NOVEMBER 1976 $1.00 *
NZ $1.15

# electronics TODAY INTERNATIONAL

FREE CATALOGUE from EDGE ELECTRIX

SIMPLE TO BUILD


Four basic games
Two ball speeds
Two or four angles • Two bat sizes
On-screen scoring • Sound effects

# TV GAME

Electronics Today International is Australian owned & produced

Registered for posting as a publication Category C.

NEW MONTHLY SECTION

# PRINT-OUT

A MINI-MAGAZINE FOR ALL MICRO-COMPUTER USERS

# Well stacked in front


The new range of JVC front-loading cassettes is here. And if you think that's the only change, you're highly mistaken. Because, as usual, JVC brings in the range with a few unique additions which are going to make you think twice about any other brand.

For a start, the JVC ANRS sound reduction system is incorporated throughout, to make hi fi recording and playback as free of hiss as possible. And in some cases, even improving the dynamic range of normal cassettes.

Another exclusive is the JVC Sen-alloy head, and believe it or not, it offers you the clearest sound and longest wearing lifespan of any head available; originally designed solely for professional use, this head is now incorporated in JVC cassette decks CD-S200 and CD-1970.

And yet another first: JVC is the only manufacturer to provide decks with 5 LED peak-level indicators so that your recordings are perfect at all times. These are featured on models CD-1920 and CD-S200.

Loading is, of course, simplified. The special compartment is air-damped and removable for uncramped head maintenance.

The JVC famous range of top-loaders is still available, offering you the very highest quality. All things considered, there is no other consideration.

**JVC**

the right choice

For details on JVC Hi Fi Equipment, write to: JVC Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033.

# electronics TODAY INTERNATIONAL

A MODERN MAGAZINES PUBLICATION

NOVEMBER 1976, Vol. 6 No. 11

Publisher Collyn Rivers
Editorial Steve Braidwood

Managing Director Arnold Quick
Secretary Charles O'Leary
Marketing Services Manager Alex Macleod
Subscriptions & Circulation Manager John Oxenford

**Electronics Today International is Australian owned and produced. It is published both in Australia and Britain and is the fastest growing electronics magazine in each country.**

## PROJECTS



## FEATURES



## NEWS & INFORMATION



SPECIAL OFFER
'Sleeping Dog'
Car Alarm . . .
see page 35

NEW SECTION FOR COMPUTER ENTHUSIASTS
Starts on page 85

*COVER: Build one of the best video games around — and whatever your level of skill you will be able to select a game to match. If you think you are really good try playing our soccer game — with a high speed ball, small men, and four-angle passing. The project starts on page 44.*

* Recommended retail price only

*Extracts from an address by Mr. E. Nakamichi, President Nakamichi Research Inc. at a recent Seminar in Sydney for Nakamichi dealers.*

*"TDK Super Avilyn Cassettes are recommended for use with all Nakamichi tape decks. Before leaving our factory, all Nakamichi equipment has bias voltages set for TDK SA to achieve optimum performance".*

*"The wear on recording heads is significantly reduced by using TDK Super Avilyn as compared with any Chromium Dioxide tape."*

*"Chromium Dioxide tape is not recommended for use with any Nakamichi tape decks."*


*From the report by Louis A. Challis & Associates Pty Ltd. Consulting Acoustical & Vibration Engineers, NATA laboratory.*

*"TDK Super Avilyn Tape looks like being one of the most important advances in tape formulations in the mid-seventies."*

The TDK Philosophy

To offer cassettes which are capable of capturing and faithfully reproducing the real essence of music and other complex sounds – the subtle harmonics and transient phenomena which give complex musical passages their unique "human" qualities: richness, depth, timbre and other natural sound characteristics.

*There is a TDK TAPE for every occasion.*

| | | Lengths Available |
|---|---|---|
| TDK DYNAMIC | Excellent quality at moderate prices | DC45, DC60, DC90, DC120 DC180 |
| TDK SUPER DYNAMIC | "The Tape-of-the-pro" – The one that turned the cassette into a true high fidelity medium | SD C45, C60, C90, C120 |
| TDK SUPER AVILYN | "The state of the art" performance | SA C60, SA C90 |
| TDK EXTRA DYNAMIC | For discriminating audiophiles who demand the very best | ED C45, ED C60, ED C90 |

*DON'T ASK FOR TAPE – ASK FOR TDK*
*FOR THE SOUND YOU FEEL AS WELL AS HEAR*

# TDK SA breakthrough in tape technology

Super Avilyn's performance exceeds that of Chromium Dioxide formulation which previously was the best choice for linear high frequency response and high-end S/N, but Cr02 suffered from reduced output in the middle and low frequencies (SA provides 1.5-2db more output than the best Cr02 in those ranges, equal output at high frequency).

SA also outperforms the ferric oxide tapes (regular or cobalt energized) which are unable to take full advantage of the noise reduction benefits of the Cr02 equalization because their high end saturation characteristics are not compatible with this standard (they require 1EC 120ms, normal or high EQ).

The net result of SA's characteristics and this EQ difference is a tape with an impressive 4-5db S/N gain over the latest top-ranked high output ferric oxide tapes and more than 10-12 db S/N gain over many so-called low noise ferric oxide tapes.

## Ask for TDK SA Cassettes

TDK

Australian Distributor
**Convoy International Pty. Ltd.**
**4 Dowling Street,**
**Woolloomooloo 2011 358 2088**

# NEWS DIGEST

RAY HAMILTON

# TELEPHONE FOR THE DEAF

Dr. James C. Marsters (who is himself completely deaf) has developed a system which enables the deaf to 'talk' to one another. With the help of a deaf electronics engineer, Dr. Marsters has worked out a communications system that combines the telephone with a teletypewriter. By tapping the teletypewriter keys, messages are carried back and forth from one terminal to another via the telephone link. The system is called 'Phonetype'.

Special features of the system are the flashing lights which make a deaf person aware of the 'phone ringing. If the person is both blind and deaf, fans are used for this purpose and a special Braille typewriter is used. The newest feature, however, is a portable keyboard which enables a deaf person to use any phone by placing the receiver into the device and sending the message in the normal way.

# Selecta Game

Somebody once described the life of a TV critic as 'looking through a glass-bottomed boat as it passes down a sewer'.

Maybe this explains the quite extraordinary worldwide sales of TV games — having spent so much on a set you might as well use it for something!

Innumerable readers have asked us to publish a TV games project — we held off doing so for some time as we felt that the complexity of such a project using discrete components was too great. We also knew that special-purpose ICs would soon be available and that these would simplify the games enormously as well as enabling more facilities to be offered.

The final result, published in this issue, is a most versatile unit featuring on-screen scoring as well as offering a wide choice of games. It can even be modified to include rifle firing practice.

Electronics Today would like to thank Dick Smith Electronics for their very considerable help and encouragement during the development of this project. (Readers will be pleased to know that Dick already has a kit available for this project. It is advertised on page 43 of this issue.)

## Golf Scores by Computer

The 105th British Open Championship, held at Southport this summer, was the first time that the R and A golf club has employed computer terminals to inform spectators of scores.

The club hope to eventually have a system to provide detailed information on the progress of the championship, backed up with analyses of the play and statistics on the players.

## THAT'S APPRECIATION!

When putting together our Mini-Mart page we were pleasantly surprised to find out that a March 1975 issue of ETI is currently worth $5! Perhaps we should put up the cover price of new issues now we know what you are prepared to pay?

## Bubbles coming

Texas Instruments will have samples of their bubble memory before the end of the year. These will be early production models — not laboratory prototypes, according to TI. The single memory chip is organised in 144 registers of 641 bits. Besides the storage material the device contains two permanent magnets to supply the constant direct-current bias needed to preserve the bubbles when the power is removed. Wire coils supply a rotating magnetic-drive field to propagate the bubbles after they've been generated within the epitaxial film. The memory in a 14-pin plastic DIP.

## Watch with a message

A new digital watch from Hughes will have, in addition to the usual functions, a preprogrammed message to flash up on its nine-segment LED displays. The message is limited to a maximum of four five-letter words, which are read sequentially. There is no masking charge for orders over 1000.

## Calling Brisbane Hobbyists

**We draw your attention to the item in Mini-Mart calling for the formation of a general electronics hobby club in your area. If anyone is interested in using the magazine to set up a club in any other area please let us know.**

## ELECTRONICS ENTHUSIASTS NEW STORE

Ian Purdie's new Sydney Western suburbs electronics parts business is expanding rapidly.

An electronics enthusiast himself, Ian knows precisely what the hobbyist needs. The company — Electronic Enthusiasts Emporium is located at Shops 2 & 3 Post Office Arcade, 7-10 Joyce St, Pendle Hill. There's plenty of parking at the rear of the premises.

### EYES IN THE BACK

A Puerto Rican company has developed a system to enable the blind to see by creating images on a matrix of electrodes pressed against the skin of the back. Blind people using the system have been able to walk unaided through obstacle courses and one man can use the system to read one-inch high lettering.

The visual images are picked up by a lens on a spectacle frame and fed via a fibre-optic link to a vidicon tube housed on the main pack worn around the waist. The electrical signals are processed and fed to 3,600 electrodes on the inside of a fabric vest. The electrode voltage is nominally 6 V.

## EMI DATA

The UK Company EMI Limited has announced the formation of a new division, EMI Data, as part of its Industrial Electronics operation, to further develop and market a range of high-security products based on the use of visible or invisible encoding using magnetic materials.

EMI Data uses secure magnetic materials to carry coded information to validate cards and documents used in cash and credit transactions, travel, restricted entry or identification situations.

## Optical link in UK cable TV

***Corning Glass Works tell us that Rediffusion Limited has been using a 1.427-kilometre length of optical cable to carry cable TV programmes to 34000 subscribers in the Hastings area (UK). The optical cable was inserted into the existing network in place of metallic-conductor cable.***

***In England, the optical cable for Rediffusion was installed in 75mm or 100 mm ducts in two sections, the first connected to the second at a distance from the start of 791 metres. Rediffusion engineers reported that the ducts were extensively silted and are generally rather wet. The ducts already carried up to a dozen other cables associated with the system's trunk route and its local distribution network. No special precuations were observed to pull the optical cables through, although quite considerable force was required. The installation was completed in two days without cable damage, the engineers said.***

***The conversion from electrical to light signals takes place in a Plessey gallium arsenide light-emitting diode. At the other end, a photodiode changes the light signals back to electrical signals.***

### ETI NEDERLAND!

Electronica Top Internationaal is now on sale in Dutch newsagents — the first issue in Dutch was published last month. That extends the ETI empire to four editions — in England, France, Holland and of course here where it all started in Australia.

In the next few months we expect to announce yet another edition, but we're keeping it a secret for the time being. At this rate we'll soon have the world completely covered and then we can start on the 'Electronics Today Intergalactical' mentioned last month.

## *BIG-DISPLAY CLOCK MODULE*

A digital clock with LED display showing numerals .84-inch high is now available in quantity from National Semiconductor.

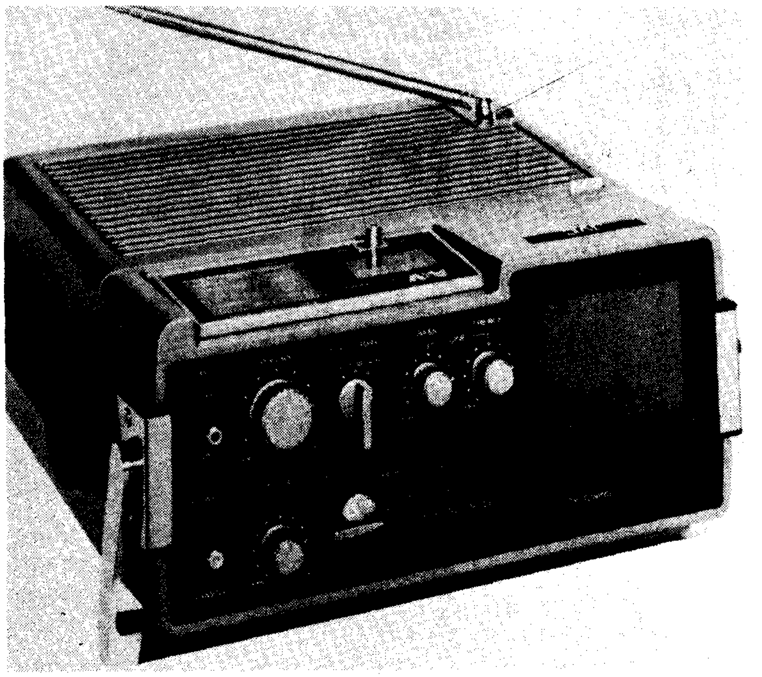
The "MA1010" series clock modules, with LS1 chip, power supply and other discrete components on a single printed circuit board, feature a four-digit .84-inch Light Emitting Diode (LED) display. According to NS this represents a larger numeric display than on any digital clock module previously manufactured.

The user only needs to add a transformer and switches to construct a pretested digital clock for application in a clock radio, digital alarm clock or instrument panel clock.

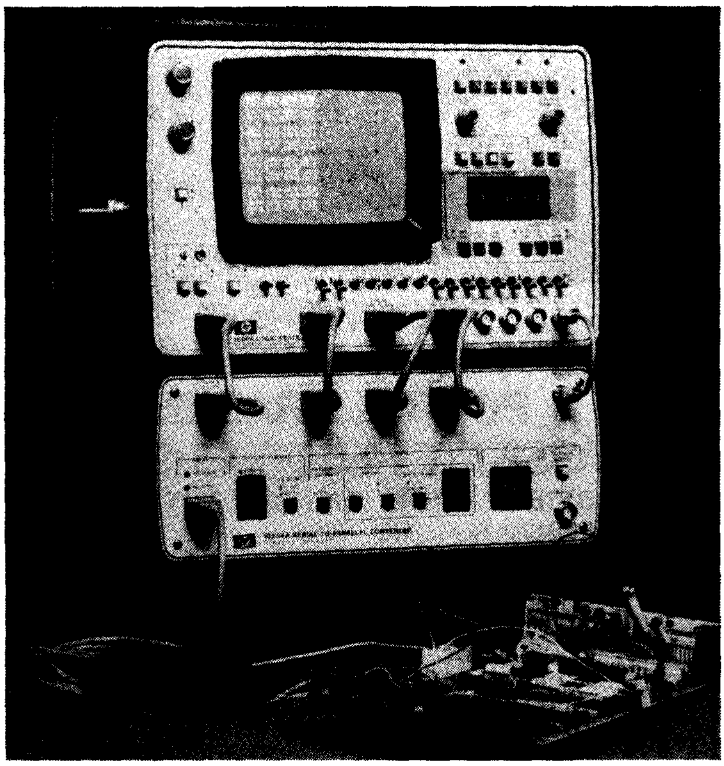
Direct, non-multiplexed drive for the LED display eliminates RF interference, which makes the module easy and economical to use in clock radios and hi-fi systems.

Features include indicators for "alarm-on" and "p.m.", a blinking colon to indicate interruption of power, "sleep" and "snooze" timers, and capability for a variable-brightness control. Time-setting is made easy for the user by providing "fast" and "slow" scanning controls.

Alarm clock options include a transistor oscillator circuit that is capable of driving an 8 ohm loudspeaker, or may be used with an inexpensive earphone type audio transducer.



*The JVC 3050 AUL is a portable FM/MW/SW radio with a TV. It uses a 3 inch screen and a 5 inch speaker. It comes with accessories for operation from car battery or mains. The recommended retail price is $269.*

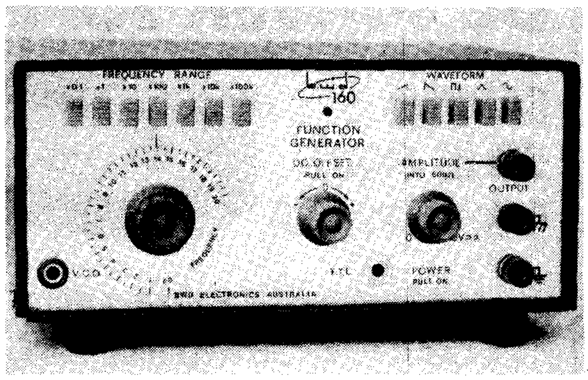


## *HP SERIAL-TO-PARALLEL*

*A new serial-to-parallel converter from Hewlett-Packard, an accessory for HP Logic State Analysers, now makes it possible to apply the analysers' full power to the serial data domain (each "word" treated serially bit by bit on a single line rather than all bits treated simultaneously on parallel lines).*

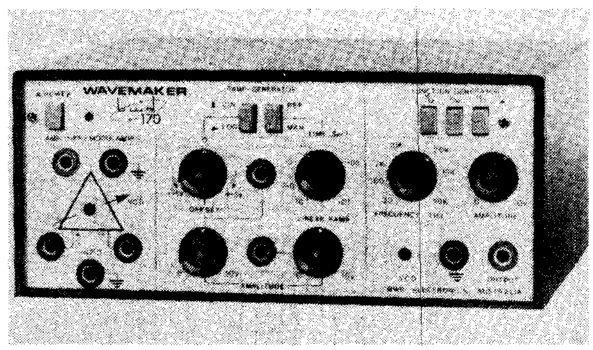
# FUNCTION GENERATORS

If you are concerned with response measurement of audio waveforms two instruments recently developed by BWD Electronics will be worth inspection.



The first of these is the BWD 160A Function Generator, a moderately priced instrument providing selection of 12 different waveforms and 5 simultaneous outputs. Any 4 decades of the frequency range can be swept by an externally-applied sweep. This job is simplified by a companion instrument, the BWD 170 'Wavemaker' which supplies log or linear sweep together with facilities for amplitude or balanced modulation and frequency doubling.

The pulse and ramp outputs are set at 1/10 the indicated frequencies and are available with rising/falling ramp or positive/negative pulse. Five outputs consist of the three basic waveforms at a 1 V p-p level on the rear panel, TTL and the main variable amplitude output (10V pp into 55ohms) on the front panel.



The BWD 170 'Wavemaker' is a unique multipurpose instrument that will generate, modulate, sweep, multiply or amplify waveforms. It supplies sine, square and triangle waveforms which may be swept over 20 Hz to 50 kHz by the ramp generator, or AM or FM modulated by an external modulation source. With a signal source such as the BWD 160A, it provides log or linear ramp to sweep the VCO and linear ramp to drive an oscilloscope or recorder. It modulates internal or external signals to 10 MHz and its frequency doubling capacity produces a variety of wave shapes.

Technical data sheets for both instruments are available from BWD Electronics Pty Ltd, Miles Street, Mulgrave Vic 3170.

# RESULT OF SEPTEMBER'S CONTEST

The Unitrex 90SC offered as a prize in our September contest goes to J E Goris of North Ryde, NSW.

The original puzzle read 'Find the smallest number which gives a remainder of eight when divided by nine, a remainder of seven when divided by eight, and so on down to giving a remainder of zero when divided by one. However at the proof-reading stage we noticed that the word 'smallest' was missing. Our immediate thought was to have the word inserted but then we thought no, we'll leave it out and see what reponse we get (and we decided to accept as valid any entry, whatever the magnitude, which satisfied the criteria).

When the entries came in interesting things started to happen. Firstly, there were many more entries than usual — in all we received over five hundred. About 50% gave a single solution and the others gave either a list of solutions or a general formula for all the solutions (of which there are an infinite number). Very few entries were incorrect (about a dozen).

The most popular general solution to the puzzle was based on 9! - 1, or (9x8x7x6x5x4x3x2x1) - 1, which works out as 362879. In general this becomes i9! - 1, where i is any positive integer. This solution does not, however, give all possible solutions.

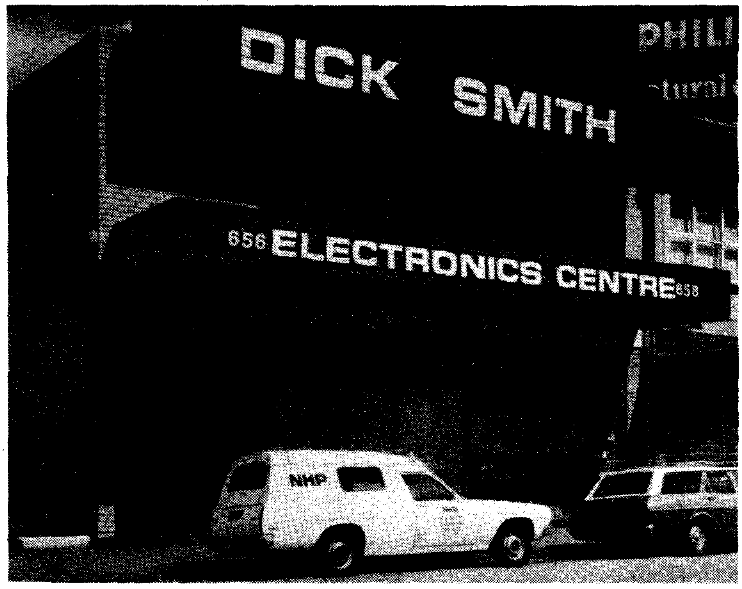
The smallest positive number which solves the puzzle is the lowest common denominator minus one: (9x8x7x5) - 1, which gives 2519. For general solutions based on this we received 2520n - n, 2520i - 1, $3x2ix3i^2x4i^3x5i^4x7i^5$ - 1, 2519 plus 12600n, 2520n - 1, 2519n plus n - 1, where i or n can be any positive integer. Some of these are correct and the last one looks like it might include all positive solutions (unfortunately we're too busy getting the magazine out to spend time investigating the validity of these formulae).

Ten entrants sent in computer printout and the programs they used to find the solution. Several of these included a few hundred suitable answers; one person sent in ten thousand two hundred!

The answer we originally were thinking of was 2519, which, as one reader pointed out, also gives a remainder of nine when divided by ten. However had we said the smallest number when we published the contest we would still have had trouble: Three readers sent in 'minus one' as the solution. This appears incorrect when you say 'nine goes into minus one zero times, zero times nine is zero, the remainder is minus one' (the same goes for all the numbers specified except "one" which goes into minus one 'minus one' times, leaving a remainder of zero).

So, it seems, it is only in the case of division by 'one' that the requirements are fulfilled. But look what happens when you say the other numbers go into minus one 'minus one' times: nine goes into minus one minus one times, nine times minus one is minus nine, the remainder is (-1) minus (-9) which gives eight! One reader actually suggested a series of negative solutions. Fortunately the randomly-selected winning entry wasn't one of these negative entries so we didn't have to decide on their validity.


*Dick's new Brisbane Store.*




*Dick's new Melbourne Store.*

# DICK SMITH'S NEW STORES

Dick Smith Electronics has opened two new stores; one each in Brisbane and Melbourne. The group now has five stores down the eastern coast of Australia, as well as many dealers across the mainland and Tasmania.

The Brisbane address is 166 Logan Road, Buranda, and the Melbourne address is 656 Bridge Road, Richmond.

**AUDIO GROUP 4 YEARS OLD**

In November the IREE Audio Group celebrates its 4th Anniversary.

Over 40 meetings have been held by the Group since it was first launched at the end of 1972. Membership continues to increase and interested readers can obtain a membership application form from the Audio Group Secretary, Mr. Peter Garde, at the School of Electrical Engineering, The University of New South Wales, PO Box 1, Kensington, NSW, 2033, Phone 662-2829.

# China's TV

China has just put a satellite into orbit to finalise its national TV network. Now Peking can broadcast to 23 of its provinces.

# Attractive Antenna

***Two of the CB antennas on sale in the US by Turner use a novel mounting idea. At the base there is a big magnet, capable of a 41 kg pull. The stainless steel whip is 122 cm long.***

# COMMUNITY CCTV

Australia's first closed circuit recreational TV system began operation in Melbourne last month.

