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eti
ELECTRONICS TODAY INTERNATIONAL

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 (CrO_2) 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.

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WT126/79

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simply excellent

ELECTRONICS TODAY INTERNATIONAL

Registered for posting as a publication – Category B

QUICK INDEX

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SOUND SECTION

PROJECT SECTION:

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 "Shoparound", "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!

Shoparound 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 Shoparound 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.

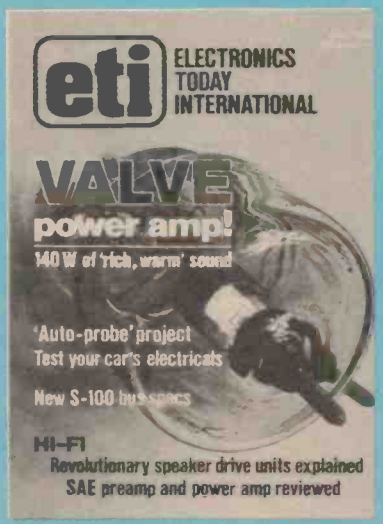
Turn to each of these three pages, **right now** — 85, 168 and 169, and see what they're all about.

After all, they're there to help you!

Roger Harrison
Editor

advertisers

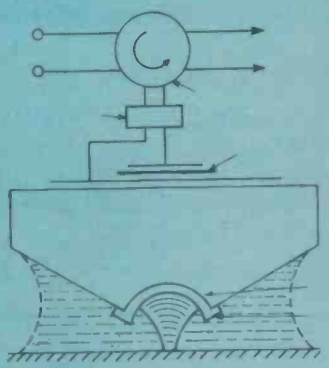
eti ELECTRONICS TODAY INTERNATIONAL



COVER

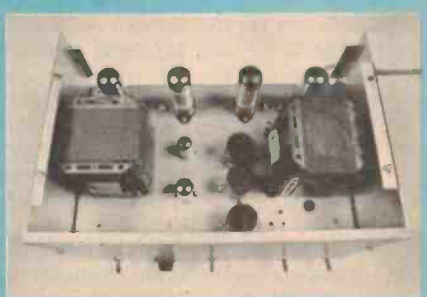
To herald our first valve project, we just had to have a picture of a valve on the front cover! The device is some 40 years old and is a type 15E triode, made by Eimac for 600 MHz airborne radar systems developed for WW II.

features



news

projects



sound

general

next month

RECEIVERS FOR THE BUDGET MINDED SW LISTENER

If you'd like to get into the hobby of shortwave listening and 'DXing', but have a limited budget — then you should read this article.

3-WAY SPEAKER — THE 4000/2

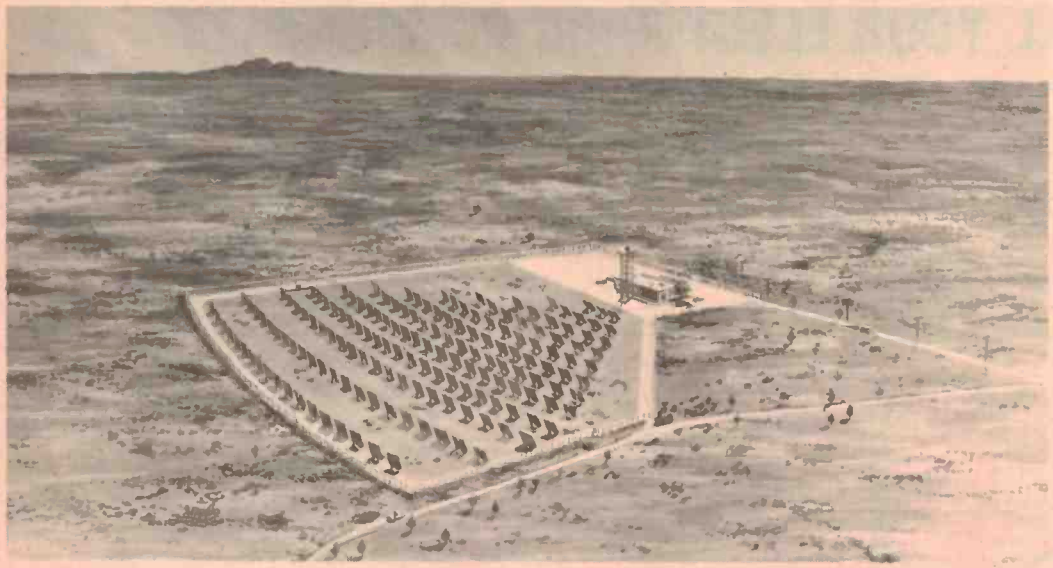
Continuing our Series 4000 projects, this three-way system is another superb design from David Tilbrook.

THE ROTEL RX-1000 AM/FM RECEIVER

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.

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 temperautre 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 $5 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 have signed an agreement with Sabemo Pty Ltd, to co-operate on the plan to build the solar power generator. Sabemo is a Sydney-based civil design, construction and engineering group and a sister company of Transfield Pty Ltd, a major steel fabrication and erection company.

McDonnell Douglas and Sabemo 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 apeal 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 accomodated 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 new 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 electron gun they claim improves colour TV 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 predetermined 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 Cema 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 Japanese 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 freatures, 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 Technics 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 Fenatach, 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

taxis 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.

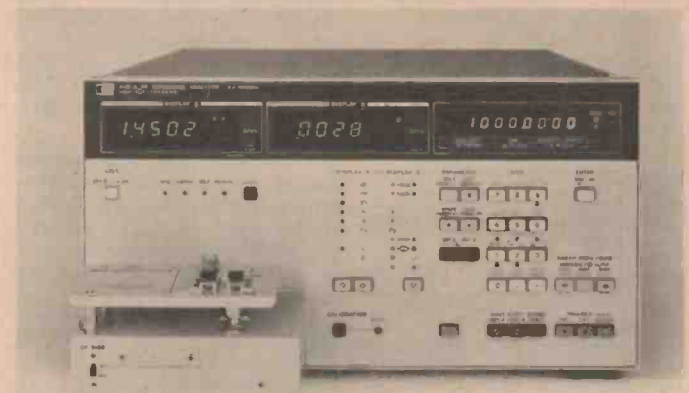
Philips supplied an SI 10 000 system to Taxis Combined Services in Sydney early last year and has since supplied a similar system to Hong Kong.

Fenatach President (Senor Juan Jara Cruz) and two of the Federation's Directors are visiting Sydney to study the operation of the SI 10 000 system in Taxi 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.

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 rang 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.

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 ranged 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 sinewave 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) sinewave and a sinewave 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.

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, matched, despatched

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 Environment, Mr David Thomson.

The committee will act as a link between the CSIRO and individuals and associations in NSW and provide an input to the CSIRO Advisory Council.

The Committee will also be involved in making the work of the CSIRO more widely known in NSW", said Dr J. Paul Wild, Chairman of the CSIRO.

• A new digital components and microcomputer store opened in Sydney late in March. Called Microbits, they carry such goodies 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 Utilux 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 Association in all state capitals and Newcastle (NSW).

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 featured in the February issue.

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

• A new solar-powered watch has been launched on the market. Called the Sunwatch" it comes with 10 display functions: hours, minutes, seconds, months, dates, leap year, speed calibration, AM/PM indicator and seconds count off. It also features an adjustable brightness display (four levels) and is programmed 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 QLD 4217. (075) 38-3472.

Matched

• You can now match some new modules to your TI Speak & Spell". There are three in the range, called Vowel Power', Super Stumper 4-5-6' and Super Stumper 7 and 8'. These modules expand the capability 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' customer 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 manufactured 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 expected the extended service facilities, located at the company's South Melbourne headquarters, will improve responsiveness to customer repair demands and to enhance 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 telephone exchange was installed at the premises of Dominguez and Barry, the only specialist fixed interest house in this country.

Described as the ultimate small PABX, 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 extensions.

• The annual report of the Electronics Research Laboratory, Department 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 navigation, semiconductor and computer research. One presumes copies are available from the Australian Government Publishing Service. It's very interesting reading.

• A new two-page technical data sheet from Hewlett-Packard describes the use of their low-pass filter kit and how it can be used to reduce high frequency noise errors in low frequency measurements. Designed specifically with frequency counters in mind, the kit provides a selection of four filters with low attenuation. They can also be used with CROs and spectrum analysers. The data sheet is numbered 5952-7554 and is available free of charge from Hewlett Packard Australia Pty Ltd, P.O. Box 36, Doncaster East Vic 3109.

• Two new catalogues became available from Instant Component Service recently. First up is the Pomona Test Accessories catalogue — 1980 edition. It lists a broad variety of test accessories, including: banana plugs, jacks, patch cords, phone tip jacks, test clips, probes, binding posts, black boxes and sockets. Available on request.

Second comes the Connectors for Commercial and Industrial Applications" catalogue from STC-Cannon Components. The new connector range is designed to MIL-C-5015 and covers applications suitable for Australian environments. It lists crimp, potting, high voltage, RFI shielding, mains and bayonet lock connectors. This catalogue is also available on request from ICS.

• IRH components has moved from their old location in The Crescent, Kingsgrove to 53 Garema Circuit, Kingsgrove 2208. Their postal address is P.O. Box 265, Kingsgrove and phone number (02) 750-6444, telex AA24949.

IRH will continue to manufacture their full range of fixed and variable wire-wound resistors, including the popular PW resistors and AW pots. They are also agents for Fujitsu, Hitachi Condensors, Murata, CTS (USA) and TRW/IRC (USA).

• Dick Smith's Adelaide store has moved a few hundred metres down Wright Street to larger premises. Dick Smith's Adelaide outlet first opened in December 1977. The old store had 370 sq. metres of space, while the new store has 550 sq. metres, an increase of almost 50%. Parking for 20 vehicles is provided. New address is 60 Wright St. phone 211-1962.

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 has named 'Sipos'. In addition 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 emitter 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 inadvertantly contained copy giving the impression that Peterson speakers are available directly from the company.

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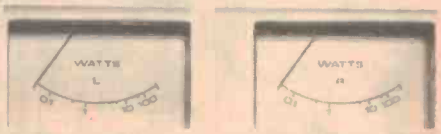

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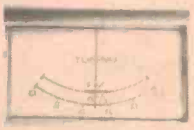

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Tools and techniques in radiometric exploration

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.

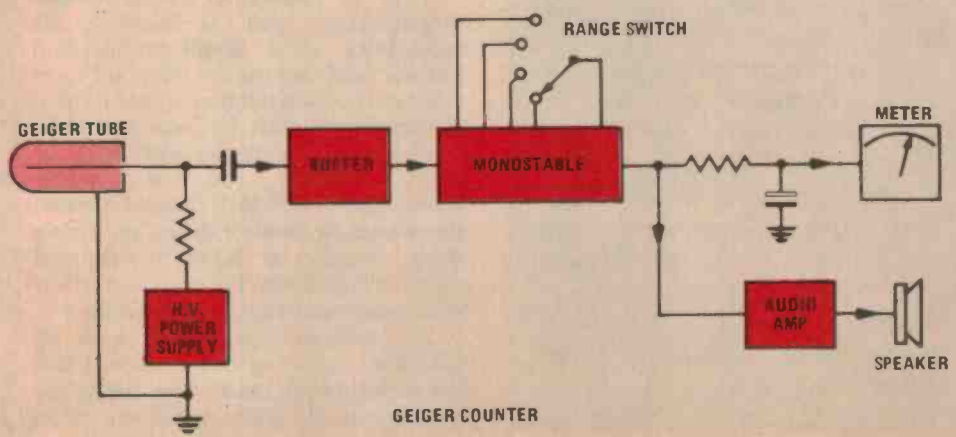
It has been necessary therefore to refine existing prospecting techniques, develop new ones, and improve the sensitivity and discrimination of all instruments in radiometric measurement techniques in common use, and to give some insight into the various methods of radiometric surveying.

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.

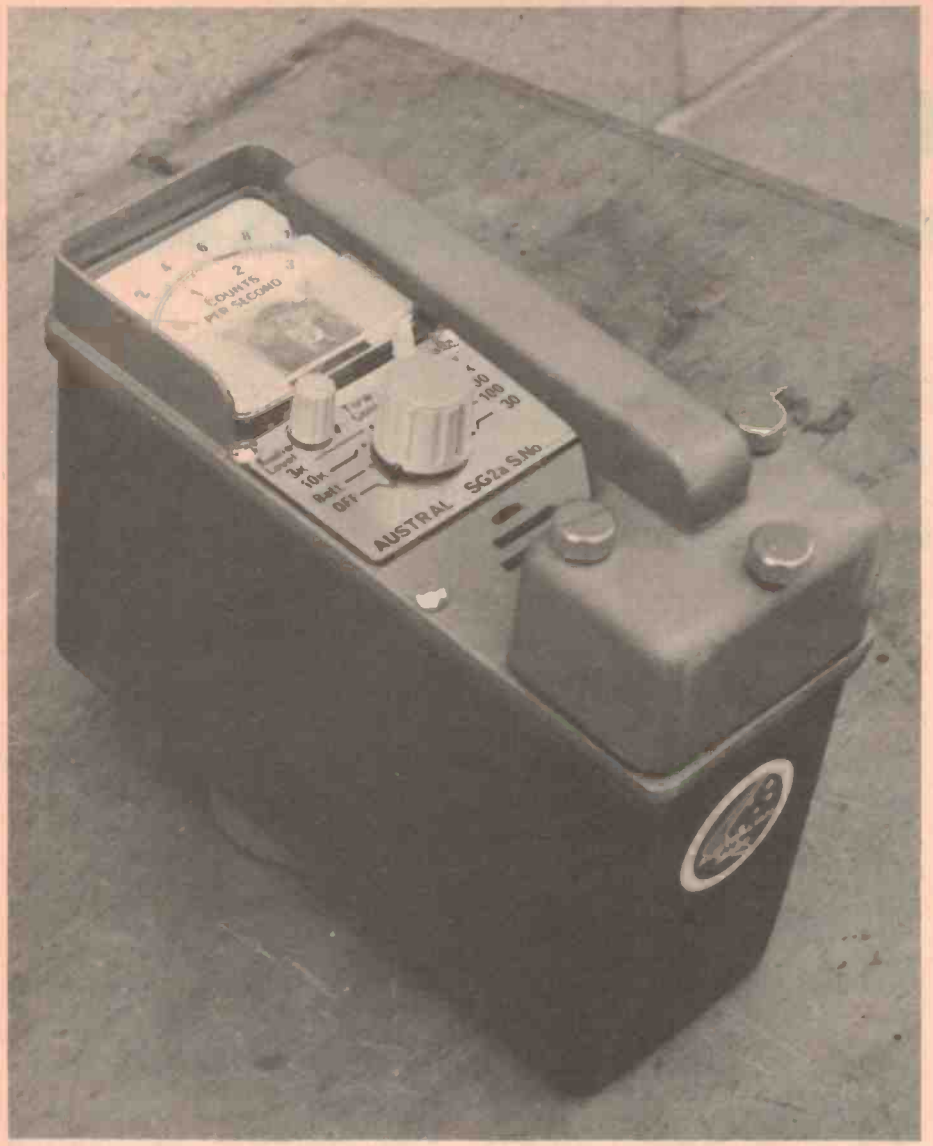
The Geiger counter circuitry shown in the accompanying block diagram is quite simple using a monostable to give a constant width to the pulses, which are averaged over several seconds so that the count rate is proportional to the average dc level. The range switch can change the monostable width, or 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).

Block diagram of a typical commercial Geiger counter. The monostable has provision for selecting preset pulse widths ('RANGE') for differing count rates, depending on the level of radioactivity being measured. The monostable output is differentiated by a CR network and drives a meter calibrated in counts per second.



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 ▶



A typical scintillation counter manufactured and marketed in Australia. This model has selectable ranges and an audio output as well as a meter indicating counts per second.

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 us).

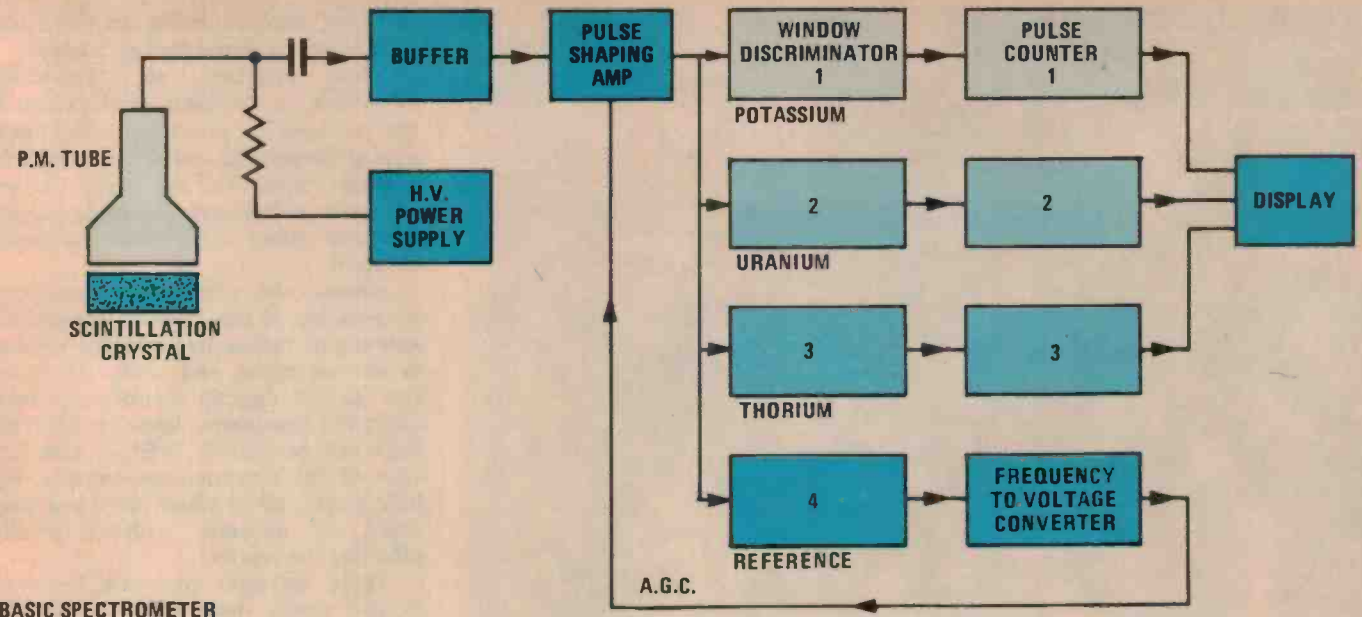
The great advantage of this rather indirect method of detection is in its efficiency, which approaches one hundred percent. Special protection is needed for scintillation crystals and photomultiplier tubes, which results in an instrument which is less rugged, more expensive, but far more sensitive than 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.

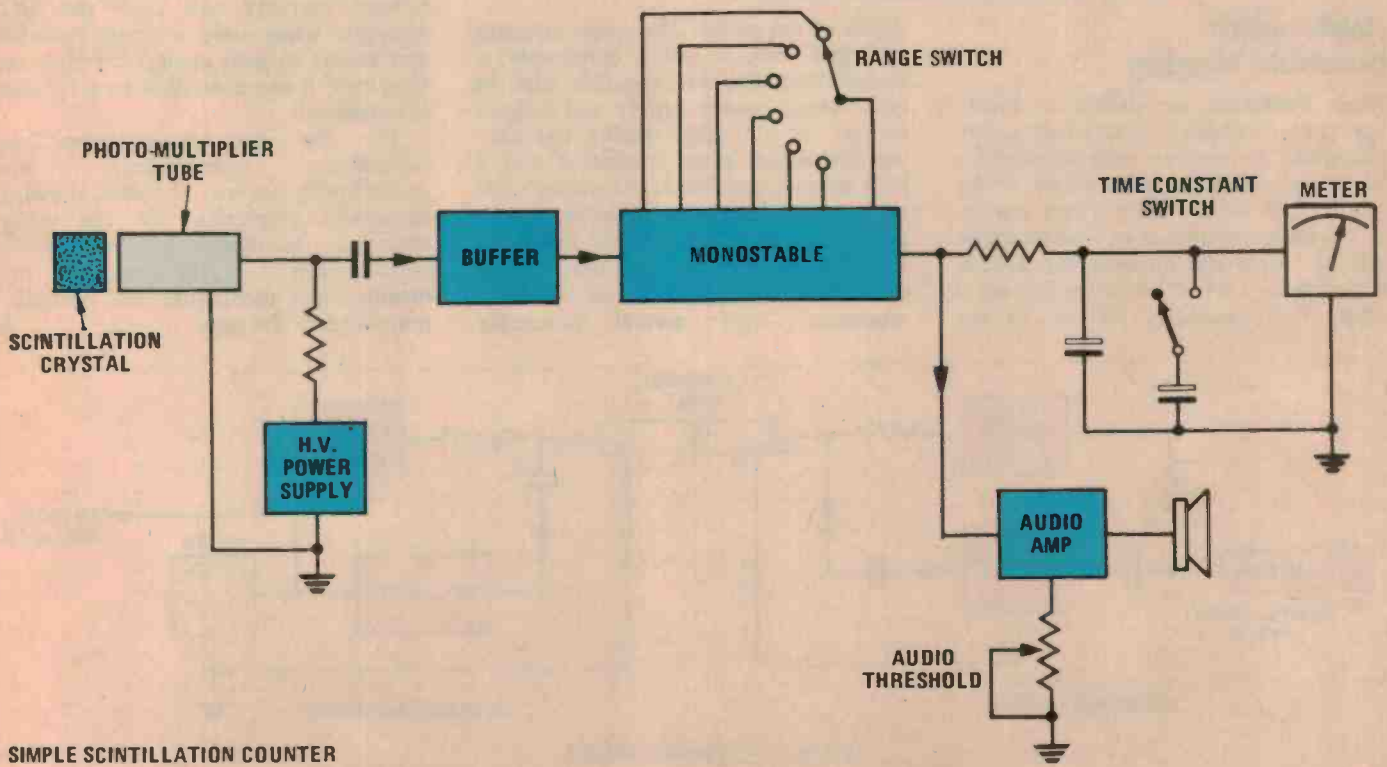
Even spectrometers cannot always determine the usefulness of a deposit, as leaching and weathering can remove the original uranium, leaving only the radioactive daughter products behind.

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. ▶



SIMPLE SCINTILLATION COUNTER

A portable radiometric borehole logger. The logging cable, which conducts power to the head 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 seam 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 ratemeter 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, and 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.

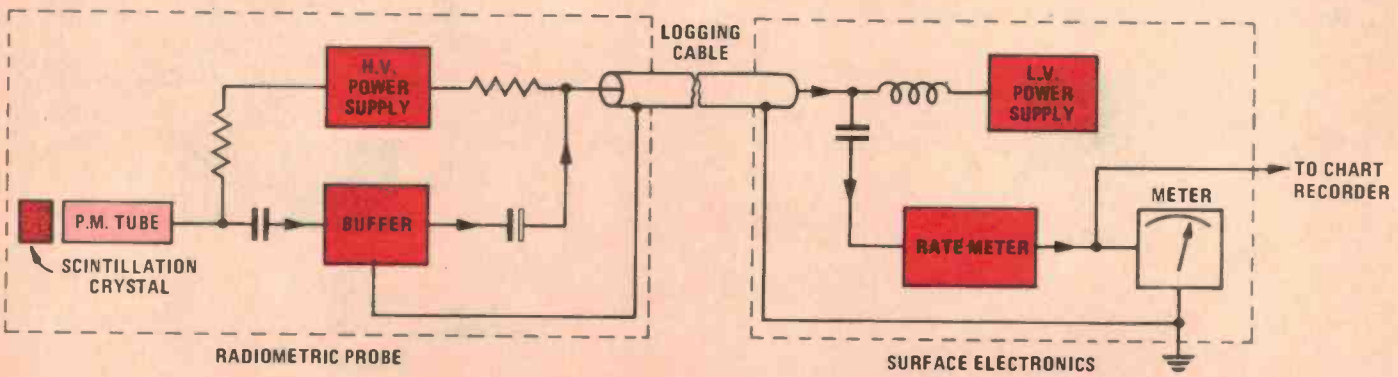
There are some problems however, as the probe must be watertight to depths of 1000 m or more and able to withstand the pressure at that depth. It must also be rugged and have a wide operating temperature range. This is an extremely harsh environment for sensitive electronic equipment, and careful design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

Summary

Modern electronics and refined measurement techniques have greatly assisted uranium exploration and has led to 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. ●



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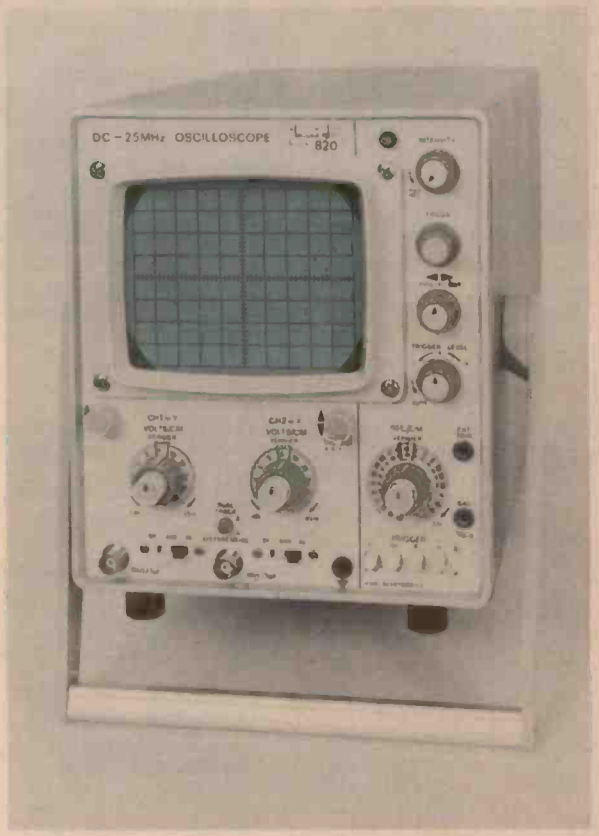

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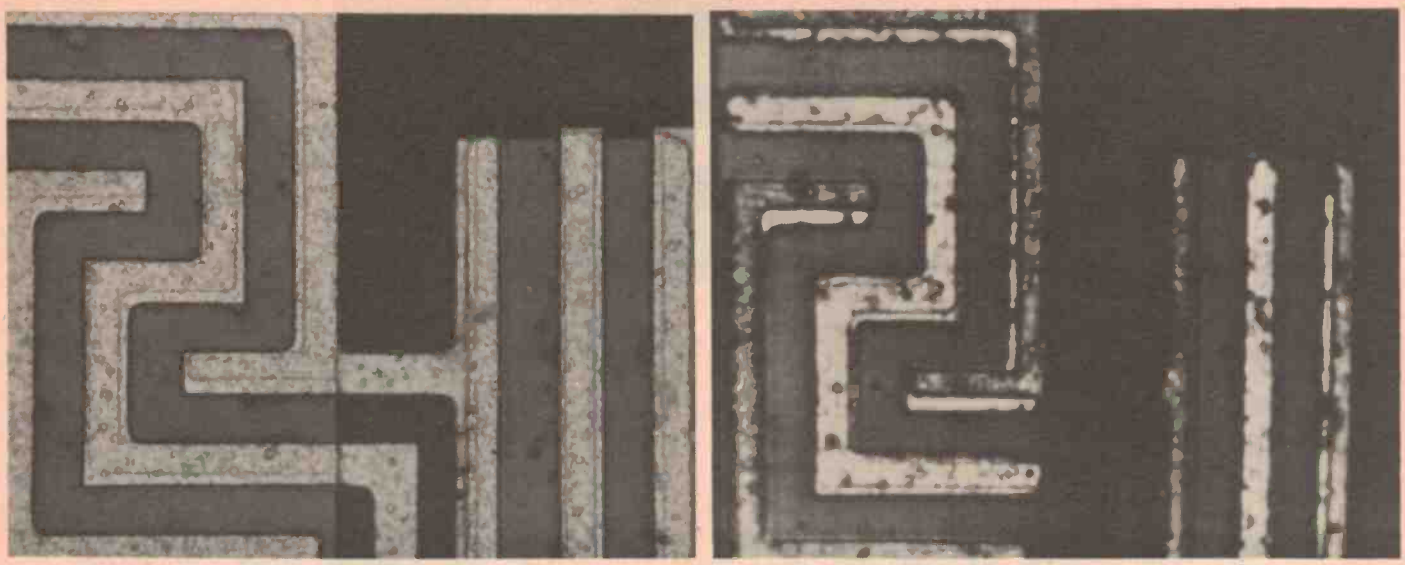
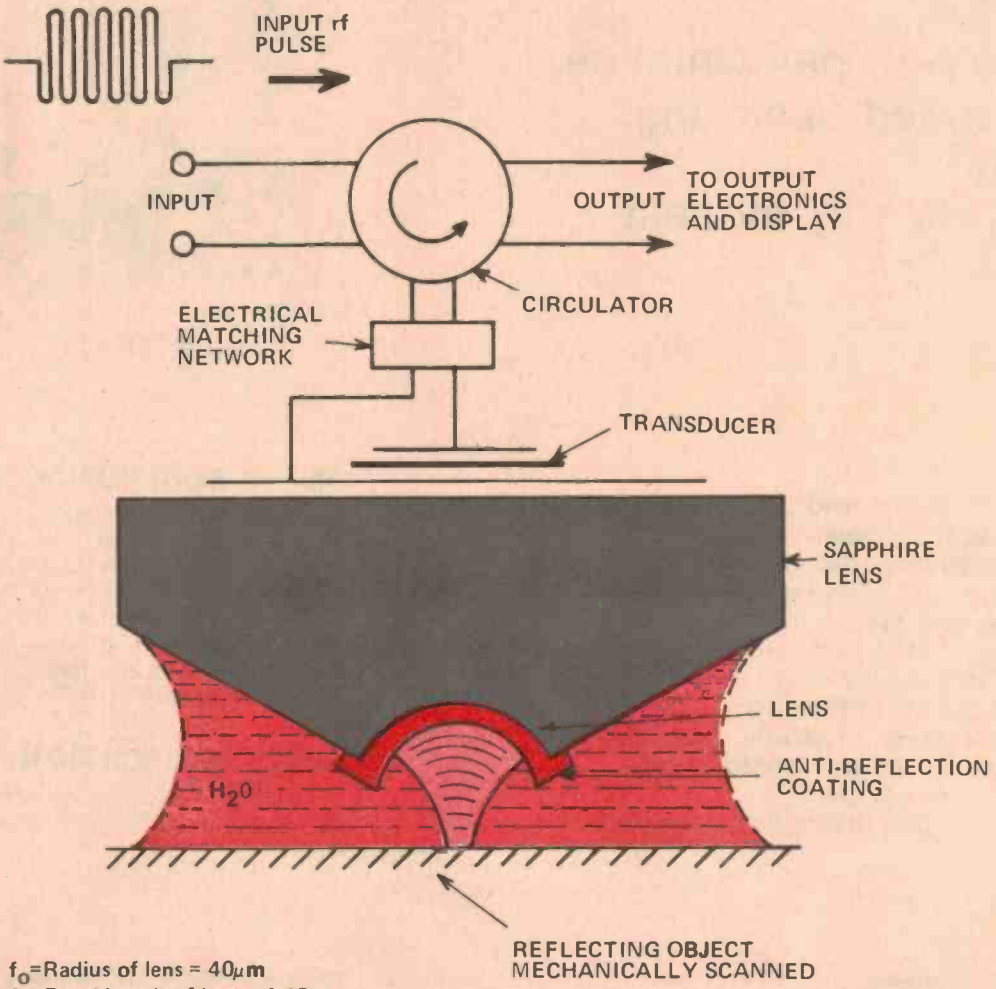


Optical (left) and ultrasonic (right) comparison of a CMOS integrated circuit that uses silicon-on-saphire (SOS) technology showing the greater resolution of blemishes brought out by the ultrasonic microscope. (Pictures courtesy Professor C.F. Quate, Stanford University, USA).



f_o=Radius of lens = 40μm
f = Focal length of lens = 1.13r_o
R = Radius of lens aperture = 0.7r_o

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

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, however, 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, Al_2O_3. 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 anti-reflective 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 ▶

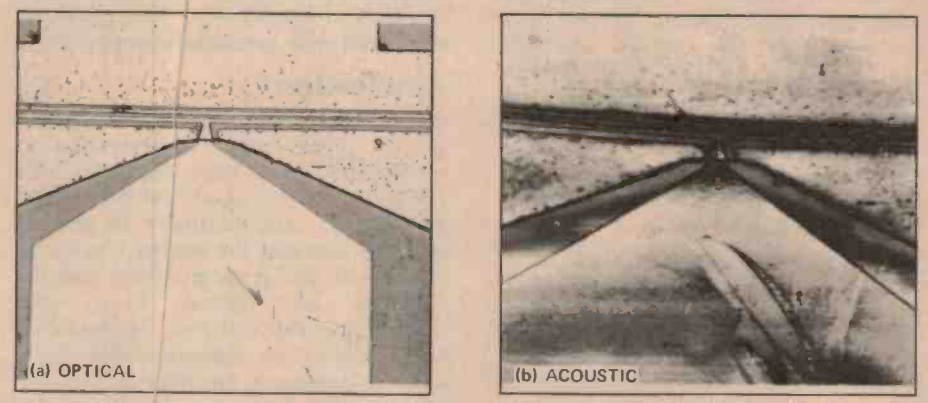


Figure 2. The high resolution obtained with the ultrasonic microscope is well illustrated in the photograph on the right. This shows the internal structure of a Hewlett-Packard FET whose gate length is only 500 nanometers! A photograph taken with a conventional optical microscope is shown, for comparison, on the left.

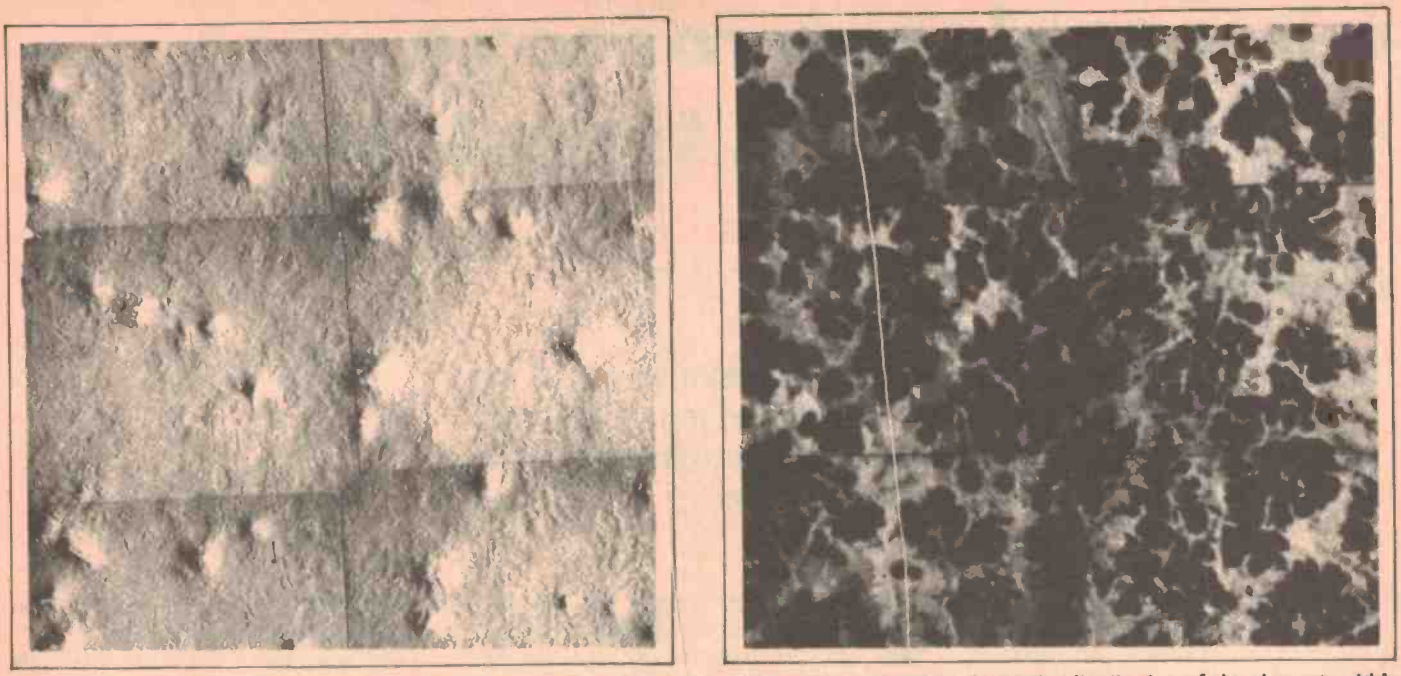


Figure 3. The surface of a cobalt-titanium alloy as seen under an optical microscope is shown on the left, whilst the ultrasonic microscope photograph on the right shows the distribution of the elements within the alloy.

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 inter-faces 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 sub-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 aluminiun 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.

For further information refer to V. Jipson and C.F. Quate, Acoustic Microscopy at Optical Wavelengths, *Appl. Phys. Lett*, 32, (12), 789-791, 15 June 1978. ●

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 (Societa 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.

The 'electronic credit card' produced by SGS-ATES of Milan. They will be used with pre-paid telephones. It contains a 136-bit non-volatile memory arranged in a 17 x 8 bit configuration.

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 single 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.●

JUST WRAP™ WIRE WRAPPING TOOL

WHY CUT? WHY STRIP? WHY SLIT? WHY NOT JUST WRAP?

JW-1-B	BLUE WIRE
JW-1-W	WHITE WIRE
JW-1-Y	YELLOW WIRE
JW-1-R	RED WIRE

JUST WRAP REPLACEMENT ROLLS

R-JW-B	BLUE WIRE	50 ft. Roll
R-JW-W	WHITE WIRE	50 ft. Roll
R-JW-Y	YELLOW WIRE	50 ft. Roll
R-JW-R	RED WIRE	50 ft. Roll

UNWRAP TOOL FOR JUST WRAP

JUW-1	UNWRAPPING TOOL

JUST WRAP KIT

JWK-6	JUST WRAP KIT

"HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

BW-2630	FOR AWG 26-30

Use "C" size NICAD Batteries, not included. Bits not included.

BT-30	BIT FOR AWG 30
BT-2628	BIT FOR AWG 26-28

HOBBY WRAP TOOLS

WSU-30	REGULAR WRAP
WSU-30M	MODIFIED WRAP

PRE-STRIPPED WIRE WRAPPING WIRE

Wire for wire wrapping, AWG-30 (0.25mm) KYNAR® wire, 50 wires per package stripped 1" both ends.

® KYNAR PENNWALT

30 B 50 010	30 AWG Blue Wire 1" Long
30 Y 50 010	30 AWG Yellow Wire 1" Long
30 W 50 010	30 AWG White Wire 1" Long
30 R 50 010	30 AWG Red Wire 1" Long
30 B 50 020	30 AWG Blue Wire 2" Long
30 Y 50 020	30 AWG Yellow Wire 2" Long
30 W 50 020	30 AWG White Wire 2" Long
30 R 50 020	30 AWG Red Wire 2" Long
30 B 50 030	30 AWG Blue Wire 3" Long
30 Y 50 030	30 AWG Yellow Wire 3" Long
30 W 50 030	30 AWG White Wire 3" Long
30 R 50 030	30 AWG Red Wire 3" Long
30 B 50 040	30 AWG Blue Wire 4" Long
30 Y 50 040	30 AWG Yellow Wire 4" Long
30 W 50 040	30 AWG White Wire 4" Long
30 R 50 040	30 AWG Red Wire 4" Long
30 B 50 050	30 AWG Blue Wire 5" Long
30 Y 50 050	30 AWG Yellow Wire 5" Long
30 W 50 050	30 AWG White Wire 5" Long
30 R 50 050	30 AWG Red Wire 5" Long
30 B 50 060	30 AWG Blue Wire 6" Long
30 Y 50 060	30 AWG Yellow Wire 6" Long
30 W 50 060	30 AWG White Wire 6" Long
30 R 50 060	30 AWG Red Wire 6" Long

TRI-COLOR DISPENSER

WD-30-TRI	TRI-COLOR DISPENSER
R-30-TRI	REPLACEMENT ROLLS

WIRE DISPENSER

WD-30-B	BLUE WIRE
WD-30-Y	YELLOW WIRE
WD-30-W	WHITE WIRE
WD-30-R	RED WIRE

DISPENSER REPLACEMENT ROLLS

R-30B-0050	30-AWG BLUE 50 FT. ROLL
R-30Y-0050	30-AWG YELLOW 50 FT. ROLL
R-30W-0050	30-AWG WHITE 50 FT. ROLL
R-30R-0050	30-AWG RED 50 FT. ROLL

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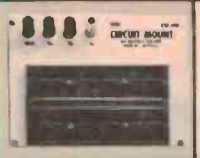
HOOK-UP WIRE

HK-18	18 AWG	25 FT.	SOLID CONDUCTOR
HK-20	20 AWG	25 FT.	SOLID CONDUCTOR
HK-22	22 AWG	50 FT.	SOLID CONDUCTOR
HK-24	24 AWG	50 FT.	SOLID CONDUCTOR
HK-26	26 AWG	50 FT.	SOLID CONDUCTOR
SHK-18	18 AWG	25 FT.	STRANDED CONDUCTOR
SHK-20	20 AWG	25 FT.	STRANDED CONDUCTOR
SHK-22	22 AWG	50 FT.	STRANDED CONDUCTOR
SHK-24	24 AWG	50 FT.	STRANDED CONDUCTOR
SHK-26	26 AWG	50 FT.	STRANDED CONDUCTOR

PRB-1 DIGITAL LOGIC PROBE

- DC to > 50 MHZ
- 10 Nsec. pulse response
- 120 K Ω impedance
- Automatic pulse stretching to 50 Msec.
- Automatic resetting memory
- Open circuit detection
- Automatic threshold resetting
- Compatible with all logic families 4-15 VDC
- Range extended to 15-25 VDC with optional PA-1 adapter
- Supply O.V.P. to ± 70 VDC
- No switches/no calibration

PRB-1	DIGITAL LOGIC PROBE



PROTOTYPE BOARD CM-100

TERMINALS: 1,020 TEST POINTS. 188 separate 5 point terminals, plus 2 horizontal bus lines of 40 common test points each.

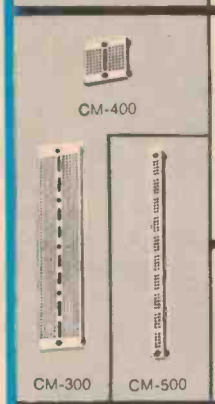
SIZE: 6½" Wide, 5" Long.

CM-100	MODULAR PROTOTYPE BOARD

PROTOTYPE BOARD CM-200

TERMINALS: 630 TEST POINTS. 94 separate 5 point terminals, plus 4 bus lines of 40 common test points each. SIZE: 6" Wide, 3½" Long.

CM-200	MODULAR PROTOTYPE BOARD



PROTOTYPE BOARD CM-300, CM-400

CM-300 and CM-400 have two separated rows of five interconnected contacts each. Each pin of a DIP inserted in the strip will have four additional tie-points per pin to insert connecting wires. They accept leads and components up to .032 in. diameter. Interconnections are readily made with RW-50 Jumper Wire. All contact sockets are on a .100 in. square grid (1¼ in. wide).

