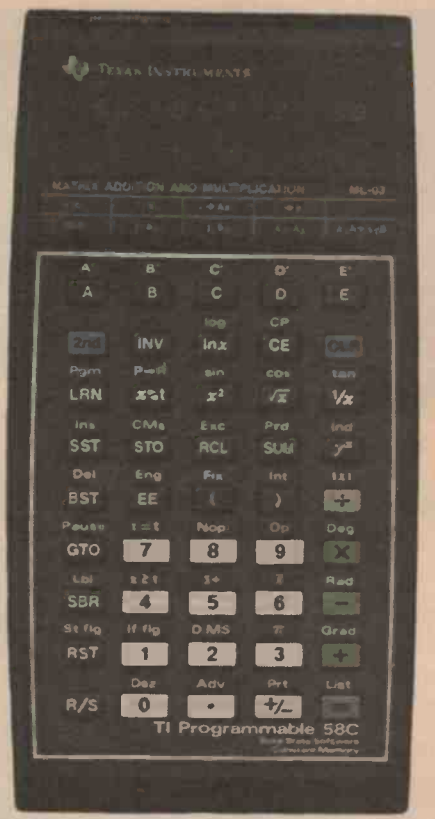
Some calculators have more than one memory, allowing different numbers to be stored in different places. In fact, some calculators have *hundreds* of memories, each of which can be independently 'written to' or 'read from'.

Programmable calculators

Although I said earlier that one of the differences between a calculator and a computer is that the computer can repeat a sequence of steps any number of times, there are in fact many calculators on the market which can also perform this feat.

So how do you tell a computer from a calculator? The answer is, "These days it's not easy." In fact, in a number of cases, the two terms overlap.

We saw how a calculator with memory is useful when multiplying a whole set of numbers by a constant value. Well, what if you wanted to take the same set of numbers and *for each one* multiply by 15.698, subtract 34.697 and find the square root of the answer? You could start by putting 15.698 and 34.697 into two memories in the machine, but you would still be left with a formidable number of key presses to get the answer.



Today's programmable calculators can do jobs which once needed a large computer.

To get away from all the repetition involved in such a calculation, the solution is to use a programmable calculator. This is a machine which can 'remember' a sequence of steps (such as x 15.698 − 34.697√). You program the calculator with the sequence of steps you want it to carry out, then for each number in the set, key in its value and press the RUN key.

Pressing the RUN key will cause the calculator to go through the programmed sequence once. The great thing about this system is that, having got the answer for the first number in the set, you simply key in the next number and press RUN again. The calculator will then apply the same sequence of calculation steps to the new number.

The program is fed into the calculator in much the same way as a value is fed into a memory — you press the PROGRAM key, which tells the machine you are about to program it, then simply press the desired key sequence. This enters the steps into a special group of memories in the calculator and when the RUN key is pressed this 'program memory' is read out, one step at a time, starting at the beginning and working through to the end of the sequence you originally keyed in. ▶

The humble office calculator has several features in common with a computer.

A high powered professional microcomputer like this Hewlett-Packard HP85 is basically similar to the simplest home computer.

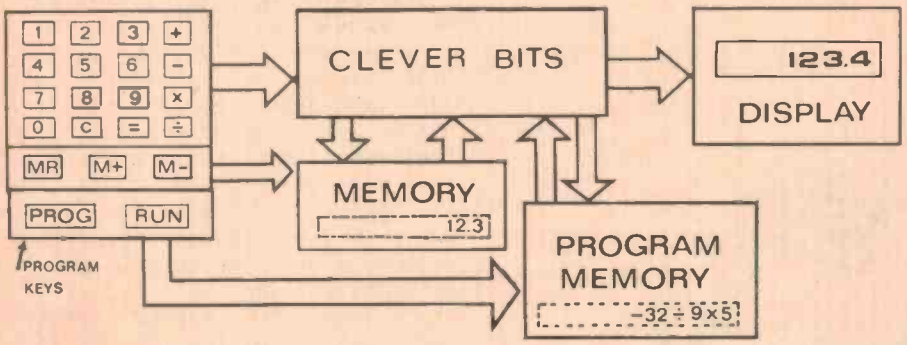


Figure 3. Programmable calculators have two distinct types of memory.

Figure 3 shows a simplified block diagram of a programmable calculator. By now we're getting close to a computer.

Computers

Figure 4 is a much simplified block diagram of the inside of a computer. As you can see, the program memory and the number memories have been lumped together into one area, which can be used for both purposes. In fact the computer will, at any given time, be using part of the memory for program storage and part for number storage. This is a very useful flexibility because some applications need a lot of program storage and very little number (or 'data') storage, while others need the opposite.

Programming a computer is exactly the same as programming a calculator. You fill up part of the memory with a sequence of steps (the program) which you want the machine to carry out.

The keyboard of a computer is a bit different to that of a calculator. Because the number of functions which a computer can perform is literally without limit, most computers use a keyboard more like that on a typewriter. For example, rather than pressing a key marked RUN, you press R, then U, then N. All the functions of the computer can

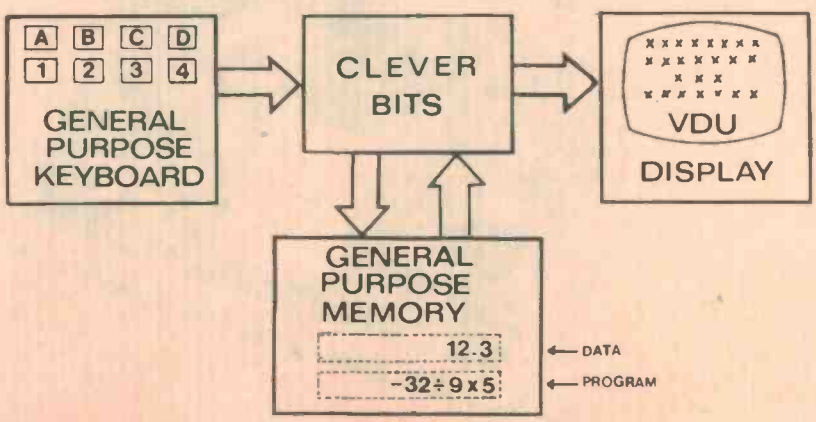


Figure 4. A computer has one large and versatile memory for both program and data.

now be designated by different 'keywords' or 'reserved words', instead of using one key per function like a calculator.

This sort of keyboard has other advantages too. The computer can not only store numbers and programs in its memory, it can also store letters — and these can be entered through the keyboard. This means that the machine can be used as a word processor — a machine that allows text to be typed in and then edited while still on the machine, so that it can be printed out free of errors and arranged in all sorts of different formats.

A computer display is different too. In general it's on a screen like a TV, which is usually called a Visual Display Unit (or VDU). This shows letters, numbers and symbols and usually has some sort of 'graphics' capability to enable the user to draw lines on the screen for tables, graphs and so forth. One of the problems with a programmable calculator is that you can't see the whole program at one time. With a VDU display, you can see whole pages of the program.

Languages

Naturally if you type the wrong word into the computer it won't do what you want it to do. For example, if instead of typing RUN you typed START, the machine would be confused. Computers can only understand certain words, just as a calculator only has so many keys. The vocabulary of a particular computer depends on what 'language' it uses. A language in computer terms means almost exactly the same as in human terms — it's an agreed way of writing things, which means the same to everyone.

The grammar of a computer language defines what order the words can be put in. For example, you can put 3 + 4 = into your calculator and get the right answer, but you can't put in = 3 + 4. Grammar is known as 'syntax' in computer jargon. Each different computer language has its own syntax rules, which govern the way the computer will interpret what is typed into it.

The three remaining articles in this series will deal with the syntax of BASIC, which is currently the commonest language for home computers.

Computer physiology

Before we get into talking about how to write programs, it's a good idea to say something about what the average home computer consists of and how it works. It's not necessary to understand the 'anatomy' or detailed internal workings of a computer to be able to recognise the major functions, which we might call the computer's 'physiology'.

First of all, every computer has some kind of keyboard. These come in a variety of shapes, sizes and styles, but most of them look very much like typewriter keyboards. One difference that is easily noticed is the RETURN key. This corresponds to the carriage return on a typewriter and is usually found at the right hand end of the keyboard. Pressing the RETURN key has the effect of making the computer read what the user has just typed in. This allows you to ▶

COMPUTER LANGUAGES

Various different computer languages are in common use for different purposes. The table below lists the principal languages and what they are used for.

LANGUAGE	EASE OF LEARNING	SPECIAL USES	COMMENTS
ALGOL	Medium	Scientific	Needs a fairly large machine
APL	Difficult	Scientific	Uses many special characters — most machines can't handle it
BASIC	Easy	Learners	Very common in home computers
COBOL	Medium	Accounting	Designed for efficiency, not ease of use
FORTRAN	Medium	Engineering	Very common in large machines
PASCAL	Fairly easy	General purpose	BASIC's only rival in home computers — but BASIC is easier to use

type a full line of instructions, then read them off the screen to make sure that they are correct before committing yourself by pressing RETURN.

Some computers have a second keypad to the right of the typewriter-style one. This second keypad looks like a calculator keypad — it contains the numbers from 0 to 9. It's there because the standard typewriter layout is not ideal for keying in numbers — all of the number keys are in a row along the top of the keyboard.

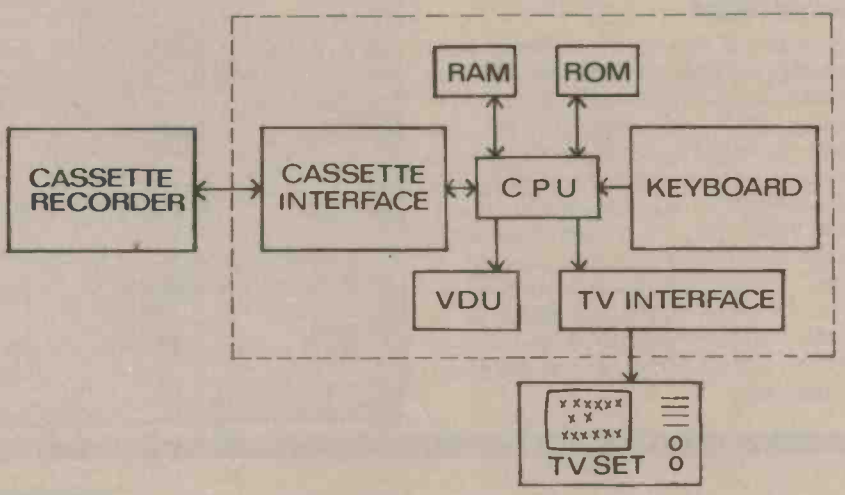
When it comes to displays, the market is split between the more expensive machines, which have their own video screen built in, and the cheaper ones which plug into the back of a domestic TV.

A normal screen layout is something like twenty rows, each containing about sixty characters (a character is a letter, a number, a symbol or a space). All but the very cheapest computers have some method of storing programs so that they can be recalled when you want to use them again.

For example, suppose you spent a whole afternoon writing a program to calculate compound interest. If you knew that you were going to need it again a week later you *could* go to the trouble of writing it down line by line so that you could type it in again the next week. But this would be time-consuming and there would always be the possibility of making a mistake.

A much easier way is to design the machine so that it can take a program which is stored in it and convert it into a sequence of musical notes that can be recorded on a domestic cassette recorder. When you play back the cassette, the computer will listen to the notes and reconstruct the program from them. Some machines have cassette recorders built in, while others require the use of an external recorder. ●

THE ANATOMY OF A TYPICAL HOME COMPUTER



CPU stands for **Central Processing Unit,** home of the famous microprocessor. This part of the machine does all the thinking and corresponds to the 'clever bits' in a calculator.

RAM or **Random Access Memory** is where the computer stores all the numbers and programs that the user enters.

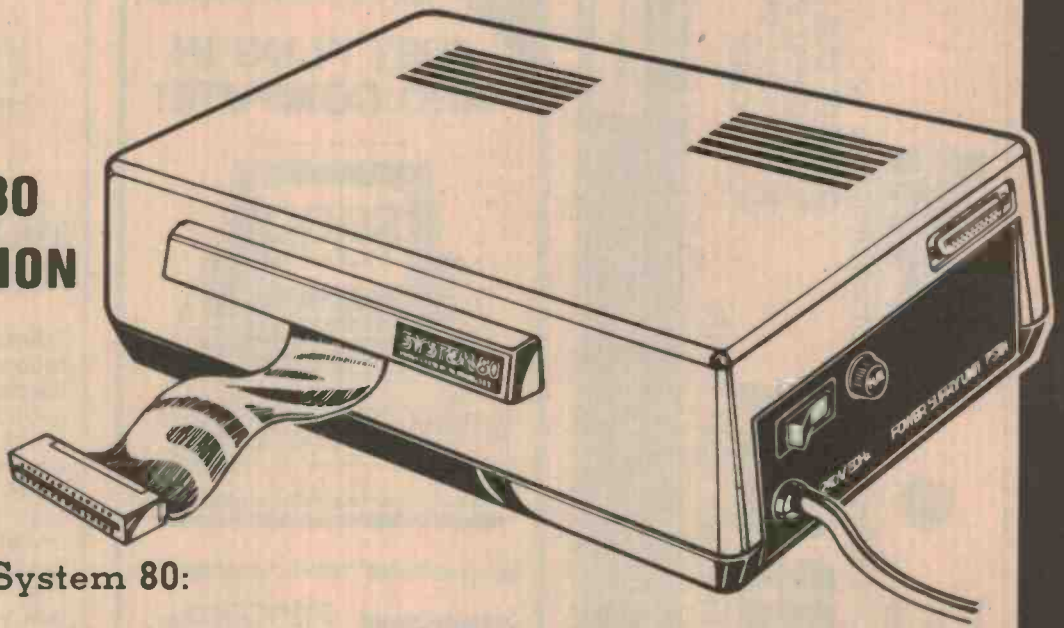
ROM means **Read Only Memory.** This is where the language is kept, in the form of an interpreter program that translates BASIC into a 'machine code' that the computer can understand. Data in ROM is permanently stored — it does not disappear when the power goes off, and it cannot be altered.

VDU stands for **Visual Display Unit,** a screen on which information is displayed in a form that humans can read. On most computers the VDU is fairly autonomous — it does not need to be refreshed all the time by the CPU, but can store a string of characters in its own memory and display them until the CPU tells it to change.

The Cassette Interface translates messages from the CPU into a code of audio tones suitable for recording on a cassette. It can also translate these tones back into machine code when the CPU needs the information again.

E-X-P-A-N-D YOUR SYSTEM 80

AT LAST! THE NEW SYSTEM 80 S-100 EXPANSION INTERFACE



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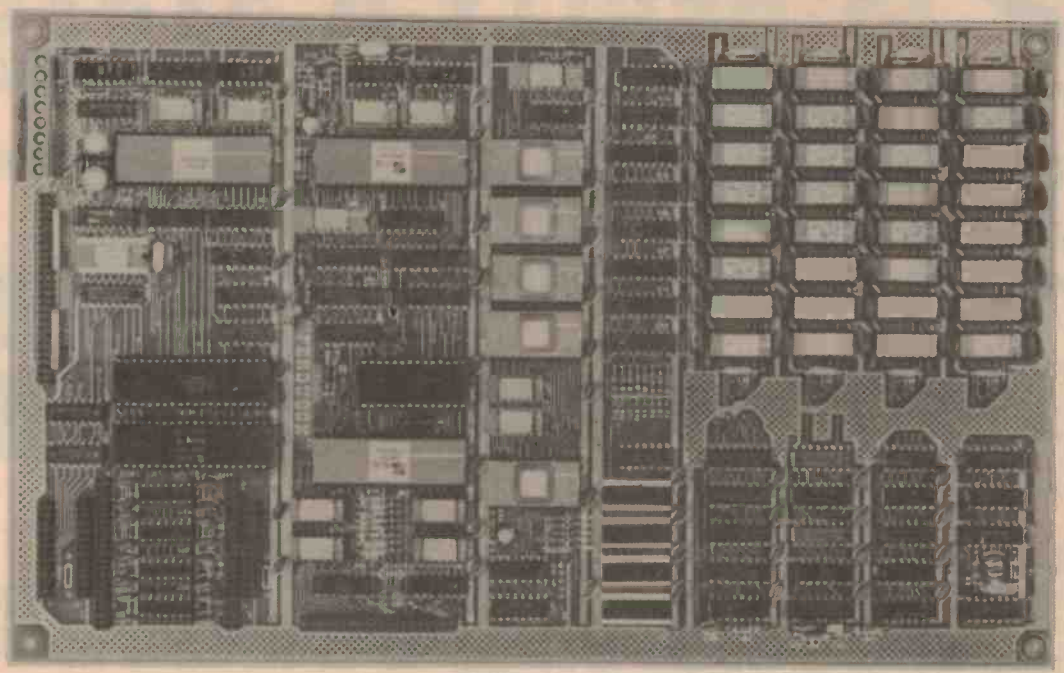

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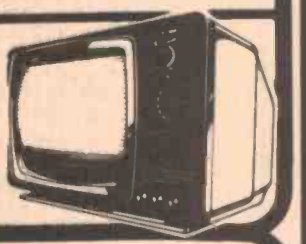

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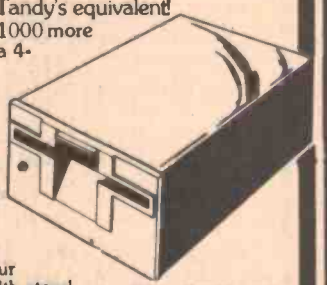

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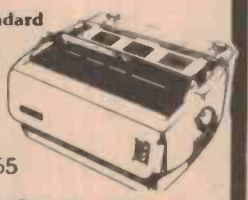

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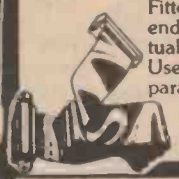

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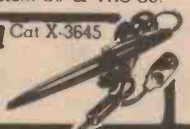

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Matrox video boards reviewed

Craig Barratt

This article looks at two stackable S-100 video graphics boards, the ALT 256 and the ALT 512, both from Canadian manufacturers Matrox.

THE PRICE OF video display units is falling all the time and their high speed and flexibility are making them the most popular output device. But their vast potential cannot be properly realised without a fairly sophisticated board to drive them. At the high end of the video board market are a range of boards from a Canadian company, Matrox. Their Australian distributors are Measuring and Control Equipment Company, of Epping in New South Wales.

Matrox's range of boards may be broadly divided into two categories, alphanumeric and graphic displays. Both of these display types are available in a variety of bus structures, including S-100, Multibus (the SBC-80 bus from Intel), LSI-11 and a variety of stand alone modules.

The alphanumeric boards have display formats starting with eight lines by sixteen characters, right through to boards with 24 lines by 80 characters. Character fonts vary between 5 by 7 upper case only and 7 by 9 upper and lower case. One board has its characters sitting in a 12 by 14 matrix and is intended for a public information environment. Some boards have special features such as software programmed display formats, colour, character blanking, inverse video and variable intensity. All the boards are memory mapped, which means the microprocessor simply writes into certain memory locations to make characters appear on the screen.

The range of graphics boards is just as extensive. Display formats include 256 by 256 dots, 256 by 512, 512 by 512 and even a 256 by 1024! These boards are I/O mapped and the features on some boards include colour, variable intensity and software programmed display formats.

Stacking boards

This seems all very well, but two problems become evident. Firstly these boards are obviously designed for the American market with a 60 Hz frame frequency and would seem unsuitable for use in Australia. This however is not a problem since Matrox have provided a series of jumper options which may be arranged to provide 50 Hz/312 line operation.

Secondly it would seem that a graphics board would need its own monitor, or you may need to switch either the alphanumeric or graphic video line through to your monitor. Matrox have overcome this problem by making their boards stackable. This means that a graphic and alphanumeric board may be combined to produce graphics and alphanumerics simultaneously on your monitor.

The only special requirement for stacking boards like this is that all boards derive their timing from one source, in other words one board must be a master and the others slaves. Most of the graphics boards and some of the alphanumeric boards have jumpers to select master/slave operation and these boards have 16 pin connectors with all the relevant signals.

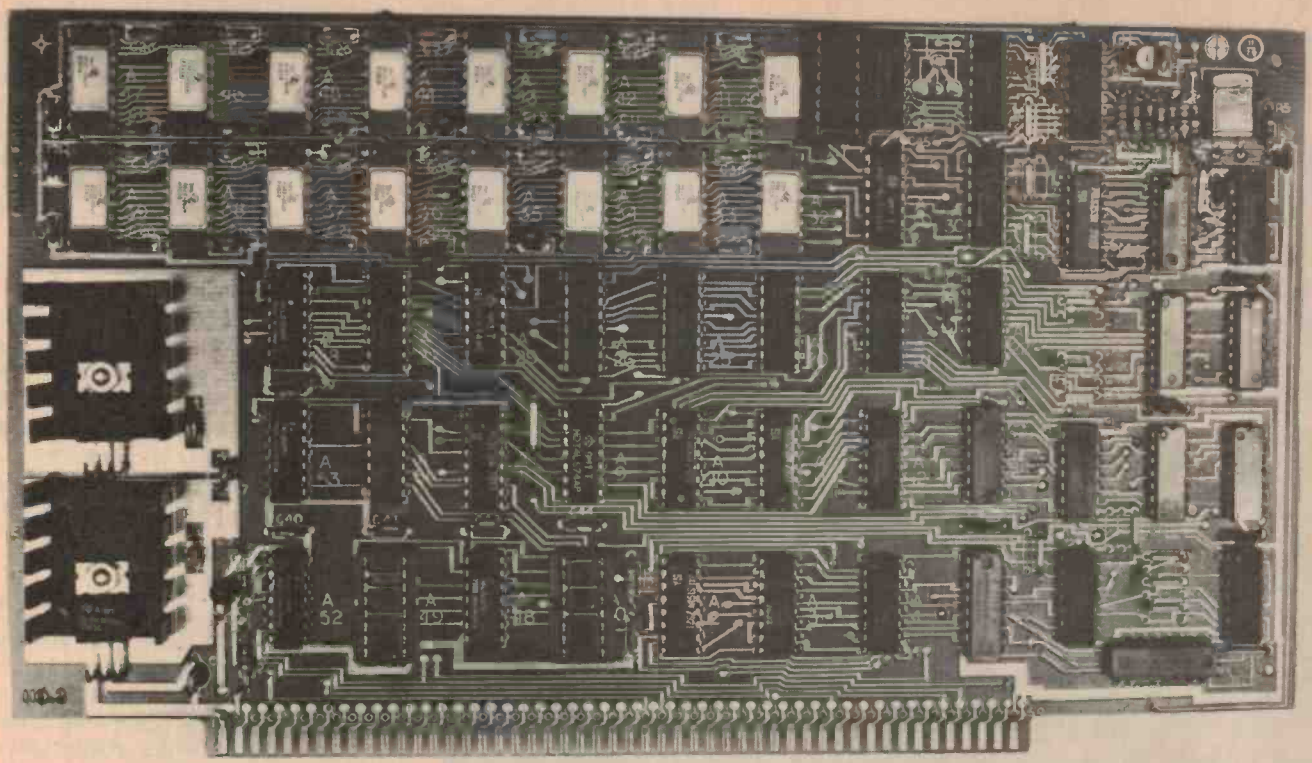
Another more useful but not so obvious application for stacking boards is to have several graphics boards in a system and use each of the boards to provide grey level, colour, flashing or some other information particular to each bit on the screen. Thus if you want a display with 256 by 256 bits, four grey levels, four colours, and a flashing bit for each dot on the screen you simply plug together five 256 by 256 by 1 Matrox graphics boards and add some of your own electronics, to give a 256 by 256 by 5 display. Now you know what to do when you win the pools!

The ALT-256

You wouldn't have guessed it, but the purpose of this article is to review an S100 graphics board from Matrox, the ALT-256. This board has only one bit per pixel (dot on the screen), in other words each of the 256 by 256 pixels may only be switched on or off. If you want colour or several grey levels you will have to stack two or more of these boards together as explained above.

The board occupies four output ports and one input port. The base address of these I/O ports is set to any multiple of four using wire jumpers on the board, and a functional breakdown of these I/O ports is provided on page 115.

As shown in figure 1 pixels are addressed with x and y coordinates. The x value for a pixel is the column number of that pixel, with the left column having x = 0, and the y value is the row number of that pixel, with the top row having y = 0. This means that the top left pixel has coordinates (0,0), and the bottom right pixel has coordinates (255,255). So to address a given pixel we simply write its x coordinate to port b+1, and its y coordinate to port b+2, where b is the base address of the I/O ports. Having set up the x and y registers of the graphics port we may now set



The ALT-256 video board provides a rock steady 256 x 256 pixel display with no flickers during screen accesses.

or reset that pixel. To reset that pixel we write a 0 to port b+0 and to set it we write a 1 to port b+0.

