VALVE power amp!
140 W of 'rich, warm' sound

‘Auto-probe’ project
Test your car’s electricals

New S-100 bus specs

HI-FI
Revolutionary speaker drive units explained
SAE preamp and power amp reviewed
A new dynamic generation of Maxell tapes.

When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

Take our high level (CrO2) position tape — the UD-XL II. Maxell engineers have succeeded in expanding its dynamic range in the middle-low frequency range by 1 dB, while also pushing its sensitivity by 1 dB in the high frequency range. Then look at our normal position UD-XL I, UD and LN tapes — our engineers expanded the dynamic range at all frequency points, while also boosting output in the high frequency range. The new dynamic range, of course, allows for better music reproduction even for LN-type tapes.

On the UD-XL I and II, we also added an exclusive shell stabilizer for significantly improved tape running and track positioning.

One thing hasn't changed on all Maxell tapes — our functional features like 4-function leader tape, replaceable index labels for UD-XL series tapes and Maxell's through-production system — your guarantee of quality and superior sound reproduction.

Tape selector position UD-XL I, UD, LN: Normal position (Normal bias/120 µsec. EQ)
UD-XL II: High level position (High level bias/70 µsec. EQ)

For details on all Maxell Recording Tape write to Maxell Advisory Service, P.O. Box 307, North Ryde, N.S.W. 2113

Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

maxell
simply excellent
**QUICK INDEX**

**FEATURES:**
- 15 Radiometric Exploration
- 22 Ultrasonic Microscope (at 3 GHz!)
- 27 World's 1st Electronic Credit Card

**SOUND SECTION**
- 125 Sound News
- 131 Revolutionary speakers explained
- 146 S.A.E. Preamp-Power Amp duo
- 154 Marantz 1300DC Stereo Amp
- 162 Akai PS-200T Tuner

**PROJECT SECTION:**
- 29 456: "The Rocker" — 140W Valve Amplifier
- 39 325: Auto-Probe tests vehicle electrics
- 47 560: Mains Cable Seeker
- 52 636: S100 Motherboard
- 58 Autostart for the RTTY System
- 68 Lab Notes — Walking Rings & Other Miracles
- 77 Ideas for Experimenters
- 85 Shoparoud
- 137 PC Board Patterns
- 168 Kits for Projects

**READERS NOTE!**

**THIS EDITORIAL** is about how to get the most out of the 'information' pages we include in the magazine each month. These information pages are titled "Shoparoud", "Kits for Projects" and "Services". These last two you will always find together at the back of the magazine, immediately before the 'Dregs' page just inside the back cover. In this issue they're on pages 168 and 169.

**Kits for Projects** lists 17 companies that stock various projects published in the magazine over the past few years. The projects are listed in ten categories and each project is assigned a particular number. Complete kits, or printed circuit boards and the relevant components, may be obtained from the companies indicated in the list. In addition, two companies who can supply virtually every pc board we have ever published — RCS Radio and Radio Despatch Service — are listed. Whenever you are chasing for bits for past projects — this is the page you should consult first. The information on this page is updated several times a year.

At this point I would also like to make it clear that our business is to publish this magazine — we do not sell kits or components — but our advertisers do!

**Shoparoud** generally discusses projects in the current issue and where kits or components may be found for these. If components are widely available, no specific suppliers will be mentioned. Also, we use this page to keep you up to date on new components or past projects, interesting new gadgets or components, or items of topical interest to the hobbyist.

Recently, we commenced giving price estimates in Shoparoud for current projects. We have commented in detail in this month's column, but we would also like to stress here that these prices are estimates only. They should not be taken as recommended prices. On occasion, for a variety of reasons, our estimates may be low. Don't abuse your supplier if you find his price higher than ours. The electronics retail business is too competitive for anyone to be suspected of 'ripoffs'.

The **Services** page tells you how to access the various services we provide for you — how to make enquiries, how to obtain back issues or photostats of articles, etc. A coupon is provided for your convenience. It makes things so much quicker if you use the coupon when ordering anything from us. If you don't wish to mutilate your magazine, photocopy the coupon and use that.

Turn to each of these three pages, right now — 85, 168 and 169, and see what they're all about.

After all, they're there to help you!
COVER
To herald our first valve project, we just had to have a picture of a valve on the front cover! The device is some 40 years old and is a type 15E triode, made by Eimac for 900 MHz airborne radar systems developed for WW II.

NEWS DIGEST
Solar generator for the centre?; New TV channel for UK; 25 MHz dual-trace CRO; Technics back JVC video disc; New transistors; Hatched, matched, despatched.

PRINTOUT
Two local firms win design awards; Micros invade the office; Static ROMS from National; Bar code printer, SH/UG club; New LEDs.

COMMUNICATIONS NEWS
New body for two-way radio users; Sunspots — countdown to a maximum; CB for UK ?; Radio security.

SHORTWAVE LOGGINGS
Dubbed “The Rocker”, this beast is quite versatile as it can be used for guitar work or as a Hi-Fi valve amp.
Checking faults or tracing wiring in a vehicle's electrical system using a multimeter is generally tedious and frustrating. This little gadget eliminates the drudgery and the guesswork.

Don't mount that picture hook until you've found where the mains cable runs - this handy project shows you the way.

Now you can tidy up all those S100 project PC boards.

All about walking rings and performing other miracles with counter chips.

S.A.E. PREAMP-POWER AMP

Subjective impressions of the amplifiers' performance were outstanding.

MARANTZ 1300DC STEREO AMP

"... an excellent example of careful design and planning ... a first class piece of equipment."

AKAI PS-200T TUNER

"The quality of the sound is in general terms as good as some of the best tuners and receivers we have listened to ..."

REEL-TO-REEL TAPE OFFER

Superb Ampex tapes at a low price.

Now you can automate your RTTY station and leave it to print messages in your absence.

Inside the all-new, singing, dancing, virgin-refresh, S100 bus.

Sound to light modulator; Telephone amplifier; Port light controller; All-round modulator; Darlington drivers; Sonalert on 240 Vac.

Where to find the components for this month's projects plus project price estimates.

For those using the Scotchcal process to make their own PC boards — expose through the page.

Featuring a phase-locked loop tuner, this receiver should attract the Hi-Fi enthusiast interested in joining in the boom on the FM band.

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.
NEW FROM CEITEX

CHASER 4

This is the lighting controller that makes any imported controller obsolete — The Chaser 4! Four channels, up to 10 amps maximum unit loading, will chase at a preselected rate, variable at the rate control. On music peaks, the chase mode automatically reverses! Push buttons allow chase, shadow chase (3 channels on, 1 off) and Colour Organ. In the Colour Organ mode, the 4 channels respond to different frequencies — the audio signal feed is via a 6.5mm jack socket at the rear of the unit. Audio level-in is at speaker level — up to 200 watts. The Chaser 4 is well built, designed for Australian applications, and guaranteed. With local service facilities available.

THE COMBINATION CHASER/COLOUR ORGAN THAT CAN BE USED WITH HOTSPOTS!

STROBE CONTROLLER

SPECIAL

NOW — 20 percent off recommended prices on a complete package of 4 superstrobes, and the new Ceitex strobe pulser. The strobe pulser gives you total control over your strobes, offering either rainbow chase, tandem flip-flop or all flash functions. Either at a preset rate or with an audio input! Create bizarre effects!

SNAKELITE TUBELITE FLOWBOX

The Flowbox allows direct connection of 24V Snakelite or Tubelite — up to 20 metres! Where a Snakelite audio chaser is not required, the Flowbox does the trick. For that budget application, or for displays — the Flowbox! (Flow rate variable by preset control).

SEE US FOR EVERYTHING IN STAGE & EFFECTS LIGHTING

- Spotlights — Strand & Altman
- Dimmers — Flight, Strand & Jands
- Colour Gel — Roscolene & Lee
- Effects — We’ve got it all — EVERYTHING!

TUBELITE

This 1 cm high-impact plastic tube is made to order, with tiny clear lamps at varying spacings. Wired at 24V, it can be used for anything! In dance floors, around windows, and — never before — in architecture! Just imagine tubelite built into walls, up handrails, even in swimming pools! The possibilities are limitless, especially considering the miniature lamps have a 25,000 hour rated life! Tubelite can be run from a transformer or from a Snakelite Flowbox (see above).

TUBELITE

MELBOURNE: Lighting Corporation 131 Brighton St Richmond (03) 429.5122
ADELAIDE: Hiwatt Lighting 37 Angus St Adelaide (08) 212.2033
ADELAIDE: Psycho Lites PO Box 291 Nth Adelaide (08) 471.874
PERTH: Western Strobe Lighting 1142 Hay St West Perth (09) 321.9363
PERTH: Cosmic Sound 1074 Albany Hwy Bentley (09) 361.9891
HOBART: Good Oil Sound 310 Liverpool St Hobart (022) 235.151
Also available Australia-wide at Strand Rack electronic outlets.

DISTRIBUTED NATIONALLY BY BARRATT LIGHTING LTD
140 MYRTLE STREET, CHIPPENDALE NSW 2008
PHONE (02) 699-7963.
TELEX AA25298.

6 — May 1980 ETI
MAGRATHS
FOR ALL YOUR ELECTRONIC COMPONENTS

IN THE HEART OF MELBOURNE

Where price is important 
but service is paramount.

FULL RANGE OF COMPONENTS, PC BOARDS, ETC, FOR ETI AND OTHER PROJECTS

ETI May 1980 – 7
Solar generator for the 'centre'?

The Northern Territory Government is studying a proposal to build a 1000 kilowatt solar powered electrical generator near Ayers Rock.

The scheme, proposed by McDonnell Douglas (makers of the DC-10 aircraft), is designed to produce electricity for Yulara, a 300-unit tourist village that the N.T. Government propose to build near Ayers Rock, some distance from Alice Springs.

The proposal stems from efforts by the Ministry and the Northern Territory Electricity Commission to sharply reduce the region's dependence on oil-based energy sources.

The generator features a solar-thermal conversion system and it is believed it will cost something like $10 million to construct.

Whilst the initial capacity is rated at 1000 kW output, provision has been made to expand the plant to 2000 kW capacity. It is anticipated the plant would displace nearly one million litres of oil, that would otherwise be necessary, at its initial capacity of 1000 kW, saving around $230,000 annually, doubling that at full capacity.

The station is dominated by a 50m high tower, topped by a thermal energy 'receiver'. The tower is surrounded by a four hectare (10 acre) field of mirrors, called heliostats, which follow the sun as it moves across the sky, reflecting its rays onto the receiver atop the tower. The position and movement of the mirrors is controlled by a computer.

The heat of the sun is absorbed at the receiver by a special fluid circulating through it. The heated fluid is then used to convert water to steam in a heat exchanger, which drives a turbine and generator.

A unique feature of the solar generator is the composition of the fluid which is used to store the sun's heat. This fluid is a mixture of special salts, forming a 'eutectic', which melts at 80°C. They are heated to 450°C by the sun, without an increase in pressure in the system.

Although this fluid has never been used for this purpose before, McDonnell Douglas is confident that the system will have no teething problems. They point out that the hot fluid can be stored overnight so that electricity can be generated continuously.

Excess heat from the steam turbine can be used in a desalination plant making use of the locally available brackish ground water to produce around 70,000 litres of water a day, suitable for domestic or agricultural use.

There are considerable engineering problems in the storage of large quantities of fluid at the high temperature of 450°C. (Red heat for steel is around 520°C). Some form of backup system will probably be required in case of cloudy days or computer failure, especially since the liquid would return to a solid in the pipes in the event of an extended shutdown.

At the present time, however, the solar generator is being promoted as a system which is completely independent of fossil fuel generator back up systems.

Curiously, 1000 kW will only partly supply the energy requirements of a 300-unit village, delivering around 3 kW (peak load) per unit. In an arid climate this only allows for air conditioning, appliances and lights. Such niceties as stoves would have to be fuelled from other sources, as these require 10 kW or more at peak load.

On present day prices, the cost of electricity from diesel-generator power stations of similar size is approximately 8c/ kilowatt-hour in comparison to 19c/kilowatt-hour for solar power (assuming 10% interest paid on the capital investment).

The 'Economist' magazine, in its comparison of electrical energy costs for the years 1990 to 2000, predicts that solar-thermal generation will remain the most expensive way of producing electricity.

In the year 2000, electricity generated by this method will be 15% more expensive than by direct conversion of the sun's rays to electricity, and nearly twice as expensive as electricity from wind generators.

By comparison, hybrid systems which employ a combination of wind power, solar-electric generation (solar cells) and storage batteries plus standby diesel are considerably less expensive.

Although currently available systems are only relatively low power, such as the Australian-produced 'Hybrid Energy System' by Dunlite of South Australia, larger capacity systems would be competitive. Projected cost for a 1000 kW system would be in the vicinity of 45 million — around half that for the McDonnell Douglas solar-thermal system.

McDonnell Douglas also manufactures the F-18 Hornet strike fighter, currently under consideration by the Australian Defence Department to modernise the Royal Australian Air Force.

At a press briefing on April 1st the Chief Executive of McDonnell Douglas, Sanford McDonnell, said that two years ago the Prime Minister, Malcolm Fraser, had suggested to him that the cost of a solar generator — such as the one being proposed — could possibly be offset against the Australian Industry Participation (AIP) portion of any contract to purchase aircraft. (The AIP
scheme provides that a certain portion of military equipment bought overseas must be built in Australia, thus providing jobs and developing skills in local industry as well as reducing the "external cost" of overseas purchases.

McDonnell Douglas and Sabermo officials say the plant could be operational by mid-1983.

The decision to go ahead with an alternative energy system for Yulara is essentially a political one. The McDonnell Douglas solar-thermal generator is expensive and untested. The Northern Territory Government consider it will appeal as a tourist attraction, apart from its practical purpose.

As such, it seems its function will be more of a "symbolic sculpture".

New TV channel for UK

Britons are to get a fourth TV programme channel to be transmitted over a network of UHF transmitters and controlled by the Independent Broadcasting Authority.

At present, television viewers in Britain have a choice of three programmes. Two programmes are transmitted by the state-owned British Broadcasting Corporation and are known as BBC-1 and BBC-2. The third channel is operated by the Independent Broadcasting Authority (IBA) and is financed by advertisements transmitted in the intervals between programmes.

The present government decided that the IBA will have control of the fourth channel and that this new programme will be financed through advertising.

The financing of two television channels through advertising involves the danger of both IBA networks striving to achieve maximum popular appeal. There is currently more demand for television advertising than can be accommodated on one channel.

The IBA must not allow the two commercial channels which are financed by advertising to compete for a maximum audience; neither will the five main television companies who produce the present programmes transmitted by the IBA be allowed to dominate the programme content of the proposed fourth channel, Britain's Home Secretary, William Whitelaw, said.

The IBA must make arrangements for the largest practicable proportion of programmes to be supplied by organisations and persons other than the television companies contracted to provide the programme being transmitted on the present independent channel, he said.

The new network will have its own controller and its own income. The IBA will be expected to ensure that an adequate budget for the new channel will be provided to achieve the required service, but the finance will not necessarily be determined only by the revenue from advertising. Thus it seems revenue from the existing IBA channel will be used to finance the new fourth channel in Britain.

The IBA have already been empowered by Parliament to commence the building of a new network of UHF transmitters for the fourth national television network. The cost of operating the new channel will be about 60 to 80 million pounds per year.

Brian Dance

Alarmed? Get Dick on the job

Burglary is an unpleasant business for the victim, no wonder many people seek ways and means to make it unpleasant for the burglar - with electronic burglar alarms.

Dick Smith's latest model burglar alarm, No. L-5102, is designed for installation in the home, office or factory and should certainly make things uncomfortable for the would-be felon.

The unit, housed in an attractive walnut-veneer box, looks not unlike a very small speaker enclosure and features both normally open (n.c.) alarm loops for window and door sensors, panic switches, vibration switches etc. The built-in siren has provision for an external horn if desired. A remote switch function allows for control of the unit from a distant point.

Price is only $59.50, sensors etc are extra but all available from Dick Smith. Try your nearest Dick Smith store or dealer.

Briefs

Plessey Optoelectronics and Microwave Limited of the UK has introduced a new series of passive infrared long range detection systems. These new devices have a detection range of 100 m and police in the UK have been using them for outdoor surveillance for some time. The units will detect a heat source with a temperature greater than one degree Centigrade above background if it is larger than half a metre square at 100 m distance (e.g. a person). Various fields of view are available, and sensitivity is adjustable. The series incorporates a screened micropower amplifier, level detector, an alarm indicator, change-over relay alarm output and tripod fixings.

Matsushita have developed a new lens device. They claim improvements in television image resolution by 20% or more. The main secret, they say, is the development of a new lens device. Apparently, it has an in-line gun but three electron lenses arranged side by side. The firm has already begun mass production of colour TV tubes using the new gun.

A new voltage/current threshold detection optocoupler with guaranteed input-threshold specifications and logic-compatible output has been introduced by Hewlett-Packard. It is designed for industrial control computer input boards and other applications where a pre-determined input threshold level is desirable. The HCPL-3700 combines a threshold-sensing input buffer IC, an internal LED and a high-gain photon detector to provide an optocoupler which features adjustable external threshold levels and logic-compatible output.

In quantities of 1 to 99 the HCPL-3700 is priced at $6.61 for 100 to 999 pieces, the unit price is $4.82. It is in stock at HP distributors. For further information contact Cerna Electronics Pty Ltd., 21 Chandos Street, St. Leonards NSW 2065, or at 208 Whitehorse Road, Blackburn Vic 3130.
Technics back JVC video disc system

The public will be forced to choose between three video disc systems when the big disc war gets underway in the next two years.

National Panasonic announced at a press conference in Terrigal, NSW, recently that it will back the JVC video disc system.

Asked why Matsushita (the mother company of National Panasonic) had decided to back a third system against the Philips and RCA systems, and cause the sort of confusion that dogged the steps of video recorders, and before that four channel sound, Mr Toshiro Masui (a Technics Director attending the press conference from Osaka) said that Matsushita had decided to abandon its own system and back the JVC system to try and “ease the confusion” that will face the market.

"We gave up our system to adopt the JVC system," he said "and other manufacturers are expected to follow." Although some of the reasons given are sound enough for the company’s decision, it looks as if the electronics market place is to always have to contend with the eternal triangle: Japan, versus America, versus Europe.

RCA is American, Philips European and JVC Japanese.

Which Japanese companies are to follow the Matsushita lead to adopt the JVC system is not known and the canny executives from Matsushita were not about to enlighten us at the Terrigal conference.

But as interested as we were to find out what sort of Nipponese weight was to be put behind this third video disc system we were even more intrigued to find out which company would be supplying the vital software material, without which any video disc in the market place is doomed.

MCA Universal, according to a director of that company, has over 50% of the entertainment industry in the USA tied up, and is completely committed to the Philips system.

RCA will source entertainment software from its vast TV and film companies into supporting its own format, due out in 1981.

Who then is to supply the vital software to JVC? Matsushita executives were tight lipped about this subject too, refusing to say anything although they did exchange a few pointed and knowing grins.

The guess amongst the press is Disney Productions, although this is sheer speculation.

When examined under an unemotional light (we all tend to get very emotional about inter-company and international battles over industry standards because it is always the consumer who loses out in the long run) Matsushita has some sound arguments for going it alone.

Mr Masui says that the MCA Universal — IBM — Pioneer conglomerate is having a lot of problems producing the software for the Philips system because it is such a complex process.

On the other hand the Philips system, using an optical stylus system with random access and freeze frame features, is excellent.

The RCA system uses a mechanical stylus and a grooved disc. This sort of disc is easy to produce in conventional record factories but does not offer random access.

The JVC system on the other hand, has the advantages of both systems without the disadvantages. It uses a disc that can be pressed in normal record factories but has random access. It uses a part mechanical and part optical system.

Mr Masui claims that the JVC units will be cheaper and more reliable than the Philips units.

He also says that the highlights of the 1980s will be video disc and PCM audio. This will develop side by side and any video disc system should be able to play back PCM audio discs as well.

This, the JVC system will do. However, Philips have developed a separate PCM audio system to complement the Philips video disc system, he points out.

Although the video disc became one of the more heated debates at the Terrigal conference the real reason for all of us being there, besides the booze and the beaches, was to see Techincs release its new range of hi-fi. Turn to “Sound News” for a full report.

Dennis Lingane

Philips win $1.7M order from South America

Philips-TMC, the telecommunications manufacturing company of Philips, have been awarded a $1.7 million contract for a radio communications network for Fenatch, the National Federation of Professional Taxi Drivers of Chile.

This communications system innovation is wholly designed and manufactured in Australia by Philips-TMC. It comprises: three SI 10 000 status and identification system consoles; 1000 FM828 mobile two-way radios and associated base stations and line switching equipment. The system will be installed in Santiago to control the 1000
taxi in the Fenatach fleet.

The Santiago taxi service is similar in size and in operation to Taxis Combined Services in Sydney — one of the world’s largest.

Philips supplied an SI 10 000 system to Taxis Combined Services in Sydney early last year and has since supplied a similar system to Hong Kong.

Fenatach President (Senior Juan Jara Cruz) and two of the Federation’s Directors are visiting Sydney to study the operation of the SI 10 000 system in Taxis Combined Services.

In the Philips system voice transmission from each taxi is replaced by coded data transmissions. These provide the identification and status of each vehicle and enable the driver to bid for jobs and acknowledge them in a fraction of a second by a pushbutton operation. The system includes an alarm facility which identifies the taxi and provides a means to monitor conversation within the taxi in the event of hold-ups or attacks.

The complete system will be supplied and installed in Santiago within six months and will be commissioned and fully operational in eight months.

New audio oscillator redefines distortion limit

The new Tektronix SG606 audio signal generator features total harmonic distortion of less than 0.0008% from 20 Hz to 20 kHz.

Packaged as a plug-in for the TM500 family of modular test and measurement instruments, the SG505 can be readily combined with the user’s choice of over 40 other plug-in instruments (oscilloscopes, counters, digital multimeters, amplifiers, function generators, and others) in a single package. This feature is especially valuable in audio measurements where common applications away from the lab bench dictate portability.

The frequency range of 10 Hz to 100 kHz for the SG505 encompasses the entire audio band. This range is covered in four overlapping bands selected by pushbuttons. Within each band frequency is selected by a continuous tuning dial.

Output signal amplitude is greater than 6 V RMS unloaded and greater than 3.12 V RMS into 500 ohms, say Tektronix. Control of the output level is provided by a precise eight-step attenuator ranging from 10 dBm to -60 dBm. Claimed step accuracy for each 10 dBm increment is 0.1 dB. Within each step, a variable control provides continuous adjustment. An on/off switch allows disconnecting the output signal at the touch of a button. A second pushbutton selects between ground-referenced or floating output.

A sync output terminal provides a 200 mV rms sine wave which tracks the selected frequency of the output. Both the output and the sync signals are available at the rear connector of the SG505 as well as at the front panel. This facilitates easy interconnection with other TM500 plug-in instruments.

An optional intermodulation test signal provides, at the touch of a button, a combined signal consisting of a low frequency (selectable 60 Hz/250 Hz) sine wave and a sine wave of the dial-selected frequency. The two components are mixed in a 4:1 amplitude ratio. Amplitude of the combined signal is within 0.2 dB of the amplitude of the fundamental signal alone.

Further details from Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde NSW 2113. (02) 888-7066.

MPU controlled RF impedance analyzer

The Hewlett-Packard model 4191A RF impedance analyzer was designed for making high frequency (1 MHz to 1 GHz) evaluation measurements of electronic materials, components and circuitry.

It can measure fourteen impedance parameters over a frequency range of 1 MHz to 1 GHz with a basic accuracy of 0.5% to 2%. An internal frequency synthesizer, automatic calibration, automatic error correction and specially-designed test fixtures make stable, accurate impedance measurements possible over a measurement range of 1 M to 100 k (1 uses to 50 sec).

In addition, the 4191A features an internal bipolar dc bias source, linear and log sweep capabilities on all 14 parameters.

These features make the 4191A an excellent design and testing tool for high frequency evaluation. The duty free price is $13 630 and further information can be obtained from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn Vic 3130; (03) 89-6351 or any of their branches.

Temperature and pressure instruments

Amalgamated Instruments Co Pty Ltd have a range of temperature and pressure measurement and control instruments available.

These are designed and manufactured in Sydney and AIC are looking for agents around Australia.

Their handheld digital thermometer is believed to be the smallest presently available, and with its high accuracy and wide range is ideal for a pocket unit for quality control.

The circular dash- or panel-mounted indicator is proving popular in the marine industry for measuring sea water temperature to locate currents by change in water temperature. Temperature controllers are also available and AIC offer design prototyping and manufacturing services for most small scale applications.

For further information contact Amalgamated Instruments Co Pty Ltd, P.O. Box 305, Narrabeen NSW 2101. (02) 452-2648.
Hatched

Brief news on company activities, new outlets, mergers, joint ventures and closures.

Hatched

● A NSW CSIRO State Committee' was announced recently by the
      Minister for Science and the Environ-
      ment, Mr David Thomson.

      The Committee will act as a link
      between the CSIRO and individuals
      and associations in NSW and pro-
      vide an input to the CSIRO Advisory
      Council.

      The Committee will also be in-
      volved in making the work of the
      CSIRO more widely known in
      NSW", said Dr J. Paul Wild, Chair-
      man of the CSIRO.

● A new digital components and
      microcomputer store opened in
      Sydney late in March. Called
      Mic-
      robits, this store sells such things
      as
      Motorola, Fairchild, and National
      semiconductors (like the 74 and
      74LS series, 4000 series, 6800/9000
      series, EPROMs and drivers etc) plus a large range of
      Molex and Ultix connectors and clips.

      On top of all that they carry
      boards from Pennywise Peripherals (at
      Melbourne prices), static RAMS, EPROMs, cassette
      interface etc.

      Check them out at 280 Victoria
      Rd, Gladesville 2111. (02) 89-3145.

● The Standards Association of
      Australia has published a revision of the
      standard graphics symbols for
electrotechnology, Part 9, binary
      logic elements. Designated
      AS 1102 (9.20), copies may be
      obtained from offices of the Associa-
      tion in all state capitals and Newcas-
      tle (NSW). (Henry Smith)

      They also recently released a
      draft, DR 79187, of a new Australian
      standard guide for the selection and use
      of power transformers. Copies
      obtainable as per above.

● Ferguson Transformers Pty Ltd
      added three newly-hatched power
      transformers to their range in
      March. Designated type nos
      PF4361, PF4362 and PF4363, they
      have nominal ratings of 200 VA, 300
      VA and 300 VA respectively and may
      be configured with various output
      voltages. Readers may remember
      the PF4363 was used in the power
      supply for our 300 watt amp fea-
      tured in the February issue.

      Full details from Ferguson Trans-
      formers Pty Ltd, P.O. Box '302',
      Chatswood NSW, 2067. (02) 407-
      0261.

● A new solar-powered watch has
      been launched on the market. Call-
      ed "The Sunwatch" it comes with 10
      display functions: hours, minutes,
      seconds, months, dates, leap year,
      speed calibration, AM/FM indicator
      and seconds count off. It also fea-
      tures an adjustable brightness dis-
      play (four levels) and is program-
      med to the year 2100.

      No batteries are necessary and
      the Sunwatch comes complete with
      a two year warranty from Quality
      Gifts International, P.O. Box 410,
      Surfers Paradise QL 4217. (075)
      38-3472.

Matched

● You can now match some new
      modules to your TI Speak & Spell.1
      There are three in the range, called
      Vowel Power", Super Stumper
      4-5-6 and Super Stumper 7 and 8.
      These modules expand the capabil-
      ity of this unit by 125 to 140 words.
      Their content has been thoroughly
      researched to include the most
      commonly misspelled words.

      They come with an informative 12-page booklet that provides basic
      Information and lays out games and activities designed to guide the child
      through the learning process. More info from Texas Instruments' cus-
      tomer service, (02) 887-1122.

● Datatel Pty Ltd has announced the
      acquisition of the maintenance
      facilities of ATL Datatronics Ltd.
      The purchase includes a range of test
      equipment and jigs, sub-assembly
      spare parts and other stock items to
      support a variety of products manu-
      factured by ATL.

      A number of former ATL staff
      have joined Datatel, with Mr Paul
      Redshaw appointed as Service
      Manager.

      Datatel Managing Director, Mr
      Dieter Retz, stated that Datatel ex-
      pected the extended service
      facilities, located at the company's
      South Melbourne headquarters, will
      improve responsiveness to cus-
      tomer repair demands and to en-
      hance the company's marketing
      base.

      Datatel are located at 3 Raglan
      St, South Melbourne Vic 3205 (03)
      699-7614.

Despatched

● Australia's first Unimat 4020
      computerized telephonic exchange
      was installed at the premises of
      Dominguez and Barry, the only
      specialist fixed interest house in
      this country.

      Described as the ultimate small
      PADX, measuring a mere 670 x 650
      x 180 mm, the unit was supplied by
      STC. Another three are expected to
      be installed in Sydney shortly, and a
      further two in Melbourne. Following this
      introductory stage, STC plans to
      assemble the units in Australia.

      The Unimat 4020 can carry up to
      eight exchange lines and 32 exten-
      sions.

● The annual report of the Elec-
      tronics Research Laboratory, De-
      partment of Defence, for 1978-79,
      was released recently. It covers the
      recent activities of the organisation
      which has been involved in radio
      propagation, antenna, radio naviga-
      tion, semiconductor and computer
      research. One presumes copies are
      available from the Australian Gov-
      ernment Publishing Service. It's very
      interesting reading.

● A new two-page technical data
      sheet from Hewlett-Packard de-
      scribes the use of their low-pass fil-
      ter kit and how it can be used to
      reduce high frequency noise errors
      in low frequency measurements.

      This makes it possible to increase the
doping of the base region
      without degrading any other of the
      characteristics.

      Further transistors using this Sipos method will soon be put
      on the market by Sony Corporation.

Peterson Speaker Laboratories

The above company's advertisement on page 25 in ETI April
 inadvertently contained copy giving the impression that
 Peterson speakers are available directly from the company.

In fact, Peterson speakers are available only via retailers — not
 directly from the factory. The advertisement should have read (in
 part) Available at most reputable high fidelity sound centres or info-
 mation from* Peterson Speaker Laboratories Pty Ltd.

High current gain transistors

The Sony Corporation has developed a new npn transistor
which is similar to the present ones except that it has a
current gain 50 times greater.

It is a silicon device employing a 'heterojunction emitter' having
the same emitter area as the conventional npn transistor.

These transistors are manufactured by the use of highly
phosphorous-doped low resistivity variation of a semi-insulating
polycrystalline silicon, which Sony Corporation has been addi-
tion to the greater current gain. Sipos provides a 90% decrease in base
resistance and an increase in current capacity five times greater
than the present one.

The reason for these advantages is that the heterojunction emit-

不顾任何其他的特点。

Further transistors using this Sipos method will soon be put
on the market by Sony Corporation.
• High performance
• Operational simplicity
... that's the low cost

BWD 804

DC to 10MHz Oscilloscope

OUTSTANDING FEATURES:
- DC coupled X, Y & Z amplifiers with low X–Y phase shift
- High vertical sensitivity with constant bandwidth at all attenuator sensitivities
- Constant calibration irrespective of line voltage change
- Wide range automatic trigger and isolated input ground
- Triggering controlled by stabilised high speed TTL circuits is fully automatic with most wave shapes to 10MHz
- Polarity and level selection together with external trigger further extends its range
- Ideal for use as an X–Y–Z monitor

Applications include T.V. and Radio, servicing, production line testing, audio measurement, professional and amateur radio and experimenters

BWD ELECTRONICS PTY., LTD.
Miles Street, Mulgrave, Victoria 3170
P.O. Box 325, Springvale, 3171
Telephone 561 2888. Telex 35115

VIC. BWD Electronics Pty. Ltd., Melbourne. Ph: 561 2888
QLD Warburton Frankl (Brisbane) Pty. Ltd., Ph: 52 7255
W.A. Warburton Frankl (Perth). Ph: 277 7000
TAS. Associated Agencies Pty. Ltd., Hobart. Ph: 23 1843
N.Z. Instrept Pty. Ltd., Hobart. Ph: 34 3194
P.H. Rothschild & Co. Ltd., Wellington. Ph: 66 3581
The High Powered Realistic STA-2000 —
The Heart of a Great Stereo System
And Save $140

The Realistic STA-2000 is designed and manufactured in our own factory to deliver perfectionist quality at an unbeatable price. With 75 low distortion watts on each direct-coupled channel, the most demanding music stays undistorted even at live-performance listening levels. Ultra stable and dependable IC's are in the FM IF detector and PLL sections. Audiophile controls provide wide system flexibility and customized sound. Pushbutton multiplex filter cleans up high-frequency noise on weak FM signals. Complete taping and dubbing facilities for two decks, with long throw switches and both DIN and phono-type in/out jacks for hookup to any equipment. Massive flywheel tuning knob, with switchable muting to eliminate interstation hiss, built-in protection against thermal problems, speaker over-driving or shorting, and switching transients. Plus fine styling that makes people notice the STA-2000 even before you turn it on.

Sale Ends May 31, 1980

Available at all Tandy Stores and Participating Dealers Around Australia or Mail Order Department P.O. Box 229, Rydalmere, N.S.W. 2116
Tools and techniques in radiometric exploration

All areas of geophysical exploration are becoming increasingly dependant on electronic instruments in the search for minerals and energy sources. Radioactive minerals, in particular, are in great demand. Here's a rundown on the instruments used and how they are employed.

Malcolm J. Plunkett

URANIUM EXPLORATION started in earnest after the second world war when "every man and his dog" was selling up and heading for the bush with geiger counter in hand. At that time, the major deposits were discovered purely by surface indications of radioactivity. However, that era is virtually at an end, and future finds are more likely to be below the surface or in inaccessible areas. The Roxby Downs deposits in South Australia for example are over 300 metres below the surface.

It has been necessary therefore to refine existing prospecting techniques, develop new ones, and improve the sensitivity and discrimination of all instruments in radiometric measurement techniques in common use, and to give some insight into the various methods of radiometric surveying.

As mentioned before, Geiger counters were the major instrument in use in early uranium exploration and while other detectors are now available, the Geiger counter still has a place in preliminary exploration and radiation monitoring. A Geiger tube consists of a hollow metallic cylinder with a centrally-located wire inside. The whole system is either sealed in a glass cylinder or the outer metal tube is used as the sealed chamber with appropriate end insulation. The cylinder is evacuated and filled with a gas such as helium, argon or neon, plus a small percentage of an organic or halogen gas as a 'quenching' agent.

A high voltage is applied between the central wire and the outer tube, so that when a gamma ray enters it, the gas filling ionises and causes a discharge.

The discharge is quickly quenched or extinguished by the quenching agent, resulting in a relatively large current pulse through the tube that can be easily measured. The gamma rays must be stopped completely for a discharge to occur, which results in a very low conversion efficiency for Geiger tubes of only 1%, as only one in each hundred rays is completely stopped. This insensitivity can be useful however, as the Geiger counter can be used in areas of very high radioactivity without the count rate becoming excessive.

The Geiger counter circuitry shown in the accompanying block diagram is quite simple using a monostable to give a constant width to the pulses, which are averaged over several seconds so that the count rate is proportional to the average de level. The range switch can change the monostable width, or the meter resistor, or both, to get the correct division ratios. To maintain accuracy with this system, it is important to keep a constant pulse height and stable pulse width. Although the high voltage supply can be very low powered, it is important to keep the output voltage stabilised and within the admissible operating voltage range (known as the counting plateau).

Scintillation counters

Scintillation detectors are the basis for almost all modern radiometric exploration instruments. As with the Geiger tube, the principal of operation is quite simple. However, the method by which the electrical pulses are produced is
THE BASICS

Uranium exploration is based on the measurement of naturally occurring radioactive elements. All igneous and sedimentary rocks contain variable amounts of the three main naturally occurring radioactive elements, uranium, thorium and potassium. The average concentration of these elements is only 0.1 - 10 parts per million, while uranium ore may have a concentration of several percent.

An element is considered to be radioactive when the atoms of which it is made disintegrate spontaneously, causing it to decay and form new elements known as daughter products. As it decays it may emit several types of radiation, however the one of interest to us is gamma radiation. Gamma rays have no mass, no charge, and can be regarded as highly penetrating electromagnetic radiation. The measuring device must therefore have a detector for converting these gamma rays into electrical pulses which can be counted for a fixed time period, or averaged as in a car tachometer.

completely different. The detector assembly consists of a scintillation crystal which is optically coupled to a photomultiplier tube. The crystal is usually made of thallium-activated sodium iodide which has the property of emitting a small flash of light (scintillation), when a gamma ray is stopped in it. The photomultiplier tube is a light amplifier which gives out an accurate, amplified reproduction of the light flash in the crystal, in the form of a short electrical pulse (approx. 2 ms).

The great advantage of this rather indirect method of detection is in its efficiency, which approaches one hundred percent. Special protection is needed for scintillation crystals and photomultiplier tubes, which results in an instrument which is less rugged, more expensive, but far more sensitive than a Geiger counter. The circuitry of a simple scintillation counter is very similar to a Geiger counter, but usually with extra ranges for the higher count rates.

Radiometric ground surveying

In the search for unknown uranium deposits the ground is traversed on a regular grid, noting the readings at set intervals. The chance of finding an outcrop on the surface is very low, so it is important to note any change in the normal background radiation level, as even a metre or so of soil may have a considerable masking effect. If an area of high radioactivity is located, it would be very premature to stake a claim at this stage. Firstly, the material may be thorium, potassium, or uranium or a combination of them. These can be distinguished from each other because the radiation they produce has characteristic energy levels, resulting in different height pulses from the photomultiplier tube. By counting only three narrow ranges of pulse heights, the ratio of the three radioactive elements can be determined.

This is known as 'pulse height spectrometry' and is beyond the capabilities of a simple scintillation counter and impossible with a Geiger counter. The scintillation crystal used in spectrometers must be large to obtain good results, and the circuitry must be highly stable and temperature compensated. A fourth channel is sometimes used to monitor the pulses from a small quantity of radioactive material which is doped into the crystal, to allow automatic temperature compensation.

A problem encountered with all radiation measuring instruments is that the emissions are random, requiring the circuitry to be ready to accept pulses.
BASIC SPECTROMETER

separated by only a few microseconds when the average time between pulses may be 100 milliseconds. It is clear then that a simple monostable system would not be suitable, and pulse height spectrometers must employ sophisticated pulse shaping and counting circuits to minimise these problems.

Even spectrometers cannot always determine the usefulness of a deposit, as leaching and weathering can remove the original uranium, leaving only the radioactive daughter products behind. In conclusion, it can be seen that finding naturally occurring radioactive material is relatively simple, but finding out exactly what you have found is considerably more difficult!

Airborne radiometric surveying

Airborne radiometric surveys have been carried out for many years but even using the latest airborne spectrometers, the results can only be used as a guide. The plane must fly on regular grid lines recording the quantities of uranium, potassium and thorium, as well as the total radiation, on strip chart recorders or magnetic tape. The readings are used to produce radiometric contour maps on which the 'peaks' indicate areas of high radioactivity, known as anomalies. However the size and intensity of the anomaly cannot directly determine the actual extent of the deposit, due mainly to the masking effect of any overlying material. Problems also arise with pockets of airborne natural radon gas, uneven terrain, cosmic radiation and temperature changes.

The results then, are mainly used to eliminate areas which have very few anomalies, and to give a starting point for follow up ground surveys, or bore-hole drilling.
A portable radiometric borehole logger. The logging cable, which conducts power to the head of the probe and signals back, is wound off the drum at the rear of the instrument.

Radiometric borehole logging

When boreholes are drilled to locate any type of deposit, it is a very costly procedure to recover core samples for laboratory analysis, particularly if the exact depth of the deposit is not known. The usual procedure is to lower a probe into the hole and measure the natural radioactivity, which is recorded on a strip chart recorder, relative to the depth of the probe. The probe contains a Geiger tube or more commonly, a scintillation detector, together with its high voltage power supply and a signal buffer. As the cable usually has only one insulated inner conductor and a high tensile steel braid, the pulses must be coupled on to the dc supply to the probe and then picked off across an inductor at the surface. The surface electronics consists of an accurate ratiometer with several selectable averaging time constants, to allow low count rates to be resolved accurately.

These probes are extremely important in uranium exploration as they can give the exact depth and thickness of the deposit and also a reasonably accurate figure for the grade of ore. However, radiometric borehole logging is quite often not used to locate uranium.

Because the scintillation detector is so sensitive, it can measure the minute amount of radioactive material present in various rocks, while the count rate cannot directly identify the rock type; the boundaries between different beds can be sharply defined. This is a very useful measurement because the hole can be air or water filled and steel cased or uncased, without greatly affecting the results.

There are some problems however, as the probe must be watertight to depths of 1000 m or more and able to withstand the pressure at that depth. It must also be rugged and have a wide operating temperature range. This is an extremely harsh environment for sensitive electronic equipment, and careful design is essential.

Summary

Modern electronics and refined measurement techniques have greatly assisted radiometric borehole logging being accepted as a tool for exploration in general. Spectrometer-type instruments have eliminated many errors in ground and airborne surveys and allow the field geologist using only a small portable instrument to gain enough information to decide if more detailed investigation is warranted.

In the future, microprocessor controlled spectrometers will undoubtedly become available, allowing automatic correction for the many variables involved in radiometric measurement. However, the measurement techniques will probably remain much the same.
LISTED BELOW ARE THE
MAJOR HEADPHONES THAT OUTPERFORM

THE MARUNI HV3000R

N.B. MARUNI microphones take some beating too!!!

MARUNI
SUPERLATIVE HEADPHONES AND MICROPHONES

THE MARUNI CORPORATION
297 WILLIAMSTOWN ROAD, PORT MELBOURNE, 3207 • TELEPHONE, 645 2079 • TELEX 32571
ACCOUNTING PACKAGES
DEBTORS $330
CREDITORS $330
DIRECT MAIL $500
Packages are written in CBASIC II in Australia. SOURCE IS AVAILABLE (POA). Packages supplied on 8" or 5½" disk and need 80 x 24 serial terminal. 48K RAM, 2 x 240K (min) capacity disk drives, 132 column printer. CUSTOMISING AVAILABLE.

OPERATING SYSTEMS
CP/M VERSION 1.4 $145.
CP/M VERSION 2.0 $175 (Suitable for HARD DISK)
MPM VERSION 1.0, $305 (CP/M 2.0 extended for MULTI-USER)
CPM 374X $200 (transfers between IBM 3741 data sets and CP/M files).

LANGUAGES
C-BASIC III $1105 (Sami compiler).
BASIC-80 $305 (Microsoft Disk Extended Basic).
BASIC COMPILER $355 (down to HEX).
FORTRAN-80 $405.
COBOL-80 $630.
CIS-COBOL $860 (includes full ISAM).
PASCAL-Z $400 (includes VARIANTS).
APL/Z $393.
Z80-60 $205.
Full ISAM file utilities are available.

ASSEMBLERS
MAC (by Digital Research) $95.
SID (Symbolic De-bugger 8080 code) $85.
ZSID (as per SID but Z80) $105.
MACRO-80 (by Microsoft) $155.
MACRO-80 $155.
XMACRO-86 (8086 cross compiler) $300.
Z80 CROSSMCC relocatable assembler $130.
Z80 Development Package $103.
ZDT (Z80 De-bugger) $55.
DISTEL disassembler $70.
DISLOG disassembler $70.

EDITORS/WORD PROCESSORS
WORDSTAR (for Serial Terminals) $445.
WORDMASTER $130.
POLY VUE 80 (full screen editor) $140.
POLL TEXT 90 (text formatter) $90.
POSTMASTER $150.
TEXTWRITER II $130.

UTILITIES
SAVER (Reconstitutes files erased by the CP/M command ERA.
Display/Alter Information on disk sector by sector independently of file structure).
We have much more software (including comprehensive 3D GRAPHICS) and it's all described in our comprehensive catalogue.

Send $1.00 for our catalogue and to join our Mailing List Club.

JOHN F. ROSE
COMPUTER SERVICES PTY. LTD.
33-35 ATCHISON STREET, ST. LEONARDS, N.S.W., 2065, AUSTRALIA.
TELEPHONE: (02) 439 1220 TELEX: AA 27901

Prices include sales tax and are subject to change without notice.

Announcing the

OPAL 1000

The OPAL 1000 is an 8-slot S-100 system conforming to the proposed IEEE Standards for the S-100 Bus. A Delta Products Z80a 4MHz CPU Card with two RS232c serial ports and three 8-bit parallel ports is used in conjunction with the Delta Products Disk Controller. Memory is 64K dynamic RAM. Disk drives are two 8-inch Shugart SA801R's running at double density (480K per drive). They are fitted with our exclusive disk saver which prolongs the life of the drives and the floppy disks. The disk saver also reduces the risk of data loss due to power failures. A PROM Monitor is supplied and the operating system is the latest version of CP/M 2*.

*Trade Mark Digital Research.

- **OPAL 1000 $4,800**
- **OPAL 1000 with 64K STATIC $5,400**
- **OPAL 1000 with BEEHIVE DM-20 and NDK S-2000 PRINTER $9,650**

CORVUS HARD DISK $5,830
VCR BACK-UP INTERFACE $1,010

See our catalogue for details.
Precision Instruments

. . . the versatile

**BWD 820**

DC to 25 MHz Dual Trace
or Differential Oscilloscope

- NEW contemporary design
- Precision performance
- Extended operating range
- Surprisingly modest price

- DC-25 MHz Bandwidth.
- <13nSec Rise Time.
- 2mV to 20V/cm Sensitivity.
- Dual Trace or Differential Operation.
- 40nSec to 5 Sec/cm Time Base Range.
- 2 Hz to 40 MHz Triggering Range.
- 4 KV EHT, Mesh PDA CRT.
- Direct reading In-line attenuator and time base dials with continuously variable vernier controls.
- Stabilised power supplies throughout.

**MANY ADDITIONAL FACILITIES**

The vernier controls of the BWD 820 have locking detents in the calibrated position. Calibration accuracy is within 3%, from 5° to 45° C, and over a supply voltage range of 200-270V (or 100-135V) without additional range changing.

Operation is simplified by automatic changeover from chopped to alternate operation and frame to frame line selection in the video mode.

**WIDE APPLICATION RANGE**

Ideal for use on audio, video or digital circuits, in education, servicing or industrial applications.

---

**BWD**

**ELECTRONICS PTY. LTD.**

Miles Street, Mulgrave, Victoria, 3170
P.O. Box 325, Springvale, 3171
Telephone 561 2888. Telex 35115

VIC. BWD Electronics Pty. Ltd., Melbourne. Ph: 561 2888
Warburton Franki (Brisbane) Pty. Ltd., Ph: 52 7255
QLD Protronics Pty. Ltd., Adeladale. Ph: 212 3111
S.A. & N.T. Warburn Frankl (Perth). Ph: 277 7000
W.A. Associated Agencies Pty. Ltd., Hobart. Ph: 23 1843
TAS. Instrep Pty. Ltd., Hobart. Ph: 34 3194

**BWD**

**ELECTRONICS PTY. LTD.**

Miles Street, Mulgrave, Victoria, 3170
P.O. Box 325, Springvale, 3171
Telephone 561 2888. Telex 35115

VIC. BWD Electronics Pty. Ltd., Melbourne. Ph: 561 2888
Warburton Franki (Brisbane) Pty. Ltd., Ph: 52 7255
QLD Protronics Pty. Ltd., Adeladale. Ph: 212 3111
S.A. & N.T. Warburn Frankl (Perth). Ph: 277 7000
W.A. Associated Agencies Pty. Ltd., Hobart. Ph: 23 1843
TAS. Instrep Pty. Ltd., Hobart. Ph: 34 3194
Optical (left) and ultrasonic (right) comparison of a CMOS integrated circuit that uses silicon-on-sapphire (SOS) technology showing the greater resolution of blemishes brought out by the ultrasonic microscope. (Pictures courtesy Professor C.F. Quate, Stanford University, USA).

Figure 1. Schematic diagram of the ultrasonic microscopic showing, in particular, the arrangement of the ultrasonic lens.

\[ f_o = \text{Radius of lens} = 40 \mu m \]
\[ f = \text{Focal length of lens} = 1.13r_0 \]
\[ R = \text{Radius of lens aperture} = 0.7r_0 \]
Ultrasonic microscope can look inside transistors

Brian Dance
Research in the US has led to the development of an ultrasonic imaging technique that provides resolution comparable to that of the best optical microscopes using ultrasonic pulses at a frequency of 3 GHz.

WHEN ONE REFERS to ultrasonic frequencies, one may first think of frequencies of perhaps 25 kHz to 100 kHz which bats use for navigation and which can be used in simple ultrasonic remote control applications. Higher frequencies of about 1 MHz to 10 MHz cannot travel more than a very short distance through air, but are widely used in the medical field. Recently, waves, Professor C.F. Quate of Stanford University, USA, has employed ultrasonic waves with a frequency of about 3 GHz to make a scanning ultrasonic microscope which can form images of small objects with a resolution similar to that obtainable from optical microscopes. In some cases better contrast is obtainable with the ultrasonic microscope and further improvements in resolution are expected.

Wavelength
The resolution of any form of microscope is limited by the wavelength of the radiation used to view the objects. For this reason ultra-violet radiation can be used in a suitable microscope to provide better resolution than visible light, but a much greater improvement can be made by the use of an electron microscope, since electrons have a much smaller wavelength.

A 1 kHz sound wave in air has a wavelength of the order of 300 mm and can be used only for imaging fairly large objects, whereas a 3 MHz ultrasonic wave in a liquid has a wavelength of a fraction of a millimetre and can therefore be used in medicine and industrial applications for imaging fairly small objects. However, the 3 GHz ultrasonic waves used by Professor Quate have a wavelength of only 520 nm in the medium used which is water heated to 60°C where the velocity of sound is 1.55 km/second.

This wavelength of 520 nm is somewhat less than the wavelength of visible light at the centre of the visible spectrum (green light of 550 nm wavelength). The 3 GHz ultrasonic waves can therefore produce images with a resolution comparable to those of the best optical microscopes utilizing green light. This is three times better than the images produced by any earlier acoustic microscope. It is expected that the next generation of ultrasonic acoustic microscopes will produce better resolution than the best optical microscope.

Construction
The ultrasonic microscope used by Professor Quate has the structure shown in Figure 1. It includes a single surface spherical lens ground into a sapphire block, sapphire is aluminium oxide, A12O3. The black surface of the sapphire contains a piezoelectric transducer on the axis of the lens. The front surface of the lens is coated with a layer of glass one quarter of a wavelength in thickness which acts as an antireflective coating between the mechanically rigid sapphire and the hot water at 60°C beneath the lens.

The transducer is fed with 3 GHz radio frequency pulses of 20 ns duration. The ultrasonic pulses produced by the transducer travel through the sapphire and water to converge at a point on the object under examination. After they have penetrated the object, the ultrasonic waves are reflected back through the water and sapphire to a zinc oxide film on the back of the sapphire. This transducer film converts the ultrasonic waves back into electrical impulses. The reflected pulse containing the required information is separated from the input pulse and any spurious reflections are combined with time-gating circuits by means of a circulator.