The system, a joint project of the Melbourne City Council and the Victorian Housing Commission, will serve about 4,000 tenants in the Debney's Park housing Commission complex. It operates by cable from a studio set up at the Debney's Park community centre.

Debney's Park is a complex in the suburb of Flemington, on the fringe of the city, and contains a number of high-rise blocks. The closed circuit TV is seen as a means of combating the loneliness which sometimes afflicts people living in high rise communities.

## 'ELECTRONICS IN MEDICINE' LECTURES

"Electronics in Medicine" is the theme of a series of public lectures in the five mainland State capitals and Canberra and Summer Schools in Sydney and Melbourne between November 29 and December 22.

"Medical Electronics — A Modern Coalition Against Ancient Constraints" is the title of the public lectures by Prof. Sayers at the University of New South Wales on December 2; University of Brisbane, December 8; University of Melbourne, December 14; University of Adelaide, December 20; University of Western Australia, December 21 and the Academy of Science, Canberra, on December 3.

In Sydney, a full 4 day Summer School Course for electronics engineers and students specialising in medical electronics will be held at International House, University of New South Wales, on November 29, 30, December 1 and 2, and a half day 4 afternoons Summer School Course for members of the medical profession and medical research workers and students on December 6, 7, 9 and 10.

In Melbourne, a four-day (full day) Summer School will be held for engineers and medical workers in both disciplines at the University of Melbourne on December 13, 14, 16 and 17.

Further information and registration forms may be obtained from the General Secretary, IREE, 157 Gloucester Street, Sydney, 2000. (Telephone 27-1039).

## MISAR from GM

GM are to introduce an electronic timing system based on a microcomputer to their 1977 model Toronado. The system continually adjusts ignition timing for the best fuel economy, drivability and emissions under a broad range of conditions.

MISAR, Microprocessed Sensing and Automatic Regulation, constantly monitors engine vacuum, coolant temperature, engine speed and the position of the crankshaft.

## *POSTGRADUATE DIGITAL CONTROL COURSE*

Footscray Institute of Technology is introducing a Postgraduate Diploma course in Digital Control. The two year part-time course is due to start in February 1977.

The course has been designed to cater for the increasing needs of industry for engineers capable of applying the latest mini-computers, microprocessors and sub-systems to specific on-line control and data acquisition systems. FIT interest in these areas is backed by considerable staff experience in industrial digital system development and a number of related research projects currently being carried out in the Department.

Subject matter for the course will include digital electronics, small computer architecture, microprogramming, interface design, data transmission and error control and advanced control theory.

Special emphasis will be placed on practical experience and actual industrial applications.

For further details please contact Mr W A Evans or Mr E K Walker, Footscray Institute of Technology, Department of Electrical & Electronic Engineering, Ballarat Road, Footscray, Vic 3011 (Telephone 689-3400).

## ERRATA

SIMPLE AMPLIFIER. Project 061. October 1976, page 64.

Negative lead from 9 V battery to Veroboard (Fig. 2) should be connected to copper track above that shown i.e., the track marked 'common'.

# NEW ETI FEATURE

# mark-down

**This is an experimental feature. We're offering our existing advertisers free space each month to offer goods or services, substantially cheaper than normal. 'Substantially' begins at 15% —there's no lower limit!**

**In theory everyone wins. You buy things cheaper — advertisers sell more at zero expense — with luck we sell more ETIs.**

**Offers expire Nov. 30, 1976 unless otherwise specified.**

**If it works we'll keep it as a regular feature.**

**Advertisers — ring Collyn Rivers on 33-4282 for details. (Companies not normally advertising may take space in this feature at our normal rate of $70 per insertion).**











When advertisers send in copy they must also send evidence of the goods being advertised by their company at 'normal prices' so that we can be sure that the discounts are genuine as specified by the Trade Practices Act.

# COLOUR YOUR CHRISTMAS WITH SANTA SMITH

HO HO HO

HO HO HO! It's that time of year again (well close enough, anyway). HO HO HO!
Maybe it's because Santa Smith wears a red suit, but he's gone mad on colour. And to show it, look at this goodie from his Christmas stocking. It's a 48cm colour TV which, we believe, is the lowest price in Australia. (We've checked!) Just $479.00

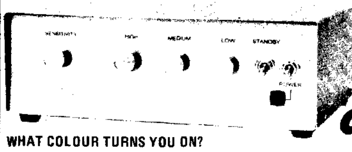
## A 43cm (18") P.A.L. VHF/UHF COLOUR TV FOR ONLY $479 INC 1 YR FULL W'TEE

GENERAL 43cm COLOUR TELEVISION MODEL GC181. Cat A-4625. Limited Stocks Available at just $479.00

Price does not include installation, as these sets are checked when they leave the factory. Just plug them in and away they go! Instructions included.

## MUSICOLOUR III KIT

Save $5.50 on M'colour II price



$49.50 complete

WHAT COLOUR TURNS YOU ON?

Find out with the all-new Musicolour 111 from EA. Modulates incandescent lamps to music (just attach to the speaker leads. Completely safe). Complete kit, down to the last nut and bolt. Cat K-3140 .................... $49.50

SAVE $20.00 – BUY ONLY WHAT YOU NEED: NO CASE OR HARDWARE.
Special 'short' kit contains just the PCB & all components (inc. transformers & pots) but no hardware – ideal for those who want to build the unit in another form of case. (Take care: mains voltages exposed on board!) Cat K-3141 .................... $29.50

## MIDLAND CB Sshh!

Dick has a MIDLAND to suit every need. From a 1W hand held to a 15W PEP SSB rig that can literally 'work the world'

We haven't the space to say too much below; so call in to a Dick Smith Store or Dealer and have a look at some of the world's best CB & boating gear: MIDLAND.

AT THE MOMENT, IT IS STILL ILLEGAL TO USE CB EQUIPMENT UNLESS YOU ARE A LICENSED HAM OR NOVICE OPERATOR. STAND BY FOR THE NEXT INSTALMENT!

1W, 2CH Hand-Held Transceiver. Range limited by topography and climate, but useable (and reliable) over 10 miles (+). Supplied with one set of crystals on 27.24 or 27.88MHz. Cat D-1100 ........ $39.75

3W, 3CH Hand Held Transceiver. Range higher than previous unit, up to 30 miles. Ideal for the weekend boatman. Supplied with one set of crystals on 27.88MHz, others open. Cat D-1252 ........ $59.90

5W, 3CH fixed (mobile) transceiver. 12V (13.5V) operation, used mainly as boating safety transceiver. Supplied with one channel on 27.88MHz, others open. Easy installation. Cat D-1400 ........ $89.50

5W, 6CH fixed (mobile) transceiver. Similar to previous but has added versatility of 6 channel capacity. 27.88MHz fitted. Both transceivers can be used as PA amplifiers. Cat D-1406 ........ $109.50

5W, 23CH, fixed (mobile) CB transceiver. AM only, full 23 channels fitted (synthesised). Ideal as first CB radio. Very popular unit. S meter, mic included. Easily installed. Cat D-1430 ...... $109.50

5W, 23CH, fixed (mobile) CB transceiver. Deluxe version of previous unit. Same features, plus Delta Tune (helps resolve off-channel signals) Antenna Warning Light tells of trouble. Cat D-1436 ........ $149.50

5W, 23CH, fixed (mobile) CB transceiver. SSB/AM transceiver, one of the best around. All the features you want here! Ask anyone who's got one! The top of the line model. Cat D-1700 ...... $239.50



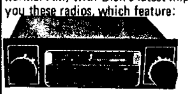
Dick Smith is the sole Australian agent for Midland CB & boating safety communication equipment. Would you like to sell Midland through your store to your local area? If so, call Gary Johnston at Dick Smith, Sydney for more details. Ph 439-5311; Telex AA20036.

## stereo RADIOS FOR WHEELS? See the BIG WHEELER!

AM/FM MPX CAR RADIO

Now you can enjoy full FM stereo reception as you drive (as well as normal AM) with Dick's latest import. He searched the world to bring you these radios, which feature:

- Push button tuning
- High FM sensitivity
- 17 Transistors, 2ICs & 4 diodes
- Tone/balance controls
- In-dash mounting
- Massive 12 watts stereo output



ONLY $125.00

Cat A-5983 ........ (speakers & aerial extra) .......... $125.00

mono only

AM/FM PUSHBUTTON CAR RADIO LOOKS SIMILAR TO ABOVE $85.00
There's just no point in buying an AM only car radio when for so little extra, you can get the Hi-Fi FM stations too. Push-button tuning (of course), in-dash mount and high power output add up to one thing: VALUE! Cat A-5982 .. (unit only) ........ $85.00

These radios ARE NOT your usual department store junk! They are high quality, high performance units which will NOT fade as you drive through a city block (like most of the cheapies do).

## FOR HEADPHONES Go straight to the HEAD

ELEGA SUPERTHIN Cat C-4122

$29.50

These unique constant velocity drivers give these superthin headphones a phenomenal performance. Their weight is so small you could almost forget they are on your head!

THIS PRICE IS RIDICULOUS! Dick must have rocks in his head to offer these headphones to you for such a low price. Fully imported by Dick at a fraction of the local wholesalers prices.

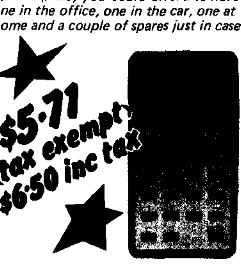
Cat C-4110 $7.50

BARGAINS

## INCREDIBLE

NOVUS 650 CALCULATOR 'MATHBOX'

*At this price, you could afford to have one in the office, one in the car, one at home and a couple of spares just in case!*



$5.71 tax exempt, $6.50 inc tax

*A 4 function calculator for just $5.71 (or $6.50 if you can't get a student's exemption) is real value. Buy a couple for Christmas gifts!*
Cat Q-3200 ...... (with tax ex) ...... $5.71
...... (incl. tax) .......... $6.50

## car cassette universal power connector

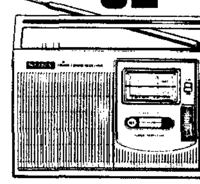
save 40% now $1.75



Has a plug with moveable pins to take care of almost any configuration of power socket (of the type used in these devices!) Has in-line fuse (3A, 3AG fitted)
TREMENDOUS SAVING: Was $2.95, now just $1.75. SAVE OVER 40%!

## SONY FM/AM radio

$32.00



IT'S A SONY! The name synonymous with quality presents a brand new radio – the TFM7040.
This radio has the best of both worlds: AM for normal broadcast stations: FM for good music and entertainment. Works on batteries or external DC supply; earphone supplied for private listening. Cat A-4329 .......... $32.00

## PLAYMASTER TWIN 25

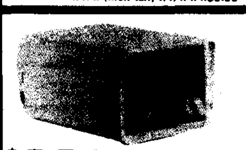
IT LOOKS SO GOOD YOUR FRIENDS WON'T BELIEVE YOU BUILT IT!

$89.50

You've seen the rest, now check the best! As an amplifier, the Playmaster Twin 25 is hard to beat. As a kit, it's unbeatable. And Dick's kit stands above the rest. See the features. See the finish. See the price! You'll save a packet compared to an equivalent commercial amplifier!
Cat K-3410 .................... $89.50

- Deluxe 'champagne' front panel
- Matching imported knobs
- Screened, fibreglass PCB
- Power transistor sockets
- Dick's EXCLUSIVE construction manual (not just a mag re-print)
- Optional extra: Speaker protector kit (see EA June '76) Cat K-3425 .................. $10.75

## FM7 DFM



$207 7 digit! 55MHz+

You've seen the Volksmeters, now meet their brother: The FM7 Digital Frequency Meter by Non-Linear Systems. Response to around 55MHz or more. 7 digit readout. Fits into the palm of your hand. Runs from Ni-cad cells (charger included in price). All this and heaven too?
What more could you want of a DFM. For just $207.00 including sales tax.
Cat Q-1700 .................................. $207.00

## 100k Multimeter AND trans. tester

Look at the specs:
You must agree that the Q-1136 is great value as a multimeter alone. 100k/V – that's almost as good as a VTVM!
With a transistor checker added, its not just great value, it's TREMENDOUS!

VALUE $45

| | | |
|---|---|---|
| DCV: | 0.5–1k (100k ohms/V) | (3%) |
| ACV: | 5–1k (10k ohms/V) | (4%) |
| DCA: | 10uA–10A (250mV) | (3%) |
| ACA: | 10A | (4%) |
| RES: | 0–50 Mohms, 4 ranges | (3%) |
| dB: | –10 to +62 | (4%) |
| TRANSISTOR CHECKER | | |
| $h_{FE}$: | 0-500 | (5%) |
| $I_{CO}$: | 0-50uA PNP-NPN | (5%) |

Cat Q-1136 .......... $45

## TOOLS ETC

SOLDER SUCKER: Fair suck of the solder! Get rid of excess and wasted solder simply and easily. All metal construction. Cat T-2560 ... $7.50

$7.50

NIBBLING TOOL: Cuts sheet metal up to 0.6mm thick (light alloys to 1.5mm) Any shape, cleanly & without burred edges. Cat T-4940 .............. $7.50

$9.50

HOLE PUNCH SET: Chassis basher's special! Five sizes from 16-30mm with tapered reamer & tommy bar all in a solid plastic pack. Cat T-4900 ...... $9.50

## BITS PACKS

50¢ CORD-GRIP GROMMETS: Pack of 4 handy grommets not only protect the mains cord from abrasion, they hold it tight so no other form of cable clamp is necessary. (Cat H-1724) ... $0.50

CABLE TIES: Pack of 20. Get rid of rat's nests with these handy ties. They are serrated and lock onto themselves when pulled through. 3¾ inches long, enough for almost all lacing jobs.
Cat H-1970 ...................... $1.00

$1.00

INSULATED STAPLES: Pack of 150; keep wiring out of sight and tidy! Ideal for speaker leads, intercoms, phones, thin co-ax, and, becuase they're insulated, fig. 8 mains lead. Easy to use.
Cat. H-1730 ...................... $1.00

## MAGAZINES

Dick has a huge range of Australian and Foreign magazines. For example:

AUST: EA, ET, Hi-Fi, Stereo, SBG, Basic Elect, Elect Its Easy, Solid State, Digital Elect, EDUC-8, Proj & Circuits, Top Proj,

FOREIGN: Rad Elect Const, Practical Elect, Pract Wireless, QST, CQ, Ham, 73, Elem Elect, Pop Science, Scientific Amer, High Fidelity, Radio Elect, Television. Radio Elect, etc etc etc;

MAGAZINES ARE NOT AVAILABLE BY MAIL ORDER. Call in now and browse through our bookworms corner at any of the five Dick Smith Electronics Centres.

## DICK SMITH ELECTRONICS GROUP

Head Office: Phone 439 5311. Telex AA20036. Cable Diksmit Sydney.
Mail Orders: P.O. Box 747, Crows Nest, N.S.W. 2065.
N.S.W. Branches: GORE HILL - 162 Pacific Highway. 439 5311.
SYDNEY - 125 York St.. 29 1126. BANKSTOWN - 361 Hume Hwy., 709 6600.
Interstate Branches: QLD. - 166 Logan Rd., Buranda. 391 6233. VIC. - 656 Bridge Rd., Richmond. 42 1614.

DICK SMITH DEALERS [illegible] Hobart 34 8232, [illegible] Darwin 81 3491, [illegible] Elizabeth South 255 2249

DICK SMITH 'MIDLAND' DEALERS (NSW) [illegible] Armidale, 72 4955 [illegible] Griffith, 62 1577, [illegible] Nelsons Bay 82 1274 [illegible] Woolongong 29 1455 [illegible] Wagga Wagga, 21 2125 (VIC) [illegible] Geelong 94 408 [illegible] Sale, 44 2677 (QLD) [illegible] Cairns, 51 1795 [illegible] Townsville, 79 8844, [illegible] Margate, 84 2341 [illegible] Dalby, 62 2389, [illegible] Palm Beach 34 1238 (SA) [illegible] Pt Adelaide, 47 3933 [illegible] Pt Lincoln, 82 1981 (NT) [illegible] Alice Springs, 52 1713 (WA): [illegible] Fremantle 39 1879 [illegible] Carnarvon, 41 1362 (TAS): [illegible] Launceston 31 5688

### POSTAL CHARGES

| Order Value. | Charge |
|---|---|
| $5 – $9.99 | $1.00 |
| $10 – $24.99 | $1.50 |
| $25 – $49.99 | $2.50 |
| $50 – $99.99 | $3.50 |
| $100 or more | $5.00 |

BY COMET FREIGHT: The minimum packing & handling charge is $3.00. We despatch freight on and you pay when you receive the goods.

bankcard welcome here

MINIMUM MAIL ORDER AMOUNT IS $5.00

# Film resistors

Two previous articles in our components series have dealt with resistors. This article now looks at carbon-film resistors and the next part will cover metal-film types.

FILM RESISTORS ARE MANUfactured by forming a deposit of an appropriate resistive material, usually carbon, carbon-boron or some metallic oxide, on a ceramic former, usually a tube or rod. A helical groove is then cut in the film coating. The groove forms the resistive coating into a long continuous path resulting in a compact resistor that can have a value up to 100 megohms. Terminations are made in a variety of ways. Metal end caps may be forced over the ends of the ceramic rod, contacting the deposited film. Leads are attached to the caps by soldering or spot-welding. In some types, the ends of the coated ceramic rod are metallized and leads are wrapped around the metallized portions and soldered. The component is then coated in a suitable lacquer for protection.

Typical construction of a film resistor is illustrated in Figure 1.

**Thick-film resistors** are a special type of film resistor. They are generally constructed by depositing the resistive material on a ceramic or aluminium-oxide substrate. A portion of the film coating is then removed, according to a predetermined pattern, to provide a long resistive path between the resistor terminals. Typical construction of one style of thick-film resistor is illustrated in Figure 2. This style is obtainable as a 'fusible' resistor. When overloaded, the substrate cracks, ensuring an open circuit which reduces the possibility of further circuit damage, physical or electronic. These thick-film resistors occupy a minimum of space on a printed circuit board and can dissipate considerable power owing to their large surface area and high hot-spot temperature (150°C).

Thick film resistors are also made in appropriate groupings on a small substrate and encapsulated in a standard DIL IC package. Certain values of resistance are standard in digital circuitry and this style is used in such applications (for example, as the 'weighting' resistor network in a digital-to-analogue converter). Another application is for 'pull-up' resistors for open-collector logic gates.

**Thin film resistors** are constructed in a similar fashion but on a considerably smaller scale. They are primarily used in IC manufacture. Some thin film resistor networks are available in standard DIL integrated circuit packages and these find application in digital circuitry.

There are four basic types of film resistor:—

(a) Carbon Film
(b) Metal Film
(c) Metal Oxide Film
(d) Metal Glaze (Cermet)

## Carbon Film Resistors

These resistors are manufactured by a 'cracking' or pyrolytic process where a hydrocarbon vapour at high temperature is decomposed onto a special

**TABLE 1. General Characteristics of Carbon Composition Resistors**

| Rated Wattage @ 40°C | Rated Wattage @ 70°C | Max. Working Voltage Commercial | Max. Working Voltage Mil. | Max. Operating (= hot-spot) Temperature Commercial | Max. Operating (= hot-spot) Temperature Mil. | Critical Resistance Commercial | Critical Resistance Mil. | Uninsulated Types Length | Uninsulated Types Diameter | Insulated Types Length | Insulated Types Diameter | Typical Resistance Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.125 | 500 | 150 | | 150 | 2 M | 180 k | | | 3.7 mm | 1.6 mm | 4.7 Ω – 1 M |
| 0.5 | 0.25 | 700 | 250 | 107 | 130 | 3M9 | 250 k | 6.4 mm | 2.3 mm | 9.5 mm | 2.4 mm | 2.2 Ω – 10 M |
| 0.75 | 0.35 | 1000 | – | 107 | 130 | 2M7 | – | 10.8 mm | 4.1 mm | 9.5 mm | 4.8 mm | 10 Ω – 4M7 |
| 1 | 0.5 | 1000 | 350 | 107 | 130 | 1M8 | 250 k | 10 mm | 3.5 mm | 11.7 mm | 5.8 mm | 2.2 Ω – 100 M |
| 2 | 1 | 1000 | 500 | 107 | 130 | 1 M | 250 k | 18 mm | 6 mm | 19.1 mm | 6.4 mm | 10 Ω – 1 M |
| | 2 | 1000 | 500 | 107 | 130 | 470 k | 120 k | 29.8 mm | 7.7 mm | 35 mm | 8 mm | 10 Ω – 1 M |

(1) Rated Wattage assumes voltage limit not exceeded.
(2) Max. Working Voltage assumes wattage rating not exceeded.
(3) Max. Operating Temperature is that due to ambient temperature plus temp. rise due to power dissipation. No power can be dissipated by a resistor if the ambient temperature equals the hot-spot temperature. The hot-spot temperature for commpercially-rated carbon composition resistors is usually between 105 and 110°C.
(4) Sizes given are body sizes for axial-lead types.

# Film resistors

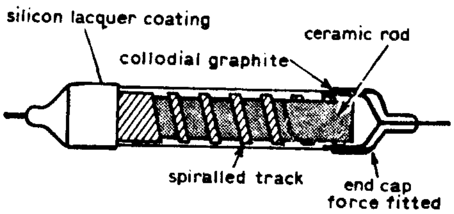
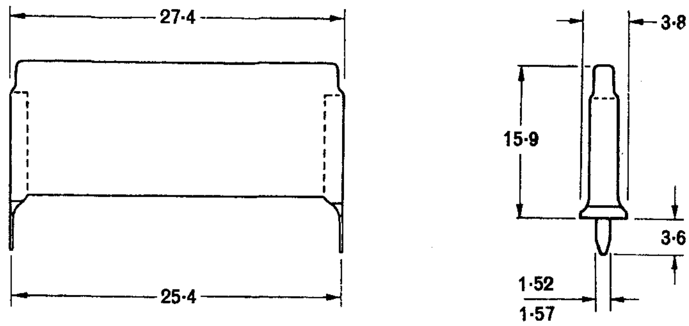



*Fig. 1. Typical construction of a film resistor.*




Dimensions in mm

*Fig. 2. Example of fusible-type of thick-film resistor.*

ceramic rod, producing a thin carbon film on the surface. These are sometimes referred to as 'deposited-carbon' film resistors. Some types use a boron-carbon film; a boron containing gas is introduced during the cracking process. This results in a resistor that has a superior temperature coefficient over a limited range of values than the plain carbon film type.

Terminations may consist of metal end-caps forced over the ends of the element, and then axial or radial leads are attached. Some manufacturers metallize the ends of the element and solder leads to them. Sometimes a combination of the two techniques is used to improve reliability.

Protection for the element is provided in a number of ways. Numerous layers of varnish may be applied followed by a final paint coating. Some modern types are completely sealed in a silicone resin base which is impervious to moisture as well as providing excellent mechanical and thermal protection. Other types may be encased in a plastic moulding or sealed in a ceramic or glass tube. The varnished types afford the least protection against mechanical damage (through handling etc) and moisture.

The voltage coefficient of carbon film resistors is very much less than that of carbon composition types, being usually less than 100 ppm/V and this rarely needs to be considered.

Carbon film resistors exhibit temperature characteristics which are superior to composition resistors, but not as good as metal film or wirewound types. Nevertheless, the temperature coefficient of carbon film resistors is quite acceptable for a wide variety of applications. Only those applications requiring a very good temperature characteristic warrant the use of the other, usually more expensive, film resistors.