CM-300	MODULAR PROTOTYPE BOARD
CM-400	MODULAR PROTOTYPE BOARD

MODULAR BUS STRIP

CM-500 is a bus strip to be used in conjunction with CM-300 and CM-400 for distribution of power and common signed lines. Two separate rows of common terminals, grouped into clusters of five. All contact sockets are on a .100 in. square grid.

CM-500	MODULAR BUS STRIP

DIP IC INSERTION TOOLS WITH PIN STRAIGHTNER

Narrow profile. Pin straightener built into tool. Automatic ejector.

INS-1416	14-16 PIN DIP/IC INSERTER

MOS, CMOS-SAFE

GROUND STRAP NOT INCLUDED

MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER

36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

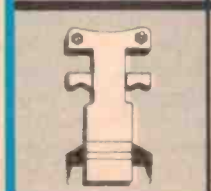
GROUND STRAP NOT INCLUDED

MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL

DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1	EXTRACTOR TOOL



24-40 CMOS-SAFE EXTRACTOR TOOL

Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2	CMOS SAFE EXTRACTOR TOOL

AMPEC ENGINEERING CO. PTY. LTD. 1 Wellington Street, Rozelle, 2039. Tel. (02) 818-1166. **Available from: NSW** David Reid Electronics, 29-6601. Radio Despatch Service, 211-0191. Electronics (Distributors), 636-6052. Martin De Launay, 29-5834. Applied Technology, 487-2711. **Vic.** Radio Parts, 329-7888. Stewart Electronics, 534-3733. Arlin Instruments 569-6984. Ellistronics, 602-3282. **S. Aust.** Protronics, 212-3111. **W. Aust.** Reserve Electronics, 328-3116. **Qld.** Wilber Sales, 391-5136.

"The Rocker" — 140W of rich, warm valve sound!

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 . . .

Phil Wait

Ron Keeley

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

Power Bandwidth	- 1 dB	- 3 dB
140 watts	22 Hz to 12 kHz	18 Hz to 17 kHz
50 watts	18 Hz to 22 kHz	14 Hz to 27 kHz

Distortion at 1 kHz

	100 mW	5 watts	50 watts	100 watts	140 watts
open loop:	1%	0.7%	1.9%	3%	15%
closed loop:	0.4%	0.22%	0.65%	1%	5%

Power output for 5% THD
140 watts (8 ohm load)

Maximum power output
200 watts (8 ohm load)

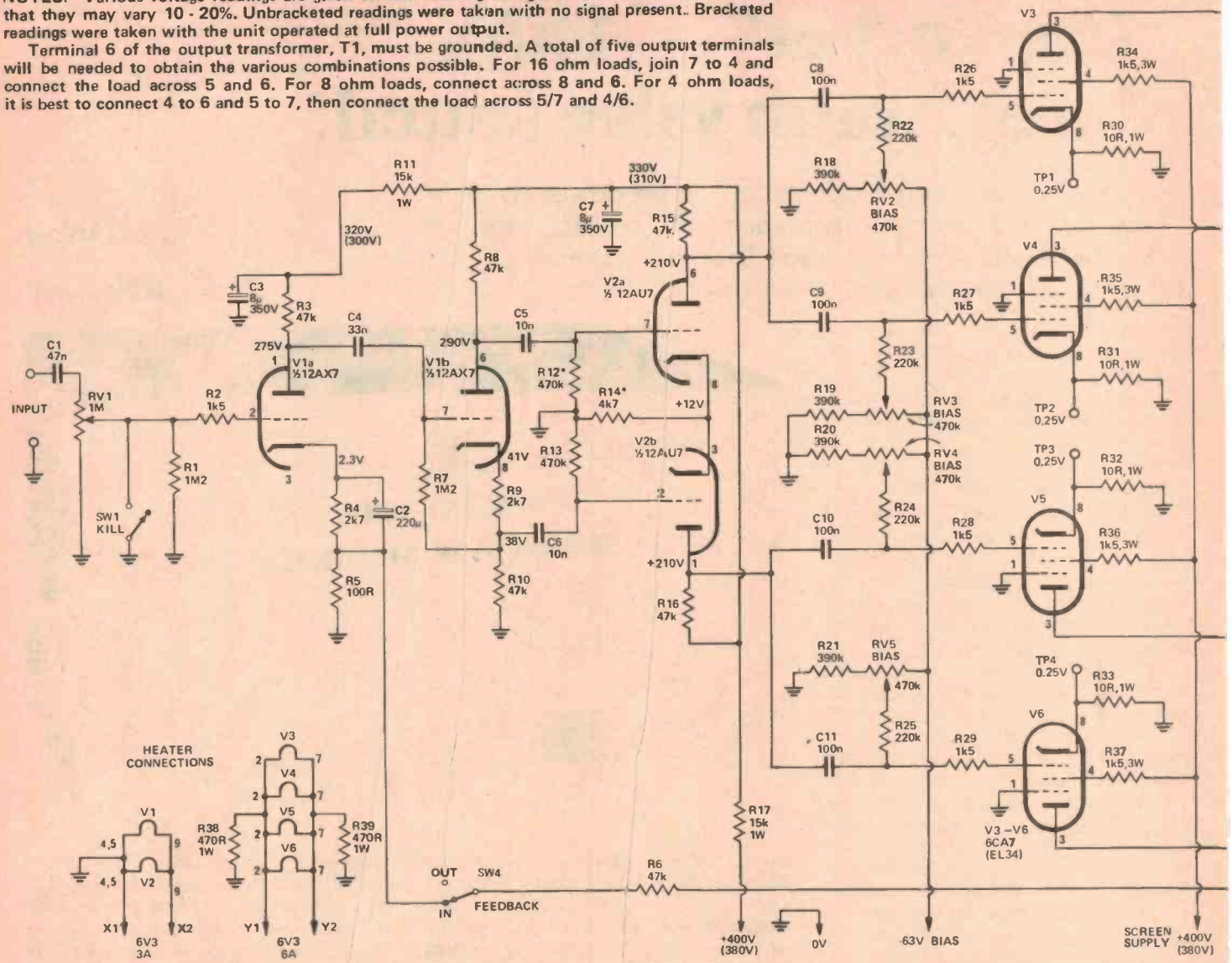
Hum and Noise
- 62 dB with respect to 140 watts output

Input Sensitivity
with feedback: 200 mV (adjustable)
without feedback: 80 mV

Feedback Ratio:
10 dB

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.



HOW IT WORKS — ETI 456

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 dc-isolating capacitor, C1, and the gain control, RV1. 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 12AU7 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.

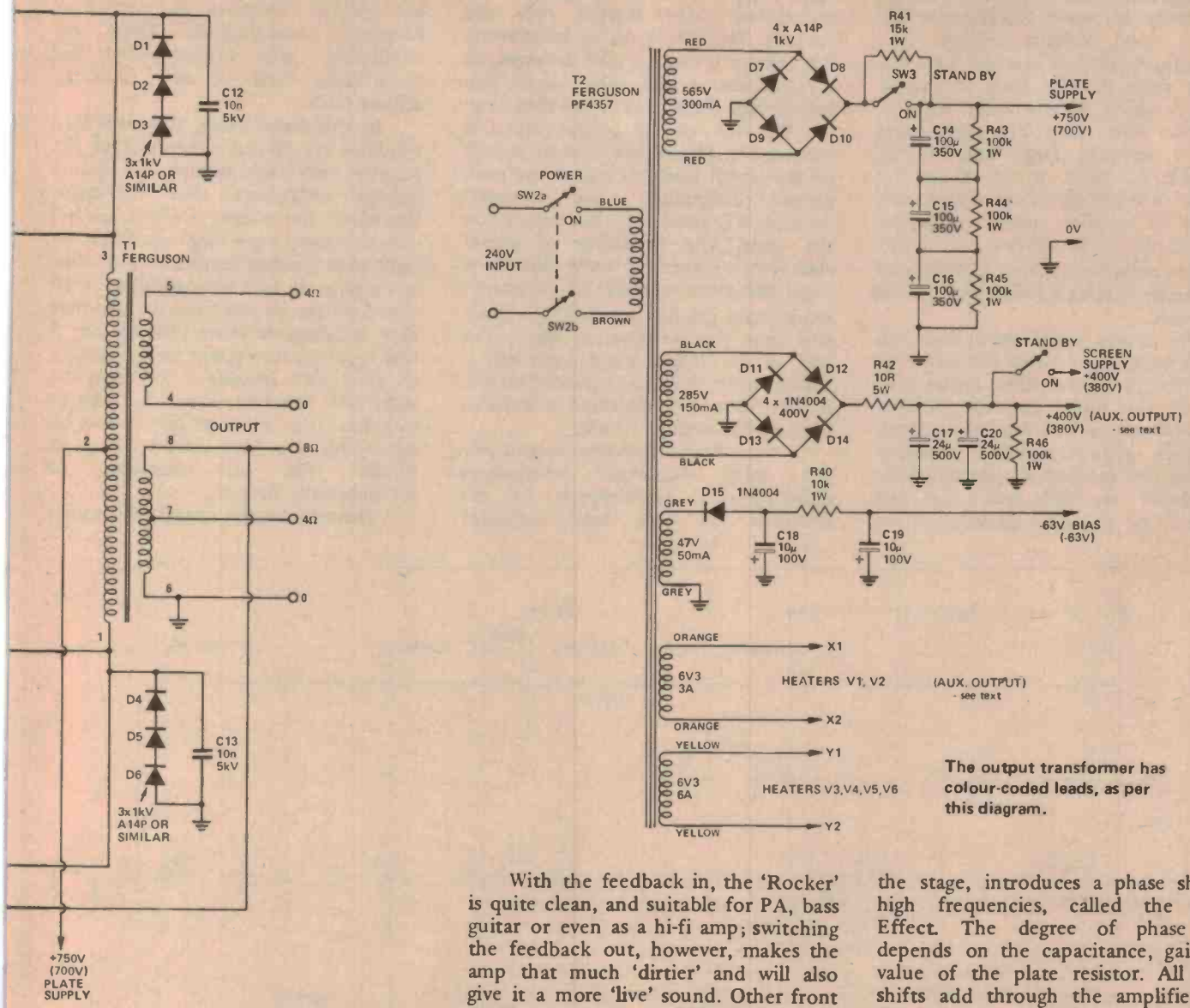
Bias for output stage is provided from a common bias supply from the power transformer, the bias for each valve being individually adjusted. As the characteristics of the 6CA7 output valves can vary widely, this adjustment is provided to ensure proper operation from unit to unit.

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.



The output transformer has colour-coded leads, as per this diagram.

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 amps 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.

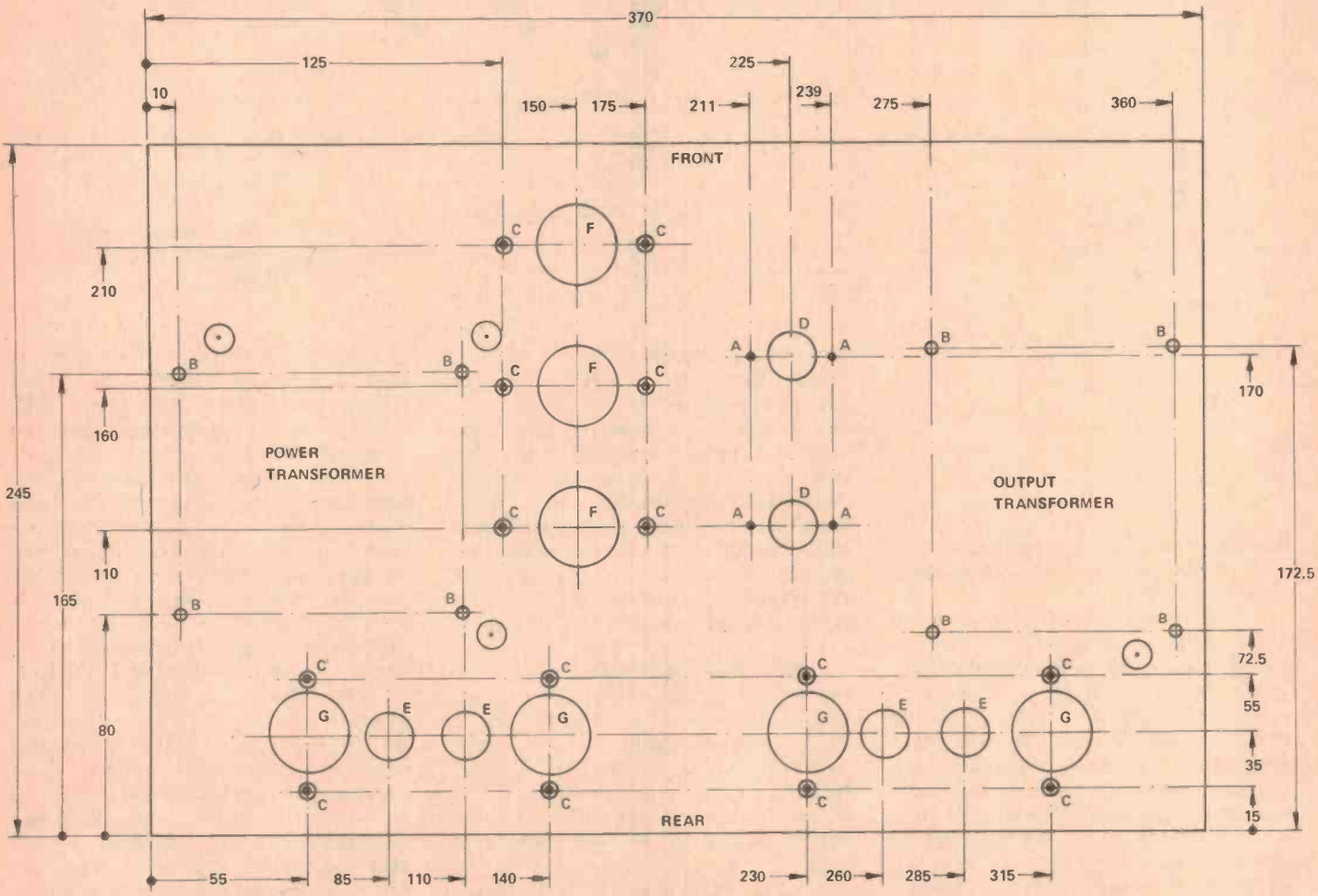
The bias for class B operation is set individually on each tube; this was found to be necessary because of the large spread in the parameters of unmatched tubes bought over the counter. The bias is set by monitoring the voltage across 10 ohm resistors, in the cathode of each valve, which also help reduce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

The life of the output valves is increased by placing 1k5 resistors in each of the screen leads to reduce the peak screen dissipation, and parasitic oscillation is avoided by 1k5 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 independantly for two.

Throughout the circuit, the values



HOLES MARKED A 6BA x 4
" " B 4BA x 8
" " C 6BA x 14 or 3mm pop rivet
" " D 18mm x 2
" " E 9mm x 4
" " F 28mm x 3
" " G 30mm x 4

ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED
MATERIAL 1–1.5mm ALUM. OR STEEL

*DRILL AND INSULATE TO SUIT FOR THROUGH WIRING FROM TRANSFORMER

Drilling details for the chassis, looking down from the top. Refer to the picture on the page opposite.

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.

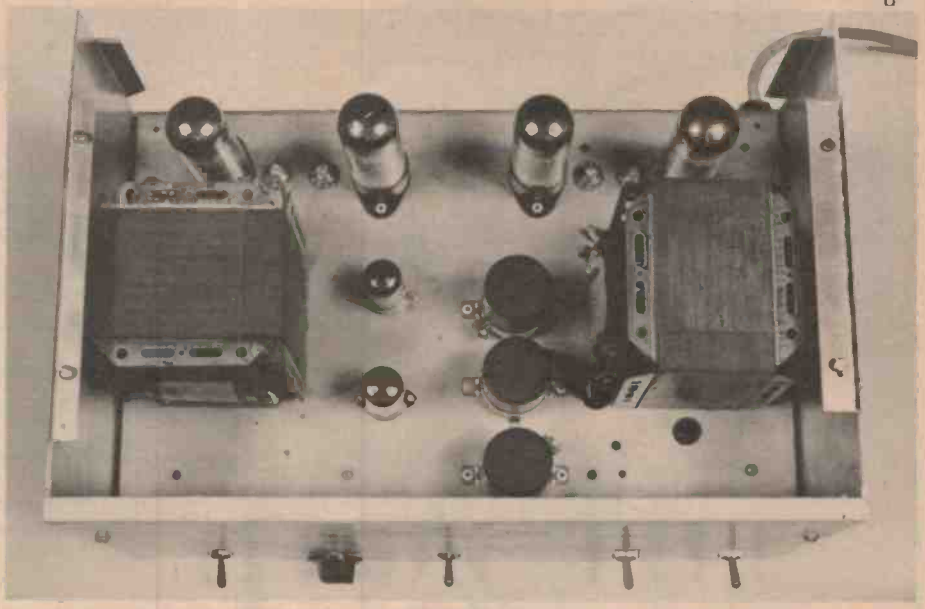
When you look at the power supply circuit, it may seem a little large. It is! It must be, to allow the amplifier to run into hard distortion, especially when used for bass guitar amplification.

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 reistor 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 dc 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.



Looking into the unit. WARNING: keep all the covers on in use as lethal voltages are present. The multimesh cover fits under the front panel lip and is secured by the PK screws at either side.

Construction

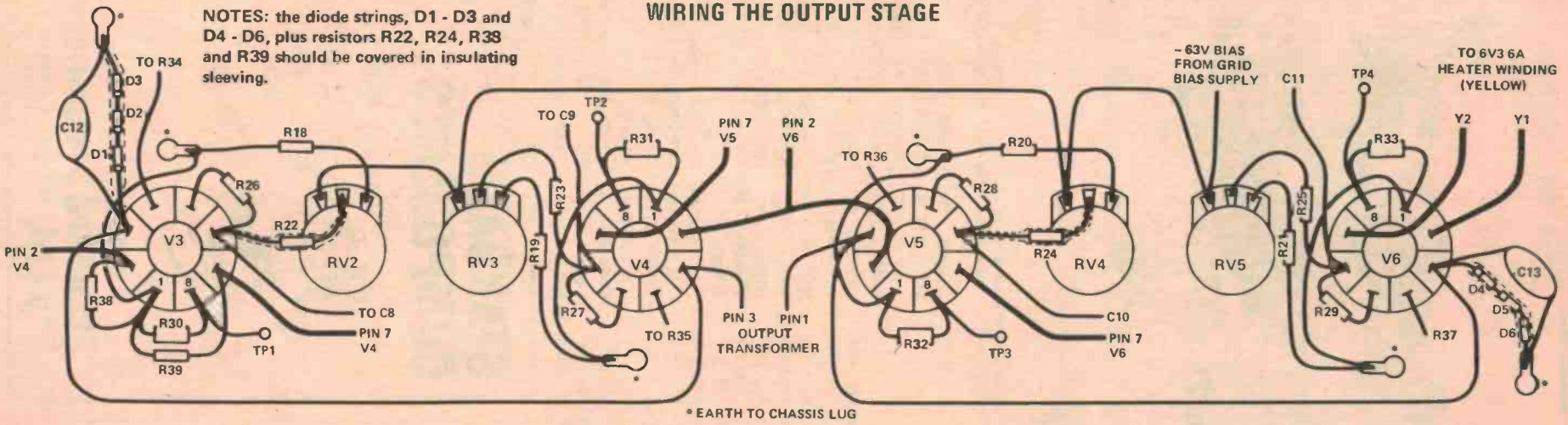
Since most of the components are mounted either on the chassis or on the valve sockets, a pc board is of little advantage. The method we used requires some care in wiring, however, and careful cross checking with the circuit diagram to ensure you haven't made any mistakes! Remember that the unit has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

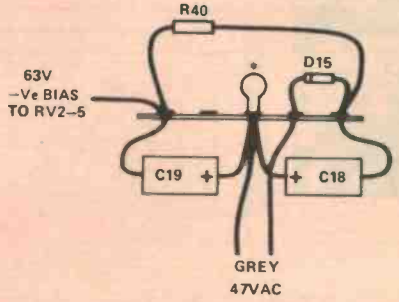
Examine the photos and the wiring diagrams and note carefully the positions of the components. The layout should be followed exactly, and all wiring should be of the highest standard. The power supply circuitry is located around ▶ the power transformer while the voltage

WIRING THE OUTPUT STAGE

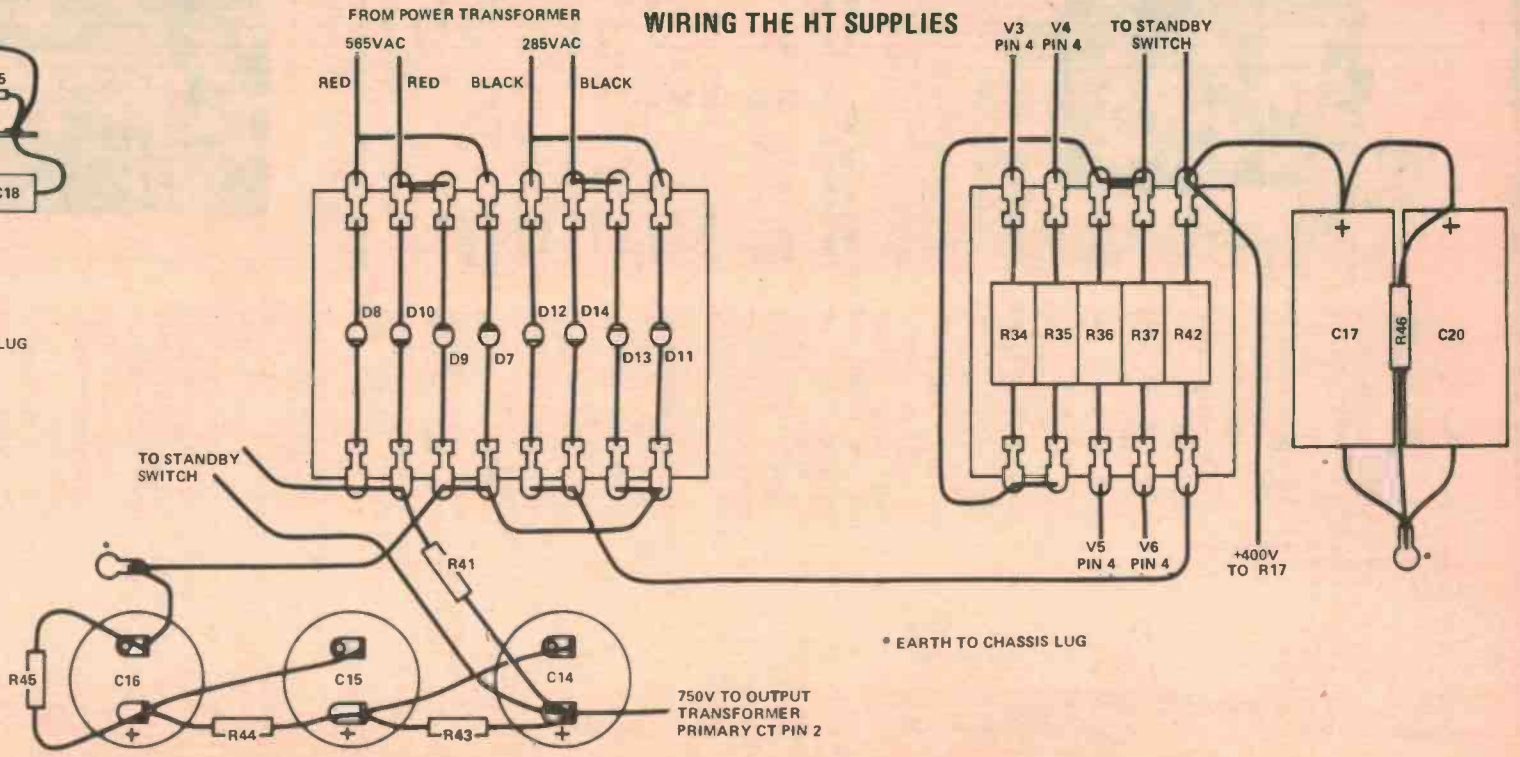
NOTES: the diode strings, D1 - D3 and D4 - D6, plus resistors R22, R24, R38 and R39 should be covered in insulating sleeving.



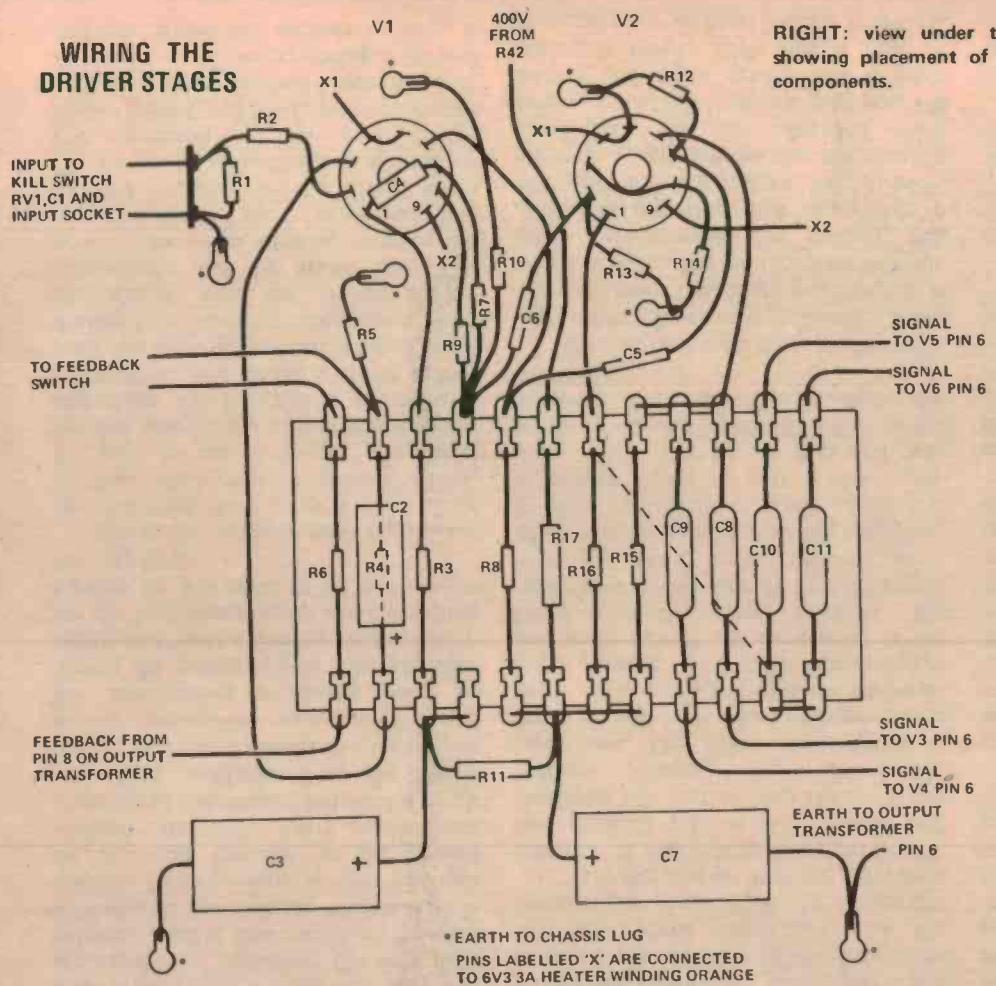
WIRING THE BIAS SUPPLY

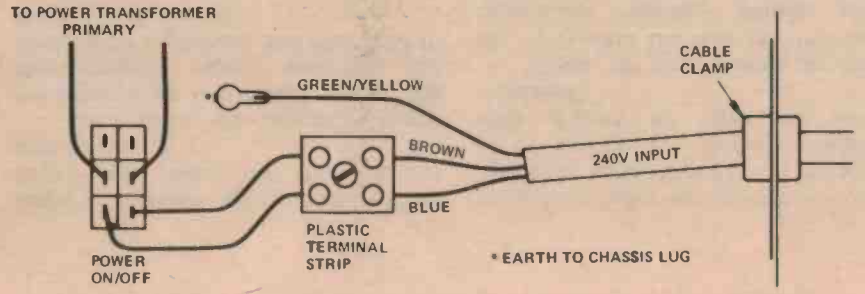


WIRING THE HT SUPPLIES



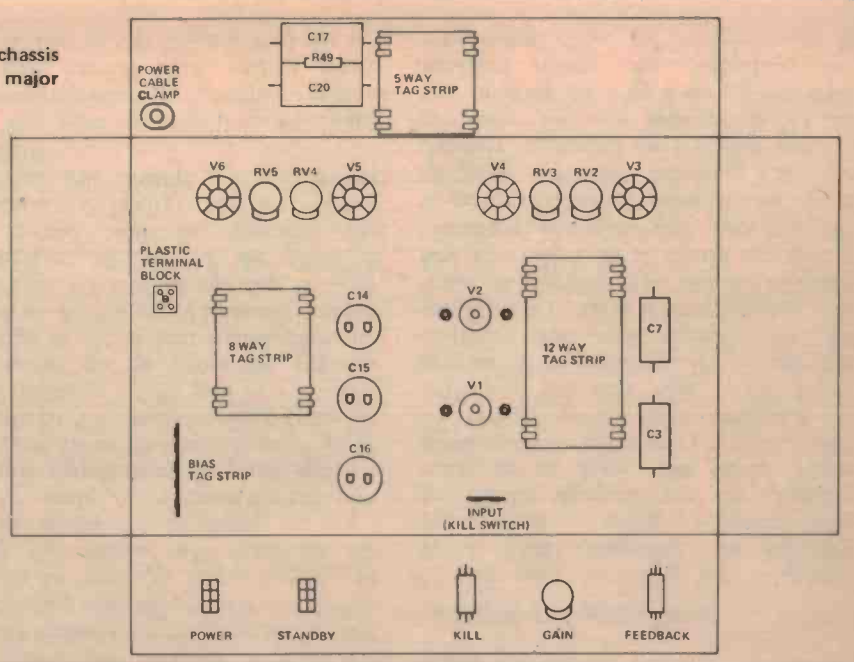
WIRING THE DRIVER STAGES





MAINS INPUT WIRING

RIGHT: view under the chassis showing placement of the major components.



PARTS LIST — ETI 456

Resistors all ½W, 5% unless noted

R1,R7	1M2
R2,26,27,28,29	1k5
R3,6,8,10,15,16	47k
R4,R9	2k7
R5	100R
R11,R41	15k, 1W, 5%
R12,13	470k
R14	4k7
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%
R38,39	470R, 1W, 5%
R40	10k, 1W, 5%
R42	10R, 5W, 10%
R43,44,45,46	100k, 1W, 5%
RV1	1M, log. pot. (GAIN)
RV2,3,4,5	470k, lin. pot. (BIAS)

Capacitors

C1	47n greencap
C2	220u, 16V electro. (pigtail)
C3,7	8u, 350V electro.(pigtail)
C4	33n greencap
C5,6	10n greencap
C8,9,10,11	100n greencap
C12,13	10n, 5kV ceramic disc or mica
C14,15,16	100u, 350V electro.(can)
C17,C20	24u, 500V electro.(pigtail)
C18,19	10u, 100V electro.(pigtail)

Valves

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

Semiconductors

D1 to D10	BC548, BC108 or similar
D11 to D15	BC558, BC178 or similar

Transformers

T1	PF4357, Ferguson power transformer (see circuit)
T2	OP603, Ferguson output transformer; 5k5 p-p impedance to 4 ohm + 8/4 ohm, 200 W.

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 8 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 bleed 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 bleed resistors are working the capacitors should already be discharged. Even so, always repeat this operation when you are working on the amplifier, as bleed 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 lk5 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 supression 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 out-of-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 beedback 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.

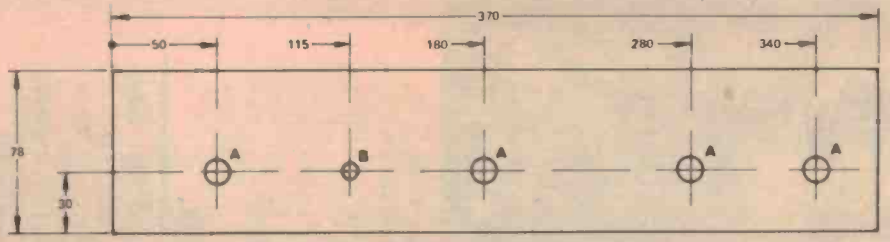
Powering up

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 each bias pot 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

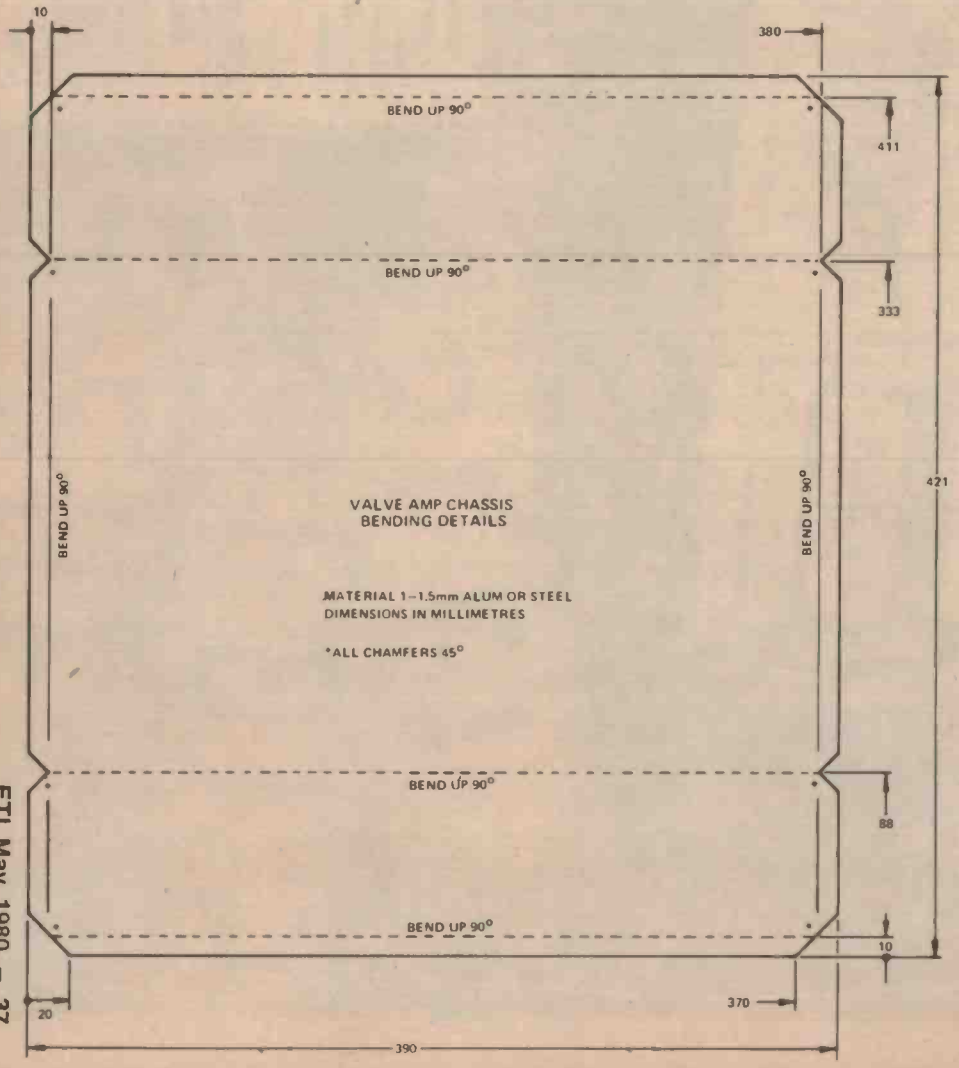
If you plan on using the "Rocker" as a guitar amplifier, we strongly recommend using loudspeakers specifically designed for the purpose, rated to at least 200 watts. These speakers are extremely rugged, with aluminium voice coils designed to withstand the very high power levels generated by guitarists. 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 irrepairable damage to your speakers without knowing it. We strongly recomend the ETI-455 speaker protector for any application, as we very quickly blew up a set of 250 watt speakers when the amplifier was overloaded. ●

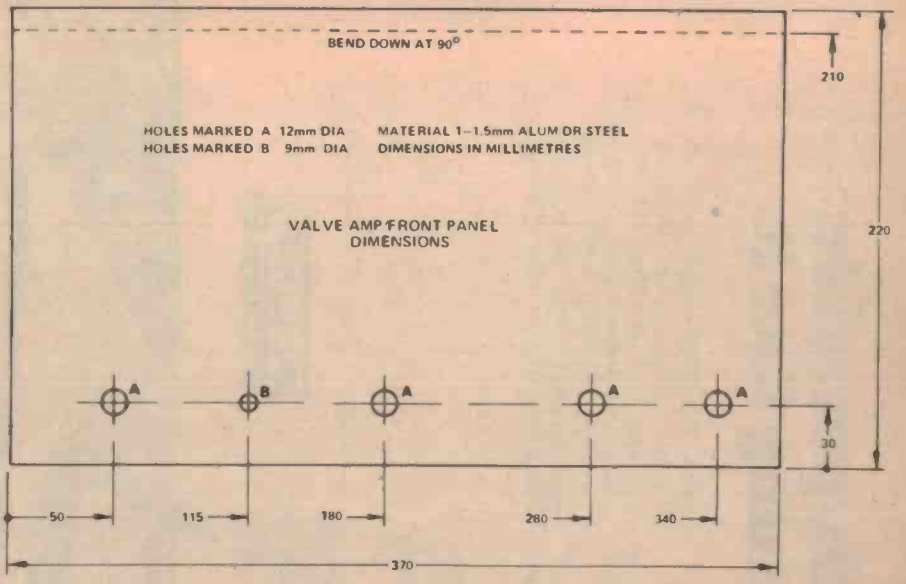


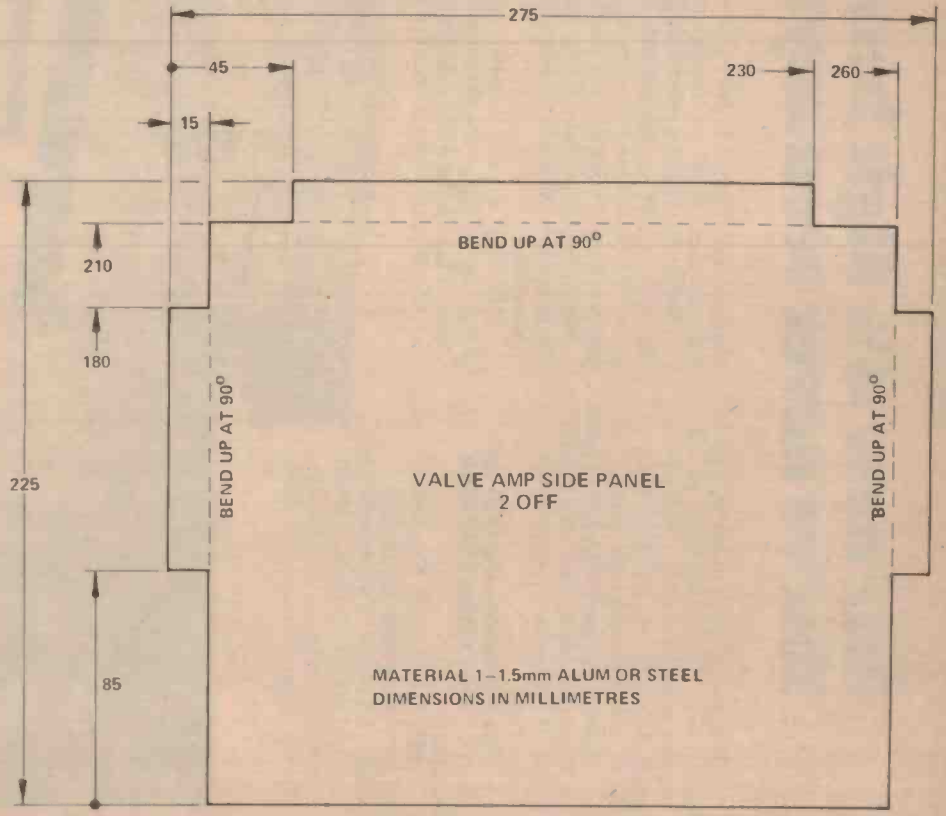
VALVE AMP CHASSIS FRONT LAYDUT DIMENSIONS

DIMENSIONS IN MILLIMETRES HOLE MARKED B 9mm DIA HOLES MARKED A 12mm DIA

NOTES: a base plate, measuring 370 x 245 mm is necessary. Suitable rubber feet may be mounted on it. The top cover is made from Lysaght 'Multimesh' expanded aluminium. It covers the top of the unit and folds down the rear to the chassis top.







Facts from Fluke on low-cost DMM's

Our new 4½-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 4½-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.

FLUKE

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Project 325

'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.

Jonathan Scott

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.

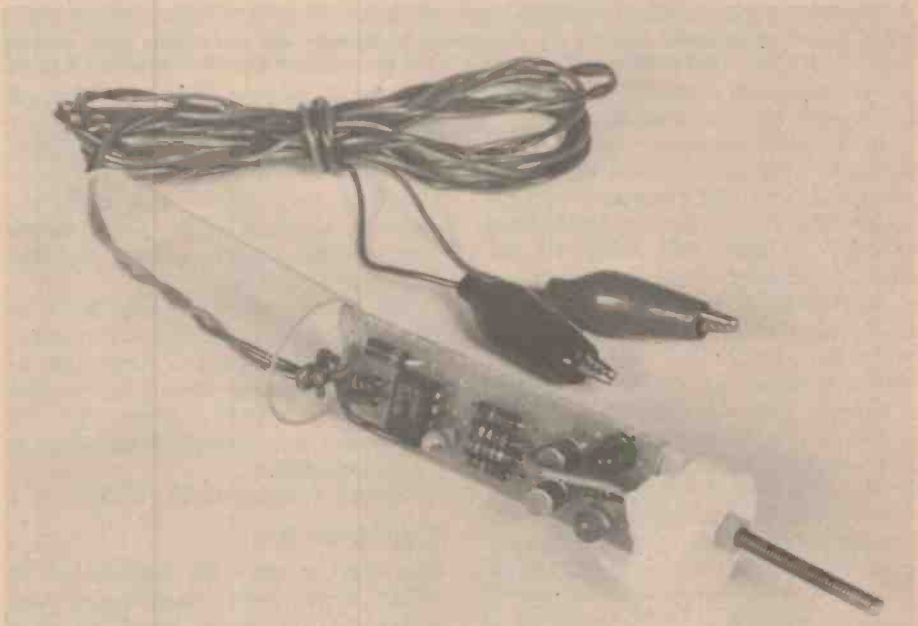
Sorting out the wiring can be a nightmare – especially on motorcycles.

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.



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 !

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

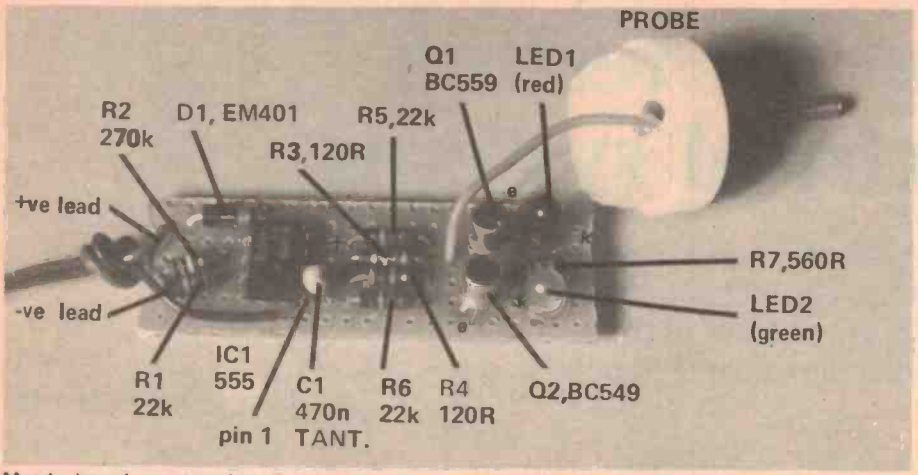
Let us consider the case of a car radio that has 'stopped working'.