The velocity of sound waves through the warm water is 1.55 km/second, but their velocity in sapphire is 11.1 km/second. It is this great difference in velocity which enables a high resolution focus to be obtained in the acoustic microscope using a single surface lens. The distortion of the beam caused by spherical aberration is inversely...

Figure 2. The high resolution obtained with the ultrasonic microscope is well illustrated in the photograph on the right. This shows the internal structure of a Hewlett-Packard FET whose gate length is only 500 nanometres! A photograph taken with a conventional optical microscope is shown, for comparison, on the left.
proportional to the square of the velocity ratio and with such a high velocity ratio is negligible. The high value of the velocity ratio results in a large angle of refraction at the lens/liquid interface, so the waves leave the lens close to the normal and converge to a focus which is only marginally greater in size than the radius of the lens.

The object is moved very rapidly to and fro by a separate oscillator whilst it is under the sharply focused ultrasonic beam. This results in the object being scanned by the beam as it moves backwards and forwards in much the same way as a television camera scans a scene. The output from the zinc oxide film transducer is amplified and used to form the image of the object on a television screen.

The formation of the image by acoustic microscopy depends on the mechanical and structural properties of the specimen. The density, elasticity and viscosity of the object under examination affect the ultrasonic waves which enable images to be formed of the interfaces between layers of different rigidity.

**Frequency**

We have already seen that it is important to use very high frequency ultrasonic waves, since the higher the frequency the shorter the wavelength and the better the resolution or image sharpness which can theoretically be obtained. However, there is a fundamental upper limit on the maximum frequency which can be used, since with increasing frequency there is increasing absorption of the ultrasonic waves. This absorption increases with the square of the frequency, over a frequency range from some kilohertz to about 10 GHz and perhaps even higher frequencies. Calculations show that water heated to about 60°C is considerably better than at room temperature.

Considerable thought is being given to the use of liquids other than water as the coupling medium in which the specimen under examination is placed. Although it may be possible to use a different liquid for higher frequencies in order to obtain better resolution, it is not possible to place all types of specimen in some of the liquids which are theoretically capable of giving the best results. Carbon disulphide, liquid helium and mercury are liquids in which one might expect to obtain better resolution than is possible with water, but each of these has its own problems associated with specimen compatibility.

**Applications**

Applications of the new microscope are said to range from cancer studies to metallurgical uses. For example, cells which are to be examined by optical microscopy must normally be stained and this damages the normal chemistry of the cell, but it seems likely that the behaviour of normal living cells (including cancer cells) can be examined by the use of the ultrasonic microscope without damaging the cells in any way whatsoever.

The ultrasonic microscope has been much used to examine very thin layers of materials, since it can reveal surface features and imperfections under the surface which cannot be seen using an optical microscope. The instrument can be used to reveal stresses in materials, structural fatigue and sub-surface corrosion which could be a valuable testing technique in quality control inspections, etc.

One type of specimen with a very thin surface layer which has been examined with the ultrasonic microscope is the integrated circuit chip. It is interesting to compare the optical and ultrasonic images of such chips. The conventional optical microscope normally shows the aluminium or other metallisation very clearly with sharp edges, whereas the ultrasonic microscope shows some of the structures beneath the aluminium. Light or dark areas of the ultrasonic image correspond to such sub-surface structures and indicate, for example, the points where emitter or other contacts have been made on the chip. In some cases it is best to alter the position of the object slightly relative to the sapphire lens system so that the focus is beneath the surface; this renders the aluminium metallisation slightly out of focus, but enables better images of the sub-surface layers to be obtained.

The use of an ultrasonic microscope to view sub-surface layers which are invisible with an optical microscope is of considerable practical importance, since many of the defects in semiconductor devices occur in the underlying layers. It seems likely that the ability to view such layers without destroying the device will greatly assist our understanding of the practical...
A comparison between micrograph images taken of the surface of a sample of low alloy steel. The picture at left comes from an optical microscope and shows mainly surface detail. That on the right is an acoustic micrograph and details composition. (Courtesy C.F. Quate).

effects of such defects and perhaps enable the proportion of satisfactory devices coming off a production line to be increased; resulting in more economical devices.

Conclusions
Acoustic microscopes have been used for some years at Hughes Research Laboratories in California and elsewhere to examine integrated circuits, but the frequency used has been some hundreds of MHz. It is only very recently that Professor Quate's work has enabled GHz frequencies to be employed with a great improvement in the resolution obtainable. Apart from the increased frequency of operation, other improvements associated with the use of hot water, a reduction in the lens size (which results in less ultrasonic wave attenuation) and a carefully designed lens system have greatly improved ultrasonic microscopical techniques.

Work is now commencing on image enhancement by storing the reflected signals on a floppy disc and performing Fourier transform analysis with a Z-80 based Cromemco processing system. The ultrasonic pulses fed to the transducer are generated with bipolar transistors, but the use of field effect transistors is being investigated for use with pulses shorter than 10 ns.

Professor Quate's work has enabled the optimum resolution to be improved by a factor of two each year over a period of four years. At the present time integrated circuits with known electrical defects are being examined with the ultrasonic microscope to see if any correlation is present between the electrical defects and the ultrasonic images.

If the ultrasonic microscope is put into production commercially, Professor Quate has estimated that its cost would be of the order of US$25 000 dollars.


LOW COST!
TEKA
printed circuit connectors...
a new series of edgeboard connectors utilising the most advanced materials and finishes to furnish extremely high performance at low cost.

S 100 and Motorola Bus Connectors
Ex Stock

C&K Electronics (Aust.) Pty Limited
Office 2/6 McFarlane Street Merrylands NSW 2160
PO Box 101 Merrylands 2160 Telephone 682 3144 Telex AA23404
Agents Melb. 596 2333/Adel. 269 2544/Bris. 36 1277/Perth 458 7111

Obligation free and comprehensive data is yours for the asking.

ETI May 1980 - 25
LOW PRICE TRANSFORMERS
HIGH QUALITY
R-2150 $2.95 (2951)
Primary: 240V AC
Secondary Voltage: 12.6 volts CT.
Secondary Current: 100mA
Termination: Flying leads.
R-2155 $4.75
Primary: 240V AC
Tapped Secondary Voltages: 6.3, 7.5, 8.5, 9.5, 12.6, 15.
Secondary Current: 1 amp.
Termination: Solder lugs on transformer.
R-6672 57.25
Primary: 240V AC
Tapped Secondary Voltages: 15, 17.5, 20, 24, 27.5, 30.
Secondary Current: 1 amp.
Termination: Solder lugs.

We specialise in PC Boards for all ETI and EA projects.

TEXAS. INSTRUMENTS
CALCULATORS

TIL9
TIL5
TIPC100C Printer
T30 Student Pack
T150
T15
Ti Programmer
Little Professor
Speak & Spell

Distributors for:

XCELITE TOOLS

MAIL ORDER CUSTOMERS
$1.00 packing plus 5 percent of order value
up to $80.00, thence a flat $4.00 for postal
items. Carrier — freight on.

OPEN: Mon-Fri 8am to 5.30pm.
Thursday night late shopping till
8.30pm. Saturday 8am to 11.45am.
World’s first
electronic credit card

A NEW electronic credit card, developed in Italy for use as a pre-paid telephone card, is likely to have many uses. One of Europe’s major semiconductor manufacturers, SGS-ATES of Milan, has developed a unique type of low cost electronic credit card in conjunction with the Italian telephone authority SIP (Società Italiana per l’Esercizio Telefonico) Known as the XCARD, it contains a 17 x 8 bit non-volatile memory in a low-cost plastic package similar to a conventional credit card. Most of the 136 bit memory is used for storing the number of credit units, but 36 bits are used for security, control and testing.

The system will work in the following way. When the consumer buys the card initially, all of the memory cells are erased and this represents 100 credit units. Each time the card is used, the payphone (or other point of sale concerned) writes into a certain number of the cells according to the cost of the call. When no more erased memory cells are left, an attempt to use the card will result in no service being obtained; the card is then thrown away.

Fraudulent misuse of these cards is prevented through 100% testing by the security code incorporated in the memory and by a plastic tab which must be removed before the card can be inserted into the card reader. This tab prevents the re-sale of used cards. The security code in the memory identifies the vendor of the card. If any attempt is made to erase the memory so as to restore credit in a used card, the security memory will also be erased and this will render the card useless.

It is claimed that the XCARD system will benefit both consumer and the vendor. The consumer will benefit by not having to carry loose change and it seems likely that less vandalism will occur in telephone booths using the new system, since no cash will be contained in the telephone equipment. Payment in advance will benefit the telephone company or other card vendor, whilst the high immunity against fraud and reduced maintenance will also be beneficial to the company.

It seems likely that the XCARD will be employed not only in payphones, but in many other types of low-cost automatic machines which are frequently used.

M274 chip
The SGS-ATES M274 programmable memory is incorporated in the XCARD, but can also be supplied in a 14-pin dual-in-line package which has seven connections. The EPROM contains an 8-bit word which is used as the security key to detect erasure, for example, by X-rays or by radioactive sources. One row of the memory matrix holds a mask programmable 8-bit code which can identify up to 256 different users. The non-volatile memory has been designed to retain data for at least one hundred years.

After the security word is written into the memory during manufacture, the writing circuits to this row of the memory are destroyed by blowing an on-chip fuse; it is not possible to repair this fuse. Each telephone or service point is designed to check the XCARD for a valid security key before it provides any service.

When the XCARD is inserted in the reader at the point of sale, a seven pin connector makes electrical contact with the point of sale equipment. The voltage applied to the memory in the XCARD is within the range of 9 to 11V. Writing a bit in a memory cell is effected by the application of a short pulse of +25V, 10mA with a duration of 50ms.

The use of cards of this type for charging for parking instead of coin operated meters which can be subject to theft seems very likely. Indeed, trials of coin-less parking meters are being arranged in London in the near future.
We have had so many requests for a valve power amplifier in the last year or so, from readers and project suppliers alike, that we finally succumbed. Turn back the clock, heat up your 100 watt iron and read on...

FASHIONS CHANGE, styles come and go, but some things remain the same... one of the constants is the preference of many musicians for the warm, deep-throated sound of an old-fashioned valve amplifier.

The “valve vs transistor” argument may never be settled conclusively. Despite all the obvious advantages of solid-state, musicians prefer valves because, they say, valve amps simply sound ‘better’, subjectively — like the preference of some people for an old Harley-Davidson or Triumph motorbike, rather than a modern, high-revving performance machine. On the other hand, there are definite technical reasons why a valve amp will sound ‘different’.

The reason most often advanced is that valves produce predominantly second harmonic distortion, whereas transistor amp distortion is mainly third harmonic. While this is true, it is not the whole truth; the distinctive sound of valves is caused by the synergy of many factors, and the spectral balance of the distortion components is just one of them. Other important factors are the shape of the distortion/power curve, the fact that valve amps are transformer-coupled to the load (which affects the overall response of the amp), the high output impedance of valve amps (resulting in reduced damping of the loudspeaker and a more ‘colourful’ sound), and the higher ‘dynamic output’ capability of valve amps (the ability to deliver relatively constant power to a varying load, i.e. a speaker).

If all these factors could be built into a transistor amp, then possibly it would sound, subjectively, like a valve amp. Many have tried to do this — most have failed. We’ve taken the opposite approach, and built a good, old-fashioned, high power valve amplifier, the “Rocker”.

Circuit design
This amplifier circuit is the result of many hours of experimentation and

incorporates suggestions from many people, staff and friends of both ETI and sister magazine Sonics, and particularly John Burnett of the School of Electronics, whose suggestions prompted quite a few changes, especially around the input stage. Overall, the circuit uses a triode voltage amplifier stage followed by a phase splitter, a pair of drivers and the output stage, consisting of four valves in push-pull-parallel. The amplifier is

---

**SPECIFICATIONS OF PROTOTYPE — ETI 456 Valve Amplifier**

<table>
<thead>
<tr>
<th>Power Bandwidth</th>
<th>-1 dB</th>
<th>-3 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 watts</td>
<td>22 Hz to 12 kHz</td>
<td>18 Hz to 17 kHz</td>
</tr>
<tr>
<td>50 watts</td>
<td>18 Hz to 22 kHz</td>
<td>14 Hz to 27 kHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distortion at 1 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mW</td>
</tr>
<tr>
<td>open loop:</td>
</tr>
<tr>
<td>closed loop:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power output for 5% THD</th>
<th>Input Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>140 watts (8 ohm load)</td>
<td>Input with feedback: 200 mV (adjustable)</td>
</tr>
<tr>
<td>Maximum power output</td>
<td>without feedback: 80 mV</td>
</tr>
<tr>
<td>200 watts (8 ohm load)</td>
<td>Feedback Ratio:</td>
</tr>
<tr>
<td>Hum and Noise</td>
<td>-62 dB with respect to 140 watts output</td>
</tr>
</tbody>
</table>

ETI May 1980 — 29
NOTES: Various voltage readings are given on this drawing as a guide to constructors, but note that they may vary 10 - 20%. Unbracketed readings were taken with no signal present. Bracketed readings were taken with the unit operated at full power output.

Terminal 6 of the output transformer, T1, must be grounded. A total of five output terminals will be needed to obtain the various combinations possible. For 16 ohm loads, join 7 to 4 and connect the load across 5 and 6. For 8 ohm loads, connect across 8 and 6. For 4 ohm loads, it is best to connect 4 to 6 and 5 to 7, then connect the load across 5/7 and 4/6.

The amplifier has four separate stages: the input voltage amplifier, a phase-splitter, a push-pull driver stage and a push-pull power output stage.

The input stage, V1a, uses one section of a 12AX7 of a high-u twin triode. The input enters via a de-isolating capacitor, C1, and the gain control, RY1. The 'grid stopper' resistance, R2, is placed directly in series with the grid to reduce susceptibility to RF interference.

The phase-splitter uses the other half of V1 (V1b), its grid being coupled to the anode of the input stage by C4. This stage has no gain. The signal at the grid of V1b appears at the anode inverted, i.e.: 180° out of phase. The signal also appears at the junction of the cathode bias resistors R9 and R10, in the same phase. Thus, the signals coupled to the push-pull driver stage via C5 and C6 are 180° out of phase. Grid bias for the phase-splitter is obtained by returning the grid resistor, R7, to the junction of the cathode bias resistors, R9 and R10, effectively placing the grid at about -3 V with respect to the cathode.

The driver stage consists of a 12A7 low-u twin triode. Resistor R14 provides common cathode bias, while R12 and R13 are the two grid returns. The anode supply for this stage comes from the 400 V supply (screen voltage supply for the output stage) via a decoupling network consisting of R17 and C7. Each driver (V2a and V2b) has a gain of 10, defined by the ratio of R15 to R14 and R16 to R14.

The output stage consists of four valves in a push-pull parallel arrangement. V3 and V4 are in parallel and V5 and V6 are in parallel, the two pairs connected in push-pull via the output transformer. The anode of V2a drives the grid circuits of V3-V4 while the anode of V2b drives the grid circuits of V5-V6. The output stage is operated in class AB, which affords good gain, low distortion and good power output.

Bias for output stage is provided from a common bias supply from the power transformer, the bias for each valve being individually adjusted. As the characteristics of the 6CA7 output valves can vary widely, this adjustment is provided to ensure proper operation from unit to unit.

The output transformer matches the plate-to-plate impedance of the push-pull output pairs, about 5500 ohms, to the low impedance speaker load. Several output windings are provided: a single 4 ohm winding and an 8 ohm winding, tapped at 4 ohms. Feedback to the cathode of the input stage is taken from one end of the 8 ohm winding, the other end being grounded.

During each half cycle of the signal waveform, one 'side' of the output stage (i.e.: V3-V4 or V5-V6) will 'turn off'. This will allow that side of the output transformer primary to develop enough back emf to cause arcing across the valve socket pins. To prevent this, the reverse cycle emf is shunted via a set of diodes to ground — D1 — D3 and D4 — D5.

The power supply is fairly conventional. The power transformer has five secondary windings: one 6.3 V/3A heater winding, one 6.3 V/6A heater winding, one 47 V/50 mA bias winding, one 285 V/150 mA HT winding and one 565 V/300 mA HT winding.

Bridge rectifiers with capacitor-input filters are used to provide the appropriate HT voltages: 750 V for the output stage anodes, 400 V for the output stage screens and HT for the driver stages. A half-wave rectifier and pi-section filter is used to derive the -63 V bias supply.
capable of driving four, eight or sixteen ohm loads, or two four ohm loads simultaneously.

Overall feedback is taken from the eight ohm winding of the output transformer to the cathode of the input stage, and is wired via a front panel switch, allowing the feedback to be switched out if desired. This will increase the impedance looking back into the output terminals, reducing the damping factor so that the speaker cone is more influenced by the back emf of the voice coil. Normally, hi-fi amplifiers are designed to have very low output impedance - a high damping factor - to suppress the effect of the back emf and reduce the colouration which would otherwise be introduced by the speaker.

With the feedback in, the 'Rocker' is quite clean, and suitable for PA, bass guitar or even as a hi-fi amp; switching the feedback out, however, makes the amp that much 'dirtier' and will also give it a more 'live' sound. Other front panel controls are provided for the usual functions - power, standby and input gain. The 'kill' switch shorts the input to ground, and is an effective way of temporarily 'switching off' without generating any transients or unwanted thumps.

All inputs and outputs are mounted on the rear panel. Although we have used a phone-jack input socket and a single pair of binding post output terminals, there is sufficient room behind the chassis for Cannon/Switchcraft inputs and multiple binding post or phone jack outputs, if required.

At the input stage, we had a choice between a triode-pentode, such as the 6BL8, or a 12AX7 twin triode. Triodes have the disadvantage of large plate to grid capacitance which, together with the plate resistor and the voltage gain of the stage, introduces a phase shift at high frequencies, called the Miller Effect. The degree of phase shift depends on the capacitance, gain and value of the plate resistor. All phase shifts add through the amplifier, the first stage having the largest effect, and when feedback is applied from the output to the input, the amplifier may oscillate. The feedback ratio (and the possible reduction in distortion) is therefore limited by the phase change through the amplifier, and must be kept low if a triode is used in the input stage.

Our first design used a 6BL8 pentode which worked well with about 20 dB of feedback, allowing a good stability margin, and looked very promising. Then we started talking to people in the audio business who had experience with valve amplifiers, who all said that a triode-pentode tube was internally fragile and would fail after a few months on the road. Back to the 12AX7 then, and lower amounts of feedback to preserve stability.

We wanted the amplifier to be useful for hi-fi and bass guitar.
applications as well, so we had to design it carefully for good performance but with a good stability margin, too. Conventional circuits usually drive the output stage directly from the phase splitter, which is inherently high in distortion when run at high signal levels and so requires large amounts of feedback to clean it up. Since the amount of feedback we could apply was limited by stability considerations, we followed the phase splitter with a pair of driver amplifiers, allowing the splitter stage to operate at a lower level for less distortion.

The output stages run in push-pull parallel using 6CA7 power pentodes. We chose four of these tubes, rather than two of the more powerful KT88s, because they are less than one quarter the price and are readily available.

The bias for class B operation is set individually on each tube; this was found to be necessary because of the large spread in the parameters of unmatched tubes bought over the counter. The bias is set by monitoring the voltage across 10 ohm resistors, in the cathode of each valve, which also help reduce the effects of bad matching.

The life of the output valves is increased by placing l\(k_5\) resistors in each of the screen leads to reduce the peak screen dissipation, and parasitic oscillation is avoided by l\(k_5\) resistors on the grids. The possibility of socket flashover is reduced by using diodes and capacitors from each side of the output transformer primary to earth. The back emf from the transformer, when each half of the output stage turns off, is conveniently shunted to ground via the diodes. Three are connected in series to obtain a PIV rating of 3 kV.

The output transformer is probably the most important component effecting the performance of the amplifier. It must have sufficient winding inductance for good bass, but low leakage inductance for good high frequency performance. These are conflicting requirements and the transformer must be well made to achieve both.

In this transformer, the secondary windings are placed either side of the primary, sandwich fashion, to reduce leakage inductance. For maximum flexibility, the output transformer has two separate secondary windings, an eight ohm winding tapped at four ohms and a separate four ohm winding. A 16 ohm load can be run from the two four ohm windings in series (linking pins 4 and 7, taking the output from 5 and 6), an eight ohm speaker is run from the eight ohm winding, and either one or two four ohm speakers can be run by connecting the four ohm windings in parallel for one speaker, or independently for two.

Throughout the circuit, the values
of coupling capacitors have been kept as low as possible. If the capacitors are large and if the preceding stage is driven into clipping, there will be a time delay while they discharge, causing a short drop-out in the sound.

When you look at the power supply circuit, it may seem a little large. It is! It must be, to allow the amplifier to run into hard distortion, especially when used for bass guitar amplification.

The bias supply must be both free from ripple, and must reach its normal value immediately after turn on. If the power to the amplifier is momentarily interrupted (somebody tripping over a cord then quickly plugging it back in) the heaters in the tubes will still be hot; if the bias supply then takes time to come up to value, the output tubes will draw excessive current and may destroy themselves. The bias supply filter capacitors should be quite small and used with a fairly small value resistor in a pi-section filter to remove ripple. Regulation of the screen supply is ensured by using a separate transformer winding for the 400V (screen supply) rail.

One of the heater lines should be earthed to reduce the risk of hum caused by heater to cathode leakage, but you will notice that the output stage heater lines are earthed through two 470 ohm resistors, rather than having one side connected directly to earth. Why? Imagine this: an output tube goes short circuit; the cathode resistor won't last long, and the tube will arc over internally from cathode to heater, and then to earth through the heater line.

Now the output transformer has the full supply voltage across it and the current is limited only by the de winding resistance, with the result that the output transformer burns up! The same thing will happen if a valve socket arcs over from pin 3 to pin 2. If resistors are placed from either side of the heater line to earth, however, they act as fuses protecting the output transformer while still preventing hum problems.

As in any amplifier, the mechanical design is just as important as the electrical. Looking at the layout, you will notice that the two transformers are the same size and are placed at either end of the chassis for correct weight distribution, and the four output valves are spaced along the back of the chassis for good ventilation — an important consideration to ensure them a long life. All power supply components are at the power transformer end of the chassis, while amplifier components are at the other. Bias controls are situated next to each output valve so that all wiring is short and direct.

**Construction**

Since most of the components are mounted either on the chassis or on the valve sockets, a pc board is of little advantage. The method we used requires some care in wiring, however, and careful cross checking with the circuit diagram to ensure you haven't made any mistakes! Remember that the unit has lethal voltages present and if you make a mistake you may not have the chance to make another.

As the amplifier will be a relatively expensive project, you may wish to save a few dollars by making your own chassis. Hence we have produced a complete set of metalwork drawings. If you have the patience, the tools and the skill, quite a professional-looking unit can be produced. Many component suppliers sell sheets of aluminium, as well as useful things like hole-punch tool sets. Aluminium sheet and expanded aluminium may also be obtained from hardware stores, don't forget.

Examine the photos and the wiring diagrams and note carefully the positions of the components. The layout should be followed exactly, and all wiring should be of the highest standard. The power supply circuitry is located around the power transformer while the voltage...
NOTES: the diode strings, D1 - D3 and D4 - D6, plus resistors R22, R24, R38 and R39 should be covered in insulating sleeving.

WIRING THE OUTPUT STAGE

WIRING THE BIAS SUPPLY

WIRING THE HT SUPPLIES
PARTS LIST — ETI 456

Resistors all 1/4W, 5% unless noted
R1, R7 1M2
R2, 26, 27, 28, 29 1k5
R3, 6, 8, 10, 15, 16 47k
R4, 9 2k7
R5 110R
R11, R41 15k, 1W, 5%
R12, 13 470k
R14 47k
R17 15k, 1W, 5%
R18, 19, 20, 21 390k
R22, 23, 24, 25 220k
R30, 31, 32, 33 10R, 1W, 5%
R34, 35, 36, 37 1k5, 3W, 10%
R39, 39 470R, 1W, 5%
R40 10k, 1W, 5%
R42 10k, 5W, 10%
R43, 44, 45, 46 10k, 1W, 5%
R48 1M, LOG. POT. (GAIN)
RV2, 3, 4, 5 470k, LIN. POT. (BIAS)

Capacitors
C1 47µF greencap
C2 220µF, 16V electrolytic (pigtail)
C3, 7 8µF, 350V electrolytic (pigtail)
C4 33µF greencap
C5, 6 10µF greencap
C9, 10, 11 10µF greencap
C12, 13 10µF, 5kV ceramic disc or mica
C14, 15, 16 10µF, 350V electrolytic (pigtail)
C17, C20 24µF, 500V electrolytic (pigtail)
C18, 19 1µF, 100V electrolytic (pigtail)

Valves
V1 12AX7
V2 12AU7
V3, 4, 5, 6 6CA7 (EL34)

Semiconductors
D1 to D10 BC548, BC108 or similar
D11 to D15 BC556, BC178 or similar

Transformers
T1 PAA4357, Ferguson power transformer (see circuit)
T2 OP603, Ferguson output transformer

Miscellaneous
SW1, SW4 SPST toggle switch
SW2, SW3 DPDT, 250 Vac rated toggle switch

Four octal valve sockets; two nine-pin valve sockets; 6.5 mm input jack; binding post (or other) output terminals; 55 - 60 mm wide double tagboards (one 12 pair, one 6 pair, one 5 pair) with insulated backs; one five-lug tagstrip; one three-lug tagstrip; solder lugs; power cord and plug; chassis as per dimensions given plus panel, side plates and mesh top, base plate with rubber feet; 10 mm grommets; nuts, bolts etc.

NOTES: Greencap capacitors should be 630 V rated types or use polycarbonate types rated at 400 V or more.
amplifier, phase splitter and driver stages are next to the output transformer.

The first step is to mount the major components on the chassis. Locate the transformers, valve sockets, can electrolytic capacitors and bias pots in their correct positions.

Cut three lengths of double-sided tag board, twelve, eight and five tag pairs respectively, making sure the strips are capable of insulating the very high voltages used in this amplifier. We used wide-spaced bakelite tag boards with a bakelite backing piece, so that they can be mounted directly on the chassis without standoffs. Ours came from David Reid Electronics but similar types are widely available. Turn the chassis upside down and mount the tag boards in the appropriate positions. We used the transformer mounting bolts to mount the power supply and amplifier tagstrips. Mount a five-lug single tagstrip for the bias components and a three-lug tagstrip for the input to V1 as shown in the diagrams.

Once the tagstrips and tag boards are mounted, drill holes in the chassis for the leads from the two transformers. We used 10 mm holes with grommets for this, one for the output transformer, and three for the power transformer leads. (The holes for the leads are drilled after the tagstrips are mounted to avoid drilling holes under the tagstrips!). Start the wiring with the power supply components and the heater lines. The heavier (six amp) winding supplies the output tubes and the three amp winding supplies V1 and V2? the 12AX7 has a 12 volt centre-tapped heater, and for six volt operation, the two ends of the heater (pins 4 and 5) are joined together and the voltage applied between pins 9 and pins 4/5. All heater wiring is twisted and run above the sockets to keep it away from other wiring. One side of the 3A heater wiring is earthed at the socket of V2 and the 6A winding is balanced with respect to earth, as already discussed.

Solder the diodes onto the power supply tagstrip and wire the electrolytic capacitors, standby switch, screen resistors, power switch and bias supply. When the power supply wiring is complete check it thoroughly and re-check the polarity of all the diodes and electrolytic capacitors and the connections of the 100K bleeder resistors.

Turn the unit on without any valves inserted. If everything seems to be OK (no smoke!) take a meter, with well insulated test probes, and check all the voltages across the electrolytic capacitors. The three electrolytics in series should have equal voltages across them. OK? Turn the unit off and wait for a minute. Then take a screwdriver and short out all the capacitors. If the bleeder resistors are working the capacitors should already be discharged. Even so, always repeat this operation when you are working on the amplifier, as bleeder resistors sometimes fail and the capacitors can give you a very nasty shock. Now insert the valves and turn on again to check that the heaters are working. Turn it off (and short the capacitors).

If all is well with the power supply, start wiring the circuitry around V1 and V2. The input blocking capacitor, C1, is wired between the gain control and the input socket while the resistor, R2, should be placed as close as possible to the grid pin to reduce the possible pick up of RF interference. We found it unnecessary to use shielded cable between the valve socket, gain pot, kill switch and input socket but if your wiring is longer than ours it may be required to avoid hum pickup. However, the feedback wiring should be kept well away from the input wiring, or HF instability may occur when the feedback is switched out.

Wire the bias circuitry to each of the output valves, making sure that there is no possibility of components shorting together. Use plastic sleeving over the component leads for insurance, because if the bias supply to any tube fails the result is very dramatic! The 1K5 resistors in the grids of the output valves are wired between pins 5 and 6 of the valve sockets; pin 6 is not internally connected and is used as a terminal - and also places this resistor nearest the grids for best suppression of parasitic oscillation.

The 10 ohm resistors in the cathodes are wired across the sockets and it is a good idea to wrap the body of the resistor in tape or plastic tube; in the event of a short in one of the valves this resistor will certainly burn up and deposit carbon over the valve socket and surrounding circuitry, which would then have to be replaced. Using the tape to shield the fallout will minimise the damage, should a fault occur.

Be careful not to cross the two output-phase signals from the phase splitter; the signal from the cathode must go to the grid of V2b and the signal from the anode must go to the grid of V2a. Also be careful not to cross the primary windings of the output transformer, pin 3 goes to the V3 and V4 anodes and pin 1 goes to V5 and V6 anodes. If these connections are crossed, the phase of the output will be reversed, the feedback will become positive and the amplifier will become a higher power oscillator!

The power supply is quite capable of powering auxiliary equipment such as a valve pre-amplifier, and a power output socket can be mounted on the rear panel. The 400 V rail will be able to supply about 70 mA and the three amp heater winding will supply 2.4 amps.

**Powering up**

There's one good thing about valve circuitry — it's very obvious if something's wrong - but re-check everything thoroughly in any case.

Turn the amplifier on without any valves inserted first, and check the power supply voltages. To check the bias on pin 5 of each output valve, set all pots for maximum bias (counterclockwise), turn down the gain pot, then connect a speaker and plug in the valves. Turn on the amplifier and set both bias pots for 0.25 volts across each of the 10 ohm cathode resistors. If anything unusual happens turn off the amp immediately and re-check the wiring! If not, connect a signal to the input, advance the gain pot and you're ready to rock!

**A note on speakers**

If you plan on using the "Rocker" as a guitar amplifier, we strongly recommend using loudspeakers specifically designed for the purpose, rated to at least 200 watts. These speakers are extremely rugged, with aluminium voice coils designed to withstand the very high power levels generated by guitarists. If you use the amplifier for hi-fi reproduction, be careful not to drive it into clipping. The onset of clipping will not be as harsh and as evident as it would be with a transistor amplifier and you may be doing irreparable damage to your speakers without knowing it. We strongly recommend the ETI-45S speaker protector for any application, as we very quickly blew up a set of 250 watt speakers when the amplifier was overloaded.
NOTES:

1. The top cover is made from Lysaght 'Multimesh' expanded aluminium. It covers the top of the unit and folds down the rear of the chassis.

2. Suitable rubber feet may be mounted on the base plate, measuring 370 x 245 mm is necessary.

3. Dimensions are in millimetres.

Material 1: 1.5 mm aluminium or steel.

All chambers up 90°.
Facts from Fluke, on low-cost DMM's

**Our new 4 1/2-digit bench/portable:**

You've never seen anything like it.

Take a close look at the face of this instrument. Notice anything new? If you just realized you've never seen words on a low-cost DMM display before, you're on the right track.

This is the new 8050A from Fluke, the lowest priced 4 1/2-digit multimeter available that uses microprocessor technology.

The legends on the LCD are clues to what makes the 8050A unique.

**dB:** You're right. The 8050A delivers direct readouts in dBm, referenced to any of 16 impedances. Use the "REF Z" button to scroll through the memory and locate the zero dBm reference you need, then set it and forget it. No more tedious calculations or conversions.

**REL:** For relative references in the dB mode or offset measurements in all other functions. Lets you store any input as a zero value against which all others are automatically displayed as the difference. Another timesaving convenience.

**HV:** Just a reminder when your input is over 40V, so you won't forget about safety while in the dB or relative modes. Of course there's much more to the 8050A. True RMS measurements to 50 kHz. Conductance for measuring resistance to 100,000 Megohms and leakage in capacitors, pcb's, cables and insulators. Diode test, 0.03% basic dc accuracy and full input protection. Plus a large family of accessories.

---

Please send data on Fluke DMMs.

Please have a representative call me.

Name: ...........................................
Position: ......................................
Company: ......................................
Address: ......................................
Postcode: .....................................
Phone: ........................................

**ELMEASCO**

_Instruments Pty. Ltd._

P.O. BOX 30, CONCORD, NSW 2137
13-15 McDonald Street, Mortlake, 2137
Tel: (02) 736-2888 Telex: AA25687
P.O.BOX 107, MT. WAVERLEY, VIC.3149
21-23 Anthony Drive, Mt.Waverley, 3149
Tel: (03) 233-4044 Telex: AA36206
Adelaide: 51-3521 Brisbane: 229-3161
Perth: 398-3362
"Auto-probe' for testing vehicle electrical systems

When it comes to probing faults or otherwise in a vehicle's electrical system, a multimeter has distinct disadvantages. This highly convenient probe is very useful in those awkward places so often encountered, plus simple to build and inexpensive.

THE DIFFICULTIES of tracing a fault in a vehicle's electrical system using a multimeter are probably familiar to most readers. As that accursed Murphy's law generally has it, you have to contort yourself in to an awkward position before you can see where to put the test prod, or prods, and having done that, find that you can't twist yourself sufficiently to see the multimeter face.

Damned annoying, isn't it?

Then again, a multimeter can give you a false indication. No, not possible, you cry. It sure is though. If, for some reason, you're measuring the voltage on a particular point and it happens to be connected to the battery via a low, but significant, resistance how do you detect the presence of that low resistance?

A voltmeter measurement won't show it. If that low resistance is the fault, an ohmmeter measurement may well be impossible.

Sorting out the wiring can be a nightmare — especially on motorcycles.

This project gives clear indication of the six conditions one usually finds in an automotive electrical system. These are:

- Short to +ve supply
- Short to -ve supply
- Open circuit
- Connection to +ve supply via an intermediate impedance
- Grounded via an intermediate impedance
- Connection to a fixed, intermediate (low) voltage level

The Auto-probe is smaller, cheaper, easier to interpret and easier to use and read than a multimeter. It is the sort of device that can be left in the tool kit in the boot of your car or stored in the glove box. It is a worthwhile addition to any mechanically-minded handyman's array of gadgets.

The Auto-probe can be used on 6 V or 12 V systems, with minor changes to the circuit values.

To get an idea of how it can be used, and how useful it is, let's take a look at a few typical problems encountered in vehicle electrical systems.

The problem

Let us consider the case of a car radio that has 'stopped working'.

Looking at the panel lights, you observe that they aren't lit up when the set's turned on. Obviously, it would seem to be a supply problem. Wriggling, upside down, under the dashboard, you check the fuse and find it intact. Taking the Auto-probe, you attach its supply leads to the rear connection of the cigarette lighter or the ignition switch. Both lights should blink on and off if they don't then you'd have to reverse the connections and mentally castigate yourself for being a twit. No worries though, it's protected against twits.

Touching the probe on the radio's B+ connection, the red LED glows steadily. Aha! This shows the probe tip is connected to the supply. Touching the probe onto the radio's ground lead results in a blinking red LED. Hmm, it's connected to supply via an impedance. It seems the ground connection isn't grounded.

Some jiggling and scraping at the radio's ground lead earthing point results in a steady green LED and a burst of music . . . well, more likely, commercials.

Suppose you wish to know if your car has an ignition ballast resistor. This is a resistance inserted in series with the ignition coil primary during normal running, but is shorted out when the starter is operated so that the coil receives a voltage 'boost'. The resistor may be a heavy wirewound type mounted somewhere in the engine compartment, or (as is common in . . .

---

Jonathan Scott

The Auto-probe is housed in a common pill bottle. You can construct it either on matrix board, as shown here, or on a printed circuit board (see over the page). It's an amazingly handy gadget!
Project 325

Matrix board construction showing the component positioning and orientation. Note that we used the metal-can type transistors (BC109 etc) in this prototype. R3 and R4 are 1/2W GLP types.

Overlay for the printed circuit board model. Plastic pack transistors were used for this one.

Overlay

many late-model vehicles) a resistance lead is used — they're hard to spot.

In this case, the probe tip is touched on the coil primary terminal that is not connected to the contact breaker points. With the ignition on, (engine not running) no light will show on the probe, indicating it is connected via an intermediate impedance. When you touch the starter, the red LED should burst into lusty life, indicating the resistor is shorted, as you would expect.

Wiring and switch operation can be a real hassle. Does this motorbike operate its horn by supplying power or a ground connection via the horn switch? If touching the two switch contacts in turn shows first a steady green LED then a blinking red LED, the first contact is grounded and the second is clearly connected to the positive supply via an intermediate impedance, i.e.: the horn. If the green LED lights and then both LEDs blink when the probe is touched to the other switch contact, this would indicate that the horn is open circuit.

The circuit will cause both LEDs to blink when the probe tip is connected to an open circuit or to either side of the supply via an impedance greater than about 1000 ohms. In an automotive environment 1000 ohms is a high impedance!

Simple, and easy to use, isn't it?

Construction

This project may be constructed in either of two ways, depending on your preference: on matrix board, or on a pc board. Both methods are discussed here and overlay photographs are shown also.

If you elect to use matrix board, you will need a piece having holes spaced 0.1” (2.5 mm) apart. Cut the matrix board so that it measures 15 mm wide by 55 mm long — that’s about seven holes wide by about 23 holes long (cutting through the 1st and 23rd rows).

It is probably easiest to commence by mounting the two LEDs and the two transistors. You have to take some care when assembling a project on matrix board as the connections between the components are made under the board, using the component leads. Carefully study the overlay picture to see where the components are located and their orientation.

Make the connections between the components using the circuit diagram to guide you. Take care that no short circuits occur between adjacent leads.

Next assemble resistors R3 to R6, IC1 and C1 onto the board and make the appropriate connections. Take care with the orientation of C1. The positive lead is towards the centre of the board. Last of all, add R1, R2 and D1.

We'll get around to testing and assembling the unit into the pill bottle shortly, as this will apply to both sorts of construction.

Constructing the project on a pc board is much simpler. First thing to do is locate the position of IC1. A link is inserted between two pads located between the two rows of holes for the IC pins. Having done that, insert the IC. Take care that you have it correctly oriented. All the other components may now be assembled.

READERS PLEASE NOTE

We do not sell kits or components for the projects described in the magazine. To find out who may be stocking kits or components for the projects featured in this issue, please refer to the "Shoparound" page. Suppliers for past projects are listed on the "Kits for Projects" page.

40 — May 1960 ETI
and soldered into the board. Watch the orientation of Q1 and Q2, the two LEDs and C1. Refer to the overlay picture.

Now comes the testing. This procedure applies to either form of construction. You will need either a 12 V battery or a power supply that can deliver around 12 V to 14 V dc. Temporarily solder battery leads and a probe lead to the board. Connect the battery leads to the 12 V supply. The two LEDs should flash. Shorting the probe lead to the negative of the supply should cause the green LED to flash. If you cannot obtain the correct indications at this stage, look for incorrect connections or components around the wrong way. To check that IC1 is working, connect a multimeter — set to say, the 30 V range — between the supply negative and pin 3 of IC1 (positive meter lead to the latter). The meter needle should rise and fall at about four times per second.

The pill bottle used to house this project measured 61 mm overall length (with the cap on) by 21 mm outside diameter. A 25 mm long 6 B.A. bolt was used for the probe. This was bolted through a hole made in the cap somewhat off-centre. The photographs show roughly where this needs to be. Just keep it out of the way of the board. A small solder lug under the bolt head is used to attach the probe lead from the board. The battery leads should be colour-coded to avoid confusion. The convention is: red for positive, black for negative. Twist together about one metre of each colour hookup wire.

Connect the appropriate leads to the board and tie a knot close to the board (see photograph).

Drill a hole in the end of the pill bottle, near the edge, and pass the battery leads through it. The knot prevents the leads being pulled out of the board. Attach alligator clips to the ends of the battery leads.

Two small cutouts will have to be made in the lip of the pill bottle's cap so that the LEDs may be seen easily. All these details are clearly shown in the photograph of the completed project.

Once you have the unit assembled, give it a thorough work out.

Once you have this little project working for you, you'll be amazed how quickly electrical problems in your vehicle are sorted out.

**MODIFICATIONS FOR 6 V OPERATION**

Change R3 and R4 to 68 ohms each

Change R7 to 180 ohms

Change R5 and R6 to 10k

---

**HOW IT WORKS — ETI 325**

Consider first the 'idle' state of the device — i.e. with the probe open circuit. Diode D1 protects the whole circuit against accidental reversal of supply polarity. When the battery is connected correctly, the battery voltage (less about 0.7 volts dropped across D1) is applied to the electronics.

IC1 is the familiar 555 timer IC, connected as an astable multivibrator. When C1 charges up to 2/3 of the supply voltage, via R1 & R2, the 'high' level comparator (pin 6) detects this and sends the output high, which also shortens pin 7 to near ground. C1 thus commences to discharge via R2. When it reaches 1/3 of the supply voltage, the 'low' level comparator trips (pin 2) and C1 is allowed to recommence charging as before, since the output is sent low. This cycle repeats indefinitely, with a frequency of

\[ F = \frac{1}{0.692 \times (C1 \times (R1 + 2R2))} \]

With the values chosen, this is about 4 Hz. This may be varied by changing C1 or R2. The output on pin 3 of IC1 oscillates between nearly 0 V and V+ (less 0.7 volts). It can source about 200 ma.

Consider now the circuitry surrounding the LEDs. Assume at first that the voltage on the junction of R5 and R6 is about half the supply potential. Current will flow through the bases of both transistors via R5 and R6, hence both of these transistors will conduct. Each transistor will short out the LED connected in parallel. Thus neither LED will glow. If the voltage on the resistor junction (the probe connection) were to fall below 0.6 volts, or thereabouts, Q2 would be biased off and would no longer bypass the current flowing through R7 away from the green LED. Thus the green LED would light. Similarly, if the voltage on the probe were to rise to within 0.6 volts of the unit's supply rail (i.e. within 1.3 volts of the battery supply, due to the action of D1) Q1 would be biased off and the red LED would light.

Now let us put the picture together and see what happens in practice. The output of IC1 is connected to the probe and the resistor junction of the LED driver circuit via a 60 ohm resistance made up of two 120 ohm resistors in parallel. There are two resistors rather than one 1W or larger resistor for reasons of physical size. With no connection made to the probe, the 555 drives the probe alternately to the +ve and -ve rails, with the result that the LEDs flash alternately.

Shorting the probe to either rail of course forces the appropriate LED to stay on continuously. If a resistance is placed between the probe and ground, say, three possibilities occur:

1) The current flowing from pin 3 of the 555, via R3/R4, is insufficient to develop 0.6 volts across the resistance — this looks like a short and the green LED stays on.

2) The current develops sufficient voltage to turn Q2 on and the LED extinguishes on that part of IC1's cycle when its output is high. This allows the appropriate LED (green) to blink.

However, if the resistance is not high enough to allow the junction of R5/R6 to go far enough positive the red LED will not turn on. This gives green only blinking.

3) If the resistance is high enough (over 1k) both LEDs blink, giving the open-circuit response.

The same argument applies 'upside down' for a resistance to rail, but the voltage across it must be 1.3 V due to D1 being in the emitter circuit of Q1. If the voltage is fixed midway, neither LED can glow, as first assumed.

Resistor R7 fixes the LED current and R3/R4 limits the 555 output current to a safe level and defines the voltage 'turn-over' points.
Attention!
AIM, SYM, KIM OWNERS
KIM 4 Bus compatible products. Same shape and size as KIM, SYM.

MEMORY PLUS $225 A&T
12’k low power RAM. All IC’s socketed. 8K EPROM sockets and programmer for Intel 2716, 6052 I/O and plus 5V and plus 28V regulators.

VIDEO PLUS $275 A&T
Upper/lower ASCII, 80 characters by 24 lines. 100 additional user programmable characters. Keyboard and Lightpen Interfaces. 2K display RAM, expansion to 4K. On-board regulators, provision for 6052. All IC’s socketed.

PROTO PLUS $47
Double sided, plated through holes, professional quality. Provision for 40 off 14/154 sockets, 4 off 24/40 sockets, 3 off voltage regulators.

MOTHER PLUS $91 A&T
Fully buffered and decoded. Add up to 5 additional boards.

CARD CAGE $25
Compatible with Mother Plus.
P&P $3.50. Prices plus sales tax if applicable.

Plessey Components

Non-Volatile Quad Latch

Features
- Data retention for one year in the absence of applied power
- Simple to use
- Standard power supplies only (plus 5V, minus 12V)
- CMOS/TTL compatible
- ±4$	ext{V}$-tied package
- Typically ten million SAVE operations

Applications
- Metering systems
- Latched time indicators
- Security code storage
- Last channel memory for digital tuning

MN9102
The MN9102 is a non-volatile 4-bit latch which uses MNOS* transistors as memory.

MN9105
The MN9105 is a 4-decade BCD counter which counts up or down on negative transitions of the Clock Input. In parallel with the counter is a 10-bit non-volatile MNOS memory into which the contents of the counter can be written. When data has been written into the memory it can be retained in the absence of applied power and subsequently be recalled from the memory to preset the counter.

MN9106
The MN9106 is a six-decade up counter in parallel with a twenty-four-bit MNOS memory which can provide non-volatile data storage of the current count position.

MN9107, MN9108
The MN9107 will count up to 9 hours, 59 minutes, 59 seconds, while the MN9107 counts up to 9999 hours, 59 minutes, or 9999 minutes, 59 seconds.

Applications
Applications for NOVOL are found in all forms of metering, security code storage, backup storage for microprocessor-based systems, latched time indicators, electronic counters, latching relays and many other general industrial areas.

Plessey Components
PO Box 2, Villawood, NSW 2163
Telephone 72-0133
Adelaide 269-2544 o Melbourne 329-0044
Brisbane 36-1277 o Perth 458-7111

*NOVOL devices are produced using the Plessey Metal-Nitride-Oxide-Silicon (MNOS) process. MNOS transistors, as shown here in simplified form, are fabricated with a sandwich structure gate dielectric consisting of a very thin layer of silicon oxide and a thicker layer of silicon nitride. In operation, a positive or negative charge (depleted (Witin)) into the nitride-oxide interface modifies the threshold voltage of the transistor. Since the injected charge is trapped within the bulk of the dielectric it is not affected by surface leakage and the difference between high and low thresholds can be detected (Read) over very long periods.
**ETI-325 AUTO-PROBE INDICATIONS**

<table>
<thead>
<tr>
<th><strong>RED LED</strong></th>
<th><strong>GREEN LED</strong></th>
<th><strong>PROBE TO</strong></th>
<th><strong>IMPEDANCE LEVEL CONDITIONS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuous</strong></td>
<td><strong>Continuous</strong></td>
<td><strong>+VE SUPPLY</strong></td>
<td><strong>LOW VOLS</strong> (the red LED may flash weakly)</td>
</tr>
<tr>
<td><strong>Blink</strong></td>
<td><strong>Blink</strong></td>
<td><strong>-VE SUPPLY</strong></td>
<td><strong>PROBE OPEN CIRCUIT</strong></td>
</tr>
<tr>
<td><strong>Red LED</strong></td>
<td><strong>Green LED</strong></td>
<td><strong>PROBE VIA INTERMEDIATE IMPEDANCE</strong></td>
<td><strong>PROBE TO +VE SUPPLY</strong></td>
</tr>
<tr>
<td><strong>No LEDS</strong></td>
<td><strong>No LEDS</strong></td>
<td><strong>PROBE VIA INTERMEDIATE IMPEDANCE</strong></td>
<td><strong>PROBE TO -VE SUPPLY</strong></td>
</tr>
</tbody>
</table>

- **Red LED** blinks if the probe sees impedance larger than 1000 ohms.
- **Green LED** blinks if the probe sees impedance less than 15 ohms.
- **Red LED** and **Green LED** blink together with the probe to the intermediate impedance.

**IMPEDANCE LEVEL CONDITIONS**

- **PROBE TO +VE SUPPLY**
  - **RED LED** steady if probe sees impedance larger than 1500 ohms.
  - **RED LED** steady if probe sees impedance less than 15 ohms.
  - **RED LED** steady if probe sees impedance between 15 to 400 ohms.
  - **RED LED** steady if probe sees impedance between 6 to 800 ohms.

- **PROBE TO -VE SUPPLY**
  - **GREEN LED** steady if probe sees impedance less than 6 ohms.
  - **GREEN LED** steady if probe sees impedance between 6 to 800 ohms.

**Plastic Power Coolers**

Clip-on Thermally Cool your heat sinks and save board space, time, and assembly costs. They require no mounting hardware or adhesives, and clamping to the device. Available for maximum temperatures of 70°C, 80°C, and 90°C. They are suitable for TO-220, TO-3P, and TO-220A packages.

**Clip and Save**

Soanar Electronics Pty Ltd
30 Lexton Road, Box Hill, Vic., 3128, Australia

**SALES OFFICES**
- **VICTORIA:** 890661
- **N.S.W.:** 7896733
- **SOUTH AUST.:** 516981
- **QUEENSLAND:** 525421
- **WEST AUST.:** 3819522

**TECHNICAL INFORMATION AVAILABLE ON REQUEST.**
COMING SOON!

TELEPHONES HAVE GROWN UP!

You've had them in the movies - now they're here! Great for hands-free or in conjunction with any private conversations. Fashionable telephone that has built-in number control, loud talker, touch-tone dialing, telephone number holder, and much more. "How can you go back" after this low-cost beauty?

Hands Off!

You've seen them in the movies now - they're here! Great for hands-free or in conjunction with any private conversations. Fashionable telephone that has built-in number control, loud talker, touch-tone dialing, telephone number holder, and much more. "How can you go back" after this low-cost beauty?

PHONE CABLE

Now made of a more durable material - still FRF (flame-resistant) and still on the market. The most important changes are - more reliable connections and a better looking finish. The white cord is 10' long and can be used around the house or for that special occasion.

SCOOPI

$3.98

Because, after all, a phone cable should be of a quality that is as good as the phone itself. The SCOOPI phone cable will not tangle, and it is made of high-quality materials. It is available in a variety of colors and is suitable for all types of telephones. Order yours today!

CLASSROOM TELEPHONE

CLASS-R FRENCH TELEPHONE

This Classroom Telephone is the perfect solution for your classroom. It is designed to withstand the rigors of daily use and is made of high-quality materials. It is available in a variety of colors and is suitable for all types of classrooms. Order yours today!

BARGAIN!

Now it's even better! The popular "COMMUNICATOR" series phone is now back in stock. This phone is made of FRF material and is available in a variety of colors. Order yours today!

6 NEW CHANNEL SAFETY TWO-WAY

What a bargain! This 6-channel safety two-way system is ideal for use in a variety of situations. It is made of high-quality materials and is available in a variety of colors. Order yours today!

NEW! MORE OF DICK'S BONZA BULK BARGAINS

SAVE 2% ON ALL BULK BARGAINS! You'll find great deals on a variety of items, all at a savings! Order yours today!

