SPECIAL SUPPLEMENT - ULTRA HI-FI DESIGN

electronics today

SEPTEMBER 1978 INTERNATIONAL

$1·25*
NZ $1.50

Windscreen Wiper Delay Unit

Space Shuttle Communications

Light Chaser Project

LED Pendant

The competition don't like the sound of this at all.

For quite some time, other manufacturers have been trying to produce tape with the qualities of the Maxell UD-XL. At the same time, Maxell have been quietly perfecting an even better series.

The UD-XL I and UD-XL II tapes are designed to attain maximum performance at the ferric and chrome position on your tape deck. Whichever tape position you choose, Maxell can give you a better performance.

UD-XL I TAPE, FOR FERRIC (norm.) POSITION (120us)

UD-XL I offers an excellent sensitivity of 1 dB higher than even UD-XL. MOL performance is also 1 dB higher over the entire audio frequency spectrum. The result is a new standard in ferric tape, with wider dynamic range and less distortion than ever before.

How does the UD-XL I compare then, with ordinary low-noise tapes?

Sensitivity is higher by 2.5 dB, and MOL performance by as much as 6 dB.

Yet, for all this UD-XL I requires no special bias or equalization. Simply set your tape selector as you normally would at the ferric position – but there the comparison ends.

UD-XL II TAPE, FOR THE CHROME POSITION (70us)

UD-XL II tape is such a dramatic improvement on most other tape that can be used in this position, that comparison is really unfair.

For example, if you're familiar with conventional chromium-dioxide tape, you'll know of the associated problems of poor output uniformity – plus low maximum output level and rather high distortion.

UD-XL II tape offers you excellent MOL, sensitivity, and an output improvement of more than 2 dB over the entire frequency range.

Maxell's unique 'Epitaxial' process gives you absolute sensitivity and stability, and no drop-out problems. What's more, the shells are moulded in diamond cut dies, and made to tolerances 5 times greater than the Philips standard. And, like all Maxell tapes, UD-XL II has the 5-second cleaning leader.

In short, if you're recording in the chrome position, you can now achieve all the advantages – with none of the drawbacks.

A prospect we think you'll find very exciting – even if the competition don't.

maxell
simply excellent

For details on all Maxell Recording Tape write to Maxell Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033

WT3/79

AUSTRALIAN OWNED AND PRODUCED

September 1978, Vol. 8 No. 9

electronics today INTERNATIONAL

Editorial: Les Bell

Publisher: Collyn Rivers

PROJECTS

Cover: Electronic jewellery offers you the ideal opportunity to display your talents — see our LED Pendant project on page 33.

FEATURES

NEWS & INFORMATION

A Modern Magazines Publication
* Recommended retail price only.

Registered for posting as a publication — Category B

News Digest

Wind Turbine Test

The 200 kW experimental wind turbine generator at Clayton, New Mexico, has been inspected after its first six months of operation. Although the inspection revealed that most components are wearing normally, 3 small cracks and many loose rivets have been found in the blades. The NASA Lewis Research Centre, which manages the large wind turbine portion of the DOE, will conduct an inspection and analysis to determine the blades' wear and life potential.

Speak and Spell

Texas Instruments' new speech synthesizer has found a new application in teaching children commonly misspelt words. The unit asks a user to spell a word and after buttons are pressed in response, will tell the user whether or not the correct answer has been indicated.

New Oscilloscope Camera

A new, low price oscilloscope camera, the Model 7000, is now available from BWD Electronics Pty. Ltd.

The Model 7000 has been completely updated. It incorporates an improved shutter and lens, with eight speeds ranging from 1 second to 1/125 second, and aperture control from f3.5 down to f32. As well as hand-held operation, the new 7000 can be used for permanent mounting with the range of precision oscilloscope adaptors. According to BWD, this is the first time that a low priced camera has been available with a choice of mounting systems.

The new camera weighs less than 680gms and is highly portable. It produces fully developed 83 mm x

108 mm (3¼" x 4¼") quality prints with virtually no picture distortion in just 30 seconds, so it is quick and simple to check that all relevant data has been recorded. It needs no focussing, and the exposures can be accurately controlled to take account of the brightness of the display and type of CRT phosphor used. Once the initial settings have been determined, changes are seldom necessary.

For further information please contact *BWD Electronics Pty. Ltd., Miles Street, Mulgrave, Victoria, 3170* or *P.O. Box 325, Springvale, Victoria, 3171.*

BWD540 – New Data Sheet

A new comprehensive data sheet is available from BWD Electronics Pty. Ltd., which fully describes their DC-100MHz dual trace oscilloscope, the Model BWD 540.

The data sheet provides full details of the specification for the oscilloscope and illustrates details of the Line Selector Module, BWD 701, which can be fitted in conjunction with a battery pack, BWD BP3 making the whole unit a completely portable data base suitable for communications, video and computor applications.

The BWD 540 oscilloscope is claimed to combine laboratory accuracy and versatility with true field portability and is well suited to all forms of logic circuitry from DTL to ECL.

Further details from: *BWD Electronics Pty. Ltd, Miles Street, Mulgrave, Vic 3170.*

Cheap Holograms

Somewhere we've heard a rumour that the CSIRO National Measurement Lab has succeeded in producing full-colour, 3-D holograms using ordinary light bulbs. This technique eliminates the need for lasers, reducing the cost and reducing the associated safety requirements. We don't normally pass on rumours, but this one really had us baffled. Would anyone at CSIRO like to either confirm or deny it?

Melbourne Parts Supplier

A new electronics store has opened in the North Melbourne suburb of Coburg, supplying a range of components, kits and hardware. Centrally located in the Coburg shopping centre, you can find Tasman Electronics at *12 Victoria St., Coburg, VIC.*

Holographic Memories

Research by the Plessey research labs at Towcester in England points to 'photonics' as the successor to electronics as a data storage and retrieval medium. Chemical behaviour known as photochromism offers the prospect of a dense holographic memory which can be read, written and erased like magnetic tape. Plessey hope to have a prototype by mid-1979.

Price of Progress

Sad tale of the month – seeking a way to make fuel to run his tractors, L. Crombie of Webster Minnesota designed a solar fuel-alcohol still made of plywood and thin plastic sheet. Trying to apply for a licence for his still, Crombie received a huge packet of materials which required that he be bonded, have an environmental study made, and once approved, would have tax and Treasury agents eyeing him up – the whole process taking about 2 years. Crombie went ahead and built his still, but then made the mistake of saying too much to the local sheriff's deputies.

No charges have been laid against Crombie yet.

Power Transistor

General Electric has developed a Darlington transistor capable of switching 400V and 350A in 1 μs with an external drive of only 0.1 A. Key to the new device is a new copper package/heatsink design.

New Catalogue

Electronic (Distributors), suppliers of electronic components and equipment, have just issued their 1978 Catalogue and Product Selection Guide. The catalogue lists a comprehensive range of products suitable for government and industry as well as providing quite a lot of product information to assist in the selection of the right component for specific applications.

Copies of the catalogue will be mailed free of charge by writing on a company or departmental letterhead to *Electronic (Distributors), PO Box 33, Pendle Hill. NSW, 2145.*

Low Distortion Function Generator

The New B & K Precision Model 3010 Function Generator is claimed to offer convenient use and excellent waveform accuracy at a moderate price. Frequency coverage spans 0.1Hz to 1 MHz in six ranges, with each range providing linear 100:1 frequency control.

Push-button range and function selection provides fast, error-free operation. The stable voltage-controlled oscillator (VCO) of the 3010 is varied on each range by the front panel frequency control, or the VCO external input. A 0 to 5.5V ramp applied to the VCO external input will provide a 100:1 output frequency change. By applying such an input ramp, the 3010 can be used as a sweep generator for response measurements in audio and I-F circuits. When an audio signal is applied in place of a ramp, the 3010 will produce a direct FM output.

The 3010 features a variable DC offset control which provides up to ±5VDC (into 600 ohm) combined with the selected audio output frequency. Engineering applications for this feature include evaluation of the effects of : DC bias on an AC circuit, an audio transformer approaching saturation and shifted operating points of a DC coupled amplifier. The DC offset function can even be used to simulate a DC power supply for the evaluation of power supply filter networks. When used in this manner, the 3010 output can be tuned to simulate the line frequency input of the "model" power supply.

For square-wave operation, the 3010 offers a fixed TTL output level and a variable amplitude output. Variable output square wave rise or fall time is 100 nanoseconds or less; TTL square wave rise/fall time is 25 nanoseconds or less. Square-wave symmetry at 100 kHz is a near-perfect 99%. In addition to response tests, the square-wave outputs are ideal for clock-pulse substitution in digital circuits.

The triangle-wave function is always useful when linearity tests are required. Small amounts of distortion indicated by non-linear changes in a waveform are easier to detect on a triangle wave than on other common waveforms. For that reason, triangle-wave linearity is a highly important specification. Again, the 3010 generates a near-perfect output by providing 99% triangle-wave linearity at 100 kHz.

As a sine-wave generator, the 3010 is conservatively rated at less than 1% distortion from 0.1 Hz to 100 kHz; less than 0.5% is typical. Above 100 kHz, harmonics are supressed by over 30 dB at maximum output amplitude.

For further information contact Bruce McCarthy, *Parameters Pty. Ltd., 68 Alexander St., Crows Nest NSW 2065.*

Solar Panels

Soanar Electronics Pty. Ltd, is now a distributor for the Philips type BPX 47A Silicon Solar Panel. The panel consists of an array of interconnected solar cells that convert solar energy directly into usable electric power. Full sunlight is not essential for operation, as the solar cells continue to supply energy even under overcast conditions.

In optimum conditions a single solar panel will deliver 11 watts of power at 15.5 volts. Several panels can be connected together in series or parallel to provide the output required for a specific purpose.

Construction of the panel consists of 34 series-connected solar cells of 57 mm diameter moulded in transparent resin and sandwiched between two clear glass plates. An edge seal of silicon rubber framed with aluminium edging completes the assembly and prevents the ingress of dirt and moisture. Overall dimensions of the panel are 468 x 365 x 15 mm and the unit weighs a mere 2.4 kg.

The Solar panel is suitable for use under severe environmental conditions and conforms to the requirements of relevant IEC tests with respect to elevated and freezing temperatures, humidity, wind pressure, salt spray and blown sand. Thus it is ideally suited to charging batteries in boats, caravans and holiday homes or for power equipment in remote or isolated areas.

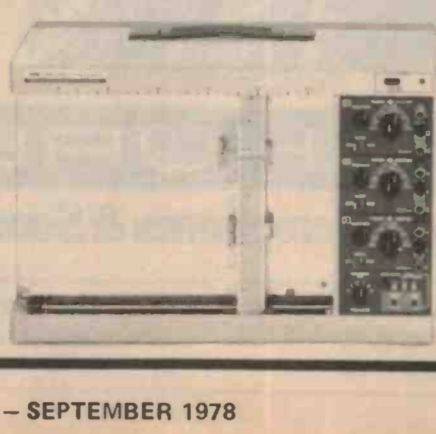
Soanar Electronics will be maintaining stocks of the BPX 47A Solar Panel at their branch and agents' stores in all states. Full technical specifications are available from *Soanar Electronics Pty. Ltd., 30 Lexton Road, BOX HILL, VIC. 3128.*

Two New X-Y Recorders

Parameters has announced the release to two new YEW X-Y Recorders Models 3036 and 3086. Both are designed for A4 size paper and the writing areas are 250 mm x 180 mm and 250 mm x 250 mm respectively.

Accuracy is maintained at ±0.25% and the sensitivity is 5uV/cm. Optional input ranges include 19 ranges from 5uV/cm to 5V/cm or for 13 ranges from 0.5mV/cm to 5V/cm. Both units are suitable for bench-top or rack-mounting and are supplied with disposable felt-tip pen cartridges for high quality traces. Electrostatic paper holddown and "light spot" paper alignment is incorporated.

Built-in time base is standard with 3036 and optional on model 3086. For further information contact Bruce McCarthy, *Parameters Pty. Ltd., 68 Alexander St., Crows Nest, NSW 2065.*



fact: Shure's up front with Maynard Ferguson... and backstage too!

The Performance

Maynard settles for nothing short of the finest . . . in his music, in his arrangements, in his creativity, in his road engagements, in his band. And in his microphones and sound system. That's why he insists on a Shure SM58 microphone. That's why engineer Tony Romano puts the sound together on Shure SR consoles.

The Sound

Maynard builds it from feelings, ideas, crescendos, rhythms, harmonics, and layers of raw sound.

Shure's professional SR sound equipment performs superbly even in Maynard's most demanding sets. It projects his trumpets to everyone—whatever the size or shape of the hundreds of clubs and halls he works. Take it from Maynard . . . Shure performs. That's the up-front information. And the backstage story, too! Shure . . . the Sound of the Professionals.

SHURE®

Professional Microphones & Sound Systems

AUDIO ENGINEERS P/L	**AUDIO ENGINEERS (Vic.)**	**AUDIO ENGINEERS (Qld.)**	**ATHOL M. HILL P/L**
342 Kent Street.	2A Hill Street.	51A Castlemaine Street.	33 Wittenoom Street.
SYDNEY 2000 N.S.W.	THORNBURY 3071 Vic.	MILTON 4064 Qld.	EAST PERTH 6000 W.A.

AE131/FP

Electronic Yoghourt

Yes, electronic yoghourt! The latest home yoghourt maker released by Rolmex Electro Inc. of Quebec, Canada, uses an electronic temperature controller instead of a conventional thermostat, to hold temperature constant to within 0.5 degrees. Because of this, it is claimed the Yogourmet completes incubation of yoghourt in 4 hours, 2 or 3 times faster than most conventional home yoghourt makers.

Latest From Polaroid

Not content with making extraordinarily simple-to-use cameras with instant results, Polaroid are now going one further by offering an auto-focassing camera. The SX-70 Sonar One Step uses a very sophisticated sonar technique, bouncing sound waves off the subject to obtain correct focus in all light levels, yet will retail for around $20 more than the standard SX70 model. The same feature will also be added to the Pronto range.

Humidity Meter

An electronic version of the wet and dry bulb psychrometer has been designed by J. de Yong of the CSIRO Div. of Chemical Technology. The instrument has two temperature sensors, one dry and the other covered with a wet sleeve, and will measure atmospheric humidity to better than 0.5%.

Dickie's Anniversary Sale

Next month, October, marks the 10th anniversary of the creation of the Dick Smith empire (or kingdom, as it was then). Accordingly, and being the nice chap he is, Dick is holding a 10th anniversary sale, with a mini-catalogue in every copy of next month's ETI. So don't miss the October ETI or you'll miss out on some bargains!

Asean Trade Fair

A number of electronic manufacturers will be among the exhibitors at the first Asean Trade Fair which is being held in Sydney at the MLC Centre from October 23 – 28. The Fair, which will involve all five Asean nations – Indonesia, Malaysia, the Philippines, Singapore and Thailand – will include displays of FM two way, long range HF/SSB and clock radios, electronic and mechanical toys, cassette recorders, burglar alarms and colour TV sets.

Television and radio components from the Tanin Industrial Company in Thailand are also scheduled for display.

The fair is for trade visitors only, although part of two days – Thursday afternonn and evening and Saturday, the last day of the exhibition – will be open to the general public. Invitations and catalogues have been sent to the trade but more are available on request. Simply ring 20622 and ask for Dick Fletcher, Asean Trade Fair, at the Department of Trade and Resources, or call into their offices at 181 Castlereagh Street.

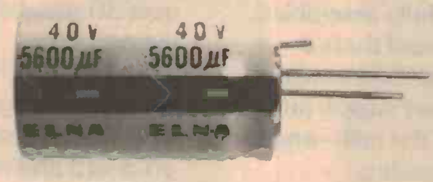
PCB – Mounting Electrolytic

A new style of electrolytic capacitor that allows large capacitance values to be mounted directly onto a printed circuit board has just been introduced by Soanar Electronics Pty. Ltd.

Designated, 'Type RP' this capacitor is generally similar to the conventional can electrolytic except that the terminations consist of a three-wire configuration instead of the usual solder pins and securing lugs. Two of the wires provide the usual electrical connections of the capacitor while the third wire acts as an anchor to provide stability to the PCB mounting.

Soanar Electronics are stocking an initial range of values, at their head office, interstate branches and agents stores, comprising 2500uF in 35V, 63V and 80V DC WkG, and 5600uF in 40V DC WKG. This initial range will shortly be expanded to meet the total requirements of the local market.

Furhter details and technical specifications are available on application to *Soanar Electronics Pty. Ltd., 30 Lexton Road, BOX HILL, VIC. 3128.*



New Bankstown Store

Radcom Pty Ltd, who for the past 4½ years have specialised in the supply of military communications equipment, are opening a new component supply store at *105-109 Eldridge Rd, Bankstown.* As well as a wide range of components, including the Silicon Valley range of semiconductors, the store will sell kits, test gear and instruments.

CB for UK?

A working party of the UK National Electronic Council has concluded that "A high quality form of citizens' band radio service should be introduced in the United Kingdom". The report, which was published in the May-June issue of National Electronics Review, recommends the use of either SSB or FM somewhere between 100 and 500 MHz. Curiously, the report recommends also that each sideband transceiver would have to be phase locked to the 200 kHz standard frequency transmission from Droitwich – a requirement which, to our minds, would be almost impossible on both technical and economic grounds, as the 200 kHz transmissions cannot be received satisfactorily in some parts of the country.

The report, by such a prestigious body as the NEC, allied with the mobile radio manufacturers' keen interest in CB (c.f. Philips in Australia) surely must mean that the Home Office cannot be so certain in their opposition to CB.

Teletext System Rivalry

The UK Post Office has not completely swept the field with its Teletext system, and in fact, there is now some fairly heavy political maneouvering going on in the electronic conference chambers of Europe. The problem is the French, who with characteristic Gallic tenacity, have set about developing their own Teletext/Viewdata system, called Antiope. This is not compatible with the UK Teletext system, but has the advantage of being able to handle the seven alphabet sets required for all European languages.

Rumours are rife that Antiope will be the Teletext system used at the Moscow Olympics in 1980, and this would be a major propaganda coup for the system.

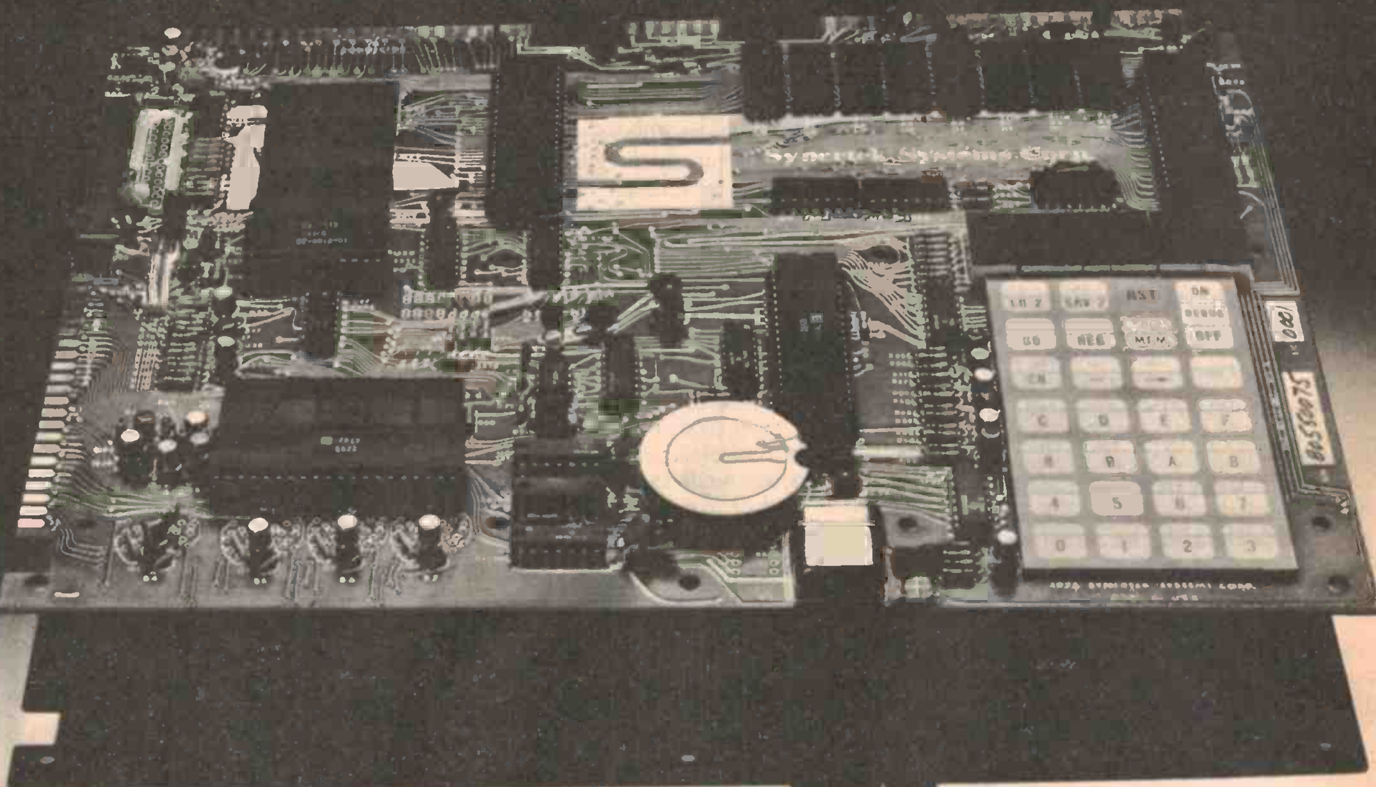
Fortunately for the UK interests, Antiope is not yet available to the French public, whereas Viewdata and Teletext equipment has been sold to West Germany, the Netherlands and Australia; although the French are trying hard to show the Germans the disadvantages of Teletext, which cannot display accents such as umlauts without modification.

Incidentally, the Viewdata service provided by the UK Post Office is now officially known as Prestel.

Computer Courses

To coincide with the recently introduced range of Central Data 2650 microcomputer systems and kits, Rod Irving Electronics have announced that they will be running microprocessor courses in September. The courses will be oriented toward the hobbyist, ranging from basic understanding of microprocessors to a general understanding of systems, followed by using and programming the Central Data 2650 system. Course Details may be obtained from Rod Irving Electronics on (03) 489 8131.

Finally.
A dependable microcomputer board.



In performance. In quality. In availability. OEMs, educators, engineers, hobbyists, students, industrial users: Here's our Versatile Interface Module, a fully-assembled, tested and warranted microcomputer board that's a true single-board computer, complete with keyboard and display. All you do is provide a +5V power supply and the Versatile Interface Module gives you the rest—and that includes fast delivery and superior quality.

Key features include:

- Hardware compatibility with KIM-1 (MOS Technology) products.
- Standard interfaces include audio cassette with remote control; both 8 bytes/second (KIM) and 185 bytes/second (Versatile Interface Module) cassette formats; TTY and RS232; system expansion bus; TV/KB expansion board interface; four I/O buffers; and an oscilloscope single-line display.
- 28 double-function keypad with audio response.
- 4K byte ROM resident SUPERMON monitor including over 30 standard monitor functions and user expandable.
- Three ROM/EPROM expansion sockets for up to 24K bytes total program size.
- IK bytes 2114 static RAM, expandable to 4K bytes on-board and more off-board.
- 50 I/O lines expandable to 70.
- Single +5V power requirements.
- Priced attractively in single unit quantities with OEM discounts available for larger quantities.

Synertek Systems Corporation.

To place your order now, contact:

AMPEC ENGINEERING CO. Pty. Ltd.

1 Wellington Street, Rozelle, NSW. 2039. Tel (02) 818-1166.

• Brisbane (07) 391-5136 • Melbourne (03) 569-6984 • Adelaide (08) 212-3111 • Perth (09) 328-3116

Also contact us for your requirements regarding:

- Microprocessor CPU's; 6502 available up to 3 MHz.
- 4K Static Rams (1Kx4); 2114 450ns.
- 8K Static Rams (1Kx8); 8108 available Jan. 1979.
- Peripheral Interface Adaptor; 6520 available up to 2 MHz.
- Asynchronous Communications Interface Adapter; 6551 available Nov. 1978.
- Mini Floppy Disc Drives; **MICROPOLIS:** S100 and SBC80 bus compatable. 1, 2 and 4 disc systems available.

News Digest

Batteries Standard

The Standards Association of Australia has published a revised standard on Primary batteries, to supersede AS C387-1967, Dry primary cells and batteries. In this revision, only those batteries which are in common use in Australia and which are appropriate for inclusion in new designs, have been included. A battery designation system, based on the International Electrotechnical Commission system, has been specified and with the increasing use of this system, it is expected that consumers will soon see a reduction in the proliferation of different type numbers – all identifying the same battery. A further requirement in the standard is that, batteries are marked with a 'use by' date.

Design and construction requirements and performance criteria have been given in the revised standard. The tests specified are all intended to simulate, as closely as possible, several applications for which batteries are commonly used and include lighting, transistor radios, toys, calculators and watches. Copies of AS 2176 ($7.60) may be obtained from the offices of the Association in the state capitals and Newcastle. Postage and handling 80 cents extra.

Electronics Trade Fair Tour

In conjuction with Astrid International Tours of Sydney, Mr. Steve Colman is organising a trip to visit 3 important Electronics Shows in Japan, Korea and Taiwan.

During the tour Tour members will be able to visit, if they wish, the following exhibitions and trade fairs:

- Japan Electronics Show
- Japan Measuring Instruments Exhibition
- Japan Analytical Instruments Show
- JETRO Exhibition at Tokyo Trade Centre
- Korea Electronics Show
- Korean Autumn Fair 1978
- KOTRA Permanent Exhibition
- Taiwan Electronics Trade Fair
- Taiwan Toys and Gifts Show
- CETDC Exhibition in Taipei

Mr. Colman emphasised that while members will have the assistance of the various Government Export Councils and will have the opportunity to enjoy their help and in some cases hospitality, it will be an organised Tour only as far as travel and accomodation is concerned. It will be up to the individual member to decide which exhibition he wishes to visit and ample time will be available for independent negotiations, visits to manufacturers factories, etc.

The cost saving is quite considerable over individual travel costs. Not including meals the tour will cost $1420 or $1590 if single room is required, subject to more than 15 acceptances.

For further particulars contact Steve Colman (02) 498-1622 who will be escorting the Group.

Schools Computer Fayre

The Computer Science Department at La Trobe University is organizing Victoria's (and in fact Australia's) first "Schools Computer Fayre". Pupils at all Victorian schools are invited to participate by submitting any work they have done which is related to computers. The Fayre will be held in October, on the La Trobe Campus.

The Fayre was conceived by Dr. Harvey Cohen as providing an opportunity for the display of computer projects, and to arouse interest in computing in Victorian schools. There will be prizes in a range of categories: these prizes have been donated by various firms concerned with computers, micro computers, and electronics.

Students are offered the following suggestions as to the sort of entries expected:

Hardware	– a microprocessor-based control system
	– a general-purpose micro-computer system
	– a digital logic circuitry
Software	– commercial program
	– scientific program
	– game-playing programs
	– an original application
Other	– animated flow diagram
	– essay
	– carton
	– model built of computer scrap, etc. etc. etc.

Prizes will be given for the best entries; details will be announced later, but there will be at least one prize in each of the levels Form 1 and 2, Forms 3 and 4, and Forms 5 and 6. Some certification will be required that the entry is the work of the person or group submitting it; an entry fee of $1 per entry will be charged.

The Fayre will be held at the end of October at La Trobe University, and all are invited to visit it, whether or not they have submitted entries.

For further information, write to *Computer Fayre, Computer Science Department, La Trobe University, Bundoora, VIC. 3083.*

Propagation Predictions

Once again, our propagation predictions seem to be ill-fated – this month, restrictions on computing time meant that the predictions could not be got to us on time, so they have had to be omitted for this month. Our apologies, and please bear with us – normal propagation will, hopefully, be resumed next month.

Radiation Supported Mirror

Oregon University Institute of Theoretical Science are proposing a mirror to reflect VHF and UHF transmissions, which would be held aloft at an altitude of 100 km by the radiation pressure of the 10 MW erp signal it was reflecting.

ETI/Unitrex Calculator Contest

The July contest obviously stumped almost all of you, as there were only a very few correct entries. The contest, you may remember, was to use the digit 4, four times in an equation, and to do this six times over to make the equations equal all the digits from integers from 70 to 75 inclusive. John Nicholson, of Salisbury, NT, got the right answers (though several are possible): his answers are:

$70 = 44 + 4! + \sqrt{4}$

$71 = \text{Antilog}\sqrt{4} - (\text{Antilog}\sqrt{4}/4) - 4$

$72 = 44 + 4! + 4$

$73 = \text{Antilog}\sqrt{4} - (\text{Antilog}\sqrt{4}/4) - \sqrt{4}$

$74 = 4! + 4! + 4! + \sqrt{4}$

$75 = \text{Antilog}\sqrt{4} - [(\text{Antilog } 4 / \text{Antilog}\sqrt{4}) / 4]$

To those of you who only got solutions for 72 and 74, commiserations; we were finding it pretty tough going ourselves!

For this month's contest, we racked our brains to come up with a good puzzle that would be fun and challenging but found that we were better at solving the darn things than making them up! We've got a few old favourites in stock, but everyone must know the answers by now! So, this month, to make it easy for ourselves, we're running a 'Design A Contest' Contest, in which we want you to write in with ideas for brain-teasers suitable for use in the ETI/Unitrex Contest in future issues. They should be short, amusing, of reasonable difficulty and preferably of unique solution to make it easy to judge.

So this month, write your entry down, stuff it in an envelope and mail it to ETI/Unitrex Calculator Contest, Electronics Today, 15 Boundary St., Rushcutters Bay, NSW 2011. We will award a calculator for every puzzle used, and the closing date is Friday, October 6th.

Modern expertise and computer technology have created a fine piece of equipment.

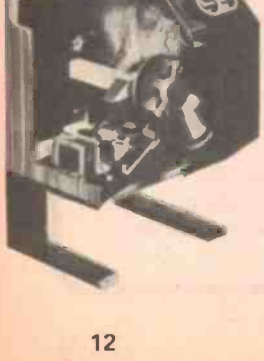
The NEW B&W DM 7

DM7 is the first of a new loudspeaker family reflecting our computer-aided research programme. It is a compact 3 unit system employing entirely new drive units in an enclosure engineered to exceptionally high standards. Many advances have been incorporated to reveal new horizons in loudspeaker performance, making possible a standard of musical reproduction unequalled in an enclosure of this size. The DM7 gives almost perfect amplitude linearity throughout the entire audio spectrum, and produces phase-coherent sound within a broad listening area. The drive units are purpose-designed and manufactured entirely in our own factory, employing new technology in order to achieve incredibly low distortion levels – typically less than 1% THD from 30Hz to 200Hz and less than 0.5% above that frequency. Another new feature in the DM7 is a variable energy control giving four frequency weightings – different to those obtainable from the control unit – to accommodate widely varying room acoustics.

Hear the B & W DM7 – you may well agree that this is the finest small speaker in the world today. Guaranteed for 5 years.

The DM7 complements a remarkable range of monitor loudspeakers from B & W.

The B & W DM6 is Britain's first linear phase loudspeaker. A dynamic system that will reproduce sound with transient accuracy usually achieved only by the very best electrostatic designs.



The DM4 is a 3-unit monitor loudspeaker system that produces high quality results from an incredibly small cabinet (20.8 litres) making it perfect for home or small studio use where space is at a minimum.

Only 28" x 9" x 9½". Despite its compact size, DM5 speakers can be rated as a system of very high quality. The design philosophy of John Bowers – "To design loudspeakers that reproduce in your home sound as you would hear in the concert hall"

NSW: CONVOY SOUND WOOLLOOMOOLOO SHOWROOM 357 2444; INSTROL HI-FI PTY.LTD. 29 7290; PARK ST. HI-FI STEREO CENTRE 26 2798; MILVERSON PTY.LTD. (CHATSWOOD) 412 2122 (PARRAMATTA) 635 3588; RIVERINA HI-FI 938 2663/4; UNITED RADIO DISTRIBUTORS PTY.LTD. 232 3718; ARROW ELECTRONICS 29 8580; RUSSIN HI-FI 799 2421; PITMAN'S RADIO & TV (WAGGA) 25 2155; ALBURY AUDIO CENTRE 25 1712; LEISURE SOUND (CHATSWOOD) 411 4944; WROTH CENTRE HI-FI (BATHURST) 31 2088; BYRON BAY TV & SOUND CENTRE 85 6762; SINGLETON HIGH FIDELITY CONSULTANTS 72 2270; HI-FI JUNCTION 389 4000; ACT: DURATONE 82 1388; VIC: SHEPPARTON HI-FI 21 9006; ENCEL ELECTRONICS PTY.LTD. 42 3761; SOUND SPECTRUM (GEELONG) 9 6616; SOUTHERN SOUND (CITY) 67 7869 (MOORABBIN) 97 7245; TIVOLI HI-FI 81 2872; THE SOUND CRAFTSMAN 509 2444; BUY RITE ELECTRIX 42 6200; NATSOUND 678158; INSTROL HI-FI 675831; INSTROL HI-FI (FRANKSTON) 783 7535; QLD. JOHN GIPPS SOUND 36 0080; PREMIER SOUND (NTH. ROCKHAMPTON) 27 4004; TARGA ELECTRONICS (CAIRNS) 53 2715; RUSS ADAM (TOWNSVILLE) 71 5618; TAS. BEL CANTO (HOBART) 34 2008; UNITED ELECTRONICS (LAUNCESTON) 318528; AUDIO SERVICES (BURNIE) 31 2390; WEST. AUST. TECHNICAL SERVICES PTY.LTD. 31 5455; THE GINZA 61 7444; STH. AUST. BLACKWOOD SOUND CENTRE 278 1281; INSTROL HI-FI 2237622; SOUND SPECTRUM 2232181.

Sole Australian agent:

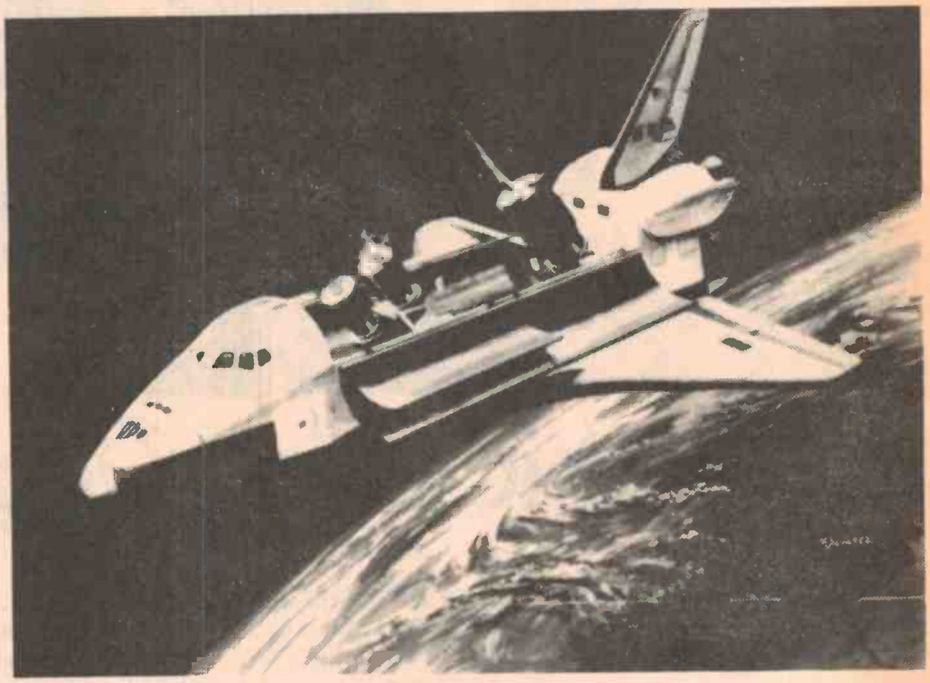
Convoy INTERNATIONAL 4 Dowling Street, Sydney 2001. Phone: 358 2088.

Shuttle communications

The successful operation of the Space Shuttle is dependent on a complex communications and navigation system. By Brian Dance.

THE SPACE SHUTTLE has been designed to carry out a very wide variety of missions, including the launching of international communications satellites, of space laboratories, etc. The Orbiter vehicle employed for the Shuttle contains complex communications systems; these systems have been carefully designed to provide all facilities required for the various missions with very little modification of the communications equipment for any particular mission.

The Orbiter vehicle carries up to 23 antennae for communications with ground stations, with detached payloads launched by the Orbiter, and with the Orbiter vehicle crew when they are carring out extra-vehicular activities. Information can be transmitted as voice or data signals using these antennae over a wide range of radio frequencies in the S-, Ku-, L-, C- and P-bands. The frequencies used for various purposes are listed on Table 1.



Ground Links

The S-band equipment in the Orbiter vehicle can communicate directly with the US ground station at White Sands, New Mexico or with other stations of the US Space Tracking and Data Network (STDN), the frequencies being somewhat over 2000 MHz. Two digitised phase-modulated links are available for this purpose, the four frequencies being shown in Table 1.

In addition, frequency modulated signals are transmitted from the Orbiter to the ground on an S-band carrier together with the frequency modulated data from the "Development Flight Instrumentation" (DFI) equipment carried aboard the Shuttle during its test flights.

During the Orbiter approach and landing phases of any mission, standard L-band TACAN units will be employed, as well as C-band radar altimeters and P-band analogue voice links for air traffic control. Voice communications for extra-vehicular activities will also use the P-band.

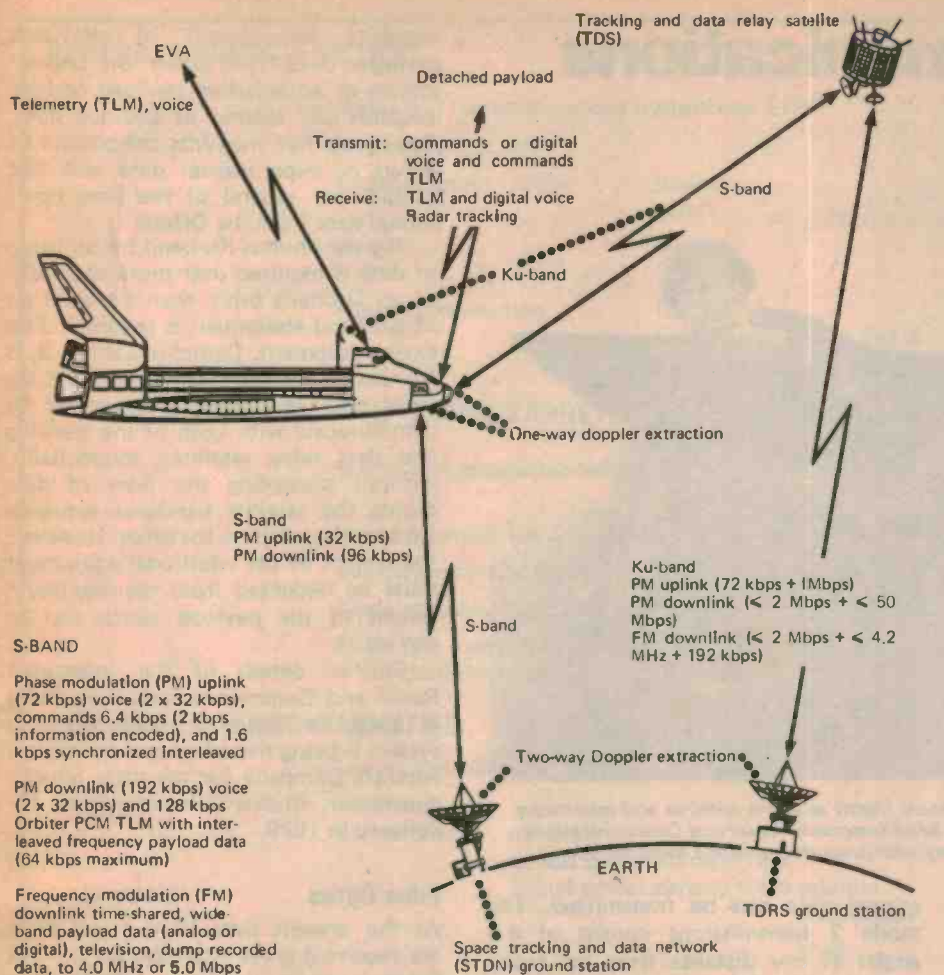
Communications with the earth networks will also be available through the use of Tracking and Data Relay Satellites which will be placed in geosynchronous orbits 35 800 km above the equator over the Atlantic and Pacific oceans. The Shuttle can employ S-band frequencies for communication with one of these satellites, but Ku-band frequencies can also be employed for wide bandwidth links capable of high data rate operation (Fig. 1).

The satellites can relay signals to and from the earth using Ku-band frequencies at data rates of up to about 2 megabits/second. The advantage of using relay satellites is that one or both of the satellites will be able to "see" both the orbiting Shuttle vehicle and also a particular ground station at least 95% of the time the Shuttle is in orbit. The satellite link carries the same kind of information as the direct S-band link, but much higher data rates are possible. The information carried will include scientific and engineering data, command signals, digital voice transmissions, video signals and performance monitoring information.

Multichannel two-way communication between the Orbiter vehicle and either attached or detached payloads is also available using S-band frequencies. However, the Orbiter rendezvous radar and the microwave scan beam landing system operate in the Ku-band.

S-band Systems

A variety of voice, command signals and telemetered data can be sent to or from the Orbiter vehicle using S-band links. Phase modulated signals beamed directly at the Orbiter vehicle from the Space Tracking and Data Network stations or relayed by means of a satellite can be transmitted at two different data rates. In the high bit rate mode, two digital voice channels at 32 kilobits



per second per channel and 8 kilobits per second of command data are interleaved into a 72 kilobits per second digital data stream.

The low bit rate consists of a single 24 kilobits per second digital voice channel together with 8 kilobits per second of command data. Transmissions via the relay satellite are convolutionally encoded.

Two bit rate modes are available for transmissions from the Orbiter directly to a ground station or via a satellite using phase modulation. The high bit rate mode accepts two digital voice channels at 32 kilobits per second per channel inter-leaved with 128 kilobits of telemetered information to form a 192 kilobits per second stream of digital information. Data from a payload can occupy up to 64 kilobits per second. When the low bit rate mode is being used, one channel of a digitised voice signal plus 64 kilobits per second of a telemetry signal can be inter-leaved for transmission.

The S-band frequency modulated signals from the Orbiter sent directly to ground can carry signals from the payload and Orbiter with a 4.5 MHz maximum bandwidth. The signals can include recorded voice, real time closed circuit television, main engine data, etc.

The Orbiter can transmit or relay a 2 kilobits per second command signal to attached or detached NASA payloads. Commands to free-flying payloads are sent at a one or two kilobaud rate by using a ternary frequency shift keyed (FSK) amplitude modulated signal. A 500 or 1000 Hz synchronisation signal is provided as the amplitude modulated signal.

Ku-band System

The Space Shuttle Orbiter vehicle will employ an integrated radar and communications Ku-band subsystem packaged in two sets of assemblies. One of these, Radar/Communications A, is carried aboard the Orbiter as standard equipment. It employs an antenna mounted on the starboard payload bay door and an electronics assembly. During the ascent of the Orbiter, the antenna is stowed in the space between the payload bay door panels and the clear volume of the payload bay.

Before the Shuttle can use the tracking and data relay satellites for communications work, it must first locate the satellites in space. When the vehicle first arrives in its orbit, the cargo bay doors are opened by the crew using a remote control system. The parabolic antenna moves into its operating position. The general location of the satellite is obtained from the Shuttle's computer and fed to the communications and radar subsystem. The

FUNCTION OR SYSTEM	ORBITER TRANSMIT	ORBITER RECEIVE
STDN Communication, Phase Modulation — 1	2287.5 MHz	2106.4 MHz
STDN Communication, Phase Modulation — 2	2217.5 MHz	2041.9 MHz
STDN Communication, Frequency Modulation	2250.0 MHz	None
Development Flight Instrumentation	2205.0 MHz	None
NASA Payloads	2025.0 to 2120.0 MHz	2202.5 to 2297.7 MHz
Separated payloads	1760.0 to 1843.0 MHz	2202.5 to 2297.7 MHz
Extra-vehicular activity communications	296.8 MHz	259.7 MHz
Rendezvous radar	13.679 to 13.887 GHz	13.679 to 13.887 GHz
Ku-band communications	15.0034 GHz	13.775 GHz
TACAN	1025 to 1150 MHz	962 to 1213 MHz
Air traffic control, voice	296.8 MHz	259.7 MHz
Microwave scan beam landing system	Ku-band	Ku-band

Ultimately It's Marantz. Go For It.

Now, professional 3-head monitoring in a cassette deck.

Up to now you had to choose between a cassette deck for convenience. Or, reel-to-reel for professional recording features. Now have it both ways in the Marantz 5030 cassette deck.

Here's how:

The Marantz 5030 has separate record and playback heads... the same as reel-to-reel. This gives you an instant check of the quality of your recording as you record. And, like some of the most expensive reel-to-reel decks, the record and playback heads on the Model 5030 are super-hard permalloy—a long-lasting metal alloy that gives better frequency response and signal to noise ratio than Ferrite material.

For precise azimuth alignment, both the playback/monitoring and record heads are set side-by-side within a single metal enclosure. They can't go out of tracking alignment.

Complementing this outstanding "head-technology" is Full-Process Dolby* Noise Reduction Circuitry. It not only functions during record and playback... but during monitoring as well.

What drives the tape past the heads is every bit as important as the heads themselves. For this reason the Model 5030 has a DC-Servo Motor System. The steadiest, most accurate tape-transport method. Speed accuracy is superb, with Wow and Flutter below 0.08% (WRMS).

To adapt the Model 5030 to any of the three most popular tape formulations, press one of the three buttons marked "Tape EQ and BIAS." There are settings for standard Ferric-Oxide, Chromium Dioxide (CrO_2) or Ferri-Chrome (FeCr) tape.

With Mic/Line Mixing, two sources can be recorded at the same time, combining line and microphone inputs. The Master Gain Control lets you increase or decrease the overall volume of the total mix.

What else could we pack into a front load cassette deck?

More features. Like a 3-digit tape counter with memory function. Viscous Damped Vertical-load Cassette Door. Switchable Peak Limiter. Fast-response LED Peak Indicators. 3" Extended-range Professional VU Meters. Locking Pause Control for momentary shut-off in record or play... and Total Shut-off in all modes when the tape ends.

And, of course, the unbeatable Marantz 5030 is front loading. Easy to stack or fit on a shelf. The styling is clean and bold. The sound is the truest recreation of what was put on tape. If you want the best—then do what you really want to do—go for it. Go for Marantz.

marantz.®
We sound better.

For further information and literature, please contact:
SUPERSCOPE (AUSTRALASIA) PTY. LIMITED, PO Box 604, Brookvale. NSW. 2100. Telephone (02) 939-1900.


PLUS SERIES
AMPEX
AMPEX
PLUS SERIES
90
AMPEX

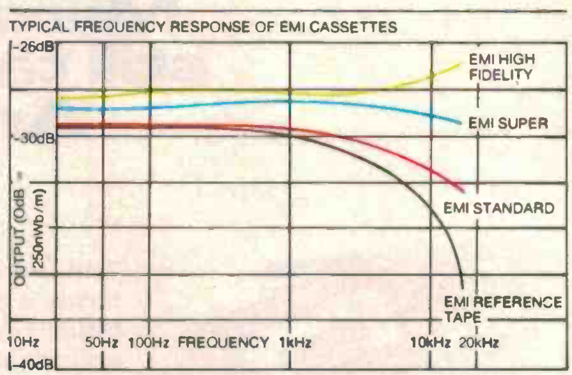
Introducing the new range of EMI Cassettes.

These new cassettes from EMI are designed to meet and exceed the exacting specifications in all performance areas, with special attention given to ensure smooth and trouble-free mechanical operation.

The new EMI Cassettes produce excellent results over the whole range of available equipment. All are available in 60, 90 and 120 minute playing time.

Whatever your equipment, whether they are recording speech or music, the EMI Cassette range will precisely match your needs.

1. Measured using the EMI recommended 2.5dB overbias at 6.3kHZ, derived from the reference batch C521V (the value of bias internationally used by the majority of domestic recorder manufacturers).
   Tape speed 4.76cm/s ($1\frac{7}{8}$ in/s)
   Track width 0.6 mm
   Record head gap length 2μm
   Replay head gap length 2μm
   Replay amplifier characteristics: 120μsec and 3180μsec
   (In accordance with IEC Publication 94 Edition 3, BS1568 Part 1 and DIN 45513)
2. The Frequency Response is obtained when the record amplifier characteristic has been adjusted to give a flat frequency response (25Hz – 15Hz) from the reference tape batch C521V of –30dB (Ref. 1*).
   **Ref 1. Relative to an RMS Flux of 250nWb/m Tape Width (25mMx/mm) at a frequency of 315Hz (in accordance with IEC Publication 94 Part 2).*



RANK AUSTRALIA
PROFESSIONAL SERVICES GROUP

12 Barcoo Street, East Roseville, Sydney 2069. Telephone: 406 5666
60 Rosebank Avenue, Clayton South 3169. Telephone: 543 4122
50-52 Vulture Street, West End, Brisbane 4101. Telephone: 44 2851
101-105 Mooringe Avenue, Camden Park 5038. Telephone: 294 6555
430 Newcastle Street, Perth 6000. Telephone: 328 3933
120 Parry Street, Newcastle 2309. Telephone: 26 2466

SOUND

New Recorders for Metafine Tapes

IN OUR AUGUST issue we forecast that new recorders would soon become available which are suitable for the recently announced Metafine tape which is essentially based on metallic iron particles instead of the normal oxide mixture. Our forecast proved very true, since the well-known Norwegian based manufacturer Tandberg announced a whole new series of recorders in August, some of which are suitable for the new type of tape. The new recorders are not specifically designed for use with the new tapes, but can be used with all types of tape currently available and any types which are likely to become available for a long time to come. Indeed, these recorders have been specifically designed so that they will not become outdated by any normal developments in tape technology.

Tandberg is the first recorder manufacturer to announce recorders suitable for use with the new iron particle tapes, but many other manufacturers are working on the design of suitable equipment and more announcements can be expected soon. It will also be interesting to see how other tape manufacturers will respond to the new development from 3M tapes.

Fundamentals

Let us first consider the fundamental reasons why new types of recorder are required for use with the iron particle tapes. Present recorders (when set for 'chrome' playback with a 70 microsecond equalisation) are quite suitable for replaying cassettes containing the iron particle tape and will provide an improved performance over that obtainable from conventional tapes using the same equipment.

Unfortunately our existing recording equipment will not enable us to obtain an optimum performance from the new tapes when used to record material. The new tapes require a stronger magnetic field to be applied across the recording head gap in order to record material on them satisfactorily and a stronger erasing field is also required to erase material from iron particle tapes. The bias current levels required for optimum performance are also different from those required for use with conventional tapes.

In case readers are becoming worried by now, we will mention that there is no possibility of their existing collection of tapes being unsuitable for replay on any new recorders designed for iron particle tapes. Obviously one can obtain the improved performance only from the new tapes, but one will be able to obtain the same quality of reproduction from one's older tapes as one has obtained in the past.

The new iron particle tapes will first be marketed as cassettes, since it is here that performance is most critical. However, it is expected that they will soon also be available in the reel-to-reel form, as video tapes and as tapes suitable for computer and data storage purposes. The new tape can provide improved performance at conventional tape speeds, but it also offers the possibility of considerably lower tape speed without any deterioration in quality.

Tape differences

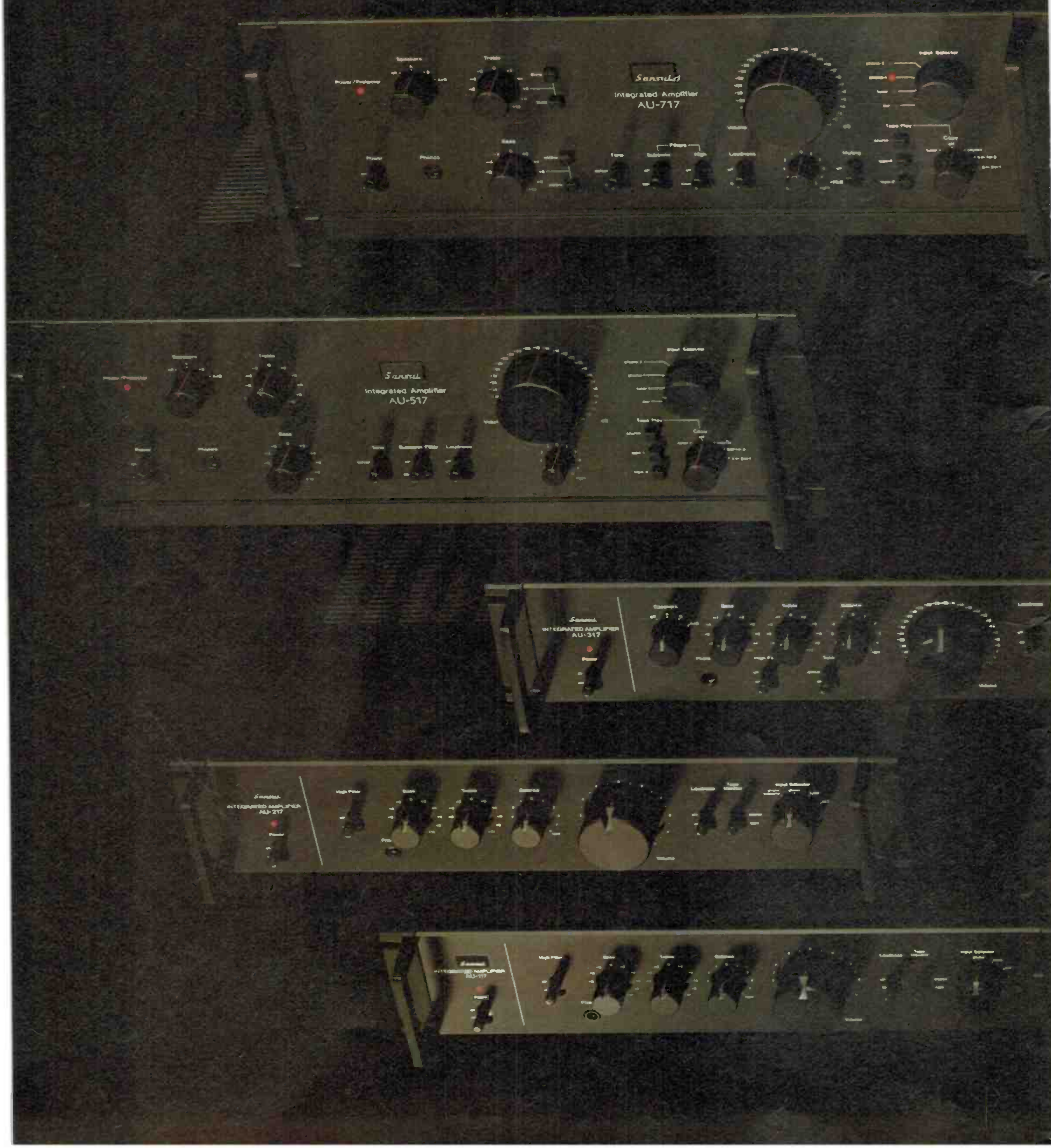
The magnetic properties of a tape are not simple, but two quantities are of vital importance in assessing the practical performance of a tape. One of these is the saturation flux density which, in everyday language, is a measure of how strongly the tape can be magnetised. It is given the symbol B_m. If one attempts to magnetise a tape above this level, severe distortion is the inevitable result. If one employs a tape with a high value of B_m, one will be able to obtain a relatively large output signal from it on replay and one may therefore expect that the signal-to-noise ratio will be improved if other factors are unchanged.

The other important property of a tape is its coercivity, H_c. This is a measure of how strong a field is required to record on the tape concerned, but it can also be employed as a measure of how well the tape retains the recorded material. A high coercivity tape will require a high signal current through the recording head, but once this signal is satisfactorily recorded, it will not easily be lost.

During the past fifteen years or so there has been a definite

Specs with a purpose!

Sansui's new amplifiers

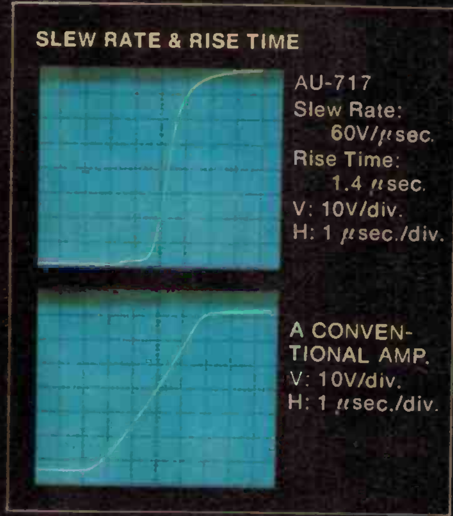


Sansui's all-new integrated amplifiers have absolutely astounding specifications. Compare them with any others in their class, and Sansui comes out far ahead. But what really makes Sansui's new amplifiers so superior is that all these great specs have a single purpose — outstanding sound quality.

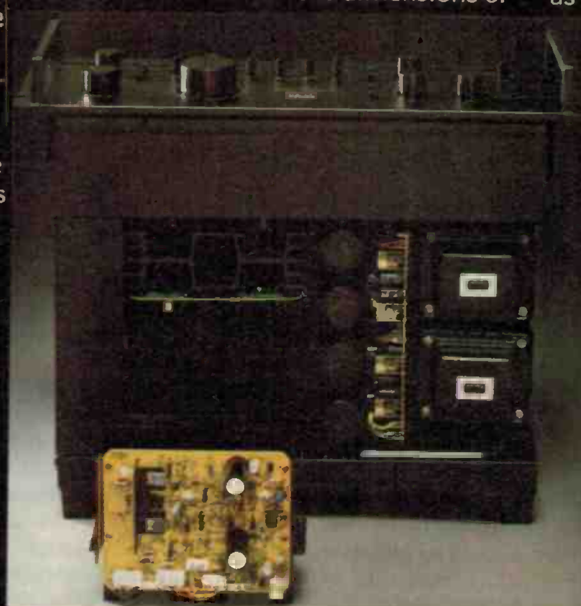
Take response speed, for example. Your amplifier doesn't move, but it does respond. The more rapid its response, the cleaner and the more accurate the sound. That's why the AU-717, for example, features an advanced DC power amplifier design. Sansui's DC amplifier eliminates all capacitors in the signal path and even in NFB loop so amplification is direct without coloration and phase delay. Response is astoundingly rapid — the proof is in the ultra-high (60v/μsec.) slew rate and ultra-rapid rise time (1.4μsec).

But Sansui didn't strive for such outstanding specs just to be able to print impressive figures. On the contrary, Sansui research showed that to achieve accurate reproduction and reduce signal loss, lightning-fast response was essential.

In addition, special circuits were incorporated to achieve new levels in stamping out TIM (transient inter-modulation distortion), a type of distortion that is now receiving high priority. Still another important benefit of Sansui's DC amplifier is the ultra-wide frequency response from zero (DC) to 200,000 Hz.



The final result is music with a purity and clarity that must be heard to be believed. All the dimensions of complex musical sounds — the wide dynamic range, the sudden pulsive signals, the nuances of barely perceptible but critical overtones in the ultra-high frequencies — all these are now crystal clear, all are proof of Sansui's new levels in superior sound quality. Impressive power is 85 RMS watts per channel, 20 — 20k Hz, and total harmonic distortion at rated output is 0.015%. That means it can be considered non-existent as far as the human ear is concerned.



Keep in mind that though the AU-717 is special, it's not special for Sansui. Each and every amplifier on the left-hand page embodies the same Sansui commitment to outstanding sound quality. All controls have been carefully thought out and designed for their specific purposes. Sansui has no place for gadgets and gimmicks in its dedication to the ultimate in hi-fi.

The AU-517 and AU-317 also feature the same DC power amplification as the AU-717, and offer 65 and 50 RMS watts respectively. The AU-217 and AU-117 offer 30 and 20 RMS watts respectively, but are not to be under-rated. In fact, they represent exceptional values in low distortion and true hi-fi performance.

Sansui for specs with a purpose — outstanding musical quality.

Sansui

Only hi-fi, everything hi-fi.

SANSUI ELECTRIC CO., LTD. 14-1 Izumi 2-chome, Suginami-ku, Tokyo 168, Japan
VANFI (AUST.) PTY. LTD. 162, Albert Road, South Melbourne, Victoria 3205, Australia Tel: 699 5473
Suite 5, Unlline House, 5 Northcliff Street, Milson Point, N.S.W. 2061, Australia Tel: 929 0293

CONVENTIONAL

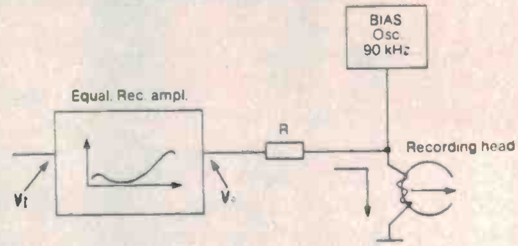


Fig. 1. A block diagram of a conventional recording system.

ACTILINEAR

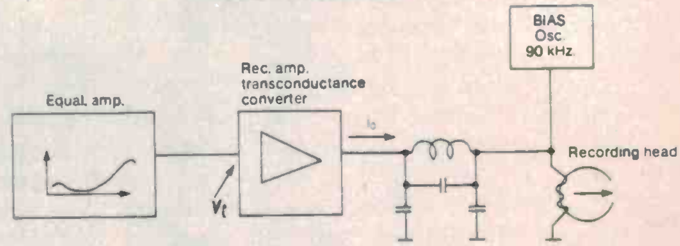


Fig. 2. A block diagram of the new Actilinear recording system.

trend towards the use of tapes of higher B_m and H_c values, largely in order to obtain improved signal-to-noise ratios. The introduction of cassette recorders greatly stimulated this trend to tapes of higher B_m and H_c values, since there is no possibility of obtaining a better performance by increasing the tape speed or increasing the track width in such recorders.

At high signal frequencies the signal-to-noise ratio is determined mainly by the value of H_c, whereas at lower frequencies it is more dependent on the value of B_m. The earliest cassette tapes had H_c values of around 250 oersted, but this was gradually increased to around 350 oersted. A big breakthrough came with the chromium dioxide tapes which have H_c values of over 500 oersted, but the new Metafine iron particle tapes have an H_c of about 1000 oersted.

Similarly the saturation flux density, B_m of the new tapes is considerably higher than that of currently available tapes. Conventional tapes have a B_m value of around 0.1 to 0.15 weber/square metre, whereas the iron particle tape has a value of about 0.34 weber/square metre.

Another feature of the new iron particle tape is that the coating thickness of the magnetic film on the base material is only 3.8 μm in contrast to the more usual 5 μm of conventional cassette tapes.

Therefore one may summarise the problem by stating that the new tapes will require recording equipment which can impress a strong signal upon them and which can generate an adequate erasing field to wipe off all previously recorded material.

Actilinear Systems

Tandberg have used the name 'Actilinear' for their new recorders, since they employ *active* components in the recording process which results in greater *linearity*. In order to understand how this type of circuitry differs from that of conventional recorders, we must first consider conventional recorders and their limitations.

The recording amplifier of a conventional system contains an equalisation circuit so that the overall record/playback frequency response is flat. As shown in Fig. 1, the output of this recording amplifier is a voltage which drives a signal current through the resistor R and through the recording head. The bias oscillator also feeds a current at the bias frequency of some 90 kHz to the recording head.

It should be noted that the network connecting the recording amplifier to the head in Fig. 1 contains only a single passive component, namely the resistor R. However, the Tandberg Actilinear recording system (Fig. 2) employs a recording amplifier transconductance converter (containing active components) between the output of the recording equalisation amplifier and the recording head network.

The full circuit of a conventional passive recording system is shown in Fig. 3 and the Tandberg Actilinear circuit in Fig. 4. In the latter circuit, the C2 and R4 network provides the correct equalisation at low frequencies, whilst equalisation at the middle and high frequencies is provided by the components L1, C1, R2 and R3. Adjustment of the trimming capacitor C_T provides a method of adjusting the system for the correct signal level for the particular type of tape in use.

The transconductance module shown within the dashed lines has two main purposes. It converts the signal voltage from the potentiometer R_5 into a signal current which is fed to the recording head to produce the signal on the tape. This stage also provides electrical buffering between the oscillator and the output of the recording amplifier so that the oscillator voltages do not enter the recording amplifier and cause interfering tones.

The transconductance module employs two transistors, Q1 and Q2 with Q2 acting as the collector load of Q1. The transistors are complementary types (that is, an npn and a pnp pair). Each transistor passes a current of about 10mA, the voltage at the junction of their collectors being about +12V under quiescent conditions. This voltage can swing from +2V to +22V when a signal is applied.

The output impedance of the transconductance module is some 5 kilohms, but as the recording head impedance is far less than this (only about 200 ohms at 5 kHz), the circuit acts as a current source. In other words, a constant voltage applied at the input produces a constant current through the recording head; this is why it is known as a transconductance module.

The capacitor C12 prevents any appreciable oscillator voltage from finding its way back into the recording amplifier. The filter circuit in the output section can reach the transistors of this module. This filter, comprising L2, C14, C15 and C16, reduces the bias oscillator voltage from its value of about 20 V at the recording head to less than 0.1 V at C13.

Apart from the better rejection of the oscillator signal, the Tandberg Actilinear system is a much better system for providing signal and bias currents to the new high coercivity iron particle tapes.

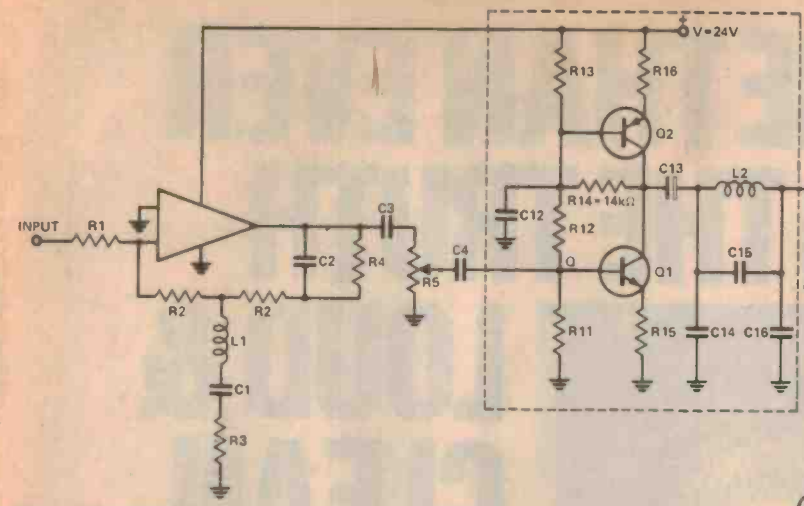


Fig. 4. The circuit of an Actilinear recording system.

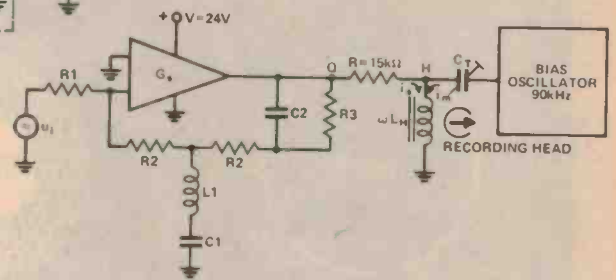


Fig. 3. A practical circuit of a conventional recording system.

Slew Rate

A further advantage of the Actilinear system is concerned with slew rate limitations. All amplifiers have a limitation on their slew rate which is the maximum rate at which their output voltage can change. If the output voltage is small, the output can follow a high frequency signal with ease, but if the output voltage is large, the output cannot change fast enough to faithfully reproduce a high frequency signal waveform.

In the circuit of Figs. 1 and 3 for a conventional system, a relatively high voltage is required from the recording amplifier to provide the necessary voltage to drive the signal frequency recording current through the resistor R. However, in the Actilinear circuit of Figs. 2 and 4, only a small voltage is required from the output of the recording amplifier to provide a signal which can be converted into an adequate current by the transconductance module. Thus slew rate distortion limitations will appear at much lower signal amplitude levels in the conventional circuits than in the Actilinear circuit; indeed, the latter is almost free from any slew rate problem.

The graph of Fig. 5 shows one of the practical benefits conferred by the new Actilinear recording technique in a reel-to-reel recorder at a tape speed of 3¾ inches per second (95 mm per second) using a conventional tape. It can be seen that the Actilinear system provides a larger dynamic range.

Perhaps the most important advantage of the Actilinear system is the availability of ample signal frequency recording current for the recording head so that the system can be employed with high coercivity tapes of any type, including the new Metafine Scotch type of iron particle tape.

It is claimed that the Actilinear system reduces intermodulation interference from the bias oscillator and increases the signal handling capacity by 20dB over that in a conventional system. Signal-to-noise ratio is improved because Actilinear recording provides a stronger recording at a given distortion level than conventional recording systems. In addition, the new system has more than 20dB overload reserve for recording on the highest coercivity tapes one can envisage in the coming years.