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 ▶



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 ½W GLP types.

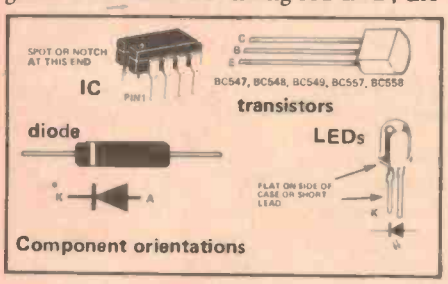
many late-model vehicles) a resistance lead is used – they're hard to spot.

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.

Tracing 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).

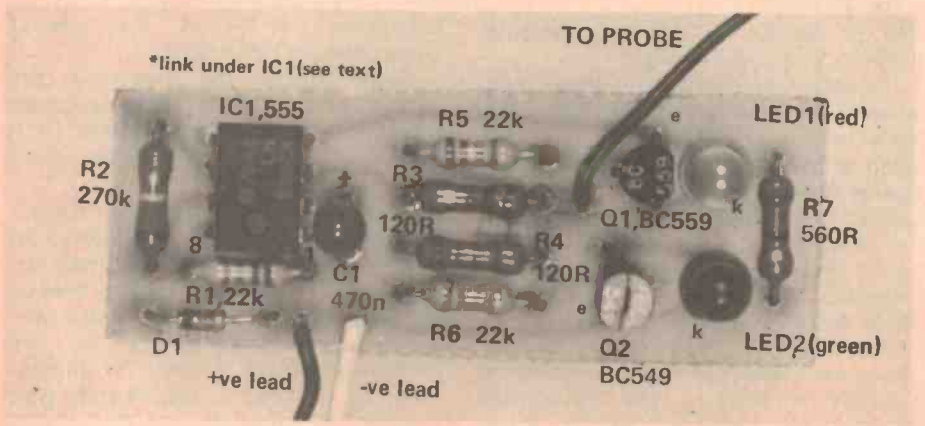
It is probably easiest to commence by mounting the two LEDs and the two transistors. You have to take some care when assembling a project on matrix board as the connections between the components are made under the board, using the component leads. Carefully study the overlay picture to see where the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



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

PARTS LIST — ETI 325

Resistors ..... all ¼W, 5% unless noted
R1, R5, R6 .... 22k
R2 ..... 270k
R3, R4 ..... 120R, ½W, 5% (GLP type) see text
R7 ..... 560R

Capacitors
C1 ..... 0.47u Tantalum (35V)

Semiconductors
IC1 555
Q1 ..... BC559, or similar
Q2 ..... BC549, or similar
D1 ..... EM401, or similar
LED1 ..... TIL220R or similar, red
LED2 ..... TIL222 or similar, green

Miscellaneous
Matrix board — 15 mm × 55 mm, or ETI-325 pc board; alligator clips; pill container; wire; 30 mm long 4 BA bolt and nut (for probe).

READERS PLEASE NOTE

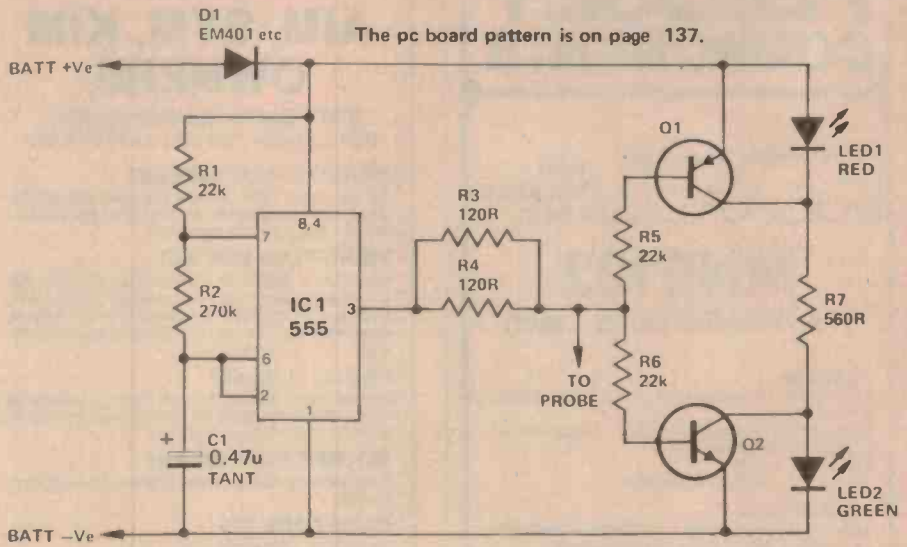
We do not sell kits or components for the projects described in the magazine. To find out who may be stocking kits or components for the projects featured in this issue, please refer to the 'Shoparound' page. Suppliers for past projects are listed on the 'Kits for Projects' page.

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 shorts 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

$F = 1/(0.692 \times C1 \times (R1 + 2R2))$

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 OV 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.

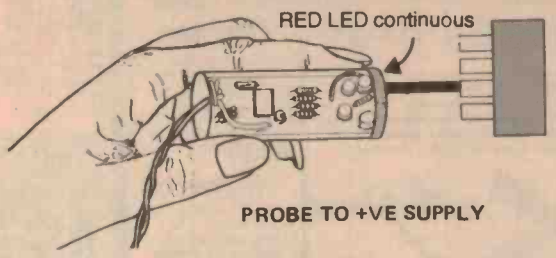
However, if the resistance is not high enough to allow the junction of R5/R6 to go far enough positive the red LED will not turn on. This gives green only blinking.

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.

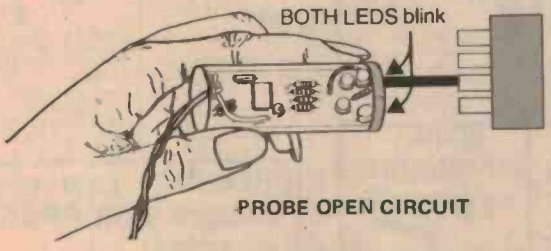
Resistor R7 fixes the LED current and R3/R4 limits the 555 output current to a safe level and defines the voltage 'turn-over' points.

ETI-325 AUTO-PROBE INDICATIONS

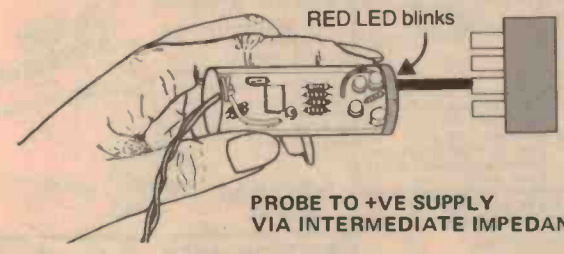


PROBE TO +VE SUPPLY

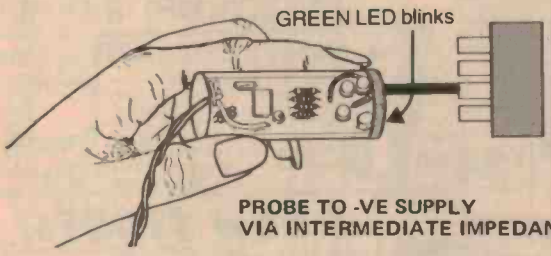
PROBE TO -VE SUPPLY



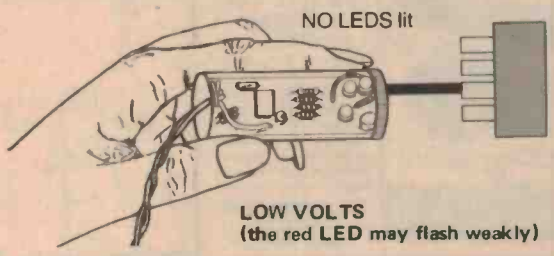
PROBE OPEN CIRCUIT



PROBE TO +VE SUPPLY
VIA INTERMEDIATE IMPEDANCE



PROBE TO -VE SUPPLY
VIA INTERMEDIATE IMPEDANCE



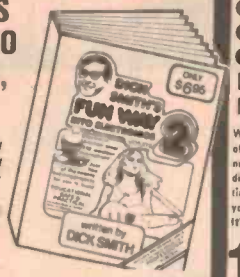
LOW VOLTS
(the red LED may flash weakly)

IMPEDANCE LEVEL CONDITIONS

Both LEDs blink	probe sees impedance larger than 1000 ohms
Red LED steady	probe to +ve via impedance less than 15 ohms
Green LED steady	probe to -ve via impedance less than 6 ohms
Red LED blinks	probe to +ve via imp. between 15 & 400 ohms
Green LED blinks	probe to -ve via imp. between 6 & 800 ohms

COMING SOON!

DICK SMITH'S FUN WAY INTO ELECTRONICS, VOLUME 2



You've seen Dick's Fun Way Volume 1 – now you're ready for something more ambitious. Here it is! With twenty new and exciting circuits to build – each one actually does something useful. If you had fun with volume one, you'll have twice the enjoyment with volume two. It's coming to a Dick Smith store or newsagent/bookseller near you SOON. Order your copy now: the first printing of Fun Way 1 sold out in just ten days!

ALL THIS FOR ONLY $6.95

WATCH FOR RELEASE DATE

Cat B-2605

KITS FOR FUN WAY II PROJECTS:

Kits for all the 20 projects in Fun Way II will be available as soon as the book is published. Full details are in our new 1980 catalogue, page 25.

TELEPHONES HAVE GROWN UP!

Tired of the same old telephone? Try these 20th century telephone-related products for a change!*

- IT'S A CALCULATOR!
- IT'S A DIGITAL CLOCK!
- IT'S A PUSH BUTTON DIALLER WITH 32 NUMBER MEMORY!

What an incredible machine! It's a must for businessses, offices, professional people, even the home! Has a huge 32 number memory – just press a button and the number is dialled for you automatically. Really saves your precious time! Plus you get a 6 digit highly accurate clock (time your STD & ISD calls!) and a superb memory calculator. It's a bargain!

179.00

LIMITED STOCKS!

Cat X-1176

HANDS OFF!

You've seen them in the movies: now they're here in Australia. Great for hands-off use, or more private conversations. Features push-button 'dial' with last number recall, high/low volume (with touch sensors) and modern, easy-care styling. Imagine how this would look on your office desk – or at home!

VALUE!

Cat X-1177

$99.00

*Please note: Although these devices are completely compatible with the Australian (Telecom) phone system, with no soldering required, present regulations do not allow them to be used for this purpose.

PHONE CABLE

Want to do some wiring? Not just for telephones, this cable is ideal for intercoms, burglar alarms, data lines, etc. It's exactly the same as Telecom use. Choice of 4 or 12 conductors, each separately insulated, tinned solid copper for easy soldering or screw connections. PVC sheathed.

4 CONDUCTOR

Cat W-2120
45¢/metre or
35¢/m for 100m

12 CONDUCTOR

Cat W-2140
75¢/metre or
60¢/m for 100m

BARGAIN!

Now a new and better model of our famous 'Communicator' VHF Radio (over 8000 sold!) Tune in to the exciting world 'upstairs' – VHF! This night radio has 6 bands, tunes AM, FM bands plus 4 others. And it includes FREE, a VHF listening guide.

- 6 bands!
- AC/DC power!

ONLY **$59.00**

Cat D-2833

NEW!

LCD CLOCK/TIMER/ALARM/STOP WATCH MODULE WITH HUGE 8mm LCD DIGITS!

AS USED IN APRIL E.A.

Incredible sophistication! This composite 7 channel digital clock and timer module operates from a single 1.5 volt penlite cell; can be used for a huge range of time and timer projects. Complete on one pcb, data supplied with unit.

Cat X-1050

$17.50

MORE OF DICK'S BONZA BULK BUY BARGAINS – BEWDY!

SAVE!

SAVE 33⅓% ON 9V EVEREADY BATTERIES

Yes, a huge reduction. R.R. price is 89¢ each: our price on this 'bulk buy' special.

60¢!!!

Cat S-3106

UHF RIGHT ANGLES:

This is more an 'oops' than a bulk buy. We over-ordered: you save by our mistake. Were selling for almost $3.00. Now look at the price! Great for tidying up shack wiring.

Cat P-2382

$1.50

Mains cord & plug

Now's this one: over 1 metre of 3-core mains cable complete with moulded 3-pin plug, ready for wiring into all types of mains projects. Colour coded wire so you can't go wrong.

Cat W-2058

was $1.40; NOW

90¢!!!

OWN A YAESU?

$3.95

Cat D-9050

Protect your valuable investment with this smart PVC cover. Fits most 'square finish' Yaesus (eg FT101, 901, etc). Cheap insurance!

Calling micro enthusiasts

Building computer oriented projects? You'll need a keyboard sooner or later. This deluxe keyboard features individually switched keys with removable tops (comes in standard 'QWERTY' format) with gold plated contacts. Full 63 set ASCII characters.

Cat X-1180

$55.00

Need a digital keyboard?

A huge number of interesting projects can be made with a numeric keypad – here's one that you assemble yourself and so save even more! High quality moulding, all parts supplied. Value!

$3.75

Cat K-2010

1980 ARRL H'BOOK

15.95

The all-new 1980 ARRL 'bible', new Radio Amateur's Handbook, is now available. With new sections, new data and new features, this is one volume that every amateur and aspiring amateur should have.

Cat B-2218

CODE-MASTER

A game of skill & intelligence!

$29.50

Cat X-1140

How's your intelligence and power of logical thinking? This remarkable game will test you to the limit – and gives you fun and enjoyment at the same time. 'Codemaster' is its name; beating you is its game. Are you good enough to beat it? Find out!

SCOOP!

~~$30.00~~

$12.50

A fantastic special scoop buy (really should be one of our bonza bulk buy bargains!) 240 volt motor for models, fans, etc. has three speeds, silent running, is beautifully made and is yours for less than half original price. Brand new, never used – just think of the uses for a motor like this one!

Cat M-9900

NEW!

INCREDIBLY LOUD AUDIO ALARM

You've got to hear this to believe it! It's ear shattering! Nominally rated at 9 volts, operates from around 5 to 25 volts.

Cat L-7024

$4.95

SPEAKER FADER

High power (25W) control for fading between front and rear speakers. Easy to fit, a delight to use!

Cat A-7834

$9.95

NEW!

FM WIRELESS TIE-CLASP MIC

Here's a brilliant idea: a tiny tie-clasp condenser microphone complete with miniature FM transmitter: receive it on any standard 88 to 108MHz FM receiver. Transmitter section is small enough to slip into shirt pocket: mic comes complete with tie bar. A great idea for entertainers, demonstrators, public address, etc etc etc.

$29.95

Cat C-1073

25-IN-1 EXPERIMENTS

$16.95

Cat K-2032

Here's one for the kids (and maybe the not so young!) An experimenter's kit featuring the latest field of electronics, solar power. Learn more about this fascinating field with these 25 projects – all in one handy package.

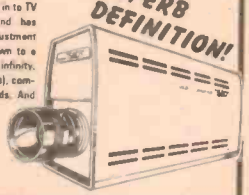
INCREDIBLE! Low cost TV camera with RF AND video output . . .

SUPERB DEFINITION!

Compare and be amazed! This superb b&w TV camera feeds straight in to TV set (video output also), and has unique mechanical vidicon adjustment for extra close focussing (down to a miniscule 15mm!) or up to infinity. High resolution (over 550 lines), compatible with Aust TV standards. And the price: a bargain!

Cat X-1195

$299.00



We've got some more Pocketcoms!

Just when we thought no more! Over 20,000 sold in a hectic 6 weeks before Christmas. Now we've located some more – but these are definitely the last! Incredible value: were selling for almost $60.00, our price less than ¼ that! Comes with one channel fitted (27.125MHz); 2nd channel left open. Batteries available at our stores. (Cat S-3005, 25¢)

Cat D-1100

$14.50

AS REVIEWED IN APRIL EA

Make a cheap CCTV system

Use the above camera in conjunction with our b&w TV set for a superb quality closed-circuit TV system. Great for all sorts of monitoring uses: pools, visitors, security applications, etc etc – the uses are endless! And compare the price of this system with comparable CCTV systems! (You can still use the TV as a TV if you wish!)

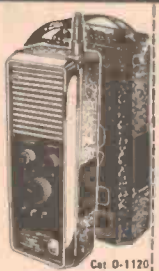
Cat X-1198

$99.00

6 CHANNEL SAFETY TWO-WAY

What a bargain! This deluxe marine transceiver features 6 channel capability; (1 channel comes fitted with 27.88MHz safety & distress freq.) and features huge 5 watts input (maximum legal power).

Why take chances when for so little you can equip your boat with two-way radio. And you take it with you when you're ashore – so it can't be stolen! It's one of the best boating investments you can make.



Cat D-1120

$99.50

NEW CHANNEL XTALS

Yes we're stocking crystals for the new 27MHz marine channels: fit them to your transceiver to make sure you'll be heard!

27.860MHz (D-6086)
27.940MHz (D-6094)
27.980MHz (D-6098)

Stocks due next month –

$5.00 pair

OLD ROCKS:

Of course, we'll continue to stock the crystals for the present 27MHz marine channels.

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

Wow! What incredible value! A superb quality cassette radio with AM, FM, plus SW for under $80.00!! It operates from both 240 volt mains plus internal batteries (not supp.) and features an inbuilt microphone plus extension mic jack. A 'sleep' feature is incorporated (turns off after you go to sleep at night!) This radio was personally selected by Dick recently as being best value for money. For those who want quality, here it is:

Cat A-4016

$75.00

INCREDIBLE!

2 NEW STORES!

NOW OPEN – OUR SECOND STORE IN BRISBANE . . .

Now for all the people on Brisbane's northside, you won't have to travel through the city! Our new store is right opposite the Chermside shopping centre. Same friendly service, same range of quality products as our Burande store; but much more convenient!

842 Gympie Road, Chermside. Phone 59 6970

OPENING SOON:

Our 6th Sydney store – at 613 Princes Hwy, Blakehurst. Watch for the opening date!

MAJOR DICK SMITH RESELLERS

Listed below are re-sellers who stock a large range of our products. However, we cannot guarantee that they will have all items in stock or at the prices we advertise.

ADVANCED ELECTRONICS
5a The Quadrant, Launceston, Tas. (317 075)

AERO ELECTRONICS
123a Bathurst Street, Hobart, Tas. (348 232)

AMATEUR'S PARADISE
121 Nerang Street, Southport, Qld. (322 644)

A & M ELECTRONICS
78a High Street, Wodonga, Vic. (244 588)

COASTAL ELECTRONICS
43 Vulcan Street, Moruya, NSW. (742 545)

CRYSTAL TV RENTALS PTY LTD
66 Crystal Street, Broken Hill, NSW. (6897)

DECRO ELECTRIC
Cnr Magellan St & Brunner Hwy, Lismore, NSW. (214 137)

ELEKTRON 2000
181 Wharf Road, Newcastle, NSW. (262 644)

ELECTROFIX
133 Malop Street, Geelong, Vic. (97 827)

GOODWIN ELECTRONICS
123 Station Street, Blackheath, NSW. (878 379)

HAWKESBURY ELECTRONIC CENTRE
111 George Street, Windsor, NSW. (773 441)

HITEL HI FI
145 Queen Street, St Marys NSW. (623 4442)

O & M HARRINGTON
6/1 Machinery Drive, Tweed Heads South, NSW. (364 589)

HUNTS ELECTRONICS
18 Neil Street, Toowoomba, Qld. (326 944)

HUTCHESSONS COMMUNICATIONS CENTRE
5 Elizabeth Street, Mt Gambier, SA. (256 404)

KELLER ELECTRONICS
218 Adelaide Street, Maryborough, Qld. (214 559)

KINGSTON ELECTRONICS & RECORDS
Channel Court, Kingston, Tas. (295 802)

KB ELECTRONICS & MARINE
361 Main Terrace, Geraldton, WA. (212 176)

KENT ELECTRONICS
42 Stuart Highway, Darwin, NT. (814 749)

LYREBIRD ELECTRONICS
50 Berry Street, Nowra, NSW. (25 525)

MELLOR ENTERPRISES
Shop 2, Forsythe St, Whyalla Norrie, SA (454 764)

M&W ELECTRONICS
48 McNamara Street, Orange, NSW. (626 491)

NAMBOUR ELECTRONIC SHOP
Shop 4, Lawson House, Ann St, Nambour, Qld. (411 604)

ODYSSEY ELECTRONICS
101 Main Street Bairnsdale, Vic. (525 282)

POWER'N'SOUND
15 Franklin Street, Traralgon, Vic. (743 638)

P.J. O'BRIEN ELECTRONICS
62 Wee Waa Street, Walgett, NSW. (243)

PURELY ELECTRONICS
15 East St, Rockhampton, Qld. (21 058)

SUMNER ELECTRONICS
95 Mitchell Street, Bendigo, Vic. (431 977)

STEVENS ELECTRONICS
42 Victoria Street, Mackay, Qld. (511 723)

SILICON CHIP ELECTRONICS
Suite 3, 98 Bridge Street, Muswellbrook, NSW.

TABLELAND RADIO SERVICE
2 Jack Street, Atherton, Qld. (912 017)

TOMORROWS ELECTRONICS & HI FI
68 William Street, Gosford, NSW. (247 246)

TRILOGY WHOLESALE ELECTRONICS
40 Princes Hwy, Fairy Meadow, NSW. (831 219)

TROPICAL TV
249 Fulham Road, Vincent, Qld (791 421)

WAGGA WHOLESALE ELECTRONICS
82 Forsyth Street, Wagga, NSW 2650

VIKING ELECTRONICS PTY LTD
3108 Gold Coast Hwy, Surfers Paradise, Qld. (388 280)

BUYING BY MAIL?

It's so easy! Simply list the items you want, with their catalogue numbers, and post it off with your cheque to our mail order centre (address at right). Don't forget to include post & packing (charges apply to total order value as per table at right).

Then watch your letterbox!

ORDER VALUE:	P&P
$5 (min) to $9.99	$1.00
$10.00 to $24.99	$2.00
$25.00 to $49.99	$3.00
$50.00 to $99.99	$4.00
$100 or more	$5.50

NOTE: These charges apply to goods sent by post in Australia only. Large and bulky items cannot be sent by post.

If you prefer, we will despatch your order by Comet Road Freight to anywhere in Australia for only $6.00 – that's below what it costs us! Large and bulky items are normally sent by Comet unless you specify differently (eg by rail or air – you pay freight on delivery.)

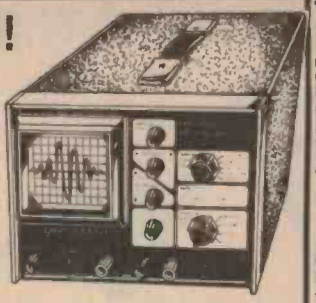
IT'S HERE!!!

AND IT'S EVEN BETTER THAN WE'D HOPED!

Yes, stocks have arrived of our fabulous new Dick Smith Laboratory Oscilloscope. We were expecting a 5MHz cro — these have a response in excess of 6.5MHz!! Everything about these smart looking units says 'quality!'

Now there is no excuse for everyone in electronics — from the service technician to the student — not to have their own cro. Imagine how much easier repairs, service work, developmental work, circuit monitoring, studies, etc become with a cro of your own. Just look at these features:

- **Bandwidth: More than 6.5MHz**
- **Sensitivity: 10mV/division**
- **Sweep Frequency: 10Hz — 100kHz**
- **Screen size: 75mm**
- **Sync: Internal and External**



ALL THIS FOR ONLY $199.00

Cat Q-1280

TRS-80 OWNERS:

Check this book out, over 75 programs for everyday usage: interest, depreciation, algebra & calculus, statistics, etc. An incredibly useful work!

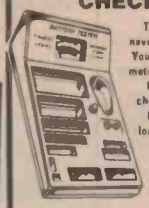
$9.95 Cat B-2345

AND NOW: A CASSETTE!

Yes, save hours of work. All the programs in the above book already on cassette. It'll be at your store this month.

$19.50 Cat X-3565

DON'T THROW 'EM OUT: CHECK 'EM FIRST!



Trouble with batteries is you never know if they're any good. You can't measure them with a meter; so you throw them out.

Here's the answer: a battery checker that takes virtually all batteries (even Nicads, etc), loads them properly and gives you a yes/no/marginal reading. Every home should have one!

$9.95 Cat Q-1525

SPEAKING OF BATTERIES

NICads are cheaper!

It's a fact: Nicad batteries work out far cheaper in the long run, they may be dearer at first, but if you work out the price vs. number of charges, you'll agree. Pentlight Nicads are ideal for replacing conventional 'AA' cells (1.2V is normally close enough)

Only $2.05 each

Or $1.80 ten or more. Cat S-3300

BUILD A KIT:

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

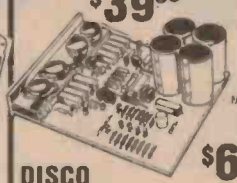
MORSE KEYER

For all hams or would-be-hams! This kit includes paddle & all components, inc. case (panel is not marked). Variable speed in correct proportion, inbuilt oscillator. Suits most transceivers.

Cat K-3470 **$39.50**

ETI 300W AMPLIFIER

More power for your dollar! Massive 300W, ideal for groups or serious audiophiles. Kit for complete module, as shown.



$69.00 Cat K-3444

DISCO STROBE

Turn a dull party into a disco with this one! Bright, vibrant flashes from easy-to-build kit. Can be added on to for even more output. We've sold thousands of this one!

Cat K-3152 **$34.50**

PROGRAM TAPES:

Use your home computer to advantage with these tapes:

FOR THE SORCERER:

YAHTZEE	(Cat X-3600) $9.95
BLACKJACK	(Cat X-3602) $9.95
WUMPUS	(Cat X-3604) $9.95

FOR THE TRS-80:

TIME TREK	(Cat X-3650) $17.95
STIM. SIMULATIONS	(Cat X-3652) $17.95
ELECT. PAINTBRUSH	(Cat X-3654) $17.95
BRIDGE CHALLENGER	(Cat X-3656) $17.95
MICROCHESS 1.5	(Cat X-3658) $22.95

COMPARE OUR PRICES WITH THEIRS!

DEAR CUSTOMERS . . .

Quite often, products we advertise are completely sold out within a few days. Or problems may hold up delivery of promised goods so they are not in the stores when the advert appears. Please don't blame the store manager or staff; they are powerless to do anything about it! What we are trying to say is that, if you are about to drive across town to pick up a particular line, give the store a ring first . . . just in case!

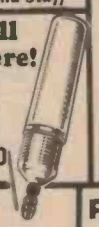
Dick Smith and Staff

SAVE YOUR CAR BATTERY

$4.50 Cat A-8509

How many times have you returned to your car only to find you've left your lights on and . . . flat battery. It need never happen again! This superb little alarm attaches in seconds with just two wires, sticks underneath your dash and beeps if you leave your lights on. (Just in case you want to leave them on, it stops after 10 seconds.) Incredible? We think so! And just look at the price — isn't that worth saving your battery — just once?

Hobbyist drill goes anywhere!



Ideal for printed circuit boards, most wood, plastic & other hobbyist jobs. Runs from two 'C' cells (extra) comes with 1mm drill & tommy bar.

Cat T-4750 **$17.50**

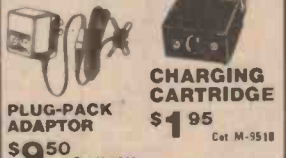
SEAL IT!

Silicon sealant is ideal for sealing projects where water might be a problem. (CDI's, TV amps, etc). Handy size tube for the hobbyist; also great for repairs to fishtanks, etc. Handy!

Cat N-1225 **$3.95**

Can't charge Nicads? Problem solved!

This great new Nicad charger cartridge from AtoR plus our multi-voltage adaptor — you're in business. Simply place 2 to 4 Nicads in the cartridge, plug in the adaptor and you're away. Come back in 15 hours and they're fully charged!



PLUG-PACK ADAPTOR **$9.50** Cat M-9525

CHARGING CARTRIDGE **$1.95** Cat M-9518

DISCOLITE

- **It's a strobe!**
- **It's a music colour!**
- **It's a light dimmer!**

This is the most incredible device going. It is three in one: a strobe circuit which flashes incandescent globes in a pseudo-strobe effect; plus it's a colour organ which has its own inbuilt mic. to modulate lights in accordance with music or sound received; plus it is a conventional light dimmer. All you do is plug it into the power point, and plug your lights into it. It really is incredible!

Cat X-1105 **$47.50**

PLUG-IN TIME SWITCH

Incredible! Up to 3 on/off actions per 24 hours, fully settable, auto and manual control. Contacts rated at 2400 watts (same rating as your power point), appliances simply plug in! Pool filters, security lights, battery chargers, electric blankets, etc etc etc. Auto or manual control, too.

Cat X-1120 **24.50**

AMATEUR POWER!

Want to build HF/VHF amplifiers? Try these superb RF power transistors from Dick. Three different ratings for various outputs, up to a massive 80 watt brute! Rugged, reliable & economical. (All 18V V_{CE} & 36V V_{CE}

Type	Cat No.	I_C	P_{TOT}	Price
2N5590	Z-2390	2A	30W	$8.48
2N5591	Z-2391	4A	70W	$13.95
2N6084	Z-2394	8A	80W	$17.95

BARGAIN 12 VOLT CLOCK MODULE

This has to be the bargain clock of the decade! It's a full fluorescent display with large bright green digits (ideal for daylight use) complete with alarm (buzzer fitted). Runs off 12 volts, with 'inhibit' line for battery saving. Incredibly accurate (quartz crystal timebase); great for building into cars, boats, planes, etc etc.

Cat X-1045

WAS $19.50

NOW $14.50!!!

WHAT A SAVING!

25W CAR STEREO BOOSTER

Road noise beating you? Up your car stereo ouput to a massive 12 watts per channel. Easy to construct, just cuts into speaker leads for an incredible difference in listening enjoyment.

Cat K-3493 **$29.50**

12 VOLT POWER SUPPLY

How many projects need a 12 volt supply? Most! Or run car radio, stereo, CB, etc on the bench. No hobbyist should be without one of these valuable supplies: 12V @ 3A.

Cat K-3448 **$29.50**

AMATEURS

Don't forget: Dick Smith will better any genuine Australian advertised price on Yaesu!

For us to better any price, simply bring along a copy of the current advert from a dealer in the same city. After checking they have stocks to sell at that price, we guarantee to better it!

NEED DATA?

REFERENCE DATA FOR RADIO ENGINEERS ITT

This is the best!

Incredibly valuable reference work for anyone involved in electronics, from beginner hobbyist through to a-hundred-letters-after-his-name engineer. Huge 1196 pages, hard cover.

Cat B-1104 **$35.00**

PROBABLY YOUR LAST CHANCE!

You've heard all about the effects of inflation and depreciating exchange rates on the prices of overseas goods. Electronics is no exception and CB radios have also had to bear the impost of a 30% duty!!! The net result of all this is that once our current stocks of CBs are sold out,

PRICES MUST RISE!

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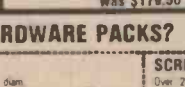

ABOVE: Midland 76A 888
Was $199.50, Now only
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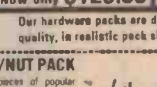

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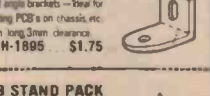

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Cat H-1910 . . . . 75¢

DON'T FORGET: We also have a large variety of packs containing nuts, bolts, washers, etc. They're at your nearest store!

DID YOU MISS OUT?

The 'New Decade' catalogue from Dick Smith Electronics was presented free with last month's Electronics Australia and Electronics Today. 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. The price is just 75c: worth that for the data specifications section alone!.

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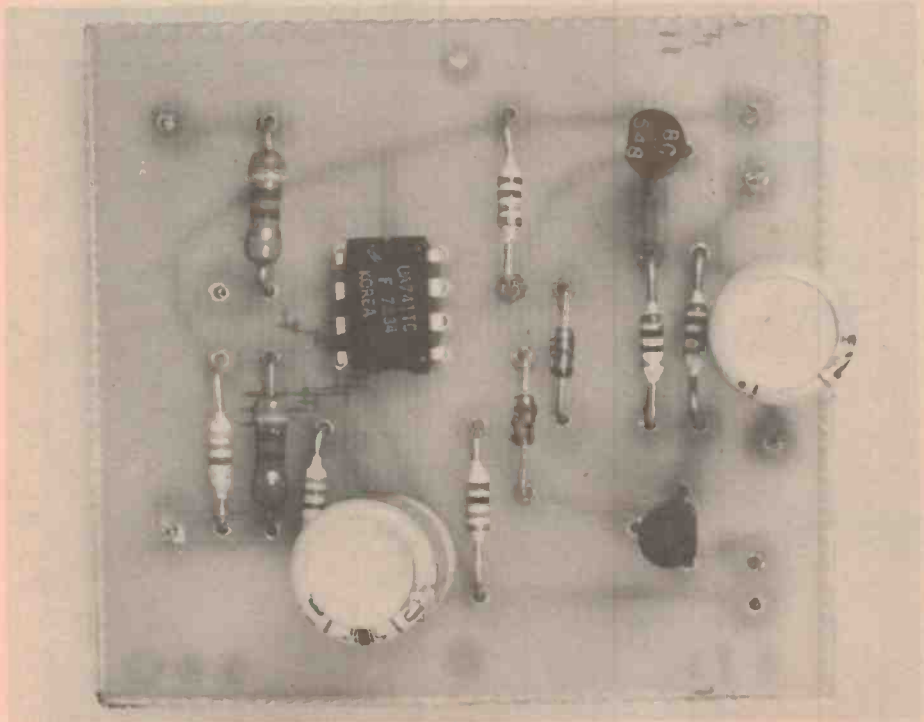
Mains cable seeker

Phil Wait

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.



Construction is very simple — just about foolproof if you use a printed circuit board; see over.

WHETHER YOU'RE engaged on extensive house renovations, or just want to bang in a picture hook, it's not only handy but a decided safety advantage to know where your mains wiring is located in the wall cavity.

After all, you don't want to drill straight into a mains cable and discover it by the shower of sparks . . . do you! It may well be the last thing you ever discover . . .

This simple device picks up the alternating magnetic field radiated by any cable connected to the 50 Hz mains. A simple, inexpensive "telephone pickup coil" is used as the sensor, the 50 Hz signal induced in this is amplified and applied to a small earpiece.

Commencing at any outlet or wall switch, you can trace where the cable runs by passing the pickup coil back and forth over the position where the 50 Hz hum is loudest, moving along the line of the loudest sound. The run of the cable may be marked with tape or whatever suitable method springs to mind.

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

HOW IT WORKS – ETI 560

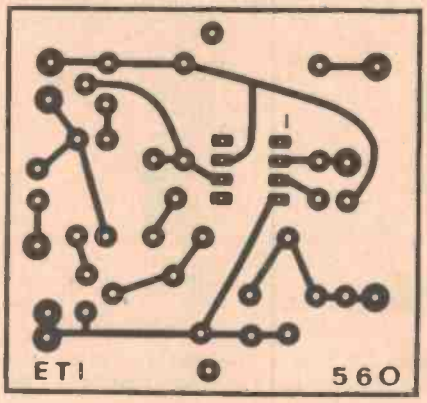
This Mains Cable Seeker works by detecting the weak alternating magnetic field of any current-carrying mains wiring. This signal is amplified to drive an earpiece. A pickup coil consisting of many turns of wire on an iron core is used to locate the field surrounding the mains cable.

The weak signal induced into the pickup coil is first amplified by IC1, a type 741 operational amplifier (op-amp). This IC normally requires to be operated from a dual supply but, in this application, is biased to operate from a single 9 Vdc supply. The non-inverting input of the 741 (pin 3, marked +) is biased to half the supply via a potential divider consisting of R2 and R4. The junction of these two resistors is decoupled for ac by a 100u electrolytic capacitor, C1. The signal from the pickup coil is applied between the half-supply point and the inverting input of the op-amp (pin 2, marked –).

The op-amp, IC1, is arranged here as a variable gain inverting amplifier; that is, the output is out of phase with the input. The output of the 741 (pin 6) drives two output transistors, Q1 and Q2. These are connected as a complementary emitter follower current amplifier, driving the earpiece. Diodes D1 and D2 ensure that the bases of Q1 and Q2 are correctly biased, bias current being provided by R5 and R6. Resistors R7 and R8 are output current limiting resistors, the output being taken from their junction to the earpiece via a dc isolating capacitor, C2.

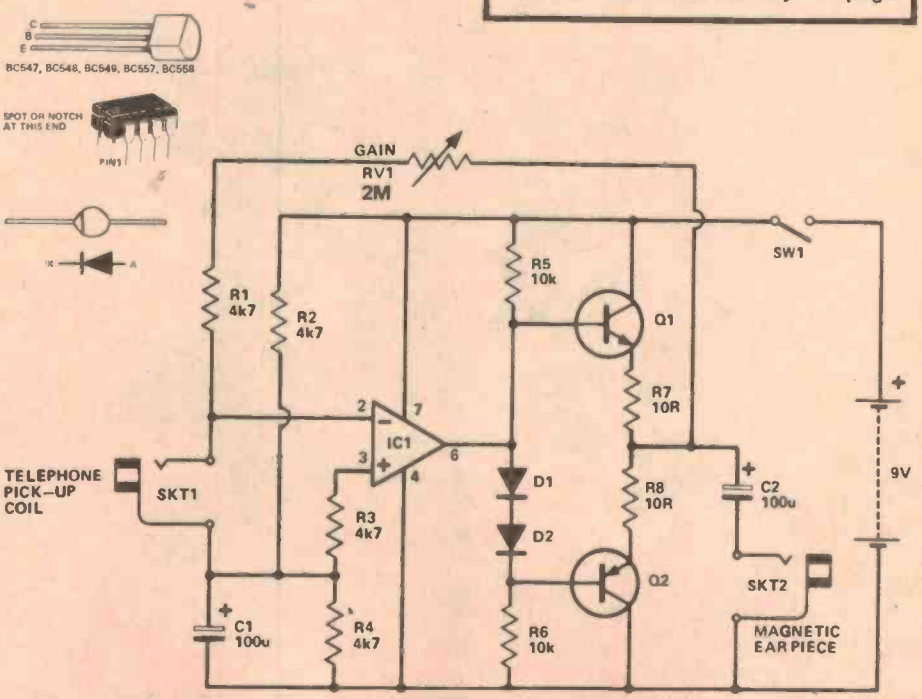
Feedback is taken directly from the output to the inverting input of IC1, via the gain control, RV1 and R1. The value of R1 sets the minimum gain (about unity).

Varying the feedback ratio, by varying R1, varies the gain of the whole amplifier.



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 ferro-magnetic 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 jumble 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. ●

PARTS LIST — ETI 560

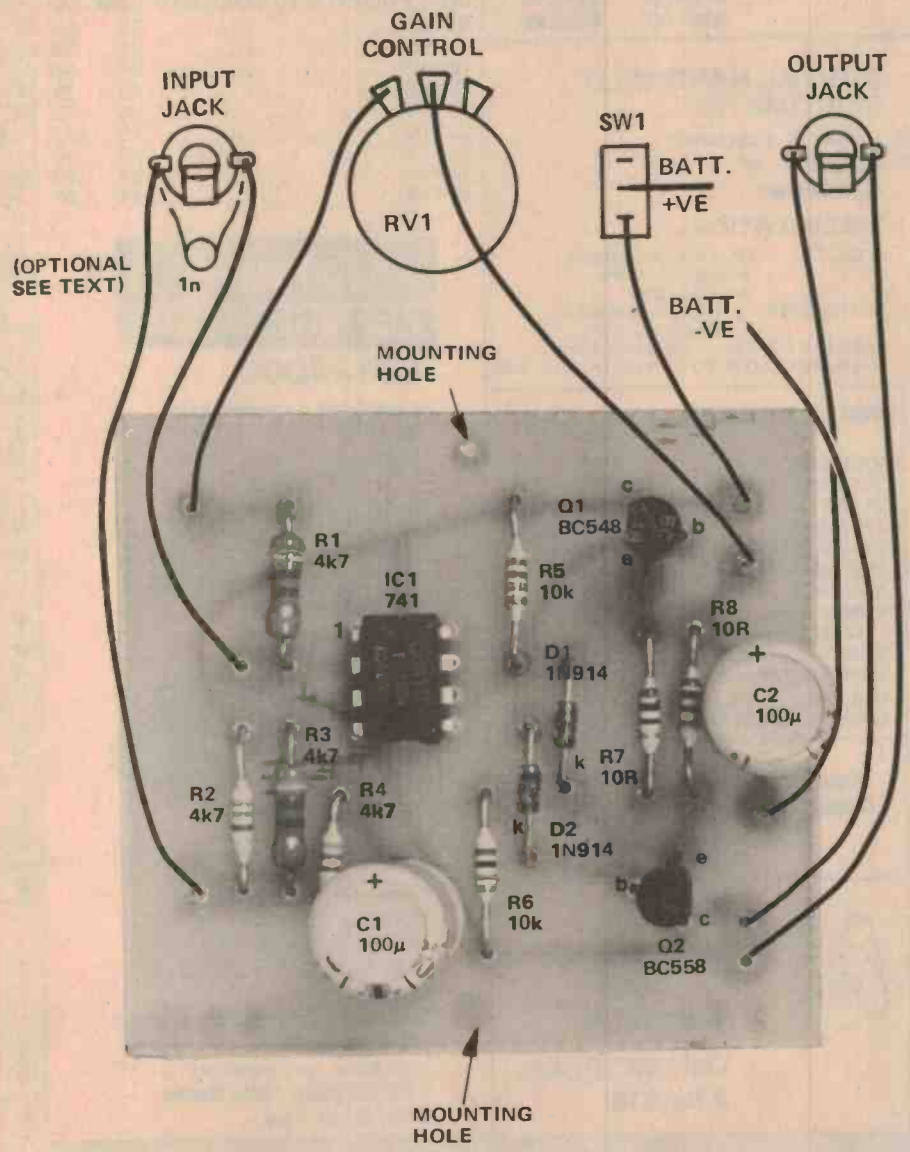
Resistors all ½W, 5%
- R1, 2, 3, 4 ..... 4k7
- R5, 6 ..... 10k
- R7 & 8 ..... 10R

Capacitors
- C1, 2 ..... 100u 16 V electrolytics

Semiconductors
- Q1 ..... BC548, BC108 or similar
- Q2 ..... BC558, BC178 or similar
- IC1 ..... 741 op-amp
- D1, D2 ..... 1N914, 1N4148 or similar

Miscellaneous
- RV1 ..... 2M linear pot
- SW1 ..... SPST toggle switch
- SK1, SK2 ..... 3.5 mm jack sockets
- B1 ..... Type 216 9 V battery

Zippy box to suit, battery clip, ETI-560 pc board, magnetic earpiece, telephone pickup coil or wire and bolt to wind your own.