As mentioned just previously, the temperature coefficient of boron-carbon film resistors is somewhat better than the deposited-carbon types. The latter may have a temperature coefficient between +350 and −550 ppm/°C for values under 100k, and between +350 and −800 ppm/°C for values under 100k. Generally though, the TC will be negative. The variation of TC with resistance value and the sort of 'spread' that can be expected for a particular batch of components is illustrated in Figure 3 for deposited carbon resistors. The temperature coefficient of boron-carbon resistors is typically between +100 and −200 ppm/°C for values under 100k, and between −50 and −400 ppm/°C for values over 100k. The variation of TC with resistance value and the spread that might be expected is illustrated in Figure 4.

The TC of carbon film resistors is also dependant on the wattage rating due to the thickness of the carbon film used in its construction.

All resistors change their value per-

**TABLE 2. General Characteristics of Carbon Film Resistors**

| Rated Wattage @ 70°C | Max. Working Voltage | Max. Operating Temp. | Critical Resistance | Typical Sizes | | Typical Resistance Ranges | |
|---|---|---|---|---|---|---|---|
| | | | | Length | Diameter | Deposited Carbon | Boron-Carbon |
| 0.125 | 250 V | 130/165°C | 250 k | 7 mm | 2.3 mm | 10 Ω – 1 M | 50 Ω – 100 k |
| 0.250 | 300 V | 130/165°C | 360 k | 10 mm | 2.3 mm | 10 Ω – 2 M | 20 Ω – 100 k |
| 0.33 (0.5 @ 40°) | 300 V | 125°C | 360 k | 9 mm | 3 mm | 2.2 Ω – 5M1 | |
| 0.5 | 350 V | 130°C | 250 k | 12 mm | 4 mm | 4.7 Ω – 5M1 | 10 Ω – 100 k |
| 0.5 | 350 V | 165°C | 250 k | 15 mm | 4 mm | 10 Ω – 7M5 | |
| 0.75 | 350 V | 165°C | 160 k | 14 mm | 6 mm | 10 Ω – 7M5 | |
| 1.0 | 500 V | 130°C | 250 k | 14 mm | 4.8 mm | 2.2 Ω – 10 M | 20 Ω – 240 k |
| 1.0 | 500 V | 165°C | 250 k | 24.6 mm | 7.2 mm | 10 Ω – 15 M | |
| 1.25 | 600 V | 165°C | 270 k | 22 mm | 9 mm | 10 Ω – 15 M | |
| 2.0 | 750 V | 130°C | 270 k | 55 mm | 7.5 mm | 10 Ω – 20 M | 30 Ω – 1 M |
| 2.0 | 750 V | 165°C | 270 k | 32 mm | 9 mm | 10 Ω – 15 M | |

(1) Rated Wattage assumes voltage limit not exceeded.
(2) Max. Working Voltage assumes wattage rating not exceeded.
(3) Max. Operating Temperature is equal to hot-spot temperature.
(4) Sizes given are body sizes for axial-lead types.
(5) Coated types and silicone resin coated types only considered.

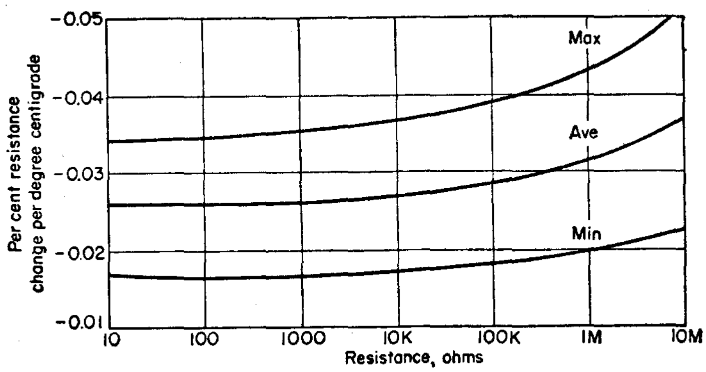



*Fig. 3. Typical temperature-coefficient spread for deposited-carbon resistors.*

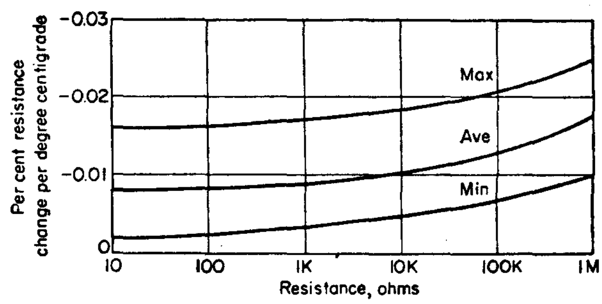



*Fig. 4. Typical temperature-coefficient spread for boron-carbon resistors.*

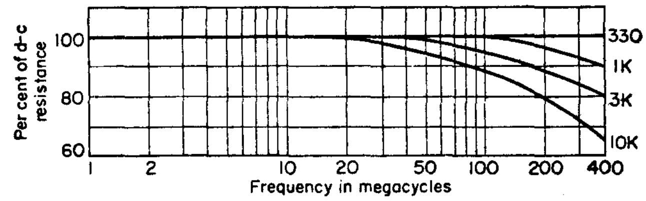



*Fig. 5. Approximate frequency characteristics for ½-watt deposited-carbon resistor.*

manently with age and use. Carbon composition resistors are the worst in this regard and may be expected to change as much as 20%. Film and wire-wound resistors are considerably better. Carbon film resistors have a stability of better than 1% which is usually more than adequate for all but the most stringent applications.

The high frequency characteristic of carbon film resistors is one of its advantages. Coated types are somewhat better than equivalent moulded or encased units. Generally speaking, the apparent value of the resistor decreases at high frequencies. Values below 1k will maintain their resistive value well beyond 500 MHz. Even relatively high values will not show a decrease of more than 10% until well into the VHF region. This is illustrated for typical coated ½W deposited-carbon film resistors in Figure 5.

The noise generated by carbon film resistors is a function of the applied voltage, the thickness of the film and the length of the spiral track. Consequently, the lower value, higher wattage units generate the least noise. For values below 10k it is typically between .08 and .5 $\mu$V/V, and for values between 10k and 100k it may be as low as 0.2 $\mu$V/V and up to 1.0 $\mu$V/V. For values above 100k, the noise ranges from 0.5 $\mu$V/V to 1.5 $\mu$V/V.

There are several power derating curves for carbon film resistors, dependant on size and construction. Miniature coated types have a hot-spot temperature of 120–125°C and are derated from 40°C to half their wattage rating, at 70°C, then derated to zero dissipation at the hot-spot temperature. This results in a 'dogs-leg' derating graph as shown in Figure 6. This mainly applies to the miniature 0.25W and 0.33W types which have body dimensions typically 6-7mm long and about 2.5mm diameter. Moulded style units are usually derated from 70°C and have a hot-spot temperature of 130°C, according to the derating curve shown in Figure 7. Some types have a much higher hot-spot temperature, being constructed on a special ceramic rod

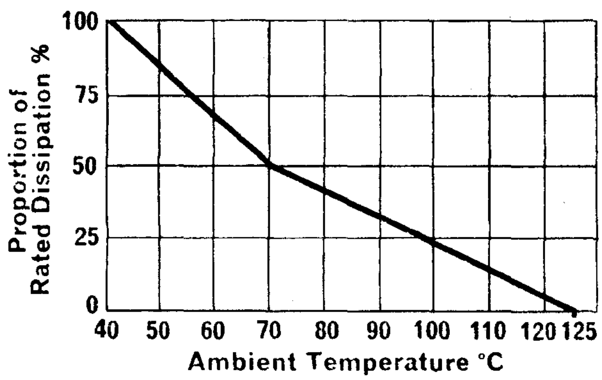



*Fig. 6. Derating curve for miniature moulded carbon-film resistors.*

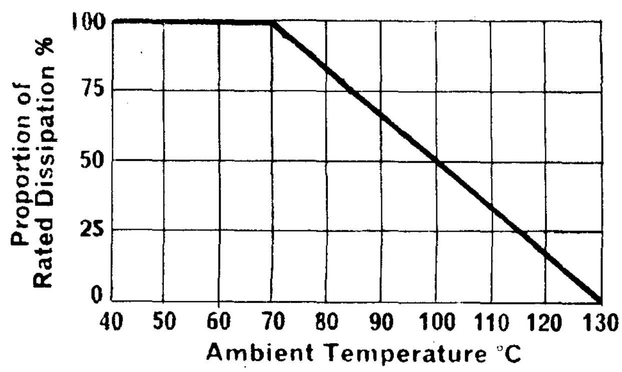



*Fig. 7. Derating curve for coated carbon-film resistors.*

# Film resistors

and coated with a silicone resin compound which have superior heat dissipating properties. These types have a hot-spot temperature of around 165°C and are derated from 70°C, as illustrated in Figure 8. It is best to check the manufacturer's literature if the power derating characteristics are needed. Special 'carbon-alloy' types have a hot-spot temperature of 200°C but are not commonly used.

Carbon film resistors are available in ratings from 0.1W to 2W and in values that range from 10 ohms to 15M for commonly available units and up to 100M on special order. They are manufactured to tolerances of ± 0.5% (E192 series), ± 1% (E96 series), ± 2% (E48 series) and ± 5% (E 24 series).

Carbon film resistors will withstand a short-term overload of twice to 2.5 times the rated maximum working voltage. Failure is more common in the high value resistors. Irregularities in the spiral track and extremely thin film contribute to the failure of the component. The resistor may burst into flame when it fails due to a prolonged overload.

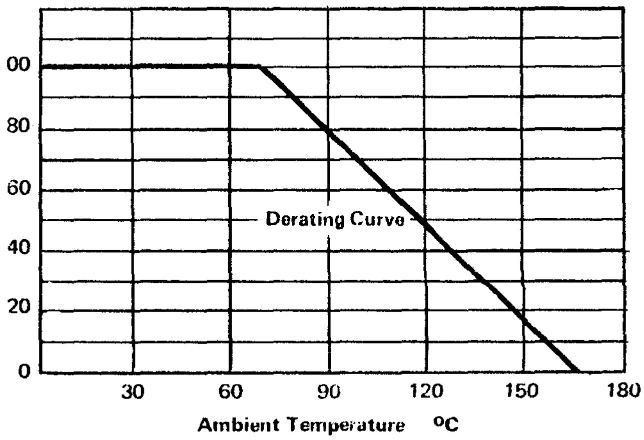



*Fig. 8. Power derating curve for specially constructed carbon film resistors.*

The execellent stability and low cost of carbon film resistors, along with other desirable features such as low noise, small TC and good high frequency characteristics have contributed to their increasing use in a wide range of electronic applications. The general characteristics of carbon film resistors is given in Table 2.

*to be continued . . .*

# LINEAR FROM TECHNIPARTS

## LINEAR INTEGRATED CIRCUITS

| Type | Case | Description | Price Ea. |
|---|---|---|---|
| LM301AH | T05 | Op Amp | .99 |
| LM301AN | 8DIL | Op Amp | .75 |
| LM307H | T05 | Op Amp | .99 |
| LM307N | 8DIL | Op Amp | .92 |
| LM308H | T05 | Op Amp | 3.23 |
| LM308N | 8DIL | Op Amp | 1.70 |
| LM311H | T05 | Voltage Comparator | 2.90 |
| LM311N | 8DIL | Voltage Comparator | 2.45 |
| LM318H | T05 | High Speed Op Amp | 4.40 |
| LM318N | 8DIL | High Speed Op Amp | 4.20 |
| LM324N | 14DIL | Quad Op Amp Single Supply | 2.90 |
| LM339N | 14DIL | Quad Voltage Comparator | 2.95 |
| LM343H | T05 | 80 Volt Op Amp | 7.04 |
| LM348N | 14DIL | Quad 741 Op Amp | 3.11 |
| LM349N | 14DIL | Quad 741 Op Amp High Slew | 3.50 |
| LM358N | 8DIL | Dual 741 Op Amp | 1.45 |
| LM370H | T05 | AGC/Squelch Amp | 4.00 |
| LM371H | T05 | RF/IF Amp | 3.50 |
| LM372H | T05 | AM/IF Strip | 4.14 |
| LM373H | T05 | AM/FM/SSB IF Video Amp/Detector | 5.06 |
| LM375N | 8DIL | Oscillator/Buffer TTL Output | 4.80 |
| LM377N | 14DIL | 2 Watt Stereo Audio Amp | 2.75 |
| LM378N | 14DIL | 4 Watt Stereo Audio Amp | 3.60 |
| LM379S | Special | 6 Watt Stereo Audio Amp | 6.05 |
| LM380N | 14DIL | 2 Watt Mono Audio Amp | 1.60 |
| LM381N | 14DIL | Dual Low Noise Preamp | 2.60 |
| LM381AN | 14DIL | Selected Lower Noise 381N | 4.15 |
| LM382N | 14DIL | Stereo Preamp with R1AA/NAB | 2.00 |
| LM384N | 14DIL | 5 Watt Mono Audio Amp | 2.30 |

| Type | Case | Description | Price Ea. |
|---|---|---|---|
| LM386N | 8DIL | 500MW 6V Audio Amp | 1.27 |
| LM387N | 8DIL | Dual Low Noise Preamp | 1.67 |
| LM387AN | 8DIL | Selected Lower Noise LM387N | 2.70 |
| LM388N | 14DIL | 1.5W Mono Audio Amp | 1.55 |
| LM389N | 18DIL | LM386 + 3 transistors | 1.55 |
| LM395T | T0220 | IC Power Transistor | 2.85 |
| LM555CN | 8DIL | Timer | .95 |
| LM556CN | 14DIL | Dual 555 Timer | 1.70 |
| LM565CH | T05 | PLL | 5.72 |
| LM565CN | 14DIL | PLL | 2.13 |
| LM566CN | 8DIL | Voltage Controlled Oscillator | 1.53 |
| LM567CN | 8DIL | Tone Decoder | 2.75 |
| LM709CN | 14DIL | Op Amp | .99 |
| LM709CH | T05 | Op Amp | .99 |
| LM710CN | 14DIL | Voltage Comparator | 1.00 |
| LM710CH | T05 | Voltage Comparator | 1.20 |
| LM723CH | T05 | Voltage Regulator | 1.50 |
| LM723CN | 14DIL | Voltage Regulator | 1.10 |
| LM725CN | 8DIL | Instrumentation Op Amp | 3.96 |
| LM733CN | 14DIL | Differential Video Amp | 2.30 |
| LM741CN | 8DIL | Op Amp | .75 |
| LM741CH | T05 | Op Amp | 1.14 |
| LM747CN | 14DIL | Dual Op Amp | 1.94 |
| LM748CN | 8DIL | Op Amp | .93 |
| LM1303N | 14DIL | Stereo Preamp | 2.00 |
| LM1310N | 14DIL | PLL FM Stereo Demodulator | 3.30 |
| LM1351N | 14DIL | FM Detector, Limiter, Audio Amp | 1.90 |
| LM1458H | T05 | Dual Op Amp | 2.29 |
| LM1458N | 8DIL | Dual Op Amp | 1.97 |
| LM1496N | 14DIL | Balanced Modulator | 1.38 |
| LM1800N | 16DIL | PLL FM Stereo Demodulator | 2.99 |
| LM1808N | 16DIL | FM IF + 2 Watt Audio Out | 3.20 |
| LM1812N | 18DIL | Ultrasonic Transmitter/Receiver | 9.50 |

| Type | Case | Description | Price Ea. |
|---|---|---|---|
| LM1820N | 14DIL | AM Radio Receiver | 1.76 |
| LM2907N | 14DIL | TACHO IC | 2.85 |
| LM2917N | 14DIL | 2907 + Zener for Dwell | 2.85 |
| LM3028AH | T05 | Differential RF/IF Amp | 1.40 |
| LM3028BH | T05 | Differential RF/IF Amp | 1.90 |
| LM3046N | 14DIL | Transistor Array | 1.15 |
| LM3064N | 14DIL | TV Audio Fine Tuning | 1.60 |
| LM3086N | 14DIL | Transistor Array | .80 |
| LM3089N | 16DIL | FM Receiver IF System | 4.00 |
| LM3302N | 14DIL | Quad Comparator | 2.30 |
| LM3900N | 14DIL | Quad Op Amp | 1.20 |
| LM3909N | 8DIL | LED Flasher/Oscillator | 1.10 |
| LM3911N | 8DIL | Low Cost Temp Controller | 1.72 |
| LM4250CH | T05 | Programmable Op Amp | 5.60 |
| LF352N | FET | Instrumentation Amp NEW | P.O.A. |
| LF355H | T05 | FET Input Op Amp | 4.00 |
| LF356H | T05 | FET Input Op Amp | 4.00 |
| LF357H | T05 | FET Input Op Amp | 6.00 |
| LF398H | T05 | FET Sample and hold | 6.00 |
| LH0042CH | T05 | FET Op Amp | 6.60 |
| LH0070-1H | T05 | 10V Precision Voltage reference | 5.10 |
| LH0070-2H | T05 | 10V Precision Voltage reference | 10.05 |
| LX5700H | T046 | Temperature Transducer | 5.60 |
| MC1330P | 8DIL | Video Detector | 2.35 |
| SAK140 | 14DIL | Tachometer IC | 2.75 |
| TCA220 | 14DIL | Triple Op Amp | 2.40 |
| UAA170 | 16DIL | 16LED "Out" Driver | 3.25 |
| UAA180 | 18DIL | 12LED "Line" Driver | 2.50 |

## VOLTAGE REGULATORS.

LM78L Series 100MA T092 Positive Regulators available in 5, 8, 12, 15, 18, 24 Volt Ranges. Price: $0.69

LM341P Series ½ Amp T0202 Positive Regulators stocked in 5 and 12 volt. Price: $1.72.

LM340 Series 1 Amp Positive Regulators in 5, 6, 8, 12, 15, 18, 24
T0220 Package . . . . .$2.10
T03 Package . . . . .$3.96
LM309K 1 Amp Positive 5 Volt T03 . . . . . $3.30

LM320 Series 1 Amp Negative Regulators in 5, 6, 8, 12, 15, 18 and 24 volt.
T0220 Package . . . . .$4.73
T03 Package . . . . .$6.05

LM325N ± 15V Dual Tracking Regulator 14DIL Package
LM326N ± 12V Dual Tracking Regulator 14DIL Package
Both . . . . . . $3.63 ea.

LM317 1.5 Amp Positive Variable Voltage Regulator
T03 Package . . . . .$4.90
T0220 Package . . . . .$3.20

LM323K 3 Amp 5 volt positive regulator . . . . . $8.50

## SANKEN HYBRID POWER AMP MODULES.

| | | Price |
|---|---|---|
| S1010G | – 10 WATT | $ 7.00 |
| S1020G | – 20 WATT | $14.00 |
| S1030G | – 30 WATT | $17.85 |
| S1050G | – 50 WATT | $26.95 |

**DATA SHEET SUPPLIED WITH EACH MODULE.**

## PUBLICATIONS – NATIONAL SEMICONDUCTOR

| | |
|---|---|
| *Linear Data Book | $5.00 Posted |
| Regulator Design Handbook | $5.00 Posted |
| Audio Handbook | $3.80 Posted |
| *Linear Applications Vol 1 | $5.00 Posted |
| Linear Applications Vol 2 | $5.00 Posted |

* In Short Supply at time of preparation.

**bankcard welcome here**

Post 50c per order
Semiconductor orders $10.00 and over Post Free

**YES – WE KEEP 90% OF THE ABOVE TYPES IN STOCK AT ALL TIMES, MAXIMUM EXPECTED DELIVERY OF OUT OF STOCK ITEMS IS 4 WEEKS – PLUS WE HAVE A FEW MORE WE DID NOT HAVE ROOM TO LIST.**

**TECHNI PARTS**
Woolworths Arcade,
95 Latrobe Terrace,
PADDINGTON. 4064
P.O. Box 118,
PADDINGTON. 4064
Ph: Brisbane (07) 36 1474
**Trading Hours (8.30am – 5.00pm Mon. - Fri., 8.00am – 11.15am Sat.)**

# CMOS-a practical guide

Inherently rugged, CMOS logic has many advantages over other logic families – high noise immunity and uncritical power requirements are but two. This, the fourth article in this series, deals with multiplexing.

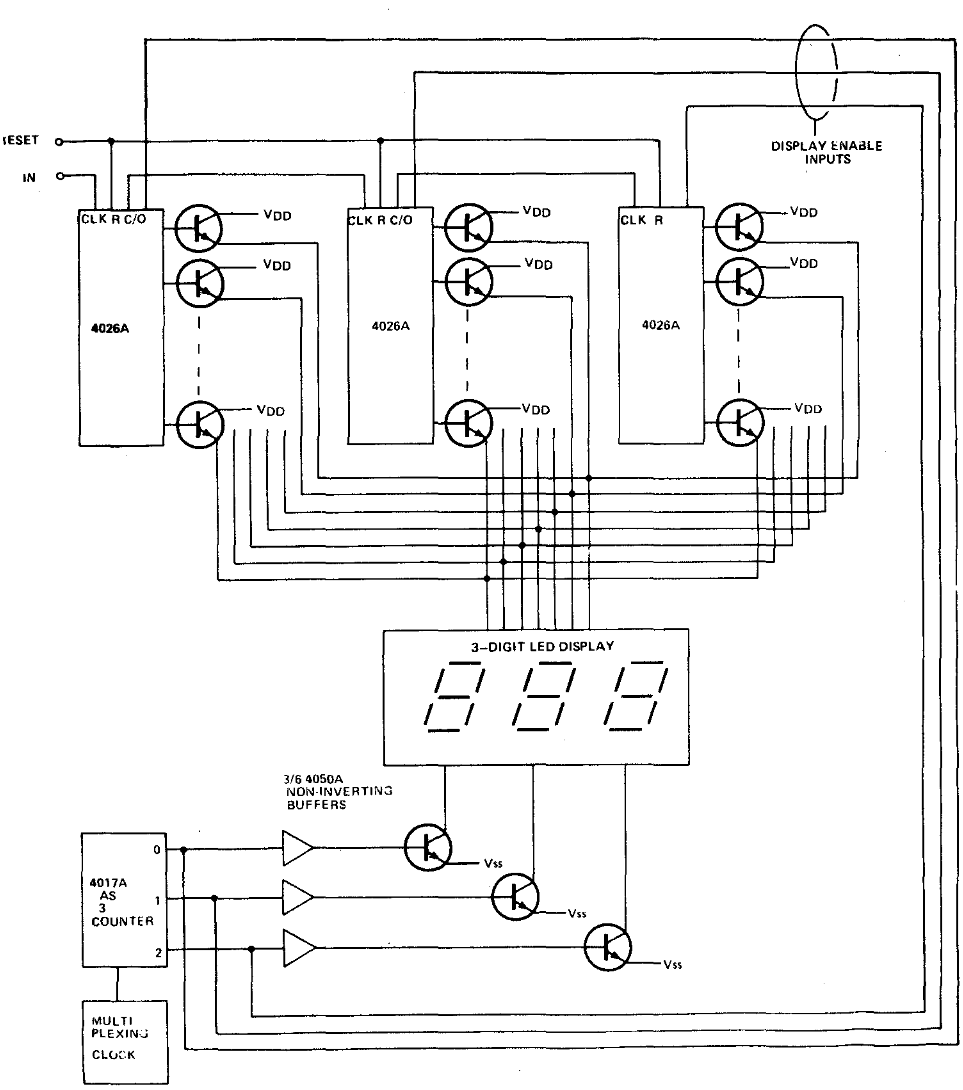



*Fig. 1. A three decade counter for a 3-digit multiplexed display. Extra buffering of the digit lines may be necessary for some displays.*

LIFE IS NEVER AS SIMPLE AS WE might want and there are two reasons for complicating the circuitry by using digit multiplexing (i.e. each digit is displayed for a fixed period, usually between about 10 and 30% of the time). These are that to do so is more efficient in terms of power consumption, and secondly that most multi-digit displays reduce the number of lead-outs (by giving just one set of seven segment drive lines for the complete display and one digit drive line for each digit).