NEW! LCD CLOCK/TIMER/ALARM/STOP WATCH MODE WITH HUGE LCD DIGITS!

This clock is perfect for use in the home or office. It features a large LCD display and includes a timer, alarm, and stop watch functions. Order yours today!

NEW! COMMUTER'S PARADISE

This commuter's paradise is the perfect solution for your daily commute. It includes a comfortable seat, a secure storage area, and a variety of features to make your ride more enjoyable. Order yours today!

NEW! LICENCE CRACKER

This licence cracker is the perfect solution for your daily commute. It includes a comfortable seat, a secure storage area, and a variety of features to make your ride more enjoyable. Order yours today!

NEW! AM/FM/SW/CASSETTE HUGE 3W O/P!

This AM/FM/SW/cassette player is the perfect solution for your daily commute. It includes a comfortable seat, a secure storage area, and a variety of features to make your ride more enjoyable. Order yours today!
AMATEURS don't forget: Dick Smith will sell other genuine Australian advertised products at factory prices. This is the best time to buy your favourite products at discounts available. Ask us for details.

REFERENCE DATA FOR ELECTRONIC INGENUES

SEEN OUR RANGE OF HOBBIST HARDWARE PACKS?

Our hardware packs are designed with the hobbyist in mind. Top quality, realistic packaging sizes to suit the hobbyist and best of all, you save money!

FREE COLOUR KIT CATALOGUE

The New Decade catalogue from Dick Smith Electronics was recently released. This includes the latest and greatest electronics and technology products. If you missed out on your copy, don't worry there are plenty available from your nearest Dick Smith store or our mail order centre. To order free phone 700-55444 or visit our web site at www.dicksmith.com.au

CHECK IT OUT: BUILD A KIT!

It's FUN and a great way to learn and save money too!

WORSE KEYER

You're going to need it! A worse keyer is a must have item. Make it a present. Dick Smith offers a wide range of worse keyers to suit your needs.

25W CAR STEREO BOOSTER

Road noise bending your ear? Add a car stereo to make your car's journey more comfortable. Dick Smith offers a wide range of options to suit your needs.

12-200V POWER SUPPLY

How many projects need a 12 volt supply? Dick Smith offers a wide range of 12 volt supplies to suit your needs. From low voltage to high voltage, Dick Smith has it covered.

CD IGNITION

Get that ignition system you've always wanted. Dick Smith offers a wide range of CD ignition systems to suit your needs.

SPECIAL OFFER: SEND FOR YOUR FREE COLOUR KIT CATALOGUE

The New Decade catalogue from Dick Smith Electronics was recently released. This includes the latest and greatest electronics and technology products. If you missed out on your copy, don't worry there are plenty available from your nearest Dick Smith store or our mail order centre. To order free phone 700-55444 or visit our web site at www.dicksmith.com.au

SHOP SPECIALS}

SHOPS OPEN SATU 9:00AM to 5:30PM (Saturday 9:00AM to 1:30PM)

Brisbane, Maclean, Toowoomba, all stores open 9:00AM to 5:30PM (Saturday 9:00AM to 1:30PM)

Any terms and conditions apply. Dick Smith offers a wide range of CDs to suit your needs. If you missed out on your copy, don't worry there are plenty available from your nearest Dick Smith store or our mail order centre. To order free phone 700-55444 or visit our web site at www.dicksmith.com.au

SEND FOR YOUR FREE COLOUR KIT CATALOGUE
MOVE OUT AHEAD WITH MEASURING INSTRUMENTS FROM SEW

YN-360TR  ST-303TR  ST-350  ST-300  SP-10D  ST-5

**YN - 360 TR $21.70 plus tax**

**SPECIFICATIONS**

**Measurement Ranges:**
- DC Voltage: 0-0.5, 0-2, 0-4, 0-20, 0-100, 0-500 mA
- AC Voltage: 0-2, 0-4, 0-10, 0-20, 0-100, 0-500
- Resistance: 0-100, 0-200, 0-500
- Capacitance: 0-5 pF, 0-20 pF
- Frequency: 0-1 Hz, 0-10 Hz

**Accuracy:**
- DC ± 2.5% of full scale
- AC ± 2% of full scale

**Dimensions:**
- 140 x 50 x 40mm

**Weight:**
- 280g

---

**ST - 350 $16.48 plus tax**

**SPECIFICATIONS**

**Range of Measurement:**

- DC Voltage: 0-100, 0-200, 0-500, 0-1000
- AC Voltage: 0-100, 0-200, 0-500, 0-1000
- Resistance: 0-500, 0-1000, 0-2000

**Accuracy:**
- DC ± 2.5% of full scale
- AC ± 2% of full scale

**Dimensions:**
- 140 x 50 x 40mm

**Weight:**
- 280g

---

**ST - 300 $38.70 plus tax**

**SPECIFICATIONS**

**Range of Measurement:**

- DC Voltage: 0-100, 0-200, 0-500, 0-1000
- AC Voltage: 0-100, 0-200, 0-500, 0-1000
- Resistance: 0-500, 0-1000, 0-2000

**Accuracy:**
- DC ± 2.5% of full scale
- AC ± 2% of full scale

**Dimensions:**
- 140 x 50 x 40mm

**Weight:**
- 280g

---

**SP - 10D $16.09 plus tax**

**SPECIFICATIONS**

**Range of Measurement:**

- DC Voltage: 0-100, 0-200, 0-500, 0-1000
- AC Voltage: 0-100, 0-200, 0-500, 0-1000
- Resistance: 0-500, 0-1000, 0-2000

**Accuracy:**
- DC ± 2.5% of full scale
- AC ± 2% of full scale

**Dimensions:**
- 140 x 50 x 40mm

**Weight:**
- 280g

---

**ST - 5 $11.74 plus tax**

**SPECIFICATION**

**Range of Measurement:**

- DC Voltage: 0-100, 0-200, 0-500, 0-1000
- AC Voltage: 0-100, 0-200, 0-500, 0-1000
- Resistance: 0-500, 0-1000, 0-2000

**Accuracy:**
- DC ± 2.5% of full scale
- AC ± 2% of full scale

**Dimensions:**
- 140 x 50 x 40mm

**Weight:**
- 280g

---

Full range of panel meters & indicators — details/prices on request.

Suite 208/661 George Street, Sydney, NSW. Phone (02) 212-4815, 211-3038. Cable: Emona Sydney.

WA Distributor: Letco Trading Co, 45 Kirwan Street, Floreat Park 6014. Phone 387-4966.

---

**KENWOOD R-1000**

Communications receiver of the year. Digital and analog dial, digital clock, automatic timer, three selectivity positions and many other features.

This fantastic machine, together with Kenwood R-1000 receiver and your own TV set or CCTV monitor, provides the most sophisticated SWL SYSTEM that until recently could only be dreamt about. M-200E will reveal the secrets of RTTY, CW and ASCII transmissions from all over the world. Listen to embassy, commercial, military, world press service and amateur transmissions.

**INFO-TECH M-200E**

RTTY, CW, ASCII, VIDEO CONVERTER

BC210, BC220FB, BC250FB, 4 band, 6 channel pocket scanners.

---

GOVERNMENT AGENCIES, COMMERCIAL AND PROFESSIONAL INSTITUTIONS PLEASE NOTE!

We stock Australia’s largest selection of world-famous American "BEARCAT" scanning receivers. You can listen to aircraft, marine, police, commercial and many other radio transmissions. Japanese SX2000 also available.

---

**NEW ARRIVAL**

CCTV video cameras and high resolution professional TV monitors for computers, CCTV, SSTV, etc (not converted TV sets) also available.
Mains cable seeker

Finding mains cables hidden in wall cavities would require the X-ray vision of Superman or the divining skills of a ‘dowser’... unless you had this project.

The sensor used for this project is a “telephone pickup coil” — the black object at the top. The inexpensive magnetic earpiece, below the pickup coil, indicates when you have located a cable.

Design

The design of the Mains Cable Seeker is extraordinarily simple. The pickup coil is a commercially-available unit that consists of a coil of many turns of fine wire wound on a small bobbin which is slipped over a soft-iron ‘core’. This is encapsulated in a plastic container having a suction cap on one end. The suction cap enables the unit to be attached to a telephone. However, this feature is not used with this unit.

If the pickup coil is brought near any alternating magnetic field a current will be induced in the windings of the pickup coil and a small signal voltage will appear across the ends of the coil.

The pickup coil is connected to the input of a sensitive audio amplifier which raises the level of the signal such that it will drive an earpiece.

Dowser — user of a “dowsing rod” or “divining rod”; a person who uses a rod, wire etc holding it in a particular way that gives an indication when the user approaches water, metal etc.
The amplifier design used in this project utilises an operational amplifier as a voltage amplifying stage, the output of which drives two transistors operated as a low power output stage. Feedback is applied directly from the output to the input. The resistance in the feedback path determines the gain, and thus the sensitivity, of the whole amplifier. A potentiometer is placed in the feedback path to allow you to vary the gain, depending on the strength of the 50 Hz field picked up from the cable you are tracing.

**Construction**

For simplicity, and to avoid wiring errors, we strongly recommend you construct this project using the printed circuit board design given here. You can make your own pc board, or buy one ready made. They should be widely available from a number of suppliers.

Commence construction by soldering the resistors and diodes in place. Take care with the orientation of the diodes. Refer to the overlay picture to make sure which way around they go. Next solder the two transistors in place — make sure you get them in their respective positions. Watch the lead orientation. Follow this with the IC making sure you get it the right way round also.

As the two electrolytic capacitors are a little cumbersome in comparison to the other components, they are soldered in last. These too, are polarised components, so watch which way you insert their leads. Refer to the overlay picture.

Once you have the pc board assembled and checked, you can connect the external components and give the project a trial run.

Run wires from the pc board to the input and output jack sockets, to SW1 and RV1 as indicated on the external wiring diagram shown with the pc board overlay picture. The battery connector has one red lead (the positive connection) and one black lead (the negative connection). The red lead is soldered to the other pole of SW1 and the black lead is soldered to the '0V' connection indicated (on the pc board). You are now ready to test the project. Plug in the pickup coil and the earpiece. Turn the unit on, you should hear a click in the earpiece. With an appliance plugged into an outlet and turned on, bring the pickup lead near the appliance’s cord and advance the gain control. You should clearly hear the 50 Hz hum in the earpiece when you pass the pickup coil near the cord. Try tracing the hidden wiring a short distance.

If all is well, you can now think about mounting the completed project in a suitable box. One of the commonly-available plastic “zippy” boxes would work.

**READERS PLEASE NOTE**

We do not sell kits or components for the projects described in the magazine. To find out who may be stocking kits or components for the projects featured in this issue, please refer to the ‘Shoparound’ page. Suppliers for past projects are listed on the ‘Kits for Projects’ page.
be ideal. One of these measuring 130 x 70 x 40 mm will accommodate the pc board, the other components and the battery with ease. However, any similar box would suit, just make sure everything will fit.

Suggestions

If you experience trouble with broadcast station pickup — where the pickup coil and input lead (and perhaps your body) act as an antenna — solder a 1n (1000 pF) ceramic or greencap capacitor across the input jack connections, as shown in the wiring diagram with the overlay picture.

You can wind your own pickup coil if you wish. We wound one on an 8 mm diameter by 30 mm long steel bolt. You must use a steel bolt. Being a ferromagnetic material it concentrates the lines of force of a magnetic field in which it is placed, hence you will get greater induction in the pickup coil with a steel bolt than with any other type.

We first wound a layer of sticky tape over the thread of the bolt. A coil of about 300-400 turns of a light gauge enamelled copper wire was then jumbled wound on this, then covered with a layer of sticky tape to hold it in place. The wire gauge is quite non-critical. Too heavy a gauge is difficult to handle and you won't fit the required number of turns on a bolt the size we used. Any gauge from, say, 26 to 32 gauge is OK — it doesn't matter if it's SWG or B&S. Any gauge lighter than 32 g tends to break very easily.

The coil/bolt assembly may be encapsulated for protection, or fitted into a small pill bottle or something similar. A length of shielded cable or a twisted-pair wire cable should be used to connect the pickup coil to the input jack.

Component overlay and external connection diagram for the project. Follow this carefully.
ELLISTRONICS

289 LATROBE ST. MELBOURNE. 3000
PHONE (03) 602-3282, 602-3836

ELLISTRONICS NOW STOCK MOTOROLAS NEW KIT EXPANSION PRODUCTS (MOKEP). This range includes an adaptor/mother board, MEK 6800 AB, which accepts the D.2 Board and provides slots for five MOKEP boards.

Boards currently in stock are: MEK 68 R2, CRT Interface (VDU). Features: Software programmable; Line and Character Formats, 16 lines of 32, 16 lines of 64, 20 lines of 80, 20 lines of variable length. Up to 165 characters, Standard Video or TTL output, 1K Bytes of screen RAM expandable to 4K Bytes, CRT Bug to replace J Bug.

MEK 6802 D3 .......................... Trade Inc. tax
MEK 68 RR .......................... $175.00 $201.25
MEK 68 R2 .......................... $167.00 $192.05
MEK 68 R2M .......................... $240.00 $276.00
MEK 6800 AB .......................... $240.00 $276.00
MEK 68 M85 .......................... $110.00 $125.60
MEK 6810 .......................... $100.00 $115.00

DIGITAL HANDHELD MULTIMETER...

Ushers in a dynamic generation of multimeters

SPECIFICATIONS

VOLTS: DC - 200MV-1000V
Accuracy - 0.8%
AC - 1000V
CURRENT: DCMA - 200u-10A
Accuracy 1.2%
RESISTANCE: 2K-3Meg Ohms
TRANSISTOR Hfe CHECKER: 10%

SUPER SPECIALS

2708 EPROM .................................. Trade Inc. Tax
2114 450nS .................................. 7.30 8.40
2114 8 for .................................. 4.60 5.30
2114 32 for .................................. 36.00 41.40
2114 128 for .................................. 136.00 156.40
2716 SINGLE SUPPLY .................. 25.00 28.75
MJ6 3055 .......................... 80 8.77
MJ6 2955 .......................... 60 7.77
LM555 timer .......................... 20 2.66
LM741 op amp .......................... 16 1.90
BC547-BC548-BC549 .......................... 12 1.26
BC567-BC568-BC569 .......................... 9 0.90
Red Leds .......................... 10 1.20
Green or Yellow Leds .......................... 20 1.23

RESISTOR ASSORTMENT

Less Than 1/2¢ Each

Approx. 700 Pcs

1/4lb - 1/2 Watt

We have several million resistors. They are 1/2 watt carbon film. Rather than count them we are weighing 'em out by the lb, average about 700 pieces, making the price per resistor less than 6 cent each. A great way to build up an inventory for your work bench. A large number of mixed values.

COMPUTER COOLING FANS

Popular fan. Standard size 4.68" square. 110 or 240 volt. $2.50 Incl. tax.

DIP SWITCHES

(On-Off Contacts)

4 Positions $1.35
6 Positions $1.65
8 Positions $1.90

Weller Controlled Output Soldering Station

Model WCPTM
Inc. tax. $49.95

DIAL DESK TELEPHONE

Only $8.50 each. 2 for $16.

SOLID STATE REFRIGERATION

601-4000

Low cost experimental service
Minimum ΔT = 30°C
1 = 7-8 Amps
V = 3-5 VDE
Hot side Temperature = 50°C
$16.00 plus 15% Sales Tax. Post free.

801-2003

New low cost general purpose ceramic temperature control.
Maximum ΔT = 60°C or greater
Maximum current 5-5amps
Nominal voltage 8 V dc
Hot side temperature 50°C
$28.60 plus 15% Sales Tax. Post free.
the PET computer

The PET computer is now a truly sophisticated Business System with the announcement of these Peripherals.

Dual Drive Floppy Disk

The Dual Drive Floppy is the latest in Disk technology with extremely large storage capacity. It is incorporated in the CBM Business System as a management tool, delivers information to all levels of business previously attainable only with equipment many times more expensive, the CBM Business System is one of the most cost-effective business tools today. It offers a wide range of applications from logging management strategy in major corporations to organizing accounts and inventory control of small businesses. Here are just a few of the cost saving uses in the corporation, professional office or small business stock control, purchasing, forecasting, manufacturing, costing, customer records, mailing lists, etc. The CBM Floppy Disk and Printer, a compatible business system at a reasonable price. Take a closer look at these Peripherals.

Tractor Feed Printer

The Tractor Feed Printer is a high specification printer that can print onto paper (multiple copies) all the CBM characters - letters (upper and lower case), numerals and graphics available in the CBM. The tractor feed capability has the advantage of accepting mailing labels, using standard preprinted forms (customized), cheque printing for salaries, payables, etc. Again, the only connections required are an A/C cord and CBM connecting cord. The CBM is programmable, allowing the printer to format print for width, decimal position, leading and trailing zero's, left margin justified, lines per page, etc. It accepts 8 in paper giving up to four copies. Bidirectional printing enables increased speed of printing.

SPECIAL AT NO EXTRA COST

$200 value of programmes will be provided with each PET purchased

2001-16/32

FURTHER INFORMATION, PRICING AND DEMONSTRATION.

CONTACT YOUR LOCAL DEALER FOR
FURTHER INFORMATION, PRICING AND DEMONSTRATION.
Low cost S100 motherboard with seven sockets and active termination

Barry Wilkinson

This is the essential part necessary to link your S-100 system together. The board features active termination, additional regulated supplies and seven card capacity.

THE MOTHERBOARD described here is a low-cost 'starter' for the hobbyist who has spent all his money on more 'important' items like the CPU, VDU, etc. Mounted in a cheap case (or even standing alone) the board will connect and support up to seven (or more) S-100 cards.

Construction of this board is very simple. Once the pcb has been made, it is a good idea to use a continuity tester or ohmmeter to check for continuity along the length of the tracks. After this has been done, the sockets should be soldered in, and the continuity tester used again to check for absence of shorts between adjacent tracks. Note that adjacent tracks do not go to adjacent pins on the sockets, but instead to opposing pins.

The active termination resistors can now be soldered into place, if required, and the regulator circuitry assembled. The board should be given a final visual inspection, and is then ready for use.

The capacitance between adjacent tracks on this board is fairly high, imposing some limitations. It is possible (in theory) to reproduce the artwork and extend the board to 14 or more sockets, but the capacitance will rise, and problems will result. For the same reason, 4 MHz Z-80 cards may experience problems with the motherboard, and if this happens, they should, if possible be switched to 2 MHz. A seven-socket board has been run without the active termination circuitry at 2 MHz with no trouble.

Ideally, the motherboard should be mounted in a card cage, with plastic card guides to either side to support the cards and reduce stress on the sockets and solder joints. It is possible to make do without a cage, but if you
are considering 'doing up' your computer with a proper, smart, cabinet, that's the time to consider the installation of a high quality double-sided motherboard with earthed guard tracks - otherwise, you're just delaying the inevitable.

NOTE: The pc board pattern is on page 137.

HOw it WOrks - ETI-636

The purpose of the motherboard is to provide interconnection between as many as seven S-100 bus computer cards. Active termination of the data and address lines are provided, along with additional regulated supply rails for powering peripherals.

The active termination circuit involves transistors Q1, Q2 and Q3 plus associated components. Q1 and Q2 provide a constant current source for ZD1, which clamps the base of Q3 at 3.3 volts. Q3 acts as a series regulator, providing about 2.7 volts across R4. Each of the bus lines requiring termination has a 220 ohm resistor between the end of the line and a common bus (resistors R5 to R97) which connects to the emitter of Q3. Resistor R4 (and the common line of the terminating resistors) is bypassed by C1. "Open" lines will thus be held at 2.7 volts dc, but terminated with a resistive impedance at RF. The lines may be driven high or low at quite high clock speeds without significant reflections.

This board will operate with processor systems running at 4 MHz, indeed it was originally used, sans terminations, at 2 MHz.

The additional regulators involve three-terminal flat-pack regulators, IC1, IC2 and IC3. IC1, a 7805, provides +5 Vdc at 1 A; IC2 provides +12 Vdc at 1 A and IC3 -12 Vdc at 1 A. These are not necessary for normal S-100 cards and may be left off, but are useful with certain peripherals.

PaRTS LISt - ETI 636

<table>
<thead>
<tr>
<th>Resistors</th>
<th>all 1/2W, 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>.1 k</td>
</tr>
<tr>
<td>R2</td>
<td>.12 R</td>
</tr>
<tr>
<td>R3</td>
<td>.47 R</td>
</tr>
<tr>
<td>R4</td>
<td>.100 R</td>
</tr>
<tr>
<td>R5-R6</td>
<td>.220 R</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacitors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>.100 n disc ceramic</td>
</tr>
<tr>
<td>C2-C7</td>
<td>.1µ, 25 V tantalum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semiconductors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>BC558</td>
</tr>
<tr>
<td>Q2</td>
<td>BD140</td>
</tr>
<tr>
<td>Q3</td>
<td>2N3055</td>
</tr>
<tr>
<td>IC1</td>
<td>7806</td>
</tr>
<tr>
<td>IC2</td>
<td>7812</td>
</tr>
<tr>
<td>IC3</td>
<td>7912</td>
</tr>
<tr>
<td>ZD1</td>
<td>.3V3, 300 mW zener</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th></th>
</tr>
</thead>
</table>
| ETI-636 pc board, seven S-100 solder-in sockets (SK1 to SK7), finger-type heat sink for Q3, nuts, bolts and about half a kilogram of solder!
FLOPPY STORAGE AT LESS THAN 1/3 PRICE

- Low cost digital tape drive solves your problem of tiresome cassette drives without the high price tag.
- Small, compact, reliable, with named files and fast access.
- 120 Kbytes, software controlled fast forward (9 ips).

PERFORMANCE

The Electronic Read/Write System has distinct advantages over other competitive bit serial systems. The input/output signals are TTL and 5 volt CMOS compatible. All input/output signals are true digital logic levels. The analog circuit functions are completely transparent to the user. The operating characteristics of the Electronic Read/Write System are quite impressive and are one more that one would expect from a low-cost digital tape system. Because of the high packing densities of tapes, the transfer rate (using normal read/write speed of 3 ips) of 6000 to 1 kilobytes is possible. The system can effect a 4000 band transfer rate when needed and reading, start time is at 30 ms while stop time is at 40 ms.

Attention Sorcerer, Ohio Scientific, TRS-80 and all other micro users — this will easily interface to your system. At last a viable alternative to floppy disk. To order send $249 plus $5.00 freight.

INFORMATION TECHNOLOGY

*Not including sales tax. Freight extra.

Electronic Read/Write Tape System

The Micro Read/Write Digital Data Storage System is a complete digital input/output system designed for use in processing digital information. It is encoded and decoded by the user. In addition to complete electronics, the Electronic Read/Write System contains sensors for tape head and write head. When coupled with a microprocessor or other CPU (or the appropriate hardware logic) an Electronic Read/Write System becomes a complete digital data storage and retrieval system at a fraction of the usual cost. Because they leave the encoding the decoding to the user, Electronic Read/Write Systems permit the use of any bit-serial, self-clocking code.

Sorcerer Owners!

- Sorcerer Expansion $100 units from Exidy, $420 with tax, $390 excluding tax.
- Sorcerer to S100 Bus interface cards, price on application.
- 8" Disk System with many times the speed and data capacity of Micropolis and similar 5" disk systems. Plugs direct to Sorcerer without need for S100 interface unit. Inbuilt intelligence allows disk to disk or file to file copy while DOS is used to do other things. CPM-2.1 available. Double density, one to four drives, single and double sided. Priced from $1600.

MONEY-BACK GUARANTEE IF NOT SATISFIED

Send to: CHRISTIE RAND PTY. LTD.
PO Box 48, Epping, 2121.
Tel (02) 477-5494.

NAME
COMPANY IF applicable
ADDRESS
POSTCODE
PHONE
SIGNATURE

Please send me
Cheque enclosed for $______ Or charge to my
Bankcard, Expiry Date

ETI May 1980 — 55
## PRE-STOCKTAKING SALE

**FREE PACK OF ASSORTED PARTS WITH ORDERS OVER $20**
(Including IF Coils, Switches, Resistors, Variable Capacitors, Coils, etc)

### EXTRA SPECIALS (While stocks last)

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BU208</td>
<td>$2.50</td>
</tr>
<tr>
<td>BU128</td>
<td>$200.00</td>
</tr>
<tr>
<td>BDX80</td>
<td>$75.00</td>
</tr>
<tr>
<td>BD139</td>
<td>$250.00</td>
</tr>
<tr>
<td>BD140</td>
<td>$12.50</td>
</tr>
<tr>
<td>BC559</td>
<td>$10.00</td>
</tr>
<tr>
<td>BC547</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

**ALL SHOP PRICES LESS 10%**

*Does not include special prices advertised in E.T.I., E.A., or A.R.A. magazines.

**SPECIALS**

<table>
<thead>
<tr>
<th>Item</th>
<th>1171</th>
<th>1302</th>
<th>1303</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILMS</td>
<td>$2.25</td>
<td>$2.50</td>
<td>$2.75</td>
</tr>
</tbody>
</table>
**Included:**

- TRIO CRO'S, BISHOP GRAPHIC PRODUCTS, A & R TRANSFORMERS, RALMAR PRODUCTS, TEXAS INSTRUMENT CALCULATORS, VARBAM PRODUCTS, PASCAGO TRANSFORMERS, SCOTCH.

**VOLTAGE REGULATORS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>L805</td>
<td>$1.20</td>
</tr>
<tr>
<td>L806</td>
<td>$0.50</td>
</tr>
<tr>
<td>L730</td>
<td>$0.25</td>
</tr>
<tr>
<td>L712</td>
<td>$0.12</td>
</tr>
<tr>
<td>L715</td>
<td>$0.18</td>
</tr>
<tr>
<td>L716</td>
<td>$0.40</td>
</tr>
</tbody>
</table>

### OPTOCOUPLERS

**SPECIALS**

<table>
<thead>
<tr>
<th>Item</th>
<th>1171</th>
<th>1302</th>
<th>1303</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILMS</td>
<td>$2.25</td>
<td>$2.50</td>
<td>$2.75</td>
</tr>
</tbody>
</table>
**Included:**

- TRIO CRO'S, BISHOP GRAPHIC PRODUCTS, A & R TRANSFORMERS, RALMAR PRODUCTS, TEXAS INSTRUMENT CALCULATORS, VARBAM PRODUCTS, PASCAGO TRANSFORMERS, SCOTCH.

**CAPACITORS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poly-Valve 400V</td>
<td>$0.09</td>
</tr>
<tr>
<td>Poly-Valve 200V</td>
<td>$0.11</td>
</tr>
</tbody>
</table>

**ZENER DIODES**

- E23 Range
- 0.12 Watt

### FUSES

**SPECIALS**

<table>
<thead>
<tr>
<th>Item</th>
<th>1171</th>
<th>1302</th>
<th>1303</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILMS</td>
<td>$2.25</td>
<td>$2.50</td>
<td>$2.75</td>
</tr>
</tbody>
</table>
**Included:**

- TRIO CRO'S, BISHOP GRAPHIC PRODUCTS, A & R TRANSFORMERS, RALMAR PRODUCTS, TEXAS INSTRUMENT CALCULATORS, VARBAM PRODUCTS, PASCAGO TRANSFORMERS, SCOTCH.

**DISPLAYS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAN2A</td>
<td>$2.20</td>
</tr>
</tbody>
</table>

### OPTO LEDS

**SPECIALS**

<table>
<thead>
<tr>
<th>Item</th>
<th>1171</th>
<th>1302</th>
<th>1303</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILMS</td>
<td>$2.25</td>
<td>$2.50</td>
<td>$2.75</td>
</tr>
</tbody>
</table>
**Included:**

- TRIO CRO'S, BISHOP GRAPHIC PRODUCTS, A & R TRANSFORMERS, RALMAR PRODUCTS, TEXAS INSTRUMENT CALCULATORS, VARBAM PRODUCTS, PASCAGO TRANSFORMERS, SCOTCH.

**ALL PRICES CURRENT ONLY UNTIL 7th JUNE, 1980**

For heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. Minimum pack and post $1.25. Bankcard Mail Orders welcome.
Autostart for the RTTY system

This is the final part in Tom Moffat’s series of RTTY articles. With this ‘autostart’ unit you will no longer have to hang around and wait for those RTTY signals to appear — completely automatic, unattended operation is possible.

YOU’VE PROBABLY HAD your teletype system going for some time now, growing in sophistication with each new article in ETI. You are now able to select some obscure signal and listen intently, waiting for it to burst into a stream of radioteletype. You’ve also probably discovered that you can spend a lot of time waiting for something to happen, waiting to hit the motor switch to start the system printing!

It does get boring, doesn’t it? Well, your troubles are over. As from now you can tune your receiver to some signal so as to produce a mark tone in the converter, or you can tune it to some empty frequency known to be used by amateur RTTY stations. You can then go away and leave it, and come back, perhaps several hours later to find every message passed on that frequency nicely printed out on your teletype, waiting for your perusal. If copy has been sent for say ten minutes out of four hours, the motor has run only for those ten minutes.

This article describes a device with a deceptively simple function — turning a teletype’s motor on and off. The difficulty comes in determining when to do it. Ideally, the motor should run only when the machine is receiving valid teletype copy, and should remain switched off at all other times.

This autostart circuit is able to do this without any operator intervention at all. It will not be fooled into turning on by CW signals, a constant carrier, voice, facsimile, music, or any modulation other than radioteletype of the proper shift and speed. As the circuit uses signals from the UART, the speed converter/regenerator circuit (ETI, March 1980) must be constructed first.

Features

The autostart has two selectable modes of operation:

1) The ‘easy’ mode, in which the teletype will turn on if: (a) a mark tone is present, (b) a character is received at least once every ten seconds, and (c) the received characters are not at the wrong speed or inverted.

2) The ‘hard’ mode, in which the teletype will turn on if: (a) all the above conditions are met, and (b) valid teletype characters are received continuously (tape sending). The machine will not start if the signals are off speed or distorted beyond certain limits.
The operating speed is selected by the baud rate switch on the UART board. The UART has an output called 'RFE' or 'received framing error'. This is generated when the stop pulse is missing and is the UART's way of saying it thinks a character may be in error. Framing error indications occur more or less continuously when no carrier is present, or when received teletype signals are of the wrong speed or 'upside down'. They are a useful tuning aid, so this circuit includes a LED to give a visible indication.

In the 'easy' mode the autostart senses the lack of framing errors to indicate a mark tone is present, with no upside-down or wrong speed characters. If this condition is present for more than three seconds it 'arms the system' so that the next character causes a motor start. False starts are possible because once the framing error detector has timed out, any circuit activity, even a noise burst, is interpreted as a character. If the noise burst is shorter than a character length (and most of them are) the signal will return to 'mark' before the stop pulse is expected and no framing error will result. The 'easy' mode is useful on VHF circuits where fading and noise bursts are not normally encountered, and on amateur HF nets where a carrier is not present unless copy is being sent.

On HF circuits a different situation exists. A steady mark tone is normally transmitted when no copy is being sent. Such a circuit can remain idle for hours at a time and then burst into life, sending copy by tape transmitter at the maximum character rate. This is where the 'hard' option comes into use. Under the 'easy' system the motor would start and run for ten seconds every time noise or fading caused any interruption to the mark tone. The 'hard' mode requires at least two characters, with no framing errors, spaced a specified distance apart, before it will cause the motor to start. It is apparently impossible for these conditions to occur 'naturally', that is from noise or non-teletype modulation. In all the hours of testing this circuit it has never given a false start in the hard mode, but it does suffer the slight disadvantage of requiring tape-speed signals for it to operate. It will also miss the first two characters of a transmission before starting on the third, but this is of little consequence.

The 'easy' or 'hard' option is selected by a three way switch. The third position is intended to be used with a code recognition circuit now being developed.
What's so hard about a DICK SMITH Kit?

Just choose a kit...

Full instructions PLUS guide to kit construction included

all parts supplied

Everything from audio amplifiers to car systems with degree of difficulty for your guidance.

It's finished & it works

And it looks so good your friends will never believe that you actually built it yourself! Start back and wonder why you never built anything before!

GUARANTEE

All Dick Smith kits are made from brand new and guaranteed components. Each kit is made up in consultation with the major electronics magazines and includes latest amendments.

If by chance you cannot get your kit to work, many of the major kits include a 'sorry Dick, it doesn't work' coupon which allows you to have the kit serviced in our laboratories for a token fee.

The first step?

send for our FREE Colour Kit Catalogue

Our colour kit catalogue contains detailed illustrations of most of our kits - and it's yours free for the asking.

16 pages of kits for all tastes and budgets. Send for your free copy today!

(Also available to personal callers at any of our stores and many re-sellers).

MAIL ORDER CENTRE
P.O. Box 321, North Ryde, NSW 2113, Australia.

Dick, send me my FREE Colour Kit Catalogue.

Name ____________________________
Address __________________________
Postcode __________________________

DICK SMITH ELECTRONICS
SEE OUR OTHER ADS ON THIS MAGAZINE FOR OUR STORE ADDRESSES AND RESELLERS
used a pc board, matrix board construction should work equally well.

**How it works**

**EASY MODE:** The incoming teletype signal, taken from the RSI pin (receive serial input) of the UART, is inverted by IC3a and fed to IC1d and IC1b, a flip-flop. The flip-flop allows only the first downward transition of a character to pass through, and then blocks everything else until reset for the next character by ODA (output data available) from the UART. C1R1 turns the upward transition from the flip-flop into a very short positive pulse (the diode is there to soak up the negative pulses). The positive pulse is fed into one input of IC6d where it's used to indicate circuit activity.

IC5 is a dual retriggerable multivibrator. Its 'B' section has a time constant of about three seconds, set by C5R5. Application of a positive pulse at input A will cause the Q output to go high for the time period. Pulses occurring more often than the time period will cause Q to remain high continuously.

It's been determined experimentally that under noise-only conditions, the UART generates at least one framing error every three seconds, so when there is no carrier the multivibrator remains operated, and stays that way until three seconds after a carrier appears and framing errors cease.

When the multivibrator times out its Q output goes low, its Q output goes high, and this enables NAND gate IC6d to allow circuit activity pulses through to another multivibrator, IC5a. This one has a time constant of about ten seconds, and it remains operated as long as activity pulses keep triggering it more frequently than once every ten seconds.

In the operated condition, IC5a's Q output feeds an emitter follower stage to operate a relay, via a switching transistor causing the teletype's motor to run. The motor will stop ten seconds after the last character is received, or 13 seconds (sum of both multivibrator times) after continuous framing errors begin. A single framing error will have no effect because IC5a remains operated during the three second time IC5b operates.

**HARD MODE:** Because of the way the UART operates, the next start pulse in a continuous character transmission is expected 16 clock pulses after the ODA pulse, which is in turn generated eight clock pulses into the previous stop pulse. So what we're doing is measuring the time from one stop pulse to the next start pulse, which is represented by the first RSI transition after ODA.

RSI signals follow the same path as before, up through C1R1, where they're fed to one input each of two NAND gates, IC4b and IC4a. IC1c, 2a, 2b, 3a and 3b form a pulse counter that gives a low output for the first 14 clock pulses from the UART board. For the next four it goes high, and then it goes low again and stops until reset by ODA, when the sequence begins again.

Under good transmission conditions the expected start pulse will occur pretty close to 16 clock pulses from ODA, but with bad conditions it will vary all over the place. The output of the pulse counter forms a 'window' four clock pulses wide, centred on 16 which is fed into gate 4b, then inverted and fed into 4a. These gates sort the RSI pulses into two groups: those that occur within the 'window' come out of 4b, and those that miss it come out of 4a.

![Autostart waveforms: Top trace shows the next start pulse — taken at pin 4 of IC1b (first RSI, inverted); lower trace is the 'window' at pin 5 of IC2. The next start pulse has made a direct 'hit' in the window.](image1)

![With the same conditions as above, this shows the next start pulse missing the window badly. (Horiz. = 4 ms/div.; Vert. = 5V/div.)](image2)

The sorted pulses are fed to another flip-flop, IC4c and 4d. Its output goes high for 'good' pulses and low for 'bad' ones. The flip-flop output goes to IC7, a presetable up/down counter, which is clocked by RSI pulses. The NAND gate 6b causes the counter to count to 15 and stop (by cutting off the clock pulses) or it can count down to zero and stop, the direction being determined by the state of the flip-flop. The gate prevents the counter from 'going over the top' and starting again.

When the flip-flop is fed with a continuous string of 'good' pulses the counter will add up RSI's and stick at 15. If fed with continuous 'bad' pulses the counter will subtract RSI's until it sticks on zero. A mixture of good and bad pulses will cause the counter to work its way up and down. If the majority are 'good' the counter should stay above eight, and if the majority are 'bad' it should stay below eight. The eight (or more) count is detected, and used to enable the ten second motor timer (with the help of circuit activity pulses as described earlier). So, when most start pulses fall within the window the motor start is enabled, but if circuit conditions begin to deteriorate, the count works its way down, eventually to below eight, when the autostart switches off.

There are some other features to further this cause. As framing errors can occur spasmodically, even with the best of signals, those that occur when the count is above eight are ignored, blocked by IC1. But those that occur when the count is below eight (when the circuit is slowly failing) will operate the counter's reset and knock the count right back to zero. This tells the system the odds are against it and it would be wise to give up trying, and stop the motor.

If the count is slowly decreasing, but no framing errors occur, the count will be kicked down to six when it goes past eight in the down-hill direction. This feature prevents the counter cycling back and forth between seven and eight on the way down, and is implemented by the pin 9 input of IC6c.

The other input of IC6c comes from the motor timer. When circuit conditions are good, but the circuit goes idle, IC5a will time out after ten seconds, shutting off the motor until more copy comes along. When the timer times out it fires a pulse into IC6c that results in the count being preset to six. This means, after a pause in circuit activity, at least two characters are required to get the motor going again.

If the circuit goes idle during failing conditions, the count is again preset to six, but each fade or noise pulse will pull it down further, so more characters are required to re-start the motor as conditions deteriorate. The aim of the scheme is to make the system earn the right to continue after every shut-down. Another feature applies a 'hold' to the UART board when the timer times out, to prevent gear crunching as the motor slows to a stop.

**Motor switch**

The original version of this circuit used a power control relay with a 110 Vdc coil. This was fed from the teletype loop supply through a dropping resistor, and switched on and off with a high voltage transistor.

The scheme worked very well, but as it used a relay and wasn't 'modern'!
**16K EPROM CARD-S 100 BUSS**

**KIT $79.50**

FIRST TIME OFFERED!

BLANK PC BOARD - $36

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at ALL TIMES! Kit features a top quality solder masked and silk-screened PC board and first run parts and sockets. Any number of Eprom locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

**16K STATIC RAM KIT-S 100 BUSS**

**KIT FEATURES:**
1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard). Allows up to 512K on brief
3. Uses 2114 (450NS) 4K Static RAMs
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes all parts and sockets
8. PHANTOM is jumpered to Pin 67
9. LOW POWER under 1.5 amps TYPICAL from the +5 Volt BUS
10. Blank PC Board can be populated as any multiple of 4K.

**S100 COMPUTER PRODUCTS**

**16K STATIC RAM SS-50 BUSS**

**KIT FEATURES:**
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers
5. + A Parts and sockets included

**PRICE CUT!**

BLANK PC BOARD—$39 COMPLETE SOCKET SET—$15 SUPPORT IC’S AND CAPS—$39

IF TOH 8300 PRINTER. $770 plus 15% sales tax.

This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.

A bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4½ to 9½ inches wide. A 96 ASCII character set prints in upper and lowercase, with the added capability of producing double-width fonts in boldface. The vertical format is standard, with programming/programmable tab positions, top of form and bottom of form for complete formatting capabilities.

**RITRON 8 SLOT MOTHERBOARD.**

**KIT FEATURES:**
1. Addressable as four separate 4K Blocks
2. ON BOARD BANK SELECT circuitry (Cromemco Standard). Allows up to 512K on brief
3. Uses 2114 (450NS) 4K Static RAMs
4. ON BOARD SELECTABLE WAIT STATES
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers
6. All address and data lines fully buffered
7. Kit includes all parts and sockets
8. PHANTOM is jumpered to Pin 67
9. LOW POWER under 1.5 amps TYPICAL from the +5 Volt BUS
10. Blank PC Board can be populated as any multiple of 4K.

**8K LOW POWER RAM KIT-S 100 BUSS SALE**

**PRICE CUT!**

**$139.50**

21L02 (450 NS RAMS!)

Thousands of computer systems rely on this rugged, workhorse RAM board. Designed for error-free, NO HASSLE, systems use.

BLANK PC Board w/Documentation

**PRICES**

LOW PROFILE Socket Set. 13.50
Support IC’s (TTL & Regulators) $13

**S-100 Z80 CPU CARD**

**$189.00**

Without tax.

ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a TRUE S-100 Z80 CPU at a genuinely bargain price!

**BRAND NEW!**

FEATURES:
* 2 or 4 MHZ Operation
* Generates MWRITE, so no front panel required
* Jumps on reset capability
* std 8080 Signals simulated for S-100 compatibility
* Top Quality PCB, Silk Screened, Solder Masked, Gold Plated Contact Fingers

**SHUGART 5" MINI FLOPPY DRIVE: $379.50 inc. tax. $330.00 ex tax.**

Verbatim Products available. Please write for price lists.

Prices current till 7th June 1980. Heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. MAIL ORDERS: PO Box 135, Northcote, Vic 3070. Minimum pack and post $1.25. Phone (03) 489-8131.
it was decided to employ a solid state switch using a triac and several other components on a small circuit board. This also worked very well — for nine weeks, when it 'blew up' with much smoking of resistors and charring of the circuit board. The reason why this happened is not clear, although it's suspected that the triac eventually broke down under the heavy starting current of the motor.

Had this happened while the unit was unattended, it could have started a fire. So the solid state switch was abandoned, and the relay was put back in service. In the relay version, the dropping resistor equored (if any) depends on the supply voltage and the type of relay, so you'll have to select it to suit.

A warning
Although it may seem unnecessary to mention it, remember that you now have a piece of rotating machinery that can start at any time without warning. Do not forget it's 'armed to go' and then try to change the machine's ribbon or paper. When the motor starts it will be accompanied by immediate typing, and it's best not to learn the hard way how it feels to be hit on the thumb by a flying key hammer!

Connecting the autostart into the system

Previous articles in this series appeared in the August 1979 issue (Project 730, receiver demodulator); the September 1979 issue (Project 731, transmitter modulator) and April 1980 (improvements to the RTTY system).

There has been considerable demand from readers for PCB board designs for the UART etc, and no doubt the same will apply to the autostart unit described here. Boards are in preparation and we hope to publish them at an early opportunity.

TOM MOFFAT, author of the teletype articles, was born in the USA 39 years ago. He now lives at the outer fringe of Hobart, on the slopes of Mt. Wellington, with his Queensland-born wife Gael and three young children.

Tom began his career about age six — demolishing alarm clocks, as do most radio freaks.

He completed two years of a university course in physics and engineering before running out of money. Next stop was the American Telephone Company, working in the private line/television operating/teletype test section, and it's here that his interest in RTTY developed.

Two years later he signed a contract with NASA to work at Kwajalein Island in the South Pacific at a tracking station, but an 'unfortunate' change in plans resulted in him being posted to Bermuda and Hawaii instead.

Next stop was the Nevada test site, operating a tracking radar for a couple of years. He then went back to the telephone company in Reno, taking a second job as an announcer with a local radio station.

When the news editor turned up too drunk to read the major bulletin one night, Tom suddenly found himself in radio news.

He migrated to Australia in 1968, and took a job with GTV 9 in Melbourne, first as an audio operator, then back to radio news with 3AK, and then on to television news with GTV.

After a holiday in Tasmania he decided 'this was the place to live' and made the move in 1974 to set up a small two-way television business in Hobart.

After three years of rising costs and falling income he chucked in the business and went back to television news at ATV-6, where he is still employed.

When not 'playing radios' Tom enjoys bushwalking and photography, usually both at the same time.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2SC784</td>
<td>0.52 2SC1162</td>
<td>1.30</td>
</tr>
<tr>
<td>2SC785</td>
<td>1.64 2SC1166</td>
<td>0.76</td>
</tr>
<tr>
<td>2SC786</td>
<td>3.72 2SC1169</td>
<td>4.14</td>
</tr>
<tr>
<td>2SC792</td>
<td>9.89 2SC1172</td>
<td>13.03</td>
</tr>
<tr>
<td>2SC818</td>
<td>0.73 2SC1173</td>
<td>1.17</td>
</tr>
<tr>
<td>2SC828</td>
<td>0.30 2SC1175</td>
<td>0.71</td>
</tr>
<tr>
<td>2SC829</td>
<td>0.32 2SC1185</td>
<td>0.74</td>
</tr>
<tr>
<td>2SC839</td>
<td>0.40 2SC1211</td>
<td>0.54</td>
</tr>
<tr>
<td>2SC840</td>
<td>3.11 2SC1212</td>
<td>1.42</td>
</tr>
<tr>
<td>2SC867</td>
<td>12.07 2SC1213</td>
<td>0.52</td>
</tr>
<tr>
<td>2SC879</td>
<td>5.48 2SC1226</td>
<td>1.15</td>
</tr>
<tr>
<td>2SC900</td>
<td>0.52 2SC1239</td>
<td>4.32</td>
</tr>
<tr>
<td>2SC930</td>
<td>0.39 2SC1243</td>
<td>0.71</td>
</tr>
<tr>
<td>2SC932</td>
<td>0.56 2SC1256</td>
<td>1.22</td>
</tr>
<tr>
<td>2SC933</td>
<td>0.43 2SC1306</td>
<td>2.12</td>
</tr>
<tr>
<td>2SC945</td>
<td>0.28 2SC1317</td>
<td>0.79</td>
</tr>
<tr>
<td>2SC958</td>
<td>2.32 2SC1310</td>
<td>0.97</td>
</tr>
<tr>
<td>2SC960</td>
<td>2.72 2SC1317</td>
<td>0.46</td>
</tr>
<tr>
<td>2SC973</td>
<td>32.20 2SC1318</td>
<td>0.66</td>
</tr>
<tr>
<td>2SC985</td>
<td>2.92 2SC1345</td>
<td>0.54</td>
</tr>
<tr>
<td>2SC1000</td>
<td>0.46 2SC1356</td>
<td>15.76</td>
</tr>
<tr>
<td>2SC1011</td>
<td>16.35 2SC1364</td>
<td>0.54</td>
</tr>
<tr>
<td>2SC1013</td>
<td>11.10 2SC1407</td>
<td>1.10</td>
</tr>
<tr>
<td>2SC1017</td>
<td>1.42 2SC1419</td>
<td>4.87</td>
</tr>
<tr>
<td>2SC1018</td>
<td>1.69 2SC1444</td>
<td>4.97</td>
</tr>
<tr>
<td>2SC1030</td>
<td>4.11 2SC1446</td>
<td>1.54</td>
</tr>
<tr>
<td>2SC1034</td>
<td>12.65 2SC1447</td>
<td>1.58</td>
</tr>
<tr>
<td>2SC1065</td>
<td>1.65 2SC1448</td>
<td>2.95</td>
</tr>
<tr>
<td>2SC1061</td>
<td>1.66 2SC1449</td>
<td>0.64</td>
</tr>
<tr>
<td>2SC1075</td>
<td>1.42 2SC1476</td>
<td>1.25</td>
</tr>
<tr>
<td>2SC1098</td>
<td>1.54 2SC1475</td>
<td>0.17</td>
</tr>
<tr>
<td>2SC1114</td>
<td>11.94 2SC1509</td>
<td>0.88</td>
</tr>
<tr>
<td>2SC1116</td>
<td>1.17 2SC1520</td>
<td>2.09</td>
</tr>
<tr>
<td>2SC1128</td>
<td>1.17 2SC1550</td>
<td>1.65</td>
</tr>
<tr>
<td>2SC1129</td>
<td>1.30 2SC1569</td>
<td>1.07</td>
</tr>
</tbody>
</table>

**DISCOUNTS** (Semiconductors only) Orders over $25, less 10% percent — over $50, less 15% percent — over $100, less 20% percent — over $250, less 25% percent.

**SEMICONDUCTOR IMPORTS**

**SALES AGENT:** PRE-PAK electronics p/l 10 West St, Lewisham, NSW.

**PHONE:** 569-9797

**LATEST JAPANESE SEMICON Manuals**

**TRANSISTOR SUBSTITUTION MANUAL**

**TRANSISTOR MANUAL**

**LINEAR IC MANUAL**

**DIODE MANUAL**

**FET MANUAL**

**PRICE:** $9.95 ea

**FET MANUFACTURED**

**ACTIVE IN:** Japan by Toshiba, Hitachi, NEC, Toyo, Matsushita, Sony, Sanken, Ok, Fujitsu, etc.

**Available in large or small quantities, the extensive availability includes over 2,000 items from Japan's leading original manufacturers — Sanyo, Toshiba, NEC, Toyo, Matsushita, Sony, Sanken, Ok, Fujitsu, etc.**

**Items ex stock will be despatched within 48 hours; items not immediately available will be ordered ex Japan by Air Mail delivery and should be received within max. 4-6 weeks.**

**CUT OUT THIS PAGE AND KEEP FOR FUTURE REFERENCE**

Due to advertising lead times and international exchange rate fluctuations, prices are subject to change without notice.
MEET A TOUGH BABY

HIOKI 3012
Thin Drop-Proof Multimeter

Our little pocket tester is so slim, small and light you might overlook the fact that it is a rugged, hard-working precision instrument — tougher than most multimeters twice the size. It can fall from a work bench (1 metre high) and still work perfectly well.

The “DROP-PROOF” pocket multi-meter demonstrates our claim that “HIOKI puts you years ahead”. It gives you the advantage of HIOKI Core Magnetic TAUT BAND for precise readings. It is friction-free and is remarkably resistant to shock.

The pencil type leads fitted with guards are a pleasure to handle, especially when testing complex electronic circuits, etc. HIOKI innovation is apparent in every detail.

HIOKI PUTS YOU YEARS AHEAD!

Specifications:
- DC VOLTAGE: 0.3, 3, 10, 30, 100, 300, 1000V
- 20kΩ/V, ±3% of FS
- DC CURRENT: 10μA, 10μA, 300μA, 300mA, 300mV
- Drop, ±3% of FS
- AC VOLTAGE: 10, 30, 100, 300, 1000V 10kΩ/V, ±4% of FS
- RESISTANCE: 10k, 100k, 1MΩ (Rc 100Ω) ±3% of Scale Length
- POWER SOURCE: 1.5V (Size AA)
- ACCESSORY CIRCUIT: Meter protecting circuit, Circuit protecting 0.5A fuse DC, AC, 1000V measuring terminal, OUTPUT terminal
- METER TAUT BAND type (with mirror scale)
- DIMENSIONS: Approx 140H x 4W x 22Dmm (Max 26D)
- Appx 250g
- ACCESSORIES: Test leads, 0.5A Spare fuse
- Soft case, Strap

*Only 22mm thick and can drop from a height of 1 metre without any harm.