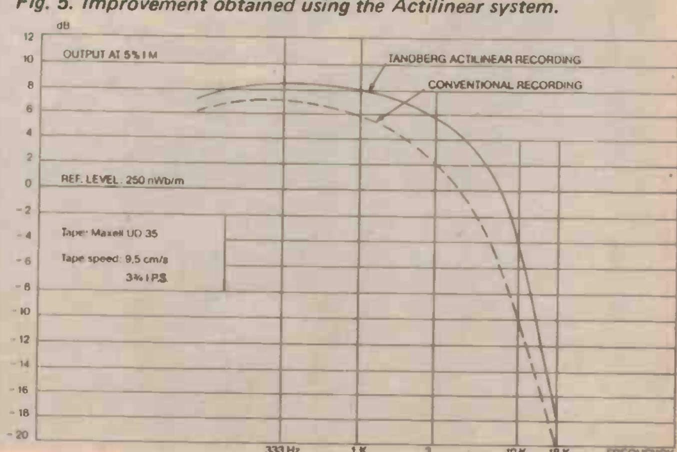
When the Actilinear recorders are employed with the new Metafine tapes, one can obtain an improvement in the signal-to-noise ratio of some 10dB; this is approximately equivalent to the improvement one can obtain through the use of Dolby circuitry. However, the Dolby system improves the signal-to-noise ratio only at the higher frequencies, whereas the use of iron particle tapes with the new Tandberg recorders is said to improve the signal-to-noise ratio by some 5dB even at the lower frequencies. In addition, no special encoders or decoders are required nor any complex circuitry. Even more impressive results can be obtained by the use of a Dolby circuit with an Actilinear recorder and Metafine tape. Perhaps this is the point of perfection in signal-to-noise ratio?

The new recorders

Tandberg have just introduced two recorders with their Actilinear system. The TCD 340A is a cassette deck with three heads (separate record and replay heads) and three motors. The new model resembles its predecessor, the TCD 330, and is equipped with 4 Dolby B processors, the Tandberg developed equalised peak reading meters for precise control of record and playback, multiplex filter and a pneumatically damped cassette compartment for the highest grade of cassette recording. The Ancilinear system used in this recorder replaces the well-known Tandberg crossed-field heads used in their current range of recorders.

Tandberg claim that the TCD 340A has a signal processing capacity of more than 20dB above the level of any cassette tape equipment currently available. Recording head azimuth adjustment is available for the manual adjustment of the angle of the tape-to-head contact so as to assure the best possible frequency response with any of the recommended high quality cassettes. Although some recorders employ two-in-one combined record replay heads, Tandberg rejected this solution and

Fig. 5. Improvement obtained using the Actilinear system.




AR11

adopted completely separate heads because they felt this is the only way to eliminate bias interference and tape tracking problems associated with such combined head systems.

On the mechanical side, the TCD 340A employs a dual capstan closed loop drive system for optimum tape handling precision and stability, whilst it eliminates uneven tape speed and sudden jumps that are often caused by poor quality cassettes.

The synchronous drive motor is designed for minimum speed deviations together with minimum effect of temperature and mains voltage on the tape speed. Two separate servo-controlled DC motors take care of the wind and rewind functions.

The TCD 340A employs electronic logic control throughout. It is thought that this is ideal for rendering the equipment safe and fool-proof in normal operation and for safeguarding both the tape and the machine. An optional remote control is available which can be pre-set with a separate radio tuner for unattended record or playback operations.

The frequency response is 30Hz to 20kHz. The production specification is for 0.12% wow WRMA for recording and playback (0.08% Japanese industrial standard). Signal-to-noise ratio is better than 65dB IECA.

TD 20A Reel-to-reel

The Tandberg TD 20A is a reel-to-reel recorder using the Actilinear process which can accept 10½ inch reels of tape. Front panel bias adjustment and optional radio infra-red remote control are incorporated into this instrument. This recorder employs a 4 motor drive system, including a phase-locked brushless Hall Effect synchronous motor combined with drive belt which prevents the transmission of unwanted, mechanically induced irregularities in the tape motion.

The TD 20A is equipped with separate power supplies for the operational and for the audio functions in order to eliminate thermal component stress and to isolate the audio chain from electrical disturbances. It incorporates PROM (electronic brain) speed regulation combined with triac controlled direct drive spooling motors for proper tape tensioning and minimum mechanical wear and tear. The fourth motor engages the pinch roller/tape guidance mechanism to ensure more precise tape tracking and head-to-tape contact.

The TD 20A is available in half track and one quarter track versions. A high speed version is provided with 15 inches per second and 7½ inches per second tape speeds whilst a low speed version has 7½ and 3¾ inches per second tape speeds.

Tandberg have also just released a TCD 320 cassette recorder (without the Actilinear recording system) and four new high quality radio receivers.

SOUND BRIEFS

PCM Now

Sony USA is now distributing the first batch of its pulse-code modulated audio units – which enable the company's Betamax video-cassette recorders (or any other similar device) to be used to record and play back audio material.

The device can record 12 bits of data on each channel and is expandable to 16 bits per channel, corresponging to 1.7 million bits per second.
Sony claim a dynamic range of 85 – 95 dB – about 20 to 30 dB greater than the best present analogue techniques. Frequency response is claimed to be 0 to 20 kHz plus or minus 0.25 dB with THD of less than 0.03% across the whole range.

Price in the USA is US$4000 which is going to limit sales for a bit but Sony are confident the system will have many professional and semi-professional applications.

Super-Recorded Cassettes

A newly formed UK company is planning to market a range of super-quality pre-recorded cassettes – claimed to be the tape equivalent of direct-cut discs.

Only the very best quality tape will be used and the recordings will be made directly from master recordings on a 'one-to-one' basis rather than by the multiple process normally used. We understand that the cassettes should sell for around £8.00 (about A$12.80). More details hopefully next month.

Direct Control Turntable

Philips has developed a range of belt-drive turntables in which the actual turntable speed itself is sensed and used to control motor speed.

The feedback loop servo system thus compensates for external influences such as changes in tracking force, drag from 'dust bugs' etc, as well as varying mains voltage and frequency, and changes in humidity or temperature.

Philips claim that their new machines achieve the performance levels of direct-drive units without incurring what Philips claim are their disadvantages.

Tone control chip

Motorola in Geneva have developed an IC which replaces the four dual potentiometers normally required to control volume, balance, bass and treble in stereo receivers. The chip enables gain to be controlled over a range of 84 dB using dc signals from 0 – 6 volts.

At present the chip is primarily suited to car radios but a hi-fi version is currently being developed.

Japan Audio Fair

A number of readers have asked for the dates of the forthcoming All-Japan Audio Fair.

It's from October 6 through October 11 at the Tokyo International Fairgrounds in Harumi (Tokyo).

A major independent research company proved that the ADC XLM MKII incurred no perceivable record wear over the life of your records!
Since then ADC's massive research programme has created a new state-of-the art, top of the line model–the ZLM Aliptic–designed for ultimate stereo performance combined with the concept of zero record wear.

Greatly reduced tip mass

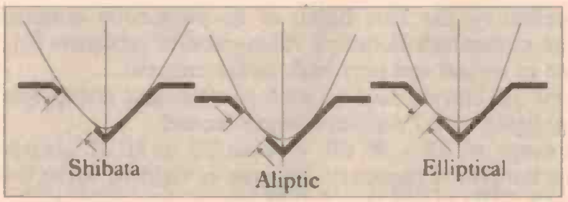
The ZLM has a tiny nude diamond with a ·004" x ·008" rectangular shank.
This achieves more lateral strength than the fashionable ·006" square shank, plus a 10% reduction in mass.
The diamond is mounted on a new tapered stylus, which again reduces mass.
In fact, the ZLM has only half the tip mass of the famous ADC XLM MkII.

Less mass by patent

The patented ADC Induced Magnet system, where the magnet is suspended over the moving stylus arm instead of being attached to it, inherently means less mass for the record groove to move. This, coupled with major innovations in the pivot block stylus suspension (which have solved deficiencies in the old system), has resulted in greatly improved frequency response characteristics.

New low-wear ALIPTIC shape

The ZLM has a new tip shape that combines the advantages of the elliptical and Shibata shapes, while eliminating their disadvantages.



It is basically elliptical (·0003" x ·0007"), but its bottom radius has been modified to extend the vertical bearing surface on the groove wall by 100%.
Large enough to greatly reduce record wear, while still small enough to prevent dirt particles being reproduced.
This new shape is called ALIPTIC.™

The best polish available

We decided it was worth the extra cost to get the ultimate polish for the ZLM.
The method involves a cam action to shape and polish evenly while forming the elliptical surfaces simultaneously with the other radii. This Pathe-Marconi method is expensive, but the result makes another important contribution towards reducing record wear.

Spatial sound

You'll notice a distinct difference in sound quality.
Words such as 'open,' 'spatial,' 'uncoloured' and 'true' spring to mind. Individual instruments are easily identified, and there's no hint of listening fatigue.
That's strictly for the competition with its peakier response.

The new ZLM Aliptic

The culmination of all ADC's research has resulted in the new ZLM Aliptic.
Its specifications below are some of the most impressive around, and with each cartridge you receive an individual, signed, frequency response testimonial.
Certain ZLM's fall within a range of ±½db 10Hz to 20kHz and ±1dB out to 26kHz.
These rare cartridges are called ZLM Select and are only available on special order.

The best cartridge we've ever made

The ZLM is without doubt the best cartridge we've ever made, but it's well worth taking a closer look at the new ADC XLM III which incorporates all of the reduced mass accomplishments of the ZLM, but with a tiny elliptical diamond. This also includes an individual specification.
Complementing the range, we have the new four-cartridge QLM Mk III series, incorporating our new design criteria and exciting innovations like the Diasa (diamond + sapphire) elliptical tip.

ZLM Aliptic specifications

Diamond tip	Nude Aliptic
Tracking force	½ to 1¼ gram
Frequency response	10Hz to 20kHz ±1dB 20kHz to 26kHz ±1½dB
Output	1.0mV per cm/sec
Output balance	1dB max. diff.
Channel separation	30dB at 1kHz/20dB at 10kHz
Inductance	580mH
Resistance	820 Ohms
Load resistance	47,000 Ohms
Load capacitance	275pF
Cartridge weight	5.75 grams
Accessories	Stylus brush, screwdriver, all mounting hardware and signed frequency response curve.

Please write for our illustrated brochure.

The new ZLM Aliptic™ cartridge. The difference between playing your records and wearing your records.

ADC

Audio Dynamics Corporation,
A Division of BSR (A'asia) Pty. Ltd., Anne Street, St. Mary's, NSW 2760.

See & hear ADC Products at

Sydney City and Metropolitan Area

Douglas Hi Fi
338 George St., SYDNEY 2000
Phone 2333922

Russin Hi Fi
256 Liverpool Rd., ASHFIELD 2131
Phone 7992421. John Russin.

Leisure Sound
871 Pacific Highway, CHATSWOOD 2067
Phone 411 4944 Alex Haindi
387 George St., SYDNEY 2000
Phone 291364 Andres Goldfinch

Buyers World (NSW) Pty. Ltd.,
Shop 7, Lindfield Arcade,
Lindfield Ave., LINDFIELD 2070
Phone 4672500. Rob Simpson.

Warringah Hi Fi,
Shop 5, Bungan St., MONA VALE 2103
Phone 9975313. A. Preston.

Riverina Hi Fi
549 Pittwater Road,
BROOKVALE. 2100
Phone 9382663. Nich Barovsky.

NSW Country

Springwood Hi Fi
170 Macquarie Rd., SPRINGWOOD 2777.
Phone (047) 513091. L. Johnston.

Wroth Hi Fi,
63 George St. (PO Box 452)
BATHURST 2795
Phone 316313. Michael Wroth.

Scotty Wallace Pty. Ltd.,
113 Rankin St., FORBES 2871.
Phone 522300. Scott Wallace.

Hi Fi Gallery
(C/- P.O.), Tamworth Centrepoint,
374-388 Peel St., TAMWORTH 2340
Phone 662474. L. Taylor.

John Roworth Television Services,
11 White St., TAMWORTH 2340
Phone 664664. J. Roworth.

Taree Photographics
Graphic House, 105 Victoria St.,
(P.O. Box 295) TAREE 2430
Phone 521488. M. Small.

ACT Duratone Hi Fi Pty. Ltd.,
3A Botany St., PHILLIP 2606
Phone 821388. M/s Fay Cull.

VIC Douglas Hi Fi
202 Bourke St., MELBOURNE 3000
Phone 6632211

QLD Brisbane Agencies Audio Centre,
72 Wickham St., FORTITUDE VALLEY 4006
Phone 2683167. G. Eldund.

Ipswich Hi Fi Centre,
61 Limestone St., IPSWICH 4305
Phone 2815485. Robert Smallwood.

Sight and Sound Investments,
Shop 8, Shaws Arcade,
TOWNSVILLE 4810
Phone 715618. Stephen Shaw.

SA Soundynamics Hi Fi Centre,
129 Payneham Rd., ST. PETERS 5069
Phone 421237. Peter Hazelwood.

Instrol,
54 Flinders St., ADELAIDE 5000
Phone 2237622

WA Hub Record & Hi Fi Centre,
Gilmore Ave., CALISTA 6267
Phone 991256. R. Takes.

Albert's Hi Fi,
542 Albany Highway,
VICTORIA PARK 6100
Phone 621188

396 Murray St., PERTH 6000
Phone 3224409

288 Hay St., East, PERTH 6000
Phone: 252699

Leslie Leonard Hi Fi,
Shop U8 City Arcade,
Upper Hay St., PERTH 6000
Phone 224304

TAS Quantam Sound Centre,
194 Liverpool St.,
(P.O. Box 1788) HOBART 7000.
Phone 343051. R. MacFie.

NESSEL LOUDSPEAKERS

PROFESSIONAL SERIES

Rugged cast aluminium

27½" W x 7" High x 19" deep.
90° lip horn
Throat adaptors for screw-on 1 ⅜" and 1" entry.
500 c/s crossover

Range of speakers

Model:

SL1201: 12" 4" coil, 100W, Guitar Bass PA, 8 kg, 80 c/s.
SL1502: 15" 4" coil, 150W, Guitar Bass PA, 9 kg, 55 c/s.
SL1403: 15" 4" coil, 200W, Bass PA, 14 kg, 70 c/s.
SL1803: 18" 4" coil, 200W, Bass, 14 kg, 50 c/s.

TRADE ENQUIRIES WELCOME

Available from

nessel

NESSEL AUDIO

**9 Neilbern Rd,
Moorabbin East, Vic. 3189
Ph (03) 95 9510**

Fed up trudging round town to find components?

VESCO

ELECTRONIC SUPPLIES

**318 Huntingdale Rd, Huntingdale.
Vic. 3166. Cnr. of Hume St.
Phone 543-4826.
Open Fri night till 9pm & Sat morn.**

WE STOCK A LARGE RANGE OF ARLEC QUALITY PRODUCTS

• DMM10 digital multimeter. • Case to suit above available. • 200H, YF370 & MF15A analog meters. • AC/DC adaptors PS 393 & PS 369. • PCI instrument cases. • Talisman 12V battery chargers • 100 amp jumper leads. • Light dimmers & night lights • Suppressor kits.

SOANAR, PHILIPS, SIGNETICS COMPONENTS & SEMICONDUCTORS

• Elna capacitors. • Full range of electronic hardware. • Resistors, diodes & rectifiers. • CB Antennas — $7.50 each. • Potentiometers, audio leads.

STOCKISTS OF ZEPHYR PRODUCTS

• RCF & Primo microphones. • Plessey speakers. • Matrix boards. • LPS-1 lubricant. • JBL, KEF, RCF, ALTEC, GAUSS, FOSTEX. • Audio & Hi-Fi equipment. • Auditec modules. • PCB pins & Cirkit. • Goldring cartridges. • Garrard turntables.

• TDK C90 cassettes, Forward & Ralmar. • Zippy instrument cases. • Sound Barrier car equipment. • Eveready batteries. • Hills TV accessories. • PVC Insulation tape. • Motorola semiconductors. • Hook-up wire & cables. • Adcola soldering irons. • Trio and B & K test equipment. • PCB board at low prices.

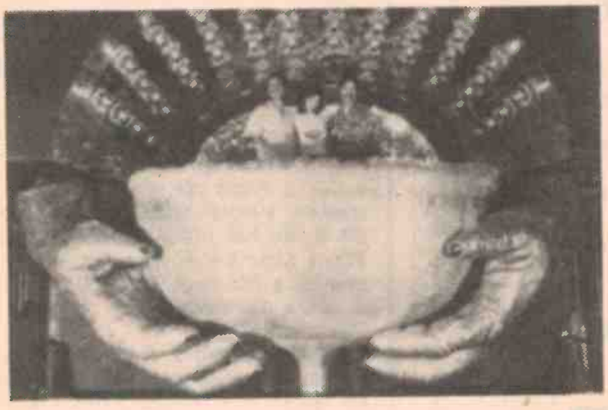
Mail order for country areas

VESCO ELECTRONICS
suppliers to the electronic industry, government and educational departments and the hobbyist. Prompt and friendly service is our aim.

TRADE ENQUIRIES WELCOME.

PROFESSIONAL

On location: Stanton is there where TGIF (Thank God, It's Friday) is filmed.



Go to the Club called *Osko's* in the Los Angeles Area. Revel in the sound around you, supplied to Osko's by Sound Unlimited Systems, Inc., a prime packager of Disco systems. They have supplied 90 systems to Stationary facilities and 60 to Mobile operations.

Sound Unlimited swears by Stanton's 500AL because they have used it for many years until Stanton came out with the 680 EL. Now they use this model exclusively in all of their installations, and endorse it without reservation.

Whether your usage includes recording, broadcasting, archives, Disco or home entertainment, your choice should be the overwhelming choice of the Professionals in every field . . . Stanton Cartridges.

P.S. "Thank God It's Friday" has turned out to be a dynamite film starring Disco Star, Donna Summer.

STANTON!

And remember, you can't get the best out of your Stanton Cartridge unless you use a genuine Stanton Stylus.

Sole Australian Distributors

LEROYA INDUSTRIES PTY LTD

W.A. Head Office: 156 Railway Pde., Leederville 6007. Phone 381 2930.
N.S.W. Office: 7 Jordan Rd., Wahroongah 2076. Phone 487 2543.

LER 214

LED Pendant

WANTING TO IMPRESS upon one's partner that electronics is not a boring useless occupation, has inspired many an electronic engineer to build egg-timers and liquid overflow indicators, etc. for their loved ones.

However, such devices, appreciated though they may be, cannot usefully be exhibited at parties and pubs to achieve maximum admiration. An obvious solution is electronic jewellery.

Before LEDs became commonly available it was possible to build illuminated jewellery using miniature catheter bulbs. But the current drain still involved the inelegant strapping-on of bulky power supplies and concealed switches.

Nowadays, by using LEDs and CMOS 'chips', it is possible to build a piece of self-contained jewellery that doesn't even need an on/off switch.
Electronic jewellery may take virtually any form that the designer seeks — the main limitation being availability of miniature resistors which are often hard to find in this country.

The example shown was in fact built using 1/8th watt resistors obtained from the UK. IRH manufacture a range of 1/4 watt resistors which are marketed via A & R-Soanar and only minor changes are needed to the mechanical details shown to accomodate these.

The operation is as follows. Upon touching the contact plates the seven-segment LED flashes between the two sections of the design for about eight seconds and then switches off again.

The pendant is not limited to letters that the seven segment display can handle. There is nothing to stop the reader from hard-wiring LEDs into dot patterns of any desired form.

(The prototype shown here was designed to flash the initials BJ).

Project 552

Mechanical Construction

Because one of the design aims was to keep the width to a minimum a common pc board design is impracticable. Therefore the components are hard wired and we do mean *hard* wired.

The front panel is cut from 16 SWG aluminium with a window for the seven-segment display and two holes below, with sufficient clearance for the heads of 8BA cheesehead screws, filed smooth. The red perspex window and the 8BA screws are fixed to the front panel using epoxy resin. Then the front is sanded down and polished. The epoxy insulates the contacts from the aluminium and also provides mechanical anchorage.

Electronic Construction

When the front facia is finished, the electronics can be mounted with super glue or epoxy resin (having first centralised the display over the window).

Great care must be taken to prevent shorts. Tinned copper wire and PTFE sleeving to suit, was used to hard wire the circuit as in the wiring diagram. Small pieces of tin plate were stuck down with double sided sticky pads for the battery contacts.

The sticky pads serve a dual purpose. They insulate the contacts from the front panel and also provide the tension to ensure good electrical contact.

Fig. 1a is the monostable and astable multivibrator which is the basic circuit. Fig. 1b and 1c show alternative circuits for BJ and AL respectively.

HOW IT WORKS - ETI 552

The prototype was designed with the initials BJ in mind, which was very convenient as the segments b, c, d and e remain on the the monostable period and segments a, f and g flash at 1 Hz to complete the letter B (Fig. 1 a, b).

To illustrate the technique involved in obtaining different combinations of letters, a further circuit (Fig.1 c) was designed to accommodate the letters A, L. This requires a further transistor Q3 and resistors R9 and R10 to give an inverse function. This circuit will be described in detail.

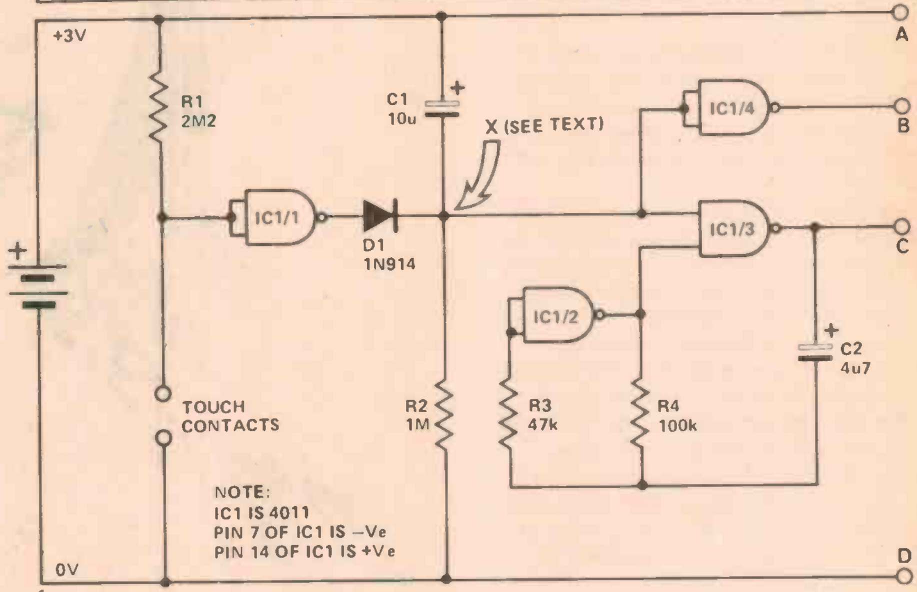
Under quiescent conditions no measurable current is drawn. When the touch plates are joined by a finger, inverter 1 discharges C1, this point X goes high for about 8 seconds, as C1 charges down. Then, via inverter 4, Q1 turns on and lights LED segments e and f. These remain on for the monostable period.

The output from the astable (gates 2 and 3) is initially low after the beginning of the monostable period, so that Q2 is switched on. This lights segments a, b, g and c, but Q3 is switched off via Q2, so that segment d is off. Thus the letter A is formed.

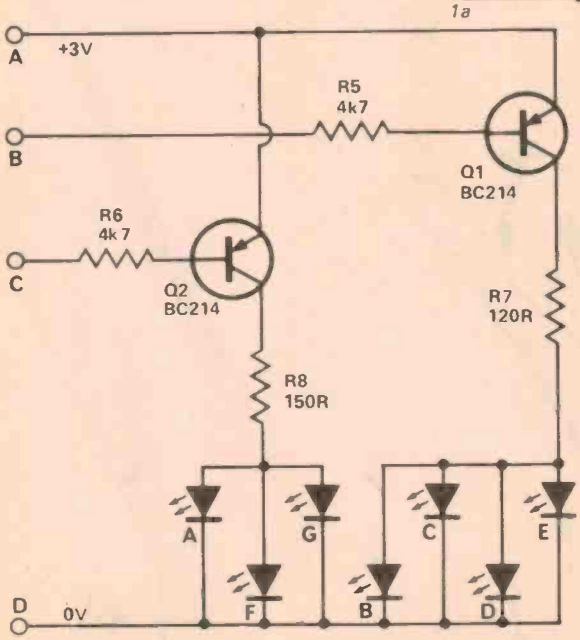
When the astable changes over Q2 is switched off, turning Q3 on, and lighting segment d. Thus with segments e and f on, the letter L is lit up.

Resistors 7, 8, 11 and 12 are chosen so that all segments have the same current and thus the same intensity. In this case about 2 mA per segment forms a compromise between battery drain and visibility.

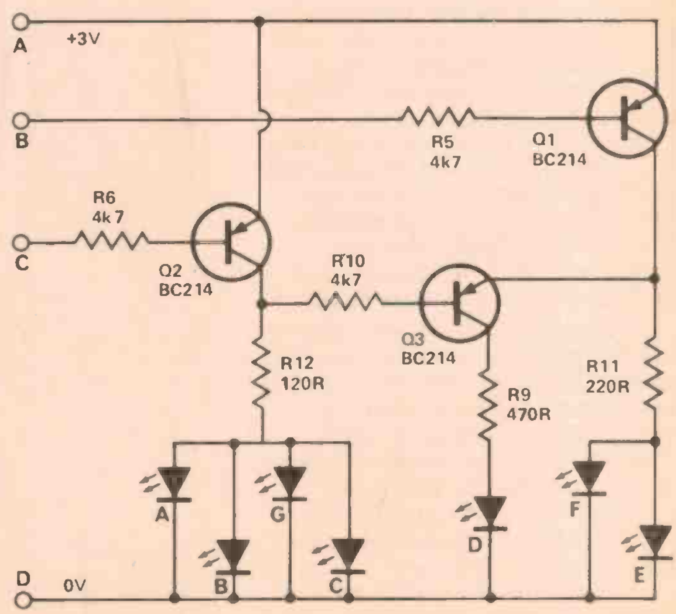
The batteries are Mallory MS76H 1.5 volt cells and in the prototype a life of two months was typical, with approx two minutes usage a day.



1a



1b



1c

Finishing It Off

When all the wiring is complete the battery compartments need to be constructed. Make up two tubes of the same external diameter as the batteries from cellophane or plastic and position them on the facia over the battery contacts, then pour quick-set epoxy around the tubes. When the epoxy has set remove the tubes and you have two battery compartments.

Make up another cellophane or plastic tube about 37 mm in diameter. Place this around the finished electronics and battery compartments and pour more clear-cast over to cover everything to the depth of the battery compartments. When this has set a thin sheet of aluminium can be screwed down with countersunk self-tappers. (This sheet forms the common connector for the two cells).

PARTS LIST – ETI 552

Resistors all 1/8 W 5% or smaller

R1	2M2
R2	1M
R3	47k
R4	100k
R5,6	4k7
R7	120R
R8	150R

Capacitors

C1	10μ 6V3 tantalum
C2	4μ7 16V tantalum

Semiconductors

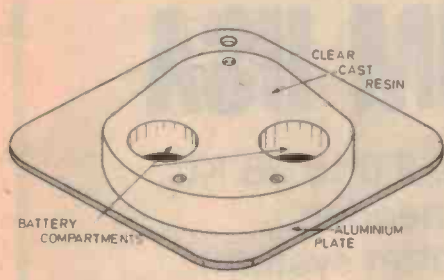
IC1	4011
D1	1N914
Q1,2	BC214
DISPLAY	7-segment common cathode type

Additional components for the circuit shown in Fig. 1(c)

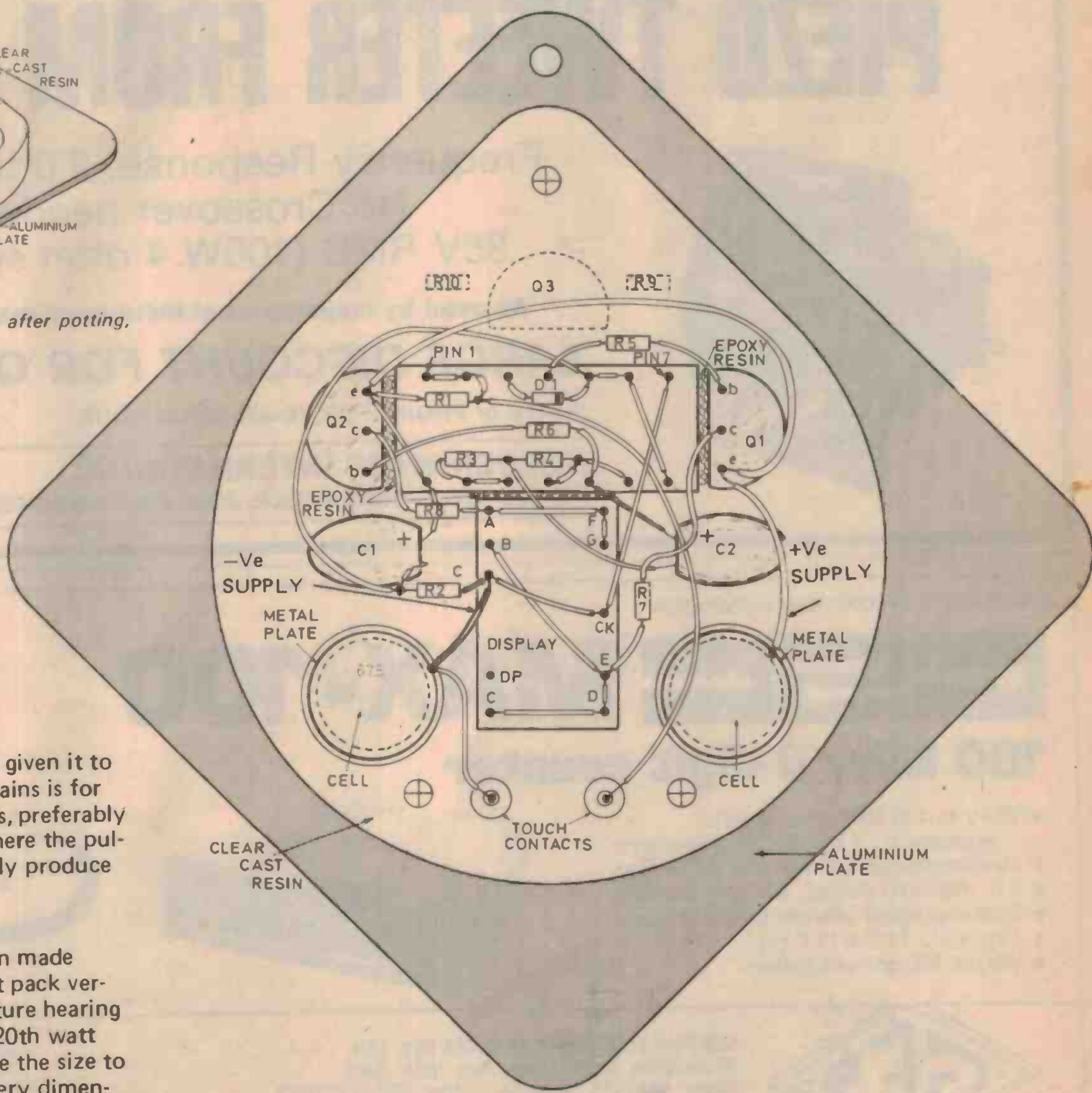
R9	470R
R10	4k7
R11	220R
R12	120R
Q3	BC214

Miscellaneous

Piece aluminium 14 B&S 50 mm square, piece red perspex 21 mm x 12 mm, epoxy resin, 2 off 6 BA brass cheese-head bolts, 19 B&S tin plate, 28 B&S tinned copper wire, PTFE sleeving, 2 off Mallory MS76M cells.



LED Pendant as seen from rear after potting, note battery compartments.



Component layout, shown at twice times life size.

Presentation

Having built the device, and given it to your loved one, all that remains is for you to reap your just rewards, preferably in dimly lit surroundings where the pulsating red glow will hopefully produce the desired effect!

Note

This project could have been made much smaller by using a flat pack version of the 4011 and miniature hearing aid type transistors, and 1/20th watt resistors. This would reduce the size to almost the display and battery dimensions. But by using commonly available components a respectable size has been achieved.

ELECTROCRAFT

COMPLETE RANGE OF TV & FM AERIALS

- Hills Channelmaster. Matchmaster 2010 Airways Screened colinear $58.26
- 215 8 Element yagi high gain $25.29
- EFC.1 75-ohm city anti ghost $32.55
- EFC.2 75-ohm Outer city $42.96
- EFC.3 75-ohm Fringe area good anti ghost high gain $62.51
- EFC.4 75-ohm Outer fringe $78.64
- Channel master complete range crossfires etc.
- 3111 Coloray $41.98

CB RECEIVERS ELECTROPHONE

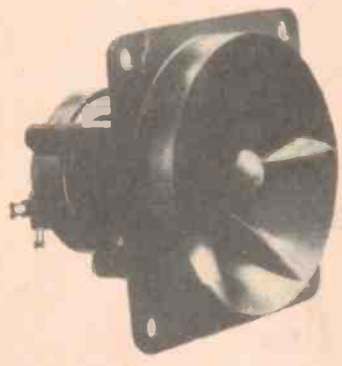
- AM CB512 .... $72.50
- AM CB530 .... $84.00
- SSB CB550 .... $197.00
- SSB Base station $248.00
- President Grant SSB 23 ch: with 18ch. Mod kit 2 only $229.00
- 1 only slightly marked $220.00
- CB UHF beam 15 el: 15dB gain 467 to 477Mz $31.00
- Rotators CDE. AR22XL $124.00
- Build your own CB power supply. Black Vinyl case $3.50 holes drilled for Ferguson transformer 240V to 18V60VA $8.95 Regulator 13.8V 2.2amp $2.94. Circuit supplied.

SWR & POWER METER

Model ME-11X is SWR and Power Meter with Directional Coupler incorporated. For SWR measurement it uses the Directional Coupler, comparing the power supplied to and reflected from the antenna, and this is indicated on the SWR meter. For power measurement, the power meter indicates the travelling wave power detected by the Directional Coupler and its frequency range is determined by the figure of Variable Resistor which is for sensitivity adjustment. **Specifications:** Maxium handling power, 100W. SWR indication, 1:1 to 3:1. Frequency range, 3.5 to 150 MHz. **PRICE: $16.20.**

ELECTROCRAFT PTY. LTD, 68 Whiting Street, Artarmon. NSW. 2064. Tel: (02) 438-3266

PIEZO TWEETER FROM USA



Frequency Response: 3.8 to 28 KC.
No Crossover needed.
35V RMS (100W 4 ohm system).

As used by major musical instrument manufacturers.

LARGE DISCOUNT FOR QUANTITY

WRITE or PHONE FOR RE-AN CATALOGUE.

HOLDEN WASP INTERNATIONAL
PO Box 532, MARRICKVILLE. 2204. Phone 560-3488.

CONTINENTAL SPECIALTIES CORPORATION

CSC MAX-100

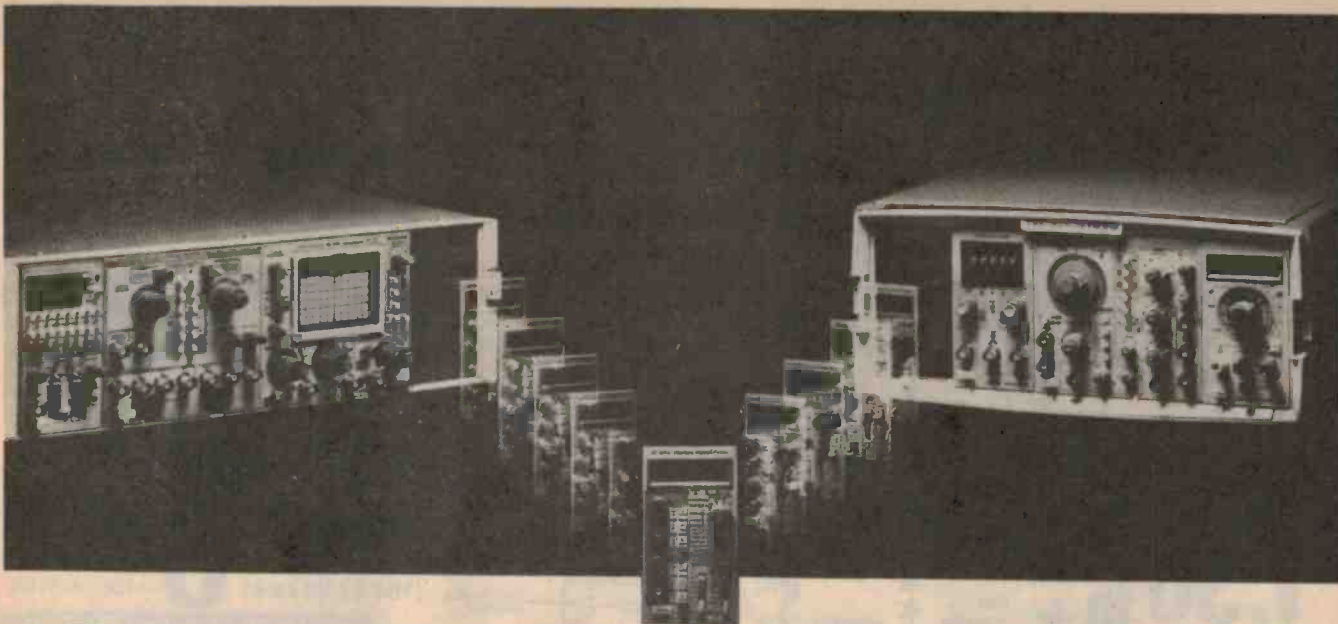
100 MHz 8-digit counter

- 20 Hz to 100 MHz (guaranteed)
  Accuracy: ± 1 count + Time base error.
- Input impedance: 1 M ohm shunted by 56 pF.
- 0.6" high LED display, lead-zero blanking.
- Battery operated with low battery indicator.
- Size: 4.5 x 14.2 x 19.7 cm.
- Weight: 680 gm with battery.

EX-STOCK
$180 + Sales Tax

GENERAL ELECTRONIC SERVICES PTY. LTD.
99 Alexander Street, Crows Nest, NSW. 2065.
Phone: 439-2488, 439-2399. Cables: SERVO SYDNEY.
Telex: 25486 A/B SERVO.

Adelaide: 42-6651
Canberra: 95-9138, 82-3581
Brisbane: 277-4311
Melbourne: 598-9207
Newcastle: 69-1625
Perth: 325-5722



Stock Exchange.

If you want the highest return for your instrument dollar, take a look at the unmatched value of an electrically configurable TM500 test and measurement system from Tektronix.

Not only do you get Tektronix bluechip performance and reliability, but also the convenience and versatility of a plug-in instrumentation, at a very reasonable cost.

If your applications are diversified, TM500 gives you the power to configure literally thousands of plug-in combinations, all mechanically compatible in your choice of TM500 mainframes.

There are nearly 40 different plug-ins to choose from, in eight major categories:

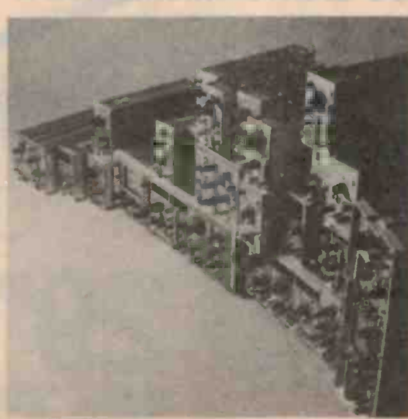
DMMs	Oscilloscopes
Counters	Logic Analyzer
Generators	Word Recognizers
Amplifiers	Power Supplies

A single mainframe accommodates up to six plug-ins. Switching your system around from one application to another is just a matter of a simple stock exchange. Slip one plug-in out, slide another one in.

If your applications are growing, a TM500 system is a wise investment. You can update your system or add on new performance capabilities to your initial TM500 system without buying another mainframe. Since all plug-ins are powered through the mainframe, you won't be paying for an unnecessary power supply component with every new instrument you buy.

TM500 go-anywhere mainframes come in six different versions for benchtop, rackmount, rollcart or on-the-road engineering.

Another long-term advantage is, as new standards are set in electronics, new instruments will be added to the TM500 family — like our 40 MHz funciton generator with log sweep, phase lock, AM and FM capabilities and a long list of added dividends.



Your investment is further protected by Tektronix Long-term Product Support Program and worldwide over-the-counter service.

So, if you're in the market for accurate, reliable instrumentation, take stock of what TM500 has to offer. In convenience, versatility and economical performance, TM500 pays big dividends.

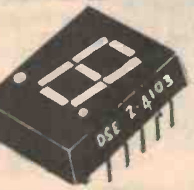
TM 500
Designed for Configurability

Write for full technical details and prices to Tektronix Australia Pty. Ltd., 80 Waterloo Rd., North Ryde. N.S.W. 2113 or phone Sydney 888 7066, Melbourne 818 0594, Brisbane 31 2896, Adelaide 223 2811, Perth 325 4198.

Tektronix®
COMMITTED TO EXCELLENCE

TK/7

INCREDIBLE BARGAIN LEDS



7 segment readouts: brand new, prime spec – as used by Electronics Australia.
LT303 common cathode – exact equiv. to Texas TIL313 and H/P 5082-7740.

BUY NOW AND SAVE:

$1.30 each 10 + Cat Z-4103

(OR $1.50 IN SINGLE QUANTITIES)

LED INDICATORS AT BARGAIN PRICES, TOO!

Prime spec devices, hundreds of uses. Be quick for these!
Small red – Cat Z-4010
Large red – Cat Z-4030

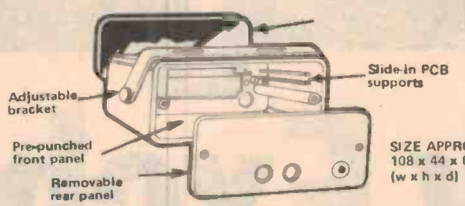
20¢ each 10+
or 22c each

WOT'S NEW?

Handy size plastic project case

ESPECIALLY SUITABLE FOR DIGITAL READOUTS – CLOCKS, TACHOS, METERS, ETC.

Yes! A compact plastic case ideal for all of those digital readout projects. Front of case is red perspex backed by a false front to support readouts. There is also room for a couple of pots or switches. The rear panel comes out too, revealing PCB supports to make simple PCB mounting. A truly versatile little case which comes complete with mounting bracket as shown.



INCREDIBLE VALUE! $3.60
(10+ $3.00 each) Cat H-3194

COMMERCIAL ENQUIRIES WELCOME!
Interested in buying this case for commercial use? Or other items on this page or in our catalogue? Generous quantity discounts are available to commercial users and resellers: ring Gary Johnston (02 - 439-5311) for details and terms.

WATCH THIS SPACE

AND FIND OUT WHAT YOU MISSED!
Each month, all of our stores feature an outstanding special which is actually BELOW COST! All you have to do is pop into your nearest store to find out what it is. N.B. – Specials are STRICTLY 'while in-store stocks last'. Don't miss out!

LAST MONTH:

A TE22D AUDIO SIGNAL GENERATOR FOR $49.70 NORMALLY $95.00

SAVING $45.30

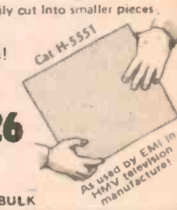
WHAT'S THIS MONTH'S SPECIAL? CALL IN AND FIND OUT YOURSELF!

FIBREGLASS PCB from $1.00 per sq ft!

IDEAL FOR ALL PROJECTS – Easily cut into smaller pieces
SIZE 13" x 14" (1.26 sq ft)
NORMAL PRICE OVER $6.00 each!

SPECIAL $1.50
10 or more $1.26

BUY A YEAR'S SUPPLY NOW – AND SAVE A FORTUNE!
GET WITH A FEW FRIENDS: BUY IN BULK



STILL SUFFERING?

There's plenty of cold weather left yet – and that first cold shock of the morning can well ruin your whole day!

Why put up with that icy shock? A Dick Smith Warmed Toilet Seat will start your day (and end it) delightfully warm. It costs peanuts to run and plugs into any p/point.

$32.50
Cat X-2000

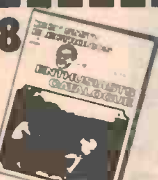
SHEER LUXURY!

TEST CLIPS for meters, etc

For hands-free measuring. Two styles, both with spring action and hooked end. Wires insert easily – positive connection.
Small: Cat W-4580 .. .. 75c (or 50c each for 10 or more)
Large: Cat W-4589 .. .. $2.20

from 50¢

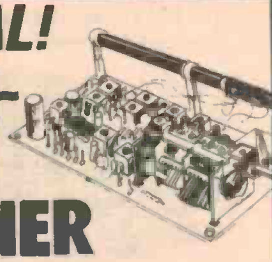
DICK SMITH'S 1978 CATALOGUE *FREE*



Contains a mind-boggling selection of products for electronics enthusiasts, car buffs, home handymen and hi-fi fiends!
• HUGE 8 PAGE DATA SECTION •
As published in April 1978 Electronics Australia
Get you FREE copy: Send in the coupon TODAY!

Name ....
Address ....
.... State .... P'code ....

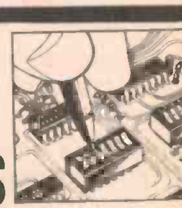
SPECIAL! AM-FM TUNER



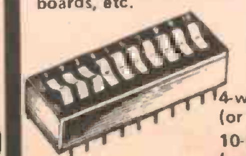
Top value: '000s in use all over Australia. Brilliant AM and FM/Stereo FM reception, and we've knocked a massive $8.00 from the price. Buy now and save while stocks last. Note: not a kit – ready to go. All you do is connect to power & amplifier! Cat F-4615.

29.50
SAVE $8.00

NEW! PCB DIL SWITCHES



4 or 10 SPST rocker switches mounted in a DIL package – ideal for PCB mounting. Use for pre-programming, for changing circuit constants on boards, etc.

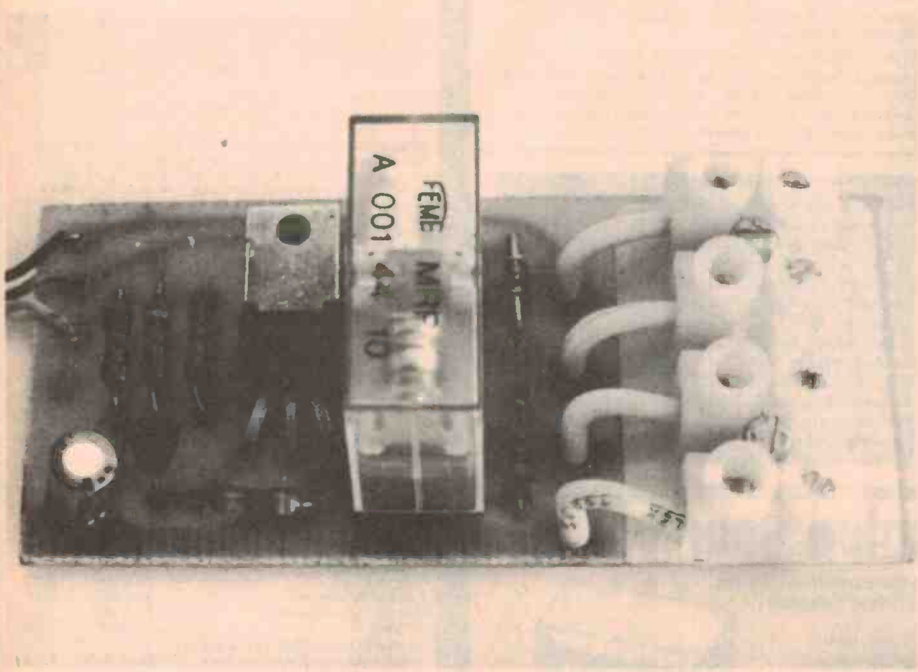


from $1.70
4-way: Cat S-1604 .. $1.85 (or $1.70 for 10 or more)
10-way: Cat S-1610 .. $2.95 (or $2.65 for 10 or more)

Project 319

Vari Wiper Mk2

This pulsed windscreen wiping circuit can be used on cars fitted with most types of modern wiper motors.



WHEN OPERATING IN heavy rain windscreen wipers often have difficulty providing adequate visibility However, during light rain or mist all that is necessary is an occasional sweep of the blades at intervals of a few seconds.

Turning them on and off repeatedly takes the driver's concentration off the road, and his hands off the wheel, increasing the risk of an accident. Alternatively, if the wipers are kept working all the time in such conditions the blades tend to scrape on dry glass, wearing out the rubber inserts, your nerves, and worse still, the screen itself.

The answer is obvious; have the wipers operate intermittently at a duration which can be varied to suit the conditions.

This project is an updated version of the popular ETI 301 Vari-Wiper which appeared in the May 71 edition.

Figure 1 shows the circuit of a modern wiper assembly. Dynamic braking is achieved by applying a short across the armature, by a cam-actuated change-over switch synchronised with the wiper blades. When the wipers are switched off, the change-over switch shorts out the motor armature via the main wiper ON/OFF switch.

The circuit of fig. 2 is suitable for use with negative earth cars fitted with permanent magnet motors. Some early model cars are fitted with wound field coil motors and are not suitable for use with this circuit (more about them later).

Some types of permanent magnet wiper motors, especially those on British cars, have a fifth wire extended to the wiper switch. These motors are designed to operate independently of an earth to allow for their use on either positive or negative earth vehicles. The circuit of fig. 2 can also be used with these motors provided they are fitted to a negative earth car. However, some more expensive imported cars have wiper motors which are reversed in the parking sequence to lower the blades below the bottom of the windscreen when not in use. The Vari-Wiper unit described cannot be used with these wipers.

Before installing the Vari-Wiper unit make sure that you have one of the types of permanent magnet wiper motors described. If necessary remove the cover of the motor and identify the wire to the centre contact of the cam-operated switch.

Normal Wiper Operation

Conventional operation of the wipers is obtained by using the vehicle wiper switch in the normal way. Figure 2 shows the sliding contacts of this switch in the correct position for each function. Note that in the off position the switch shorts lead B to lead C. In the SLOW position the short is removed and an earth is extended to B, while in the FAST position the earth is removed from B and extended to A. For single speed wipers slide contact A will be omitted.

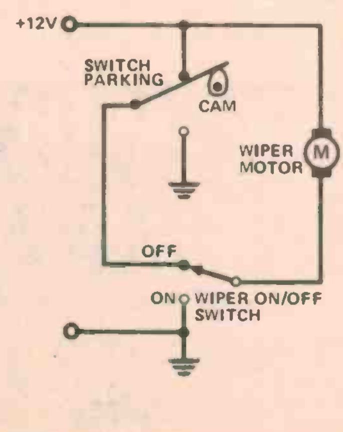


Fig. 1. Circuit of modern wiper motor assembly. Dynamic braking is achieved by applying a short across the armature.

HOW IT WORKS - ETI 319

The timing circuit is energized by operating switch SW1, which is part of switch/potentiometer RV1. This switch applies power to the unijunction/SCR circuit via the still-closed parking switch contacts.

Capacitor C1 charges via RV1 and R1, at a rate determined by the setting of RV1, until the unijunction 'fires', producing a positive going pulse which triggers the SCR into conduction. Resistor R4 ensures that the SCR latches on, thus energizing relay RL1.

Relay contacts RL1 (1) now changeover, removing the short circuit from the motor armature before energizing the motor by extending an earth via the now-closed relay contacts.

As the motor gathers speed, the associated cam-actuated switch changes over, removing power from the timing circuit (causing the relay to drop out) and extending an earth to the wiper motor via wiper switch contacts B and C, the now de-energized relay contacts, and the cam-actuated switch.

The wipers continue their sweep across the screen, but on their return the cam-actuated switch cuts in just before the end of the sweep. This removes power from the wiper motor and places a short circuit across the armature.

Operation of the ETI319A unit is similar except the motor, which does not require dynamic braking, can be driven directly from the SCR, saving the cost of a relay. Note that either D1 or D2 become redundant depending on the polarity of the vehicle.

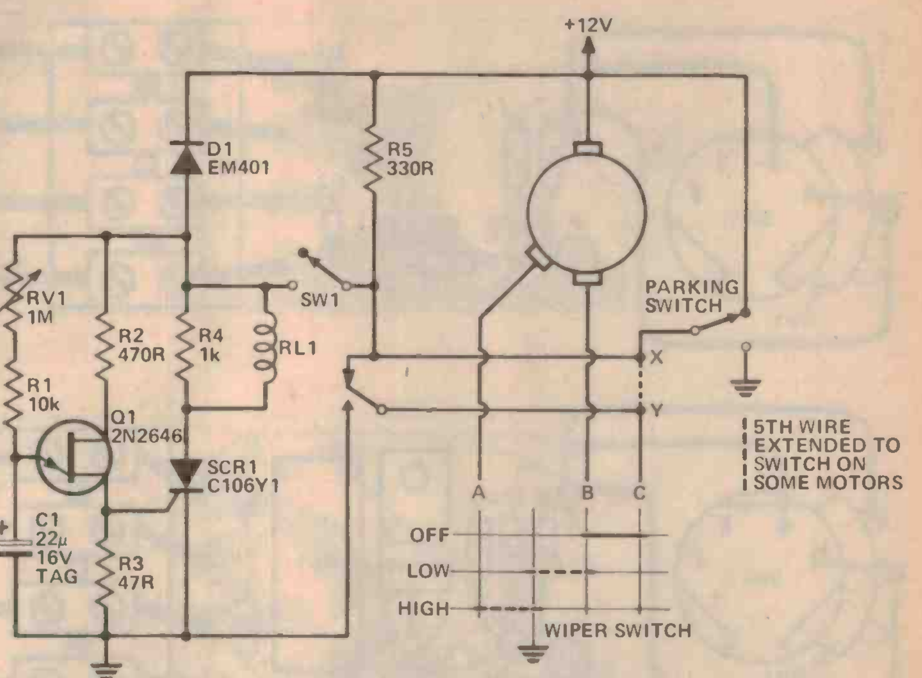
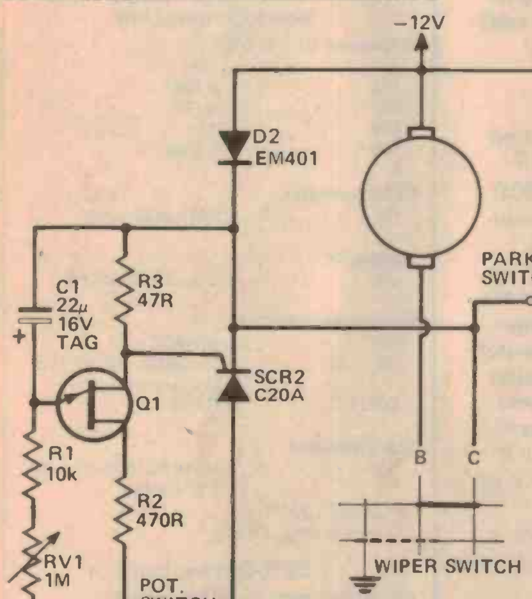


Fig. 2. The ETI319B Vari-Wiper circuit using relay output for use with permanent magnet motors.



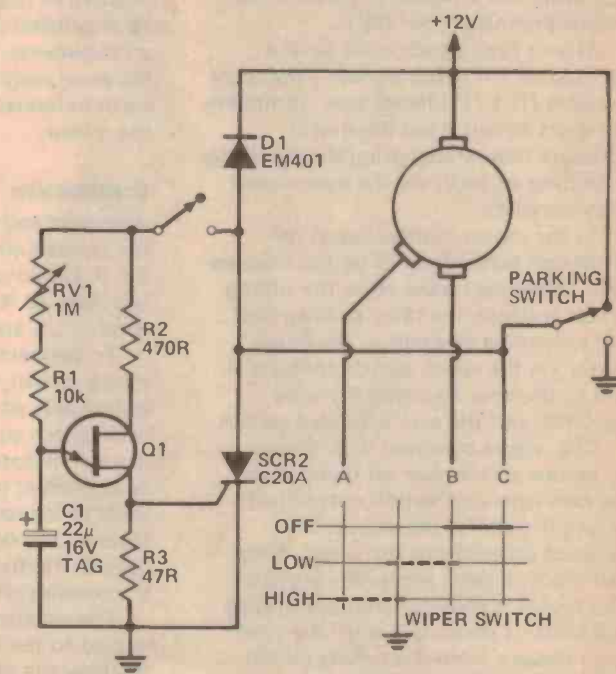


Fig.3. Simplified ETI 319A Vari-Wiper for use with wound field coil motors. The right circuit is for use with negative earth vehicles, and the left for positive earth. Both share the same PCB.

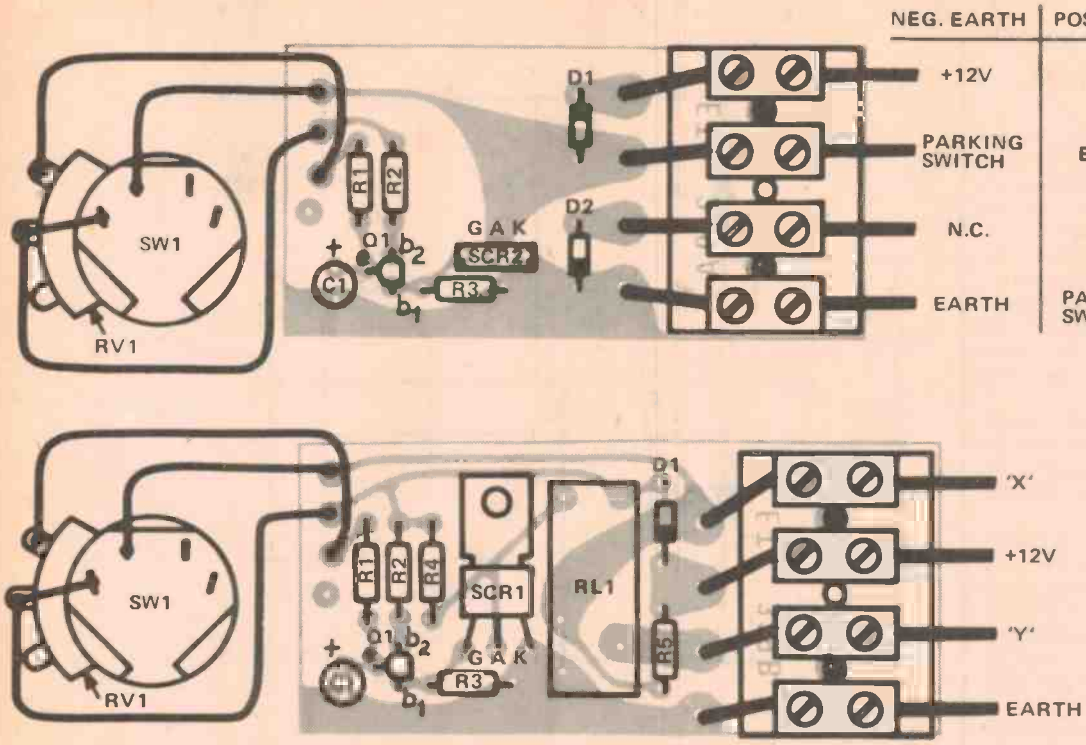


Fig. 5. Component overlays. Note that the same PCB is used for both earth polarities on the ETI 319A.

Delayed Operation

When delayed operation is required, the upper switch is left in the OFF position and the timing circuit energised by operating SW1 which is part of the switch/potentiometer RV1.

After a time which is set by the position of RV1 (0.5-25 secs.) the relay contacts RL1 (1) change over, removing the short circuit from the motor armature before energising the motor by extending an earth via the now closed relay contacts.

As the motor gathers speed the associated cam-operated switch changes over, removing power from the timing circuit (causing the relay to drop out), and extending an earth to the wiper motor via the wiper switch contacts B and C, the now de-energised relay contacts, and the cam-activated switch.

The wipers continue their sweep across the screen, but on their return the cam-operated switch cuts in just before the end of the sweep. This removes power from the wiper motor and places a short across the armature. The motor is thus dynamically braked and remains stationary until the next relay closure from the timing circuit. When this arrives the sequence is repeated.

Wound Field Coil Motors

Because wound field coil motors do not use dynamic braking, the Vari-Wiper can be made without a relay. Figure 3 shows the simplified Vari-Wiper circuit and its connections to either a positive or negative earth vehicle. The same printed circuit is used for both arrangements. Operation is similar to the previously described unit, having an earth extended through the SCR to start the motor.

Construction

Assemble and solder all components on the printed circuit board as shown in fig. 5. Do not bend the lugs of the SCR too close to its case and ensure all semiconductors are the right way round.

To connect the unit to the wiper motor circuit, the existing lead from the centre pole of the wiper motor change-over switch to the wiper ON/OFF switch (shown in dotted lines in fig. 2), should be broken at points X and Y and these leads taken to the normally closed contacts on the relay. Ensure that point X goes to the fixed contact and point Y to the moving one.

The potentiometer should be connected to the unit with just enough wire to allow the printed circuit to be mounted in a convenient position under the dash. The potentiometer can be mounted through a 10 mm hole drilled in the facia panel or by attaching it to a bracket mounted in a convenient place.

PARTS LIST – ETI 319

Relay Output Unit

Resistors all ¼W 5%

R1	10k
R2	470R
R3	47R
R4	1k
R5	330R

Potentiometer

RV1	1M switch pot

Capacitor

C1	22μ 16 V electro

Semiconductors

D1	EM401
Q1	2N2646 or MU10 unijunction
SCR1	C106Y1

Miscellaneous

RL1	Mini PC heavy duty 12 V relay

PCB ETI 319B
Nylon terminal strip

SCR Output Unit

All components identical, except:

R5	deleted
D1/2	EM401
SCR2	C20A
RL1	deleted

PCB ETI 319A

SPECIAL OFFER
Tacho Kit $29.95

ETI 318

WE HAVE arranged with Mike Pratt of S M Electronics for him to offer ETI readers a complete kit of parts for this project at the special price of $29.95 plus $2.00 for packing and certified postage.

The kit includes all components necessary to build the project, including a metal case which has a rectangular hole in the front for the LED display.

To order, complete the coupon below, and send it, with a cheque for the appropriate amount, to: Tacho Offer, Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011. Cheques should be made payable to 'Tacho Offer'. Please allow 4-6 weeks for delivery.

Send to: Tacho Offer, Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011.

Please forward .... ETI 318 Tacho kits at $29.95 each plus $2.00 each certified postage and packing.

I enclose herewith cheque/postal order total ....

Please make cheques, etc., payable to 'Tacho Offer'.

Name ....

Address ....

.... Postcode ....

Offer closes 29 September, 1978 and is open to Australian residents only. Apologies to our overseas readers.

TANDY ELECTRONICS

There's now 120 Tandy Stores & Dealers in Australia, but if there's not one close to where you live you can order by mail.
Mail orders to: Tandy Electronics P.O. Box 229, Rydalmere, 2116
Minimum order accepted 2.50—ADD SHIPPING & PACKING EXPENSES 2.50 to 4.99 send 80c•5.00 to 14.99 send 1.50•15.00 to 49.99 send 2.50•50.00 to 99.99 send 5.00•100.00 and over send 8.00
WE WILL SHIP ANYWHERE IN AUSTRALIA FOR THE ABOVE EXPENSES!

Tandy Expands Your Listening Horizons

5-Band Communication Receiver for a World of Listening Enjoyment!

150-400 kHz Longwave
535-1600kHz AM Band
1.5-4.5 MHz Shortwave
4.5-13 MHz Shortwave
13-30 MHz Ham and CB

Covers 5 Action Bands, Including All CB Channels AM and SSB

199^{95}
Including matching speaker

Realistic® DX-160. Hear marine, aviation, weather and more on longwave. Tune in shortwave programmes and news from major cities around the globe. Get Hams and CB operators, WWV time signals, standard AM. A product detector and variable BFO bring SSB and CW reception, too. Eleven front panel controls, including electrical bandspread tuning and calibrated logging scale. With FET's in all critical stages. Zener stabilisation, noise limiting in IF and audio stages. Illuminated "S" meter. Headphone jack plus instruction manual. For 240 VAC or 12VDC neg. gnd.
20-152

Patrolman CB-8

149^{95}

- *Battery Condition/Signal Strength Meter*
- *Precision Fine-Tuning on All Bands*
- *Tunes: UHF, VHF-HI, VHF-air, VHF-Low; CB Shortwave, AM/FM*

Tunes all CB channels, foreign broadcasts, police, planes, trains—more. Has 10.1cm speaker, squelch on CB/VHF/UHF, dial light, tone control, automatic AC-to-battery switching, FM-AFC, ¼" headphone jack, telescoping antennas, jack for external SW/CB/FM/VHF antenna. Requires 6 "C" batteries. With AC cord.
12-763

Patrolman CB-6

119^{95}

- *Tunes VHF-Lo, VHF-HI, UHF, CB, AM, FM*
- *Automatic AC-to-Battery Switching*
- *All-Band Fine Tuning* • *Squelch Control*

Hear CB channels, police and fire calls, trains, trucks and aircraft, plus AM/FM. Features big 10.1 cm speaker, ¼" headphone jack, AFC on FM, dial light button, telescoping UHF and FM/CB/VHF swivel-mount antennas and external-antenna jack. AC cord. Requires 4 "C" batteries.
12-761

Shortwave Listeners' Guide

Regular price 2.25 **1^{99}** SALE

Lists stations by country, city, call letters, frequency, power, transmission times. With log.
62-2032

CB-HAM-SWL Log Book

1^{75}

Keeps accurate records of stations heard. 64 pages.
62-2034

Monophonic Headphones

7^{95}

Soft earcushions and adjustable plastic headband for comfortable listening. Standard ¼" phone plug. 8 ohms impedance.
279-200

Base Station Coax Cable Assemblies

52-ohm polyfoam dielectric cable with PL-259 connectors factory installed on each end. 15.2m RG58/U.
278-971 .... 16.95
15.2m RG8/u.
278-970 .... 26.95

Low As **16^{95}**

Morse Code Practice Set

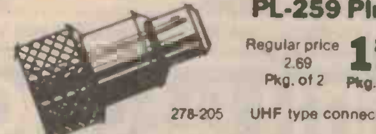
4^{99}

Buzzer, adjustable spring and contacts, headphone jack. Requires "D" battery.
20-1087

High Speed, Brass Hand Key

4^{49}

Adjustable spring and contacts. Smooth ball-bearing pivots.
20-1084



PL-259 Plug

Regular price 2.69 Pkg. of 2 **1^{80}** SALE Pkg. of 2

UHF type connections, screw-on lock.
278-205

Independent Tandy Electronics dealers may not be participating in this advertisement or have every item advertised. Prices may vary at individual dealer stores.

BUILD YOUR OWN MINI-COMPUTER & SAVE!

A COMPLETE SYSTEM FOR JUST **$369.20**

Here it is — the first system that enables you to break into the big time without spending big money! You don't have to know about computers to start — just imagine the astounded looks on your friends' faces when you tell them "I built it myself!" When you've built the system you can play games with your computer right away using the special EA/Signetics disc. Then, when you've gained some programming experience, you can use your computer for an incredible variety of tasks. A similar built-up system would cost well over $800 - think of the money you'll save by building it yourself. It's easy with a Dick Smith kit!

Your own TV set — Video Display Unit — Mini-Computer — Cassette Interface — Your own record player or cassette recorder — EA/Signetics recording

Components marked † below are required to build the system shown in this block diagram. They make a total of only $369.20!

2650 MINI-COMPUTER (See E.A. May'78)

Fantastic new 2650 Mini Computer. Complete kit includes all electronic parts, PC board and power supply plus case, Marviplate lid and deluxe brushed aluminium front panel.

Complete kit for above: Cat K-3447 .... $115.00†

SEPARATE PARTS

PCB (78 up 5) fibreglass: Cat H-8341 .... $5.00
2650 microprocessor chip: Cat Z-9201 .... $28.50
2608/CN0035 pip bug 8k ROM: CatZ-9309 .... $19.75
2114 ROM chip: Cat Z-9306 .... $14.50

VIDEO DISPLAY UNIT (See E.A. Feb & May'78)

Incredibly low cost Video Display Unit uses your own TV set as the monitor.

Basic Video DisplayKit: CatK-3460 .... $97.50†
Video Modulator Kit for above: Cat K-3462 .... $4.50†
ASCII Keyboard Encoder kit for above: Cat K3464 ... $39.50†

SEPARATE PARTS

UART IC (S1883/MM5303N/TMS6011: Cat Z-9204 . $5.90†
Keyboard Console Metalwork: Cat H-3130 .... $24.50†
Keyboard (fully assembled)· Cat X-1180 .... $55.00†

CASSETTE TAPES

AC/DC cassette recorder ideal for this system.

Cassette recorder Cat A-4092 .... $39.95
Cassette tapes: C60 LN Cat C-3350 .... $1.50
C90 LN Cat.C-3352 .... $2.00

CASSETTE INTERFACE

Enables your cassette recorder or record player to interface with mini-computers such as the 2650. Kit includes PC board and all components except power transformer. The complete PC board assembly will fit inside your 2650 mini-computer case, the 2650's transformer providing the AC power. We believe this kit to be the best available on the market to suit the 2650 system.

Complete kit (as above) Cat K-3465 .... $24.50†
PCB only (Cat H-8331) $3. 75

SOFTWARE RECORDING

This is a 33·1/3rpm recording of useful 2650 system software. Use it on your record player or dub onto a cassette and use it in your cassette interface system. Then you can program the 2650 for new programs and games. It contains 22 programs you can run.

Record Cat B-6300 .... $2.80†

PAPER TAPE READER KIT

See page 33 of our new catalogue for full details. Ideal for use with the 2650 mini-computer. Kit includes all electronic components, handsome black anodised aluminium case, ribbon interface cable and complete assembly and interface instructions, schematics and software.

Tape Reader Cat K-3466 .... $95.00

Ask at any of our stores for your FREE copy of our new Mini-Computer brochure. Contains full details of our computer kits.