We may also erase the screen by writing to port b+3. Writing a 0 will clear all pixels and writing a 1 will set all pixels. Erasing the screen obviously isn't instantaneous, and in fact takes between 20 and 40 milliseconds (one and two frame times) and new commands issued during erase time will have undefined effects. To avoid this an input port has been provided with two status bits. The bottom bit (bit 0) is high if the display is busy (being erased) and low if the display is ready to accept commands. Bit 1 is low if the video portion of the screen is currently being scanned, and is high during vertical blank. Although setting and clearing bits doesn't put flickers on the screen, this bit is useful for things like animation, where it wouldn't be desirable even for one TV frame to have half of a new image and half of an old image on the screen. The idea is that the processor should do all its screen manipulations during the vertical blank period.

Software interface

Obviously most programs that use graphics output will not use the graphics board at such a low level. Such an approach would be very clumsy, and all programs would have to be modified if a new and different graphics board was required for some reason. There are two good software solutions, one from an American company called Sublogic and another courtesy of myself.

Sublogic have written what they have called a Universal Graphics Interpreter. The idea is that programs produce a file of data for the interpreter, and the interpreter then looks at this data and draws the corresponding lines and pictures on the screen. This has the advantage that if your hardware changes, you only need a new interpreter while all your programs and data files need not change.

Interpreter commands include drawing lines, dots, polygons (shaded or unshaded), ellipses, moving the cursor or origin and setting various display modes. Things may be done single precision (8 bit) or double precision (16 bit) and the interpreter does its best to fit what you want done onto the display for which it was written. ▶

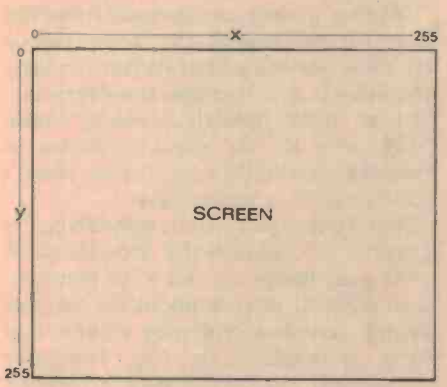


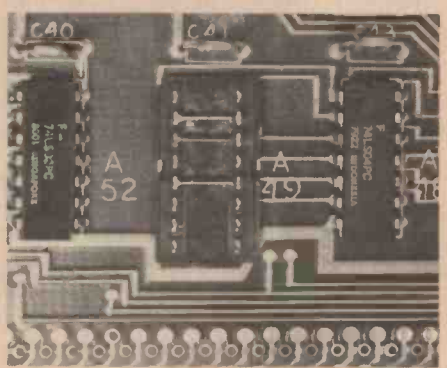
Figure 1. Pixels are addressed with x and y co-ordinates.

TABLE OF I/O PORTS

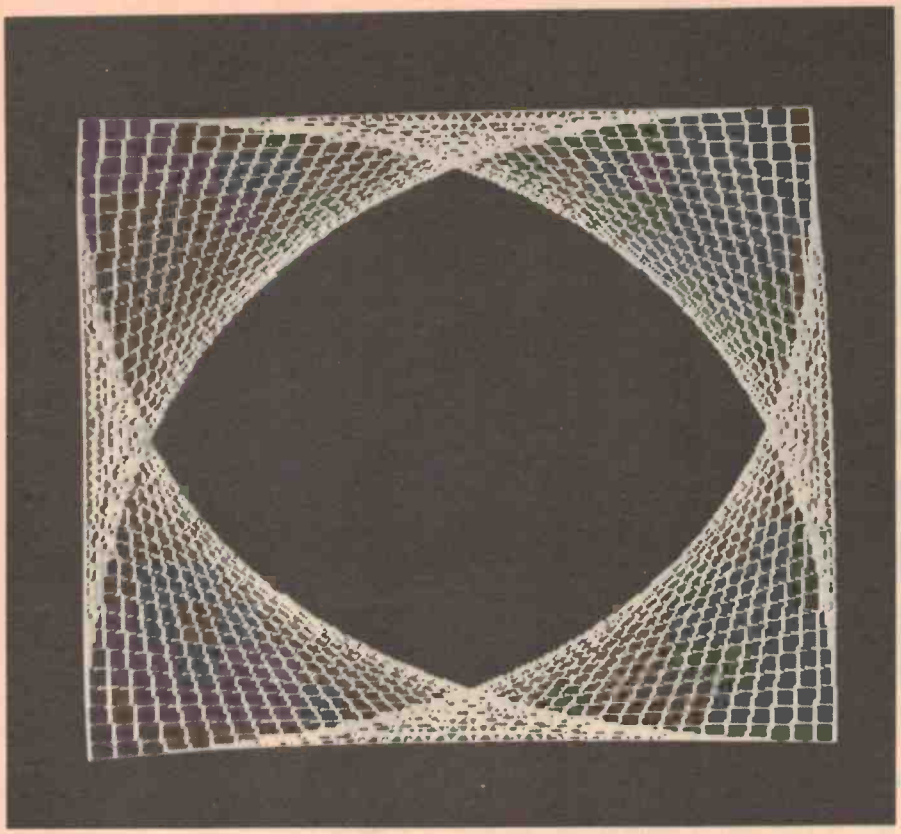
Write ports:
- b+0 Dot intensity
- b+1 X address
- b+2 Y address
- b+3 Erase

Read port:
- b+0 Status

b is the base address of these ports and is any multiple of 4.



Jumpers convert the board from 60 Hz to 50 Hz operation.



Writing the program to generate a pattern like this is very difficult if you use BASIC. It's relatively simple in PASCAL. A related pattern is shown on the facing page, together with the program used to generate it.

While this approach is a good one you would really need at least one disk drive and a good operating system to use the software package effectively.

Unfortunately the wrong Sublogic interpreter was given to us with the board, so we never got a chance to use it. Obviously we needed some method of drawing pictures for the photos you can see in this article.

All we wanted was three functions: clear the screen, set or reset a dot and draw a line between two points. These individual functions should really be written in assembly code for speed and should be linked into some higher level language. BASIC is not the obvious choice, and is about the worst choice we could make for this task. The juggling of variables required and the difficulty in interfacing assembly code subroutines (let alone passing parameters to them) ruled out BASIC. In fact a good langauge to choose is PASCAL and the above assembly code routines were quite easy to link in as procedure calls, with parameters passed in the usual fashion.

The PASCAL program that produced the triangle pattern is shown on page 117.

The hardware

Having covered the software aspects of the ALT-256, it would be a good idea to look at its hardware, and our impressions of it.

On the plus side the boards are stackable, and may be selected for 50 or 60 Hz operations, as explained above. Besides these there are only two other nice aspects of the hardware that deserve mention. These are that there are no screen flickers during processor accesses, and the picture on the screen is rock stable.

In the category of "nasties" there are more than just trivial things, which isn't very satisfactory. The major shortcoming of the board we feel is that you cannot test a bit on the screen. In other words the board has write only memory (or WOM). This may not seem to be a problem if you are using Sublogic's interpreter but if you are writing interactive software, games or simply drawing pictures with a joystick you have to maintain a duplicate copy of the screen in system memory. This slows down screen accesses, because the duplicate copy has to be updated as well, and complicates programs quite unnecessarily. We cannot understand why such a feature on a supposedly very good board was omitted.

The second non-trivial shortcoming is that the position of the video data with respect to the vertical and horizontal synch pulses is fixed, in other words you cannot move the picture up and down or left and right to centre it on your monitor screen. Although on our monitor the whole picture was visible, it certainly wasn't centred, and it is quite possible that with some monitors it would be necessary rather than just nice to be able to move the picture.

The only trivial hardware "nasty" of the board is that it is 145 mm high — even though Matrox's catalogue specifies that the ALT-256 is a 135 mm board. This is only a minor detail but if the accepted thing is to have 135 mm cards, why make one that is 145 mm high? Anyhow, just be careful if you want to plug this card into a close fitting card cage — you may not be able to get the lid on!

The ALT-512

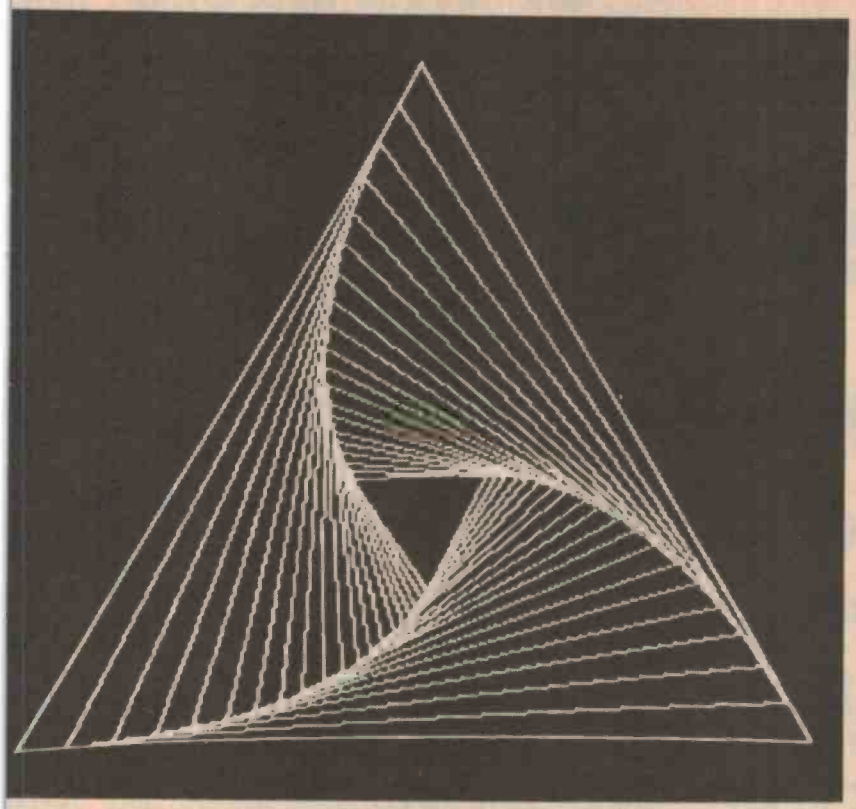
This board is the big brother of the ALT-256, and is the only other S100 graphics board that Matrox makes. There are no prizes for guessing that its display format is 256 by 512 by 1, but that is only half true. The ALT-512 allows you to select under program control one of eight display modes, including 256 by 512 by 1, 256 by 256 by 2 (4 grey levels) and 256 by 256 by 1. In the last mode the processor may write into one 256 by 256 by 1 plane while the other plane is being displayed, which is ideal for applications in animation.

The price

Both the ALT-256 and ALT-512 are available from Measuring & Control Equipment Co Pty Ltd. Their postal address is P.O. Box 78, Epping, NSW 2121, and their phone number is (02) 86-4060. These two boards are available only in assembled and tested form, and come with a three month warranty. Now for the bit that hurts; the ALT-256 will cost you $474 and the ALT-512 considerably more at $695. Neither of these prices include sales tax, so you will have to add another 15% if you have to pay tax.

Matrox boards are obviously just the thing for the OEM market where people are after assembled hassle free modules and price is a more minor consideration. But as most hobbyists would think, $474 is a lot for eight kilobytes of memory, especially when the board isn't quite as good as it should be.

Now I think you will be wondering "Is it worth it?". This really depends upon what your budget is and what you may need it for. If you are about to buy your second hard disk, you may want one of these to brighten up your computer room, but if you have to save up for each month's ETI, you needn't think about buying a Matrox board yet.



```
program triangle;
   uses drawline;

   const ratio = 0.06;
   var new, old : array [1..6] of real;
      count, count1 : integer;

procedure newpt(var x1,y1 : real; x2,y2 : real);
var m, b : real;
begin
     line(round(x1),round(y1),round(x2),round(y2),1);
     if x1<>x2 then begin
          m := (y2 - y1)/(x2 - x1);
          b := y1 - m * x1;
          x1 := x1 + ratio * (x2 - x1);
          y1 := m * x1 + b
     end
     else y1 := y1 + ratio * (y2 - y1)
end;
begin
     clrscr;
     new[1]:=128;new[2]:=0;new[3]:=0;new[4]:=255;
     new[5]:=255;new[6]:=255;
     for count := 1 to 20 do begin
          for count1 := 1 to 6 do
               old[count1] := new[count1];
          newpt(new[1],new[2],old[3],old[4]);
          newpt(new[3],new[4],old[5],old[6]);
          newpt(new[5],new[6],old[1],old[2]).
     end
end.
```

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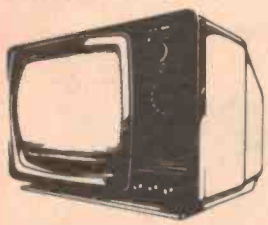

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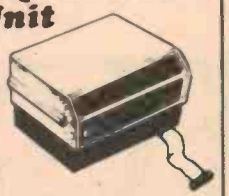

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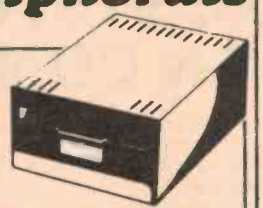

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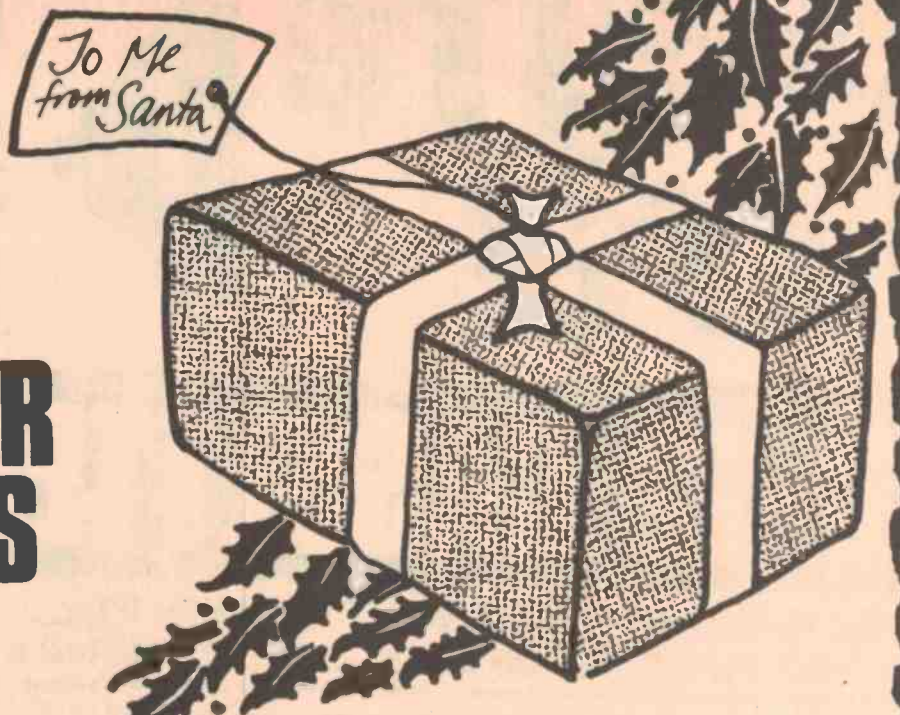

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AT.004

Micros invade the communications world

Microprocessor technology has begun to change the style of radio communications equipment, making it lighter, more effective and easier to operate and service.

F.E. Phillips

THE INCREASING use of large scale integration and particularly the microprocessor has had a major influence on product design to the extent that modern radio communications equipment is becoming rather like the snack bar menu, 'chips with everything'. Almost no area of communications is escaping the relentless onslaught of the increasingly powerful microprocessor and other associated LSI products.

Chips are finding applications in control and display functions as well as providing memory and computing functions. In the near future we can expect that they will be used for improved fault location and diagnosis; circuit operations like frequency synthesis and automatic gain control; demodulating, decoding, handling and printing of data; and as the controlling link between synthesisers and preselectors.

An added benefit of the use of LSI is the general reduction in both size and weight over the modules that they replace. This is particularly apparent in the military field, where reduction in size and weight of manpack equipment, the simplification of controls, and the growing need to be able to handle data efficiently are the predominant issues.

The Redifon R1006 receiver can control up to 99 remote receivers over any distance by ordinary telephone lines or radio links as appropriate.

Ease of operation

But the services have one problem that they share with industry. They too find it increasingly difficult to recruit and train personnel of consistently high calibre. Consequently, unless the new equipment can be operated and serviced effectively — the advantages in performance will be largely lost. This problem has been closely studied by communications equipment designers. The solution has been to incorporate microprocessors into communications equipment; thus the intelligent receiver has been developed. Such a receiver clearly opens up a number of interesting possibilities.

For example, if the receiver can be arranged to have its own channel information storage, the frequency, mode, bandwidth and other parameters for a particular operating state can be stored against a particular channel number. This enables the user to preprogram the channels he most frequently uses. Change of data can be effected quickly whenever required and without affecting the receiver's current operating status.

Having given the receiver storage for channel information and mode of operation, it is a simple matter to instruct it to scan through a number of channels for traffic. To achieve this, the number of each channel to be scanned and the dwell time required can be fed into the receiver.

If the receiver has the software for a scan capability it is easy to program it to sweep between two frequencies. In this instance, the only information required is the upper and lower frequencies of the sweep, the sweep increment and the dwell time on each increment.

These examples show just a few of the possible functions which can be delegated to the receiver to reduce the load ▶

on the operator simply by changing its software. Obviously many other automatic functions can be programmed in to suit given operational requirements.

For instance, Redifon has just arranged to fit R1000M marine receivers to three British Post Office cable ships. Programmed with the channel information for shore stations and linked to a telex machine, the receivers will scan pre-determined channels for traffic, enabling telex messages to be passed virtually automatically and without time delays. This will remove from the operator the need to listen through long traffic lists broadcast by the shore stations and then have to set up the necessary links.

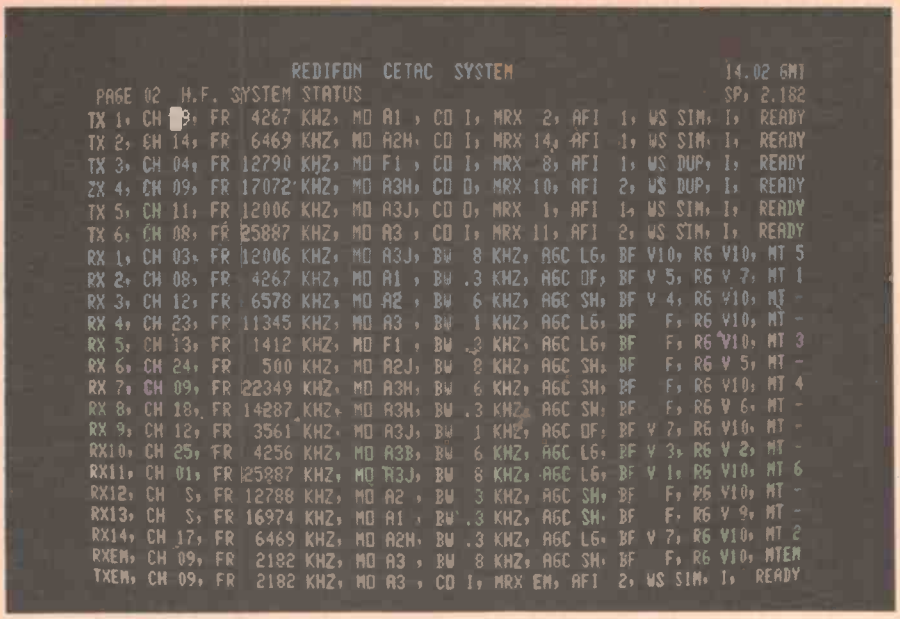
It will be readily appreciated that an intelligent receiver can be used not only for local, but also for extended and remote control applications. The problems that hitherto faced the designer of computerised control systems for remote installations were principally tied up with the sheer volume of data involved. There was no feedback of information from the remote installation, which meant that the overall level of confidence in the system was low. Furthermore, it was not possible to separate the control facility by much more than 1km without prejudice to system reliability.

The high data rates involved meant that digital control over either telephone or radio links was not possible without interface problems. In fact, the use of high speed serial data of non-standard format would have involved the design of special interfaces for the control computer and also special equipment to test the complete system — clearly not a desirable situation in the light of current trends to achieve compatibility between civil and military networks.

Control simplicity

Again, the microprocessor has changed all this. These control limitations have been overcome in a positive way which has extended the system flexibility without increasing the complexity of the control system and without recourse to special interfaces.

Such a receiver for local or remote control applications could, for example, incorporate a microprocessor with 6K of ROM, a 1K RAM and two serial input/output ports. This overcomes the problems described previously because the volume of data that is sent to each receiver is greatly reduced by sending only those parameters which need to be changed. If it were desired to alter the bandwidth of a receiver then all that need be sent is a label, saying that the data is bandwidth data, and then provide the new bandwidth instructions. By this means, the data rate can be kept down to 600 baud yet still retain an adequately fast response time under manual control. This latter requirement is important as it gives the operator the same 'feel' as is achieved with local control.



A typical CETAC page readout immediately identifies current operational status which can be pre-programmed and amended by simple keyboard operations.

Secondly, once the microprocessor in the receiver has received the data, it then retransmits it back down the line. So a revertive data capability now exists, which allows for built-in self-checking and enhances operational confidence.

Thirdly, such a system can be designed to use asynchronous ASCII characters for its data format. The big advantage of this is that any device which can produce ASCII characters can now control the receivers. Therefore, control can be derived from any standard serial input/output board, whether this be a computer, VDU, teletype or any other similar device. This really is what distributed processing is all about!

Furthermore, the data format can be designed so that error correcting modems can be used in the transmission path, thus enabling control to be achieved over less than perfect paths. Full control is therefore possible over virtually any distance by line or data link. The need for special interfaces is eliminated and consequently, it becomes much simpler to test the complete system. Of course, as the volume and rate of data are low the receiver can be used for remote control applications over ordinary telephone lines, as well as for local systems.

A particular application would be in the area of frequency synthesis, where the basic synthesiser can now be made by LSI technology, but where a large number of discrete peripheral ICs are still required for interface with control display and other interdependent functions. The microprocessor can sweep some of these ICs out of the way.

Digital AGC

A persistent problem in HF receivers has been the AGC. Here the microprocessor can easily out perform analogue systems.

Microprocessors can also be used for a host of other applications such as diversity analysis and diversity combining. Methods can be used which are quite unlike currently available analogue combiners and a reduction in error rates by a factor of ten is possible.

There is yet another complete area where the microprocessor will be used. This is in the demodulation, decoding, handling and printing of data. Whilst this may not actually be done in the receiver itself, it may be carried out by a very compact unit.

All the above applications really come under one heading — signal processing. The sheer complexity of functions per chip have now made digital filtering a reality. In the past, the accuracy of analogue filtering was determined by the quality of the component parts used. Now the only really critical component is the crystal reference and the practical limitations to accuracy are the number of bits per word and the processing speed.

Last but not least, a microprocessor

can test its own systems and diagnose any fault in them. A particularly important tool for achieving self-test is signature analysis. The elegance of a system based on signature analysis is that the signature print can be stored in the processor memory itself, thus simplifying test procedures.

In the longer term microprocessors may well take over most of the signal processing of an HF receiver. Most of the data or information that is handled by such a receiver is at a relatively low information rate and, therefore, if the information can be processed at the actual information rate as opposed to the RF frequency, it is quite possible that microprocessors could do a large proportion of the signal processing. This is likely to lead to a receiver comprising an RF filter and first mixer followed by a microprocessor which would perform the remaining functions. Such a receiver would have no filters, no crystals — except for a very accurate clock — and very little analogue circuitry.

The real bonus however, arises from the nature of digital processing. So far the tendency has been to think more in terms of the accuracy and reliability of digital versus analogue systems. The advantage of translating communications intelligence into a digital format is that it can easily be stored and processed according to need, i.e: signal processing need no longer mean adhering to a fixed format for processing but can be designed for adaptive processing.

Systems applications

Having discussed the application of microprocessors to equipment, it is worth looking at their applications in the management of complete communication systems. With the complexity of modern communications, experience has shown that at times of high activity or stress operational errors can and will arise. The incorrect selection of frequency, channel, mode or even equipment could, in a military context, result in catastrophic loss of communications. In addition faults or breakdowns in hardware require valuable time to locate and repair. However, these problems can be overcome by centrally controlling the system with a minicomputer and its associated equipment to exercise control over distributed processing built into the system.

One such system is the Redifon CETAC. Originally designed for the management of fighting ships communications, it is equally applicable to land-based civil and military communications. The heart of the system is a central control unit employing a mini-computer with VDU and keyboard. This controls a range of standard, digitally-controllable communications equipment (HF/VHF/UHF), transferring the control data along data highways using conventional multiplexing techniques. These data highways carry the command and tuning data to the transmitters, receivers and ancillary units.