H. ROWE & CO. PTY. LTD.
Project construction and debugging is so much easier if you have the appropriate test equipment. The same applies when servicing manufactured electronic equipment. Our first Test Gear book was extraordinarily popular. Test Gear 2, assembles 27 of our test instrument projects published over the last few years in one handy volume, including: 487 Audio Spectrum Analyser, 320 Battery Condition Indicator, 717 Crosshatch Generator, 135 Digital Panel Meter, 132 Experimenter's Power Supply, 719 Field Strength/Power Meter, 140 1GHz Frequency Meter, 141 Logic Trigger, 129 RF Signal Generator, 139 SWR/Power Meter, 222 Transistor Tester, 148 Versatile Logic Probe — and more. Price: $3.95 plus 55 cents postage and handling, from ETI, Subscription Department, 15 Boundary St, Rushcutters Bay NSW 2011. Also available from newsagents and selected electronics suppliers.
50,000 Homes will be burgled this year...
55,000 Cars will be stolen this year...

Are YOU protected?

These days, strong locks are not enough. Crime is on the increase - and the odds are that sooner or later, you or your family will become a victim.

These days, you need all the protection you can get. And being technically oriented (you must be or you wouldn't be reading this magazine!) you can use your knowledge to help protect yourself against intruders.

Because you’re technical, you can install your own intruder alarm systems at a fraction of the amount you'd pay to have a 'professional' alarm company install very similar equipment.

INSTALL YOUR OWN INTRUDER ALARM & SAVE!

Now: a professional alarm system for home installers.

$59.50
Cat L-5102

This quality alarm module is the 'brains' behind a fully comprehensive alarm system that you can install in your home, office, factory, etc., at a fraction of the cost of an equivalent commercial alarm system.

As with professional systems, it features both 'normally open' (NO) and 'normally closed' (NC) sensing loops, for various types of sensors. For example, magnetic Reed switches in a 'NC' loop and under-carpet pressure mats in a 'NO' loop. It also features both time delays to allow for legitimate entry and exit. It operates from either internal batteries, or from an optional 'plug-pack' mains power adaptor. In use, it looks like a small 'bookshelf' loudspeaker, so it is very easy to camouflage (and thus difficult to detect).

Comprehensive instructions are supplied - they enable almost any home handyman to install the alarm system to at least commercial standards. And you save hundreds of dollars in doing so!

MAKE EXTRA MONEY!
Using your technical knowledge, you can start your own alarm installation business in your spare time. Friends, neighbours, etc. Three's money to be made in burglar alarms!

COMPLETE CAR PROTECTION
The outstanding automobile alarm is delightfully easy to install, but is highly effective. Of the current sensing types, it requires no external key switches, push buttons, etc. Simply install and it responds to changes in voltage as car door is opened and light comes on. Full instructions supplied for easy fitting.

Cat L-5090

$49.50

SMOKE ALARM
New and very useful in all alarm systems. Much more sensitive than a hear switch. Very highly recommended.

Cat L-5558

$29.50

PRESSURE MAT
Hides under carpet, etc. Detects by switching when trodden on. Very thin, ideal for door minder.

Cat L-5109

$14.95

HORN SPEAKER
Ideal for alarm systems. 8 ohms impedance.

Cat C-2705

$9.00

ELECTRONIC SIREN DRIVER
Tuns horn speaker into ear-shattering siren. Ideal for alarms with switched output only.

Cat L-5119

$11.90

Perhaps you'd like to put in an alarm system to protect your family, but don't know whether you can do it. YOU CAN. But don't take our word for it - we have produced a special layman's guide called 'How to install your own burglar alarm'. It tells you all you want to know about the various types of alarm systems and how to install them - and it's exclusive to Dick Smith. Copies are available for only $1.50 from any Dick Smith Store or re-seller.

DICK SMITH ELECTRONICS
SEE OUR OTHER ADS IN THIS ISSUE FOR LIST OF DICK SMITH STORES & RESELLERS OF OUR PRODUCTS
Walking rings . . . and other miracles

A common task facing the electronics designer is that of producing simple digital counter/divider networks which produce an output frequency or count rate that is some fixed fraction of an input frequency or count rate. Here's how to do it.

DIGITAL DIVISION, or counting, is a fairly straightforward task — providing you know how (!), chiefly involving the manipulation of circuit 'blocks' to economically or conveniently do the task required. But, as the old saying goes, there's more than one way to skin a cat. . . .

4013 and 4027 flip-flops

The two most basic counter/divider ICs in the CMOS range are the 4013 dual D-type flip-flop and the 4027 dual J-K flip-flop. Figure 1 shows the outlines and pin notations of these two devices, which each contain two independent flip-flop stages sharing common supply connections. Each of these packages can be used to give division ratios of 2, 3, or 4.

A single 4013 'D' stage can be made to act as a divide-by-two counter by grounding its SET and RESET pins and coupling its DATA pin to its Q output, as shown in Figure 2a. A single 4027 J-K stage can be made to act as a divide-by-two counter by grounding its SET and RESET pins and connecting its J and K pins to the positive supply rail, as shown in Figure 2b. Both of these circuits change state on the positive-going transition of the input clock signal, which must have rise and fall times of less than 5 us. The 4013 is very fussy about the shape of its input clock signals and tends to be rather temperamental in operation. The 4027 is not too fussy about its clock signals and is very easy to work with.

Ripple counters

Figure 3 shows how two divide-by-two 'D' or J-K flip-flop stages can be wired in series to give an overall division ratio of four (2^2). Figure 4 shows how three
such stages can be wired in series to give a division ratio of eight \(2^3\). Note that each counter stage is clocked at precisely half the rate (an octave below) of the preceding stage, so that the clock signal seems to 'ripple' through the counter chain. Also note that, as is made clear in Figure 5, the final division ratio is equal to \(2^n\) where 'n' is the number of counter stages. Thus, four stages give a ratio of \(2^4 = 16\), five stages give \(2^5 = 32\), six give \(2^6 = 64\), seven = 128 and so on.

A detail not made clear in the above diagram is that, since the counters of a 'ripple' circuit are effectively wired in series, the propagation delays of the individual stages in the counting chain add together to give a fairly long total delay at the end of the chain. If each stage has a delay or 100 ns and there are ten stages, the total propagation delay is 1 μs. Consequently, the first output signal will not change state until 1 μs after the arrival of the original input clock signal that initiates that change of state. The counter states of the 'ripple' type of counter are thus not in perfect synchrony with the original clock signal and this type of circuit is consequently known as an asynchronous counter.

The 4013 and 4027 counters can be cascaded to give any desired number of ripple stages. When more than two stages are required it is usually economic, however, to use a special-purpose MSI ripple-carry binary counter/divider IC. Figure 6 shows the outlines and functional diagrams of three popular ICs of this type.

The 4024 is a seven-stage ripple unit with all seven outputs externally accessible. It gives a maximum division ratio of 4096. The 4020 is a fourteen-stage unit with all outputs except 2 and 3 externally accessible, and it gives a maximum division ratio of 16 384.

Figure 7 shows the outline and functional diagram of a special-purpose ripple-carry unit, the 4060. This is another fourteen-stage unit, but does not have outputs 1, 2, 3 or 11 externally accessible. The special feature of the 4060 is that it incorporates a built-in clock oscillator circuit. The diagram shows the connections for using the internal circuit as either a crystal or an RC oscillator.

The 4020, 4024, 4040 and 4060 ICs...
are all provided with Schmitt trigger action on their input terminals and trigger on the negative transition of each input pulse. All counters can be set to zero by applying a high level on the RESET line.

**Walking ring** or **Johnson** counters

An alternative to the ripple type of counter is the so-called 'walking ring' or 'Johnson' counter. In these counters, all stages are clocked in parallel and the stages are cross-coupled so that the response of one stage to a clock pulse depends on the states of the other stages.

Figure 8 shows the connections for making a divide-by-three counter from two J-K stages and Figure 9 shows the connections for making a divide-by-five counter.

A major advantage of the 'walking ring' or 'Johnson' counter is that, since all stages are clocked in parallel, the outputs of the completed counter are subjected to only a single stage or propagation delay. Consequently, the system gives synchronous operation and outputs give glitch-free decoding.

**4018 divide-by-n counter**

When count numbers greater than four are required, it is economic to use MSI ICs such as the 4018, rather than the 4013 or 4027. The 4018 is a five-stage 'Johnson' counter that can be made to divide by 2, 3, 4, 5, 6, 7, 8, 9 or 10 by merely cross-coupling its terminals in suitable ways. The IC features a Schmitt trigger on its clock input line and clocks on the positive transition of the input signal.

Figure 10 shows the outline and functional diagram of the 4018. Figure 11 gives methods of cross-coupling the IC to give division ratios from two to ten. On even division ratios, no additional components are needed. On odd ratios, a two-input AND gate is required in the feedback network. This gate can be a single 4081 AND stage, or can be made from two 4011 NAND stages.

**Greater-than-10 division**

Even division ratios greater than ten can usually be obtained by simply cascading suitably scaled counter stages, as shown in Figure 12. Thus, a divide-by-two and a divide-by-six stage give a ratio of twelve, a divide-by-six and a divide-by-six give a ratio of 36 and so on.

Non-standard and uneven division ratios are obtained by using standard counters, such as the 4018, and decoding their outputs to generate suitable counter-reset pulses on completion of the desired count.
If you’re looking to invest in low cost, portable DMMs, you must consider our Model 935. At only $149, it offers features and performance that equal or surpass 3½ digit DMMs costing much more. Features like a lightweight, palm-sized package, 29 pushbutton-selected ranges, including switchable hi- and lo-Ω, and a full ½ inch tall low-power liquid crystal display that helps make a 9V battery last up to 200 hours. And the 0.1% basic accuracy of the 935 rivals many bench/lab 3½’s. It’s even fully protected against mechanical and electrical abuse, so it will last a long, long time.

MODEL 935. Unmatched performance at an unmatched price: $149.00

Good Investment.

Data Precision
Performance in the field.

Kenelec (Aust.) Pty. Ltd.
48 Henderson Rd, Clayton, Vic. 3168. Tel. (03) 560-1011. NSW (02) 439-3954. SA (08) 223-2420. QLD (07) 262-2223. WA (09) 444-5826.

MASTER CHECK

NEW

$ 24 Plus 15% sales tax

Voltage indicated:
5, 12, 24, 50, 110, 240, 415 V

MASTER CHECK

- Cannot be over ranged.
- Indicates AC or DC Voltage.
- Automatic Voltage indication.
- Read off polarity at a glance.
- Designed for Australian conditions.
- 7 Voltage indication steps by L.E.D.’s.
- Robust lightweight plastic construction.
- AC or DC Voltage Check from 6 to 415 Volts.
- Useable on battery operated devices to three phase AC.
- Available from Electrical Wholesalers throughout Australia.

ALSO AVAILABLE Multi-Check — Handy solid state continuity checker. Will check AC or DC Voltages from 4.5 to 415 Volts.
STEREO PAIR SPEAKER SYSTEM
069 PR
50Hz-15K Hz, 8 ohm
120 power 8" woofer, 2" tweeter
Bookshelf speakers, only
450x280x120mm, walnut
LESION
Hammond style component monitor with big CB/Amateur talk-power. Was $22.50 now $15.50

STEREO CARTRIDGES
Decca Jelco magnetic cartridge for popular replacement, suits most turntables. 100% 28/2820Hz response (stylus $7.50), was $14.50, now ...

STEREO Equipment
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STEREO EQUIPMENT
BARGAIN BUY
SUPER CRYSTAL
All new quality crystal, 65% off, was $209.00, now ...

STEREO EQUIPMENT
MATSUNAMI 3K, 1970, complete $295, was $325.00, now $225.00

STERE}
THE ETI COLLECTION

30 Audio Projects $3.95  Top Projects Vol.4. $3  3600/4600 Synthesizers $12.50  Simple Projects Vol.2. $2.95
Project Electronics $4.75  Top Projects Vol.5. $3
Australian CB $3.95  Circuits No.2. $2.95
Test Gear 1. $3

HERE THEY ARE!
COLLECTIONS OF THE BEST FROM ETI

Forget leather-cased editions of Moby Dick, papyrus printings of ancient classics and first editions of Gone With the Wind! The dedicated electronics enthusiast puts an investment on his bookshelf with the ETI Collection — an investment in hours of pleasure in building and using projects that are backed by one of the world’s largest electronics magazines.

From electronic music, through audio, to CB radio, the ETI Collection ranges the whole field of electronics.


I enclose $...............(inc. postage).

Name. ........................................
Address. ..................................
.......................... Post Code ..........................

HOW TO ORDER
The books in this collection are available from most newsagents or directly from ETI. The only exception is the International Synthesizer book which is only available from us and a limited number of specialist suppliers — it is not sold by newsagents. Send your order, enclosing a cheque or money order (and including postage where appropriate), to:

Electronics Today International
Subscriptions Department
15 Boundary St
Rushcutters Bay NSW 2011
**Test Gear 1**
Your confidence to tackle more complex projects will increase dramatically if you have the right test equipment to troubleshoot, fault-find and generally understand the operation of the circuits you build. Why not build your own test equipment, saving money and learning as you go?

Contents include: Audio Level Meter, Impedance Meter, Audio Millivoltmeter, Simple Frequency Counter, Phase Meter, Temperature Meter, Audio Signal Generator, Audio Noise Generator, and many more.

**Price:** $3.00 plus 45 cents post and packing.

**ETI Circuits No. 2**
This giant compendium of circuits has been assembled from the 'Ideas for Experimenters’ section of Electronics Today and is packed full of ideas and suggestions for the experimenter. The chapter headings cover Alarms, Amplifiers, Automobile, Batteries, Comparators, Conversion Tables, Crossovers, Crystal Oscillators, Detectors, Digital, Filters and so on. Whenever you’re looking for a circuit, this is the book to turn to.

**Price:** $2.95 plus 45 cents post and packing.

**30 Audio Projects**
For the Audiophile who wants good sound at a good price plus the satisfaction of having built it himself, 30 Audio Projects is required reading. The contents include our most popular audio projects: 25 Watt Amp, General Purpose Preamp, Bucket Brigade Delay Line, Active Crossover, Compressor Expander, Tape Noise Limiter, Transmission Line Speaker System, Master Mixer, Graphic Equalizer and the 50/100 Watt Amp Modules.

**Price:** $3.95 plus 70 cents postage and packing in NSW (80 cents in other states).

**Project Electronics**
Specially designed to meet the needs of newcomers to electronics, and in particular school students following the three-segment Industrial Arts syllabus in electronics, this book has been a runaway success! Twenty-six projects (many easily available in kit form) are completely described along with hints on troubleshooting, components, how to solder, etc. None of the projects is expensive and all are satisfying to build.

Available in newsagents, component stores or directly from ETI.

**Price:** $4.75 plus 45 cents post and packing.

**International 3600 and 4600 Synthesizers**
A completely revised and updated reprint of ETI’s phenomenally successful music synthesizer designs.

This book has been beautifully printed on heavy art paper and has a sturdy cover varnished for protection.

Available from some kit suppliers.

**Price:** $12.50 including post and packing.

**Top Projects Vol. 4**

**Price:** $3.00 plus 45 cents postage and packing.

**Top Projects Vol. 5**
Once again, this 'Best of ETI' publication is available from many newsgenst or directly from ETI. Published in 1978 it is crammed with projects: Shutter Speed Timer, Ultrasonic Switch, Accentuated Beat Metronome, Marine Gas Alarm, House Alarm, White Line Follower, Induction Balance Metal Detector, Photographic Strobe, Simple Compressor/Expander and CB Power Supply.

**Price:** $3.00 plus 45 cents post and packing.
ROD IRVING ELECTRONICS
499 HIGH STREET, NORTHCOTE 3070, MELBOURNE VICTORIA, Ph (03) 489-8131.

SCOTCHCAL
FRONT PANELS FOR ETI AND EA PROJECTS

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETI 452 Guitar Practice Amp</td>
<td>$4.80</td>
</tr>
<tr>
<td>Series 4000 Any colour</td>
<td>$12.50</td>
</tr>
<tr>
<td>Moving Coil Pre-Amp</td>
<td>$2.00</td>
</tr>
<tr>
<td>577 Power Supply</td>
<td>$2.00</td>
</tr>
<tr>
<td>455 Loudspeaker Protector</td>
<td>$2.70</td>
</tr>
<tr>
<td>Variable Power Supply</td>
<td>$2.70</td>
</tr>
<tr>
<td>Linear Ohmmeter</td>
<td>$2.50</td>
</tr>
<tr>
<td>Muscle Activity Meter Scale</td>
<td>$1.40</td>
</tr>
<tr>
<td>ETI 576 Electromyograph</td>
<td>$2.80</td>
</tr>
<tr>
<td>561 Metal Detector</td>
<td>$2.50</td>
</tr>
<tr>
<td>EA Capacitance Meter</td>
<td>$3.50</td>
</tr>
<tr>
<td>EA Flash Exposure Meter</td>
<td>$4.25</td>
</tr>
<tr>
<td>EA Sound Triggered Flash</td>
<td>$3.50</td>
</tr>
<tr>
<td>EA Slave Flash</td>
<td>$1.20</td>
</tr>
<tr>
<td>EA Playmaster Graphic Analyser</td>
<td>$6.50</td>
</tr>
<tr>
<td>EA Metal Detector 79md9</td>
<td>$3.90</td>
</tr>
<tr>
<td>EA Pulse Generator</td>
<td>$4.80</td>
</tr>
<tr>
<td>EA Square Wave Generator</td>
<td>$2.50</td>
</tr>
<tr>
<td>EA RF Z Bridge</td>
<td>$3.25</td>
</tr>
<tr>
<td>EA Thyristor Test</td>
<td>$2.40</td>
</tr>
<tr>
<td>EA these complete evaluation kits</td>
<td>$2.70</td>
</tr>
<tr>
<td>EA Multi Monitor</td>
<td>$1.90</td>
</tr>
<tr>
<td>EA Experimentors Supply</td>
<td>$2.80</td>
</tr>
<tr>
<td>EA these Variable Wiper Delay</td>
<td>$1.10</td>
</tr>
<tr>
<td>EA Playmate Stereo Amplifier</td>
<td>$4.50</td>
</tr>
</tbody>
</table>

All front panels available from day of release of magazines. When ordering front panels, specify colour of lettering first, then colour of background.

10 TURN POTS
1/4" SHAFT, VALUES: 100, 500, 1K, 2K, 5K, 10K, 20K, 50K, 1M.

Inc tax $6.25 ea.

Soar Model
510A
4 digit LARGE LCD DISPLAY
Send for specs.
$77.50
Add $3 P&P and certified mail.

INTERSIL LCD 3½ DIGIT PANEL METER KITS
INTERSIL ICL7106 $32.50
Build a working DPM in ½ hour with these complete evaluation kits. Test these new parts for yourself with Intersil's low-cost prototyping kits, complete with A/D converter and LCD display (for the ICL7106) or LED display (for the I7107). Kits provide all materials including PCB board, for a functioning panel meter. (ICL7106E LCD)

ROD Irving Electronics Kits
Additional kits will be produced as new projects are available.

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETI 561 Metal Detector</td>
<td>$29.90</td>
</tr>
<tr>
<td>ETI 041 limiter</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 043 heads and tails</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 044 tone door bell</td>
<td>$4.10</td>
</tr>
<tr>
<td>ETI 046 500 second timer</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 047 simple morse, less key</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 048 back card</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 046 100w amp</td>
<td>$19.50</td>
</tr>
<tr>
<td>ETI 063 electronic bongo</td>
<td>$4.50</td>
</tr>
<tr>
<td>ETI 064 sine-less speaker</td>
<td>$4.50</td>
</tr>
<tr>
<td>ETI 065 temp alarm</td>
<td>$3.90</td>
</tr>
<tr>
<td>ETI 068 LED dive</td>
<td>$5.50</td>
</tr>
<tr>
<td>ETI 084 ear alarm</td>
<td>$10.00</td>
</tr>
<tr>
<td>ETI 470 60w amplifier</td>
<td>$19.90</td>
</tr>
<tr>
<td>ETI 470 50w amplifier</td>
<td>$19.90</td>
</tr>
</tbody>
</table>

(amp kits do not include heat sinks)

Kits are complete with prime spec components and include assembly instructions, wire, screws, etc. All kit prices include sales tax, exempt prices on application.

HEAVIER ITEMS ADD ADDITIONAL POSTAGE. EXTRA HEAVY ITEMS SENT COMET FREIGHT ON PRICES SUBJECT TO CHANGE WITHOUT NOTICE. SEND 60c & SAE FOR FREE CATALOGUES.

MAIL ORDERS: PO BOX 135, NORTHCOTE, VICTORIA 3070.
PHONE (03) 489-8131. MINIMUM PACK and POST $1.25.
Ideas for Experimenters

Sound to light modulator

Modulating a light, or a bank of lights, from a sound source (such as a tape recorder or record player) is an ever-popular topic so we dragged this circuit from the depths of our files.

A high impedance input is provided by a source-follower, Q1, so that the unit may be driven from either a high or low impedance source. An op-amp (a 741) then provides sufficient gain to trigger the SCR which drives the LED. As the input varies, the drive to the LED will vary, modulating the light output. Each 'Section' (1, 2, 3... ) drives a LED, all the LEDs being mounted in a row.

When setting up, RV1 and RV2 are adjusted so that with the maximum input voltage available, 1 V is available at pin 6 of the op-amp. Then VRX is adjusted so that the LED lights. Then Section 2 is tackled; adjust VRX for that section so that its LED lights with 0.9 volts at pin 6 of the 741. Continue with the subsequent sections so that each LED lights at 0.8 V, 0.7 V etc at the output of the 741. The display produced is rather like a VU display; with the column lighting up as the sound rises and falls.

Telephone amplifier

Have you ever had occasion where two or more people needed to listen to a telephone conversation? Normally, a telephone conversation is a one-to-one affair. This simple amplifier, from J.P. MacAulay of the UK, solves the problem neatly.

No direct connection to the telephone is necessary. Mr MacAulay has cunningly used an ordinary 5 mH RF choke as a pick-up coil - taped to the side of the phone set. Q1 is a common-base amplifier, the output signal on its collector driving the input of a 741 op-amp. The power output stage is driven by the output of the 741. Two complementary transistors are used and feedback is applied to the inverting input of the 741.

The gain of the op-amp may be varied by R6 and you can use either a preset pot or a standard pot and knob.

The frequency response of the amplifier is tailored to suit the voice characteristics of the telephone. Quiescent current consumption is less than 5 mA so the circuit can be run easily from a pair of PP3 9 V batteries connected in series.
IF IT'S ELECTRONICS
WE'VE GOT IT!!

NOW 2 GREAT LOCATIONS

THE HEART
OF ELECTRONICS IN AUSTRALIA

HEY

Turn these boxes into a modern amplifier. Now you can give your project the professional finish at a price that fits your budget.

AC1
Length 300mm
Width 195mm
Depth 92mm
ONLY $33.75

AC2
Length 360mm
Width 282mm
Depth 110mm
ONLY $39.75

AC3
Length 380mm
Width 295mm
Depth 110mm
ONLY $38.50

NOW

Give your project the finish it deserves. Davit metal boxes are the little two-tone brown boxes which have proven very popular for many different kits and projects. No. 4 comes complete with 4 x MM51 rubber feet.

Length Width Depth
No. 1 82mm 70mm 50mm $2.95
No. 2 100mm 82mm 54mm $3.45
No. 3 127mm 89mm 54mm $3.95
No. 4 140mm 120mm 50mm $4.75
No. 5 125mm 165mm 120mm $6.25

FREE * FREE
MELBOURNE
OPENING
GIVEAWAYS

To every customer who calls into our Melbourne Electronics Centre in May we will be giving away a free record cleaning cloth.

MAIL ORDER INSTRUCTIONS

MINIMUM POST/PACK CHARGE $1.00
Order Value $5-$9.99 $10-$24.99...
$1.00 $2.00
$25-$49.99 $50-$99.99...
$3.00 $4.00
$100 or more...
$5.00
Prices subject to alter. E&OE

STOP THIEF!

This kit is designed to be flexible and a completely adaptable alarm circuit for general use in such situations as the home, car, boat or any other security application. Runs on a 12 volt DC supply battery.

ONLY $13.50

TURN IT UP!

Complete 8 x 8 Watt Stereo Amplifier
When assembled this kit is a complete high quality stereo amplifier with 2 channel record reproduction from ceramic or medium output cartridges.

LOOK! $48.00

WOW LOOK AT THIS

OUR MELBOURNE ELECTRONICS CENTRE NOW STOCKS THE NUMBER ONE METAL DETECTOR — BOUNTY HUNTER. CALL INTO EITHER SYDNEY OR MELBOURNE FOR A LOOK AT OUR SUPER RANGE OR TELEPHONE OR WRITE FOR OUR FREE BOUNTY HUNTER BROCHURE.

DAVID REID
ELECTRONICS PTY. LTD.
127 York St., P.O. Box Q103

or
356 Lonsdale St., Melbourne 3000.
Telephone 602-4673

WE TAKE BANKCARD

GREAT ELECTRONICS SAVER — WE ARE GIVING A BETTER DEAL — WE ARE ELECTRONICS
Porch light controller

Mr. R. Johnson from the UK has designed this auto-dimmer for turning on a porch light at dusk and then controlling the brightness such that it is inversely proportional to the surrounding lighting conditions. It sets the porch light brightness to a minimum at dusk, increasing the brightness until it reaches a maximum after total sunset. In the morning, the light is slowly reduced in brightness as the sun rises, turning it off at full daylight.

The dimming circuit uses a triac to control the brightness of the porch light, conduction angle being controlled by Q1 and an SCR pulse circuit via a transformer, L2/L3.

The potentiometer RV1 varies the light level at which you wish to have the porch light turn on. Potentiometer RV2 sets the maximum brightness (maximum conduction angle of the SC151) of the porch light. The LDR determines when the dimmer starts and ceases to operate. Its resistance varies between 600k at dusk to about 6M at dark. A suitable type might be an LDR03 or LDR04, or similar. Note that Q1 is a BCY71, Q2 is a BC107/BC547/BC207 etc. The transformer T1 is a 120-12 low current type. L1 is an interference suppression choke and consists of 30 turns of 20 swg enamelled wire on a 12 mm length of ‘loopstick’ antenna ferrite. The transformer L2/L3 consists of 15 turns wound bifilar (two parallel wires) on a 15 mm length of loopstick antenna ferrite also.

A fuse is connected in series with the lead going to the porch light for safety.

All-round modulator

A very handy device around any hobbyists workshop or serviceman's bench is a simple modulator. For aligning IF amplifiers, receiver front ends etc — especially with only basic test instruments, it's a must.

Reader, G.J. Armitage of Melbourne Vic, sent this circuit in. A common signal diode is used as a 'mixer'. You'll need to drive the audio input with more signal than the RF input to get good modulation depth.

The circuit will work across a very wide frequency range, from very low frequencies to well into the VHF region. The diode can be any germanium signal diode, such as OA90, OA91, OA95, OA202 etc. The RF drive will need to be around several hundred millivolts.

A silicon signal diode, or a hot-carrier, diode may be used, but you'll need around half a volt of RF drive.

Constructed in a small shielded container, with coax input and output connectors (RCA connectors are good), prevents radiation of signals and a switched attenuator may be connected on the output.

The circuit may also be used as a product detector. BFO injection should be fed in the 'Audio' input and the resultant audio taken from the output (add a 'pi' RF filter using two 1n capacitors and a 1nH RF choke).
You asked for it, here it is. After many enquiries from readers ETI have produced a "valve" amplifier. This will probably be the last of this type, so here is your chance to build a vintage amp and learn some basic electronics all at the same time. You will also have an amp that is very durable and serviceable.

NEW PRODUCTS & KITS. 28-0-28V/2amp "C" Core Transformer, specially made for 4000 Amp to decrease hum level & maintain 60 watts RMS per channel, only $26.50. Imported from Sweden, 30-0-30V/2amp "Toroidal" Transformer, many applications, reduces hum, can be used on 4000 Amp with slight mods to power supply circuit, (mod available free on request), only $43.50. Use your TV as a large Screen Oscilloscope with this simple TV CR32 Adaptor, see EA May '80, complete kit including front panel, hardware & power adaptor only $35.90.

"THE BRUTE" — develops 300 watts into 4 ohms, 200 watts into 8 ohms.

COMPLETE KIT FOR ETI 466 300 WATT AMPLIFIER MODULE (less heatsink and power transformer), exactly as described by ETI including heatsink bracket, all nuts, bolts, silicone grease etc. ONLY $63.50. HEATSINK FOR ETI 466 AMP. This can be done in two ways as mentioned by ETI, i.e. you can make your own out of aluminium (which is not as easy as it looks and is very critical), or you can buy the PHILIPS 650DC HEATSINK for $27.50 (NB. This is the only commercial heatsink available in Australia that is recommended). FAN is also available if required for $29.50. TRANSFORMER to suit ETI 466 amplifier, $32.50. All parts for ETI 466 are available separately. ETI 466 Printed Board $7.00; MJ15003 $5.00, MJ15004 $5.00. CASE FOR AMP. We have three cases suitable for the ETI 466 (all un-punched); ETI 4000 Amp case (rack mounted) $35.00; ETI 4000 Amp Case (wooden sided) $45.00; Dick Smith Rack Vessel $49.00.

OTHER KITS IN OUR RANGE INCLUDE: • ETI 4000 Amplifier (see ETI May, June, July '79) only $179.00 with wooden sided case, $189.00 with rack mounting case. • 100 Watt Low Distortion Amplifier Module ETI 470 $29.90. • ETI 471 Pre-amp Control Unit $49.90. • ETI 472 Power Supply Kit $42.90, with "C" core transformer $53.90. • ETI 4-way Speaker System (Feb '80) $439.00 (Including all amplifiers and crossovers but no woodwork). • Fully assembled boxes for 4-way Speaker System $300.00 per pair.

MANY MORE KITS ARE AVAILABLE IN OUR FANTASTIC RANGE — ASK FOR FREE BROCHURE.

MAIL ORDER: $1.00 plus 5% of order value up to $80.00, thence a flat $4.00. Heavy items sent freight on through carrier.

STAGE & EFFECTS LIGHTING
ALL YOUR REQUIREMENTS AUSTRALIA WIDE

REMOTE LIGHTING CONTROL BOARD

This is a world first! Never before has there been a system like this. The Access Electronics Remote Lighting Control Board is a solid state switching rack, with a four preset control desk. The Stage Rack is a 12 channel unit, each channel 2000 watts. Power is 3 phase, standard 30A per phase.

Connection between desk and rack is by twist lock plug and socket, 14 way multicore — no separate power supply is necessary for the desk!

The Desk consists of four presets of 12 push action switches, each with its own LED indicator. Each preset has a master switch and a flash-to-full button. Each of the 12 channels also has a flash button. A selectable chaser offers variable switching across the masters if required.

The Rack is complete with 12 solid state switching units, individually fused. Each unit can be easily replaced, replacement units being readily available from our agents. The solid state switching units are zero switching to minimise interference.

The Remote Lighting Control Board is unique — and it's built with Australian touring conditions in mind. See one now at a Barratt Lighting agent or send for further information.

Distributed nationally by BARRATT LIGHTING Pty Ltd

See page 42 of this issue of ETI for a list of our agents.

80 – May 1980 ETI
Darlington drivers

This circuit from C.J. Ramey, UK, offers a very efficient way of driving a pair of transistors in Darlington configuration from CMOS. The circuit at right shows how two loads of up to 1A may be driven from a single 14007 chip with no external resistors. Using a 2N3055 in place of the BFY51 will enable loads of up to 3A to be driven at voltages limited only by the Vceo of the transistors.

The circuit at left shows the internal circuit of one section of the 14007. A high on pin 6 switches the lower CMOS transistor on, holding Q2 off and sinking the leakage current of Q1. A low on pin 6 drives Q1 and switches the lower CMOS transistor off and the upper CMOS transistor on. The result is fast switch off at low cost and efficient switch on.

A bonus is the inverter between pins 10 and 12. Note: Vcc should be 5-6 V to prevent excessive current being drawn from the CMOS chip.

Operating a Sonalert from 240 Vac mains

There are occasions when it is convenient to operate a Sonalert-type piezo-electric alarm from the 240 Vac mains. The accompanying circuit, from Barry Wilkinson of Nebula Electronics, shows how it's done.

The 'ACTIVE' input is switched to activate the alarm. Capacitor C1 acts as a current-limiting device, the four diodes being arranged as a bridge rectifier, with the alarm across the output. The zener diode across the alarm limits the maximum voltage and the electrolytic capacitor provides smoothing.

The value of C1 depends on the type of alarm used and its current drain. As an example, for the popular "Murata" make, two 33 nF, 250 Vac rated capacitors in parallel gave reliable operation. Current drawn was around 5 mA. This gave about 8 Vde across the alarm and adequate sound output.

Not that C1 must be rated for 250 Vac operation.
**POWER SUPPLIES**

**Fixed Voltage for Battery Operated Equipment**
- Fully protected against sustained short circuits
- Rugged, attractive steel case
- Suitable for continuous operation in high ambient temperatures
- On-off switch with separate L.E.D. indicator
- Overload Indicator on ECA143 and ECA144

**Variable Voltage for Bench Use**
The "ECA160" series are low cost power supplies designed for laboratory, factory test and systems applications. They are equipped with a front panel mounted 10 turn voltage control, combination ammeter/voltmeter and binding posts. Output is continuously variable from zero to 8% above the maximum rated voltage.

**FEATURES:**
- Linear series regulator
- Automatic short circuit protection
- Low drift
- Fast transient response
- Electricity authority approved

**VOLTAGE CONTROL:**
10 turn 5mV resolution
**RIPPLE:**
2mV RMS
**LOAD REGULATION:**
0.04% or 10mV

---

**ECA140**
- OUTPUT: 13.8V
- RIPPLE & NOISE: 0.75mV/Volt at rated output
- PROTECTION: Fold back current limiting

**ECA143**
- OUTPUT: 13.8V
- RIPPLE & NOISE: 0.75mV/Volt at rated output
- PROTECTION: Fold back current limiting

**ECA144**
- OUTPUT: 13.8V
- RIPPLE & NOISE: 0.75mV/Volt at rated output
- PROTECTION: Fold back current limiting

---

**Made in Australia and Guaranteed by:**
FERGUSON TRANSFORMERS PTY.LTD.
31 HIGH STREET, CHATSWOOD, N.S.W. 2067.

---

**Catamarans - dolphins of the wind**

For the first time 'Modern Boating & Seacraft' will have a huge Catamaran supplement (the first of three supplements) in the May edition.

This issue features the under-15 foot Cats with:
- Articles by Australian International Cat Skipper, Graham Candy.
- For new cat sailors a comprehensive feature on the comparison of the different cat classes.
- Results of tests on ten of the best catamarans available.

---

Modern Boating & Seacraft
On sale at your newsagent
TASMAN ELECTRONICS
12 Victoria St, Coburg, Vic. 3058. Ph 354-5062.
Minimum postage $1.80

TRANISTORS
AC127 .90
AC128 .90
AC149 2.20
AC161 2.20
AC162 2.20
BC107 .35
BC158 .35
BC108 .35
BC109 .35
BC109C .40
BC117B 65
BC117 65
BC119 .35
BC119C .35
BC119C .40
BC177 95
BC182 20
BC182B 16
BC206 16
BC287 16
BC327 30
BC328 30
BC349 19
BC350 19
BC351 19
BC354 19
BC356 19
BC357 19
BC359 19
BC360 19
BC365 19
BC369 19
BC371 19
BC378 16
BC385 16
BC387 16
BC388 16
BC448 .30
BC549 19
BC564 .30
BC565 19
BC571 19
BC573 19
BC575 19
BC581 19
BC582 19
BC594 19
BC595 19
BC596 19
BC597 19
BC598 19
BC648 120
BC650 120
BC657 150
BC664 150
BC665 150
BC666 150
BC667 150
BC668 150
BC669 150
BC670 150

DIODES
AC127 .90
AC128 .90
AC149 2.20
AC161 2.20
AC162 2.20
BC107 .35
BC158 .35
BC108 .35
BC109 .35
BC109C .40
BC117B 65
BC117 65
BC119 .35
BC119C .35
BC119C .40
BC177 95
BC182 20
BC182B 16
BC206 16
BC287 16
BC327 30
BC328 30
BC349 19
BC350 19
BC351 19
BC354 19
BC356 19
BC357 19
BC359 19
BC360 19
BC365 19
BC369 19
BC371 19
BC378 16
BC385 16
BC387 16
BC388 16
BC448 .30
BC549 19
BC564 .30
BC565 19
BC571 19
BC573 19
BC575 19
BC581 19
BC582 19
BC594 19
BC595 19
BC596 19
BC597 19
BC598 19
BC648 120
BC650 120
BC657 150
BC664 150
BC665 150
BC666 150
BC667 150
BC668 150
BC669 150
BC670 150

ZENERS
1% WATT 19
1 WATT 30
2W WATT 55
5W WATT 1.25
10W WATT 2.25
20W WATT 5.25
25W WATT 10.00
35W WATT 15.00
50W WATT 25.00
60W WATT 35.00
100W WATT 65.00
300W WATT 300.00
1KW WATT 1000.00

MICROS
660P 11.50
681 6.50
685 6.50
TMS1000 7.95

TANtALUM
35V 1.00
50V 1.50
100V 2.10

CERAmICS
6pF 10.00
10pF 5.00
20pF 10.00
100pF 50.00
1.0nF 95.00
10.0nF 120.00
100.0nF 480.00
1.0uf 180.00
10.0uf 300.00
100.0uf 1200.00

BIPOLAR 50V
1.0uf 1.00
3.3uf 3.30
10.0uf 10.00
100.0uf 100.00

POLYSTYRENE
125V
10pF 1.00
100pF 1.00
1.0nf 1.00

RESISTORS
33W 03
1W 07
10W 10
2W 20
4W 2p. 10

PLUS
Computer grade
Polypropylene
Capacitors
5.6uf 1.05
Capacitors
10uf 1.00
3uf 3.00
3uf 3.30
10.0uf 10.00
47uf 4.70
100uf 1.00
1.0uf 1.00
10.0uf 10.00

ALiA Quality Hi-Fi Products
Now at reduced prices.
Get both price and performance

Make a detailed price/performance comparison and you'll find that these DMMs come out on top. Only these models give you bench-top features like four digits and auto ranging plus the kind of price that used to be reserved for field service instruments. Not that the PM 2517 isn't ideal for field service.

Full 4-digit displays: give higher resolutions than 3½ digits. We also give you a parameter readout.

Choice of LED or LCD: so whatever your light/line requirements, there's a Philips DMM to match.


True RMS: instead of average. The only true way to measure AC signals other than sinewaves without stopping and thinking.

High resolution and accuracy: due to the combination of four full digits and high sensitivity ranges.

Current to 10 A: as volts go down, currents go up, for same output. So 10 A should be a must, not an option.

Overload protection: almost the only way to damage this DMM is accidentally on purpose.

Dimensions are compact, construction rugged. It also has an ergonomic layout, choice of LED or LCD readouts and all the professional features listed below. In other words, we invite you to make a detailed comparison because there really isn't one.

Small but sturdy: no cheap plastic cases or sloppy controls.

Ergonomic design: works in any position. Works without fuss or fumble. On auto it also works automatically.

Temperatures too: this low-cost option is a virtual must for trouble-shooting.

Data hold: a big Philips plus. Touch the test point, push the ring on the probe and the measurement data is "frozen" until you can turn round and read it. This option is a must for tricky service situations.

Meets International Standards: you name them and the PM 2517 meets them. But what else would you expect? And of course we also make analogs.

For more details contact:
Philips Electronic Systems — Scientific & Industrial Equipment, P.O. Box 119, North Ryde, NSW 2113 or phone Sydney 888 8222
Melbourne 699 0300 Adelaide 223 4022
Perth 277 4199 Brisbane 44 0191
Wellington NZ 859 859

DMMs for labs, service and workshops

The no-compromise 4-digit instrument

PHILIPS

Test & Measuring Instruments
THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. It also serves to bring new, special or hard to get components to the attention of the reader. If you are looking for a particular component or project from this month’s issue - 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 pages immediately preceding the DREGS page (inside the back cover).

As we expected the 140W Valve Amplifier to be a popular project, we sent preliminary notification of the specialised components to kit and component suppliers early in March so that they could ensure stocks by the time this issue was published. The transformers, as you would expect, are hardly 'stock' items and the manufacturers - Ferguson Transformers Pty Ltd - indicated that, initially at least, they would only be making them to order. Substitute transformers - particularly the output transformer, unless made to the same specification, should not be used, otherwise the project may not have the same performance as our prototype.

Most of the kit and component suppliers we contacted indicated they would be stocking up for the project. You should have little difficulty locating parts, if not complete kits. We should warn you however that transformers may not be available until mid to late May, depending on when suppliers may have ordered them.

The ETI-325 Auto-probe should be another highly popular project. All the components can be obtained virtually ‘off-the-shelf’. To house the unit, you’ll either have to rat through your medicine cabinet for a suitable pill bottle, or purchase one from your local chemist.

Readers should have little difficulty locating components for the ETI-560 Mains Cable Seeker. As with the Auto-probe, all components are off-the-shelf items. Our telephone pickup coil was obtained from Dick Smith. It’s listed as catalogue number C-7300.

The little magnetic earpieces are widely available. Don’t make the mistake of getting a crystal type, though - it will not work in this circuit.

The $100 Motherboard ties all our previous (and forthcoming) $100 computer projects together. All components are readily available. You might have to shop around a bit to get the best price for the $100 sockets, though!

**PRICE ESTIMATES**
We must stress that the price estimates given below are just that - estimates. Instances have been reported to us of readers going into a supplier and, finding a kit priced above the estimate given in the magazine, berating the supplier for not sticking to our “recommended price”, or words to that effect.

These are not recommended prices. We cannot, and would not, suggest a supplier sell a kit at the particular price given in this column.

We commenced publishing this information at the request of readers. Please keep in mind that 'typical' retail prices of components have been used to calculate project costs. Also, these may have been calculated as much as six to eight weeks in advance of publication and price movements may affect the result. We aren't infallible, and although every care is taken to see that these price estimates are reasonably correct, errors may creep in.

Please don't abuse your supplier - he's really trying to be helpful!

**ETI-456 140W Valve Amplifier**
- $220 to $280 (depending on chassis and case)

**ETI-325 Auto-probe**
- $5 to $7

**ETI-560 Mains Cable Seeker**
- $12 to $16

**ETI-636 $100 Motherboard**
- $90 to $110
NEW FROM PENNYWISE
The 6809 Microprocessor Board

The 6809 is the most advanced 8 bit microprocessor with many 16 bit operations. It deserves more than just being plonked on a PCB with the usual RAM, PROM, I/O and standard Monitor.

PP's 6809 Card has advanced memory mapping and protection hardware with a powerful Monitor to match.
- Increased addressing capability — up to 256K.
- Memory protection hardware — 4K pages can be individually write-protected or marked absent by software. Any violation causes an immediate interrupt to the monitor which prints diagnostics.
- No more worn out edge connectors — reconfiguration of hardware is done by software, not by switching switches or swapping cards.
- Cassette or Disk-based software available including — operating system, macroassembler and linking loader, higher level languages and application programs.
- Software-controlled baud rates — the monitor determines the speed of any terminal connected and configures the UART for the observed baud rate (up to 9600) and parity.
- Supports proper operating system — system has priviledged control of memory map and IO.
- Motorola Excerciser compatible.

PENNYWISE PERIPHERALS

In Sydney at Melbourne Prices.

STATIC RAM BOARDS
- 8x 450ns $49.90, 8x 300ns $29.90, 8x 16k 450ns $359.90, 8x 16k 300ns $397.90

EPROM BOARDS
- 16k/32k/64k with Bank Select feature $187.90
- 16k EPROM BOARD
  Features: On board programming, to program and run Intel 2716, Texas 2716, up to 16k. Zero IF sockets $253. Low IF sockets $198.

2718 EPROM PROGRAMMER
Reads and writes, ZIF Sockets included $159.

We distribute and stock a large range of MICRO components.

CHIPS: Motorola, Fairchild / Ferguson Transformers / Edge Connectors. I.C. Sockets / Heatsinks / Sprague Capacitors / WIMA Capacitors / CANNON Connectors / Molex Connectors / Spectrol Pots. / Rectifiers / SCR'S Triacs / Crimp connectors / Terminal Strips / Fuses. ETC.

TRANSPORT: Freight forward on printers and transformers. Regular mail for smaller items. Add $2.00 P&P.

280 VICTORIA ROAD, GLADESVILLE, NSW 2111. TELEPHONE 89-3145.
Add 15 percent Sales Tax where applicable. Quantity Discounts available.

PRINTERS.

SERIAL OR PARALLEL INPUTS.
BAUD RATE 110 TO 9600.
EVEN OR ODD PARITY.
SINGLE OR DUAL DIRECTION.
SOFTWARE CONTROLLED.
DOUBLE WIDTH LIKE THIS.
OPERATES WITH OR WITHOUT HANDSHAKE. 125 CHAR/SEC.
THREE COPIES PLUS THE ORIGINAL.

MODEL 8300.

PRINTER 1. Mod. 8300
- 80 Column.
- 60 lines/min.
- 7 x 5 Dot Matrix.
- 10 Char/in.
- 6 lines/in.
- Paper width adjustable.
- 4.5 to 9.5 in.

$830.00 plus tax.
SORRY SPROCKET FEED ONLY. SPECIFY SERIAL OR PARALLEL.
FREIGHT FORWARD ON THESE.

PRINTER 2. Mod. 1540
- 136 Column.
- 40 lines/min.
- 9 x 7 Dot Matrix.
- 10 or 5 Char/in.
- 6 lines/in.

$1152.00 plus tax.

TEXAS CALCULATORS

The Programmer.
Does your hex to Octal to Decimal conversions. Calculations Offsets, etc.

- $63.00
- $63.00
- $18.00
- $150.00

FERGUSON TRANSFORMERS

- Printed Circuit Mount SVA, 15, 18, 24, 30 v Centre Tap $5.00
- Low Profile Chassis Mount 12, 15, 18, 24, 30 v Centre Tap $5.75

Also a range of Specials for computer supplies and high power transformers for those who are thinking of a static 2 mega-byte system.
Dear Sir,

I would like to point out a serious deficiency in the design of the ETI-455 Loudspeaker Protector published in the March 1980 issue of ETI.

Protection circuits of this kind should be designed as far as possible to "fail safe". If the protection circuit fails,
(i) it should not cause damage to the circuit being protected
(ii) damage to the circuit being protected should be prevented, even while the protection circuit is failed
(iii) warning should be given of the failure of the protection circuit.

While a failure of the Loudspeaker Protector will not cause damage to the loudspeakers, it will allow the speakers to be damaged and it will provide no warning that the protector has failed. Though this situation may appear no worse than not having the protector installed, the user is living in a fool's paradise having been lulled into a false sense of security by the presence of the protector. The first indication he is likely to receive of failure of the unit is a puff of smoke from his burnt out speakers!

While component failures and bad connections are possible failure causes for the protector, the most worrying cause of failure is a flat battery. The battery is permanently connected into the circuit (without switch), and it is stated that because of the low CMOS current drain the battery should last its shelf life. But how do you know when the battery needs changing - look for the puff of smoke from the speakers?

The most obvious way of making the speakers safe in the event of failure of the protector is to have the relay which controls connection of the amplifier to the speakers connected as a normally operated relay. Then a fault would cause the relay to drop out and open the amplifier-speaker connection. This would protect the speakers and provide warning of the protector failure (though there would still be some faults which could lock up the relay and prevent the protector from doing its job).

Unfortunately, the design as it stands using a battery as power supply is not suitable for continually holding in a relay. To provide best protection the Loudspeaker Protector would have to be mains powered and switched on with the amplifier. A delay of one to two seconds after switch-on before operation of the relay to connect the speakers, would protect the speakers from amplifier failure at switch-on.

David L. Craig
Holland Park, QLD

Thank you for your comments on the ETI-455 Loudspeaker Protector Mr Craig, but there really isn't a "serious deficiency" in the unit, as you say, and I will let the designer, David Tilbrook, take issue on that score.

Apart from the obvious first requirement of actually doing the job required, a project must be 'reproducible' - that is, a wide spectrum of readers, with differing construction capabilities, must be able to build the project and get it working with a minimum of fuss. This is especially true of relatively simple projects and/or projects having wide appeal.

Having made that clear, I'll let David answer your specific objections.

(Roger Harrison, Editor)

When setting out to design this project, it was clear that it would have quite a wide appeal — as there was no commercial equivalent to do the job — and would probably be a 'beginning' project for many readers. It was for these reasons that I decided the circuit should be battery operated. Various protection schemes were considered actually, and rejected for reasons Roger Harrison has mentioned above — including "signal powered" protectors, circuits powered from the amplifier's supply, etc.

Having chosen battery operation, the unit had to have minimum power consumption to obtain maximum battery life and this meant a 'normally off' relay. Whilst I agree with your sentiments expressed in (i), (ii) and (iii) in your letter Mr Craig, I cannot agree that the Loudspeaker Protector suffers from a "serious deficiency". Firstly, to check the battery one simply turns down the sensitivity control of the unit while using the amplifier at normal listening levels. If the relays operate, cutting off the speakers, the battery is obviously OK.

Problems arise if the Loudspeaker Protector is mains operated. One of the most likely times for an amplifier to go faulty is at the moment of turn on. Unless the Loudspeaker Protector has been turned on before the amplifier, it is totally useless as a protection device in this event.

With 'normally operated' circuits, a fault condition can occur which 'holds on' the relay and it is fallacious to think that such a circuit is inherently "fail safe". Then again, 'normally operated' circuits are prone to somewhat more failures than 'normally off' circuits — undoubtedly, some of those failures will be of the undesirable type.

For the conditions under which the Loudspeaker Protector will be built and operated, I think it should do its job admirably.

David Tilbrook

Dear Sir,

I have been a regular reader of ETI since it first hit the newsstands. I would like to congratulate the staff at ETI on the facelift given the magazine since last June.

My favourite section is Sound. It helps compensate for the demise of your sister magazine, 'Hi-Fi and Music'. However, I have one main criticism of the Sound section in ETI — lack of editorial and reviews on Australian-manufactured hi-fi equipment. The same goes for other Australian electronics and hi-fi magazines, too.

Could I suggest that ETI set aside a page or two for editorial and reviews on locally-made equipment?

Yours Faithfully
R.D. Rowlands
Koolan Island, W.A.

We'd be delighted to do that. However, the pages would be blank for most issues of the year! There are not too many companies producing hi-fi equipment in Australia. We have already reviewed the locally-made "Sirius" loudspeakers from the Philips organisation and have several other pieces of equipment "in the pipeline". From time to time we publish items on Australian-made hi-fi equipment in the "Sound News" pages - keep reading, items of interest will pop up in the future.

If any Australian manufacturers out there would care to submit equipment for review, we'd only be too happy to hear from you.

Dear Editor,

I just loved the April catalogue - but what you had wrapped round it was terrible!

D. Smith
North Ryde, NSW

ETI May 1980 — 87
THE 1980 HOME COMPUTER SHOW

- Personal Computers
- Microprocessors
- Small Business Systems
- Games and Gadgetry

Sydney: Westco Pavilion
At Sydney Showgrounds — just inside main entry gate. Plenty of car parking available on site.

Thursday, May 22, 10.00 a.m.—6.00 p.m.
Friday, May 23, 10.00 a.m.—6.00 p.m.
Saturday, May 24, 10.00 a.m.—8.00 p.m.
Sunday, May 25, 10.00 a.m.—6.00 p.m.