DICK SMITH ELECTRONICS

bankcard welcome here

SHOPS OPEN 9AM to 5.30PM (Saturday 9AM — 12 noon) BRISBANE 1/2 Hour earlier.

· ANY TERMS OFFERED ARE TO APPROVED APPLICANTS ONLY

SYDNEY 125 York Street, SYDNEY. Ph. 29-1126
147 Hume Hwy, CHULLORA. Ph. 642-8922
162 Pacific Hwy, GORE HILL. Ph. 439-5311
30 Grose Street, PARRAMATTA. Ph. 683-1133

MELBOURNE 399 Lonsdale Street, MELBOURNE. Ph. 67-9834
656 Bridge Road, RICHMOND. Ph. 42-1614

BRISBANE 166 Logan Road, BURANDA. Ph. 391-6233

ADELAIDE 203 Wright Street, ADELAIDE. Ph. 212-1962

Many lines available from the Dick Smith Electronics Centres at

GRACE BROS ®
Broadway · Bondi · Chatswood · Liverpool
Miranda · Mt Druitt · Parramatta · Roselands
and Warringah Mall

MAIL ORDERS P.O. Box 747, Crows Nest, N.S.W. 2065. Post and packing extra.

Dealers across Australia.

Project 551

LIGHT CHASER

Low cost, simple design handles up to 1000 W per channel and can be expanded if required.

A LIGHT CHASER is a mechanical, or in this case, electronic, gadget which controls three or more sets of lights arranged in a chain. These are flashed on, one at a time in sequence, to create an illusion of movement. Such devices can be seen at fairgrounds, on advertising signs and in shop windows. Here is a design that is simple and cheap to build, and suitable for any of these applications.

Design Features

We have seen many designs for light chasers ranging from three relays switched sequentially by a motor and cam follower contacts to elaborate phase control circuits. We chose to steer for a happy medium retaining features like easily adjustable rate and zero crossing switching but still being simple and cheap to build.

To reduce cost, we decided against using an isolation transformer. Because of this, the *entire* circuit is at mains potential and should therefore be treated with due respect. By using a series capacitor which costs about $1.50, we save a power transformer ($4.50) and three pulse transformers (about $2.00 each), resulting in a $9 – $10 saving.

The unit can be expanded beyond three channels if desired by moving the reset line of IC4 (pin 15) from the fourth output to the (n+1)th, where n is the desired number of channels. The sequence in which the pins on IC4 go high is 3,2,4,7,10,1,5,6,9 and 11. Therefore for a 6 channel unit pin 5 will be connected to pin 15. The output stage consisting of the NAND gate, transistors, capacitor and triac will of course have to be duplicated for each additional channel.

The unit as described is suitable for about 1000W per channel but if additional heatsinks are used this could be raised to the 15 A limit of the triacs or, if different triacs are used (e.g. the BTW 41-400) even higher currents can be handled.

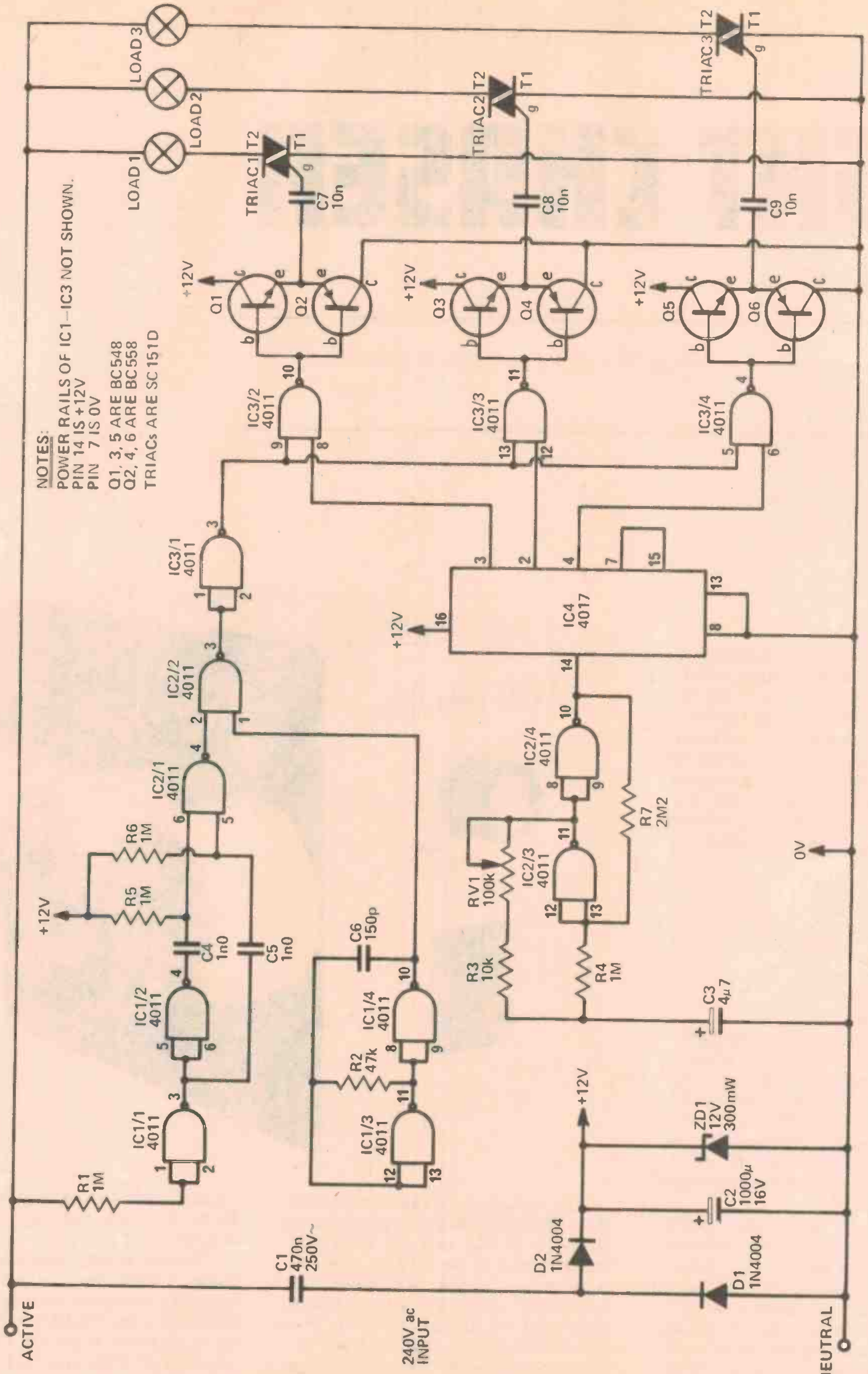


Fig. 1. The circuit diagram of the complete chaser.

HOW IT WORKS – ETI 551

A light chaser consists of three or more ac switches which are turned on, one at a time, in sequence. To make this explanation simpler, we have separated the circuit into several sections.

Power Supply

The 240 Vac is reduced to the 12 Vdc required to operate the control circuitry by the use of a series capacitor C1, the diodes D1 and D2, the smoothing capacitor C2, and is then regulated by zener diode ZD1.

Synchronization Generator

The input to IC1/1 is connected to the 240 Vac supply via the 1 M resistor R1. The value of this resistor, combined with the effects of the protection diodes inside the IC, prevent damage to the IC. The output of this device is a 50 Hz square wave which is synchronized with the mains. IC1/2 is used to invert this square wave and then the RC networks R5/C4 and R6/C5 are used to generate negative pulses on the two inputs of IC2/1 on each zero crossing of the 50 Hz signal – i.e. 100 pulses per second. The width of these pulses is about 0.6 ms.

High Frequency Oscillator

This is formed by IC1/3 and IC1/4, and runs at about 80 kHz. Its output is gated with the synchronizing pulses by IC2/2; this results in 600 μs long bursts of 80 kHz at the start of each half cycle.

Low Frequency Oscillator

This is formed by IC2/3 and IC2/4 and its frequency is variable by RV1 from 1 Hz to 10 Hz. We have used this form of oscillator in preference to that used for the high frequency oscillator to prevent reverse biasing the tantalum capacitor.

Counter

This is IC4 which is normally a divide-by-ten counter with ten decoded outputs which go high in sequence. By connecting the fourth output back to the reset, a divide-by-three is formed. This IC is clocked by the low frequency oscillator.

Driver & Output Stages

There are three identical output stages consisting of a two input NAND gate, a two transistor buffer, a series capacitor and a triac. The function of the gate is to direct the high frequency tone bursts onto the appropriate triac gate. The counter IC4 selects the required gate.

General

The use of a short tone burst at the start of each half cycle is intended to minimise RFI as the triac can only switch on at this point. This does, however, limit its use to incandescent loads. For use on fluorescent loads C4 and C5 can be increased to 10 n.

The fact that we have not used an isolation transformer reduces the cost, but it does mean that the complete circuit must be considered live! We did not use a fuse in the prototype, but one can be used if required in the active input lead. Ensure that the fuse used will protect the triac.

WARNING

The circuit described here does not use an isolation transformer and therefore all sections of the circuit must be considered dangerous.

If the unit does not work when switched on, disconnect the mains and then, using a separate dc power supply, apply 10 V across C2. Now add a 50 Hz ac signal of 12 – 32 V onto the normal active-neutral input. In this way the control circuitry can be safely checked up to the triacs.

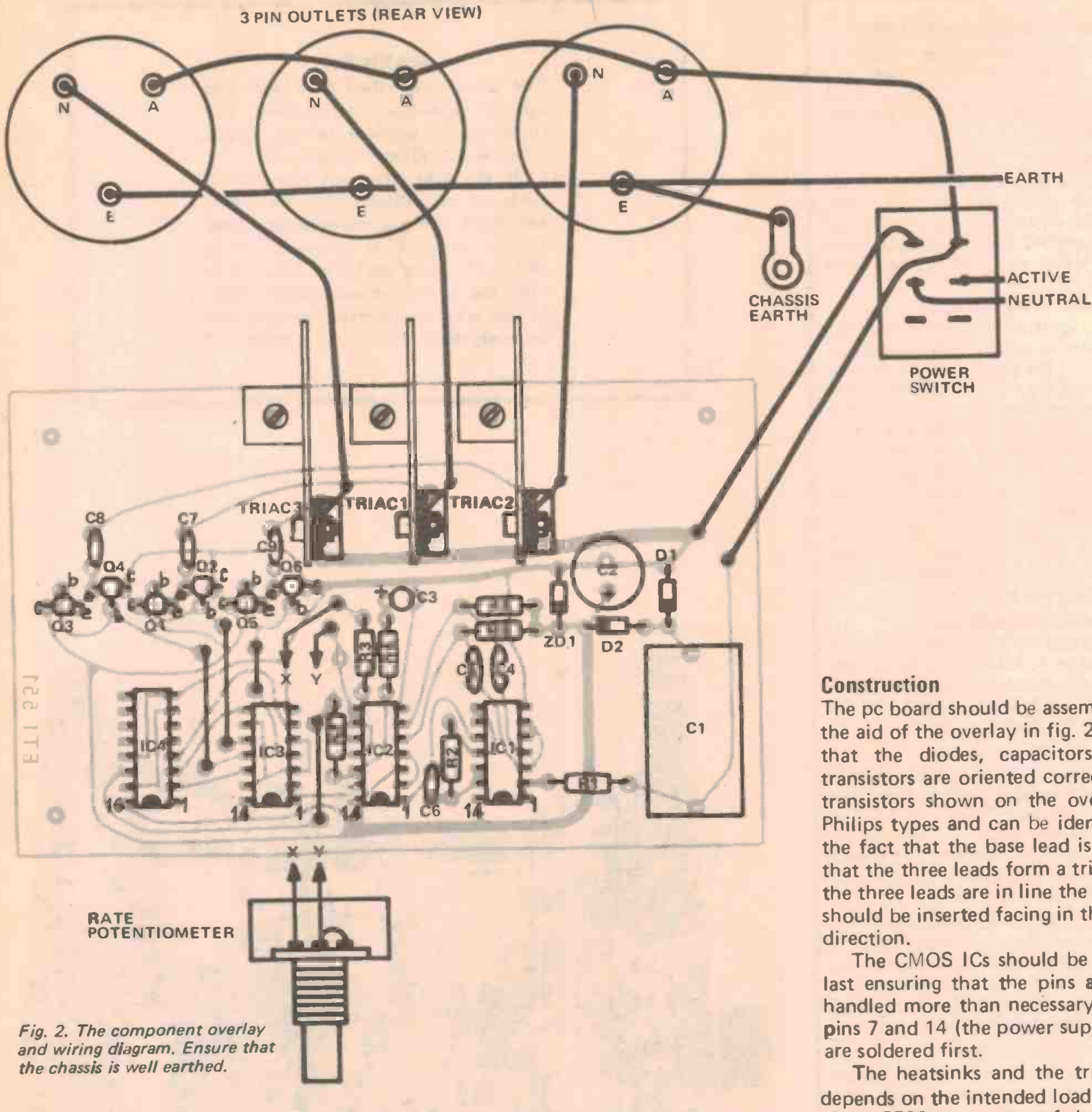


Fig. 2. The component overlay and wiring diagram. Ensure that the chassis is well earthed.

Construction

The pc board should be assembled with the aid of the overlay in fig. 2. Ensure that the diodes, capacitors and transistors are oriented correctly. The transistors shown on the overlay are Philips types and can be identified by the fact that the base lead is bent so that the three leads form a triangle. If the three leads are in line the transistors should be inserted facing in the opposite direction.

The CMOS ICs should be inserted last ensuring that the pins are not handled more than necessary and that pins 7 and 14 (the power supply rails) are soldered first.

The heatsinks and the triacs used depends on the intended load. We used about 2500 square mm of aluminum on each triac, and found this to be satisfactory for about 1000 W per channel. The tabs of the triacs are live and separate heatsinks, insulated from earth, should be used or the triacs should be insulated from the heatsink.

We mounted our prototype into a simple folded aluminium box, with an external rate potentiometer and three 3-pin sockets. If an external potentiometer is not required a trim potentiometer can be mounted on the board. To adjust this potentiometer an insulated trimming tool must be used. The unit can be wired according to fig. 2 taking care with insulation as many points are at 240 V.

PARTS LIST – ETI 551

Resistors all ½W, 5%
- R1 . . . . . 1 M
- R2 . . . . . 47 k
- R3 . . . . . 10 k
- R4–R6. . . 1 M
- R7 . . . . . 2M2

Potentiometer
- RV1 . . . . 100 k lin (trim or rotary)

Capacitors
- C1. . . . . . 470n 250 V ac (AEE type PME 271M)
- C2. . . . . . 1000µ 16 V electro
- C3. . . . . . 4µ7 25 V tantalum
- C4, 5 . . . . 1n0 polyester
- C6. . . . . . 150p ceramic
- C7–C9 . . . 10n polyester

Semiconductors
- IC1–IC3 . . 4011 (CMOS)
- IC4 . . . . . 4017 (CMOS)
- Q1, 3, 5 . . BC548
- Q2, 4, 6 . . BC558
- D1, 2 . . . . 1N4004
- ZD1. . . . . 12V, 300mW
- TRIAC 1–3 SC151D

Miscellaneous
- PC board ETI 551
- Metal box to suit
- Three 3 pin power outlets
- Power switch
- 3 core flex and plug

Get both price and performance

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

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.

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

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

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

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

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

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

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

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

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

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

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

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

The no-compromise 4-digit instrument

DMMs for labs, service and workshops

For more details contact:
Philips Electronic Systems — Scientific and Industrial Equipment.
P.O. Box 119, North Ryde, NSW 2113. Ph: Sydney 888 8222 or Melbourne 699 0300

PHILIPS Test & Measuring Instruments

PHILIPS

HRME-132-0029

SOME OF AUSTRALIA'S LOWEST COMPONENT PRICES

NOTE: REGULAR PRICES – NOT TEMPORARY SPECIALS – KEEP US IN MIND FOR THAT NEXT ORDER

POLYESTER FILM CAPS

E12 10% 100V
All values .001 to .01 — 7c ea.

.01	— 7c	.1	— 13c
.012	— 8c	.12	— 14c
.015	— 8c	.15	— 14c
.018	— 8c	.18	— 14c
022	— 8c	.22	— 16c
.027	— 8c	.27	— 16c
.033	— 8c	.33	— 18c
.039	— 9c	.39	— 19c
.047	— 9c	.47	— 22c
.056	— 9c	All	
.068	— 10c	values	
.082	— 10c	in uF	

10% off 100 same uF

ELECTROCAPS (UPRIGHT)
'per 100 prices in brackets)

Cap.	16V	25V	50V
0.47 uF thru to	all	all	all
10 uF	5c($3½)	6c($3¼)	7c($4)
22 uF	6c($3¾)	7c($4)	8c($5)
33 uF	8c($4)	9c($5)	10c($6)
47 uF	9c($5)	10c($6)	11c($7)
100 uF	10c($6)	12c($7)	14c($11)
220 uF	12c($8)	16c($10)	35c($17)
470 uF	16c($12)	22c($16)	45c($30)
1000 uF	22c($18)	30c($25)	75c($50)

1000 uF/16V axial — 20c ea. $8 per 50
2200 uF/50V axial — 95c ea. $8 per 10
Full axial price list — SAE

LEDS: $12 per 100, $110 per 1000, or 17c each, 10 for $1.50 clips 3c each all quantities. LEDS superb — 5mm red — well diffused. Wide viewing angle — sample 40c stamp.
TO3 MOUNTING KITS: 10 for $1 or $4 box of 50. Generous kit includes mica, screws, nuts, washers, tag, nylon brushes.

Potentiometers: 50c ea. rotary carbon sing. gang) log or lin: 1K, 5K, 10K, 25K, 50K, 100K, 25K, 500K, 1M, 2M (metal shafts) Trim Pots: 17c ea. — 10mm 1W horiz. or vert: 100 Ohm to 2M

ZENER DIODES: 15c each 400mW 5% E24 values 3V to 33V

2c RESISTORS — our 2 year old price still current. Opposition hoped we would go broke but our price remains at 2c ea.
1 Ohm to 10 M ¼W 5% E12 carb. film $1.80 per 100 same value (or ½W 3c, $2.50 per 100 same value)

Keep electronics a hobby and not a luxury, compare our prices and buy from us. Same day turnaround service (unless swamped). All goods top quality and new. No minimum order. One P/P charge of 40c regardless of quantity. Advert current 3 months for late readers.

SCRs:				TRIACS:		DIODES:	
0.8A	30V C103Y	—	35	2A 400V ESP240 —	65	1N4001 —	7c (1A 50V)
0.8A	200V C103B	—	60	6A 400V SC141D —	$1.30	1N4002 —	8c (1A 100V)
4A	30V C106Y1	—	40	10A 400V SC146D —	$1.50	1N4004 —	9c (1A 400V)
4A	400V C106D1	—	75	25A 400V SC260D —	$2.50	1N4007 —	12c (1A 1000V)
8A	400V C122D	—	$1.05	DIAC ST2 —	35	1N4148 —	6c $4.50/100
8A	500V C122E	—	$1.20	Chart to identify leads			$38/1000
25A	400V C37D	—	$2.50	Plus trigger info.			

DIGGERMAN ELECTRONICS
P.O. BOX 33, CORAMBA NSW. 2466.

INCREDIBLE!

A superbly designed 9 band receiver. Sensitivity, selectivity, (the VEF radios will easily separate the proposed 9 kHz B/C station separation) stability, image rejection, and sound quality are all superior to any comparably priced radio. More than that, VEF reliability is legendary and the construction quality incomparably better — hence our 3 year guarantee.

Normally $89, this is a special $69 offer extended to ETI readers.

(Optional AC unit $4 extra.)

ELECTROIMPEX AUSTRALIA PTY. LTD.

- 279-283 Latrobe St, Melbourne. 3000. Ph. 602-3533.
- 91 Goulburn St, Sydney. 2000. Ph. 212-3576.
- 1st Floor, 75 Grenfell St, Adelaide. 5000. Ph. 223-6150.
- Shops A11 & 12, Local Point Arc, Cnr Brunswick & Wickham Sts, Fortitude Valley. 4006. Ph. 52-2909.

RAVE

PROFESSIONAL
SOUND & LIGHT
SOUND & LIGHT
SOUND & LIGHT
SOUND & LIGHT

Importers of Quality Electronic Equipment

Complete HIRE • SALES • DESIGN service to the entertainment industry.

OFFICE and SHOWROOMS
2388 Gold Coast Highway,
Mermaid Beach. Qld. 4218.
Phone (075) 38-3331.

DJ S77 STEREO DISCOMIXER

SUPERIOR DESIGN CLEAN, CRISP SOUND REPRODUCTION.

Automatic voice overide • tape-in, tape-out • 2 microphone in • 2 x turntables in • T.T. start buttons • slave out • 2 year guarantee.
Available separate or in console C/W turntables and 200 watt power amp built-in. Mono or stereo. Size (mixer only) 17cm x 86.5cm x 9cm. Weight 4.5kg.

LITO 250 PROFESSIONAL EFFECTS PROJECTOR

• New 250W Quartz Iodine Effects projector for use with effects from spectacular Lightomation range • Lens system totally enclosed to eliminate light spill • Cool, quiet operation, high efficiency tangential air blower • Used free-standing or suspended with adjustable handle • Supplied as "Main-Frame Unit" with 50mm lens, 60, 85 & 100mm avail. • 14 attachments available — changed by slide-in rotator system — wide selection of cassettes & 6" Effect Wheels • Mains voltage selector gives range of 6 input voltages.

• STROBES • SOUND TO LIGHT UNITS • DRY ICE FOG MACHINES • ROPELITES • LIGHTING STANDS • BEACONS • JBL SPEAKERS & CABINETS • Brochures available on request.

TEMPERATURE STABILIZED LOG—EXPONENTIAL CONVERTER

This converter can be set up for either logarithmic or exponential operation and incorporates a neat heater circuit for temperature stability.

IN THE CONVENTIONAL musical scale, consecutive notes are not separated by the same frequency, but by the same ratio – the twelfth root of two. This is quite acceptable for most musical instrument manufacturers, except that in electronic music equipment it is easier to make oscillators which have an accurately linear frequency/control voltage characteristic. The keyboards of most music synthesizers give an output voltage of 1 V for each octave on the keyboard. This can easily be generated by a set of equal resistors between the contacts on each key and a voltage applied to each end (normally 5 V). However this means the oscillator is required to have an exponential frequency/control voltage response.

This is where the trouble usually starts. An exponential converter is normally used which relies for its operation on the relationship between current and voltage in a silicon diode or transistor. However unless temperature stabilisation is used the oscillator will not stay in tune for very long. With this unit the transistor used is heated to around 55°C and stabilised at this temperature, eliminating the problem of thermal drift.

In the instrumentation field a lot of functions are displayed in dBs which are a logarithmic measurement. As this unit can be connected in either exp or log modes it is useful for this purpose also.

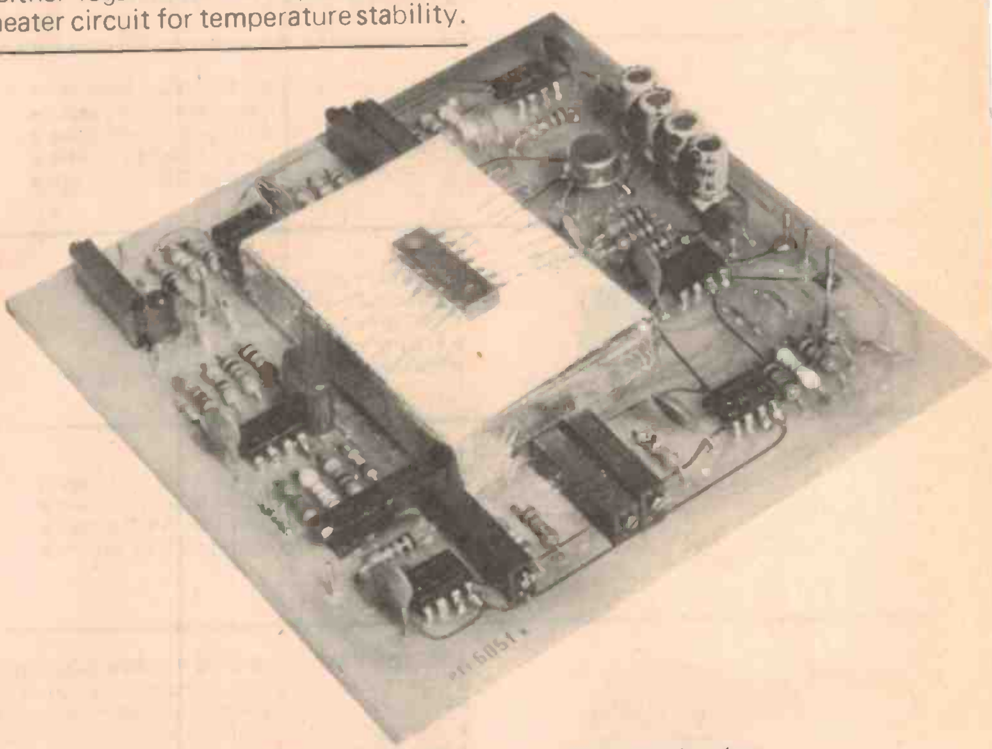


Photo showing the complete unit with the top of the oven removed to show IC5. Note that link 1 is made out of a couple of pins from an old valve socket.

Construction

As the unit will normally be used with some other equipment, we have not described any mechanical housing. The only difference between the assembly of this board and any other is the oven and the connections to the transistor array package. The oven is made out of two pieces of polystyrene about 55 x 35 x 12 mm. The outside of the oven should be covered with aluminium foil to help reduce heat loss. The aluminium itself should be covered with a layer of adhesive tape where the leads can touch. A piece of thick paper should be used between the oven and the pcb to insulate the tracks.

The centre of the oven should be hollowed slightly to hold the IC (bend the leads out straight as shown in the photo); a hot soldering iron is the easiest method. Do not remove more than necessary. Now solder a 40 mm length of thin copper wire (a single strand of a multistrand cable is best) to each pin, then with the base of the oven in position, sit the IC in the oven and connect the leads to the appropriate holes. If a small amount of epoxy cement is placed under the oven it will stay in position. Now fit the top of the oven and secure with a piece of adhesive tape until it has been checked out. It finally can be cemented with epoxy adhesive.

The potentiometer values chosen are a compromise between ease of adjustment and the ability to compensate different transistors. If the potentiometer does not have enough range then the series resistor will have to be varied. We have specified 2% resistors throughout to obtain a better temperature coefficient than is possible with conventional 5% resistors. It will not help to select out of normal 5% types.

SPECIFICATION – ETI 605

Transfer functions	
exponential	V out = 0.15625×2^{Vin}
log.	V out = Ln (Vin/0.15625) / Ln 2
Useful dynamic range	50dB or 8octaves
Oven temperature	approx. 55° C
Warm up time	about 2 minutes
Power supply	∓10 to ∓15 volts

HOW IT WORKS – ETI 605

This unit relies on the fact that the collector current of a transistor is exponentially related to the base voltage.

In the log mode the collector of the transistor is linked back to the input of IC1. In this way the collector current is proportional to the input voltage and therefore the voltage on its emitter is logarithmically related to the input voltage. This voltage is then amplified and level shifted by IC3 to give the desired output.

In the exponential mode the 10k resistor R9 is linked back to the input of IC1 and the voltage on the emitter of the transistor is proportional to the input voltage; the collector current is exponentially related to the input voltage. This current is converted to a voltage by IC3.

All this works well provided the transistor is at a constant temperature. Compensation can be made by using other junctions and thermistors, however even the self-heating effect of the transistors can affect linearity. The translstors we have used are part of a transistor array IC which has three individual NPN transistors and a differential pair. We heat the chip up by dissipating heat in the differential pair while measuring the base-emitter voltage of one of the individual transistors. IC8 is used to compare this voltage to one set by the divider R25, 26, 27 and RV7. The base-emitter voltage is normally about 0.67 V at 20°C and drops about 2.2 mV per degree above this temperature. IC8 then stabilises the chip temperature to about 35°C above the temperature at which it was initially calibrated. As it warms up the current in the transistors will fall and when hot the voltage drop across R31 will be low enough that the LED will extinguish. The transistor array is housed in a polystyrene housing to conserve heat.

VALUES OF UNMARKED COMPONENTS		
	LOG	EXPONENTIAL
R3	33k	390k
R5	∞	150k
R13	∞	100k
R15	22k	470k
R17	390k	33k
RV3E	LINK	200k
RV3L	200k	LINK
LINKS REQUIRED		
	A–B D–C	A–D B–C

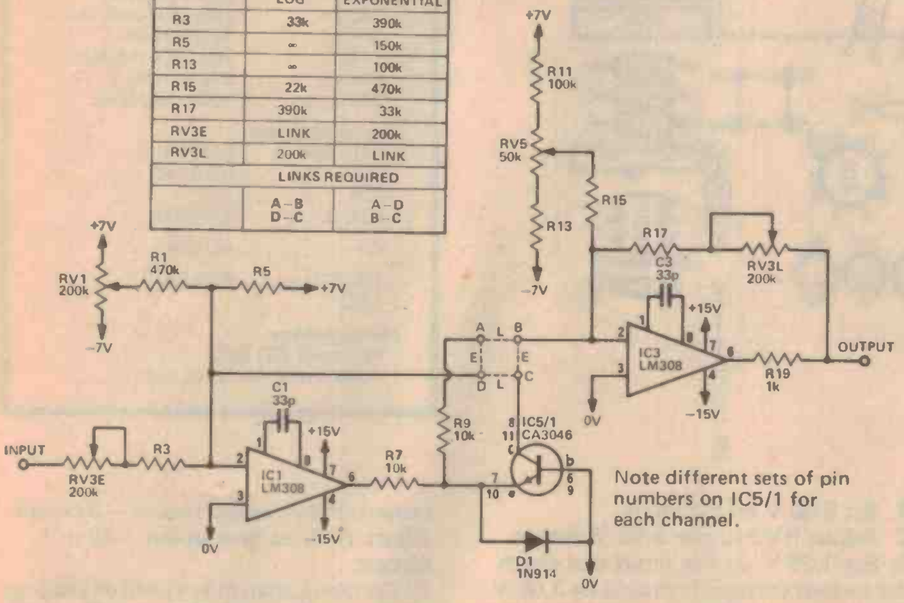


Fig. 1a. The circuit diagram of the converter section. Note that although only one channel is shown here that there are two identical units on the pcb. The component numbers used on the second channel are the missing even numbers, ie R12 is the same as R11.

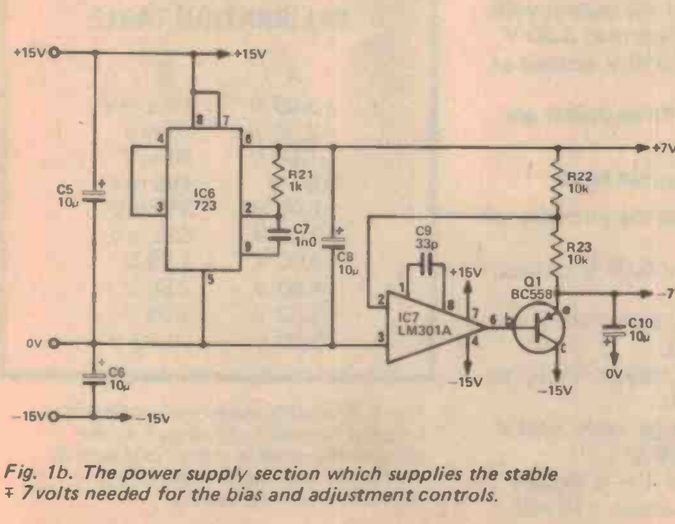


Fig. 1b. The power supply section which supplies the stable ∓ 7volts needed for the bias and adjustment controls.

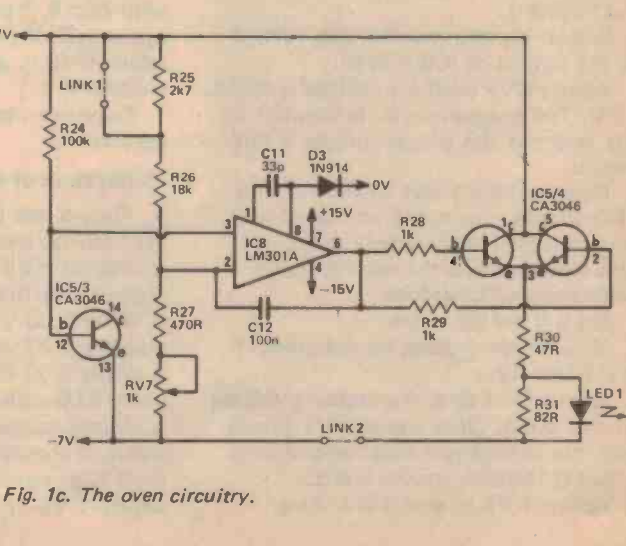


Fig. 1c. The oven circuitry.

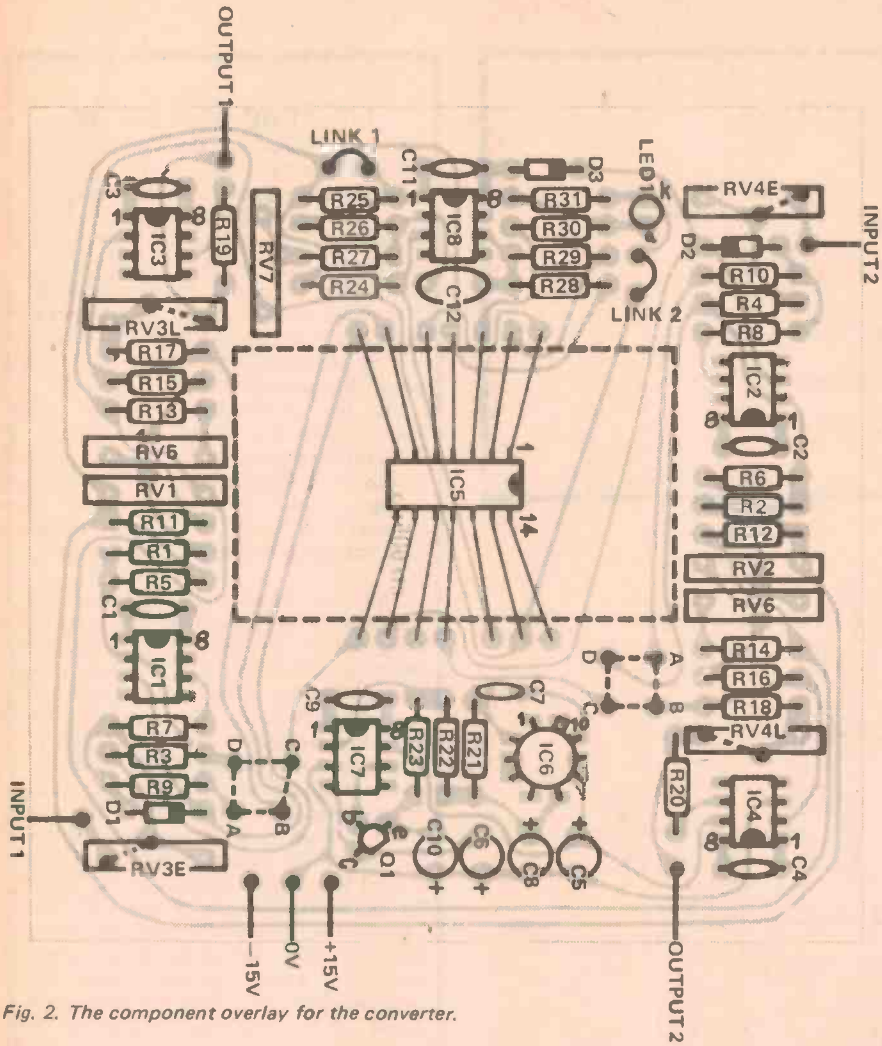


Fig. 2. The component overlay for the converter.

PARTS LIST – ETI 605

Resistors	all 2%, 5W
R1, 2	470k
R3–R6	see table 1
R7–R10	10k
R11, 12	100k
R13–R18	see text
R19–R21	1k
R22, 23	10k
R24	100k
R25	2k7
R26	18k
R27	470R
R28, 29	1k
R30	47R
R31	82R
Potentiometers	
RV1–RV4	200k multiturn trim
RV5, 6	50k multiturn trim
RV7	1k multiturn trim
Capacitors	
C1–C4	33p ceramic
C5, 6	10µ 25V electro
C7	1n0 polyester
C8	10µ 25V electro
C9	33p ceramic
C10	10µ 25V electro
C11	33p ceramic
C12	100n polyester
Semiconductors	
IC1–IC4	LM308
IC5	CA3046
IC6	723
IC7, 8	LM301A
Q1	BC558
D1–D3	1N914
LED	
Miscellaneous	
PC board ETI 605	
Polystyrene foam for oven	

Calibration

The equipment needed comprises an accurate digital voltmeter and a variable power supply with a fine voltage control. The +7 V rail can be used for this with a multi-turn potentiometer.

Oven Control

1. Before switching on, remove link 2 and fit link 1.
2. Switch on and monitor the voltage on the output of IC8 (pin 6).
3. Adjust RV7 until the voltage is about –5 V. The potentiometer is sensitive in this area but the actual voltage is not critical.
4. Remove link 1 and fit link 2. The LED should now come on for about two minutes before slowly going out. This indicates that the oven is stable.

Calibration of Log Mode

1. Set 0 V on the input.
2. Monitor the voltage on the junction of R7 and R9.
3. Adjust RV1 to give a negative voltage on this point. Now adjust RV1 slowly until the voltage just switches positive.
4. Set 0.15625 V on the input.
5. Adjust RV5 to give 0 V output.
6. Set 5.00 V on the input.
7. Adjust RV3 to give 5.00 V output.
8. Set 1.25 V on the input and check the output voltage. It should be 3.00 V. If it is higher go back to step 4 except adjust RV5 to give –0.010 V and use RV1 to bring it back to zero. Continue with step 6, 7 and 8. If the output voltage at 1.25 V input is less than 3.00 V adjust RV5 to give +0.010 V instead of –0.010 V.

Continue until all three points are correct.

Calibration of Exponential Mode

1. Place a link between the junction of R7 and R9, and 0 V.
2. Adjust RV5 to give 0.00 V output. Remove the link.
3. With 0.00 V input, adjust RV1 to give 0.15625 V output.
4. With 5.00 V input, adjust RV3E to give +5.00 volts output.
5. Check output voltage with 3.00 V input. It should be 1.25 V.
6. If high repeat steps 1 – 5 except adjust RV5 to give about +10 mV output. If low, repeat steps 1 – 5 except adjust RV5 to give about –10 mV output.
7. Continue adjustment until all readings are correct.

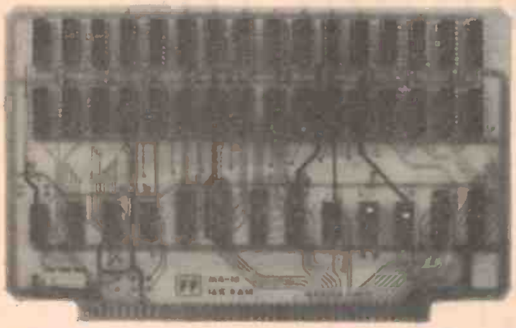
CALIBRATION TABLE

A	B
–3.00 V	19.5 mV
–2.00 V	39 mV
–1.00 V	78 mV
0.00 V	156 mV
+1.00 V	312 mV
+2.00 V	625 mV
+3.00 V	1.25 V
+4.00 V	2.50 V
+5.00 V	5.00 V
+6.00 V	10.00 V

Fig. 3. This table shows the relationship between the input and output. In the exponential mode A is the input with B the output while in the log mode B is the input and A the output.

16K STATIC RAM

USES LATEST GENERATION 2114 1Kx4 STATIC RAMS



- **KIT WITHOUT RAMS $97.20**
- **8K KIT 450 nS $257.20**
- **16K KIT 450 nS $410.60** (P&P $2.00, Add sales tax 15 percent)

- Completely static operation.
- Single +5 volt supply, low power.
- Add 1K bytes with only 2 ICs.
- Motorola Exorcisor Bus as on MEK6800D2 Kit.
- Control logic compatible with M6800, 8080/85, 2650, SC/MP etc.
- Each 8K block switch addressable.
- Quality PCB with plated through holes and solder resist, Edge connector 43 x 2 way 0.156"

PP Pennywise Peripherals 19 Suemar St, Mulgrave, Vic. 3170. Ph (03) 546-0308.

AUDIO & DESIGN RECORDING (ADR) UK.
Signal processing equipment now in use at EMI studios, ALBERTS studios, ABC and many other top studios, radio and television stations.

VOCAL STRESSER F769XR
'Total Voice and Instrument Control' compressor, limiter, expander/gate, De-Esser, 4 band sweep equaliser. $1374 plus 15 percent sales tax.

COMPEX LIMITER F760XRS.
2 channel compressor, seperate limiter, expander/gate with stereo link switch. $1529 plus 15 percent sales tax.

'SCAMP' Units
ADT (automatic double tracking) flanging, reverb, etc $933. S01 comp/lim, F300 exp/gate, S03 sweep Eq, S07 octave Eq, S05, S06 dynamic noise filters, $381 plus 15 percent sales tax.

Agents for: Calrec studio mics, Shure mics, JBL and ATC speakers, Ampex recorders, JPS power amps and other professional products. Repairs and service to electronic equipment.

AUDIO & RECORDING

AUSTRALIA PTY. LTD.
20 Morgala Drive, Holden Hill. SA. 5088.
Phone (08) 261-1383
INTERSTATE AGENTS REQUIRED

A&R AUSTRALIA

EPROM ERASER

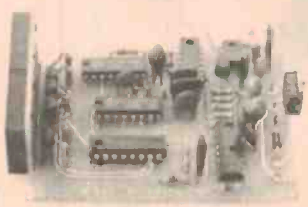
Erase up to 4 Eproms at once. 240 volt. Size: 3 x 4 x 8. Assembled and tested. Aluminium anodised case.

$47.50 plus $2 P&P.

DIGITAL TACHO

KIT **$36** post free

$48 assembled & tested



ETI 318 PROJECT KIT
See July '78 ETI for full details. Complete kit includes pre-punched case. All kits in stock.

New!

16K PROM BOARD

Kit 2780's $115 plus $2 P&P.
See Sept EA for details.

S100 WIRE WRAP BOARD, $24.50
S100 BACKPLANE BOARD, Double-sided, 8-slot, $24.50.
S100 EXTENDER BOARD KIT, $24.50

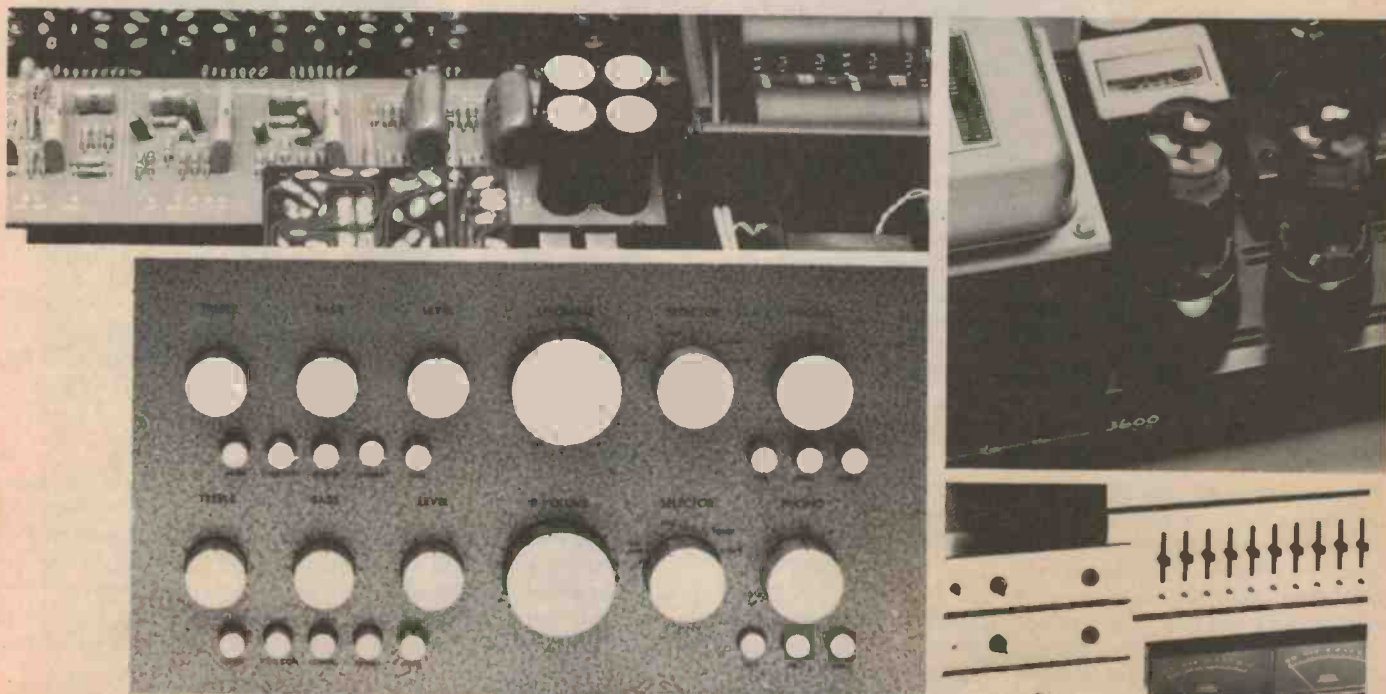
Sm ELECTRONICS MELBOURNE

10 Stafford Crt., Doncaster East. Victoria. 3109.
Box 19, Doncaster East. 3109. Ph (03) 842-3950.
Built & tested prices and tax free prices on application.

MAD MAL'S
BEST BUYS
SEPTEMBER MADNESS!
MAD MAL © 1978
ANNOUNCING-
GREAT! HURRAH WHOOPEE!
silicon valley
SEMICONDUCTOR PRODUCTS are now available at MAD MAL'S electronic shop
OVER 2,000 DIFFERENT SEMICONDUCTORS, INCL. IC's, TRANSISTORS, DIODES, OPTO, etc. AT WHOLESALE PRICES
SEND MAL A 9" x 4" ENVELOPE FOR PRICE LISTS
5" TV TUBE
150CB4 B/W TUBE $5.95 EA
NEW! LAST FEW. 2 FOR $11 OR
Engine Analyzer
MEASURE VOLTS 0-16, AMPS 0-60A, RPM 0-12,000/16,000, POINTS TEST ETC with full instructions SO EASY TO USE $22.50
3 TRANSISTOR AM RADIO Tuner
Add-on for Hi-Fi system, for test bench or build your own radio, includes ferrite rod, gang etc, add only 6v AC or DC, 10mA
WAS $14.95 $9.98
MUSICOLOUR MKIII COLOUR ORGAN KIT
SAVE $10 OFF OUR NORMAL PRICE of $59.90 See E.A. Sept '76 $49.90
NT-3102 Eht Trans.
$6.50 EA
Brand new Philips EHT Transformers Popular Model
SYSTEM PRICE $55
BUILD YOUR OWN LIKE THESE!
HI-FI STEREO SYSTEM KIT
3W+3W AMPLIFIER
Volume, Bass, Treble Controls - also h'phone and Spin din Rec/Play socket - all parts and instructions are supplied - includes teak finish wood base suit BSR or Garrard $19
NEW Garrard
TURNTABLE BASES
in beautifull TEAK! Size 21" x 14" x 3½"
Plenty of room for amplifier
JUST MAD! $3
6" BASS + 3" TWEETER KITS TO BUILD YOUR OWN SPEAKERS-10W EA. $7
DE-LUXE TURNTABLE
Complete with cer cartridge - will suit above amplifier $22
SUPER CARTRIDGES... New!
MAD MAL'S Bargains
'A' $1.80 STEREO CERAMIC
B 90¢ MONO CRYSTAL
C $1.80 STEREO CRYSTAL
PHILIPS AM RADIO TUNER MODULE UF-411
UF-411
3 Sil Trans. Just add Ferrite Rod Aerial $1 extra plus Tuning Gang $2.00 ea. 6v or 9v, etc to build complete tuner.
ONLY $2.50
SWITCH BARGAINS!
MINI-SLIDER DPDT 25¢
DPDT ROTARY 40¢
SPST FOOT-SWITCH 30¢
DPDT De-Luxe Toggle 55¢
Telescopic Aerial
TOP QUALITY CHROME
TOTAL LENGTH 5'6"
SCOOP 2 FOR $1
ELECTRICAL TERMINAL BLOCKS IN MULTIPLES OF 12 (12 FOR 50¢) 50¢
6-12 V MOTOR for Cassette
SUITS CAR OR PORTABLE CASSETTE $3.50
FUSEHOLDERS 15¢ ea STD 3AG FUSE
LOOK SUPER SCOOP!
2 Gang Condenser 200pf + 90pf 25¢
ROTARY WAFER SWITCHES
$1 ea
3 Pole 3 Pos 3 Bank
6 Pole 2 Pos 1 Bank
4 Pole 2 Pos 3 Bank
Hot-Line Filter
SUIT CB or CAR STEREO $2.50 EA
Reduces Ignition Noise
U-BEAUT POWER TRANSFORMER
240v IN, 12v 1A plus 26v 1A OUT
$3.95 EA OR 2 for $7
BRAND NEW & G'TEED, WITH SHIELD. Lots of uses eg: Amplifiers, Power Supplies, Test Equipment etc. Ask our price for quantity - total 400 available.
6.5mm STEREO SOCKET 50¢ EA $4 FOR 10
3.5mm PLUGS 10¢ EA OR 80¢ FOR 10
3.5mm SOCKETS 10¢ EA OR 80¢ FOR 10
PACK/POST: 50¢ plus 10% ORDER
NEON BEZEL 40¢
Std ⅜" Mounting New, top quality 250v AC
NE-2 NEONS 10¢
15v 2AMP POWER SUPPLY KIT $12.50
Comprises: Trans, 4 x 2.5A Sil Rectifiers, 3300uF Electrolytic. Plus instructions to build a CB Power Supply etc.
NEW Push-Button 250v AC Switch
PUSH-ON, PUSH-OFF 1 AMP 20¢
MAL'S VALU-PACKS
LUCKY DIP ASSORTMENTS FOR VALUE CONSCIOUS EXPERIMENTERS
500 ½W RESISTORS $2
200 1W RESISTORS $2
250 MIXED ½, 1, 1 WATT RESISTORS $2
40 5W RESISTORS Also 3W, 7W $2
25 NEW PRESET POTS $2
12 NEW SLIDER POTS $2
40 RADIO, TV KNOBS $2
20 ASST. POTS $2
100 CAPS CERAMIC $2
45 CAPS ELECTROS $2
20 RF, IF, OSC COILS $2
10 PCES PCB OFFCUTS $2
50 ASST TAGSTRIPS $2
20 ASST. LOW VOLTAGE PILOT LIGHT GLOBES $2
30 6" PCES SPAGHETTI TUBING $2
20 MINI POTS $2
BUY 10 PACKS + EXTRA ONE FREE!
NEW, DE-LUXE STEREO H'PHONES
SAVE 33⅓% NOW ON ALPHA H'PHONES $15
NOW REDUCED FROM $22.90
Vol, Tone adj
MASTER/SLAVE INTERCOM SETS
Instal Yourself, Complete kits with all wire, battery, insts. etc. LIMITED QUANTITY
2 WAY $12
3 WAY $20
4 WAY $25
VORTEX STEREO CASSETTE MECHANISM
LAST SHIPMENT OF THESE TOP QUALITY DECKS - Ideal for computer enthusiasts or build your own cassette recorder. 120v only $29.50
240v-120v TRANSFORMER also 15v 1A and 6.3v 1A windings $7.50 EA
RECORD/PLAYBACK KIT Reduced now $15 EA
NUTS and BOLTS all packs JUST $1.20 EA
BUY 5 PACKS GET ONE FREE
60 ASST SELF-TAPPERS
60 ASST HEX. NUTS
100 ASST SCREWS
120 ASST WASHERS
200 ASST HARDWARE PACK
12 POT-NUTS AND WASHERS
MAD MAL's BONANZA * PAK
A VAST ASSORTMENT OF GOODIES FOR ALL YOU ASPIRING HOBBYISTS!
All new, all high quality parts, samples, specials, end-of-line, useful components, incl semiconductors, transformers, resistors, capacitors, pots, IC's, switches, relays etc. etc. etc. WORTH $$$$$ Over 2Kgm weight, size approx 11" x 7" x 6"
$9.98
BONANZA PAK NEW!
KRAZY Semiconductor PRICES
All top quality brands full spec - Equivalents may be supplied.
7400 20¢ | 2N3053 35¢
7401 20¢ | 2N3643 30¢
7441 $1 | 2N4250 40¢
7473 70¢ | BC337 25¢
7490 70¢ | BC338 25¢
M-A-D
IR60 600 PIV 25A Rect. 75¢
IN5404 400 PIV 4A Rect. 55¢
VJ148 100 PIV 10A Bridge $3.75
MDA3504 400 PIV 35A Bridge $4.13
C122D 400V 8A SCR $1.34
SC146D 400V 10A Triac $2.20
TIC44 40V 600mA SCR 4 for $1
MPF102 Fet 75¢ MPF105 Fet 75¢
EDGEWISE PANEL METERS 250uA 1.2K coil $3
NEW
AMPLIFIER BOX!
LAST FEW! 15½ x 5 x 10 DEEP + ALUM. FRONT PANEL (Simulated front panel) $4.90
2W+2W STEREO AMPLIFIERS
Volume, tone control all parts on PCB, 2 x LM-380 IC's, 12v-18v supply, add only transformer if required (extra $4.50), 100mV input, T.H.D. 1% at 1KHz at 1.5W. Ideal mounting under turntable for cheap home stereo!
$5.95
12V DC RELAYS
10 AMP 3 POLE Contacts Coil: 110Ω Small Size All new, top grade Popular style.
QTY 1-9 $2 EA
QTY 10-24 $1.80 EA
QTY 25+ $1.70 EA
Be early, limited supply available now.
National DIGITAL CLOCKS
MA1002 0.5" High Digits
MA-1002 12 Hr $12 EA
Last few at this low price, transformer is avail. extra $5.50
ASST TRANS RADIO OUTPUT & DRIVER TRANNIES 50¢
VALVE OUTPUT TRANNY General Purpose $1 EA
INSTRUMENT CASE $3
Size 12" x 4½" x 4¾" Few Only
Plastic mantel radio cabinets with metal front panel etc.
NUMERICAL * KEYBOARD KIT
Ideal for keyless entry lock systems, burglar alarms, all microprocessor applications etc. Keys 0-9 and CLR key, top quality, low profile, keys are 18mm x 18mm $5.90 ea.
MAD MAL
c/- PRE-PAK electronics
P.O. BOX 43, CROYDON 2132
718 Parramatta Rd. Croydon NSW
PH: 797-6144 Open 7 Days
Supa-Specials *
2 TRANS RADIO KITS $2.50
NEW PUSH-BUTTON PERMEABILITY TUNERS & Coils Suit Synchrodyne $2
MANUAL Tuners $1
¼ TAPE SPLICER $2.50
6-10 Henry DC FILTER CHOKES Brand New, Suit most valve TV's etc! $1

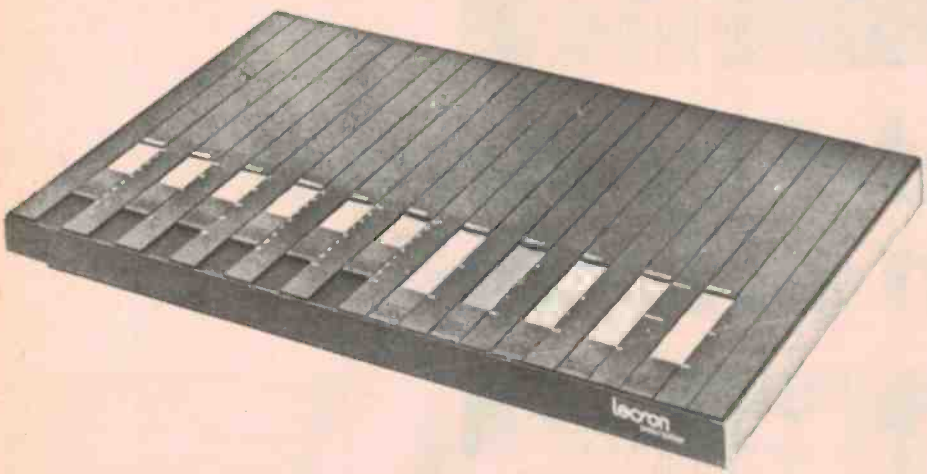
special supplement to ETI September 1978

Ultra-Fidelity Amplifiers -design principles



Ultra-Fidelity
-design principles

Audio amplifier design has come a long way since the introduction of semiconductors into hi-fi. Stan Curtis, who has been responsible for such excellent examples of the art as the Cambridge Audio and the Lecson, explains here the black arts of ultra hi-fi design.



CAREFUL listening tests have shown that while an amplifier that measures badly is *unlikely* to sound good one that measures well *cannot* be guaranteed to sound good. Thus it is apparent that the traditional measurements of power distortion and frequency response need supplementing by new and more powerful laboratory tests. Such tests should more closely relate to the conditions prevailing when the amplifier is driving realistic loads and using music signals rather than sine-waves, which of course represent only one special case.

Balancing Act

The first such test was popularised by Peter Walker of Quad. It is a simple nulling system which attempts to cancel the input and output signals of an amplifier. With full cancellation whatever remains must be distortion, i.e. signals added to or subtracted from the original. The ideal or perfect amplifier will produce no residual at the output of the nulling circuit.

In practical terms the balancing of this circuit is very difficult if a significant degree of accuracy is required. Thermal drifts can aggravate the problem and generally it is difficult to set up for more than one amplifier type as usually the whole phase-balance network needs to be recalculated and readjusted each time. However this simple circuit is useful for showing just how often amplifiers are clipping the signal in the course of a piece of music and how frequently some amplifiers slew-rate limit the signal.

However, with such high current capability it is essential that the amplifiers have speaker muting to prevent switch-on "thumps" (or more accurately, earthquakes) and dc offset protection to protect the loudspeakers from the effects of 20 amps of pure dc!

Offsetting Long Tails!

Dc offset has been a major problem with many dc coupled amplifiers (i.e. those having no output capacitor). The offset voltage measured across the output terminals should not be any more than ±50 mV. Once this voltage starts to rise the loudspeaker is subjected to a dc bias which moves the coil out of the central position. This in turn causes the coil to heat up and the power-handling capability of the loudspeaker to be restricted.

Eventually (and often sooner) the loudspeaker will blow.

Amplifiers

Many amplifiers have an offset voltage that is acceptable when the amplifier is first switched on but which starts to increase as the amplifier heats up. Such amplifiers are subject to thermal drift and this drift is normally due to a component mismatch in the circuit. The conventional amplifier, with a long-tailed pair at the input, is "theoretically" free of thermal drift as these will be automatically compensated for by the DC feedback.

However, this is on the assumption that the first two transistors (or FETs), forming the long-tailed pair, are perfectly matched.

The input offset voltage (upon which the output offset voltage is dependent) is related to the base-emitter voltage V_{BE} of each transistor.

e.g. $V_{OS} = V_{BE1} - V_{BE2}$

This difference can be made almost insignificant by using a dual-transistor or a monolithic integrated-circuit differential stage where matching is provided by the simultaneous adjacent fabrication of the two transistors. With discrete transistors, however, a close match is unlikely.

Similarly unbalanced output loading or mismatch of the collector resistors also increases the offset voltage. These mismatches also worsen the linearity (and hence the distortion) of this stage. Thus well designed amplifiers usually use 1% tolerance resistors in these positions and adopt balanced circuitry throughout.

The offset voltage is considerably reduced by the application of local dc feedback that occurs when emitter resistors are fitted. In this case;

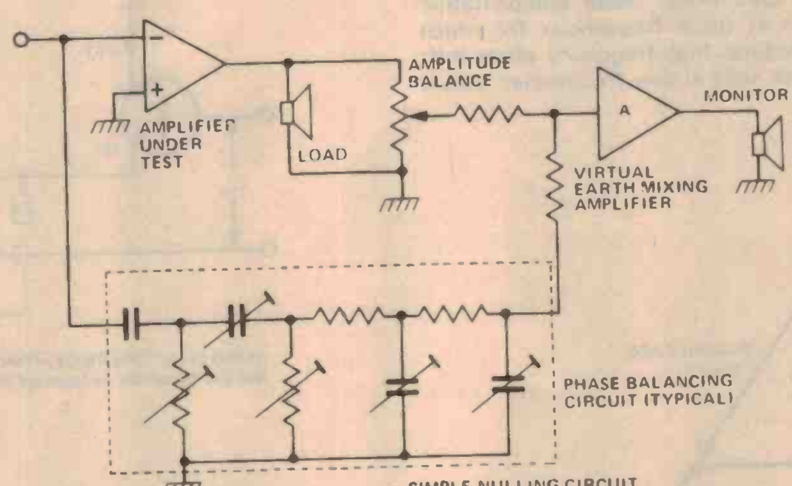
$$V_{OS} = V_{BE1} - V_{BE2} + I_{E1} R_{e1} - I_{E2} R_{e2}$$

and so by adjusting the balance between R_{e1} and R_{e2} with a trimpot a balance can be achieved.

Emitter Resistance

Note that $R_e = R_E + r_e$ is the total external emitter resistance and r_e is the transistor dynamic emitter resistance. Thus it can be seen that in the earlier typical example of a stage without emitter resistors, an imbalance of r_e and r_e will cause a worsening of the offset voltage. More importantly it can reduce the common mode rejection of the stage.

Of course the presence of emitter resistors also lowers the ac gain of the stage. For reasons to be discussed later this is not such a bad thing. This gain can be recovered by using bypass capacitors.



Block diagram of the Peter Walker balancing test.

Clip-on Off Set

Another situation where abnormal dc offset voltages occur is following a clipping overload. When many amplifiers are driven into clipping, the dc voltage of output rises towards one of the HT lines and then when the signal comes out of clipping the amplifier takes a finite time (often several seconds) to recover with the output dc voltage often oscillating between a positive and negative voltage before finally settling back to its nominal zero. Of course, when the amplifier is driven into clipping the normal negative feedback system ceases to control the amplifier.

Ultra-Fidelity Amplifiers -design principles

Thus the dc instability is indicative of poor low frequency stability in the amplifier. Some of the worst (but not all) amplifiers in this respect, have separate ac and dc feedback loops and so have big electrolytic capacitors (decoupling the ac loop) which take time to charge and discharge.

The old Cambridge P100 amplifier had this problem and the effect on the reproduction of a loud bass note can be imagined. Regrettably many amplifiers still suffer from this problem.

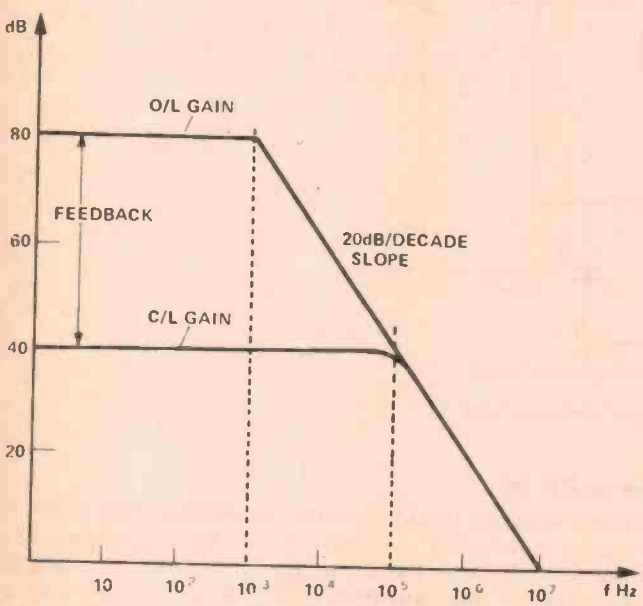
Quite often some amplifiers go unstable without their owners becoming aware of the problem. Sometimes the oscillation may be moderate in level and at a very high frequency; the only symptom being that the amplifier seems to run hotter and next-door's electric drill causes more TV interference than before!

Compensation Phase

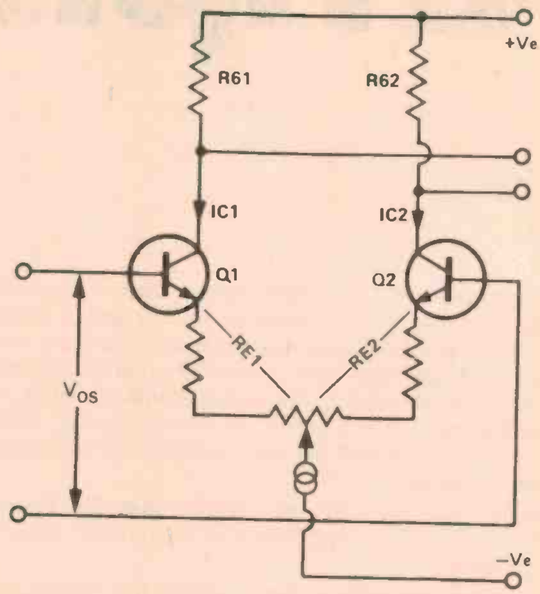
To know why some amplifiers are potentially unstable it is necessary to understand the principles of phase compensation. Much of the low distortion characteristics of amplifiers is achieved through negative feedback. If the phase shift around the feedback loop reaches 360 at any frequency at which the loop gain (i.e. the overall amplifier gain) is unity the result is a self-sustaining oscillation at that frequency.

The phase-inversion to provide negative feedback produces a stabilizing 180 (eg. "out of phase") phase shift, but an additional 180 can be developed in the amplifier.

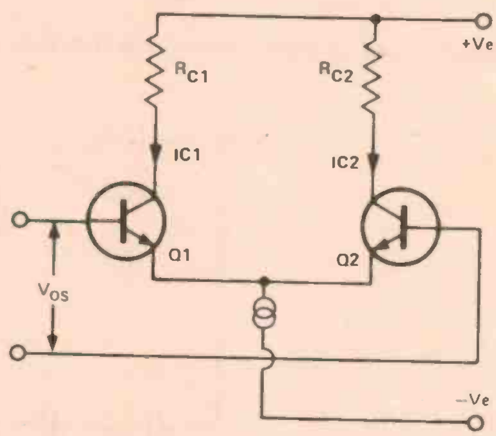
The phase shift developed through an amplifier is the combined phase shift of its several stages, and it usually develops 180 at higher frequencies. To ensure frequency stability under feedback conditions, phase compensation *reduces* the amplifier gain at those frequencies for which phase shift is high and it reduces high frequency phase shift by accepting a greater phase shift at low frequencies. This is



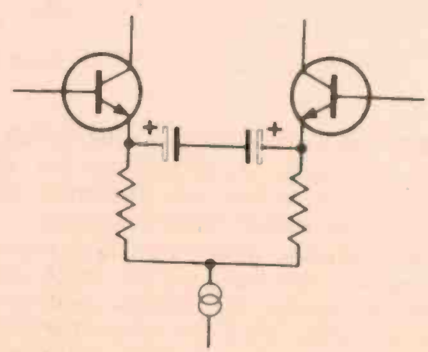
In the case shown in the diagram (unconditional stability) the open-loop response of the amplifier is stabilised by rolling it off at a slow 20 dB/decade slope with a single pole at 1 kHz. This amplifier would be stable with any amount of resistive feedback. However it will be seen that at higher audio frequencies the amount of feedback available reduces and so the distortion of the amplifier will increase. For this reason many amplifiers are of the "marginally stable" type.



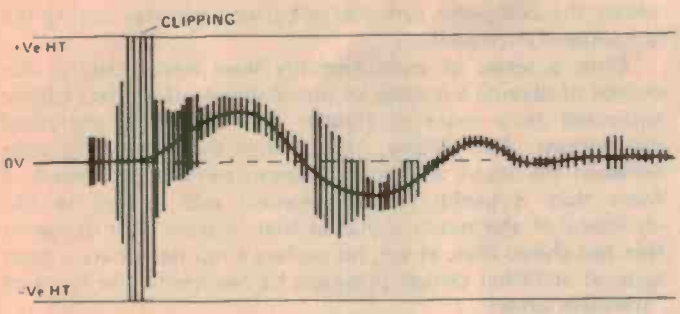
Differential pair with variable emitter resistances balanced by variation of the potentiometer.



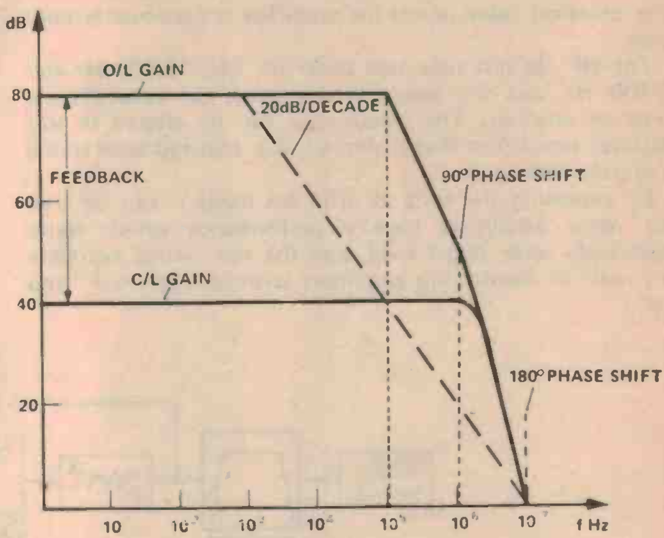
In this circuit the input offset voltage is related to the base-emitter voltage of this transistor.