The system memory allows for the programming of several separate action states. This gives the operator the facility to recall on the VDU at a single keystroke the operational modes of all equipment needed in any particular action state for status verification.

New generations of equipment will probably feature a greater degree of module commonality so that modules fulfilling roughly similar functions in different equipment will tend to become standardised in the same way that the motor industry has adopted a common approach to such things as door handles, alternators and ignition systems. ●

This article has been reprinted from the March 1980 issue of Communications International. Communications International is published at 40/50 Hatton Garden, London EC1N 8XS, England by Northwood Publications Limited, trade and technical publishing division of the Thomson Organisation Ltd. We are indebted to Vicom International for supplying us with the article and photographs.

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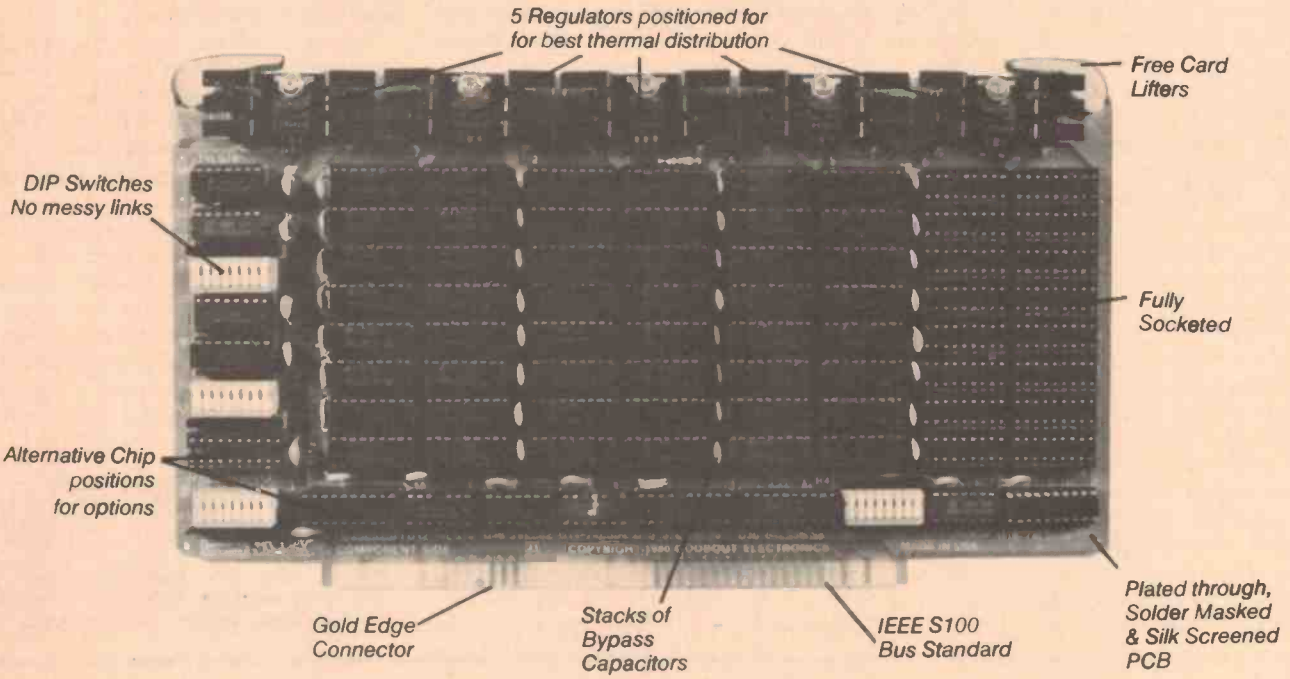

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COMMUNICATIONS

Six metres "buried"

— but it ain't dead and gone !

Two days after multicultural ("ethnic") TV went to air on channel 0 at the end of October, a group of Sydney amateurs "buried" the six metre band.

The mock funeral was held on 26 October outside the Gore Hill studios of ABC TV as a protest against the use, "temporary as it might be", of channel 0.

A group of some 15 people carried a coffin from the ABC studios to Gore Park where they buried their beloved six metre rigs. Quite a bit of media coverage was obtained, news teams from channels 2, 7 and 10 attended as well as several radio stations and newspaper reporters.

The Sydney Morning Herald carried a small piece on the event the following day.

A "Sydney Channel 0 Action Group" was formed subsequently with the aim of (1) educating the public about the interference-prone channel 0 and its alternative, channel 28; and (2) promoting the utilisation of the amateur six metre band as a portable/mobile/handheld band. The group feels that aim (2) is imperative to sustain interest in the band.

Frankly, we disagree. Any TVI that arises from operating on six metres is the fault of (a) the TV set, (b) antenna deficiencies or (c) antenna/feedline problems — that is, apart from straight front-end overload. In any event, the onus is on the TV set owner to have the problem rectified, not the amateur.

Your scribe once lived in a valley in one of Melbourne's eastern suburbs — and operated AM on six metres (those were the days . . .) following the introduction of channel 0 there. The RI had in excess of 120 TVI reports to 'cure'. He made the points I just made. If you operate six metres, as I do, and intend to 'pack up and go on some other band', as I don't, then you should re-think your position carefully.

They may have "buried" six metres, but "the awakening" is yet to come!

Roger Harrison VK2ZTB

Requiem for six metres, Gore Hill, Sydney (pix: Sam Voron VK2BVS)

National VHF Field Day

For many years there has been much discussion about a nationally-coordinated VHF field day.

Many VHF field days have been held over the years, but they have generally suffered from being only state-wide affairs.

The Geelong Amateur Radio Club from Victoria has decided to accept the challenge to co-ordinate a national VHF field day weekend.

It was decided to hold the contest when interest is highest — during the annual Ross Hull contest period — hopefully giving added impetus to the event. The Ross Hull rules and scoring have been adopted for the National VHF Field Day to keep the two contests compatible for scoring and log-keeping purposes.

The contest period is any 24 hours within the first 48 hours of the Ross Hull contest. Only entries from portable stations will be accepted. A station is deemed portable when more than 2 km from his home QTH. No equipment may be set up more than 24 hours prior to the start of the contest. Power may be derived from any source available. A scoring contact may be made with the same station on the same band repeatedly provided at least four hours elapse between successive contacts. Each entry must include a front sheet giving details of station, location and score claimed.

All entries will be acknowledged and certificates will be awarded to the overall winner plus the highest scorer in each call area. All entries to "Contest Manager", Geelong Amateur Radio Club, P.O. Box 520 Geelong 3220 Vic.

VK2DTE on the air !

A new callsign — so what ? This one's different — it belongs to the Modern Magazines Electronics and Communications Club !

That's us folks!

There being five hams more or less on staff — Roger VK2ZTB, Phil VK2DKN, David VK2YMI, Jonathan VK2YBN, Simon VK2YAZ plus a number of correspondents and close associates with callsigns, we thought it a good idea one night, over a few synergistic beers, to form a club and apply for a club call.

VK2DTE is the result. So, if you recognise the callsign on the air, you're welcome to break in and say hi!, or whatever takes your fancy (and complies with the regulations!).

The Gosford Convention

Yes folks, it's on again. The 24th annual field day (convention, really) of the Central Coast Amateur Radio Club will be held on Sunday 22 February 1981.

All the familiar goodies and events are planned: scrambles, foxhunts, disposals, trade displays, outings etc. Read all about it in next year's first issue!

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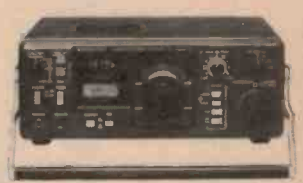

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JANUARY 1981

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KEY TO SYMBOLS

A blank area means no normal propagation is possible.

● . . . path open less than 50% of days in month.

% . . . path open 50-90% of days in month.

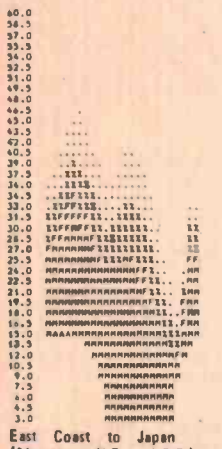
F . . . path open at least 90% of days in month.

X . . . complex mixture of modes. Expect abnormal propagation.

M . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

A . . . High absorption indicated. Expect weak signals.



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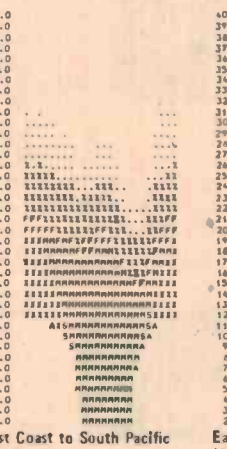

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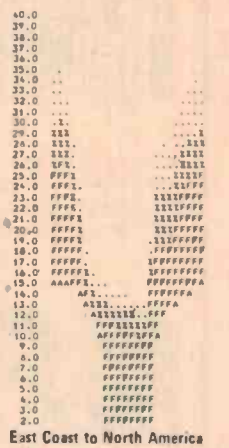
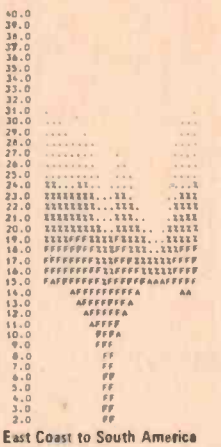
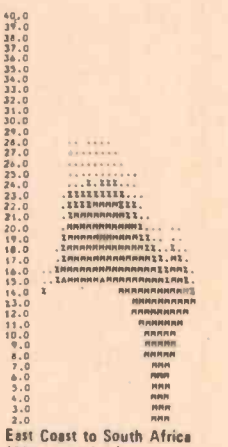


East Coast to North America
(Also serves N.E. and S.C.)



East Coast to South America
(Also serves S.C.)

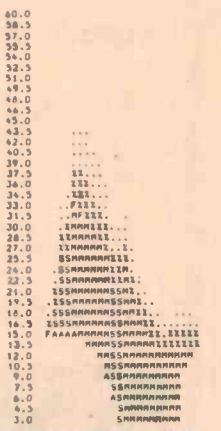
East Coast to North Africa
(Also serves S.C.)



East Coast to South Africa
(Also serves S.C.)

East Coast to Europe
(Short Path)

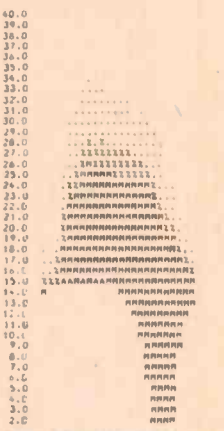
E.C. and S.C. to Europe
(Long Path)



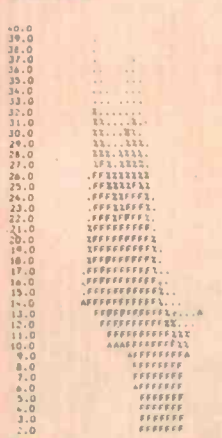
East Coast and S.C. to Persia

North East to South Pacific
(Also serves S.E.)

North East to North Africa

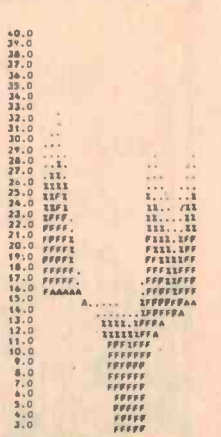


North East to South Africa

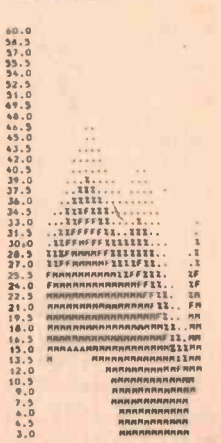


North East to Europe
(Short Path)

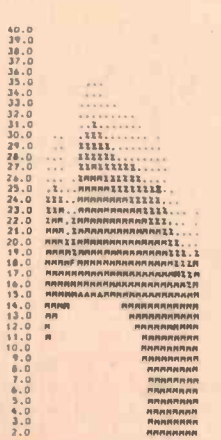
S. Central & W.C. to Europe
(Short Path)



West Coast to North America



West Coast to Japan



West Coast to North Africa

West Coast to South Africa

THE RECEIVER

WIN A TRIP TO HONG KONG CONTEST
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Cat. D-2840

First the incredibly popular FRG-7. Then the FRG-7000. Now a brilliant new all mode, general coverage receiver with all the features the keen amateur or short wave listener really needs. Digital Display — reading from 150kHz to 30MHz! This also doubles as a highly accurate crystal controlled clock. Wide dynamic range. Selectable AGC. All mode (including FM and 3 widths of AM). Optional twelve memory channels with backup. A remarkable piece of solid state engineering — and it is actually cheaper than the FRG-7000 (and many other 'similar' receivers on the market). Ask to see one soon at your nearest Dick Smith store or re-seller. . . . . .Magnificent!

Freight $6
Below cost anywhere in Aust.

$525

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Memory Unit extra

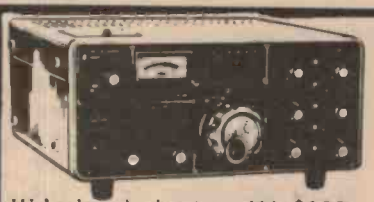
NEW FT480

- **All mode 2 metre SSB/CW/FM!**
- **Microprocessor controlled**
- **Digital display!**
- **30 watts PEP**

$543.00

OR FROM $63 DEPOSIT AND $26.28/MONTH (24 MONTHS)

This is the one they're all talking about: the fabulous new 2 metre all-mode transceiver from Yaesu. Offering outstanding performance and ease of controls, it must be **the** transceiver of the eighties! Cat D-2887



SAVE ON FT625!

ALL MODE 6M

WAS $795.00 . .
NOW ONLY

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We've knocked an incredible $100 off the price of these popular all-mode 6 metre rigs. There's still plenty of good DX out there on 6 – and the FT-625 is just the transceiver to get it! Cat D-2886

NEW FT707

- **All HF bands!**
- **AM/SSB/CW!**
- **Tiny Size!**
- **True digital display**
- **New WARC bands!**

$765.00

OR FROM $85 DEPOSIT AND $22.86/MONTH (48 MONTHS)

They've been pretty hard to get; and small wonder! The superb FT-707 packs a huge punch from its tiny size: 240W DC! It's the ideal rig for mobile, base or portable work. Cat D-2869

SUPERB FT-207

- **Microprocessor controlled hand held giving full 144–148 band!**
- **Digital display.**

$358.00 Cat D-2888

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For today's active ham, this is the set to take with you. Takes up virtually no room, but really gets out! Make contacts wherever you go with the FT-207R.

NEW FT107M

- **The ultimate!**
- **WARC bands**
- **All solid state**
- **Variable IF bandwidth!**
- **Speech proc.**

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OR FROM $138 DEPOSIT AND $38.32/MONTH (48 MONTHS)

It must be every amateur's dream to own one of these! You can: and take full control of the bands. Whatever you want from your transceiver, the FT-107 offers it! Cat D-2871

BUDGET FT-101Z

We throw in a digital display kit worth over $100! This turns the FT-101Z into an FT-101ZD!

More hams have 'cut their teeth' on one of the famous '101' series than any other rig! Rugged and reliable, with all the features you really need. Cat D-2862

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New Indian programme for DXers

All India Radio has joined the growing ranks of international radio stations which have a weekly programme specifically for shortwave DXers and shortwave listeners.

The new DX programme was introduced during October, and goes to air every week during the Monday English programmes.

For listeners in Australia and New Zealand, best reception is during the service beamed our way from 1000 to 1100 each evening. Current frequencies for the nightly Australia and New Zealand service from Delhi are: 17 875, 15 285 and 15 205. Keep in mind that frequencies are subject to change at short notice. Any frequency modifications are usually announced on air a few days in advance.

The programme, scripted by well-known Calcutta DXer, Alok das Gupta, will include each week a phone-in report detailing the very latest available news of happenings on the shortwave bands.

With All India Radio and Trans World Radio on Guam recently introducing DX programmes, Radio Australia is left as the odd station out, in that Australia's overseas service is one of the very few international broadcasters in the Asia/Pacific area not to have a programme in English for DXers and shortwave enthusiasts.

All India Radio would welcome listeners' comments and suggestions concerning the new DX programme, and any letters should be addressed to: The Director, External Services Division, All India Radio, Post Box 500, New Delhi.

Hot summer nights bring Africa

Summer nights often make for good listening on the higher frequency bands as far as signals from Africa are concerned.

Late night or very early morning listening can sometimes reveal strong signals from many countries which at other times of the year may be hard to log.

Signals from eastern and southern Africa usually start to become audible from about 1330 on the 31 metre band. Watch for Mozambique on 9618, which is usually one of the first signals to become audible, and Tanzania on 9685 and 9750. Zambia operates an Overseas Service in English from 1500 on 9580 and the Malawi Broadcasting Corporation operates from Blantyre on 7130 from 1600 with English news.

Radio Uganda has recently fired up its two powerful transmitters, each of 250 kilowatts, and one of these broadcasts from the northern town of Soroti with the English service on 6030 from 1430 to 1530. Probably the strongest African signals at this time would be from Addis Ababa in Ethiopia, from their station known as "Voice of Revolutionary Ethiopia", operating the English service from 1500 to 1600 on both 9560 and the parallel outlet of 7165.

Most of these stations will reply to correct reception reports with a verification card or letter, and these early morning broadcasts present the DXer with good opportunities to verify some of the countries of Africa which otherwise only operate on the low frequency or "tropical" bands below 5900 kHz where noise levels are an increasing problem in city locations.

Lesotho boosts signals

With the addition of new 50 kilowatt shortwave transmitters, the Lesotho National Broadcasting Service at Maseru has considerably increased the strength of their 4800 signal during our early mornings.

The two new transmitters were recently purchased by the Lesotho government in Britain, and installed at their transmitting centre at Lancer's Gap near Maseru. The station now provides good to very good reception on 4800 (Lesotho's only shortwave frequency) between about 1900 and sign off at 2110. Sign-off does vary and sometimes is as early as 2030.

Most programmes of the Lesotho National Broadcasting Service are in SeSotho, but occasional programmes in English are also heard, notably between 2000 and 2100 every Sunday (early Monday morning in Australia) when the LNBS carries a religious programme produced in Pennsylvania, USA.

The Lesotho station generally verifies correct reception reports with a QSL card showing the national flag, and reports can be sent to: Lesotho National Broadcasting Service, PO Box 552, Maseru.

Iceland coming in well !

As mentioned in our column a couple of months ago, Reykjavik Radio's recent time shift for their Home Service relay on shortwave brought this rarely heard country within reach for Australian listeners.

Reykjavik Radio is now heard fairly regularly on 12 175 during our early mornings from 1955 to 2000 with Home Service programming beamed for Icelandic seamen and Icelandic workers in Scandinavia. Programmes are in Icelandic and consist of news, comment, music and magazine features.

The programmes are relayed directly from the Home Service programming which is usually only broadcast on medium wave. The transmitter used on 12 175 for the Home Service relay from 1855 to 2000 is at other times used for utility broadcasting purposes.

The Iceland station has the reputation of being a good verifier of correct reception reports from overseas listeners. These reports should be sent to: Iceland State Broadcast Service Rikisutvarpid, P.O. Box 120 Reykjavik.

NOTE ! All times are given in Greenwich mean time (GMT). To convert to Australian Eastern Standard Time, add 10 hours (11 hours during Daylight Saving Time, November to February). To convert to Central Standard Time, add 9.5 hours and Western Time add 8 hours.

All frequencies are given in kHz.

These notes are compiled by Peter Bunn on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of the ARDXC may be obtained from P.O. Box 79, Narrabeen, NSW 2101, for a 22¢ stamp.

Let your fingers travel the world.

Sony proudly presents an exciting world receiver with FM & AM that gives you the best value in its class. Frequency synthesized "calculator-type" tuning of the LW/MW/SW bands offers unprecedented convenience, versatility and wide frequency coverage.

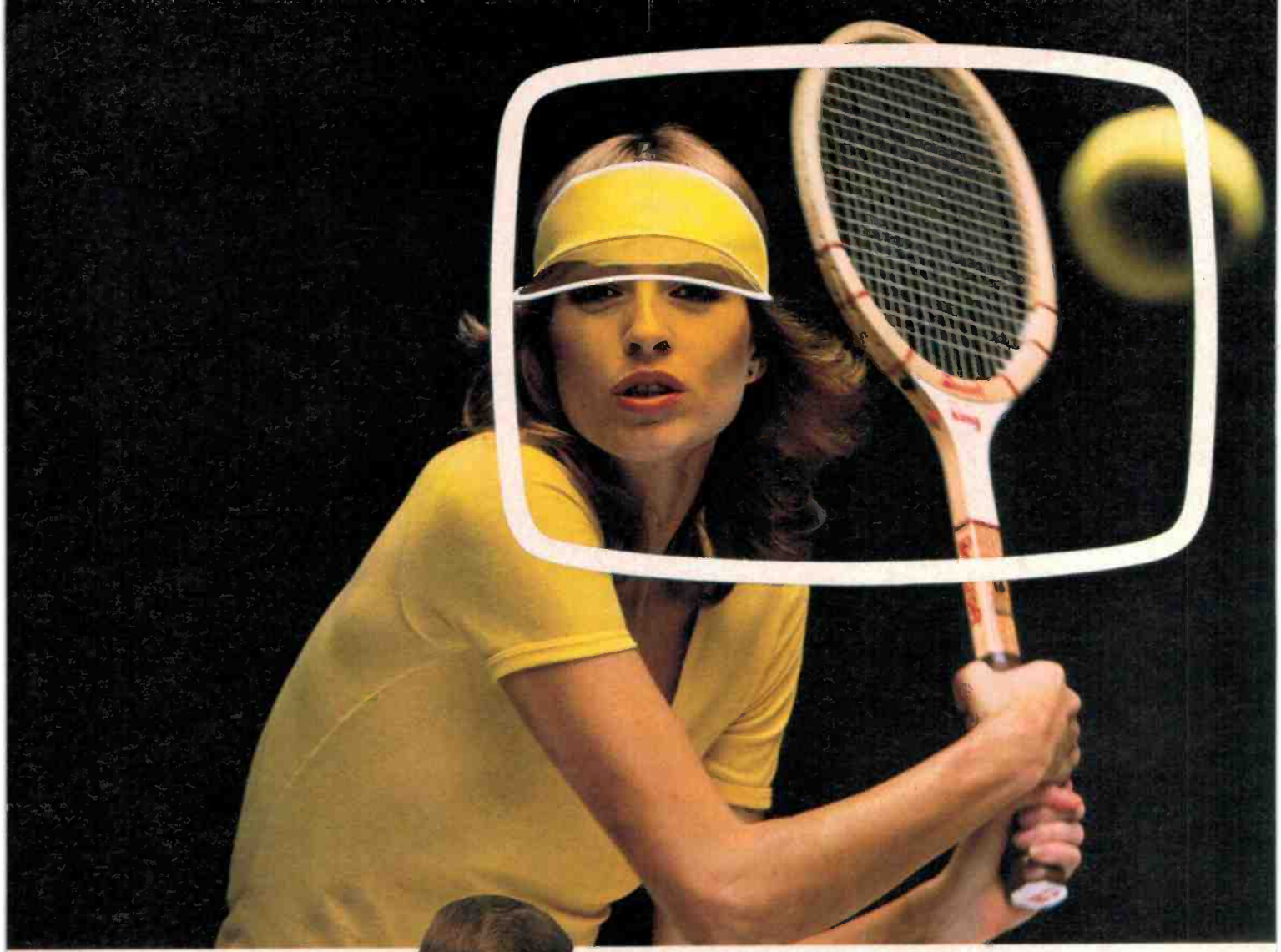
We call it the ICF-2001. It captures broadcasts with a push of a button from virtually every source on the globe including marine, amateur radio and other fascinating short wave transmissions. Even citizen band.