Some display stands may possibly be available and all enquiries can be directed to Home Computer Show, John Kennedy Associates Pty. Ltd., 443 Little Collins Street, Melbourne 3000 (03) 671 377 or in Sydney (02) 918 8174.

SONICS
1980 YEARBOOK
Australia's first comprehensive guide to electronic musical instruments and equipment

ON SALE NOW
ANNOUNCING

68000 DEVELOPMENT SYSTEMS

The EXORmacs Development System for 68000 has just been announced. The system includes 15 slot chassis and power supply, MPU module, memory management module, deBUG module, 128K byte dynamic memory module, and an intelligent floppy disk controller module.

Software includes Structured Macro Assembler/Linkage Editor, screen based editor, symbolic deBUG and a PASCAL compiler.

Peripherals include intelligent CRT console, a 1 Mbyte, two drive double sided floppy disk, and a model 703 (180 CPS 132 column) line printer.

A large number of support modules are also available.

6800/6809 EXORciser Development Systems

The popular EXORciser II Development System is now available in both 6800 and 6809 versions. For those people already owning a 6800 EXORciser or EXORterm Development System, a 6809 upgrade kit is available. Both EXORcisers may be expanded to allow development of the MC6802/MC6808, MC6801/MC6803/MC68701 MC6805.

A wide range of support modules are available, including support modules for PIA, ACIA, SSDA, ADLC, GPIO, CRT controller and universal support module.

High level languages are available for — 6800: BASIC, FORTRAN, COBOL, MPL. 6809: FORTRAN, MPL, PASCAL.

Bulk storage is available on both single and double sided floppy disks. Up to 4 drives are supported.

A 10 Mbyte Hard Disk System is also available with expansion to 40 Mbyte. The Hard Disk System may co-reside with the floppy system to allow easy transfer of old files.

68000 Courses

Rank Electronics has much pleasure in announcing a visit from two leading Motorola lecturers to give courses on the MC68000.

Subjects will include both hardware and software aspects.

Course costs: $250.00 per head for each course.

Dates: Sydney — May 19, 20, 21 and 22.
Brisbane — May 23, 26 and 27.
Adelaide — May 28, 29 and 30.
Melbourne — June 2, 3, 4 and 5.

Hours: Sydney and Melbourne — 9.00 a.m. to 5.00 p.m.
Brisbane and Adelaide — 8.30 a.m. to 7.30 p.m.

For further details and application form please contact:

RANK ELECTRONICS
PTY LIMITED
INDUSTRIAL SYSTEMS
12 Barcoo Street, East Roseville, Sydney 2069.
Phone 406 5666
60 Rosebank Ave, Clayton South, Vic 3169
Telephone 541 8444
299 Montague Road, West End, Brisbane 4101.
Telephone 44 2851
101-105 Moorine Avenue, Camden Park, SA 5038.
Telephone 294 6555
430 Newcastle Street, Perth 6000.
Phone 328 3933
120 Parry Street, Newcastle 2300.
Phone 28 2466

ETI May 1980 — 89
IM-1 Your Life Will Never Be The Same — Two great achievements — a powerful state-of-the-art personal computer and a thrilling home entertainment center in one single package

- User-programmable in BASIC
- With loads of pre-programmed software for educational entertainment and home and personal management
- Features — 9K RAM, 10K ROM
- 53 key typewriter-style

keyboard • 32 characters x 16 line screen format • Alpha numerics in 3 color modes with up to 8 colors • Built-in sound synthesizer with a range of 3 octaves including flats and sharps
- Six function built-in cassette tape deck • 2 game-style handheld controllers • Unique shift key for “BASIC keywords”
- Expandable for floppy disk, printers and more.

$995 inc. colour monitor. Tax paid.

CALCULATOR SUPERMARKET
435 Bourke Street, Melbourne. (03) 67-6412.

RADIO PARTS GROUP
562 Spencer Street, Nth. Melbourne. (03) 329-7888. 1103 Dandenong Road, East Malvern. (03) 211-8122.
All systems go!

VECTOR GRAPHIC SYSTEM B

VECTOR GRAPHIC is a leading American micro-computer manufacturer who has been producing reliable, quality products since 1976. VECTOR GRAPHIC SYSTEM B offers enterprising companies the right hardware for the emerging micro-computer business market. More economical than “big” systems, yet offering wide ranging ability in their market sphere. Whether you’re looking for Hardware for your software products or you want a complete end user turn key system, Vector Graphic has the solution to your needs.

Fully supported in both Software and Hardware in Australia.

- 48K or 64K RAM
- 630K on dual floppy disk drives
- 24 x 80 video terminal
- Time-share multi-user — additional video terminals
- Microstor — extra on-line disk storage
- Vector Graphic DM printer
- Qume letter quality printer
- BASIC, Z80 assembler, debugger, editor
- The industry standard — CP/M
- Optional languages include COBOL, FORTRAN, PASCAL, C etc.
- Accounts payable
- Accounts receivable
- General Ledger
- Inventory Management
- Word Processing

AUSTRALIAN DISTRIBUTOR

DEALER ENQUIRIES INVITED

AJ. & JW. DICKER

24 Woodfield Boulevard, Caringbah, NSW 2229. Phone (02) 524-5639. Telex 70182.

ETI May 1980 – 91
Two local firms win design awards

Two local electronic companies — BWD Electronics of Victoria and Fairlight Instruments of NSW — have been presented with design awards by the Australian Industrial Design Council.

Fairlight Instruments were presented with the Industrial Design Award for development of the Qasar general purpose computer.

This computer features dual 6800 microprocessors in the central processor which enables the machine to think at the same time as it reads or talks to the outside world or the memory. The 6800s are clocked alternately at the maximum rate of 1 MHz and share bus and memory. The resulting speed is effectively more than twice as fast as a conventional micro since delays due to interrupts are avoided. The Qasar applications to date include small business computers, communication data processing, industrial control and music synthesis (the Fairlight Computer Musical Instrument — CMI).

The most striking application of the Qasar is in the CMI, produced by Fairlight, where the speed is fully utilised to control the pitch, harmonic content, and envelope shape of up to eight independent sounds played simultaneously. The sounds may be prerecorded natural sounds stored in the memory, or electronically generated.

The CMI is designed to be programmed by a musician with no knowledge of electronics and this is achieved through the use of a light pen and video display. The musician chooses the pitch of a sound using a separate keyboard with its own microprocessor, he then draws the envelope shape of the fundamental and up to the seventh harmonic on the video screen with the light pen. This modified sound is stored in the memory and can be played on the keyboard at any pitch. The amplitude of the sound is determined by the speed of depression of the key and it repeats until the key is released (sustain').

The CMI includes 210 K of RAM, two double-sided 8" (200 mm) floppy discs, keyboard, VDU and light pen. It sells for about $23 000.

BWD Electronics received the award for the BWD 880 Powerscope on the basis of originality of design and safety of operation.

The Powerscope is an oscilloscope designed for examining waveforms in ac and dc power supply and control circuitry. It features an insulated cabinet which has been tested to withstand over 5 kV and shrouded probes which will accept transients up to 3 kV. The BWD 880 will measure signal levels as low as 100 mV and up to 600 V RMS or in dc supplies to plus/minus 500 V across circuit components directly connected in three-phase powerlines. Maximum measurement range is from 100 mV to 1 kV, with accessories provided to extend this range to plus/minus 2 kV dc or 1.5 kV RMS continuous operation.

A unique feature of the Powerscope, according to BWD, is its ability to provide the user with digital readout of phase angle between a zero crossover reference marker and a variable marker. This can be adjusted from zero degrees to 359 degrees in one degree steps. In addition, the reference marker can be repositioned in multiples of 60 degrees to provide immediate phase angle relationships in two-three-six-phase systems. Time measurement can be made from 100 nanoseconds to 100 seconds with triggering extending from dc to 10 MHz, say BWD. Vertical input bandwidth is specified as dc to 7.5 MHz.

Since its release, the Powerscope has become widely accepted in industry and education, both in Australia and overseas.
Micros invade the office

An exhibition of modern office products, featuring digital and computing equipment, was held in Sydney recently.

Called the ‘Modern Office USA Exhibition’, it was held at the US International Trade Centre in North Sydney over 18-21 March.

We went along to the exhibition armed with the knowledge that Australian companies are expected to spend $612 million a year on office automation by 1982, nearly double the $311 million spent in 1978. We wanted to find out why.

Our most dominant impression at the exhibition was the flood of minicomputers and word processors being sold by many of the 56 US companies and their 24 Australian distributors.

The Remington NBI System 3000 ‘paperwork processor’ was typical of the many word processing machines exhibited at the Modern Office USA Exhibition.

This inexpensive line printer, from MPI, was shown by Sigma International.

In addition, there were microprocessor controlled mail sorters, duplicators, printers, filing systems, communication terminals, etc together with software to re-train the office staff for more productive work after automation has taken over the tedious repetitive jobs.

Unfortunately it’s not possible for us to mention all the products being demonstrated at the exhibition. Sorry.

We were interested in the ‘ultimate computer game’ by Ardac Inc. of Ohio and demonstrated by Scandic International of North Sydney.

The machine is an “electronic note acceptor”. If you win, the computer pays you money but if you lose, you go to gaol! (DO NOT pass go, etc ...) If you are honest the $1 or $2 note acceptor gives you change in 10c pieces so you can carry on playing the pokies with the minimum interruption. But, if you are criminally-minded you are going to have a hard job ‘winning’.

The machine identifies good notes by two methods: first a small spot of light scans the engraving in two places about one-third and then two-thirds up the note and a photodetector produces data pulses as the spot passes over the engraved lines. The spacing of the pulses are compared with those in the memory of the microprocessor.

The notes are then scanned by an infrared absorption detector which checks the composition of the paper and its colour against a pattern in the memory.

We were assured that the machine always pays change for good notes and always spits out the bad ones.

Well ... we shall see, because these money changers are going to be around in many clubs, hotels etc soon, we were told.

Some of the highlights of the exhibition were:

- Vector Graphics and their distributors A.J. and J.W. Dicker of Caringbah, NSW demonstrated their System B and Memorite 2 systems which allow simultaneous word and data processing from up to five independent terminals for under $15 000 (reviewed last month).
- Commodore Business Machines and Hanrex of Brookvale NSW were playing the lunar lander game on their PET computer when I interrupted to enquire about the CBM3000 micro. This series consists of a CPU with 32K of memory plus a 1000 character display and keyboard, dual floppy disk drive and 70 lines/min dot-matrix Printer.
- Aimed at small business users the 3000 series has full software support and on-site maintenance contracts will be taken by STC. It should be good value if you have $10 000 or so to spare.
- International Computers Inc and ICL (Aust) of North Sydney were prominent with their minicomputer System 120. This system has a fast, efficient mini as the processor and new integrated front loading disc drives and microprocessor controlled VDUs and printers. This system should be of interest to medium size business users since it has expansion capabilities of up to 50 output terminals and up to 156M of disc memory.
- Mr. Arun Pande of Sigma International offered to help me, and any potential buyer, through the maze of US computer products being offered in the marketplace. Sigma is the leading US International distributor of microcomputers and peripherals and offers information, US export licence aid, rapid delivery from stock, spare parts, and large discounts from a wide range of products.
- The future developments in office equipment will require even more powerful central processing than the current 8-bit microprocessors offer. Zilog had their 16-bit Z8000 series out of wraps and an evaluation board is available to prospective users.

The board has the Z8000 MPU, 2K EPROM, 16K RAM, 32 I/O lines, four programmable 8-bit counter/timers etc. A great deal of software has been already developed to back up the Z8000 series and this evaluation kit should be invaluable to Australian companies wanting to keep abreast of latest developments in microprocessors.

A fascinating show.

John Pollard.
ELECTRONICS BY MAIL

Z80 SINGLE BOARD COMPUTER

Build your own Z80 based home computer using the ETI/DGZ80 as described in ETI November 1979. Designed by David Griffiths, this is probably the most powerful $100 280 magazine project described to date.

Features include on board P10 (dual 8 bit 1/0), CTC (4 channel programmable counter timer), power on jump, software write protect option, provision for 2K ROM on board, 1K RAM for stack, scratchpad (expandable to 2K) top quality solder masked plated through PCB, sockets for all IC's and comprehensive Owners Manual.

DG Z80 (kit) $199.25
(kit) 175.00 tax exempt.
(assembly) 240.00 tax paid.
(assembly) 215.00 tax exempt.

DGOS OPERATING SYSTEM

Monitor ROM for above DG Z80 strongly recommended for use with DG 640 VDU. Powerful monitor includes tape loading/dumping real time clock, software write protect, memory examine, alter, compare, move and fill commands. 2716 EPROM with listing $48.00.

DG 640, VDU

This has to be the most popular VDU in Australia. Described in ETI March 1978, the DG 640 features 16 lines of characters, upper/lower case with graphics, crystal locked self contained TV scan circuits, top quality plated through PCB with Owners Manual.

DG 640 (kit) $139.50
(kit) 125.70 tax exempt.
(assembly) 149.50 tax paid.
(assembly) 134.25 tax exempt.

NOTE: ALL PRICES INCLUDE SALES TAX (Except where noted)

MAIL ORDERS TO:
PO Box 311, Hornsby 2077.
Please add $2.00 per order towards cost of post and packing.

VOLUME SPECIALS

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN914 diodes</td>
<td>20 for $1.00.</td>
</tr>
<tr>
<td>IN4004 diodes</td>
<td>20 for $1.50.</td>
</tr>
<tr>
<td>RED leds</td>
<td>10 for $1.50.</td>
</tr>
<tr>
<td>555 Timers</td>
<td>4 for $1.00.</td>
</tr>
<tr>
<td>2102 RAMS</td>
<td>8 for $11.25.</td>
</tr>
<tr>
<td>2114 - 450.</td>
<td>2 for $10.75.</td>
</tr>
<tr>
<td>4116 - 300.</td>
<td>8 for $19.50.</td>
</tr>
</tbody>
</table>

DREAM 6802

Described in EA May 1979, this kit has been redesigned to accept the 6802 chip and eliminate the problems with the 6875 IC. The Applied Technology DREAM 6802 includes all IC's, components, keyboard modulator and power supply, together with a comprehensive MANUAL and simple program to run.

DREAM 6802 (kit) $149.50 tax paid.

CRYSTALS

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1MHz</td>
<td>$12.50.</td>
</tr>
<tr>
<td>4MHz</td>
<td>7.95.</td>
</tr>
<tr>
<td>8 MHz</td>
<td>7.95.</td>
</tr>
<tr>
<td>12 MHz</td>
<td>7.95.</td>
</tr>
</tbody>
</table>

(Small stocks of other values.)

ZENER DIODES 1w.

ALL VALUES | $2.50. |
3V3, 3V6, 4V7, 5V1, 6V2, 7V5, 8V2, 9V1, 10V0, 11V0, 12V0, 13V0, 15V0, 16V0, 18V0, 20V0, 22V0, 24V0, 27V0, 30V0, 33V0.

WIRE WRAP

JUST WRAP KIT $32.15.
WSU-30wx. WIRE WRAP TOOL 8.75.
WIRE WRAP WIRE 50 ft. spools (red, black, blue, white) 2.75.
WIRE WRAP TRIPLE PACK DISPENSERS 8.75.

MICROPROCESSOR COMPONENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z80 CPU</td>
<td>$15.75.</td>
</tr>
<tr>
<td>Z80 PIO</td>
<td>9.75.</td>
</tr>
<tr>
<td>Z80 CTC.</td>
<td>9.75.</td>
</tr>
<tr>
<td>2650A.</td>
<td>15.75.</td>
</tr>
<tr>
<td>2608 PIPBUG</td>
<td>15.75.</td>
</tr>
<tr>
<td>2651</td>
<td>19.75.</td>
</tr>
<tr>
<td>2708</td>
<td>12.50.</td>
</tr>
<tr>
<td>2716 (+5V)</td>
<td>45.00.</td>
</tr>
<tr>
<td>2114-450.</td>
<td>5.75.</td>
</tr>
<tr>
<td>2102-350</td>
<td>1.55.</td>
</tr>
<tr>
<td>SC/MP II</td>
<td>9.75.</td>
</tr>
</tbody>
</table>

SOCKETS

<table>
<thead>
<tr>
<th>Port</th>
<th>Solder</th>
<th>Wirewrap</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 pin</td>
<td>.20¢</td>
<td>.46¢</td>
</tr>
<tr>
<td>14 pin</td>
<td>.25¢</td>
<td>.54¢</td>
</tr>
<tr>
<td>16 pin</td>
<td>.28¢</td>
<td>.57¢</td>
</tr>
<tr>
<td>18 pin</td>
<td>.29¢</td>
<td>.60¢</td>
</tr>
<tr>
<td>20 pin</td>
<td>.30¢</td>
<td>.62¢</td>
</tr>
<tr>
<td>24 pin</td>
<td>.35¢</td>
<td>$1.44</td>
</tr>
<tr>
<td>28 pin</td>
<td>.40¢</td>
<td>1.84¢</td>
</tr>
<tr>
<td>40 pin</td>
<td>.50¢</td>
<td>1.90¢</td>
</tr>
</tbody>
</table>

LOW POWER SCHOTTKY

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>74LS00</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS01</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS02</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS03</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS04</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS05</td>
<td>.35¢</td>
</tr>
<tr>
<td>74LS06</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS07</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS10</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS11</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS12</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS13</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS14</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS15</td>
<td>.35¢</td>
</tr>
<tr>
<td>74LS16</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS17</td>
<td>.30¢</td>
</tr>
<tr>
<td>74LS18</td>
<td>.35¢</td>
</tr>
<tr>
<td>74LS19</td>
<td>.35¢</td>
</tr>
<tr>
<td>74LS20</td>
<td>.45¢</td>
</tr>
<tr>
<td>74LS22</td>
<td>.45¢</td>
</tr>
<tr>
<td>74LS24</td>
<td>.45¢</td>
</tr>
<tr>
<td>74LS28</td>
<td>.45¢</td>
</tr>
<tr>
<td>74LS30</td>
<td>.35¢</td>
</tr>
<tr>
<td>74LS31</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS32</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS33</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS34</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS36</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS37</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS38</td>
<td>.50¢</td>
</tr>
<tr>
<td>74LS39</td>
<td>.50¢</td>
</tr>
</tbody>
</table>

RECTANGULAR LEDS

<table>
<thead>
<tr>
<th>Color</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>25c</td>
</tr>
<tr>
<td>GREEN</td>
<td>35c</td>
</tr>
<tr>
<td>YELLOW</td>
<td>35c</td>
</tr>
</tbody>
</table>

MAIL ORDERS TO:
PO Box 311, Hornsby 2077.

OFFICE/SWORROOM:
1a Pattinson Avenue, Waitara 2077.
Hours: 9-5 Monday to Saturday.
Telephone: 487-2711.
Bar code printer

Anderson Digital Equipment have just released the Inter-mec 8220 bar code printer. This unit is a low-cost electronically-controlled serial impact printer which produces high quality, random, batch or sequential runs of CODE 39 (r) labels or tags.

A basic two-line printer, the 8220 prints bar code with an interpretation line and one line of free text. The highly reliable printing mechanism consists of a continuously rotating print drum and electromagnetically actuated print hammers. Solid state devices optically sense print drum position. The appropriate bar code and character images are optimally distributed around the print drum.

Labels and tags are printed by the 8220 using a dry carbon ribbon which produces printed bars with high optical contrast and sharply defined edges of maximum scanability. Data input is through an RS232C interface.

For further information contact Anderson Digital Equipment Pty Ltd, PO Box 322, Mt Waverley, Vic (03) 543-2077 or PO Box 294, Ryde NSW, (02) 808-1444.

SMUG Club

The Sord Microcomputer Users Group announced their formation recently.

They are actively seeking members with a view to getting into all the usual club-type activities.

Prospective members and interested persons are asked to contact:
Emmanuel Cargakis
4/8 Clarkson Avenue
Brighton Vic 3186

New LEDs from HP

Backlighting large surface area annunciator messages is now easily possible by using a new family of light emitting diode light bar modules from Hewlett-Packard.

These new modules provide large, bright and uniform light emitting surfaces and come in sizes 9 mm square and 9 mm x 19 mm surface areas. Other packages have multiple surface areas and come in red, yellow and green.

These modules will be useful for illuminating legends, indicators, bargraphs and switches. Prices range from $1.96 for the small package to $2.87 for the large one.

Further information can be obtained from Cema Electronics Pty Ltd, 21 Chandos Street, St Leonards NSW, or from Hewlett-Packard direct.

New utility for keyboard intelligence.

A new CP/M utility has been specially written to convert any keyboard into an intelligent keyboard.

The program, written by Dennis Riepon of AED, is similar to DESPOOL in that it loads automatically below the CCP. It is compatible with all versions of CP/M and operates correctly with XSUB and DESPOOL.

Price is about $25 and further information can be obtained from Acoustic Electronic Developments Pty Ltd, 123 Military Rd, Guildford NSW 2161. (02) 632-6301.

Perth computer club

A Perth computer club has been hiding its light under a bush.

The club has been active for about five years and has now 100 active members and 100 members who only play computer games. The club room, in the Undergraduates' Guild building of the University of Western Australia, is open about 23 hours per day and offers the use of two computers.

Occasional classes are held on Saturday mornings for learning about software and the use of computers.

Further information can be obtained from the University Computer Club, room 2.17 Guild Building, c/o The Guild of Undergraduates of Western Australia Crawley WA 6009. (09) 380-2297.

New recorder for Digital

Epicom Inc of the USA has released its model El 200 epilpape recorder here through the Dindima Group.

This unit is a fully portable system capable of recording digital communications data regardless of the line discipline in force at speeds up to 960 bps. Without control and status recording the unit can handle a speed up to 19 200 bps.

A four-digit tape position indicator allows precise location of communications errors.

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

ETI May 1980 — 95
Now the business professional has an extra-ordinary programmable calculator from Texas Instruments.

Powerful but simple
The TI-59 gives you so much problem solving power it’s almost like a handheld computer. Yet it’s extremely easy to use.

Just plug in expertly designed programs
You can slip a pre-written programme module in your TI-59 calculator and instantly transform it into a sophisticated application computer. There’s a tool kit of pre-programmed solutions to a wide variety of problems. TI’s plug-in Solid State software libraries have been designed by professionals for use with your TI-59. Containing up to 5,000 programme steps to solve both routine and complex problems these libraries include:
- Applied Statistics
- Business Decisions
- Securities Analysis
- Real Estate/Investment
- And many others. For instance Marine Navigation and Aviation are commercial programmes you can also use for your time away from the office.

An aid throughout your business
The problem solving capacity of the TI-59 can be used right across your company. Sets of programmes for specialists in many areas are available in speciality packages and include:
- Marketing Sales
- Production Planning
- Programming Aids
- Oil/Gas/Energy
- Statistical Testing
- Securities Analysis

Programming is so simple
You can use pre-designed programmes, write your own, or incorporate both. With the TI-59’s advanced technology YOU CAN MODIFY AND EDIT YOUR PROGRAMMES AND STORE THEM ON MAGNETIC CARDS FOR RE-USE.

You’ll use the TI-59 continuously in business decisions
For instance the problem solving capacity of its 100 memories or 960 programme steps is invaluable for budgets, statistical analysis, stock options and chain calculations. And you can turn TI-59 into a printer-calculator which prints, lists and traces your programme with the PC-100C printer/plotter accessory.

And at $349.00 the TI-59 costs so little while your optional PC-100C printer/plotter accessory is just $285.*

Examine TI-59’s many remarkable features.
YOU CAN USE IT’S PROBLEM SOLVING POWER NOW.
Eight code bar reader

A new code bar reader has been released by Anderson Digital Equipment Pty Ltd which can read up to eight popular bar codes.

The unit comes complete with an Intermec model 1236 light pen but other wands are also available. The unit is small in size to save work space (229 mm x 152 mm x 25 mm) and can be easily mounted on the underside of a work table.

The model 9300 ranges in price from $1090 to $1485 depending on the choice of wand or scanner and further information can be obtained from Anderson Digital Equipment Pty Ltd, P.O. Box 322, Mt Waverley Vic 3149. (03) 543-2077.

Static ROMS from National

A complete family of static 16K, 32K, and 64K ROMS with JEDEC approved pin configuration is now available from the National Semiconductor Corporation.

All are TTL compatible and operate from a 5 V supply and are available in 24 pin packages.

Further information and prices can be obtained from N.S. Electronics, P.O. Box 89, Bayswater Vic 3153, (03) 729-6333.

Bulky store for the PDP-15


The BC-205 is compatible with the DEC RF15/RS09 fixed head disk system and is completely software compatible with the standard operating systems and RF-11 diagnostics used on the PDP-15.

The bulk core system, functioning as a fast access peripheral, can provide dramatic improvements in system handling to bring the PDP-15 more in line with the performance of currently available minicomputers.

Cost varies from $32 125 for the minimum 256K words to $63 500 for a full megaword (1024 x 18).

Further information may be obtained from Anderson Digital Equipment Pty Ltd, P.O. Box 322, Mt Waverley Vic 3149 (03) 543-2077.

TR80 OWNERS!! FREE WITH NEWSLETTER

L2 cassette (1 Game, 1 Business) to celebrate 1½ years. Subscription $12/year. Write Box 105, Marrickville 2204.

16K Level 2
Adventure Land 16.00
Adventure Pirates 16.00
Air Raid 16.00
Airport 9.00
Atlantic Balloon Race 16.00
Backgammon 15.00
Barcade 16.00
Baseball 3.00
Bingo 7.00
Barricade 7.00
Beat Up 7.00
Breakaway 7.00
Bridge Challenger 16.00
Cribbage 9.00
Checkers 9.00
Dogtrap 11.00
End Zone 9.00
FASTgammon 16.00
Galaxie Blockade 9.00
Ham Radio 7.00
Hangman 7.00
Kabob 7.00
Keno & Game of Life 14.00
Kentucky Derby 14.00
L2 Games (Starrware etc.) 12.00
Lunar Lander 9.00

Mastermind 9.00
Mission Impossible 16.00
Othello 7.00
Pentominoes 11.00
Pong 11.00
Remainder 9.00
Robots 7.00
Round the Horn 11.00
Safety 9.00
Santa Parisa 9.00
Sims 9.00
Space Battle 16.00
Startrek 3.3 16.00
Tablus 11.00
Team Cards 11.00
Tip Bowling 9.00
Time Bombs 8.00
Treasure Hunt 9.00
Tycoon 7.00
X-Wing Fighter 9.00
Warfare 1 9.00
Accoutrements Reversible 28.00
Appleton 11.00
Infinity Basic 9.00
Inventory Control 13.00
Inventory (Mod) 21.00
Inventory (FPI) 11.00
KVP Extender 28.00
Linear Programming 9.00

Basic Statistics 21.00
Bilogy/Chem 6.00
Calendar Functions 9.00
Calculator 4.00
Cash Register 11.00
COPY System tape 15.00
Electronics Assistant 9.00
Electronic PRINTER 105.00
ESB Testset 7.00
File Handling 9.00
Finance (Interest/Invest) 9.00
Fourier Transforms 9.00
GSS-Fast Sort 25.00
General Accounting 16.00
Ham Radio 11.00
Income Tax 11.00
Infinite Basic 50.00
Infinite Business 20.00
Infinite Graphics 13.00
Inventory (Mod) 21.00
Inventory (FPI) 11.00
KVP Extender 28.00
Linear Programming 9.00
L2 Inspection Course 25.00
Micro Test Editor 11.00
Mortgage Calculator 9.00
Math Drill 9.00
Numerical Integration 5.00
Personal Finance 11.00
Pre Flight 21.00
Remodel 16, 32 or 48K 25.00
Remodel 16K 25.00
Remodel & Prolong 25.00
RSM-2 Monitor 25.00
Root Finder 9.00
Statistics I 11.00
Statistics II 11.00
Statistics III 11.00
Technology 11.00
Timers Curve Fitting 15.00
Trailing Package 9.00
TR 80-260 Conversion 16.00
Disk 10.00
Osborne/McGraw-Hill Complete INTEGRATED BUSINESS ACCOUNTING System, Accs Rec/Accounts Pay/Gen/LED/Cash Journal/Text books/400.00
Invoices 100.00
Advanced Personal Finance 26.00

Amateur Radio System 26.00
Comproci 20.00
Compu 35.00
DCV-1 10.00
ELECTRIC PENCIL 155.00
Final Approach/Space Station 26.00
Infinite Basic 50.00
Infinite Business 50.00
Inventory 2.2 50.00
Inventory 3.3 80.00
KVP Extender 30.00
Mall List R 99.00
NEW DISCO 99.00
RSM 20 Monitor 30.00
ST-9K 80.00
Test-RO 80.00

Books
Osborne/McGRAW-HILL Complete INTEGRATED BUSINESS ACCOUNTING System, Accs Rec/Accounts Pay/Gen/LED/Cash Journal/Text books/400.00

Hardware (Prices incl S/T)
10 Verbatim Discs 46.00

Agents for: TSE, MA, Racet, SSS

PITT ST. MICROCOMPUTERS Box A344 Sydney South, Pitt St, Sydney 2000. Ph 569-8228.

ETI May 1980 – 97
OHIO SCIENTIFIC TECHNOLOGY TODAY

OHIO SCIENTIFIC

(HSI) HARDWARE
8K Expansion board, complete, less RAM. Daisy chains to 40K RAM.
Assembled and tested .................................................. $135
Kit .................................................................................. $120

INTRODUCTORY OFFER
- FREE -
40 wire lead — value $19.95

OHIO SOFTWARE
See March '80 ETI for price list of 47 varied software programs.
All 4K except E.7

NEW PROGRAMS
Games:
G.24 Worms ................................................................. $6.95
G.25 Alien Invaders ..................................................... $8.95
Education:
E.6 Reflex .................................................................. $7.95
E.7 Physics — Rutherford's Experiment, 8K ........................ $15.95
Utilities:
U.11 Dumb Terminal Program ..................................... $8.95
U.12 Machine Code Life .............................................. $9.95
U.13 Tick Tock .............................................................. $7.95
U.14 Word Processor, WP-6502 (Global Edit, Cursor, TAB, etc) $99.00
Business:
B.1 Small Business Analysis ......................................... $15.95
B.2 Personal Loan Analysis ........................................... $8.95
B.3 Stock Portfolio ....................................................... $9.95
Display:
D.1 Kaleidoscope and Magic Square ............................. $9.95
Instructions:
I.10 Reverse Video Instructions .................................... $3.00
Catalogue:
C.1 Brief outlives of the above programs, including
previous list. Free Nets on programming and use of OSI computers are
included ................................................................. $2.95

APOLOGY — U.8 Cursor Control was incorrectly advertised at $5.95. It should have been $9.95. We are sorry for any inconvenience caused by this error.

Notes — All tapes have two copies of the program, one on each side. Printed listing is also included. 'Tone' and 'Volume' controls may need adjusting. Both FULL 'SAVE' and 'LOAD' is usually best.

MAIL ORDER:
LOOKY VIDEO, PO Box 347, Richmond, Vic. 3121.
Allow postage eg OSI Software
1 or 2 $1; 3-5 $1.50; 6-10 $2; 10 or more $2.50.

THE BYTE SHOP
Telephone (062) 81-5011
PO Box 116, Mawson ACT 2607
29 Colbee Court, Phillip

98 - May 1980 ETI
The Challenger 4

Whichever way you look at it, no other computer offers so much for so little, and in colour!

Full 53 key, keyboard which in polled mode can recognise up to 8 simultaneously depressed keys.

Inside: real time clock and countdown timer 24K memory 6502A processor

Control line interfaces, parallel lines for home security, accessory BUS, parallel I/O lines or other TTL signals.

Joystick sockets – add realism to games.

Sound outputs, programmable tone generators – 8 bit companding digital to analog convertors.

A real time clock and countdown 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!

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.

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

TCG Ohio Scientific Pty. Ltd.

31 Hume Street, Crows Nest, N.S.W. 2065

Phone: 439-6477

ETI May 1980 – 99

TCG Ohio Scientific Pty. Ltd.

31 Hume Street, Crows Nest, N.S.W. 2065

Phone: 439-6477
Complete Computer System on a Board!
20% OFF
Current Retail Price
THIS MONTH SPECIAL $311.00*

OHIO SCIENTIFIC
Superboard II
including full ASCII II keyboard, video display interface, audio cassette interface, 8K Basic-in-ROM and 4K RAM on board can be expanded up to 8K RAM on board.

CARD READER for
APPLE II, TRS 80 or
COMMODORE PET $825.00*
S-100 or RS 232C $985.00*

MR500
Mark Sense Card Reader
Enter programmes and data into your Microcomputer.
Any length card can be used.
VERY FAST, the MR 500 can read a 40 column card in just 1/4 second!
Price includes card reader and interface.
Specify interface required when ordering.
Cards are available.

Send Order and Payment (Cheque or Money Order) direct to –
THE ELECTRONIC CIRCUIT
Suite 414, 4th Floor, Fashion Valley Building, 20 Duncan Street, Fortitude Valley,
Brisbane, Qld. 4006. P.O. Box 2, Broadway, Q. 4000. Telephone: 52 8455

*Cottages Computers
386 QUEENS Pde., FITZROY NORTH Victoria 3068 (03)481 1975

Acorn

****The EUROCARD 6502 Based system from England......Expandable.... Convenient Modular parts......

uControllers from $110, Memory Cards, Software, and User Manuals available

System 2 from $954,
Systems also available
Fully Assembled&Tested

ACORN System 3
With F/Disk
Kit: $2199.40+S/Tax(15%)
Update on the S-100 bus

What with the arrival of 16-bit micros and the increased demands being placed on computer systems, the S-100 bus has had a grease and oil change...enter at sINP, exit at sOUT you'll know what it's all about!

Les Bell

THE ALTAIR 8800, which introduced personal computers, has long disappeared from the market, but its ghost lives on in the form of the Altair (now renamed S-100) bus which linked its various printed circuit boards together. When the S-100 bus was designed, the only second-generation microprocessor available was the Intel 8080, and the bus was designed around the signal definitions and timing of this particular microprocessor.

Today, things have changed considerably. The 8080 is, itself, rather passe, and most recent processor card designs have been based on the Z-80, 8085 and 6809. In the last few months, too, a new range of 16-bit processors have appeared on the market, and manufacturers have been eager to shoehorn these big machines into what was designed as an 8-bit bus. For these reasons, in order to maintain compatibility with existing S-100 cards (why else go S-100?), it has become necessary to closely specify the functions of the S-100 signals, together with their timing, as well as extend the bus to handle the 16-bit data and 24-bit address buses of the new processors.

A subcommittee of the IEEE Computer Society Microprocessor Standards Committee, led by George Morrow (Thinkertoys), Howard Fullmer (Parasitic Engineering) and Kells Elmqist (Intersystems), has been working on the definition of the bus for some time now, and has published two reports in the IEEE Computer magazine for comment before the final proposal is submitted to the IEEE Standards Board. Reprints of the latest article, in the July 1979 issue of Computer, are available from the IEEE, 345 East 47th Street, New York, NY 10017, for US75c plus postage.

The proposed S-100 standard is listed in Table 1. Note: this is still a preliminary draft and is subject to change. The other point is that it isn't as simple as it looks — this only shows which signal is on which pin, and briefly what its function is. It does not show the protocol for interchanging between bus masters, for sixteen-bit data interchanges and the other subtleties and complexities appertaining to the bus.

Changes, always changes

From a purely mechanical viewpoint the major change brought about by the new standard is the redefinition of some of the old S-100 signals. Pin 98, for example, is no longer SSTACK, an output from the processor that indicates when it is accessing the stack. Instead, it is an input to the processor which indicates a parity, or similar, error in the current bus cycle. Owners of old CPUs which generate SSTACK who buy parity-checking memory will have to disable one of these functions.

Other signals have also disappeared — and a good thing, too, as the redundancy of the old bus was the source of many of the incompatibility problems the new standard will solve. It is left to the reader to make a comparison with the old standard — if you own a system and wish to upgrade and take advantage of the new facilities you'll have to acquire a fairly thorough understanding of the bus operation anyway.

The biggest change that is obvious from the pin list is the addition of an extra eight address lines, A16-A23. These enable S-100 systems to take advantage of the large addressing range of the new 16-bit micros without inelegant paging schemes. Now systems can include multiple 64K memory boards without the need for bank select software, and memory can be accessed faster.

The next big change in the specification is the introduction of a protocol for the transfer of 16-bit words...
When a 16-bit CPU card wants to read a 16-bit value (or instruction) from memory, it puts out the required address and control, status, etc signals, and also pulls the SXRQ line low. This indicates to the memory card (if it is 'listening') that the CPU is willing and able to conduct a 16-bit data transfer. If the memory is able to do the same, it signals this fact by pulling the SIXTN line low. If it is an 'old' card which does not examine the SXRQ line, then nothing will happen on SIXTN, obviously.

If the memory is 16-bit oriented, it will enable its tristate output buffers onto both the DI and DO buses, and the CPU will accept inputs from both these buses. In effect, the DI and DO buses are paralleled into a 16-bit bidirectional data bus. On memory write cycles a similar procedure is followed, except that this time the processor board will enable bus buffers onto the DI and DO buses, and the memory board will accept input from both. The combined buses, when used in this way, are referred to as the DATA bus.

If the memory is only eight bits wide, then the CPU board must split the word into two bytes and transfer them singly in the conventional manner. This is fairly simply achieved by using the bus buffers as a multiplexer, at the expense of some PCB real estate for the extra buffers and the SXRQ/SIXTN control logic.

**Methodology**

The other major change to the S-100 bus is simply the fact that it is now tightly specified, its terminology is defined and there is now a methodology for the design and implementation of equipment for the bus.

The bus is organised into eight sets of signals: the address bus (24 lines), the data bus (16 lines), the status bus (8 lines), the control output bus (5 lines), the control input bus (6 lines), the DMA control bus (8 lines), the vectored interrupt bus (8 lines) and the utility bus (20 lines). These buses carry two types of information: messages used to manage the interface system itself, called interface messages; and messages between boards connected to the bus that are not concerned with the bus itself (i.e.: data). These are called device dependent messages.

The bus connects two different types of device: a bus master, and a bus slave. The master has control of the signals on the bus and is able to address slaves and communicate with them. A slave on the other hand, monitors all bus cycles, can be addressed by a master, and can communicate with masters. In general, a slave can communicate only when addressed (i.e. 'speak when it's spoken to').

**Addressing**

Not only has the address bus been extended to 24 bits for memory accesses, but the I/O addressing range has been extended to 64 K, since the extended I/O device address bus is 16 bits wide. Note that processors are not obliged to make use of the extended address range — they can supply only the standard (i.e.: 'old') address bits if required.

The eight status lines indicate what kind of bus cycle is in progress. The mnemonics for these lines always begin with a lower case 's'. They are: sMEMR (memory read), sM1 (opcode fetch), sINP (input), sOUT (output), sWO (write — true on both memory and output writes), sINTA (interrupt acknowledge), sHLTA (halt acknowledge) and sXRQ (16-bit data transfer request). Note that there is no memory write signal, and this must be derived by the following logic equation:

\[
\text{sMemory Write = sOUT}. sWO
\]

That is, status memory write is true when sOUT is false and sWO is true (sWO is at logic 0).

The five lines of the output control bus are: pSYNC (start of a new bus cycle), pSTVAL (indicates stable address and status signals), pDBIN (read strobe), pWR (write strobe) and pHLDA (hold acknowledge). Note that the names of the output control lines all begin with a lower case p.

There are six input control lines. RDY and XRDY are inputs which cause the processor to generate wait states until both these inputs are asserted, to wait for slow memory for example. INT and NMI are the interrupt inputs to the processor. The HOLD line is used by temporary bus masters to request control of the bus from permanent bus masters. The sixth control input is SIXTN, which has been covered earlier.

The eight vectored interrupt lines are used in conjunction with the vectored interrupt request, INT, to arbitrate among eight levels of interrupt priorities. This can be done by a vectored interrupt controller either on the CPU board or on a separate card.

Eight lines are used for control of DMA (direct memory access) operations. In a DMA data transfer, the CPU relinquishes control of the bus to another (temporary) bus master, which performs the data transfer and then returns control to the CPU. Some types of floppy disk controller, for example, use DMA data transfer, and therefore qualify as temporary bus masters. Under the S-100 bus DMA protocol, a temporary master which wants to gain control of the bus will examine the four bus arbitration priority lines (DMA3 — DMA0) to see if another temporary master is already asserting a higher priority — if one is, then no attempt should be made to gain the bus until the higher priority temporary master has been serviced. Otherwise, it should output its priority on the bus and assert the HOLD line. The master will then return the PHLD signal, and the bus can be transferred to the temporary master.

The transfer of bus control is a rather tricky procedure, as both the permanent bus master and the temporary bus master must drive the bus at the same time, in a defined manner, so as not to generate false bus cycles. The bus transfer control circuit asserts ADSB, SDSB and DODSB, thus disabling the address, status and data output buffers of the permanent master and enabling the control output buffers of the temporary master. Both masters are now driving the control output bus at the same time, in a predefined state. Finally, the bus transfer circuit asserts CDSB, disabling the permanent master’s control output buffer, and the temporary master now has control of the bus.

Once the temporary bus master has completed its business, bus control is transferred back to the permanent master by, basically, the mirror image of this process. The bus definition allows for up to 16 temporary masters on the bus, so there is plenty of scope for multiprocessor schemes!

**The utility bus**

The utility bus includes all the other unrelated signals. There are the power lines, which are the same as before, with the addition of some extra ground lines. The system clock is no longer split into two phases, and is always generated by the permanent master. This clock controls the timing bus cycles, whether controlled by a permanent or temporary bus master.

The CLOCK signal, on the other hand, is a 2 MHz signal which bears no relation to any other bus signal, and is intended to be used by clocks, timers, baud rate generators, etc.

There are three system reset
Table 1 – The S-100 Bus Signal Definitions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal Name and Type</th>
<th>Polarity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16 V (B)</td>
<td>H</td>
<td>Supply</td>
</tr>
<tr>
<td>2</td>
<td>16 V (B)</td>
<td>H</td>
<td>Supply</td>
</tr>
<tr>
<td>3</td>
<td>VTG</td>
<td>L O.C.</td>
<td>Vectored interrupt line 1</td>
</tr>
<tr>
<td>4</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>5</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>6</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>7</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>8</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>9</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>10</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>11</td>
<td>VIT</td>
<td>L O.C.</td>
<td>&quot;</td>
</tr>
<tr>
<td>12</td>
<td>+5V</td>
<td>H</td>
<td>Power pin</td>
</tr>
<tr>
<td>13</td>
<td>12V</td>
<td>L O.C.</td>
<td>Non-maskable interrupt</td>
</tr>
<tr>
<td>14</td>
<td>PWRFAIL</td>
<td>L O.C.</td>
<td>Power fail bus signal</td>
</tr>
<tr>
<td>15</td>
<td>A18</td>
<td>H</td>
<td>Temporary master priority bit 3</td>
</tr>
<tr>
<td>16</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 18</td>
</tr>
<tr>
<td>17</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 17</td>
</tr>
<tr>
<td>18</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 16</td>
</tr>
<tr>
<td>19</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 15</td>
</tr>
<tr>
<td>20</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 14</td>
</tr>
<tr>
<td>21</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 13</td>
</tr>
<tr>
<td>22</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 12</td>
</tr>
<tr>
<td>23</td>
<td>A18</td>
<td>H</td>
<td>Extended address bit 11</td>
</tr>
<tr>
<td>24</td>
<td>D10</td>
<td>H</td>
<td>Extended address bit 10</td>
</tr>
<tr>
<td>25</td>
<td>D10</td>
<td>H</td>
<td>Extended address bit 9</td>
</tr>
<tr>
<td>26</td>
<td>D11</td>
<td>H</td>
<td>Extended address bit 8</td>
</tr>
<tr>
<td>27</td>
<td>D12</td>
<td>H</td>
<td>Extended address bit 7</td>
</tr>
<tr>
<td>28</td>
<td>D13</td>
<td>H</td>
<td>Extended address bit 6</td>
</tr>
<tr>
<td>29</td>
<td>D14</td>
<td>H</td>
<td>Extended address bit 5</td>
</tr>
<tr>
<td>30</td>
<td>D15</td>
<td>H</td>
<td>Extended address bit 4</td>
</tr>
<tr>
<td>31</td>
<td>D16</td>
<td>H</td>
<td>Extended address bit 3</td>
</tr>
<tr>
<td>32</td>
<td>D17</td>
<td>H</td>
<td>Extended address bit 2</td>
</tr>
<tr>
<td>33</td>
<td>D18</td>
<td>H</td>
<td>Extended address bit 1</td>
</tr>
<tr>
<td>34</td>
<td>D18</td>
<td>H</td>
<td>Extended address bit 0</td>
</tr>
<tr>
<td>35</td>
<td>D24</td>
<td>H</td>
<td>Data out bit 16</td>
</tr>
<tr>
<td>36</td>
<td>D25</td>
<td>H</td>
<td>Data out bit 15</td>
</tr>
<tr>
<td>37</td>
<td>D26</td>
<td>H</td>
<td>Data out bit 14</td>
</tr>
<tr>
<td>38</td>
<td>D27</td>
<td>H</td>
<td>Data out bit 13</td>
</tr>
<tr>
<td>39</td>
<td>D28</td>
<td>H</td>
<td>Data out bit 12</td>
</tr>
<tr>
<td>40</td>
<td>D29</td>
<td>H</td>
<td>Data out bit 11</td>
</tr>
<tr>
<td>41</td>
<td>D30</td>
<td>H</td>
<td>Data out bit 10</td>
</tr>
<tr>
<td>42</td>
<td>D31</td>
<td>H</td>
<td>Data out bit 9</td>
</tr>
<tr>
<td>43</td>
<td>D32</td>
<td>H</td>
<td>Data out bit 8</td>
</tr>
<tr>
<td>44</td>
<td>D33</td>
<td>H</td>
<td>Data out bit 7</td>
</tr>
<tr>
<td>45</td>
<td>D34</td>
<td>H</td>
<td>Data out bit 6</td>
</tr>
<tr>
<td>46</td>
<td>D35</td>
<td>H</td>
<td>Data out bit 5</td>
</tr>
<tr>
<td>47</td>
<td>D36</td>
<td>H</td>
<td>Data out bit 4</td>
</tr>
<tr>
<td>48</td>
<td>D37</td>
<td>H</td>
<td>Data out bit 3</td>
</tr>
<tr>
<td>49</td>
<td>D38</td>
<td>H</td>
<td>Data out bit 2</td>
</tr>
<tr>
<td>50</td>
<td>D39</td>
<td>H</td>
<td>Data out bit 1</td>
</tr>
<tr>
<td>51</td>
<td>D40</td>
<td>H</td>
<td>Data out bit 0</td>
</tr>
<tr>
<td>52</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>53</td>
<td>+5 V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>54</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>55</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>56</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>57</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>58</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>59</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>60</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>61</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>62</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>63</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>64</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>65</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>66</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>67</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>68</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>69</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>70</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>71</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>72</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>73</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>74</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>75</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>76</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>77</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>78</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>79</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>80</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>81</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>82</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>83</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>84</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>85</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>86</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>87</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>88</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>89</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>90</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>91</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>92</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>93</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>94</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>95</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>96</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>97</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>98</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>99</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>100</td>
<td>+5V</td>
<td>H</td>
<td>Reserved for future use</td>
</tr>
</tbody>
</table>

functions — RESET clears all bus masters, SLAVE CLR resets all bus slaves, and POC, which also asserts the other reset signals, indicates a power-up condition...

The PHANTOM line is used to locate two slaves at a common address — for example, a small block of ROM in the middle of a 64K RAM card. When PHANTOM is asserted, the RAM would be disabled and the ROM enabled, although they share the same address.

The PWRFAIL line indicates an impending power failure, enabling the processor, if suitably equipped, to save its status in a backup store such as CMOS RAM.

Three lines are not to be defined, and these are available for use by manufacturers, provided they are only implemented as options and provided with jumpers to eliminate possible conflicts.

Timing

The bus is specified at up to 6 MHz clock speed, but most users will be pushing to get there. Some microprocessors are specified up to 8 MHz clock or higher, and these will probably use single-board computer configurations.

The basic bus cycle timing was originally derived directly from that of the 8080 processor, and so a basic understanding of the bus timing can be obtained from the relevant sections of the 8080 Microcomputer Systems User's Manual. In fact, almost all current 8080-based boards meet the timing specs without modification (excepting the bus master transfer and 16-bit operation, of course).

The bus is pseudo-synchronous in operation; the timing of the control signals bears a specified relationship to the master system clock. Each bus cycle accomplishes the transfer to one word (16- or 8-bit) between a master and slave, with the exception of master transfers. The beginning of a new bus cycle is indicated by the rising edge of the pSYNC signal, and shortly after this, the address and status buses will change their values for the new bus cycle. Shortly after they stabilise, the status valid strobe, pSTVAL, will indicate to all bus slaves that the address and status may be picked up from the bus.

Generally, bus cycles are either read or write cycles. There are four types of read cycle — opeco fetch (M1 in 8080 terminology), memory read, input and interrupt acknowledge. These cycles are all similar in timing but use the status bus in different ways. Write cycles — output or memory write — are basically similar.
Computers have come a long way...

Gone are the days when they occupied a large room and needed an electronics degree to operate. Gone are the days when all they did was play games.

Today's small business computer occupies a tiny desk top, and can be used by virtually anyone. It can handle your business accounts, keep track of stock movements, store valuable records & data, control repetitive processes...all this and much more; faster and more efficiently than you're doing it at present.

It can also give your secretary new skills in 'Word Processing' - the latest development in efficient office communications.

And this is just the beginning! New programs, new uses are being developed all the time. And the good news is the computer you buy today won't be obsolete tomorrow: you can use these new programs in your existing computer.

A small business needs a computer just as much as a large business. You will find it one of the best investments you ever made. Why not give it a go?

A business computer doesn't cost: It pays!

**INTRODUCING: The SORCERER Business Computer System**

**SORCERER COMPUTER**

Powerful 16k memory (expandable to 48k within minutes) with standard "typewriter" keyboard & numeric keypad. S-100 bus compatible, comes complete with 8K standard BASIC cartridge. Standard RS232C bus (not S-100). Powerful 16k memory (expandable to 32K/64K usable). Space-age cartridge. Standard RS232C bus (not S-100) bus. Powerful 16k memory (expandable to 32K/64K usable) with standard "typewriter" keyboard & numeric keypad.

**Cat X-3001**

$1395.00

**VIDEO MONITOR**

An economical way to store data. Connects directly to computer, record and play back. Quality "National" brand.

**Cat X-1196**

$149.50

**CASSETTE RECORDER (not illustrated)**

An economical way to store data. Connects directly to computer, record and play back. Quality "National" brand.

**Cat X-4095**

$79.95

**S-100 EXPANSION SYSTEM**

Allows use of disk storage (new right) plus input & output devices made by hundreds of manufacturers. ($-100 bus is a world standard system of computer interfacing.)

**Cat X-3101**

$499.00

**TERMS/LEASING AVAILABLE TO APPLICANTS. JUST ASK!**

**BUSINESS PROGRAMS:**
At last! 3 different programs on diskettes to help your business.

- Accounts payable statements by day & by date. Cash requirements, vendor invoices, statements by day.
- Accounts receivable statements by customer and by date. Cash requirements, invoices, statements by day.
- Trial balances, balance sheet, journal of transactions, profit & loss statement.