Recovering lost gain by use of bypass capacitors across the emitter resistances.



Effect of a sine wave of varying amplitude as signal upon the dc offset voltage at the output.



In this case the amplifier has a fast roll-off which allows an improved closed loop performance at higher frequencies but without careful compensation they are not stable under all conditions of feedback. Once the phase shift reaches 180° the amplifier will become unstable so it can be seen that our example is only marginally stable.

accomplished by adding response poles and zeros in the form of resistor-capacitor networks (real or inherent in the transistors) in the amplifier circuitry.

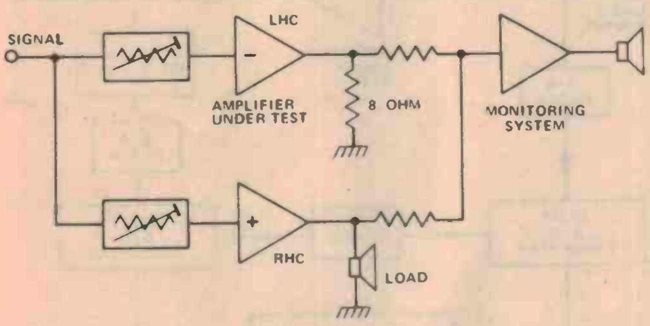
Equally important, to the owner of an expensive pair of loudspeakers, is the problem of high-frequency instability. These days very few high quality amplifiers are so unstable that they break into oscillation. However, quite a few respected units are on the edge of instability and so can potentially become unstable following a shift in operating conditions or of output loading.

Sum Theory

The author used another technique at Cambridge to investigate the changes in amplifier performance that are dependent upon the loudspeaker load. The two channels of a stereo amplifier are driven in mono but one channel is converted to become non-inverting. The outputs of both channels are summed and the resulting signal is monitored. Theoretically both channels should transmit the signal in the same way and (for a given circuit design) any distortion, time aberrations etc. should be the same for both channels. It is often quite possible to balance the two channels (driving 8 ohm resistive loads) so that the residual is inaudible. However when one 8 ohm load is replaced by a real "live" loudspeaker the residual betrays problems caused by the new load. In a refined form the test works well and reveals two interesting things;

i) the two channels of average amplifiers are rarely identical

ii) some amplifiers work better in the inverting mode than in the non-inverting.

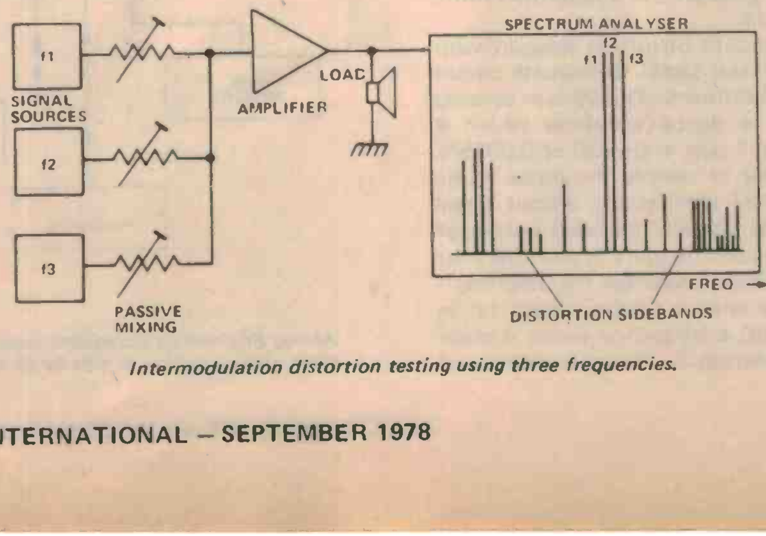


SIMPLIFIED TEST SYSTEM

Using one channel as an inverting amplifier to monitor distortion produced by the design.

IM High

The conventional IM test uses an LF (50 Hz) and an HF (7 kHz) tone in a 4 to 1 ratio and then measures the sum-total of the sideband (e.g. distortion) components. This is of



Intermodulation distortion testing using three frequencies.

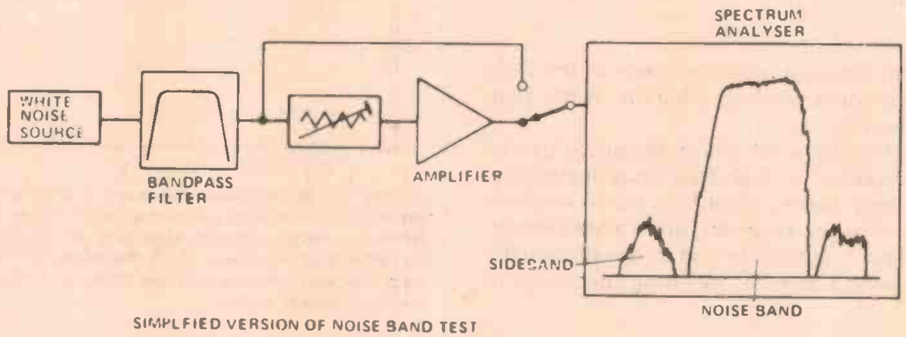
little practical value unless the amplifier is particularly non-linear.

The HF IM test uses two tones of, say, 15 000 Hz and 15 100 Hz and the resulting side-bands are viewed on a spectrum analyser. The frequencies can be altered to suit whatever simulation that is desired, e.g. two sopranos trying to sing the same note.

By repeating the tests at different levels it can be seen that many amplifiers have a performance which varies appreciably with signal level, and the test results correlate very well in identifying amplifiers with an aggressive "top end".

which the computer can use to correct the data during the subsequent error analysis.

Once a series of measurements have been made in the course of playing a passage of music the resultant data can be subjected to a series of Fourier and coherence analytical calculations. Put simply, this means that any difference between the input and output signals can be described in a form that is useful to the engineer and related to the structure of the music signal at that instant. Unfortunately this test shows that, as yet, no perfect amplifier exists — each type of amplifier circuit produces its own particular types of "transient error".



Noiseband testing with a spectrum analyser, the sidebands produced by the amp are clearly visible.

Dynamically Noisy

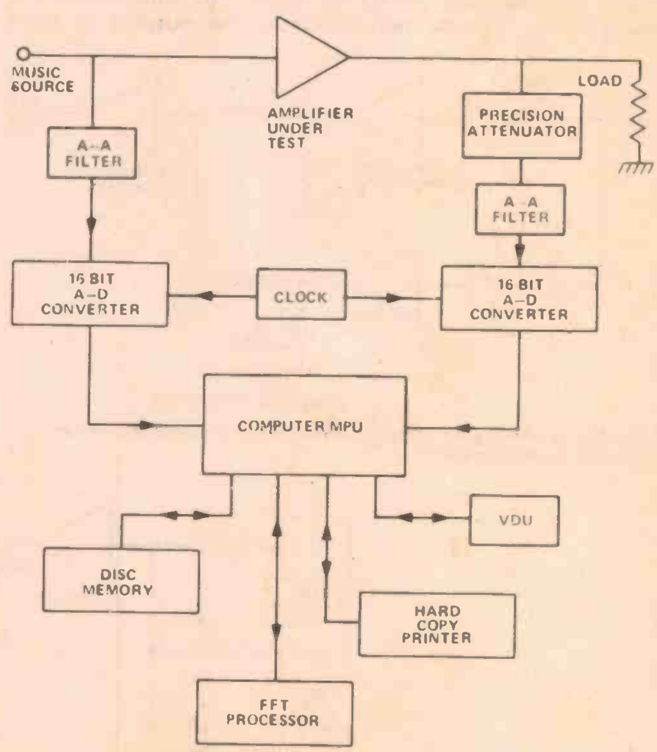
The second test is similar but attempts to measure the, amplifiers' performance under more varying "dynamic" conditions. A white noise source has a harmonic and amplitude structure which is variable and random and thus provides a better simulation of a music signal than does a sine-wave. The noise signal is passed through a bandpass filter to define its frequency response. The bandwidth and centre-frequency can be altered to suit the investigation as can the overall operating level. The output of the amplifier is fed to a spectrum analyser where the out of band components can be studied. Again this test is very useful for studying the effects of different loudspeaker loads but more significantly for subjecting the amplifier to random momentory "clipping" overloads.

A Channel and A Log

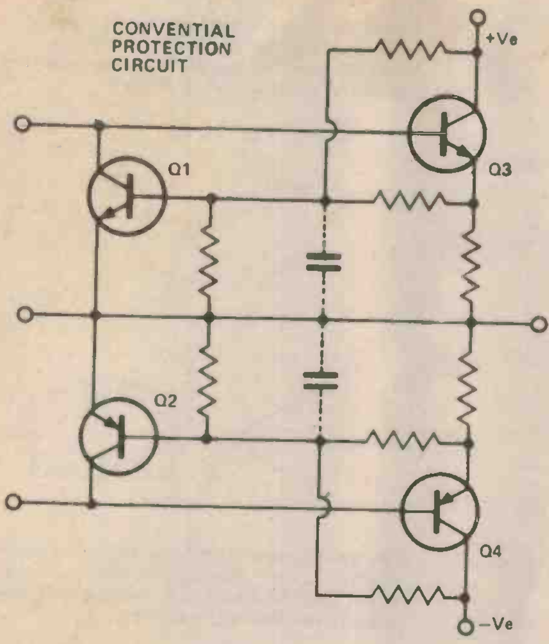
Possibly the most complex type of testing in use is a form of input and output signal comparison used by Analog Engineering Associates of the USA and, in a simplified form, by Mission Electronics in the UK.

AEA have developed a transient distortion measurement system that uses a music as a test signal to evaluate circuit performance under dynamic conditions. This system consists of a dual channel analogue to digital converter which is designed to have a resolution of 1 part in 65,536 or 0.0015%.

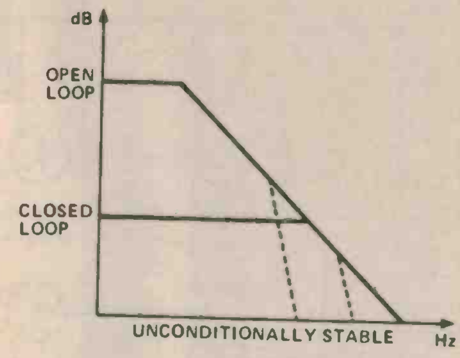
One channel of this is used to sample the input music signal whilst the second channel samples the output signal via a precision attenuator. The digitally encoded output of the convertors is fed to a computer memory system for later analysis. Instead of trying to compensate for the amplifier's phase and frequency response with a passive circuit (as in the earlier simple nulling circuit) a frequency sweep is made through the amplifier to generate a "transfer function"



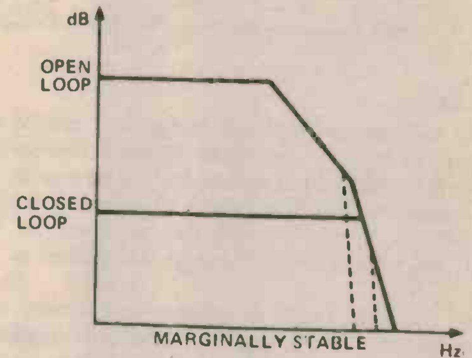
Analog Engineering's transient intermodulation distortion measurement system, used in Britain by Mission Electronics.

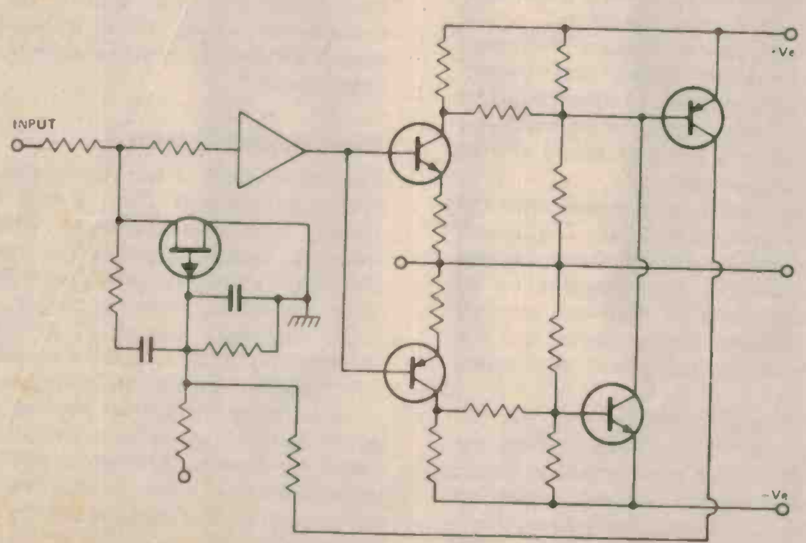


A study of the circuit of a conventional V - I protection circuit will show that as the protection transistors turn on they become a 'non-linear resistor' across the bases of output transistors Q3 and Q4 and as such create unpleasant distortion. One solution tried by some companies was to slug the bases of Q1 and Q2 with a capacitor to provide a time delay to prevent the protection operating except during a sustained short-circuit.



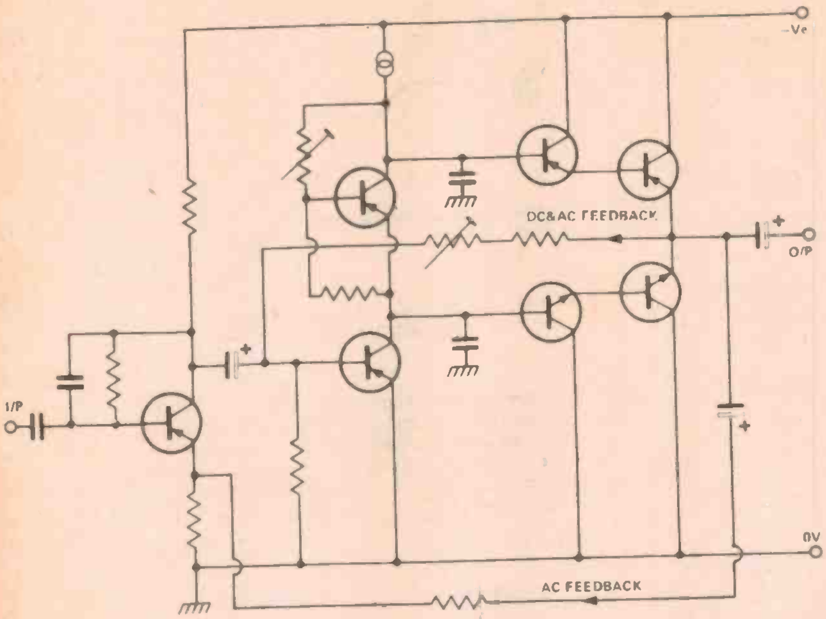
Above: Effect of adding an extra pole at the output of an unconditionally stable amplifier, such as might be added by a complex cross-over network. Below: Same condition applied to marginally stable type. Phase shift now borders on 180°, i.e. oscillation.



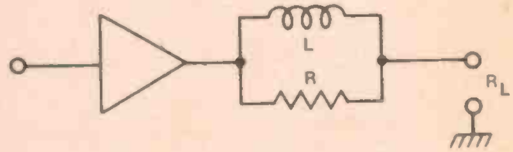


In this protection circuit the FET starts to turn-on when full-power is delivered into a 2 ohm load. The main advantage over a conventional protection circuit is that the limiting is "soft" (i.e. very gradual) and thus audibly acceptable and secondly that the distortion is much lower — and still only about 0.1% at limiting.

Ultra-Fidelity Amplifiers -design principles



Circuit diagram showing a typical circuit which would prove to be prone to dc instability when in use. Note that separate paths exist for ac and dc feedback.



Ever wondered what this circuit in the output of an amplifier is for? Wonder no more — it's to aid the output stage in handling a capacitive loading by partially cancelling the effect.

Out of The Rut

A few years ago power-amplifier design had settled into a satisfying rut. In the UK the Quad 303 and the Cambridge P-Series had achieved very satisfactory performance figures and they were generally considered to be good amplifiers. In the USA the Crown DC300 has achieved an almost theoretically perfect specification and was hailed as "State of the Art".

However, the first crack to appear was caused by new loudspeaker designs. Some had very demanding impedance curves which in some cases presented a two ohm load to the amplifier. Such a low value of load (almost a short circuit to some minds!) operated protection circuits in many amplifiers, limiting the current to protect the output transistors.

The operation of these caused a very unpleasant "clipping" sound in some cases and even stranger "clicks" and "bangs" in others. Thus alerted it became apparent to some designers that conventional protection circuits were turning partly-on quite frequently in the course of a piece of music and so giving a sort of premature clipping action.

Without any doubt the best results are achieved when the output stage is devoid of any protection at all. The output stage should be designed to deliver all the current a load demands without limiting. Consider the reproduction of a bass drum. If the amplifier starts to limit the start of the "thump" the sound pressure will collapse and the bass-drum will appear to have no body and thus sound unrealistic.

The output-stage should ideally be able to sink the full energy of the power-supply until its regulation causes the current to limit progressively. So in a good amplifier design the output-stage and the power-supply must be designed as a single item and not as separate circuits. Several amplifiers *are* designed like this. The Lecson AP3 Mk II, the BGW models 500 and 750, and the Mission Power Amplifier. The Lecson AP3/11 can, for instance, deliver nearly 20 amps to the load before the mains fuse blows and the BGW model 750 even more.

If the amplifier now has to drive a capacitive load eg. electrostatic speakers, or complex crossover networks; another pole is added at the output.

In the case of the unconditionally stable amplifier the only ill-effect will be some "ringing" in the closed loop step response — but in the case of the marginally stable amplifier it may go completely unstable. The most popular "belt and braces" solution to this problem is to fit a resistor-inductor network at the output to "cancel-out" the effect of the capacitive loading.

It is interesting to note that some marginally stable amplifiers omit those components as most speaker cables have sufficient resistance and inductance. However, some of the new "Super-Cables" (Litz and Lucas, etc) have a very low resistance and almost no inductance but some capacitance — and their use with certain amplifiers has caused instability, with the amplifier (or speakers) eventually blowing-up!

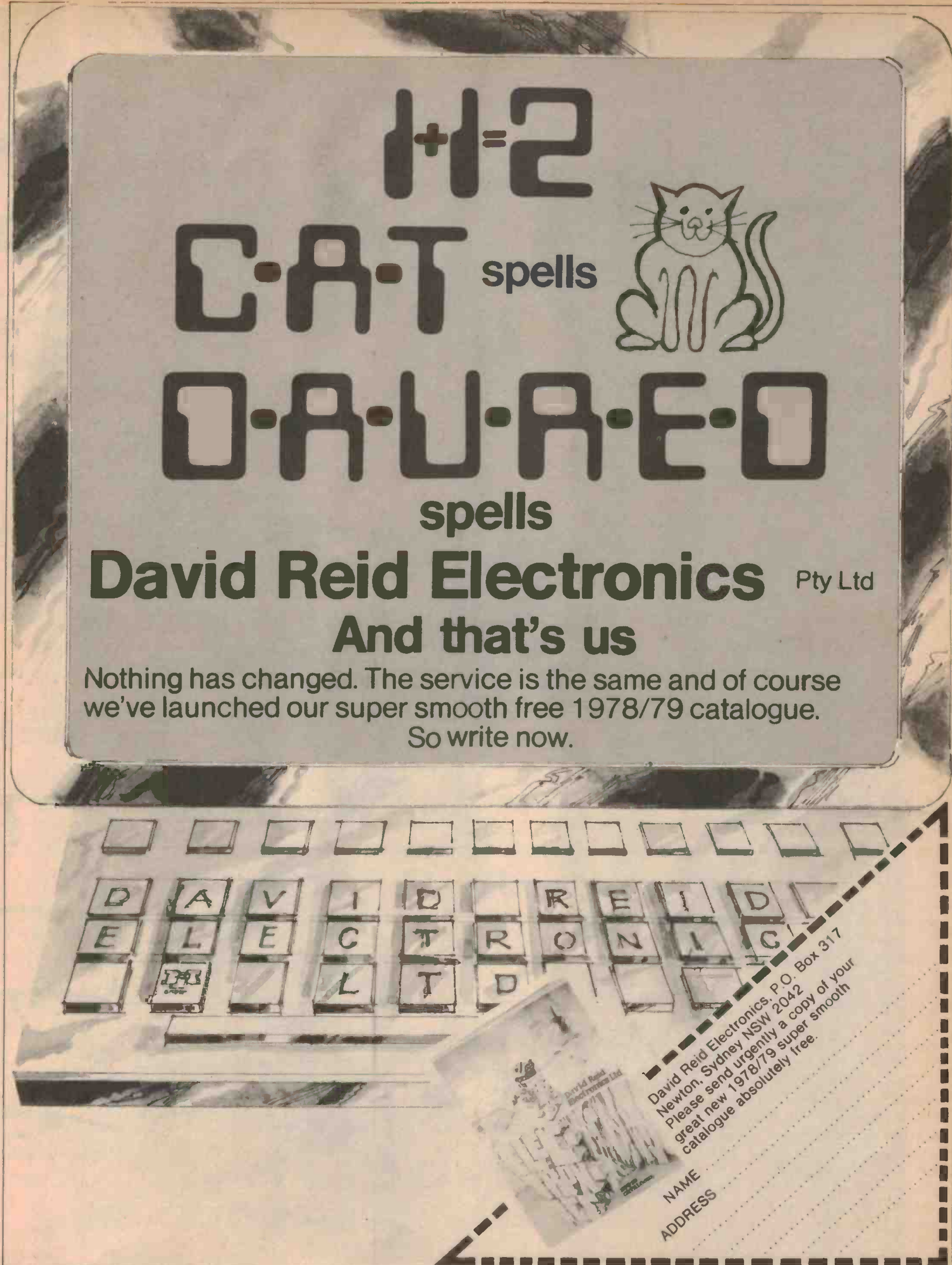
Which Parameters Matter?

For many years it has been usual to specify and compare amplifiers through their ability to handle a continuous (steady state) sine-wave signal. Thus such a signal is used to measure power-output, frequency response, harmonic distortion, crosstalk, input overload capability, intermodulation distortion, damping factor, and gain! Unfortunately many engineers and Hi Fi pundits still believe that such information is ALL that is necessary to quantify an amplifiers performance and to compare it with others. Not so!

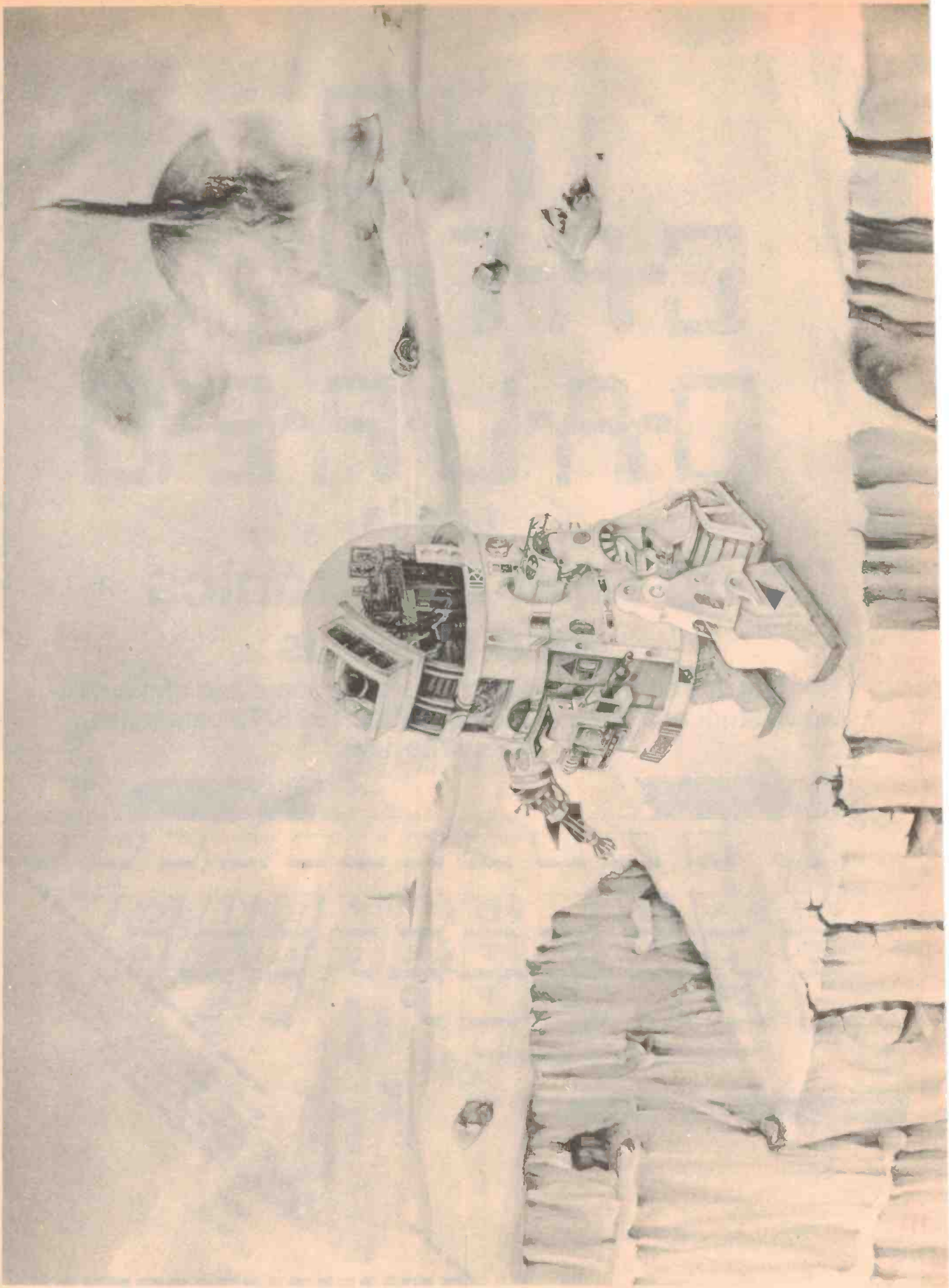
Steady-state sine-wave testing can tell only part of the story and can often be misleading. Music contains complex wave forms with a spectral content of greater than eight octaves and dynamic ranges of up to 100 dB. Yet such complexity is readily understood by the human brain which, in mastering the subtleties of spoken language, has evolved the ability of extraordinary auditory sensory perception. The music signal, as with all audio signals, can be considered in terms of two variable qualities — the frequency domain, and the time domain.

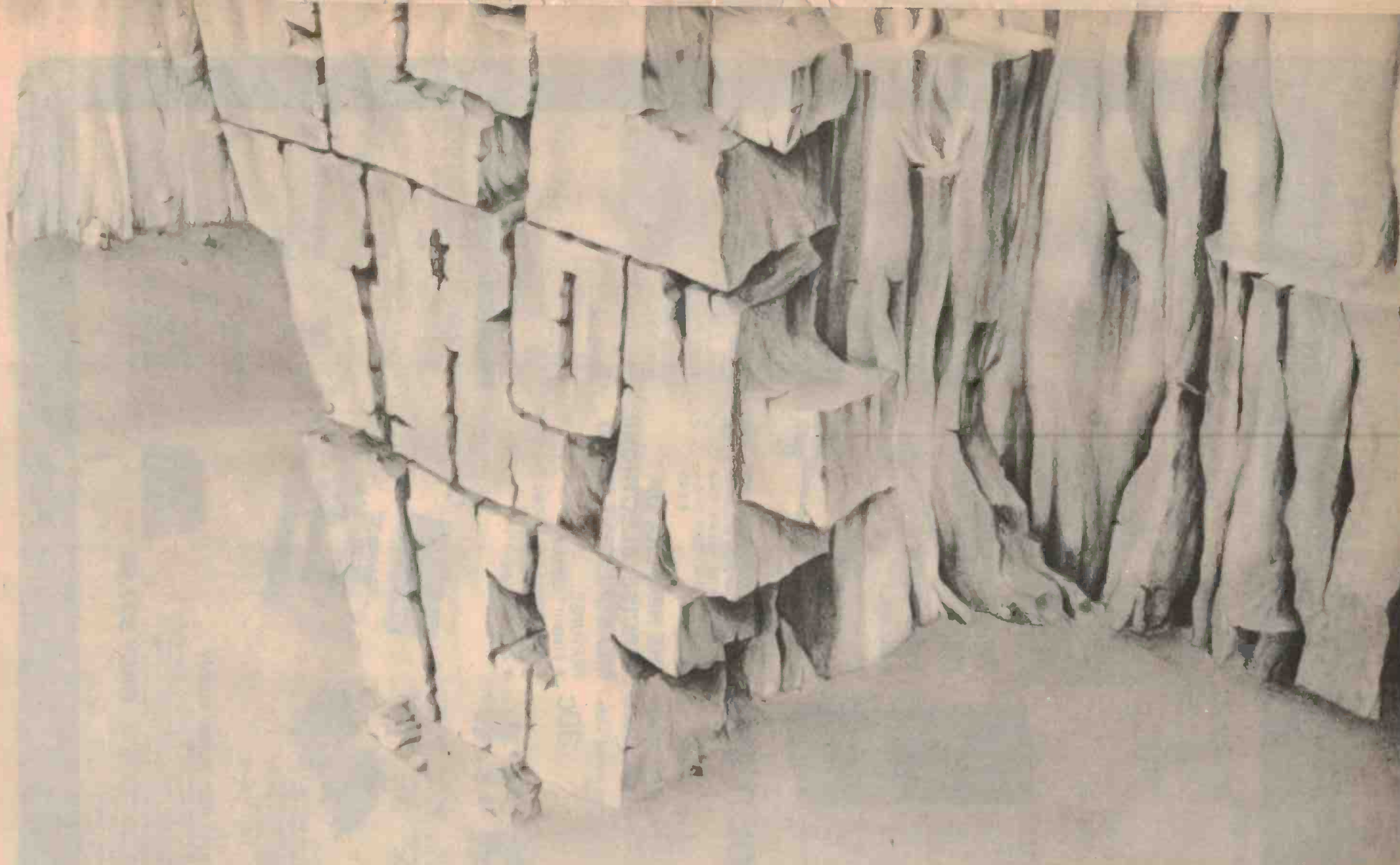
The frequency domain has monopolised engineers' thought

Continued on p.73. . .



1+1=2
C-A-T spells
D-A-V-I-D-R-E-I-D
spells
David Reid Electronics Pty Ltd
And that's us
Nothing has changed. The service is the same and of course we've launched our super smooth free 1978/79 catalogue.
So write now.
David Reid Electronics, P.O. Box 317
Newton, Sydney NSW 2042
Please send urgently a copy of your great new 1978/79 super smooth catalogue absolutely free.
NAME
ADDRESS





Meet ELECTROBOT, the affable robot who will be heading David Reid Electronics 1978/79 Electrokit programme. During the next 12 months Electrobot will introduce many exciting, new electronic kitsets to the already extensive Electrokit range. Electrobot is also featured in full colour on the cover of David Reid's exciting new 1978/79 Mail Order Catalogue which has been redesigned with many new items, while also being easier to read.

The same picture as above will shortly be launched in full colour on a 30 x 40 poster which will be a must for every electronic enthusiast's workshop or den. Keep an eye on the regular David Reid advertisements for full particulars plus many future Electrobot specials.

DAVID REID ELECTRONICS LIMITED

P.O. BOX 317, NEWTON, SYDNEY, NSW 2042, 104—106 KING ST. PHONE 5196361

NEON INDICATORS

Colours available: Red, Amber, Green, Clear.
OL — Self Clip-in fitting
ZL — Spire clip washer fitting
C — Conical head
R — Flat head
All fit 9.5 mm recess.

FQ-R/OL
FQ-c/QL — 240 VOLT 80c
FQ-C/ZL
FQ-R/ZL — 12 VOLT 90c

It's the LASER TORCH/ALARM

At last you can be safe at night. The Laser torch/alarm has its own batteries to power an ear-piercing alarm for early warnings of danger when out walking or just to summon a neighbour's help when needed. Many molesters' attempts could be thwarted by the scarey sound, especially when thrown out of reach. If they try to stop it the victim can run for help. At night the high pitched sound can be heard for a great distance. Ask to have it demonstrated at an electronic centre or send payment with the order form on Page 54.
Remember — our money-back guarantee.
Only $2.45

EARPIECES FOR ALL REQUIREMENTS

H1 8 ohm quality with 3.5 mm plug. Ideal for private listening to radio, TV, cassette player, etc. **80c**
H5 8 ohm standard with 3.5 mm plug. Lightweight earpiece for portable radios, cassettes, etc. 50c
H5A 8 ohm standard with 2.5 mm plug. For pocket radios fitted with 2.5 mm mm sockets. 50c
H6 Crystal. High impedence for crystal sets. **$1.00**
H7 1000 ohm. Ideal for monitoring high impedence outputs, i.e. on test equipment. $2.00

Potentiometers

WOS Log 5K, 10K, 50K, 100K, 500K.

SEPT ONLY 45c ea.

WOS Lin 1K, 5K, 10K, 50K, 100K, 250K, 500K, 1 meg.

SEPT ONLY 45c ea.

QUAD POTS

4 channel, 100K Linear Quad Pot. Comes complete with knob. Measures 49 mm square. Ideal for radio control, quad boxes, etc. **$4.25**

ADCOLA SOLDERING IRON

Adcola D30
Duotemp — dual capacity. Repair and rework or continuous use.
3 mm tip.
$20.45
Adcola RS50
ONLY $13.75

DAVRED TOP 20 REPLACEMENT STYLII SAVE $$$$$$$$$$$
Double Sapphire $1.00
Single Diamond $1.00
Sapphire Diamond $1.50
Double Diamond $2.00
Piezo Diamond Y 995 $3.00

COOL IT MAN

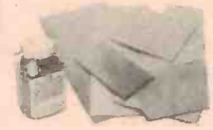
TO-220 dissipator lets the semiconductor function as a free standing assembly. Spring loaded, vibration free.
30c

H308	H310	SF2 TO5,	RQA TO18
10mm D,TO5	6mm D, TO5	15 mm dia.	8 mm dia.
13 mm square	19 mm square	x 5 mm D.	x 10 mm D.
70c	80c	30c	75c

113 mm wide x 30 mm high

Ideal for mounting semiconductors required to dissipate large amounts of heat. Fluting provides greater heat dissipation. Flanges on base allow for mounting on any position, for natural or forced cooling. Supplied undrilled.
4" **$3.00** 12" **$4.75**
6" **$3.75**

MAKE YOUR OWN PC BOARDS



Ferric Chloride Pellets. An etching solution. Prepared by adding the crystals to water. Supplied with all instructions for use.
WHAT A PRICE!
ONLY $3.95 20 oz jars.

Paper Phenolic
6" x 3" 50c
12" x 6" $1.60

Epoxy Glass
6" x 5" $1.75
12" x 5" $3.25

THE NEW ERA OF PRECISE ELECTRONIC MEASUREMENT DM 10

FEATURES:
- Instant Readout
- Automatic Over Range Indicator
- Overload Protection
- Zero Locked

Instantaneous Readout with no parallax error typical 1% accuracy with high resolution robust construction for bench and portable use.
$78.04
15% Tax
= $89.70

GIVE YOUR AMP THE PROFESSIONAL LOOK

SW17A Min. multi slide switch. 4 pole 2 pos. Anodized Lever **60c**

SW44A Push on/off. Same specs. as 43A. SPST. Black $1.20

SW44 Push on/off Red and Black 240V 3 amp Same size as above. **$1.20**

KIT 39 build your own power supply

Multi voltage 1 amp regulated power supply
This electronic Kitset is designed to provide 6 alternatives switched voltages with a current rating of 1.0 amp. Voltages are 3.0, 4.5, 6.0, 7.5, 9.0 and 12.0. It is also possible to set these voltages to any other preferred voltage within this range. The unit is short circuit proof against short period malfunctions.
Regulation: h 2½% with mains variation of 10%.
Ripple Voltage: Maximum 5mv at 1 amp rating.
Current Limiting at approximately 2.0 amps.
Aproximate dimensions of the unit 116 x 105 x 105 mm.

ONLY $27.50

Mail Order Instructions
Minimum P + P $1.00
Orders over $9.99 must include additional postal charges (see right).

ADDITIONAL POSTAL CHARGES

Order Value	Charge
$5-$9.99	Nil
$10-$24.99	$0.50
$25-$49.99	$1.50
$50-$99.99	$2.50
$100 or more	$4.00

REMEMBER ALL ORDERS OVER $100 RECEIVE A 10% DISCOUNT

HEY OZ! HAVE YOU SEEN OUR NEW SUPER SMOOTH DAVID REID ELECTRONICS 1978 CATALOGUE? WRITE FOR IT NOW for so long — even the most complex music signal can be represented by a Fourier analysis.

This mathematical equation lists separately each frequency making up the signal, (together with its phase and amplitude). However, a Fourier analysis is only complete in the case of simple waveforms, with more complex waveforms it becomes only a convenient approximation.

To make a Fourier analysis of a signal the components of that signal have to be analysed over a period of time such that complete cycles of the lowest frequency can occur. Thus we take consideration of the time domain.

Where steady-state signals are concerned the time domain is not normally considered, as the signal is of a continuous unchanging nature between any two periods. If the "time window", during which the signal is Fourier analysed, is reduced progressively it becomes apparent that an accurate spectral analysis becomes less possible. It can then be seen that the important characteristics of the signal are amplitude and rate of change. In other words its envelope.

What Do We Want?

What is required is the amplification of an audio waveform in such a way that the ear can detect no degradation.

Let us consider ways in which such degradation can occur. The waveform envelope can be distorted by amplitude changes of any component or by changes in the phase relationship of the component harmonics.

Experimental work has established that changes in the relative amplitudes of the harmonic structure of the waveform are readily detectable.

Other work has shown that the qualitative characteristics of a complex sound depend upon the phase relationships of the component harmonics. It would seem that as a phase difference must be interpreted as a time delay between the component parts of the signal, then a sufficient phase shift in a system must eventually become audible as these component parts are moved in respect to each other in time. In practice large phase shifts are very audible and indeed telephone lines are often phase and delay corrected to render speech intelligible. However, establishing an acceptable degree of phase shift is extremely difficult.

Following the arrival of "linear phase" loudspeakers great controversy has raged over whether phase shifts affect sound quality. A study of the experimental work performed to date shows that

1. It seems to be very difficult to replicate someone else's experiment.
2. It seems, on balance, that where recurrent waveforms (steady state) such as sine-waves (and instruments producing a "continuous" although decaying tone) are concerned; then quite large phase shifts, between the extremes of the frequency band, have no identifiable effect on sound quality. However, a phase non-linearity on the leading edge of a true transient appears to be audibly more perceptible, particularly on speech and percussive sounds.

Bandwidth and TID

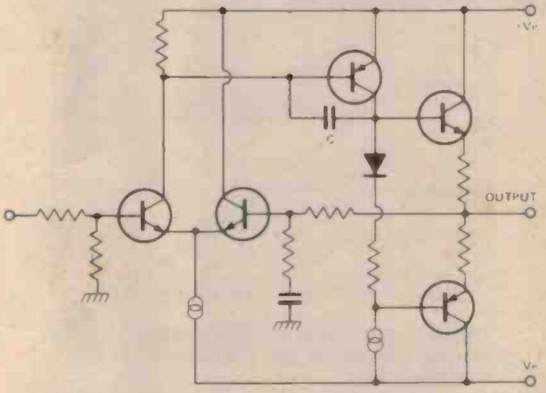
Transient signals cause many problems of which phase linearity is but one. Other problems include; instability and ringing, clipping, slew-rate limiting, and transient intermodulation distortion.

Transient intermodulation distortion (TID or TIM) is much in vogue but is often misunderstood. TID most commonly occurs when an amplifier, with overall negative feedback over several stages, is driven by a large enough signal whose frequency (or equivalent rise time) is above the open loop bandwidth of that amplifier.

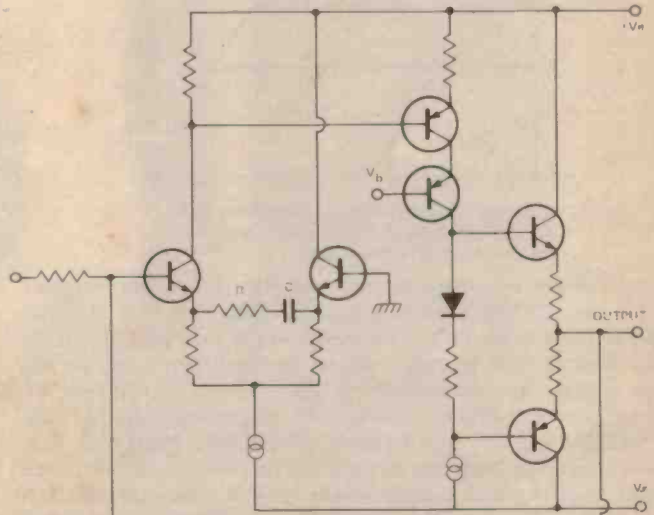
Because the feedback loop is fed from the output of the amplifier, there is no effective feedback until signal current flows at the output, i.e. during the open-loop rise time of the amplifier.

Very large signals occurring in the intermediate stages of the amplifier cause those stages to distort or even to clip. With some amplifiers this clipping can cause the stage to latch-up for a time until the operating conditions restabilise. Thus not only is the leading edge of the signal severely distorted — in some cases it is removed completely.

TID is therefore a form of overloading that is dependent upon both amplitude and time. It is audibly (but at a higher signal level) similar to cross-over distortion, as both effects cause phase and amplitude modulation of the signal due to momentary change in gain. (Remember that at the crossover point zero, there is no current flow in the output stage and hence no feedback current and so the amplifier is momentarily open-loop.)



Circuit diagram of a typical amplifier circuit which employs lag compensation techniques — provided by C.



Lead compensation: components R and C provide the time constant.

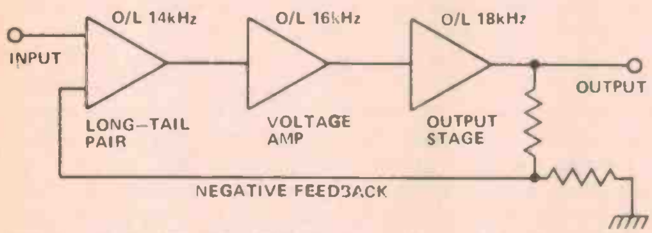
Ultra-Fidelity Amplifiers -design principles

Making Big Bands

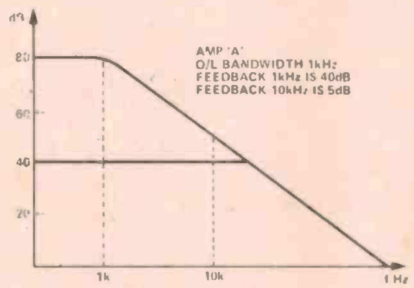
TID can be avoided by designing an amplifier whose open-loop bandwidth is greater than the highest frequency of the input signal. The maximum bandwidth can then be defined at the input by a passive RC filter. Thus if we decide upon a maximum signal bandwidth of 20 kHz than our filter will limit the signal waveform rise-time to T = 0.35.

$$T = \frac{0.35}{20\ \text{kHz}}$$

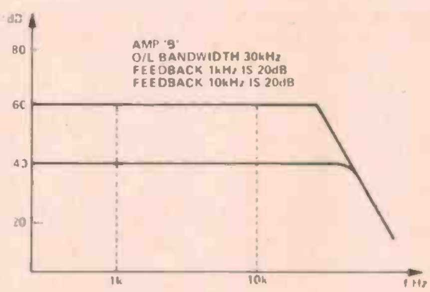
i.e. 17.5 μs.



Third method of avoiding TID. Each stage in the design has a wider bandwidth than the preceding one.



This amplifier design has a limited open loop bandwidth and the THD will rise with frequency.



Contrast this with the graph above. The bandwidth here is much wider, resulting in a more linear THD response.

Our amplifier's open-loop bandwidth should be designed to be, say, 23 kHz, giving it an open-loop rise-time of 15 μs and freedom from TID. If however, in the interests of a good specification, and possibly better reproduction, we decide upon a close-loop bandwidth of 100 kHz (i.e. a rise time of 3.5 μs) then our amplifier will need an open-loop bandwidth of greater than 100 kHz to maintain freedom from TID. In a power amplifier such performance is not easy to obtain. Fast power transistors are notoriously easy to blow-up and are expensive. The common form of lag compensation (used where the open-loop bandwidth is restricted) has to be replaced by lead compensation:—

Another technique is an extension of the first in that the preceeding stage of the power-amplifier is designed to have a lower open-loop band width than the next.

Important or Not?

Many people now consider that TID is unimportant or even that it doesn't exist. This is partly because it is very difficult to measure and only readily visible (in the laboratory) in the "clipping" state. To reach this stage with most amplifiers (but not TID — free designs) there is a requirement for either fast rise-time or higher signal levels or both, — conditions that are unlikely to occur in practice. However, a large degree of non-linearity and hence bad intermodulation will still occur with more realisable input signals. Although this cannot be measured yet (how do you measure say, 5% IM over a period of 5 milliseconds?) it can be predicted mathematically and, just as important, heard. Amplifiers free of TID have a very "open" quality with accuracy of depth.

An amplifier designed with a wide open-loop bandwidth, for low TID, often has other more tangible benefits. The high frequency THD is usually no higher than at the mid-point; in stark contrast to more traditional designs. This is because gain is still available at high frequencies for negative feedback. Such amplifiers also usually have much higher slew-rate.

Slew

Slew-rate defines the speed with which the amplifier can deliver output voltage to the load. For example, if an amplifier has a maximum output of 100 volts p/p and a rise-time of 100 μs, then the amplifier, if it were perfect, should have an output of about 80 volts after 10 μs in response to a suitable square wave input. In other words the output voltage would have risen at the rate of 8 V/μs. However, amplifiers do not generally respond to large changes as fast as their small signal characteristics predict, for circuit and transistor capacitances can be charged only as fast as their driving circuits allow.

In its simplest form the slew-rate of an amplifier defines how fast the output voltage can change for large signal conditions, and it is normally quoted in volts per micro second. The maximum slew-rate of an amplifier is usually limited by the slowest stage in its circuit.

That stage will have an operating current T (as set in the design) and a capacitance C (usually a frequency compensation capacitor)

$$\text{Slew-Rate} = \frac{T}{C}$$

Thus if a transistor stage has a standing current of 100 μA and is compensated by a 43 pF capacitor then its slew-rate will be

$$\frac{100}{33}$$

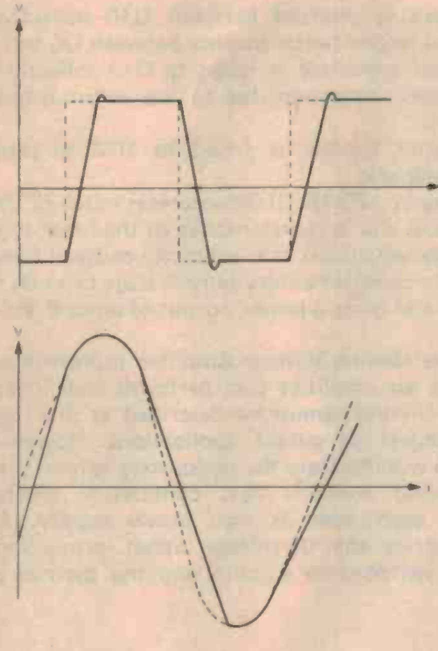
i.e. 3 V/μs

Depending upon the design some circuits have a different slew-rate depending upon whether their output is negative-going or positive-going. Slew limiting also defines the full-power bandwidth; a figure more commonly quoted by manufacturers.

$$fp = \frac{SR\ (10^6)}{2\pi\ E\ op}$$

E op = peak output swing in volts
fp = Full power bandwidth in hertz.

Thus in a 100 watt (into 8 ohms) amplifier having full-power bandwidth of 20 kHz the required minimum slew-



The effects of slew-rate on a signal passing through an amplifier prone to this fault. Top: a squarewave, note the slight overshoot. Below that, a sinewave. In both cases the dotted line represents the input.

rate would be about 5 V/μs. This is, however, the absolute minimum figure and experience suggests that such an amplifier would have a hard, gritty high-frequency sound. Such an amplifier should have a slew-rate greater than 20 V/μs to be certain of avoiding the increase in distortion caused by the gradual onset of slew-limiting.

Unfortunately the higher the power output of the amplifier the greater the required slew-rate as more volts swing at the output in the same period of time and so as our 100 W amp needs 20 V/μs an otherwise identical 50 W amp needs 14 V/μs and a 20 W amp needs only 9 V/μs. But these forms of distortion tend to give subtle audible effects compared to the most common amplifier problem — that of clipping.

Clipping

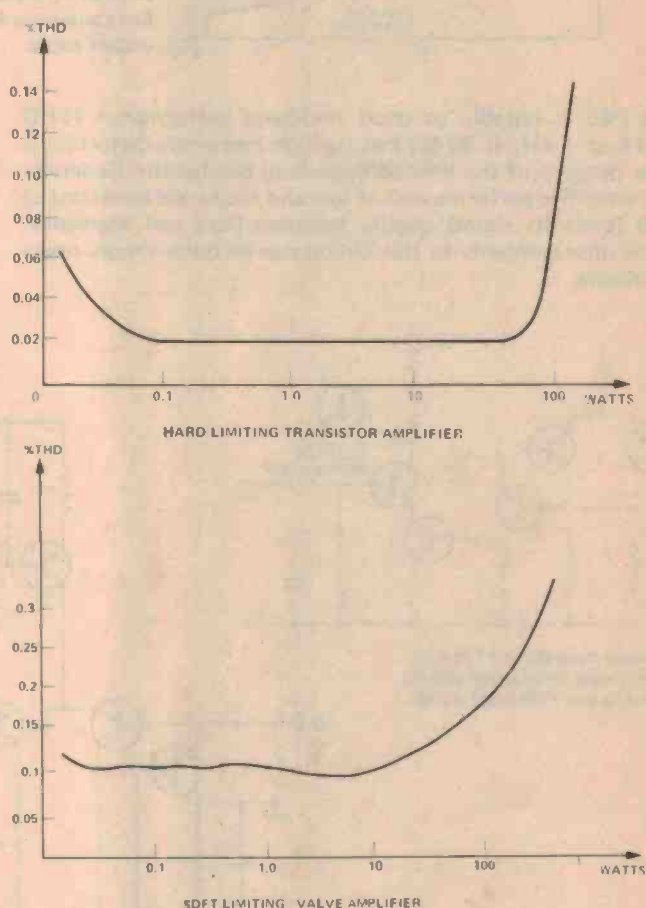
Clipping occurs when an amplifier is overloaded by high level signal peaks. Such peaks occur frequently in much music material and so the manner in which the amplifier clips determines its audibility. A soft, clipping effect where the distortion rises gradually (typical of valve amplifier circuits) is audibly preferable to the hard clipping typical of transistor circuits.

Worse still, some amplifiers tend to suffer saturation effects on clipping and take a time to recover; thus artificially extending the length of time the signal is clipped. The use of overall negative feedback to reduce distortion unfortunately makes things worse. Overall feedback effectively linearises the clipping — the distortion changes from 0.01% (say) to 10%, and quite suddenly too.

Design Procedure

We have covered just a few of the requirements a designer must consider when working upon the design of power-amplifiers. There are many more to be considered to even rough out a design specification before the circuit hardware is considered. The following sequence is mandatory:

1. What parameters are important to prevent audible degradation of the signal?
2. Detail a performance specification that meets the requirements of (1).
3. Decide upon the circuit technology necessary; Bipolar; MOSFET; Valve; Class A; Class B; Switching; etc; etc.
4. Undertake a development programme to produce a prototype.



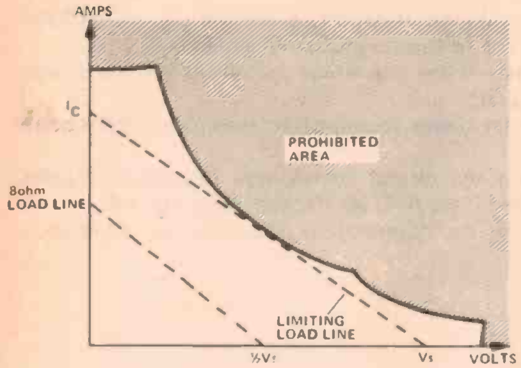
A comparison of the limiting characteristics — in general — of both transistor and valve amplifier types. There is a body of opinion which holds these curves to be the whole truth as to why valve amplifiers are preferred by many musicians.

At this point the designer has to accept that it's a real world and that his performance specification cannot be achieved in a way that is acceptable to accountants, salesmen, customers, customer's wives or whoever else is around. Trade-offs are necessary and much of the "art" is in deciding which defects and degradations are more acceptable than others.

As an illustration of the changes in design approach over the years we will briefly illustrate three designs for which the author has been responsible:

1. Cambridge Audio P60 (P80)
2. Lecson AP3 Mk II
3. Mission Electronics Voltage Amplifier

Ultra-Fidelity Amplifiers -design principles



Illustrating the load line conditions for output stages.

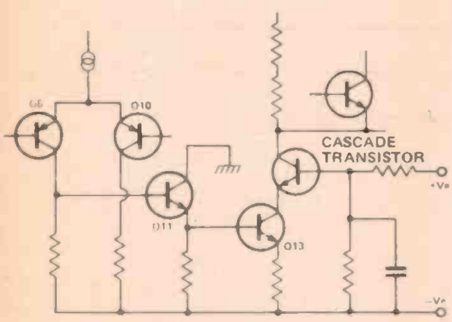
The P60 is capable of good mid-band performance (THD 0.01% at 1 kHz is 30 W) but its high frequency distortion is poor because of the limited open-loop bandwidth. Generally this amplifier performs well at low and moderate levels but at high levels its sound quality becomes hard and aggressive. Some improvements to this circuit can be quite simply made as follows:

1. A resistor is inserted between Q10 collector and the negative rail to give better balance between Q8 and Q10.
2. A cascade transistor is fitted to Q13 collector to reduce "early effect" distortion due to the collector-base capacitance of Q13.
3. An emitter resistor is fitted to Q13 to provide local negative feedback.

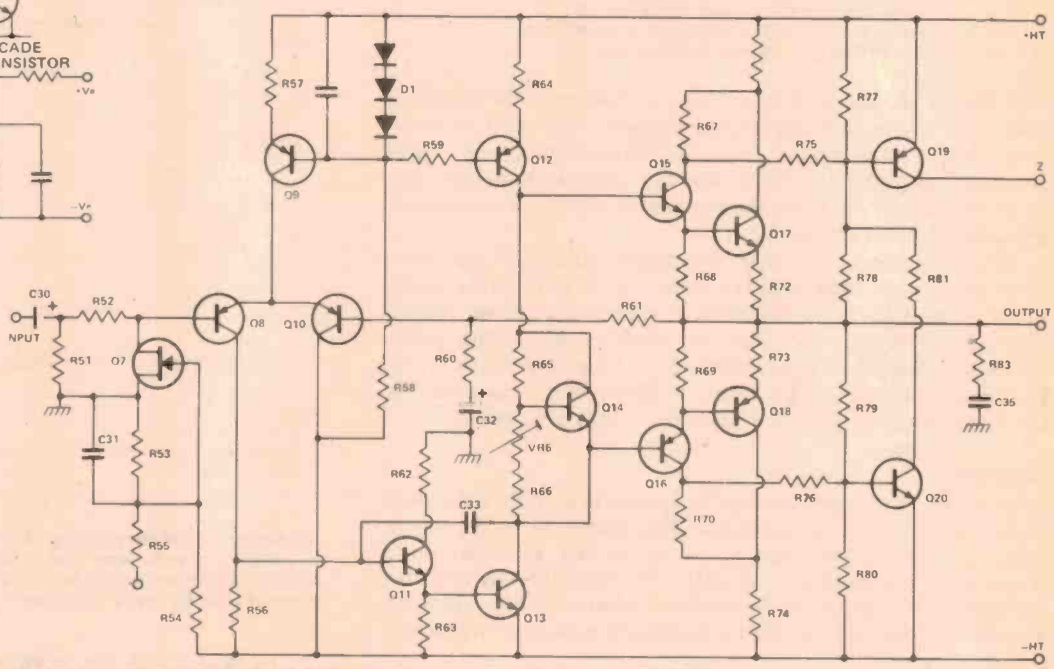
The Lecson AP3 Mk II incorporates much of the thinking in this article and is representative of the latest types of high performance amplifiers. It is a directly-coupled Class B design using a fully complementary output stage of series connected transistors and gives a power output of around 150 watts per channel.

The New Mission Voltage Amplifier represents an attempt to produce an amplifier that performs well irrespective of load. The circuits cannot be described at this stage as they are the subject of patent applications. However, a brief description will illustrate the philosophy behind the design.

The casing contains two completely separate mono amplifiers, each with its own power supply. A separate module carries the dc-voltage offset protection circuits; the delay switched-on circuits; and the thermal protection



Showing how some of the improvements mentioned can be added to the P60 basic design.



Full circuit diagram of the Cambridge P60 power amplifier design.

HOW IT WORKS—Cambridge P60

The P60 power amplifier is of a conventional design but with care being taken to optimise each stage. Q8 and Q10 form a long-tailed pair with Q9 as their emitter current source. Q8 and Q10 must be very closely matched for minimum DC offset and for maximum common-mode rejection to avoid H. T. ripple appearing at the output. The next stage is the Q13 voltage amplifier which is loaded by a current source (Q12) instead of the more common "bootstrapped" resistors. Note that Q13 is buffered from the long-tail pair by an emitter follower (Q11) to prevent any loading of that stage worsening the distortion characteristics.

Capacitor C33 gives lag compensation which defines the dominant pole of the amplifiers. The open-loop bandwidth is quite high (for this type of circuit) at 12 kHz but none the less this amplifier is prone to TID effects. The protection circuit is very unusual in that the output is limited by an FET (Q7). Q19 and Q20 each form conventional V-I summing circuits which monitor the loading on the output stage.

If either Q19 or Q20 turns-on, the gate of the FET Q7 (normally biased-off by R54 to the negative HT) is biased positive and it starts to turn-on. It then acts as a potential divider with R52 and thus attenuates the audio signal. This protection only turns on at the equivalent of 50 W into 2 Ohms load and when it turns on it only adds moderate distortion (0.2% typically) as distinct from clipping.

circuits. Particular attention has been paid in the design to achieving:

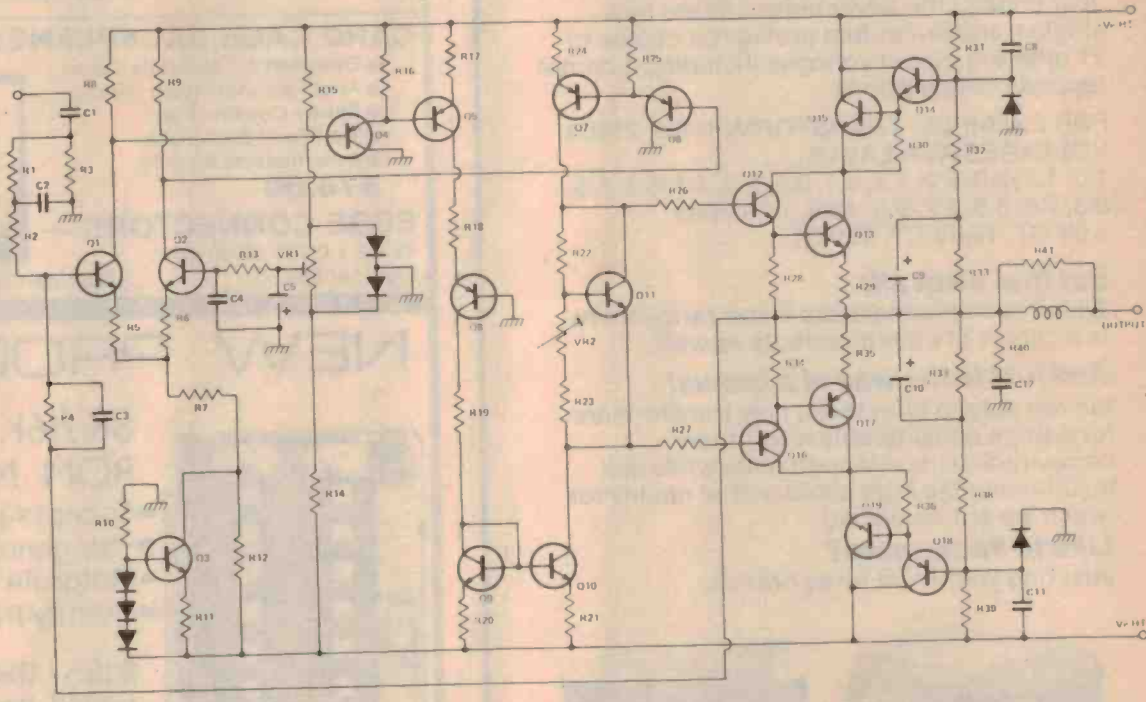
1. Low distortion with a very low order of overall feedback
2. Wide open-loop bandwidth with an excellent slewing rate
3. Minimum time and phase distortion
4. A high transient power capability with virtual freedom from clipping effects.

The output stages have a very high current capability but have no protection circuits, the output transistors being designed to sink the full energy of the power-supply into the load. A patented form of voltage feed to this stage gives the amplifier a short term power delivery capability of about 600 watts (compared to the rated 150 watts 8 ohms). This represents a 6 dB increase in power availability over the rated figure. The voltage amplifing stages are designed to clip softly and this combined with the low-overall feedback gives overload characteristics similar to those of an equivalent valve amplifier.

Conclusion

This feature has discussed just some aspects of modern audio amplifier design. At present much attention is still given to whether an amplifier is designed around bipolar transistors, FETs, valves, or switching transistors. However designers are beginning to appreciate that the major stumbling block is not designing a circuit using any of these technologies but in deciding upon what is the performance specification required *that will give faithful reproduction of the sound source.* Until this problem is solved there will continue to be an element of uncertainty in amplifier design.

The Mission Amplifier referred to in this article is due for release very soon now, and we will be taking a closer and more detailed look at this design — results as soon as possible in ETI.



Full circuit diagram for the Lecson AP3 power amplifier design, producing around 150W.

HOW IT WORKS—Lecson AP3

Transistors Q1 and Q2 form a long-tailed pair differential amplifier with Q3 as the emitter current source. Local feedback is applied in the form of emitter resistors R5 and R6. The base of Q2, instead of being grounded, is connected to a potential divider RV1 which permits the DC offset at the output to be set to zero. The input signal to Q1 is passed through a low-pass filter (R1, C2) which sets the bandwidth to 22 kHz (i.e. below the open loop bandwidth for no TID effects). The bi-phase outputs of the long-tail pair feed a second differential amplifier Q5 and Q7. Transistor Q5 has a constant current load (Q8) whilst is terminated by a current mirror (Q9 and Q10). Transistor Q10 will always deliver the same current as transistor Q9 hence the term "Current Mirror" and the excellent symmetry and balance this stage achieves. Functionally, however, Q10 can be considered as an active load whilst Q7 is a voltage amplifier from whose collector the drive to the output stage is taken. Note that Q5 and Q7 both have local emitter feedback (R17, R24) and that both are buffered from the long-tail pair (Q4 and Q6 emitter followers).

Transistors Q12, Q13, Q16 and Q17 each form conventional Darlington emitter follower stages. Each stage is series connected to a further power transistor (Q14, Q15 and Q18, Q19 respectively) which is permanently biased ON. Their emitter potentials are determined by the ratio of the base potential dividers. This ratio was chosen such that Q13 and Q15 each has half the supply rail across them.

The whole amplifier is in the inverting mode with overall shunt feedback through R4 and C3.

This amplifier is quite fast having an open-loop bandwidth of about 27 kHz. The circuit is stable without the usual compensation capacitors within the loop. THD is low being typically (at 100 W into 8 Ohms) 0.004% at 1 kHz and 0.02% at 10 kHz. The HF distortion can be further improved by selection of transistor Q7 for a device with a low collector-base capacitance.

No conventional protection circuits are used as extremely high power transistors are fitted and these can survive a short-circuit condition in the time taken for the power supply to shut down.

SAVE $ $ $ $ $

HARMONIX

SPEAKER KITS

Simply a better sound.

PLESSEY/FOSTER COMPONENTS

Loudspeakers to satisfy the most demanding enthusiast.

Here they are — from the small HX8-2 way to the big HX15-3 way loudspeaker system. If you've ever heard from them, you'll know you've listened to the result of superb craftsmanship in the science of sound.

Model	Power	Frequency Range	Price Per Pair Kitform	Price Per Pair Assembled	Do-It-Yourself You Save Per Pair
HX8-2W	20W RMS	20 Hz-15 kHz	$155.00	$195.00	$40.00
HX10-3W	20W RMS	20 Hz-20 kHz	$210.00	$275.00	$65.00
HX12-3W	35W RMS	20 Hz-22 kHz	$255.00	$345.00	$90.00
HX12-3WA	45W RMS	20 Hz-21 kHz	$235.00	$345.00	$110.00
HX15-3W	70W RMS	18 Hz-40 kHz	$365.00	$465.00	$100.00

MAIL ORDER: NSW Country & Interstate – Freight extra.

For further technical information and your nearest dealer contact **Harmonix Acoustix** on (02) 519-5127 or write to 29 Vincent St, Marrickville. 2204.

TRADE ENQUIRIES WELCOME

DEALERS — the list grows.

- *HARMONIX speaker kits now available from:*

— **HI-FI CITY,** 269 Elizabeth St, Sydney. 235-8401
— **IN ELECTRONICS,** Haberfield. 79-9331
— **HI-FI JUNCTION,** Bondi Junction. 389-4000
— **TERRY'S SOUND LOUNGE,** Bowral.

HX15-3W

HX12-3WA

HX12-3W

HX10-3W

HX8-2W

SUPER SPECIALS

BD 139 — 50c ea.
BD 140 — 50c ea.
BC 547/8/9 — 15c ea.
20 555 Timers for $5
MJ2955 — 80c.
2N3055 — 75c.
T03 Mounting Kits — 5c ea.
20 741 Op Amps for $5

CANNON CONNECTORS

XLP-3-11	$2.30
XLP-3-12c	$3.25
XLP-3-31	$3.25
XLP-3-32	$3.00
XLR-LNE-11c	$3.05
XLR-LNE-32	$4.30

Weller cordless soldering iron kit, model WC100DKW — includes batteries, solder, 4 interchangeable tips, battery charger and instructions for only $29.50.

TTL

7400	.28
7401	.28
7402	.28
7403	.28
7404	.37
7405	.37
7406	.50
7407	.50
7408	.34
7409	.34
7410	.30
7411	.37
7413	.54
7414	1.03
7416	.60
7417	.60
7420	.30
7422	.30
7426	.45
7427	.45
7430	.30
7432	.43
7437	.50
7438	.50
7440	.30
7441	1.50
7442	.70
7447	1.25
7448	1.25
7450	.35
7451	.35
7453	.35
7454	.30
7460	.35
7470	.65
7472	.45
7473	.60
7474	.65
7475	.65
7476	.45
7480	1.25
7483	1.25
7485	1.45
7486	.65
7489	1.20
7490	.75
7491	1.00
7492	.75
7493	.75
7494	1.10
7495	.95
74100	2.45
74107	.65
74121	.60
74123	1.10
74132	1.25
74150	1.80
74151	1.10
74153	1.10
74154	1.70
74157	1.10
74160	1.55
74164	1.55
74165	1.55
74173	2.75
74175	1.65
74180	1.35
74192	1.40
74193	1.40
74221	1.50
74367	1.40

74LS

74LS00	.30
74LS01	.30
74LS02	.30
74LS03	.30
74LS04	.35
74LS05	.35
74LS08	.30
74LS09	.30
74LS10	.30
74LS11	.30
74LS12	.30
74LS14	1.20
74LS20	.30
74LS21	.30
74LS27	.30
74LS28	.40
74LS30	.30
74LS32	.33
74LS37	.45
74LS38	.45
74LS40	.30
74LS42	1.20
74LS73	1.20
74LS74	.50
74LS75	.70
74LS78	.50
74LS85	1.50
74LS86	.50
74LS90	1.20
74LS92	1.20
74LS93	1.20
74LS95	1.50
74LS109	.50
74LS113	.55
74LS114	.55
74LS138	1.20
74LS151	1.20
74LS154	1.60
74LS157	.90
74LS163	1.20
74LS164	1.30
74LS174	1.00
74LS175	1.00
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.20
74LS196	1.20
74LS221	1.20
74LS253	1.85
74LS279	.65
74LS365	.80
74LS367	.80
74LS368	.80

CMOS

4000	.25
4001	.25
4002	.25
4006	1.40
4007	.25
4008	1.25
4011	.25
4012	.25
4013	.55
4014	1.35
4015	1.20
4016	.50
4017	1.40
4018	1.40
4019	.75
4020	1.60
4021	1.40
4022	1.60
4023	.25
4024	.90
4025	.40
4027	.80
4028	1.25
4029	1.90
4030	.40
4040	1.30
4041	1.25
4042	1.25
4043	1.50
4044	1.50
4046	1.95
4049	.60
4050	.60
4051	1.20
4052	1.20
4053	1.20
4060	2.65
4066	1.00
4068	.40
4069	.35
4070	.40
4071	.40
4072	.40
4073	.40
4074	.40
4076	1.85
4077	.40
4078	.40
4081	.40
4082	.40
4510	1.50
4511	1.50
4518	1.50
4520	1.45
4528	1.20
4555	1.20
14553	7.50
14584	1.25
74C00	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	1.90
74C48	2.55
74C73	1.20
74C75	1.20
74C76	1.35
74C90	2.25
74C93	2.25
74C175	1.85
74C192	2.25
74C193	2.25

LINEAR

301	.40
307	.65
308	1.35
311	.85
324	1.35
339	.90
349	2.25
356	1.65
380	2.00
381	2.00
382	2.00
386	1.95
555	.35
556	.85
565	1.95
566	2.50
567	2.65
709	.75
723(VR)	.55
741	.35
747	1.25
3900	.90
3909	1.25

VOLTAGE REGS.