This is the reason why the 4026A has a display enable input which, although the counter continues to function, cuts off the display when it is held low. The display enable output gives a replica of the input and may be used to enable other counters which are to be "on" during the same period. It also explains the presence of the "ungated C-segment" output which is used for producing some divide by "N" configurations which operate when the display is disabled.

The basic arrangement of a three decade counter is shown in Fig.1 and attention is drawn to the note that additional buffering may be necessary on the digit lines. It is also worth noting the use of a 4017 divide by three counter (using the flip-flop reset mode) to control the display.

Other types of displays which are often used are higher current LEDs such as the MAN-1 which is, in contrast to the MAN-3 a common anode device. This means it must be driven by inverting buffers as shown in Fig. 2a We have been relying here on the output current limit of the CMOS chip to limit

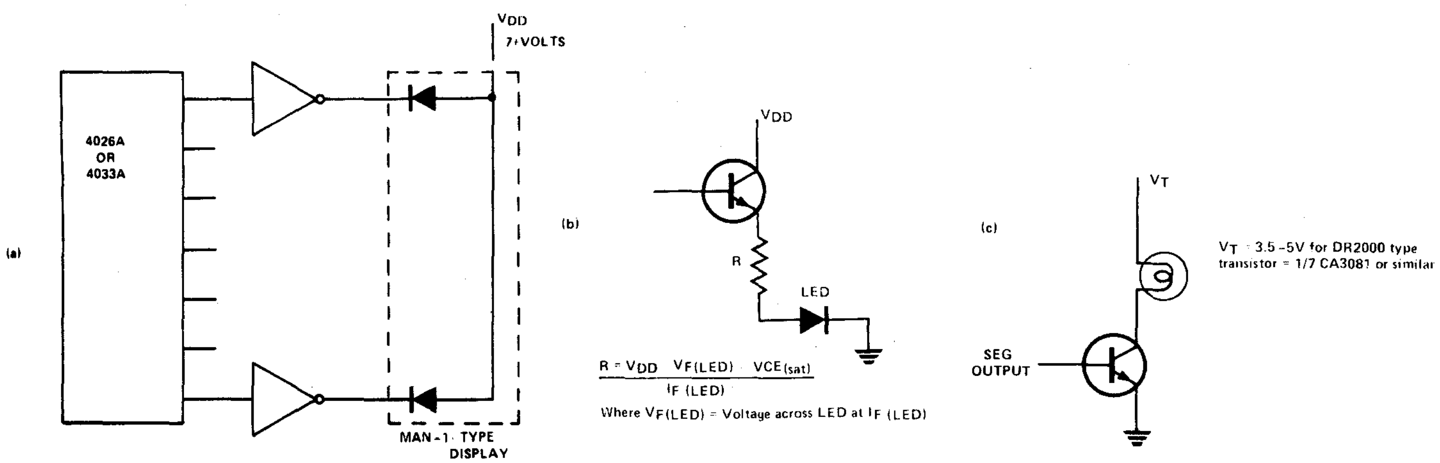



*Fig. 2. Driving other displays: (a) MAN-1 type (b) example of calculation of limiting resistor (c) Numitron type incandescent display.*

the forward current in the LEDs. It may be necessary to add current limiting resistors in the segment lines, particularly when transistor drivers are employed. The calculation of the value is simple given the required segment current and voltage drops (see Fig. 2(b). In multiplexed displays the limiting resistors should, of course, be put in the common segment lines. A considerable saving in resistors in non-multiplexed displays may be achieved by putting a single resistor in the common line to each digit. The disadvantage is that the display brightness varies with the digit. Fig. 2(c) shows the technique for interfacing with "Numitron" and similar displays.

The ripple blanking facility is for blanking leading and trailing zeroes in the display and it works as follows. Take the ripple blanking input (RBI) of the most significant 4033A on the integer side of the display low. Then take the ripple blanking output (RBO) of the IC and connect it to the RBI of the next counter and so on until the position of the assumed decimal point is reached. Follow exactly the same procedure from the least significant counter in the fractional part of the display backwards to the decimal point (see Fig. 3(a). Of course, if the assumed decimal point is at one end of the display then half the procedure would be unnecessary. If non-significant zeroes in the places either side of the decimal point are to be displayed (so that 7 and .6 appear as 7.0 and 0.6) then the RBIs of the two counters concerned should be taken to Vdd. Finally on these two ICs, the lamp-test facility on the 4033A just forces all segment outputs high when it is taken high.

## THE 4029A and 4081A

We shall conclude our discussion of counters by looking briefly at two more devices. The 4029A is a general purpose counter which, at the price that a 7490 was a year or two ago, has most of the features of the more exotic TTL devices. Briefly, the device is positive edge triggered and advances when the clock and preset enables are both low. Furthermore it counts in *binary* when the binary/decade input is high and BCD otherwise. A high signal at the up/down input persuades it to count up and a low input forces it to count down. As though this were not enough, when the preset enable input is high, the Q counter outputs are forced to follow the J ("Jam") inputs. The prefix "4" in both cases indicates the most significant digit. The pinout diagram is given in Fig.

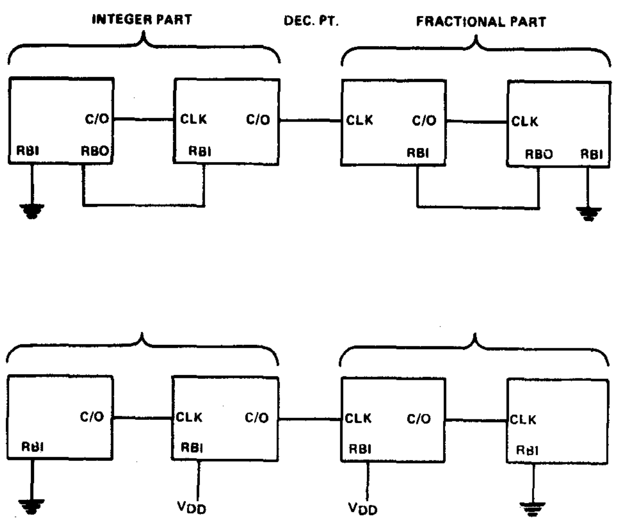



*Fig. 3. Four digit counters using the 4033A with non-significant zero supression (a) in all positions (b) in first and last position only.*

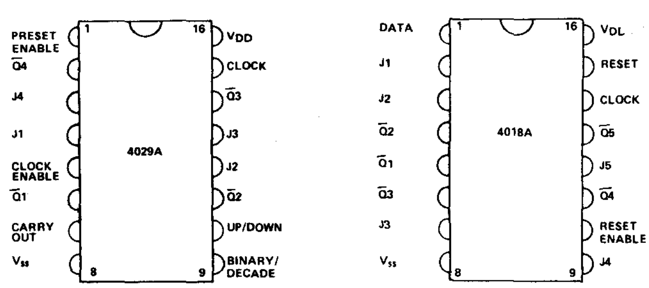
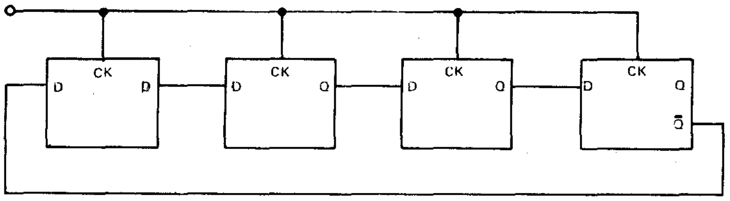



*Fig. 4. Pinouts of the 4029A and 4018A.*

# CMOS-a practical guide




| $Q_1$ | $Q_2$ | $Q_3$ | $Q_4$ |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 |

*Fig. 5. Circuit diagram and counting sequence for a four stage Johnson or "twisted ring" counter.*

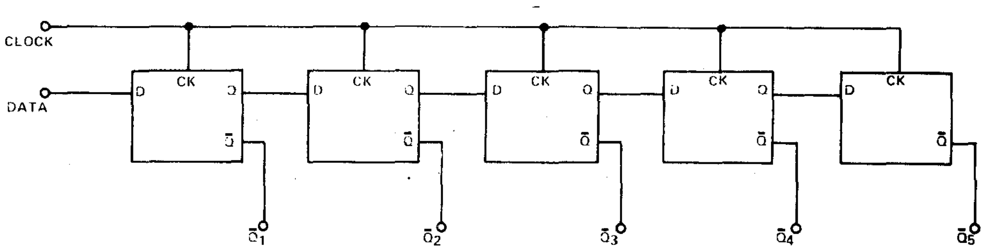



*Fig. 6. Simplified internal diagram of the 4018A.*

| TO DIVIDE BY | CONNECT |
|---|---|
| 3 | $\bar{Q}_1$, $\bar{Q}_2$ — DATA |
| 4 | $\bar{Q}_2$ — DATA |
| 5 | $\bar{Q}_2$, $\bar{Q}_3$ — DATA |
| 6 | $\bar{Q}_3$ — DATA |
| 7 | $\bar{Q}_3$, $\bar{Q}_4$ — DATA |
| 8 | $\bar{Q}_4$ — DATA |
| 9 | $\bar{Q}_4$, $\bar{Q}_5$ — DATA |
| 10 | $\bar{Q}_5$ — DATA |

*Fig. 7. Connection of the 4018A as a divide by "N" counter Input to clock, output waveform from DATA input is symmetric when N is even, almost so when N is odd.*

4 along with that for the 4018A presettable divide by N counter.

There are two basic ways of producing counters. Firstly there is the chain of flip-flops each of which halves the frequency produced by the one before it. This was the principle behind the binary counters, which we considered at the beginning of this month's discussion, and also of the 4029A.

The second method is known as a Johnson counter and it is basically a shift register consisting of a chain of flip-flops with the Q output of the last counter connected back to the data input. A little patience and a pencil and paper will soon show that such a counter will divide the input frequency by 2N where N is the number of stages.

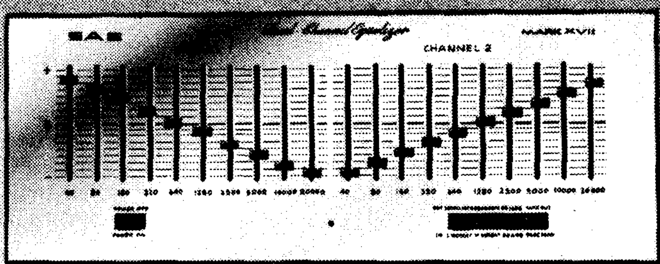
The counting sequence for a four stage counter is shown in Fig. 5 and the reader will notice that if the counter starts with contents not in the counting sequence (e.g. 1010) then the contents are always nonstandard thereafter. Thus some special gating is required. The simplified internal diagram of the 4018A in Fig. 6 is not complete. Also the Jam inputs and preset enable (which work in the same way as in the 4029A) together with the reset (which zeros all stages (Q1 — Q5 = 1) have been omitted for clarity.

Figure 7 shows the way to connect the 4018A to divide by all numbers from three to ten. Just as an example of how versatile this device is, one application will be considered in a totally different field from counting. By disregarding the clock, the Jam inputs and inverted data outputs ($\bar{Q}$) can be used as a five data latch for temporary storage, the outputs being updated to the inputs while the present enable is high.

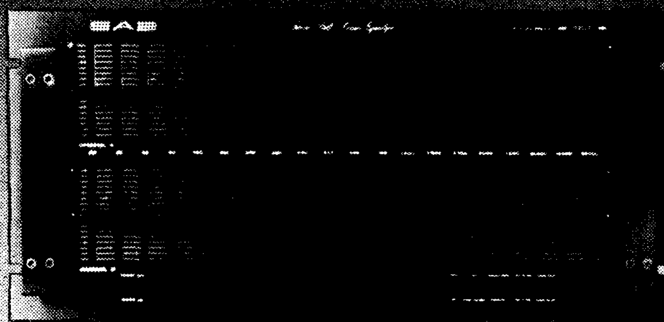
*To be continued*

# some are more equalizer than others

• MARK XVII octave equalizer



• MARK 2700B half octave equalizer



## specifications...

Your tone controls are just not designed to compensate for
☐ Room acoustics
☐ Speaker placement
☐ Old or bad recordings.

We built the Mark XVII Equalizer to solve these problems and more. These are some of the ways:
☐ Individual Octave Control for each channel.
☐ Long throw, oil-damped linear slide pots for greater accuracy.
☐ Dual range operation (controls operate over either ± 8dB or ± 16dB)

**Plus**
☐ Capable of driving any system
☐ Low distortion– less than 0.03% THD and IM
☐ Low noise — greater than 90dB
☐ 5-year parts and labour service contract
☐ SAE's reputation as the finest manufacturer in the audio field.

You'd have to look a long time to find an EQ that delivers this much value. SAE innovation has done it.

price $356.50

## specifications...

**Pink Noise Generator.** A built-in pink noise generator assures an accurate reference for proper equalization of wide band speaker response, speaker phasing, channel power balancing and frequency equalization.
**Low Distortion.** Fully complementary output drive circuits provide total harmonic and inter—modulation distortion levels of less than 0.02%.
**Low Noise.** High Q Toroid inductors in combination with low loss capacitors and low noise professional slide potentiometers result in circuitry offering greater than 100dB signal-to-noise ratio and accurate equalization curves.
**IC Power Supply.** Individual IC control for positive and negative power supplies further assures low noise circuitry and stability with changing line conditions.
The SAE 2700B Dual-Channel Half Octave Equalizer delivers +23dBm for recording applications, offers complete control, extremely low noise, accurate equalization, and the usual superb SAE quality.

price $695.00

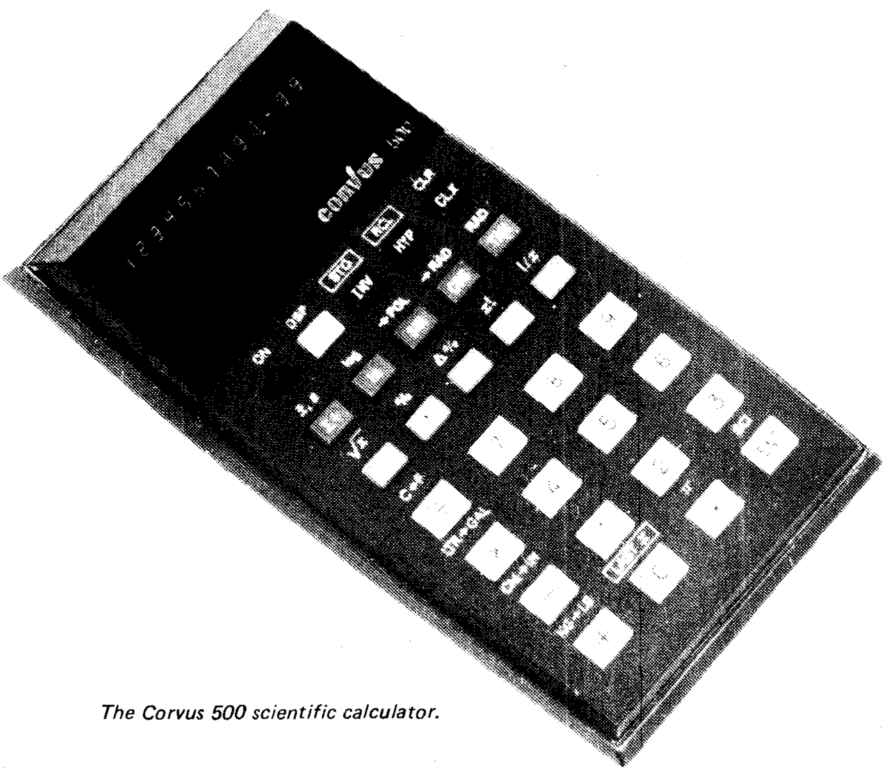
SAE
components for the connoisseur.

Sole Australian Distributors.
**LEROYA INDUSTRIES PTY LTD**
**Head Office, W.A.: 156 Railway Pde., Leederville 6007. Phone 81 2930.**
**N.S.W. Office**: 100 Walker St., North Sydney. 2060. Phone 922 4037.
**VICTORIA Office**: 103 Pelham St., Carlton. 3053. Phone 3477620.

LER 119

# CALCULATOR OR COMPUTER?

When is a calculator chip a calculator chip and when is a microprocessor chip a microprocessor chip? Rudi Hoess of Electronic Concepts Pty Ltd looks at some calculator ICs that work like microprocessors . . .



*The Corvus 500 scientific calculator.*

WITH CALCULATORS BECOMING more sophisticated and powerful with every new model, how do LSI manufacturers handle the resultant obsolesence factor and associated costs? Clearly the necessity to remain competitive and constantly upgrade machine capabilites and preprogrammed functions calls for a flexibility akin to microprocessors — where the addition of memory (RAMs) and programs (ROMs) will make upgrades and new model releases easier, quicker and more cost-effective.

An interesting approach was developed by Mostek Corp of Dallas, Texas. The IC combinations described here are used with the Mostek developed Corvus calculators by Electronic Concepts Pty Ltd of Sydney.

Mostek developed an expandable modular family of LSI ICs requiring minimum external components for any given application. A typical chip set centres on the Arithmetic Logic Unit

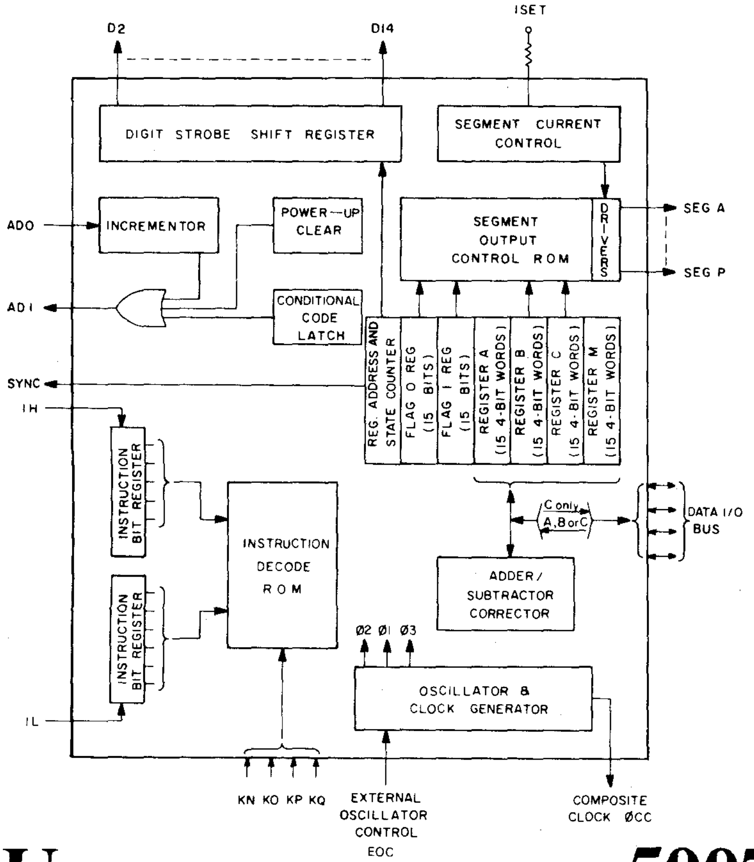
## SCIENTIFIC CALCULATOR = 50103 + 50104 + 50075.
**This is the combination used in the Corvus 500.**

The MK 50075, ALU circuit, combined with the MK 50103, 50104 ROM circuits forms a powerful twelve digit scientific calculator. The display format can be fixed point (user programmed) or floating point in either business or scientific notation. The calculator has four rotatable stack registers plus nine addressable memory registers. All entries use the reverse polish notation.

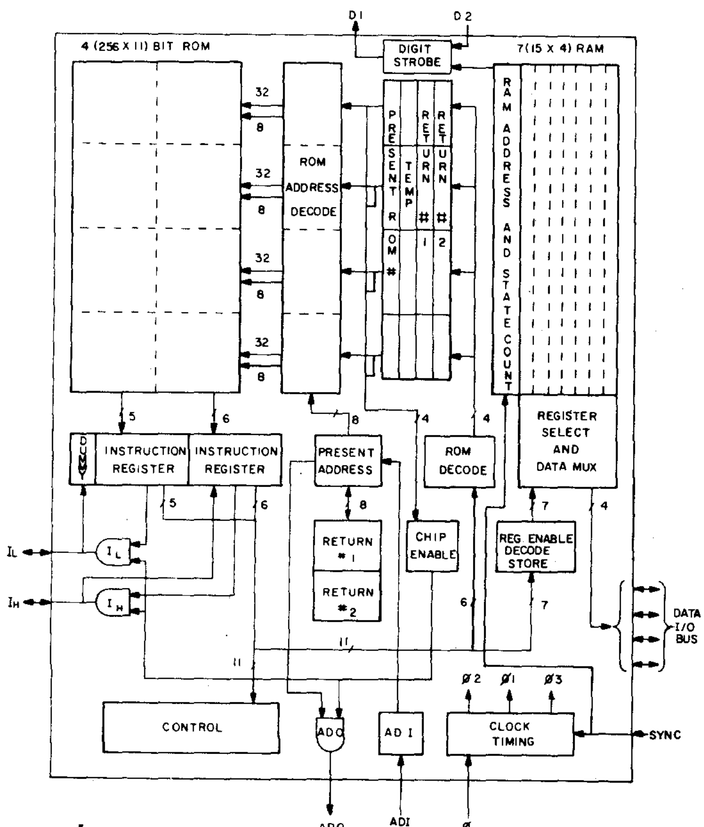
Effective combination of key functions on this calculator make it possible to offer fifty-five functions with thirty keys. Multifunction keys are accomplished by utilizing the SHFT/DSP, INV/STO, and HYP/RCL control keys. SHFT (Function) enables the upper case key function while INV (Function) enables the inverse of a function. The HYP key is used in conjunction with hyperbolic functions. Several keys have both upper case, and inverse functions while COS, SIN, and, TAN have hyperbolic, upper case, and inverse functions. The order in which the control keys are entered will have no effect on the function. For example, both the key sequence SHFT, INV, C → F and INV, SHFT, C → F will convert degrees Fahrenheit into degrees Celsius.

The calculator can work trigonometric functions in either degrees, grads, or radians. When in the radian mode an indicator is turned on. Switching between grads and degrees is achieved by a slide switch while switching from grads to radians or degrees to radians is a key function. The calculator can do the following transcendental functions: sinx, arcsinx, cosx, arccosx, tanx, arctanx, sinhx, arcsinhx, coshx, arccoshx, tanhx, arctanhx, $e^x$, lnx, $10^x$, and logx.

Besides trancendentals, it calculates the single variable functions of X!, 1/X, $\sqrt{X}$, and $x^2$ and the two variable functions of $y^x$, $\sqrt[x]{y}$, %, and Δ%. It has ten preprogramed conversions which automatically change the contents of the display register into the desired units. It calculates mean and standard deviation using the unbiased method. Its Σ +, Σ −, and RCL Σ + functions combined with its polar to rectangular conversion makes vector addition straight forward.