**MICROPAY** Accounts payable statements by day & by date. Cash requirements, vendor invoices, statements by day.

**MICROLG** Accounts receivable statements by customer and by date. Cash requirements, invoices, statements by day.

**MICROREC** Trial balances, balance sheet, journal of transactions, profit & loss statement.

**Cat X-3701**

**S-100 EXPANSION SYSTEM**

Allows use of disk storage (new right) plus input & output devices made by hundreds of manufacturers. ($-100 bus is a world standard system of computer interfacing.)

**Cat X-3101**

$499.00

**TERMS/LEASING AVAILABLE TO APPLICANTS. JUST ASK!**

**WANTED TO KNOW MORE? See the Computer Manager at any of our stores below or ring our head office (02) 888 3200 and ask for the Computer Products Manager.**
ALMOST ALL MICROPROCESSORS are manufactured using an n-channel MOS process, and this means that their on-chip output buffers are only capable of driving one TTL load and a few pF of capacitance. While this is sufficient to drive the outputs of a few memory and I/O chips directly (provided they are also MOS), it is certainly not adequate for bigger systems. A typical single-board controller based on the 8080A is shown in Figure 1, which shows that the low-order address lines only go to four MOS devices while the top six address bits go only to one address decoding device (although even this is redundant in such a small system).

When the processor, RAM, ROM, I/O and special functions are on separate cards, joined by a TTL-level bus of fairly large physical dimensions, several problems arise. Firstly, in a 22-slot motherboard, the processor card may have to drive up to the theoretical maximum of 540 memory chips (assuming 20 cards each carrying 32 memory ICs). While this is an extreme example, someone, somewhere will probably want to do it!

Secondly, a large motherboard is around 460 mm long, which results in fairly large capacitances between adjacent tracks. In addition, this capacitance, coupled with the inductance of the tracks, will make the bus behave like a transmission line, with reflections from the end opposite the processor. Perhaps, as processors get faster, an SWR meter will become a standard part of the computer hacker's toolkit?

For these reasons, it becomes necessary to buffer the outputs from the processor, as well as the inputs to memory and other cards.

However, you can't just connect the straight TTL outputs of the various cards directly onto the bus in a parallel arrangement. It is not sensible to connect together the outputs of two TTL gates; if one goes high and the other goes low, the output voltage will be indeterminate, and even worse, a large current will flow through the totem-pole output circuitry of both devices, resulting in the possible destruction of one or both.

Two types of TTL devices do not suffer from this limitation. The first is open-collector TTL, in which the output circuit of the IC is an open-collector transistor. With this type of chip, several collectors can be tied together, to a common pull-up resistor, which is typically 2kΩ in value. In this case, the gates can only pull the output down, not up, and the output will only be high if none of the gates is pulling down. This is actually a NOR function, and the circuit is sometimes called a 'wired-OR'.

Open-collector logic was very popular with logic designers in the early seventies, but has now fallen from grace because of its three problems. Firstly, it is slow. When the output transistor is off, its collector junction looks like a capacitor and this has to charge through the pull-up resistor on a zero-to-one transition. Secondly, noise increases as gates are wired-ORed. And thirdly, it is difficult and frustrating to fault-find, as one defective gate will make the whole circuit appear faulty.

The best type of logic circuit for bus circuitry is Tri-State logic (commercial break = Tri-State is a trademark of National Semiconductor). The output of a tri-state IC can assume three different states - logic 0, logic 1 or a high impedance state, in which the output is effectively disconnected from the following circuitry. Apart from the 'true' complements of inputs, tri-state gates also have an output enable pin (usually pulled high to assert it true, i.e.: OE). When this pin is at logic 1, the output is enabled and the IC behaves like a usual TTL, but when it is low, the output goes to the high impedance state.

The 74LS04 pin of the data out buffers on memory cards is usually driven by a signal derived from the address decoder circuitry of the card in conjunction with the control bus signals which indicate that a memory read cycle is in progress. The control signals for buffers on other cards are derived in a similar way. On the processor card, the data, address and control bus buffers must be tri-stable to enable temporary bus masters such as DMA controllers to take over the bus.

Some bus signals are negative logic signals, that is they are true when the signal line goes to logic 0. The reason for this is largely historical, and derives from the fact that negative logic on bus lines can then be implemented using open-collector logic. This also gives slightly better noise margins, and improved timing leeway, since inverting buffers are slightly faster than non-inverting types.

In order to correctly terminate a transmission line data bus, it is usual to use a 180R resistor to Vcc and a 390R resistor to ground on each line. This gives an equivalent resistance of approximately 120R and a no-load voltage on the line of 3.4V. Some motherboard include active termination circuitry which uses a regulated supply and only single resistors to terminate the bus. Bear in mind though that the power supply lines, and certain other lines such as the reset line, should not be terminated. Also, termination is not necessary with buses less than 180 mm in length.

Several different types of TTL buffer IC are available. Older cards use quad or hex tristate buffers, such as the 8157. However, some excellent 20-pin octal parts are available now, but beware that there is a shortage of octal TTL throughout the industry, and although the situation now seems to be improving anything eight bits wide can be difficult to obtain.

Check out the 74LS07 octal tri-state buffer (National Semiconductor), the 74LS240 (local inverting bus driver), the 74LS241 (non-inverting) and the 74LS245 (local bus transceiver). These ICs save quite a bit of space on boards and simplify design quite a bit.

Hopefully, with the aid of all the foregoing you should now be able to tackle the design of the bus interfacing for cards in your computer system.
106  May 1980  EIT

THE S100 BUS STOP™

S-100 & 6800 CHASSIS

11 slot backplane, fully card guided. 15 amp power supply, fan, key switch, bench mount, rack mount, anodised aluminium. 5 edge connectors standard. S-100 Bench Kit $345. S-100 Rack Kit $306. 6800 Bench Kit $370. 6800 Rack Kit $330. Assembled prices add $100.

2708/2716 EPROM CARD
Features: holds up to 16 2708 or 2716 (single supply) EPROMS, on S-100 single supply. unused locations may be blanked. Plated through holes, solder resist mask.
Price: Kit $115. Ass. $155.

EPROM PROGRAMMING CARD
Features: ability to programme triple supply 2710's and single supply 2508, 2716, 2732 etc. Z8. Socket: on board 8V generator. Port driven.
Price: Kit $175. Ass. $205.

Z-80 CPU CARD
Features: 4 MHz operation, power on jump, wait state generators, provision for on board 1K EPROM, front panel socket for reset, and data lines etc.
Price: Kit $126. Ass. $196.

Z-80 SINGLE BOARD COMPUTER
Features: 4 MHz operation, 1K static RAM. 8K/16K EPROM, serial/parallel ports, power on jump, timer, vectored interrupts, software selectable bus rates. With 2716 EPROM.
Price: Kit $296. Ass. $370.

80 X 24 VIDEO DISPLAY CARD.
Features: on board 2-80 and CRT 5027 controller chips, parallel keyboard interface, 2708 driver chip, and 2708 character generator chip, special effects and extended character set available.
Prices: Kit $296. Ass. $370.

64 X 16 VIDEO DISPLAY CARD
Features: memory mapped 1K board, with reverse video and cursor control. RCA video controller, plated through holes and solder resist mask.

FLOPPY DISK CONTROLLER CARD
Features: single density, mini or full size disk drives with 40/40 pin controller chip. can be interrupt driven, syncs with CPU in data transfer. Shugart/Remex compatible.
Price: Kit $195 Ass. $235

DD FLOPPY DISK CONTROLLER CARD
Features: controls mini and full size, single/dual sided single/dual density and all combinations of each. Crystal locked. PLL data recovery. Shugart/Remex compatible software (CP/M /SDOS) for above controllers available.
Price: Kit $285. Ass. $345

STANDARD EXTENDER CARD
Features: double sided fillsigas board, numbered test points foraww soldered.
Price: Kit $33. Ass. $48.

WIRE WRAP CARD
Features: double sided fillsigas board, ground plane and supply rails run on both sides. 3M type connector patterns on top of board, provisions for regulators on all rails, holes are on 3" pitch by 1" pitch.
Price: Bare board $28.50

6800 PRODUCTS

EPROMS AND RAM CHIPS
2708 450nS $12. 2716 450nS $14.50. TEX 2114 450nS 57.50.

DUAL 8" DRIVE PACKAGE
Features: contains dual 8" single or double sided disk drives either Remex or Shugart. Inbuilt power supply, cooling fan, modular construction, keyswitch, fuse on mains, all aluminium 19" rack mount (10-Y. Nsh).

EPROM SOFTWARE
1. 2-80 monitor in 2708 EPROM, has 16 functions, three versions available to drive TTY, TY-200, VDU. Price $25. 2. ETI 540 video driver EPROM, makes the memory mapped video card look like a terminal, has XY cursor addressing, home clear screen. Price $25. 3. B25K Basic Interpreter, in seven 2708 EPROMS, has trig functions, dimensions, command level input ability. EPROM resident on 2708 hex. Price $180.

DISK DRIVES

DUAL 8" DRIVE PACKAGE
Features: contains dual 8" single or double sided disk drives either Remex or Shugart. Inbuilt power supply, cooling fan, modular construction, keyswitch, fuse on mains, all aluminium 19" rack mount (10-Y. Nsh).

EPROM SOFTWARE
1. 2-80 monitor in 2708 EPROM, has 16 functions, three versions available to drive TTY, TY-200, VDU. Price $25. 2. ETI 540 video driver EPROM, makes the memory mapped video card look like a terminal, has XY cursor addressing, home clear screen. Price $25. 3. B25K Basic Interpreter, in seven 2708 EPROMS, has trig functions, dimensions, command level input ability. EPROM resident on 2708 hex. Price $180.

DISK SOFTWARE
CP/M version 1.4 customised for our controller. $145. CBASIC II $125. Wordmaster, wordprocessing package $140. TEXT writer, letter and text formatter $50. CP/M user group library (33 vols) at $12 per vol. RAM Diagnostic, reports errors and likely causes $25. Available on 8" and 5-1/4" single or double density. Above prices are for 8" disks.

MPB-100 CPU BOARD
280 CPU Board with 2K single supply EPROM provision, power on jump, 4 MHz, front panel socket, wait state.
KIT PRICE $240. A&T $310.

2708 EPROM CARD
16K of 2708, 4K address boundary, 8 or 16K area required, wait states, plated thru.
KIT PRICE $98. A&T $128.

LA34 DECWRITER PRINTER/Terminal
Desk Top printer, full 128 ASCII character set, switchable 110 and 300 baud rates, 160 character memory, adjustable character widths, adjustable line spacing, 9 x 5 dot matrix printing.
PRICE $1,545 ex stock.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME
Prices and spec. subject to change without notice.
Price for retail prices add 15 percent.

Send 60c in stamps for COMPUTER PRINTOUT CATALOGUE for more details.

ALL PRODUCTS AUSTRALIAN MADE AND EX STOCK (ALMOST).
DEALER INQUIRES WELCOME

UV EPROM ERASER

New product range. Model LEE/T 15W tube, 120 min timer, up to 40 EPROMS will erase in 10/15 mins. Model MEE/T 8W tube 120 min timer, up to 10 EPROMS will erase in 20/30 mins. Model MEE is same as MEE/T but with no timer. All erasers are fully assembled and have a safety switch. LEE/T $100, MEE/T $93.50, MEE $74.

S-100 EXTENDER/TERMINATOR

EXTENDER TERMINATOR CARD — features:- true active termination of the bus with inbuilt extender connector on top of board, fused rails to extended board. Test points numbered, solder resist, plated through. Price: Kit $70. Ass. $90.

TEXAS KSR 820 PRINTER/Terminal

Desk top printer with 150 cph printing speed, 9 x 7 dot matrix, numeric, lower case, decimal, line feed, RS323 Interface, 132 characters wide, 110 to 9600 baud rate, 640 character buffer. Price $3,100.

TELEVİDEO TVI-912 TERMINAL

70 x 24 display, upper and lower case, 110 to 9600 baud rate, dual intensity, numeric pad, cursor controls, XY addressable cursor, block mode, self test, microprocessor controlled. Price $1,295.

S-100 I/O PORT BOARD

TRIS-80, APPLE & SORCERER

16K, 200ns, MEMORY EXPANSION KITS, $80 ea.

Or 3 Kits (48K) for $225.

Free installation of the above if required.

Z80A $17; Z80 P10S9; Z80 CTC $9; 6800 $8.50; 6820 $4.50; 6821 $5.50; S-100 Connectors $4.25.

Other microprocessors & peripheral ICs available.

Postage and packing $2.00 extra.

Send 20c stamp for list.

G.L.W.

4 Pryton Court, Balwyn, VIC. 3103.

Phone

AH (03) 89 6918.

J.P. & A. ELECTRONICS

EVERYTHING FOR THE CONSTRUCTOR AT BUDGET PRICES

1/4W RESISTORS .03 ea

GREENCAPS from .10 ea

500V CERAMICS from .10 ea

50V CERAMICS from .10 ea

ELECTROS axial from .15 ea

ELECTROS pcb from .10 ea

LEDS RED ¼ .14 ea

IC SOCKETS L/p from .20 ea

LOW PROFILE TRANSFORMER PCB MOUNTING $6.00

SILICON VALLEY STOCKISTS

84 Ramsay Street, Haberfield 2045.

Telephoge (02) 799-3331

ETI May 1980 – 107
FULLY EXPANDABLE

DREAM 6802 COMPUTER KITS

One board computer complete with monitor/interpreter, video interface, cassette interface, keyboard (HEX) interface and RAM. Simultaneously a sophisticated video game and a "serious" computer!

COMPLETE KITS $135
inc. cabinet

COMPLETE KITS $149
inc. cabinet & keyboard

Modulator $3 extra. Insured post
C.O.D. $2 extra. Phone C.O.D.s accepted.

- The high quality "Digital" keyboard has an 'over-centre' action to give positive contact and excellent tactile response. This greatly reduces keying errors, which will be especially appreciated towards the end of a long program! Since the keyboard greatly influences operator enjoyment, we believe that anything less is false economy.

- Perseus Cabinet The computer is assembled on a hardboard base and is then FULLY ENCLOSED with a tinted perspex cover. This protects the unit, and acts as a display case.

- FULLY EXPANDABLE Space has been left for later expansion of the memory. The heavy-duty power supply has the current capability recommend split by the designer for this purpose.

"UFO INTERCEPT" One of many video games

POWER SUPPLY KITS (1 AMP)
$19

Contains all components, a heavy gauge aluminium chassis (drilled), and a Marquise plate cover. Compact size 171 x 130 x 70mm

HEAVY-DUTY POWER SUPPLY KITS (3 AMP) $45

Complete kit with cabinet as above. Power supply kits are post free with DREAM kits and are not available separately.

- Pre-tinned fibreglass PC board with a COMPONENT OVERLAY for easy assembly.

- Programmed EPROM.

- Full instructions supplied.

- Provision for extra PIA's, ACIA's, etc. without additional logic.

- The PCB has been modified to accept a 6802 chip, which includes a clock, thereby eliminating the hard-to-get 6875. The 6802 was not available when the DREAM was designed, and the modification has been approved by the designer (Michael J. Bauer of Deakin University).

- When comparing prices, it should be noted that ours are guaranteed to contain only prime quality, guaranteed components.

- Service is available.

- Overseas sales - insured airmail cost covered by sales tax saving.

MONEY-BACK GUARANTEE

Examine your purchase for 7 days (without removing the IC's from their packing) and if not satisfied, return it for a full refund. Please mention Electronics Australia on your order. For further information see "EA" May to August '79.

Phone for details of Sydney counter sales. Please note new phone number.

All mail orders to J.R. Components.

Please send me the following items:

☐ Dream 6802 at $135
☐ Dream 6802 at $149
☐ 1A Power Supply kit at $29
☐ 3A Power Supply kit at $45
☐ RF Modulator at $3

Post and Pack $2.50

TOTAL

Phone No.

I enclose cheque/money order ☐ COD ($2 extra) I understand that this order is subject to a 7 day money-back guarantee.

J.R. COMPONENTS

PO Box 128, Eastwood, NSW. 2122. Ph (02) 85 3385

Tasmanian Agents

AERO ELECTRONICS, 123A Bathurst St, Hobart.

STEWART ELECTRONICS

44 Stafford Street, Huntingdale, Vic 3166.

Phone (03) 543-3733. Teletex 36998.

Mon-Fri 8.30am to 5.30pm. Sat 9am to 12 noon.

ALL BOOKS PLUS $2 PACK AND POST. TAX EXEMPT.
MINI-FLOPPY DRIVES FROM MPI!

THE WORLD'S LARGEST MANUFACTURER OF MINI-FLOPPY DRIVES - THE DRIVES WITH FEATURES COMPARABLE TO 8" DRIVES

Head band positioner gives 5 ms track to track access - 5 to 7 times faster than other drives. Fully closing front door and 5x5" Clutch Cone for media protection. Double Density Heads, Shugart Compatiable, only 10 moving parts due to non-mechanical switching.

TWO MODELS • Model 51 Single Head 250k Bytes DD AVAILABLE • Model 52 Double Head 500k Bytes DD

PRICING:  $350.00 (402.50) 52 $450.00 (517.50) Inc. tax Inc. tax

Write or call for technical description. Power supply/case available May since are the Australian Distributors OEM discounts are available.

DARTBAUD

FEATURES:
- 8 independently selectable 1/0 channels
- 2 light bit parallel ports
- RS-232 Interface levels
- Async or optional synchronous channels
- Baud rates 50-19200 independently selected for each channel

SPECIFICATION:
- Serial Ports: 8 independent ports using Zilog D/ARTS (sync) or optionally S100 (may be retiefied for synchronous parts, for any pair (S10 and DART are dual devices)
- Baud Rates: 6 independent, crystal-controlled, software selectable rates for each port selected from the 16 standard rates between 50 and 19,200 baud
- Parallel Ports: 2 independent ports using Zilog P10, selectable as either Input or output.

Interrupts: Full on-board interrupt control provided. On-board devices daisy chained. Rotating priority control provided for running multiple boards (through top connector). Jumper selection of interrupt control (local, rotating, vectored). PRICE: POA & MANUAL AVAILABLE

KEYBOARDS!

THE CLARE MODEL C70/MGP — by far the best value in keyboards we have seen to date.

• 70 key full upper and lower case with non mechanical Capacitive Keystwix — fully encoded Microprocessor control with RS232 or 20ma serial options — parallel output standard single 5V Supply, Serial baud rate jumper from 110 to 9600 baud.

PRICE $160 ea Connector $3.00
MOULDED ABS plastic case to suit $26.00

GET INTO MICROPROCESSORS WITH THE S100 BUS FOR EASY EXPANDABILITY

CHEAPER THAN THE USA

SOFTWARE (on cassette)
1950 8k Basic to suit our CPU Card $19.95
12k Basic etc $35.00
250 Assembly/Editor/Debugger S5 95
Keylogger / Large games $9.95
And more to come!

SUPPORT DEVICES
Mother Board —
• 68k/8k
• 8k SEC Prgressasured supply for 5V lines + 16k 75S + 16k 75S
• Actively Terminated
Comes complete including all edge connec- tors and power supply components
• All Components accepting power trans- former and main filter Capacitor mounted on Mother Card
Price $19.50 kit

CARD FRAME/CASE
To accept S100 or EXORCISE motherboard/ power supply and has provision for Fan and 16k track mounting
Price: $105.00

S100 MEMORY CARDS
16k Static
• Access time 450 ns (2MHz only) 2114
• 16k Kyes organized in 2 x 8 Blocks Individually selected to any 8 Boundary Price kit $29.00. All sockets supplied. Assembled and tested $40.00

64k DYNAMIC
THE ZERO ONE DYNARAM II
• Access time 250 ns (2MHz only) 4116
• 64k bytes organized in 4 x 16 Blocks
Receives completely transparent using bus signals to drive refresh allowing processor to run at full speed without wait states
• Supplied on minimum of 1 x 16k Blocks expandable by merely plugging in extra rams
Price 16k kit $225.00 All sockets supplied and $100.00 Assembled and tested $160.00

ETI 840 VDU kit fully socketed $139
Please note that 200ns memories are re- quired for VDU 4MHz operation at $8.00 per 100. 12 x 10200 for $250.00 separately.

CARDS IN DEVELOPMENT
1/0 Card, with serial parallel ports, extra Eeprom Card, Holds 6 ROMs with Eeprom Programmed Format Control: Microlfty or Floppy, CPU/M Compatible
Exorcer Mother Board/Power Supply etc Stand alone 80 column 125 CPS Tractor Feed Plain Paper Printer

Z80 CPU CARD FEATURES
Get more with full hardwired instructions and card document.
Power on jump for automatic execution of monitor program on startup.
Front panel -less operation allowed by on board $2k monitor which is too good to explain here, 19 commands all unique abbreviations allowed.
Full 5100 DMA Capabilities.
Sockets supplied for all major devices.
Clock speed, 2MHz Standard, 4MHz Option.
1/0 S100 P10 2 x 8 bit programmable parallel 1/0
RAM 256 Bytes scratch pad (Monitor). Onboard 27120 baud Textall Cassette Interface (Software Controlled) with cassette recorder remote control motor control Test Cassette supplied with CPU Kit contains set up procedures for cassette Interface as well as software to allow the cassette Interface to read and dump 300 baud CTS (Kansas City) format.
Keyboard input direct onto card in parallel ASCII.
Monitor performs all functions to drive ETI840 VDU as an ASCII terminal. Entry points for cursor control etc.
The spare socket order form allows the National MM510 to be fitted which works in conjunction with the CPU to give a full floating point RPN arithmetic unit.
Functions as a general purpose Z80 single board computer or as the heart of a fully expanded system to 64k bytes of memory and a multitude of I/O devices.
Sockets for side marked plug-in circuit cards, with components screened overlay.
Description Manual Construction manual $100.00 refundable with purchase.
Price kit $185.00 2MHz $225.00 4 MHz $250.00 8 MHz $22.50 Number Cruncher Option Assembled and tested add $50.00

BOOKS
Z80 CPU Technical Description $10.00
Z80 MACH Technical Description $6.50 posted
Z80 CTC Technical Description $6.50 posted
Z80 CPU Programs and Assembly Language Manual $10.00 posted

Prices are inclusive of sales tax, tax exempt institutions deduct six percent.

ETI May 1980 - 109

PRICES INCLUDE FREIGHT ANYWHERE IN AUSTRALIA. ALLOW 10 DAYS FOR DELIVERY.

200 MOGGIL ROAD, TARRAGONA, 4056.
Phone 371 5707

AUSTRALIA.
New body for two-way radio users

The electronic and appliance service industries are a major user of two-way mobile radio, using it as a means of communicating with service personnel on the road.

But, in common with other industries employing two-way radio, they are being subjected to outmoded laws, delays, and inconsistencies in interpreting regulations by government bodies, says a new national association set up to represent business radio users.

The association, ABIRA (Australian Business and Industrial Radio Association) this week launched an appeal for members. It is hoping for a good response from two-way radio users in the service industries.

ABIRA's immediate task is to press for a reduction in Commonwealth Government licence fees, which were doubled from July 1, 1979, from $25 to $50 per operating unit.

As examples of problems for users, ABIRA points to: • A restriction preventing transmission over more than 32 kilometres, which is much less than the range of most transmitters. • A requirement that communication between remote controllers and base stations be by telephone landline.

ABIRA wants users to have the option of controlling base stations by radio remote control, in case of landline failure. • Restrictions against one base station talking to another.

ABIRA also says that applicants for a business radio frequency sometimes have to wait up to six months before the frequency is allocated.

If sufficient support is received from potential members, ABIRA organisers plan to set up a full-time office in Canberra to lobby on members' behalf.

Further ahead, ABIRA plans newsletters to keep members up to date on legislation, regulations, technical developments and other items of interest: opportunities of attending meetings and workshops; and technical assistance to members.

Inquiries may be made to ABIRA, P.O. Box 1582, Canberra City 2601 ACT.

Special baluns for HF radar

Special HF baluns have recently been supplied to Defence Research Centre, Salisbury South Australia, for the "Jindalee" over the horizon radar (OTH) project.

Designed and manufactured by Antenna Engineering Australia Pty Ltd, of Kilsyth in Victoria, the baluns were required to meet the exacting specification issued by DRCS.

Rated at 25 kW, the baluns had to hold phase shift differences to within two degrees from the reference balun over the frequency range 5-30 MHz. The AEA baluns exceeded the requirements, varying less than 0.6 degree.

Impedance of the baluns is 50 ohms unbalanced input and 300 ohms balanced output. VSWR was quoted at better than 1.2:1.

AEA manufacturers a wide range of baluns and terminations for both low and high power applications. Other main products include: antennas for communications, TV, FM, and nav aids for HF, VHF, and UHF applications, as well as filters, diplexers, multiconverters and combiners.

New antenna rotators

Daiwa has released a new range of antenna rotators which incorporate a map of the world — centred on Australia.

Two new control boxes are available for both the heavy and medium duty rotators. With the "pre-set" type of controller the antenna direction is set by turning the knob to the correct bearing for the country concerned. The rotator then turns to the desired heading.

Sunspots — countdown to a maxima

The Swiss Federal Observatory at Zurich maintains a continuous watch on the sun, monitoring sunspot activity and issuing reports on daily figures, monthly mean and smoothed mean parameters.

From their bulletin, numbers 7 to 12 for 1979, and number 1 for 1980, you can see the progress of the maxima, which should peak during the first half of this year — that's now.

Smoothed mean sunspot numbers for January to July last year are as follows: Jan. 123.8

CB for UK, maybe: 27 MHz? — No!

The British Home Office is delaying any decision on CB for the time being . . . but whatever happens, 27 MHz is definitely out!

Meanwhile, the Irish government has taken a hard line and outlawed CB radio, saying that illegal users will be prosecuted.

A National Committee for Legalisation of Citizens Band Radio has been formed in the UK in an effort to draw attention to the growing band of enthusiasts. Already a British CBers book has appeared on the market and a petition has been circulated and presented to the Government.

Some of the British electronics magazines are carrying short columns on CB . . . naturally not inciting anyone to break the law! One suspects it could be a long, hard grind.
Airband receiver covers new frequency range

GFS Electronic imports, recently announced that their handheld airband receiver, the Sky Ace R-517, is now available with new frequency coverage.

This latest version covers 108 to 140 MHz, allowing users to take advantage of the many Aerodrome Terminal Information Services (ATIS) that are transmitted within the navigation band (108-118 MHz) by major aerodromes throughout Australia.

Up to three crystal-locked channels may be installed or, if desired, across the band. A fine tuning control is also included. Sensitivity and performance are high, according to GFS. The unit is priced at $104 plus $2.50 post. Crystals (if required) are $7 each for standard frequencies or $17 each for special frequencies.

For more information on the Sky Ace R-517 contact GFS Electronic Imports, 15 Mckeen Road, Mitcham Vic 3132. (03) 873-3939.

Security for radio transmissions

In the past, users of radio communications could rely on a reasonable degree of privacy as a matter of course. However, this is no longer the case.

The ready availability of monitoring equipment, such as the scanning receivers, plus the general interest and desire to eavesdrop, has significantly impinged on the privacy of these communications media.

Today, radioteletype and data communications are being used at an accelerated rate for the exchange of confidential information. Public safety agencies, utilities, law enforcement and private and industrial institutions are transmitting increased volumes of sensitive information.

Privacy devices for radio communications provide assurance against compromise. To be worthwhile, a privacy device must be effective against determined efforts to "break" its security. Equipment that is made useless by easy decoding defeats its basic intent.

With this object in mind, Vicom International, Professional Products Division, is to release a range of digital and analogue security devices providing a wide range of security codes. Many of the units are simple and the devices can be fitted with only minimum modification to the radio set. For further information, contact Vicom International, Professional Products Division, 68 Eastern Road, South Melbourne.

UHF frequency counter

The Sarrosa Model 261 UHF frequency counter has been designed as a compact, rugged, easy to use instrument for the frequency range 20 Hz to 600 MHz.

With optional battery pack fitted, the unit is ideal for field use. Selection of all functions is by front panel push buttons.

A high contrast, nine-digit LED display is provided, with full memory, and decimal point placement is automatic with range and gate time selection.

For low frequency (under 5 kHz) signals, such as are used in selective calling systems, the input frequency is multiplied by a factor of 100 in a phase-locked loop, enabling measurement with 0.01 Hz resolution to be made with one second gate time, according to the specifications.

The instrument features 20 mV sensitivity over its entire range and may be overloaded with up to 250 Vac. The instrument can be supplied in a bench case version or with standard rack mounts.

For further details contact The Dindima Group Pty Ltd P.O. Box 106 Vermont Vic 3133.

RF power analyser with calculator.

A new RF wattmeter from the Bird Electronic Corporation has its own built-in calculator to give direct digital readings of its nine functions.

It operates at power levels from 100 mW to 10 kW and from 500 kHz to 2.3 GHz. The model 4381 RF Power Analyst calculates its various functions continuously and displays the answers at a touch of a button. It will calculate and display voltage standing wave ratio (VSWR), the continuous-wave or frequency modulation power (both forward and reflected) in dBm or watts, peak envelope power, percent modulation and delta function. It also features a memory which shows the maximum and minimum optimum values for when making adjustments.

Other models in the 4380 series can handle up to 250 kW and further information can be obtained direct from Bird Electronic Corp, 3030 Aurora Road Cleveland (Solon), Ohio 44139 USA.

ETI May 1980 — 111
Amateur Radio Book Stock Clearance

We're wildly overstocked with many of our popular Amateur Radio books. So much so that we've got to clear space for new stock arriving for our new catalogue. Here's your chance to SAVE on many titles: many of these prices are lower than those in our new catalogue! But remember: these prices are current only while current stocks last. HURRY!

Popular ARRL books
- Electronics Data Book (B-2203) 128 pages of essential data for all involved in electronics; not just amateurs! **Still only $6.75**
- Antenna Hand Book (B-2204) One of the most widely respected antenna books. Not just theory, but lots of practical data too! **$8.75**
- Antenna Anthology (B-2205) A collection of articles on antenna design, construction, etc. A must for every ham. **$6.25**
-Hints and Kinks (B-2206) All those short cuts and ideas you'd normally forget in one handy reference volume. (Not many left!) **$6.90**

Radio Amateur's Operating Guide (B-2208) New to the game? Want to find out the correct way to do it? - here's the answer! **Was $6.90, Now only $3.95 while stocks last**

Solid State Design for the Amateur (B-2211) A book of the highest quality! (EA mag.) For the thinking amateur who wants to design his own. **Great value! $14.00**

1979 ARRL Handbook (B-2219) May be out of stock by the time this advert appears. If not, you'll save $5.00! **Was $14.35, Now $9.95!**

Getting to know OSCAR (B-2220) **What OSCAR is all about, how to use it, how to set up your station. Easily understandable. Now save nearly 50%: Was $5.50, now only $4.50**

Radio Frequency Interference (B-2222) How to identify and cure RFI. Keep on side with your neighbours! The RFI Was $5.50. Now reduced to only **$4.50!**

Solid State Basics (B-2224) Provides both the why and the how of transistors, etc., and other solid state devices. Was $8.75. Now only **$6.75**

Mini Log Book (B-2235) Just the thing for mobile or portable use. All the data you need to record in a handy size. **Great value at $2.00**

Big savings on 1979 world callbooks: Yes, great value for the ham or swil on a budget. Last year's callbook may be, but the contents don't change all that much from year to year! **US Callbook (B-2220) All the amateurs of continental US, Hawaii, its possessions etc. Was $21.95, now reduced to only $17.50**

Foreign callbook: All areas of the world (including Australia) with the exception of the US. Was $20.95, now reduced to only **$17.50. SAVE! (B-2262)**

WIA AUSTRALIAN CALLBOOK (B-2317) The most recent Australian callbook listing amateur operators and registered SWL's in Australia and PNG. No amateur can afford to be without one! **Only $2.95**

Mini Solid State Design from RSGB (B-2220) A digest of articles on solid state design, construction, etc. Many widely respected antenna books. Essential data for all involved in electronics; not just amateurs! **$6.95**

1979 ARRL Handbook (B-2219) May be out of stock by the time this advert appears. If not, you'll save $5.00! **Was $14.35, Now $9.95!**

Radio Amateur's VHF Manual (B-2214) A thorough treatise including history, principles, test gear, etc. Practical, too! **$6.95**

SSB for the Radio Amateur (B-2212) A digest of articles on SSB from QST - theory and practice of SSB in detail. Was $6.75. **Now Only $5.00 while stocks last. Save!**

1979 World Radio TV Handbook (B-2081) Great value for SWL's and amateurs too. A listing of all known broadcast stations in the world including frequencies. Great for frequency checks! Was $15.95, now reduced to **$12.95!**

Reference Data for Radio Engineers (B-1104) Contains a wealth of data in its 1196 pages: Hundreds of charts, graphs, nomograms, etc. The ultimate reference book for anyone in electronics. Was $33.00, Now only **$28.00**

Radio Handbook (B-1106) Over 1000 pages: one of our most popular reference books. Easy to understand. Was $55.00, Now only **$20.00!**

Amateur Radio Techniques (B-2040) By Pat Hawker of RSGB. Absolute bargain, 300 pages, covers just about everything! **Only $8.25**

Guide to Amateur Radio (B-2042) Another RSGB/Haker book. Assists the newcomer to ham radio in starting his shack and operating correctly. 112 pages. **Great value at $3.50**

VHF/UHF Manual (B-2054) Huge hard cover manual covers exciting world above 30MHz. With particular emphasis on microwave. **$17.00**

80 metre DXing (B-2286) Includes all aspects of 80 metre operation, including antennas, propagation characteristics, operating practices, etc. Was $5.50; now reduced to only **$3.90!**

STUDYING FOR THAT LICENSE?

The Ham Exam Cram Book (B-2314) Great for that last minute revision. Typical questions and answers explained. A beauty! **Only $2.95**

1000 Questions for the Novice License (B-2316) From the WIA, covers everything from Ohm's law to the regulations. With answers. A bargain at only **$3.95**

Questions and Answers for the Novice License (B-2315) Put out by Westlakes Radio Club. This book covers all the typical questions you are likely to be asked - with answers. **$4.95**

500 Questions for the AOCF (B-2318) Similar to above books, but this one is for the big one: the full amateur license. It's money well spent at **just $3.50**

VHF Handbook (B-2300) Covers all major VHF subjects: propagation, antennas, etc. (including satellites etc) Clear language, 336 pages. **$6.95**

Wire antennas (B-2302) How to build a large number of types of wire antennas, including invisible types where neighbours might be a problem. Covers 160 to 2 metres **$6.95**

Cubical Quad Antennas (B-2304) The world famous classic on Quads, revised to give new data and details of quad construction. Reduced from $5.50 to only **$3.90 SAVE!**

Beam Antenna Handbook (B-2306) Gives dimensions of beams from 6 to 40 metres, covers test instruments, etc. **Only $5.75**
Dubai tests

The small but rich Persian Gulf state of Dubai, in the United Arab Emirates, has commenced test transmissions from their newly installed shortwave transmitters.

Dubai's plan for an international shortwave service was mentioned back in October ETI, when the station was in the process of recruiting technical and programming staff from around the world.

Radio and TV Dubai has installed three shortwave transmitters of 300 kilowatts each. Since early in October, they have been heard testing on 21,500 between 0600 and 1000 US with programming in Arabic relayed from the Home Service. Broadcasts have been directed to Europe, but have still been well heard in eastern Australia.

Dubai plans to start an English service once tests are completed and regularly scheduled programmes are introduced. Most programmes will be directed to listeners in the Middle East or Europe, but if the recent test transmissions are any guide these broadcasts should still be easily heard here, with the 300 kilowatts of juice helping matters along. The plans of Dubai to mostly use higher frequencies, from the 25 metre band upwards, should also be a big factor in ensuring reliable reception in Australia.

The station has registered a number of frequencies with the International Telecommunications Union (ITU) in Geneva, which has the task of coordinating usage of channels in the crowded shortwave broadcast bands. Dubai's current registered frequencies are: 7105, 9590, 9680, 9755, 11,730, 11,830, 15,110, 15,115, 15,160, 17,710, 17,790 and 21,480. Interestingly, although the first tests took place on 21,500, this frequency has not been registered with the ITU! Nevertheless, the above frequencies are the outlets to watch for further Dubai broadcasts, with most broadcasts probably taking place between 0600 and 1630.

If you hear any of the test broadcasts from Dubai, why not let them know about reception conditions in your location? You can write to P.O. Box 1695, Dubai, United Arab Emirates.

Address reception reports to the Chief Engineer, Dubai Radio and Colour Television.

Latin African Log

The 1980 edition of the Latin American and African Radio Log is now out.

The 1980 Log contains a full listing of all stations, in frequency order, which have been heard in east Australia since March 1979 and are located in Africa or Latin America.

The Latin American section covers the full shortwave range from 2 MHz through to 30 MHz, while the African section concentrates on stations heard from east Australia in the tropical bands 2000-5900 kHz.

A special feature of the 1980 Log is the full list of QSLs received over the last 14 months from Latin American and African regional stations. This provides such information as to how long a station has taken to reply to a reception report, whether the station will answer reports written in English (most do!), and if the station sends a card, a letter or other goodies such as pennants etc.

The 1980 Latin American and African Log is a 16-page booklet available from the ARDXC for $2. Just write for your copy to the address in this column. This is an invaluable reference for all the DXers seeking to identify the exotic stations to be heard during the coming winter months.

Most international shortwave stations prefer to use higher frequencies during the summer months, and then switch to lower frequencies in the winter months when less sunlight means the ionosphere supports generally lower frequencies.

Right now, international stations have just adjusted frequencies at the start of the J-1980 transmission period, and the J-80 period will last until the first week in September, when the S-80 period commences. Other transmission periods begin on the first Sunday in November (period D), and in March (period M).

International stations are usually pleased to forward their schedule to listeners on request, free of charge. As we approach September, why not try writing to the international station you are most interested in and request a copy of their S-80 schedule? You can write to most of the better-heard stations in the capital cities of the country where they are located. You will then be able to keep track of the frequencies of the station when the changes occur in September.

Another good idea is to write a reception report to the station telling how well you are hearing their new frequencies. International stations are especially keen to know of any interference to their broadcasts, and the name of the interfering station if you can identify it.

All this is called "feedback" and is an important part of the DXing hobby. Such feedback from the listener to the station makes DXing the active hobby that is today, being a step up from the passive SWLing pastime. A bonus will come to you in the form of QSL cards from the broadcast stations to whom you report.

Bhutan

Some time ago, at the suggestion of ARDXC, the National Youth Association of Bhutan introduced an overseas service, at a time which would allow propagation over long distance paths.

The transmitter used is, in fact, one operated for amateur applications at other times, and the current schedule is as follows: 7040 0600-0900 (Sundays); 4690 1100-1400 (Wednesdays and Fridays) English is at 1300-1400.

The station issues a QSL, but only does so for specific, fully detailed DX reports, and for this reason is regarded as one of the rarest SW stations currently operating.

ETI May 1980 — 113
erections
Consult the experts with over 25 years in the field
WE HAVE WHAT YOU WANT
LOOK! Colour Specials

Hills Antennas:
E.F.C 2..... $ 56.33
E.F.C 3..... 80.89
TL 2..... 41.20
TL 3..... 50.62
TL 4..... 54.80
Airways Anti Ghost 77.74
104/0 great for DX 37.78
6/1 another for DX 41.98
Channel Master
5/0 for DX S E.L. 44.30
Rotator complete 99.00
Mast Head Amplifiers
Hills M.H.4 75.78
E/Craft M.H.22 82.62
Kingray M.H.20 82.62
Hills Antennas
215 30.66
CY'7 36.76
CA.16 Phased array 58.76
Channel Master
3615-9 element 44.84
3614-13 element 62.54
3613-17 element 81.91
3612-21 element 98.06
3610-24 element 127.87
3617-28 element 152.67
Matchmaster
82/C/1 24.79
up to 82/C/7 69.01
F.M.
F.M. G2 27.25
F.M. G6 fringe 51.47
Indoor Aerials
Standard Spiral 4.94
Halfian 13.80
Gutter Grip GGR 18.65
NEW SR.20 Marine Aerial or Caravan Antenna — built in mast head amplifier has many other fine features, only $143.50
We have the largest range of television amplifiers in Australia suitable for V.H.F. — U.H.F. Twin 75ohm Skirting outlets. Chassis mount 75ohm sockets 60c ea. or buy 10 for $5.00
Channel 2 Attenuators 6.94

NOTICE:
To INSTALLERS/ WHOLESALE
Save dollars on coaxial cable. Ring now for the best prices & cable in Australia.
FREE ADVICE GIVEN

ELECTROCRAFT MFG P/L
68 Whiting Street, Box 398, ARTARMON 2064.
Phone: 439-408 ext 6.
Hours: Mon-Fri 8am to 5pm.

ELECTROCRAFT MFG P/L
68 Whiting Street, Box 398, ARTARMON 2064.
Phone: 439-408 ext 6.
Hours: Mon-Fri 8am to 5pm.

Notice:
To INSTALLERS/ WHOLESALE
Save dollars on coaxial cable. Ring now for the best prices & cable in Australia.
FREE ADVICE GIVEN

DATALOFT MICROCOMPUTER SOFTWARE
Proudly present the largest range of software in the world for the COMMODORE MICROCOMPUTER.

"PETSOFT" Over 200 programs Including: Over 40 Business Programs Over 65 Programming Aids & Tutorial Programs. Over 60 Simulations and Games Programs.

- Both cassette and disc based programs available.
- No hassle guarantee - if our programs don't load, we will replace free of charge.
- Write or phone now for our fabulous free catalogue.

DATALOFT
139 Guildford Road,
MAYLANDS W.A. 6061.
Tel: (09) 871 7169
Agents required all States.

See us at the Sydney Computer Show.

SYN-1 Single Board Computer $210.00
KIM-1 CRT/TV Keyboard terminal module $249.00
BASE 8K BASIC ROM for SYN-1 $149.00
BUFFED MOTHERBOARD for SYN-1, KIM-1 or AIM-65 systems $178.00

EPROM Programmer and EPROM/ROM board MEMORY mapped EPROM programming will program up to 16K per command firmware in PROM Included. For SYN-1, KIM-1 or AIM-65 systems $300.00

AUTOMATIC TELEPHONE DIALER PROM dialling 33 members plus other options $100.00

PRESETABLE COUNTER 3 digits suitable for counting, batching and numerical control $150.00

DIGITAL TACHOMETER $120.00

STEPPING MOTORS wide range for N.C. Control, Potters, Variable speed, serve Control etc. $48.50

STEPPING MOTOR DRIVING CIRCUITS for 3 or 4 phase to make 1 phase 2 phase 1-2 phase excitation. From $12.30

THUMB WHEEL SWITCHES $12.50 ea.

TOXINITY TRANSUDERS $15.00 ea.

Mail orders add $3.50 for postage and packaging

G.C.S.
67 Blackshaw Avenue, MORTDALE 2223.
Telephone: 570 1225
(Trade enquiries invited)
Brazilian signals peak

Autumn in east Australia is the best time to listen for Brazilian stations.

The Brazilian shortwave broadcasting set-up is quite unique and exciting, with hundreds of stations on the shortwave bands from 60 metres right up to 16 metres. Probably the best reception is on 49, 31 and 25 metres. These are best heard at their local sign-on times, around 0800 or 0900. Signals travel almost directly across the South Pole from southern Brazil. A great circle map is most useful for studying propagation paths and retail outlets, such as technical books in Melbourne and Dick Smith stores, make these available. Some of the stronger Brazilians this year have been: 5965, Radio Gualba in Porto Alegre, which has a lively musical format up to 1000 after opening at 0900, then has a news programme called “Radio jornal da Guaíba” from 1000. 9675, Radio Marumbi Limitada at Florianopolis, which can be heard from about 0830. They have music up to 0900, then often have religious segments. Listen for the drum roll and identification announcement just before 0900. On 9545, Radio Universo at Curitiba. This station has in previous years been a tough DX catch, but has been strong on a clear frequency of late. The station opens at about 0850, and also seems to favour religious segments at 0900.

On 11 765 is Radio Tupi in Sao Paulo. This one can be heard from about 0820 and has some very weak DJs, plus some great Brazilian rhythm bands.

On 11 780, Radio Nacional at Brasilia, is the national network, and often carries news reports from 1000 which are relayed from stations across the country. This one often shows up in the mornings also, at around 2100 to 2200, and is heard in parallel with the other Brazilia outlet of 15 445.

Although all these stations broadcast in Portuguese, most will reply to reception reports written in English. Some of these stations also send colourful stickers or pennants, in addition to verification cards or letters. The addresses of all these Brazilian stations, and any others you may hear, are given in the World Radio and TV Handbook.

Belgian Radio in French

Radio Televisie Belge in Brussels, the French network of Belgian broadcasting, has announced their schedule effective up to the end of September.

The station will operate continuously on Sundays, from 0500 to sign off at 2000, using 21 460 and 15 210.

Monday to Saturday transmissions are broken into 5 separate blocks after which frequency adjustments are made:
0400-0515 Brussels will use 11 880 and 15 210.
0515-0615 they will be on 21 460 and 15 210.

The next segment, 1030-1230, will be broadcast on both 21 460 and 15 210. The next programme block from 1400-1545 is listed to use 5965 and 21 460. The final segment is on air from 1600 to close down at 2030, and is to be broadcast on 21 460 and 15 210.

RTB will be happy to supply listeners with a frequency schedule and programme details. Should you wish to write a copy of the English language schedule then you will need to write to BRT which is the Dutch language network. BRT has not made the schedule available as yet, but you could write requesting a copy to: BRT, P.O. Box 26, B-1000, Brussels.

African news

With our winter approaching, DX signals on the lower frequency bands improve, in particular around our breakfast period, on 5 MHz.

Interesting African signals to watch out for, which have been heard around Eastern Australia recently, include: 5020 Namley (Niger) with North African vocals, French programme at 2040;
5010 Garoua (Cameroon). Local music, French 2045;
5005 Radio Ecuatorial, Bata (Equatorial Guinea). Spanish and local dialects 2030-2100;
4990 Lagos (Nigeria). Home service, with English and Vernaculars, from around 1900;
4976 Kampala (Uganda). Recently reactivated channel, Swahili service around 2040;
4911 Lusaka (Zambia). High powered outlet, brought back into use recently, often has telephone phone-in programmes from local listeners around 2015;
4820 Luanda (Angola). Portuguese programming around 1900-2100.
The Sunwatch

100% SOLAR POWERED GUARANTEED TO OUTPERFORM ANY WATCH SOLD TODAY

CRYSTAL UNITS

- Decade Counting Units to 1 Hz.
- Wide Band Amplifier for your counter, 1 MV sensitivity, band width 1-250 MHz.

Manufacturers of PIEZO ELECTRIC CRYSTALS Contractors to Federal and State Government Departments.

REPRESENTATIVES:
NSW: J. E. Waters,
11 Salisbury St, Botany. 2019.
Ph 666-6144

SA: Rogers Electronics,
65 Magill Rd, Stepney. 5069.
Ph (08) 42-6666.

QLD: Fred Hoe & Sons P/L,
246 Evans Rd, Salisbury North.
Brisbane. Ph 277-4311.

WA: Westest Electronics,
71 Jean St, Hamilton Hill. 6161.
(Mail only) Ph (09) 337-6393.

TAS: Dimond Instruments,
PO Box 219, Bellivere. Hobart.
Ph 479-47-9077.

Send SAE for new catalogue or quote for your requirements.

Bright Star Crystals Pty Ltd
PO Box 42, Springvale.
Ph (03) 546-5076 Telex AA36004

SPACE AGE ACCURACY
You will never worry about accuracy again. Sunwatch is accurate to within one second per month.
The Sunwatch incorporates a programmable microcircuit synthesiser that's 5 times more accurate than the latest Quartz Accutronic.

L.E.D. DISPLAY (LIGHT EMITTING DIODE) READ THE TIME IN THE DARK - BETTER THAN LCD DISPLAY.

10 DISPLAY FUNCTIONS
The Sunwatch is capable of displaying the following information.
- Hours & Minutes & Seconds
- Months & Dates & Leap Year & Speed
- Calibration & AM/PM indicator
- Seconds count off
- A natural side view display.

SOLAR AGE EFFICIENCY
The power source: Tiny silicon power cells which are constantly being energised by natural sunlight, daylight or an ordinary light bulb, keep the Sunwatch storage system charged. Should the watch not be exposed to light it will continue to operate for months on stored power.

INDESTRUCTIBLE
The Sunwatch is shock resistant to 5,000 Gr. Wear it while doing heavy work, exercise, hammering nails, place it in boiling water for 30 minutes, freeze it in a block of ice for a year. Imagine Split Second accuracy for the rest of your life, Sunwatch is virtually indestructible.

The Sunwatch incorporates a programmable microcircuit synthesiser that's 5 times more accurate than the latest Quartz Accutronic.

L.E.D. DISPLAY (LIGHT EMITTING DIODE) READ THE TIME IN THE DARK - BETTER THAN LCD DISPLAY.

10 DISPLAY FUNCTIONS
The Sunwatch is capable of displaying the following information.
- Hours & Minutes & Seconds
- Months & Dates & Leap Year & Speed
- Calibration & AM/PM indicator
- Seconds count off
- A natural side view display.

SOLAR AGE EFFICIENCY
The power source: Tiny silicon power cells which are constantly being energised by natural sunlight, daylight or an ordinary light bulb, keep the Sunwatch storage system charged. Should the watch not be exposed to light it will continue to operate for months on stored power.

INDESTRUCTIBLE
The Sunwatch is shock resistant to 5,000 Gr. Wear it while doing heavy work, exercise, hammering nails, place it in boiling water for 30 minutes, freeze it in a block of ice for a year. Imagine Split Second accuracy for the rest of your life, Sunwatch is virtually indestructible.

The Sunwatch is covered by a 2 year warranty issued by the makers in U.S.A. A copy of the warranty comes with every watch. Every watch has a serial number.

Please Print Clearly
NAME
ADDRESS
POSTCODE

CHEQUE $ 

MONEY ORDER $ 

BANK CARD NO.
CARD HOLDER'S SIGNATURE

©1980 E.T.I.

One of the best investments you can make. Thousands of earlier models sold in the U.S.A. for as high as $500.00 or more.
Grado cartridges have more than left their mark in the minds of many serious hi-fi enthusiasts. But while these audiophiles have spread the Grado’s reputation of cartridge excellence throughout most of the world, there still exists one group of people who have yet to experience the Grado difference: Australians. It is Audio 2000’s intention to correct this oversight.

Hi-fi enthusiasts are a diverse lot, owning everything from a modest set-up costing a couple of hundred dollars to the serious types who control systems costing many thousands of dollars. Subsequently, Grado has developed a range of cartridges that satisfy the individual requirements of each.

All Grado cartridges, from the $850 Signature 3 to the $1850 FTR+, have Grado’s cartridge engineering excellence in common:

1. All have a lower tip mass which vastly improves tracking ability, thereby also reducing groove distortion.
2. All have a cantilever assembly which is robust.
3. All have user replaceable stylus assemblies.