309	2.25
317	3.50
323	8.25
325	2.60
723	.55
7805	1.30
7806	1.30
7808	1.30
7812	1.30
7815	1.30
7818	1.30
7824	1.30
7905	2.25
7912	2.25
7915	2.25
78L05	.50
78L12	.50
78L15	.50
79L05	.85
79L12	.85
79L15	.85

OPTO

FND507 C/A	1.70
FND 357C/C	1.40
FND 500C/C	1.50
Red LED	.22
Green LED	.35
Yellow LED	.35

DIODES

IN4148	6c — 5c/100
IN4004	9c
IN5625 5A 400V	45c

I.C. SOCKETS

8 PIN DIL	.25
14 PIN DIL	.30
16 PIN DIL	.33

Also in stock Multimeters, relays, veroboard, solder, solderwick, soldering irons, transformers. All components brand new by top companies. Prices current till end of October.

ROD IRVING ELECTRONICS

Shop 499, High Street, Northcote. Vic. 3070. Ph (03) 489-8131. Open Mon-Thurs 8 am — 5.30 pm, Fri 8am — 7 pm. Sat 9 am — 1 pm. Mail Orders: PO Box 135, Northcote. Vic.3070. Minimum 75c post and pack. Send 30c stamp for free condensed catalogue.

DISPLAYS— the state of the art

Dramatic developments are currently underway in both analogue and digital displays – ETI's special correspondent Associate Professor Peter Sydenham describes the present state of the art.

DURING the past few years digital displays have often been specified for applications where their analogue equivalents would have been more suitable. Now though, common sense is beginning to prevail. Analogue displays are gradually regaining ground as it becomes clear that they are more suitable for trend and other dynamic observations. Nevertheless many of today's analogue displays use digital techniques internally.

Rotating pointers, bar-graphs and similar analogue visual effects are now being developed for use in the automotive industry. Large-scale production prototype systems are already undergoing trials in cars. From this area of development it is logical to expect these new forms of analogue display to find their way into other applications. Now that most of the development has been completed the costs should be low. The consequence is that they will be introduced very rapidly into general use.

CHOICE OF DISPLAY

Choosing a display can be quite a task because many options exist.

Factors of key importance relate to the appearance of the display as seen by the user, reliability, ease of servicing, and power consumption.

Of particular importance is the 'price to use'. This can greatly exceed the cost price because of the costs of power supply, mounting, wiring, and possible connectors. It is also important that at least two sources of supply are available.

Another factor to consider is the special characteristics of a display. Each has some good and some bad characteristics. For example a liquid crystal display is fine where ambient light exists but needs auxilliary illumination in low light conditions. LED's on the other hand are best seen in the dark – they need to be very bright to be seen in full sunlight.

It is also important to assess if the device is really fully developed. Many new products reach the marketplace before they have been fully tested. Today a new solid-state product can be realised and marketed in a matter of a year but it is not possible to test it for the whole of that time. The tens of thousands of hours life that may be postulated by the manufacturer is often merely conjecture. Liquid crystal displays were one example. No user wants to be part of a test programme . . . especially if he's paying for the privilege. New is not necessarily best!

The main display contenders are currently LED's, gas discharge tubes, cathode ray tubes, liquid crystals, and the fast-emerging electroluminescent panels.

The time-honoured filament lamps continue and need no further comment except to say that they are being replaced in small power displays by the more up-to-date devices.

LEDS

LED's emerged first as single element light sources of rather low brightness and in red only. Today they are available in brighter forms and of many different optical styles providing diffusing effects, wider angles of viewing and generally greater utility. Present day technology can provide 50 um square elements of which 300-600 may be integrated into a matrix. Such LEDs are available with light output sufficient for aircraft instrumentation

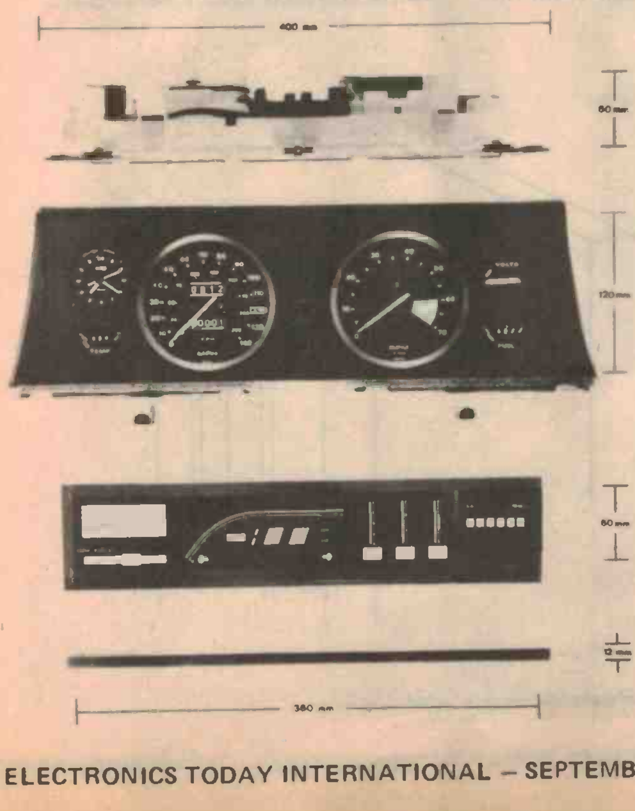


Fig. 1 (left). The conventional mechanical instrument panel (upper) contains 430 parts and is much bigger than the 35-part electroluminescent solid-state display (lower).

Fig. 2. Comparison of the display technologies now in vogue.

		Optimum Number of Bits
Tungsten Filaments		1 - 20
Light Emitting Diodes	LED	1 - 30
Cathode Ray Tubes	CRT	10K - 250K
Gas Discharge (Plasma Panels)		30 - 5K
AC or DC Electroluminescence	DCEL	30 - 3K
Liquid Crystal Display	LCD	5 - 200
Electrochromic (liquid or solid)		5 - 200
Electrophoretic		5 - 200
Vacuum Flourescent	VAC.FL.	10 - 100

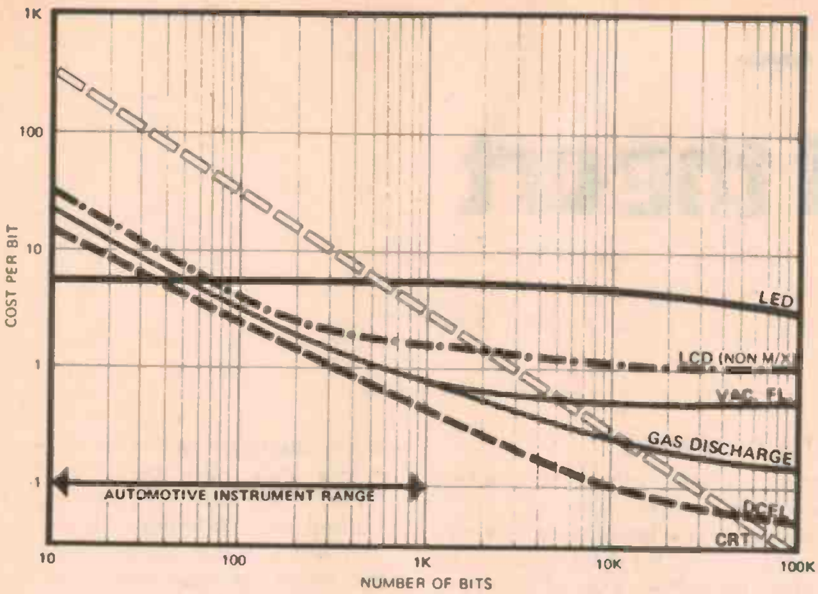


Fig. 3. Comparison of the cost per bit of the various display options.

(10^5 Lux) and can be made to full MIL specifications including operation over a temperature range of –55°C to 125°C.

They are available in colours ranging from red (the most common and cheapest) through yellow, green, orange and violet. Blue LEDs have been made but appear to lack a large enough market to enable them to be produced at a commerically attractive price.

The reliability of LED's is variously claimed to be from 10^4 to 10^9 hours. There is a suggestion (based on evidence from large-scale users) that price wars have tempted makers to reduce reliability. Reject rates as high as 20% are said to be experienced by some buyers.

LED's are fast operating: typical rise times are 10 - 50 ns. They are offered in pcb packages, in larger metal packages suitable for sealing and in more-expensive-still ceramic packages.

The ready ease with which they can be assembled into lines, circles, matrices and other graphical forms enables them to be used in analogue displays.

LED's are not necessarily the best choice for all displays. Figure 2 compares various displays on the basis of the optimum number of bits for each alternative. It can be seen that LEDs are restricted to applications where the type of display requires only a small number of bits. Electroluminescent panels (discussed below) are more suitable where the application calls for the use of many bits.

Another factor is the cost per bit to manufacture. Figure 3 compares this variable for the various types of displays. The LED does not compare well for applications requiring over 100 bits. On this basis the CRT is way ahead. As yet it is not even remotely matched by any solid-state technique. The CRT's main drawback is that it is bulky and fragile compared with most other types of display.

GAS DISCHARGE TUBES

Gas discharge tubes were the first displays that could reasonably be regarded as versatile. Many older readers will recollect the Dekatron counter tubes of the 1950's in which 'dots' moved circumferentially in a scale of ten. A later development incorporated grids placed behind one another in a single glass envelope in what was generally called the Nixie tube. Their main disadvantage for use with solid-state circuits was their need for a 170 volt supply.

With the introduction of solid-state displays it might be thought that gas discharge tubes would have been supplanted. This has not happened so far. Indeed indications are that they will be used for a considerable time yet. Their brightness and large size are still strong advantages.

Gas discharge tubes are made in many forms. These include low profile, alpha-numeric, bar-graph, special purpose graphical displays, and still in the research and development stage, are phase addressed matrix co-planar units which use thick film manufacturing techniques.

It is possible to construct gas-discharge cells so that a particular cell is set to strike and erase at different discrete voltage levels. Thus, increasing the voltage level to a line of adjacent cells will produce a bar-graph effect. Once struck, the cells latch on exhibiting a bistable storage characteristic.

Cross-bar arrangements of grids (as shown in Fig 4) enable 'dot' discharges to be established at the junction of any two selected bars. Thick-film replication methods are used to manufacture the units.

The colour of discharge tubes can be finely tuned to just about any wavelength. This is done by adding an appropriate phosphor to the cell during manufacture. White and blue remain difficult to produce.

A phase-addressed technique has been developed to reduce the number of leads otherwise needed to connect all matrix positions to external circuits.

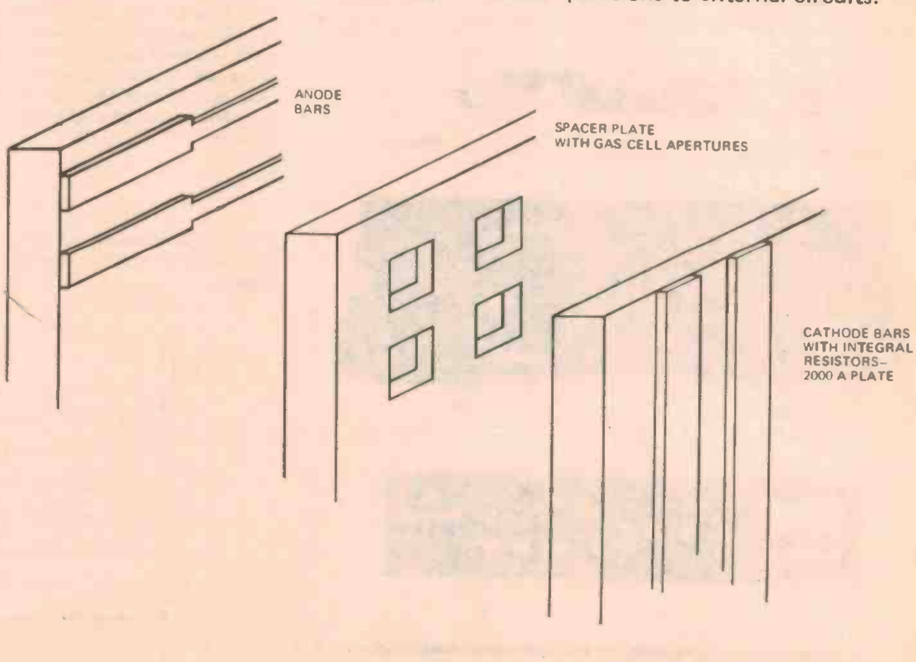


Fig. 4. Construction of dot-matrix gas-discharge display unit.

Gas discharge tubes are still, and will remain, a strong contender in the choice of a display. Figure 2 illustrates this well.

CATHODE RAY TUBES

A CRT screen of good quality and having a good linear scanning system can accomodate a display of 1000 by 1000 elements. The full range of colours is available as well as an intensity scale having perhaps 200 levels. Cost per element is very low but size and fragility go against the CRT in many applications. Eventually, as matrix manufacturing methods become more developed, the CRT's thin flat digital equivalent will become a serious rival. At present (1978) though the CRT has no rivals for displays requiring large numbers of bits.

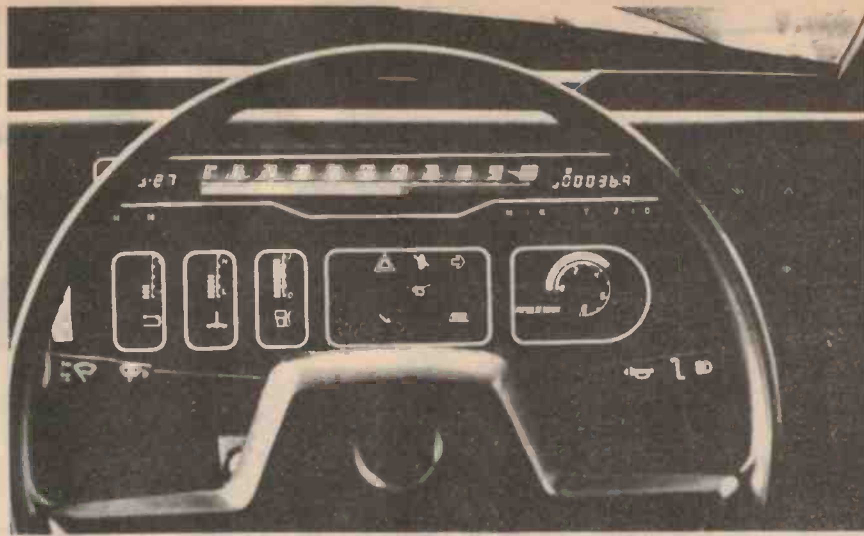


Fig. 6. On-vehicle electroluminescent display dash panel (Smiths Industries).

LIQUID CRYSTAL DISPLAYS

In many ways LCD's got off to a start less worthy than they deserved. Reliability was variable: many failed rapidly whilst others did very well. Failure of an individual display within a batch could vary from almost immediate through to years.

The second generation of LCD's has shown itself to be very much better if made by more controlled procedures and with better materials. Figures such as 90 000 hours to reach a 2% cumulative failure have been claimed for twisted-nematic LCD displays.

A key factor has been the realisation that a non-zero dc cell level rapidly degraded the cell. That restriction was originally controlled by the use of ac bias but now zero level dc working has been devised.

Initial commercial incentive came from watch manufacturers, but now researchers are seeking ways of building much larger panels — 150 mm square for example. Such large sizes pose manufacturing problems for the glass enclosing the LCD material must be flat to within a mere 10 um.

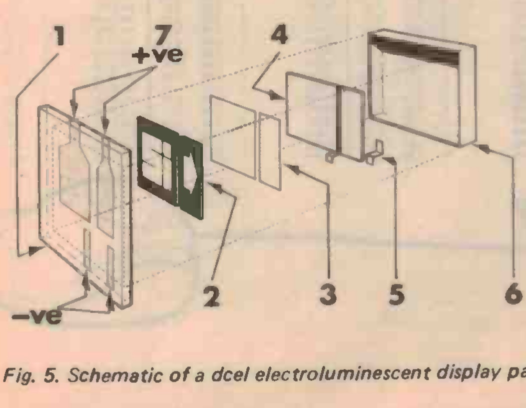
Manufacturing methods are constantly being improved. The glass front seal has been greatly changed . . . that was a cause of many premature failures. Purer LCD material and improved stability with temperature and humidity have also improved.

Matrix units are being investigated but, as with all such units, connecting problems remain. Some LCD's currently being released have shift registers integrated onto the display. This trend may become common practice, for the user does not wish to connect any more than the minimum of leads from the drive circuits to the display.

In general LCD manufacturers suggest that their products are best suited for applications requiring a portable display. The current LCD's are certainly much better than the first generation and their low power consumption gives them a firm place in the display range.

ELECTROLUMINESCENT DISPLAY PANELS

Electroluminescent devices are basically just a layer of special paint between two pieces of glass.



D.C. ELECTROLUMINESCENCE ASSEMBLY

1. FRONT GLASS
2. INSULATING MASK
3. PHOSPHOR — in contact with 7 through apertures in 2
4. ALUMINIUM REAR ELECTRODE
5. CONDUCTIVE STRIP — joining 4 to 8
6. HERMETICALLY SEALED COVER
7. TRANSPARENT CONDUCTIVE PATTERN

Fig. 5. Schematic of a dcel electroluminescent display panel.

Two basic groups exists . . . ac working (called acel) and dc working (called dcel). Each uses zinc sulphide, manganese-doped phosphors which radiate a yellow-orange light at 585 nm wavelength. The ac cells operate in a capacitive mode, the dc units in a resistive mode. Figure 5 shows the schematic of a dcel unit.

Manufacturing processes are mainly vacuum deposition using photolithographic procedures for masking. This method offers great prospects for the future. The British Post Office for example is considering 1250 character displays for phone call costing. Smiths Industries have vehicle instrument panels in pilot scale production. (Figure 6 shows a recent panel of this type).

As always, addressing the display is a problem. Multiplexing methods have been used to reduce lead counts from 257 (for a 256 unit) down to only 32. The displays can be used in a continuous mode or they can be pulsed. Pulse durations of around 0.5% duty cycle are typical using 5 — 15 microsecond pulses.

Around 120 volts is needed to drive the display present day units require 50 mW per character. A prototype unit using CMOS circuitry consumes only two watts for a 480 character display.

This information was compiled from lectures delivered at an Institution of Electrical Engineers day meeting held in London in January 1978. No full Proceedings were published but the five speakers would be able to provide further information if contacted. Details can be obtained from the Conference Secretary, IEE, Savoy Place, London. Smiths Industries kindly provided most of the illustrations used here.

STOP PRESS

741	–	OP AMS	5 for $1.50
555	–	TIMERS	5 for 1.50
4001	–	CMOS	5 for 1.00
4011	–	CMOS	5 for 1.00
1N914	–	DIODES	20 for 1.00
7805P	–	REGULATORS	2 for 2.00
C106Y1	–	SCRS	5 for 2.50
LM382	–	PREAMP	2 for 3.00

LATE FINAL EXTRA

BRIDGE RECTIFIERS

Type	Bag Qty	Price	+ Tax
MDA104A	1	0.78	0.15
MDA204	1	1.18	0.23
MDA3502	1	3.04	0.59
MDA3504	1	3.46	0.67

DIODES

Type	Bag Qty	Price	+ Tax
1N218	1	3.00	0.58
1N238	1	3.00	0.58
1N914	15	1.20	0.24
1N4001	15	1.00	0.20
1N4004	15	1.20	0.24
1N4007	5	1.20	0.24
1N4148	15	1.20	0.24
1N5401	2	0.80	0.16
A14D	3	0.84	0.17
MR754	1	1.00	0.20

ZENER DIODES

	Bag Qty	Price	+ Tax
½ Watt 3.3V–68V 5%	4	0.92	0.18
5 Watt 3.3V–68V 5%	1	1.00	0.20

Voltage	½ Watt	5 Watt
3.3	1N746A	1N5333B
3.6	1N747A	1N5334B
3.9	1N748A	1N5335B
4.3	1N749A	1N5336B
4.7	1N750A	1N5337B
5.1	1N751A	1N5338B
5.6	1N752A	1N5339B
6.2	1N753A	1N5341B
6.8	1N754A	1N5342B
8.2	1N756A	1N5344B
9.1	1N757A	1N5346B
10	1N758A	1N5347B
11		1N5348B
12	1N759A	1N5349B
13	1N964B	1N5350B
15	1N965B	1N5352B
16	1N966B	1N5353B
18	1N967B	1N5355B
20	1N968B	1N5357B
22	1N969B	1N5358B
24	1N970B	1N5359B
27	1N971B	1N5361B
30	1N972B	1N5363B
33	1N973B	1N5364B
36	BZX	1N5365B
39	BZX	1N5366B
43	BZX	1N5367B
47	BZX	1N5368B
51	BZX	1N5369B
56	BZX	1N5370B
62	BZX	1N5372B
68	BZX	1N5373B

Type	Bag Qty	Price	+ Tax
2N2222A	2	0.80	0.16
2N2646	1	0.82	0.16
2N2907A	2	0.90	0.18
2N3053	2	1.10	0.22
2N3054	1	0.76	0.15
2N3055	1	0.99	0.20
2N3442	1	1.49	0.29
2N3644	3	1.06	0.21

TRANSISTORS

Type	Bag Qty	Price	+ Tax
2N3789	1	2.20	0.43
2N3866	1	1.09	0.21
2N4121	3	0.90	0.18
2N4220A	1	0.90	0.18
2N4236	1	1.73	0.34
2N4250	3	0.90	0.18
MPS4258	2	0.96	0.19
2N4351	1	2.85	0.56
2N4352	1	2.70	0.52
2N4360	2	1.08	0.21
2N4427	1	1.24	0.24
2N4870	1	0.79	0.16
2N4871	1	0.75	0.15
2N5191	1	0.98	0.19
2N5194	1	1.08	0.21
2N5458	2	0.90	0.18
2N5459	2	1.00	0.20
2N5461	2	1.34	0.26
2N5484	2	1.00	0.20
2N5485	2	1.02	0.20
2N5486	2	1.00	0.20
2N6027	2	0.88	0.17
2N6425	1	1.80	0.35
2N6578	1	1.55	0.30
3N140	1	1.45	0.28
3N210	1	1.45	0.28
AC126	1	0.75	0.15
AC128	1	0.75	0.15
AD149	1	1.79	0.35
AD161	1	1.44	0.28
AD162	1	1.50	0.29
AF126	1	0.75	0.15
AF127	1	0.75	0.15
BC107	3	1.05	0.21
BC108	3	1.05	0.21
BC109	3	1.05	0.21
BC177	3	1.05	0.21
BC178	3	1.05	0.21
BC179	3	1.05	0.21
BC327	3	0.90	0.18
BC328	3	0.90	0.18
BC337	3	0.90	0.18
BC338	3	0.90	0.18
BC547	3	0.90	0.18
BC548	3	0.90	0.18
BC549	3	0.90	0.18
BC557	3	0.90	0.18
BC558	3	0.90	0.18
BC559	3	0.90	0.18
BC635	2	0.80	0.16
BC636	2	0.80	0.16
BC637	2	0.84	0.17
BC638	2	0.84	0.17
BC639	2	0.86	0.17
BC640	2	0.86	0.17
BD135	2	1.10	0.21
BD136	2	1.10	0.21
BD137	2	1.30	0.25
BD138	2	1.30	0.25
BD139	2	1.30	0.25
BD140	2	1.40	0.27
BD235	1	0.75	0.15
BD236	1	0.75	0.15
BD262	1	1.10	0.21
BD263	1	1.15	0.22
BD437	1	1.20	0.23
BD438	1	1.20	0.23
BF115	2	1.26	0.25
BF185	2	1.22	0.24
BF337	1	0.90	0.18
BF495	3	0.90	0.18
MJ901	1	1.72	0.33
MJ1001	1	1.72	0.33
MJ2501	1	2.03	0.39
MJ300	1	2.03	0.39
MJ4032	1	3.31	.064
MJE340	1	0.85	0.17
MPF102	2	1.22	0.24
MPF131	1	1.00	0.20
MPSA12	2	1.16	0.23
MPSA14	2	0.96	0.19
OC28	1	3.20	0.62
OC74	1	0.75	0.15
TIP31A	1	0.75	0.15
TIP31B	1	0.79	0.16
TIP31C	1	0.83	0.16
TIP32A	1	0.77	0.15
TIP32B	1	0.82	0.16
TIP32C	1	0.90	0.18
TIP33A	1	0.97	0.19
TIP33C	1	1.25	0.24
TIP34A	1	1.13	0.22
TIP34C	1	1.35	0.26
TIP41A	1	0.87	0.17
TIP41C	1	1.09	0.21
TIP42A	1	0.94	0.18
TIP42C	1	1.20	0.23
TIP49	1	1.10	0.21
TIP50	1	1.35	0.26
TIP112	1	0.96	0.19
TIP117	1	0.99	0.19
TIP127	1	1.52	0.30
TIP2955	1	1.49	0.29
TIP3055	1	0.97	0.19

THYRISTORS

Type	Bag Qty	Price	+ Tax
2N4441	1	1.28	0.25
2N4443	1	1.88	0.36
2N6069B	1	1.02	0.20
2N6070	1	0.80	0.16
2N6073A	1	1.32	0.26
2N6073B	1	1.50	0.29
C103Y	2	1.10	0.21
C103YY	2	1.20	0.23
C106B	2	0.88	0.17
C106D	2	1.28	0.25
C122D	1	1.12	0.22
C122E	1	1.32	0.26
MBS4991	2	1.36	0.26
P13T1	1	1.10	0.21
P13T2	1	1.20	0.23
SC141D	1	1.39	0.27
SC141E	1	1.99	0.39
SC146D	1	1.84	0.36
SC146E	1	2.64	0.51
SC250D	1	3.85	0.75

LINEAR

Type	Bag Qty	Price	+ Tax
301A-8	2	1.04	0.11
307-8	1	0.66	0.07
308-8	1	1.20	0.13
310-8	1	2.80	0.30
311-8	1	1.12	0.12
324-14	1	1.24	0.13
339-14	1	0.98	0.11
380-14	1	1.46	0.28
555-8	1	0.56	0.06
556-14	1	1.30	0.14
565-14	1	1.90	0.20
566-8	1	3.20	0.34
567-14	1	2.80	0.30
709-8	1	0.69	0.08
710-14	1	0.75	0.08
711-14	1	0.78	0.08
725-8	1	4.10	0.43
733-14	1	1.45	0.28
741-8	1	0.66	0.06
747-14	1	1.12	0.12
748-8	1	0.75	0.08
1310-14	1	4.20	0.83
1403-8	1	2.60	0.28
1406-14	1	5.90	0.62
1408L8-14	1	4.50	0.48
1437-14	1	2.26	0.24
1456-CAN	1	2.85	0.30
1458-8	1	0.82	0.09
3301-14	1	1.15	0.12
3302-14	1	1.10	0.12
3900-14	1	0.95	0.10
3909-8	1	1.25	0.24
4558-8	1	0.98	0.11
4741-14	1	1.60	0.17
CA3046-14	1	2.20	0.43
CA3086-14	1	1.80	0.31
CA3130-CAN	1	2.60	0.27
CA3140-CAN	1	1.90	0.20
TL071	1	1.20	0.13
TL081	1	1.00	0.11
TL083	1	0.80	0.08
TL084	1	2.40	0.25

REGULATORS

Type	Bag Qty	Price	+ Tax
309K	1	2.90	0.31
317KC	1	3.39	0.36
323	1	4.50	0.48
350K	1	8.65	0.91
723-14	1	0.90	0.10
7805P	1	1.20	0.13
7806P	1	1.20	0.13
7808P	1	1.20	0.13
7812P	1	1.20	0.13
7815P	1	1.20	0.13
7818P	1	1.20	0.13
7824P	1	1.20	0.13
7905P	1	1.65	0.18
7912P	1	1.65	0.18
7915P	1	1.65	0.18
78H05	1	8.65	0.91
78L05	2	1.00	0.11
78L06	2	1.00	0.11
78L08	2	1.00	0.11
78L12	2	1.00	0.11
78L15	2	1.00	0.11
78L18	2	1.00	0.11
78L24	2	1.00	0.11
79L05	1	0.75	0.08
79L06	1	0.75	0.08
79L08	1	0.75	0.08
79L12	1	0.75	0.08
79L15	1	0.75	0.08
79L18	1	0.75	0.08
79L24	1	0.75	0.08

INTERFACE

Type	Bag Qty	Price	+ Tax
8T20N	1	4.07	0.43
8T23N	1	2.29	0.24
8T24N	1	2.29	0.24
8T26AN	1	2.75	0.29
8T28	1	2.75	0.29
8T38N	1	2.31	0.25
8T96N	1	1.65	0.18
8T97N	1	1.65	0.18
8T98N	1	1.65	0.18
1488N-14	1	1.40	0.15
1488L-14	1	1.75	0.19
1489AL-14	1	1.40	0.15
1489AN-14	1	1.76	0.19
75107	1	2.49	0.26
75108	1	2.49	0.26
75109	1	2.49	0.26
75110	1	2.49	0.26
75112	1	2.99	0.32
75154	1	3.99	0.42
75188	1	1.40	0.15
75189	1	1.40	0.15
75363	1	3.99	0.42
75365	1	3.69	0.39
75451	2	1.22	0.13
75452	2	1.22	0.13
75491	1	1.18	0.13
75492	1	1.29	0.14
HD1-0165-5	1	8.25	0.87
S1757	1	8.50	0.90
S1883P	1	7.75	0.82
S2350	1	15.00	1.58
TMS6011	1	5.50	0.58

CMOS

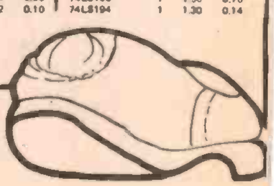
Type	Bag Qty	Price	+ Tax
4000	2	0.70	0.08
4001	2	0.70	0.08
4002	2	0.70	0.08
4006	1	1.81	0.19
4007	2	0.70	0.08
4008	1	1.48	0.16
4009	1	0.80	0.09
4010	1	0.80	0.09
4011	2	0.70	0.08
4012	2	0.70	0.08
4013	1	0.87	0.09
4014	1	1.61	0.17
4015	1	1.16	0.12
4016	1	0.87	0.09
4017	1	1.61	0.17
4018	1	1.81	0.17
4019	2	1.28	0.14
4020	1	1.71	0.18
4012		1.61	0.17
4022	1	1.51	0.16
4023	2	0.70	0.08
4024	1	1.20	0.13
4025	2	0.70	0.08
4026	1	2.00	0.21
4027	1	0.87	0.09
4028	1	1.42	0.15
4029	1	1.21	0.13
4030	2	1.20	0.13
4032	1	1.91	0.20
4033	1	2.00	0.21
4034	1	3.52	0.37
4035	1	1.91	0.20
4040	1	1.61	0.17
4041	1	0.94	0.10
4042	1	1.30	0.14
4043	1	1.61	0.17
4044	1	1.51	0.16
4046	1	2.32	0.25
4049	1	0.90	0.10
4050	1	0.90	0.10
4051	1	1.20	0.13
4052	1	1.20	0.13
4053	1	1.20	0.13
4060	1	1.31	0.14
4066	1	1.01	0.11
4068	2	0.70	0.08
4069	2	0.70	0.08
4070	2	0.70	0.08
4071	2	0.70	0.08
4072	2	0.70	0.08
4073	2	0.70	0.08
4075	2	0.70	0.08
4076	1	1.81	0.19
4175	1	1.60	0.17
4194	1	1.81	0.19
4402	2	0.70	0.08
4404	1	0.94	0.10
4408	1	10.06	1.06
4409	1	10.06	1.06
4410	1	9.28	0.98
4411	1	11.60	1.22
MC14412FP	1	16.54	1.74
SCL4412	2	0.84	0.09
4415	1	10.16	1.07
4416	1	0.70	0.08
4419	1	3.26	0.35
4422	1	8.67	0.91
4426	1	2.20	0.23
4428	1	1.50	0.16
MC14433	1	12.78	1.34
SCL4433	1	2.11	0.22
4435	1	7.93	0.84
4441	1	1.21	0.13
4445	1	2.36	0.25
4446	1	3.34	0.35
4449	2	0.88	0.09
4450	1	3.62	0.38
4451	1	3.62	0.38
4490FP	1	3.62	0.38
4490VP	1	3.12	0.33
4500	1	10.92	1.15
4501	2	0.70	0.08
4502	1	1.71	0.18
4503	1	1.16	0.12
4506	1	0.70	0.08
4507	2	0.70	0.08
4508	1	4.28	0.45
4510	1	1.71	0.18
4511	1	1.42	0.15
4512	1	1.42	0.15
4513	1	2.36	0.25
4514	1	3.34	0.35
4515	1	3.34	0.35
4516	1	1.71	0.18
4518	1	1.71	0.18
4519	1	0.91	0.10
4520	1	1.71	0.18
4521	1	3.12	0.33
4522	1	1.71	0.18
4526	1	1.71	0.18
4527	1	3.12	0.33
4528	1	1.81	0.19
4529	1	2.02	0.22
4530	1	0.90	0.10
4531	1	1.45	0.16
4532	1	2.52	0.27
4534	1	8.30	0.87
4536	1	6.03	0.64
4538	1	2.22	0.24
4539	1	1.44	0.16
4541	1	2.02	0.22
4543	1	2.81	0.30
4549	1	6.52	0.69
4553	1	6.84	0.72
4554	1	2.12	0.23
4555	1	1.01	0.11
4556	1	1.01	0.11
4557	1	6.87	0.72
4558	1	2.02	0.22
4559	1	6.52	0.69
4560	1	3.26	0.35
4561	1	1.13	0.12
4562	1	8.15	0.86
4566	1	2.68	0.28
4568	1	3.78	0.40
4569	1	2.34	0.25
4572	2	1.08	0.12
4580	1	8.88	0.94
4581	1	4.13	0.44
4582	1	1.61	0.17
4583	1	1.41	0.15
4584	1	0.76	0.08
4585	1	2.00	0.21
4599	1	3.04	0.32
74C00	2	0.70	0.08
74C02	2	0.70	0.08
74C04	2	0.70	0.08
74C08	2	0.70	0.08
74C10	2	0.70	0.08
74C14	1	1.75	0.19
74C20	2	0.70	0.08
74C30	2	0.70	0.08
74C32	2	0.80	0.09
74C42	1	1.42	0.15
74C48	1	2.31	0.35
74C73	1	1.10	0.12
74C74	1	0.90	0.10
74C76	1	0.90	0.10
74C83	1	2.20	0.23
74C85	1	2.56	0.27
74C86	1	0.99	0.11
74C89	1	6.75	0.71
74C90	1	1.32	0.14
74C93	1	1.32	0.14
74C95	1	1.61	0.17
74C107	1	1.89	0.20
74C151	1	2.50	0.27
74C154	1	3.84	0.41
74C157	1	2.36	0.25
74C160	1	1.96	0.21
74C161	1	1.96	0.21
74C162	1	1.96	0.21
74C163	1	1.96	0.21
74C164	1	1.61	0.17
74C165	1	1.61	0.17
74C173	1	1.61	0.17
74C174	1	1.75	0.19
74C175	1	1.61	0.17
74C192	1	1.75	0.19
74C193	1	1.96	0.21
74C195	1	1.65	0.18
74C221	1	2.05	0.22
74C901	1	0.84	0.09
74C902	1	0.95	0.10
74C903	1	0.84	0.09
74C904	1	0.84	0.09
74C906	1	0.84	0.09
74C907	1	0.84	0.09
74C904	1	2.18	0.23
74C922	1	5.66	0.60
74C925	1	7.40	0.78
74C926	1	7.40	0.78
74C927	1	7.40	0.78
74C928	1	7.40	0.78
80C97	1	0.94	0.10

TTL

Type	Bag Qty	Price	+ Tax
7400	2	0.70	0.08
7401	2	0.70	0.08
7402	2	0.70	0.08
7403	2	0.70	0.08
7404	2	0.80	0.09
7405	2	0.80	0.09
7406	1	0.76	0.08
7407	1	0.76	0.08
7408	2	0.78	0.08
7409	2	0.78	0.08
7410	2	0.70	0.08
7411	2	0.86	0.09
7412	2	0.80	0.09
7413	1	0.76	0.08
7414	1	1.03	0.11
7416	2	0.80	0.09
7416	1	0.73	0.08
7417	1	0.73	0.08
7420	2	0.70	0.08
7422	2	0.80	0.09
7423	2	0.80	0.09
7425	2	0.80	0.09
7426	2	1.04	0.11
7427	2	0.94	0.10
7428	1	0.66	0.07
7430	2	0.70	0.08
7432	2	0.94	0.10
7433	2	0.90	0.10
7437	1	0.66	0.07
7438	1	0.66	0.07
7439	1	0.66	0.07
7440	2	0.70	0.08
7441	1	1.43	0.15
7442	1	0.99	0.11
7443	1	1.66	0.17
7444	1	1.15	0.12
7445	1	1.97	0.21
7446	1	1.26	0.14
7447	1	1.26	0.14
7448	1	1.26	0.14
7450	2	0.70	0.08
7451	2	0.70	0.08
7453	2	0.70	0.08
7454	2	0.70	0.08
7460	2	0.70	0.08
7470	1	0.66	0.07
7472	2	1.08	0.12
7473	1	0.66	0.07
7474	1	0.66	0.07
7475	1	0.96	0.10
7476	1	0.66	0.07
7480	1	1.16	0.12
7481	1	1.80	0.18
7482	1	1.70	0.18
7483	1	1.67	0.18
7484	1	1.62	0.17
7485	1	1.48	0.16
7486	1	0.66	0.07
7489	1	3.18	0.34
7490A	1	0.66	0.07
7491	1	0.66	0.07
7492	1	0.90	0.10
7493	1	0.66	0.07
7494	1	1.20	0.13
7495	1	1.08	0.12
7496	1	1.32	0.14
7497	1	3.18	0.34
74100	1	2.60	0.28
74107	1	0.75	0.08
74109	1	0.83	0.09
74110	1	0.66	0.07
74111	1	0.86	0.09
74116	1	2.19	0.23
74120	1	1.88	0.20
74121	1	0.65	0.07
74122	1	0.73	0.08
74123	1	1.04	0.11
74125	1	0.85	0.09
74126	1	0.85	0.09
74128	1	0.78	0.08
74132	1	1.37	0.15
74136	1	0.69	0.08
74141	1	1.59	0.17
74142	1	3.29	0.35
74143	1	5.50	0.58
74144	1	5.50	0.58
74145	1	1.67	0.18
74147	1	2.83	0.30
74148	1	1.88	0.20
74150	1	1.59	0.17
74151	1	1.59	0.17
74152	1	1.59	0.17
74153	1	1.59	0.17
74154	1	2.10	0.22
74155	1	1.59	0.17
74156	1	1.37	0.15
74157	1	1.37	0.15
74158	1	1.37	0.15
74159	1	1.96	0.21
74160	1	1.73	0.18
74161	1	1.77	0.19
74162	1	1.73	0.18
74163	1	1.69	0.18
74164	1	1.73	0.18
74165	1	1.73	0.18
74166	1	1.73	0.18
74167	1	3.68	0.39
74170	1	2.75	0.29
74172	1	8.29	0.87
74173	1	2.60	0.27
74174	1	1.89	0.20
74175	1	1.77	0.19
74176	1	1.77	0.19
74177	1	1.77	0.19
74178	1	1.89	0.20
74179	1	1.89	0.20
74180	1	1.84	0.20
74181	1	3.04	0.32
74182	1	1.50	0.17
74184	1	2.69	0.29
74185	1	2.56	0.27
74186	1	16.36	1.72
74188	1	2.74	0.29
74190	1	2.33	0.25
74191	1	2.33	0.25
74192	1	1.99	0.21
74193	1	1.50	0.16
74194	1	1.84	0.20
74195	1	1.30	0.14
74196	1	1.65	0.18
74197	1	1.65	0.18
74198	1	1.98	0.21
74199	1	1.98	0.21
74221	1	1.70	0.18
74246	1	1.98	0.21
74247	1	1.98	0.21
74248	1	1.98	0.21
74249	1	1.98	0.21
74251	1	1.37	0.16
74259	1	2.60	0.27
74265	1	0.99	0.11
74273	1	2.74	0.29
74276	1	1.19	0.13
74278	1	2.80	0.30
74279	1	0.92	0.10
74283	1	1.64	0.18
74284	1	4.62	0.49
74285	1	4.62	0.49
74290	1	0.95	0.10
74293	1	0.09	0.10
74298	1	2.13	0.23
74351	1	2.98	0.32
74365	1	0.95	0.10
74366	1	0.95	0.10
74367	1	0.95	0.10
74368	1	0.96	0.10
74390	1	1.64	0.18
74393	1	2.36	0.25
74425	1	0.95	0.10
74426	1	0.96	0.10
74490	1	2.53	0.27

TTL (LS)

Type	Bag Qty	Price	+ Tax
74LS00	2	0.75	0.08
74LS01	2	0.75	0.08
74LS02	2	0.75	0.08
74LS03	2	0.75	0.08
74LS04	2	0.80	0.09
74LS05	2	0.80	0.09
74LS08	2	0.75	0.08
74LS09	2	0.75	0.08
74LS10	2	0.75	0.08
74LS11	2	0.75	0.08
74LS12	2	0.75	0.08
74LS13	1	0.75	0.08
74LS14	1	1.40	0.15
74LS15	2	0.75	0.08
74LS20	2	0.75	0.08
74LS21	2	0.75	0.08
74LS22	2	0.75	0.08
74LS27	2	0.75	0.08
74LS28	2	1.02	0.11
74LS30	2	0.75	0.08
74LS32	2	0.80	0.09
74LS33	2	0.90	0.10
74LS37	2	0.90	0.10
74LS38	2	0.90	0.10
74LS40	2	0.90	0.10
74LS42	1	0.90	0.10
74LS47	1	1.50	0.16
74LS48	1	1.50	0.16
74LS51	2	0.75	0.08
74LS54	2	0.80	0.09
74LS55	2	0.80	0.09
74LS63	1	2.24	0.24
74LS74	1	0.65	0.07
74LS75	1	0.75	0.08
74LS76	1	0.65	0.07
74LS77	1	0.75	0.08
74LS78	1	0.75	0.08
74LS83	1	1.22	0.13
74LS85	1	1.22	0.13
74LS86	1	0.65	0.07
74LS90	1	0.90	0.10
74LS91	1	1.56	0.17
74LS92	1	0.90	0.10
74LS93	1	0.90	0.10
74LS95	1	1.25	0.14
74LS96	1	1.56	0.17
74LS107	1	0.65	0.07
74LS109	1	0.66	0.07
74LS112	1	0.65	0.07
74LS113	1	0.66	0.07
74LS114	1	0.65	0.07
74LS122	1	0.66	0.07
74LS123	1	0.75	0.08
74LS125	1	0.75	0.08
74LS126	1	0.75	0.08
74LS132	1	1.25	0.14
74LS133	2	0.80	0.09
74LS136	1	0.65	0.07
74LS138	1	1.25	0.14
74LS139	1	1.25	0.14
74LS145	1	2.00	0.21
74LS147	1	2.30	0.25
74LS148	1	1.50	0.16
74LS151	1	1.89	0.20
74LS153	1	1.89	0.20
74LS154	1	1.89	0.20
74LS155	1	1.50	0.16
74LS156	1	1.50	0.16
74LS157	1	1.26	0.14
74LS158	1	1.30	0.14
74LS160A	1	1.40	0.15
74LS161	1	1.40	0.15
74LS162	1	1.40	0.15
74LS163	1	1.40	0.15
74LS164	1	1.45	0.16
74LS165	1	2.15	0.23
74LS166	1	2.24	0.24
74LS170	1	2.70	0.29
74LS173	1	1.30	0.14
74LS174	1	1.30	0.14
74LS175	1	1.30	0.14
74LS181	1	3.60	0.38
74LS183	1	3.80	0.40
74LS190	1	1.65	0.18
74LS191	1	1.65	0.18
74LS192	1	1.50	0.16
74LS193	1	1.50	0.16
74LS194	1	1.30	0.14



NEWS For

- * HOBBYISTS
- * EXPERIMENTERS
- * PROFESSIONALS

WIDEST RANGE OF COMPONENTS RETAIL/MAIL ORDER SERVICE

AUGUST 15—Applied Technology has become a franchised dealer for the rapidly expanding range of SILICON VALLEY components.

The move is a reciprocal one whereby Applied Technology will distribute the full range of devices available from Silicon Valley and in return Silicon Valley will shortly offer key microprocessor products from Applied Technology.

Now read on for more hot news . . .

MICROPROCESSORS

8080A	$15.75	SC/MP II	$16.75
6800	19.50	Z80	35.00
2650	26.50		

SUPPORT DEVICES

8212 8 bit I/O	$ 4.95
8215 bus driver	5.95
8224 clock generator	8.50
8228 system controller/bus driver	10.95
8255 programmable peripheral I/O . . .	16.50
3881 Z80 parallel I/O controller	15.50
3882 Z80 counter time circuit	15.50
6810 128 byte RAM	5.75
6820 PIA	13.75
6850 ACIA	13.75
6860 600 bps modem	13.75
8T26 bus tranceiver	3.75
8T97/98 bus drivers	1.95
8T31 bidirectional I/O port	5.75
DM8131 6 bit address comparator	6.25
DM8554 quad switch debouncer	2.25
DM8553 8 bit addressable latch	4.25

ETC

2513 character generator (upper case) . .	14.75
5303 UART	5.75
1602 UART	7.50
5740 keyboard encoder	19.75
57109 number cruncher with data	19.75
2101 & 2112 256 x 4 static RAM	3.75
2114 1K x 4 static RAM	14.25

MICROPROCESSOR CRYSTALS

1 Mc/s	$7.95	10 Mc/s	$7.95
2 Mc/s	7.95	12 Mc/s	7.95
4 Mc/s	7.95	18 Mc/s	7.95
4.43 Mc/s . . .	4.25	20 Mc/s	7.95
5 Mc/s	7.95		

SOCKETS

8 pin solder . .	0.25	22 pin solder . .	0.80
14 pin solder . .	0.30	24 pin solder . .	0.80
16 pin solder . .	0.35	28 pin solder . .	0.95
18 pin solder . .	0.45	40 pin solder . .	1.00

2650 SOFTWARE

2650 Programming Course: Written by David Brown this introductory course is ideal for beginners with this exciting micro. The course explains in detail the operation of PIPBUG monitor and machine language programs and gives easily understood program examples **$12.75**

T.C.T. BASIC: Now available this powerful 4K interpreter written for any 2650 with PIPBUG coresident. Instructions include: RUN, LIST, SIZE, NEW, DUMP, GOTO, GOSUB, RETURN, IF, FIX, DO . . . UNTIL, FOR . . . NEXT, PRINT, INPUT, STOP. Requires a minimum system with 5K RAM. Cassette tape and full user manual **$29.50**

GAMES PAK 1: A fascinating collection of computer games for the 2650 including; ASTROTREK, TARGET SHOOT, NIM, MASTERMIND GUESSING GAME, SIMPLE TEXT EDITOR, ROTATE, POKER MACHINE, CHOMP, HANGMAN. Cassette with full instructions **$12.50**

GAMES PAK 2: More fun with games such as: FUNNY FARM RACES, SOLITAIRE, BIORYTHM, RUSSIAN ROULETTE, LUNAR LANDER, GRAPHIC HANGMAN, MODIFIED MASTERMIND. Cassette with rules and insturctions **$12.50**

UTILITY PAK 1: A useful set of routines to assist serious users to develop their own programs quickly. Tape includes: BLOCK MOVE, BLOCK SEARCH, LIST, DISSASSEMBLER, REASSEMBLER, LIST AND LOAD, BINARY DUMP, BINARY LOAD. Cassette with full listings **$12.50**

2650 USERS GROUP: A strong users group has been established for those serious users of the 2650. Membership fee covers comprehensive listings of the rapidly expanding software base as well as an update mailing service. Prerecorded cassettes of programs are also available to registered members at nominal costs. 2650 Membership fee **$40.00**

74LS195	1	1.30	0.14
74LS196	1	1.66	0.18
74LS197	1	1.65	0.18
74LS221	1	2.01	0.21
74LS240	1	2.10	0.22
74LS341	1	2.10	0.22
74LS242	1	2.69	0.29
74LS243	1	2.69	0.29
74LS244	1	2.69	0.29
74LS245	1	2.69	0.29
74LS247	1	2.20	0.23
74LS248	1	2.20	0.23
74LS249	1	2.20	0.23
74LS251	1	1.50	0.16
74LS253	1	1.50	0.16
74LS257	1	1.50	0.16
74LS258	1	1.50	0.16
74LS259	1	1.50	0.16
74LS261	1	3.54	0.37
74LS266	1	0.75	0.08
74LS275	1	5.20	0.55
74LS279	1	1.25	0.13
74LS280	1	2.86	0.30

74LS283	1	1.35	0.14
74LS290	1	1.35	0.14
74LS293	1	1.50	0.16
74LS295	1	2.20	0.23
74LS298	1	2.20	0.23
74LS323	1	6.18	0.65
74LS324	1	1.46	0.15
74LS325	1	4.16	0.47
74LS326	1	4.16	0.47
74LS327	1	4.16	0.47
74LS348	1	2.20	0.23
74LS352	1	2.50	0.27
74LS353	1	2.50	0.27
74LS362	1	9.20	0.97
74LS365	1	1.04	0.11
74LS366	1	1.04	0.11
74LS367	1	1.04	0.11
74LS368	1	1.04	0.11
74LS373	1	2.60	0.27
74LS374	1	2.60	0.27
74LS375	1	0.90	0.10
74LS377	.1	3.12	0.33
74LS378	1	1.65	0.18

74LS379	1	2.25	0.24
74LS386	1	0.75	0.08
74LS390	1	1.78	0.19
74LS393	1	2.30	0.24
74LS395	1	2.20	0.23
74LS396	1	1.92	0.20
74LS398	1	3.90	0.41
74LS399	1	2.86	0.30
74LS424	1	7.20	0.76
74LS445	1	2.26	0.24
74LS447	1	1.65	0.18
74LS490	1	3.35	0.35
74LS668	1	1.26	0.13
74LS669	1	1.25	0.13

UV PROMS

Type	Bag Qty	Price	+ Tax
ML1702AR	1	5.50	0.58
TMS2708JL	1	15.00	1.58
TMS2716JL	1	40.00	4.20
TMS2516JL	-1	56.00	5.88
TMS2532JL	1	77.00	8.09

LOW PROFILE SOCKETS

CA-08LS1-T	2	0.65	0.07
CA-14LS1-T	2	0.90	0.10
CA-16LS1-T	2	1.00	0.11
CA-18LS1-T	1	0.63	0.07
CA-22LS1-T	1	0.79	0.09
CA-24LS1-T	1	0.80	0.09
CA-28LS1-T	1	1.10	0.12
CA-40LS1-T	1	1.47	0.16

STANDARD SOCKETS (WIRE WRAP)

CA-08S-WW	2	1.20	0.13
CA-14S-WW	1	0.75	0.08
CA-16S-WW	1	0.80	0.09
CA-18S-WW	1	0.90	0.10
CA-22S-WW	1	1.20	0.13
CA-24S-WW	1	1.30	0.14
CA-28S-WW	1	1.82	0.19
CA-36S-WW	1	2.20	0.23
CA-40S-WW	1	2.38	0.25

APPLIED TECHNOLOGY PTY. LTD.

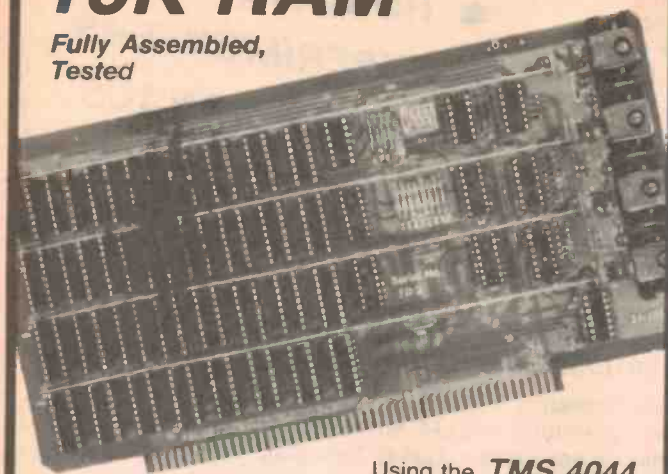
POST & PACK. COMPONENTS $2.00
POSTAL ADDRESS: P.O. Box 355, Hornsby, 2077.
SHOWROOM: 109-111 Hunter St., Hornsby 2077
(9-5 Monday to Sat.)

PHONE 476 4758 – 476 3759
PRICES SUBJECT TO CHANGE AFTER SEPT. 30th, 1978

bankcard welcome here

16K RAM

Fully Assembled, Tested



Using the ***TMS 4044***

PRICES SLASHED

FULLY S-100 BUS COMPATIBLE

250 nsec. chips-$439

Z-80A 4 MHz fast — no wait states. If you have a slower CPU now, this board will loaf along — and it WON'T be obsolete when you upgrade!

450 nsec. chips-$399

Fully static is best — Texas Instruments TMS 4044 chips — no clocks — no refresh — DMA compatible
Easy on your power supply — 8V at 1.7A nominal
Each 4k block addressable to any 4k slot, separately protected by DIP switches, and supplied through its own regulator. Jumpers to customize to any known S-100 system.
First quality factory parts — fully socketed and buffered — quality plated-through PCB with gold plated edge fingers, silk screened and masked both sides — busbars for lower noise

GUARANTEED FOR ONE FULL YEAR

COMING SOON —
Centaur 2000 disc based S-100 business system.

Post, packing and insurance included in price - add 15 per cent sales tax. Dealer inquiries invited - generous discounts available.

Centaur Industries

PO Box 37243,
WINNELLIE, N.T. 5789.

BOOKS

Just some of the books from the biggest range of radio and electronics books in Australia. If the book you require is not listed below, it can be ordered from us.

NEW – NEW – NEW Latest editions of some of the most popular books on the subject:

Just in — New A.R.R.L. Handbook 1978 Edition $12.95
Just in — World Radio TV Handbook 1978 .... $12.95
R.S.G.B. Handbook (New Edition) Volume 1 .... $21.85
R.S.G.B. Handbook (New Edition) Volume 2 .... $18.90
Reference Data for Radio Engineers (New Edition) I.T.T. $40.50
Radio Handbook (William Orr) 20th Edition $26.50
How to Build Proximity Detectors and Metal Locators (John Potter Shields) $6.35
An Introduction to Microcomputers — Volume 1 — Basic Concepts (Adam Osborne) $12.55
An Introduction to Microcomputers — Volume 2 — (New Enlarged Edition) — Some Real Products (Adam Osborne) $21.55
6800 programming for Logic Design (Adam Osborne) $12.55
8080 Programming for Logic Design (Adam Osborne) $12.55
Weather Satellite Handbook $7.80
VHF Antenna Handbook $7.80
The 73 Test Equipment Library — Volume 1 — Component Testers $7.80
The 73 Test Equipment Library — Volume 2 — Audio Frequency Testers $7.80
The 73 Test Equipment Library — Volume 3 — Radio Frequency Testers $7.80
The 73 Test Equipment Library — Volume 4 — IC Test Equipment $7.80
111 Digital and Linear IC Projects (Don Tuite) $8.50
Unique IC OP-AMP Applications (Walter C. Jung) $7.00
IC OP-AMP ookbook (Walter C. Jung) $17.80
TTL Cookbook (Lancaster) $12.25
TV Typewriter Cookbook (Lancaster) $13.50
RTL Cookbook (Lancaster) $6.60
CMOS Cookbook (Lancaster) 1st Edition 1977 .... $13.50
Active Filter Cookbook (Lancaster) $20.25
IC Timer Cookbook (Jung) $13.50
Transistor Specifications Manual — 8th Edition $9.50
Transistor Substitution Handbook — New Edition $6.75
International Transistor Selector (T. D. Towers) $6.95
Master Tube Substitution Handbook (Tab Books) $7.00
Australian Electrical Wiring Theory and Practice (Pethebridge & Williams) $11.45
Electronic Components and Materials (Philips) $3.75

American Radio Relay League Publications:
Hints and Kinks for the Radio Amateur $7.20
The Radio Amateur's VHF Manual $7.20
A.R.R.L. Antenna Handbook $8.80
Understanding Amateur Radio $8.80
The Radio Amateur's License Manual $6.20
A Course in Radio Fundamentals $7.20
Specialized Communications Techniques for the Radio Amateur $7.20
FM & Repeater for the Radio Amateur $7.20
Single Sideband for the Radio Amateur $7.20
Ham Radio Operating Guide $7.20
Electronics Data Book $7.20
Solid State Design for the Radio Amateur $12.80
Learning to Work with Integrated Circuits $4.00
Getting to Know Oscar from the Ground Up $6.20

Microcomputers/Microprocessors Books:
Programming Microprocessors (M. W. McMurran) $9.75
Microprocessors: Technology, Architecture and Applications (Daniel R. McGlynn) $18.80
Microprocessors (Electronics Book Series) Hardcover $17.65
Microcomputers/Microprocessing: Hardware, Software and Application (Hilburn & Julich) $26.50
Minicomputer Systems: Structure, Implementation and Application (G. Weitzman) $29.55
Microcomputer Primer (Waite & Pardee) $10.75
Minicomputers for Engineers and Scientists-(G. Korn) $33.15
How to Buy and Use Minicomputers and Microcomputers (W. Barden, Jr.) $13.50
Microprocessing/Microprogramming Handbook (B. Ward) $9.75

Howard W. Sams Publications:
TV Servicing Guide — Arranged by Trouble Symptoms (Leslie D. Deane & Calvin C. Young, Jr.) $6.50
Electric Guitar Amplifier Handbook (Jack Darr) $10.20
Transistor Fundamentals — A Programmed Learning Course Volume 1 — Basic Semiconductor and Circuit Principles (Robert J. Brite) $7.25
Transistor Fundamentals — A Programmed Learning Course Volume 2 — Basic Transistor Circuits (Charles A. Pike) $7.25
Transistor Fundamentals — A Programmed Learning Course Volume 3 — Electronic Equipment Circuits (Martin Gersten) $7.25
Transistor Fundamentals — A Programmed Learning Course Volume 4 — Digital and Special Circuits (Louis Schweitzer & Reginald H. Peniston) $7.25

Other Titles:
Colour Television Theory (Hutson) $10.00
The Oscilloscope (G. Zwick) $8.50
Radio, Valve and Semiconductor Data 10th Edition (Compiled By A. Ball) $4.25
MOS Digital IC's (G. Flynn) $8.60
Wind/Solar Energy — For Radio Communications and Low Power Electronic/Electric Applications (E. Noll) $10.75
Sound System Engineering (Don & Carolyn Davis) $26.95
Servicing with the Oscilloscope — 2nd Edition (Gordon J. King) $11.20
Slow Scan Television Handbook (Miller & Taggart) $7.90
73 Dipole and Long-Wire Antennas (Edward M. Noll) $6.75

For Mail Orders please add: $1.10 Local $1.75 Interstate

McGILL'S AUTHORISED NEWSAGENCY PTY. LTD.
187 Elizabeth Street, Melbourne. Phone: 60-1475-6-7
Prices Subject to Alteration

PRINTOUT

ETI's COMPUTER SECTION

NEWS

Appledisk

Now available from Computerland, 55 Clarence Street, Sydney, is the Disk II floppy disk subsystem for the Apple II personal computer. The Disk II comprises a Shugart minifloppy in a heavy duty steel case with an intelligent interface card which plugs into the Apple II, and offers 116 Kbytes of soft-sectored storage. The Disk II Operating System supports both ROM Applesoft and Apple Integer BASIC, and has a comprehensive selection of commands. Computerland say they had samples of the disk within one week of its release in the States, so Australia is obviously catching up with the US in personal computing technology.

Amongst other new products from Computerland is a new multi-user multi tasking disk operating system which is claimed to be machine independent and compatible with hard disks. According to Rudi Hoess of Computerland, the system also offers ISAM multi-keying file support and communications in the IBM 2780 mode. Incidentally, Computerland, which started in the States, celebrates its 2nd birthday shortly with a giant party stretching right across the US and Pacific from Boston to Sydney. 50,000 guests are expected to attend at the many Computerland stores.

Print Out Cutback

Our S100 Printer Project this month 'just growed and growed' until it reached the stage where it wouldn't fit in the space we'd allowed for it. Rather than chop it into two parts, we've had to cut back the Print Out section this month – but the magazine still contains the same amount of computer articles, so don't feel too cheated!

TACS

TACS is an acronym for Tasmanian Amateur Computer Scoiety, which is now up and running in Hobart. The Secretary, Clive Myers, dropped us a line to tell us TACS meets regularly, on the first and third Tuesdays of the month, in the Computer Studies Area of the Rosny Matriculation College, at 7.30 p.m. So drop in and swell the numbers of the TACS-men (?), or if you want, phone Clive on 65 2252 after 6.30 p.m.

16K RAM Card

Pennywise Peripherals' new 16K x 8 bit static RAM card is designed for those who are after a quality compact memory system which uses the latest technology.

The PCB is 247.5 x 152.5 mm and has plated through holes with a solder resistant coating. The edge connector is for the Motorola Exorcisor bus (43 way x 2 double sided 0.156" pitch) as used by the popular MEK6800D2 KIT. However, the read/write control logic is jumper selectable for a variety of schemes other than the M6800, such as 8080/85, 2650, SC/MP.

The 2114 1K x 4 bit static RAM used is an industry standard and probably the most popular latest generation 4K static RAM. It is produced by a variety of manufacturers including Intel, Texas Instruments, Motorola, Synertek and Signetics. It requires only a single +5 volt supply.

The 16K bytes on the memory card are divided into two 8K blocks each of which is switch selectable to any 8K area within 64K. All bus signals are buffered with low powered schottky TTL and the bi-directional data bus is driven by tri-state buffers. Further information from *Pennywise Peripherals, 19 Suemar Street, Mulgrave, Vic, 3168.*

IREE Microprocessor Group

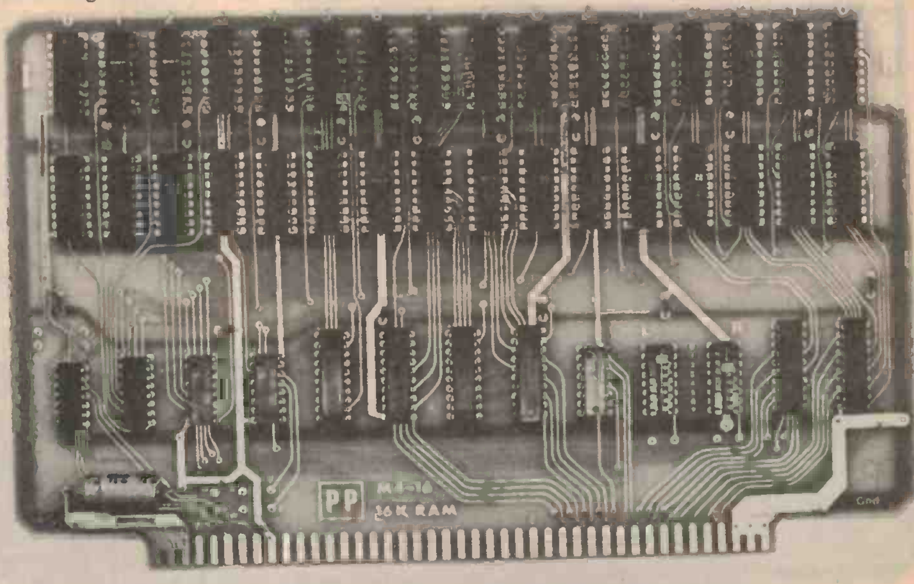
At a recent well attended meeting, over 130 people formed the I.R.E.E. Sydney Microprocessor Group.

The aim of the Group is to foster greater knowledge of microprocessors and to improve the link between the programming and hardware fields.

Non members of the I.R.E.E. will be welcome to become members of this new Group.

Further information can be obtained from: *The Hon. Secretary, Dr. Barry Madden, School of Chemical Technology, University of New South Wales, P.O. Box 1, KENSINGTON, NSW, 2033.*

The other office bearers are S. Wolkowicz (Chairman) and D. Skellern (Treasurer).



The CENTRAL DATA 2650 is designed for you.

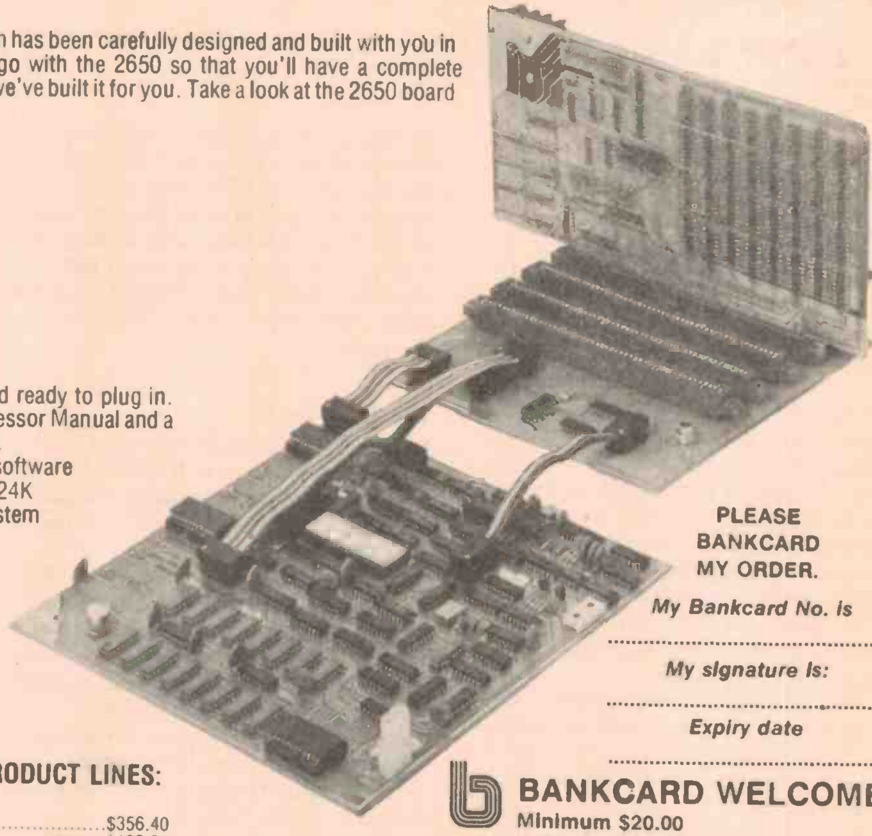
Get into microprocessors with this fully expandable system. Buy in kit form or assembled, the choice is yours. But before purchasing a system, check our range below.

The Central Data 2650 Computer Board system has been carefully designed and built with you in mind. We've also software and memory to go with the 2650 so that you'll have a complete system. You deserve quality equipment, and we've built it for you. Take a look at the 2650 board features and see for yourself.

- a 2650 microprocessor
- an 80 character by 16 line display
- a 300 Baud cassette interface
- a powerful 1K Supervisor Program
- Two parallel input ports and one bit settable output port
- 2048 bytes of read-write memory for the video display and your programs
- expands to S-100 bus
- low price of $356.40

The 2650 board comes assembled, tested and ready to plug in. The price includes a Signetics 2650 Microprocessor Manual and a Computer System Manual from Central Data.
We offer the Editor/Assembler and 8K Basic software packages for the 2650 system, and our S-100 24K memory board allows full expansion of the system (16K and 32K memory boards are also available). Each software package costs only $30. The 24K memory board is $480.00. All software comes with a cassette tape and a **program listing.**

With all these features you can't afford to pass up the Central Data 2650 system.



PLEASE BANKCARD MY ORDER.

My Bankcard No. is

....

My signature is:

....

Expiry date

....

BANKCARD WELCOME.
Minimum $20.00

PLEASE SEND ME THE FOLLOWING PRODUCT LINES:

A. 2650 Computer Board System Assembled	$356.40
B. S100 Extender Board	$133.65
C. 16K R.A.M. Board	358.00
D. 24K R.A.M. Board	480.00
E. 32K R.A.M. Board	600.00
F. Floppy Disc with Twin Drives	1278.00
KITS	
A. 2650 Computer Board System	248.00
B. S100 Bus Extender Kit	118.85
SOFTWARE	
A. Editor/Assembler	30.00
B. 8K Basic	30.00
C. De Bug	30.00
D. Assembly Language Pack (inc. De Bug)	45.00
E. Extended Basic	45.00
PARTS	
A. 2650 I/C Chip	23.04
B. 3624-4 Standard Program	19.50
C. 3624-4 Unprogrammed	15.00
D. 2650 Computer System Circuit Board	54.00
E. S100 Circuit Board	40.00
F. S100 Cables	22.28
G. Keyboard 1 ASCII Central Data	138.00
H. Keyboard 2	53.00
I. Xtal 14.192640 for above	12.03

I ENCLOSE BANKCARD/CHEQUE FOR

$ ....

NAME ....

ADDRESS..

....

PHONE .... POSTCODE ....

Please note all prices are plus 15 percent sales tax (unless exempt). If purchased mail order, sufficient postage/freight must be added to items purchased.