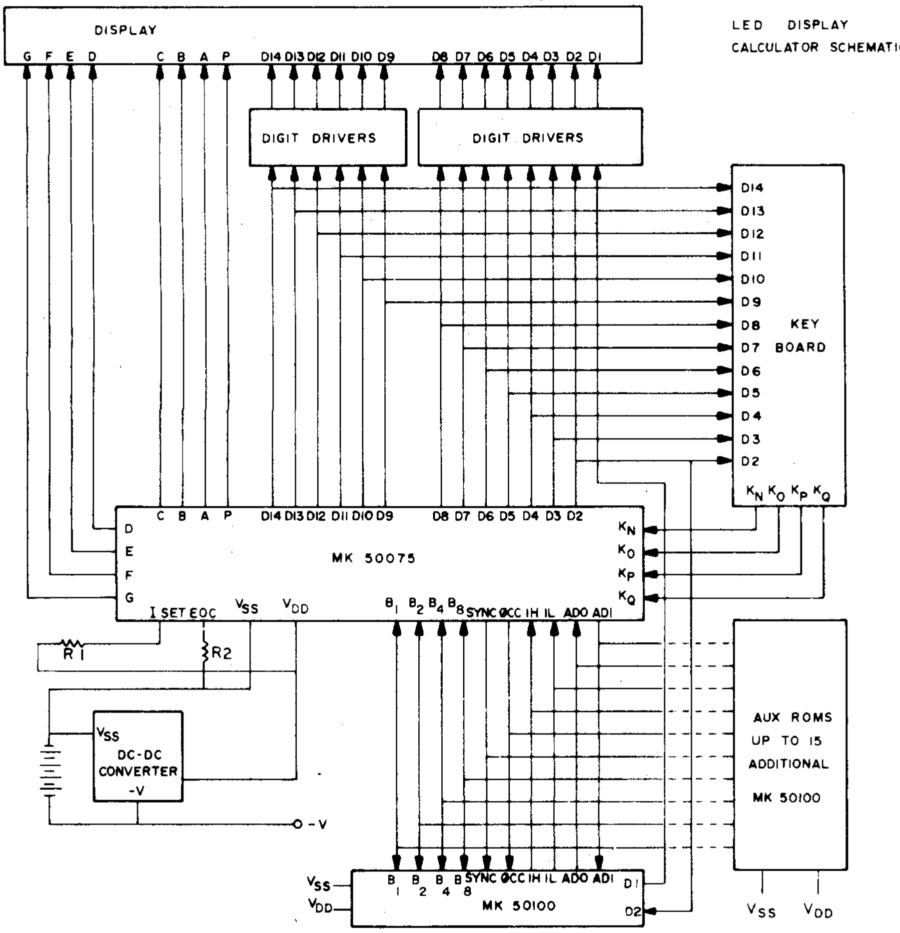



# ALU 50075

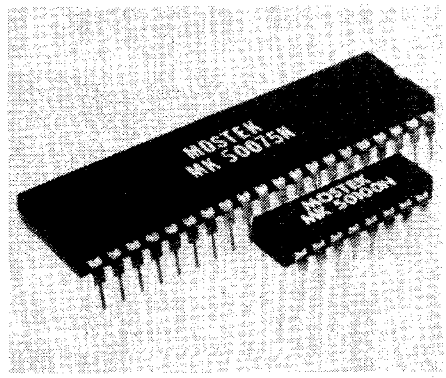



# RAM/ROM 50100

# CALCULATOR OR COMPUTER?




LED DISPLAY CALCULATOR SCHEMATIC



# SYSTEM

MK 50075, designed to handle all typical calculator in and output requirements, directly interfaced to a RAM/ROM/Interface chip MK 50100 containing 1K words of instructions (ROM), seven 15 digit registers of read/write storage (RAM), plus all I/O interface requirements to facilitate automatic synchronisation with the ALU.

Maximum configuration allows for 16 MK 50100 memories to be connected to one 50075 ALU.

To develop a new application, or expand an existing one, only the ROM area needs to be imposed on a standard MK 50100 – thus simplifying the creation of a new product or the upgrading of an existing product without the development costs inherent in the creation of a ROM of similar capability and ease of interface. ●

## BUSINESS CALCULATOR = 50101 + 50102 + 50075.
## This is the combination used in the Corvus 600.

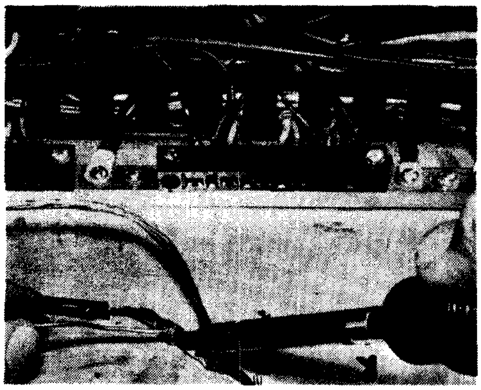
The MK 50075, ALU circuit combined with the MK 50101, MK 50102 ROM circuits forms a nine or twelve digit algebraic business calculator. The calculator normally has a nine digit display although all internal calculations are computed to thirteen digits. By adding two diodes and a switch twelve digits can be displayed. The display format may be fixed point (user programmed) or floating point.

The chip set has nine memory registers. The memory operations of addition and subtraction are performed on the contents of memory register one and the display register without affecting the display contents.

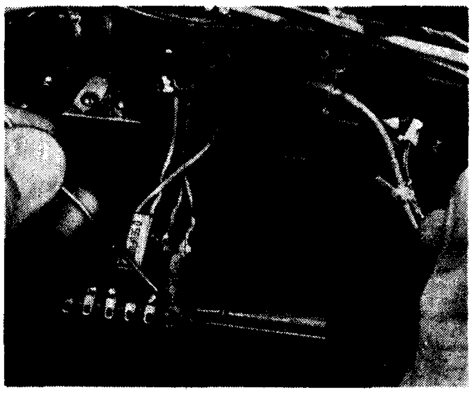
The calculator has the standard four functions of addition, subtraction, multiplication, and division. The equal key serves two functions. The first time it is pressed, it completes the previously entered operation. The second time it is pressed the calculator will perform constant operations in which the second numerical entry is treated as the constant. The calculator also performs the functions of percent, $y^x$, and gross profit margin.

Stored in its ROMs, this chip set has a unique financial program. Tied in with this program are five financial keys: i, interest; n, number of payments; PMT, amount of payment; PV, present value; and FV, future value. All financial calculations require a minimum of three input parameters to solve for the other two. Input parameters may be entered in any order from the keyboard or be stored in the financial registers as the result of previous calculations. These keys make financial calculations easier than adding or subtracting.

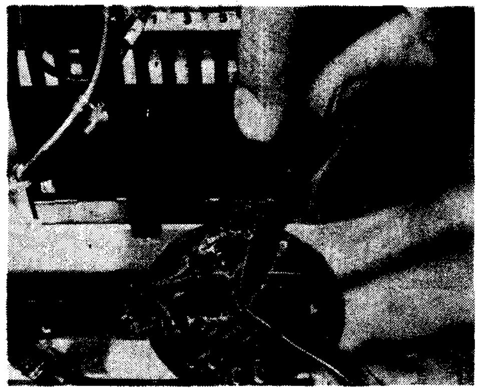
# "WITHOUT MY SCOPE IRONS I RECKON I'D NEED A 25 HR. DAY."



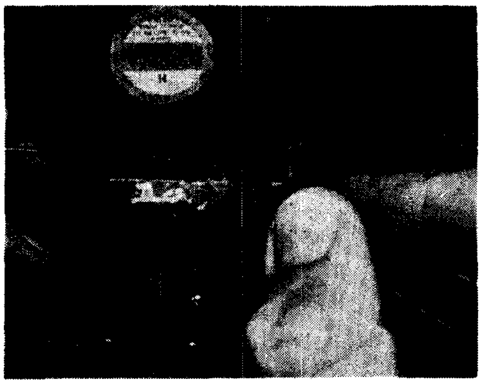
**8.00am** "Start the day with a heavy earth connection on the emergency power plant. Need a 130 watt iron. My Superspeed's got that and more. Just as well, the workshop's 400 yards away".



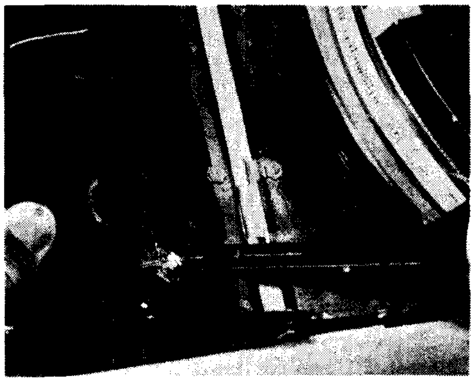
**9.15am** "Call from No. 2 Moulding Shop. Ran some temporary leads involving both tag joints and Printed Circuit Board (P.C.B.) connections. The Scope Minispeed handled the lot".



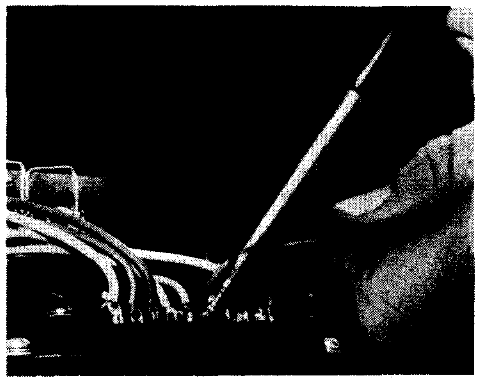
**10.55am** The V.D.U. in the process control room is playing up. Replacing miniature resistors on a P.C.B. is, ideally, the job for a temperature controlled 60w iron but my Scope Minispeed did the job and did it well.



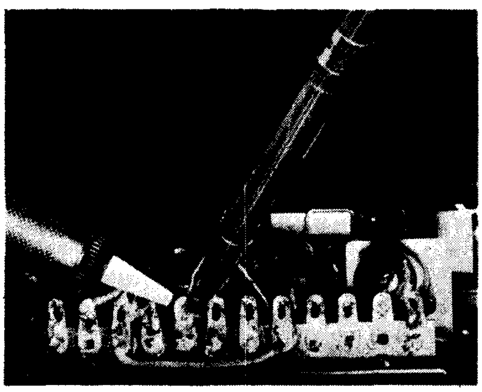
**11.15am** "Fix the speaker leads in the canteen P.A. Need a 30-40 watt iron, but my Scope Minispeed did the job".



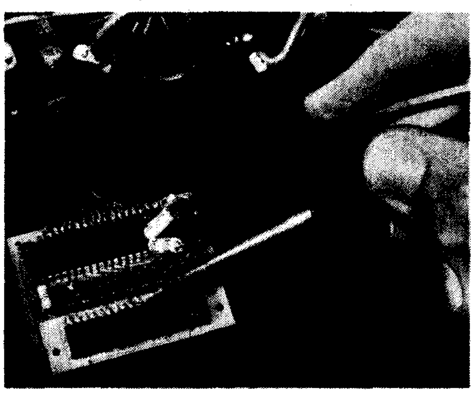
**1.30pm** "Resolder a 7/036 earth to sheet metal — LP gas flame would work, but too much risk of heat damage to PVC cable. The Superspeed iron produced its full 150 watts and did the job".



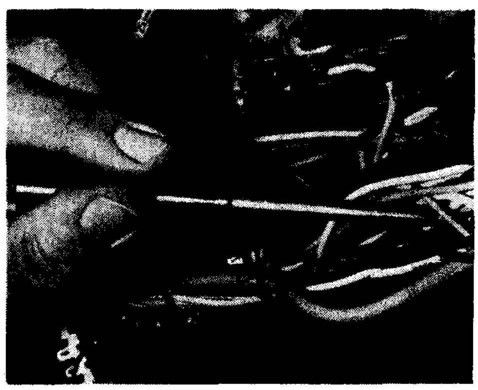
**2.15pm** "Fred borrowed my Minispeed to tackle an open circuit on the fork lift's headlights. He permanently soldered the wires to the terminal block, and used the Mini's 75 watts to do it".



**2.17pm** "Tag soldering in the workshop and a desolder job on a P.C.B. Using the Minispeed saves swopping between conventional 60 watt and 25 watt irons".



**3.58pm** "Emergency in shop six. I used my Minispeed to unsweat the leads of the main heater control circuit and then desolder the pyrometer circuit on the P.C.B. One iron, two different jobs".



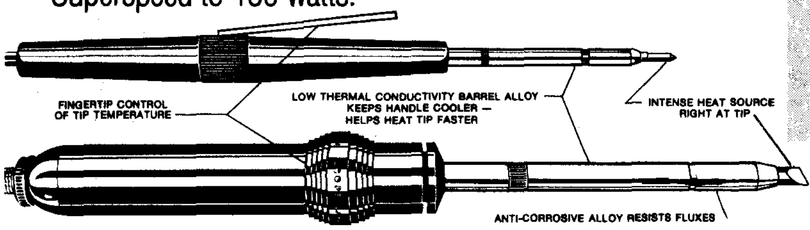
**4.18pm** "This wiring's a real birds nest. Passed through the wires with the Minispeed stone cold, desoldered the three joints, let the iron cool down, then withdrew through the PVC insulation. The 5 second heat up and low tip mass let's me do this".

## Scope soldering irons save time three important ways:

1. Versatility.

One Scope iron replaces several conventional irons because it can tackle a wide range of soldering problems, from integrated circuits and printed circuit boards to heavy earth and chassis connections.

You don't have to swap irons half-way through the job. Both the Minispeed and the Superspeed function as 20-30 watt irons, and then within seconds and a touch of the finger switch, you get increased heat output to increase the Minispeed to 75 watts, and the Superspeed to 150 watts.



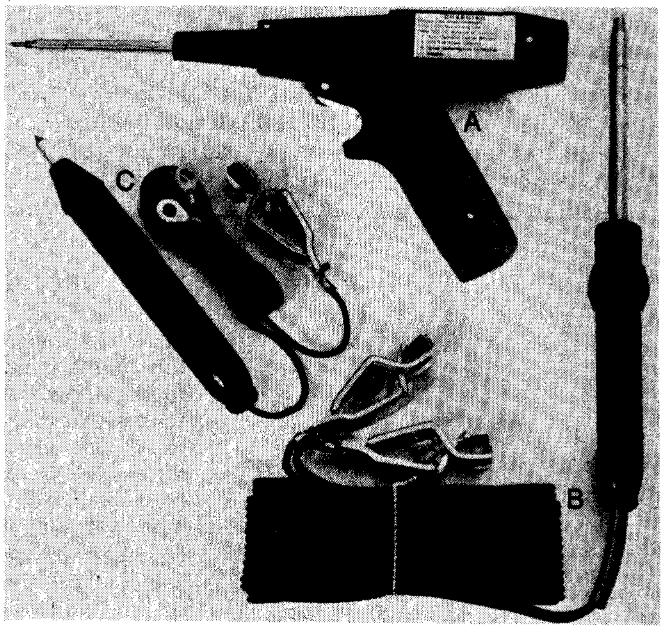

2. Speed.

Five seconds gets both irons ready for work, and they cool down quickly as well. When you encounter a heat sink you want an iron that can make up the heat loss instantly and maintain good soldering temperature. Result, the job's done fast and you can move onto the next.

3. Safety.

Scope irons are isolated from the mains. The special isolation transformer lets you work on live equipment with a higher degree of safety than a conventional iron.

The Scope range of products is designed to deliver efficiency and convenience. Consider the advantages of these products.




(A) Scope Cordless. 60W.

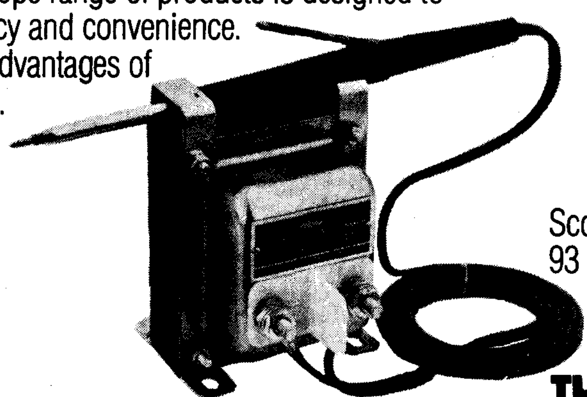
Designed for working where no power is available or during temporary failure. It's powered by two rechargeable Nicad cells with the capacity to solder between 100 and 200 typical electronic connections before overnight recharging.

(B) Scope 12V Hobby Iron.

This versatile iron is designed to work within 6 metres of your car battery.

(C) Scope Vibroscope.

This electric pencil allows for permanent writing on all metals. Valuable in an engineering store identifying metal tools, dating and naming parts, inscribing trophies.



For enquiries and further information on the Scope range of products contact: Scope Laboratories, 93 Matthews Avenue, Airport West, Melbourne, 3042.

**SCOPE**

**THE RIGHT IRON FOR THE RIGHT JOB.**

SL1

# COMPUTER APPLICATION REPORT

Well we've talked enough about microprocessor evaluation kits and how to get them going . . . but what about an actual example of a company buying one of these and putting it to work — using a microcomputer to test the car burglar alarms which are on special offer in this issue.

*In this photo you can see six alarms plugged into sockets on a piece of board. In all there are sixteen alarms tested at the same time.*

*The commands are entered via the keyboard, but once the program was written this was used only to start the test. The printer on the right gives the results of the test.*

*The middle box in the stack of three in the centre of the picture holds the Motorola evaluation board and the interface board. These can be seen in the photographs on page 32.*

**THE PROBLEM:** TESTING A 'Sleeping Dog' burglar alarm normally takes one person about ten minutes, this means it would take three months to test a few thousand, but it is needed to test at the rate of this many per week. One way to do this is to employ sixteen or seventeen workers, but a better way is to use a microcomputer.

**THE SOLUTION:** By using a microcomputer the desired testing rates were achieved and there was the added bonus of an individual printout giving the specifications of each alarm. And human error was eliminated.

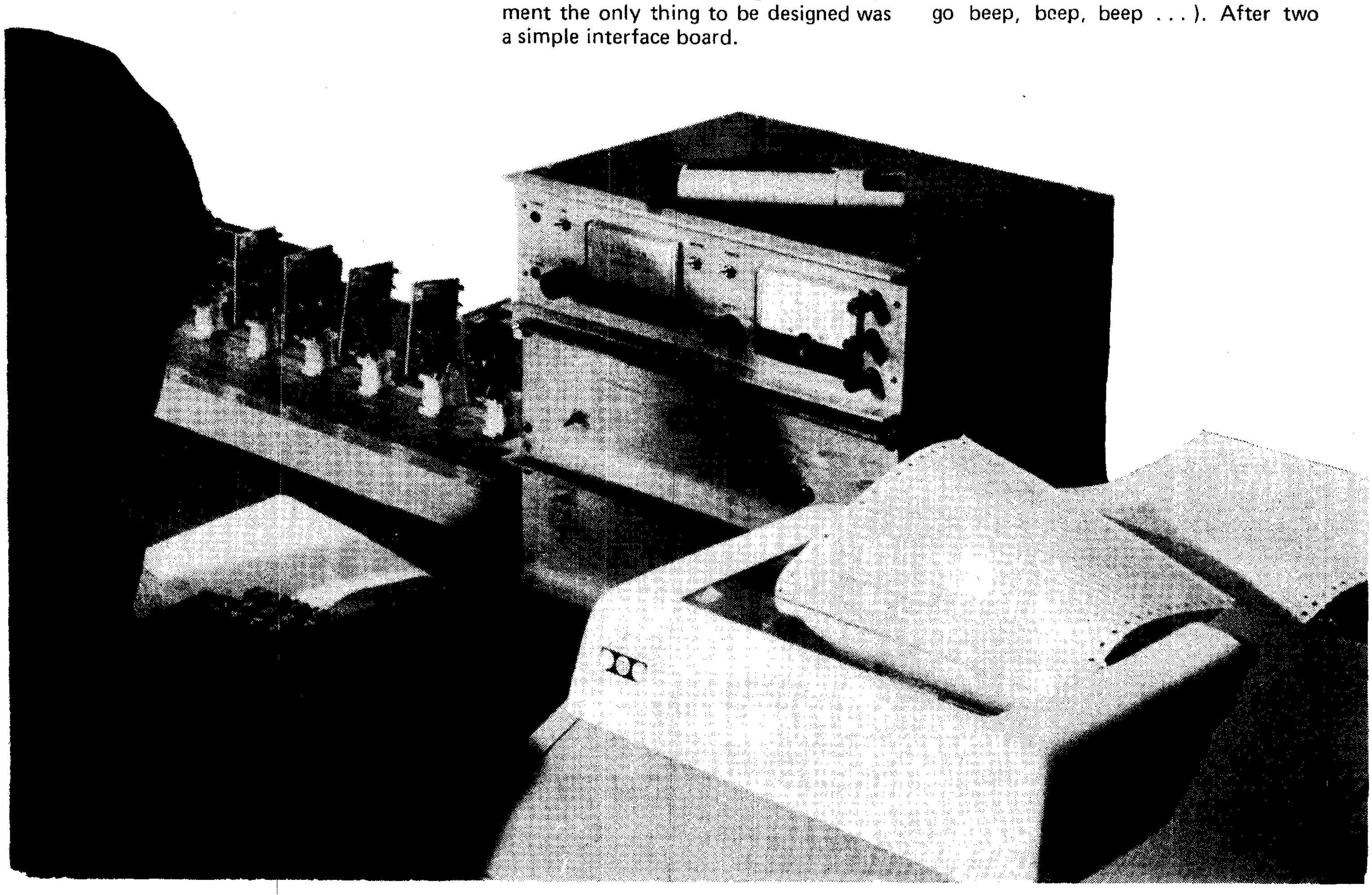
The system developed by the company enables alarms to be tested 16 at a time and apart from program development the only thing to be designed was a simple interface board.

## Testing Procedure:

1 To test reverse-voltage and over-voltage protection circuits, the alarm is deliberately abused in these two ways before the testing starts.

2 To test arming of the alarm, the voltage is removed from the 'ignition' input (to simulate switching off the ignition) and the signal on the 'lamp' output is monitored. An intermittent voltage (to flash the lamp) should appear after 90 seconds (this indicates that the alarm is armed).