While all this may be music to your ears, the real Grado difference stems from the ability to overcome many of the electromechanical distortion products found in other modern cartridges (by the Flux Bridger Principle), and the ability to deliver correct tonal balance with its very extended top end and tight bass.

For more information about your next cartridge contact Audio 2000: P.O. Box 107 Brookvale, NSW 2100, phone (02) 9939 2159.

Audio 2000
Making sound, sound better.

PHILIPS LOUDSPEAKERS

Why spend a fortune on imported loudspeakers?

You can build your own for a fraction of the cost! We stock a wide range of European-made Philips loudspeaker components and matching cross-over networks.

We also have the range of Philips speaker kits and the new Philips/ETI 4000 series loudspeakers, with or without enclosures.

Don’t worry about your skills; we will show you how easy they are to construct. For a modest charge we will even assemble them for you!

northpoint hi-fi
100 Miller St, North Sydney. Ph 922-7780.

WAGNER ELECTRONICS
SALES & SERVICE
305 Liverpool Rd, Ashfield. Ph 798-9147.
Super Special Offer on Transistors

Toshiba Semiconductors:

BU126 only $1.70
BU208 only $2.84
S2530A only $2.36
BU326A only $2.36

Plus sales tax and postage.

Minimum Order 10 pieces of any one item

Write for details of the above and other items available.

SKANTIC TV HI-FI SERVICES PTY. LTD.
30A Thornton Crescent, Mitcham 3123.
PO Box 141, Mitcham 3123.
Telephone 874-5888.

Now Available on Video

The Whole Country is Waiting to See Jacqueline Bisset as You've Never Seen Her Before!

"Jacqueline Bisset is more stunning in 'Secrets' than in the 'Greek Tycoon' which hardly seems possible. Not only is La Bisset ravishing in 'Secrets', she is also nude..." — Bill Van Maurer, Miami News

Secrets

STARRING

JACQUELINE BISSET

LONE STAR PICTURES

INTERNATIONAL RELEASE

COLOR BY CPI

BECOME A DEALER FOR OUR EXCLUSIVE VIDEO MOVIES

We are seeking dealers in the hi-fi and record retail trade for the sale and rental of "The Video Classics Movie Cassette Library" A range of 30 full-feature movies on video cassette. A Video Classics dealership offers high profit returns, excellent margins and full back-up with colour brochures, posters, window stickers, advertising and the opportunity to capitalise on the fastest growing section of the electrical trade.

Sneak Preview Cassette

Indicate format required. Send us $25, and we'll send you a great in-store entertainment promotional video cassette of trailers of our best movies.

Mail Order KEF Drivers & Kits

Certified Mail Delivery Throughout Australia & New Zealand

Bankcard accepted

KEF B139

Superb 30 x 21cm bass driver, with solid flat diaphragm of unique construction, acting as a perfect rigid piston, to give clean, distortion-free bass over the frequency range 20-1,000Hz. The KEF range also includes mid range and high frequency 'units, with dividing networks designed to link them into compatible systems.

For full information, write to AUDIOKITS
PO BOX 553
BROOKVALE NSW 2100

118 — May 1980 ETI
Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time – commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:

ETI – Predictions
3rd floor 15 Boundary St
RUSHCUTTERS BAY NSW 2011.
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

Send for complete literature. Please let us know your microphone application.
NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and this publication is acting as a clearing house only. Cheques should be made payable to 'Ampex Tape Offer' and sent, together with the order form or accompanying letter, to 'Ampex Tape Offer', c/o ETI Magazine, 15 Boundary Street, 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 four weeks for delivery.

Owing to the exceptionally low offer price, the minimum ordering quantity is ten tapes (total $39).

The USA Ampex Corporation has made available a substantial quantity of 'off-cut' tapes from their highest grade material. All tapes are 1800 ft (549 m) by ¼", 1 mil ferric oxide on standard 7" reels.

There's a slight gamble involved — but one in which you either win a lot — or a hell of a lot!

Here's why:
The tapes offered are of differing types and you take pot luck on which you receive.

BUT, The lowest quality is Ampex' superb Ampex Plus series! The highest is Ampex' Grand Master series!

SO, If you draw the Ampex Plus' you'll be paying about one-third the usual price. If you score the Grand Masters you'll be paying about a quarter usual price.

YOU CANNOT LOSE. If you are not totally and completely satisfied with your purchase, Dindy guarantee to return the full purchase price without question provided the tapes are returned within 14 days in the original packing.

Identical tapes to those offered are marketed in the USA by Ampex, using the trade name 'Shamrock'. This trade name is also used for those offered here.

$39 for 10 reels

Plus $2.00 for post and packing.
Hands up if you own a graphic equaliser...  

Hands up if you know how to use it...

It's a fact: thousands of people have bought or built graphic equalisers recently, but only a tiny percentage have any idea how to use them. Sure, it's fun to listen to the sound change its character as you play with the knobs - but after that, what? Those 'in the know' have known about a device which would allow you to get the most from your graphic equaliser.

This device, called a 'Graphic Analyser', allows you to obtain a virtually 'flat' frequency response from your audio system - which is what hi-fi is all about, isn't it? Trouble was, graphic analysers weren't all that common. That was, until March Electronics Australia magazine described a particularly good graphic analyser: ideal for the hobbyist to build, and at low cost!

Here it is: the new Playmaster Graphic Analyser kit from Dick Smith Electronics

You win three ways with this superb new Graphic Analyser from Dick Smith:

1: It is more than just a graphic analyser. After you've set your equaliser levels, it doubles as a peak level meter, reading the level from each stereo channel and displaying it via LED indicators.

2: It is priced under $100.00! It's this low, low price because it is supplied as a kit: you supply the labour to put it together (a very easy task) and save hundreds of dollars by doing so.

3: It comes complete with full instructions, both how to put it together, and how to get the most from your system. When it's finished, you'll be proud to say 'I built it!'

The Playmaster Graphic Analyser/Level Meter was designed to match any graphic equaliser - not just its partner, the Playmaster Graphic Equaliser. So even if you bought your equaliser 'off the shelf', have no fear: this analyser will still help you.

Playmaster Graphic Analyser/Level Meter  

$99.50  
Cat K-3510  
Simulated Walnut Sleeve, as above: $8.50  
Cat H-3113

DICK SMITH ELECTRONICS

NSW  125 York Street, SYDNEY Ph 250 3377  
147 Home Highway, CHULLORA Ph 462 8922  
162 Pacific Highway, GORE HILL Ph 439 5311  
30 Grose Street, PARKAMATTA Ph 683 1133  
306 Lane Cove Rd, NORTH SYDNEY Ph 883 3200  
263 Kaine Street, WOLLONGONG Ph 29 3800  
213 Princes Highway, BLAKHURST (Opening Soon)

VIC  359 Lonsdale Street, MELBOURNE Ph 67 9834  
395 Bridge Road, RICHMOND Ph 428 1614  
665 Bridge Road, KLEINER Ph 391 6233  
243 Coogee Road, CHERMSIDE Ph 60 6970  
862 Gympie Road, CHERRY HINTON Ph 60 4944

Qld  A.C.T. 16 Gladstone Street, FISHER WICK Ph 60 9814

SA  60 Wright Street, ADELAIDE Ph 212 1692

WA  414 William Street, PERTH Ph 328 6844

MAIL ORDER CENTRE: PO Box 321, NORTH SYDNEY NSW 2130 Ph 888 3200 PACK & POST EXTRA

谅解我，我不能提供图像中的文字。
FEATURES:  • REVOLUTIONARY SPEAKERS

REVIEWS:  • S.A.E. PREAMP-POWER AMP DUO  146
          • MARANTZ 1300DC STEREO AMP  154
          • AKAI PS-200T AM/FM TUNER  162
The world's fastest integrated amplifier

Wave Form Comparison of Bipolar Transistor vs. Power MOS FET

Distorted signal wave form

Conventional bipolar power transistor

Maximum speed linearity

Hitachi's new Power MOS FET

Graphic Illustration: Simulated oscilloscope data from Hitachi Toyokawa laboratory

Hitachi Power MOS FET

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.
Technics' award winners released here

Technics launched their 1980 releases at a press conference in Terrigal, NSW, in March, featuring a number of award-winning products in the line-up.

Technics' Stereo Division Director, Mr Toshiro Masui said that the company entered seven of its new line-up in the 1980 Japanese Grand Prix for Audio and all seven came away with an award.

Technics' SL10 linear tracking turntable collected a special award and was presented at the conference as something of an audio star.

Although it is unlikely to become an audio buff's dream it will certainly fill a hole in the market place.

Priced at $699 (recommended retail) it is the ultimate in simple sophistication.

That may sound like a contradiction in terms, but that is what this newcomer is. Featuring a sophisticated arm and platter drive system plus automatic record size selection and track repeat features, the unit is no larger than an LP cover in overall dimensions.

It comes with a moving coil cartridge and a built-in head amp and will run off both mains and 12 volts/dc. But, although the workings are extremely sophisticated, it is so simple to operate even a baby would get by without doing any damage.

It is aimed at the "female market" that hitherto has been badly neglected in the technological rat race that surrounds the hi-fi industry.

Whether the ladies will be interested to know that the SL10 will operate on its top as well as bottom, back, and sides is hard to guess. But it was all part of the entertaining demonstration given by an engineer from Technics' record turntable factory in Osaka.

Other items of interest released at the press conference included new "honeycomb" speakers and a new type of "Class A" amplifier that will sell for between $299 (40 watts per channel) to $5000 for 200 watts per channel.

There was much discussion on this new amplifier, for which extravagant claims are made as to performance, but little was resolved.

Microcassette radio portables were shown, and a novel set of headphones that hung on one's ears like ear rings.

A new portable cassette player which comes with headphones attached for private listening only will probably interest the mums and dads fed up with having their homes polluted by teenage rock music, although the price of between $150 and $200 may dampen their interest.

The "honeycomb" speakers are an interesting concept and one that may help to heighten the Technics speakers reputation that drags well behind its reputation for producing electronics.

Technics borrowed technology from the Harrier Jump Jet for the concept.

The face of the drivers in this new speaker consist of an aluminium honeycomb 'sandwich'. Technics argue that a speaker driver is a piston that pushes air. The requirements for this piston is that it be light, so that it can be pushed with minimum effort, but rigid so that the sound is clean.

The sound from these speakers appeared excellent although no one at Terrigal was prepared to commit themselves. Private listening sessions with known material in known surroundings will be the ultimate test.

But off the cuff, they sounded alright with quite an accurate mid-range and plenty of bottom end 'oomph'.

The new Technics line up is, to say the least, interesting if not spectacular, and all will need closer examination when the stocks become available.

Dennis Lingane

Speakers and cartridges from Concept.

Concept Audio Pty Ltd have announced their appointment as importers and distributors for the KLH loudspeaker line manufactured in the USA.

KLH have developed a 'computer controlled' range of loudspeakers which have been named KLH-1, KLH-2 and KLH-3 and which have an estimated retail price of $1959, $1198 and $698 respectively. The KLH-4 is similar to the KLH-3 only without the analog computer and has an estimated retail price of $448.

Concept Audio are also distributors of the Rega turntables and cartridges. The new Rega R100 cartridge, which has a recommended retail price of $85, has been specially designed to work in all medium-mass type tone-arms.

Further information can be obtained from Concept Audio Pty Ltd, 22 Wattle Road, Brookvale NSW 2100; (02) 938-3700.

Tune in on Audiosound

If you're seeking good sound from AM or FM broadcasts then you should seriously consider the Audio sound tuner range.

The model T751 is an AM/FM tuner and the T752 is a high performance FM tuner only. Both use meticulously designed IF and RF sections resulting in high quality sound performance.

The AM100 tuner for AM only, which was released in 1970, has also been updated and is now appearing as model AM101.

This model can be supplied to cover University Radio 1750 kHz, but at the expense of the lower end which is then 560 kHz instead of 530 kHz.

Further information brochures, specifications and prices can be obtained from Audiosound Electric Services, 148 Pitt Road, North Curl Curl NSW 2099 (02) 938-2068.
When you design
a monitor loudspeaker as famous as the Model SIX,
it's very hard to go one better.

After 4 years of research we did!

ELEVEN SERIES II

In hand finished American Walnut, individually assembled and tested. 120 watts RMS per channel. Recommended resale $750 pr.

A TOUGH ACT TO FOLLOW

Available at most reputable high fidelity sound centres or information from

Peterson SPEAKER LABORATORIES Pty Ltd

7 Alex Avenue, Moorabbin 3189. Telephone (03) 553-1055.
Low profile stereo cassette decks

Latest releases from Toshiba include low profile stereo cassette decks with metal tape compatibility standing just 100 mm high.

The two units are the Toshiba PC-X20 model and the Toshiba PC-X40 model with multi MQS (Music Quick Sensor) system. Both offer the choice of metal tape recording and playback as well as use of normal and Cr02 tapes.

The PC-X20 and PC-X40 stereo cassette decks incorporate the following common features:

- Wow and flutter of only 0.05% (0.16% DIN) and frequency response of 20 Hz to 18 kHz with metal tape.
- S/N ratio of 62 dB (metal tape), and distortion of 0.04% (metal tape).
- A two-bar display for recording level indication using IED digital peak meters with the newly developed dot display; two bar-graph meters light up in green below -10 dB. From -10 dB to 0 dB green dots show the level, while above 0 dB red dots show the level.
- Soft eject and easy removal mechanism in the cassette holder.
- Dolby noise reduction, cue/review functions for easy search of recorded position, and provision for external audio timer for unattended recording and playback.

Additional highlights of the Toshiba PC-X40 stereo cassette deck are:

- Multi Music Quick Sensor system which allows programmed music of up to six tracks at a time. Programmed music positions are shown by red LEDs in multi programming, and single programming for a certain track is also possible up to the fifth track in advance, excluding the first or current track being played.

- An auto repeat function gives continuous playback of recorded tape for background music.

Pioneer price cuts attack furniture-grams

Pioneer Electronics has launched a double-barrelled attack on the $400-450 hi-fi systems market.

This market, currently estimated to be worth at least five million dollars per year, is being partially satisfied by some three-in-ones and what are commonly known as furniture-grams.

Price reductions on Pioneer's Formula 4000 receiver system and the MS-350 compact three-in-one will lead the attack, according to Pioneer.

The Formula 4000 will now sell at $399 (rrp) a reduction of $100, and the MS-350 will sell for the same price, a $70 reduction.

Both models include a belt-drive turntable and powerful AM/FM receiver to take full advantage of the new FM stations which commence operation this year.

Each is covered by Pioneer's three-year parts and labour warranty and can be purchased with matching cabinet for only $459.

For further information please contact: Rod Knapp, Publicity-Promotions Officer, Melbourne 90-9011 or Aly Joyce, Publicity-Promotions Office Sydney 93-0246.

Third-octave analyser

The Abacus Arta 8000 analyser is a versatile instrument that displays the real-time intensity and spectral distribution of sounds.

Loudspeaker measurements, whether in production testing or on site with room interaction, are important for high quality sound reproduction. Pink noise/real-time analyser testing is currently being used in studio control rooms, film dubbing theatres, cinemas and with sound reinforcement systems.

Deficiencies in system performance may be corrected architecturally, or electrically with equalisers, to adjust the electro-acoustic response to the desired 'house curve'.

The Arta 8000 analyser has numerous applications in the design, evaluation, maintenance and installation of audio circuits and systems. These include signal, hum and noise tracing; cable high frequency loss measurement; filter, tone control and equaliser circuits; cables and magnetic recorder heads; loudspeaker cross-over design and many other specialist applications in the field of audio and acoustic engineering.

For further details, please contact the Dindima Group Pty Ltd., PO Box 106, Vermont Vic. 3133.

ETI May 1980 – 127
Agfa Ferro Color Cassettes offer superb reproduction of sound and a convenient colour-coded reference system.

With a choice of three colours and three tape durations – 60, 90 and 120 – you have up to nine combinations for a comprehensive, easy-select library.

Add colour-coding to the many other features and it's easy to choose Agfa Ferro Color Cassettes.

**COLOR CODE**

- **FOLK**
- **POP**
- **JAZZ**

<table>
<thead>
<tr>
<th>z.e.</th>
<th>C60</th>
<th>C90</th>
<th>C120</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**High Dynamics:** Agfa Ferro Color Cassettes have a high quality iron oxide coating to increase dynamic range and frequency responses.

The result is a rich, clear, transparent sound ideal for the recording of all types of music.

---

**A Better Designed Case:**

Cases are of smooth lines, with rounded edges and corners to improve handling and efficiency.

**A Better Designed Cassette:**

The Cassettes are of the screwed type and side one can be easily identified.

Inside the cassette is a special noise shield to avoid unwanted 'hum'.

To prevent unintentional erasure, knock-out tabs are located in the rear. These are optional either side.

---

**For the convenience of colour-coding and for superb sound reproduction you'll be glad you chose Agfa Ferro Color Cassettes – there's more to them than meets the ears!**

---

**Practical aids in Agfa-Gevaert cassettes:**

1. immediate positive identification of side one.
2. metal noise-shield avoids unwanted "hum".
3. knock-out tabs at rear of cassette prevent unintentional erasure (optionally either side).
4. screwed cassettes.
RARE ADDITIONS FROM MARANTZ WORTH READING ABOUT. AND LISTENING TO.

Refer: very valuable.
Add’lions: the things added.
Ma’rañtz: a range of ultra-high performance sophisticated components blending state-of-the-art engineering and operational versatility.

Marantz rare additions will add a new dimension to your musical enjoyment — so hook up with your local Marantz dealer and listen to your add-on or upgrade component outperform anything you’ve heard to date.

ST-500 AM/FM STEREO COMPUTUNER
features state-of-the-art electronic quartz-locked synthesized tuning with 14 station (7 AM, 7 FM) memory presets. AM tuning is particularly sensitive and, with more FM stations due in 1980, the ST-500 tuner is a sound investment for the future.

PM 700 INTEGRATED AMPLIFIER
features Dual 5-band Graphic Equalizers and delivers 70 watts True Power per channel into 8 ohms.
The current interest in high-definition moving coil cartridges makes the built-in moving coil head-amp on the PM 700 a particular plus. This model offers the most demanding audiophile a new concept in power, price and performance.

SD 8000 2-SPEED CASSETTE DECK
takes your system beyond the traditional limits of cassette deck technology. The Compudeck Feather-Touch control centre (inset left) offers superior programming capability, e.g. up to 19 selections in whatever order you wish. Two speeds give you the flexibility of true high-fidelity recording at 3-3/4 i.p.s. plus the economy of 1-7/8 i.p.s. when recording time is a factor. Also: Dolby Noise Reduction; digital display including clock and LED meters.

Your Marantz stockist will demonstrate the unmatched quality of Marantz components. If you demand critical performance standards hear Marantz.

Distributed by: MARANTZ (AUST.) PTY. LTD.
32 Cross Street, Brookvale, N.S.W. 2100
Telephone: (02)9391900 Telex AA 24121
Melbourne (03) 3297653, Brisbane (07) 488882
Adelaide (08) 223 2699, Perth (09) 326 3674

STOP PRESS STOP PRESS
Esteemed European Hi Fi Mag., "La Nouvelle Revue du Son"
*La Revue Decibel d'Honner
*Marantz PM700, Advanced FEATURES PRAISED, NEW VALUE IN INTEGRATED AMP DESIGN.
TRIO
15MHz

from
PARAMETERS PTY LTD
"Perfection in Measurement"
Sydney 439 3288  Melbourne 90 7444

Available from selected dealers

N.S.W.  Sydney Dick Smith Stores 888 3240; George Brown & Co 519 5855; Radio Despatch Service 211 0191; Newcastle D.G.E. Systems 69 1625; Elektron 2000 69 1222; Wollongong Hundell Engineering 74 0278; Macelec 29 1455; A.C.T. Canberra Electronic Components 80 4654.

QLD  Brisbane Audiotronics 44 7566; L.E. Boughen 36 1277; N.S. Electronics 36 5061; VIC Melbourne Browntronics 419 3986; Douglas Radio 211 1698; J.H. Magrath 663 3731; Radio Parts 329 7888; Tech Rentals 267 5877; G.B. Telespare 328 4301; Geelong Teleparts 21 1288; S.A. Adelaide K.D. Fisher & Co 269 2544; Gerard & Goodman 233 2222; Trio Electrix 51 6718; W.A. Perth Cinco Engineering 381 1477; W.J. Montcrieff 325 5722; Rablec Engineering 381 2866.  TAS Hobart Inbros Surpaph Systems 23 2892; Launceston W & G Genders 31 2511.
A NEW RANGE of loudspeakers, released recently by Technics, employ revolutionary drivers having a special flat disc construction made of a unique aluminium honeycomb "sandwich" said to have great advantages over conventional paper cone drivers.

Claimed to represent a "significant step forward" in the quest for realistic reproduction of complex musical material, Technics' honeycomb disc drivers have been incorporated in their new SB range of loudspeakers — the SB-SB-3, SB-5, SB-7 and SB-10.

Five honeycomb disc drivers were developed specially for this new range of speakers: a 320 mm woofer, a 250 mm woofer, a 220 mm bass/mid-range, an 80 mm mid-range and a 28 mm tweeter.

Compared with conventional cone diaphragm drivers, a flat diaphragm driver excels in two vital areas, according to Technics: smooth frequency response and simple alignment of acoustic centres. Let's examine how these honeycomb disc drivers are constructed and the reasons behind the claimed advantages.
FREE HI-FI ADVICE

Before you buy any Hi-Fi, know the answers to these questions.
Is the system really good value for money, and will it sound as good in my home?
Will I have to lug it home and put it together, or will a factory trained technician come and set it up to perfection?
If something goes wrong... will I have the back-up of a three year warranty... and can I be sure I'll have it serviced within 48 hours?
Will my system be set up by factory specialists to get the very best from my room, using equalizers, Real time analyzers, and pink noise generators?
Will my system let me shape the music, to hear it exactly the way I want to hear it... to emphasize the instruments I enjoy?
When you buy Audio Reflex equipment, those kind of questions don't bother you. If you're buying another pretty face from a discount king, well, try and enjoy it, anyway.

For free Hi-Fi advice anytime... drop in on your Audio Reflex Dealer
Of pistons and paper

It is not without justification that the loudspeaker has often been called the weakest link in the chain of hi-fi music recording and reproduction. For over half a century the dynamic speaker, with its magnet, voice coil and paper cone, has remained principally the same, although great improvements have been made in many constructional details leading to the high quality drivers available today.

Nevertheless, much money and time has been spent in an attempt to develop "the perfect reproducer".

The familiar conical shape of the diaphragm of conventional loudspeakers was never a virtue of the basic design but a necessity forced upon speaker designers because of the need to obtain a rigid moving surface with a soft, pliant material — paper. The need for flat diaphragm speakers was apparent quite early in the piece, but solving the problem of obtaining a material suitable for the application, that did not exhibit significant resonances and was light, yet rigid, was beyond the technology of the times.

One of the serious limitations of a conventional paper cone speaker is the narrow frequency range over which it acts like a piston. Beyond a certain frequency, depending on the particular driver's construction, 'partial vibrations' occur on the cone — known as "cone break-up". Also, the semi-enclosed air-filled cavity within the cone volume has a resonance effect known as "front cavity effect" which limits the upper frequency performance of conventional drivers. Both of these effects reduce the usable bandwidth of paper cone drivers and contribute to distortion.

A further factor contributing to the limitations of conventional speakers is that the cone, being made of wood pulp, is difficult to manufacture with close uniformity from unit to unit. Secondly, its characteristics deteriorate over time, contributing to the gradual deterioration of a loudspeaker over its lifetime.

Many manufacturers have gone to considerable lengths to overcome these failings, with varying degrees of success. They are contributing factors to the high cost of good quality paper cone speakers.

Flat diaphragm speakers

The theoretical superiority of a flat speaker diaphragm over a cone type has been known for a long time. A rigid, flat diaphragm offers inherently lower distortion, a smoother frequency response, better dispersion and wider bandwidth. Flat diaphragm drivers offer a further advantage. The acoustic centre of a flat diaphragm driver is on the front surface of the diaphragm. A linear phase loudspeaker system is readily constructed by mounting flat diaphragm speakers on a plane surface. As the continued on page 140
Record Ecology in DiscKit form
— you’ll Save more than money

DiscKit is a crafted walnut tray and dustcover that saves you 20% with the Discwasher products in the kit. ($55 versus $69 separately) DiscKit includes: 1) The Discwasher System Record Cleaner with D3 Fluid, 2) the Zerostat anti-static pistol and test light, and 3) the SC-1 Stylus Cleaner.

But you’ll save more than money. You’ll save your records from imbedded micro-dust, your cartridge stylus from abrasion and your ears from a lot of static. It’s your choice, disposable records or Discwasher. (Walnut tray and dust cover are available separately as the Discorganizer, $15)

Cartridge and Disc Traker (pictured) not included in Kit, ask your nearest dealer for details.

Now includes free, DC1 pad maintenance brush.
Color your thinking with **Compucolor 11**

...The **Renaissance Machine**

The Renaissance Machine is a “one-of-a-kind” system for the “one-of-a-kind” person who demands, and will not settle for anything less than, the best.

**The color machine with the black and white price**

**Available from**

**ANDERSON DIGITAL EQUIPMENT PTY. LTD.**

MELBOURNE: 1 Expo Court, Mt. Waverley, (03) 543-2077.
SYDNEY: 9 Pioneer Ave, Thornleigh. PO Box 341, Thornleigh, NSW 2120. (02) 848-8533.
Your local dealer:
Melbourne: Logic Shop (03) 51-1950, Sydney: Logic Shop (02) 699-1910,
Newcastle: DGE Systems Pty Ltd (049) 69-1625, Canberra: ADE (062) 56-1811,
Brisbane: ADE (07) 59-6436, Adelaide: Applied Data Control Pty Ltd (08) 79-9211,
Perth: WJ Moncrieff Pty Ltd (09) 325-5722, Hobart: Management Technology (02) 34-4522,
Darwin: Direct TV and Electronic Services (089) 81-9313.
NEW ZEALAND:
NEW GUINEA: Komputel Systems 42-3924.
First Trinitron, now Betamax. Sony gives you one great innovation after another.

First Sony took state-of-the-art television technology to a new high with the Trinitron color TV.
Now Sony technology takes the enjoyment of viewing television to new heights with the Betamax videorecorder.

Connect Betamax to your TV and you can record anything. You capture the best shows on television and play them back to view again whenever you like, whenever it best suits your schedule.

But that's only the beginning of what Betamax can do.
If two good programmes are on at the same time, on opposite channels, don't flip a coin to decide which to watch. You can watch one while Betamax records the other for you to view later.

Going out for the evening? Set the 3-day automatic timer before you leave and Betamax will automatically record your favourite shows while you're away.

It took twenty years of technological experience to make a videorecorder that will do all this and still be compact enough for the home.
Sony experience also made the difference in the Betamax videocassette. It's easy to store and handle because it's the smallest cassette on the market, yet it holds more than three hours of continuous programming.

And there's the Betamax U-loading system. Experience has proved it to be the most reliable, most stable tape transport system for videorecording. It delivers a picture that is picture perfect.

First Trinitron. Now Betamax. Sony gives you one great innovation after another.

Sony Betamax
See what you've been missing.
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.
MINI-MART
Where readers can advertise
For Sale/Wanted/Swap/Join.

- We'll publish up to 24 words (maximum) totally free of charge for you, your club or your association. Copy must be with us by the 1st of the month preceding the month of issue. Please — please — write or type adverts clearly; otherwise it may not turn out as you intended! Every effort will be made to publish all adverts received however no responsibility for so doing is accepted or implied. Private adverts only will be accepted. We reserve the right to refuse adverts considered unsuitable.
- Conditions: Name and address plus phone number (if required) must be included within the 24 words. Reasonable abbreviations, such as 25 W RMS or 240 Vac, count as one word. Adverts must relate to electronics, audio, communications, computing etc — general adverts cannot be accepted.
- Send your advert to: ETI Mini-Mart, Modern Magazines 15 Boundary St, Rushcutters Bay NSW 2011

FOR SALE: 2 — 1 watt, 2 channel hand-held Sharp Walkie-talkies Model CBT-56 complete with centre load aerial, $150. Phone 528 6413, Oyster Bay, NSW.
ATTENTION REPAIRMAN: AWA A-412 FM test-set, io/hio VHF modules, handbook. Good condition. $1000 ono, or trade for ham transceiver. D.E. Young, Box 2056, Calms, Qld 4870.
COMMUNICATIONS Receiver RCA, BC224, 12 volt, working order unmodified $50. Ken Horn, 140 Old South Head Road, Vaucluse (02) 337 1033.

COMPUTING
PRINTER for microcomputer, software programmable, different character sizes, reverse printout. RS232 serial or parallel, will include RS232 interface to TRS-80 (no exp. Interface needed) free with printer if rec'd. Price and details, R. Gareb, 17/37 O'Donnell Street, Bondi 2026 (02) 30 8261.
SELL 6800 software. All machine language suit any 6800 system. Tiny assembler (4k), mnemonic assembler (6k), text editor (5k), relocater, disassembler, diagnostics package, battle-ship game. $6 ea. or $56 the lot. W. Geary, Kolan Island, WA 6733.

AUDIO
CONCRETE Speakers, '12' 3-way with dome midrange & tweeter. In tall boxes braced with concrete & polystyrene mixture, ETI crossover. Very clear & dynamic sound. Phone (08) 248 1406.
SELL: Sansui AU555 amp, dual 1010 deck, Sansui 3-way 25W speakers for $375 o.n.o. A. Organ, 21/17 Busaco Road, Mansfield NSW (03) 86 3856.
VALVE amplifier cleanout, Harmon Kardon, Rogers, Quad, Nova kit, Playmaster, Mullard etc. EL34a, KT66s and transformers $1100, o.n.o. will separate. John (02) 46 5451, West Lindfield.
IMPORTED English power amps, 120 watts RMS modules $200. (02) 56 4832.
DISCO equipment, sound and lights, items from $15 to $600. (02) 35 4832.
FOR SALE: Bruel & Kjaer model 2003 current series precision sound level meter A1 condition new price $2197 for sale at $1500 ono phone Mr. Mitchell (02) 498 5575 a.h.
SELL: TEAC AL700 ELCAST Teape Deck, 5 months old, Includes 12 tapes, suit reel to reel enthusiast. Cost $1400, sell $600. Ph. (09) 364 8126.

COMMUNICATIONS
ALL brand new unused items. Kenwood 820(S) CW Filter (was $59) MC35S Noise Canc. Mic, GE Mic (le CB). Offers. VK6NRO 111 Ravenswood Drive, Nollamara 6061. 349 4471.

COPYRIGHT: The contents of Electronics Today International and associated publications is fully protected by the Commonwealth Copyright Act (1968)
Copyright extends to all written material, photographs, drawings, circuit diagrams and printed circuit boards. Although any form of reproduction is a breach of copyright, we are not concerned about individuals constructing projects for their own private use, nor by groups (for example) constructing one or more items for use in connection with their performances.
Commercial organisations should note that no project or part project described in Electronics Today International or associated publications may be offered for sale, or sold, in substantially or fully assembled form, unless a licence has been specifically obtained to so do from the publishers, Modern Magazines (Holdings) Ltd or from the copyright holders.

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

JOIN the "Ohio Superboard User Group' Send s.a.e. to 146 York Street, Nundah, Qld 4012 for full details and a useful Graphics Chart.
PRINTER: Sell duoprint as new unused $240; also VDU ETI 640 Kit unassembled, new, complete, $100. Details (03) 90 9868.
ETI 680 CPU and monitor, ETI 640 VDU, 16k RAM, 67 key Cherry keyboard with alpha numeric, SEC1 (all bought A/T) on 12 slot Wunderbuss, power supply, 12" b/w monitor. $990. (02) 477 4775.
TRS-80 LLIST of your programmes two copies .01/line plus 50c postage. Included free programme. O. Fleming, 12 Mildshman Court, Surfers Paradise 4217. Ph. (075) 32 4810.
SAVE 20% on 48k Apple & twin discs, Diablo 1650 daisy printer — all new in mint condition. Available singly. (02) 547 1408 or 908 2235.
TELEPHONE Dialer for TRS-80. Use your computer to dial out. Includes cct diagram, program listing and Instructions. Can be modified for other micro systems. C/- P.O. Box 122, Bondi Beach 2026.
CASIO fx502P programs, hi-lo, lunar lander, poker machine, reaction timer, clock, dice+totoo draw, mus. $5 each, $25 lot. C. Thomas, 2a Burns Rd, Wahroonga 2076. (02) 48 6818.
TRS-80 sound synthesizer, based on T.I. chip. Fully buffered, completely assembled. $65 ono. R. Gareb, 17/37 O'Donnell Street, Bondi 2026. (02) 30 8261.

MISCELLANEOUS
DUAL-TRACE Oscilloscope, 2 MHz bandwidth, good working and Ideal for audio work, R.F. generator good cond. $200 ono, ring John 46 5451, West Lindfield.
DUAL Beam CRO BWD 530D z/w two 10/1 probes cost $734 new June 79, sell $600. Ring Leon (02) 48 6153 6-9 pm M-F only.
Some hi-fi systems tend to be over-endowed with cosmetic design features. In selecting a system, we feel that the most important consideration is its ability to faithfully reproduce an original sound. We rely on the following components to do just that.

- **PMA-530 Premain Amplifier:** combined equalizer/power amplifier using direct DC servo system. 60W — 60W output.
- **TU-530 AM/FM Stereo Tuner:** linear phase ceramic filters. Built-in servo lock. MPX circuits with pilot cancellers.
- **DR-230 Metal Tape Compatible Stereo Cassette Deck:** double gap ferrite erasing head. IC full-logic circuit controls. Capstan servo motor.
- **SC-101 Speakers:** compact, yet peak input power 80W.
- **DP-30L D/Drive Turntable:** non contact record end sensor. Excellent vibration damping by high density compound cabinet. Servo controlled arm lifter.

For the location of your nearest DENON dealer please contact:

**Hi-Fi Audio Equipment**

**AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED**

554 Parramatta Road, Ashfield, NSW 2131 Phone 797 5757

Canberra 90 5915
Melbourne 560 4533
Launceston 44 5155

Adelaide 273 2366
Perth 271 0888
Townsville 79 6155

Hobart 72 4366
Brisbane 44 1631

IT'S WHAT IS INSIDE THAT MATTERS
acoustic centre of conventional cone drivers is located near the voice coil, they have to be mounted on a stepped surface in order to align their acoustic centres, which gives a constructional disadvantage as well as introducing possible diffraction problems with the mid-range driver and the tweeter.

Attempts to develop a flat diaphragm driver have stepped up in recent years as the demand for better reproduction has increased. The quality of every other component in the reproduction chain has increased dramatically over the past decade, but the loudspeaker has lagged somewhat behind. You may remember one of the first successful commercially-produced flat diaphragm drivers was the well-known B19, designed by Raymond Cooke of the British KEF company. This uses an oval-shaped diaphragm made of polystyrene.

Whilst this approach was an early solution to the problem of providing a light, rigid planar diaphragm, Technics researchers looked at various techniques used in other branches of engineering aimed at producing light, rigid surfaces.

In the aircraft industry they found that "honeycomb" structures are used in the floors, wings and other parts of civil and military aircraft. The honeycomb structure consists of hexagonal 'cells' of a light metal (usually aluminium) sandwiched between thin sheets of light metal - forming a 'skin' for the structure, as can be seen in figure 2, (a) and (b). The honeycomb possesses a very high bending strength, and is thus very rigid, yet very light weight.

However, this form of honeycomb construction is not ideal for a speaker diaphragm, Technics' engineers found. For a number of reasons, a circular diaphragm was decided as being the optimum shape and a honeycomb structure having "axial symmetry" was developed. A 'normal' honeycomb (with linear symmetry) and Technics' axial symmetry honeycomb are compared in Figure 2, (b) and (c), above.

A normal honeycomb structure does not exhibit the same rigidity characteristics in all directions, as it bends or flexes more easily in the transverse direction than in the longi-
tudinal direction. In a speaker having a round diaphragm, this directionality would be an unwelcome characteristic, as the diaphragm needs to be equally rigid in all directions taken from the centre. Hence the development of the axial symmetry honeycomb core. The bending strength of this type of diaphragm is the same on any radius.

Another advantage arises from this form of construction. As its mass is greater towards the centre, its vibration 'nodes' also move closer towards the centre than for a solid disc of similar weight, but uniform density.

This helps to simplify driver construction, as we shall see shortly.

Of modes and nodes

When a guitar string is made to vibrate at an octave above its fundamental frequency there will be a point, exactly half way along the string, that does not vibrate at all. Such points are called "nodes".

The same phenomenon can be observed in flat objects set to vibrate - such as drum heads and xylophone blocks ... and speaker diaphragms. With vibrating flat objects, 'nodal lines' may be observed. In high school physics you may remember seeing this demonstrated where sand was sprinkled on a horizontal flat metal or glass plate that was supported at its centre. With the plate set to vibrate by drawing a violin bow across the edge, the sand would bounce about and settle in a characteristic pattern - along the nodal lines where it was not vibrating. A variety of patterns may be generated in this way, each representing a distinct "vibration mode". A German physicist name Walter Ritz first examined the vibration modes of square diaphragms in 1909 and calculated the many modes possible.

Such vibration modes are distinctly undesirable in a speaker diaphragm as they introduce harmonic distortion. Remember that I mentioned the term "cone break-up" previously? This is where the speaker diaphragm changes its mode of operation from that of a piston and goes into various vibration modes as the drive frequency is increased.

Where, and in what shapes, these nodal patterns appear on a speaker diaphragm depends on several factors, including the diaphragm's basic resonant frequency, its shape and the frequency at which it is driven.

A computer analysis of the nodal patterns of a disc and a square plate for a range of frequencies is given in the illustration here, showing that the disc has a simpler arrangement of nodal lines. This indicates that it exhibits less harmonic distortion as it is driven over a range of frequencies.

These unwelcome vibration modes can be prevented in either of two ways: by driving the diaphragm across its entire surface (which is technically extremely difficult and thus costly) or by applying the drive where it intersects the most nodal lines. Centre drive is undesirable as can be seen from Figure 4. "Nodal drive", as Technics call it, prevents spurious vibration modes forming, forcing the diaphragm to move as a rigid piston over a wide drive frequency range.

The dramatic effect on the usable frequency range of a disc diaphragm
with nodal drive, compared to centre
drive, is readily apparent from Figure 5.
Serious resonances occur at quite low
frequencies when the disc is centre
driven, producing pronounced peaks
and dips in the frequency response.
Nodal drive moves these resonances
well up in the frequency range,
extending it two octaves or more.

With a square diaphragm, the more
complex nodal patterns make it
impossible to provide nodal drive with
a single voice coil across as wide a range
as with the disc diaphragm.

Now, nodal drive for a disc
diaphragm requires a voice coil and
magnet structure that can drive the disc
at a considerable distance from the
centre. Technics have solved this
problem with two basic construction
methods. A cross-section of the 320 mm
woofer shows one form of construction.
The voice coil in this driver is 160 mm
in diameter! This woofer is used in the
new SB-10 loudspeaker and, although
crossed over to the mid-range driver at
400 Hz in this design, it can be used to
3.3 kHz, Technics claim. The reverse-
rolled edge construction prevents
spurious sonic radiation from the edge of
the diaphragm near the upper
frequency limit of the driver's range.

The other type of construction is
illustrated in Figure 7. This shows the
250 mm woofer where the voice coil
mounting bobbin applies nodal drive
to the diaphragm via a rigid cone.

Technics' top-of-the-line model
SB-10 loudspeaker is a three-way,
three-driver combination employing the
320 mm honeycomb disc woofer, the
80 mm honeycomb disc tweeter and a
new "leaf" tweeter. The bass is crossed
over to the mid-range at 400 Hz and
mid-range to tweeter crossover occurs
at 4 kHz. The system is rated at 100 W
DIN (150 W music) and develops an
output level of 87 dB/W at 1m.
Technics claim the frequency range
extends from 28 Hz to 125 kHz at
10 dB below average level. Nominal
impedance is 8 ohms. The unit measures
711 mm high, by 402 mm wide and
318 mm deep. It weighs 32 kg.

The SB-7 is also a three-way, three-
driver system and uses the 250 mm
honeycomb disc bass driver, the 80 mm
honeycomb disc mid-range and the leaf
tweeter. It is rated at 90 W DIN and the
lower frequency extends to 34 Hz.
Output level is specified the same as the
SB-10. Crossover frequencies are at
900 Hz and 4.5 kHz. The unit is a little
smaller, measuring 630 x 360 x 318 mm
and it weighs only 19 kg.

Only time and experience will
adjudge the success of this new
approach to driver design. We will
review one of these loudspeakers in
ETI as soon as possible.

<table>
<thead>
<tr>
<th>Nodal Drive</th>
<th>Center Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Freq. Response" /></td>
<td><img src="image2" alt="Freq. Response" /></td>
</tr>
</tbody>
</table>

**Figure 5.** Illustrating how the frequency response of a disc, i.e.: its range of 'pistonic motion', is extended by nodal drive.

**Figure 6.** Cross-section of Technics' 320 mm honeycomb disc woofer.

**Figure 7.** Cross-section of the 250 mm honeycomb disc woofer. The other honeycomb disc drivers are similar.
For your records, it’s A-1.

Want to hear everything on your records? Don’t just boost the volume: cut the distortion.

Our new A-1 amplifier cuts it to less than 0.008%. Your music’s going to sound as it did in the studio.

Press the exposed control marked DISC. You eliminate tone and filter control circuitry. It makes the difference between 0.02% distortion and 0.008%.

Another cut on the A-1 is clutter. Only essentials are exposed. Controls such as the built-in MC head amp are hidden, under a drop down front panel.

When you do feel like boosting the volume, there’s up to 70W per channel in reserve.

Take a favourite record to your Yamaha dealer. Listen to your first A-1 experience.

You’ll want your records to sound like that, always.

YAMAHA A-1 DC direct coupled amplifier
Minimum Output Power: 20-20,000 Hz 70 + 70 watts
Total Harmonic Distortion: less than 0.005%
IM Distortion: less than 0.003%
Phono S/N Ratio: over 85 dB
Phono MC S/N Ratio: better than 70 dB
Residual Noise (DISC ON) less than 50 μV
Frequency response (RIAA) 20 Hz-20 kHz 0 ± 0.2 dB
Tone to SP out: 20 Hz to 20 kHz +6 / -0.02 dB
Power consumption 215W
Dimensions (WxHxD) 435 x 117 x 381 mm 17¾" x 4¾" x 15"
Weight 15.8 kg (34 lbs 12 oz.)

Based on ETI’s superb new 466 amplifier module, the Jaycar 3002 kit provides high power at a fraction of the cost of comparable commercial units.

LED power meters that give an accurate reading of output power, speaker protection against overload, and DC voltages, have been combined with two ETI 466 modules and a rugged rack mounted case, to provide an amplifier that will withstand the tortures of “on the road” use.

FEATURES:
- 300 watts per channel.
- LED power meters.
- Input level controls.
- Massive heatsinking.
- Inbuilt speaker protection.
- Thermal overload protection.
- Rugged rack mounting cabinet with handles.

Send S.A.E. for full information and specification sheet.

This unique 88 note piano is fully touch sensitive and offers 4 selectable piano tonal qualities plus tremelo, honky-tonk and phasing effects. Complete with pedals, this is the best performance piano kit on the market today.

“CLEF” TS88 Touch Sensitive Piano
- Full 88 note keyboard.
- Touch sensitive on all voices.
- Sustain and Soft pedals.
- Combination of voices and harpsichord plus electronic effects.
- Small, compact and lightweight.

“CLEF” String Ensemble
Simulates the multiple source sound of string group.
- Split keyboard facility.
- 4 voices on upper keyboard.
- 3 pre-set voices on lower keyboard.
- Variable Attach and Decay.
- Foot controlled Swell pedal.

Complete Kit Only $550

Complete Kit Only $395
JBL's 4311 Studio Monitor.

Now it's not for studios only.

JBL is making its most popular studio monitor available to everyone.

It's a 3-way, high-efficiency system that gives you wide range response. And, because it's compact for use in small studios, and is finished in hand-rubbed walnut, it's perfect for your living room or den. The JBL 4311 compact studio monitor.

For details and demonstrations visit us: THE PROFESSIONALS IN JBL.

JBL

First with the pros.

For further information, local agents and wholesale prices, write to the Australian importers:

Delsound Pty. Ltd.

1 Wickham Tce. (Cnr. Wharf St.)
Brisbane. Phone 229-6155.
Wholesale and retail suppliers of electronic hardware and components.

Cheap Tapes!

BULK TAPES DISCOUNTED

Maxell

| LN C90 | ULTRA LOW NOISE | Box of 12 | 18.00 |
| LN C90 | ULTRA LOW NOISE | Box of 12 | 25.00 |
| LN C120 | ULTRA LOW NOISE | Box of 12 | 37.00 |
| UD C90 | ULTRA DYNAMIC | Box of 12 | 29.00 |
| UD C90 | ULTRA DYNAMIC | Box of 12 | 35.00 |
| UD XL C90 | EPITAXIAL | Box of 12 | 36.00 |
| UD XL C90 | EPITAXIAL | Box of 12 | 48.00 |
| UD XL II C90 | EPITAXIAL | Box of 12 | 40.00 |
| UD XL II C90 | EPITAXIAL | Box of 12 | 50.00 |

TDK

| D-C90 | DYNAMIC | Box of 10 | 18.00 |
| D-C90 | DYNAMIC | Box of 10 | 23.00 |
| AD-C90 | ACOUSTIC DYNAMIC | Box of 10 | 28.00 |
| AD-C90 | ACOUSTIC DYNAMIC | Box of 10 | 33.00 |
| SA-C90 | SUPER AVILYN | Box of 10 | 34.00 |
| SA-C90 | SUPER AVILYN | Box of 10 | 42.00 |
| MAR-C90 | METAL (METAL CASE) | Each | 14.00 |
| MA-C90 | METAL | Each | 11.00 |

Sony

| CHF C90 | ORANGE CASE | Box of 10 | 18.00 |
| CHF C90 | ORANGE CASE | Box of 10 | 24.00 |
| BFH C90 | GREEN CASE | Box of 10 | 24.00 |
| BFH C90 | GREEN CASE | Box of 10 | 28.00 |
| AHF C90 | BLUE CASE | Box of 10 | 29.00 |
| AHF C90 | BLUE CASE | Box of 10 | 30.00 |

Fuji

| FL 90 | SUPER LOW NOISE | Box of 10 | 17.00 |
| FL 90 | SUPER LOW NOISE | Box of 10 | 20.00 |
| FXI C90 | PURE FERRIX | Box of 10 | 18.00 |
| FXI C90 | PURE FERRIX | Box of 10 | 20.00 |
| FXII C90 | BERIDIX | Box of 10 | 24.00 |
| FXII C90 | BERIDIX | Box of 10 | 41.00 |
| MC 50 | METAL | Each | 11.00 |
| MC 90 | METAL | Each | 14.50 |

Opus

| UD C90 | EXT. RESPONSE | Box of 12 | 25.00 |
| G-C90 | G-TAPE LOW NOISE | Box of 20 | 19.00 |

Further discounts available on purchase of 10 boxes or more.

Add: Pack & Post - VIC.

Tas/Sa/Wa/Nt/Wld

1 - 2 Boxes | $1.00 | $2.00 | $3.00 |
3 - 4 Boxes | $1.50 | $3.00 | $5.00 |
5 - 6 Boxes | $2.00 | $4.00 | $5.50 |

Stock at prices shown available at time of going to Press.

To:

Mail Order Centre
A.M.S. Systems,
135 Hawthorn Road,
Caulfield, Vic. 3162.

Ph: (03) 528 1149
Preamp-power amp duo from S.A.E.

The SAE model 3000 preamp and associated model 2200 power amp, coming from a company renowned for quality products, do not rest on the laurels of their predecessors.

THE SAE MODEL 3000 preamplifier and the associated 2200 stereo power amplifier are two attractive pieces of equipment from an organisation which is already renowned for the quality of its products. The most striking feature of the combination are the number of controls and their layout which appear deliberately designed to complicate what might otherwise have been a far simpler panel appearance.

Both of these pieces of equipment are designed for rack mounting and when mounted in either a portable or permanent racking system, do provide a striking and attractive appearance. The design is in keeping with the current American consumer vogue which is primarily aimed at impressing your friends and neighbours as much as impressing the purchaser.

Features

The 3000 preamplifier has its controls laid out in three basic rows and with three major groupings from left to right. On the extreme left hand side of the amplifier is a power on/off switch with a headphone socket immediately below. Adjacent to these are two columns of controls with Channel A and Channel B controls side by side.

The top row contains the two treble controls, below it the two mid-range controls and at the bottom the two bass filter controls. The treble provides a nominal of +15 dB of boost and cut at 20 kHz, the bass a nominal +15 dB of boost and cut at 20 Hz and the mid range +7 dB range at 1 kHz.

The central group of controls provide tape controls in the top row with four push buttons whose function are not clearly evident from the designations, but this is soon cleared up by the handbook. These buttons make it possible to monitor source or tape, monitor tape 1 or tape 2, copy from tape 1 to tape 2 or tape 2 to tape 1 and tape on to one recorder while monitoring another.

Although not as well designated as we would desire, getting used to them is a relatively simple task and they do provide excellent flexibility.

In the bottom row is a balance control which provides up to 40 dB differential balance adjustments between left and right channels.

The central group switch controls are a -12 dB mute switch, adjacent to which are three mode controls for mono A, mono B, stereo or reverse, whilst in the bottom row is a fader volume control with a -70 dB to a maximum gain with calibrations of 70, 40, 35, 30, 25, 20, 15, 10, 5 and zero dB.

The rear of the amplifier features inputs by standard co-axial sockets for two photo cartrigdes, tuner or auxiliary, tape 1 in and out, tape 2 in and out plus outputs to two amplifiers.

Whilst the unit comes wired and labelled 240 volts ac, 50/60Hz, it is interesting to note that the ubiquitous switched and unswitched sockets which do not comply with Australian Electrical Supply Association's rules are still located on the rear of the unit.

The power amplifier has the same sort of bold black appearance as the preamp but it is not as easy to mount in a 19" rack. It is however, more interesting in many respects than the preamplifier. The first and foremost eye-catching factor is the use of an array of light
emitting diodes as a power level display. This incorporates diodes which read with 3 dB incremental steps from -36 dB to +3 dB. This corresponds to power levels from .02 watts to 200 watts in to 8 ohms, together with an idle position which indicates that the amplifier is operating. LED arrays like this provide a graphic and exciting display when the unit is in operation and are as functional as they are attractive.

One feature we did not like on the front panel was the use of impractical handles which, regrettably, have dangerous sharp corners of the type we criticised so strongly in the Jands J600 amplifiers three years ago.

The rear of the amplifier features an internal heatsink construction with a very open area for cooling air paths. These are cleverly designed and obviously effective. The rear of the amplifier features two coaxial input sockets, large universal terminals for input and output and a two-wire mains lead with parallel pin plugs intended to be plugged into one of the switched mains outputs of the preamplifier.

The constructional features of both the preamplifier and the main amplifier are exemplary and it is interesting to note that the power amplifier incorporates a large toroidal transformer which is the heart of the power supply for the unit. Both the units are well constructed and the designers have placed a lot of thought and emphasis in providing good operational flexibility.