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

commodore

the PET computer

The Pet has a television screen, a keyboard as simple to use as a typewriter and a self-contained cassette recorder which is the source for programmes and for storing data in connection with these programmes. And it has, in its standard configuration, an 8K user memory. (This is in addition to the 14K operating system resident in the computer).

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2001-16/32

The CBM Computer is now a truly sophisticated Business System with the announcement of these Peripherals.

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2040

Dual Drive Floppy Disk

The Dual Drive Floppy is the latest in Disk technology with extremely large storage capability and excellent file management. As the Commodore disk is an "intelligent" peripheral, it uses none of the RAM (user) memory of the CBM The Floppy Disk operating system used with the CBM computer enables a programme to read or write data in the background while simultaneously transferring data over the IEEE to the CBM The Floppy Disk is a reliable low cost unit, and is convenient for high speed data transfer. Due to the latest technological advances incorporated in this disk, a total of 340K bytes are available in the two standard 5¼" disks, without the problems of double tracking or double density. This is achieved by the use of two microprocessors and memory I.C.s built into the disk unit. Only two connections are necessary — an A/C cord and CBM interface cord.

Tractor Feed Printer

2022

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), numbers 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 8½" paper giving up to four copies. Bidirectional printing enables increased speed of printing.

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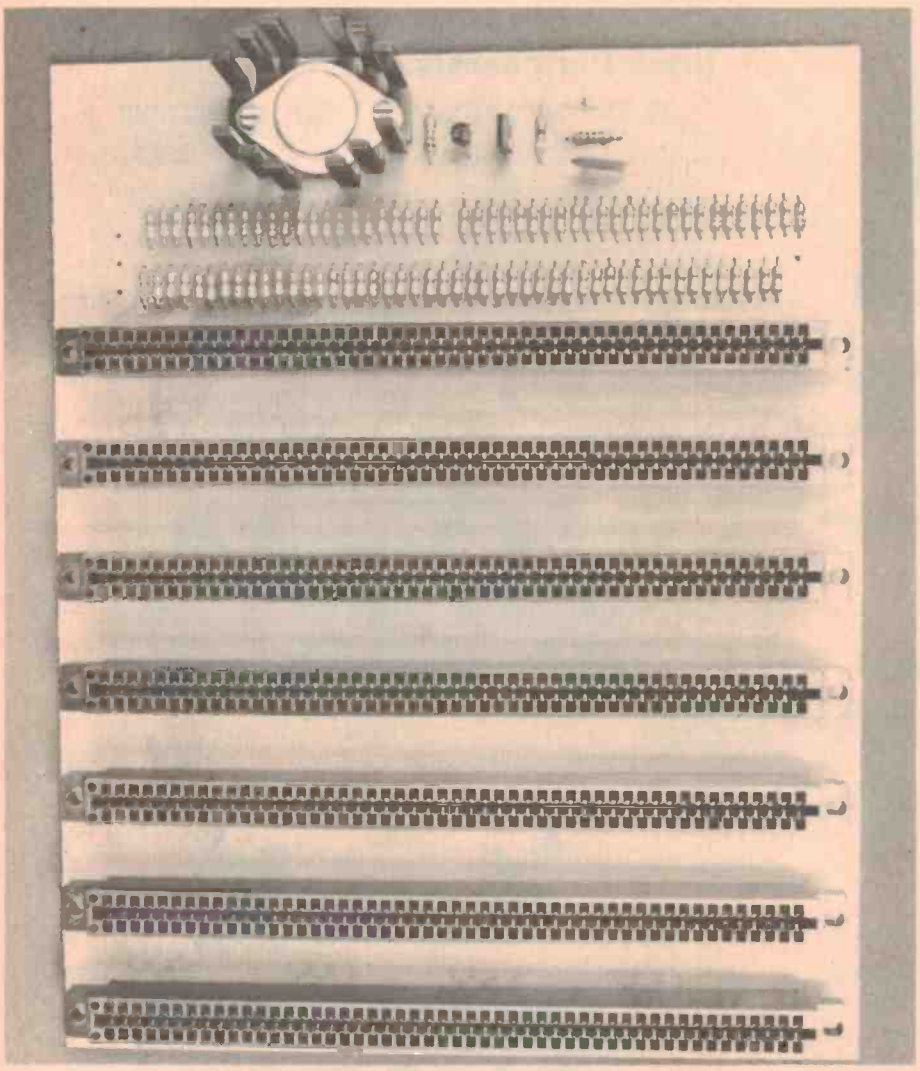
Low cost S100 motherboard with seven sockets and active termination

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.



Overall view of the S-100 Motherboard. We have not mounted the extra power supply regulators and components on the board.

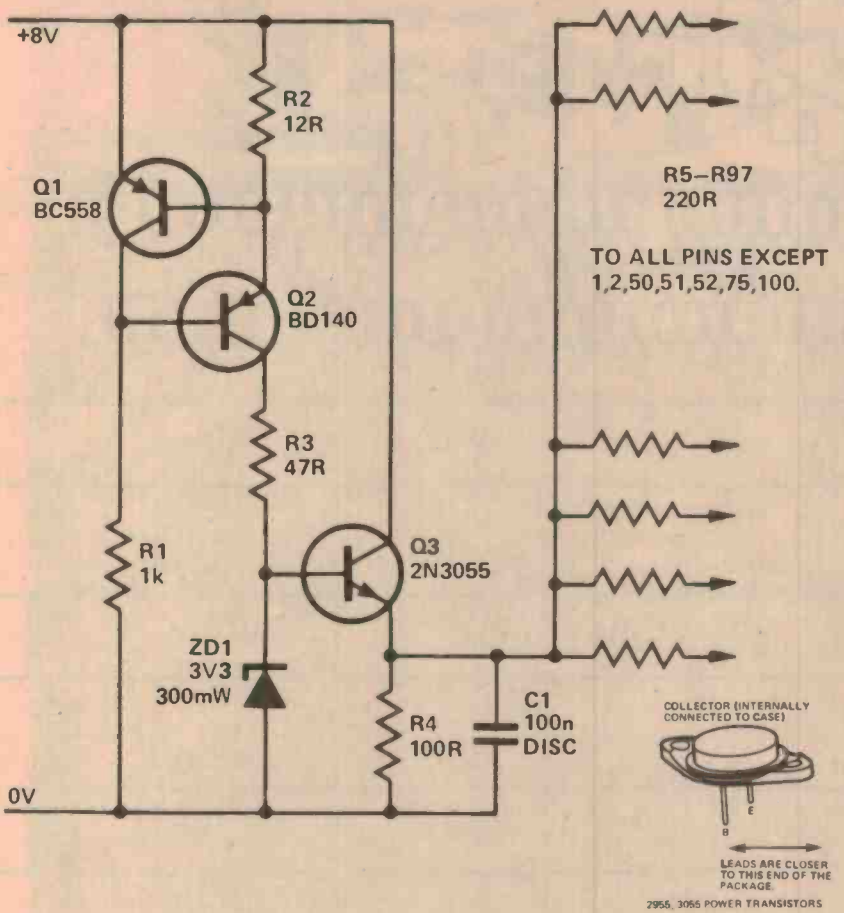
THE MOTHERBOARD described here is a low-cost 'starter' for the hobbyist who has spent all his money on more 'important' items like the CPU, VDU, etc. Mounted in a cheap case (or even standing alone) the board will connect and support up to seven (or more) S-100 cards.

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



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.

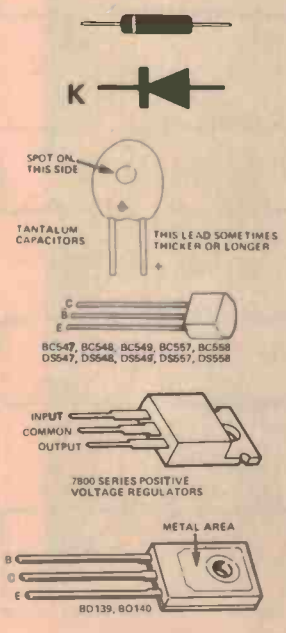
The active termination circuit involves transistors Q1, Q2 and Q3 plus associated components. Q1 and Q2 provide a constant current source for ZD1, which clamps the base of Q3 at 3.3 volts. Q3 acts as a series regulator, providing about 2.7 volts across R4. Each of the bus lines requiring termination 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 hi or lo at quite high clock speeds without significant reflections.

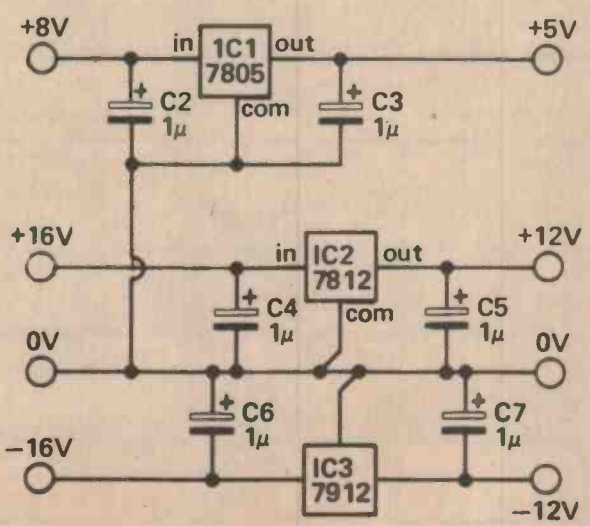
This board will operate with processor systems running at 4MHz, indeed it was originally used, sans terminations, at 2 MHz.

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

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.





PARTS LIST – ETI 636

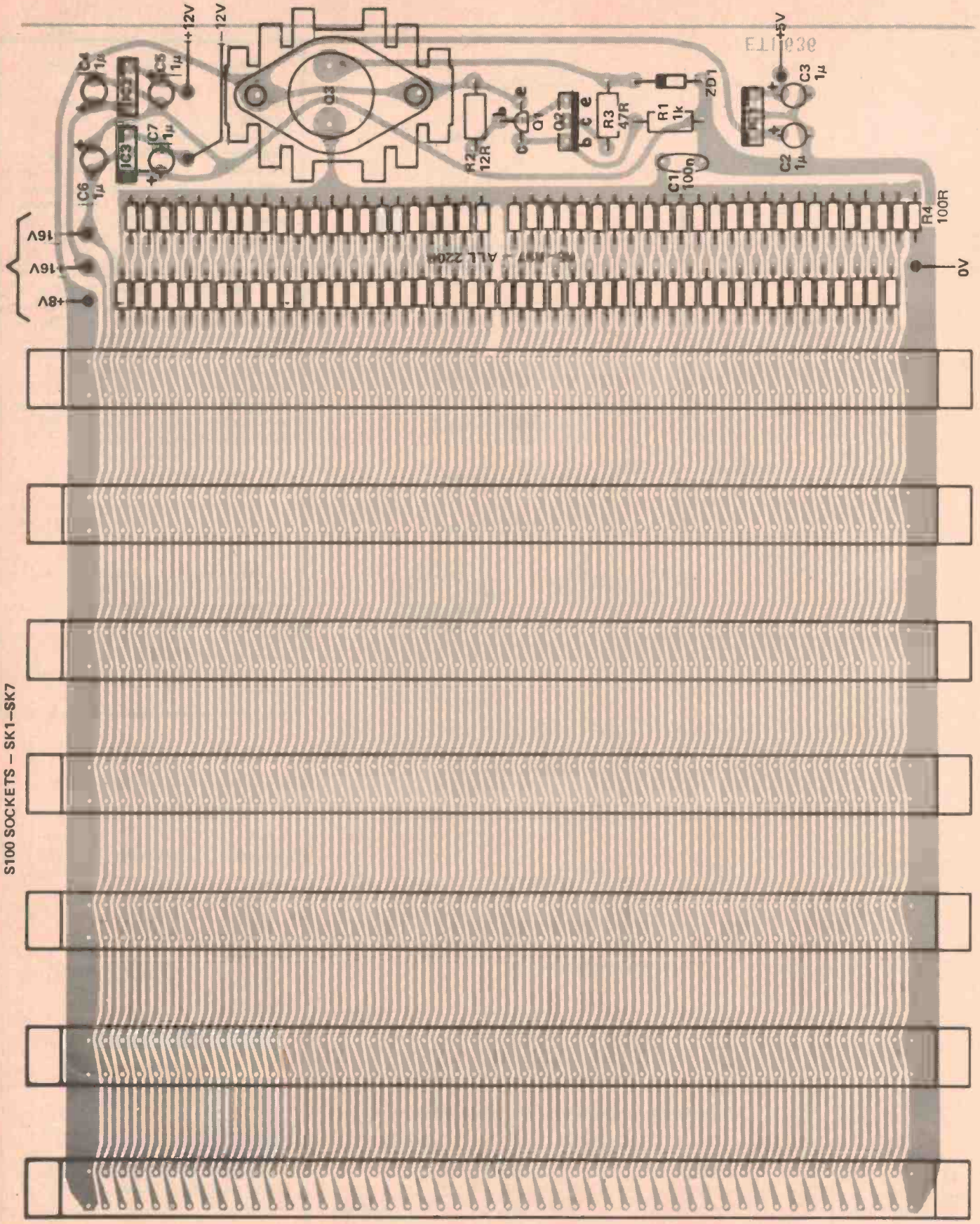
Resistors all ¼W, 5%
- R1 . . . . . .1k
- R2 . . . . . .12R
- R3 . . . . . .47R
- R4 . . . . . .100R
- R5-R6 . . . .220R

Capacitors
- C1. . . . . .100n disc ceramic
- C2-C7. . . . .1µ, 25V tantalum

Semiconductors
- Q1 . . . . . .BC558
- Q2 . . . . . .BD140
- Q3 . . . . . .2N3055
- IC1 7805
- IC2 7812
- IC3 7912
- ZD1. . . . . .3V3, 300 mW zener

Miscellaneous

ETI-636 pc board, seven S-100 solder-in sockets (SK1 to SK7), finger-type heatsink for Q3, nuts, bolts and about half a kilogram of solder!


+12V
-12V
+5V
C4 1µ
C5 1µ
C7 1µ
C6 1µ
C3 1µ
C2 1µ
IC3
Q3
Q1
Q2
R2 12R
R3 47R
R1 1k
ZD1
C1 100n
R4 100R
16V
16V
8V
0V
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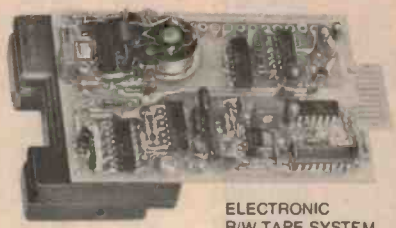

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499 HIGH STREET, NORTHCOTE 3070. MELBOURNE. PH (03) 489-8131

CMOS

4000	.25
4001B	.25
4001A	.25
4002	.25
4006	1.10
4007	.25
4008	1.00
4009	.46
4010	.46
4011	.25
4012	.22
4013	.37
4014	1.10
4015	.90
4016	.45
4017	.90
4018	1.10
4019	.60
4020	1.10
4021	1.10
4022	1.05
4023	.25
4024	.72
4025	.25
4026	1.60
4027	.48
4028	.90
4029	1.20
4030	.40
4031	2.20
4034	3.00
4035	1.30
4039	.70
4040	1.05
4041	1.05
4042	.70
4043	.70
4044	.70
4046	1.20
4047	1.20
4048	.50
4049	.40
4050	.45
4051	.90
4052	.80
4053	.80
5060	1.20
4066	.60
4068	.35
4069	.25
4070	.35
4071	.25
4072	.35
4073	.30
4075	.30
4076	1.20
4077	.35
4078	.40
4081	.30
4082	.40
4089	1.00
4093	.60
4503	.60
5407	.60
5410	1.10
4511	1.00
4512	1.10
4514	2.50
4516	1.40
4518	1.00
4519	.55
4520	1.10
4522	1.25
4527	1.20
4528	1.25
4529	1.60
4539	1.60
4541	1.60
5443	2.00
4553	5.50
4555	1.00
40097	.95
40098	.95
40175	1.00

74C SERIES

74C00	.25
74C02	.25
74C04	.25
74C08	.25
74C10	.25
74C14	.50
74C20	.30
74C30	.30
74C32	.30
74C42	1.10
74C48	1.55
74C73	.75
74C74	.60
74C76	.75
74C83	1.40
74C85	1.20
74C86	.50
74C90	.60
74C93	1.40
74C95	.95
74C107	.70
74C150	3.40
74C151	1.00
74C154	2.90
74C160	.90
74C192	.90
74C164	1.10
74C173	1.00
74C174	.80
74C175	1.00
74C192	1.20
74C193	1.10
74C195	1.00
74C221	1.50
74C373	1.80
74C374	2.00
74C901	.60
74C902	.60
74C905	11.20
74C906	.50
74C907	.60
74C915	1.00
74C922	3.80
74C923	4.00
74C925	4.70
74C926	4.70
74C927	4.70
74C932	1.20

80C SERIES

MM80C95	.90
80C96	.90
MM80C97	.90
80C98	.90

LINEAR

LH0002	9.50
LH0022CD	16.60
LH0042CH	5.60
LH0070	12.70
LH0071	12.70
REF02CJ	8.40
TL071	.80
TL072	1.50
TL082	1.10
LM0091CD	26.40
LH0094CD	37.60
SAK140	2.20
UAA170	3.50
UAA180	3.50
TCA220	2.20
LM301	.30
LM301-H	.50
LM304-H	1.70
LM305-H	.80
LM307-CN	.40
LM307-H	.90
LM308	.70
LM308-H	1.20
LM310-N	2.20
LM310-H	2.60
311	.60
LM311	.60
LM311-H	1.20
LM318	2.80
LM322	3.90
LM324	.70
LM325	3.10
LM329-DZ	1.40
LM334-Z	1.30
LM335	12.40
LM336-Z	3.20
LM339	.60
LM348	1.10
LM349	1.80
LF351-N	.70
LF356-AN	1.10
LF357	1.10
LM358	.70
LM373	4.10
LM374	5.40
LM376	.70
LM377	2.90
LM379	5.70
LM308 8 PIN	1.00
LM380 14 PIN	1.20
LM381A-N	2.40
LM381N	1.80
LM382N	1.60
LM383	2.70
LM384	2.40
LM386	1.00
LM387	1.30
LM391	1.80
LM393	.80
LF398	5.00
465P	1.60
NE530	1.10
555	.30
556	.70
LM565	1.30
LM565CH	2.00
NE566	2.50
LM567	1.50
NE571	6.50
TBA641BX1	2.50
TBA641B11	2.50
LM709-LN-8	.60
LM709-14PIN	.70
UA710CA	.60
LM710-CH	.90
711	.80
UA711-H	.85
UA716HC	6.25
723	.45
LM723CH	1.10
LM725	3.90
LM733	1.20
UA739	2.00
741	.25
LM741-H	.55
UA747	1.00
UA747HC	2.20
UA748	.50
UA748HC	1.25
UA753	1.80
UA760HC	4.10
UA777	2.40
UA777HC	2.65
UA796HC	1.70
LM802	1.10
LM131ON	2.40
1408	4.90
LM1458	.60
UA1488	.90
UA1489	.90
MC1495	7.30
MC1496L	1.40
LM1558	1.50
LM1596	1.40
LM1380	3.10
2719	4.00
LM2902	1.40
LM2917 8 Pin	2.80
LM2917	3.10
CA3028	1.80
LM3039	.90
CA3046	1.70
3065	.45
LM3080	1.20
LM3089	3.90
CA3130T	1.20
CA3130E	1.80
CA3140	1.20
3401	.70
3611	1.10
LM3900	.80
LM3909	1.00
LM3914N	3.90
4136	1.20
LM4250	1.75
UA4558TC	1.40
MM5837	1.45
LM7555	1.80
MC10116L	.95
LF13741	.60
LF13741-H	.70
DS75452	.50
76477	4.20

TTL (S)

74S00	.30
74S02	.30
74S04	.80
74S10	.75
74S11	.75
74S32	.75
74S51	.75
74S74	1.20
74S86	1.40
74S112	1.20
74S135	2.20
74S138	3.20
74S157	2.95
74S158	2.95
74S182	3.30

7400 SERIES

7400	.20
7401	.20
7402	.20
7403	.20
7404	.20
7405	.25
7406	.20
7407	.30
7408	.20
7409	.20
7410	.20
7411	.25
7412	.30
7413	.35
7414	.35
7416	.30
7417	.45
7420	.20
7421	.20
7423	.35
7425	.45
7426	.30
7427	.30
7430	.20
7432	.25
7437	.30
7438	.35
7440	.25
7441	1.00
7442	.45
7443	1.40
7444	1.20
7445	1.10
7446	.90
7447	.70
7448	.90
7450	.22
7451	.22
7453	.20
8T26	1.80
9300	.60
9307	1.80
9308	1.20
7454	.20
7470	.35
7427	.35
7473	.35
7474	.30
7475	.25
7476	.30
7480	.65
7482	1.80
7483	.80
7485	.80
7486	.40
7489	1.60
7490	.28
7491	.55
7492	.35
7493	.30
7494	.90
7495	.45
7496	.80
7497	2.50
74107	.45
74109	.35
74116	2.20
74121	.45
74122	.65
74123	.60
74125	.55
74126	.60
74132	.80
74141	1.10
74145	.85
74147	2.00
74148	1.40
74150	.70
74151	.40
74152	4.90
74153	.70
74154	.70
74155	.90
8T28	1.60
9310	.65
9311	1.00
9312	1.35
74156	1.50
74157	.60
74160	1.00
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74166	1.40
74167	2.50
74170	2.10
74173	1.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	1.20
74185	1.20
74190	1.00
74191	.90
74192	.70
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
74293	.90
74365	.80
74366	.80
74367	.60
74368	.80
8T96	1.80
9314	1.30
9368	1.75
9370	2.00
74LS00	.20
74LS01	.20
74LS02	.20
74LS03	.20
74LS04	.20
74LS05	.20
74LS08	.20
74LS09	.20
74LS10	.20
74LS11	.20
74LS13	.45
74LS14	.65
74LS15	.25
74LS20	.25
74LS21	.25
74LS22	.20
74LS26	.20
74LS27	.20
74LS28	.30
74LS30	.25
74LS32	.25
74LS33	.35
74LS37	.35
74LS38	.30
74LS40	.25
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.25
74LS54	.25
74LS55	.55
74LS58	.65
74LS73	.55
74LS74	.35
74LS75	.45
74LS76	.40
74LS78	.40
74LS83	1.00
74LS85	1.00
74LS86	.30
74LS90	.45
74LS92	.90
74LS93	.60
74LS95	.65
74LS96	1.55
74LS107	.35
74LS109	.35
74LS112	.35
74LS113	.65
74LS114	.50
74LS122	.45
74LS123	.75
74LS125	.50
74LS126	.70
74LS132	.80
74LS133	.35
74LS136	.35
74LS138	.70
74LS139	.85
74LS151	.75
74LS153	.60
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.70
74LS174	.70
74LS175	.70
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	1.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.90
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.40
74LS266	.70
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.50
74LS366	.70
74LS367	.55
74LS368	.50
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	8.00
11C90	12.50
81LS96	2.10
81LS97	2.10
81LS98	2.10

TRANSISTORS

2N301	2.20
2N657	.20
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.00
2N2219A	.60
PN2222	.20
2N2222	.30
2N2463	.35
2N2484	.65
2N2646	.65
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.30
2N3053	.35
2N3054	.75
2N3055	.75
2N3301	.30
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.20
2N3564	.25
2N3569	.20
PN3565	.18
PN3566	.18
PN3567	.18
PN3568	.18
2N3638	.20
2N3639	.20
2N3640	.20
2N3641	.20
2N3645	.15
PN3642	.20
PN3643	.15
PN3644	.16
2N3646	.15
2N3692	.50
2N3693	.35
2N3702	.25
PN3694	.13
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.30
2N3866	2.00
2N3904	.20
2N3906	.20
2N4030	1.10
2N4032	.55
2N4033	.90
2N4036	1.00
2N4037	.90
PN4121	.18
2N4233	1.60
2N4235	1.90
2N4236	2.20
2N4248	.20
PN4249	.30
2N4250	.15
2N4258	.20
2N4292	.70
2N4354	.25
2N4355	.25
2N4356	.20

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2N5088	.17
2N5089	.17
2N5179	1.90
2N5303	3.30
2N5320	.80
2N5401	.25
2N5458	.45
2N5459	.45
2N5461	.70
2N5484	.55
2N5485	.45
2N5486	.50
2N5769	.18
2N5770	.25
2N5830	.25
2N5831	.30
2N5856	.30
2N5873	1.10
2N5874	1.40
2N5961	.18
2N5963	1.10
2N6027	.45
2N301	.90
AC127	.70
AC128	.70
AC187	.70
AC188	.70
AD149	2.00
AD161	1.70
AD162	1.70
BC318	.18
BC319	.18
BC327	.15
BC328	.17
BC337	.20
BC338	.20
BC547	.12
BC547B	.18
BC548	.12
BC548B	.18
BC549	.12
BC549C	.18
BC557	.16
BC558	.16
BC559	.16
BC637	.25
BC638	.36
BC639	.30
BC640	.30
BCY70	.85
BCY71	.85
BD115	1.50
BD135	.50
BD136	.50
BD137	.40
BD138	.40
BD139	.40
BD140	.40
BD235	.65
BD234	.50
BD237	.50
BD262	1.20
BD301	.75
BD302	.75
BD263	1.25
BD435	.70
BD646	1.70
BD647	1.80
BD675	.80
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BF115	.50
BF173	.70
BF180	.60
BF195	.30
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LF199	.15
BF336	.80
BF337	.80
BF458	.90
BF494	.20
BFX85	.75
BFY50	.90
BFY90	1.30
BSV17	1.00
BU126	3.00
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FT2955	1.40
FT3055	.75
MEL12	.90
BU326A	3.40
MJ2955	.75
MJ4032	7.40
MJ802	3.40
MJ4035	6.90

MJ4502	3.70
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MJE350	1.20
MJE700	1.30
MJE800	1.00
MJE1101	2.20
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MJE3521	.55
MPF102	.40
MPF131	1.20
MPSA05	.20
MPSA14	.30
MRF475	4.40
MPSA92	.60
TIP31B	.75
TIP31C	.60
TIP32B	.75
TIP32C	.75
TIP33A	1.10
TIP34A	1.20
TIP24B	1.50
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TIP110	1.30
TIP120	1.30
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ADCD 800	12.00
DACO 808	2.00
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2113 300NS	6.30
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8 to 31	5.60
32 Up	5.40
2513	12.40
2516	55.00
2532	74.90
2650	27.00
2708	8.50
2716	33.00
4116	12.00
5101	9.00
55101	5.50
MM52030	14.50
MM5204	12.50
MM5220	7.20
MM5303N	4.10
MM5307	18.00
MM5309	6.50
MM5312	9.00
MM5369	2.50
5387	8.50
MM5395	6.50
MM5740	15.60
6502	10.50
6508	5.50
6520	5.50
6522	10.00
6532	17.00
6551	17.00
IM6561	4.50
MCM6574	19.60
MCM6575	9.20
MC6800P	9.00
MC6802	13.60
MC6808	12.50
6810A	4.90
6820	5.50
6821	6.00
6850	5.15
6852	6.40
7106	12.90
7107	15.00
7210	13.20
LS7220	6.00
8035	27.00
INS8050	15.00
INS8080	8.00
P8085	25.00
8155	22.00
8156	22.00
8205	5.00
P8212	4.00
8214	8.00
8224N	5.50
8224	7.50
8228	9.50
8238	8.00
8243	8.00
8251 INTEL	14.00
INS8251	6.50
8253	19.50
8255A	8.60
8295	25.00

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100	BU208	$200.00
10	BU126	$2.90
10	BDX80	$75.00
10	BD139	$2.50
10	BD140	$2.50
10	BC549	$1.00
10	BC559	$1.50
10	BC547	$1.00
10	BC557	$1.50
10	BC327	$1.50

10	2114 (450 ns)	$47.50
10	2708	$84.00
10	Red Leds	$1.20
100	Red Leds	$10.00
10	Green Leds	$2.00
10	7447	$6.00
10	7490	$3.50
10	7400	$1.50
10	RL4136	$13.00

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

SPECIALS

2114	(450 ns)	8 for $38.00
2114	(450 ns)	16 for $75.00
2114	(450 ns)	32 for $149.00
2114	(450 ns)	64 for $293.00
2708	(450 ns)	1-8 for $8.50 ea
2708	(450 ns)	16-32 for $8.35 ea
4116	(200-250 ns)	1-7 $10.00 ea
4116	(200-250 ns)	8-15 $9.85 ea
4116	(200-250 ns)	16-31 $9.68 ea
4116	(200-250 ns)	32 or more $8.62 ea

DM8578	3.50
AY-5-2376	19.56
MM5104N	10.00
MM55106N	10.00
MM57160	7.50

OPTOCOUPLERS

MCT2	.80
MCT6	3.30
MCT275	1.50
MCC671	3.00
4N28	.85
4N33	1.20
4N26	.85

ZENER DIODES

E23 Range	
400MW	.12
1 Watt	.23

CAPACITORS

Polyester 100V-250V	
.001-027	.09
.033-056	.11
.068-1	.15
.12-22	.25
0.27uf	.30
0.33uf	.30
0.39uf	.45
0.47uf	.40
.56,.68,.82	.50
1,1.2,1.5	1.00
1.8uf	1.00
2.2uf	1.20
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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.

Tom Moffat VK7TM

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.

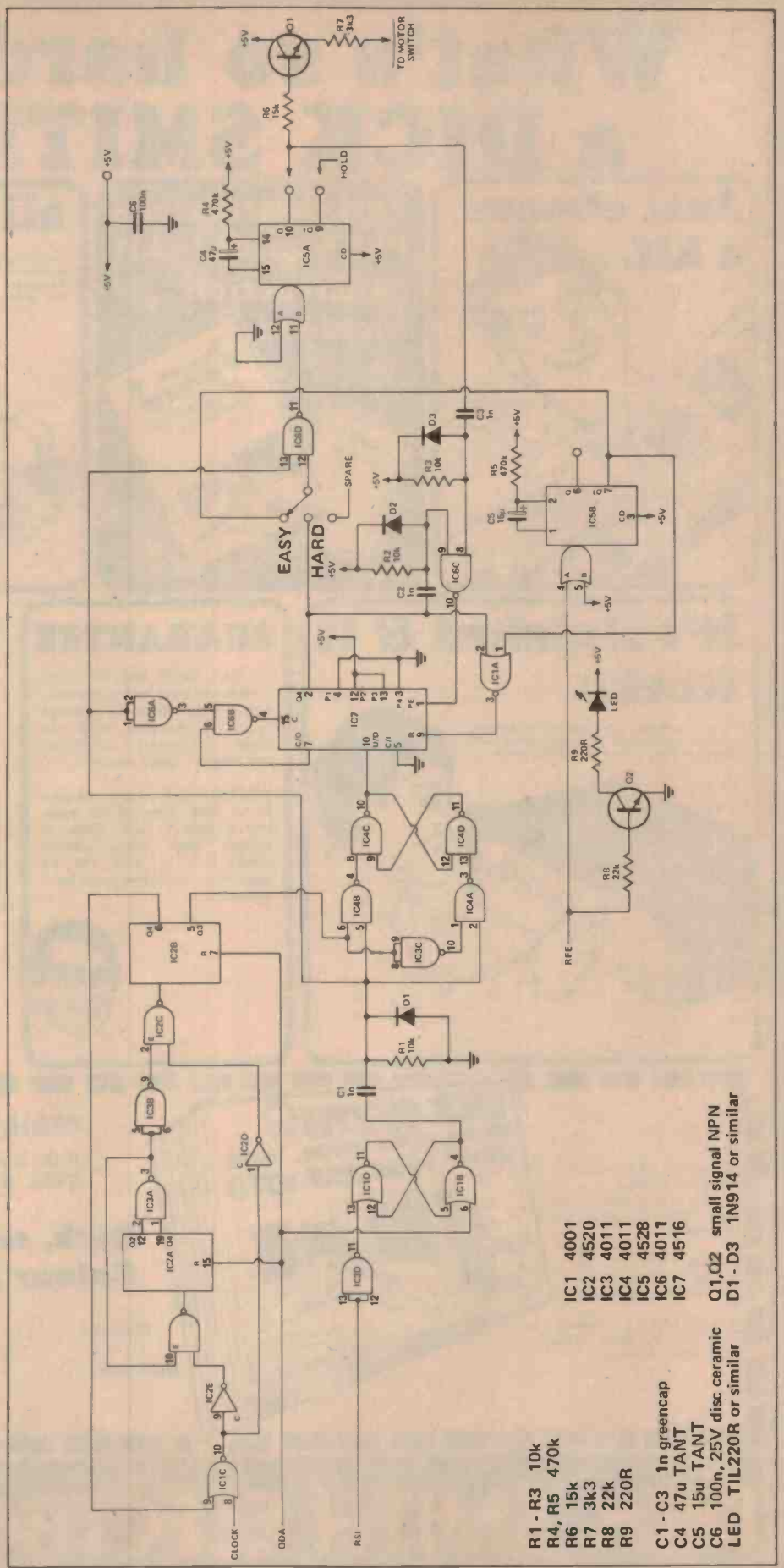
The operating speed is selected by the baud rate switch on the UART board.

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.



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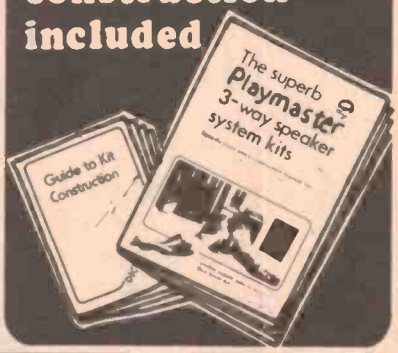

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used a pc board, matrix board construction should work equally well.

How it works

EASY MODE: The incoming teletype signal, taken from the RSI pin (receive serial input) of the UART, is inverted by IC3d and fed to IC1d and IC1b, a flip-flop. The flip-flop allows only the first downward transisition 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 transisition 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 occuring 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.

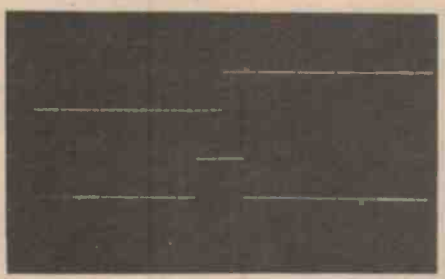
When the multivibrator times out its Q output goes low, its $\overline{Q}$ output goes high, and this enables NAND gate IC6d to allow circuit activity pulses through to another multivibrator, IC5a. This one has a time constant of about ten seconds, and it remains operated as long as activity pulses keep 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.

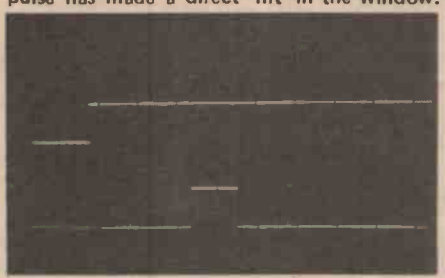
HARD MODE: Because of the way the UART operates, the next start pulse in a continuous character transmission is expected 16 clock pulses after the ODA pulse, which is in turn generated eight clock pulses into the previous stop pulse. So what we're doing is measuring the time from one stop pulse to the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



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

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 presettable 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 count 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' ▶

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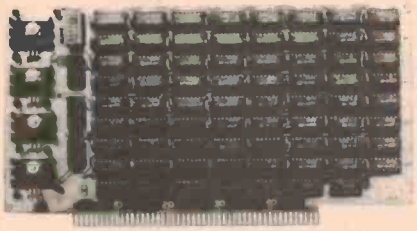

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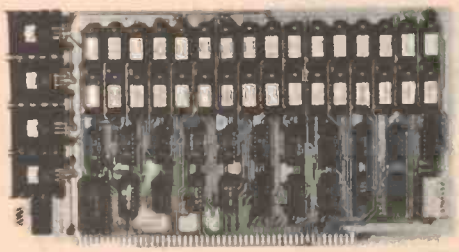

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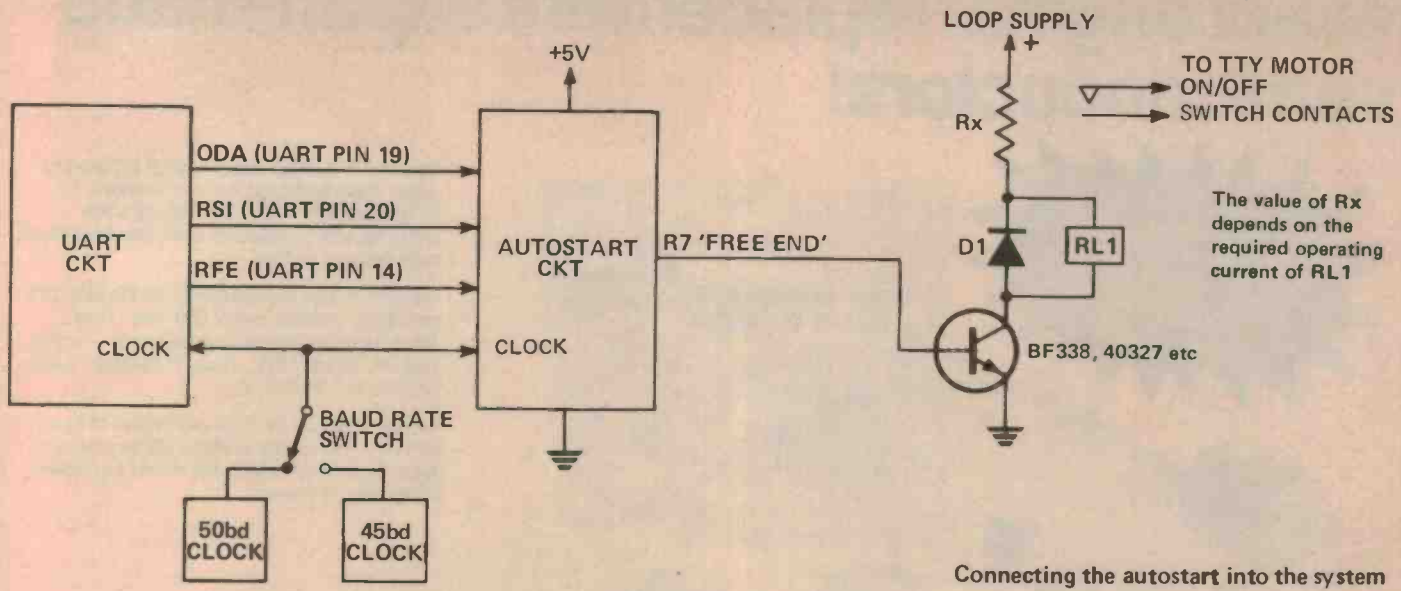


Connecting the autostart into the system

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.

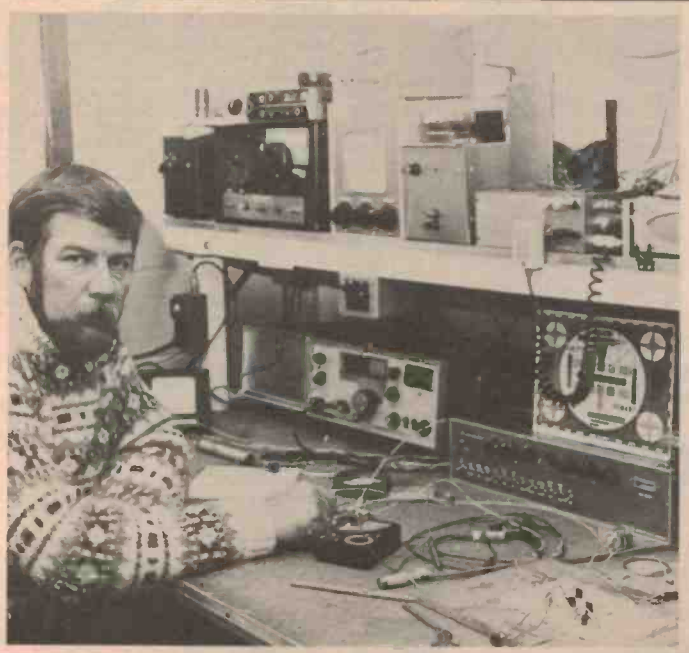
Had this happened while the unit was unattended, it could have started a fire. So the solid state switch was abandoned, and the relay was put back in service. In the relay version, the dropping resistor equired (if any) depends on the supply voltage and the type of relay, so you'll have to select it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

A warning

Although it may seem unecessary 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 o learn the hard way how it feels to be hit on the thumb by a flying key hammer! ●

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 pc 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 radio business in Hobart.

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

When not 'playing radios' Tom enjoys bushwalking and photography, usually both at the same time.

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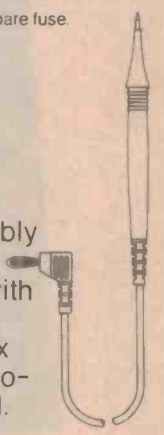

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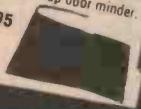

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Lab Notes

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.

Ray Marston

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 or 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 $\overline{Q}$ 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

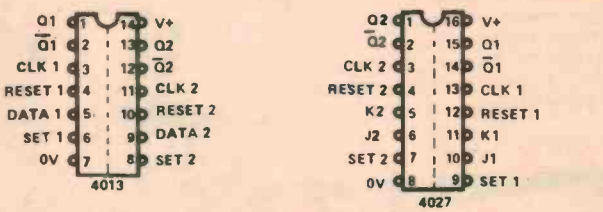


Figure 1. Outlines and pin notations for the versatile 4013 dual-D and 4027 dual J-K CMOS flip-flop ICs.

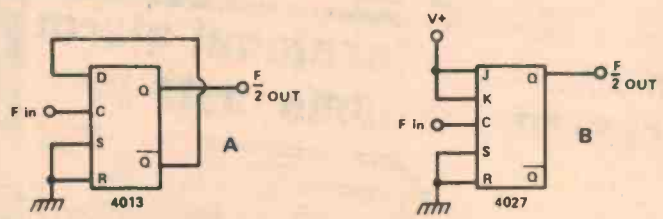
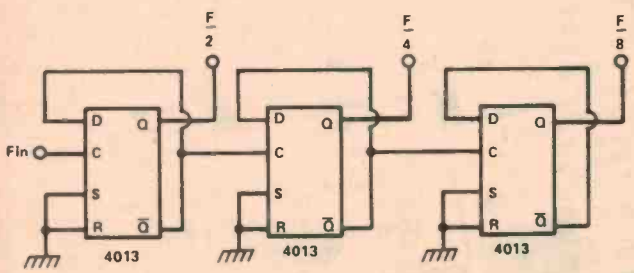


Figure 2. Divide-by-two counters made from D-type (left) and J-K (right) flip-flops.



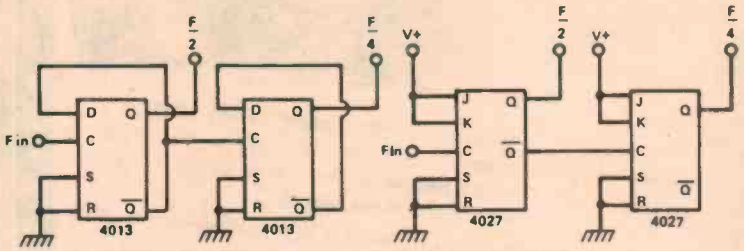


Figure 3. D-type and J-K versions of a divide- by-four ripple counter

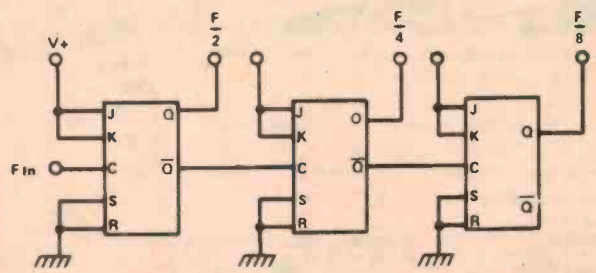


Figure 4. Two versions of a divide-by-eight ripple counter using D-type (top) and J-K (bottom) flip-flops.