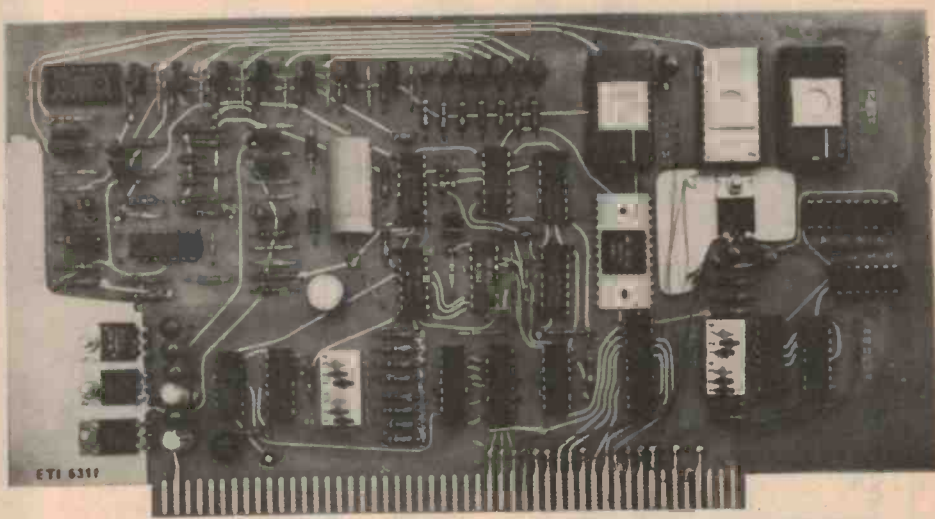
OUR SPECIAL OFFER: To help Hobbyists to become familiar with, and use, Microprocessors, Rod Irving Electronics will be conducting Microprocessor Courses. The Courses will begin Mid-September, held on Monday and Thursday evenings, with details as follows. **COURSE No. 1. UNDERSTANDING MICROPROCESSORS AND SYSTEMS, GENERAL. (M.P.G.)** A Basic course explaining how Micro's work in general and how they can be used, together with program demonstrations. Course includes notes, runs 2 weeks for 2 hours per night, 2 nights per week. Costs $50 per head. (Definitely limited No. of places). **COURSE No. 2. USING AND PROGRAMING THE CENTRAL DATA 2650 SYSTEM (C.D.I.)** A practical programing course using the Central Data System. This course follows No. 1. Course length and cost to be advised. Phone Rod Irving Electronics (03) 489-8131 for details or send SAE for information and application form.

ROD IRVING ELECTRONICS

Shop 499, High Street, Northcote. Vic. 3070. Ph (03) 489-8131. Open Mon-Thurs 8 am — 5.30 pm, Fri 8 am — 7 pm. Sat 9 am — 1 pm. Mail Orders: PO Box 135, Northcote. Vic. 3070.
Send SAE for free condensed catalogue.

S100 PRINTER

Our most ambitious project yet for the computer hobbyist — low cost hard copy!



WHILE THE COST of the large-scale integrated electronics built into computers has dropped, that of the mechanical peripheral devices has not followed this trend. Most printers cost several hundreds, if not thousands, of dollars, so when Philips showed us a new mechanism which costs around $70 we were more than interested.

You rarely get something for nothing and this printer is no exception — it cannot do everything more sophisticated types can. It uses a 60 mm wide paper which allows 32 characters per line, and the paper is a special metallized type. However it is still a very useful printer, especially for the hobbyist who doesn't have a grand to spare.

Design Features

As we seem to have standardised on the S100 bus this was the obvious choice for mechanical construction and electrical interfacing. Philips do offer an interface for the printer; however it requires the computer to be dedicated to it during the print cycle. The computer has to present and hold each character in sequence as requested by the printer. This involves a fairly lengthy program (124 steps for the MEK6800D2) as well as tying up the processor.

We therefore chose a different approach using a dedicated memory on the interface to store the characters which can be entered at any speed (up to approximately 5 µs apart) until either 128 characters (the limit of the memory) or a carriage return has been transmitted. At this point the print cycle starts and no further action is required from the processor. We initially tested the unit using only a keyboard, entering data manually with the carriage return initiating printing.

Text continued on page 96.

SPECIFICATION — ETI 641

Print format	7 x 5 dot matrix
Number of different characters	127
Number of characters per line	32
Printing speed	2 lines per second
Character height	2.4 mm
Interface format	S100 bus compatible
Data entry time	5µs per character
Character storage capability	128
Power supply motor stopped	+16 V @ 100mA +8V @ 350mA −16 V @ 80mA
motor running	+16 V @ 200mA +8V @ 350mA −16 V @ 180mA
Printer mechanism	EUY−10E023LE (Philips)
Paper	EUY−SUB006

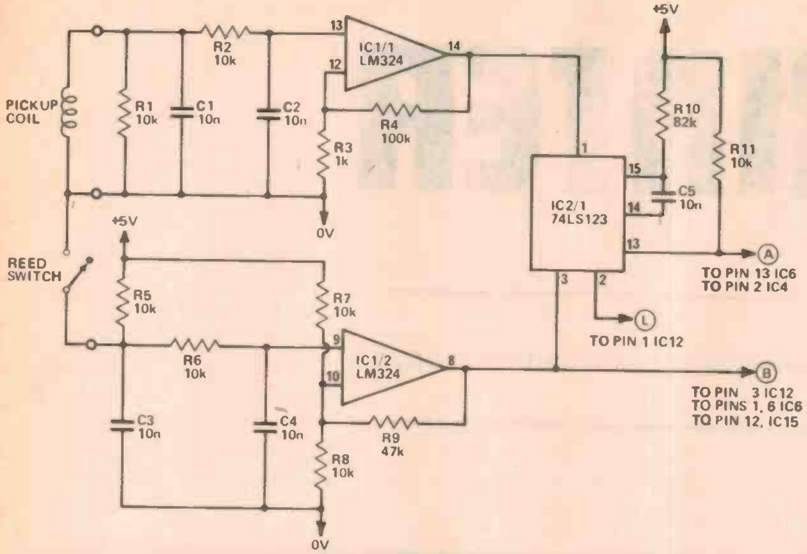


Fig. 1a. The circuit diagram of the pickup coil and reed switch buffer.

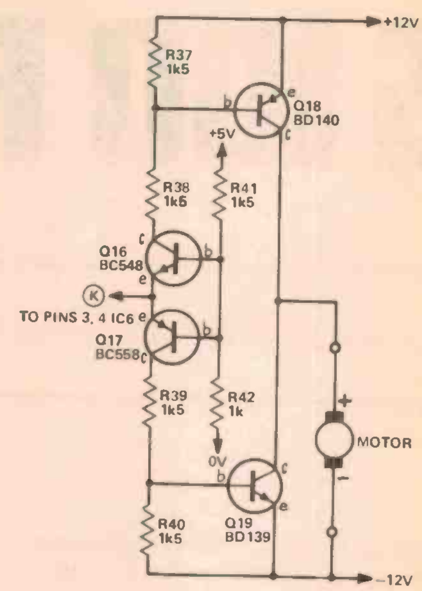


Fig. 1d. The motor drive interface.

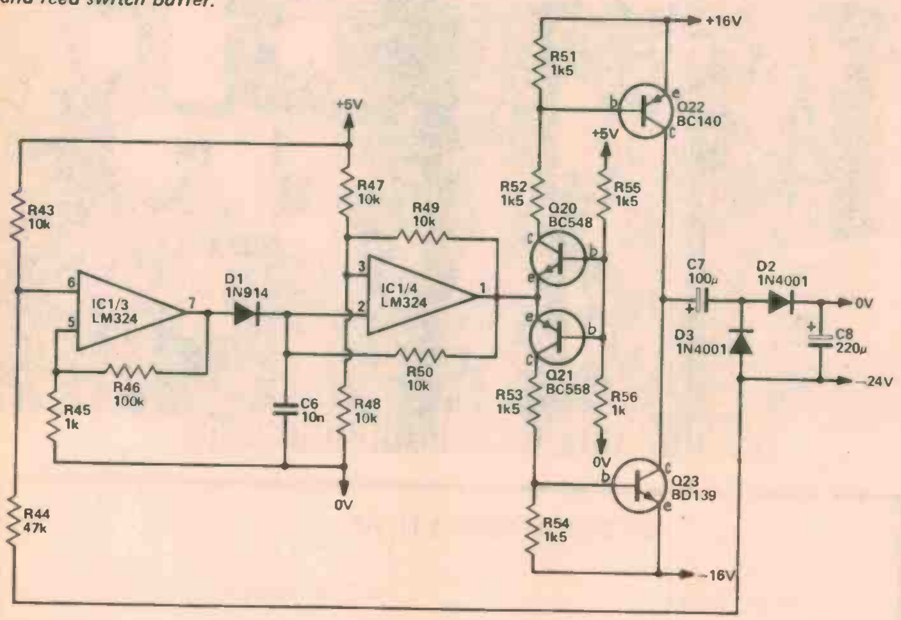


Fig. 1b. The −24 volt power supply.

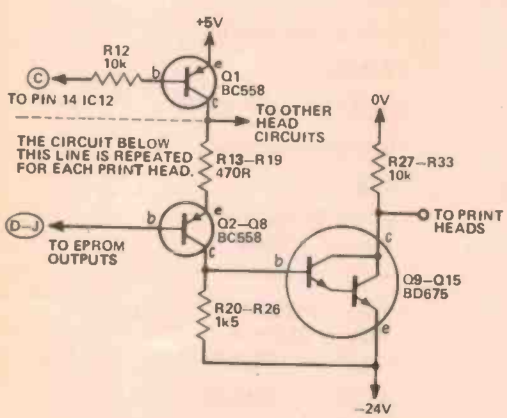


Fig. 1c. The circuit of the head drive. Although only one channel is shown there are 7 identical circuits.

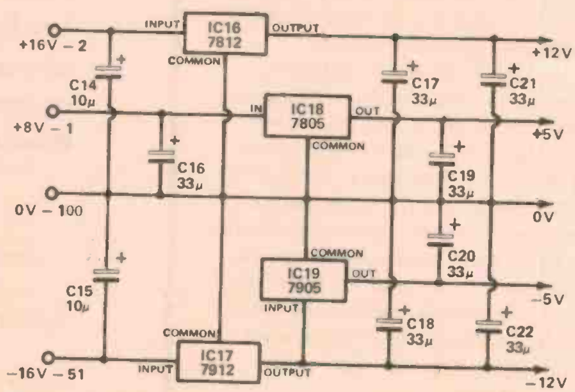


Fig. 1e. The main power supply.

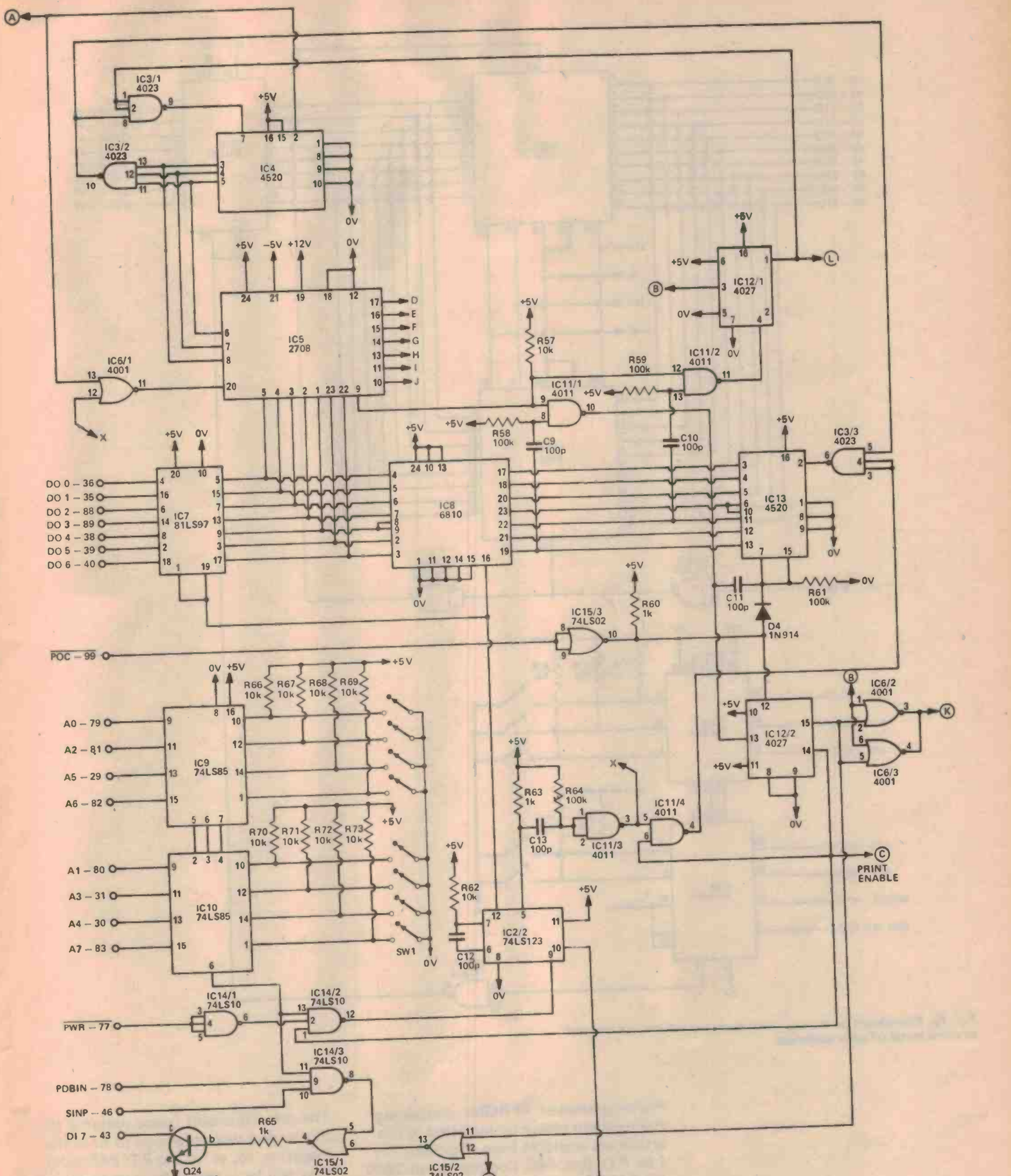


Fig. 1f. The main logic diagram.

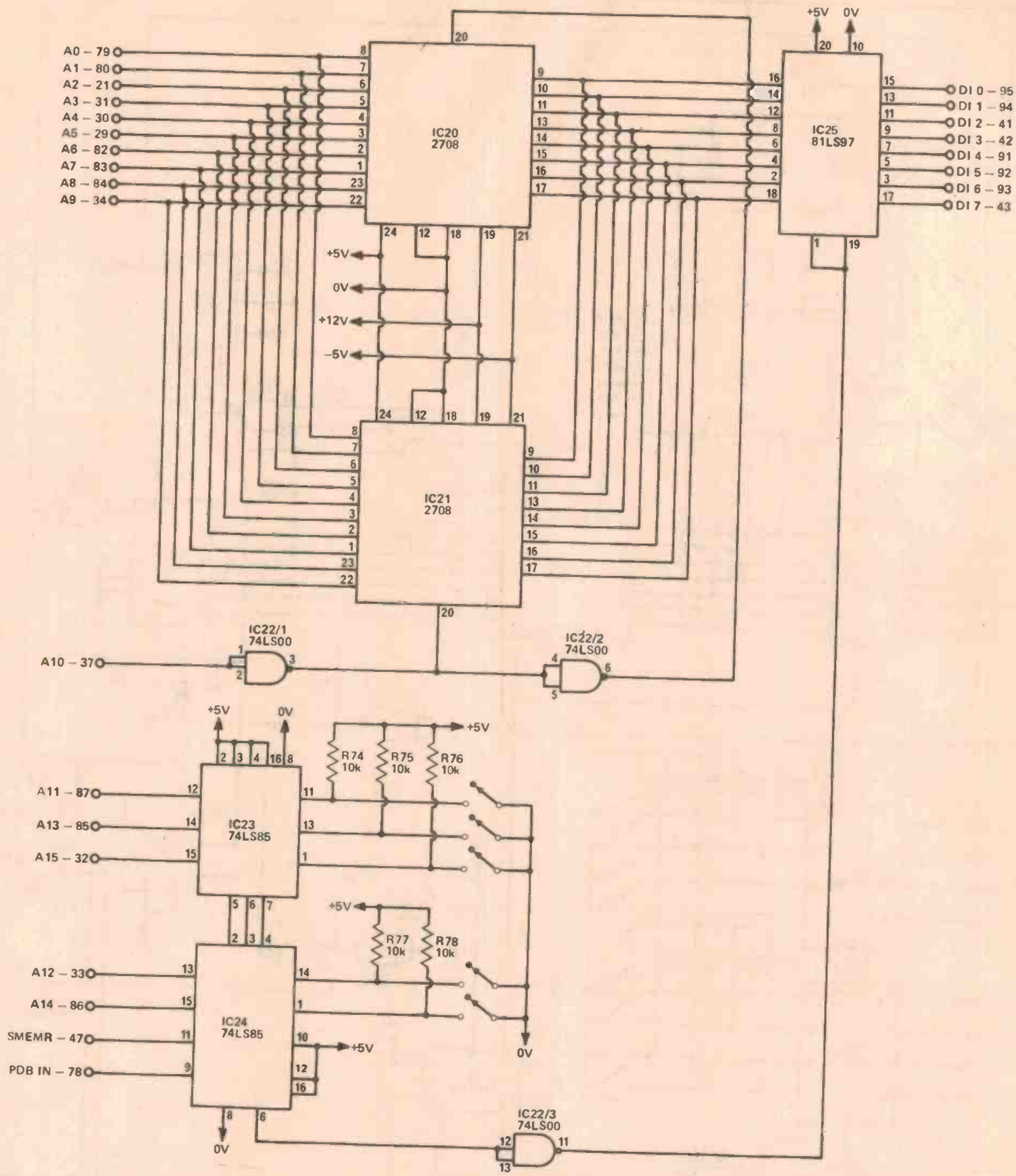


Fig. 1g. The circuit of the auxillary memory which can be used to store some of your software.

Pre-programmed EPROMs containing the standard character set listed in this article are available from Romtech Pty Ltd, P.O. Box 446, Campbelltown 2560 for $15.00 including sales tax + $2.00 for postage and packing.

The printed circuit board patterns for this project were too large to fit in the magazine, so, as for the ETI 640 VDU, they will be available from us on receipt of a large stamped self-addressed envelope. The address to write to is *Printer PCBs, Electronics Today, 15 Boundary Street, Rushcutters Bay, NSW 2011.*

HOW IT WORKS – ETI 641

Before starting an explanation of the electronics we will give a description of the printer used. It has a 24 Vdc motor which drives both the paper feed and the head drive. The head is simply a set of seven fine contacts arranged in a vertical line and is moved across the paper from left to right. The 'paper' is metallized with a thin coating of aluminium, and by applying a voltage pulse between one of the head contacts and the paper the metallization is burnt off at that point. By applying pulses to each of the seven heads in the correct sequence as the head moves across the paper characters and words can be formed in a 5 x 7 dot matrix. The pulse required is –24 V for 240 – 480 μs with a peak current of around 3 A per head.

At the end of the left to right scan of the head it returns quickly to the left while advancing the paper feed. The head is lifted off the paper on the return pass.

Also in the printer mechanism is a toothed wheel and pickup coil which gives an ac output of about 1 V which is used to synchronise the printing, and a reed switch which closes on the left to right passage of the print head. This is used to indicate the start of the line when printing.

The Electronics

The circuit is designed to operate on the S100 bus, and a proportion of the electronics forms an interface to the bus. The principle of operation of the unit is to present the data representing the first character to an I/O port along with the S100 timing signals to tell the printer circuitry to accept the character, and then repeat this process for up to 128 characters. No characters are printed until 128 characters have been output to the printer or until it recognises a carriage return. Printing starts immediately either of these events occurs and during printing a busy signal is available on the I/O port as no data can be entered while printing is in progress.

The S100 bus has available +8 V and ±16 V unregulated dc supplies, and from these we derive, using three-terminal regulators, both positive and negative 5 V and 12 V supplies. Also required for the printer is –24 V, and we derive this from the ±16 V supply using a diode pump type circuit. This consists of IC1/4 which is connected as a square wave oscillator running at 400 Hz. Its output drives the transistor buffer stage Q22 – Q25 the output of which is a square wave of 32 V p-p. The capacitors C7 and C8, and the diodes D2 and D3 rectify this to give a negative voltage which if not limited would reach –30 V. However IC1/3 acts as a comparator and when the voltage on pin 6 drops below 0 V, which represents a voltage of –23.5 V, its output will go high, disabling IC1/4. This effectively regulates the –24 V supply.

Before we can print any data we must first store it. The data is presented to IC7 on the Data Out lines, then if the address presented to IC9 and IC10 is correct along with pin 10 (IC2) being high and a high pulse on pin 3 (IC14), the monostable IC2/2 is triggered. This produces a 500 ns wide pulse which enables the three-state buffer IC7, allowing the data to be written into the RAM IC8. At the end of this pulse, a second monostable (IC11/3) is triggered (about 5 μs) and during this time the contents of the EPROM are examined. If the character just written into the RAM is not a carriage return, pin 9 of that IC (IC9) will remain high. At the end of this 5 μs period, the address counter IC13 is incremented. The next character can now be entered.

If a carriage return is entered pin 9 of IC5 will go low during this 5 μs wide pulse. This forces pin 10 of IC11 high resetting the address counter IC13 and clocking the flipflop IC12/2. If a carriage return is not detected but the 128th character has been entered pin 13 of IC13 will go low and this, via C9, will cause a positive pulse on the output of IC11/1 as well as causing the flipflop IC12/2 to be toggled.

Toggling this flipflop the first time causes pin 15 to go high and 14 low. This disables the monostable via IC14/2, and starts the motor. This is controlled by Q16 – Q19; if point K is low Q16 and Q18 will turn on hard applying 24 V to the motor. When point K goes high, Q17 and Q19 will turn on, shorting out the motor and stopping it quickly.

Also reset by the carriage return is IC12/1, and a '0' will be applied to pins 1 and 2 of IC3 which holds IC4 reset. Once the motor starts, pulses are generated by the pickup coil. The output of the coil is filtered by R1,2 and C1,2 to remove any high frequency interference and is then buffered by IC1/1 which is connected as a schmitt trigger. The output of IC1/1 is used to clock the monostable IC2/1 which generates the 350 μs wide pulse used for printing.

The reed switch is also filtered by R5,6 and C3,4 to remove contact bounce and noise, before being buffered by IC1/2 which is also connected as a schmitt trigger. The output of this IC is high from the start of the printing line until the start of the head return.

Once the print stroke has commenced the closing of the reed switch toggles the flipflop IC12/1, allowing IC4 to be clocked. IC4 then scans the 3 least significant address lines of IC5 ;on each successive clock pulse the EPROM is interrogated for 350 μs. The outputs from the EPROM are used to drive the print head circuitry.

After seven clock pulses IC3/2 detects this and resets IC4 back to zero so forming a divide by seven circuit. This pulse also clocks the RAM address counter IC13 to the next step. In this way, the RAM tells the EPROM what character it wants.

If a carriage return is detected the outputs of IC11/1 and IC11/2 will both go high, resetting IC12/1 preventing any further clocking of IC4. It also resets IC13 and clocks IC12/2 back to its original state where pin 14 is high and pin 15 low.

This allows data to be again entered, but as the reed switch is still closed the motor will continue to run due to the action of IC6/2,3 until the reed opens. If more than 32 characters were entered before the carriage return, after the first 32 characters have been printed pin 11 of IC13 will go low and the mono formed by C10/R59 causes IC12/1 to be reset, stopping IC4 from being clocked. IC12/2 however is not affected and the motor will continue to run, even after the reed switch opens. The printer then starts a second print stroke and the re-closing of the reed switch clocks IC12/1 allowing printing to continue.

The print head requires a negative 24 V pulse of 240 – 480 μs width with a peak current of about 3 A (for only 10 μs) while the metallization is evaporated. The drive consists of seven identical circuits each with an interface transistor and a drive darlington transistor. One additional transistor is used (Q1) to disable the print head while the EPROM is active during the write mode.

The carriage return detection is performed by the EPROM as part of its programming. As there are only seven heads but eight bits in the memory, the least significant bit is always programmed as '1' except for the carriage return character. While the CR character Ψ is programmed in the EPROM it cannot be accessed on this printer.

The auxiliary EPROMs use a standard address decoding and buffering circuit and do not require explanation.

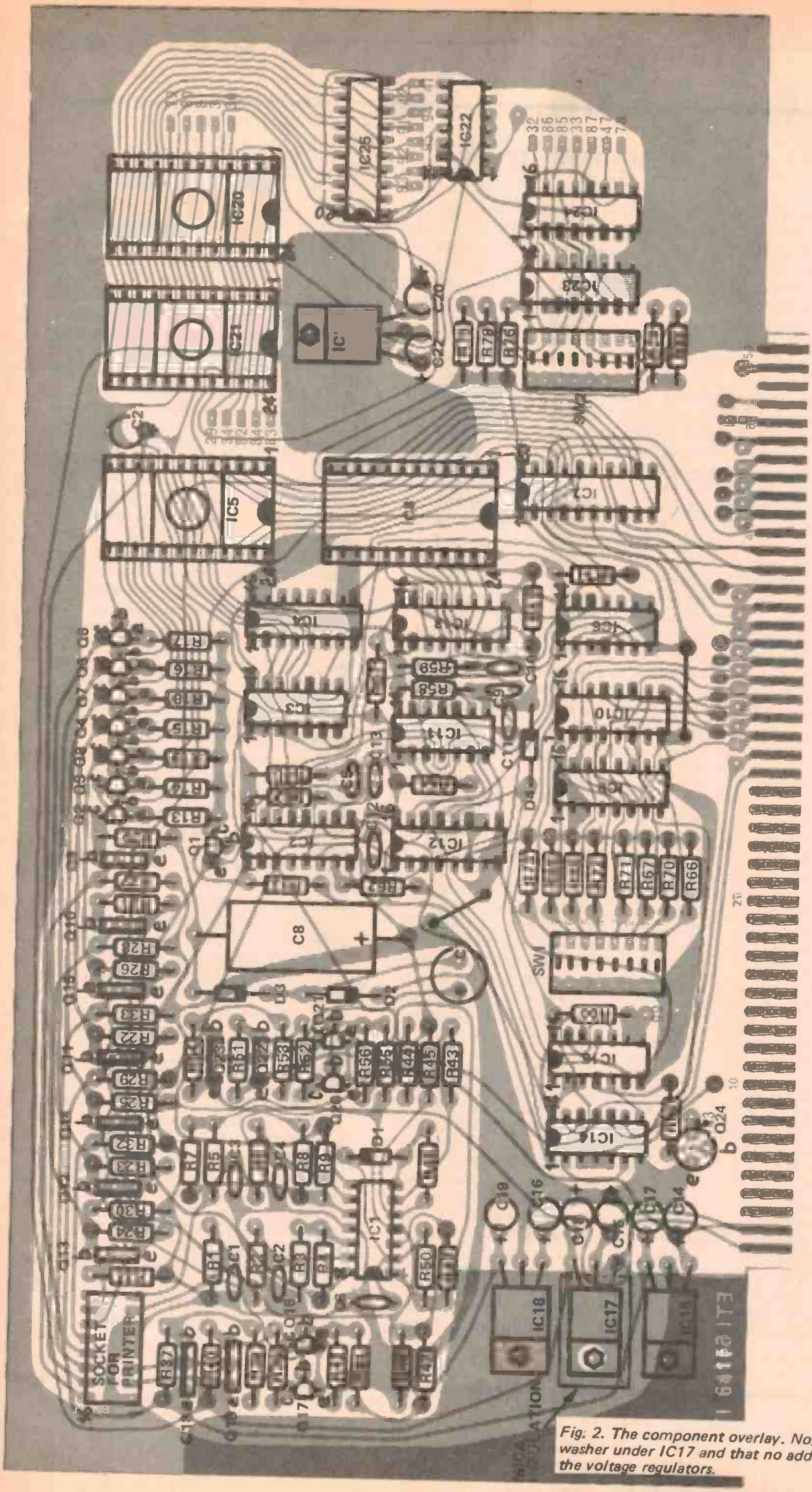


Fig. 2. The component overlay. Note that there must be an insulating washer under IC17 and that no additional heat sinks are needed on the voltage regulators.

CONNECTIONS

Header Pin No.

1	Head common
2	Motor –Ve
3	Motor +Ve
6	Coil-reed common
7	Pickup coil
8	Reed switch
10	Head 5
11	Head 4
12	Head 6
13	Head 3
14	Head 7
15	Head 2
16	Head 1

Printer Pin No.

1	Reed switch
2	Pickup coil
3	Coil-reed common
4	Motor +Ve
5	Motor –Ve
6	Head common
7	NC
8	Head 1
9	Head 2
10	Head 3
11	Head 4
12	Head 5
13	Head 6
14	Head 7
15	NC

PARTS LIST – ETI 641

Resistors all ½W, 5%

R1,2 . . . . . . 10k
R3 . . . . 1k
R4 . . . . 100k
R5–R8. . . . 10k
R9 . . . . 47k
R10. . . . . . 82k
R11,12. . . . 10k
R13–R19 . . 470R
R20–R26 . . 1k5
R27–R33 . . 10k
R34–R36 . . numbers not used
R37–R41 . . 1k5
R42. . . . . . 1k
R43. . . . . . 10k
R44. . . . . . 47k
R45. . . . . . 1k
R46. . . . . . 100k
R47–R50 . . 10k
R51–R55 . . 1k5
R56. . . . . . 1k
R57. . . . . . 10k
R58,59. . . . 100k
R60. . . . . . 1k
R61. . . . . . 100k
R62. . . . . . 10k
R63. . . . . . 1k
R64. . . . . . 100k
R65. . . . . . 1k
R66–R73 . . 10k
* R74–R78 . . 10k

Capacitors

C1–C6 . . . . 10n polyester
C7. . . . . . . 100µ 25V electro
C8. . . . . . . 220µ 35V electro
C9–C13 . . . 100p ceramic
C14,15 . . . . 10µ 25V electro
C16–C22 . . 33µ 16V tantalum

Semiconductors

IC1 . . . . . . LM324 quad op-amp
IC2 . . . . . . 74LS123 dual mono
IC3 . . . . . . 4023 three input NAND
IC4 . . . . . . 4520 dual ÷ 16
IC5 . . . . . . 2708 8K EPROM
IC6 . . . . . . 4001 two input NOR
IC7 . . . . . . 81LS97 octal buffer
IC8 . . . . . . 6810 128x8 RAM
IC9,10 . . . . 74LS85 comparitor
IC11 . . . . . 4011 two input NAND
IC12 . . . . . 4027 dual JK flipflop
IC13 . . . . . 4520 dual ÷ 16
IC14 . . . . . 74LS10 three input NAND
IC15 . . . . . 74LS02 two input NOR
IC16 . . . . . 7812 positive 12V reg.
IC17 . . . . . 7912 negative 12V reg.
IC18 . . . . . 7805 positive 5V reg.
IC19 . . . . . 7905 negative 5V reg.
* IC20,21 . . . 2708 8K EPROM
* IC22 . . . . . 74LS00 two input NAND
* IC23,24 . . . 74LS85 comparator
* IC25 . . . . . 81LS97 octal buffer

Q1–Q8. . . . BC558
Q9–Q15 . . . BD675
Q16. . . . . . BC548
Q17. . . . . . BC558
Q18. . . . . . BD140
Q19. . . . . . BD139
Q20. . . . . . BC548
Q21. . . . . . BC558
Q22. . . . . . BD140
Q23. . . . . . BD139
Q24. . . . . . 2N3643

D1 . . . . . . 1N914
D2,3 . . . . . 1N4001
D4 . . . . . . 1N914

Miscellaneous

PC board ETI 641
Mosaic printer EUY–10E023LE
Four 24 pin sockets
One 16 pin socket and header
Two 8 pole DIP switches
One 15 pin 0.156 inch edge connector

* These components are not required if the additional memory is not needed.

Construction

As this is an economical printer, it was decided that the expense of a through-hole plated pcb was not warranted. This means that a lot of components are soldered on both sides of the board preventing the use of sockets except for the EPROMs and the 6810 RAM.

The board can be assembled with the aid of the overlay in fig. 2. If the additional EPROMs are not required these ICs and the associated components can be deleted. None of the components in this area are used as feedthroughs for the printer electronics. In the printer circuitry there are two links in the 0 V rail and three more leading to the edge connector. If the additional EPROMs are used all the address and data lines are linked to the edge connector as it was not possible (without a plated-through board) to use copper tracks. We used thin enamelled wire of the type where the enamel will melt on soldering for all these links. The numbers on the pcb next to these points indicate the pins on the edge connector to which they are to be linked. Note that the connector is numbered 1 – 50 on the component side and 51 – 100 on the copper side.

Connection to the printer is made via a 16 pin IC socket using a piece of ribbon cable and a 16 pin DIP header.

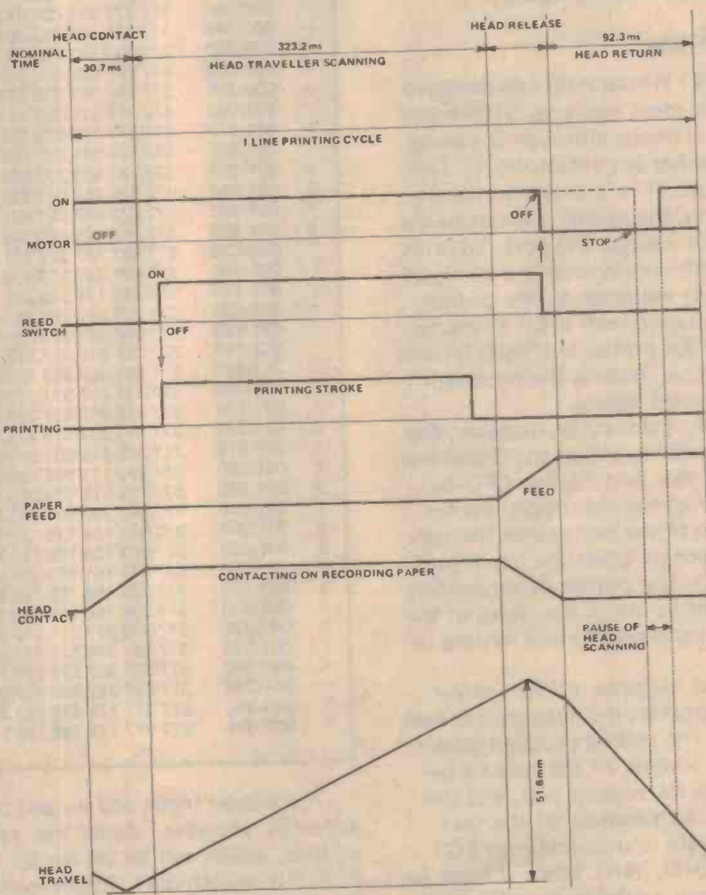


Fig. 3. The timing chart for the printer.

This method simplifies the software required and only ties up the processor long enough for it to output data at its own rate.

As we had some space left over on the card we decided to make provision for two additional 2708 EPROMs and their associated decoding/buffering. These are completely independent of the printer logic and can be used to store any software the user wishes. We do use another 2708 as the character generator as we were unable to find a suitable commercial device at a reasonable price. As this EPROM has 1024 locations, using eight bytes per character, we can have 128 characters. We therefore chose the full upper and lower case font with some Greek and mathematical symbols thrown in for good measure. As we are limited to a 5 x 7 dot matrix character some of the lower case characters are a bit strange (the ones with tails normally below the line) but are still quite legible.

Using the Printer

The ETI 641 Printer has been designed to interface most easily to S100-based computer systems, although it can be used with other bus structures, or even no bus at all. If it is plugged into an S100 system, the printer appears to the system to be a single I/O port. To print, the processor simply writes a string of characters in sequence to the output port, terminating with a CR character, whereupon the printer will itself initiate the print cycle, freeing the processor from any housekeeping.

During the print cycle, however, the printer is unable to accept any characters, and signals this fact to the CPU by pulling bit 7 of the input port low for the duration of the print cycle (though this only appears when the input port is addressed). The printer driver routine should therefore check the status of the printer from this port before writing to it.

A general purpose printer driver which incorporates this feature is shown in Table 2. The calling program passes the starting address of the text to be output in the HL register pair, and the routine will then output all the text from there until it encounters an EOT character (004Q, 04H). When it finds an EOT, the routine substitutes a CR and outputs it to the printer to start the print cycle.

Table 1

α	000:000	377 363 355 355 363 355 377 377	@	002:000	377 203 175 105 125 207 377 377
β	000:010	377 377 201 155 155 223 377 377	A	002:010	377 201 157 157 157 201 377 377
γ	000:020	377 163 155 201 277 177 377 377	B	002:020	377 001 155 155 155 223 377 377
δ	000:030	377 223 155 155 163 377 377 377	C	002:030	377 203 175 175 175 273 377 377
ε	000:040	377 377 343 325 325 377 377 377	D	002:040	377 001 175 175 175 203 377 377
θ	000:050	377 203 155 155 155 203 377 377	E	002:050	377 001 155 155 155 175 377 377
ι	000:060	377 377 343 375 373 377 377 377	F	002:060	377 001 157 157 157 177 377 377
λ	000:070	377 335 353 367 373 375 377 377	G	002:070	377 203 175 175 155 141 377 377
μ	000:100	377 377 201 367 367 217 377 377	H	002:100	377 001 357 357 357 001 377 377
ν	000:110	377 337 301 373 367 317 377 377	I	002:110	377 377 175 001 175 377 377 377
π	000:120	377 357 301 337 301 337 377 377	J	002:120	377 373 175 175 003 177 377 377
Σ	000:130	377 175 071 105 155 175 377 377	K	002:130	377 001 357 327 273 175 377 377
Φ	000:140	377 347 333 001 333 347 377 377	L	002:140	377 001 375 375 375 375 377 377
ψ	000:150	376 316 366 000 366 316 376 376	M	002:150	377 001 277 317 277 001 377 377
ω	000:160	377 363 355 373 355 363 377 377	N	002:160	377 001 337 357 367 001 377 377
Ω	000:170	377 315 261 277 261 315 377 377	O	002:170	377 203 175 175 175 203 377 377
0	000:200	377 377 363 355 355 363 377 377	P	002:200	377 001 157 157 157 237 377 377
1	000:210	377 377 377 355 371 375 377 377	Q	002:210	377 203 175 165 173 205 377 377
2	000:220	377 377 355 331 325 355 377 377	R	002:220	377 001 157 147 153 235 377 377
3	000:230	377 377 333 335 325 353 377 377	S	002:230	377 235 155 155 155 163 377 377
0	000:240	377 377 237 157 157 237 377 377	T	002:240	377 177 177 001 177 177 377 377
2	000:250	377 377 267 147 127 267 377 377	U	002:250	377 003 375 375 375 003 377 377
±	000:260	377 333 333 213 333 333 377 377	V	002:260	377 007 373 375 373 007 377 377
÷	000:270	377 357 357 253 357 357 377 377	W	002:270	377 003 375 343 375 003 377 377
≈	000:300	377 267 157 267 333 267 377 377	X	002:300	377 071 327 357 327 071 377 377
√	000:310	377 367 373 001 177 177 377 377	Y	002:310	377 077 337 341 337 077 377 377
∫	000:320	377 373 375 203 177 277 377 377	Z	002:320	377 171 165 155 135 075 377 377
|	000:330	377 377 377 001 377 377 377 377	[	002:330	377 377 001 175 175 377 377 377
←	000:340	377 357 307 253 357 357 377 377	\	002:340	377 277 337 357 367 373 377 377
→	000:350	377 357 357 253 307 357 377 377	]	002:350	377 377 175 175 001 377 377 377
↑	000:360	377 357 337 203 337 357 377 377	^	002:360	377 337 277 177 277 337 377 377
↓	000:370	377 357 367 203 367 357 377 377	_	002:370	377 375 375 375 375 375 377 377
	001:000	377 377 377 377 377 377 377 377	`	003:000	377 377 177 277 337 377 377 377
!	001:010	377 377 377 015 377 377 377 377	a	003:010	377 373 325 325 325 341 377 377
"	001:020	377 377 037 377 037 377 377 377	b	003:020	377 001 355 355 355 363 377 377
#	001:030	377 327 001 327 001 327 377 377	c	003:030	377 377 343 335 335 335 377 377
$	001:040	377 333 253 001 253 267 377 377	d	003:040	377 363 355 355 355 001 377 377
%	001:050	377 073 067 357 331 271 377 377	e	003:050	377 377 343 325 325 347 377 377
&	001:060	377 363 215 145 233 365 377 377	f	003:060	377 377 357 201 157 277 377 377
'	001:070	377 377 337 277 177 377 377 377	g	003:070	377 377 357 327 325 343 377 377
(	001:100	377 377 307 273 175 377 377 377	h	003:100	377 377 001 357 357 361 377 377
)	001:110	377 377 175 273 307 377 377 377	i	003:110	377 377 355 241 375 377 377 377
*	001:120	377 327 357 203 357 327 377 377	j	003:120	377 377 377 375 243 377 377 377
+	001:130	377 357 357 203 357 357 377 377	k	003:130	377 377 001 367 353 335 377 377
,	001:140	377 377 375 363 377 377 377 377	l	003:140	377 377 175 001 375 377 377 377
–	001:150	377 357 357 357 357 357 377 377	m	003:150	377 341 337 347 337 341 377 377
.	001:160	377 377 377 371 377 377 377 377	n	003:160	377 377 341 337 337 341 377 377
/	001:170	377 373 367 357 337 277 377 377	o	003:170	377 377 343 335 335 343 377 377
0	001:200	377 377 203 175 175 203 377 377	p	003:200	377 377 301 327 327 357 377 377
1	001:210	377 377 275 001 375 377 377 377	q	003:210	377 357 327 327 301 375 377 377
2	001:220	377 275 171 165 155 235 377 377	r	003:220	377 377 301 357 337 337 377 377
3	001:230	377 173 175 135 055 163 377 377	s	003:230	377 357 325 325 325 373 377 377
4	001:240	377 347 327 267 001 367 377 377	t	003:240	377 377 337 203 335 377 377 377
5	001:250	377 033 135 135 135 143 377 377	u	003:250	377 303 375 375 301 375 377 377
6	001:260	377 303 255 155 155 363 377 377	v	003:260	377 307 373 375 373 307 377 377
7	001:270	377 177 161 157 137 077 377 377	w	003:270	377 303 375 363 375 303 377 377
8	001:300	377 223 155 155 155 223 377 377	x	003:300	377 335 353 367 353 335 377 377
9	001:310	377 237 155 155 153 207 377 377	y	003:310	377 377 317 367 365 303 377 377
:	001:320	377 377 377 311 377 377 377 377	z	003:320	377 335 331 325 315 335 377 377
;	001:330	377 377 375 311 377 377 377 377	{	003:330	377 357 357 223 175 175 377 377
<	001:340	377 357 327 273 175 377 377 377	¦	003:340	377 377 377 021 377 377 377 377
=	001:350	377 327 327 327 327 327 377 377	}	003:350	377 175 175 223 357 357 377 377
>	001:360	377 377 175 273 327 357 377 377	~	003:360	377 357 337 357 367 357 377 377
?	001:370	377 277 177 145 137 277 377 377	▒	003:370	377 125 253 125 253 125 377 377

The printer input and output ports, although separate, share the same address, which can be set up on the 8-bit DIL switch SW1. In our example, the printer is set up for I/O address 031Q (19H). Although, the routine given is assembled at 001:000Q (0100H), it can easily be reassembled to any other address. Be sure when trying out the program, to initialise the Stack Pointer, as otherwise, the routine will return to 377:377Q and 'gallop off into the wide blue yonder', possibly self-destructing for good measure.

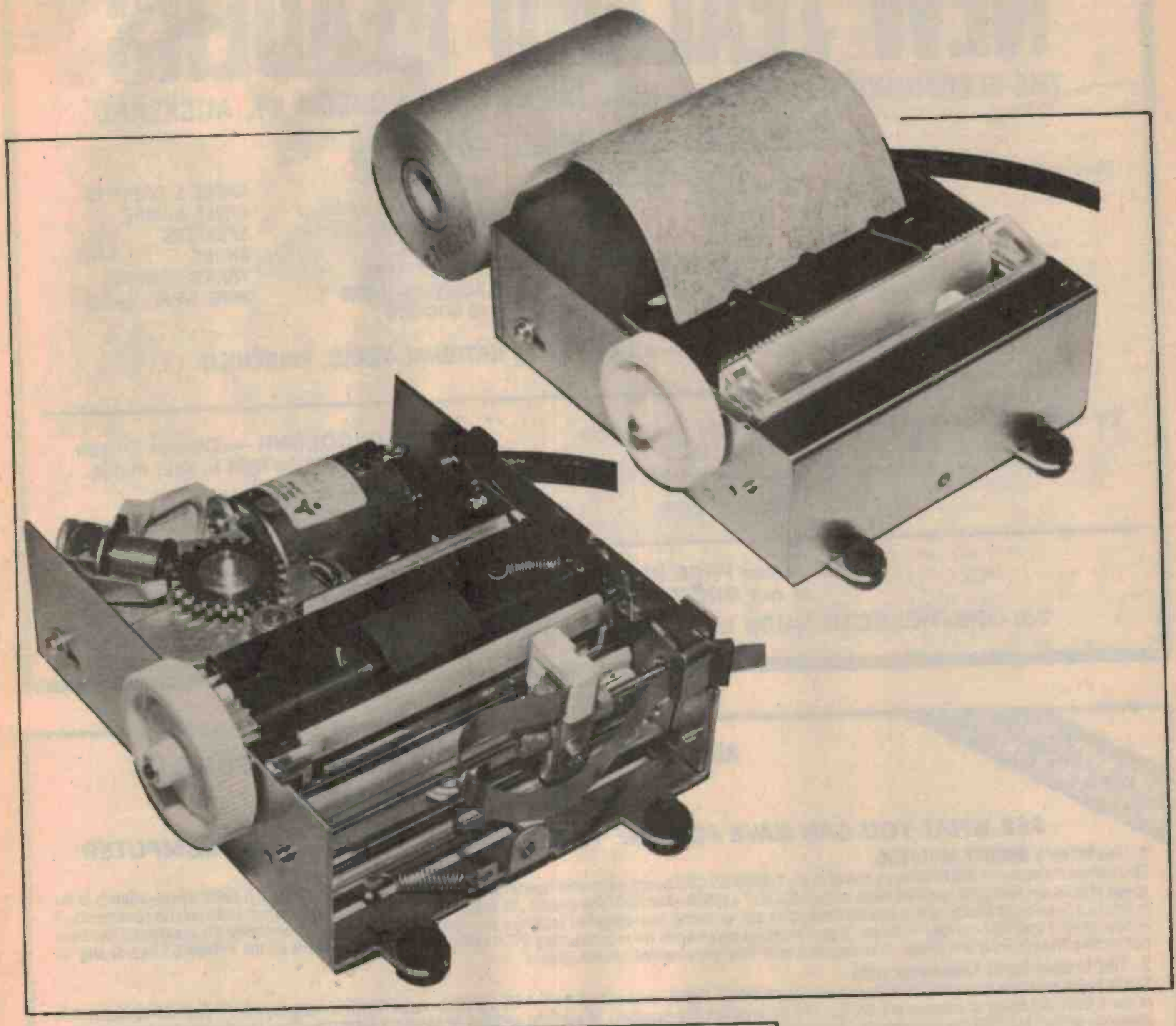


Table 2

001:000	333	031		PRINT	IN	PRINTER	CHECK STATUS
001:002	376	177			CPI	177Q	BIT 7 ZERO?
001:004	312	000	001		JZ	PRINT	LOOP IF YES
001:007	176				MOV	A,M	FETCH CHAR
001:010	043				INX	H	NEXT CHAR
001:011	376	004			CPI	004Q	EOT?
001:013	312	023	001		JZ	END	END IF YES
001:016	323	031			OUT	PRINTER	OUTPUT CHAR
001:020	303	000	001		JMP	PRINT	ROUND AGAIN
001:023	076	015		END	MVI	A,015Q	LOAD CR
001:025	323	031			OUT	PRINTER	PRINT CR
001:027	311				RET		BACK TO CALLING ROUTINE

This general-purpose printer driver routine will output a character string until it comes to an EOT character, when it will output a CR to begin the print cycle. Beware if reassembling this program that your assembler can differentiate between the labels PRINT and PRINTER — it may be wise to choose alternative labels.

Another common trick used to indicate the end of message text is to set the most significant bit of the last character — as this is 7-bit ASCII it will not affect the printer or the CPU. However, the printer driver should recognise this and insert a CR, otherwise nothing will be printed.

The two EPROM sockets are addressed as a contiguous 2 K block of memory — they cannot be split apart. Consequently only 5 bits of address information have to be set on SW2 — one more bit selects which 2708 is addressed, and the final 10 bits are decoded inside the 2708's.

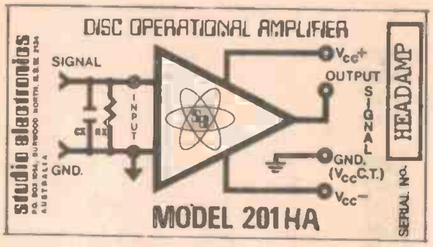
News from studio electronics

HOW about this then?

6 PROFESSIONAL AUDIO MODULES

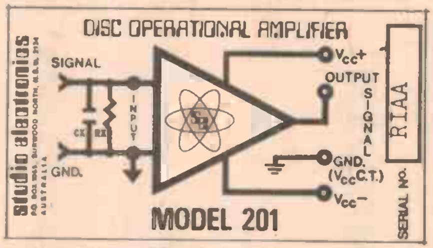
ONLY $223.60

SALES TAX & P.P. INCLUDED



MOVING COIL HEADAMP

GAIN: 31 dB
NOISE: less than -144 dBA
PRICE: $50.70 ea
INCL. TAX



PHONO EQUALIZER

GAIN: 34 dB
RIAA (NEW): ±0.5 dB
NOISE: -125 dBV u.w.
PRICE: $58.50 ea
INCL. TAX

AUDIO OP-AMP

GAIN: UNITY to 60 dB
NOISE: -125 dBV u.w.
BANDWIDTH: 80 kHz
OUTPUT: +18 dBV/600 ohms
PRICE: $35.10 ea
INCL. TAX

We can also supply most other professional audio components.

studio electronics 3 BURWOOD ROAD, BURWOOD NORTH. 2134. AUSTRALIA.
PHONE: (02) 747-5686
Cable: STUDIOTRON, SYDNEY.

FANTASTIC OFFER

DIGITAL WATCH KIT

5 functions, hour/minute/second/date/month. Good quality leather band. 6 month guarantee on mechanism. Order now for next shipment.

INTRODUCTORY MAIL ORDER OFFER

$11.50
plus $1.00 p&p.

KIT BITS

110 Rosemead Rd, HORNSBY. NSW. 2077. Ph (02) 476-3975
Trade enquiries welcome

To: KIT BITS, 110 Rosemead Rd, Hornsby. NSW. 2077.

Please send me .... Digital Watch Kits. I enclose cheque/postal order for $ ....

NAME ....

ADDRESS ....

.... P/Code ....

Performance features at a price you can afford – and fully backed by Tektronix

Only Telequipment offers you:

TEKTRONIX GUARANTEE
The Telequipment family of oscilloscopes is fully guaranteed by Tektronix, the world's leading oscilloscope manufacturer.

PERFORMANCE FEATURES YOU NEED AT A PRICE YOU CAN AFFORD

Model D61a Designed for portability and easy operation, the D61a is a dual trace 10 MHz scope. For easy, accurate viewing, the D61a features automatic triggering and bright stable waveforms on an 8 x 10 cm display.

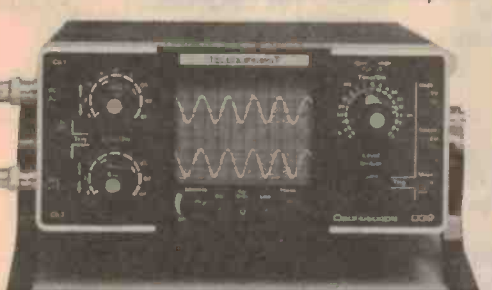
Model D83 A plug-in oscilloscope with a big display. The D83 sets high standards of performance, versatility and value. Plug-in options include 50 MHz dual trace at 5mV/div., single or delayed sweep and high gain differential.

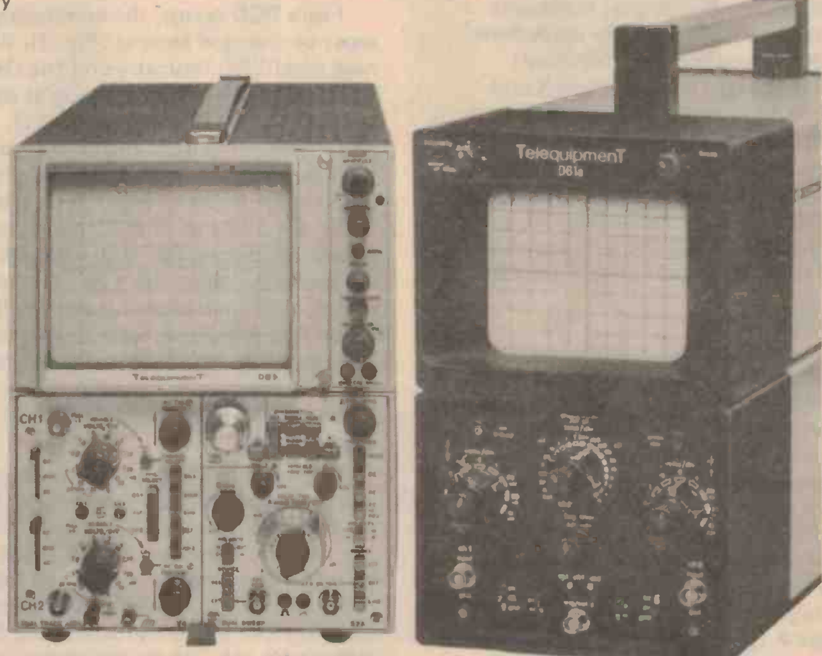
Model D32 When you demand an extremely portable scope, the D32 is ideal. Battery or ac line operated, this 10 MHz dual trace scope weighs only 10 lbs. An optional shoulder strap or attache carrying case can be used to take your scope into the field.

Tektronix
COMMITTED TO EXCELLENCE

IDEAL FOR MANY APPLICATIONS
If you're servicing pocket calculators, T.V., radio, microwave ovens, alarm systems or dozens of other consumer products, Telequipment scopes can do the job for you. Easy viewing and operating make Telequipment ideal for classroom use too.

TELEQUIPMENT . . . THE CHOICE FOR YOU
Performance features at a price you can afford, plus full backing by Tektronix make Telequipment a wise choice when you're looking for low-cost oscilloscopes.





For more information about Telequipment oscilloscopes, contact **Tektronix Australia Pty. Ltd.,** 80 Waterloo Road, North Ryde 2113. Sydney **888 7066**, Melbourne **818 0594**, Brisbane **31 2896**, Adelaide **223 2811** Perth **325 4198**.

TK11

DIGITAL ELECTRONICS BY EXPERIMENT part7

Continuing our series on TTL digital logic — this month decade counters.

THE 7490 DECADE COUNTER is a single-chip counter containing four flip-flops and various gates, which are arranged so that frequency division and decimal counting can be carried out. To make the counter more versatile, one flip-flop is separately connected so that it can be independently used as a scale-of-two counter, and the remaining three flip-flops are gates so that they act as a scale-of-five. The two sections of the counter can be connected together in different ways, either as a divide-by-ten circuit, or as a decimal counter with BCD outputs.

Twos Into Tens

BCD — meaning Binary-Coded-Decimal — is a form of binary code which is particularly useful if decimal numbers have to be displayed. In a BCD count, each figure of a decimal number is represented by its binary equivalent, so that the number 85 (decimal) becomes 1000 0101, binary B and binary 5. Although more convenient, because each BCD counter can then drive a display unit, this form is longer than a pure binary number (binary 85 = 1010101, only seven figures), and BCD numbers are not so simple to add and subtract as pure binary numbers.

BCD in Practice

Connect the power supplies to the 7490 with pin 10 to earth and pin 5 to +5 V. Pins 2 and 7 should also be earthed for most of the experimental work in this section, although we may use pin 2 later for resetting to zero. Now connect LEDs and their limiting resistors, using the spare pads on the board, to Qa on pin 12 and Qd on pin 11. Connect the clock pulse from the slow oscillator to input A (pin 14) and by watching the clock LED and the LED connected to pin 12 (Qa), note the action of this section of the counter.

Switch off, transfer the clock pulse input to input B on pin 1, and switch on again, watching the clock LED and the Qd LED on pin 11. Note that the counter will operate only if the reset pins, each pair being inputs to an AND gate which operates the reset. Pins 2 and 3 are the reset to zero pins, and earthing either of them enables the counter. If both are allowed to float to logic 1, or are taken to logic 1, the counter resets to zero. Pins 6 and 7 also act through an AND gate, but with both high the reset is to BCD 9 (1001) rather than to zero.

To use the 7490 as a frequency divider (Fig. 2), we connect Qd (pin 11) to INa (pin 14) and take the clock pulse to INb (pin 1). The output will appear at Qa, on pin 12, and the state of this output is monitored by an LED already. Connect up the clock pulse from the slow oscillator on the board, and by counting pulses, confirm that the correct division ratio is being obtained.

For a BCD count, the connections must be changed around (Fig. 3). We now need LED indicators on the Qb (pin 9) and Qc (pin 8) outputs as well as on Qa (pin 12) and Qd (pin 11), and the cross-connections are different, with Qa connected to input B and the clock input taken to input A on pin 14. Label the LEDs as A, B, C, and D, and switch on, noting the values at each stage of the count. Use a de-bounced switch as a clock supply if the oscillator is too fast to follow. Note that in the circuit of Fig. 3 a reset switch has been used; because we are using push-to-make switches, an inverter must be used as shown.

Because the 7490 is on a single chip it may be more convenient to adapt it for counts of less than 10, rather than use separate flip-flops. This is made easier by the arrangement of the reset lines, connected through AND gates. Ignoring the reset-to-nine pins, we can arrange for pin 2 to be driven by a gate whose output must be zero during the count, rising to 1 at the end of the count. Pin 3 must be kept high, or the count will not be interrupted.

Try the circuit of Fig. 4 — can you work out what the count figure will be? Connect up and try the circuit out.

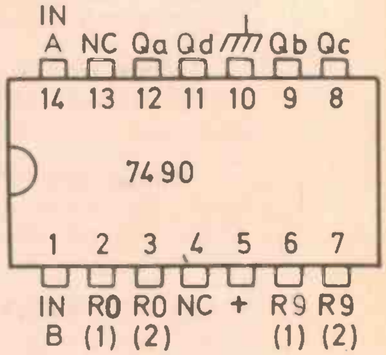


Fig 1. Pinout of 7490 Decade counter.

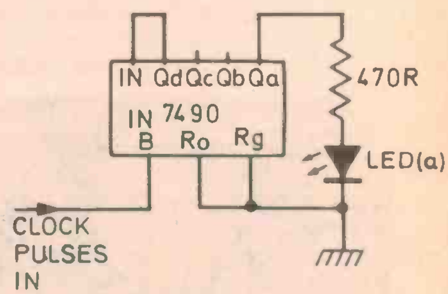


Fig 2. Connections for frequency division by ten — note that the symbol does not show the true pin positions.

Displays

Though several other forms of display exist, the most convenient type for use with TTL circuits is the seven-segment LED display. The type used for this board, the Jumbo DL747 is one of the largest displays of this type available at the time of writing, and has been selected from the point of view of easy reading at a distance. If any other type is substituted, care will have to be taken with the pin connections, since there are several pinout standards for this type of display.

As the name suggests, the seven-segment display consists of seven LEDs made in one chip in the arrangement of a figure-of-eight, as shown in Fig. 5. The letters allocated to the strips are also shown (fortunately these are standardised).

Looking at the arrangement of the segments, we can draw up a table of the segments that will have to be activated (ON) for each number we want to display. Fig. 6. shows such a table for the numbers 0 to 9, and also some of the other characters which can be obtained. We now have to translate this ON/OFF table into terms of logic 1 and 0.

The next step depends on the type of display that is being used — common cathode or common anode. As the name suggests, the common cathode display has all of the LED cathodes connected together to logic 0, and each anode must be taken to logic 1 to be illuminated. To prevent excessive current flowing — because the normal forward voltage across the LED is less than the +5 V of the logic circuits — we must wire a limiting resistor in the connection to each anode. We cannot use one single resistor in the cathode lead, as this would cause the brightness of the display to alter according to the number of segments lit.

The other possibility is to connect the anodes of the LEDs together and take the cathodes out to separate pins. In this common-anode type of display, the segments will be lit when their respective cathodes are at logic zero, and once again limiting resistors must be used between each cathode and the TTL driving stage.

The type of display specified for this board is a common anode type, with several of the pins on the display connected to the common anode. Only one of these pins need be connected to the 5V line.

Decoders

To obtain a decimal readout from the BCD output of the 7490 counter, a decoder stage, is needed with the truth table shown in Fig. 7.

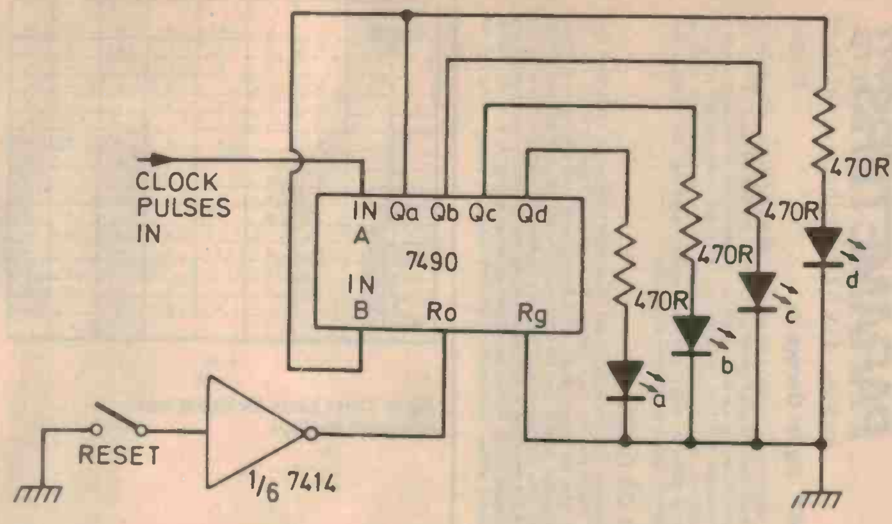


Fig 3. Connections for BCD counting, with reset switch. The reset pin must be kept at logic zero for counting, and taken to logic 1 for reset, so that an inverter must be used along with the push-button switch.

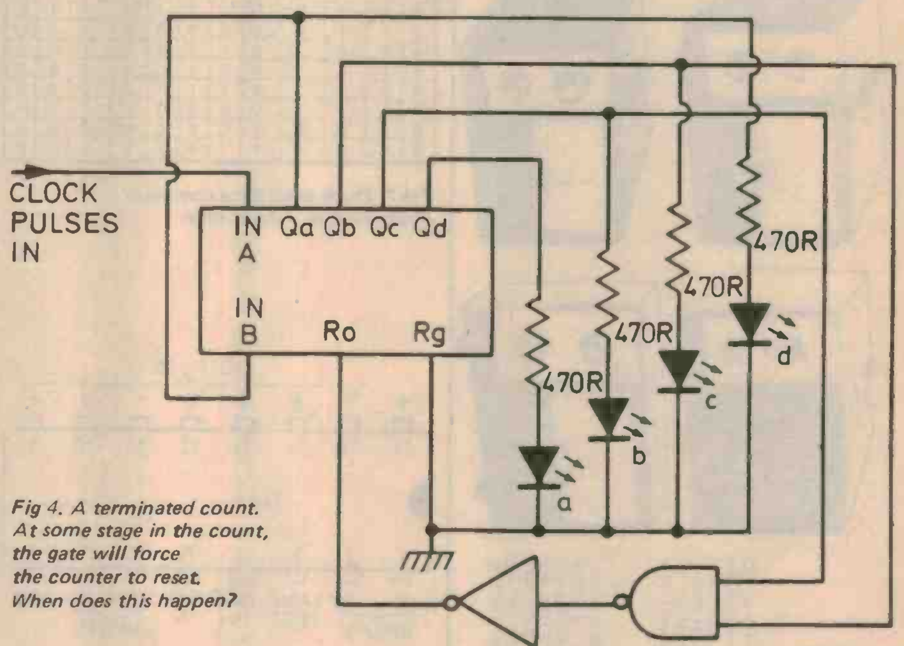
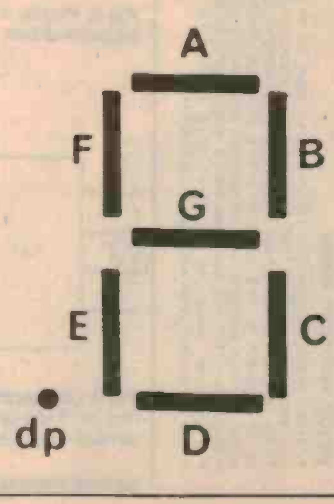


Fig 4. A terminated count. At some stage in the count, the gate will force the counter to reset. When does this happen?



Number/ Character	a	b	c	d	e	f	g
0	x	x	x	x	x	x	–
1	–	x	x	–	–	–	–
2	x	x	–	x	x	–	x
3	x	x	x	x	–	–	x
4	–	x	x	–	–	x	x
5	x	–	x	x	–	x	x
6	–	–	x	x	x	x	x
7	x	x	x	–	–	–	–
8	x	x	x	x	x	x	x
9	x	x	x	–	–	x	x
⊏(10)	x	–	–	x	x	x	–
⊐(11)	x	x	x	x	–	–	–
⊔(12)	–	x	–	–	–	x	x
(13)	x	x	–	x	–	x	x
⊏(14)	–	–	x	x	x	x	x
Blank (15)	–	–	–	–	–	–	–

x - lit
— - unlit

Fig 6 Truth table for figure and character displays.

	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	0	0	0	0	0	0	1
1	1	0	0	0	1	0	0	1	1	1	1
2	0	1	0	0	0	0	1	0	0	1	0
3	1	1	0	0	0	0	0	0	1	1	0
4	0	0	1	0	1	0	0	1	1	0	0
5	1	0	1	0	0	1	0	0	1	0	0
6	0	1	1	0	1	1	0	0	0	0	0
7	1	1	1	0	0	0	0	1	1	1	1
8	0	0	0	1	0	0	0	0	0	0	0
9	1	0	0	1	0	0	0	1	1	0	0

Fig 7 Truth table for a common-anode display, figures only.

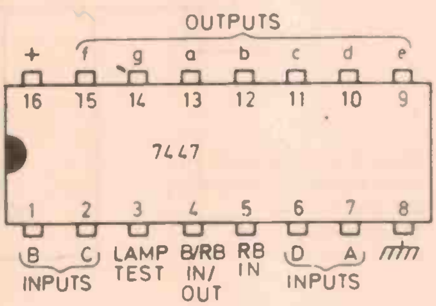


Fig 8. Pinout of the 7447 BCD to 7-segment decoder-driver.

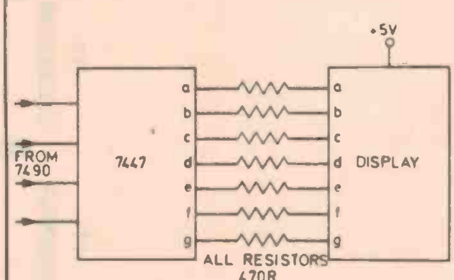


Fig 9. Connection of the 7447 to the display – not that the arrangement on the board is as neat as the drawing would suggest!

The type used here is the 7447 BCD-to-seven segment decoder/driver, which has output stages of transistor collectors with no loads. In this way, the combination of LED and limiting resistor acts as load for the collectors of the output transistors in the 7447.

Care should be taken that the outputs of a 7447 are never connected directly to the +5 V line, as excessive currents could flow if the decoder were operated.

In use, the segment output pins of the 7447 are connected through the limiting resistors to the segment pins of the display. The values of the limiting resistors used will determine the brightness of the display. For the 7447 display we can use 150 R resistors, but 470R resistors have been specified on our board to ensure long life and to cut down current consumption. If other displays are used, 470R should also be suitable – in general the small displays need less current, and so larger values of limiting resistors should be used than with larger displays. If a common cathode display, such as the MAN-3 types, had been used, the 7448 decoder would have been needed.