3 To test the trigger input (connected to the car door) and the horn output, the alarm is triggered and after 10 seconds an intermittent voltage should appear on the horn output (to make it go beep, beep, beep . . . ). After two



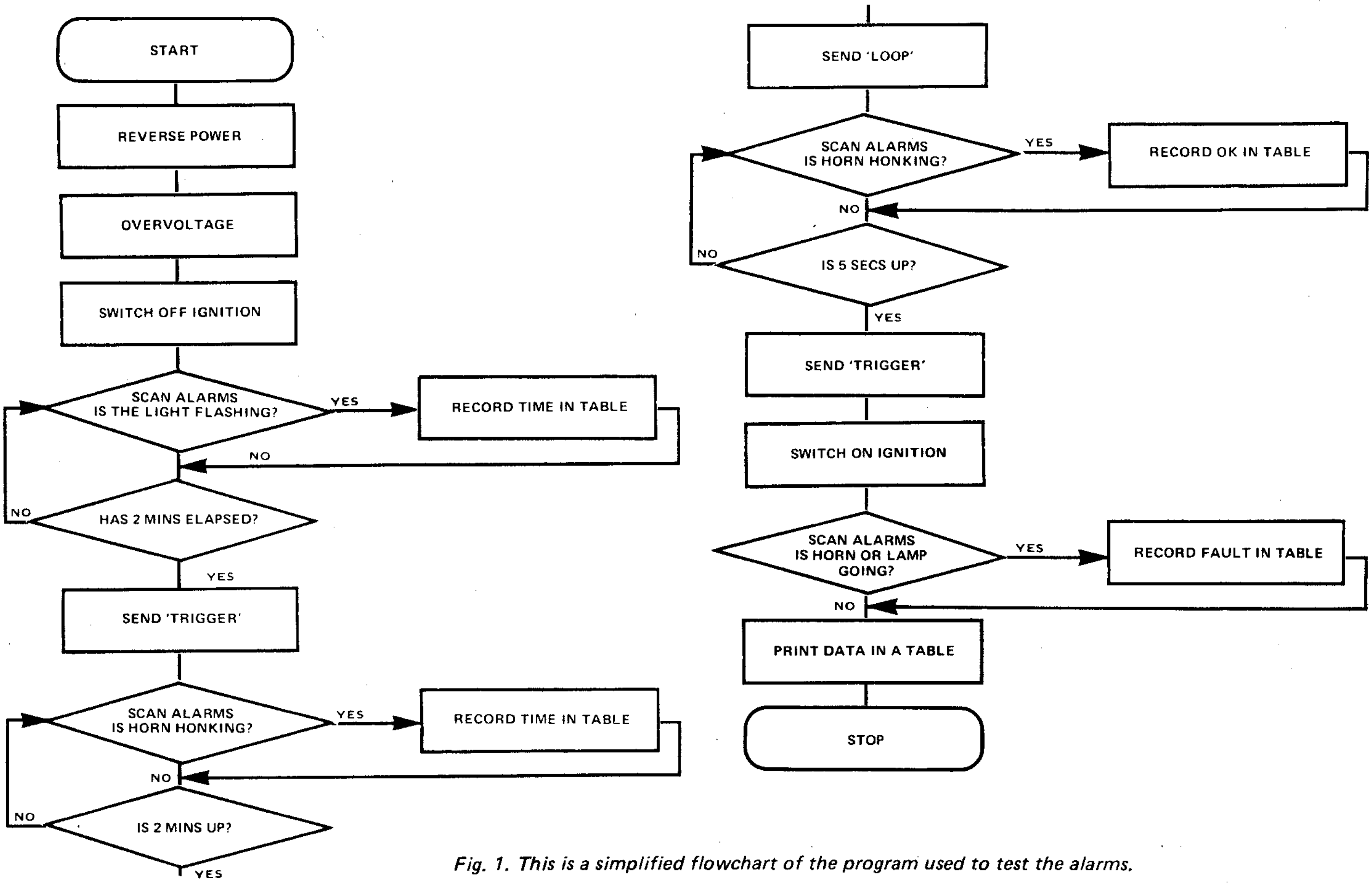



*Fig. 1. This is a simplified flowchart of the program used to test the alarms.*

minutes the horn should stop and the alarm remain armed.

4 To test the 'loop' input (which protects accessories on the car) the normally-closed contacts across the input are opened and the 'horn' output is monitored to check for two minutes of beeping.

5 To check that the alarm switches from its armed to its dormant state when the ignition is switched on, the alarm is triggered and then the 'ignition' input is taken high within ten seconds. The absence of outputs indicates that the alarm is dormant.

The testing procedure is the same for the computer as it is for the human tester. The flow-chart shows, in simplified form, how these tests are carried out on sixteen alarms at the same time.

TEST RESULTS, ALARM # 0101

EXIT TIME 74 SECS

ENTRY TIME 12 SECS

"TRIG" ALARM 66 SECS

"LOOP" ALARM 64 SECS

*Fig. 2. The test results for alarm number 101.*

## How The Computer Does It

Looking at the flow-chart you will see that the program can be broken down into a series of logic functions. As it starts its program it needs only to put a suitable bit in a latch on the interface board and relay logic takes over to reverse the power supply to all the alarms. In a similar way the computer can provide the overvoltage instruction, the ignition-on and ignition-off voltages, the closed and open conditions on the loop circuit, and the trigger voltage which simulates opening the car door. These five computer outputs (alarm inputs) are decoded from a 6-bit bus on the interface board. The status of the lines in this bus results from the data put into certain memory locations on the processor. On the interface board a decoder looks at these bits and puts five relays into appropriate states.

This takes care of the signals from the computer to the alarms (all 16 alarms are spoken to at the same time) and before we look at communication in the other direction we will look at the need for isolation and how the interface board is organised.

## Isolation

Above we mentioned that relays are used to isolate the computer circuit from the alarm circuit. Isolation is needed because the alarms work on a 12 V supply and the computer uses 5 V, also noise immunity is improved. When isolating the two circuits the designer had the choice of opto-isolators or relays. He chose relays because these can easily be protected against high currents (by a simple fuse). An opto-coupler would probably blow up when faced with short-circuited alarm.

## The Interface Board

We have looked at the way the computer sends out signals to the alarms via relays. Now we will see how it reads the outputs from the alarms. Each of the sixteen alarms has two outputs (one to flash the lamp, one to beep the horn). There are simple networks on the interface board to differentiate then integrate these intermittent signals, so a steady high or low voltage will not get through.

These thirty-two outputs are multiplexed to a single alarm output line. When the flow-chart says 'scan the alarms to see if there is a flashing lamp signal' the computer looks at this single output line and addresses each of the alarms in turn. As there are 32

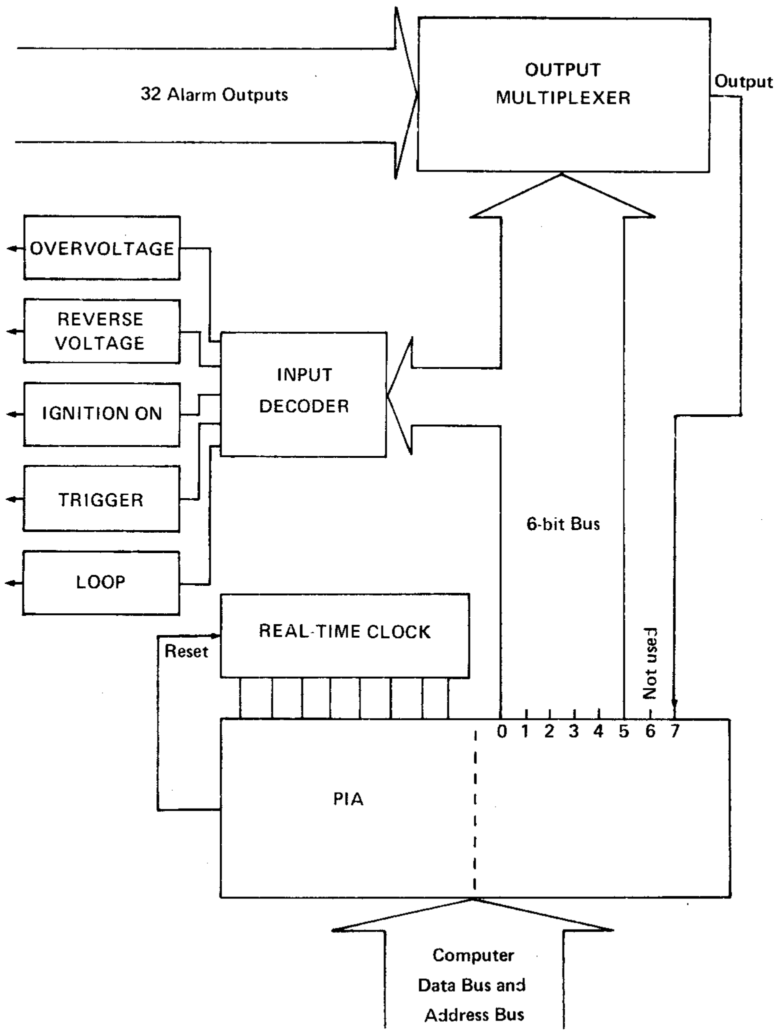
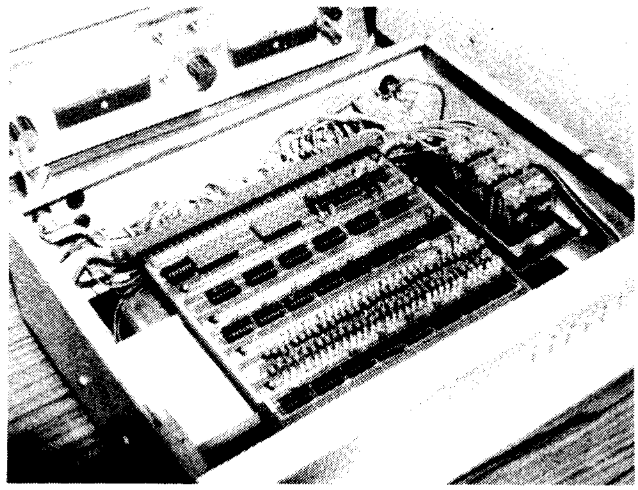
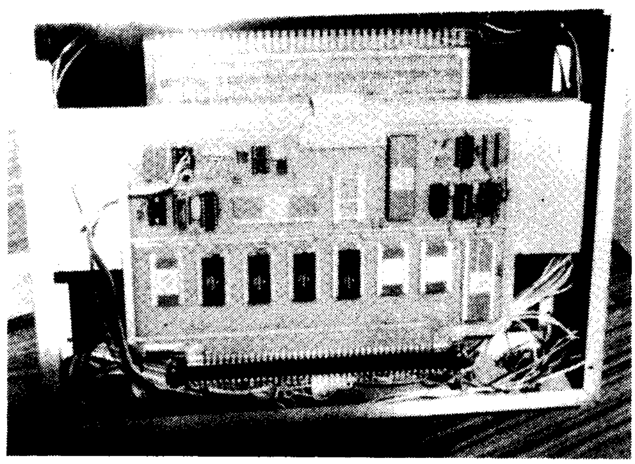



*Fig. 3. Block diagram of the interface board.*



*This photo shows the interface board mounted in the top of the computer housing.*



*This photo shows the Motorola evaluation kit mounted in the bottom of the computer housing.*

outputs each can be uniquely addressed with a 5-bit code from the computer. This code is sent along the 6-bit bus from the PIA (see the diagram). The outputs have addresses from 000000 to 011111 (note the first bit is always 0). When the computer tells the PIA to send out a code starting with a 1 this is decoded by the input decoder and the appropriate input signal is sent to the alarms.

The interface board contains the 6-bit bus, the logic to decode addressed outputs and inputs, the relays and interface components to handle signals to and from these inputs and outputs, plus two other sections. These are the PIA and the real-time clock. We will look at the PIA in more detail later; for now it can be regarded as two 8-bit ports to the computer. One of these is an input port, the other is used as a 6-bit output port (driving the 6-bit bus) and a 1-bit input port (one pin is unused).

## The Real-Time Clock

The 8-bit input port in the PIA is connected to a real-time clock. This counts seconds in binary and is available for the computer to read at any time. The reason an external clock is used (rather than telling the computer to count cycles) is because of the count cycles) is because of the magnitude of the times involved (a computer cycle is around 2 microseconds). The clock is reset by the computer with a signal on a peripheral control line from the PIA.

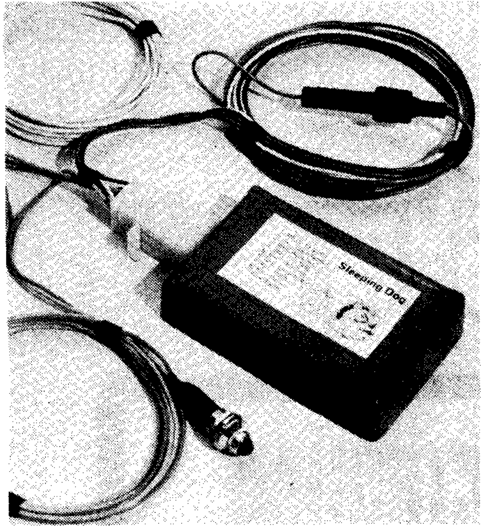
## The PIA

This IC sits on the data and address buses of the computer and has two sets of 8 lines which can be used as inputs or outputs in any combination. This setting-up is done by writing prescribed numbers into certain memory addresses. Each of the 8-bit ports has a memory address through which the processor can insert or extract data.

## The System

The system used in this application was based on a Motorola evaluation kit. In addition to this board and the interface board described above all that was used was a printer (this is not essential for simply testing the alarms; its inclusion in the system is simply to provide diagnostic data to assist fault-finding), a power supply and the hardware for connecting up the alarms. The program was contained within the RAM of the system in the photographs but in the long term it will be included as a PROM.

For developing the program an alphanumeric keyboard was used (this came ready-encoded to give ASCII output and a UART was added so that the monitor program in the evaluation kit would see it as a teletype). ●



# SPECIAL OFFER TO ETI READERS

# 'SLEEPING DOG'

## CAR BURGLAR ALARM

## $39·40 PLUS $1·60 p&p

Some months ago, Fairlight Instruments showed us a car burglar alarm which they had developed.

The basic *concept* was to provide a sophisticated alarm system that would nevertheless be easily installable by the average car owner — a necessary feature nowadays as commercial alarm installation is far from cheap.

The 'Dog' is enabled solely by the car's ignition switch so there's no need for concealed switches and you can't forget to enable the alarm — when the ignition's off the alarm's on — and vice versa.

On entering the car you have ten seconds to turn your ignition switch either to 'on' or 'accessories' before the alarm is set off. However even if one overuns the ten second delay time switching the ignition on immediately disables the alarm.

We have found that it takes about one to two hours to fit the alarm — the time depending upon the model of car and how well one knows its electrical system.

The 'Dog' is extremely well designed and made — an example of Fairlight's thoroughness is that they have built a microprocessor-based testing system and not only is every single alarm tested before despatch — a copy of the relevant computer print out is supplied with the unit!

Electronics Today International has no hesitation in thoroughly recommending this unit. At its normal selling price of $58.50 it's very good value — at the special offer price of $39.40 it's even better.

### HOW THE ALARM WORKS

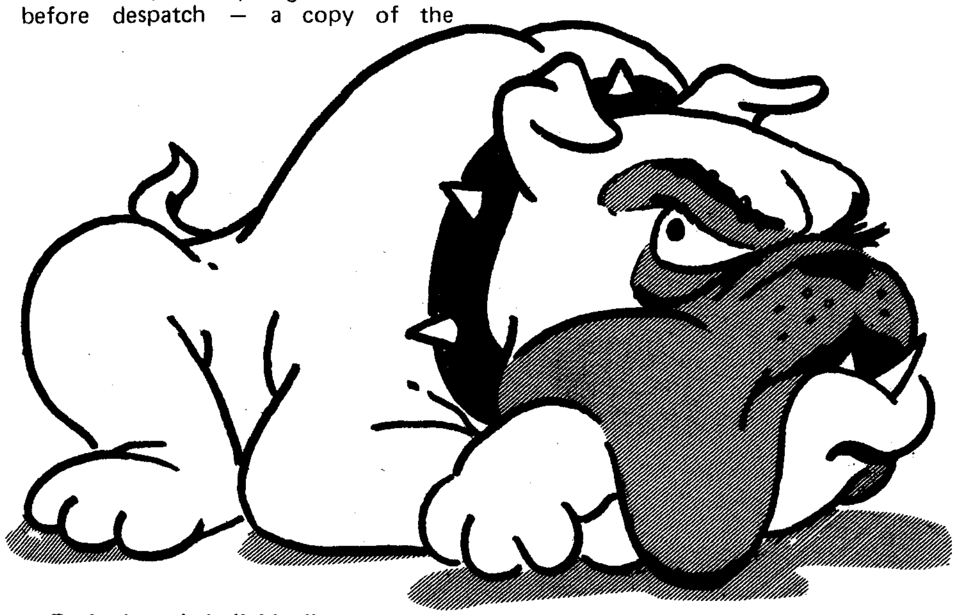
Unless the ignition switch is turned on within 10 seconds of entering the car the alarm sounds.

The alarm can also be activated by breaking a loop to ground connection, in this case, activation of the horn is instanteneous. The ground loop may have a number of switches connected in tandem and finally to an earth point such as a radio, trailer or cassette deck. The earth loop may also pass into outside mounted lamps — when the wires to the lamp are cut, the loop is broken and the alarm activated.

When activated, the car horn will sound intermittently for two minutes after which time it will stop and the alarm will be reset.

A lamp which may be mounted on the dash flashes while the alarm is set, as a deterrent to would-be burglars.

When the ignition of the car is switched off, there is a 90 second delay before the alarm is armed allowing reasonable exit time.



- **Each alarm is individually computer-tested and is supplied with computer printout result.**
- **Quarter window deterrent transfers**
- **Works only on vehicles with negative earth 12 volt system (most modern cars).**
- **Three month replacement guarantee**
- **Supplied with complete installation instructions.**
- **Does not rely on battery voltage drop sensing, which is highly vulnerable to false triggering.**

**Please send me . . . . . . . . . Sleeping Dog alarms, I enclose $. . . . . . . . . . . . . . . which includes $1.60 p&p.**

**Send to "Sleeping Dog" offer,**
**ETI Magazine,**
**15 Boundary Street,**
**Rushcutters Bay,**
**NSW 2011**

Alarm Options:

* Mercury Switch, connects in "loop", protects bonnet or boot. Tick ☐ add $3.00 each

* Isolating Switch (toggle), defeats alarm operation. (Alternatively remove fuse when car goes in for service). Tick ☐ add $2.00 each

Name: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

Address: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . Postcode: . . . . . . . . . . . . . . . . . . . . . .

# ELECTRONICS IN THE YEAR 2000

## EVOLUTION OR REVOLUTION

By Peter Sydenham

SCIENCE PROVIDES US WITH knowledge about existence. It is based on a procedure of collecting facts which are placed into apparently logical groupings in order to lead to stage two of scientific method – the realisation of one or more hypotheses. Man's imaginative powers then enable ideas about these facts to be "tried out" in the mind. (The mind creates what are called 'models'). After a brain-storming session some ideas emerge about the collected facts. These are likely contenders of generalised models that will describe many seemingly different ideas by one unified concept. Figure 1 depicts this process.

Having hit upon an hypothesis it is then tested by performing experiments upon it to see if more examples that would appear to also be correct are indeed allowed for. The hypothesis, as long as it is found satisfactory, is then held as current and applicable until a new case emerges that is not described adequately enough by it. The scientific process is then begun again to find a new hypothesis that is better than the earlier one.

Old hypotheses are not necessarily useless. They find their use in limited cases. We are quite satisfied in everyday life to regard mass as a constant entity but on some special occasions, in the design of some cathode ray devices for example, mass must be considered as being convertable to energy. Einstein's work predicted that conversion process.

New hypotheses produce new ideas for technology to take up and apply. Once it was *known* that the atom was divisible, scientists sought to split it further.

This brings us to the role of technology in the development of ideas. Technology and engineering is the broad discipline that devises machines and structures that do not exist as such in nature but using resources that are available naturally – see Fig. 2. Machines provide us with power conversion, with mechanisms and with measuring and information tools.

Technology is a sister requirement of scientific pursuit – inseparable partners in progress, each affecting the other's progress at varying degrees with time. Figure 3 shows an example of this interaction.

One often-seen mis-statement is that scientists build the so-called scientific machines. "Scientists put a package on

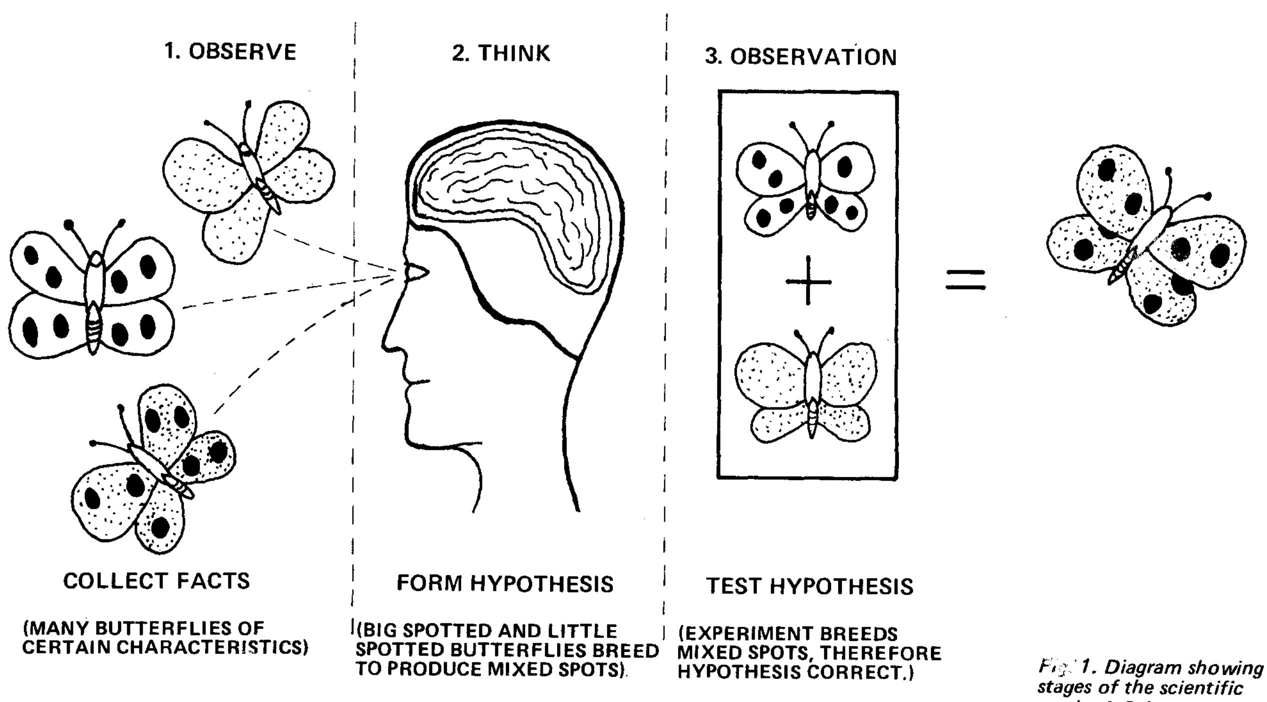



*Fig. 1. Diagram showing stages of the scientific method. Science produces knowledge.*

# Electronics 2000

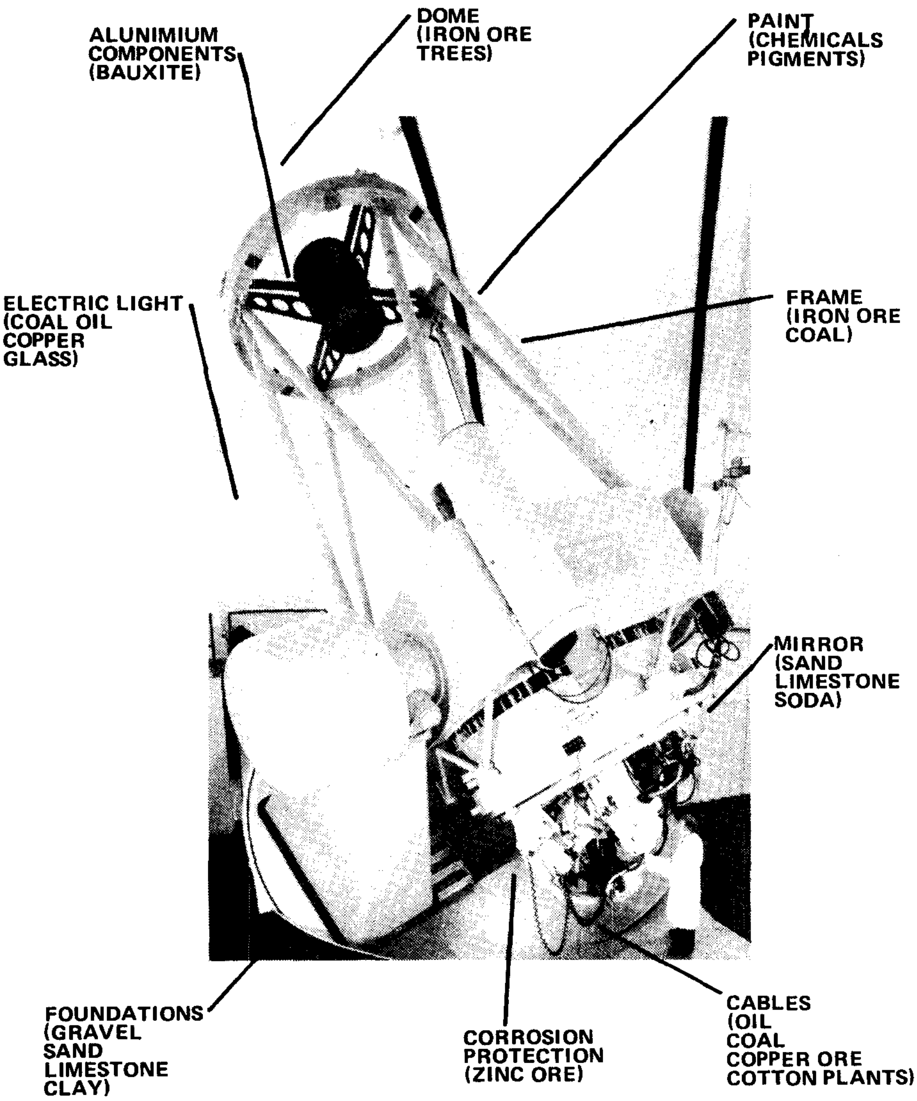



*Fig. 2. Technology produces new objects, using naturally available resources, for specific tasks. (98 inch telescope at Royal Greenwich Observatory).*

Mars is the greatest scientific achievement yet made by man". If it had been a failure then it would have been due to engineering failure! The Mars' probe is rather the greatest *technological* achievement.