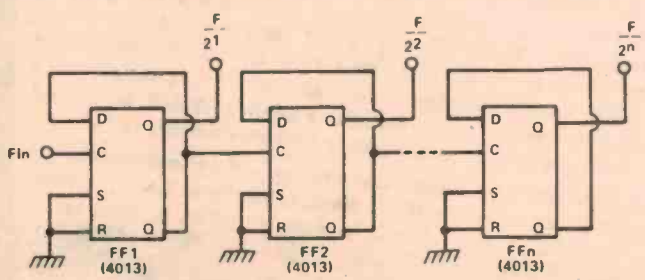


Figure 5. How a chain of D-type flip-flops can be linked to provide a divide-by-2 ripple counter.

*(Uh, sorry . . . no offence to cat lovers)

An occasional series in which we discuss interesting circuit techniques, circuits we have tried in our own laboratory but not developed as a project, practical notes on projects, measurement techniques for hobbyists etc.

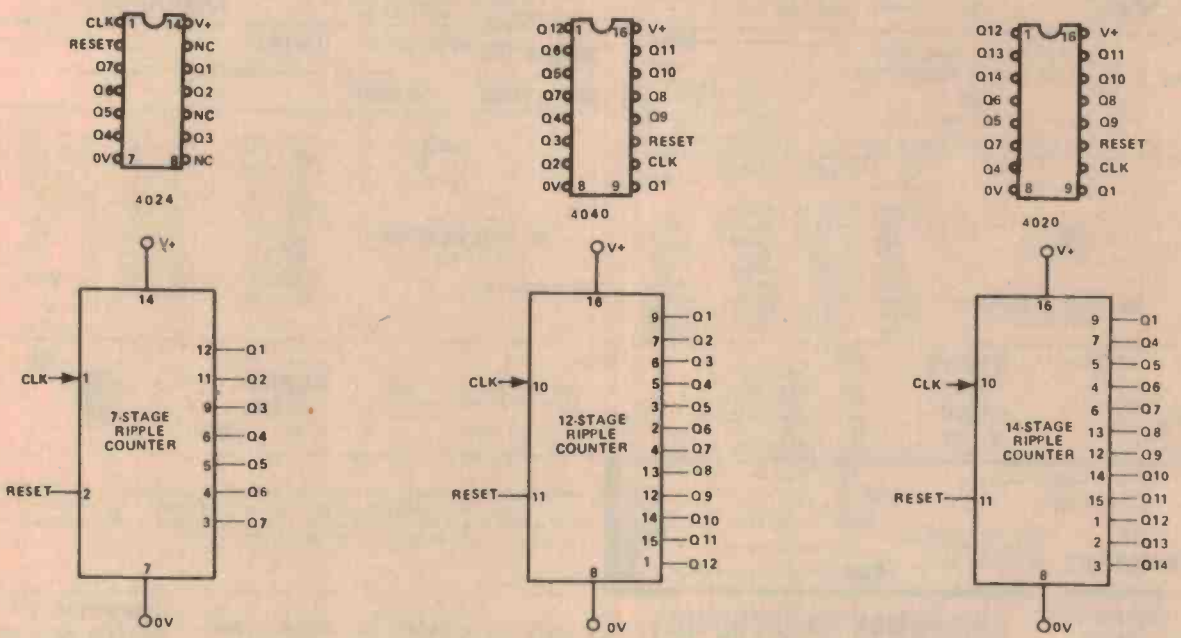


Figure 6. Outlines (above) and functional diagrams (below) of three popular CMOS multi-stage ripple counter ICs.

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 preceeding 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 propogation 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 us. Consequently, the first output signal will not change state until 1 us 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 ▶

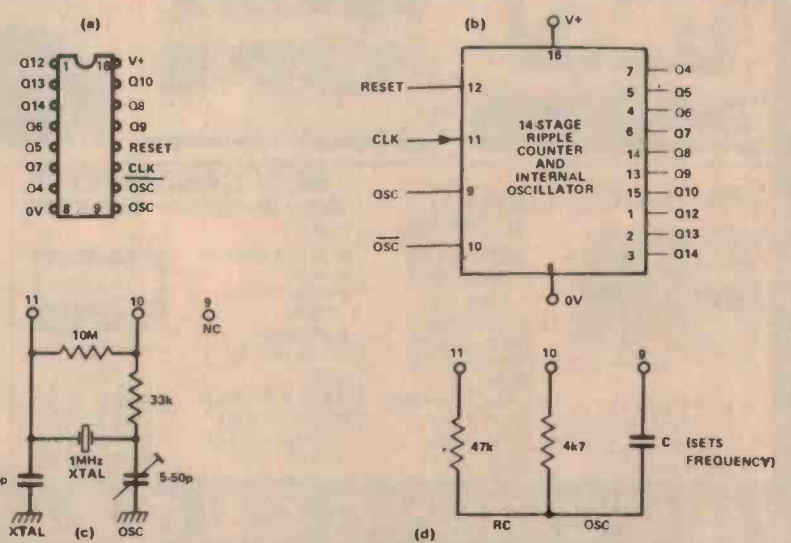


Figure 7. Outline (a), functional diagram (b) and alternative oscillator connections (c and d) for the 4060 fourteen-stage ripple counter.

Lab Notes

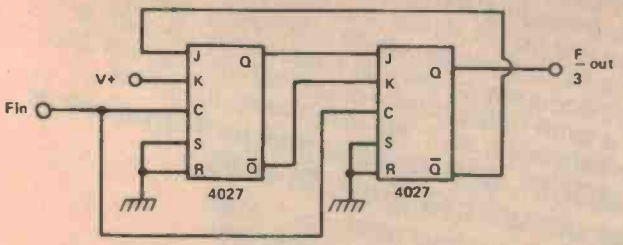


Figure 8. A divide-by-three 'walking ring' or 'Johnson' counter using J-K flip-flops.

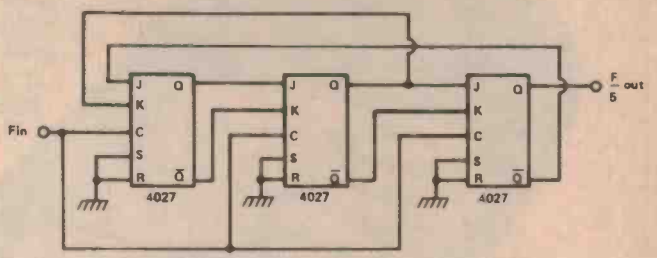


Figure 9. A divide-by-five Johnson counter using J-K blocks.

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. ●

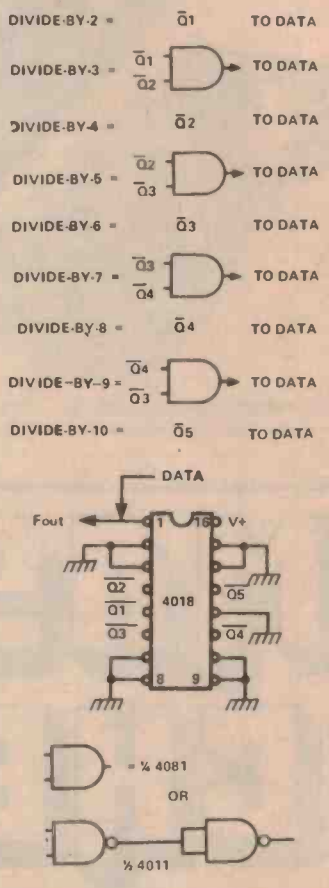


Figure 11. Methods of connecting the 4018 for divide-by-two to divide-by-ten operation.

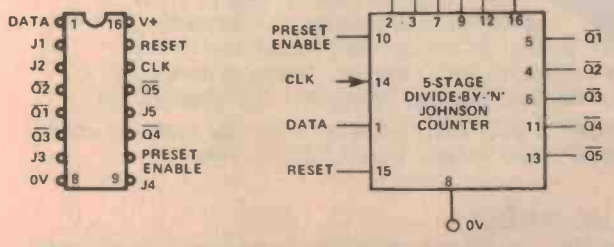


Figure 10. Outline and functional diagram of the 4018 presettable divide-by-n counter.

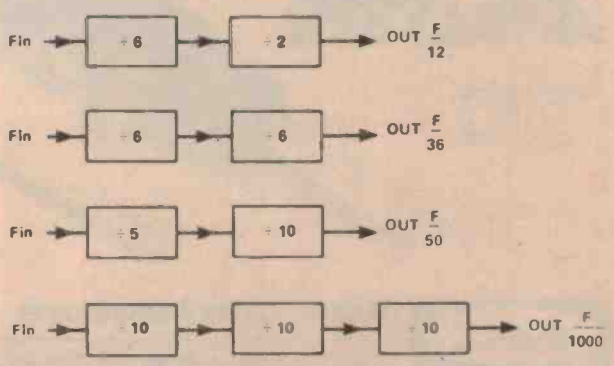


Figure 12. Typical examples of division by numbers greater than ten.

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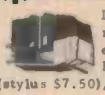

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Ideas for Experimenters

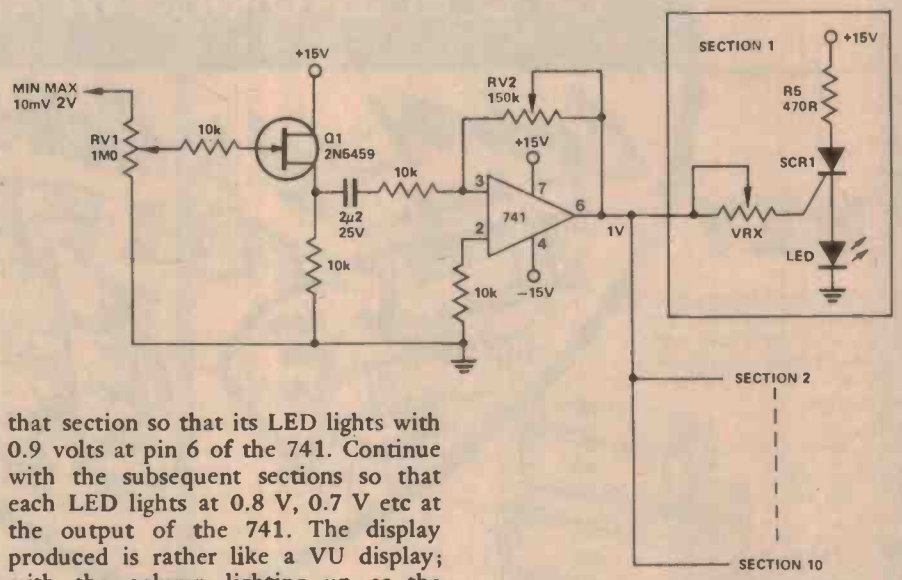
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we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

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.



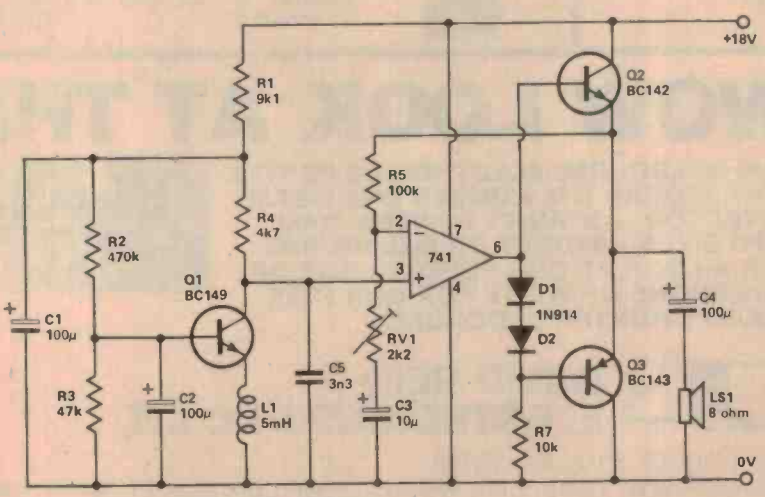
Telephone amplifier

Have you ever had occasion where two or more people needed to listen to a telephone conversation? Normally, a 'phone 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.



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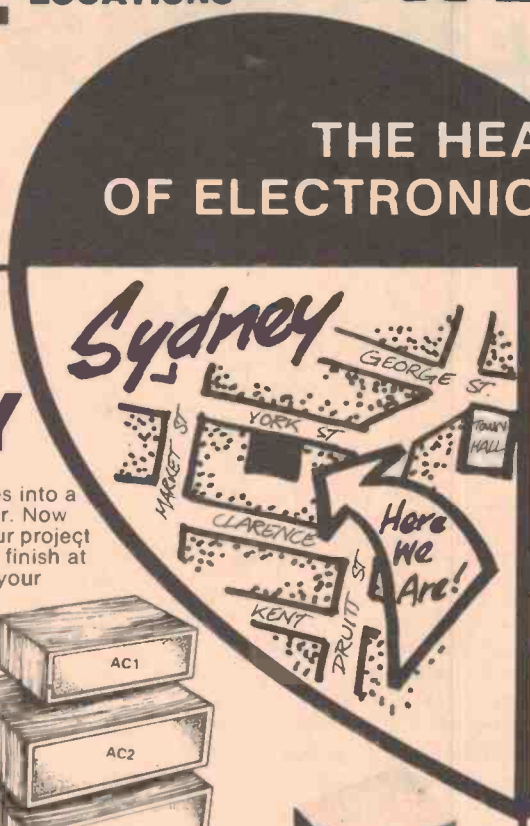

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NOW

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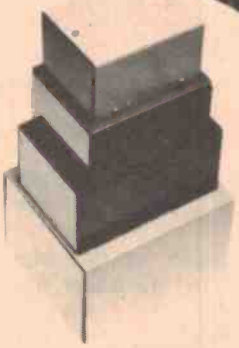

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with an electrokit

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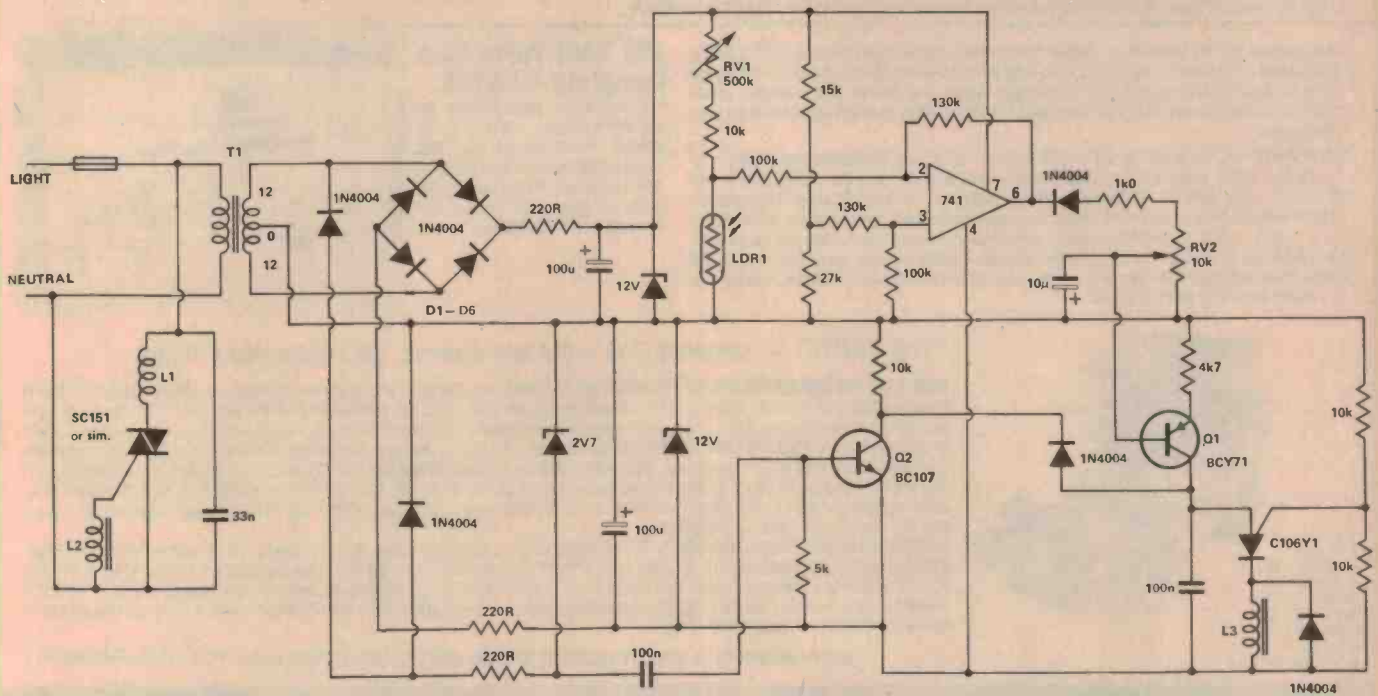


Porch light controller

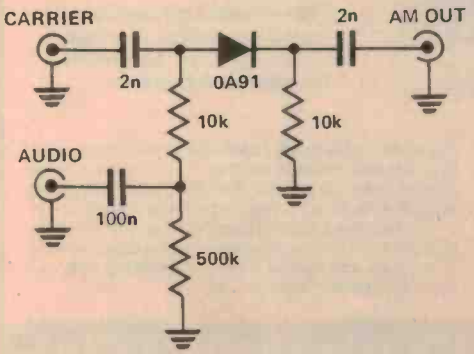
Mr. R. Johnson from the UK has designed this auto-dimmer for turning on a porch light at dusk and then controlling the brightness such that it is inversely proportional to the surrounding lighting conditions. It sets the porch light brightness to a minimum at dusk, increasing the brightness until it 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 12-0-12 low current type. L1 is an interference suppression choke and consists of 30 turns of 20 swg enammelled 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).

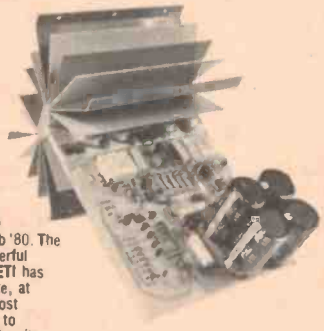
Trading Hours: 9am-5.30pm Weekdays, 9am-Noon Sat, 10am-2pm SUNDAY.

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 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 CRO Adaptor,** see EA May '80, complete kit including front panel, hardware & power adaptor **only $39.90.**

150 Watt Valve Amp Complete Kit $195.

Kit includes everything for construction, nuts, bolts, solder, front panel, etc. **NB.** Expanded aluminium cover is not supplied. Price correct at time of going to press. Not available till mid May.



ETI 466
See ETI Feb '80. The most powerful amplifier ETI has had to date, at minimal cost compared to assembled units.

"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, silicon 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 65D6C 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) $55.00; **ETI** 4000 Amp Case (wooden sided) $45.00; Dick Smith Rack Mount $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. $10.00 extra with 'C' core transformer • 60 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 speakers and crossovers but not woodwork). • Fully assembled boxes for 4-way Speaker System $300.00 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

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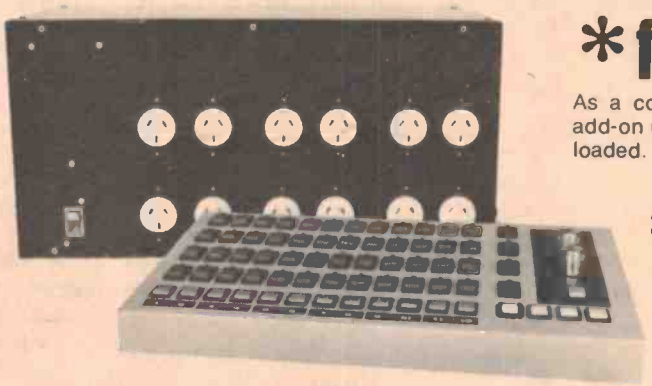
REMOTE LIGHTING CONTROL BOARD



* for BANDS

As a complete control system, or as an add-on unit where current capacity is overloaded.

* DISCO'S

The Remote Lighting Control Board will switch most electronic lighting controllers, hotspots, strobes etc.

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.

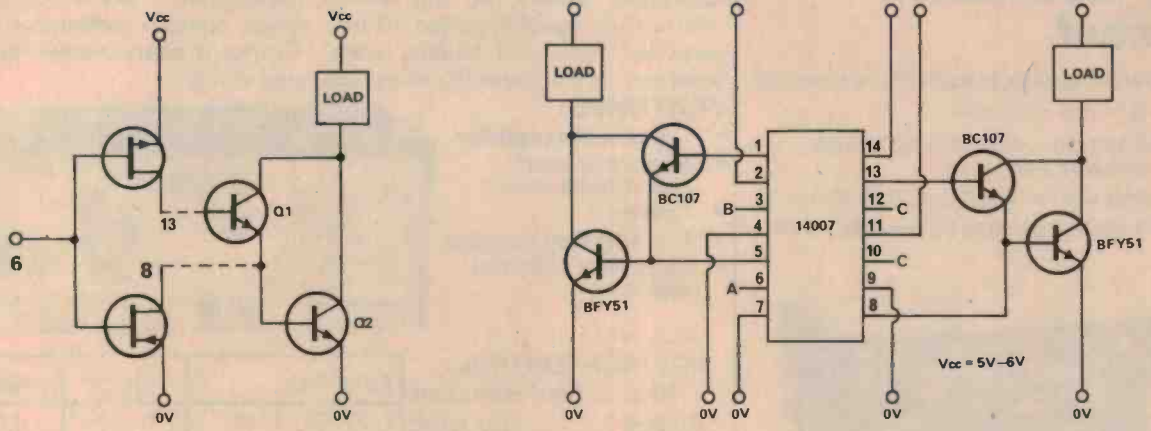
The Rack is complete with 12 solid state switching units, individually fused. Each unit can be easily replaced, replacement units being readily available from our agents. The solid state switching units are zero switching to minimise interference.

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.

Ideas for Experimenters



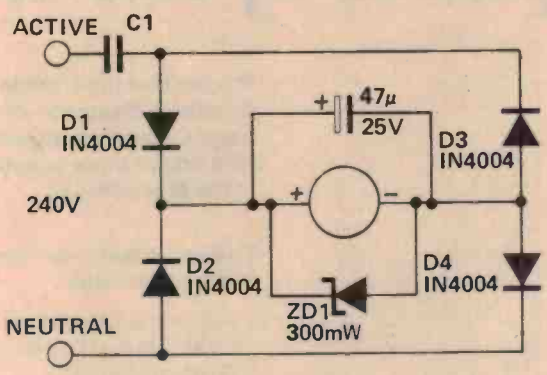
Darlington drivers

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 Vdc across the alarm and adequate sound output.

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

Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

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BC109C	.40
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BC178	.35
BC179	.40
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BC319	.22
BC320	.22
BC182B	.20
BC286	.16
BC287	.16
BC327	.30
BC337	.30
BC338	.30
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BC548	.19
BC549	.19
BC549C	.20
BC557	.20
BC558	.20
BC559	.20
BC639	.40
BC640	.40
BCY71	.69
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BD140	.59
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BD263	1.20
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MPS3565	.18
MPS3638	.18
MPSA05	.30
MPSA06	.30
MPSA12	.50
MPSA14	.45
MPSA55	.30
MPSA92	.40
MPSA93	.55
PN3564	.24
PN3565	.18
PN3566	.18
PN3567	.18
PN3568	.18
PN3569	.18
PN3638	.18
PN3638A	.22
PN3641	.20
PN3642	.20
PN3643	.20
PN3644	.22
PN3645	.22
PN3646	.22
PN3693	.29
PN3694	.29
PN4121	.35
PN4248	.22
PN4250	.29
PN4355	.29
TIP31A	.65
TIP31C	.85
TIP32C	.85
TIP2955	1.60
TIP3055	1.00
TT800	1.20
TT801	1.20
2N697	.60
2N918	.65
2N2102	.82
2N2219	.50
2N2219A	.65
2N2222A	.35
2N2368	.25
2N2484	.55
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2N2904	.50
2N2905	.50
2N2905A	.50
2N2906A	.50
2N2907	.50
2N2907A	.50
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2N3642	.59
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2N6129	1.40
2N6130	1.30
2N6132	1.60
2N6134	1.70
3N140	1.70
3N201	1.60
3N210	1.70
40673	1.40

DIODES

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OA90	.20
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OA636	.70
P600G	.90
1N3493	1.70
1N3493R	1.70
1N4001	.08
1N4002	.10
1N4004	.10
1N4007	.20
1N4148	.06
1N5404	.40
1N5408	.80

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100V 2A	.95
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7815	1.00
7818	1.00
7824	1.00
78H05	7.50
78H12	7.50
78HG	7.95
78P05	8.00
78L05	.40
78L09	.40
78L12	.40
78L15	.40
78L18	.40
78L24	.40
78CB	2.40
7905	1.85
7905K	2.95
7906	1.85
7908	1.85
7912	1.85
7912K	2.95
7915	1.85
7918	1.85
7924	1.85
79HG	10.80
79L03	.95
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79L12	.95
79L15	.95
79L18	.95
79L24	.95
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79MGT2C	1.80

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318	3.20
324	1.00
339	.90
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379S	6.90
380-8	1.50
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381AN	3.96
382	2.00
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565CH	3.30
566	3.10
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CA3046	1.65
CA3086	.65
CA3130	1.50
CA3140	1.50
CA3302	.70
CA3401	.80
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OM350	7.90
RC4136	1.45

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1488	1.00
9368	2.30
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RAMS

2102A-4	1.90
2114-N	6.50
2114-3	8.00
2102	1.60

74LS

74LS00	.30
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74LS114	.55
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74LS165	1.40
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74LS197	1.60
74LS221	1.50
74LS247	1.95
74LS251	.85
74LS253	.85
74LS257	.75
74LS259	2.20
74LS279	.70
74LS290	1.30
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74LS366	.80
74LS367	.90
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7400 TTL

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7496	1.10
74100	2.00
74107	.70
74121	.70
74123	.85
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74150	1.50
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74154	1.40
74157	1.40
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74165	1.70
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4011	.38
4012	.30
4013	.65
4014	1.40
4015	1.20
4016	.60
4017	1.30
4018	1.30
4020	1.40
4021	1.30
4022	1.30
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4043	1.00
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4053	1.20
4060	1.50
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4068	.45
4069	.30
4070	.30
4071	.30
4072	.30
4076	1.75
4077	.30
4078	.60
4081	.30
4082	.30
4093	.70
4441	.95
4502	1.40
4506	.70
4510	1.50
4511	1.30
4518	1.80
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4582	1.40
4584	1.00
40014	.90
40097	1.00
40098	1.20
74C02	.35
74C04	.35
74C08	.35
74C10	.35
74C20	.35
74C48	2.50
74C73	1.10
74C76	.95
74C90	1.40
74C93	1.40
74C175	1.70
74C192	1.90
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ST4	.80

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16V	
4u7	.20
22uF	.30
47uF	1.30
6.3V	
47uF	.40
100uF	1.10

CERAMICS

1P-u01	.06
.0056uF	.10
.0068uF	.12
.0082uF	.20
.047uF	.08
.1uF	.12
.22uF	.22
.47uF	.25

GREENCAPS

100V	
.001uF to .027uF	.10
.033uF to .056uF	.12
.068uF to .1uF	.16
.12uF to .22uF	.30
250V	
.27uF	.30
.33uF	.34
.39uF	.48
.47uF	.50
.56uF to .82uF	.60
1uF to 1.5uF	1.00
1.8uF	1.20
2.2uF	1.40
3.3uF	2.10
4.7uF	3.50
630V	
.001uF to .0082uF	.20
.01uF to .015uF	.25
.022uF to .033uF	.30
.047uF to .1uF	.40
.22uF	.60
.33uF	.80
.47uF	.85

TRIM CAP

—5.5pf	.30
—22pf	.40
—40pf	.40
—65pf	.30

ELECTRO. RT.

16V	
33uf	.15
330uf	.40
25V	
100uf	.25
330uf	.45
2500uf	1.00
50V	
2500uf	2.15
63V	
10uf	.16
47uf	.30
100uf	.40
220uf	.65
470uf	.75
1000uf	1.65

RB. (PCB)

6.3V	
470uf	.20
1000uf	.30
10V	
4.7uf	.10
100uf	.10
16V	
10uf	.08
22uf	.10
33/47uf	.10
100uf	.15
220uf	.20
330uf	.20
470uf	.25
640uf	.45
1000uf	.40
2500uf	.65
25V	
2u2/3u3	.10
4u7/10u	.10
25u/33u	.12
47uf	.13
100uf	.15
220uf	.20
330uf	.25
470uf	.35
1000uf	.50
2200uf	.90
35V	
2u2/3u3	.10
10uf	.15
100uf	.20
220uf	.30
1000uf	.70
2000uf	.90
2200uf	1.10
50V	
0.47uf	.08
1u/2u2	.08
3.3uf	.15
4.7uf	.15
10uf	.15
22u/33u	.20
47u/100u	.20
220uf	.50
470uf	.60
63V	
0.47uf	.10
1u/2u2	.10
3u3/4u7	.10
10u/25u	.15
47uf	.20
100uf	.25
220uf	.40
330uf	.45
470uf	.80
160V	
2.2uf	.20
10uf	.30
22uf	.50
250V	
2.2uf	.25
350V	
1uf	.20
CAN TYPE	
35V	
2500uf	1.60
2500uf	1.95
40V	
5600uf	2.40
50V	
6800uf	5.20
53V	
2500uf	3.25
75V	
3300uf	5.90

BIPOLAR 50V

1u/2u2	.25
3u3/4u7	.30
6.8uf	.30
10/22uf	.40
33uf	.50
47uf	.69
100uf	.80

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125V	
10pf to 680pf	.45
1000pf to 10,000p	.55

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.4W 2p.c.	.10

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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.

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Autoranging: for quicker, much more convenient readings. Manual too, of course.

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Shoparound

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 preceeding 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 S100 Motherboard ties all our previous (and forthcoming) S100 computer projects together. All components are readily available. You might have to shop around a bit to get the best price for the S100 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.

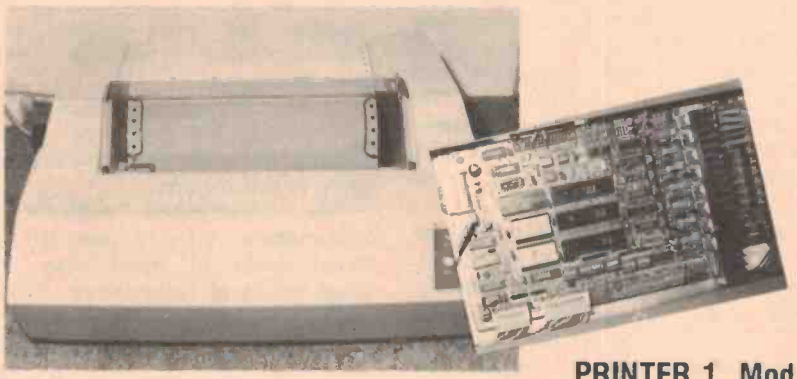
We commenced publishing this information at the request of readers. Please keep in mind that 'typical' retail prices of components have been used to calculate project costs. Also, these may have been calculated as much as six to eight weeks in advance of publication and price movements may affect the 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 -$16
ETI-636 S100 Motherboard	$90-$110

To get the maximum in hum suppression in your homebrew hi-fi amp, a toroidal transformer is recommended. This one suits the Series 4000 amp (with slight mods to the power supply). It delivers 30 V + 30 V @ 2A (240 Vac pri.) and costs $43.50 from Electronic Agencies, 115-117 Parramatta Rd, Concord NSW, 2137.

MICROBITS



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LETTERS

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 'reproduceable' – 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 newstands. 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

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.

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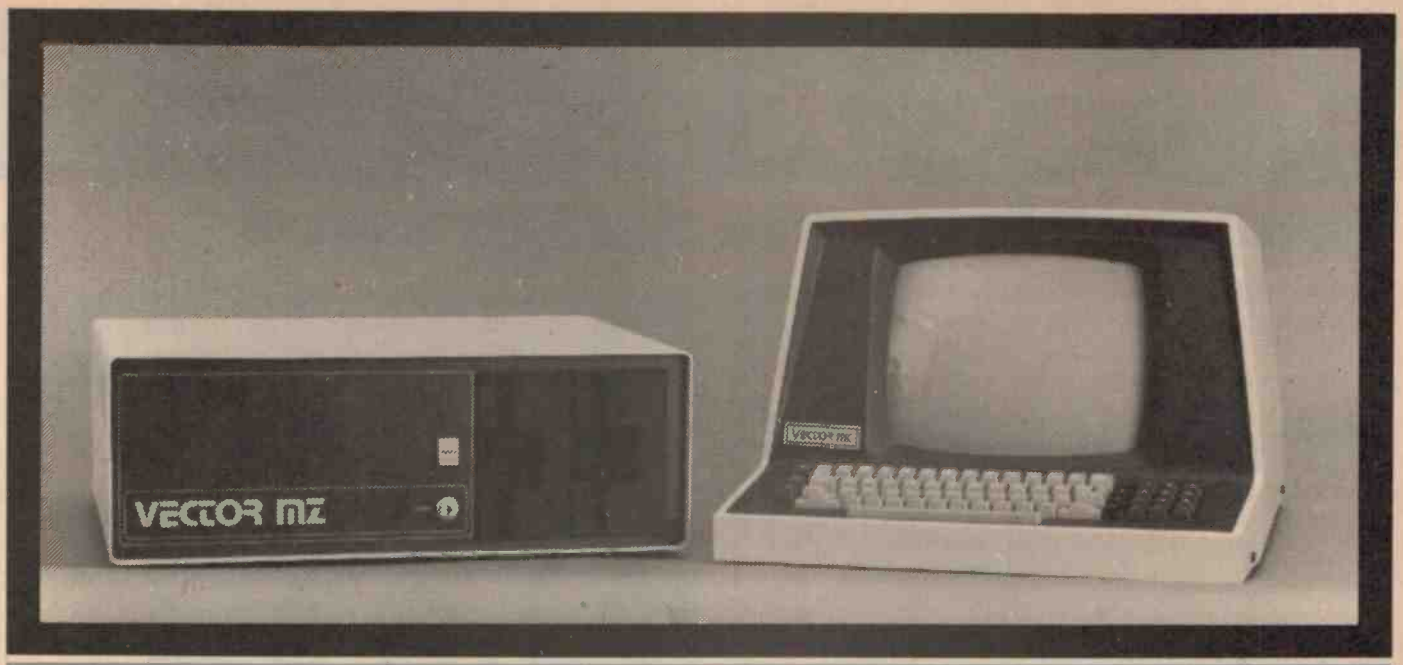

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PrinT-out

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 sounds. 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.

Above: Kim Ryrie, a partner in Fairlight Instruments, accepts the Design Award. Below left: the Qasar twin-processor computer.

Above: John Beasley, designer of the BWD-880 Powerscope, with the award-winning instrument.

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.

This inexpensive line printer, from MPI, was shown by Sigma International.

In addition, there were microprocessor controlled mail sorters, duplicaters, 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 Remington NBI System 3000 'paperwork processor' was typical of the many word processing machines exhibited at the Modern Office USA Exhibition.

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 10¢ 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 absorbtion 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 Hanimex 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 offer information, US export licence aid, rapid delivery from stock, spare parts, and large discounts from a very 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 S100 Z80 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	tax paid.
(kit)	175.00	tax exempt.
(assembled)	240.00	tax paid.
(assembled)	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	tax paid.
(kit)	125.70	tax exempt.
(assembled)	149.50	tax paid.
(assembled)	134.25	tax exempt.

NOTE: ALL PRICES INCLUDE SALES TAX (Except where noted)

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(Offer closes 15/6/80)

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IN4004 diodes	20 for $1.50.
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555 Timers	4 for $1.00.
2102 RAMS	8 for $11.25.
2114 – 450.	2 for $10.75.
4116 – 300.	8 for $89.50.

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.

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(Small stocks of other values.)

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2651	19.75
2708	12.50
2716 (+5V)	45.00
2114-450.	5.75
2102-350	1.55
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74LS10	.30	74LS139	.95
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74LS13	.60	74LS153	1.10
74LS14	1.20	74LS155	1.10
74LS15	.35	74LS157	1.10
74LS21	.35	74LS158	1.90
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74LS30	.30	74LS164	1.30
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74LS37	.45	74LS174	1.00
74LS38	.45	74LS175	.90
74LS40	.45	74LS181	3.95
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74LS47	.70	74LS191	1.20
74LS51	.45	74LS192	1.20
74LS54	.45	74LS193	1.20
74LS55	.50	74LS194	1.35
74LS73	.65	74LS195	1.35
74LS74	.45	74LS197	1.85
74LS75	.65	74LS253	1.85
74LS76	.70	74LS257	1.65
74LS78	.80	74LS258	1.85
74LS83	1.25	74LS279	.85
74LS85	1.25	74LS290	1.45
74LS86	.45	74LS293	1.55
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Printout

Bar code printer

Anderson Digital Equipment have just released the Intermec 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.

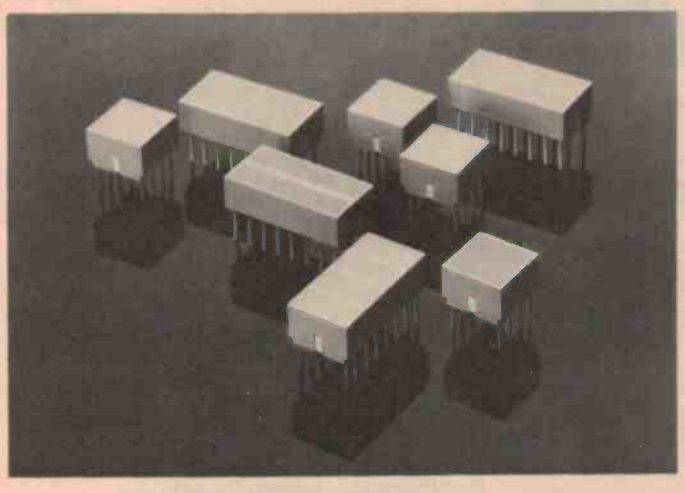
SMUG Club

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.

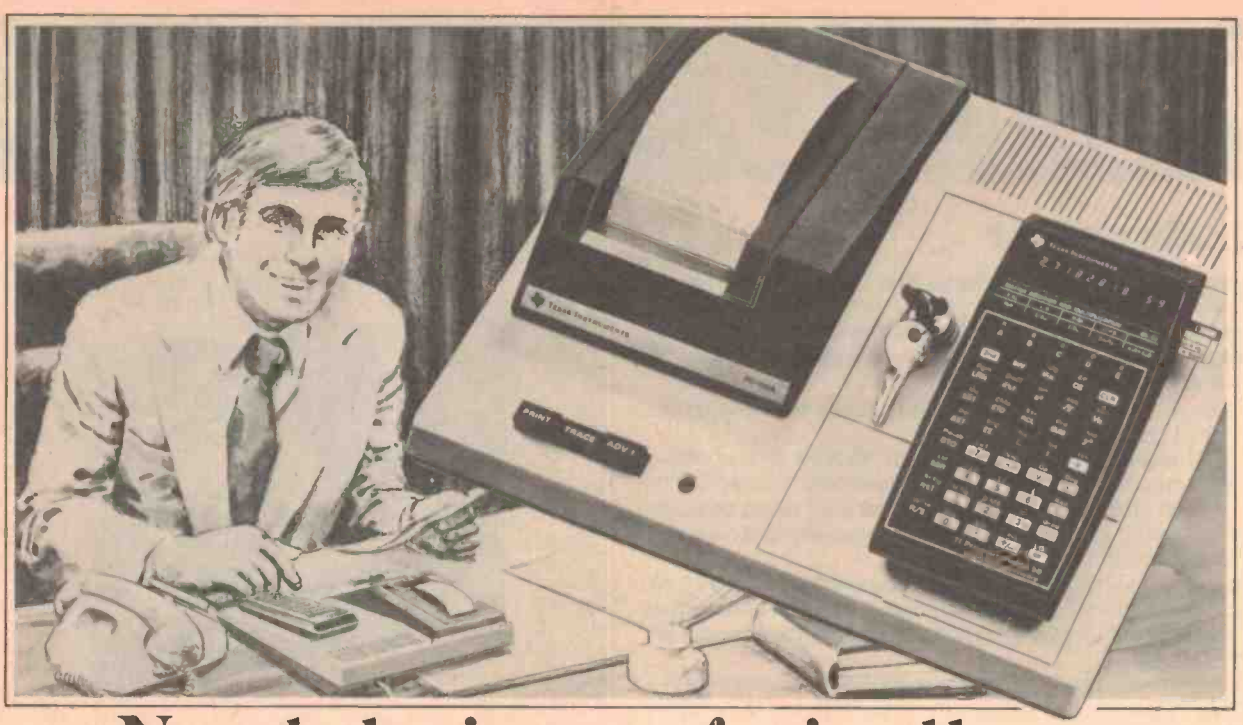
New recorder for Digital

Epicom Inc of the USA has released its model EI 200 epitape 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 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.



Now the business professional has an extra-ordinary programmable calculator from Texas Instruments.

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The TI-59 gives you so much problem solving power it's almost like a hand-held computer. Yet it's extremely easy to use.

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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.

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Printout

Eight code bar reader

A new bar code 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 Intermac 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.

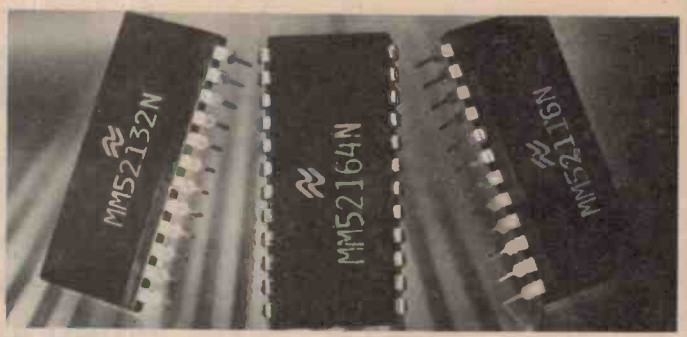
The model 9300 ranges in price from $1090 to $1485 depending on the choice of wand or scanner and further information can be obtained from Anderson Digital Equipment Pty Ltd, P.O. Box 322, Mt Waverley Vic 3149. (03) 543-2077.

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.



Bulk store for the PDP-15

Anderson Digital Equipment recently announced the release of the Dataram BC-205 bulk core system for the Digital Equipment Corporation's PDP-15 series of minicomputers.

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.

The Challenger 4

Whichever way you look at it, no other computer offers so much for so little, and in colour!

Minifloppy – two can be added.

Full 53 key, keyboard which in polled mode can recognise up to 8 simultaneously depressed keys.

RF shielded aluminium case with 2 step baked on enamel finish.

Inside: real time clock and countdown timer 24K memory 6502A processor

Solid oiled walnut sides.

Control line interfaces, parallel lines for home security, accessory BUS, parallel I/0 lines or other TTL signals.

Joystick sockets – add realism to games.