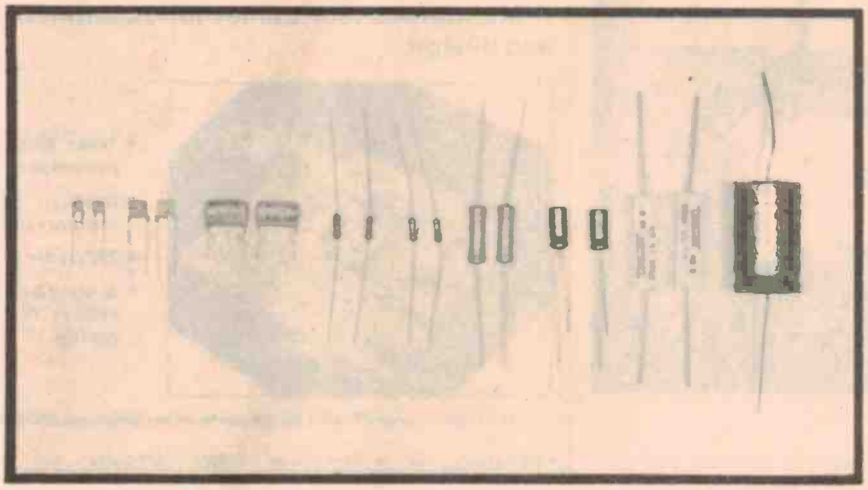
Now connect up the display and the decoder on your board, noting the connection diagram of Fig. 9. In the prototype boards, the very small resistors used for limiting could be passed under the body of the display, so avoiding long paths around it. The +5 V supply is taken to pin 16 of the 7447, and earth is taken to pin 8. The outputs of the 7447, all on the side facing the display, and marked on the circuit diagram with small letters, are taken through the 470R limiters to the correspondingly lettered pins of the display. The inputs indicated by the capital letters A, B, C and D on pins 1, 2, 7 and 6 of the 7447 are for the BCD input from a 7490 and should be connected to the appropriate Q outputs from the 7490 counter.

Testing and Blanking

Note that pin 3 of the 7447 is labelled "lamp test". Taking this pin to logic 0 illuminates all segments of the display irrespective of what stage the count has reached, and is a useful check on the operation of the display. For example, an operator can check that a steady display of 8 is not just 3 with two segments faulty.

Pins 4 and 5 on the 7447 are for blanking, used mainly when the display is one of a set, to suppress zeros occurring before the first significant figures and after the last one. When pin 4 is low, the display is blanked out, though counting is unaffected.

silicon valley
adds 2,000 plus passive components to its already extensive range



Electronic
Components
And materials

PHILIPS

Silicon Valley has added an extensive range of Philips resistors and capacitors to its on-the-shelf stock. The addition of these passive components to Silicon Valley's already wide range of electronic components means Silicon Valley can now supply all the major requirements for most electronic projects, hobbyist applications, one-off bench test experiments and the needs of industry requiring one-off products for design research and development.

Silicon Valley now has more than 7,000 active and passive components with off-the-shelf availability

silicon valley

SYDNEY:
Silicon Valley, 23 Chandos Street, St. Leonards.
Tel: (02) 439 2965
BRISBANE:
Silicon Valley, 22 Ross Street, Newstead.
MELBOURNE:
Silicon Valley, 380 Bridge Road, Richmond.
Tel: (03) 429 4780
ADELAIDE:
Silicon Valley, 170 Sturt Street, Adelaide. Tel: (08) 51 4080
NEW ZEALAND:
Silicon Valley, 7-9 Kirk Street, Grey Lynn, Auckland,
Tel: 76 1169

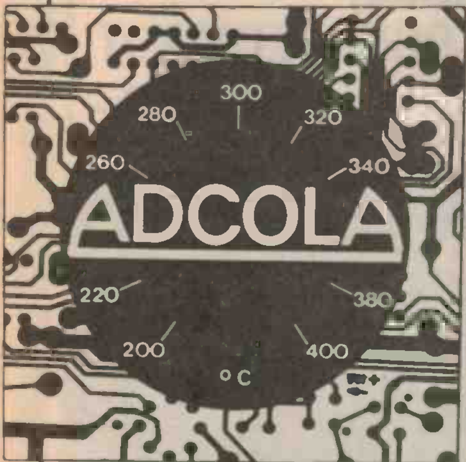
Fill in coupon for the following
Silicon Valley Customer Services

Tick
- ☐ Active Components Price List
- ☐ Passive Components Price List
- ☐ M.P.U. Price List
- ☐ Literature/Data Price List
- ☐ Mail Order Information
- ☐ Complete List of Stockists.

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

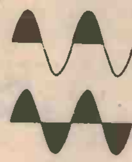
Post to Silicon Valley, P.O. Box 898, Crows Nest, N.S.W. 2065.

Soldering printed circuits?



The Duotemp protects circuits and components at a cost far lower than soldering tools with automatic temperature control.

- Correct soldering temperature for printed circuits.
- Fast heat-up and heat recovery.
- Power boost for long sequences or heavy joints.



THE PUSH BUTTON . . .

The Duotemp soldering tool will idle all day on half-wave AC without overheating. A touch of the button converts it to full wave, instantly doubling the thermal capacity.

From your electronic parts supplier or enquire from

ADCOLA PRODUCTS

Melbourne, 848 3777. Sydney, 709 5293. Brisbane, 44 0131. Adelaide, 42 6655. Hobart, 34 2233. Launceston, 31 2511. Perth, 381 5500.

DUOTEMP

AVAILABLE IN 240V AC & 24V AC

MODEL D30	3mm tip
MODEL D50	5mm tip
MODEL D65	6.5mm tip

A77A

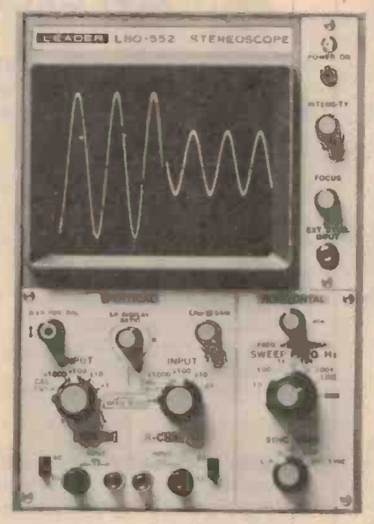
LEADER TEST INSTRUMENTS

STEREO

LBO-552
5" Horizontal, Dual Trace/ Dual Chan. Oscilloscope

WITH SIMULTANEOUS LEFT/RIGHT WAVEFORM DISPLAY

A solid state achievement that makes audio testing, on-line quality control and general purpose measurements easier than ever. Features a horizontal dual trace/dual channel format that lets you view two independent signals simultaneously and side-by-side on a bright CRT display. Perfect for inspecting and aligning the most sophisticated stereo equipment, the LBO-552 also provides a single channel input for conventional readout. Sensitivity is 20mVp-p/cm; Vert. B'width is DC or 2Hz to 2.5MHz. Sweep speeds are from 10Hz to 100KHz in 4 ranges with input impedance 1MΩ shunted by 40pF.
250mm h x 180 w x 380 d; 6.5kg.



LMV-186A
Dual Chan./ Dual Pointer AC Millivolt Meter

Check stereo signal quality, especially where a big difference exists in two points. This instrument uses identical switches and amplifiers in each channel to operate without crosstalk effects. Measuring range is 100µV to 300V, 12 steps. It has two dB scales: an easy-to-read meter face; 2 scale readings; built-in dual amplifier output. Accuracy is ±2% full scale (1KHz). Channels operate individually, or in common at ch. 2. Scale calibration reads effective values. With input cable 240V/50Hz.
150mm h x 200 w x 250 d; 3.5kg.

WARBURTON FRANKI

- ADELAIDE 356-7333 • BRISBANE 52-7255 • HOBART 23-1841
- MELBOURNE 699-4999 • PERTH 277-7000 • SYDNEY 648-1711
- AUCKLAND N.Z. 79-7781 • WELLINGTON N.Z. 698-272

CB COMMUNICATIONS

FCC propose 900 MHz PC band.

The FCC is considering establishing a new Personal Communications (PC) band in the United States around the 900 MHz region.

The proposed band would be at least 10 MHz wide and could be divided into 400 FM channels at 25 kHz spacing. If and when established, it would not replace the existing US 27 MHz CB band but would operate in addition to that service.

A legal conversion?

Johnson's Viking 352D 23 channel side-band rig was a very popular set in its heyday. If you own one and omitted/forgot/didn't bother to get it licensed before January 31 this year did you know that you could get a fully type approved 18 channel conversion done by Mike Skovron Agencies. And only $35 too! That not only makes you legal – but you can resell the rig later too!

If you actually managed to license your 352D, and you want to go to 18 channels – remember you get two channels not on the 23 channel rigs, then you can have an 18 channel switch fitted for a mere $25.

The type-approved conversion must be done by the *Mike Skovron Agencies* crew at *5 Curlewis St, Bondi Junction NSW* (phone 30-4334). You'll get a rig to match the specs of the 4740-18 and a proper type-approval label pop-rivetted on the back! Do it, and feel good.

Amazing! Fact! Shock release – draft RB14!

The long-awaited draft RB14 was finally released for (more or less) public consumption around 21 July. The NCRA has a few weeks preview and have already submitted a 'commentary' – more a rebuff really.

There are quite a few improvements over the first RB14 (still 'in force', even though it's not worth a pinch of goatsh). There are also a few things that won't curry much favour around the traps included in the draft. CB Australia's June issue front-page story foreshadowed most of the major changes.

However, while the P & T draftees have removed the original restrictions on antenna heights etc they have introduced a new 'rule' that disallows the use of antennas having more gain than a half-wave dipole. This is not going to be well received by a large body of CBers and the CB industry alike. Instantly, such antennas as 5/8 groundplane base antennas, the UHF 'gain' mobile antennas and the UHF collinear base antennas (6 dB omni-gain), are all 'not on mate'!

Good grief, any 27 MHz antenna offering 'substantial' real gain – like 10 dBi – is almost impossible to fit in the standard suburban real estate and restricting UHF users to nothing bigger than a 30 cm dipole antenna is ludicrous! **If excessive TVI is feared, then it's not going to come from the use of 'gain' antennas. Linears and 'garbage' rigs are the trouble makers.**

Among the concessions included in the draft are: up to five transceivers allowed per licensee; other persons (limited to family, employees and club associates) allowed to operate a licensee's rig; dedication of channels five on HF and UHF for emergency calling and traveller's assistance; no antenna height restrictions other than State – local government or Department of Transport requirements; no more '32 km rule' – which allows skip working within the geographical boundaries of Australia; introduction of 'notice of violation' system etc.

The full text of the new RB14 appears in the August issue of CB Australia.

Classy Wattmeter

In their 'classic' tradition, CPI present the WM7000 wattmeter – a comprehensive transmission performance test instrument. The WM7000 will read peak or average power on three scales: 20, 200 and 1000 watts as well as VSWR over the frequency range from 1.8 to 30 MHz. It features a 30 dB coupler and a large, easy to read meter face.

For more information, contact *Communications Power Inc*, at *P.O. Box 246, Double Bay 2028* or phone (02) 36-3703.

A Hi-fi CB Rig?

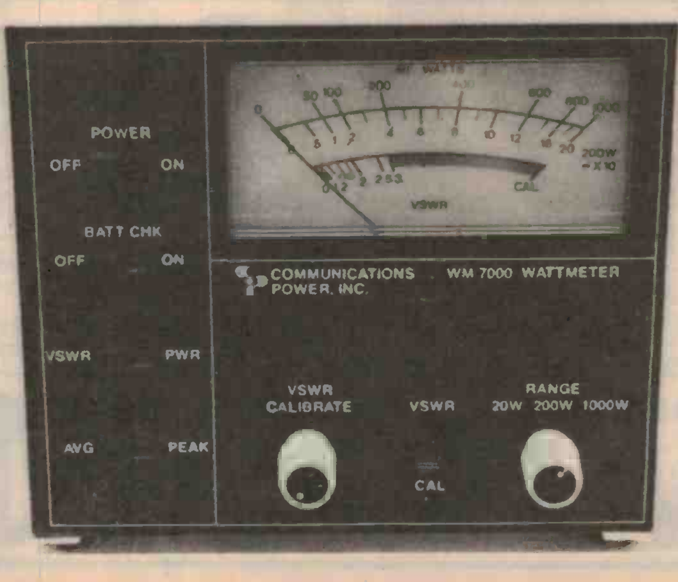
You might think their timing is wrong, you might wonder what the hell they're doing getting into the CB market, but Pioneer are determined that they have a winner with their first CB rig.

Called the GT-202, Pioneer's latest equipment release is an AM-only mobile rig specifically designed for under-dash mounting and features a unique slide-lock, theft-preventing mounting bracket.

Styling of the GT-202 follows on from Pioneer's long expertise in other consumer electronics markets – hi-fi and tape recorders ect. It is undoubtedly the smallest rig on the market at present as it measures a tine 150 mm wide by 50 mm high by 198 mm deep.

Technically it features a PLL frequency synthesizer, LED digital readout and a proper noise blanker – unusual on AM-only rigs. A dimmer push-button is provided to dim the LED display and S/RF meter light for night time use.

The GT-202 will be available through Pioneer stores throughout Australia and selected retailers later.



LISTENING GEAR

CONVERTERS

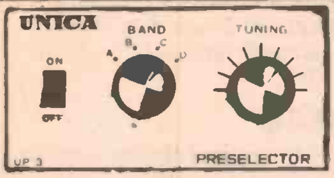
VLF 10-500 KHz with 3.6 MHz IF	$89.00
432 MHz with 28 MHz IF	$59.00
144 MHz with 28 MHz IF	$59.00
1296 MHz with 28 MHz IF	$70.00
432 MHz with 144 MHz IF	$59.00

ANTENNAS

Listener-3 3-30 MHz dipole kit	$49.00
Listener-1 wire antenna kit	$22.00
GDX-1 Discone 80-480 MHz Tx & Rx	$84.00
SCAN-X Discone (Receive only) 65-530 MHz	$35.00

The famous NDR505 professional receiver with all options $2999.00. Other receivers from $350 to $20,000. Give us a call today and tell us your requirements!

RECEIVERS HF, VHF, UHF



PRE-AMPS

The UP-3 Preamplifier covers 2-30 MHz with a gain of 15dB in four switchable bands. This great little unit can improve sensitivity, selectivity and signal to noise ratio of your favourite receiver. Price $41.00.

Bearcat

210 Scanner for VHF & UHF

VICOM 747 AIRCRAFT RECEIVER
* 16 CHANNELS
* SCAN OR MANUAL
* AC/DC OPERATION
* 4 CRYSTALS SUPPLIED

AND OUR PRICE ONLY $199.00

quality aircraft receivers

HAM GEAR

ICOM IC-701
HF transceiver

The NEW IC-701 features: • Solid-state • RF speech processor • 100 W continuous on all bands, all modes • USB, LSB, CW, CW-N, RTTY operation • Double balanced Schottky Diode Mixer used in boty RX/TX • Dual built-in digital VFO • Price includes mic

ICOM IC-211 785.00
2m transceiver

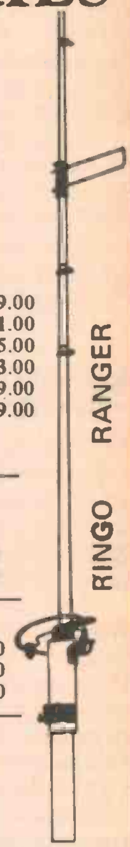
Features: • 144 to 148 MHz coverage • Modes: SSB, CW, FM • LSI synthesizer PLL • 4-digit LED readout • Pulse-type noise blanker • VOX, antivox • Semi-break-in CW • Built-in SWR bridge • CW monitor and more!

computer compat.

ACCESSORIES

- .HY-GAIN
- .DAIWA
- .ANTENNAS
- .ROTATORS
- .PROCESSORS
- .MORSE KEYS

HK702 deluxe key with marble base	$39.00
HK708 economy key	$21.00
HK706 operator's key	$25.00
MK701 manipulator (side swiper)	$43.00
EK103Z electronic Keyer	$169.00
Palomar IC Keyer	$149.00



KENWOOD

TS520S HF transceiver	$789.00
TS820S HF transceiver	$1,279.00
SP820 matching speaker with filters	$66.00
SM220 station monitor	$335.00
TL922 Linear Amplifier	$1,450.00
AT200 matching antenna tuner	$185.00
TV506 6m transverter	$236.00
TV502S 2m transverter	$290.00
TR3200 70cm fm portable transceiver	$229.00

VALVES

6146B for Uniden, Kenwood, Yaesu	$13.00
6KD6 for early Yaesu linears	$13.00
6JS6C for FT101 series	$13.50
572B for Yaesu linears	$59.00

ANTENNA CHANGE-OVER RELAYS (DAIWA)

CX-2L 1.8 thru 170 MHz, 100w pep max	$48.00
CX-2H 1.8 thru 450 MHz, 200w pep max	$69.00

2M BEAMS

5Y/2M Jaybeam, 7.8 dBd, length 1.6M, 5el	$39.00
8Y/2M Jaybeam, 9.5 dBd, length 2.8M, 8el	$47.00
10Y/2M Jaybeam, 11.4 dBd, length 4.4M, 10el	$79.00

NEW FROM DAIWA, QUALITY ANTENNA ROTATORS COMPLETE WITH 240VAC CONTROL BOX:

NEW

Model DR7500S medium duty	$189.00
Model DR7600S heavy duty	$259.00

VICOM

68 Eastern Road
SOUTH MELBOURNE VIC 3205
PH (03) 699.6700 Telex AA30566

Perth	446.3232	Sydney	681.3544
Adelaide	43.7981	Brisbane	38.4480
Gold Coast	32.2644	Hobart	43.6337
Canberra	82.3581	Melbourne	836.8635

Reyco antenna traps

Scalar Industries have recently been appointed sole Australian distributors for the Reyco range of multibrand trap antenna coils.

Designated type KW40, the coils are rated at 2 kW PEP (min.), weigh only about 180 grams and measure a compact 46 mm diameter by 140 mm long. They are encased in a waterproof coating for protection from the effects of the weather.

Construction of the coils is such that high Q values are achieved using aluminium wire wound on a threaded polystyrene former with an integral resonating capacitor.

A multi-band dipole can be readily constructed using the KW40 trap coils; complete details are available from *Scalar Industries, 18 Shelley Ave, Kilsyth Vic., 3137,* (03) 725-9677. They also have agencies in Sydney and Brisbane.

Combination counter/generator

An unusual test bench instrument was recently brought to our attention by GFS Electronics Imports. This is a combination frequency counter and RF signal generator manufactured by Mizuho. Designated DX555D, this compact little instrument features a generator coverage from 400 kHz to 30 MHz and a five-digit (switchable to seven digits) LED readout frequency counter that will read up to 220 MHz.

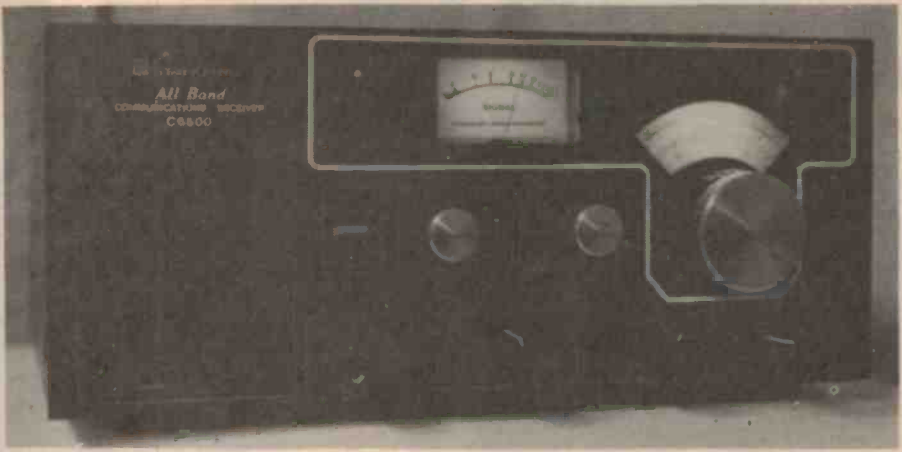
It measures only 160 x 58 x 215 mm and operates from the 240 Vac mains. For further information, contact *GFS Electronics Imports* at *15 McKeon Rd, Mitcham, Vic,* (03) 873-3939.

Daiwa Coax Relays

Vicom have recently released a range of coaxial antenna changeover relays from the Japanese Daiwa Corporation.

Two models are available for different powers and frequency ranges. The first is rated at 100 W PEP and covers 1.8 MHz through 170 MHz; the second being rated at 200 W PEP covers from 1.8 to 450 MHz. Both feature extremely low insertion loss, 50 ohm impedance across the frequency range and operation from 10 – 15 volts DC.

For further information contact *Vicom P/L, 68 Eastern Rd, South Melbourne 3205, (03) 699-6700.*



Wadley-loop receiver from Standard

Standard Radio Company of Japan have produced a general coverage receiver using the now-common Wadley-loop technique for the front end, providing coverage from 500 kHz to 30 MHz in 1 MHz-wide bands.

Designated the type C-6500, it provides a dial readout down to 5 kHz and will resolve AM, SSB and CW signals. It may be operated from an internal battery supply (which requires eight cells), a 12 Vdc external supply, or the ac mains.

A large illuminated S-meter is featured on the receiver's front panel and an internal speaker is included. The C-6500 is currently available for around $300 from *GFS Electronic Imports* of *15 McKeon Rd, Mitcham Vic,* (03) 873-3939.

The 5A/0 battle

Most readers will be aware of the amateur fraternity's opposition to the allocation of channels 5A and 0 for 'special broadcasting' purposes and the proliferation of ch. 5A stations being proposed, particularly a high powered station for Mt Dundas in Victoria.

Committees under the auspices of the state Divisions of the WIA have been formed in all states, but a special technical committee was formed in Victoria to draft a submission for presentation to the Minister for Post and Telecommunications, Mr Tony Staley.

Mr Staley requested the submission be presented directly to him, with a copy to the P & T Department, early in August. However, it is likely that we will have to wait until after the budget session of Parliament before we'll hear any news.

Keep your fingers crossed.

US Antenna case won

John L. Schroeder, a Californian amateur accused of committing a criminal misdemeanour by violating a local zoning ordinance which restricted the height of radio and television antennas, has won a three-year long court battle against the California State courts, who were pressing for this conviction.

The California Supreme Court refused to review the case indicating that State courts do not have jurisdiction over radio interference cases. The Supreme Court decision means that the US Federal Government, through the FCC, has complete jurisdiction over "radio transmission, including assignment of frequencies and interference phenomena, and therefore State courts do not have jurisdiction to consider interference cases."

John Schroeder, who had the support of the Personal Communications Foundation in his battle through the courts, had claimed that the ordinance which limited antenna heights also violated the US Constitution.

The PCF backed him on this, saying that operation of an amateur radio station was clearly an exercise of freedom of speech! However, none of the courts petitioned, including the Supreme Court, agreed with this. They did say that had the ordinance restricted antenna heights only for interference reasons it would have been invalid, but that there were other justifications for restricting height, including safety and aesthetic considerations.

Two precedents have emerged from this case: Only the US Federal Government has the right to deal with such matters as TVI and frequency assignments; and restrictions imposed by State and local government authorities can only be imposed for other than radio interference reasons.

SWL COMMUNICATIONS

Compiled by Peter Bunn,
on behalf of the Australian Radio DX Club (ARDXC).

The Australian Radio DX Club is a non-profit body with headquarters in Melbourne. For further information on shortwave radio, and on the activities of the ARDXC, please write to the General Secretary, PO Box 67, Highett, Vic. 3190, enclosing a 30c. stamp for return postage.

BBC Fare Eastern Relay Station On The Move

The BBC is currently in the process of transferring its Far Eastern Relay transmitters from Tebrau in penninsular Malaysia to a site at Kranji in nearby Singapore. Adrian Peterson, Director of Adventist World Radio in Asia, recently paid a visit to the new Kranji shortwave relay base, and provides the following report:

Kranki is located on the northern edge of the island of Singapore, just 14 miles from the older station at Tebrau. When Kranji becomes fully operational, the Tebrau station will be phased out.

The BBC estate at Kranji contains just 4 acres, but into this compact area the construction engineers have erected a comprehensive antenna system and a large two story transmitter building. This building is constructed on cement piles because of swampy location. There are 17 self-supporting masts from which are strung 18 antennas. These antennas are slewable and reversible and are of various designs, some being unique to BBC broadcasting. They are intended for coverage of the BBC's several target areas in Asia.

Inside the main transmitter building is the transmitter hall, and the switching room for programmes. Four transmitters, each of 250 kilowatts, have been installed at Kranji, and two of these are currently operational. When the station is fully commissioned, there will be 4 transmitters of 250 kilowatts and 4 of 100 kilowatts, all of these transmitters having been originally located at the old site at Tebrau. Two of the older units of 100 kilowatts located at Tebrau will not be transferred to Kranji.

At present, off-air programs for the BBC Far Eastern Relay Station are received at Pongol on the south-west edge of Singapore island. The receiving antenna is actually located in the edge of the sea. Programs are sent by microwave link to Tebrau, where they are split for Kranji on shortwave and for Tanglin (on the edge of Singapore city) for FM broadcasting.

The first two shortwave transmitters at Kranji were switched into regular service on February 1st 1978. The transfer of transmitters from Tebrau is expected to be completed by late 1979, when the Malaysian relay site is expected to leave the air.

Many test broadcasts have been made from BBC Kranji, and these have been either test tones or broadcasts of the regular World Service or Asian language programs as carried by BBC Tebrau. Frequencies used have all been channels allocated to the Tebrau transmitters.

The schedule for the Kranji transmitters is not available, however their schedule up until September 3 was as follows: 6010 kHz 2200-2315, 6050 kHz 1215-1645, 6080 kHz 2315-0045, 6195 kHz 0900-1830, 7180 kHz 2200-0045 and 0930-1830, 9725 kHz 0930-1245, 11710 kHz 0015-0045, 11865 kHz 2200-2230.

DX On The Air

Radio station HCJB in Quito, Ecuador, has a weekly program for shortwave enthusiasts known as "DX Party Line" heard between 0900 and 0930 each Thursday. A new feature of the program is "South Pacific Report" presented once a month by Robert Hanner of the Australian Radio DX Club. Robert will feature comment and discussions of recent DXing activity and developments in Australia and the Pacific region. The next South Pacific Report is expected to be aired on DX Party Line of either Thursday September 21 or 28. Frequencies to tune to are: 11900, 9745 ro 6130 kHz.

The Australian Radio DX Club now presents a "Pacific DX Report" over the DX session heard on the Sri Lanka Broadcasting Corporation in Colombo. Aired monthly, this is also hosted by Robert Hanner, and the first segment went to air on September 4 during "Radio Monitors International" heard on Mondays at 1115 on frequencies of 11835, 15120 and 17850 kHz. Best reception in Australia is on 11835 kHz.

Latin American Round-up

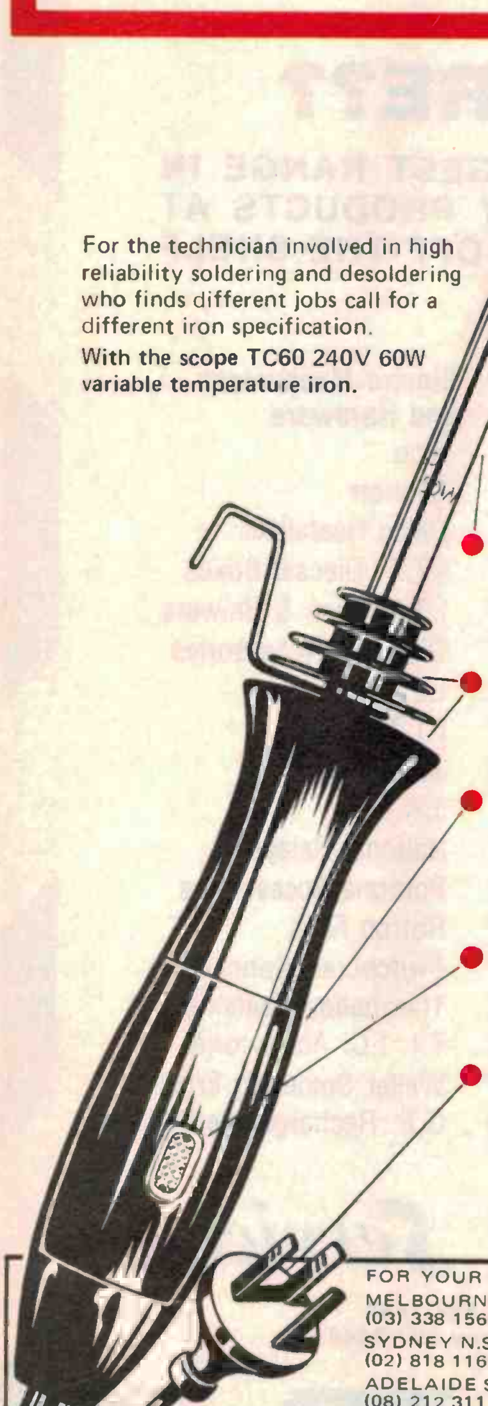
The Colombian station, La Vox de la Selva at Florencia, which operates on 6170 kHz, gives excellent reception between 0700 and 1000 when operating to a 24 hour schedule. This station is one of the Caracol network stations, and many Caracol announcements may be heard during programming.

Radio Mineria, at La Oroya, is a seldom heard Peruvian station which is currently audible on 6145 kHz, with popular songs noted between 1120 and 1200. The station usually identifies itself after each musical selection. Programmes are of course all in Spanish.

Further to our summary of Brasilian stations last issue, one Brasilian outlet giving unusually good reception at present is Radio Continental at Rio de Janeiro on 6195 kHz. Sign-on time for Radio Continental is generally 0900, and the station remains audible until 1000.

All times are given in Greenwich Mean Time (GMT) and you should add 10 hours to calculate Australian Eastern Standard Time.

A professional iron with adjustable temperature – wattage and tip size...



For the technician involved in high reliability soldering and desoldering who finds different jobs call for a different iron specification.

With the scope TC60 240V 60W variable temperature iron.

You specify exact temperature required without changing tip.
Dial any intermediate temperature 200°–400°C and make adjustment while soldering. This will be controlled with unusual accuracy ± 2% of set temp. You no longer need to invest in a range of tips just to vary temperature.

You specify exact tip profile required without affecting temperature.
Screw on any one of 14 tip shape and weight combinations from 0.8 mm to 6.4 mm all iron plated for long life. No need to buy up to 3 irons to span this tip range.

You specify that the desired wattage range lies between 10W–60W.
Then let actual wattage required for the job be determined by the iron's simple mechanical sensing and control system. Consisting of expansion rod and micro switch in the handle.

PROTECTION
Component protection is aided by earthed tip and barrel. Critical components & operator can then be earthed to common point.

COOLER FINGER GRIP
Cooling fins keep your finger tips comfortable handle shape aids good balance and feel.

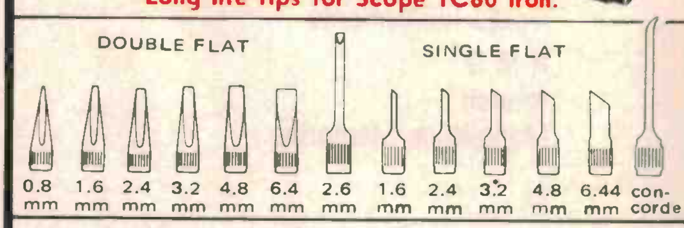
TEMPERATURE KEY
Is inserted into handle 40°C variation per quarter turn. Key is removable to discourage unwanted alteration to setting.

NEON
Indicates when power is being applied to element – monitors control system.

50V, 24V VERSIONS
Are available with 50W elements.

SOLDERING–DESOLDERING STATION

Long life tips for Scope TC60 iron.



Iron plated screw-on pre tinned. *This tip is fitted as standard.

SCOPE TC 60

The iron you completely adjust to your job.

FOR YOUR NEAREST STOCKIST RING:

MELBOURNE VIC. (03) 338 1566
SYDNEY N.S.W. (02) 818 1166
ADELAIDE S.A. (08) 212 3111
BRISBANE QLD. (07) 221 1933
TOWNSVILLE QLD. (077) 71 3448
ROCKHAMPTON QLD. (079) 27 3370
HOBART TAS. (002) 34 2811
LAUNCESTON TAS. (003) 31 5545
PERTH W.A. (09) 381 4155
AUCKLAND N.Z. 54 6029
WELLINGTON N.Z. 85 9578

KITS FOR ETI PROJECTS

We get many enquiries from readers wanting to know where they can get kits for the projects we publish. The list below indicates the suppliers we know about and the kits they do.

Any companies who want to be included in this list should phone LES BELL on 33-4282.

Key to companies:

- **A** Applied Technology Pty. Ltd. 109-111 Hunter St, Hornsby. 2077. NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW. (see Ads. for address).
- **E** All Electric Components (formerly ED & E Sales), 118 Lonsdale Street, Melbourne, Victoria, 3000.
- **J** Jaycar Pty. Ltd. 405 Sussex St., Sydney 2000.
- **L** Delsound Pty. 1 Wickhám Terrace. Queensland.
- **M** Mode Electronics. PO Box 365, Mascot 2020.
- **N** Nebula Electronics Pty. Ltd. 15 – 19 Boundary St., Rushcutters Bay 2011. NSW.
- **P** Pre-Pac Electronics. 718 Parramatta Rd., Croydon NSW 2132.
- **T** Townsville Electronics Centre. 281E Charters Towers Rd, Risinq Sun Arcade, Hermit Park. 4812

PROJECT ELECTRONICS

ETI 041	Continuity Tester	DS
ETI 043	Heads or Tails	DATSE
ETI 044	Two-Tone Doorbell	DATSE
ETI 045	500 Second Timer	DS
ETI 047	Morse Practice Set	DS
ETI 048	Buzz Board	DS
ETI 061	Simple Amplifier	DATS
ETI 062	Simple Amplifier Tuner	DSE
ETI 063	Electronic Bongo's	DS
ETI 064	Intercom	ATS
ETI 065	Electronic Siren	DS
ETI 066	Temperature Alarm	ADTSE
ETI 067	Singing Moisture Meter	DS
ETI 068	Led Dice	ADSE
ETI 072	2-Octave Organ	DS
ETI 081	Tachometer	E

TEST EQUIPMENT

ETI 102	Audio Signal Generator	E,DS
ETI 105	Lab Power Supply	E
ETI 107	Widerange Voltmeter	E
ETI 108	Decade Resistance Box	ES
ETI 109	Digital Frequency Meter	E
ETI 111	IC Power Supply	ES
ETI 112	Audio Attenuator	ES
ETI 113	7-Input Thermocouple Meter	P,E
ETI 116	Impedance Meter	ES
ETI 117	Digital Voltmeter	E,AS
ETI 118	Simple Frequencv Counter	E,AS
ETI 119	5V Switching Regulator supply	ETS
ETI 120	Logic Probe	L,ES
ETI 121	Logic Pulser	L,ES
ETI 122	Logic Tester	ES
ETI 123	CMOS Tester	ES
ETI 124	Tone Burst Generator	ES
ETI 128	Audio Millivoltmeter	L,ES
ETI 129	RF Signal Generator	L,ES
ETI 130	Temperature Meter	E
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	NSE
ETI 133	Phase Meter	E
ETI 134	True RMS Voltmeter	E

SIMPLE PROJECTS

ETI 206	Metronome	T
ETI 218	Monophonic Organ	ET
ETI 219	Siren	ET
ETI 220	Siren	ET
ETI 222	Transistor Tester	ETS
ETI 234	Simple Intercom	T
ETI 236	Code Practice Oscillator	E
ETI 239	Breakdown Beacon	E
ETI 240	High Powered Emergency Flasher	E

MOTORISTS' PROJECTS

ETI 301	Vari-Wiper	ET
ETI 302	Tacho Dwell	ET
ETI 303	Brake-light Warning	E
ETI 305	Car Alarm	E
ETI 309	Battery Charger	P,E
ETI 312	CDI Electronic Ignition	P,ET
ETI 313	Car Alarm	E,DT
ETI 316	Transistor Assisted Ignition	E
ETI 317	Rev. Monitor	E

AUDIO PROJECTS

ETI 401	Audio Mixer FET Four Input	E
ETI 406	One Transistor Receiver	T
ETI 408	Spring Reverb. Unit	E
ETI 410	Super Stereo	E
ETI 413	100 Watt Guitar Amp	P,L,J,DT
ETI 413	x 200 Watt Bridge Amp	SE
ETI 414	Master Mixer	E,J
ETI 416	25 Watt Amplifier	E
ETI 417	Amp Overload Indicator	E
ETI 419	Guitar Amp Pre-Amp	P.E.DT
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	S L,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
ETI 423	Add-on Decoder Amp	E
ETI 424	Spring Reverberation Unit	S L,E
ETI 425	Integrated Audio System	E
ETI 426	Rumble Filter	E
ETI 427	Graphic Equaliser	S L,E,J
ETI 429	Simple Stereo Amplifier	E
ETI 433	Active Crossover	J
ETI 435	Crossover Amp	J
ETI 438	Audio Level Meter	L,ES
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,ES
ETI 443	Compressor-Expander	E.J.
ETI 444	Five Watt Stereo	ES
ETI 445	Preamp	J,E,D
ETI 446	Audio Limiter	J
ETI 447	Phaser	E.J
ETI 449	Balanced Mic Preamp	JE
ETI 480	50 W. 100 W Power Amp	A
ETI 480P	Power Supply	DAT
ETI 481	12V to 40V DC Inverter	E
ETI 482A	Preamp Module	AE
ETI 482B	Tone Controller	AE
ETI 484	Compressor Expander	E
ETI 485	Graphic Equalizer	JSE
ETI 480	50W, 100W Power Amp	ADBE

MISCELLANEOUS

ETI 502	Emergency Flasher	E
ETI 503	Burglar Alarm	ET
ETI 505	Strobe	L,E,D
ETI 506	Infra-Red Alarm	E
ETI 509	50-Day Timer	E
ETI 512	Photographic Timer	E
ETI 513	Tape Slide/Synchroniser	E
ETI 514	Flash Unit — Sound Operated	E
ETI 515	Flash Unit — Light operated	E
ETI 518	Light Beam Alarm	ET
ETI 525	Drill Speed Controller	E
ETI 528	Home Burglar Alarm	P,ET MS
ETI 529	Electronic Poker Machine	E
ETI 532	Photimer	E
ETI 533	Digital Display	L,E,AS
ETI 534	Calculator Stopwatch	A,D
ETI 539	Touch Switch	E
ETI 540	Universal Timer	ES
ETI 541	Train Controller	ET
ETI 543	Double Dice	A
ETI 544	Heartrate Monitor	AE
ETI 546	GSR Meter	E
ETI 547	Telephone Bell Extender	E
ETI 548	Photographic Strobe	E
ETI 549	Induction Balance Metal Locator	E
ETI 581	Dual Power Supply	E
ETI 582	House Alarm	E
ETI 583	Gas Alarm	ME
ETI 586	Shutter Speed Timer	E

ELECTRONIC MUSIC

ETI 601		
4600	Synthesiser	J
3600	Synthesiser	J
ETI 602	Mini Organ	E,A,D
ETI 604	Accentuated Beat Metronome	E

COMPUTER PROJECTS

ETI 630	Hex Display	AE
ETI 631	VDU Keyboard Encoder	AE
ETI 632	VDU 1 k x 8 Memory Card	AE
ETI 633	VDU Sync Generator	AE

RADIO PROJECTS

ETI 701	TV Masthead Amplifier	E,D
ETI 702	Radar Intruder Alarm	DE
ETI 703	Antenna Matching Unit	E
ETI 704	Crosshatch/Dot Generator	L,A,D,ES
ETI 706	Marker Generator	ES
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 709	RF Attenuator	E
ETI 710	2 metre Booster	C,E
ETI 711B	Single Relay Remote Control	AE
ETI 711C	Double Relay Remote Control	AE
ETI 711R	Receiver	AE
ETI 711AR	Remote Control Transmitter	AE
ETI 711DR	Remote Control Decoder	AE
ETI 712	CB Power Supply	E
ETI 740	FM Tuner	AE
ETI 780	Novice Transmitter	E

ELECTRONIC GAMES

ETI 804	Selecta-Game	O,A,DS

PCB's

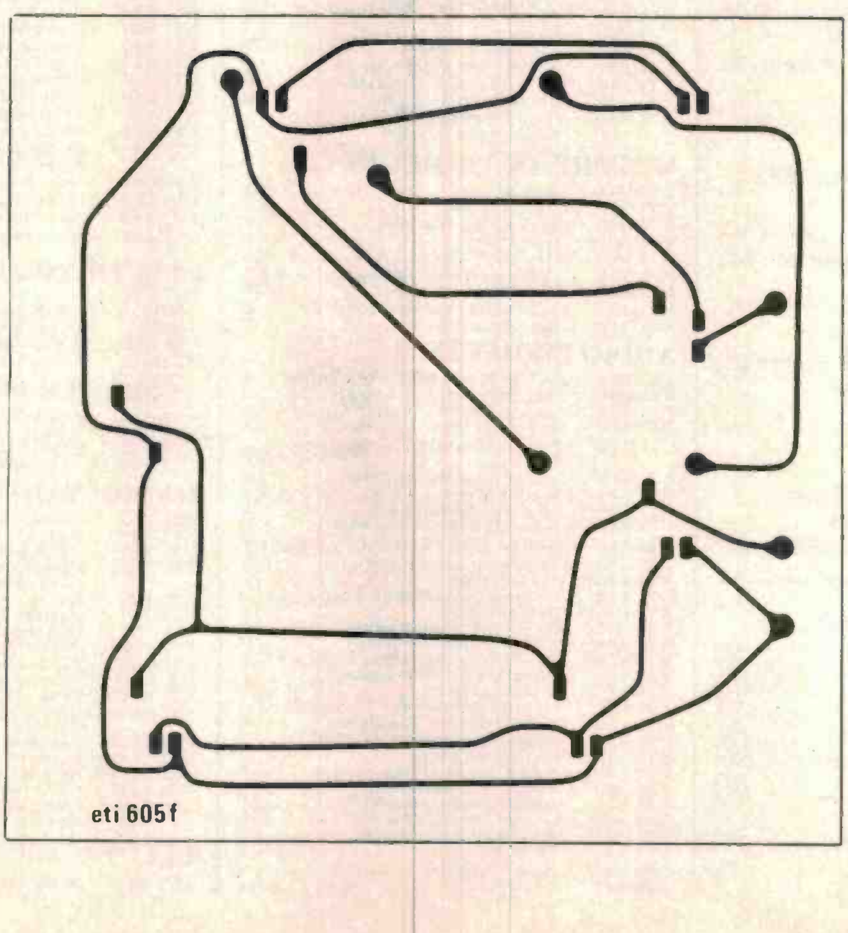
Using ETI PCB Artwork

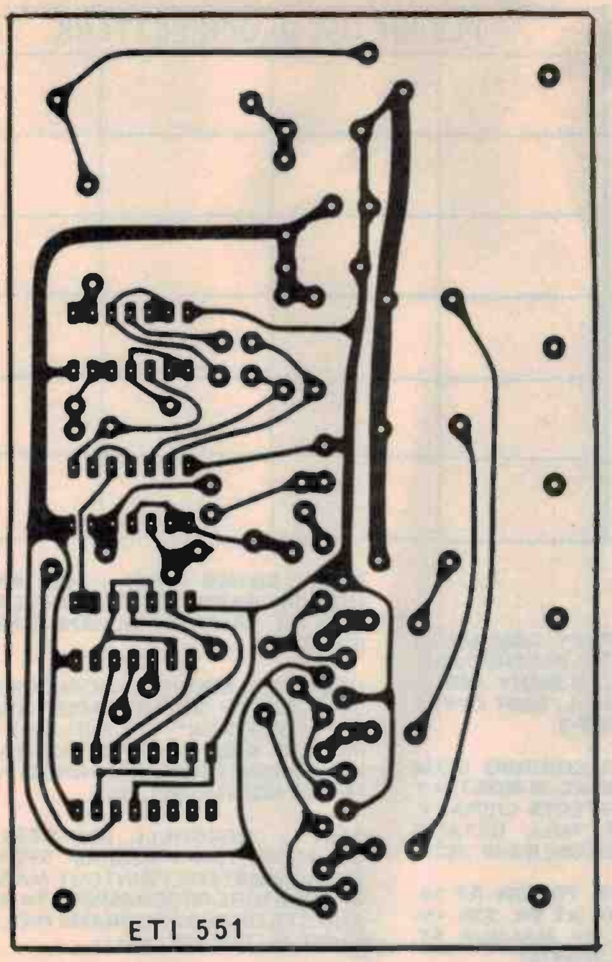
This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007 which is UV sensitive and can be used under normal subdued light.

Cut a piece of film a little larger than the PC board and expose it to UV light through the magazine page. The non emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner - it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

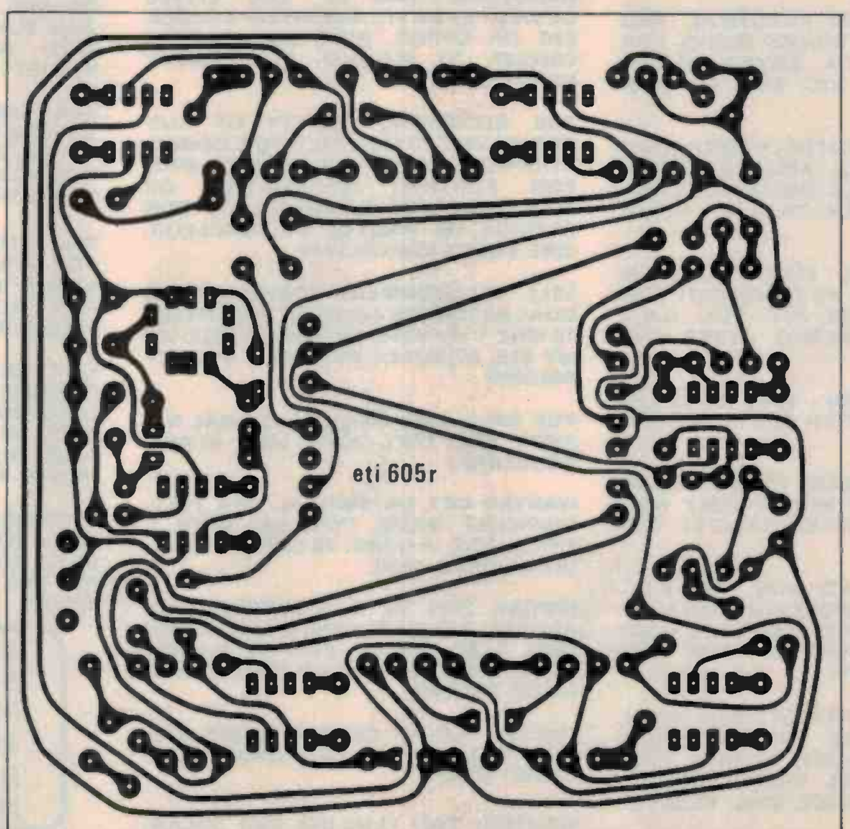
The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

Further information on Scotchcal and PCB manufacture can be found in the September and December 1977 issues of ETI. Please note also, that occasionally pressure on space may unfortunately prohibit the printing of blue type behind all PCB's, in which case the reader must resort to more conventional photographic techniques for PCB manufacture.





The printed circuit board for the ETI 641 S100 Printer is a double sided, 125 x 250 mm (approx) board, and is too big to reproduce here. However, printed circuit board drawings for the ETI 641 are available from us on receipt of a large, stamped, self-addressed envelope. Write to: *ETI 641 PCB, Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011.*



Mini-Mart

We'll print your 24 words (maximum) totally free of charge. Copy must be with us by the 7th of the month preceding the month of issue. Please, please write or preferably type your adverts clearly, using BLOCK LETTERS.

CONDITIONS

Name and address plus phone number (if required) must be included within the 24 words allowed.

Reasonable abbreviations, such as 25 Wrms, count as one word.

Private adverts only will be accepted. Please let us know if you find a commercial enterprise using this service.

Every effort will be made to publish all adverts received – however, no responsibility for so doing is accepted or implied.

Adverts must relate to electronics or audio – general adverts cannot be accepted.

PLEASE USE BLOCK LETTERS

ANTENNAS RECEIVERS TRANSMITTERS METERS CB. HAM BOOKS MAGAZINES PWR-SUPPS PWR-TRANS MANY MISC ITEMS SEND LARGE S.A.E. FOR LISTS. J. SILVESTER 9 GOODWOOD DRIVE, SPRINGVALE 3171 PHONE AH 5463940.

KYOKUTO 10SXRII INCL. 2 MOBILE ANTENNAS 2 MTR. 1000 CHANNELS TRANSCEIVER PERFECT CONDITION $220 TEL. (02) 6363162.

SELL TELETYPE M15 PAGE PAGE PRINTER WITH KBD. 110^VAC MOTOR, 5 UNIT CODE 50 BAUD OPERATION. RTTY OR MICROPROCESSORS. $70 MLB 700-1563.

HAVE ALMOST 200 PRACTICAL AND EVERYDAY ELECTRONICS BOOKS FOR SALE OR SWAP F.A. BRYER, BOX 68 RYE G.P.O., RYE, VIC. 3941. PH. (059) 853634.

SSTV WØLMD BOARD FULLY POPULATED WITH BACK SPACE AND X2 HEIGHT BOARDS PLUS FULL DOCUMENTATION $95. G.N. CHAPMAN, 70 CLIFF ROAD, EPPING. NSW. 2121.

SELL ETI632 VDU FULLY BUILT & FUNCTIONAL. USE AS AN OUTPUT FOR YOUR EVALUATION KIT. $100 O.N.). RING MARCUS 888-3563 AFTER 5PM NTH RYDE NSW.

PAY $5 COPY ETI JAN – JUNE 75, AUG 76, EA FEB 77. R. HUNTER BOX 350 CAIRNS 4870. PH 542-385.

TECHNICO 9900 BOARD COMPUTER, AS REVIEWED IN ETI WOULD COST NEW $700, SELL $450. GILES PUCKETT, (02) 89-3605 A.H.

FOR SALE. ETI 632 VDU AND KEYBOARD, BUILT & WORKING, SUITABLE FOR USE WITH ANY COMPUTER. $200 (ONO) PHONE ROSS BALDICK (02) 419-3918 AFTER 4 PM.

YAESU FT-301D TRANSCEIVER WITH MATCHING DELUXE FP-301D POWER SUPPLY, $1200. FV-301, REMOTE VFO, $125. FT-221R $600. YC-221 DIGITAL DISPLAY, $85. FL-2100B, $525. VL3AVE. (03) 379.1213.

ETI 4500 SYNTH. PARTLY ASSEMBLED INCLUDING KEYBOARD, PATCHBOARD, FRONT PANEL ETC. PLUS MANY ASSTD. COMPONENTS MUST SELL. BEST OFFER (02) 44.7421 AFTER HOURS.

BOOMERANG TAPE RECORDING CLUB WELCOMES NEW MEMBERS. BI-MONTHLY MAGAZINE. SOUND EFFECTS LIBRARY. ROUND ROBINS. C.B. FULL DETAILS P.O. BOX 118, WELLINGTON, N.S.W. 2820

POWER SUPPLIES: –90v TO +30v AT 1A. $25. –14v & +10v, +20v AT 5A. $35. +5v & –5v AT 50A $45. 24 MALOUF ST. CANLEY HEIGHTS. PH. 6044137

RESISTORS: 2000 OF THE LITTLE DEVILS. ¼ WATT. ASSORTED VALUES. $20 OR OFFER. RING CAM McLEAN 6044137. 24 MALOUF ST., CANLEY HEIGHTS 2166.

THE RECORDING SOCIETY OF AUSTRALIA MEETS MONTHLY FOR DEMONSTRATIONS, LIFE RECORDINGS ETC., FOR FURTHER INFORMATION OR SYLLABUS RING OR WRITE TO DON PATRICK, 36 ARGYLE ST., MACLEOD, 3085. PHONE (03) 459.1717

SELL TELEQUIPMENT SCOPES (1) D43 DUAL BEAM WITH 4 PLUG-IN AMPLIFIERS 15 MHZ 1 mV $150. (2) S32A 10 MHZ 100 mV $75. MANUALS INCLUDED. SYDNEY 449.5885

FOR SALE: BWD 539C CRO. SERIAL NO. 32879 $400 ONO. JOHN (062) 47.0491 CANBERRA.

WANTED CKT OR MANUAL FOR TELEQUIPMENT SCOPE TYPE D43 WITH A TYPE AMPS. A CORK, 16 COOK STREET, UNANDERRA. 2526.

UNIDEN 2020 Mk 2. 3 MONTHS OLD. AS NEW. INC MATCHING SPEAKER BOX $800. ALSO UNIDEN 2020 Mk 1 VERY GOOD COND $550 PHONE BERT 67.9834 OR AH 758.4086.

DIGITAL LOGIC COURSE. COMPLETE. COST $82, AS NEW, $60, ONO. PHONE 82.5591 (AH).

WANTED: TWO PLUG-INS FOR SOLARTRON CD1400 CRO – 15 MHZ OR HIGHER BANDWIDTH – DEQUINCEY, BOX 132, BAIRNSDALE, 3875. RING (051) 52.4380.

HELP! MELBOURNE MICROCOMPUTER CLUB BADLY NEEDS CIRCUIT DETAILS OF "QUOTRON" TICKER-TAPE TERMINALS AND CONTROL UNITS, (EX-MELBOURNE STOCK EXCHANGE) PLEASE PHONE (03) 615.4521 (BH).

SALE – ROCKWELL 920 DESK CALCULATOR, 1000 PROGRAM STEPS, 100 DATA REGISTERS, PRINTOUT, MAGNETIC CARDS STORE PROGRAMS/DATA, MATHS AND STATISTICS PROGRAMS INCLUDED. $1400. PH. (02) 639.7447.

AUSTRALIAN RADIO DX CLUB, FOR SW AND MW DXERS. MONTHLY MAGAZINE PUBLISHED. WRITE FOR DETAILS, WITH 30c STAMP, TO PO BOX 67, HIGHETT, VIC. 3190.

BABY 2650 IK RAM POWER SUPPLY $80 EA. VDU MODULATOR UART KEYBOARD POWER SUPPLY ENCODER $200 HULLS (02) 449.5715, 19 COMENARRA PARKWAY TURRAMURRA, SYDNEY 2074.

SELL ETONE SPEAKERS $200 OR NEAR FOR FOUR "246" SPEAKERS IN TWO LARGE BAFFLES. TOTAL 320 WATTS FOR QUALITY CONCERT WORK ETC. PHONE (02) 7977514 CROYDON.

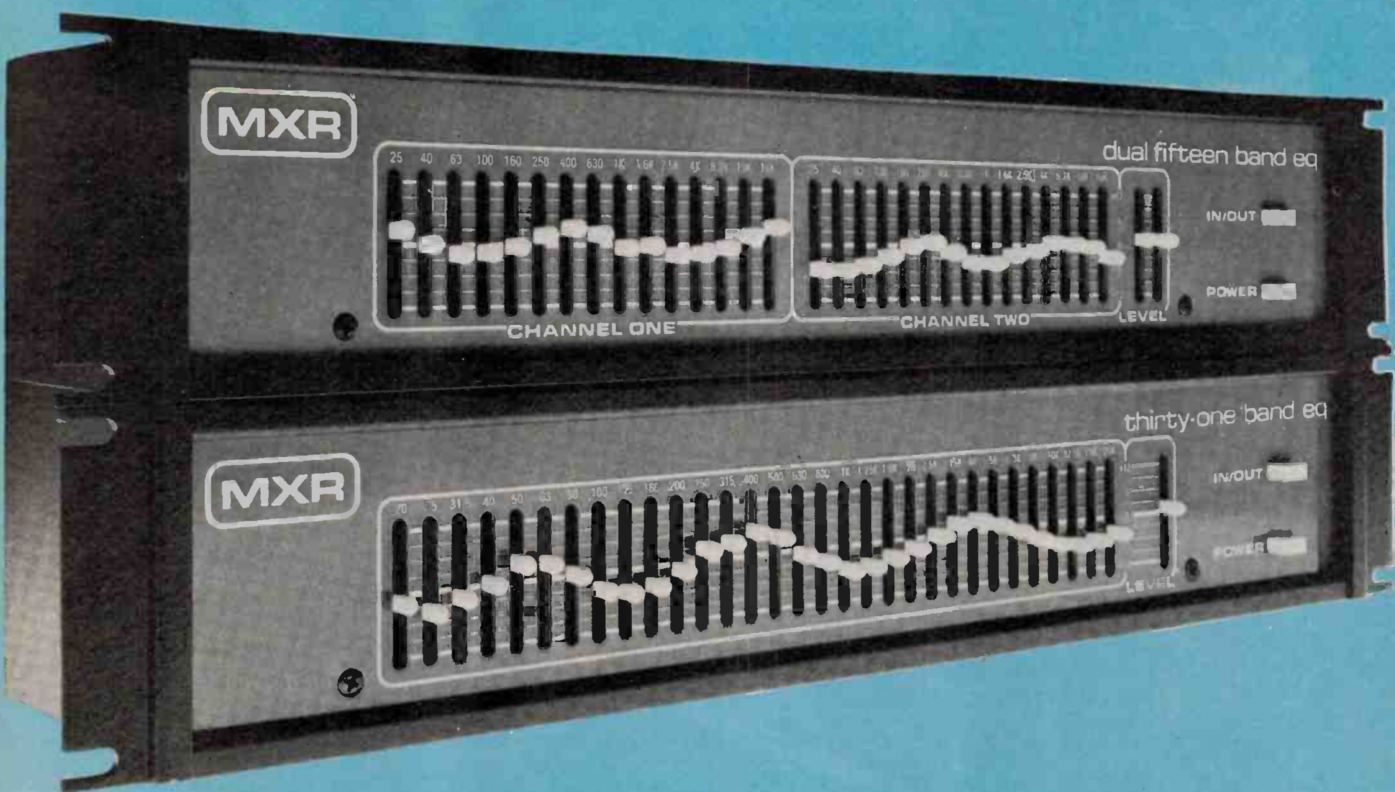
SELL REVOX A78 STEREO AMPLIFIER 80 WRMS $260. LENCO L85 TURNTABLE ELECTRONIC STOP AND ARMLIFT $180. BOTH AS NEW COMPLETE WITH SCHEMATICS, MANUALS AND ORIGINAL PACKINGS. H. BUFF (02) 9222666 O.H.

BEGINNER REQUIRES COMPUTER OR EVALUATION KIT IN/OUT DEVICES AND DATA REASONABLE PRICE RAY EVANS PO BOX 36 ILUKA 2460. PH. (066) 466173.

send your ad to –
ETI MiniMart,
Modern Magazines,
15 Boundary Street,
Rushcutters Bay,
NSW 2011.

MXR

Dual Fifteen Band Equalizer
Thirty-One Band Equalizer



MXR is proud to present two additions to our Professional Products Group—the Dual Fifteen Band Equalizer and the Thirty-One Band Equalizer.

The Dual Fifteen Band Equalizer is a professional, two-channel frequency equalizer offering 15 bands of discreet adjustment per channel. Each of the bands, spaced at 2/3 octave intervals, has a range of −12 to +12 decibels and can be independently adjusted using the slide controls. In addition, each channel has its own level control slider.

The Thirty-One Band Equalizer is a professional, single channel graphic equalizer providing precise control over thirty one discreet frequency bands spaced at 1/3 octave intervals. Like the Dual Fifteen Band Equalizer, each band has a range of −12 to +12 decibels. In addition, there is a broadband level control to provide optimum dynamic range and ease of operation.

Due to their advanced design and high quality construction, both units are reliable, versatile instruments, that can be utilized in a wide variety of situations. Adjustments can be made in the basic tonal characteristics of any instrument to suit one's taste or needs. Specific portions of program material may be accented or diminished. A room can be "tuned" by adjusting for tonal discrepancies caused by room acoustics. Compensation for inadequacies in microphones, speakers, or even hearing is easily accomplished.

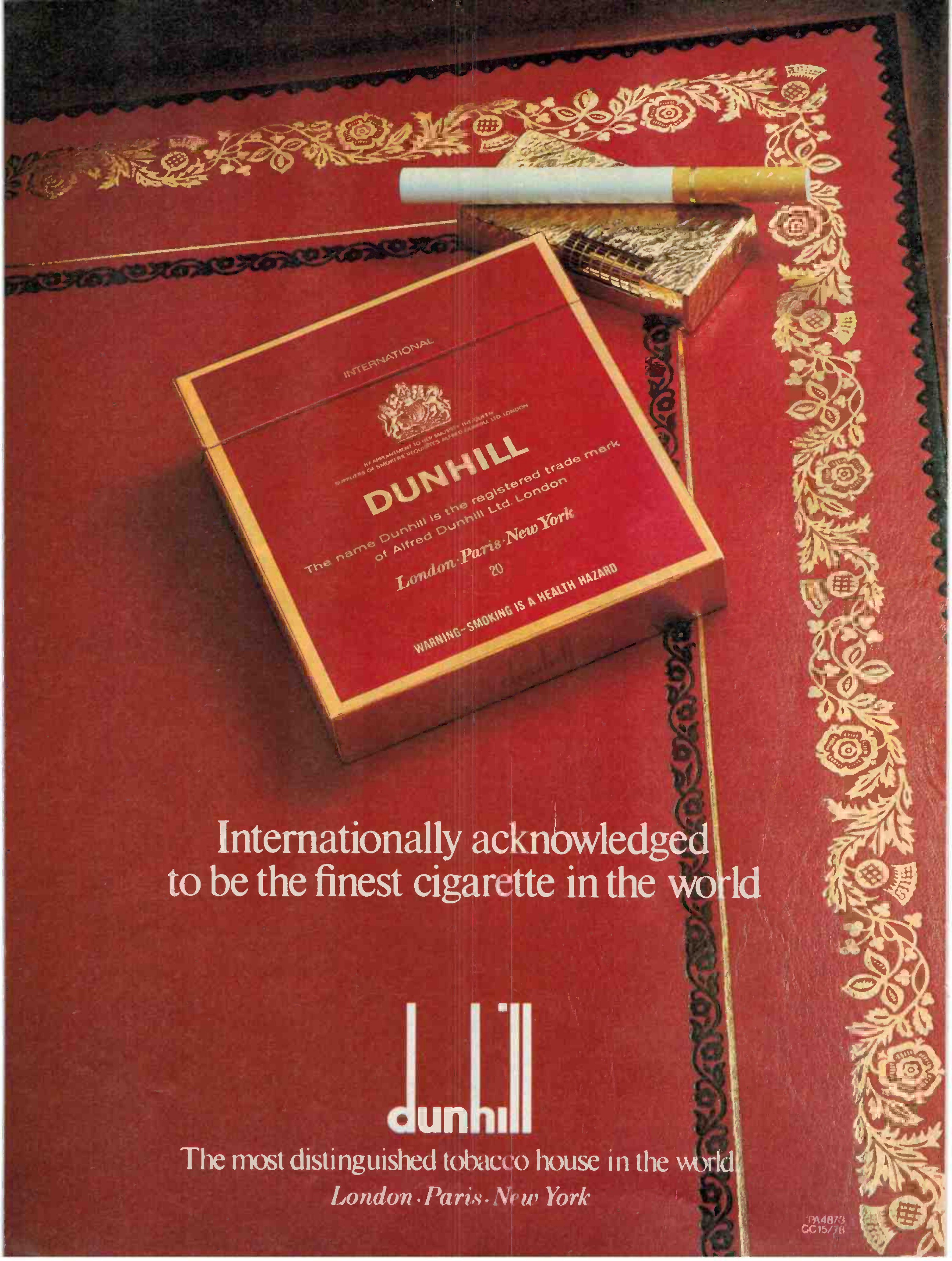
The Dual Fifteen Band and Thirty-One Band Equalizers are graphic units in that their response is illustrated on the front control panel. The outline of the frequency response curve is reflected in the positions of the slide controls. This visual representation facilitates duplication of the desired effects.

Both units can be easily mounted in any standard EIA 19" rack for studio installation, or in the optional road case for portable use.

As with every MXR product, the Dual Fifteen Band Equalizer and the Thirty-One Band Equalizer are designed and manufactured with all of the care and attention given to our products used around the world in recording studios and musical performances.

Distributed by:
The Music Distillery,
503 Pittwater Road,
Brookvale, NSW.
938-4095 938-2372

MXR Professional Products Group


INTERNATIONAL
DUNHILL
The name Dunhill is the registered trade mark of Alfred Dunhill Ltd. London
London·Paris·New York
20
WARNING–SMOKING IS A HEALTH HAZARD
Internationally acknowledged to be the finest cigarette in the world
dunhill
The most distinguished tobacco house in the world
London · Paris · New York
PA4873
CC15/78

End noise and cross-talk with our exclusive Noiseguard™ system

Capacity: 20 positions for edge connectors.
Edge Connectors: S-100 type, 25" spacing.
Shielding: Every signal fully shielded by both interconnected ground lines.
Termination: Active termination of each line. Termination network includes LM201 op amp, 2N3904, 2N3906, TIP29 and TIP30 transistors, 2.4 volts, 180 ohms.

The Wünder Buss™

A product of Morrow's Micro-Stuff for

COMPUTER BITS

A DIVISION OF AUTOMATION STATHAM PTY. LTD.

47 Birch Street, BANKSTOWN
N.S.W. 2200
Phone (02) 709-4144
Telex AA26770

electronics today INTERNATIONAL

BINDERS

HOLDS 12 COPIES OF ETI

Protect and file your back issues of Electronics Today with these attractive binders. Price $4.50 plus postage and packing (90c NSW, $2.00 other states)

Write enclosing cheque/postal note/money order to:

SUBSCRIPTION DEPARTMENT,
ELECTRONICS TODAY INTERNATIONAL,
3rd Floor, 15 Boundary Street,
Rushcutters Bay, NSW. 2011.

BUILD YOUR OWN

BIG SCREEN COLOUR TV

YOU ASKED FOR IT

THE NEW ***SUPER SCREEN.***

The SELF-CONTAINED internal TV that will utilize any transistor portable TV (12" to 19") . . . requires only 2 x 4 feet of floor space, fits neatly against any wall, and lends its beauty to the decor of any room.

Takes 10 to 15 hours to build, wood and TV not included.

- ***Sporting events are an experience as exciting as being there.***
- ***Movies are seen the way they were meant to be seen.***

Can be used with video tape playback equipment.

We have received enquiries for a big screen TV that would:
● utilise any portable TV as an image source ● be a beautiful piece of furniture ● require a minimum of floor space.

NOW – XENON IS HAPPY TO ANNOUNCE THE NEW SUPER SCREEN.

Designed for the do-it-yourself enthusiast who wishes to have the enjoyment and excitement of a professional Big Screen TV, but refuses to pay the $4,000 that most manufacturers charge for this luxury.

FACTS

Lens and front surface mirror supplied are the same type used by Big Screen TV major manufacturers.

CONTENTS OF PACKAGE DEAL:

1 Super Screen 30" by 40" approx.
1 Super Lens
1 Front Surface Mirror 8" x 10"
1 Silver Float Mirror 14½" x 20"
1 Set of Plans (not sold separately)

$299

EXTRAS AVAILABLE:

1 Sharp 14" portable modified for above and video output. $515.
1 Akai 3hr. Video Recorder $1,250
1 S H Video Recorder Color $660
1 S H Video Recorder Black and White $285

1 SUPER SCREEN PACKAGE KIT at $299

Please send me ....
Also .... Totalling $ ....

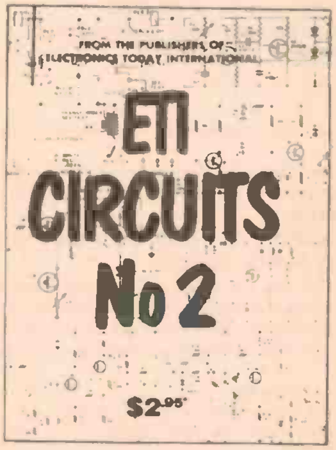
Name .... Bankcard No. ....
Address .... Expiry date ....
.... Signature ....

Import Agents

XENON WORLD IMPORTS, Box 33, Warradale, SA. 5047.

ETI SPECIALS

TOP PROJECTS VOL 5
Our latest project book. All the most popular projects which have been published recently in Electronics Today. Includes Bucket Brigade Audio Delay Line, Howl-round Stabilizer, Transmission Line Speakers . . . . . . $3.00.



ETI CIRCUITS NO 2
Ideas and data for experimenters. There are about 200 circuit ideas in this book. It's not for the beginner. But someone with a fair bit of experience in electronics will get a lot of use from this book. Invaluable for ideas and inspiration.. . . . . $2.95.

PROJECT ELECTRONICS
If you're just getting interested in electronics this is the book for you. There are lots of projects to build. They're simple, educational and useful too. And there's advice about constructional methods and electronics components . . . . $4.75.

AUSTRALIAN CB
All about CB. . How to buy and install a rig. How to work interstate on skip. What UHF CB is like. How to build accessories. Australian CB is a thorough, simple yet authoritative guide to CB in Australia 1978 . . . . $3.95.

If your newsagent has sold out, order directly from us at Modern Magazines, 15 Boundary Street, Rushcutters Bay, 2011.
Just add 45 cents to the price for post and packing

RADIO PARTS

VOLTAGE REGULATORS

LM300H TO5 Voltage Regulator $3.60
LM304H TO5 Negative Regulator 2.83
LM305H TO5 Voltage Regulator 1.07
LM309H TO5 5 Volt Regulator 2.61
LM309K TO3 5 Volt Regulator 2.74
LM317T TO220 3 Terminal Adjustable Regulator 3.19
LM317K TO3 3 Terminal Adjustable Regulator 4.59
LM320T TO220 Neg. 1 Amp Regulators, 5, 6, 8, 12, 15, 18, 24 volt 2.74
LM320K TO3 Neg. 1 Amp Regulators 5, 6, 8, 12, 15, 18, 24 volt 5.04
LM323K TO3 Pos. 3 Amp — 5 Volt Regulator 7.09
LM340T TO220 Pos. 1 Amp Regulators 5, 6, 8, 12, 15, 18, 24 volt 1.59
LM340K TO3 Pos. 1 Amp Regulators 5, 6, 8, 12, 15, 18, 24 volt 4.02
LM723CH TO5 Voltage Regulator 1.20
LM723CN 14 Pin Dil Voltage Regulator 0.71
Prices include sales tax.