It is important to see how much technology compared with how much science goes into a manufactured product for this helps us predict when new ideas will come into practical use.

There is, however, another aspect to technology. Many lifestyle changing ideas do not occur as the result of applying science in a systematic manner. In fact many valuable machines and ideas arrive by way of an unknown, often poorly trained, inventor who applies an uncommonly good amount of common-sense to solving an immediate problem.

But society itself is also a strong influence on the application of new ideas. Somehow a new idea appears out of place. We now accept spectacles as normal technology, but think how a person wearing a filtering false nose (a possibility for reducing hay-fever allergies) would be received. Organ transplants were, and still are to some extent, opposed. Test-tube babies are currently controversial.

Many problems of society could be solved more speedily if we were prepared to accept change and make what appears at the time to be sacrifice more readily. We have seen over the past two years a strong swing toward the smaller car. Air travel is now cheaper than by sea — the reverse of a decade ago. A trans-world telephone call now gives more message content than a telegram for the same price.

This introduction and the previous part of this study sets the scene for what I see could be some aspects of future living. I possess no crystal ball; I claim no extra sensory perception ability, nor do I have a pact with the maker or devil! What is given now is composed from studying the past trends and extending them into the future, this being sprinkled with some personal ideas of myself and others.

## GETTING ABOUT IN THE FUTURE

Although there have been instances in history where knowledge of man has been lost by chance or by political decree (the 1930's burning of the books in Germany) — technological change has continued to advance in all civilisations (albeit sometimes extremely slowly). It is most unlikely that the "alternative" communes we see today will be how man will live in future. It would need a global catastrophe to destroy all technology so thoroughly that the survivors would have to live as cave men and reinvent all inventions again.

Technology of long-distance transportation — railways, ships and even cars — requires great financial investment. Few people can afford a handmade car today — even mass-produced ones are becoming harder to reach. Thus, if big commercial business survives into the 2000s, or the State takes over, we can confidently expect changes to slowly emerge in transport. It takes about four to six years for a current design railway and its rolling stock to be built from conception. A new technology such as airships (a revival really), needs a decade and a half once a serious commitment is given to using it.

Electric cars are constantly being researched and developed — Fig. 4 — but it has become vitally clear that two areas of difficulty exist. The first is that the lead-acid battery is not adequate to power a car with performance that we have become accustomed to. The best produced to date is not an equal to the smallest family petrol car. What is needed is much more effective

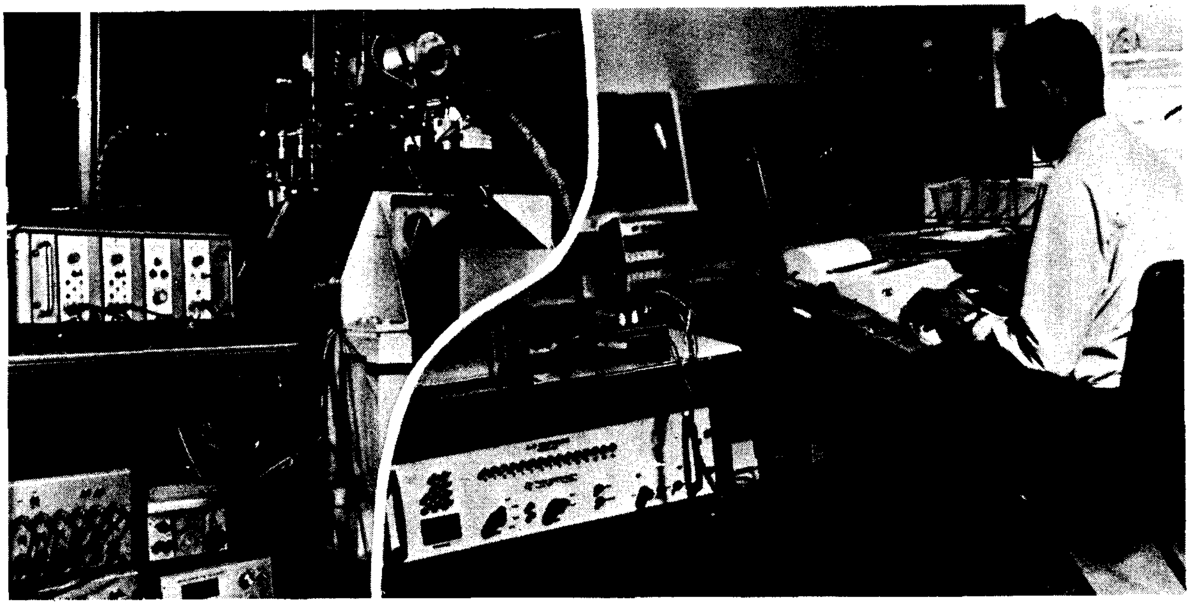


*Fig. 3. Science and technology go hand in hand helping each other continuously. (Computer controlled engine testing at Cranfield, UK).*

electrical storage arrangement. High-temperature sodium-sulphur batteries, as pictured in Fig. 5, have been developed to prototype stage. (See ETI, December, 1974) but the manufacturers suggest these cells will not be available to car makers before 1980. Add a few years more for design testing in practice and we may have a better electric car proposition by 1985. The second difficulty, however, may be a more serious barrier to the widespread use of electric vehicles. This is the general reluctance to move on a downward trend of performance. Petrol will still be available in the '90s so the choice will probably move toward smaller, just as well-performing cars that stretch the litre further.

Other likely developments are automatically steered vehicles running on specially modified highways. The cars would be guided by control units sensing guidance paths laid in the surface. Collision prevention by short distance doppler-radar and optimal route selection using telemetry signals picked up by radio or from transmitters also laid in the road (ETI, September, 1974) can be implemented now that research is in progress on these devices. Possible schemes are shown in Fig. 6. The computing capability needed, including built-in redundancy to improve reliability, is now available in micro-processors that will soon be as cheap as a good transistor radio. Social influences, people's suspicions and mistrust and overall cost are the constraints on rapid developments in this area.

With the thirst for speed perhaps settled to a resonable level the next thrust will be safety and again, perhaps, longevity of the vehicle. New ideas obtain much publicity — but promotion and worthwhileness of the product are not always related attributes.

Experimental Safety Vehicles, ESVs, have reached advanced levels. Figure 8 is Nissan's $E_2$ model. Urathane bumpers are now being used; other safety features are gradually being introduced. Perhaps vehicles adhering to the surface will be displaced by slightly levitated ground-effect machines like the hovercraft. Again, experience has shown that these are not the complete replacement for all ground transport systems. As yet they are still noisy, power hungry and not as responsive to directional control as the wheel-borne car.

The electric tram is another development that may come back again in a new form. Melbourne, for example, has a workable mass passenger transit system that now gets people into and out of the city generally faster than by car — yet it was not so long ago that the tram was regarded as archaic. Today it is recognised that mass transportation routes are better for concentrated city mobilisation than a melee of cars.

Magnetically levitated vehicles running on relatively inexpensive tracks were forecast to be capable of over 500 km/h speeds (see ETI July, 1973). Development of short test tracks and vehicles continues but the pace of development is slow to provide economic alternatives to maintenance and repair of existing systems. Figure 9

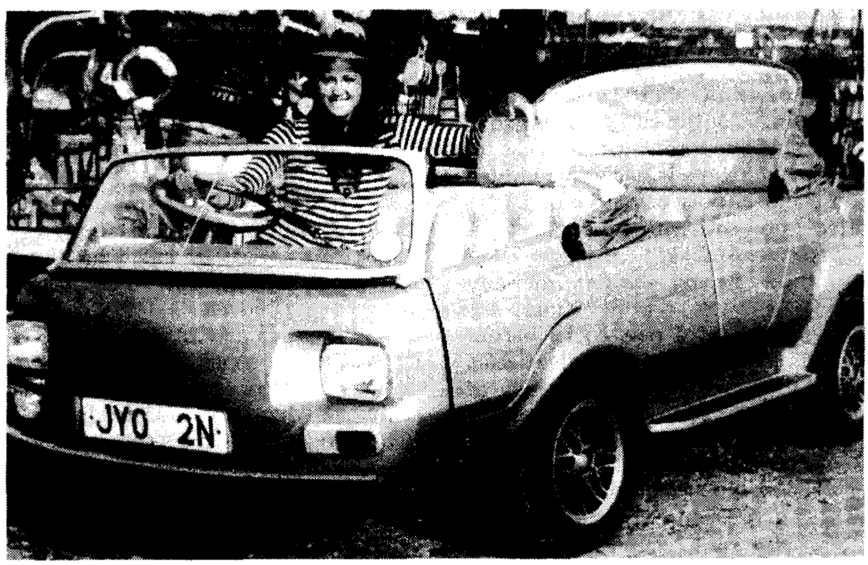



*Fig. 4. The electric car can only provide satisfactory transportation for short haul tasks. This is a pleasure version by ElecTraction.*

# Electronics 2000

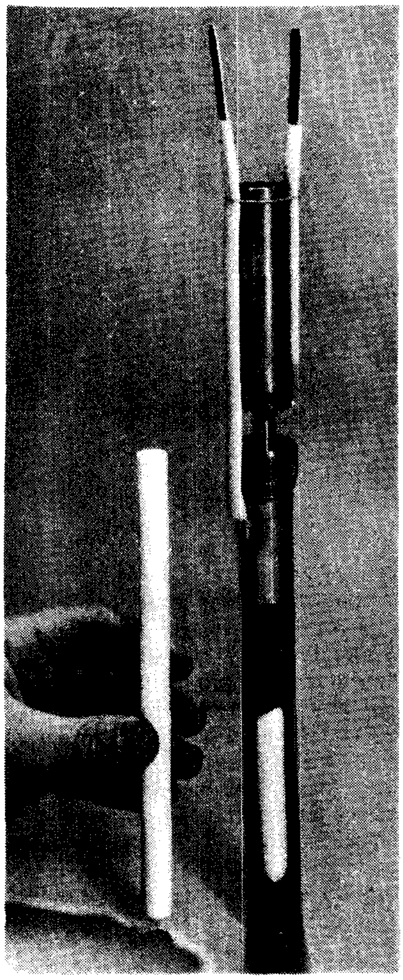


*Fig. 5 Na-S high temperature batteries can store much more power for a given weight than lead acid cells but they will not be available for another five years or more.*

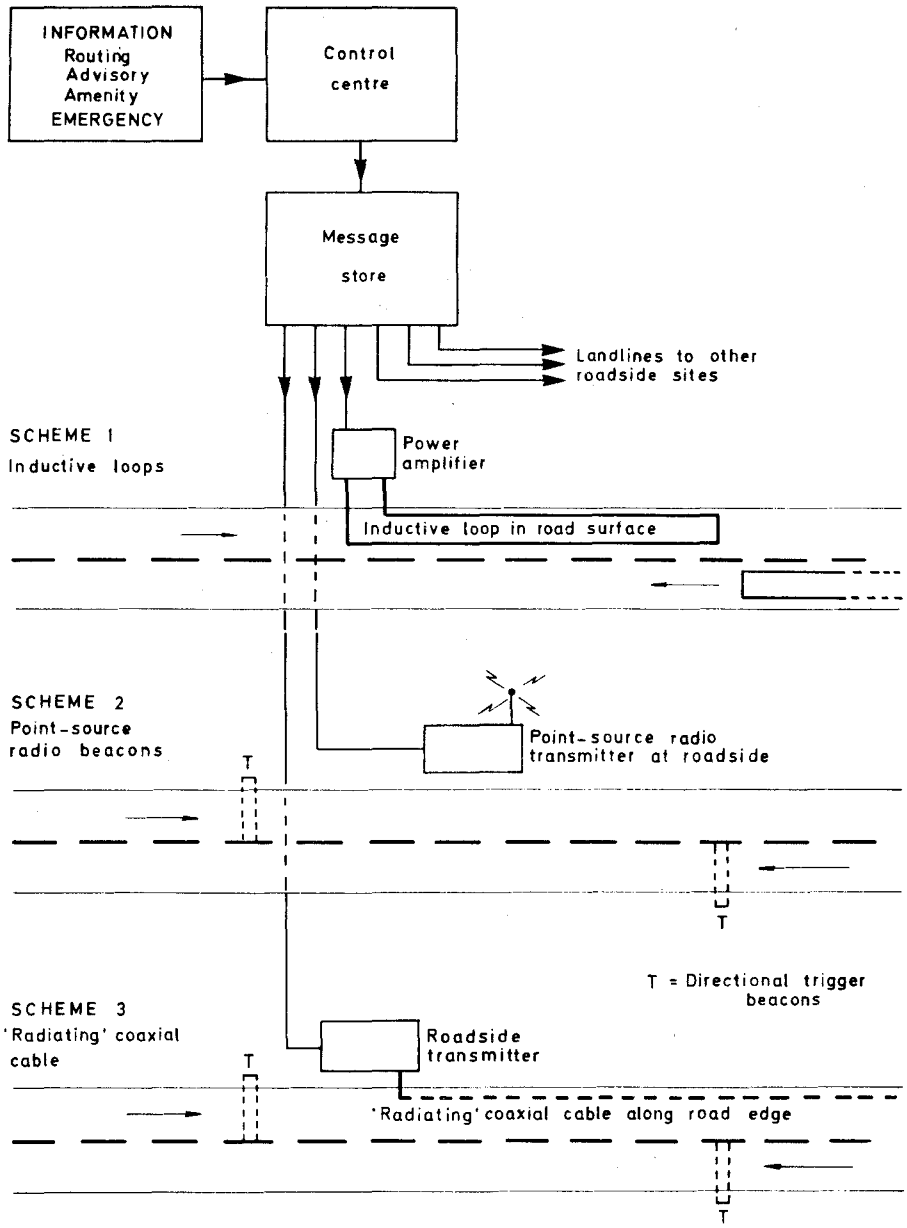



*Fig. 6. Alternative methods by which drivers may be fed information about their optimal route and safety conditions ahead.*

shows Maglev vehicles around 1973 — remember that prototypes are quicker to materialise than service vehicles. For inter-city distances in big countries we need a speed of about 500 km/h to make journeys sufficiently shorter than the current alternative of the car or train. Airflight time is becoming limited by cost and airport turnaround time — door to door and with no connections to make, a 1000 km distance takes about three hours. Maglev inter-city systems, however, now must designed in light of a new social barrier not obviously in existence five years back — they need great quantities of power to run at such high speeds. Societal values no longer ignore such demands on resources. Superconducting Maglev systems (ETI, June, 1973) will require vast quantities of scarce helium — this may limit their widespread useage.

The bicycle is good for the health but its slowness and effort requirements do not suit most people who live far from their workplace. A compromise between the bicycle and the car seems how things should develop but social constants, personal comfort and the ability to carry passengers and loads require a wide degree of flexibility for the future personal transport vehicle.

Moving on to transport at sea we can confidently expect to see automatic ships navigating by electronic control. Position sensing devices (see ETI, December 1973 and April 1974) are sufficiently developed for the task — especially when the Omega navigational net is complete across the globe. Computer control is well capable of the data processing needed and machinery control is now extremely reliable and well defined. Automation of ships, however, would need global acceptance of the concept and more faith in machinery. Automatic fishing is also a realisable goal — for we can now detect where fish are in the sea.

Ship-forms may shift to surface-effect designs — plans were announced in the US last year for design studies of a 10 000 tonnes naval cruiser that

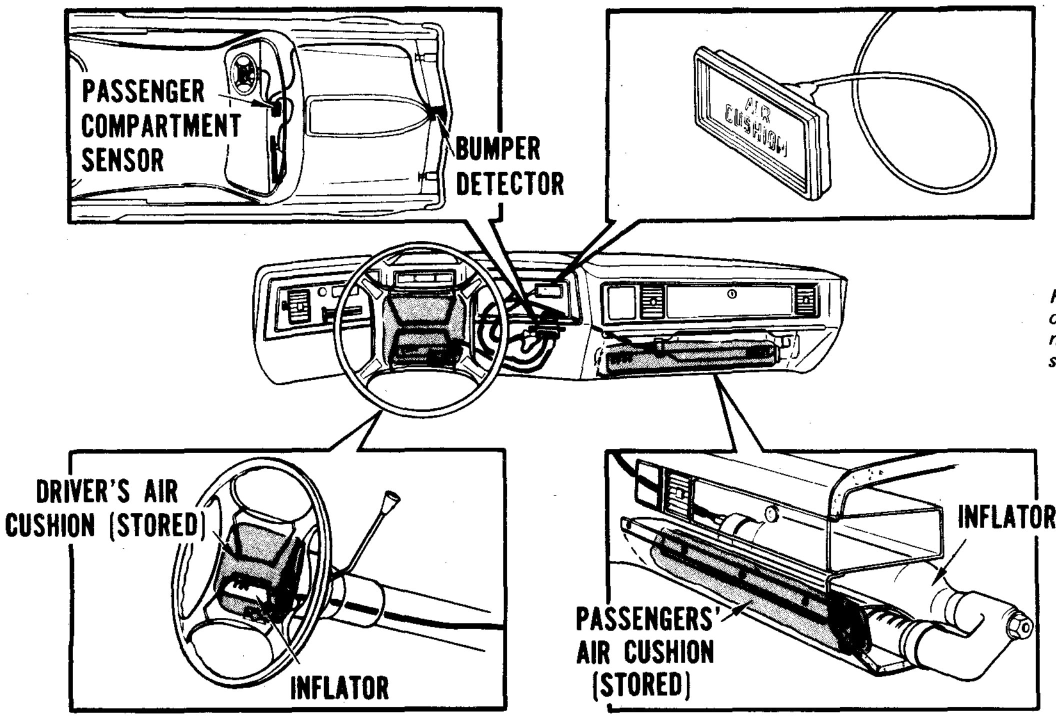



*Fig. 7 General Motors' air cushion restraint system. These may be the answer to collision survival in later years.*

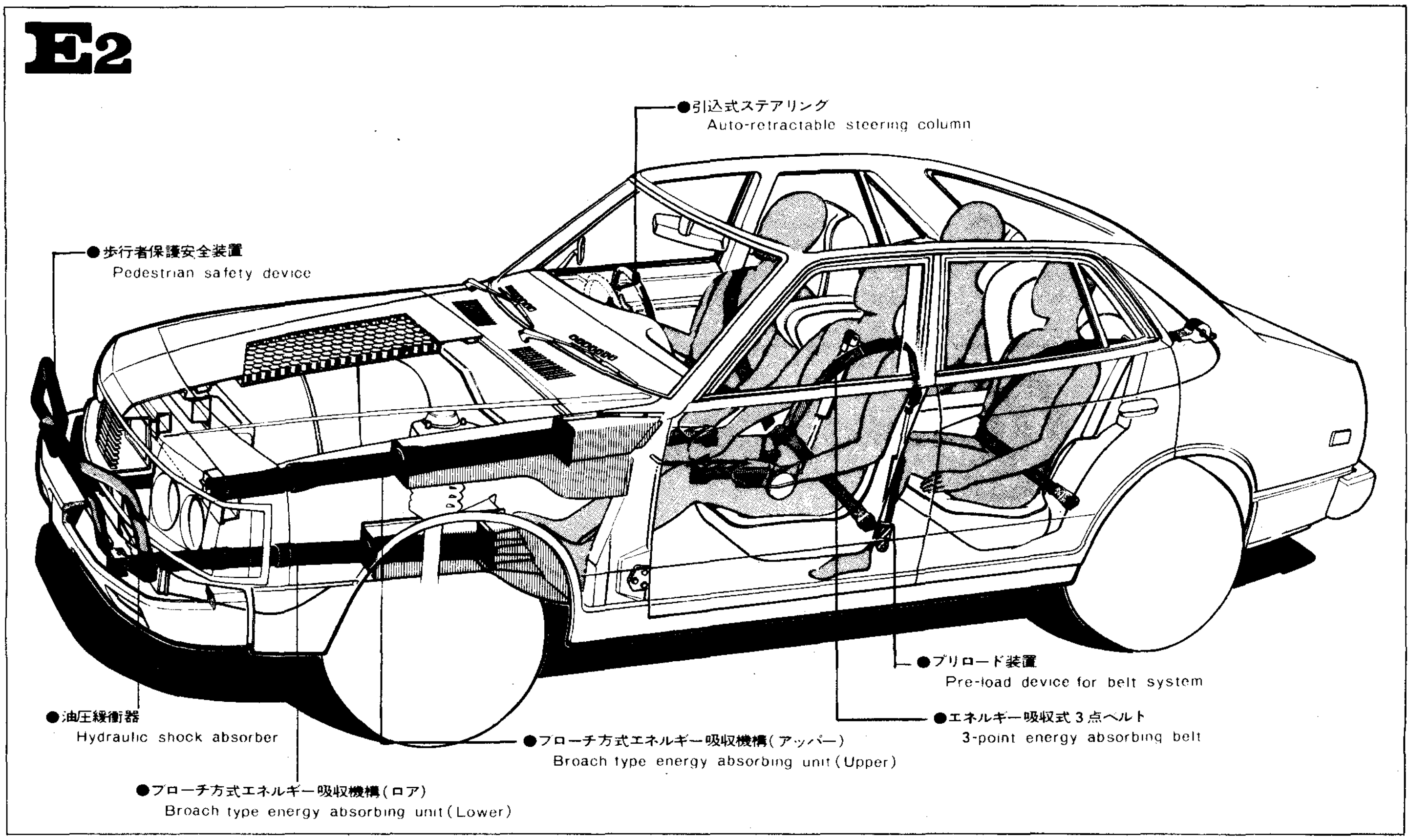



*Fig.8. Nissan $E_2$ type ESV incorporates ideas yet to be included in production cars. Gradually changes to improve safety are being incorporated.*

# Electronics 2000

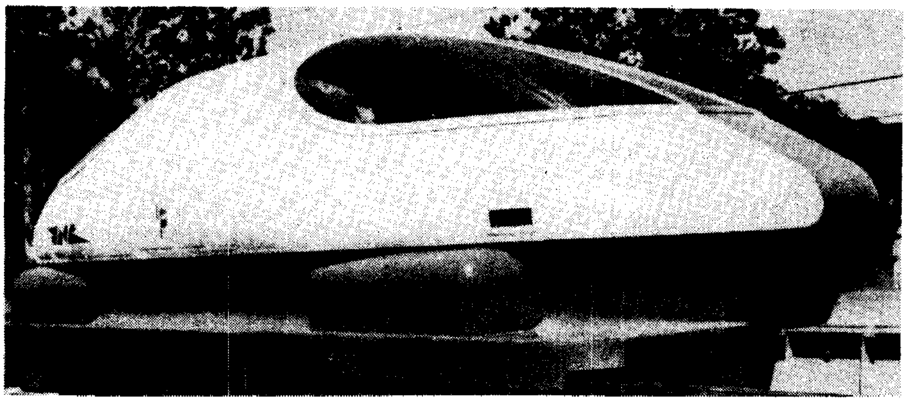


*Fig. 9 Maglev vehicles can provide great speeds but they will requite much more development and testing before they replace current forms of railway.*

could move at speeds double those of today. Ship speeds are decided by physical limitations arising because of the wetted area surface drag and the disturbance caused to the water physically displaced by the ship's motion. Raising speeds above 10 knots or so demands enormous increases in fuel consumption. Solutions to this are to go completely under like the submarine for this also reduces the power needed, or rise out of the water on skis or the hover principle. One advantage of the latter is that the swell and roll of sea travel is greatly reduced. Hover ships can run today at speeds of 80 knots but problems with skirt sealing in rough weather appears to be a major current limit on usefulness on the open sea. The history of naval architecture, however, shows that ships change in only minor ways and at a slow pace.