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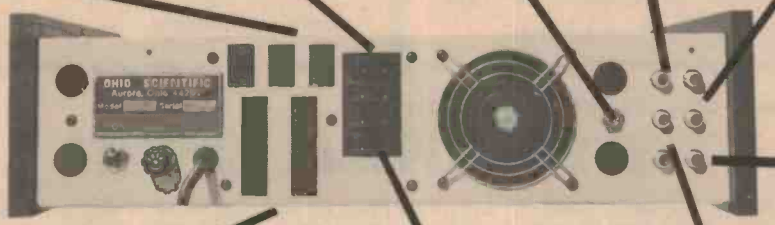
Sound outputs, programmable tone generators – 8 bit companding digital to analog convertors.



RF output for control of AC appliances.

Printer RS232 interface

Numeric key pad slots.

Cassette sockets.

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

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

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

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

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

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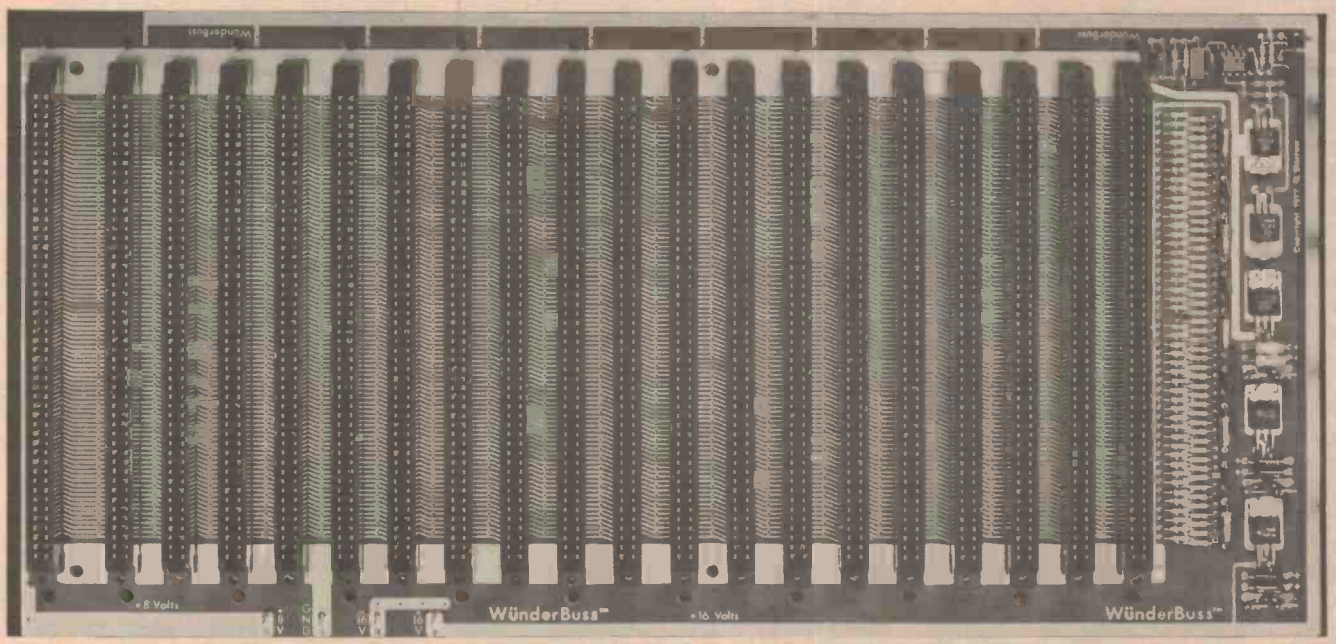
Update on the S-100 bus

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 you'll know what it's all about!

Les Bell



The 20-slot S-100 motherboard from George Morrow's 'Thinkertoys' company features active termination and "guarded" microstrip interconnecting rails to eliminate crosstalk and signal propagation problems.

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 (Thinker Toys), Howard Fullmer (Parasitic Engineering) and Kells Elmquist (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 ▶

over the bus. The old S-100 bus had two unidirectional data buses – the data in (DI) bus, over which data and instructions are read from memory, and the data out (DO) bus, which carries data to be stored in memory. The new bus still uses this system so that it will work with existing memory cards, but is extended to cope with the 16-bit processors.

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 sXTRQ 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 sXTRQ 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 parallelled 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 sXTRQ/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 status lines always begin with a lower case 's'. They are: sMEMR (memory read), sM1 (opcode fetch), a sINP (input), sOUT (output), sWO (write – true on both memory and output writes), sINTA (interrupt acknowledge), sHLTA (halt acknowledge) and sXTRQ (16-bit data transfer request). Note that there is no memory write signal, and this must be derived by the following logic equation:

$$\text{sMemory Write} = \overline{\text{sOUT}}.\text{sWO}$$

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 control output 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 pHLDA 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 temporaty master. Both masters are now driving the control output bus at 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

Pin No.	Signal Name and Type	Polarity		Description
1	+8 V (B)			Supply
2	+16 V (B)			Supply
3	XRDY (S)	H		Ready input to bus master
4	VIO (S)	L	O.C.	Vectored interrupt line 0
5	VI1 (S)	L	O.C.	" " " 1
6	VI2 (S)	L	O.C.	" " " 2
7	VI3 (S)	L	O.C.	" " " 3
8	VI4 (S)	L	O.C.	" " " 4
9	VI5 (S)	L	O.C.	" " " 5
10	VI6 (S)	L	O.C.	" " " 6
11	VI7 (S)	L	O.C.	" " " 7
12	NMI (S)	L	O.C.	Non-maskable interrupt
13	PWRFAIL (B)	L		Power fail bus signal
14	DMA3 (M)	L	O.C.	Temporary master priority bit 3
15	A18 (M)	H		Extended address bit 18
16	A16 (M)	H		Extended address bit 16
17	A17 (M)	H		Extended address bit 17
18	SDSB (M)	L	O.C.	Status disable control
19	CDSB (M)	L	O.C.	Control signals disable
20	GND (B)			Common with pin 100
21	NDEF			Not defined
22	ADSB (M)	L	O.C.	Disables 16 address bits
23	DODSB (M)	L	O.C.	Disables data out bus
24	φ (B)	H		Master timing signal
25	pSTVAL (M)	L		Status valid strobe
26	pHLDA (M)	H		Hold acknowledge
27	RFU			Reserved for future use
28	RFU			Reserved for future use
29	A5 (M)	H		Address bit 5
30	A4 (M)	H		Address bit 4
31	A3 (M)	H		Address bit 3
32	A15 (M)	H		Address bit 15 (most significant bit if non-extended)
33	A12 (M)	H		Address bit 12
34	A9 (M)	H		Address bit 9
35	DO1 (M)/DATA1 (M/S)	H		Data out bit 1, bidirectional data bit 1
36	DOO (M)/DATA0 (M/S)	H		DAta out bit 0, bidirectional data bit 0
37	A10 (M)	H		Address bit 10
38	DO4 (M)/DATA4 (M/S)	H		Data out bit 4, bidirectional data bit 4
39	DO5 (M)/DATA5 (M/S)	H		Data out bit 5, bidirectional data bit 5
40	DO6 (M)/DATA6 (M/S)	H		Data out bit 6, bidirectional data bit 6
41	DI2 (S)/DATA10 (M/S)	H		Data in bit 2, bidirectional data bit 10
42	DI3 (S)/DATA11 (M/S)	H		Data in bit 3, bidirectional data bit 11
43	DI7 (S)/DATA15 (M/S)	H		Data in bit 7, bidirectional data bit 15
44	sM1 (M)	H		Machine cycle 1 (op-code fetch)
45	sOUT (M)	H		Output data transfer cycle
46	sINP (M)	H		Input data transfer cycle
47	sMEMR (M)	H		Memory read cycle
48	sHLTA (M)	H		Halt acknowledge
49	CLOCK (B)			2 MHz clock
50	GND (B)			Common with pin 100
51	+8 V (B)			Common with pin 1
52	−16 V (B)			Supply
53	GND (B)			Common with pin 100
54	SLAVE CLR (B)	L	O.C.	Resets bus slaves. Must be active with POC
55	DMA0 (M)	L	O.C.	Temporary master priority bit 0
56	DMA1 (M)	L	O.C.	Temporary master priority bit 1
57	DMA2 (M)	L	O.C.	Temporary master priority bit 2
58	sXTRQ (M)	L	O.C.	Request for 16-bit data transfer
59	A19 (M)	H		Extended address bit 19
60	SIXTN (S)	L	O.C.	16-bit data transfer acknowledge by slave
61	A20 (M)	H		Extended address bit 20
62	A21 (M)	H		" " " 21
63	A22 (M)	H		" " " 22
64	A23 (M)	H		" " " 23
65	NDEF			Not to be defined
66	NDEF			Not to be defined
67	PHANTOM (M/S)	L	O.C.	Disables normal slaves and enables phantoms
68	MWRT (B)	H		pWR.sOUT
69	RFU			Reserved for future use
70	GND (B)			Common with pin 100
71	RFU			Reserved for future use
72	RDY (S)	H	O.C.	
73	INT (S)	L	O.C.	Interrupt request
74	HOLD (M)	L	O.C.	Control signal to co-ordinate bus master transfers
75	RESET (B)	L	O.C.	Resets bus masters. Must be active with POC
76	pSYNC (M)	H		Identifies BS1
77	pWR (M)	L		Signifies valid data on DATA or DO bus
78	pDBIN (M)	H		Requests data in from slave
79	A0 (M)	H		Address bit 0 (least sig.)
80	A1 (M)	H		" " 1
81	A2 (M)	H		" " 2
82	A6 (M)	H		" " 6
83	A7 (M)	H		" " 7
84	A8 (M)	H		" " 8
85	A13 (M)	H		" " 13
86	A14 (M)	H		" " 14
87	A11 (M)	H		" " 11
88	DO2 (M)/DATA2 (M/S)	H		Data out bit 2, bidirectional data 2
89	DO3 (M)/DATA3 (M/S)	H		Data out bit 3, bidirectional data 3
90	DO7 (M)/DATA7 (M/S)	H		Data out bit 7, bidirectional data 7
91	DI4 (S)/DATA12 (M/S)	H		Data in bit 4, bidirectional data 12
92	DI5 (S)/DATA13 (M/S)	H		Data in bit 5, bidirectional data 13
93	DI6 (S)/DATA14 (M/S)	H		Data in bit 6, bidirectional data 14
94	DI1 (S)/DATA9 (M/S)	H		Data in bit 1, bidirectional data 9
95	DI0 (S)/DATA8 (M/S)	H		Data in bit 0, bidirectional data 8
96	sINTA (M)	H		Interrupt acknowledge
97	sWO (M)	L		Write cycle
98	ERROR (S)	L	O.C.	Indicates error condition
99	POC (B)	L		Power-on clear signal for all bus devices
100	GND (B)			System ground

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 – opcode 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. ▶

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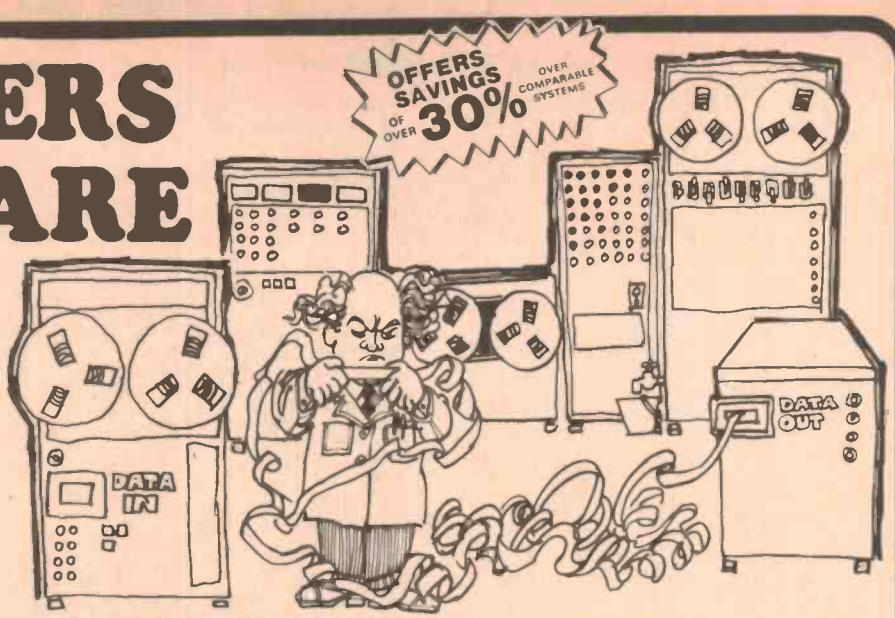

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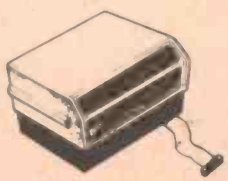

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Bus Hardware – and Some Notes on Logic Design

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 inputs 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 a theoretical maximum of 640 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 tool kit?

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 2k2 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 up through the pull-up resistor on a zero-to-one transition. Secondly, noise increases as gates are wire-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 'normal' complement 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 'normal' TTL 9 usually LS TTL), but when it is low, the output goes to the high impedance state.

The OE 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 mother boards 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 8T97. 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 DM8097 octal tri-state buffer (National Semiconductor), the 74LS240 (octal inverting bus driver), the 74LS241 (non-inverting) and the 74LS245 (octal 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. ●

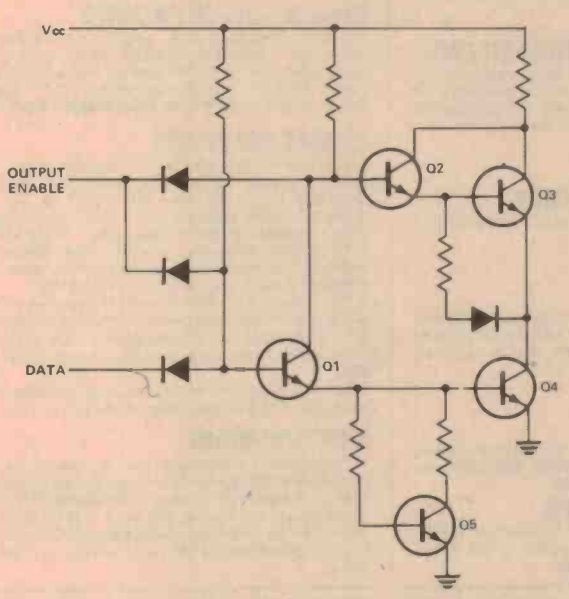

Figure 2. A typical tri-state buffer output stage. When OUTPUT ENABLE is brought low, both Q1 and Q2 are turned off, disabling the totem pole (Q3 and Q4).

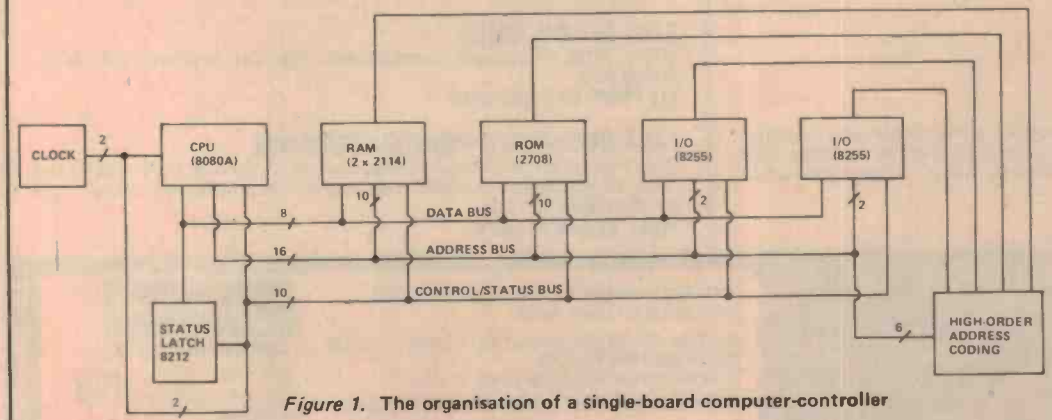

Figure 1. The organisation of a single-board computer-controller

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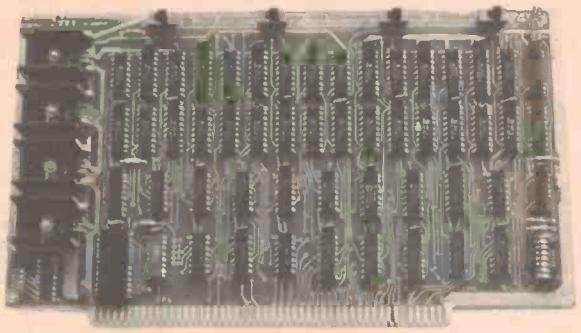

Features:- 2114 low power static RAM's, 4K addressing, 4K write protect, bank select, wait state gen., plated through hole, solder resist mask, 300 or 450 nS speed, ETI 642.
Kit $315. Ass. $380. Add $32 for 300 nS.

2708/2716 EPROM CARD
Features:- holds up to 16 2708 or 2716 (single supply) EPROMS, on board wait state gen. Unused locations may be blanked. Plated through holes, solder resist mask.
PRICE:- Kit $115. Ass $155.

EPROM PROGRAMMING CARD
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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 $156. 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 buad rates. With 2716 EPROM. **Price:- Kit $295. Ass $370.**

80 X 24 VIDEO DISPLAY CARD.
Features:- on board Z-80 and CRT 5027 controller chips, parallel keyboard interface, 2708 driver chip, and 2708 character generator chip, special effects and extended character set available.
Price:- Kit $290. Ass $370.

64 X 16 VIDEO DISPLAY CARD
Features:- memory mapped 1K board, with reverse video and cursor control. RCA video connector, plated through holes and solder resist mask.
PRICE:- Kit $155. Ass. $180.

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Features:- single density, mini or full size disk drives with FD 1771 controller chip, can be interrupt driven, syncs with CPU in data transfer, Shugart/Remex compatabile.
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EPROM SOFTWARE
1. Z-80 monitor in 2708 EPROM, has 16 functions, three versions available to drive TTY, TTY/VDU, KBD/VDU. Price $25. 2. ETI 640 video driver EPROM, makes the memory mapped video card look like a terminal, has XY cursor addressing, home clear screen. Price $25.
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64K DYNAMIC RAM CARD
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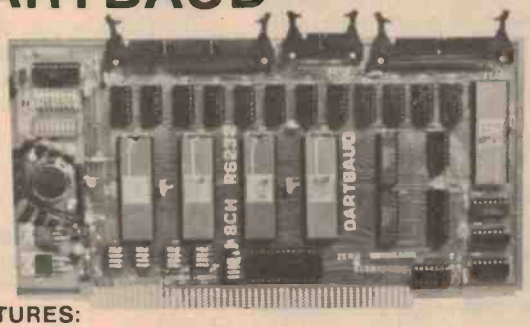

FEATURES:
- 8 Independently selectable 1/0 channels
- 2 Eight bit parallel ports
- RS-232 Interface levels
- Async or optional synchronous channels
- Baud rates 50-19, 200 independently selected for each channel

SPECIFICATION:

Serial Ports: 8 Independent ports using Zilog D/ARTs (sync) or optionally S10/0 (may be retrofitted 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**

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MOULDED ABS plastic case to suit $26.00

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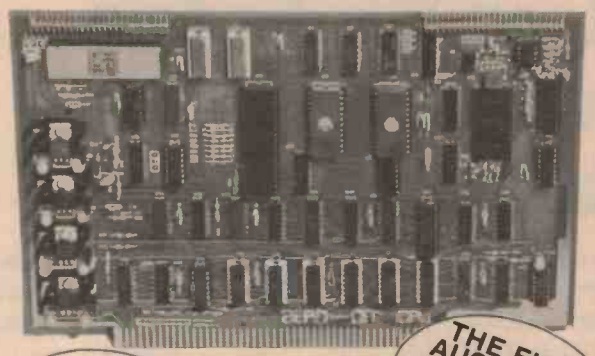

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- Comes complete including all edge connectors and power supply components
- All Components excepting power transformer and main filter Capacitor mounted on Mother Card

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S100 MEMORY CARDS
16k Static —
- Access time 450 ns (2MHZ only) 2114
- 16k Kytes organised in 2 x 8k Blocks individually selected to any 8k Boundary

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64k DYNAMIC
THE ZERO ONE DYNARAM II
- Access time 250 ns (2MHZ or 4MHZ) 4116
- 64k Bytes organised in 4 x 16k Blocks
- Refresh completely transparent using bus signals to derive refresh allowing processor to run at full speed without wait states
- Supplied on minimum of 1 x16k Blocks expandable by merely plugging in extra rams.

Price 16k kit $255.00 All sockets supplied. **each 16k add $100.00**
Assembled and tested add $60.00

ETI 640 VDU kit fully socketed $139
Please note that 200ns memories are required for VDU 4MHZ operation at $6.00 extra or 10 x 21L02-2 for $26.00 separately.

Z80 CPU CARD
FEATURES —
- Comes with full assembly instructions and card documents.
- 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.
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- Sockets supplied for all major devices.
- Clock speed, 2MHZ Standard, 4MHZ Option.
- 1/0 Z80 P10 2 x 8 bit programmable parallel 1/0.
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- Onboard 2100 baud Tarbell Cassette Interface (Software Controlled) with cassette recorder remote 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 CUTS (Kansas City) format.
- Keyboard input direct onto card in parallel ASCII.
- Monitor performs all functions to drive ET1640 VDU as an ASCII terminal. Entry points for cursor control etc.
- The spare socket onboard is to allow the National MM57109 to be titted 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 1/0 devices.
- Plated thru solder masked printed circuit board with components screened overlay.
- Description Manual Construction manual $1.00 refundable with purchase.

PRICE KIT $199.50 2MHZ
$225.00 4 MHZ
$22.50 Number Cruncher Option
Assembled and tested add $50.00

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COMMUNICATIONS

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 (OTHR) 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 less than 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 navaids for HF, VHF, and UHF applications, as well as filters, diplexers, multicouplers 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.

The other type of controller uses the traditional method of pressing a button until the direction pointer stops at the correct bearing.

The Daiwa range of rotators are distributed in Australia and the Pacific by Vicom and are available at most ham dealers.

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 bulletins, 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
Feb.	131.0
March	136.7
April	141.5
May	147.8
June	153.8
July	156.2

The provisional mean for December 1979 was 182.2 and for January 1980, 162.2

The bands are jumping — get amongst it!

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 (A.T.I.S.) 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 McKeon Road, Mitcham Vic 3132. (03) 873-3939.

Field day success

The Central Coast Amateur Radio Club's 23rd annual field day, held on Sunday 17 February, was a great success.

The registered attendance was 790. The contests and events were keenly contested and this year saw a noticeable trend towards younger contenstants — with junior competitors taking out open as well as junior prizes!

Overall first for the day's events was a tie between Dave Andrews VK2AWZ and Athol Tilley, VK2BAD. Overall first in the junior section was young Craig Smith.

The amateur television display at the field day provided a telecast of the WIA NSW Division's Sunday morning news broadcast, with John Williams VK2BUI as news reader, and a live cross to the Gosford Showground venue for a report from the field day.

The ever-popular 'disposals market' — where everyone gets rid of unwanted equipment (including the gear they brought at last year's disposals market . . . Ed!), was a raging success, becoming instantly crowded immediately it opened. Some 503 items changed hands.

The CCARC wishes to acknowledge the generosity of the following companies and individuals who provided prizes for field day events and/or display stands: Applied Technology, ANARTS, Dick Smith Electronics, Emtronics, Ferguson transformers, Hy-Q Industries, Lyle Patison VK2ALU, NSW QSL Bureau, Scalar Industries, Sideband Electronics Engineering, Sideband Electronics Imports, Sideband Electronics Sales, Trio-Kenwood (Aust.), Union Carbide (Aust.), Vicom International, Westlakes Radio Club, WIA NSW Division, YRS Education Service.

See you there next year.

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 measurements 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 or with standard rack mounts.

For further details contact The Dindima Group Pty Ltd P.O. Box 106 Vermont Vic 3133.

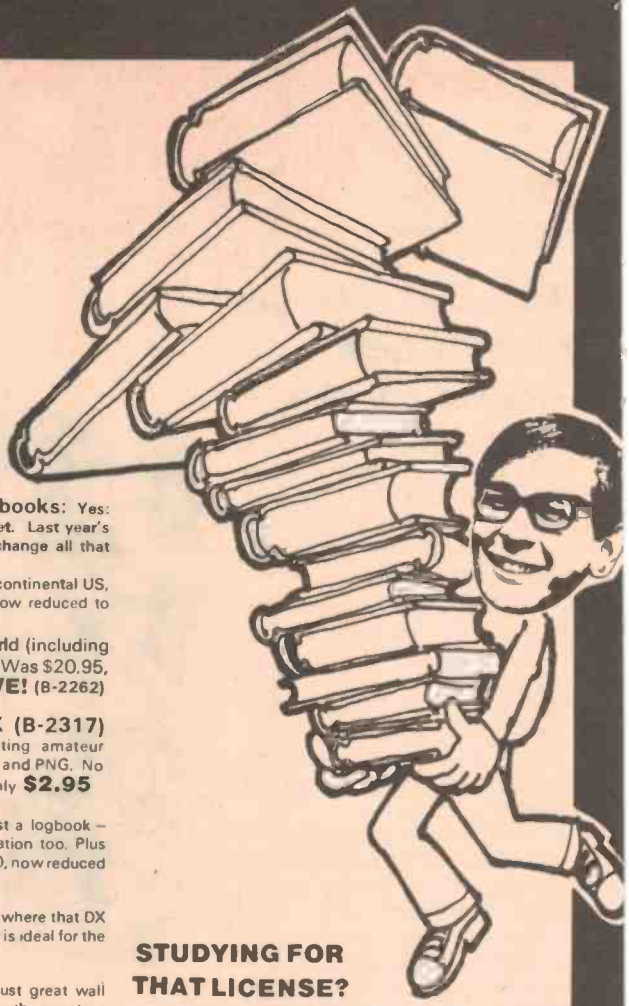
RF power analyst with calculator.

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, 30303 Aurora Road Cleveland (Solon), Ohio 44139 USA.

HELP!



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: designs 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! Save on this one: 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. **$12.00**

Radio Amateur's VHF Manual (B-2214) A thorough treatment 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 ARRL Handbook (B-2219) May be out of stock by the time this advert appears. If not, you'll save $5.00!! Was $14.95, 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 20%: was $5.50, now only **$4.50**

Radio Frequency Interference (B-2222) How to identify and cure RFI. Keep on side with your neighbours: and the RI! Was $5.50, Now reduced to only **$4.50!**

Solid State Basics (B-2224) Provides both the why and the how of transistors, ic's, 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**

DICK'S OWN 'Australian Amateur Radio Handbook' (B-2320) The first amateur book written just for Australia. In a relaxed, easy-to-read style, it's a great gift idea for anyone interested in the world of amateur radio. Only **$6.95**

Big savings on 1979 world callbooks: Yes: great value for the ham or swl on a budget. Last year's callbook maybe, but the contents don't change all that much from year to year!

US Callbook (B-2260) All the amateurs of continental US, Hawaii, its posessions 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**

EA Logbook (B-2258) More than just a logbook – contains loads of data and amateur information too. Plus plenty of room for your station log. Was $2.50, now reduced to only **$1.95**

World Atlas (B-2268) Ever wondered where that DX call actually came from. This handy size atlas is ideal for the shack. **$3.90**

World Prefix Map (B-2264) Not just great wall decoration for your shack; this map shows the amateur prefixes of all zones, too. **$2.20**

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 $35.00, Now only **$28.00**

Radio Handbook (B-1106) Over 1000 pages; one of our most popular reference books. Easy to understand. Was $$25.00, 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 microwaves. **$17.00**

80 metre DXing (B-2286) Includes all aspects of 80 metre operation, including antennas, proption characteristics, operating practices, etc. Was $5.50; now reduced to just **$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 AOCP (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, repeaters, satellites, etc 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, baluns,etc. Only **$5.75**

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shortwave loggings

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 March they've been heard testing on 21 500 between 0600 and 1000, 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 either 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.

International schedules

Unlike stations on the mediumwave band, international shortwave broadcasting stations do not have fixed frequencies. Instead, frequencies are changed at regular intervals throughout the year to take advantage of seasonal propagation factors.

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 it 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.

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.

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.

shortwave loggings

Laos good

Shortwave broadcasting in Laos is very extensive, with most of the main towns possessing a shortwave transmitter.

Nevertheless, broadcasting in Laos has a touch of the exotic, with most transmitters being of low power, apt to drift in frequency, and tending to operate on odd-ball frequencies well away from the mainstream of the shortwave bands.

The Vientiane National station operates on a conventional 49 metre band outlet of 6130 and usually gives good signals after HCJB in Ecuador leaves the frequency at about 1130 nightly. Vientiane has a major news bulletin at 1200 preceded by clock chimes, and this programme is usually relayed by all other shortwave stations across the country.

Best heard of the regional stations at present is Savannakhet on 7385, sometimes drifting down towards 7380. This station usually opens by 1100, but try them a little later for, by 1200, signals should be much improved.

Also showing at present is Luang Prabang on 7000, which is either a recent deliberate shift in frequency, or just a drift from 6997. The recent change of frequency, whatever the cause, is helpful for it means Luang Prabang is now relatively free of interference from the strong China station on 6995.

Pakse is another of the regional stations which is frequently well heard, and the last monitored outlet from them was 6600. But just as signals became quite good, it has become inactive recently, although this may be only a temporary silence.

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 south eastern 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 Guaiba 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 Guaiba" 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 wild 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 Brasilia 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 Television 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 receive 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 Niamey (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

Radio Thailand in clear

Although close to Australia, and with a regular international service on shortwave, Radio Thailand is not one of the better heard Asian stations.

Currently however, Bangkok's English service is on a clear frequency during the evening programme.

The English service is heard on 9655 from 1055 to 1155, with news at 1100. The English programme is also listed for broadcast at this time on 11 905 but reception of this outlet is virtually impossible in Australia at present due to the Central Broadcasting System in Taiwan using the frequency in our evenings for programmes to China.

Most Radio Thailand programmes feature interesting talks about the country together with local music.

Meanwhile, the Home Service from Bangkok, in Thai, is often audible on 4830 from fade in at about 1300 through to sign-off at 1600.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert to Australian Eastern Standard Time, add 10 hours (11 hours for Daylight Saving Time). To convert to Central Time, add 9.5 hours and for Western Time add 8 hours. All frequencies are in kHz.

Shortwave Loggings is compiled by Peter Bunn on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett Vic 3190, or from PO Box 79, Narrabeen NSW 2101, for a 30c stamp.

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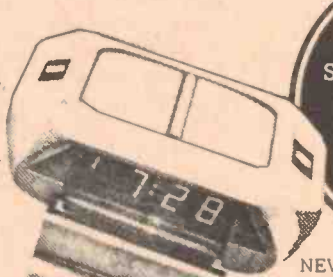

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PREDICTIONS JUNE 1980

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.

These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . . path open 50 - 90% of days in month.

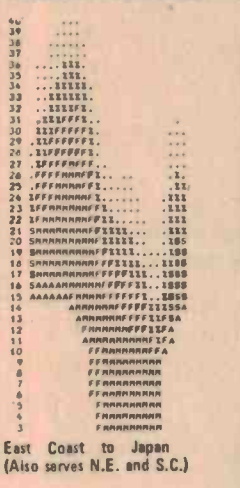
F . . . . . path open at least 90% of days in month.

B . . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

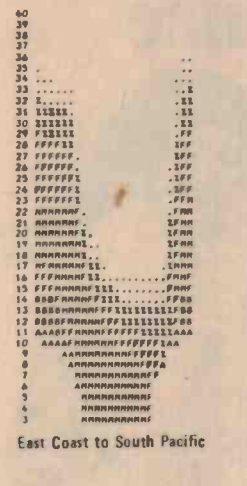
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

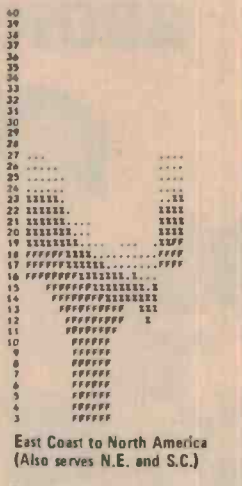
A . . . . . High absorption indicated. Expect weak signals.



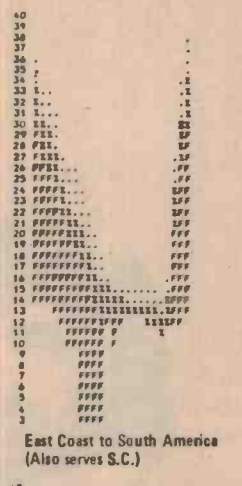
East Coast to Japan
(Also serves N.E. and S.C.)



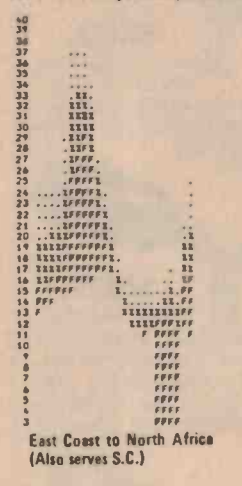
East Coast to South Pacific



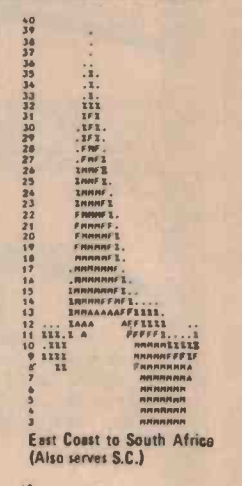
East Coast to North America
(Also serves N.E. and S.C.)



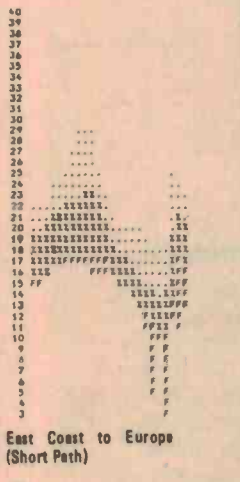
East Coast to South America
(Also serves S.C.)



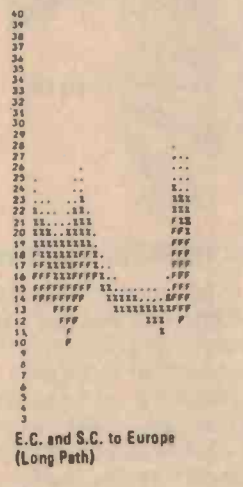
East Coast to North Africa
(Also serves S.C.)



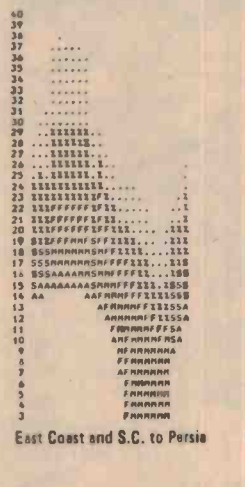
East Coast to South Africa
(Also serves S.C.)



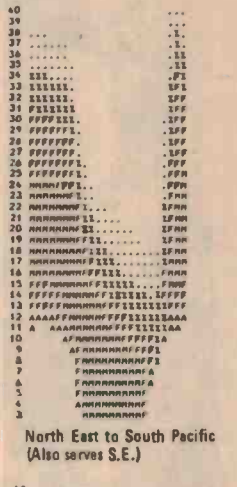
East Coast to Europe
(Short Path)



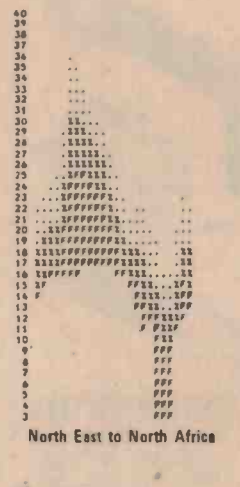
E.C. and S.C. to Europe
(Long Path)



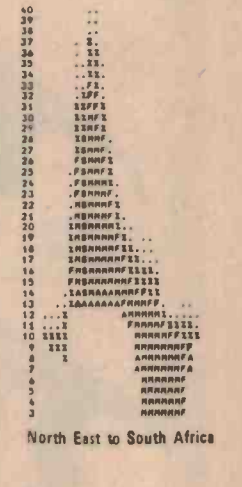
East Coast and S.C. to Persia



North East to South Pacific
(Also serves S.E.)

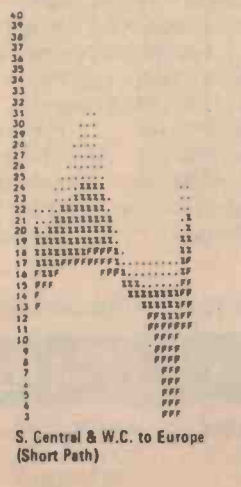


North East to North Africa

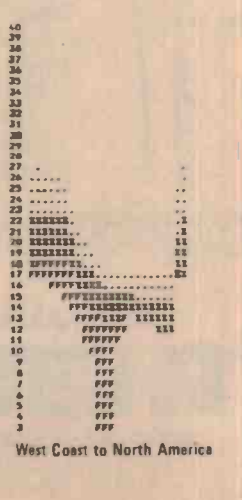


North East to South Africa

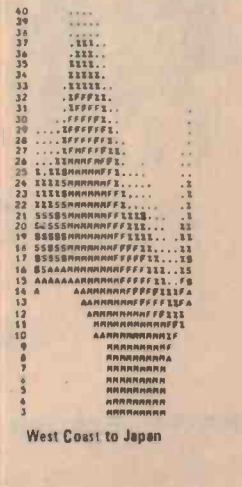
North East to Europe
(Short Path)



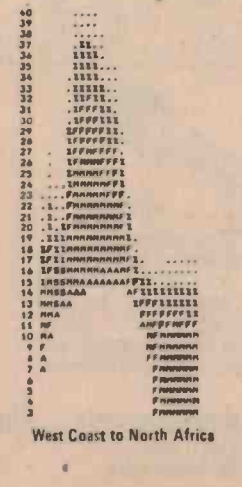
S. Central & W.C. to Europe
(Short Path)



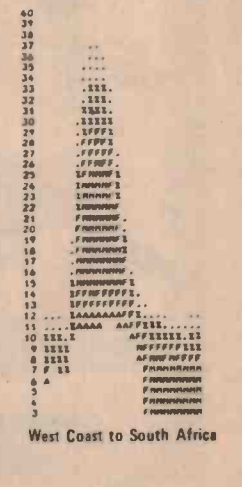
West Coast to North America



West Coast to Japan



West Coast to North Africa



West Coast to South Africa

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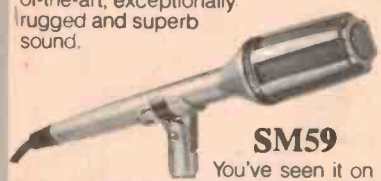

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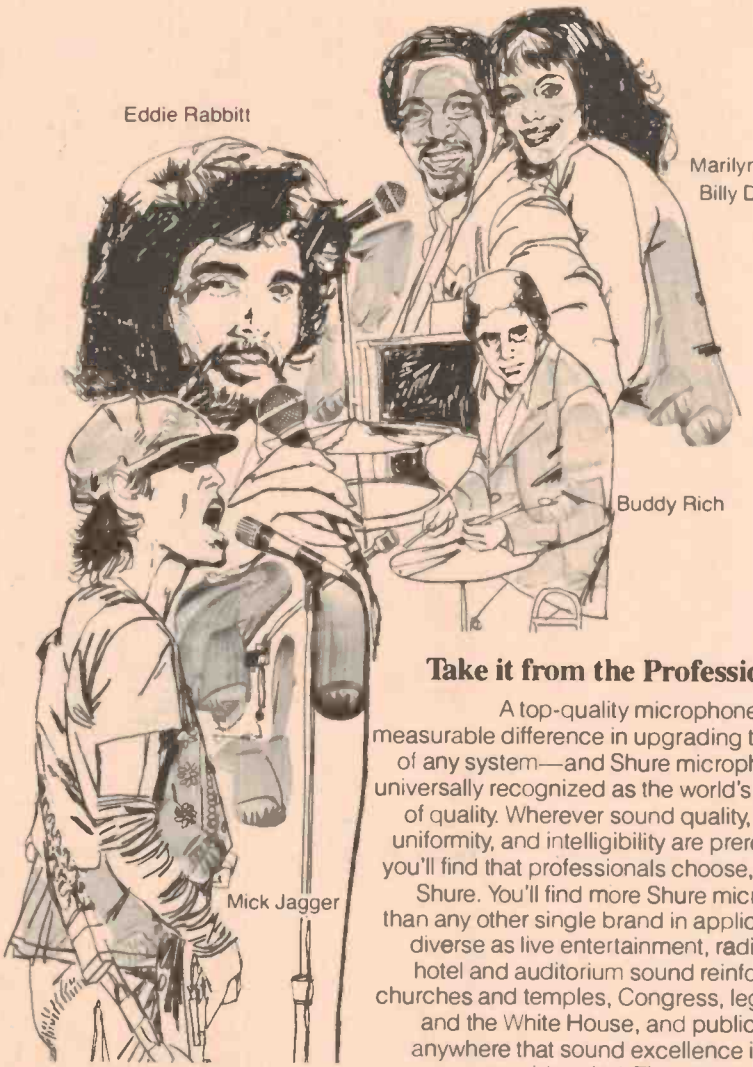

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$39 for 10 reels

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Sure, it's fun to listen to the sound change its character as you play with the knobs – but after that, what?

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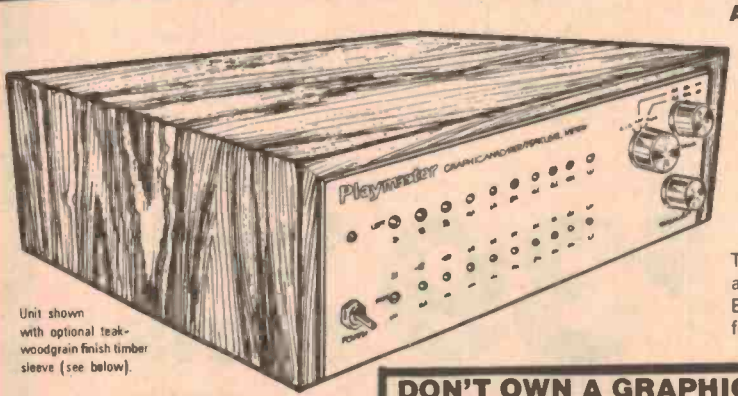
This device, called a 'Graphic Analyser', allows you to obtain a virtually 'flat' frequency response from your audio system – which is what hi fi is all about, isn't it?

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



Unit shown with optional teak-woodgrain finish timber sleeve (see below).