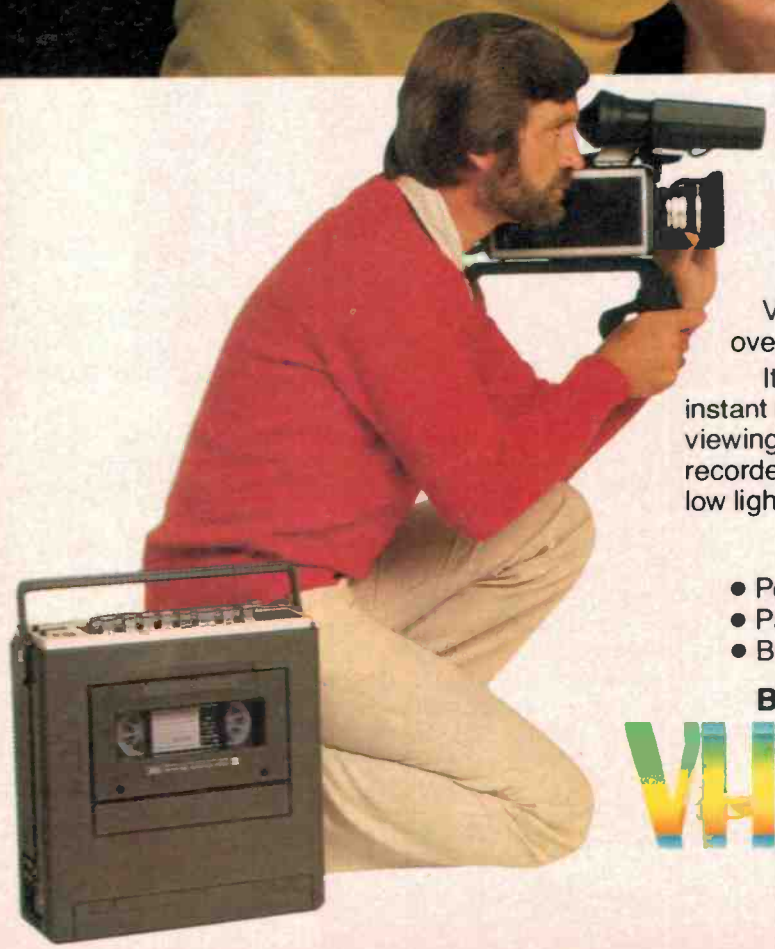
Now world travelers can hear where they've been and where they're going. Or "practice" another language. Or literally share another culture. But you don't have to be versed in complicated radio lore to enjoy your foreign adventures because our world traveler is marvelously easy to use.

Sophisticated technology such as a frequency synthesizer for extreme stability as well as a microcomputer gives you four different tuning methods for fast, easy operation. Direct Access, Memory, Auto Scan and Manual tune in the exact frequency you're searching for. They're push-button easy and only Sony gives you the communication spectrum at your fingertips.

Sony's ICF-2001 brings home the world. Bon voyage.

AP3529





Remember how great she looked last summer.

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Other features include:

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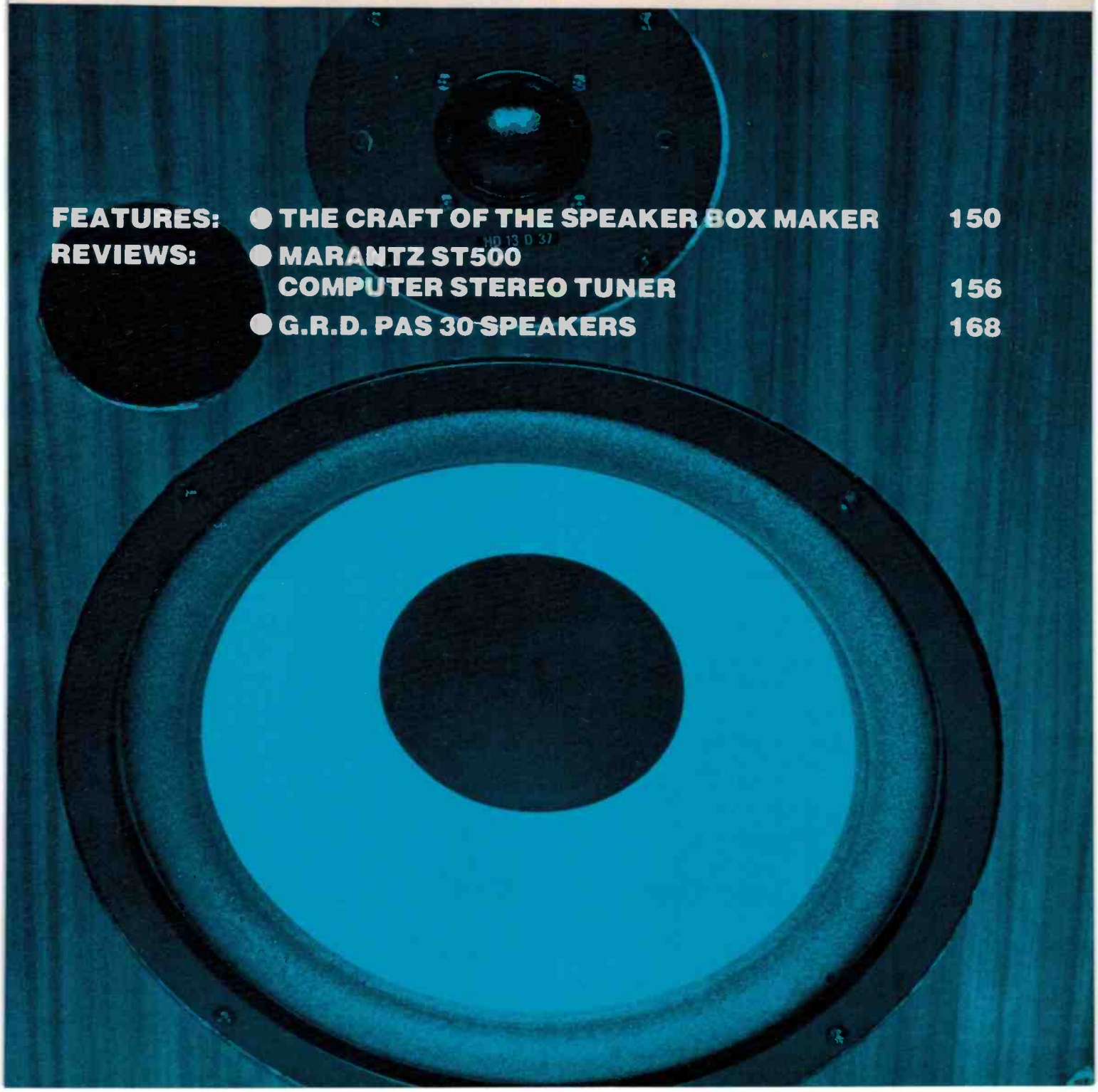
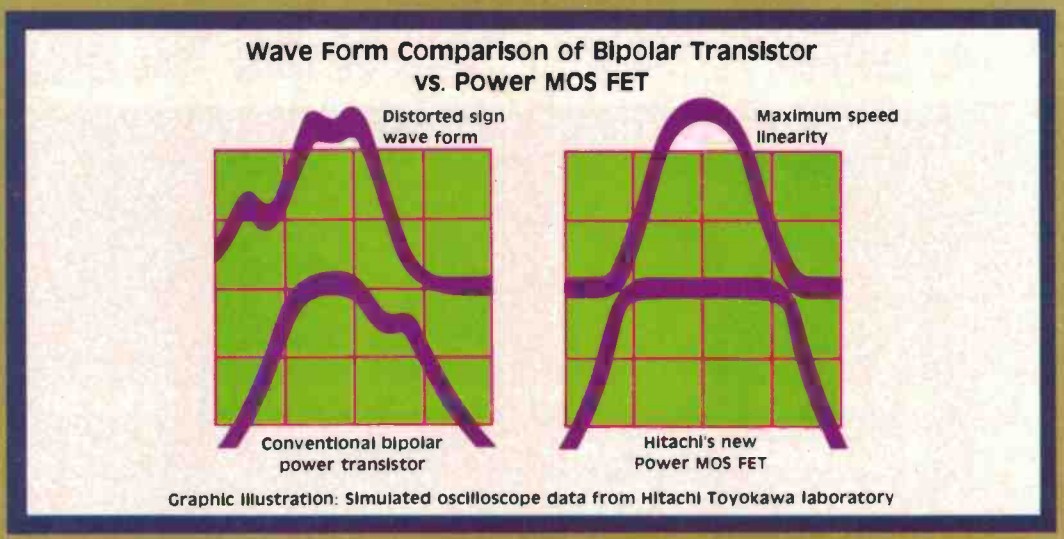


The world's fastest integrated amplifier



Hitachi Power MOS FET

HA-7700

The HA-7700 Stereo Integrated Amplifier brings you stunning sound reproduction. The Hitachi Power MOS FET offers ultra-high switching speed for dramatically reduced distortion and outstanding transient response. It features the same incredible technology that went into our renowned HMA-7500 Stereo Power Amplifier and HA-8700 Stereo Integrated Amplifier.

Power output is 70 watts per channel with no more than 0.008% total harmonic distortion from 20 to 20,000 Hz. And all stages are direct coupled, so you get the purest waveform reproduction fidelity from input to output.

The RIAA phono equalizer is a top-precision design employing only the highest-quality components for low-distortion and true-to-life disc playback. There's a full complement of control and convenience features for maximum system flexibility.

The HA-7700. True purity in waveform reproduction is here.

HITACHI

Hitachi Sales Australia Pty. Ltd., 153 Keys Road, Moorabbin, Victoria 3189 Tel: 95 8722

Forward thinking by Sansui

Sansui claim that their new Super Feedforward system completely eliminates all kinds of distortion in the power stage of amplifiers.

Feedforward techniques were actually invented 52 years ago by the same American scientist, H.S. Black, who later developed the negative feedback approach currently adopted in all hi-fi amplifiers.

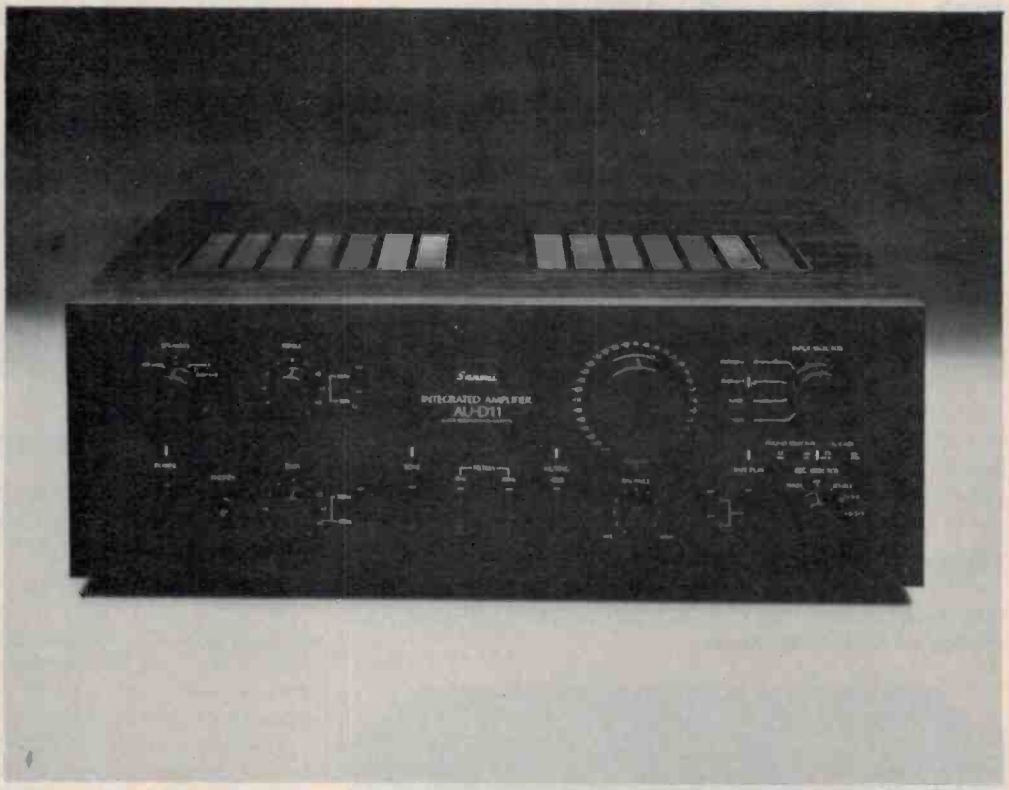
In principle feedforward involves taking a fraction of the amplifier output (actually 1/a times the output, where a is the open loop gain) and comparing it with the input signal to derive a difference signal which is fed to the output to cancel the distortion. The system has been successfully applied in communications equipment, but it has not so far been effectively used in hi-fi amps.

Sansui's feedback system combines feedforward in the power amp stage with a relatively low level of negative feedback applied to both preamp and power amp. In a manner they don't explain, they have arranged things so that the NFB operates mainly at lower frequencies and the feedforward at higher frequencies.

The first of Sansui's amplifiers in which the new Super Feedforward system has been adopted are two integrated amplifiers, the AU-D9 and the AU-D11. These have output power ratings of 95 watts and 120 watts per channel respectively.

Both have a built-in moving coil head amp, both are direct coupled and both feature the newly developed 'C1' core power transformer.

Total harmonic distortion does not exceed 0.005% for either of these amplifiers and the quoted frequency response is the same for each, showing a variation of no more than 3 dB over the entire range from dc to 300 kHz.



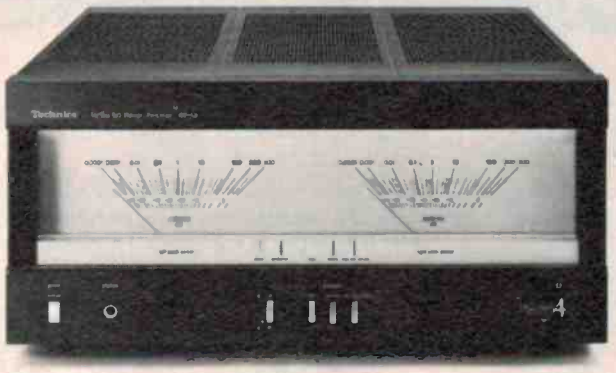
Audio level meter

Signal levels down to −72 dB can be measured by a small analogue meter recently available from Soundex.

The calibrated range of the AMM100 is from −72 dB to +22 dB. Input impedance is 100 kilohms, balanced, switchable to 600 ohms and the protected headphone output has an impedance of approximately 50 ohms, according to the specs.

The meter comes in a tough plastic case with a built-in mains adaptor and is small and light enough to hold in the hand. It's described as a multimeter, which is odd because it appears to have only one function.

For more information, contact the distributors R.H. Cunningham Pty Ltd, P.O. Box 4533, Melbourne, Vic 3001; (03) 329-9633 or P.O. Box 214, Neutral Bay Junction, NSW 2089; (02) 909-2388.



DC amp is really AB

Technics describe their new SE-A3 200 W per channel power amp as Class A, but we at ETI maintain it's really Class AB.

The reason for the disagreement is its 'synchro-bias' circuitry that samples the input waveform and adjusts the bias of the output transistors so that they are never quite cut off. This arrangement allows the efficiency of Class B operation without switching distortion.

We don't want to knock this amplifier though — its specifications are certainly impressive. Total harmonic distortion over the range from 20 Hz to 20 kHz is only 0.002% with the amp running at its full rated power into eight ohms. At 1 kHz, THD is only 0.001%. Transient intermodulation distortion is said to be immeasurably small.

Independent left and right channel power supplies keep the channel separation up to 70 dB and signal to noise ratio is extremely high at 123 dB.

Brochures available from your local Technics dealer. Tell 'em you read about it in ETI.

Plus Series Tuners

Two tuners are included in Sanyo's recently released 'Plus Series' of hi-fi components.

The slightly more expensive model T55 has a quartz crystal reference oscillator. Frequencies of this and the controlled oscillator are digitally divided by different whole numbers and the divided signals are phase locked together with a correction signal to keep them precisely in phase.

A two-position IF bandwidth switch allows selection of a narrow bandwidth for 80 dB alternate channel rejection when FM stations are closely spaced.

The Plus T35 AM/FM tuner has a sampling quartz locked tuning system. Tuning is simplified by the provision of a LED bar graph signal strength indicator and a 'centre of signal' position indicator. Both these displays use high gain dc-coupled voltage comparators.

For correct balancing levels when recording from the FM tuner onto tape, the T35 has a record level calibrator with adjustable output level. This provides a 400 Hz tone at a level equal to the level of the tone produced by an FM signal with 50% modulation.

Suggested retail prices are $470 for the T55 and $399 for the T35.

A new approach to noise

Phase Linear's new noise reduction system is claimed to reduce noise by 10 dB even on recordings that have already been Dolby or dbx processed.

The 1300 Series Two system is based on what Phase Linear claim is the principle that "The human ear doesn't hear noise when accompanied by music." It incorporates circuitry that recognises harmonic relationships. What the circuit recognises as 'music' is sent direct to the output stage; what it thinks is 'noise' is expunged.

But not all music nowadays consists entirely of harmonious mixtures of tones that an electronic circuit can recognise.

Much avant-garde serious and popular music uses some sounds that in other contexts would be considered noise.

Phase Linear's circuitry is probably not capable of sensing when this is happening and lovers of such music would perhaps be better off not spending $349 on a machine which is likely to impose a kind of aesthetic censorship on them.

Planar 2 released in Australia

The Rega Planar 2 turntable, once described by UK magazine Hi-Fi Answers as at least the third best in the world, is now available in Australia.

Intended as a 'budget' version of the renowned Planar 3, the Planar 2 turntable alone sells for $335. Price with its own tonearm is $445 and a cartridge adds a further $45 to the price.

The Planar 2 is fundamentally a very similar design to its illustrious up-market relative, with a few modifications to reduce the cost. The glass platter is somewhat thinner, the mat is also thinner and rubber backed instead of being all felt and the base is made of chipboard instead of laminate.

Rega Planar turntables are made in the UK and distributed in Australia by Concept Audio Pty Ltd, P.O. Box 422, Dee Why, NSW 2099. (02) 938-3700.

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Heavy.

Introducing another Sony only. The MDR series open-air headphones. The smallest, lightest stereo headphones available today. Or tomorrow.

With our lightest at 40 grams, you will barely know you're wearing them. Yet the sound is dynamite.

Through a remarkable new audio breakthrough, our engineers have succeeded in reducing big-headphone technology down to the size of your listening channels.

The MDR series headphones' airy spaciousness delivers absolute clarity through an ultra-small driver unit that produces more than three times the energy of conventional circuits. And a new high-compliance diaphragm accurately reproduces the 20 to 20,000Hz bandwidth and improves low-range response.

That means you can listen to the heaviest of music for hours. Lightly. And know that you're hearing every nuance of the original recording from deep bass to the highest treble.

Listen to our new MDR series headphones. They're light. And heavy.

STEREO HEADPHONES
MDR

AP3528

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Name .....

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Please send me ... Disco Lite units @ $49.99 each plus $2 post and handling. TOTAL $ .....

I enclose cheque/money order, No: .....

Signed .....

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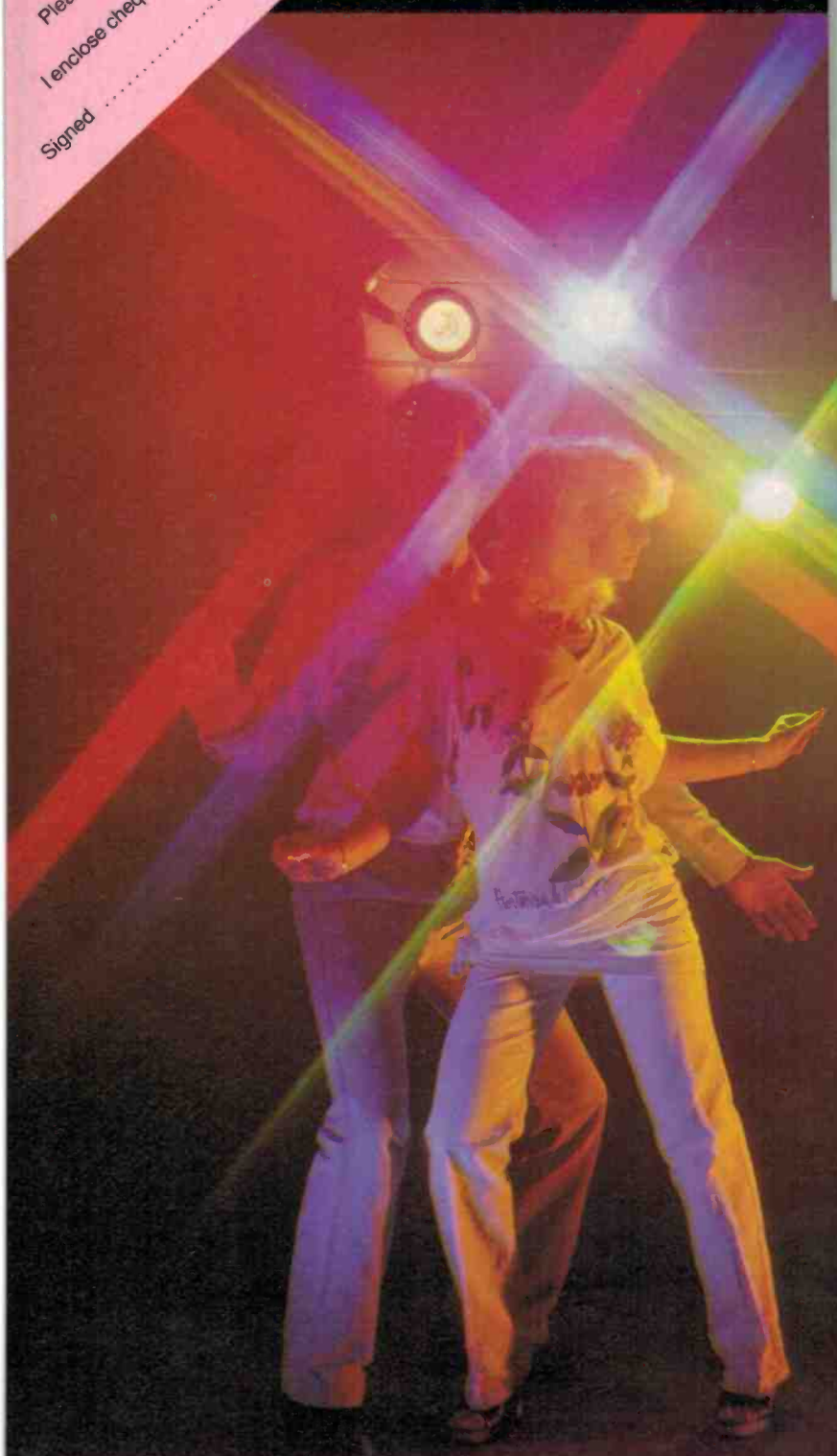
3-IN-1 LIGHT CONTROLLER



PC410

- Great for parties, advertising displays, Christmas tree lights etc.
- Light dimmer for mood and effects lighting
- Variable speed strobe
- Flashes lights to beat of music

FEATURES

• Plugs directly into 240 V power socket, no wiring needed • Three position switch selects (1) "music colour" (using coloured lights) that flashes lights to beat of music — built in microphone, variable sensitivity control; (2) "strobe" effects for flashing lights at variable speed; (3) light dimmer with variable intensity • Continuously variable control provides complete flexibility in all modes of operation • Can be used with 240 V filament lamps to the total of 500 watts • Double insulated • S.E.C. approved and fully guaranteed.

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This magazine is acting as a clearing house for orders. Make out your cheque or money order to 'ETI Disco Lite Sales'. We will process your order and send it on to A & R who will mail you the goods. Please allow up to four weeks for delivery.

The PC410 Disco Lite is a product of A & R Electronics, manufactured under the Arlec label.

While these units are sold through some retail outlets, they are not generally available and ETI has arranged to offer them to readers via mail order.

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Rare: very valuable.
Addi'tions: the things added.
Ma'rantz: a range of ultra-high performance FM Tuners which blend state-of-the-art engineering with operational versatility.

The name Marantz guarantees your choice from a superior range of AM/FM Stereo Tuners, guarantees exceptional quality and, with the advent of more FM stations, Marantz guarantees your total listening pleasure.

MARANTZ ST500
AM/FM STEREO COMPUTUNER

Sleek, slimline and microprocessor controlled — tune and recall stations with amazing speed and precision. The Computuner features state-of-the-art, quartz-locked, drift free frequency synthesised tuning with 7AM and 7FM memory presets. The LED signal strength display doubles as a multipath indicator and the Wide and Narrow IF Selector enables the switching of a tuning bandwidth best suited to reception area conditions.

MARANTZ ST600
AM/FM STEREO TUNER

This model incorporates a built-in oscilloscope that affords the most precise means possible to determine optimum reception, even from weak or distant stations. The functions of the oscilloscope extend well beyond those of conventional tuner meters.

MARANTZ ST400
AM/FM STEREO TUNER

A large, fuss-free Vacuum Fluorescent readout clearly displays the selected frequency and Electronic Gyro-Touch with Servo-Lock guarantees drift-free, razor-sharp tuning every time. Uncompromising quality through and through.

MARANTZ ST300
AM/FM STEREO TUNER

Consistent with all quality Marantz tuners, the ST300 features MOSFET FM front end and Phase Lock Loop demodulator for superlative performance — low distortion, extremely linear operation and wide dynamic range. Illuminated dial cursor, LED function indicators and Gyro-Touch tuning make the ST300 an exceptionally sophisticated buy at a modest price.

Your Marantz stockist will be pleased to demonstrate the complete range of Marantz tuners. If you see your hi-fi as an investment and, if you demand critical performance standards as well as the best value for money, listen to the future.

Listen to Marantz.

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sound news

TEAC breaks away from tape.