OPERATIONAL AMPLIFIERS/BUFFERS

LH0002CN 10 pin dil Current Amp 7.29
LH0042CH TO5 low cost FET Op Amp 5.69
LM301H TO5 Op Amp 0.69
LM301A 8 pin dil Op Amp 0.41
LM302H TO5 Voltage Follower 3.83
LM307H TO5 Op Amp 1.15
LM307N 8 pin dil Op Amp 0.66
LM308N 8 pin dil Op Amp 1.10
LM318N 8 pin dil Op Amp 3.17
LM324N 14 pin dil low power quad Op Amp 1.10
LM343H TO5 high voltage Op Amp 8.13
LM348N 14 pin dil quad 741 Op Amp 1.50
LM349N 14 pin dil wide-band decompensated quad 741 Op Amp 2.30
LM358N 8 pin dil low power dual Op Amp ... 0.97
LM709CH TO5 operational amplifier 1.10
LM709CN 8 pin dil Op Amp 0.82
LM741CH TO5 operational amplifier 0.61
LM741CN 8 pin dil Op Amp 0.41
LM747CN 14 pin dil dual Op Amp 1.15
LM1458N 14 pin dual Op Amp $0.82
LM3900N 14 pin dil quad amp 0.94
LM4250H TO5 Programmable Op Amp 2.32
Prices include sales tax

VOLTAGE COMPARATORS

LM311N 8 pin dil voltage comparator 0.89
LM319N 14 pin dil high speed dual comparator 4.54
LM339N 14 pin dil low power low offset voltage quad comparator 0.92
LM360H TO5 high speed differential comparator 5.23
LM361H TO5 high speed differential comparator 3.83
LM393N 8 pin dil low power low offset voltage dual comparator 1.25
LM710H TO5 voltage comparator 0.94
LM711H TO5 dual comparator 0.94
Prices include sales tax

AUDIO, RADIO AND TV CIRCUITS

LM370N 14 pin dil AGC/Squelch amp 5.48
LM371H TO5 Integrated RF/IF amp 4.02
LM372H TO5 AM IF strip 4.78
LM373H TO5 AM/FM/SSB IF AMP/detector .. 6.18
LM374H TO5 AM/FM/SSB IF video amp/detector 5.07
LM375N 14 pin dil oscillator and buffer with TTL output 5.74
LM377N 14 pin dil dual 2 watt audio amp ... 3.06
LM378N 14 pin dil dual 4 watt audio amp ... 3.24
LM379S 14 pin in line dual 6 watt audio amp 6.45
LM380N 14 pin dil audio power amp 1.73
LM381N 14 pin dil dual preamp $2.87
LM381AN 14 pin dil low noise dual preamp .4.59
LM382N 14 pin dil low noise dual preamp ... 2.23
LM384N 14 pin dil 5 watt audio power amp 2.55
LM386N 8 pin dil low voltage audio power amp 1.40
LM387N 8 pin dil dual preamp 2.63
LM388N 14 pin dil 1.5 watt audio power amp 1.72
LM1303N 14 pin dil stereo preamp 1.68
LM1304N 14 pin dil FM multiplex stereo demodulator 2.04
LM1305N 14 pin dil FM multiplex stereo demodulator 2.04
LM3065N 14 pin dil television sound system 1.61
Prices include sales tax.

FLUKE 8020A

Specifications:— Sensitivity: 3½ Digit Liquid Crystal Display (10 Meg all ranges); Dimensions: 180 x 86 x 45 mm; Power Requirement: 9 Volt Battery e.g. 216 Eveready (Further information available upon request). $205.28 including sales tax

ESTABLISHED OVER 35 YRS . . . NOW CARRYING IN EXCESS OF 12,000 LINES . . .

DOMINION PRO SERIES. HIGH QUALITY REGULATED POWER SUPPLIES

11 to 16 volts adjustable. Ideal where long continuous use and excellent regulation are required. All supplies are totally short-circuit proof.

NG3 3.5 amps — $49.00 including tax. For CB, hobbyists, experimenters, school, etc. Input 240V AC, Output 11 to 16V DC, Regulation 0-3.5A 20mV. Ripple at 3.5 amps-4mV. Dimensions: 3¾ wide x 4½" deep x 6" high. Weight approx 5 lb.

NG7 6 amps — $57.00 including tax. High power single side band CB radios, service bench repairs, 2-way radio base supplies. Input 240V AC, Output 11 to 16V DC, Regulation 0-6A 30 mV. Ripple at 6 amps-4mV. Dimensions: 5" wide x 5¼" deep x 6" high. Weight approx 8 lb.

NG12 12 amps — $115.00 including tax. Heavy duty model. Ideal for operating high power linear amps, hybrid 2-way radios, etc. Input 240V AC. Output 11 to 16V DC, Regulation 0-12A 10mV. Ripple at 12 amps-1.5mV. Dimensions: 10" wide x 5¼" deep x 6" high. Weight approx 16 lb.

Manufactured by Radio Parts Group. Trade enquiries welcome.

MULTIMETERS

TMK VF4

Specifications:— Sensitivity: 2K Ω /Volt DC, 2K Ω /Volt AC. DC Voltage: 0.25V, 2.5V, 10V, 50V, 250V, 1000V; AC Voltage: 10V, 50V, 250V, 1000V; DC Current: 0-500 µA, 10MA, 250MA, 10A; Resistance: x1, x10, x100, x1K, (6,60,600,6K Centre Scale); Capacitance: 500 µµF to 1 µF (in two Ranges); Decibels: —15 to plus 32dB (in four Ranges); Dimensions: 145 x 95 x 45 mm. $21.27 including tax.

TMK TP5SN

Specifications:— Sensitivity: 20K Ω /Volt DC, 8K Ω /Volt AC; DC Voltage: 0.5V, 5V, 50V, 250V, 500V, 1000V; AC Voltage: 10V, 50V, 250V, 500V, 1000V; DC Current: 0-50 µA, 5MA, 50MA, 500MA; Resistance: x1, x10, x100, x1K (60, 600, 6K, 60K Centre Scale); Capitance: 50 µµF to 0.1 µF (in two Ranges); Decibels: —20 to plus 36dB; Dimensions: 135 x 95 x 40 mm. $25.18 including tax.

TMK200

Specifications:— Sensitivity: 20K Ω /Volt DC, 10K Ω /Volt AC; DC Voltage: 0.6V, 6V, 30V, 120V, 600V, 1200V; AC Voltage: 6V, 30V, 120V, 600V, 1200V; DC Current: 0.06MA, 6MA, 60MA, 600MA; Resistance: 0-10K Ω, 100K Ω, 1M Ω, 10M Ω; Capacitance: .002 µF to 0.2 µF Decibels: —20 to plus 63dB; Dimensions: 130 x 90 x 35 mm. $27.91 including tax.

TMK500

Specifications:— Sensitivity: 30K Ω /Volt DC, 13K Ω /Volt AC; DC Voltage: 0.25V, 1V, 2.5V, 10V, 25V, 100V, 250V, 1000V; AC Voltage: 2.5V, 10V, 25V, 100V, 250V, 500V, 1000V; DC Current: .05MA, 5MA 50MA 500MA, 12A. Short Test: Internal Buzzer. Decibels: —20 to plus 56dB; Dimensions: 160 x 85 x 70 mm. $41.22 including tax.

NEW "SOLDER-EATER" DE-SOLDERING BRAID (1.8m)

In cassette package. For standard PCB — Part No. 213. For miniature PCB — Part No. 214. $1.60 each (exempt).

SINCLAIR PDM35

Specifications:— Sensitivity: 3½ Digit LED Display (10 Meg input DC); DC Voltage: 1MV to 1000V (Four Ranges); AC Voltage: 1V to 500V (40 Hz-5 kHz); DC Current: 1 MA to 200 MA (Six Ranges); Resistance: 1 Ω to 20 Meg Ω (Five Ranges); Dimensions: 153 x 76 x 39 mm; Power: 9 volt Battery (e.g. 216 Eveready). $61.89 including sales tax

LIFE PANEL METERS

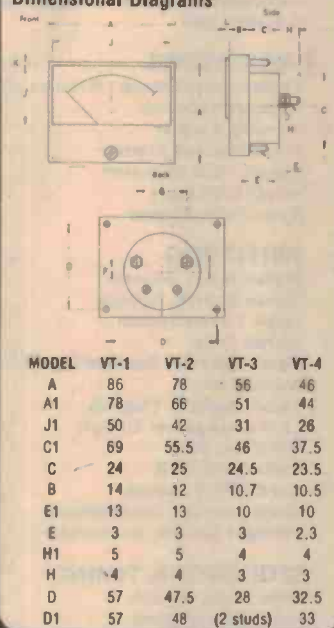
VT1 SERIES:
Ranges available: 0-50uA, 50-0-50uA, 0-100uA, 100-0-100uA, 0-200uA, 0-500uA, 0-1mA, 0-5mA, 0-10mA, 0-100mA, 0-500mA, 0.1A, 0-5A, 0-15A, 0-15V, 0-50V, DC, Plus 0-300V AC. All one price $7.36 ea. incl. sales tax.

VT2 SERIES
Ranges available: 0-50uA, 50-0-50uA, 0-100uA, 100-0-100uA, 0-200uA, 0-500uA, 0-1mA, 0-5mA, 0-10mA, 0-100mA, 0-500mA, 0-1A, 0-5A, 0-15A, 0-15V, 0-50V DC. All one price $6.90 ea. incl. sales tax.

VT3 SERIES:
Ranges available: 50-0-50uA, 100-0-100uA, 0-200uA, 0-5mA, 0-10mA, 0-100mA, 0-500mA, 0-1A, DC Plus 0-300V AC. All one price $6.44 ea. incl. sales tax.

VT4 SERIES
Ranges available: 0-50uA, 50-0-50uA, 0-100uA, 100-0-100uA, 0-200uA, 0-500uA, 0-1mA, 0-5mA, 0-100mA, 0-500mA, 0-1A, 0-5A, 0-50V DC Plus 0-300V AC. All one price $5.98 ea. incl. sales tax.

Dimensional Diagrams



MODEL	VT-1	VT-2	VT-3	VT-4
A	86	78	56	46
A1	78	66	51	44
J1	50	42	31	26
C1	69	55.5	46	37.5
C	24	25	24.5	23.5
B	14	12	10.7	10.5
E1	13	13	10	10
E	3	3	3	2.3
H1	5	5	4	4
H	4	4	3	3
D	57	47.5	28	32.5
D1	57	48	(2 studs)	33

NOW MAKE METAL LABELS IN MINUTES . . . FOR LESS THAN 3c PER SQ. INCH!

Here's all you need: "SCOTCHCAL" Brand Photo-Sensitive Metal Label . . . your blueprint machine or a carbon arc lamp . . . and about 15 minutes per process. That's all it takes. No camera. No darkroom. No developing tanks. This system is at least 4 times faster than any other in-plant process. You get 6 mm aluminium nameplates, dial faces, schematics, instrument panels, any prototype or permanent metal labels — right 1

INTRODUCTORY KIT: 8002 KA.
Contains: 1 sheet of each of Metal/Plastic/8007 Film, 1 litre 8500 developer, 1 can 3900 Gloss Clear, 1 ML3 Applicator Block, 1 box ML4 Developer/Pads, 1 Sensitivity Guide, Full instructions. $52.90 incl. sales tax.

METAL LABEL:
(all prices include sales tax) **8001 RED:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8005 BLACK:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8009 LIGHT BLUE:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80.

PLASTIC LABEL:
(all prices include sales tax) **8011 RED/WHITE:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8012 BLACK/TRANSPARENT:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8013 BLACK/YELLOW:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8015 BLACK/WHITE:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8016 BLUE/WHITE:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 600 x 1200 mm 2 sheet pack, $59.80. **8018 GREEN/WHITE:** 250 x 300 mm 10 sheet pack, $35.65. 300 x 600 mm 5 sheet pack, $41.40. 600 x 900 mm 3 sheet pack, $67.85. 6600 x 1200 mm 2 sheet pack, $59.80.

EXPOSURE FILM:
(all prices include sales tax) 8007: 250 x 300 mm 10 sheet pack, $21.28. 300 x 600 mm 5 sheet pack, $26.45. 600 x 900 mm 3 sheet pack, $36.80. 600 x 1200 mm 2 sheet pack, $33.35.

ACCESSORY ITEMS:
(all prices include sales tax) **8500 Developer:** 1 litre, $4.60 ea. **ML3 Applicator Blocks:** $4.60 ea. **ML4 Developer Pads:** 100 sheet roll, $4.03 per roll. **3900 Gloss Clear Coat Aerosol:** 368 grm, $6.90 ea. **3930 Matte Clear Coat Aerosol:** 368 grm, $6.90 ea. **8019 Protective Overlay Film:** 10" x 12", 10 sheets, $12.08, 12" x 24", 5 sheets, $14.38. **10 S.G. Sensitivity Guide:** $7.48 ea. **P.A. 1 Squeegee Applicator:** 40c ea.

Further information available on request.

Note: Metal & Plastic Label and Exposure Film in 600 x 900 mm and 600 x 1200 mm sizes will be available in single sheets at a later date.

Trade enquiries welcome

To: Radio Parts Group, 562 Spencer St., West Melbourne. (03) 329-7888.
1103 Dandenong Rd., East Malvern. (03) 211-8122.

Please send me ....

....

I am enclosing cheque ☐ money order ☐

or please debit my Bankcard — Number ....

$5 minimum order plus $1 P&P. Orders in excess of $25 freight free in Aust. Outside Aust. freight on. Write for our comprehensive Semi-Conductor price list.

Signature ....

Name ....

Address ....

.... P/Code ....

Number Two
ETI CIRCUITS

Contents

ALARMS
Comprehensive Burglar Alarm
SCR Alarms
Car Radio Protector
Fire Alarm, Simple

AMPLIFIERS & PREAMPLIFIERS
Non-Inverting Amplifier
AC Amplifier
AC Amplifire, Simple
Voltage Follower
Flexible Response
Hi Z, Hi Gain Amplifier
Voltage Controlled Amplifier
Recording Pickup
Direct Coupled Power
CMOS Power Booster
Photocell Amplifiers
12 Volt PA System
Class A Amplifier
Clipper Preamp
Headphone Amplifier
Op-Amp Circuits, Standard

SIGNAL PROCESSORS
Track and Hold Circuit
Track and Hold, Simple
ADSR Envelope Shaper
Frequency Doubler
Frequency to Voltage Converter
Frequency Meter, Analogue
Digital to Analogue Convertor
Schmitt Trigger, Without Hysteresis
Schmitt Trigger, Simple
Pulse Lengthener, Optical

SIGNAL GENERATORS
Square Wave, Low Frequency
Square Wave Generator
Monostable Multivibrator
Triangular Waveform Generator
Marker Generator
Voltage and Frequency Calibrator
VCO, Simple
Voltage Controlled Oscillator
Sine Wave Oscillator
Tone Burst Generator
Thermistor Oscillator
Theremin
Exponential Waveform Generator

FILTERS
Loudness Control
Rumble Filter, Switchable
VCF, Cheap
CMOS Filters
Voltage Controlled Filter
Tone Control, Active
Tone Control Circuit

SPECIAL EFFECTS
Organ, Simple
Warbling Alarm
Guitar Synthesiser
Guitar Fuzz
Drum Simulating
Fishcaller, Transistorised

MIXERS
Audio Mixer
Basic Mixer
Switched Mixer

DETECTORS & COMPARATORS
Low Battery Warning
Battery Voltage Monitor
Recording Level Meter
Comparator Voltmeter
Voltage Comparator
True RMS Detector
Positive Peak Detector
True RMS Convertor
Temperature Sensor, Differential
Schmitt, 555

INDICATORS
Temperature Sensor, Remote
Warmth Indicator
Warning Flasher
Transistorised Flasher
Blown Fuse Indicator
Novel Indicators
Neon Tube Flasher

SWITCHING
Stereo Input Selector
Stereo Switch, Simple
Logic Touch Switch
Stereo Only
Input Selector, Sequencing
Audio Switch
Touch Switch, Thermo
LED Changeover Circuit
OR Gate, SCR
AND Gate, SCR
4016 DPDT Switch
Beam Splitter, Oscilloscope
Twilight Switch, Automatic

SEQUENCE & TIMING
Time Delay Switch
Snooze Delay Unit
Timer, 1-12 Minutes
Code Switch
Timing Circuit
Combination Lock
Flexible Timer

POWER CONTROL
Impulse Power
Half-Wave Control
Improved Half-Wave
Zero Switching
Triac Lamp Flasher
Triac Slave Controller
Light Show, Simple
DC Lamp intensity
Train Speed Control
Temperature Controller

POWER SUPPLIES
Current Source, Drift Free
Constant Current, High Voltage
Output Voltage, Adjustment
High Voltage, Variable Regulator
Switched Output
Dual PSU
Mobile Power Supply
Converting Single to Dual
Op-Amp Supply
Low Ripple PSU
Zener Assistance
Crowbar, Simple
Low Voltage, Short Protection
Low Ripple at Low Current
30 Volt Regulators
Standard Configurations

TEST
FET Testing, Static
Diode Tester
Ammeter, Wide Range
Millivoltmeter, Audio
DC Probe, 100 000 Megohm
Measuring RMS with a DVM
Logic Indicator, Audible
Transformer-Inductor Tester
Pulse Catcher Probe
JFET Test, Quick

DIGITAL
Data Selector, Two Way
7 Segment Improvement
3 Chip Die
Hex to 7 Segment
Binary Calculator
TTL Keyer
ASCII Keyboard
Counter-Display Module
Clock Generator, Multiphase
Windicator
Self-Clear
LED Counter

AUTOMOBILE
Fuel Gauge, Digital
Immobilisation, Automobile

MISCELLANEA
Emergency Lights
Digital Thermometer
SCR One Shot
SCR Multivibrator
Meter Amplifier
Night Light, Automatic
Telephone Circuit
Headphone Adaptor
Rising Edge Trigger
Position Transducer, Digital
Temperature Stabilized Relay

CRYSTAL OSCILLATORS
LF-VHF, Various

SPEAKER CROSSOVERS
Computer Aided Design

BATTERIES
Characteristics and Composition

CONVERSION TABLES
Hex-Decimal-Hex
Decimal-Hex-Octal-Binary

LOGIC DATA
CMOS-TTL Comparison
TTL Functions
CMOS Functions
Truth Tables, Logic
Boolean Algebra, Laws
CMOS Pinouts
TTL Pinouts
MPU Glossary

MISCELLANEOUS DATA
Transistor Characteristics
FET Characteristics
Diode Characteristics
Semiconductor Packages
Problems?
Colour Codes
Component Codes
Preferred Values

Please note: the Circuits Books are intended as 'ideas directories' — they are not meant for the beginner.

$2.95* ON SALE NOW

All major newsagents — or direct from Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011 — at $3.40 incl. postage.
(*recommended retail price only).

BOOK REVIEWS

Electronics (2nd Edition), Sparkes, Hutchinson & Co, 1978, $5.80.
Originally published in 1972 as Electronics for Schools, this volume forms a course in the fundamentals of electronics for 11 to 14 year old schoolchildren. The first eight chapters introduce the theory of electronics by means of practical experiments using cheap, easily available components.

The material in the book is covered at a fairly fast pace, although the difficulty level is not high - progress is smooth, with no gigantic 'leaps' in level. Chapter 2 introduces semiconductors, Chapter 3 covers 'controlling the transistor, Chapter 4 is about inverters, and Chapter 5 discusses other switching circuits. This material concerns only dc operation of the circuits, but Chapter 6 onwards more on to ac theory and amplifier circuitry.

The treatment is thoroughly non-mathematical, obviously a qualitative rather than quantitave approach to circuit operation. Once the student has a 'feel' for the operation of various components and circuits, Chapter 10 gives designs for 14 projects which may be attempted.

The book is well thought out and will provide a firm basis for further experiment. Our review copy was supplied by McGill's Authorised Newsagency of 187-193 Elizabeth Street, Melbourne, 3000.

Programmable Calculators – Business Applications, Aronofsky, Frame and Greynolds, Jr, McGraw-Hill, 1978, $9.85.
In reviewing a book like this, as an engineer it is difficult to put oneself into the position of a businessman who is new to the potential of programmable pocket calculators (PPC's). Most engineers have been using PPC's for some time now and are both numerate and logical enough to handle them with ease. Unfortunately, the impression one gets from this book is that businessmen are not so fortunate.

The bulk of the book deals with the programming features and logic of the TI-58 and -59 calculators in great depth – information that is of dubious value to the owner of one of these calculators since it is all explained in the handbook, and is of little interest to those who don't own one. However, the approach taken is to use examples of a business, rather than a scientific, nature. The examples are not very complex, but cover the calculation of uneven cash flows and elementary sensitivity analysis.

As a refresher course for a businessman who hasn't done any mathematics since his school days, the book would undoubtedly be of benefit, but we would suggest that any TI-58 or -59 owning reader of ETI is probably at a much more advanced level than this book. Our review copy was supplied by McGill's Authorised Newsagency of 187-193 Elizabeth Street, Melbourne 3000.

Now. Two 3-way 40 watt speakers with nine tonal choices

Save about $50 per hour while you assemble them

Even if you didn't know them by number, you probably heard about the Philips AD12K12 MK11 Speaker Kits.

Because they are now a no.1 best-seller.

And here is the compact AD8K30, 8" 3-way compact system, with fine electronic and acoustic components (1" domed tweeters, 5" mid-range, super 8" bass drivers). Brilliant clean sound, with a frequency response closely following the ideal Bruel & Kjaer curve for hi-fi equipment measured in an actual listening room, using the "Third Octave Pink Noise Method".

Plus 9 combination tonal choices to adjust to the acoustics of your own listening-room.

You can assemble the AD8K30's in about two hours. You will get a professional result and save about $100 per pair over a comparable system.
Phone or send coupon now for full details of this and all our kits.

PHILIPS ELECTRONIC COMPONENTS AND MATERIALS

Sydney 427 0888 • Melbourne 699 0300 • Brisbane 277 3332 • Adelaide 45 0211 • Perth 65 4199

ELCOMA
Philips Electronic Components and Materials
P.O. Box 50, Lane Cove, NSW 2066

Please send me full details and brochures on your loud speaker kits and a list of retailers who stock them.

NAME ____________________

ADDRESS ____________________

____________ STATE ________ P/CODE ________

ETA

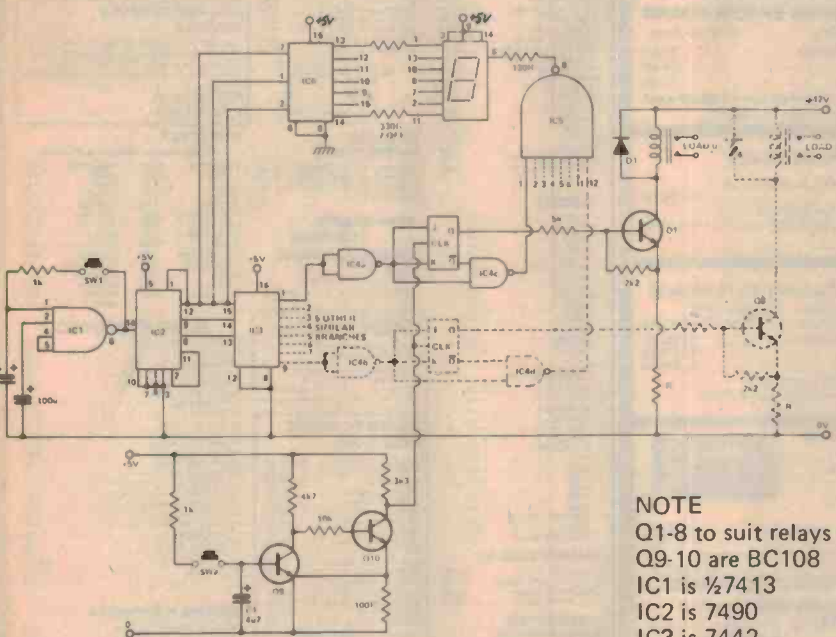
PHILIPS Electronic Components and Materials

PHILIPS

8A.EL.3

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.
Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.



NOTE
Q1-8 to suit relays
Q9-10 are BC108
IC1 is ½7413
IC2 is 7490
IC3 is 7442
IC4 is 7400
IC5 is 7430
IC6 is 7447
Display is DL707

Electronic Switch

This circuit provides remote switching of up to eight loads, and uses only two switches for selection. One switch is used to select the load to be controlled, the second controls whether the load is energised or not. If the state of one of the loads needs to be changed, SW1 is depressed until the number of the load appears on the 7-segment display. The decimal point then indicates whether or not the load is energised. To change the state of the load, SW2 is depressed (pressing SW2 again will change the load's state again).

The circuit is based on a 7442,1 of 8 multiplexer and a 7490 binary counter. When SW1 is closed, the Schmitt trigger IC1 will oscillate and clock the 4-bit counter. This drives the 7-segment decoder and the 1 of 8 multiplexer. The outputs from the multiplexer are inverted and fed to the J-K flip-flops. When SW2 is pressed and released, a pulse will occur at the collector of Q10. The pulse will clock the selected flip-flop and activate or deactivate the relevant relay driver transistor (Q1-8).

ADVANCED COMPUTER PRODUCTS

THE FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES NOW LOWERS PRICES EVEN FURTHER!

1. Proven Quality Factory tested products only, no re-tests or fallouts. Guaranteed money back. We stand behind our products.

2. Same Day Shipment All prepaid orders with cashiers check, money order or charge card will be shipped same day as received.

S100 PRODUCTS

LOGOS I 8K STATIC RAM


- ★ Low Power
- ★ Selectable Memory Protect
- ★ Totally Buffered
- ★ Battery Back-up
- ★ Address on 1K boundary
- ★ Requires no front panel
- ★ No wait states

ASSEMBLED & TESTED
250ns. 199.95
450ns. 179.95

KIT
250ns. 149.95
450ns. 125.95

WE OFFER GROUP DISCOUNTS

Bare PC Board w/Data $21.95
Now over 1 year successful field experience
"Special Offer" Buy (4) 8K 450ns. Kits $117.00 ea.

IMS 16K STATIC RAM
- ★ Memory mapping
- ★ Phantom
- ★ Address 16K Bound
- ★ Use with or w/o front panel
- ★ Power 2.1 amps typ.
- ★ Uses 2114

ASSEMBLED & TESTED ONLY
450ns. $439.95 250ns. $495.95

S-100 32K STATIC RAM
- ★ Address 32K Boundary
- ★ Power 450ns. 2.8 amps typ.
- ★ No wait states on 2MHz
- ★ Fully Buffered
- ★ Phantom can be added
- ★ 2114/TMS4045 or 9135

ASSEMBLED & TESTED	KIT
250ns. $849.00	250ns. $790.00
450ns. $799.00	450ns. $740.00

Bare PC Board w/Data $59.95
SPECIAL OFFER:
Kit without Memory only $99.95. Add 2114 Memory for $160.00 per 8K

PARATRONICS LOGIC ANALYZER KIT
MODEL 100A $219.95
(analyzes any type of digital system)
Trigger Expander Model 10 .... $229.00
Baseplate 9.95
Model 10 Manual 4.95
Model 150 Bus Grabber Kit 369.00

DC HAYES DATA COMMUNICATIONS ADAPTER
★ Telephone/TWX ★ S-100 compatible
★ Bell 103 freq. ★ Originate & answer mode
Assembled & Tested $279.95
Bare PC Board w/data .... $ 49.95

Z-80/Z-80A CPU BOARD
- ★ On board 2708
- ★ Power on jump
- ★ 2708 included (450ns.)
- ★ completely socketed

Assembled and tested $165.00
Kit $129.95
Bare PC Board .... $ 34.95
★ For 4MHz Speed Add $15.00

TDL COMPATIBLE Z-80 CPU
★ Compatible to TDL software & hardware ★ Can be upgraded for 4MHz operation
Assembled and tested $199.95
Kit $139.95
Bare PC Board .... $ 34.95

BYTE USER 8K EPROM BOARD
★ Power on Jump ★ Reset Jump
Assembled & Tested 94.95
Kit 64.95
Bare Pc Board 21.95
Special Offer: Buy 4 kits only $59.95 each
NOTE: 2708-6 only $5.95

TRS 80 UPGRADE KIT
16K Memory with Jumpers and Instructions $159.95
(Specify Level I or Level II)
APPLE II 16K UPGRADE KIT $149.95

TARBELL FLOPPY INTERFACE
★ S100 Compatible ★ Uses CPM
★ Jumper Selectable ★ Persci, Shugart, etc
Assembled and tested $269.95
Kit $179.95
Bare PC Board .... $ 39.95
NOTE: For CPM Add $70.00
Documentation Add $20.00

PET TO S-100 ADAPTER


Allows Pet to be interfaced to popular S-100 Bus.
Kit $169.95
Assembled $269.95
For Low Cost 8 Slot Bus to expand your Pet only .... $149.95 Kit

MICRODESIGN MR-16 2716 EPROM BOARD (MR-8 Also Available at same price)
★ Individual Prom Address
★ Uses Low cost 16K TI EPROMS
★ Optional 1K RAM ★ Phantom-control
Assembled and Tested 174.95
Kit 99.50

DATABOOKS & MANUALS

NSC TTL Data	$ 3.95	AMI MOS/LSI Data	3.95	Mot. Vol 4 Mecl Data	3.95
NSC Linear Data	4.95	GI MOS/LSI Data	4.95	Mot. Vol. 5 CMOS Data	2.95
NSC Linear APP/note I	3.95	Osborne Intro to Micro Vol. 0	7.50	Mot. Vol. 6 Linear Data	3.95
NSC Linear APP/note II	3.95	Osborne Intro to Micro Vol. I	7.50	Mot. Vol. 9 Schottky TTL	2.95
NSC CMOS Data	2.95	Osborne Intro to Micro Vol. II	7.50	Mot. MPU Applications	25.00
NSC Audio Data	3.95	Osborne 8080 Programming	7.50	Mot. MPU Prog. Ref. Manual	3.95
NSC Volt Reg. Data	2.95	Osborne 6800 Programming	7.50	Mot. Power Data	2.95
NSC Memory Data	3.95	Osborne Z80 Programming	7.50	Mot. Rectifier Data	2.95
NSC MOS/LSI Data	3.95	TI Power Semi's Data	7.50	Mot. Switching Tran.	2.95
NSC Power Transistors	2.95	TI TTL Data	6.95	Mot Zeners	2.95
Intel Databook	3.95	TI Transistors & Diodes	8.50	Basic Software SRI Vol. I or II	24.95
Intel MCS85 Manual	7.50	TI Memory Data	3.95	Basic Software SRI Vol. III	39.95
Intel MCS80 Manual	7.95	TI Optoelectronics	3.95	Basic Software SRI Vol. IV or V	9.95
Intel MCS40 Manual	4.95	TI Linear Data	3.95	Basic Software SRI Vol. VI	49.95
AMD 8080 Handbook	5.95	TI Bipolar Memory	3.95	Basic Software SRI Vol. VII	39.95
AMD Linear Data	4.95	TI Interface Data	4.95	1978 IC Master	47.50
AMD Schottky Data	4.95	Motorola Semi Data 1, 2, 3	9.95		

6800 DESIGNER BOARDS MODULES PROTO BOARDS

★ Motorola Compatible Modules*

MEK 6800 D2 Kit	$235.00	AMI EVK 200 Kit	249.95
9600 6800 MPU Module	495.00	AMI EVK 300 Assembled	275.00
9601 16 slot Mother Bd.	175.00	EVK Kluge Board	95.00
9602 16 slot Card Cage	75.00	EVK 16K Byte Ram Board	75.00
9603 8 slot Mother Bd.	99.00	EVK 6 Slot Motherboard	35.00
9604 System Power Supply	250.00	EVK Extender Board	45.00
9610 Prototype Board	36.00	EVK Solid Frame Chassis	129.00
9615 4KEprom Module	250.00	EVK Connectors	6.50
9620 16 port parallel I/O	375.00	AMI 6800 Proto Rom	30.00
9626 8K Static RAM	295.00	AMI 6800 Micro Assembler Rom	30.00
9626K 8K Static RAM Kit	225.00	6800 Tiny Basic Paper Tape	20.00
9630 Extender Card	60.00	6800 Tiny Basic Eprom	125.00
9640 Multiple Tuner Prog.	395.00		
9650 8 port Duplex Asyn. I/O	395.00		
Mot 43/86 Connectors w/wor s/t	5.95		
AMI EVK 99* 6800 sub Kit	99.00		

ZILOG COMPATIBLE BOARDS
Z-80 CPU 395.00
ZDC Disc Controller 395.00
MEM 16/65K Memory 595.00

SUPPORT DEVICES

AM9511 Arith Processor	$195.00
AM9517 DMA Controller	71.95
AM9519 Universal Interrupt	24.95
3881 (Z80 PIO)	11.25
3881-4 (4MHz)	14.95
3882 (Z-80 CTC)	11.25
3882-4 (4MHz)	14.95
8205/74S138 Decoder	2.95
8212 8 bit I/O	3.25
8214 Priority Int	7.95
8216 Bus Driver	3.25
8224 Clock Gen	3.95
8224-4 (4MHz)	8.75
8226 Bus Driver	3.95
8T26 Bus Driver	2.39
8228 Sys. Control	6.95
8238 Sys. Cont	7.95
8251 Prog. I/O	11.50
8253 Int. Timer	27.95
8255 Prog. I/O	11.50
8257 Prog. DMA	27.95
8259 Prog. Int	27.95
8275 CRT Controller	125.00
8279 Prog. Keyboard	19.95
6810-1 128 x 8 RAM	4.75
6820 PIA	7.95
6828 Priority Int	11.95
6834-1 512 x 8 Eprom	12.95
6850 ACIA	7.95
6852 Serial Adapter	9.95
6854/HD46505 CRT Contr.	39.95
6860 Modem	14.50
6862 Modulator	17.50
6871A 1.0MHz OSC	25.95
2350 USRT	9.95
6880 Bus Driver	2.39
1821 SCD 1K RAM	25.00
1822 SCD 256 x 4 RAM	16.95
1824 CD 32 x 8 RAM	9.95
1852 CD 8 bit I/O	10.95
1856 CD I/O	8.95
1857 CD I/O	8.95
6520 PIA	8.95
6522 Mult	9.95
6530-002	15.50
6530-003	15.50
6530-004	15.50
6530-005	15.50
3851 F8 Prog. Store	14.95
3853 F8 Memory I/O	14.95

PROMS

2708	12.95
2708-6	5.95
1702A	4.95
1702A-6	3.75
2716-5V	44.95
2716-5V, 12V	24.95
2758 5V	25.95
5203AQ	11.95
5204AQ	9.95
6834-1	12.95
IM 5610	2.95
82S123	2.95
82S126	4.50
82S129	4.95

RAMS DYN.

4116 16K x 1	18.95
4115 8K x 1	11.95
4050 4K x 1	4.45
4060 4K x 1	4.45
4096 4K x 1	4.25
2104 4K x 1	4.95
2107B-4 4K x 1	4.95
5261	1.95
5262	1.95
5270	4.95
5280	4.95
1103	1.95
4006L	1.95
TMS4070 16K x 1	19.95
4027-3	4.95
MCM6605 4K x 1	4.95

FLOPPY DISK I/O

1771 I/O 8" only	22.95
1771-01 8" & Minifloppy	27.95
uPd372 Nec Floppy	49.95
1781 Dual Floppy	89.95

CHARACTER GENERATORS

RO32513-001 (5V) Upper	9.50
RO32513-002 (5V) Lower	10.95
RO32513-ADM3 (5V) Lower	14.95
MCM6571	10.75
MCM6571A	10.75
MCM6574	14.50
MCM6575	14.50

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

UARTS/USRTS

TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	5.50
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	9.95
IM6403	9.95
2350 USRT	9.95
1671B Astros	24.95

BAUD RATE GENERATORS

MC14411	11.25
4702	14.95
WD1941	9.95

TV CHIPS

MM5320 TV Synch	7.95
MM5369 Prescaler	3.95
LM1889 Modulator	3.95
CW300 Saw Function	1.50
MM57100 Color TV Game	6.95
MM57104 Clock	3.75
AY38500-1 TV Game	5.95
AY38600 Color TV Game	24.95
AY38615-1 Color Converter	8.95
AY38700-1 Tank Chip	29.95
RF Modulator with Audio	8.95

A/D CONVERTERS

8700	8 bit Binary	13.50
8701	10 bit Binary	22.00
8702	12 bit Binary	36.95
8705	12 bit TS	42.95
9400	Volt to Freq. Conv.	7.25
8750	3-1/2 Digit BCD	13.95
8038	Multifunction	3.95
1408L6	6 bit	3.95
1408L8	8 bit	5.95
DAC01	A/D	5.95

TV INTERFACES

Pixie-Verter	8.50
TV-1 Video Interface	8.95
Pickles & Trout TV Mod. Kit.	20.00
Multiverter	35.00
M&R Modulator	35.00

MICROPROCESSORS

Z-80	$21.95
Z-80A	29.95
F-8 (3850)	19.95
2650	24.95
CD1802	19.95
8080A	12.95
SALE 8085	18.95
8008-1	14.95
2901	21.95
2901A	29.95
TMS 9900JL	89.95
CP1600	39.95
6502	19.95
IM6100	29.95
6800	19.95
6802P	32.95

SOCKETS

8 Pin ww	.32	14 Pin S/T	.20
14 Pin ww	.37	16 Pin S/T	.22
16 Pin ww	.38	18 Pin S/T	.31
18 Pin ww	.60	22 Pin S/T	.35
20 Pin ww	.80	24 Pin S/T	.41
22 Pin ww	.83	28 Pin S/T	.49
8 Pin S/T	.17	40 Pin S/T	.63

CONNECTORS

6 Pin Single S/E	1.49
15/30 Dual S/E	1.95
18/36 Dual S/E	2.36
22/44 Dual S/E	2.95
40/80 W/W	4.95
43/86 Dual W/W/S/T	6.50
50/100 IMSAI W/W	4.75
50/100 IMSAI S/T	4.75
50/100 Altair W/W/S/T	5.95
IMSAI Card Guides	4/1.00

25 Pin-D Subminiature

DB25P	3.25
DB25S	3.75
Hood	1.25
Set w/Hood	6.50

NEW CTS DIPSWITCHES

CTS206-4	$1.75	CTS206-8	$1.95
CTS206-5	$1.75	CTS209-9	$1.95
CTS206-6	$1.75	CTS209-10	$1.95
CTS207-7	$1.75		

8080 USER'S IT'S HERE LIVERMORE BASIC
ON 65K ROM
THAT'S RIGHT ON ROM!!
OUR PRICE only $95.00

PCG PROGRAMMABLE CHARACTER GENERATOR
The hottest version of STARWARS available.
S-100 Compatible 2MHz Kit with object code on tarbell or cuts $169.95

NAKED PC BOARD SALE S-100

Z-80 CPU (ITHACA)	34.95
Z-80 CPU (TDL comp.)	34.95
8080A CPU	34.95
8K Static Logos	21.95
8K Eprom Byteuser	21.95
32 Static S-100	59.95
Tarbell Floppy I/O	39.95
Tarbell Cassette	29.95
Vector 8800 Proto	19.95
ACP Proto Bd	27.95
ACP Extender w/conn	15.95
Realtime Clock	34.95
WMC 13 Slot Mother Bd	33.00
S-100 8 Slot Mother Bd	34.95
Vector 8803 11 Slot M. Bd	29.95
SSM Video I/O	27.95
SSM I02 Parallel I/O	27.95

UV "Eprom" Eraser
Model UVs-11E $59.50
Holds 4 Eprom's at a time
Backed by 45 years UV experience
Model S-52T $219.95
Professional Industrial Model

ATTENTION KIM USERS
[illegible]

ATTENTION PET USERS
[illegible]

ATTENTION TRS-80 USERS
[illegible]

ATTENTION APPLE II USERS
[illegible]

All Shipments FCM or UPS. Orders under $100.00 add 5% handling and postage. Orders over $100.00 add 2.5% handling & postage. Mastercharge/Bankamericard/COD accepted w/25% deposit. California Residents add 6% tax. Foreign Orders add 8% handling. All parts prime factory tested guaranteed. Same day shipment. Add 25 cents for Data.

Retail pricing may vary from Mail Order Pricing

STATIC RAM HEADQUARTERS

	1-24	25-99	100
21L02 450ns	1.30	1.25	1.15
21L02 250ns	1.59	1.55	1.45
2102	1.25	1.15	1.10
91L02APC	1.75	1.65	1.60
21L11-1	4.10	3.95	3.75
211-1	3.75	3.65	3.55
21L12-1	4.25	4.10	3.95
2112-1	2.95	2.85	2.65
21L01-1	3.95	3.75	3.65
2101-1	2.90	2.70	2.55
2114-3 300ns	9.95	9.75	9.25
2114-4 450ns	9.95	9.75	9.25
TMS4044	9.95	9.75	8.25
TMS4045	9.95	9.75	9.25
EMM4200A	12.80	11.95	9.95
EMM4402	7.95	7.25	6.95
5101C-E	7.95	7.95	7.25
upd410(4200)	10.95	10.25	9.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
FSC 460/48416K CCD Only $18.95 Each			
1101	1.95	1.75	1.25
P2125/93425 (45 ns.)	7.95	7.35	7.25

WAVEFORM GENERATORS

8038 Function Gen.	3.95
MC4024 VCO	2.45
LM566 VCO	1.75
XR2206 Function Generator	5.25

CHARGE COUPLED DEVICES
16K CCD -First time offered Fairchild 460 CCD 16K Memory (now you can experiment with CCD technology at a reasonable price. 17 page Application note supplied with each order. Quantity Limited)
$18.95 each (reg. 43.00)

CRYSTALS
Microprocessor Timebases TV Game

Frequency	Price	Frequency	Price
1.0MHz	$5.85	6.0MHz	$ 4.95
1.8432	4.95	6.144	4.95
2.0MHz	5.85	6.5536	4.95
2.01MHz	2.95	10.0MHz	4.95
2.097152MHz	5.85	13.0MHz	4.95
2.4576MHz	5.85	14.31818	4.95
3.579545MHz	1.50	18.0MHz	4.95
4.0MHz	4.95	18.432MHz	5.95
4.194304MHz	5.95	20.0MHz	4.95
4.91520MHz	5.95	22.1184MHz	5.95
5.0MHz	4.95	27.0MHz	4.95
5.0688	4.95	36.0MHz	5.95
5.7143MHz	5.95	48.0MHz	5.95
		100KC	12.95

DISPLAYS/OPTO

DL 704/707/CC/CA 300	1.25
FND359 CC 357	.95
FND 500/507/CC/CA 500	1.35
FND 503/510 CC/CA 500	.95
FND 800/807 CC/CA 800	2.50
Bowmar 9 digit bubble	.89
FSC 8024 4 digit CC 800	4.95
HP7340 HEX Display	19.95
TIL 305 5 x 7 Array	4.50
TIL 306 7 seg w/logic	6.95
TIL 308 7 seg w/logic	6.95
TIL 309 7 seg w/logic	7.95
TIL 311 HEX Display	12.95
MA 1003 12 auto clock	17.95
MA 1002 4 digit clock module	9.95
MA 1010 4 digit clock module	9.95
NSN 373/374 dual CC/CA 300	2.20
NSN 583/584 dual CC/CA 800	2.60
NSN 783/784 dual CC/CA 700	3.00
4N25 Opto Isolator	1.10
MCT 2 Opto Isolator	.89
4N33 Darlington ISOL	1.75
Red Led's .185 Dia	5/1.00
Green/Yellow	4/1.00
HP 5082/7731 7 seg	.90

MONTHLY SPECIALS

14 Pin S/T sockets 1000 pcs	.10
16 Pin S/T sockets 1000 pcs	.11
22 Pin S/T sockets 1000 pcs	.12
FSC460/464 16K CCD's	18.95
AMD 9140CDC Static Ram	10.95
4116/416 16K Dynamic Ram's	8 for/149.95
1488 or 1489 RS232 Driver	1.25
8T97 Buffer	1.25
8130 or 8131	2.45
8833 or 8835	1.99
74367 or 74368	6/5.00
75451/52/53	10/2.50
8T26 Bus Driver	2.39
78L05 Regulator	2/1.00
MCT2 Optoisolator	.69
2510A Shift Register	2.95
2519A Shift Register	2.95
MM5056 Shift Register	2.95
LM760N-14 Compartor	1.10
DS0025CN Clock Driver	1.49
DS0026CN Clock Driver	2.50
8T20 Bidirect oneshot	3.49
1403AN Shift Register	1.50
9368	2.95

NEW 1978 CATALOGUE SEND 25¢ POSTAGE

DISCOUNT COMPUTER CORNER

	Discount Cash	Computer Credit Card
Apple II/16K	$1125.00	$1156.00
TEI PT208	4599.00	4699.00
TEI MCS122	450.00	462.00
Cromemco Z-2	536.00	551.00
Cromemco SYS III	5499.00	5561.00
Decwriter II	1475.00	1525.00
Persci 277	1230.00	1266.00
Shugart 800/801	495.00	512.00
Pertec FD200	299.00	319.00
MFE Dual 751	730.00	744.95
Shugart 400	326.00	316.00
Horizon I	1439.00	1479.00
North Star	599.00	617.00
Low Cost S-100 Bus	149.95	155.95
ADM 3 Assem	829.95	865.00
Soroc IQ 120	895.00	948.00
Teletype Model 43	1199.00	1230.00
AM100	Contact sales desk	
Imsai w/22 slots	599.00	617.00
Oliver 2708/16 Programr.	278.00	288.00
Pennywhistle Modem	129.95	129.95
Cromemco 16K Ram	449.00	462.00
Hazeltine 1500	1175.00	1195.00
Okidata 110 w/TFR5232	1675.00	1705.00
Okidata 22 w/TFR5232	2705.00	2810.00
MEK 6800 D2 Kit	235.00	Same
KIM I 6502	229.95	Same
Intercept Jr 6100	281.00	Same
Technico 9900 Kit	299.00	Same
RCA VIP Cosmac	249.00	Same
Rockwell AIM	375.00	Same
Synertek VIM-1	269.00	Same

P. O. BOX 17329 Irvine, California 92713 New Phone (714) 558-8813
TWX: 910-595-1565

Retail Store Open Mon. - Sat.
Located at 1310 "B" E. Edinger, Santa Ana, CA 92705

Ideas for experimenters

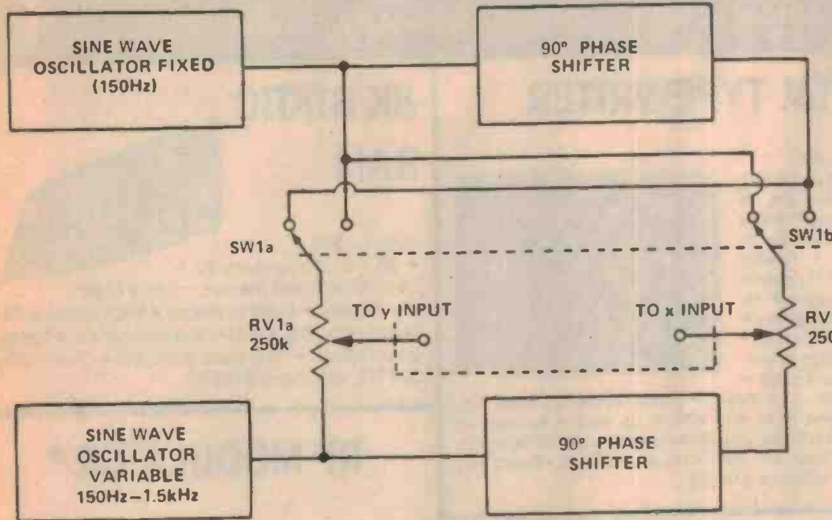


Fig. 1. Block diagram of the 'Spirograph'.

Electronic 'Spirograph'

The circuit will generate 'Spirograph' patterns on a conventional oscilloscope. The circuit consists of two sinewave generators followed by allpass filters which we use to phase shift the input signals by 90°. Applying a sinewave to the y input gives a circular trace. If a second set of sin and cos signals are mixed in, a 'Spirograph' pattern is obtained. A block diagram of the system is shown in Fig. 1.

RV1 is a balance control which varies the contribution of each oscillator to the pattern without affecting the size, so that once set up there is no need to re-adjust the gain controls on the oscilliscope. This type of control can only be used if the oscillators have a low impedance output.

SW1 is a reversing switch which has the effect of turning the pattern inside out.

An existing sinewave oscillator can of course be used and the 50 Hz mains could be employed (attenuated to about 2 V RMS from a low voltage transformer secondary) as the fixed oscillator. However flickering is a problem with lower frequencies (complex patterns requiring four or more cycles to complete will flicker at about 10 Hz using the mains frequency as an oscillator. I found 150 Hz to be a good compromise (higher frequencies require more critical tuning).

The allpass filter is recommended for phase splitting as it has a unity gain for all frequencies and settings of RV5.

First connect the y input of the scope to the output of an oscillator and adjust RV2 until a two volt RMS sinewave is obtained, repeat for second

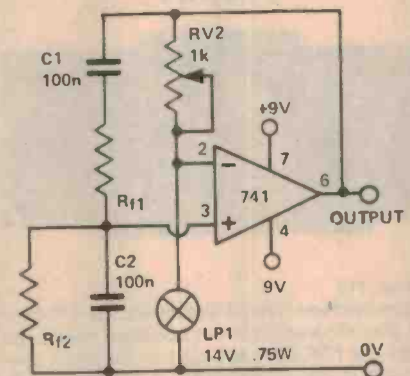


Fig. 2(a). Suitable oscillator for the 'Spirograph'.

oscillator. Then connect up the x and y inputs as shown in Fig. 1, turn the balance control to one end so as to look at the output of the fixed oscillator then adjust the 100 k pot until a circle

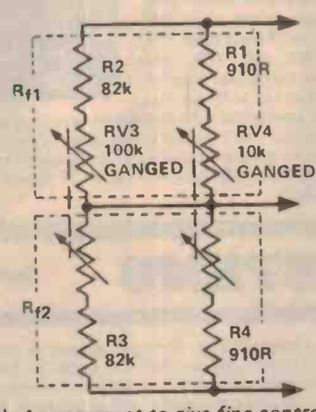


Fig. 2(b). Arrangement to give fine control of the frequency of the oscillator shown in Fig. 2(a). For 150 Hz fixed frequency use Rf1 = Rf2 = 10 k.

Ideas for experimenters

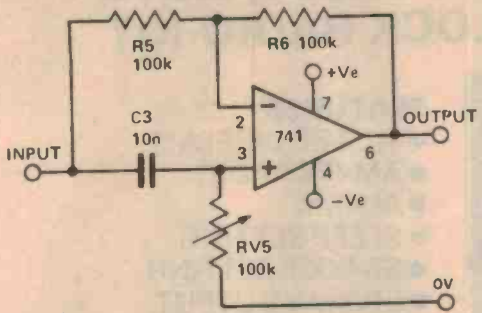


Fig. 3. Phase shifter circuit for use in the 'Spirograph' circuit.

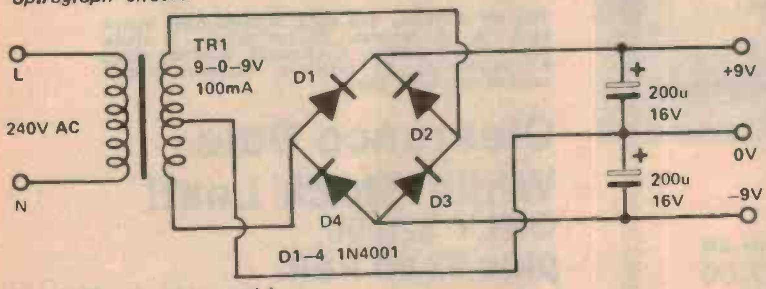
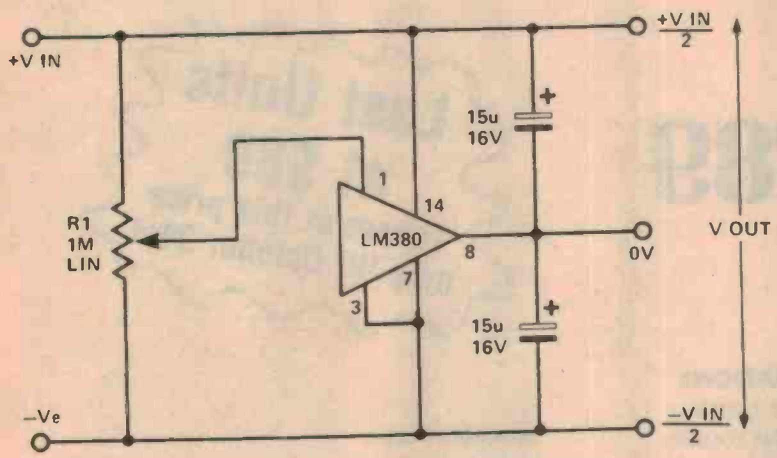


Fig. 4. PSU for 'Spirograph'.

is obtained (with suitable x and y gains). Now put the balance control in the middle and adjust the frequency controls until a stable pattern is produced. SW1 and RV1 the balance control can be used to alter the nature of the pattern without affecting its overall size, stability or symmetry. Adjust RV5, the phase control (following the variable oscillator) for symmetry. — Have fun!



Simple Dual Power Supply

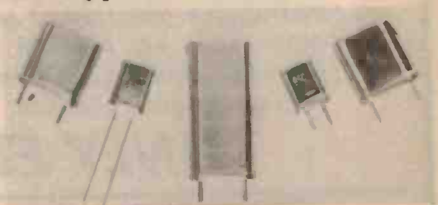
This circuit offers a cheap and simple way of obtaining a split power supply (for Op-amps etc.), utilising the quasi-complementary output stage of the popular LM380 audio power IC.

The device is internally biased so that with no input the output is held mid-way between the supply rails.

R1, which should be initially set to mid-travel, is used to nullify any inbalance in the output. Regulation of V_{OUT} depends upon the circuit feeding the LM380, but the positive and negative outputs will track accurately irrespective of input regulation and unbalanced loads.

The free-air dissipation is a little over 1 watt, and so extra cooling may be required. The device is fully protected and will go into thermal shutdown if its rated dissipation is exceeded, current limiting occurs if the output current exceeds 1A3.

The input voltage should not exceed 20 V.



EDUCAL KIT SPECIALISTS

DIGITAL AM-FM CLOCK RADIO KIT

MODEL EDUCAL DCR-77

Why pay $30.00 for just a clock in an instrument case? Only an extra $7.00 gives you an AM-FM radio plus a moulded plastic case as sold in Europe. (We get English version).

FEATURES

- ½" LED DISPLAY
- AM-FM RADIO
- ALARM
- SLEEP SETTING
- SNOOZE SETTING
- 500mW OUTPUT
- COMMERCIAL CASE

The kit contains one case, transformer, mains cord, 3 PC Boards, 13 transistors, 1 clock module, 10 diodes, 9 IF coils, 8 other coils, 47 capacitors, 51 resistors, speaker, knobs, connectors, wire, etc.

Clearance Sale
While Stock Last!
ONLY $29.00
plus $3.00 P&P.

We are trying to obtain the AM-FM modules pre-aligned for you!

ONLY EDUCAL HAS THE DCR-77

EDUCAL

AM-FM STEREO TUNER KIT

$89

Last Units at $89
Tuners at this price only till October 31st

FEATURES

- PRE-ALIGNED FM MODULES (3)
- MONO/STEREO
- LOCALLY PRODUCED—NOT IMPORTED
- 4 PRE-SET STATIONS ON FM
- FULL RANGE MANUAL TUNING AM-FM
- 75 or 300Ω INPUT
- A.F.C.
- STEREO BEACON
- PROFESSIONAL FINISH

SPECIFICATIONS

TUNING 88-108MHz
BANDWIDTH 300KHz
I.F. 10.7MHz
I.F. REJECTION 65dB
IMAGE SUPRESSION 40dB
A.M. REJECTION 40dB
CHANNEL SEPARATION 38dB (min.)
DIMENSIONS 13.75" x 10.5" x 4.25"

P.&P. $3.00

Available from:

McGRATHS
Lt. Lonsdale St,
Melbourne. Vic.

GEORGE HAWTHORN
968 High St,
Armadale. Vic.

QUANTUM ELECTRONICS
Cnr Liverpool & Harrington Streets, Hobart. Tas.

AQUARIAN SOUNDS
Canberra. ACT.

NOTE ALL KITS EX STOCK SENT RETURN MAIL.
MAIL ORDERS BOX No.182, CARLTON SOUTH, VIC. 3053.

OR EDUCAL, 21 WELLS AVENUE, BORONIA, VIC. 3155 (Tel. 762 5713).

JADE

21L02 (350ns) Static Rams 120 @ $1.00 ea.	1702A E-PROM $4.75 ea.	6502 Microprocessor 5 @ $11.00 ea.	2708 (450ns) E-PROM 8 @ $7.50 ea.	21L02 (250ns) Static Rams 100 @ $1.25 ea.	Z–80 A Microprocessor 5 @ $25.00 ea.
Z-80 Microprocessor 5 @ $20.00 ea.	MM5257 lo pw repl. TMS4044 8 for $8.00 ea.	2114 L (250 ns) 8 for $8.25 ea.	TMS 4044 (250ns) 16 @ [illegible] ea.	4200 A (200 ns) Static Rams 25 @ $10.00 ea.	4116 (200ns) 16K Dyn. Ram 8 @ $20.00 ea.

MICROPROCESSORS

F8	16.95
Z80	20.00
Z80 A	25.00
1802	19.95
2650	24.95
AM2901	22.95
6502	10.95
6800	17.95
6802	24.95
8008-1	12.00
8035	22.00
8080 A	9.95
8085	27.00
8748	60.00
TMS9900	67.00

8080 A SUPPORT DEVICES

8212	3.00
8214	8.50
8216	3.75
8224	3.50
8224-4	9.95
8226	3.95
8228	7.95
8238	7.50
8251	8.75
8253	20.95
8255	11.00
8257	19.95
8259	19.95
8275	75.00
8279	20.00

6800 SUPPORT

6810P	4.95
68B10P	6.00
6820P	7.50
6821P	7.50
6828P	11.25
6834P	16.95
6850P	9.75
6852P	11.75
6860P	10.00
6862P	14.50
6871P	28.00
6875P	8.75
6880	2.00

CHARACTER GEN.

2513 U/L	6.75
2513 (5v) U/C	9.75
2513 (5v) L/C	10.95
6571	10.95
6571 A	10.95
6574	13.25

DYNAMIC RAMS

416D (200ns)	20.00
4116 (200ns)	20.00
2104/4096	4.00
2107B-4	3.95
TMS4027	4.00
TMS4050	4.00
TMS4060	4.50
4096	4.00
MM5270	4.50

PROMS

1702A	5.00
2516 (5v)	50.00
27.08	9.00
2716 (TI)	30.00
2716 (INTEL)	50.00
2758	26.60

STATIC RAMS

	1-63	64 up
21L02 (45 (450ns)	1.50	1.18
21L02 (250ns)	1.75	1.50
410D	10.00	8.50
2101-1	2.95	2.50
2102	1.25	.90
2111-1	3.25	2.65
2112-1	2.75	2.35
2114 (300ns)	10.00	8.25
2114 (450ns)	9.00	7.69
2125L	11.00	8.30
TMS4044 (250ns)	8.95	8.00
TMS4044 (450ns)	8.20	7.40
4200A	10.00	8.60
TMS4045 (250ns)	8.95	8.00
TMS4045 (450ns)	8.20	7.40

FLOPPY DISC CHIPS

1771B-01	39.95

KEYBOARD ENKODERS

AY-5-2376	12.75
AY-5-3600	13.75

SHUGART 801R

8" FLOPPY DISC DRIVE.

$550.00

KIM – 1

Assembled and Tested
$245.00

MEMORY PLUS

for KIM–1
8K RAM (21L02)
8K EPROM
ASSEMBLED & TESTED
$245.00

THE APPLE II COMPUTER

One of the best "Total Package" home and business computers on the market. "Basic" in ROM, Color Graphics, Floating Point Basic Package, etc.

16K version only **$1,095.00**

416D 16K x 1

Dynamic Ram Chip can be used for expanding Apple II Memory or the TRS-80 (200ns)

8 for $20.00 ea.
16 for $18.00 ea.

Call for quote on larger quantities

full ASCII PROFESSIONAL KEYBOARDS

* Full 128 Character ASCII
* Tri-Mode MOS Encoding
* MOS/DTL/TTL Compatable Output
* Two-key Rollover
* Level and Pulse Strobe
* Shift and Alpha Lock
* Selectable parity
* Positive or Negative Logic.

MODEL 756 (56 keys)

PRICING INFORMATION

Model 756 (assembled)	$59.95
Model 756K (kit)	$49.95
Model 702 enclosure	$29.95
Model 710 numeric pad	$9.95
Model 756MF Mtg. Frame	$8.95

MOTHER BOARDS - S100 STYLE

9 slot "Little Mother"	$35.00
Assembled and Tested	$75.00
13 slot with front panel slot	
Bare board	$35.00
Kit	$70.00
Assembled & Tested	$110.00
22 slot Assembled & Tested	$149.95

CONNECTORS

DB-25P $2.25 DB-25S $3.25
COVER $1.50

44 Pin - PC & EYE	$1.95
44 Pin - WW	$2.50
86 Pin - (6800) PC	$5.00
86 Pin - (COSMAC ELF) PC	$5.00
100 Pin - (Altair) PC	$4.50
100 Pin - (Imsai) WW	$4.25
100 Pin - (IMSAI) PC	$3.25

MODEL 801R Shugart Disc with Cabinet

Includes Cabinet, Disc Drive, Power Supply, Cable, Fan & Data Cable. Has AC line filter.
Cabinet size 10"H x 10"W x 16"D
MODEL DM 2700-S **$750.00**

FLOPPY DISC INTERFACE

JADE Floppy Disc (Tarbell Board) KIT **$175.00 ea.**

S.D. Computer Products Versa Floppy Kit **$149.00 ea.**
Assembled & Tested **$189.00 ea.**

STATIC RAM BOARDS

ASSEMBLED & TESTED

8K

Ram 8 (250ns)	$169.95
Ram 8B (450ns)	$139.95
250ns KIT Mem-1	$169.95
450ns KIT Mem-1	$125.00
BARE BOARD	$25.00

16K Uses 2114 (lo pwr.)

Ram 16 (250ns)	$375.00
Ram 16B (450ns)	$325.00
MEM-2 Kit (250ns)	$285.00

32K Assembled & Tested by SEALS ELECTRONICS

JG-32 (250ns)	$795.00
JG-32B (450ns)	$725.00
250ns KIT	$575.00

6800 Adapter - adapts Mem-1 8K board to Motorola MEK 6800D2 evaluation kit.

16K STATIC BOARD

with memory management can be used with Alpha Micro or Cromenco Systems. ASSEMBLED & TESTED

RAM 65 (250ns)	$390.00
RAM 65B (450ns)	$350.00

E-PROM BOARDS

MR-8 (8K uses 2708) KIT with 1K RAM	$99.50
MR-16T (16K uses 2716) KIT with 1K RAM	$99.50
EPM-1 (uses up to 4K of 1702)	$59.95
RAM/N/ROM (16K uses any E-PROM) KIT	$117.00
JG-8/16 (uses 2708 or 2716) KIT	$59.95
BARE BOARD	$30.00

EXPANDABLE E-PROM – S.D. Computer Products
16K or 32K EPROM $49.95 without EPROM

Allows you to use either 2708's for 16K of Eprom or 2716's for 32K of EPROM.

COMPUTER MAINFRAME

Includes: **$295.00**
Power Supply +8v at 18amps
±16v at 2 amps
Mother Board - 12 slots with connectors Assembled & Tested
Has Whisper Quiet Fan & AC Line Filter
Cabinet size 7"H x 19"W x 22" D

DYNAMIC RAM BOARD

by S. D. Computer Products

On board refresh is provided with no wait states or cycle stealing required. +8 VDC 400MA DC, +18 VDC 400MA and -18 VDC 30 MA DC.

EXPANDABLE 32K uses 4115 (200ns)

8K Kit	$151.00	24K Kit	$325.00
16K Kit	$240.00	32K Kit	$400.00

EXPANDABLE 64K uses 4116 (200ns)

16K Kit	$250.00	48K Kit	$675.00
32K Kit	$475.00	64K Kit	$875.00

JADE 16K DYNAMIC KIT
uses 4096 (300ns) **$200.00**

JADE Z80 KIT

with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

(2MHZ)	$135.00 ea.
Assembled & Tested	$170.00 ea.
(4MHZ)	$149.95 ea.
Assembled & Tested	$184.95 ea.
Bare Board	$35.00 ea.

JADE VIDEO INTERFACE KIT

KIT	$99.95
Assembled & Tested	$139.95

S-100 Bus compatible
32 or 64 Characters per line - 16 lines
Graphics (128 x 48 matrix)
Parallel & compositive video
On board low-power memory
Powerful software included for cursor, home, EOL, Scroll Graphics/Character Upper case, lower case and Greek. Black-on-white & White-on-black.

JADE PARALLEL/SERIAL INTERFACE KIT

KIT	$124.95
Assembled & Tested	$154.95

* S-100
* 2 Serial Interfaces with RS232 interfaces or 1 Kansas City cassette interface.
* Serial interfaces are crystal controlled
* Selectable baud rates.
* Cassette works up to 1200 baud.
* 1 parallel port.

TV-1

Convert T.V set to Video Monitor
KIT . . . $8.95

JADE 8080A KIT

$100.00 KIT
BARE BOARD $30.00

JADE
Computer Products

4901 W. Rosecrans
Hawthorne, Ca. 90250
U.S.A.

Phone: (213) 679-3313
Telex: 18-1823 JADECPHWTH

Discounts available at OEM quantities. All prices above are quoted in U.S. $ F.O.B. Hawthorne, Calif., U.S.A. To expedite shipments please include international money order or bankers check payable against any U.S. bank in U.S. $, or use your Barclay, Access, or American Express credit card (include card number, expiration date, and signature). Add 20% of total order for postage.

electronics today SERVICES ADVERTISERS INDEX

READERS' LETTERS

No charge for replies but a foolscap-size stamped addressed envelope must be enclosed. Project queries can only be answered if related to item as published. We cannot assist if project is modified nor if components are otherwise than specified.
We regret we cannot answer readers' enquiries by telephone.

SUBSCRIPTIONS AND BACK ISSUES

ETI subscriptions cost $17.00 per year (inc. postage) within Australia. Cost elsewhere is $17.65 (inc. postage — surface mail). Airmail rates on application.
Back issues cost $1.25 each plus 45 cents post and packing.
We can supply only the following issues.
1976: Nov., Dec.
1977: All issues except Jan, Feb, March.
1978: All issues.
Photostats are available of any article ever published in ETI. We charge a flat $1.00 regardless of page quantity from any one issue of ETI. Thus if the article is in three issues the cost is $3.00 Send orders to address below.
Binders $4.50 plus 90c post NSW, $2.00 other States.
Microfiche editions of this publication are available by annual subscription from Microsystems Pty Ltd, PO Box 188, North Sydney, NSW. 2060.

LIABILITY

Whilst every effort has been made to ensure that all constructional projects referred to in this edition will operate as indicated efficiently and properly and that all necessary components to manufacture the same will be available, no responsibility whatsoever is accepted in respect of the failure for any reason at all of the project to operate effectively or at all whether due to any fault in design or otherwise and no responsibility is accepted for the failure to obtain any component parts in respect of any such project. Further, no responsibility is accepted in respect of any injury or damage caused by any fault in the design of any such project as aforesaid.

A MODERN MAGAZINES PUBLICATION

Secretary: Charles O'Leary
Publisher: Collyn Rivers

PRODUCTION

Art Director: Sheila Tonsic
Assembly: Bill Crump/Simon Bracken
Production Manager: Bob Izzard
Subscriptions & Circulation: John Oxenford
Project Design: Nebula Electronics
Acoustical Consultants: Louis A. Challis & Assoc.

ADVERTISING

Sydney: Modern Magazines
Bob Taylor (Manager), Geoff Petschler (NSW Manager), 15 Boundary St., Rushcutters Bay 2011. Tel: 33-4282.

Melbourne: Modern Magazines
Tom Bray (Manager), Poppe Davis, Suite 24, 553 St. Kilda Rd, Melbourne. Tel: 51-9836.

Brisbane: Modern Magazines
Geoff Horne, 60 Montanus Drive, Bellbowrie, Qld. 4070. Tel: 202 6229.

Adelaide: Modern Magazines
Tony James, 16 Montrose Ave, Netherby. 5062. Tel: 79 4740.

Perth: Aubrey Barker, 133 St. George's Terrace, Perth. 6000. Tel: 322 3184.

Hobart: H.W. Lincone, 23 Lord St, Sandy Bay. Tasmania. 7005.

Tokyo: Genzo Uchida, Bancho Media Service, 15 Sanyeicho, Shintuku-Ku, Tokyo 160.

London: Electronics Today International, 25-27 Oxford St, London, WIR 1RF. Tel: 01-434-1781/2.

U.S.A.: Elmatex International, PO Box 34607. Los Angeles, CA. 90034. Tel: (213) 821 8581. Telex: 18 1059 (Elmatexint USA)

Electronics Today International is published by Modern Magazines (Holdings) Ltd, 15 Boundary St., Rushcutters Bay, NSW 2011. It is printed (in 1978) by Wilke & Co., Browns Rd, Clayton, Victoria and distributed by Australian Consolidated Press.

ADVERTISERS INDEX