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

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Cat K-3510

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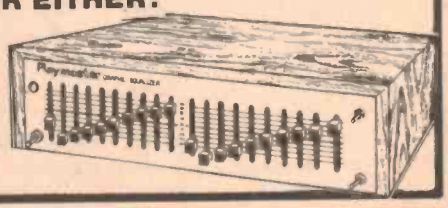

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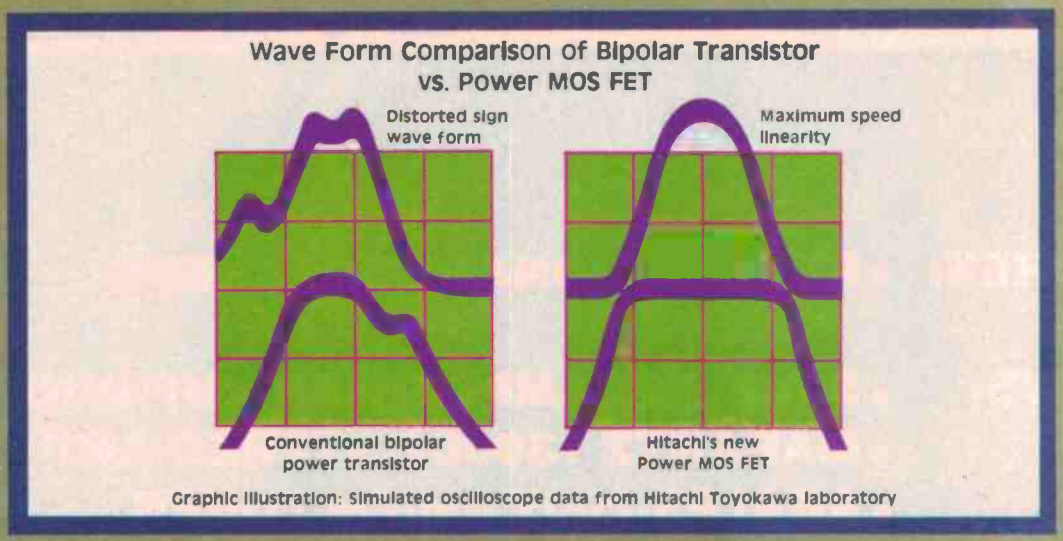

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The RIAA phono equalizer is a top-precision design employing only the highest-quality components for low-distortion and true-to-life disc playback. There's a full complement of control and convenience features for maximum system flexibility.

The HA-7700. True purity in waveform reproduction is here.

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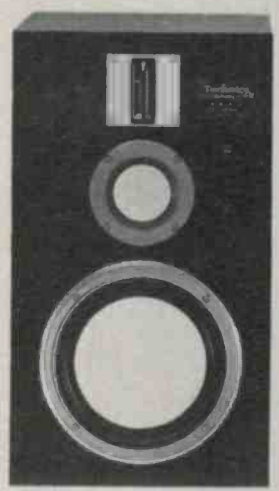
Technics' award winners released here

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 speaker 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 $1995, $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.

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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% WRMS (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.

More information from Toshiba Australia's Pty Ltd, 16 Mars Rd, Lane Cove NSW 2066.

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 Jocys, Publicity-Promotions Officer Sydney 93-0246.

Sound Archives conference

The 1980 Conference of the Australian Branch of the International Association of Sound Archives will be held in Canberra on May 10 and 11, 1980.

Venue for the Conference is the Common Room, Bruce Hall, Australian National University, Canberra, A.C.T. It is situated on the campus in Daley Road (telephone: (062) 49-2818).

All persons interested in the creation, use and preservation of sound are invited to attend. Contact Peter Burgis, IASA Secretary, on (062) 621-513 for details.

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 architectually, 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.

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Add colour-coding to the many other features and it's easy to choose Agfa Ferro Color Cassettes.

COLOR CODE

z.B.: e.g.:	FOLK	POP	JAZZ
C60			
C90			
C120			

High Dynamics: Agfa Ferro Color Cassettes have a high quality iron oxide coating to increase dynamic range and frequency responses.

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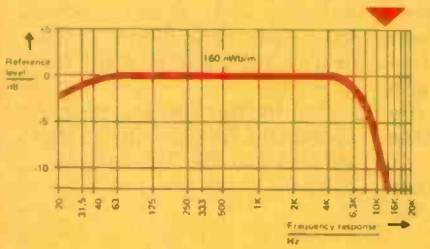
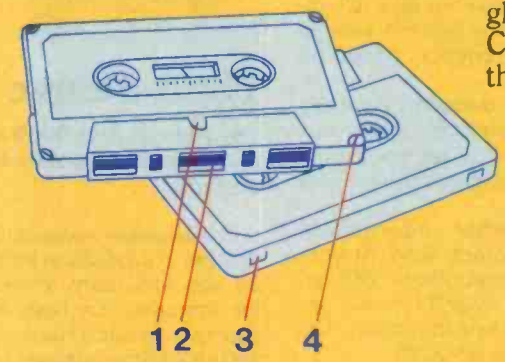


A Better Designed Case: Cases are of smooth lines, with rounded edges and corners to improve handling and efficiency.

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.



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.

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!

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Agfa-Gevaert for still cameras, flash-guns, colour film for slides, prints and movies, magnetic tapes.

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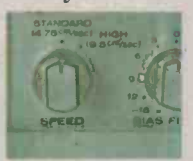
Marantz rare additions will add a new dimension to your musical enjoyment — so hook up with your local Marantz dealer and listen to your add-on or upgrade component outperform anything you've heard to date.

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.



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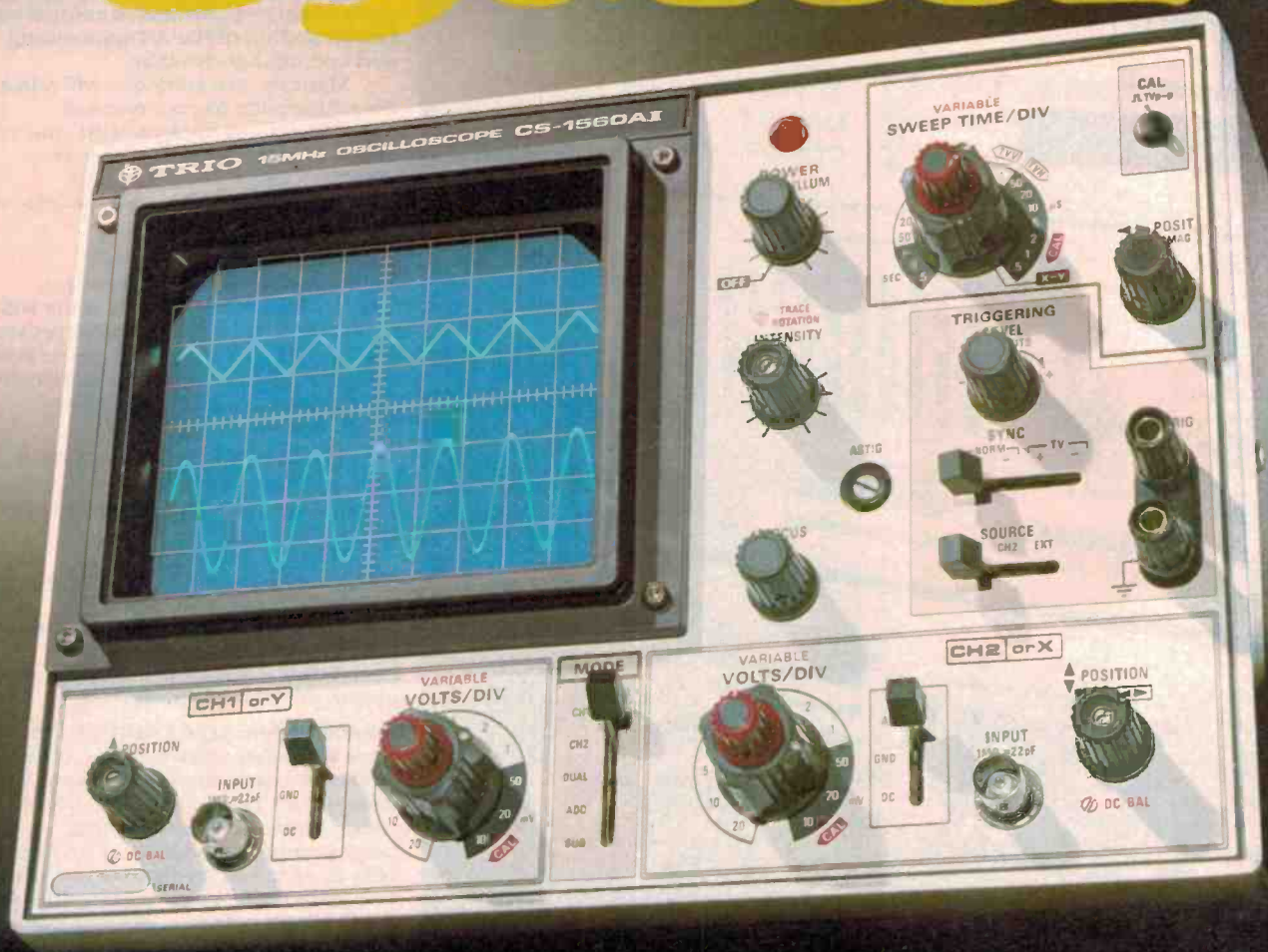

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Revolutionary "honeycomb disc" drivers in new loudspeakers

Roger Harrison

Cutaway view of the Technics 320 mm honeycomb disc woofer showing the construction of the diaphragm and the voice coil (see also, page 142). Picture courtesy National.

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.

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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?

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"Honeycomb disc" drivers

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.

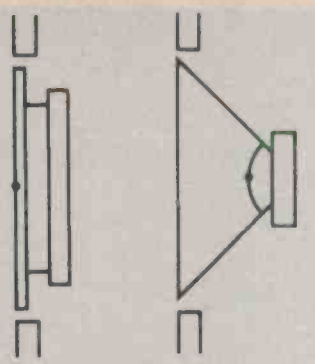


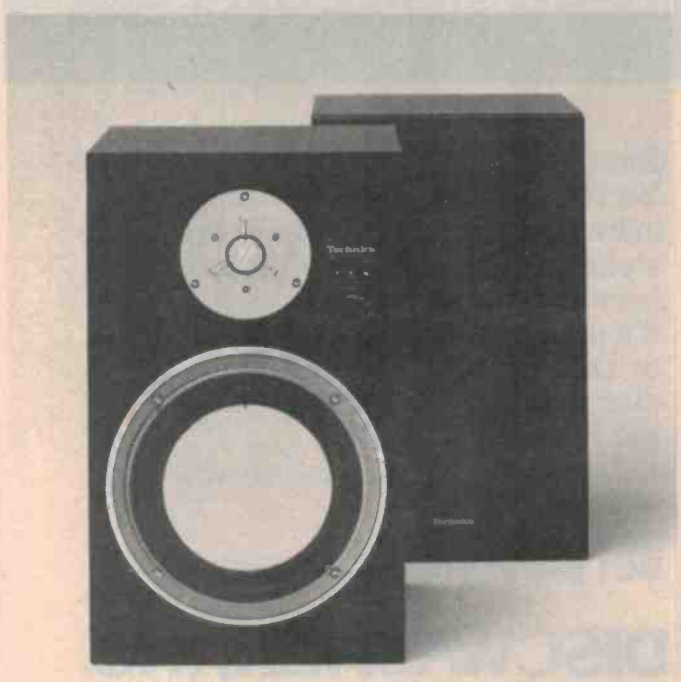
Figure 1. The dot shows the relative acoustic centres of a flat diaphragm driver (left) and a cone type driver (right).

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 ▶

At left is Technics' SB-3 two-way speaker system featuring a 220 mm bass/mid-range driver and a 28 mm tweeter – both employing honeycomb disc construction. At right is the SB-10 system. This is a three-way employing a 320 mm woofer, an 80 mm mid-range – both honeycomb disc types, and a special 'leaf' tweeter.



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Cartridge and Disc Traker (pictured) not included in Kit, ask your nearest dealer for details.

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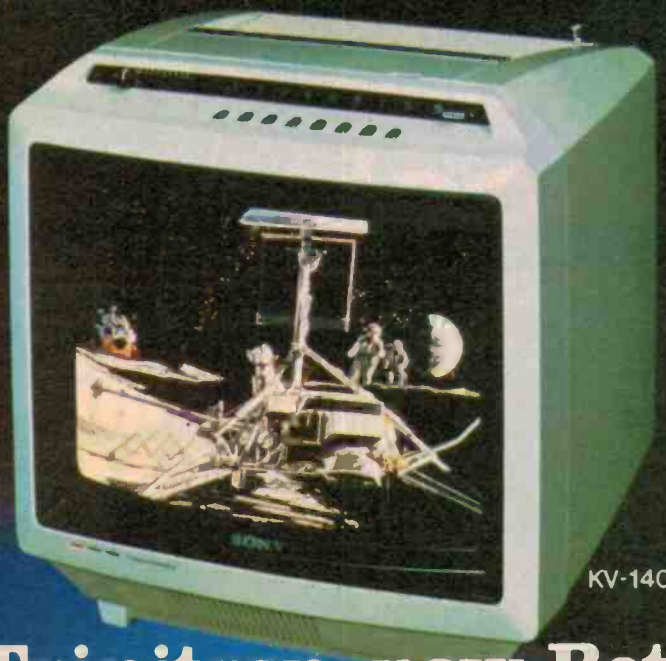

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First Trinitron, now Betamax. Sony gives you one great innovation after another.

SL-8000AS

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.

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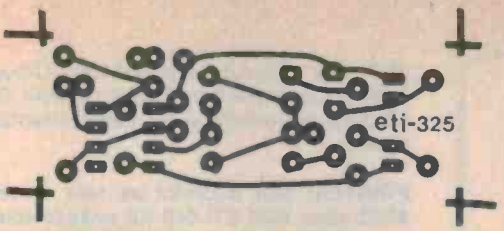
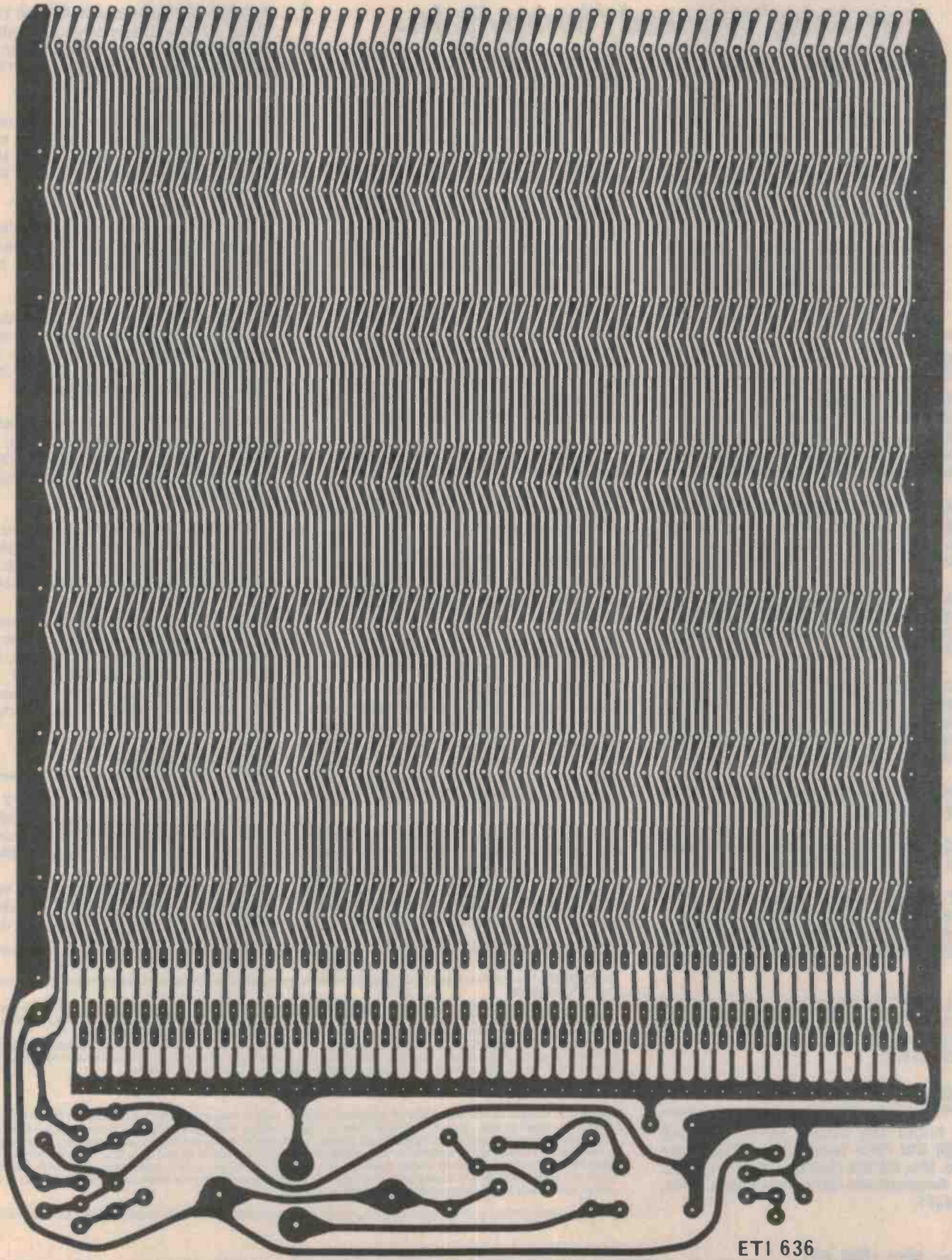


PCBs

Instructions on how to make your own pc boards using the Scotchcal method and exposing through this page may be found on page 113 of the March '80 issue.



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SELL: TEAC AL700 ELCASET Tape Deck, 5 months old, includes 12 tapes, suit reel to reel enthusiast. Cost $1400, sell $600. Ph. (09) 364 8126.

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ALL brand new unused items. Kenwood 820(S) CW Filter (was $59) MC35S Noise Canc. Mic, GE Mic (ie CB). Offers. VK6NRO 111 Ravenswood Drive, Nollamara 6061. 349 4471.

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COMMUNICATIONS Receiver RCA, BC224, 12 volt, working order unmodified $50. Ken Horn, 140 Old South Head Road, Vaucluse (02) 337 1033.

COMPUTING

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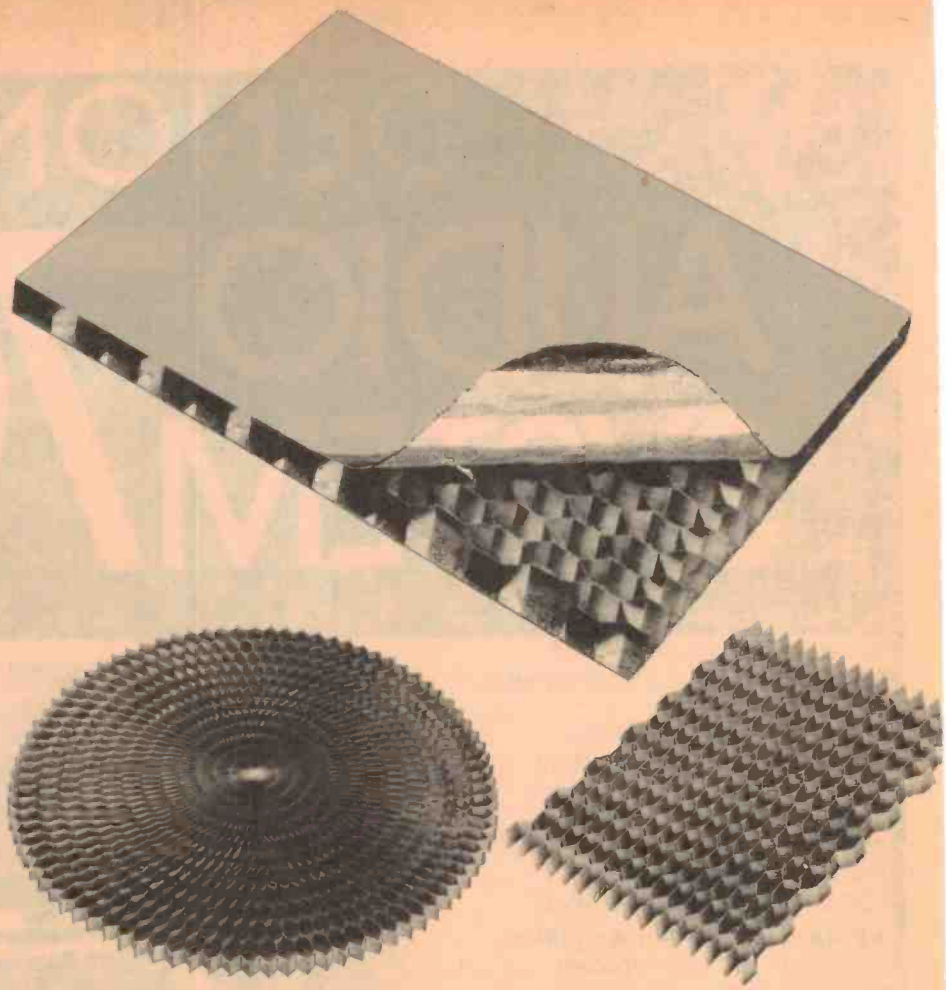


Figure 2. **At top is a "honeycomb sandwich" structure (a). The basic honeycomb at bottom right (b), usually made of aluminium, is sandwiched between layers of thin metal foil. This is unsuitable for speakers however, and Technics engineers developed the circular structure shown at bottom left (c).**

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 B139, 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.

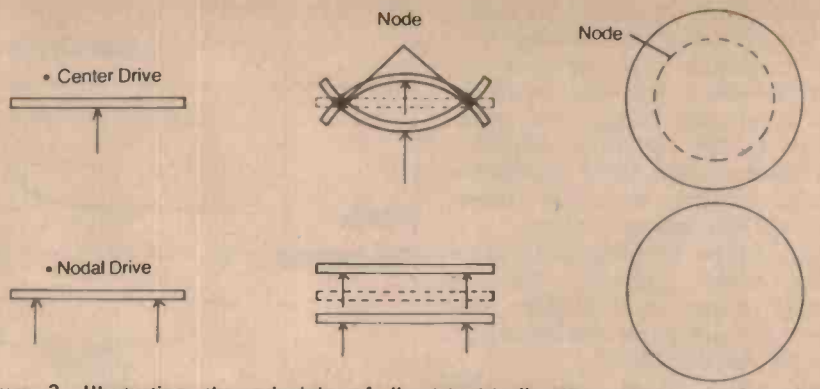


Figure 3. **Illustrating the principle of "nodal drive". When driven at the centre the disc will tend to resonate and vibrate as shown at top. When driven at or near the indicated node line, this spurious vibration is eliminated.**

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.

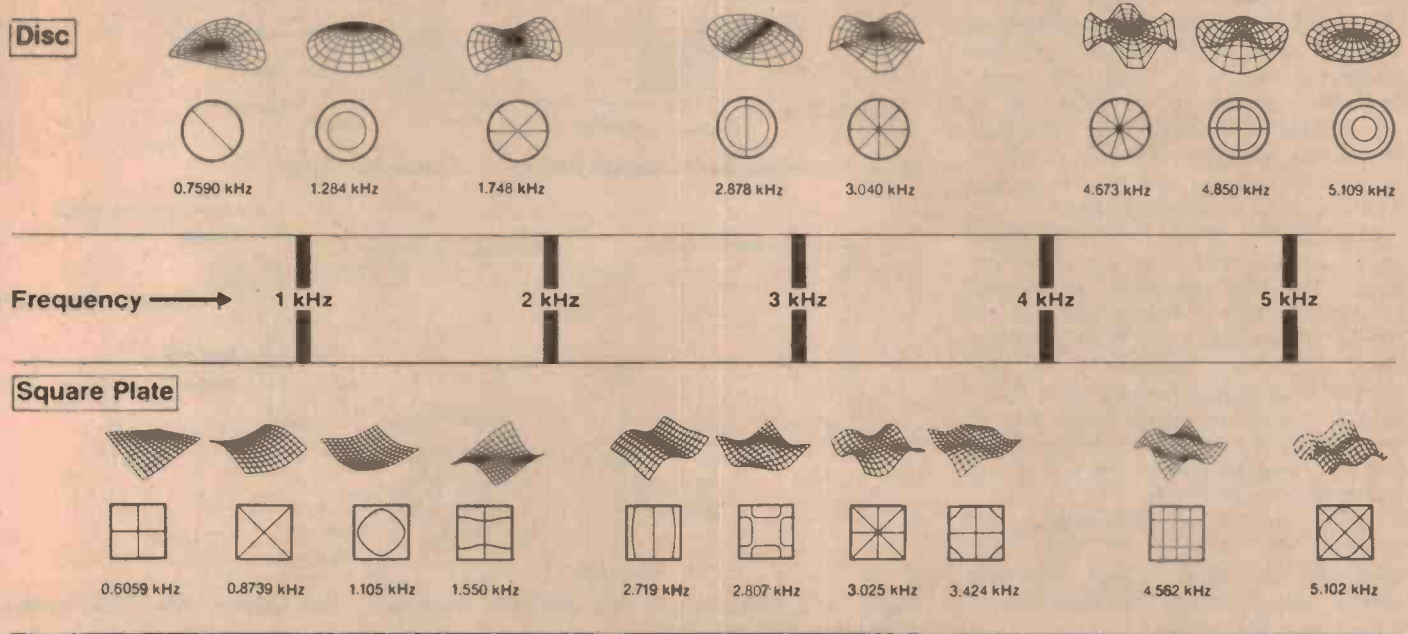
Where, and in what shapes, these nodal patterns appear on a speaker diaphragm depends on several factors, including the diaphragm's basic resonant frequency, its shape and the frequency at which it is driven.

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 ▶

Figure 4. **Computer analysis of the modes of vibration of a disc and a square plate showing the flexing patterns and the nodal lines produced (lines of least vibration) when driven at different frequencies. Clearly, a disc has the least complicated variety of vibration modes. (All diagrams courtesy National).**



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. ●

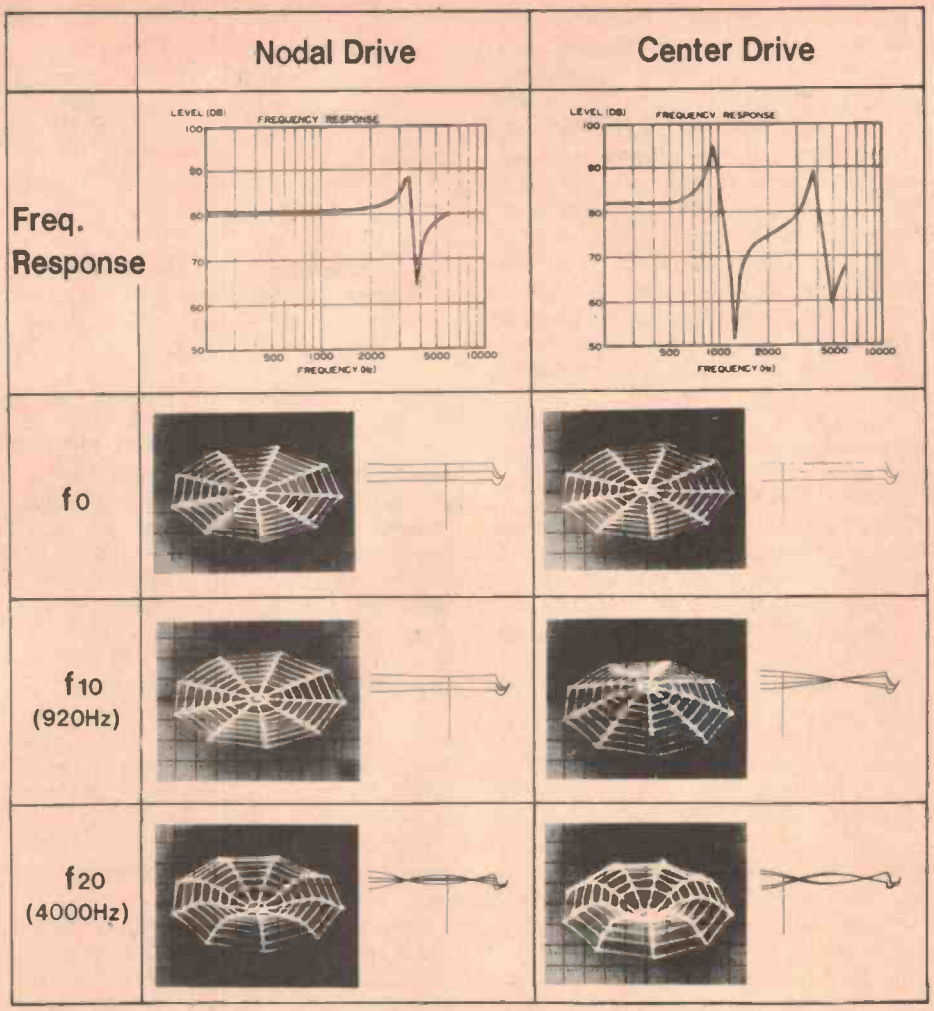


Figure 5. **Illustrating how the frequency response of a disc, i.e.: its range of 'pistonic motion', is extended by nodal drive.**

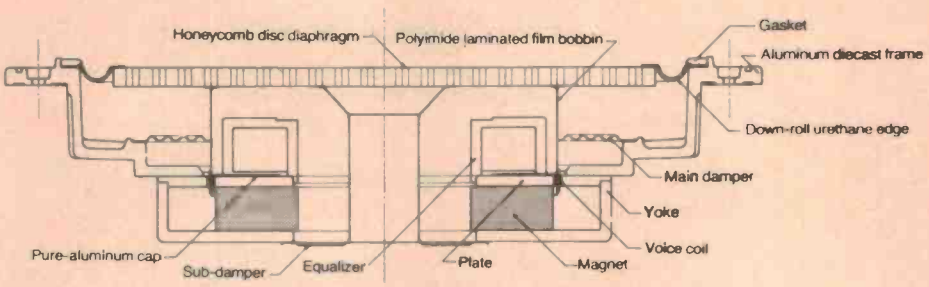


Figure 6. **Cross-section of Technic's 320 mm honeycomb disc woofer.**

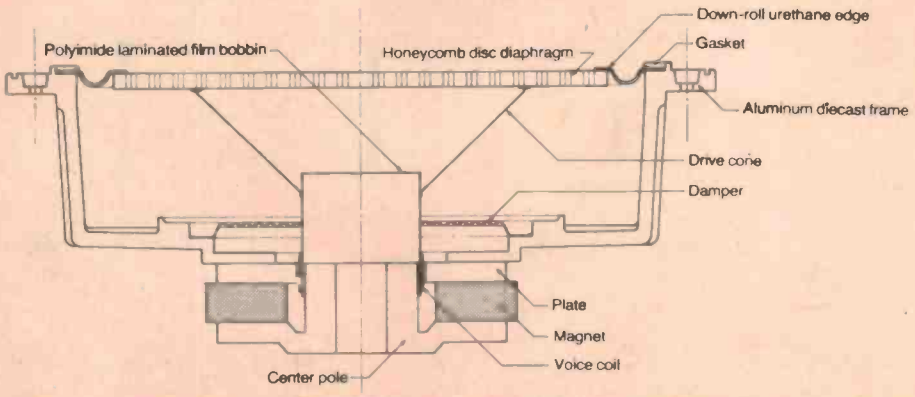


Figure 7. **Cross-section of the 250 mm honeycomb disc woofer. The other honeycomb disc drivers are similar.**

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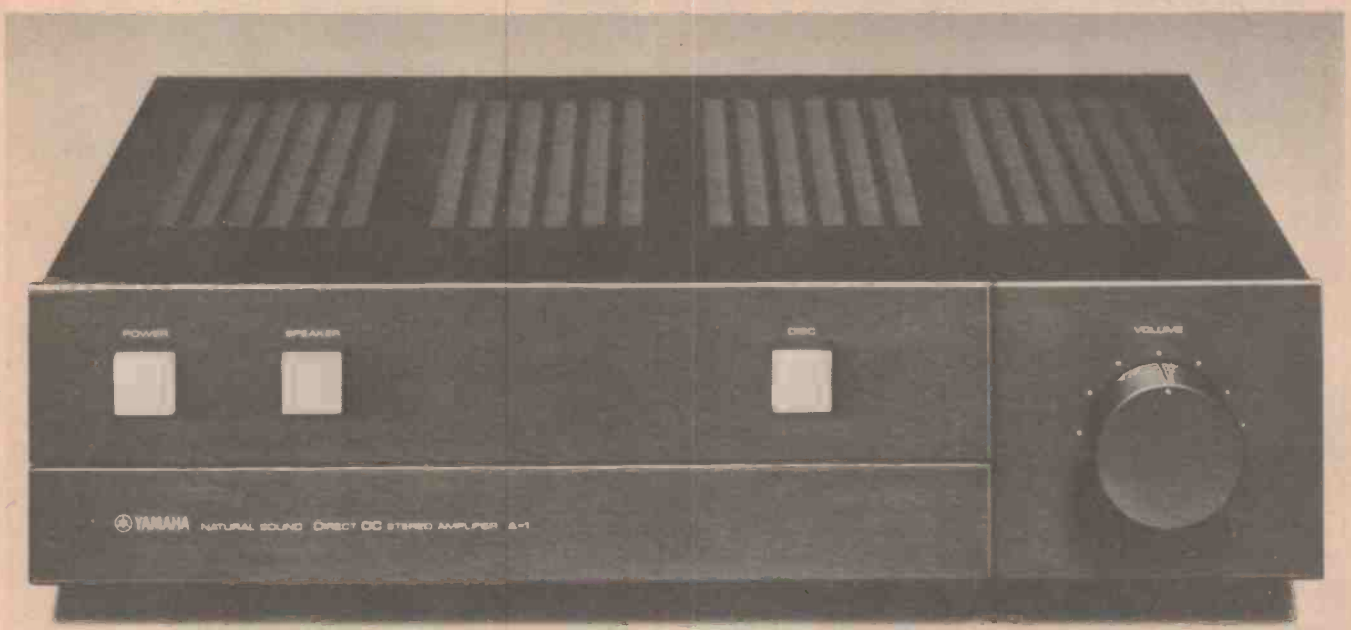
Power consumption 215W
Dimensions (WxHxD) 435 x 117 x 381mm 17⅛" x 4⅝" x 15"
Weight 15.8 kg (34 lbs 12 oz.)

YAMAHA



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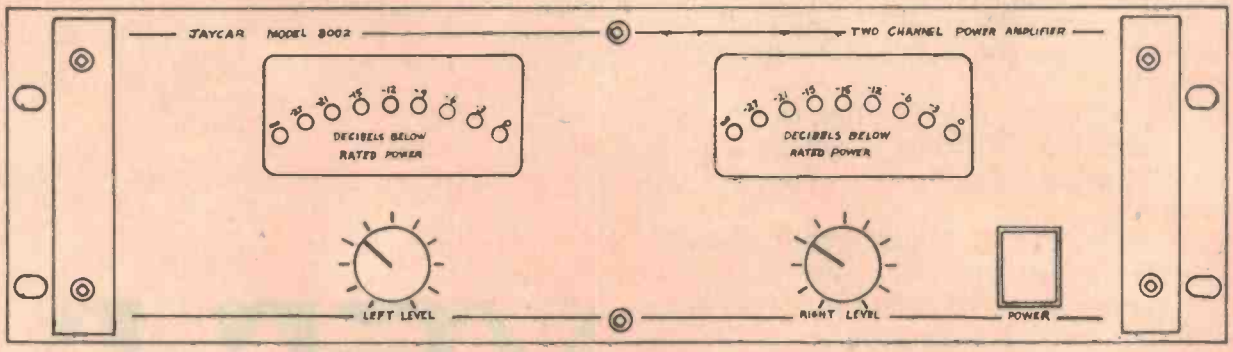

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Preamp-power amp duo from S.A.E.

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 row below the tape control switches are the low pass filter switches with a 30 Hz and 100 Hz cutoff frequencies, plus a tone control defeat switch which has the ability to switch the tone controls into the tape recorder circuit path or in the normal preamplifier line circuit.

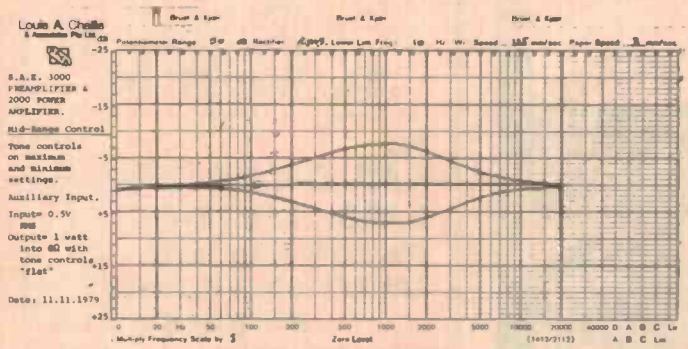
In the bottom row is a balance control which provides up to 40 dB differential balance adjustments between left and right channels.

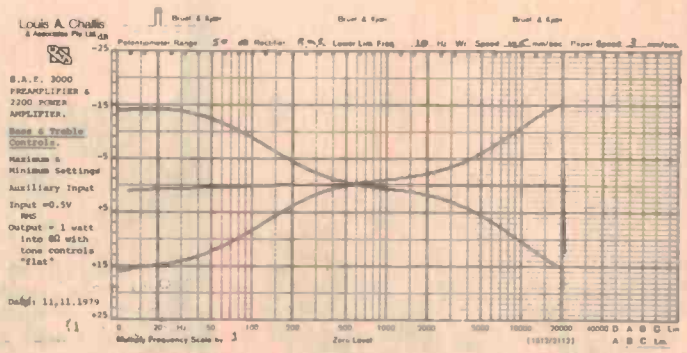
The central group switch controls are a −12 dB mute switch, adjacent to which are three mode controls for mono A, mono B, stereo or reverse, whilst in the bottom row is a fader volume control with a −70 dB to a maximum gain with calibrations of 70, 40, 35, 30, 25, 20, 15, 10, 5 and zero dB.

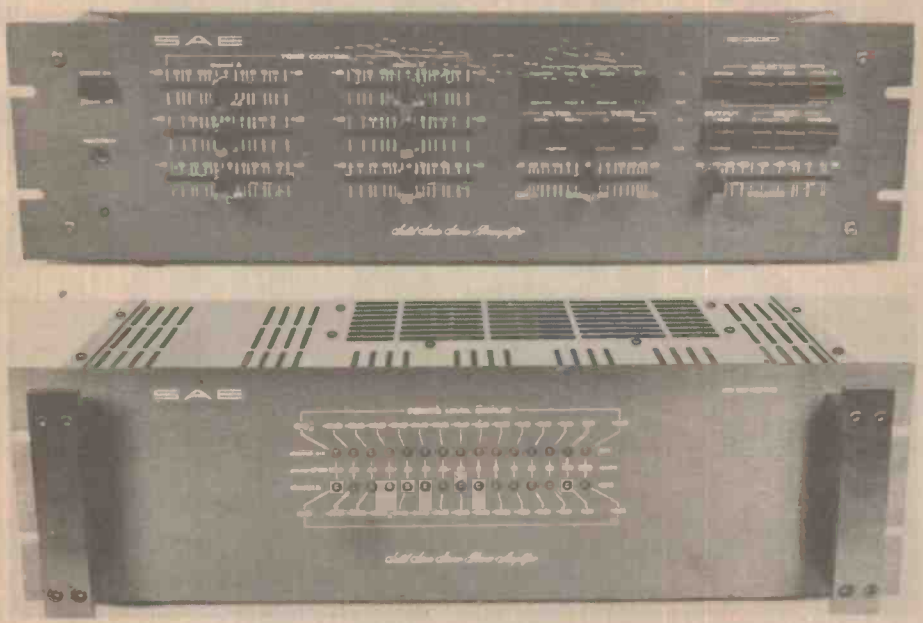
The rear of the amplifier features inputs by standard coaxial sockets for two photo cartridges, tuner or auxiliary, tape 1 in and out, tape 2 in and out plus outputs to two amplifiers.

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 eyecatching 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 lot 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.

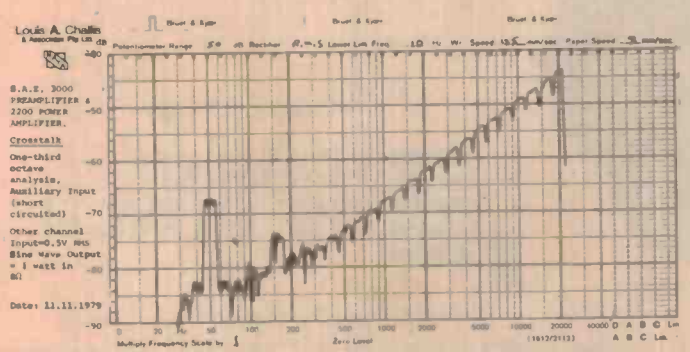
The distortion characteristics of the amplifier are, however, *exemplary* and at the 100 watt level the performance is almost in the category of being "state of the art".

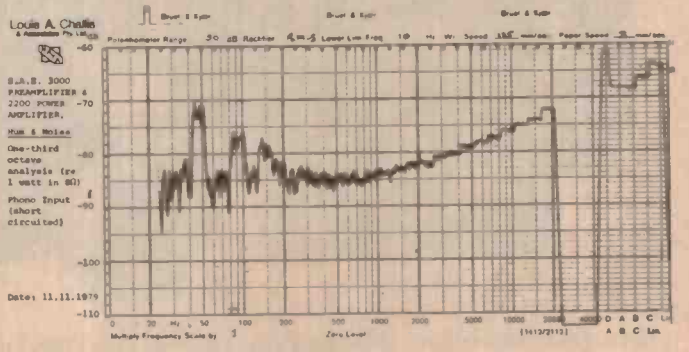
At 100 Hz the distortion level is a maximum of .024%, at 1 kHz .009% and at 6.3 kHz .013%. At lower power levels the distortion levels are even lower still and are, without a doubt, a credit to the system's designers.

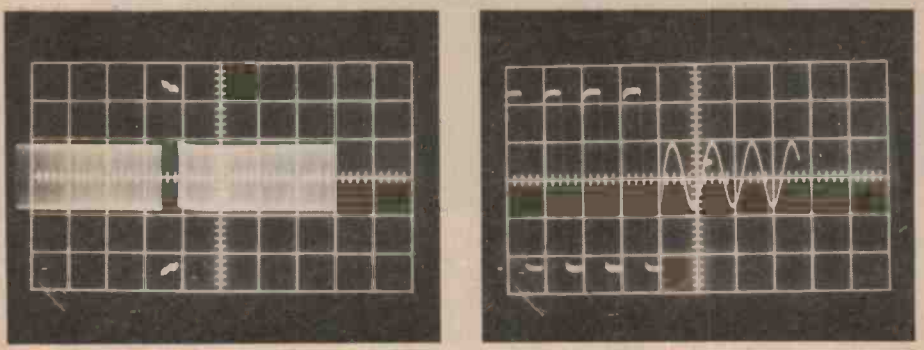
We were surprised that the distortion in the left channel and the right channel were significantly different, with the left channel generally producing higher magnitudes than the right channel produced. Even so, the left channel produced inconsequential levels of distortion and the difference between 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 ▶







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 ms; IHF-A-202).

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 enraptured 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 AND 2200 POWER AMPLIFIER

PREAMP MODEL 3000

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.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF

S.A.E. 3000 PREAMPLIFIER (S.N. 2902) AND S.A.E. 2200 POWER AMPLIFIER (S.N. 8420)

Our Ref: E27

FREQUENCY RESPONSE:
(-3dB re 1 watt, 0.5V Input to Aux.)