The introduction of a new amplifier system marks a break with TEAC's former policy of specialising in tape recorders.

The PA-7 preamplifier and its complementary MA-7 power amp are both direct coupled designs with exceptionally high slew rates. The MA-7 is claimed to have no more than 0.003% distortion from 10 Hz to 20 kHz and the PA-7's distortion is said to be less than 0.005% over the same range. TEAC neglect to say at what output power these figures were obtained.

To avoid damage caused by dc voltages appearing on the signal path (which can be very dangerous for a DC amp), the PA-7 incorporates special protection circuitry and muting relays that shut off the output if any signal below 2 Hz and above 60 mV appears. This same circuit prevents the popping noise that would otherwise appear because of power surge when the unit is switched on and also prevents clicks when switching phono inputs.

The PA-7 has a moving coil headamp built in. Input sensitivity on the moving coil input is 5 mV at 1 kHz and the frequency response is better than 20 to 20 000 Hz at ±0.2 dB for any input.

The MA-7 power amplifier can deliver 150 W per channel into eight ohms. It has completely separate power supplies for left and right channels.

Arena for A & R

The highly-regarded products of the UK company A & R will soon be marketed in Australia by Arena Distributors.

A & R's reputation is based on their A60 amplifier, a slimline unit with a nominal rating of 35 watts into eight ohms, whose success is largely due to its reliability and ability to cope with a wide variety of input sources without distortion. The company also make an FM stereo tuner and have recently introduced a moving coil head amplifier in response to demand from audiophiles.

The company is still basically a cottage industry, producing a relatively small number of units which are all subjected to rigorous checks before they are released from the factory.

For example, to test the overload protection, all amplifier circuit boards are given a short circuit on the output terminals for ten seconds at full power.

For more information on A & R products contact Arena Distributors Australasia Pty Ltd, P.O. Box 178, East Victoria Park, WA 6101. (09) 361-5422.

Audible demagnetisation

A tape head demagnetisation device just introduced into this country from the USA emits an audible tone that rises in pitch as the demagnetisation proceeds.

The Whistle Stop demagnetising cassette contains an oscillator whose frequency increases from below 60 Hz to well over 20 kHz in the course of six seconds after the 'Play' switch on the tape recorder is pressed. The oscillator output is applied to a built-in demagnetising coil that produces an alternating magnetic field of gradually increasing frequency.

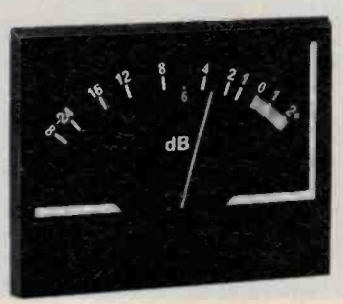
The oscillator output has a constant amplitude, but because the reluctance of the coil increases with frequency the amplitude of the alternating magnetic field at the heads steadily diminishes as the frequency increases. This results in effective demagnetisation of the heads.

The Whistle Stop comes in a standard size cassette case, equipped with its own batteries, and retails for $19.95. It is distributed in Australia by Concept Audio Pty Ltd, P.O. Box 422, Dee Why, NSW 2099. (02) 938-3700.

Scaling the peaks

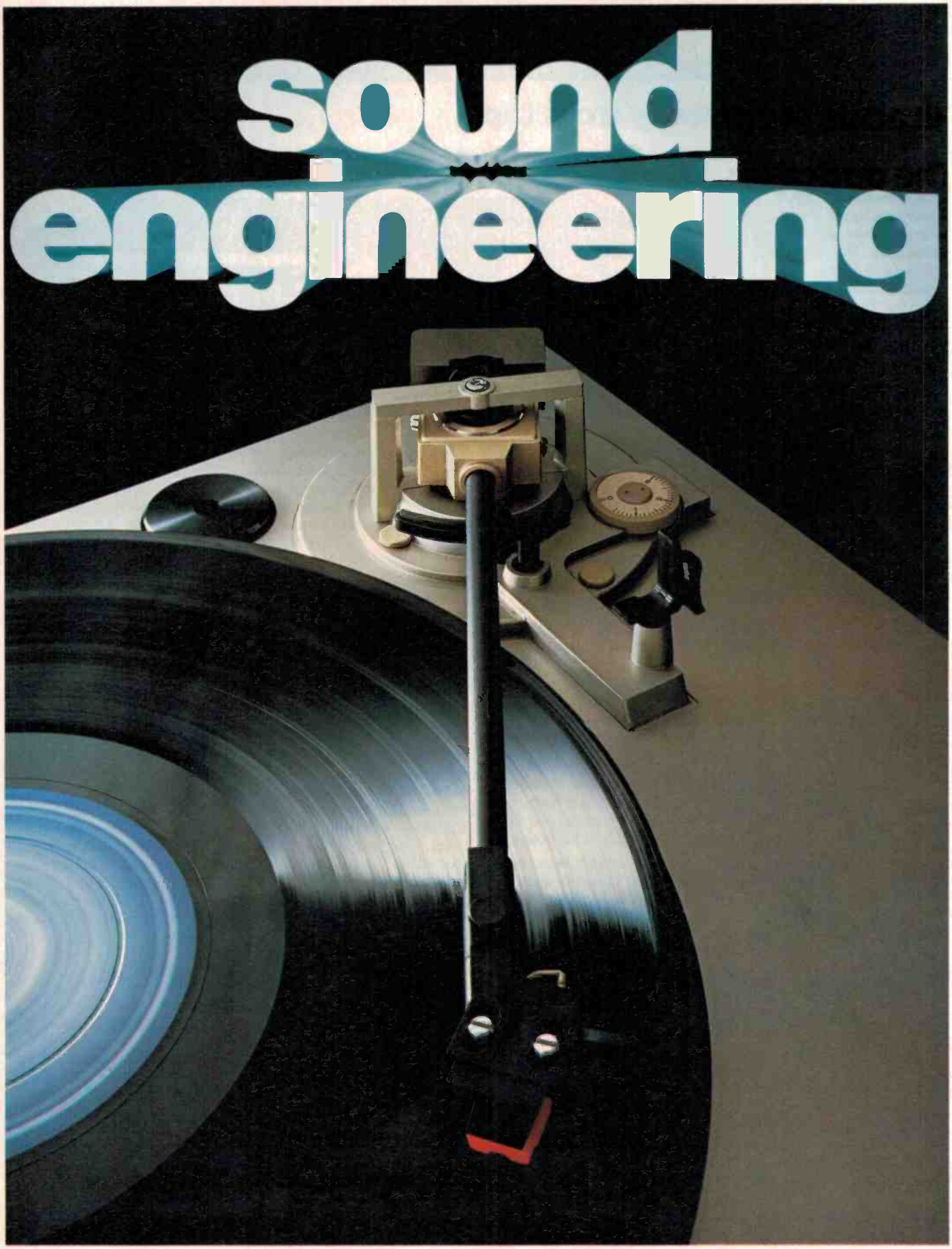
The Soundex division of Bulgin Electronics recently released a full range of audio peak programme meters.

They are available in three different standards in both single channel and stereo. The Series 100 was designed to meet the exacting requirements of the British Broadcasting Corporation, the Series 300 is designed to DIN 45406 and BS 5428 (Type 1) and the Series 400 is an economy version that closely resembles the BBC style



The meters comprise a sophisticated meter movement with fast ballistics and an amplifier with a high input impedance and low thermal drift. More information from the distributors, R.H. Cunningham Pty Ltd at P.O. Box 4533, Melbourne, Vic 3001. (03) 329-9633 or P.O. Box 214, Neutral Bay Junction, NSW 2089. (02) 909-2388.

sound engineering



HITACHI

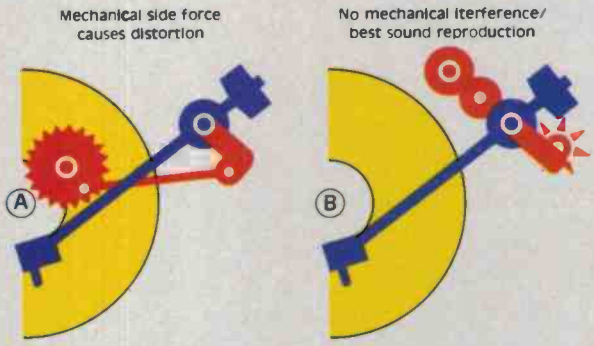
Hitachi's Photo Sensing Straight Tonearm

The optically-activated straight tonearm eliminates side force and reduces mass to keep the HT-60S Turntable in line with excellence.

The photo sensing straight tonearm is sound engineering. Precision engineering. Optical activation does away with the side force that's common to conventional systems. And the straight tonearm is significantly lower in mass, so sound quality is greatly improved. In the HT-60S Turntable these two design advances are joined by a Quartz-locked Unitorque motor. It makes every revolution of the platter exceptionally smooth. Wow and flutter is just 0.025% WRMS.

The benefits of non-contact switching are readily apparent – every time you play a record. Distortion-producing mechanical parts have been replaced by a light beam and a photo sensitive cell. There's no drag, less required tracking pressure and it's very reliable.

The straight arm is a responsive design that cuts resonance way down and resists oscillation. And it can be used with a variety of high-performance, low-compliance cartridges.



Ⓐ Conventional mechanical sensor tone arm return system
Ⓑ Hitachi photo sensor tone arm return system with LED

Graphic illustrations are reconstructed from Hitachi Toyokawa audio laboratory data.

The HT-60S Turntable is fully automatic, of course. But all auto functions are independently powered, so there's no drain on the main drive motor. And the controls for those functions are right up front. You never have to lift the dust cover to get to them.

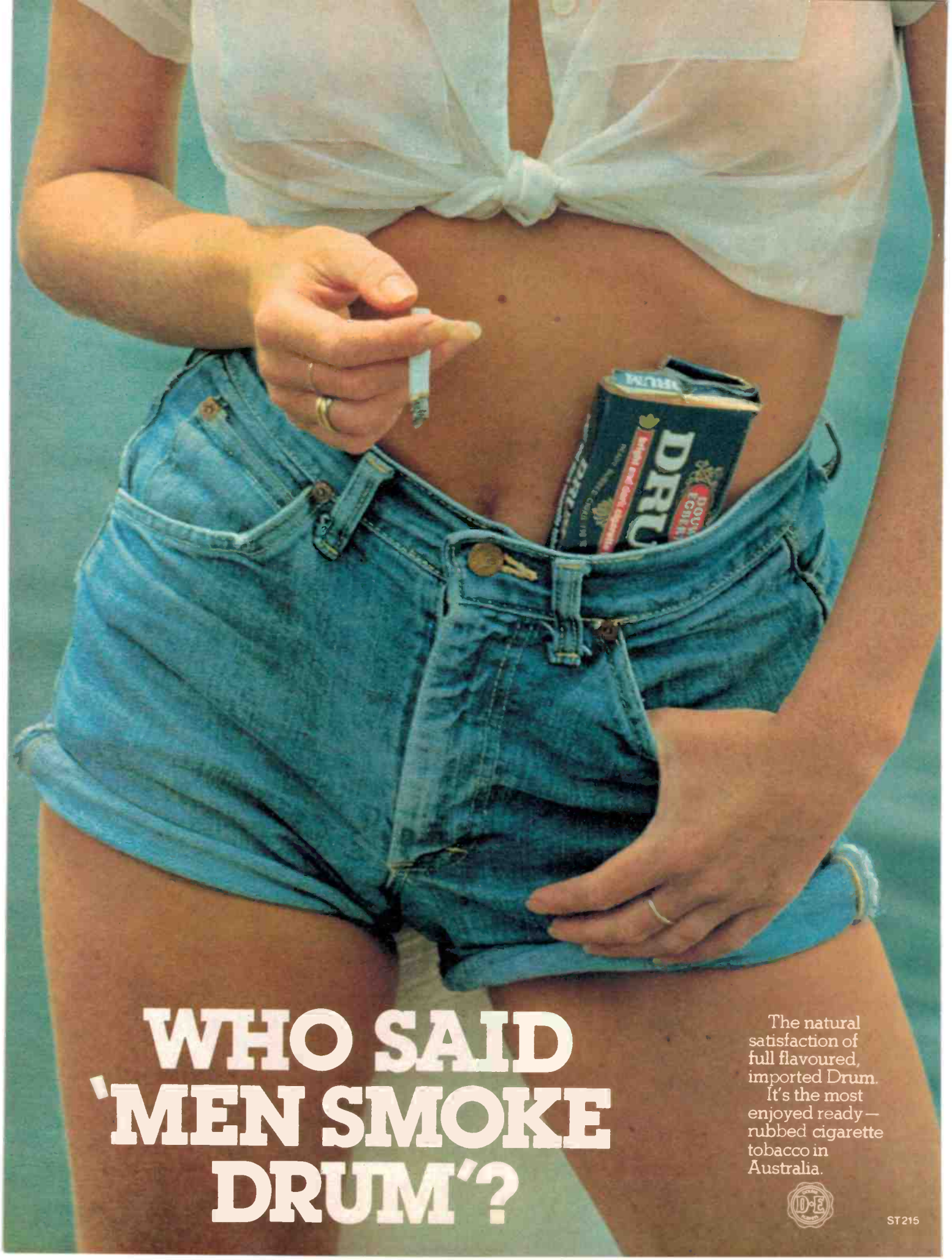
Hitachi technology is at work to bring you greater turntable accuracy through advanced design and electronics. The HT-60S Turntable with photo sensing straight tonearm and Unitorque with Quartz is the result of those efforts. Listen to the soundness of Hitachi engineering today.

Professional sound through sound engineering

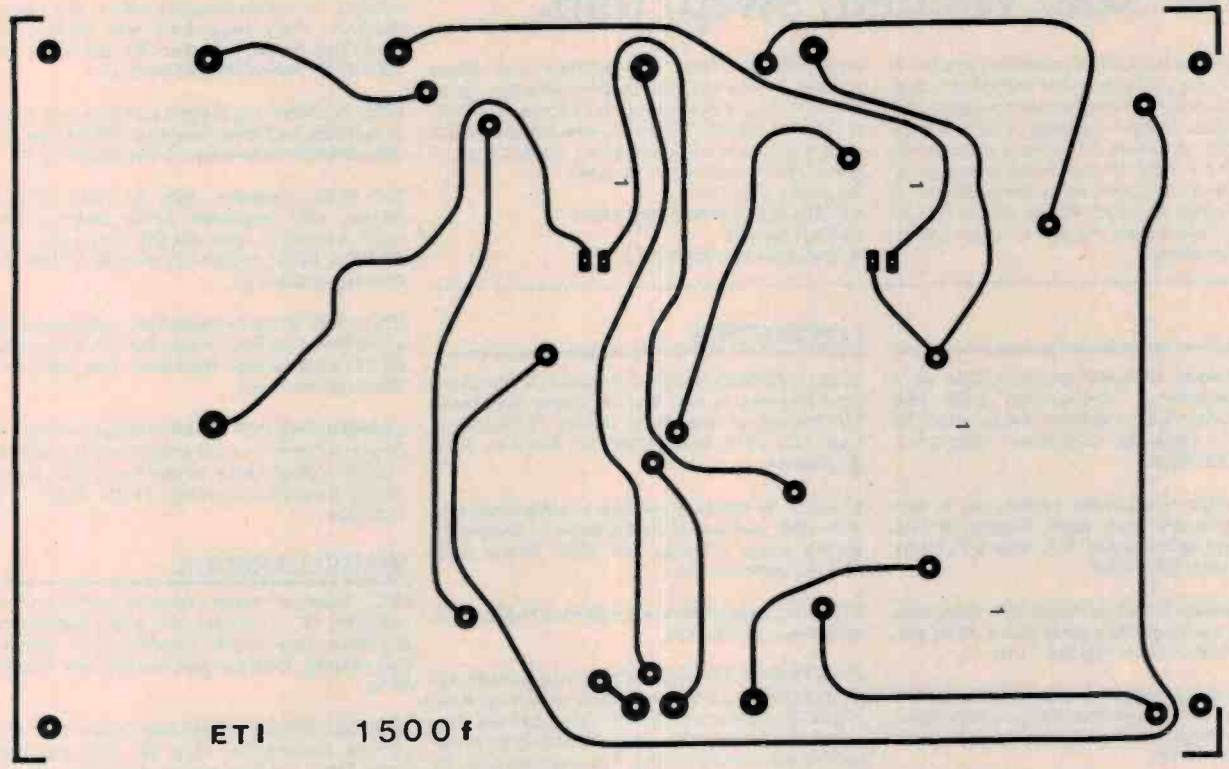
HT-60S

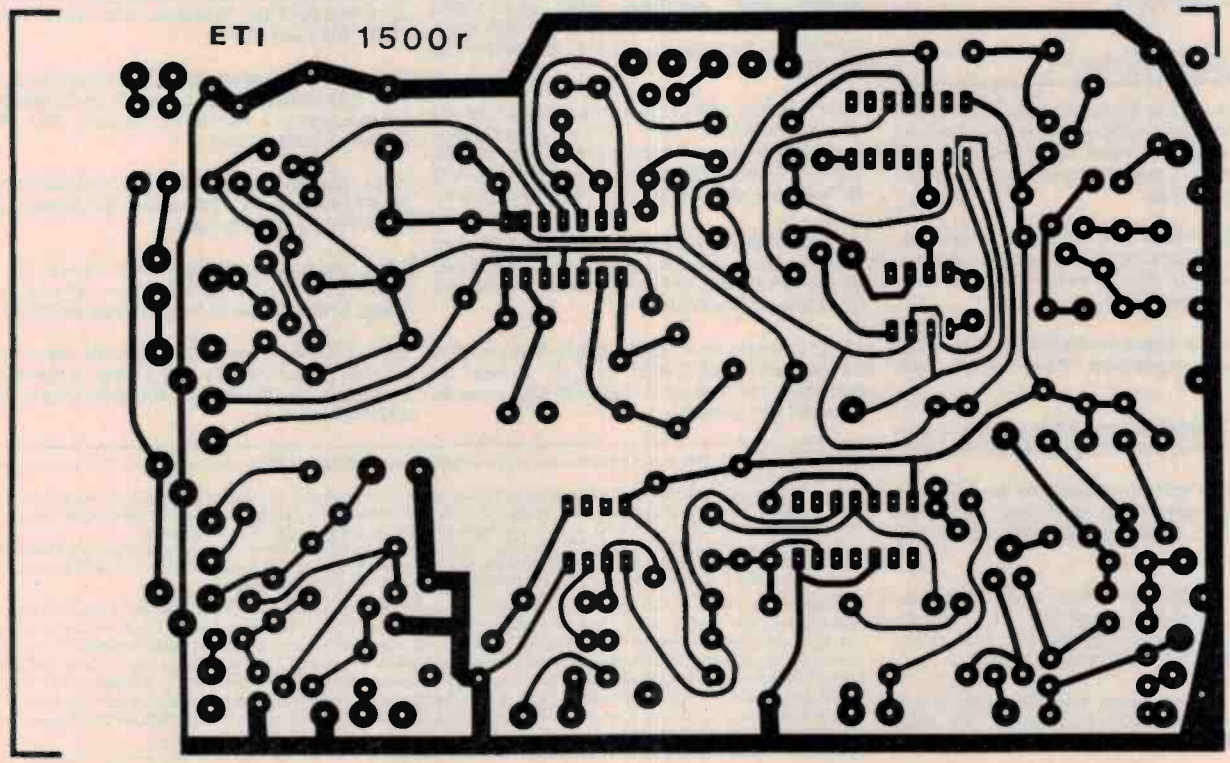
Hitachi Sales Australia Pty. Ltd.,
153 Keys Road, Moorabbin, Victoria 3189 Tel: 95 8722

HT-60S Job No. 08163: Electronics Today Int'l (Australia)


DRUM
WHO SAID
'MEN SMOKE
DRUM'?
The natural satisfaction of full flavoured, imported Drum.
It's the most enjoyed ready—rubbed cigarette tobacco in Australia.
ST215

Instructions on how to make your own pc boards using the Scotchcal method and exposing through this page may be found on page 113 of the March '80 issue.





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AUDIO

SELL: Kenwood KSQ-400 amplifier. Use as 4 channel decoder or stereo amp $100. Pair speakers 2-way 25W, excellent sound $100. M. Johnson, 31 Hazel St, Girraween, NSW 2145. Phone (02) 631-2092.

The Tape Club of Australia invites you to join others in this new club. Make friends all over Australia and New Zealand. Full details P.O. Box 118, Wellington, NSW 2820.

Acoustic Research XB1 turntable. Exc cond, new Shure mag. cartridge. Very good specs. Must sell. $180 o.n.o. Phone Chris (02) 939-7141.

QUAD 22 valve preamplifier $85. Dynaco Mark 3 mono valve power amps 60W RMS, mint condition $400 pair. G. Page, 17 Elm St, Unley Park, SA 5061. Phone (08) 271-9191.

AMPLIFIER wanted. Phase Linear 400. Must be in good original condition.
For sale. Sansui AU717, only $440. Phone Peter (08) 31-5220 after 6 p.m.

COMMUNICATIONS

WANTED: R.1155-N, Ex-R(A)AF communications receiver, preferably working but other condition/model acceptable. I have appropriate manual. John Lavender, 3 Raw Place, Farrer, ACT 2609. Phone (062) 86-4029.

AUSTRALIAN Radio DX club for shortwave, mediumwave DXers. For a sample copy send one 22c stamp to P.O. Box 79, Narrabeen, NSW 2101 mentioning this ad.

WANTED: Valve type communications receivers. All ages and conditions. Phone Peter (042) 29-5047 a.h.

WANTED: Teleprinter, mod 15 or similar. J. Lee, MS 30, Chinchilla, Qld 4413. Phone (074) 65-8183.

SELL: SX-190 extra crystals $165 or exchange for Barlow Wadley MKII or DR-28. N. Glaros, 11 Norman St, Underdale, SA 5032. Phone (08) 43-4981.

YAESU FT-7 SSB transceiver. Ideal for novice, 80m-10m, excellent condition, all manuals, accessories and mounting bracket. $429 o.n.o. Phone Stephen Dennis (02) 630-5552 a.h.

TELETYPE ASR-33 good condition $550 o.n.o. John Delforno, 4 Argyle St, Glenroy, Vic 3046. Phone (03) 306-1464.

COMPUTERS

SELL: OSI(6502) 8K BASIC in ROM (4 x 2k chips). I have changed to disk and no longer need them. $80 the set of four. Geoff Cohen, 72 Spofforth, Holt, ACT 2615. Phone (062) 54-7608 b.h., (062) 49-2688 a.h.

SYSTEM 80 owner would like to swap programs with other owners. Mark Fairbairn, 8 Shelley St, Spring Gully, Bendigo, Vic 3550. Phone (054) 42-4450 weekend only.

S100 16K static RAM Board, 450 ns, ETI-642. $280. Alan Peek (02) 89-1450.

Z80 STARTER KIT: Hex key pad, hex address and data displays, 2 x S100 sockets, wire wrap area, PROM programmer, parallel port, Kansas City cassette interface, timer chip (Z80 CTC), 2K monitor PROM, monitor listing, 120 page manual, 2K RAM. $250 o.n.o. Phone Paul Forte (03) 615-4183 b.h., (03) 543-5451 a.h.

S100 SYSTEM sale, DG640 $120, 8K RAM $150, monitor $150, mainframe $120 plus VDMII, modem, keyboard, 2650, SCMP I0. 466 North Rocks Rd, Carlingford, NSW 2118. Phone (02) 871-2858.

JOIN OMEGA (OSI Microcomputer Enthusiasts Group Australia) and receive newsletters, hardware mods and software exchange details. Contact Geoff Cohen, 72 Spofforth St, Holt, ACT 2615. Phone (062) 54-7608 a.h., (062) 49-2688 b.h.

OSI C2/4/8 owners, join 540-Board Mutual Benefit Society. Resources all areas. Need members. Please send S.A.E. to Peter Meulman, 4 Halsmere St., Geebung, Qld 4034.

SELL: Crystals, new 12MHz, divide down to MPU frequencies (6,4,3,2,1MHz are all factors) 12 available — $4.50 each. N. Cook, 22 Brightman St, Flagstaff Hill, SA 5159.

SELL: Dream 6802 with H/D power supply, cassette recorder, tapes, spare ICs, no bugs. $200. P.O. Box 283, Carnarvon, WA 6701.

WANTED: Documentation for Polymorphics CPU card 101031, and VIDEO card (Especially I/O pinouts, jumpers and monitor commands). Xerox or original. Ken Grimes, 51 Dudley St, Sherwood, Qld 4075. Phone (07) 379-3895.

EA2650 1K microcomputer with CUTS cassette interface. Fully assembled and working $100 o.n.o. Roy Anton, P.O. Box 333, Coonabarabran, NSW 2857. Phone (068) 42-1470 a.h.