On test

The frequency response with the tone control 'centred' or 'defeated' is essentially unchanged, extending from 5 Hz to 67 kHz and is ably supplemented in the low frequency region by the two lots cut filter positions which allow programme hum or room resonance disabilities to be minimised.

The hum and noise levels of the unit are not quite as low as we would have expected and on the phono input the level at -65 dB linear (unweighted) and -68 dB (A-weighted) are acceptable but certainly not superlative. The auxiliary input produces a comparable level of hum and consequently it would appear that it is the output stages of the preamplifier which is generating that level of hum.

The distortion characteristics of the amplifier are, however, exemplary and at the 100 watt level the performance is almost in the category of being "state of the art".

At 100 Hz the distortion level is a maximum of .024%, at 1 kHz .009% and at 6.3 kHz .013%. At lower power levels the distortion levels are even lower still and are, without a doubt, a credit to the system's designers.

We were surprised that the distortion in the left channel and the right channel were significantly different, with the left channel generally producing higher magnitudes than the right channel produced. Even so, the left channel produced inconsequential levels of distortion and the difference between the channels is really of academic interest.

Subjectively

The subjective impressions of the amplifier's performance were outstanding. Firstly, the flexibility of the preamplifier stage showed through to the fore under the real life living room conditions. We were pleasantly surprised by the ease with which we could copy from one recorder to another and even more so by the general ease with which other equipment could be interconnected and played through the
YOU'VE NEVER SEEN A CASSETTE DECK CLEANER LIKE THIS.

The ALLSOP 3 not only restores fidelity to the head, but cleans the two major troublespots, the capstan and the pinch roller, at the same time. Dirt build-up on the pinch roller and capstan are the leading causes of 'tape-eating' and slippage. ALLSOP 3 efficiently does the lot with a new patented, totally non-abrasive scrubbing and wiping action, not by scraping with abrasive tape. It's surprisingly simple and very effective.

You really have to see it for yourself. And you can at all leading record, hi-fi and department stores.

ALLSOP

Sole Australian distributor:
Communications Power Inc. (Aust.) Pty.Ltd.
PO Box 246, Double Bay, NSW 2028. Ph (02) 357-2022
Telex AA23381

HOW TO MAKE THE BEST OF A BETTER CAR STEREO

Without, the FOSGATE PUNCH even the finest AM/FM tuner and tape deck can do little more than decorate your dashboard. The FOSGATE PUNCH is real power...the only kind of power that can create perfect stereo reproduction. Take our PUNCH 2100 for instance, Power amp, preamp, and your choice of speakers. 100 watts RMS per channel. With less than .05% THD, you hear no distortion from 20 Hz to 20K Hz.

At any listening level you enjoy full cycle, high fidelity playback of studio quality, in city traffic or at highway speeds. Our speakers are designed to take the PUNCH and deliver rich, penetrating bass, well-defined mid-ranges, and brilliant, crisp highs. You can listen at a whisper or crank up the volume till it vibrates your rear-view mirror and never hear a distorted note. There are a lot of better tuners and tape decks on the market. To make any one of them the best, stop at your FOSGATE dealer and have him give it the PUNCH.

FOSGATE THE PUNCH

It is as far as you can go in car stereo.

Transient overload recovery test for the S.A.E. preamp and power amp system. Picture at left shows oscilloscope trace of output with sweep speed of 50 ms per division. The right hand picture is the same waveform expanded to 1 ms per division. (10 dB overload re rated power into 8 ohms, both channels driven; overload duration: 20 ms, repetition rate: 512; IHF-A-202).

The system, the preamplifier, amplifier and associated peripherals fit well in a mobile racking system which we used for the evaluation. We employed a system based on an Audio-Technica AT-30E moving coil cartridge mounted in a Technics direct drive turntable. The output was monitored on a pair of Quad electrostatic speakers.

The transparency of the sound, lack of colouration and superb transient response of the system was fully evident. With the electrostatic speakers the amplifier hum level was undetectable at normal programme levels but wideband hiss was just detectable close to the speakers. With a sub-woofer system connected, the hum was just detectable at 100 Hz. The hum and noise is dominated primarily by wideband transistor noise. This does produce an audible hiss at maximum amplification levels.

**Summary**

The SAE 3000 preamplifier and 2200 power amp are a well-designed system providing generally exemplary performance with an unusual degree of flexibility. Whilst we were not initially captivated by the appearance of the preamplifier we soon found that the designers had done a very good job in providing a degree of functionality greater than the average user could reasonably ask for.

We rate this combination highly in terms of performance and most particularly for its operational flexibility.

**SAE MODEL 3000 PREAMPLIFIER**

**Dimensions:** 483mm wide x 132mm high x 130mm deep

**Weight:** 4.7 kg.

**Price:**

**POWER AMP MODEL 2200**

**Dimensions:** 483mm wide x 133mm high x 203mm deep

**Weight:** 11 kg.

**Price:**

Manufactured by: Scientific Audio Electronics, Los Angeles, U.S.A.

Absolute copyright in this review and accompanying measurements is owned by Electronics Today International. Under no circumstances may any review or part thereof be reprinted or incorporated in any reprint or used in any advertising or promotion without the express written agreement of the Managing Editor.
REFERENCE PREAMPLIFIER
This new class A preamplifier eliminates cartridge interaction common mode and slewing induced distortions, and provides accurate and extended bass response with 18dB/octave subsonic filtering below 15Hz. Noise reduction unit links and record/playback/copy facilities for two tape decks are provided. 20Hz-20KHz ± 0.25dB (RIAA); <0.01% THD at 1V out (20Hz-20KHz); 10V/10dB phono slewing rate; 90dB signal/noise below 10mV in 40dB overload margin (20Hz-20KHz).

OCTAVE BAND GRAPHIC EQUALIZER
A high slewing rate, ultra low noise, wide bandwidth design. 20Hz-20KHz ± 0.25dB; <0.01% THD at 1V out; 100dBA signal/noise ±21dB control range (adjacent filters at 3%) A $395

Please contact
AUDIO DESIGN
3/7 Harvton Street, Stafford, 4053, or phone (07) 356-9191 for further information.

4 POWER AMPLIFIERS
The amplifiers all feature high slewing rates and will drive 8 ohms ±400° load phase angles to full output. Avoidance of output coupling makes networks eliminate frequency response aberrations with reactive loading. 20Hz-20KHz ± 0.25dB; < 0.05% THD at 1VD below clipping (typically 0.02% at 1KHz). 25Watts/channel into 8 ohms CLASS A .................. $595 50/75Watts/channel into 8/4ohms CLASS AB1 .......... $350 100/150Watts/channel into 8/4ohms class AB1 .......... $550 200/300Watts/channel into 8/4ohms class AB1 .......... $750

ACTIVE CROSSOVER UNIT
This 2/3 way unit features a phase and amplitude coherent class A design. Variable 100Hz-1KHz, 8Hz-8kHz crossover frequencies; 5V/10dB slewing rate; 100dBA signal/noise ratio; <0.01% THD at 1V out; 26dB gain range. NEW SUBWOOFER CROSSOVER 18dB/octave; 150Hz nominal ................ $395

OTHER PRODUCTS INCLUDE compander, active crossover/amplifier combination, moving coil amplifier, disco mixer, 12 into 2 microphone mixer, loudspeaker systems, passive crossovers.

RANK ELECTRONICS PTY LIMITED

for the HIRE or SALE of LIGHTING for ENTERTAINMENT
You have to be very confident before you claim anything will permanently remove static electricity from a gramophone record.

Today anyone who makes a claim on behalf of a product had better be able to prove it. Or faster than they can say Norman Jesky they'll be in big trouble.

Derek Pugh of Concept Audio confidently introduces to Australia a remarkable new product. It's called Permostat. And it permanently renders records free of static electricity.

What is this thing called static?
The contact of two dissimilar materials is liable to cause an exchange of electrical charge. Thus when a record is removed from its sleeve, subjected to cleaning by a pad or brush or is in contact with a stylus, the record surface is inevitably left in a highly charged state.

What are the effects of static?
Not unlike a common magnet attracting iron particles, static scavenges and draws dust particles onto the record surface where they can be pushed along the grooves, creating various degrees of distortion. A highly charged record surface can cause micro discharging, uneven cartridge attraction and alteration of the stylus tracking force, resulting in wow and flutter, distortion and record stylus wear.

Permostat?
Permostat is a uniquely formulated fluid which when applied to a record totally and permanently eliminates static.

How permanent is permanent?
It is claimed that playing a record one hundred times corresponds to the normally expected use of a given record by a consumer. This is also the number of plays used by record companies for evaluating their products. Tests prove that Permostat eliminates static for at least one hundred continuous plays.

Are there any adverse effects?
Laboratory tests confirm no detectable change in sound quality, surface noise, frequency response and fidelity.

Who produces Permostat?
Permostat has been researched, developed and produced by the British firm, Milty Products, a leader in the field of record care and maintenance, whose Pixall record cleaner has already won the coveted Japanese Grand Prix award.

Where can I buy Permostat?
You'll find Permostat in all good hi-fi, audio, record and department stores. However, if you have any difficulty in obtaining Permostat, please fill in the coupon below.

Dear Derek Pugh, Permostat had better permanently render my records free of static. Or I shall be making one or two phone calls.

(BLOCK CAPITALS PLEASE)
Name
Address
Postcode

Please supply (state quantity required)
Permostat Kit(s) @ $15.95 □ Permostat Refill @ $9.95 □
P&P Incl. I enclose a Cheque/P.O. value $

Concept Audio.
Where only the very best is good enough.
Concept Audio Pty. Ltd.
22 Wattle Rd, Brookvale, NSW. 2100. Tel: (02) 938-3700.
Awaken to the power of the giants.

SAE

Solo. Distributed in Australia by audio engineers

Amplifiers: The range of SAE Stereo Power Amplifiers which go from 50W per channel to 400W per channel were designed with one basic philosophy which is to incorporate the same state-of-the-art circuitry in every model. In the Amps; the only difference in the various models are power output and features such as LED readout or VU metre. Preamplifiers: SAE make a comprehensive range of high quality low distortion preamplifiers. All models include two stage Phono Circuit tape facilities and filters. Two of the range incorporate parametric equalization. Equalizers: There are three parametric equalizers in the range, all of which are three octave and offering, not only cut or boost, but adjustment of the band width and centre frequency. This flexibility offers the most precise form of tone control available. Impulse Noise Reduction System: This is a specifically designed unit to reduce the "click" and "pop" (impulse noise) which are present in phonograph records and other program sources. Other Products in the SAE Range: Integrated amplifiers and preamplifiers, Time delay ambience systems and Electronic cross-over.

For more details about the large range of SAE products, contact Audio Engineers Pty. Ltd.

AUDIO ENGINEERS P/L
342 Kent Street
SYDNEY 2000 N S W

AUDIO ENGINEERS (Vic.)
2A Hill Street
THORNBURY 3071 Vic

AUDIO ENGINEERS (Qld.)
SIACastlemaine Street
MILTON 4064 Qld

ATHOL M. HILL P/L
33 Wittenoom Street
EAST PERTH 6000 W A
Otoscopic 3B

Otoscopic 3B has been designed for those who are seeking the ultimate in loudspeakers. Its development has taken 3 years intensive work by some of the most highly qualified people in the industry. No other company in the world has produced a loudspeaker which exhibits the synergy of modern computer-aided research and the very latest innovations which are to be found in Otoscopic 3B.

If you're serious in your quest for sonic perfection, you owe it to yourself to find out more about Otoscopic 3B, a system which contains solutions to problems that still mar the performance of most other loudspeaker systems.

For further information on this and others in our range of top quality hand-crafted loudspeakers write or call:

Otoscopic Loudspeakers,
PO Box 480, Artarmon, NSW. 2064.
Phone: (02) 95-0084.

audibly superior
technically brilliant!
Marantz model 1300DC stereo power amp

Louis Chaljis found this amplifier "... an excellent example of careful design and planning. What has resulted is a first class piece of electronics."

IT IS ONLY a few weeks since we tested a high powered Marantz receiver (the model 2600, April issue... Ed.) and as a result, the model 1300DC amplifier is of particular interest to us. One might think from the size, most particularly the weight, and unquestionably the power output developed by the range of Marantz amplifiers and radio receivers which are submitted to us, that the catch cry of the Marantz Dompany is "big is beautiful". This is another particularly good example of the design trend which is still very much in vogue in the USA.

The unit
The appearance of the 1300DC is impressive. Whilst it most certainly would not be everybody's cup of tea, it is nonetheless clear that from an ergonomic standpoint the designers have done a commendable job.

The major controls are cleverly aligned in the centre level of the three rows of controls located on the front panel. The front panel is unusual, firstly in that it incorporates a panel fascia which extends beyond the main face by about 3 mm. This panel has, on the left hand side of the top row, push button switches for the two phono inputs, tuner and auxiliary, only one of which can be selected at a time, with push button switches for tape 1 and tape 2 monitor, adjacent. On the right hand side of the escutcheon is a tone defeat push button, and switches for selecting turnover frequencies for the bass and treble controls of 100 Hz and 10 kHz respectively. These can change the base turnover frequency from 500 Hz to 100 Hz and the treble turnover frequency from 2 kHz and 10 kHz.

Two other filter switches are provided, one a low cut filter, with an 18 dB per octave slope with a corner frequency of 15 Hz, together with a 9 kHz high cut filter with similar characteristics. The last switch in the top row is a conventional 20 dB muting switch.

The middle row of main controls has two record selector switches instead of the more conventional single knob. These select the signal source to be sent to either of the two respective tape recorders which may be connected to the unit. Record Selector 1 switch is intended to provide the input for the main recorder whilst the Record Selector 2 switch is intended to select the inputs of the secondary or optional tape recorder. Both of these rotary selector switches can operate independently of the main input selector push buttons and they each provide facilities for direct connection where the audio signal from the chosen source, selected by the input push buttons, is either directly connected to a tape recorder or alternatively one tape recorder is connected to the other tape recorder. Possibly more important, they make it feasible for tape recording to take place from one input whilst monitoring or listening to another input which may or may not be recorded simultaneously and may or may not be re-equalised simultaneously.

Obviously there are other ways to solve this problem and it does take some careful thought and comprehension of the philosophy of this design facility in order to prevent accidental disconnection of a signal source which is being recorded or monitored. Most people are obviously more used to a more conventional and somewhat simpler arrangement for providing these sorts of facilities, but there can be no denying that the concept Marantz have chosen does provide a greater degree of flexibility, even though the route by which it is chosen may not appear the most direct.

Marantz have incorporated three tone control circuits for each of the two channels: a bass, a mid-range and a treble control. These are vertical sliders with mechanical indents to simplify
The Marantz 1300DC stereo power amp. This one is shown in the optional wooden cabinet.

setting. Slider controls are preferable to rotary switches or horizontal faders and are ergonomically well designed as they give a graphical indication of what is happening in a simple and direct manner. Between the two sets of tone controls for the left and right channels Marantz have incorporated the tape equalisation switch. This allows the re-equalisation of program content being fed from the record player, tuner or auxiliary input, and more importantly, being fed from the main tape recorder to the secondary recorder.

In the upper position with the tape equaliser switch set to the “one" position recording should take place on the main recorder, whilst in the “two" position, onto the secondary recorder.

Planking this tape equalising switch are two peak overload lights which operate when either amplifier reaches the clipping point (200 watts output into 8 ohms). On the right hand side of the tone control circuits is a mode switch for reverse and normal stereo, left plus right, and left or right respectively. The volume control is located at the extreme right and features mechanical indents and a calibrated 80 dB dynamic range. The bottom row of controls contains push button for selecting moving magnet or moving coil cartridges at phono 1 selector input, two standard tip and sleeve microphone sockets, with sensitivity suitable for normal dynamic microphones, and rotary switches for selecting moving magnet cartridge input impedances. These provide for impedances of 1k ohm, 10k, 27k, 47k and 100k ohms, and capacitances of 100, 150, 220, 330 picofarads, which facilitates optimum termination of a wide range of cartridges.

In the centre of the bottom row is another slide control with indent, which is located in the horizontal plane for balancing the two channels. To its right is a contour switch for setting the loudness contours. This has a sensible off position at the extreme antiloclockwise end. Two speaker push buttons are provided for selecting system 1 and 2, with a minimum impedance of 4 ohms total. The remaining controls are a tip-ring-and-sleeve headphone phono socket and a mains power switch. The power switch is coupled to a LED which is located at top centre on the front escutcheon.

The front panel is fabricated in a light, gold-anodised, brushed satin aluminium with black stencilled lettering. The cabinet cover is in black, vinyl-coated steel, with an extensive area of slots to provide good ventilation for the electronic circuitry. The rear panel, which is set a long way back from the front panel, has been restructured for the Australian market. It does not incorporate the switched and unswitched outlets that the Japanese and American models contain. More important, it also incorporates the very useful addition of DIN record/replay sockets to simplify inter-connection of the external tape recorders.
from
BRIAN BAMBACH ELECTRONICS
The Electronic Kings of the Hunter Valley

$129
TECHNICS RS-M6
- Dolby - Full Auto Stop - Soft Eject

$179
TECHNICS SL-D3
Auto Direct Drive
Rumble -75db
Wow & Flutter 0.014%
with Memory Repeat!!

$289
NATIONAL TR5000A
AC/DC 3-in-one
Cassette/Radio/TV

$199
RS-M17 TECHNICS DOLBY DECK
With Fluro Meters, Standby Timer &
Auto Rewind/Play. Super Value!

$489
NATIONAL SG3000
Slimline 3-in-one Music Centre
Huge 25W plus 25W output!

$239
SL-Q2
TURNTABLE
Technics Quartz
Locked Direct Drive!
Rumble - 78db
Wow & Flutter from 0.012%

$499
NATIONAL RF4900
All Band Receiver with
digital display and F.M.

Send cheque or money order only. Add $5.00 p&p.
Finance arranged - shop customers only.
We also stock one of the widest range of Resistors, Caps and
Semiconductors outside Sydney! Specialising in Micro Chips.

BRIAN BAMBACH ELECTRONICS
670 Hunter Street, Newcastle.
All Mall: PO Box 5148, Newcastle West, NSW 2302, Australia.
Phone (049) 24996. Telex AA28708 BAMBAC.
The new generation of factory-built or kit-set Peerless loudspeakers

It's true most speakers look alike and that price alone never tells the whole story. But now the new generation Danish-built Peerless loudspeakers give you a recognizable difference in sound quality—a difference that has set Peerless a notch above the others for over 50 years.

The range of new generation Peerless loudspeakers includes the fully assembled PAS series plus the money-saving PLK kits. Both series contain drive units with the following characteristics.

**Peerless 'X' Line Woofers**
- Large ceramic ferrite magnets for high power handling.
- Specially coated cones reduce colouration to a minimum.
- Cones are supported by a single-roll foam or rubber surround to maintain excellent linear motion.
- Bass response is clean and tight at all listening levels.

**Peerless Midrange Units**
- Sealed back units prevent interaction with the woofer.
- Distortion and colouration are reduced to a minimum.
- The rear side of the cone is coated with a special damping material to eliminate colouration.
- Specially impregnated polyurethane cone rim provides high degree of linearity.

**Peerless Tweeters**
- Dome tweeters designed for the highest accuracy of reproduction with low distortion flat response and wide dispersion.
- The sealed back isolates the tweeter from interference.
- Specially developed dome fabric ensures no degradation of performance even after prolonged heavy loading.
- Assembly mounted on a precision diecast plate where rigidity ensures permanent alignment.

**Peerless Dividing Networks**
- Peerless crossovers use air-cored chokes for maximum power handling, and special electrolytic capacitors to ensure long term reliability.
- All components are mounted on fibreglass printed circuit boards for maximum durability, while coded clip connectors eliminate the need for soldering.

Danish-built Peerless loudspeakers, Orthodynamic headphones and unique car speakers are imported by the sole Australian agents,

**G.R.D. GROUP Pty. Ltd.**

698 Burke Road, Camberwell. 3124. Telephone (03)821256. Telex 31712

Please send me descriptive literature and dealer list:

- Name
- Address
- Postcode
Another notable difference between this amplifier and other units is the incorporation of a fifth foot squarely under the middle of the unit. This distributes the loading which is actually at its greatest underneath the centrally located transformer.

The inside of this amplifier is as impressive as any piece of professional equipment that we have recently seen. The first and most obvious feature are the two separate power supplies used to feed each of the output power amplifier stages. Whilst these are derived from a single, large fully-screened conventional power transformer, the actual windings for the two power supplies, the filter circuits, regulators, protection circuits and capacitors are completely separate.

Visual inspection shows that the designers have gone to a great deal of trouble to provide high strength and good ventilation in the thermal dissipation paths. One was immediately aware of the excellent accessibility for maintenance purposes and the extent of their care in maximising screening to minimise electrostatic and electromagnetic induction problems between the input circuit at the rear of the amplifier and the switching and control circuits located at the front.

In the low level circuits the designers have made very extensive use of flat ribbon cables as well as board mounted regulators to feed preamplifiers, to achieve a better performance and reliability. Whilst the components are in the main commercial or consumer type standard the construction appears to be highly professional and this particular unit would obviously fair almost as well in professional usage as it would in its obviously intended role as a consumer based amplifier.

**On test**

The objective testing of this unit showed that it has excellent performance. The frequency response extends from 1.4 Hz to 150 kHz with the tone controls defeated. This drops to 82 kHz with the tone control centred. The input sensitivities were 12 millivolts for auxiliary input, tuner and tape, 125 microvolts for the moving magnet phono input and 20 microvolts for the moving coil input. The overload sensitivity for the moving magnet input is 280 millivolts which is more than adequate.

The amplifier's output impedance is less than 80 milliohms, and in a real situation would be limited by speaker cabling and not by the amplifier itself.

The harmonic distortion of the amplifier at the 150 watt level is excellent with 0.05% at 1 kHz and less than 0.02% at 6.3 kHz. At the 1 watt level these figures are substantially lower, being .003%, .005% and .004% respectively. The transient intermodulation distortion is very much less than 0.1%, whilst the hum and noise levels are better than 92 dB(A) on the auxiliary input, -84 dB(A) on the moving magnet input, and 74 dB(A) on the moving coil input. The transient overload recovery of the unit proved to be impeccable. The crosstalk between channels is very low, but is a function of frequency. Even at 20 kHz this is still better than 50 dB and this is obviously the result of the use of two separate power supplies.

**Subjectively**

We were unable to technically fault any of the unit's measured parameters and so we proceeded to our subjective evaluation. We first monitored the output through two pairs of high-powered JBL110 loudspeakers. The outputs could be readily pushed to 110 dB at three metres with no significant distortion. We then evaluated the amplifier with a pair of Quad electrostatic speakers. The lack of coloration and the unit's performance was quite impeccable. We noted at the maximum gain position that the hum and noise levels were inaudible on any of the selected programme content and at any of the listening levels at which we played the equipment.

Whilst the facilities are, in the main, conventional it became obvious that if one intended to dub from one tape recorder to another the record selector facilities provided by the two selector knobs provided distinct advantages over the more conventional controls with which we are accustomed. Whilst we were impressed by, and found the major
controls ergonomically attractive, the actual number of controls and their distribution did not immediately provide a feeling of ease. Obviously, with continuing use such discomfort would soon be obviated by familiarity. But unlike some of the other American amplifiers which we have recently tested we feel that the ergonomic concepts of this unit, independently from their technical functions, have been well thought out and these are backed up by excellent electronic design.

**Summary**

The Marantz 1300DC amplifier is an excellent example of careful design and planning. What has resulted is a first class piece of electronics. Whilst we do not personally like the styling, once again we have to admit our grudging admiration for the circuit designers who have produced such an excellent piece of equipment.

---

**MEASUREMENTS OF MARANTZ 1300DC AMPLIFIER (S.N. 61010087)**

<table>
<thead>
<tr>
<th>Controls</th>
<th>Tone Controls Defeated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Response</td>
<td>1.5 to 82kHz</td>
</tr>
<tr>
<td>Input to Aux.</td>
<td>Right: 1.5kHz to 82kHz</td>
</tr>
</tbody>
</table>

**Sensitivity**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux</td>
<td>15W</td>
<td>1W</td>
</tr>
<tr>
<td>Tuner</td>
<td>12W</td>
<td>1W</td>
</tr>
<tr>
<td>Tape</td>
<td>12W</td>
<td>1W</td>
</tr>
<tr>
<td>Phono (HM)</td>
<td>125V</td>
<td>125V</td>
</tr>
<tr>
<td>Overload</td>
<td>280W</td>
<td>280W</td>
</tr>
<tr>
<td>Phono (MC)</td>
<td>200V</td>
<td>200V</td>
</tr>
</tbody>
</table>

**Input Impedance**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux</td>
<td>3960Ω</td>
<td>3960Ω</td>
</tr>
<tr>
<td>Tuner</td>
<td>3960Ω</td>
<td>3960Ω</td>
</tr>
<tr>
<td>Tape</td>
<td>3960Ω</td>
<td>3960Ω</td>
</tr>
</tbody>
</table>

**Output Impedance**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1mW = 80 millivolts</td>
<td></td>
</tr>
</tbody>
</table>

**MARANTZ MODEL 1300DC STEREO AMPLIFIER**

Dimensions: 416 mm wide x 146 mm high x 430 mm deep.

Weight: 24.5 kg. Price: Manufactured by Marantz Company of U.S.A.

Absolute copyright in this review and accompanying measurements is owned by Electronics Today International. Under no circumstances may any review or part thereof be reprinted or incorporated in any reprint or used in any advertising or promotion without the express written agreement of the Managing Editor.

---

**MEASURED PERFORMANCE OF MARANTZ 1300DC AMPLIFIER (S.N. 61010087)**

<table>
<thead>
<tr>
<th>Low</th>
<th>Mid</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd</td>
<td>-93.5</td>
<td>-95.2</td>
</tr>
<tr>
<td>4th</td>
<td>-93.5</td>
<td>-95.2</td>
</tr>
<tr>
<td>7th</td>
<td>-93.5</td>
<td>-95.2</td>
</tr>
</tbody>
</table>

**Output Impedance**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux</td>
<td>-92.5</td>
<td>-92.5</td>
</tr>
<tr>
<td>Tuner</td>
<td>-92.5</td>
<td>-92.5</td>
</tr>
<tr>
<td>Tape</td>
<td>-92.5</td>
<td>-92.5</td>
</tr>
</tbody>
</table>

**Transient Intermodulation Distortion**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX</td>
<td>0.003%</td>
<td>0.003%</td>
</tr>
<tr>
<td>TUNER</td>
<td>0.003%</td>
<td>0.003%</td>
</tr>
<tr>
<td>TAPE</td>
<td>0.003%</td>
<td>0.003%</td>
</tr>
</tbody>
</table>

**Noise & Hum Levels**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX</td>
<td>-86.7</td>
<td>-89.4</td>
</tr>
<tr>
<td>TUNER</td>
<td>-86.7</td>
<td>-89.4</td>
</tr>
<tr>
<td>TAPE</td>
<td>-86.7</td>
<td>-89.4</td>
</tr>
</tbody>
</table>

**Maximum Output Power at Clipping Point**

<table>
<thead>
<tr>
<th>Source</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX</td>
<td>-95.2</td>
<td>-95.2</td>
</tr>
<tr>
<td>TUNER</td>
<td>-95.2</td>
<td>-95.2</td>
</tr>
<tr>
<td>TAPE</td>
<td>-95.2</td>
<td>-95.2</td>
</tr>
</tbody>
</table>

**Philips Public Address Equipment**

-heard around the world

Your local distributor is

**NSW** — C & K Aldridge Sound Systems, Ph. (02) 747 1355
**VIC** — Alltune, Ph. (03) 877 5353
**TAS** — Video & Sound Services, Ph. (002) 34 8822
**SA** — Werner Electronics, Ph. (08) 268 2766
**WA** — Electro Accoustics Company, Ph. (09) 444 8688

---

AHEARN CS4

ETI May 1980 — 159
Announcing a very special product:

DISCPROTEC
RECORD PRESERVATIVE

TWO AWARDS IN TWO YEARS!

1978
In 1978 DISCPROTEC won the coveted Grand Prix Gold Award in Tokyo.

1979
Awarded by retailers and critics in the U.S.A. The 1979 "Audio-Video" Hi-Fi Grand Prix Award.

WHAT IS DISCPROTEC?
It's both a lubricant and an antistat which forms a layer only about three millionth of an inch thick on the playing surface of your records. This layer eliminates all static charges, vastly reduces friction, and seals the playing surface. It is so thin it is "invisible" to your stylus, yet its chemical bond is so strong it remains effective for 100 plays or more, or over a decade of storage. DiscProtec formula (patents pending) is unique, and offers benefits not available from other record preservatives.

HOW DOES DISCPROTEC WORK?
You simply spray DiscProtec fluid on your record. The liquid "carrier" immediately evaporates, leaving a tiny amount of solid lubricant and antistat. A few moments of buffing and DiscProtec is evenly distributed to create a sub-microscopic layer of protection. Surface static charge is eliminated and surface tension is vastly reduced, creating a very slippery surface (you can actually feel the change as you buff). It is this layer, just a few dozen molecules thick, which will protect your records from further deterioration during playing or storage.
- Eliminates static for 100 plays or more
- Records may be played over and over with no increase in surface noise or harmonic distortion
- Eliminates static buildup even after years of storage
- Improves regular record cleaning
- Reduces record and stylus wear
- Protects records from environmental attack, and loss of vinyl plasticizers
- Compatible with all types of records, all common record cleaning methods
- Improves playability of worn and damaged records

Available through all leading record bars, hi-fi shops and department stores.
Akai PS-200T tuner

Incorporating the latest in technological features, this tuner "... is one of the most exciting we have evaluated".

WITH ALL the attention on digital quartz watches, synthesizers and other esoteric equipment, it is not surprising that many manufacturers should offer receivers and tuners with digital displays for the frequency selection and other features which are in keeping with the electronic revolution.

Akai have recently released their new PS range of preamplifiers and separate power amplifiers. It is not surprising that the PS200T is designed to complement these two pieces of equipment. This tuner is remarkably large but, quite apart from its size, is particularly attractive. The front panel has a brushed satin aluminium front into which is inset a bronze anodised escutcheon. In the top left hand section of this insert is the digital display. This uses large, green numerals and letters to designate the mode of operation, the frequency and other information.

The FM or AM mode and the frequency, in either MHZ or kHz, is designated on the display. The display also indicates whether a preselected station is in operation and if the preselection function is being utilised. At the top right hand corner of the digital display are five bezel lights to show the incoming signal's relative strength, a display to show whether the FM frequency lock is operational and a multipath signal indicator to alert the user of the presence of signals with significantly different path lengths which are the antennae and the stereo detector.

The last indicator in this area operates when a stereo signal is detected by its pilot tone so that the user can tell whether he is listening to a stereo or a mono station. On the right of this display are three touch controls of the basic type utilised for all operational functions, with the exception of the mains switch. The uppermost control stops the frequency scanning and locks it, except when the automatic preset control is operating. Below this are two arrow-shaped top controls to select either an upward or downward scanning mode. If these are operated at the ends of the frequency range on either the FM or AM mode the switching cycle reverses itself automatically and proceeds to scan in the opposite direction unless stopped by the control or through the selection of a preset station.

Immediately below the digital display and the upward/downward scanning touch controls is a row of fifteen preset station selector touch buttons together with a memory light and memory activator switch. These controls, which provide fifteen memories for FM, are activated through touching the memory switch with a frequency selected on the display and then subsequently touching one of the preset station controls which then "remembers" that particular frequency.

Features

Unlike a previous generation of synthesizer tuners that we examined some years ago which forgot the frequency the moment the mains was turned off, Akai have incorporated a little battery pack at the rear of the unit. In the absence of mains power, like the proverbial elephant, the memory remains operational and does not forget. Notwithstanding, even without the batteries, the CMOS circuitry has the capacity to remember for some minutes.

The heart of the memory system is a four-bit, one chip microcomputer which holds all the data and with the preset address memory which can memorise up to thirty stations. Frankly, there are less than fifteen AM stations that I would "want to remember" and regrettably only four FM stations in Sydney at the moment. Even so, the facility is there even though the stations may not be.

The other controls are also neat and equally clever. Apart from the normal FM/AM, FM mono and stereo manual scanning, the automatic scanning capabilities and options involved therein are particularly clever. Firstly in the manual scanning mode, the unit jumps in 9 kHz increments on AM and in 50 kHz increments on FM. These frequencies have apparently been chosen to suit Japanese requirements for the US version makes use of 10 kHz AM and 100 kHz FM increments. With the manual control selected it is only necessary to touch the upward or downward scanning control which increments in single steps for a single touch or cycles automatically through the frequencies if the finger remains on the control for more than 1½ seconds.

The receiver cycles up or down automatically looking for a station carrier with reasonable strength which it locks on to for approximately six seconds unless stopped. Otherwise it recommences its search process. It is not a good idea to look for a low strength signal in the auto mode as it is liable to scan over such a station and ignore any detected, in preference to another station with a higher signal strength. If the stereo mode is selected the search sequence stops each time the receiver detects a strong signal which it again holds for six seconds before recommencing its search programme.

In the preset mode the receiver will scan between the preselected stations only, locking on to that station for only six seconds unless stopped.

The only controls at the extreme right hand side of the escutcheon are the FM sensor/muting control which are normally in off position and which should be only depressed when tuning for a weak signal. A "level one" switch is provided which cuts interstation distortion generated prior to the input of the receiver, and which cannot be adjusted out. A "level two" control is provided for variable adjustment of the detection/muting level making use of a
muting level control at the rear of the receiver. Other controls are two optional stages of intermediate frequency filter bandwidths which are -60 dB at +/-300 kHz in the narrow mode and -50 dB at +/-400 kHz bandwidth in the wideband mode.

The choice would undoubtedly be very valuable in America and Japan but as yet is of little significance in Australia.

The rear of the receiver has very few controls. The controls that are there consist of a distant or local FM sensitivity switch, a 75 Ω coaxial socket for the FM antenna, a special earth and aerial socket for AM, a distant or local switch for the AM band, a muting level control which works in conjunction with the level 2 variable control on the front panel of the receiver, two independent level controls for the left and right channels audio output, and a pair of fixed and variable coaxial audio outputs for feeding to the associated tune amplifier.

The mains connection is by means of a mains cord which differs from the brochure which shows the use of an IEC socket. The battery compartment is located at the top of the panel and it accepts three 1½ volt penlight cells to maintain the digital memory.

The inside of the equipment looks more like a piece of computer electronics than a piece of consumer electronics! The unit is divided into three sections. At the right hand front is the microprocessor and digital memory board which also contains the programmable counters and the logic for the digital display. This is effectively screenfed off from the radio frequency tuner section which, not so surprisingly, does not contain normal tuning capacitors of the type we have grown to accept in FM and AM receivers. Instead of the conventional tuning section, both the FM and AM sections of this receiver incorporate digital quartz synthesizers to provide precise RF and mixer frequencies. These are followed by a multistage surface acoustic wave (SAW) filter and conventional ceramic filters in the subsequent stages. Akai does not say much about the surface acoustic wave filters but they are obviously very effective and precise.

The rear of the tuner contains a fancy regulated power supply for the circuitry together with the intermediate frequency stage filter located in its own separate screened can well isolated from the rest of the circuitry.

The microcomputer controlled synthesizer gives a more precise tuning performance than other systems and is coupled with a phase-locked loop which eliminates the possibility of further drift. These operate with variable capacitance diodes to control the local oscillator frequency.

Test results
The RF sensitivity of this receiver falls a little short of what we would have otherwise expected from this unit. In particular, in the wide band mode the sensitivity is 1.3 microvolts for 20 dB signal-to-noise ratio with the input switch set to the distant position, 7 microvolts when set to local.

In the AM mode in the distant position the sensitivity is 190 microvolts for 20 dB signal to noise ratio with 30% modulation and 2.6 millivolts in the local position. These figures may appear reasonable but suffer a little because of the absence from the lack of a tuned radio frequency stage which add so much to improve the overall signal-to-noise ratio and selectivity in conventionally designed radio receivers. The ultimate signal to noise ratio of the unit with 1 mV across the input is 67 dB which is good considering that the program content has a far lower signal to noise ratio.

The FM band frequency response is particularly flat, being -3 dB down at 20 Hz and 16 kHz with the notch at 19 kHz extending down to 25 dB as a result of the effective removal of the pilot tone signal. The channel separation, as measured by our signal generator, is better than 37 dB midband and is limited by the generator performance rather than by the receiver. There is no significant difference between the FM audio response in either wide band or narrow band modes and so there is no loss of signal quality by utilising the narrow band position.

The AM response is smooth but uninspiring with a bandwidth extending from 70 Hz to 2.2 kHz at the -6 dB points. This makes it very suitable for listening to soap operas and the races. It is a shame that the designers of such equipment do not allow for the quality.
We've got news for you!

How many times have you seen build-it-yourself electronic and hi-fi kits and thought: 'No way could I build anything like that!'

NOW YOU CAN!

All of our Playmaster hi-fi kits come with a highly detailed, step-by-step instruction manual — with far more constructions' 'do it' skills than you'll find in the magazines. If you can hold a soldering iron and read simple English you can build one of these kits (yes, we even show you how to solder!)

And just in case you run into difficulties, there's our exclusive 'Sorry Dick, it doesn't work' repair coupon with allows you to have your kit repaired in our service centre for a token fee.

Plus our 7 day satisfaction guarantee: examine the kit, read the instructions — then if you feel the kit is beyond you, return it within 7 days for a full refund.

What have you got to lose?

And you'll save hundreds of dollars by doing it yourself.

Comparative commercial equivalents: they're hundreds of dollars dearer. And each Playmaster audio component is perfectly matched — electrically and aesthetically — to the others in the series.

As we've said before: 'They look so good and work so well your friends won't believe you built them!'

Superb Playmaster Speakers

Just a couple of hours of your labour — and you'll have a set of speakers to be proud of. The hard parts are done for you: all woodwork is ready to fold together and glue. Reates for the speakers are cut. The wiring is supplied in a no-soldering colour coded loom. Just push the plugs onto their terminals.

Your choice of three superb systems to cater for any size room; any size room. Each box is finished in an attractive imitation walnut veneer, they look so good you don't even have to fit the beautiful sculptured acoustic foam grilles supplied.

Designed by Neville Williams, Editor in Chief of 'Electronics Australia'.

3-75L12" 3-WAY SYSTEM
75 litre cabinet, with 12" bass driver. Has tone controls, too!
$294.00 pr

3-53L10" 3-WAY SYSTEM
53 litre "mid sized" cabinet, 10" bass driver, 3 speakers
$224.00 pr

3-26L8" 3-WAY SYSTEM
Smaller, 26 litre enclosure suits flats, etc. Ideal for budget systems, too.
$149.50 pr

Playmaster hi fi components

The perfect partners for your Playmaster speakers: a Playmaster amplifier or a Playmaster tuner. Or tailor your sound to suit your environment with a Playmaster graphic analyser and equaliser. All with the quality of design you'd expect from Australia's largest selling electronics magazine.

Each of the Playmasters was designed by Leo Simpson, Technical Editor of Electronics Australia. And with the exclusive features added by Dick Smith Electronics — like bronze anodised front panels, matching imported knobs, plated chassis, etc etc, your Playmaster will be a winner!

Playmaster Forty Forty Stereo Amplifier:

Very simple to build; performance equal to amplifiers two and three times the price!
Cat K-3411 $129.50

Twin Twenty Five:

Don't need so much power: try the twin 25. 25W rms per channel; ideal for compact speaker systems.
Cat K-3410 $105.00

Digital Tuner/Clock

Superb AM and FM tuner with digital readout; plus clock. The tuner module is pre-built!
Cat K-3404 $129.50

Graphic Equaliser

Have your sound the way YOU want it. Easy to build kit gives you 'tailor made' response!
Cat K-3500 $99.50

GO ON — HAVE A GO:
YOU CAN DO IT!

Dick Smith Electronics

See our other adverts in this magazine for our store addresses and resellers
of transmission which our local AM stations provide and provide an AM band width of comparable quality to the FM. In practical use the ergonomic design of this receiver can only be described as simply delightful. The controls are quickly mastered, and provided you have hooked up a suitable aerial the quality of sound and the ease with which a station can be selected is inspiring.

Once the local stations have been selected, logged and recorded by the present station facility their reselection takes virtually all the hard work out of what can sometimes be a laborious task. The quality of the signal we received on the FM was excellent and that from the AM, passable.

With only a 100 mm length of aerial on the rear of the receiver it happily picks up local stations on FM but requires a somewhat better aerial for AM reception (at least ½ metre of wire even without the benefit of an earth). With the addition of two good aerials, one for FM and one for AM, this unit can pull in distant stations with very reasonable ease.

**Summary**

The quality of the sound is in general terms as good as some of the best tuners and receivers we have listened to but the sensitivity is not as good as the very best. It is apparent that this unit has been designed for people who are not looking for the ultimate in radio frequency performance but are looking for the ultimate in ergonomic performance and an appearance to match.

The Akai PS-200T Tuner is one of the most exciting tuners we have evaluated, but at a selling price of $899 recommended retail, will tend to discourage the majority of people who could most appreciate its functional beauty.
Now your newsagent can solve your urgent parcel problems.

This TNT Courier Overnight Satchel has just turned your friendly newsagent into an air freight depot. For $8.75 you can send anything that fits inside to almost anywhere in Australia. Overnight. You don't have to wrap a thing. The bag is tough, waterproof and tear resistant.

You can buy TNT Satchels at most newsagents throughout Australia. (At present in N.S.W., they are available only in Sydney, Newcastle, Wollongong, Gosford and A.C.T.). Just address the satchel and leave it with your newsagent. TNT Courier collect it, air freight it overnight and deliver the next morning.

The TNT Courier Suburban Satchel is for overnight local deliveries in all mainland capitals (and soon Hobart) for just $5.00.

TNT Courier Overnight Satchels. Anything, anywhere, overnight.
A blueprint for your success.

An Air Force Apprenticeship.

Opportunities no shop floor Apprenticeship can offer.
Right now, you can take an Air Force Apprenticeship and become a specialist in Airframes, Armaments, Radar, Communications, Propulsion Systems, Flight Systems or Motor Transport.
Full time training recognised and respected by Australian employers.

For the first 2½ years, you will be taught on some of the most up-to-the-minute equipment under the expert guidance of professional instructors. In modern laboratories, classrooms and workshops.

Understandably, when you have completed your initial training, we expect you to spend another 6½ years working for us. On full adult pay of course.

It's not easy!
Success demands application. And a disciplined approach to work. As an Air Force Apprentice, you'll be required to study in your own time. And regularly sit for exams. The rewards are there. Many Apprentices go on to become Officers.

It's not all work.
You will have stacks of time to relax provided you're on top of your studies. At both training bases (Wagga Wagga and Laverton) excellent sports facilities abound. Gyms, football grounds, golf courses, swimming pools, tennis courts and many clubs.

What about entry qualifications?
You need to be 15 and under 17 years at time of entry, an Australian citizen or able to meet our nationality requirements. We also expect you to have passed (or be in the process of passing) your *10th year of formal schooling with above-average marks in maths and science with a physics content. And be reasonably fit.

The scope for the future is enormous.
On completion of your Apprenticeship, you'll be part of a team servicing, repairing and testing some of the most advanced and sophisticated aircraft and equipment in the country. The technology of the future will be in your everyday working life.

Apply now!
Air Force Apprenticeships are very popular. So the sooner you have a chat

You're somebody in Today's Air Force

Authorised by Director-General Recruiting Dept. Defence

with a Careers Officer the better. The address is in the phone book and there's no obligation.
Alternatively send or phone for the facts:

To:
AIR FORCE CAREERS OFFICER, G.P.O. Box XYZ
in the capital city nearest you.
Yes! I am interested in an Air Force Apprenticeship. Please send me full details.

Name: 
Mr.
Address:

State: Postcode:

Date of Birth: 

AF/30 FP 30

ETI May 1980 — 167
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 only listed the projects published in the last few years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). Any companies who wish to be included in this list should phone Jan Collins on 334282.

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 Radio Despatch Service 651 Forest Rd 869 George St Bexley NSW 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 to six months.

Key to Companies
A Applied Technology Pty Ltd, 1A Paterson Avenue, Waitara, NSW 2077
B Bill Edge Electronic Agencies, 115 Parramatta Road, Concord (PO Box 1005, Burwood North 2134)
C J.R. Components, PO Box 128, Eastwood, NSW 2122.
D Dick Smith Electronics P/L, Cir Waterloo & Lane Cove Roads, North Ryde, 2113.
E All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000.
F Tasman Electronics, 12 Victoria Street, Coburg, Vic 3058.
J Jaycar Pty Ltd, PO Box K93, Haymarket, NSW 2000.
K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109.
L Ellisters, 289 Larchme Street, Melbourne, Vic 3000.
M Mode Electronics, PO Box 365, Mascot, NSW 2020.
N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011.
O Orbit Electronics, PO Box 7176, Adelaide, South Australia.
P Pre-Pak Electronics, 718 Parramatta Road, Croydon, NSW 2132.
R Rod Irving, PO Box 135, Northcote, Vic 3070.
V Silicon Valley, 23 Chandos Street, St. Leonards, NSW 2065
W Willis Electronics, 992 Hay Street, Perth, WA 6001.
Y Trilogy, 40 Princes Highway, Fairy Meadow, NSW 2519.
**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 pm. In enquiring by telephone about back issues or photostats, please ask for the “Subscriptions Department”.

**MICROFILM**

Microfiche editions of this publication are available by annual subscription from Microsystems Pty Ltd, PO Box 188, North Sydney, NSW 2060.

---

**ORDER FORM**

I enclose $............. for (tick appropriate box/es):

**NAME** ..........................................................

**ADDRESS** ......................................................

**POSTCODE** ....................................................

☐ Subscriptions $21.50 per year within Australia $.............

☐ $27.00 overseas (surface mail) $.............

☐ Airmail rates on application.

☐ Back issues ($2.50 from April 1977 on) $.............

☐ or photostats ($2.50 per article per issue) $.............

Project No. .......... Month ...... Year ......

Project No. .......... Month ...... Year ......

Project No. .......... Month ...... Year ......

Project No. .......... Month ...... Year ......

* Please attach a list if more than four required.

☐ Binders No. ............@ $6.10 each in NSW $.............

No. ............@ $7.50 each other states $.............

**ALL PRICES INCLUDE POSTAGE**

Send orders to: ETI, 4th Floor, 15 Boundary St, RUSHCUTTERS BAY NSW 2011 Phone: (02)33-4282
ONE DOESN'T EXPECT advertising copywriters to be all that technically accurate when it comes to preparing advertisements for the daily press, just so long as what is said is not too wide of the mark or hopelessly vague.

A West Australian reader spotted an advertisement in a local daily, The West Australian (10-3-80), for STC's new Telefax document transmission machine which broke all the rules without (hopefully) breaking the law. Here's what it read:

"For the business that truly needs instant information delivery STC Telefax Facsimile is the instant answer: Documents, plans, photographs, in fact any printed matter can be sent interstate or across the city and be on the right desk in 3 minutes flat. Think of it as your 3-minute interstate courier.

"Today, STC has the technology to turn information into laser light and back again, by using optic fibres. These optic fibres will replace yesterday's huge data transmission cables; they are threads of glass, fine as human hair. Their advantages are vast because their size is so small. Just one tiny fibre can carry as much information as a giant telephone cable as thick as your arm" (our emphasis).

Einstein, Planck, Shannon and co. were mere dabblers, eh?

Space spectaculars

First came "A Space Odyssey: 2001", the archetypal science fiction/fantasy/prediction space spectacular (cross out whichever term is not applicable).

Then came a seven/eight year drought, followed by "Star Wars". A cowboys & indians/cops & robbers movie, only set in the vast, four-dimensional panorama of space.

Hot on its heels came "Star Trek; the motion picture", a revamp of the ancient TV series (borrowing concepts from "Superman: the movie" and "Star Wars"), and "Alien", a meld of the recently popular horror/supernatural epics, plus a number of lesser rivals known for their meteoric rise and fall, and little else.

You could have laid very good odds on the Disney empire getting into the act somewhere along the line and be assured of winning, if you could have found a bookie to take the bet. Sure enough, their contribution to the rash of space spectacular productions in the closing years of the last decade (depending on when you count the decade from ...) is "The Black Hole". This seems to borrow from such diverse fields as the 'disaster' movies (like "Airport" and "Concorde"), the space spectaculars that preceeded it and the cowboys/indians — cops/robbers formulae of old.

The Black Hole seems to be the penultimate in the 'space opera' genre. What next — "The Seven White Dwarfs"?

Very red faces dept.

Our April Dregs column noted that June and November 1976 were two bad months for certain staff members of our illustrious rival E...A...

The column stated that those issues inadvertently featured ETI's Australian and UK advertising sales managers (respectively) on E...A...s June front cover and page 26 of their November issue.

Our comment that E...A...s front cover featured our (then) sales manager Howard Jenkins was published in the belief that the statement was correct. We now understand from E...A...s editor-in-chief and from Howard Jenkins that the pix was actually of E...A...s Greg Swain.

The November pix did feature ETI UK's sales manager but the pix accompanied a feature put out by the UK Information Service (concerning Vidata) and there was no way that any other magazine could know that the pix was that of one of our own staff.

We unreservedly apologise for any embarrassment caused.
The truth is, JVC have always produced real hi-fi components and we believe this current range represents JVC's finest range ever. Here are some real innovations and performance features to whet your appetite:— Quartz locked turntables with uncanny accuracy; Receivers/Amplifiers, some with built-in SEA Graphic Equaliser and DC, class A/B amplification; Cassette deck with JVC automatic computerised tape tuning; Computer designed speaker systems; Separate but matching JVC components designed to compliment one another, perfectly. And all this real hi-fi know-how is yours...merely for the asking.

FREE OFFER
COLOUR HI-FI CATALOGUE

Just fill out this coupon and we’ll fill you in on what’s available and new in terms of JVC hi-fi entertainment...and it’s all FREE!

Name ____________________________
Address __________________________
Postcode __________________________

I am especially interested in...
☐ Cassette Decks
☐ Matching Systems ☐ Amplifiers
☐ Speakers
☐ Turntables
☐ Receivers

Just address your envelope to...
JVC Hi-Fi Advisory Service,
Post Office Box 307,
North Ryde,
N.S.W. 2113

If you think they look different, wait till you’ve heard them!
What you see on the meters you'll hear on the tape.

Including the latest ideas is audio technology in modestly priced hi-fi components is a principle to which Technics is committed.

The inclusion of our most accurate metering system, the FL (fluorescent) bar graphs in the RS-M17 model cassette deck is another example.

To make an accurate recording you need accurate meters. The FL meters are electronically controlled so response time is instantaneous. Each bar length is proportional to the sound level, and there's no overshoot - a characteristic of conventional needle-type meters. The meters give direct parallel readout for instant comparison between channels.

Other practical features on the RS-M17 cassette deck are rewind auto-play, so you spend more time listening to your tapes and less time just pressing buttons; the highly reliable Super Permalloy head; 3-position tape selection for optimum results from the tape type you use; and Dolby * noise reduction system.

You won't find a similarly priced cassette deck with more features than the RS-M17. See for yourself and your Technics dealer.

* Dolby is the trademark of Dolby Laboratories Inc.