Tone Controls Centred

Left:	4Hz to 70kHz
Right:	5Hz to 67kHz

Tone Controls Defeated

Left:	4Hz to 73kHz
Right:	4Hz to 72kHz

SENSITIVITY:
(for 1 watt in 8Ω)*

	Left	Right
Aux.:	12.5mV	12.6mV
Tuner:	12.5mV	12.6mV
Tape:	12.5mV	12.6mV
Phono:	120μV	120μV
Overload:	260mV	260mV

INPUT IMPEDANCE:

	Left	Right
Aux.:	43kΩ	43kΩ
Tuner:	43kΩ	43kΩ
Tape:	43kΩ	43kΩ
Phono:	42kΩ	43kΩ

OUTPUT IMPEDANCE: 0.17Ω (1kHz)

HARMONIC DISTORTION:
(at rated power of 100 watts into 8Ω = 28.3 volts)

	100Hz Right	100Hz Left	1kHz Right	1kHz Left	6.3kHz Right	6.3kHz Left	
2nd	-77.3	-74.4	-89.4	-57.5	-82.7	-84.8	dB
3rd	-80.6	-77.7	-89.4	-82.0	-79.0	-80.0	dB
4th	-87.7	-85.4					dB
5th	-94.7	-90.6					dB
THD	.017%	.024%	.005%	.009%	.013%	.01%	
(at 1 watt into 8Ω) 2nd	-78.5	-75.6	-91.8	-84.2	-85.0	-82.7	dB
3rd	-80.5	-77.1	-92.3	-86.5			dB
4th	-89.9	-87.0					dB
5th	-92.9	-90.2					dB
THD	.016%	.022%	.004%	.008%	.006%	.007%	

TRANSIENT INTERMODULATION DISTORTION:
(3.15kHz square wave and 15kHz sine wave mixed 4:1) Less than 0.1%

NOISE & HUM LEVELS:
(re 1 watt into 8Ω)
(with volume control set for 1 watt output with, 0.5V input -Aux. 5mV input -Phono)

Aux.:	-66.5dB(Lin)	-69.0dB(A)
Phono:	-64.0dB(Lin)	-68.0dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT: 96V P-P
(IHF-A-202) = 144 watts
(20mS burst repeated at 500mS intervals) Dynamic Headroom = 1.6dB (re 100 watts)

*Note: This sensitivity may vary with position of tone switch when gain control is at maximum. Figures quoted are for tone in, sensitivity may be higher with tone out.

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, frequence 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.

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22 Wattle Rd, Brookvale, NSW. 2100. Tel: (02) 938-3700.

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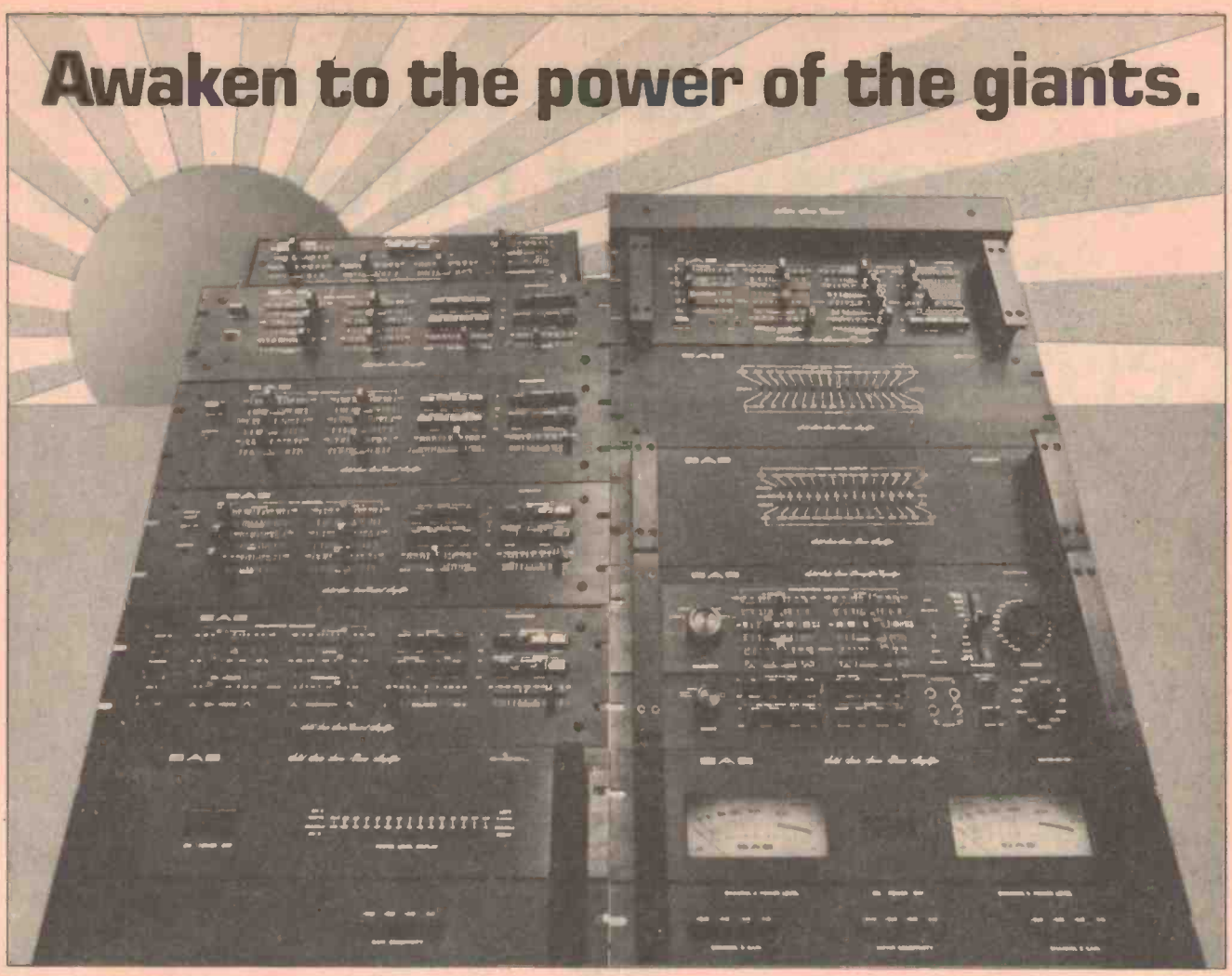
Permostat by Concept Audio.

Awaken to the power of the giants.



SAE

Solely 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 specificaly 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.

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342 Kent Street.
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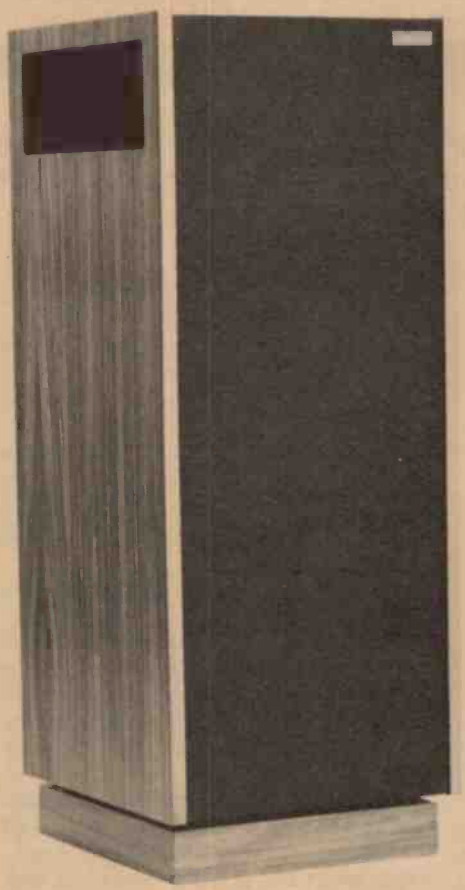


Otoscan 3B

Otoscan 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 Otoscan 3B.

If you're serious in your quest for sonic perfection, you owe it to yourself to find out more about Otoscan 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:

Otoscan Loudspeakers,
PO Box 480, Artarmon, NSW. 2064.
Phone: (02) 95-0084.

Marantz model 1300DC stereo power amp

Louis Challis 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.

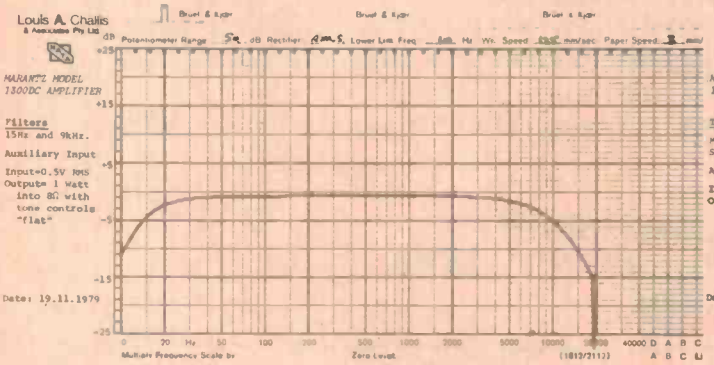
The major controls are cleverly aligned in the centre level of the three rows of controls located on the front panel. The front panel is unusual, firstly in that it incorporates a panel fascia which extends beyond the main face by about 3 mm. This panel has, on the left hand side of the top row, push 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 Kz and the treble turnover frequency from 2 kHz and 10 kHz.

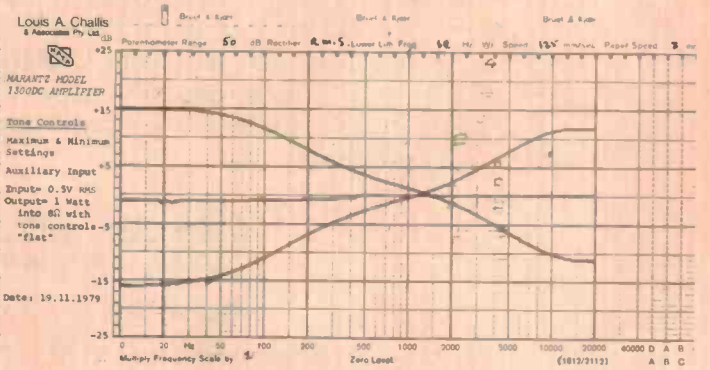
Two other filter switches are provided, one a low cut filter, with an 18 dB per octave slope with a corner frequency of 15 Hz, together with a 9 kHz high cut filter with similar characteristics. The last switch in the top row is a conventional 20 dB muting switch.

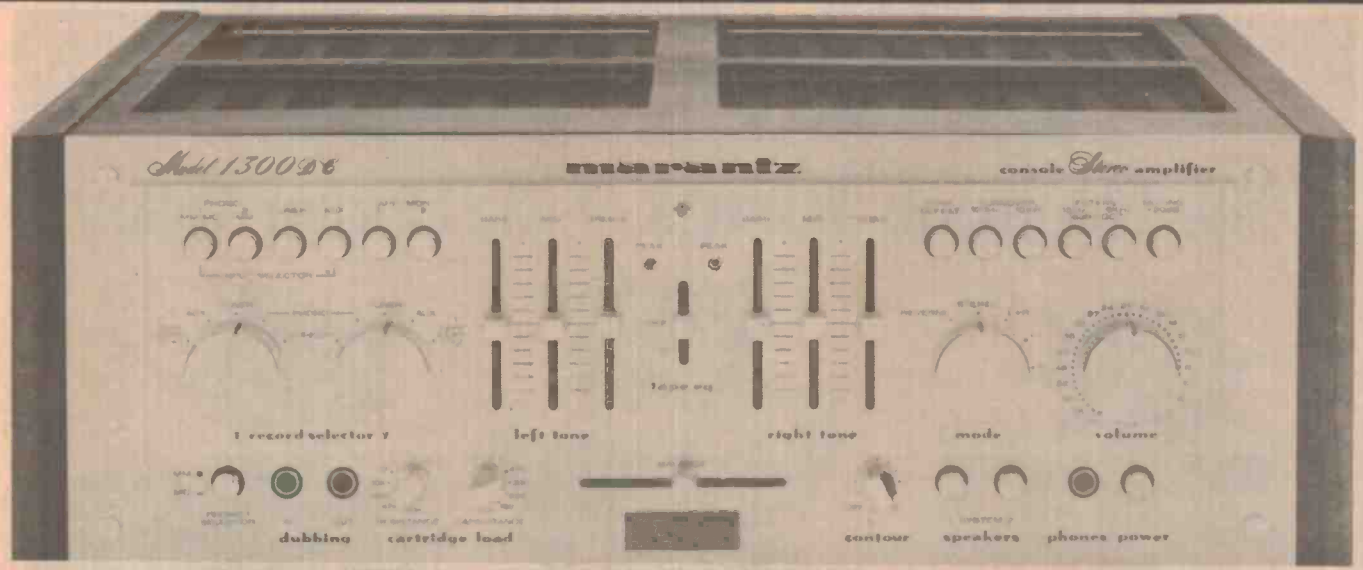
The middle row of main controls has two record selector switches instead of the more conventional single knob. These select the signal source to be sent to either of the two respective tape recorders which may be connected to the unit. Record Selector 1 switch is intended to provide the input for the 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.

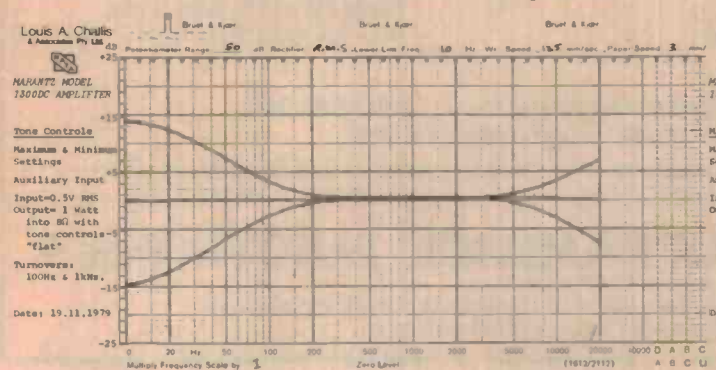
setting. Slider controls are preferable to rotary switches or horizontal faders and are ergonomically well designed as they give a graphical indication of what is happening in a simple and direct manner. Between the two sets of tone controls for the left and right channels Marantz have incorporated the 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.

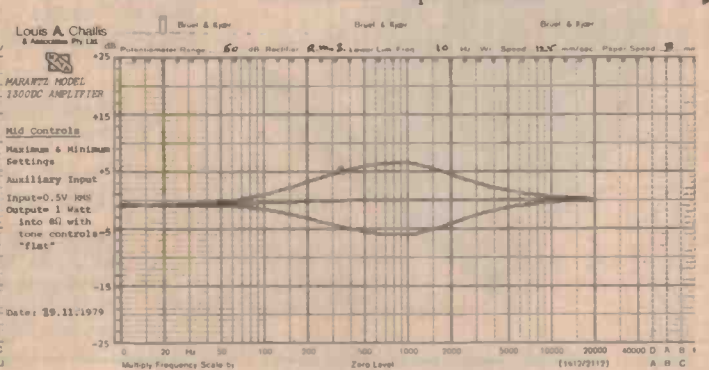
In the upper position with the tape equaliser switch set to the "one" position recording should take place on the main recorder, whilst in the "two" position, onto the secondary recorder.

Flanking 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 anticlockwise 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. ▶





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 kit-sets*. 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.

Power handling

The power handling capacity is high and conservatively rated at 100W RMS, however, due to the high efficiency of Peerless speakers, the recommended amplifier power is between 25-100W RMS.

Whether you settle for the smart timber-veneered PAS assembled series or the PLK kit-set, you're getting the same Danish-made Peerless quality–a quality selected by many of the world's most reputable names in loudspeakers, for inclusion in their own speaker systems.

Contact us now, and discover where you can hear Peerless loudspeakers–then let your ears make up your mind.

Danish-built Peerless loudspeakers, Orthodynamic headphones and unique car speakers are imported by the sole Australian agents,

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698 Burke Road, Camberwell. 3124. Telephone (03)82 1256. Telex 31712

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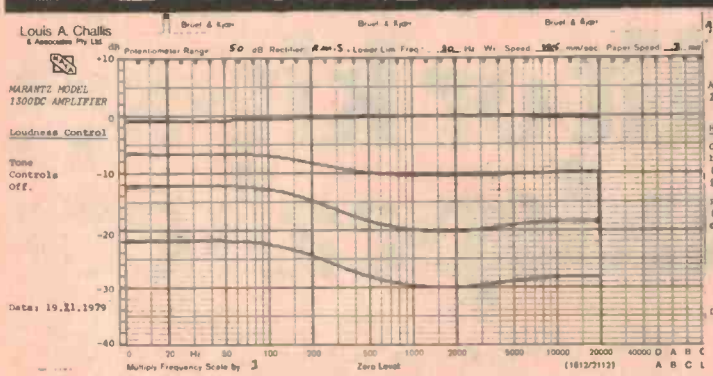

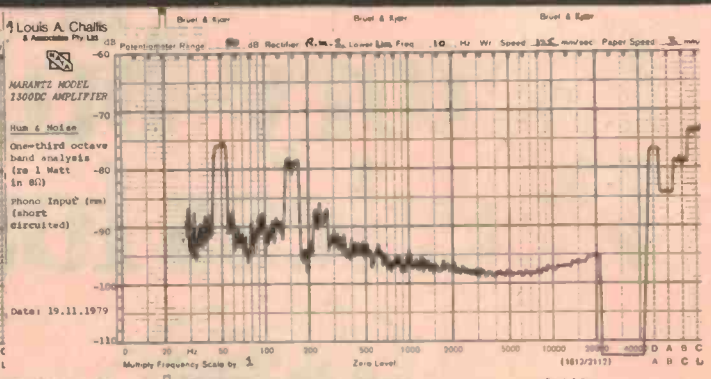

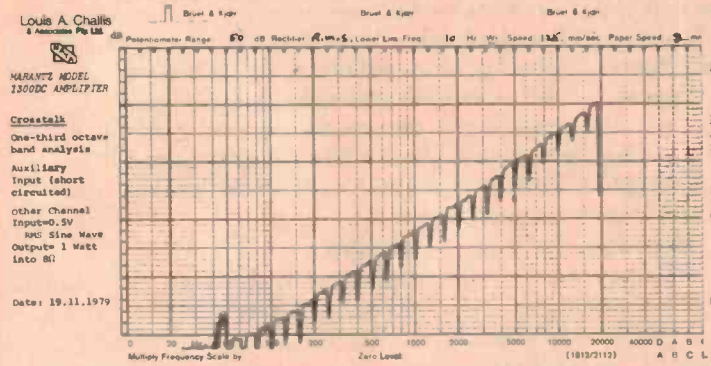

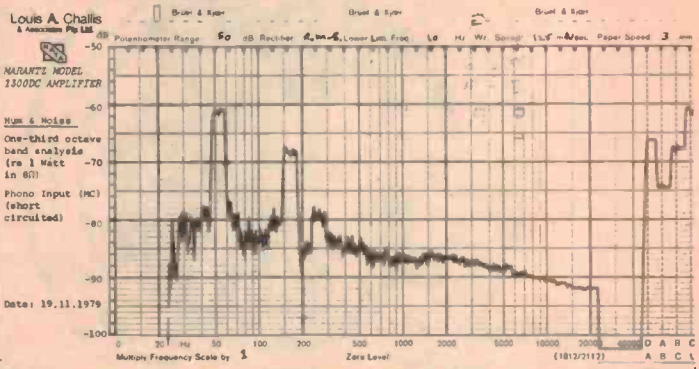

Another notable difference between this amplifier and other units is the incorporation of a fifth foot squarely under the middle of the unit. This distributes the loading which is actually at its greatest underneath the centrally located transformer.

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 accessability for maintenance purposes and the extent of their care in maximising screening to minimise electrostatic and electromagnetic induction problems between the input circuits 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 0.08% at 100 Hz, 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. ●

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.

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF
MARANTZ 1300DC AMPLIFIER (S.N. 91A010087)

FREQUENCY RESPONSE:

(-3dB re 1 watt, 0.5V Input to Aux.)		Tone Controls Centred
	Left:	1.3Hz to 82kHz
	Right:	1.4Hz to 85kHz
		Tone Controls Defeated
	Left:	1.2Hz to 115kHz
	Right:	1.3Hz to 115kHz

SENSITIVITY:

(for 1 watt in 8Ω)		Left	Right
	Aux:	12mV	12mV
	Tuner:	12mV	12mV
	Tape:	12mV	12mV
	Phono (MM)	125μV	125μV
	Overload	280mV	280mV
	Phono (MC)	20μV	20μV

INPUT IMPEDANCE:

		Left	Right
	Aux:	39kΩ	39kΩ
	Tuner:	39kΩ	39kΩ
	Tape:	39kΩ	39kΩ
and other values of impedance as per spec.	Phono (MM)	47kΩ	47kΩ
	Phono (MC)	50Ω	50Ω

OUTPUT IMPEDANCE: @ 1khz = 80 milliohms

HARMONIC DISTORTION:

(at rated power of 150 watts into 8Ω = 34.6 Volts)		100Hz	1kHz	6.3kHz	
	2nd	-74.9	-83.7	-79.5	dB
	3rd	-62.6	-66.8	-82.9	dB
	4th	-93.5	-95.2	-	dB
	5th	-93.5	-	-	dB
	THD	0.076%	0.046%	0.013%	
		100Hz	1kHz1	6.3kHz	
(at 1 watt into 8Ω)	2nd	-71.2	-86.7	-89.4	dB
	3rd	-75.1	-	-95.	dB
	4th	-86.2	-	-	dB
	5th	-86.1	-	-	dB
	THD	0.033%	0.005%	0.004%	

TRANSIENT INTERMODULATION DISTORTION:
(3.15kHz square wave & 15kHz sine wave 4:1 (Output 150watts) Less than 0.1%

NOISE & HUM LEVELS:
(re 1 watt into 8Ω)

(with volume control set for 1 watt output with,			
0.5V input (Aux)	Aux:	-82dB(Lin)	-92dB(A)
5mV input (Phono MM)	Phono(MM)	-72dB(Lin)	-84dB(A)
0.5mV input (Phono MC)	Phono(MC)	-60dB(Lin)	-74dB(A)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:
(IHF-A-202)
(20mS burst repeated at 500mS intervals) 114V P-P = 203 Watts
∴ Dynamic Headroom = 1.3 dB (re 150 Watts)

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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.

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- 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
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- Improves playability of worn and damaged records

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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 utilises 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 pre-selection 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 ohm 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 screened 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 at 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 ▶

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Very simple to build, performance equal to amplifiers two and three times the price!
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Have your sound the way YOU want it. Easy to build kit gives you 'tailor made' response!
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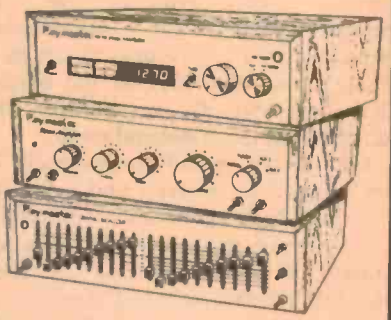

NOTE: All units shown with optional walnut vinyl veneer sleeve: Cat H-3113 **$8.50**

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75 litre cabinet, with 12" bass driver. Has tone controls, too!
$284.00 pr

3-53L 10" 3-WAY SYSTEM
53 litre 'mid sized' cabinet, 10" bass driver. 3 speakers
$224.00pr

3-26L 8" 3-WAY SYSTEM
Smaller 26 litre enclosure suits flats, etc. Ideal for budget systems, too.
$149.50 pr

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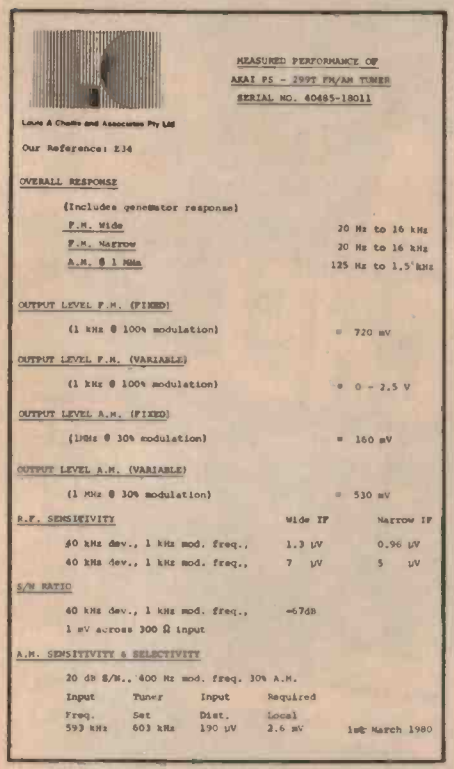


MEASURED PERFORMANCE OF
AKAI PS - 299T FM/AM TUNER
SERIAL NO. 40485-18011

Louis A Challis and Associates Pty Ltd

Our Reference: Z34

OVERALL RESPONSE

(Includes generator response)

F.M. Wide	20 Hz to 16 kHz
F.M. Narrow	20 Hz to 16 kHz
A.M. @ 1 MHz	125 Hz to 1.5 kHz

OUTPUT LEVEL F.M. (FIXED)

(1 kHz @ 100% modulation) = 720 mV

OUTPUT LEVEL F.M. (VARIABLE)

(1 kHz @ 100% modulation) = 0 - 2.5 V

OUTPUT LEVEL A.M. (FIXED)

(1MHz @ 30% modulation) = 160 mV

OUTPUT LEVEL A.M. (VARIABLE)

(1 kHz @ 30% modulation) = 530 mV

R.F. SENSITIVITY	Wide IF	Narrow IF
40 kHz dev., 1 kHz mod. freq.,	1.3 µV	0.96 µV
40 kHz dev., 1 kHz mod. freq.,	7 µV	5 µV

S/N RATIO

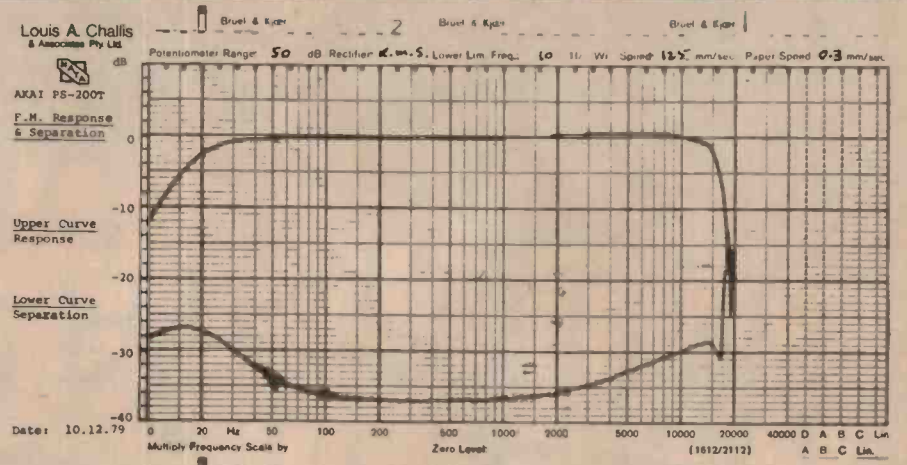
40 kHz dev., 1 kHz mod. freq., -67dB
1 mV across 300 Ω input

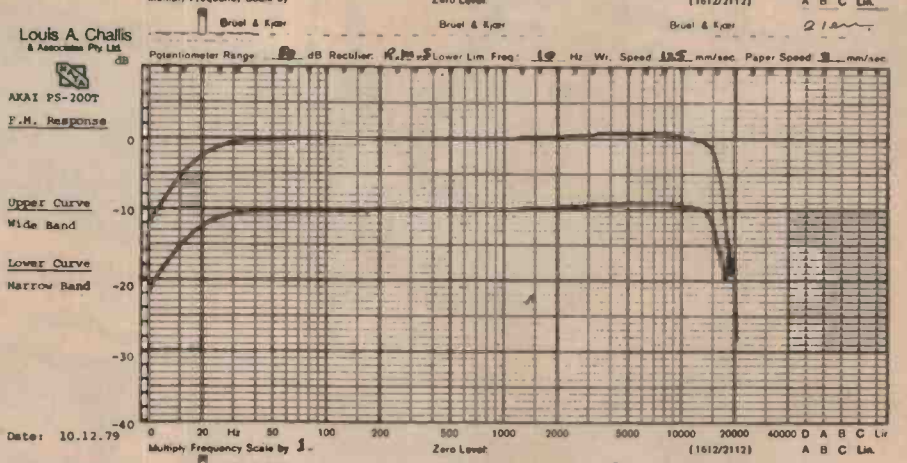
A.M. SENSITIVITY & SELECTIVITY

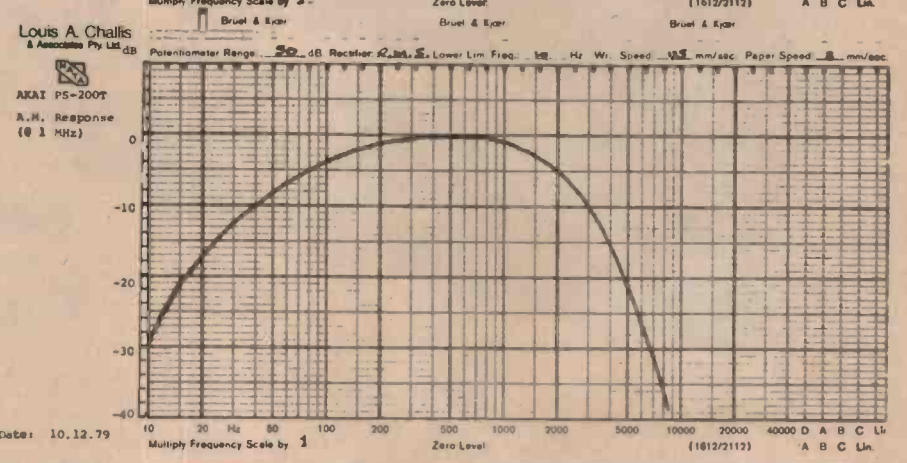
20 dB S/N., 400 Hz mod. freq. 30% A.M.

Input Freq.	Tuner Set	Input Dist.	Required Local
593 kHz	603 kHz	190 µV	2.6 mV

1st March 1980







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 preset 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. ●

THE AKAI PS-200T FM/AM DIGITAL QUARTZ SYNTHESIZER TUNER

Dimensions: 440mm wide x 90mm high x 443mm deep

Weight: 7.8 kg. *Price: $889 rrp.*

Manufactured by: AKAI Electric Co., Tokyo, Japan

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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.

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Hobart: 34 7077	Adelaide: 223 2891	Perth: 325 6222	

* 11th year will be required for 1982 entry for Certificate of Technology Scheme.

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Mr: _____

Address: _____

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State: _____ Postcode: _____

Date of Birth: __/__/__

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KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have 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
651 Forest Rd
Bexley NSW

Radio Despatch Service
869 George St
Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four 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, Cnr 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 K39, Haymarket, NSW 2000.

K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109.

L Ellistronics, 289 Latrobe 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, Auckland, New Zealand.

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, 993 Hay Street, Perth, WA 6000.

Y Trilogy, 40 Princes Highway, Fairy Meadow, NSW 2519.

Project Electronics

041 Continuity Tester ... W,R,D,B,Y,L
042 Soil Moisture Indicator ... R,B
043 Heads or Tails Circuit (Oct 76) ... W,R,D,E,A,F,B,Y,L
044 Two Tone Door Bell (Oct 76) ... W,R,D,E,O,A,F,B,Y,L
045 500 Second Timer ... W,D,E,A,B,Y,L
047 Morse Practice Set ... W,D,O,A,B,Y,L
048 Buzz Board ... W,D,A,B,Y,L
061 Simple Amplifier (Oct 76) ... W,R,D,E,A,B,Y,L
062 Simple AM Tuner (Mar 77) ... W,D,E,B,Y
063 Electronic Bongos ... R,D,A,B,Y,L
064 Simple Intercom (Nov 76) ... W,A,
065 Electronic Siren ... W,R,D,E,O,A,B,Y,L
066 Temperature Alarm (Dec 76) ... W,D,E,A,B,Y,L
067 Singing Moisture Meter ... D,B,Y
068 LED Dice Circuit (Oct 76) ... W,R,D,E,A,B,L
070 Electronic Tie Breaker (Jan 77)
071 Tape Noise Limiter (Jun 78) ... R,E,F
072 Two-Octave Organ (Jun 78) ... W,D,B,Y
081 Tachometer (Mar 77) ... W,E,O
082/528 Intruder Alarm ... W,R,E,A
083 Train Controller ... W,R,E,L
084 Car Alarm ... W,R,D,E,A,B,Y,L
085 Over-rev Alarm ... W
086 FM Antenna ... W
087 Over-LED ... W,E
088 Hi-Fi Speaker ... W

Test Equipment

132 Experimenter's Power Supply (Feb 77) ... E,O
133 Phase Meter (Apr 77) ... E
134 True RMS Voltmeter (Aug77) ... E
135 Digital Panel Meter (Oct 77) ... E
136 Linear Scale Capacitance Meter (Mar 78)
137 Audio Oscillator (May 78) ... W,D,E
138 Audio Wattmeter (Nov 78) ... E,B
139 SWR/Power Meter (May 78)
140 1GHz Frequency Meter-timer (Mar 78)
141 Logic Trigger (Jan 79) ... E
142 High Current Power Supply (Feb 79) ... W,E
143 Curve Tracer (Jan 79) ... W
144 Expanded-scale RMS Voltmeter (Jun 79) ... E
148 Versatile Logic Test Probe (Jul 79) ... E,L

Simple Projects

243 Bip Beacon (Apr 77)
244 Alarm Alarm (Feb 77) ... F
245 White Line Follower (Nov 77) ... F
246 Rain Alarm (Apr 78) ... F
248 Simple 12V to 22V Converter (Jul 78) ... W
249 Electronic Combination Lock (Apr 79) ... E
252 The Passionmeter (Aug 79)
253 Electronic Grenade (Hot Potato) (May 79)
254 Egg Timer (Jun 79) ... W

Motorists' Projects

316 Transistor Assisted Ignition (May 77) ... W,E,O,K
317 Rev. Monitor Counter (Jul 77) ... E
318 Digital Car Tacho (Jul 78) ... W,E,K
319 Variwiper MK II (Sep 78) ... W,E,O
320 Battery Condition Indicator (Apr 79) ... E,L

Audio Projects

448 Disco Mixer (Nov 76) ... W
449 Balanced Microphone Amp (Nov 76) ... W,D,E,J,F,Y
450 Bucket Brigade Audio Delay Line (Dec 77) ... W,E
451 Hum Filter (Jul 79) ... D,E,F
455 Class A Headphone Amp (Nov 78)
470 60 W Amp Module (May 79) ... W,R,E,F,B,P,L,A,V
471 High Performance Stereo Preamp Control Unit (Jun 79) ... W,R,E,F,B,P,A,V,L
472 Power Supply — the Series 4000 Stereo Amp (Jul 79) ... W,R,E,F,B,A,V,L
473 Series 4000 Moving-coil Cartridge Preamplifier ... F,J
480 50-100 Watt Amp Modules (Dec 76) ... W,R,D,E,J,O,A,Y,L
481 12V 100 Watt Audio Amp (May 77) ... R,E
481 High Power PA/Guitar Amp (Jun 77) ... W
482 Stereo Amp (Jan 77) ... O,E
482 Stereo Amp Part 2 (Feb 77) ... O,E
483 Sound Level Meter (Feb 78) ... E
484 Simple Compressor Expander (Jul 77) ... E,A
485 Graphic Equaliser (Jun 77) ... W,E,J,O
486 Howl-round Stabiliser (Nov 77) ... J
487 Audio Spectrum Analyser (Feb 78) ... E
489 Audio Spectrum Analyser 2 (Apr 78) ... E,J
490 Audio Compressor (Dec 78)
491 Simple Graphic Equaliser (Mar 79) ... W,E
495 Transmission Line Speakers (Aug 77)

Miscellaneous

546 GSR Monitor (Mar 77) ... W,E
547 Telephone Bell Extender (Jun 77) ... E
548 Photographic Strobe (May 77) ... W,E
549 Induction Balance Metal Detector (May 77) ... W,D,E,L
550 Digital Dial (Aug 78) ... E,O
551 Light Chaser (Sep 78) ... W,E,O
552 LED Pendant (Sep 78) ... A
553 Tape/Slide Synchroniser (Oct 78) ... E
556 Wind Speed/Direction Indicator (Dec 78)
557 Reaction Timer (Feb 79) ... E
558 Mast-head Strobe (Feb 79) ... E
559 Cable Tester (Mar 79)
575 Portable Fluorescent Light Wand for Car, Camping (Aug 79) ... W
577 General Purpose Power Supply ... J
581 Dual Power Supply (Jan 77) ... W,E,Y
582 House Alarm (Jul 77) ... W,E,O,A,
House Alarm — Installation Instructions (Aug 77) ... W
583 Marine Gas Alarm (Aug 77) ... D,E,M
585 Ultrasonic Switch (Sep 77) ... R,D,E,O,F
586 Shutter Speed Timer (Oct 77) ... E
587 UFO Detector (May 78)
588 Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78) ... N
589 Digital Temperature Meter (PCB135) (Dec 77) ... E
590 LCD Stopwatch (Oct 78) ... O,N
591 Up/Down Presettable Counter (Jul 78) ... D,E
592 Light Show Controller (Aug 78) ... E
593 Colour Sequencer (Dec 78)
594 Development Timer (Apr 79) ... E
595 Aquarium Lamp Controller (May 79)

Electronic Music

602 Mini Organ (Aug 76) ... W,D,E,A
603 Sequencer (Aug 77) ... W
604 Accentuated Beat Metronome (Sep 77) ... E
605 Temp Stabilized Log-exponential Converter (Sep 78)

Computer Projects

630 Hex Display (Dec 76) ... E,A
631 ASCII Keyboard (Dec 76) ... W,E,O,A
631 Keyboard Encoder (Apr 77) ... W,E,O,A
632 Video Display Unit (Jan 77) ... E,O,A
633 TV Sync Generator (Jan 77) ... E,A
634 8080 Educational/Prototyping Interface (Jul, Aug 78)
635 Microcomputer Power Supply (Sep 77) ... O
637 Cuts Cassette Interface (Jun 78) ... V,E,A
638 Eprom Programmer (Jul 78) ... W,E,A
639 Computerised Musical Doorbell (Mar 78) ... A
640 S100 VDU (Apr, May, Jun 78) ... W,O,A,V
641 S100 Printer (Sep 78) ... O
642 16k S100 RAM Card (Feb 79) ... K
650 STAC Timer (Nov 78) ... E,A,L
651 Binary to Hex Number Converter (Jun 79) ... E

Radio Projects

712 CB Power Supply (Jun 77) ... W,E
713 Add-on FM Tuner (Sep 77)
714 VHF-Log-Periodic Antenna (Feb, Mar 78)
715 VHF Power Amplifiers (Nov 77)
716 VHF Power Amplifiers (Jan, Feb 78)
717 Crosshatch Generator (May 78) ... W,D,E,A,Y
718 SW Radio (Oct 78) ... E
719 RF Field Strength Indicator (Nov 78)
720 2m VMOS Power Amp (Jan 79)
721 Aircraft Band Converter (Mar 79) ... W,E
722 Antenna for Aircraft Band Converter (May 79)
724 Microwave Oven Leak Detector (Jul 79) ... D,E,B
725 Simple SSB Generator employs Polyphase Network using Standard Components (Aug 79) ... E,L
730 Get Going on Radioteletype (Aug 79) ... E,L

Electronic Games

804 Selectagame (Nov 76) ... O
804 Selectagame (Rifle Project) (Mar 77) ... O
805 Puzzle of the Drunken Sailor (Oct 77)
806 Skeet (Jan 78) ... O
810 Stunt Cycle TV Game (Jun 78) ... D,O
811 TV Tank Game (Oct 78) ... O
812 Wheel of Fortune (Dec 78)
813 Race Track Game (Jan 79) ... O
814 The 'Dinky-Die' (Aug 79)

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Electronics Today International is published by Modern Magazines (Holdings) Ltd, 15 Boundary St, Rushcutters Bay, NSW 2011. It is printed (in 1980) by Wilke & Co, Browns Rd, Clayton, Victoria and distributed by Gordon and Gotch. Recommended retail price only.

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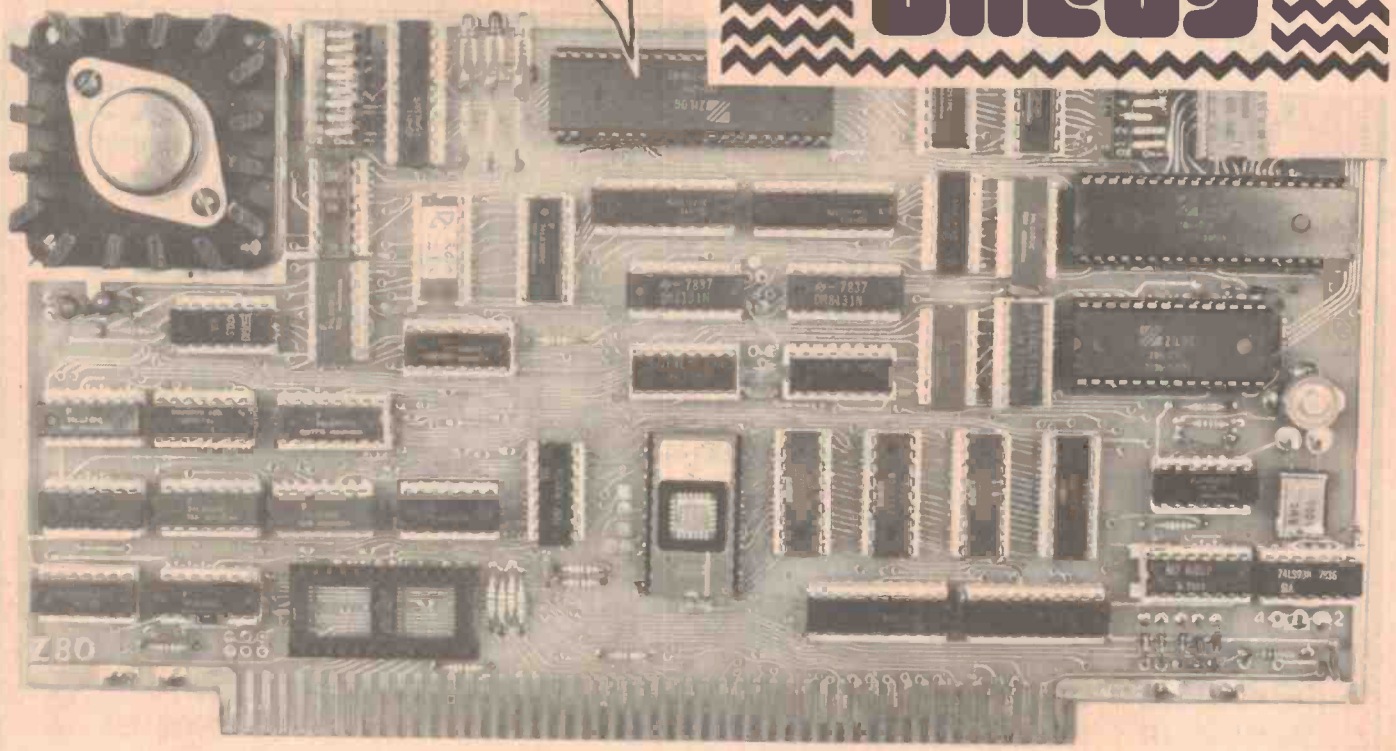
I was a 4K weakling till I took Dr Digital's 64K dynamic RAM course !

DREGS



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).

Einstien, 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 Viewdata) 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.

REAL HI-FI

AND IT'S ALL IN OUR COLOUR CATALOGUE

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.

If you think they look different, wait till you've heard them!

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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!

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WT1323/ETI/79

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Post Office Box 307,
North Ryde,
N.S.W. 2113

JVC

the right choice

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.

Technics

*Dolby is the trademark of Dolby Laboratories Inc.

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