WISH TO SWAP my Sargon computer chess book or program for Eddie Paay level II ROM map. Cash adjustment if necessary. Phone (02) 337-2317.

Z80 S100 computer. 48K. 5" Drive, Selectric printer, VDU, keyboard. CP/M, Macro assemb, word processor, disk BASIC, chess and more. $2500. A. Peek, 10 Gale St., Woolwich, NSW 2110. Phone (02) 89-1450.

SELL: TRS 80 Level II with 32K, numeric pad and expansion interface. Also disk drive and Axiom EX 801 microprinter. Best offer. Max Hooper (02) 399-5158 evenings.

COMMODORE PET — 16K business version and Decwriter printer — full documentation, software including diagnostics, assembler, editor, listings, circuit diagrams, manuals $1400. Phone Chris 419-4424

MISCELLANEOUS

SELL: Schober theatre organ, kit-built. 2 x 61 note manuals, 16' - 1' voicing, pre sets, couplers, percussions, tape-reverb, amplifiers etc. Complete and playing. Bargain opportunity. Gary (03) 233-5510.

WANTED: Wireless World May 1972 or data of advanced preamplifier. Pay $5. Very desperate. Louis Ziras, 144 Beavers Rd, Northcote, Vic 3070. Phone (03) 481-1209.

SELL: Amplifier, Playmaster Twin 40, built and tested. Kit costs $129, will sacrifice at $80 cash. 7/14 Burtfield Dr, Chiswick, NSW 2046. Phone Chris (02) 712-1460.

FOR SALE: Automatic telephone equipment. 25 pos. switches 200 relays. Sell or exchange. E.A. Whatmough, 14 Heriot St, Lismore, Vic 3524. Phone (03) 055-962145.

SELL: Magazines. ETI 72-79 inc., EA 69-79 inc., PE 69-78 inc. Greg, 12 Coombell St, Jindalee, Qld 4074. Phone (07) 376-1484.

SELL: Wire wrap sockets, new, 14 pin DIL, in boxes of 7. Ten boxes available — 50¢ each. N. Cook, 22 Brightman St, Flagstaff Hill, SA 5159.

CAPACITORS: Tants 220uF 10vw $3 100uF 25vw $2 Met. Poly. 3uF3 $1 + 40c pep. R. Barratt, 2 Davidson Av, Parkholme, SA 5043. Phone (08) 277-2982.

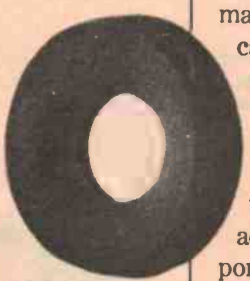
Introducing a totally new concept in stereophones.

The new Koss HV/X high velocity stereophone represents a remarkable breakthrough in hear-thru stereophone design and performance. For the first time, Koss engineers have been able to create a lightweight, hear-thru stereophone that combines the transparency of high velocity phones with the superior bass performance of closed-type phones. The result is a breathtaking musical experience.

Koss HV/XLC

CONTOURED VARIABLE-DENSITY EARCUSHIONS

While most lightweight, hear-thru stereophones have earcushions that fit against the ear, the new Koss HV/X features a unique, contoured, variable-density cushion that fits around the ear. Not only does this unique earcushion design create a far more comfortable stereophone but it has also allowed Koss engineers to create a dramatically better element design as well.



These new variable-density earcushions are made up of a very porous material that is acoustically transparent at the perimeter of the earcushion yet compressed toward the center region. This varies the pattern of acoustic resistance over portions of the earcushions creating the proper seal for specific bass frequencies while allowing the flow of middle and high frequencies at the perimeter of the earcushions.

LIGHTWEIGHT ELEMENT

The uniqueness of the new variable-density earcushions made it possible for Koss engineers to design a lightweight element that reproduces a Sound of Koss you have to hear to believe. Incredibly, even though the overall weight of the element was reduced, Koss engineers were able to develop a magnet with enough magnetic density to drive an extra large diaphragm. With a response range of 15 to 35,000 Hz, the new Koss HV/X will drive you into ecstacy and our competitors nuts.

HEARING IS BELIEVING.

Slip into the new Koss HV/X or HV/XLC with volume/balance controls at your audio dealer soon. You'll like the best of both worlds: the open, airy, up-front sound of hear-thru stereophones and the deep, rich bass performance of closed-type stereophones.

For more information on the HV/X and our full line of stereophones write to

ELECTRO-VOICE AUSTRALIA PTY. LTD.

KOSS® stereophones/loudspeakers

hearing is believing™

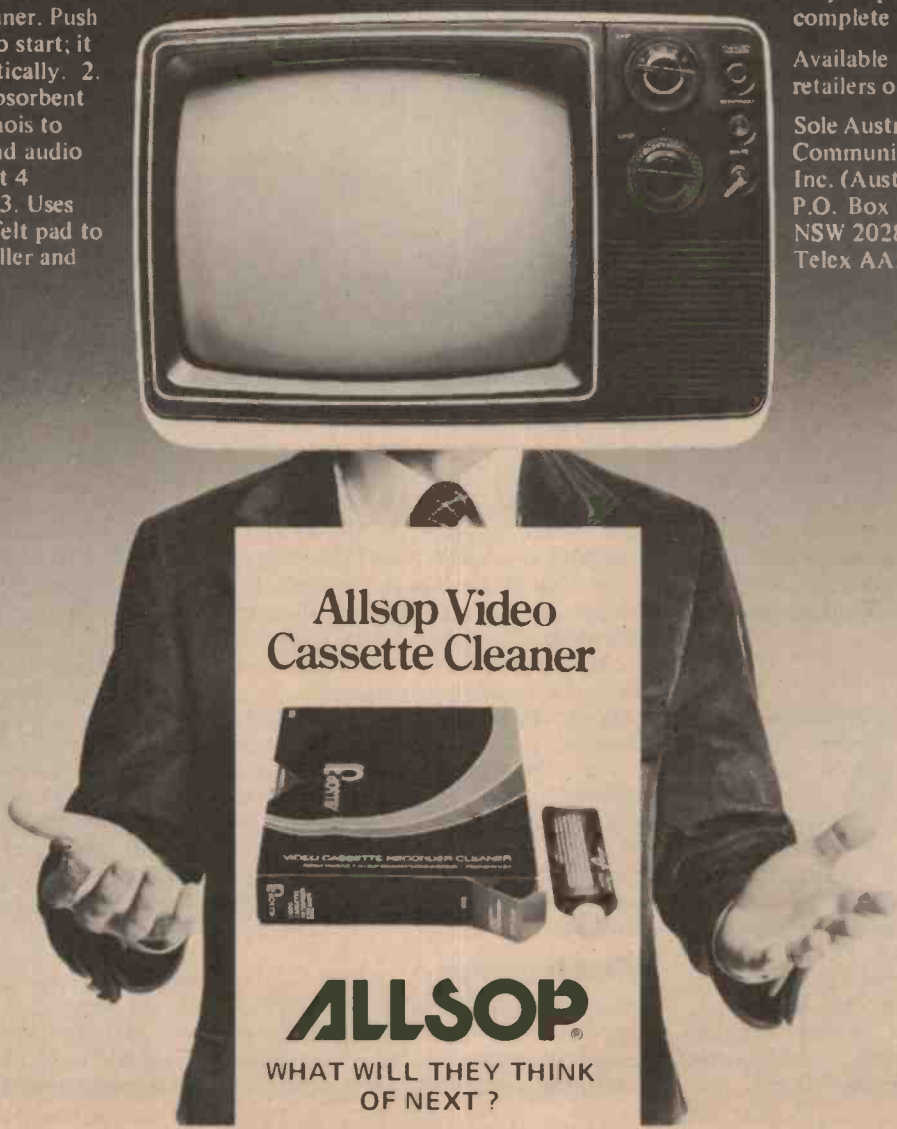
ELECTRO-VOICE AUSTRALIA PTY. LTD. 174 Taren Point Road, Taren Point, NSW, 2229. Phone (02) 525-8588.

Not Hazardous To Your Head.

Cleaning a video cassette recorder is one thing, not hurting the heads is another. The new Allsop VHS Video Cassette Cleaner completely cleans the (1) Audio Head, (2) Video Head, (3) Pinch Roller and (4) Capstan. It saves your head because: 1. It's a healthy alternative to the abrasive continuous loop tape cleaner. Push play button to start; it stops automatically. 2. Uses a soft, absorbent cleaning chamois to clean video and audio heads in about 4 seconds flat. 3. Uses non-abrasive felt pad to wipe pinch roller and capstan clean. Saves you money. You can use the original Allsop Video Cleaner forever. Cassettes should be cleaned every 30 to 50 hours of playing time and replaced after one year – with a replaceable cleaning cartridge supplied with solution. This eliminates the necessity of purchasing another complete cassette.

Available at all leading retailers of video products.

Sole Australian distributor:
Communications Power Inc. (Aust) Pty Ltd
P.O. Box 246, Double Bay
NSW 2028. (02) 357-2022
Telex AA23381



The craft of the speaker box maker

There's more to making a speaker box than first meets the eye. Despite automated woodworking machinery, or more likely, with its assistance, the manufacture of speaker boxes is still more a craft than an assembly job.

NEXT TIME you walk into a hi-fi store, have a look at the loudspeakers on display. Chances are that, despite the Japanese, European or even American 'brand name', it has been assembled here, using a locally-made box. It's a big industry, in terms of quantity, and competition is tough at both the so-called 'budget' end of the market as well as the 'top-line' end. At each year's annual Consumer Electronics Show we have never failed to be *staggered* at the array of speakers, both in kit form and ready-made, on display. Quite apart from the number of 'all-Australian' speakers available, we were recently surprised to learn the extent to which overseas companies have their speakers locally assembled.

So, when Chadwick Audio Furnishings Pty Ltd offered to show us their factory, we jumped at the opportunity. We found the whole operation fascinating and thought readers might like to see 'behind the scenes' too. Our photographer, Ivy Hansen, followed the proceedings and recorded the 'evolution' of a speaker box from blank board to the finished article.

The company

Chadwick Audio Furnishings was started in 1972 by Wayne Chadwick. The venture began life as virtually a 'hobby' business which Wayne conducted from his home (as all good hobby businesses start . . .). Business progressed apace and an associate, David Crabtree, bought into it in 1974. In 1978, the firm became a proprietary limited company with David Crabtree at the helm and in mid-1978 he bought factory premises in the Sydney industrial suburb of Silverwater and installed some quite sophisticated woodwork production machinery.

David Crabtree

Apart from doing a considerable amount of OEM work, Chadwick produce a small range of locally designed loudspeakers, dubbed their "Executive" range. Top of the line is the Executive Monitor, a four-way system, then the Executive 12, followed by the Executive 10. All are finished in wood veneer — in which the company specialises.

Okay, okay — we can hear readers clamouring already for us to review a pair from the Executive range, especially as they're Australian designed and manufactured (see November editorial). All in good time. Apart from speaker boxes, Chadwick make speaker stands and equipment cabinets.

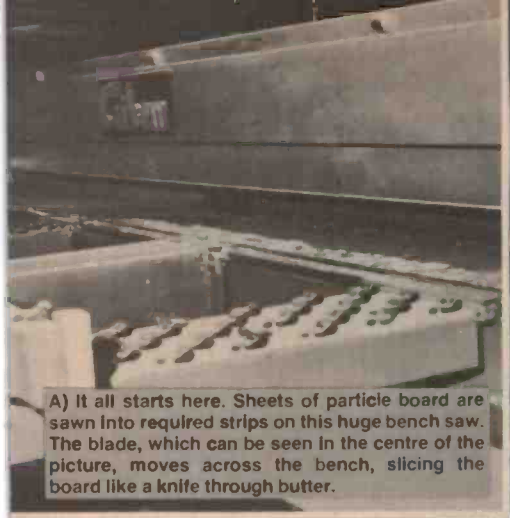
What happens

The pictures tell the story, for the most part. Great sheets of veneered and plain particle board provide the raw material. Particle board is ideal for speaker box material as it's dense, has generally uniform characteristics, is easier to 'work' than timber and boxes generally suffer from fewer resonance problems compared to timber. It's less expensive, too. The sheets are cut into appropriate strips, calculated so that the least waste is produced.

The cabinet top and sides are formed from a single strip, grooved and chamfered so that it can be folded around the front and rear panels. That edge of the strip which is to appear to the front of the cabinet is specially grooved so that it can be 'rolled back' on itself and glued, the veneer then continuing around the front lip of the cabinet right to the front panel. Very cunning — and a precision job.

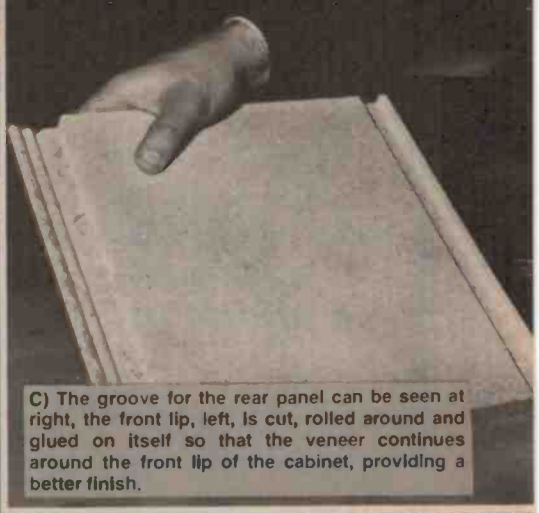
The panels then have the corner chamfers cut in them. Power driven circular blades cut two slots at 45° to the plane of the panel right to the veneer, without *cutting the veneer!* The veneer then acts as a hinge when the panel is assembled. It's quite a precision job, too.

At the same time, the front and rear panels have the appropriate holes cut in them and all the pieces are brought together for assembly. Glue is run in the grooves in which the front and rear panels sit, the panels inserted and the cabinet literally folded together around the front and rear panels. The box is then put in a jig for setting. Small strengthening 'chocks' are glued in at this stage. When ready, the cabinet is cleaned up and sent for oiling or spraying and final finishing work. If drivers and crossover etc. are to be assembled in the box, then it goes to a final assembly line, otherwise it's packed and shipped to the customer. Assembled speakers are tested before despatch. There you have it! The 'evolution' of a speaker box, from blank board to finished article. ●



A) It all starts here. Sheets of particle board are sawn into required strips on this huge bench saw. The blade, which can be seen in the centre of the picture, moves across the bench, slicing the board like a knife through butter.

B) Grooving the panels.

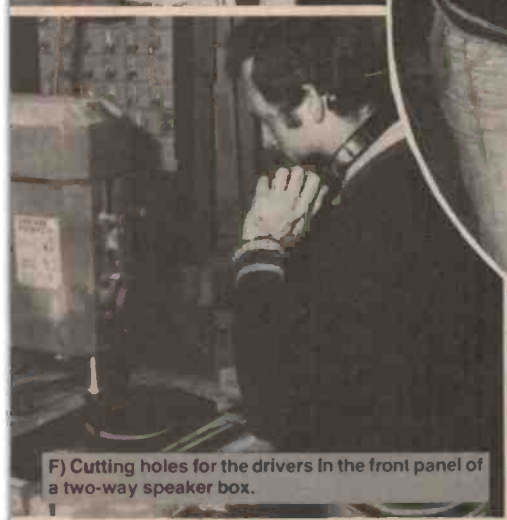


C) The groove for the rear panel can be seen at right, the front lip, left, is cut, rolled around and glued on itself so that the veneer continues around the front lip of the cabinet, providing a better finish.

D) The grooved strip has the front lip rolled and glued on this machine.

E) Cutting the corner chamfers. This machine can make a precision depth cut at 45°, leaving the veneer as a 'hinge'.

G) Glue is run in the grooves, the front and rear panels assembled in place and the cabinet folded around them. The box is then placed in the jig, visible behind the operator here, for setting.



F) Cutting holes for the drivers in the front panel of a two-way speaker box.

H) When ready, the box is removed from the jig and cleaned before final finishing.

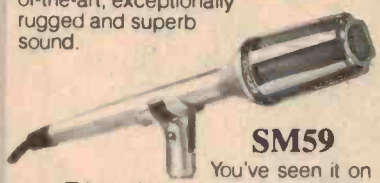
I) Some cabinets are sprayed, others are oiled to provide the required surface finish.

J) A stack of boxes awaiting final finishing. Chadwick take great care to preserve the quality of the surface finish.

K) Final assembly of complete loudspeakers.

fact: there's a Shure microphone that's right for your application & equipment...

SM81
First of the new breed of high-performance, studio-quality unidirectional condensers—technically state-of-the-art, exceptionally rugged and superb sound.



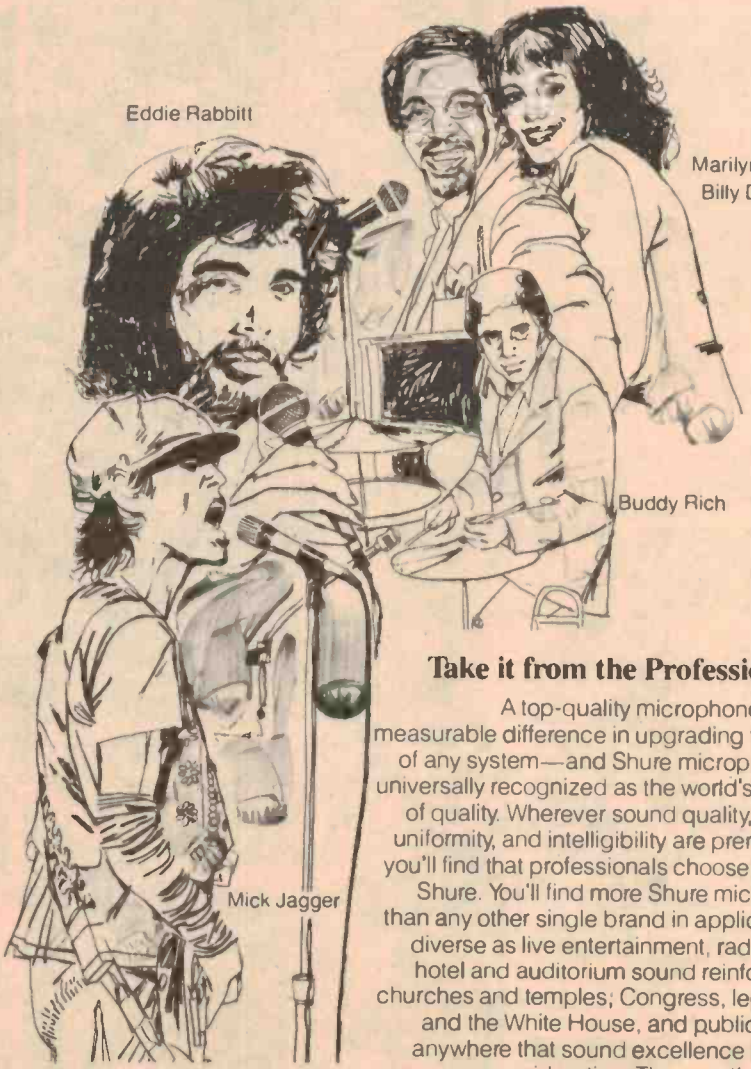
SM59
You've seen it on TV musical shows where sound quality is a must. Unidirectional, dynamic with *exceptionally* flat response, extremely low handling noise; mellow, smooth, and accurate sound.

SM58
The most widely used "on-stage" hand-held dynamic cardioid microphone—the world standard noted for its distinctive, crisp sound.

UNIDYNE® III
The world-famous *UNIDYNE®* III family offers top value per dollar. Uniform cardioid pattern helps control off-axis coloration, background noise, and feedback.

SM61
Omnidirectional dynamic. Outstanding low handling noise. Handsome, smooth looks with new VERAFLEX® dent-resistant grille—a favorite on-camera mic with soundmen and entertainers.

fact: the microphone is your link with your audience



Take it from the Professionals...

A top-quality microphone makes a measurable difference in upgrading the sound of any system—and Shure microphones are universally recognized as the world's standard of quality. Wherever sound quality, reliability, uniformity, and intelligibility are prerequisites, you'll find that professionals choose, and use, Shure. You'll find more Shure microphones than any other single brand in applications as diverse as live entertainment, radio and TV, hotel and auditorium sound reinforcement, churches and temples; Congress, legislatures and the White House, and public safety—anywhere that sound excellence is a prime consideration. They are the reliable, professional connection between you and the people you're trying to reach. Send for complete literature. Please let us know your microphone application.

The Sound of the Professionals

® SHURE ®

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2A Hill Street
THORNBURY 3071 Vic.

AUDIO ENGINEERS (Qld.)
51A Castlemaine Street
MILTON 4064 Qld.

ATHOL M. HILL P/L
33 Wittenoom Street
EAST PERTH 6000 W.A.

NOMIS ELECTRONICS P/L
689 South Road
BLACK FOREST 5035 S.A

HAWKINS AE 152 FP

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Up to now, if you wanted a terrific pair of loudspeakers you had to hassle with wasted Saturday mornings and Thursday nights listening to a myriad of salesmen when you should have been listening to the loudspeakers they were standing in front of. Did they have something to hide?

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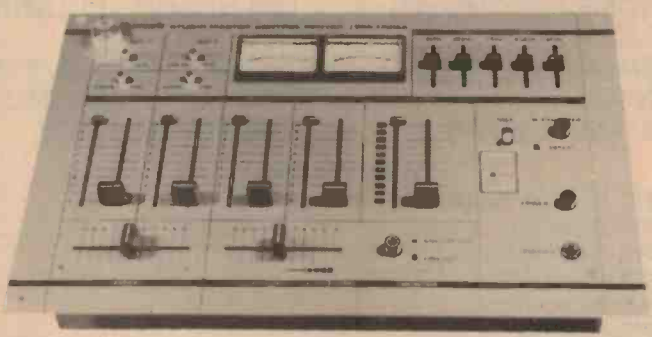

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- Full Cueing Facility

SPECIFICATIONS

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	LINE	150mV
Input Impedance	MIC	10K ohms
	PHONO	50K ohms
	LINE	50K ohms
Maximum Input Level	MIC	45mV
	PHONO	140mV
	LINE	35V
Rated Output	AMP	1V
	REC	1V
Output Impedance	100 ohms	
Harmonic Distortion	At Rated Output 0.2%	
	At 6V Output 0.3%	

Hum And Noise	MIC	-52dB
	PHONO	-62dB
	LINE	-65dB
Frequency Response	MIC	30 to 16000Hz (-1dB)
	PHONO	30 to 20000Hz (RIAA±2dB)
	LINE	20 to 30000Hz (-1dB)
Equaliser Section		
Control Frequencies	60Hz, 250Hz, 1kHz, 3.5kHz, 12kHz	
Control Range	±12dB, Boost or Cut	
Control Type	Slide Centre Detent for "Flat" setting	
Headphone Output (CUE)	50mW at 75 ohms at 0.5% THD	
Talk Switch	14dB at Phono or Line at TALK Position	
Power Consumption	AC 240V 50/60Hz 8 Watts	
Dimensions	15.3" (W) x 3.7" (H) x 10.2" (D)	
Shipping Weight	9.3lb	

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Marantz ST500 computer stereo tuner

Louis Challis found this tuner delightfully convenient to operate and praises its "faultless quality of reception".

LARGE SCALE integration, generally in the form of the microprocessor, means that today's electronic equipment can be provided with features that not so long ago were only wild and impractical ideas in the minds of designers. The sophisticated tuning, preset and display features of the Marantz Computer Stereo Tuner are examples of the kind of elaboration that is now feasible.

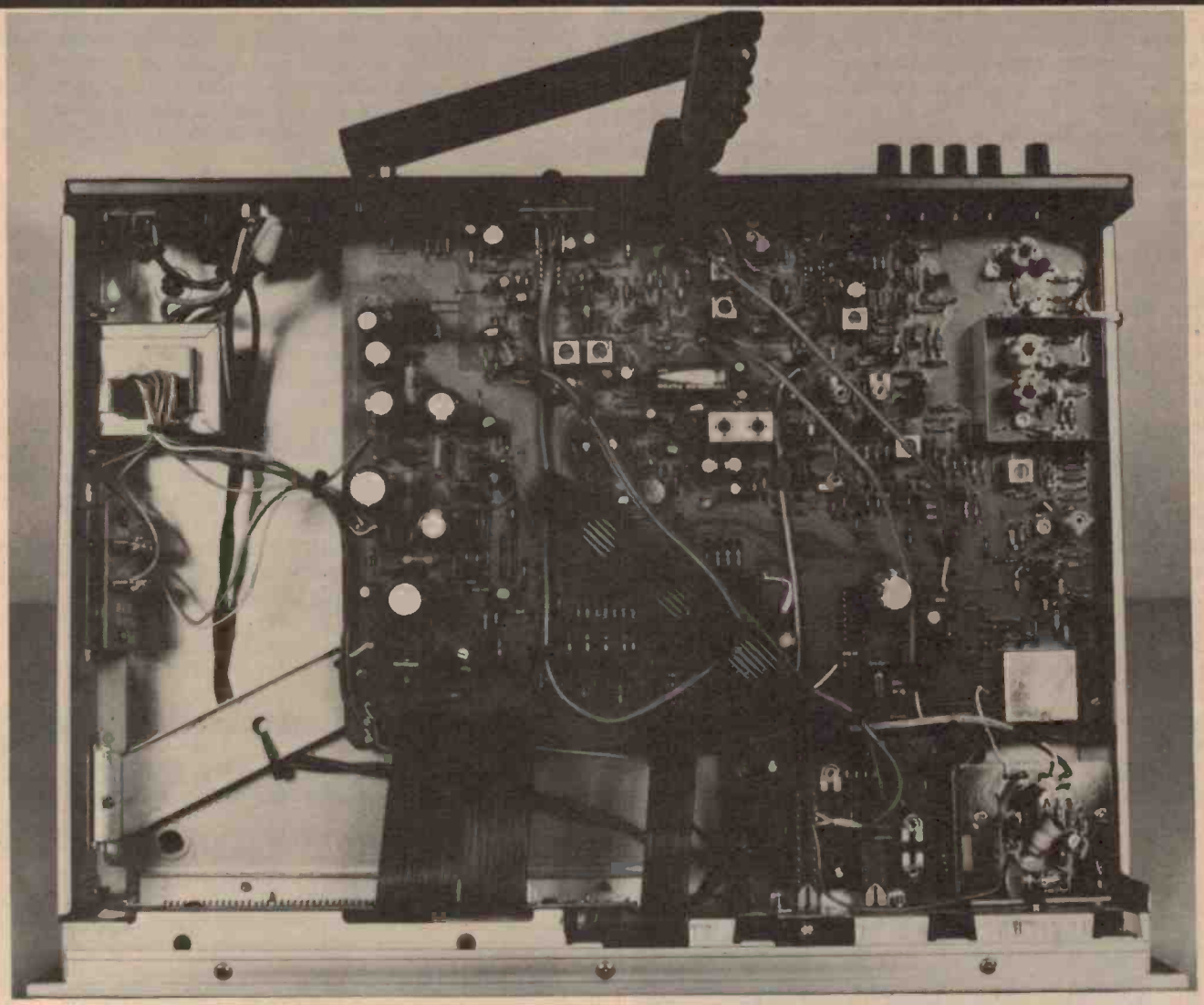
Design

The external appearance of this tuner is remarkably neat, with black lettering anodised into the brushed satin aluminium escutcheon. The panel is divided into three sections. At the left is a five digit frequency display with green gas plasma digits. In the top left hand corner the words "FM Stereo" are displayed when the signal strength is sufficient and below this is an "ME" display which indicates when the memory is active and the station is stored.

To the right of the digital display is a signal strength and multipath indicator with five rectangular light emitting diodes. These are clear and effective in their operation and normally indicate relative signal strength on both AM and FM. When the multipath switch is depressed, this five-LED array provides (in the FM mode only) an indication of the extent to which there are multipath reflections present on the received signal. These reflections, which occur when radio waves from the transmitter bounce off mountains and tall buildings, arrive at the receiver slightly out of phase with the direct signal and are responsible for much of the sibilance and distortion which characterise poor FM reception. In the owner's manual which accompanies the tuner, Marantz give advice on installing directional antennas to minimise multipath problems.

Immediately below the signal strength and multipath indicators are seven small LEDs which indicate that a preset station has been selected and is actually recorded in the microprocessor's memory. The centre of the escutcheon contains seven rectangular switches numbered 1 to 7 and a "memory" switch. To enter a station frequency in the memory, you tune to that station and press the "memory" switch followed by one of the numbered switches. Many receivers contain batteries to maintain this kind of memory function, but Marantz have designed in storage capacitors to supply power to retain the data for up to ten days. Obviously if you go away for more than ten days you have to rewrite the memory.

To the right of the preset controls are four selector buttons for FM/AM, wide or narrow band on the FM, multipath indication and stereo/mono. The wide/narrow band facility enables the FM bandwidth and frequency response to be narrowed and cut off more steeply to minimise adjacent channel interference where this occurs. In Australia this is not a problem on FM as we do not have



the same station density as Japan and America, but it is a pity that the makers did not provide this facility with the AM tuner as well.

On the extreme right of the escutcheon is a wide switch bar for tuning and scanning. Pressing the right hand side of this bar causes the tuner to scan upwards automatically; pressing on the left makes it scan downwards in frequency. It can be set to scan continuously or to lock onto the nearest station with sufficient signal strength. If it approaches the end of the band without finding a station it switches to the other end of the band and continues the search.

The cabinet is made of neatly pressed and folded steel, finished with a black matt plastic coating. The tuner would be equally at home mounted in a rack or stacked on top of other equipment on a shelf.

At the rear of the receiver are five terminals for 75 ohm and 300 ohm aerial cable termination, a ground connection and an AM antenna connection. The centre of the panel is fitted with a neat plastic encapsulated universal AM loopstick antenna which is attractive and effective, and a scan step control with increments of 9 kHz or 10 kHz for AM and 50 kHz or 200 kHz for FM. The unit supplied to us was adjusted for 9 kHz and 50 kHz steps to suit Australian conditions. Also at the rear are a pair of coaxial sockets for left and right channel outputs, a mains voltage selector and an unusual mains socket which accepts the two-pin plug moulded onto the mains lead.

The inside of the unit is every bit as neat as the outside and features one large printed circuit mother board, neatly labelled with component numbers and stencilled on top with the track lying underneath. Four minor boards immediately behind the front panel contain the frequency indication, selector switch connections and the tuning search control. All these boards are connected to the mother board in a neat and professional manner.

The mains power transformer and fuses are separately located on the side of the chassis, but the rest of the power supply and all the other components are on the main board. The connections to the input and output sockets are all made directly onto the board and the general impression is of a unit designed for the minimum number of wiring connections. ▶

from page 49

range and switch the *mode selector* to *VLF*. Hold the search head up in the air and well away from metal objects, press the *tune memory* button and rotate the *tune* control. The meter should swing either side of the centre position. Set the pointer to centre scale and release the tune button. The meter should remain at this position but may drift slightly, which it will tend to do immediately after switch on. Pressing the *tune memory* button at any time should return the meter to centre position, set by the *tune* control.

The next step is to determine that the polarity of the receive coil is correct. After tuning the detector as described, bring a piece of iron near the search head. If the meter swings to the right your circuit is correct, if it swings to the left you will have to reverse the two wires on the DIN socket that connect to the receiver section on the pc board. The meter should now swing to the right.

Ground balance

With the detector tuned, lower the search head to the ground. The meter may swing off scale. If it swings to the right turn the *ground* control to the left, if it swings to the left turn the *ground* control to the right. Raise the search head from the ground, press the tune button and the meter will return to centre scale. Lower the search head again and repeat the procedure until there is little difference in the meter reading when the search head is lowered. Setting the ground control is quite critical and may take some time to achieve the first time around. The detector can now be used in the VLF mode.

Sensitivity control

The *sensitivity* control sets the gain of the dc amplifiers in the detector and will generally give best results at mid-range. If the control is set fully clockwise the tuning will tend to drift, requiring more frequent operation of the *tune memory* button.

Discriminate controls

The mode switch selects one of three discriminate ranges: TR1, TR2 or TR3, while a vernier action is provided by the *discriminate* control. The discrimination ability of this circuit is extremely effective and it is possible to discriminate between an aluminium ring pull tab and a gold ring. Remember that discrimination depends on the resistivity of the target object.

When set to TR1, *discriminate* control at mid-range, the meter should show 'bad' for ferrous objects and 'good' for non-ferrous objects along with a tone from the speaker. As the discrimination controls are advanced, some non-ferrous objects such as brass will start to give a 'bad' reading, while gold and silver will give a 'good' reading. As the controls are advanced further aluminium will start to give a 'bad' reading, and so on. As you use the detector you will become familiar with its operation.

The best way of setting the discrimination controls is to carry around a few sample objects of the type you want to discriminate against just for this purpose. One thing to remember is that a corroded object will require a different setting of the controls to a non-corroded one so carry samples typical of what you are likely to dig up.

By careful setting of the controls, unwanted objects can be tuned out, giving no meter movement at all so the detector can be used to reject particular objects and at the same time discriminate between others.

Well, it's now up to you. Remember, the secret of success in metal detecting is more knowing where to look than the type of detector you have. There are many books available on the subject which could help put you on the right track. ●

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In the lab

The objective testing of this unit was unusual in that the first parameter that most people are interested in, the usable sensitivity, was a little complicated to evaluate. In the stereo mode the inbuilt muting, which cannot be disconnected, makes it impossible to measure the sensitivity in the normal manner. At 26 microvolts into 75 ohms the receiver mutes and that's it! In the mono mode things are a little better. A signal to noise ratio of 26 dB (commonly regarded as the lower limit of acceptability) occurs at 1.3 microvolts input, which is slightly higher than the maker's specification but nevertheless a good performance.

A plot of the signal to noise ratio against input signal power is shown on this page. Performance on mono is particularly good — for signals above the 68 dBf level the S/N ratio is 68 dB. When the stereo muting takes place the S/N ratio is still 58 dB so it is apparent that the designers intend that you should receive premium quality reception in the stereo mode and revert to mono where less adequate signals are received. The surprising thing about this receiver is that the unweighted signal to noise ratios in the stereo mode are superior to those in the mono mode, being 70 dB for narrow band stereo and 65 dB in mono.

The FM frequency response extends from 24 Hz to 16 kHz but it is not the smoothest we have ever seen. However, the channel separation is particularly good, exceeding 35 dB from 40 Hz to 2 kHz. Image rejection, IF rejection, channel balance and subcarrier rejection are all excellent.

By contrast the AM tuner has only a mediocre sensitivity of 25 microvolts for 26 dB signal to noise ratio with 30% modulation. This is suitable for local reception only and has been designed for that purpose. The AM bandwidth, in the usual Japanese fashion, is 50 Hz to 3.2 kHz — only slightly better than the norm.

Subjectively

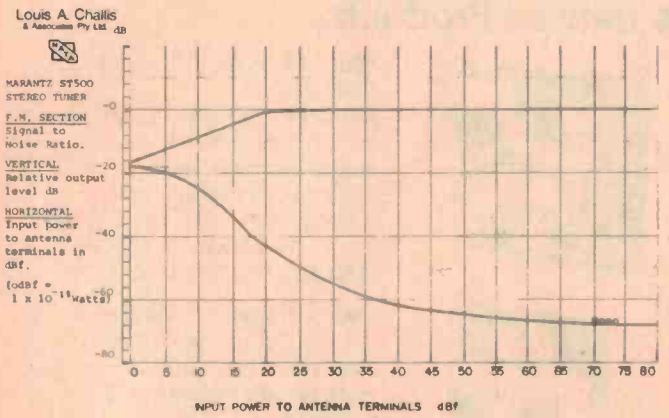
Subjective evaluation of this tuner was a real delight. Of all the tuners I have ever used this is without doubt one of the easiest and most pleasant to operate. The computuner circuitry has been very well conceived and in conjunction with the automatic tune and search facility produces the sort of results and convenience I believe most listeners really want.

The quality of reception is faultless. Especially noteworthy is the freedom from distortion on both the FM stereo and mono reception. Distortion is less than 0.25% under any operating conditions and that is a remarkably good performance.

The Marantz ST500 is not the cheapest or the most expensive tuner on the market; it is not the biggest or the smallest. It is, however, one of the nicest and easiest to use and frankly I liked it. ●

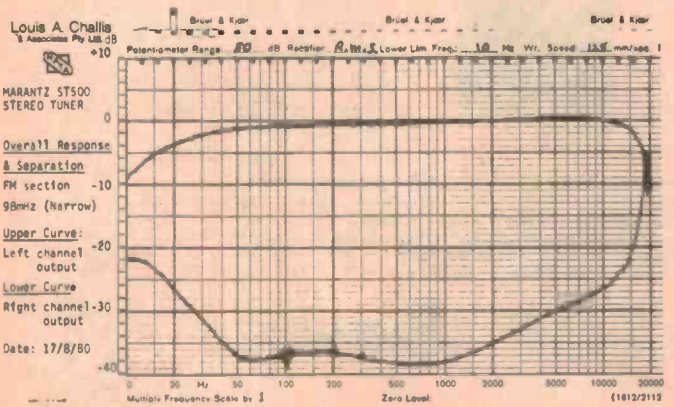
MARANTZ STEREO COMPUTER TUNER MODEL ST500

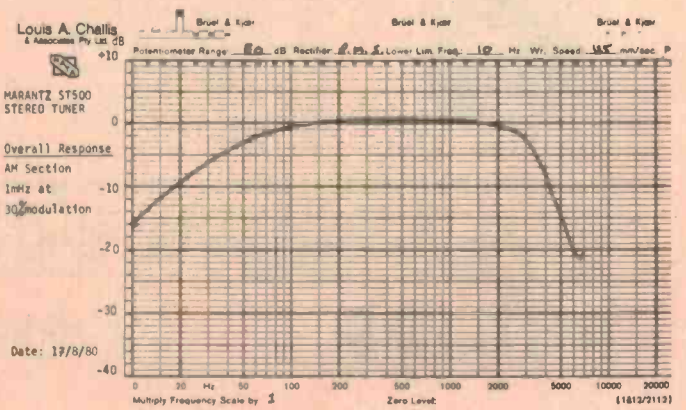
Dimensions: 416 mm wide x 73 mm high x 300 mm deep
Weight: 4 kg Price: $399
Manufactured by: Marantz in Japan



MEAURED PERFORMANCE OF
MARANTZ ST500 STEREO TUNER SN 03A020048

USABLE SENSITIVITY:	With 40kHz deviation at 98MHz into 75 ohms Mono signal to noise ratio 26dB (narrow) 1.3 µV Stereo signal to noise ratio 58dB (narrow) 26 µV	
SIGNAL TO NOISE RATIO:	With 50kHz deviation at 98MHz into 75 ohms Unweighted mono in the narrow mode 65dB Unweighted stereo in narrow mode 70dB	
CHANNEL SEPARATION:	Better than 35dB from 40Hz to 2kHz	
FREQUENCY RESPONSE:	FM 24Hz to 15kHz AM 50Hz to 3.2kHz	OUTPUT IMPEDANCE: At 1kHz - 600 ohms
CHANNEL BALANCE:	Better than 0.2dB	OVERALL SENSITIVITY
OUTPUT VOLTAGE:	At 1kHz - 1.45 volts	PERFORMANCE: See graph





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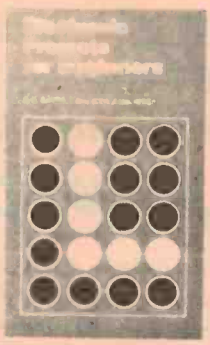

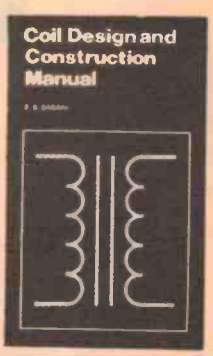

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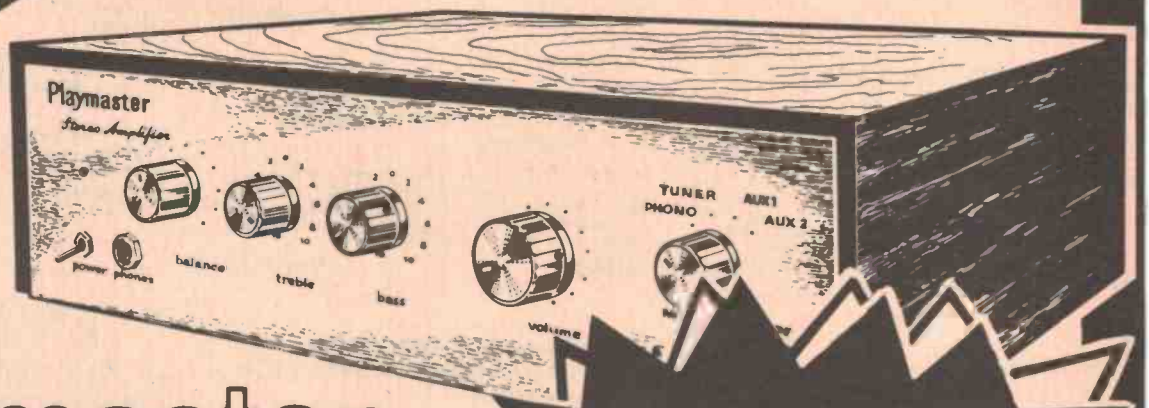

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Peerless PAS 30 speaker system

Locally manufactured enclosures keep the price of these speakers below that of comparable fully-imported systems. Louis Challis tried them out and found them good value.

ONE OF THE questions I am most often asked by friends and associates is, "What loudspeakers should I buy for my new system?" When I reply by asking, "How much do you want to spend?", the most common answer is $500. Likewise, most retailers will tell you that $500 seems to be the current 'watershed price' for loudspeakers that separates the serious from the less serious audiophiles.

So when I receive a set of speakers with a recommended retail price of $498 I tend to sit up and take notice. Are the speakers priced to just pip the intending purchaser's budget or do they have other merits and offer a performance that matches their price?

The Peerless Company of Denmark has always been one of the most respected manufacturers of loudspeakers in Europe. I have used many of their speakers and have found that they offer competitive performance and are usually well designed, with construction apparently based on sound research and good manufacturing techniques. The GRD group of Melbourne have been able to keep the cost of the PAS 30 speakers in this country down to below the magical $500 by making the enclosures locally, thereby avoiding most of the freight costs and duty which usually add so much to the price of imported systems.

The manufacturers rate the PAS 30 system as having a 100 watt capability with an eight ohm impedance. They're three way speakers incorporating a 200 mm diameter bass driver with a rolled polyethylene foam surround, a 100 mm diameter midrange driver with a conventional 25 mm diameter voice coil and a 25 mm soft dome tweeter to provide the extended high frequency response.

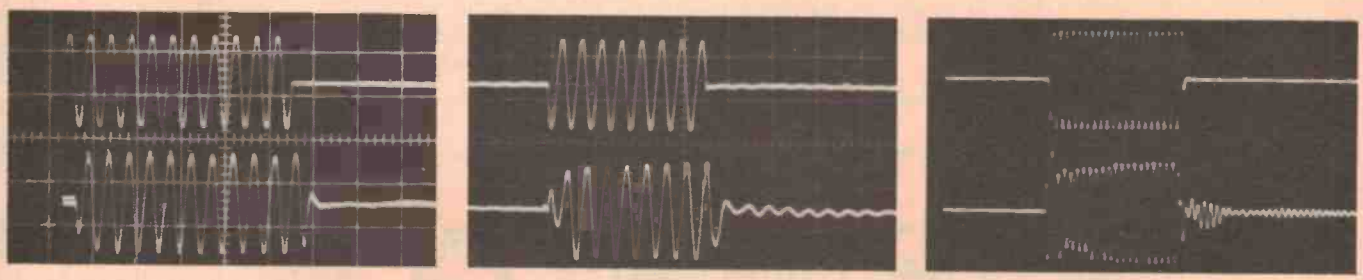
The enclosure is made out of 18 mm chipboard veneered on the sides and front edges with Australian walnut. The fascia is a black ply panel covered with an open weave artificial fibre and attached to the enclosure by strips of Velcro at the corners and sides.

All the drivers are mounted from the front of the fascia to facilitate construction and repair and the unit incorporates infill in the form of low density fibreglass to provide internal resonance control and balanced output. In keeping with current thinking about reduction of phase differences, the drivers are aligned vertically with the woofer at the bottom and the tweeter at the top. The back of the cabinet contains two spring-loaded colour coded terminals for the speaker leads. These are set into a recessed circular plastic well on the lower rear face of the unit.

In the lab

Objective testing of these units showed they have a frequency response that extends from 70 Hz to 20 kHz (+/− 6 dB). Hence they match the normal concept of a 'bookshelf' speaker system, which in most cases is expected to have a lower cutoff frequency between 50 and 70 Hz. The frequency response curve is remarkably flat and although there are interactions between the various drivers, whose individual characteristics are not perfect, the resulting response is still particularly good.

The off-axis response is flatter than



Tone burst response: left, at 100 Hz; centre, at 1 kHz; right, at 6.3 kHz.

the on-axis response and the general frequency response characteristics are above average. The individual responses of the three drivers have been very well selected and the crossover frequencies are well chosen. This is borne out by the phase response of the unit, which is exceptionally flat and shows how effective the design is in reducing phase differences.

The impedance curve shows a sharply rising response at the fundamental resonance of 55 Hz and a ripple whose lowest level is seven ohms. This impedance curve is quite acceptable and would allow these speakers to be paralleled with any other nominal eight ohm speaker system without risk of excessively low impedance.

The distortion characteristics are particularly good. At the 90 dB level at two metres on-axis the total harmonic distortion at the test frequencies of 100 Hz, 1 kHz and 6.3 kHz never exceeds 0.8% — a very satisfactory performance. At higher levels the distortion starts to rise and at sound pressure levels exceeding 100 dB it begins to become unacceptable.

The speakers are moderately efficient, requiring 8.2 watts to achieve 90 dB on-axis, from which it can be seen that the manufacturer's 100 watt rating is fairly realistic. The tone burst response proved to be good, with only a slight trace of ringing being apparent in the 4, 7, 8 and 10 kHz regions. This ringing was not particularly pronounced and was indicative of an acceptable transient performance.

To the ear

The subjective evaluation of the units gave, in many respects, a better impression than the objective testing. Unlike many of the other speakers we have recently reviewed, the PAS 30 system imposes a remarkably low level of colouration and offers a performance similar to the AR6s, which used to be one of my favourite systems a decade ago. Unlike the AR6s, whose frequency response was still excellent at 50 Hz, the PAS 30s do not perform so well at the bottom end of the register. Fortunately they do not exhibit gross frequency doubling or excessive dis- ▶

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tortion either, so I was only aware of a general reduction of low frequency response in comparison with our reference speaker system.

The most striking attribute of this speaker system is that it can reproduce speech with reasonable fidelity, an ability which I regard as very important and which so many speakers lack. On orchestral music the speakers perform admirably on all string, brass and woodwind instruments, but not on drums. On soft rock they give an acceptable performance but hard rock recordings with electric guitar sounds in the 40 to 80 Hz region cannot be played satisfactorily at high levels.

By contrast with many other speaker systems we have evaluated, the PAS 30s achieve a reasonable degree of attenuation of those frequencies below their range and thereby reduce what could otherwise be distress for the listener.

Summary

The Peerless/GRD PAS 30 is undoubtedly one of the better small speaker systems available, offering lower distortion and a flatter frequency response than most. It constitutes good value in the hotly contested 'under $500 stakes'. ●

PEERLESS PAS 30 SPEAKER SYSTEM

Dimensions: 580 mm high x 291 mm wide x 290 mm deep
Weight: 15kg each unit
Price: $498
Manufactured by: GRD Group, Melbourne.

MEASURED PERFORMANCE OF PEERLESS PAS 30

FREQUENCY RESPONSE: 70Hz - 20kHz

CROSSOVER FREQUENCIES: 500Hz, 2.5kHz

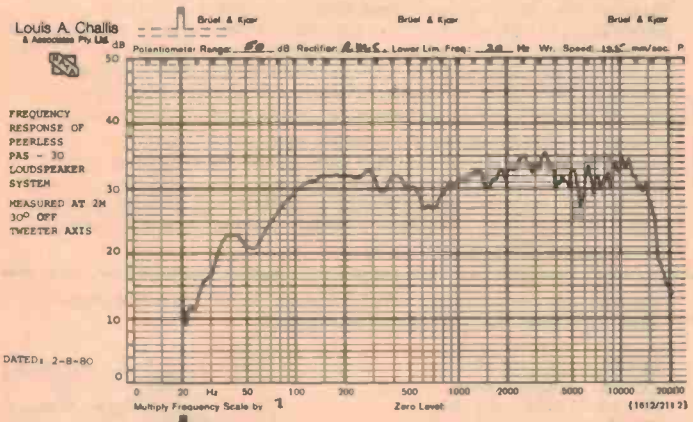
SENSITIVITY:
(for 90dB average at 2m) 8.1 VRMS = 8.2 Watts (nominal into 8Ω

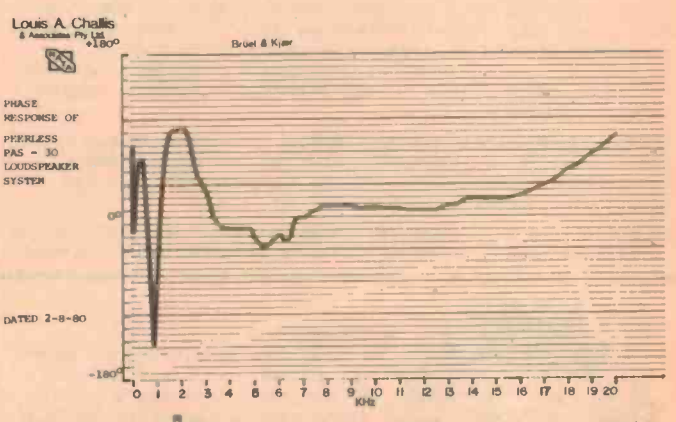
HARMONIC DISTORTION:
(for 90dB at 2m)

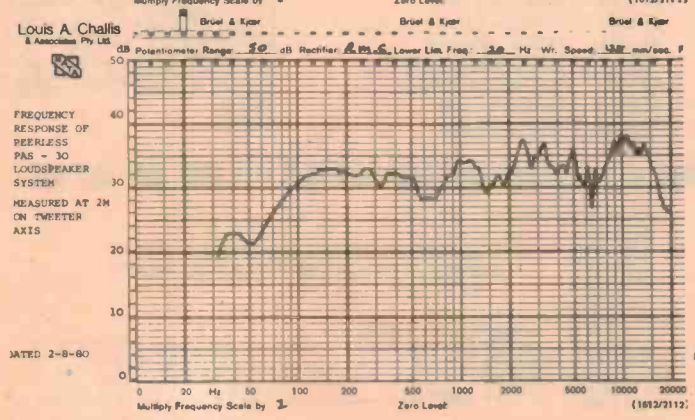
	100Hz	1kHz	6.3kHz	
2nd	-43.4	-51.5	-42.5	dB
3rd	-46.9	-46.1	-55.7	dB
4th	-64.7	-69.0	-	
5th	-66.7	-56.3	-	
THD	0.8%	0.6%	0.77%	

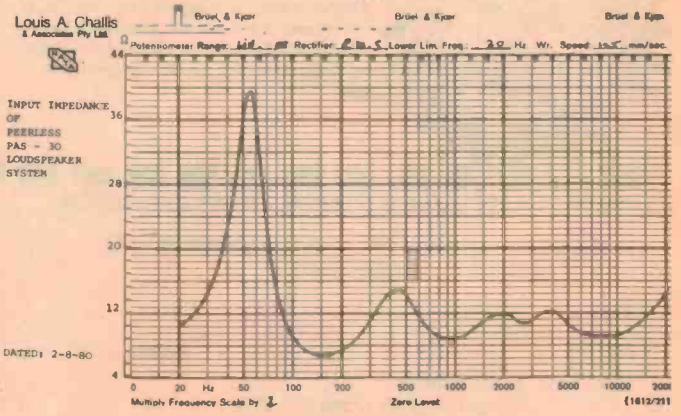
INPUT IMPEDANCE:

100Hz	9.2Ω
1kHz	8.9Ω
6.3kHz	9.2Ω
Minimum at 150Hz	6.8Ω









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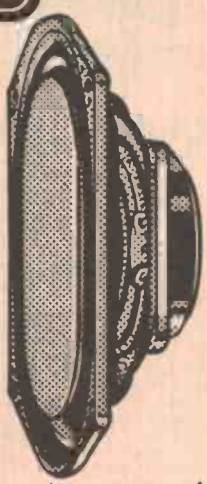

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Discs Referenced Above
1 Three Blind Mice TBM5005 "No Tears"
2 East Wind EW1001, "The Three"
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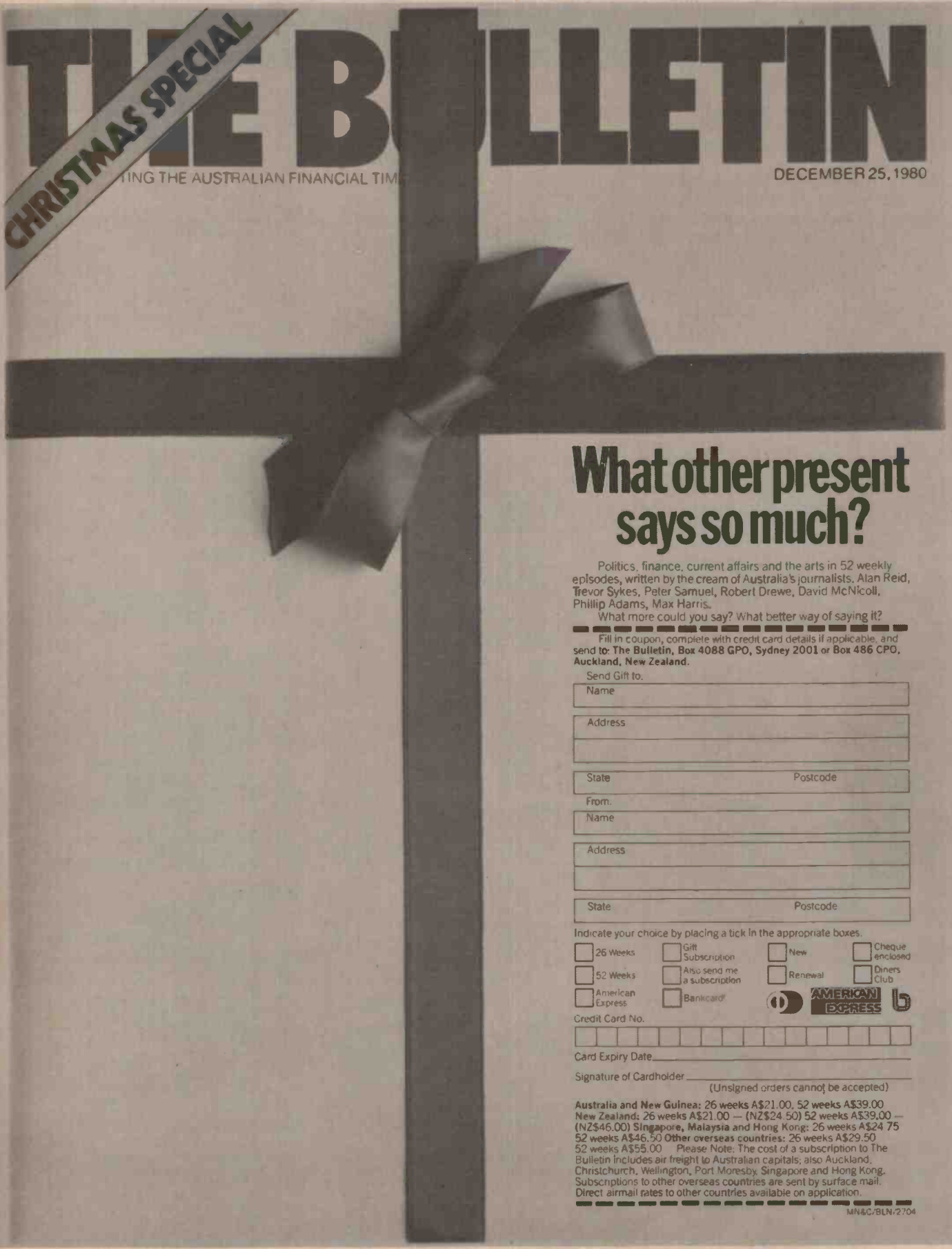
THE BULLETIN

TING THE AUSTRALIAN FINANCIAL TIM

DECEMBER 25, 1980



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KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have listed here most of the projects published over the last few years which are either available as kits or can still be made up by shopping around for components. Suppliers listed against a particular project will either stocvk it as a kit or stock the pc board plus the other components.

Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project ever published in ETI are available through the following companies (to the best of our knowledge):

RCS Radio
651 Forest Rd
Bexley NSW

Radio Despatch Service
869 George St
Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four months.

Key to Companies

A Applied Technology Pty Ltd. 1A Paterson Avenue, Waitara. NSW 2077. Ph. (02) 487-2711.

B Bill Edge Electronic Agencies. 115 Parramatta Road. Concord (PO Box 1005, Burwood North 2134). Ph. (02) 747-6472.

C J.R. Components, PO Box 128. Eastwood. NSW 2122. Ph. (02) 85-3385.

D Dick Smith Electronics P/L. Cnr Waterloo & Lane Cove Roads. North Ryde. 2113. Ph. (02) 888-3200.

E All Electronic Components. 118 Lonsdale Street, Melbourne. Vic 3000. Ph. (03) 662-3506.

F Tasman Electronics. 12 Victoria Street, Coburg. Vic 3058. Ph. (03) 354-5062.

J Jaycar Pty Ltd. PO Box K39. Haymarket. NSW 2000. Ph. (02) 211-5077.

K SM Electronics, 1096 Doncaster Rd, Doncaster East Vic 3109. Ph. (03) 842-3666.

L Ellistronics. 289 Latrobe Street. Melbourne. Vic 3000. Ph. (03) 602-3282.

M Mode Electronics. PO Box 365. Mascot. NSW 2020. Ph. (02) 666-6324.

N Nebula Electronics Pty Ltd. 15 Boundary Street. Rushcutters Bay. NSW 2011. Ph. (02) 33-5850.

O Orbit Electronics. PO Box 7176. Auckland. New Zealand.

P Pre-Pak Electronics. 718 Parramatta Road. Croydon. NSW 2132. Ph. (02) 797-6144.

R Rod Irving. PO Box 135. Northcote. Vic 3070. Ph. (03) 489-8131.

V Silicon Valley. 23 Chandos Street. St. Leonards. NSW 2065. Ph. (02) 439-4655.

W Willis Electronics. 993 Hay Street. Perth. WA 6000. Ph. (09) 321-7609.

Y Trilogy. 40 Princes Highway. Fairy Meadow. NSW 2519.

Project Electronics

041	Continuity Tester	W.R.D.B.Y.L
042	Soil Moisture Indicator	R.B
043	Heads or Tails Circuit (Oct 76)	W.R.D.E.A.F.B.Y.L
044	Two Tone Door Bell (Oct 76)	W.R.D.E.O.A.F.B.Y.L
045	500 Second Timer	W.D.E.A.B.Y.L
047	Morse Practice Set	W.D.O.A.B.Y.L
048	Buzz Board	W.D.A.B.Y.L
061	Simple Amplifier (Oct 76)	W.R.D.E.A.B.Y.L
062	Simple AM Tuner (Mar 77)	W.D.E.B.Y
063	Electronic Bongos	R.D.A.B.Y.L
064	Simple Intercom (Nov 76)	W.A
065	Electronic Siren	W.R.D.E.O.A.B.Y.L
066	Temperature Alarm (Dec 76)	W.D.E.A.B.Y.L
067	Singing Moisture Meter	D.B.Y
068	LED Dice Circuit (Oct 76)	W.R.D.E.A.B.L
070	Electronic Tie Breaker (Jan 77)	
071	Tape Noise Limiter (Jun 78)	R.E.F
072	Two-Octave Organ (Jun 78)	W.D.B.Y
081	Tachometer (Mar 77)	W.E.O
082/ 528	Intruder Alarm	W.R.E.A
083	Train Controller	W.R.E.L
084	Car Alarm	W.R.D.E.A.B.Y.L
085	Over-rev Alarm	W
086	FM Antenna	W
087	Over-LED	W.E
088	Hi-Fi Speaker	W

Test Equipment

132	Experimenter's Power Supply (Feb 77)	E.O
133	Phase Meter (Apr 77)	E
134	True RMS Voltmeter (Aug77)	E
135	Digital Panel Meter (Oct 77)	E
136	Linear Scale Capacitance Meter (Mar 78)	
137	Audio Oscillator (May 78)	W.D.E
138	Audio Wattmeter (Nov 78)	E.B
139	SWR/Power Meter (May 78)	
140	1GHz Frequency Meter-timer (Mar 78)	
141	Logic Trigger (Jan 79)	E
142	High Current Power Supply (Feb 79)	W.E
143	Curve Tracer (Jan 79)	W
144	Expanded-scale RMS Voltmeter (Jun 79)	E
148	Versatile Logic Test Probe (Jul 79)	E.L

Simple Projects

243	Bip Beacon (Apr 77)	
244	Alarm Alarm (Feb 77)	F
245	White Line Follower (Nov 77)	F
246	Rain Alarm (Apr 78)	F
248	Simple 12V to 22V Converter (Jul 78)	W
249	Electronic Combination Lock (Apr 79)	E
252	The Passionmeter (Aug 79)	
253	Electronic Grenade (Hot Potato) (May 79)	
254	Egg Timer (Jun 79)	W

Motorists' Projects

316	Transistor Assisted Ignition (May 77)	W.E.O.K
317	Rev. Monitor Counter (Jul 77)	E
318	Digital Car Tacho (Jul 78)	W.E.K
319	Variwiper MK II (Sep 78)	W.E.O
320	Battery Condition Indicator (Apr 79)	E.L

Audio Projects

448	Disco Mixer (Nov 76)	W
449	Balanced Microphone Amp (Nov 76)	W.D.E.J.F.Y
450	Bucket Brigade Audio Delay Line (Dec 77)	W.E
451	Hum Filter (Jul 79)	D.E.F
470	60 W Amp Module (May 79)	W.R.E.F.B.P.L.A.V
471	High Performance Stereo Preamp Control Unit (Jun 79)	W.R.E.F.B.P.A.V.L
472	Power Supply — the Series 4000 Stereo Amp (Jul 79)	W.R.E.F.B.V.L
473	Series 4000 Moving-coil Cartridge Preamplifier	F.J
480	50-100 Watt Amp Modules (Dec 76)	A.W.R.D.E.J.O.Y.L
481	12V 100 Watt Audio Amp (May 77)	R.E
481	High Power PA/Guitar Amp (Jun 77)	W
482	Stereo Amp (Jan 77)	O.E
482	Stereo Amp Part 2 (Feb 77)	O.E
483	Sound Level Meter (Feb 78)	E
484	Simple Compressor Expander (Jul 77)	A.E
485	Graphic Equaliser (Jun 77)	W.E.J.O
486	Howl-round Stabiliser (Nov 77)	J
487	Audio Spectrum Analyser (Feb 78)	E
489	Audio Spectrum Analyser 2 (Apr 78)	E.J
490	Audio Compressor (Dec 78)	
491	Simple Graphic Equaliser (Mar 79)	W.E
495	Transmission Line Speakers (Aug 77)	

Miscellaneous

546	GSR Monitor (Mar 77)	W.E
547	Telephone Bell Extender (Jun 77)	E
548	Photographic Strobe (May 77)	W.E
549	Induction Balance Metal Detector (May 77)	W.D.E.L
550	Digital Dial (Aug 78)	E.O
551	Light Chaser (Sep 78)	W.E.O
552	LED Pendant (Sep 78)	A
553	Tape/Slide Synchroniser (Oct 78)	E
556	Wind Speed/Direction Indicator (Dec 78)	
557	Reaction Timer (Feb 79)	E
558	Mast-head Strobe (Feb 79)	E
559	Cable Tester (Mar 79)	
575	Portable Fluorescent Light Wand for Car. Camping (Aug 79)	W
577	General Purpose Power Supply	J
581	Dual Power Supply (Jan 77)	W.E.Y
582	House Alarm (Jul 77)	W.E.O.A.
	House Alarm — Installation Instructions (Aug 77)	W
583	Marine Gas Alarm (Aug 77)	D.E.M
585	Ultrasonic Switch (Sep 77)	R.D.E.O.F
586	Shutter Speed Timer (Oct 77)	E
587	UFO Detector (May 78)	
588	Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78)	N
589	Digital Temperature Meter (PCB135) (Dec 77)	E
590	LCD Stopwatch (Oct 78)	O.N
591	Up/Down Presettable Counter (Jul 78)	D.E
592	Light Show Controller (Aug 78)	E
593	Colour Sequencer (Dec 78)	
594	Development Timer (Apr 79)	E
595	Aquarium Lamp Controller (May 79)	

Electronic Music

602	Mini Organ (Aug 76)	W.D.E.A
603	Sequencer (Aug 77)	W
604	Accentuated Beat Metronome (Sep 77)	E
605	Temp Stabilized Log-exponential Converter (Sep 78)	

Computer Projects

630	Hex Display (Dec 76)	E.A
631	ASCII Keyboard (Dec 76)	W.E.O.A
631	Keyboard Encoder (Apr 77)	W.E.O.A
632	Video Display Unit (Jan 77)	A.E.O
633	TV Sync Generator (Jan 77)	A.E
634	8080 Educational/Prototyping Interface (Jul, Aug 78)	
635	Microcomputer Power Supply (Sep 77)	O
637	Cuts Cassette Interface (Jun 78)	V.E.A
638	Eprom Programmer (Jul 78)	W.E.A
639	Computerised Musical Doorbell (Mar 78)	A
640	S100 VDU (Apr, May, Jun 78)	W.O.A.V
641	S100 Printer (Sep 78)	O
642	16k S100 RAM Card (Feb 79)	K
650	STAC Timer (Nov 78)	A.E.L
651	Binary to Hex Number Converter (Jun 79)	E

Radio Projects

712	CB Power Supply (Jun 77)	W.E
713	Add-on FM Tuner (Sep 77)	
714	VHF-Log-Periodic Antenna (Feb. Mar 78)	
715	VHF Power Amplifiers (Nov 77)	
716	VHF Power Amplifiers (Jan, Feb 78)	
717	Crosshatch Generator (May 78)	W.D.E.A.Y
718	SW Radio (Oct 78)	E
719	RF Field Strength Indicator (Nov 78)	
720	2m VMOS Power Amp (Jan 79)	
721	Aircraft Band Converter (Mar 79)	W.E
722	Antenna for Aircraft Band Converter (May 79)	
724	Microwave Oven Leak Detector (Jul 79)	D.E.B
725	Simple SSB Generator employs Polyphase Network using Standard Components (Aug 79)	E.L
730	Get Going on Radioteletype (Aug 79)	E.L

Electronic Games

804	Selectagame (Nov 76)	O
804	Selectagame (Rifle Project) (Mar 77)	O
805	Puzzle of the Drunken Sailor (Oct 77)	
806	Skeet (Jan 78)	O
810	Stunt Cycle TV Game (Jun 78)	D.O
811	TV Tank Game (Oct 78)	O
812	Wheel of Fortune (Dec 78)	
813	Race Track Game (Jan 79)	O
814	The 'Dinky-Die' (Aug 79)	

10

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Reader Enquiries

By Mail: There is no charge for replies but a foolscap-size stamped addressed envelope **must** be enclosed. Queries relating to projects can **only** be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are otherwise than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

By phone: We can only answer readers' technical enquiries by telephone **after 4.30 pm**. In enquiring by telephone about back issues or photostats, please ask for the "Subscriptions Department". **33-4282**

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DREGS

Direct current from the sun?

The idea of using the sun's energy to generate electric power is nothing new. Silicon cells and artificial photosynthesis are probably the best known ideas for harnessing some of the 1.35 kilowatts of radiant energy our local star throws at every square meter of our atmosphere. However, these are really small beer compared to some of the exotic suggestions that have been put forward.

The Australian astronomer, V.A. Bailey, calculated some twenty years ago that the electric potential of the sun relative to the Earth may be around 10^{19} volts (give or take an order or two of magnitude). With this kind of potential difference, even a very small current flowing from the sun to the Earth would deliver a lot of power!

But how could such a current be initiated and kept going? In the movies of course, this would be no problem — you'd use a laser, just as you do for everything else in sci-fi these days. And would you believe that an American by the name of John Krepak has seriously suggested that a high energy laser fired at the sun could in fact initiate a current by ionising molecules in the very low density gas that we normally call 'space'?

The photons in such a laser would of course need to be quite energetic, so an ultraviolet laser seems the best possibility. Except that there are rumours that the US military (or the CIA, or somebody) is working to develop a gamma ray laser (also known as a 'graser') to use for non-benevolent purposes (naughty, naughty . . .). The graser seems to be ideal for ionising atoms in space. Coherent gamma rays would probably not only free the orbiting electrons, they might very well smash up the nucleus into fundamental particles.

John Krepak suggests putting a graser on the moon and aiming it at the sun, then using the current from the sun to generate microwave radiation which is beamed to Earth. Remember, you read about it first in Dregs!

More puns

There were some clever ones this time around, the standard of puns is getting noticeably better (or worse, depending on your point of view!). Young Chris Hoffman of Riverstone NSW came up with several, his best being about interfacing a camera to the S100 buss to get a photographic memory! G. Hansper of Tullamarine in Victoria also had several, his best being about boasting of "record-breaking turntable sales". Ian Compton of SA had an amusing tale about polylingual puns being punishable and Chris Price of Brookvale NSW had this poem:

"The readers of Dregs got together
To think of new ways to make weather
Instead of less sun
They each made a pun
Their first (and their last!) get together"

Very good!, but this month's prize goes to Jim McBeath of East Doncaster, Vic, with the following tale:

"Early in World War I, electronic equipment was very heavy and horses were used where portability was needed. The Australian Wireless Corps had only one unit operating at Gallipoli, Morse Cpl. Murphy and his tatty old roan horse. The Turks had no portable units at all. One day Cpl. Murphy was shot and the horse captured. The Turks tried to use the roan and the wireless to intercept the allied morse communication, but the horse proved most unco-operative, killed two Turks and was shot. The moral of this story is: A stolen roan gathers no morse."

UNTIL WE DEVELOPED THE STEREO GROOVE, HI-FI WAS PRETTY HO-HUM!

The world of hi-fi owes a lot to the original and continuing innovation of JVC. Few companies, if any, have done as much to help turn records and record-players into the virtual musical instruments they are today . . . or to lead the way in developing so many *firsts* in the more recent concepts of sound amplifiers, cassette decks and computer-designed speaker systems. Hi-fi, as we know it today, had its beginnings in 1956, with JVC's development of the 45°/45° groove for stereo records. The fact that this system still remains as the world standard is, in itself, outstanding testimony to the technology of JVC. The development revolutionised not only the record-*making* industry, in which we've been involved since 1930; it also paved the way for enormous advancement in the design and engineering of record-playing equipment. Now, hi-fi has expanded to

R-S77. Super-A FM/AM Stereo receiver

embrace a wealth of highly-sophisticated electronic equipment; and it's not surprising that JVC has continued to play a leading role in so much of its development.

HR-3660 EA.VHS Colour Video Cassette recorder

THAT WASN'T OUR ONLY FIRST, EITHER.

We also pioneered Japan's television industry, introducing their first TV receiver just over 40 years ago. A more recent innovation is VHS, the home video recording system now gaining world-wide acceptance as *the* system for such equipment. In the course of staying ahead, we've introduced a number of world *firsts* of radical importance: the Quartz Lock turntable is one of them.

THE QUARTZ LOCK TURNTABLE. MANY TIMES MORE ACCURATE.

It stands to reason that if your equipment is at the top end of the range, then your turntable must be capable of comparable performance. Only Quartz Lock ensures this, tying the speed of the turntable to the unvarying pulse of the atom, and providing a level of accuracy far in excess of conventional turntables.

MORE MILESTONES IN HI-FI.

To match the superb quality of Quartz Lock, we produced the S.E.A. graphic equalizer system. Then we refined it to such a degree it even compensates for the effect your furniture has on sound when it leaves the speakers! To expand the capabilities of tape, we designed ANRS and

SEA-80. Stereo Graphic Equalizer

Super ANRS — automatic noise reduction systems which not only reduce distortion and 'hiss' but actually extend the dynamic range of the tape. Similarly, with speakers: at JVC we employ computers in their design to help provide the ultimate in sound reproduction.

AND NOW, SUPER-A.

In its own way, as significant a hi-fi development as the stereo groove. Imagine an amplifier which combines the *best* features of the two recognised amplifier classes (A and B) . . . an amp which combines the *efficiency* of one with the *low distortion* of the other. Some engineers said it couldn't be done; but not those at JVC. Enter the Super-A amplifier . . . the *latest* JVC *first!*

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JVC
the right choice

THE FUTURE.

It's already with us. For instance, we were so far ahead in the new metal tape technology that our cassette decks were metal-compatible before the tapes were generally available. And now there's the JVC Electro-Dynamic Servo Tonearm, damping tonearm resonance by means of a purely electronic system and two 'thinking' linear motors. Who was it who dubbed JVC, 'the innovators'?

1861

new class A synchro-bias

SU-V8

Stereo Integrated DC Amplifier

Technics new Class 'A' amp. eliminates 'switching and cross-over distortion' with Class 'B' efficiency.

Technics

Sounds Alive

New Class A circuitry with synchro bias. Straight DC circuitry for direct coupling between DC power amp section and high-level input signals. Concentrated power block prevents distortion from electro-magnetic induction. ICL phono EQ circuit with ultra-low noise FET's permits use of MC cartridge without pre-preamp or step-up transformer. Independent right and left power supplies using 2 transformers. 105 watts per channel power output at 8 Ohms from 20Hz – 20kHz. 0.007% THDF. Super bass brings the deepest bass sounds to life. Recording selector with 2-way dubbing. Remote action switches.

Technics