Finally, in the air: what will happen there? There was once a time – just a few years ago – when air travel had become the pinnacle of transport comfort and speed. But today it fails to provide a fast enough overall journey time because of airport regulations of arrival before departure time, clearance at security barriers, checking of tickets, settling of passengers and the like. It seems, as a rule of thumb, that the actual flight time is about equal to the sundry time involved for short international flights. Plans were published in the early seventies of cabins (in which people were assembled) ready to be attached to the plane. In some countries super highways link the remote airports from the city centres. Somehow these plans did not provide the answer now seen to be needed.

Supersonic transportation is finding difficult acceptance, and it is just not possible to state at present whether it is good or bad with any degree of certainty. Only time will tell; hypotheses need verification by experiment.

The air ship is a strong contender especially if a design needing less helium were invented (certainly not one based on hydrogen, for it is highly inflammable when oxygen is available). The hot air balloon is thirsty for energy due to huge heat losses from the balloon surface – new materials and processes may provide us with an insulated enclosure of light enough structure for these to become viable for long flights.

Several companies have been formed to exploit commercial freight transport by airships. The idea is appealing – quiet, safe, speedy, not plagued with terrain problems and capable of loads equalling many semi-trailer cargoes put together. Airships are an example of past design hopes being reborn due to better technological availability.

In the next part we will look at communications and entertainment developments of the future.

## FUTURE READING

We have recently learned from our New York office that a book, "People's Almanac" by Doubleday, New York has just been released in the US. This giant work looks into numerous aspects of the years ahead.

*(To be continued . . .)*

# SELECTA-GAME

*with on-screen scoring and sound effects*

*** tennis**
*** soccer**
*** squash**
*** practice**
*** optional rifle**

This low-cost yet sophisticated TV game contains just one main IC plus a handful of other components yet out-performs virtually all other units currently on the market.

IT IS ABOUT A YEAR NOW SINCE TV games first appeared in Australia. Initially these units retailed for around a hundred dollars and had fairly limited capabilities. Many of our readers requested a TV game project but our investigation showed that 20 to 30 CMOS ICs would be required. As the circuit is quite complex we felt that the chances of a hobbyist building such a unit without problems were small, and any problems encountered would have been likely to be beyond solution with the equipment and knowledge available to the average constructor. We therefore decided not to do the project until single-chip TV game ICs became available. We knew that these chips were being developed and that they would make the project much simpler from the constructional point of view.

This project is based on such a single-chip device type AY-3-8500 from the General Instrument Corporation. The chip offers a choice of six games together with on-screen scoring and sound effects. The games are tennis, soccer, squash, practice and two rifle games. The rifle games require a 'rifle' which has additional circuitry built into it. If there is sufficient demand we will describe the construction of such a rifle at a later date.

Some additional circuitry, including two extra ICs, is required to build the game but the complexity of the complete circuit is still greatly reduced by the use of this particular IC. In addition, the chip, although expensive, does allow the cost of the unit to be reduced considerably even though its performance is superior to many other games on the market.

## Construction

The TV game employs some VHF circuitry which demands correct lay out if proper operation is to be obtained. For this reason the game should only be built onto the printed-circuit board specified.

Commence construction by installing the seven tinned-copper wire links and then the low-height components (resistors, diodes, etc). Next install the capacitors and the transistors. ICs 2 and 3 are CMOS devices and should only be removed from their protective packing when you are ready to install them. Handle them as little as possible and when inserted solder the power supply pins (7 and 14) first. The main IC is expensive and it is therefore recommended (but not essential) that a 28-pin IC socket be used to mount it.

The coils L2 and L3 should now be constructed as detailed in Table 1 and then soldered into position making sure that L2 is oriented correctly.

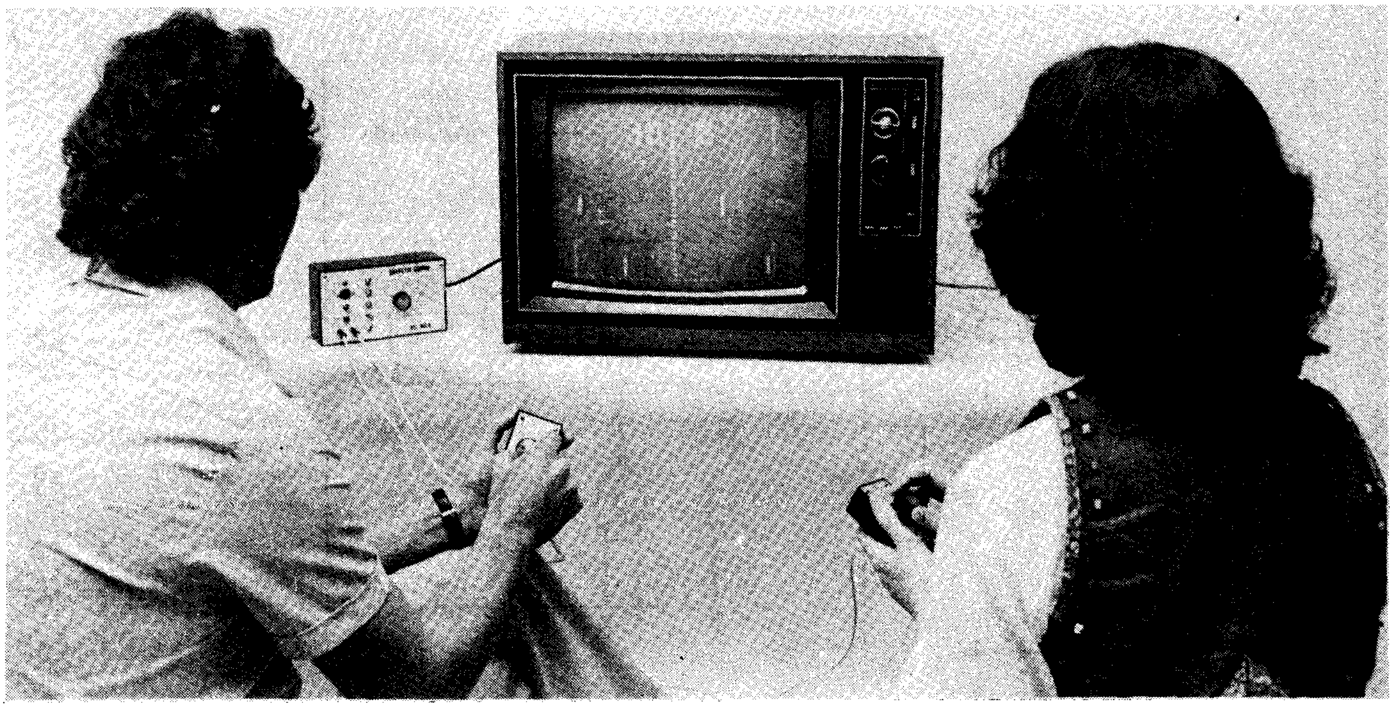
The rotary switch may now be mounted in the following manner: First solder 25 mm lengths of tinned-copper to each of the switch pins (14 in all). Now orientate the switch correctly and feed the wires through the respective holes in the printed-circuit board, press the switch down onto the board and solder all the wires to the tracks of the board.

Now prepare the push buttons, the 5-pin DIN socket and the phono socket by soldering 40 mm lengths of tinned-copper to each of the terminals. Feed the wires through the respective holes in the printed-circuit board but do not solder just yet.

The slide switches should also be prepared in the following manner: Cut 60 mm lengths of 20 gauge BS tinned-copper wire (largest gauge that will fit through the switch holes) and thread them through the holes in the switch pins so that pairs of poles are linked together. Centre the wires in the lugs and then solder them to the lugs. Now bend the wires down on either side and insert them in the holes provided in the printed-circuit board but do not solder at this stage.

Fit the front panel to the rotary switch (use a spacer washer) making sure that the board is square to the front panel and that there is enough clearance for the RF coil and the shield which have yet to be fitted. Attach the phono socket, the DIN socket and the push buttons to the front panel and then solder their leads to the board. Push the slide switches up against the front panel, line the switches up with the openings in the front panel and, making sure that the switch doesn't move, solder the leads to the board.

Now remove the front panel and



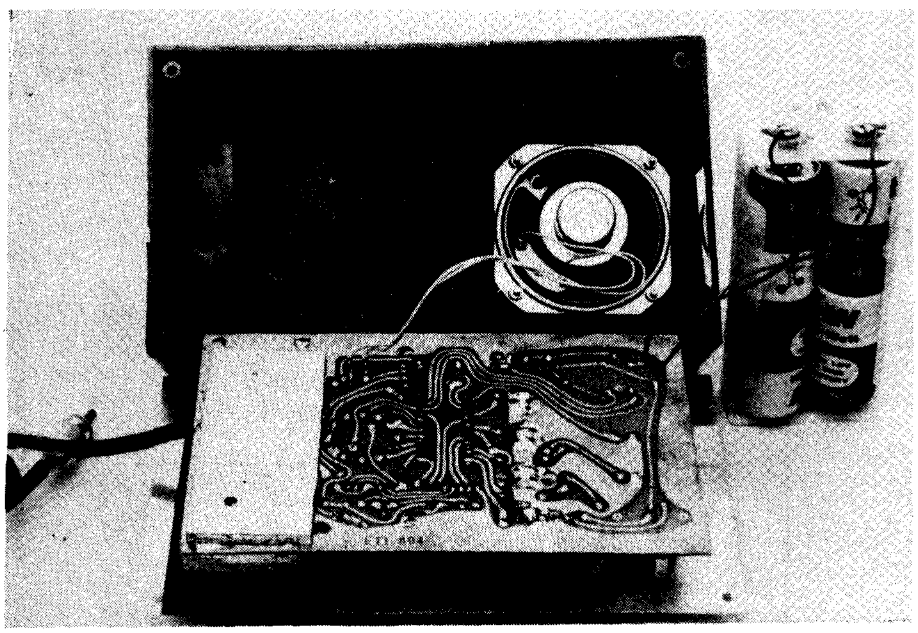
fit the 75-ohm output coax and the coax for the bats to the printed-circuit board. Feed the bat cables through rubber grommets in the front panel after first tying knots in them to prevent them being pulled through accidentally. Alternatively 3.5 mm jacks may be installed on the front panel for the bat outputs and the cables fitted with plugs so that they can be unplugged when the game is not being used.

Add the battery leads and connect the speaker by means of 150-mm long wires. Check all wiring and solder joints before fitting the main IC to its socket.

Before the shields for the RF stage are fitted the unit should be connected to a TV set and aligned and checked as detailed in the alignment section.

After alignment is satisfactorily completed fit the component-side shield using four short lengths of tinned-copper wire and then fit the copper-side shield by simply soldering it to the copper earth plane in four or five places. Make sure that the shields do not touch any other tracks, leads or components which would cause a short.

The alignment of the unit may now be peaked up if required. The front panel is normally at +7.5V due to the connections to the phono sockets and the shield is at 0V. Some plastic insulation tape should be used over the top of the shield or on the front panel to prevent shorting. Now fit the front panel and mount the assembly in the box. The batteries and speaker should be fitted into the bottom of the box under the printed-circuit board. Holes should be drilled in the box under the speaker to act as a grill to let out the sound from the speaker.



We initially used four "C" size batteries for power as the unit will work from about 5 to 8 volts. However to increase battery life 5 cells of either "C" or "AA" size should preferably be used.

If an external power unit is used either 6 or 7.5 volts dc will operate the unit and the 3.5 mm phone jack used should be used with the +Ve lead on the common terminal.

## Alignment

Switch the TV set to channel 6 (5 or 7 could alternatively be used if channel 6 is used in your area), connect the TV game to the antenna input of the set and switch both units on.

Press the reset button on the game and tune coil L2 until the set appears to be receiving the signal. (At this time the picture may appear to be just a series of dots). Adjust the trimmer capacitor CV1 until the picture locks. Then it may be necessary to readjust L2 for the best picture.

When performing these adjustments it is best to use non-metallic tools so that the tuning point does not alter when the tool is removed.

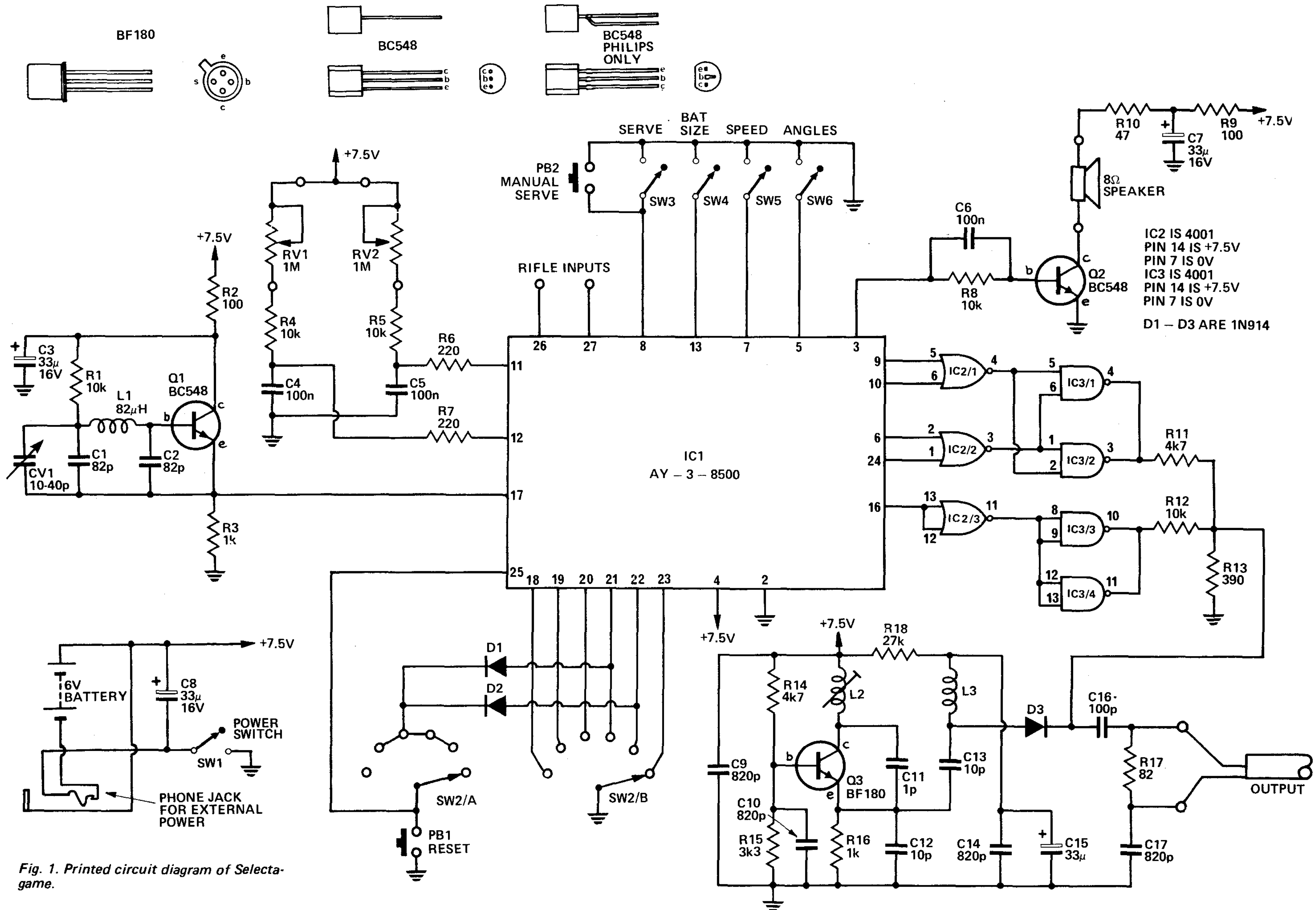



*Fig. 1. Printed circuit diagram of Selecta-game.*

## How It Works — ETI 804.

Unfortunately the manufacturers don't give much information on how the main IC works — we are only told how to use it. The chip is obviously a digital IC (because there are two ball speeds, the rebound angles are defined and there is no provision for variable speed or bounce).

A 2 MHz oscillator is required for the chip to derive the synchronising pulses required for line and frame synchronisation of the TV set. This oscillator is provided by Q1 and its associated components with CV1 providing calibration.

The bats are simply one megohm potentiometers connected as variable resistors which effectively vary the charging time of capacitors C4 and C5. The capacitors C4 and C5 are discharged by the chip at each frame sync pulse and the time taken to charge again (as set by the bat pot setting) determines the vertical position of the bats on the screen. The bat size, ball speed, deflection angles and serve are simply selected by connecting the appropriate pin of the IC to '0' volts.

Outputs from the chip are left and right bat, sync, ball, score and sound — all on separate pins. The bats, ball and score outputs are combined by IC2/1,2 and IC3/1,2 to produce a composite video signal. The sync pulse is buffered by IC2/3 and IC3/3,4. The sync and information pulses are then added by R11, 12 and 13. The sound output is buffered by Q2 to provide the power necessary to drive the speaker.

So that the game may be fed into the antenna terminals of a TV receiver the video signal must be modulated onto an RF oscillator tuned to the desired channel (176 MHz for channel 6). Transistor Q3 and its associated components form the required oscillator. The oscillator is then modulated with the composite video by means of the diode modulator D3.

The oscillator and the modulator are screened by means of shields to prevent the RF from causing interference to other TV sets (and to prevent other TV sets from interfering with the game). These shields also minimise detuning effects when the hand is brought close to the oscillator.

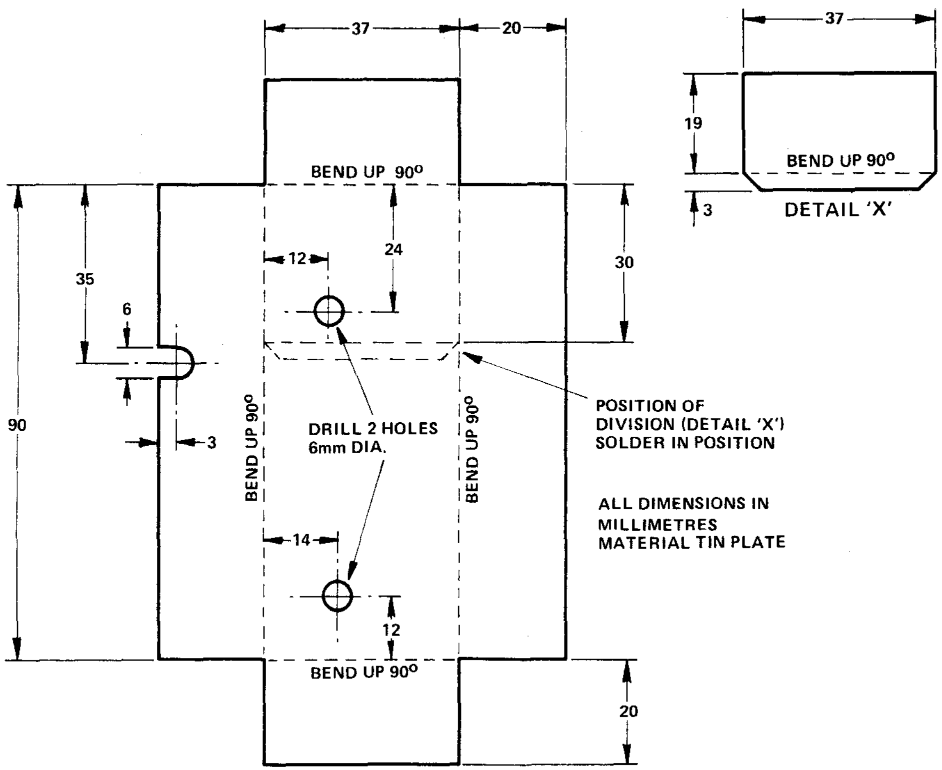



Fig. 2. Dimensions of shield on component side.

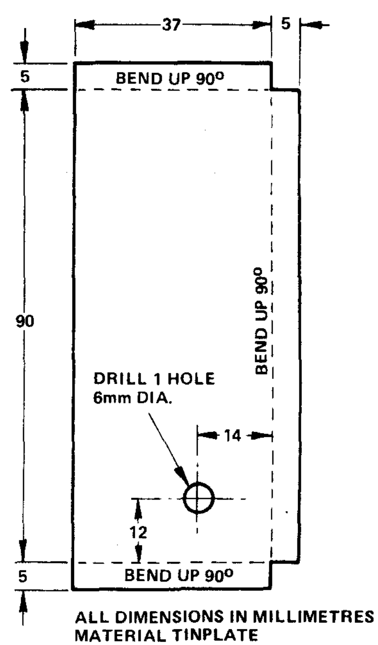
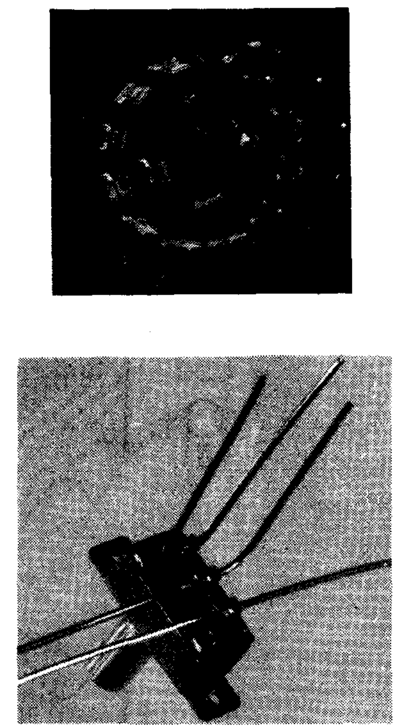



Fig. 3. Dimensions of shield on copper side.



Photographs showing wires attached to switches before installation.

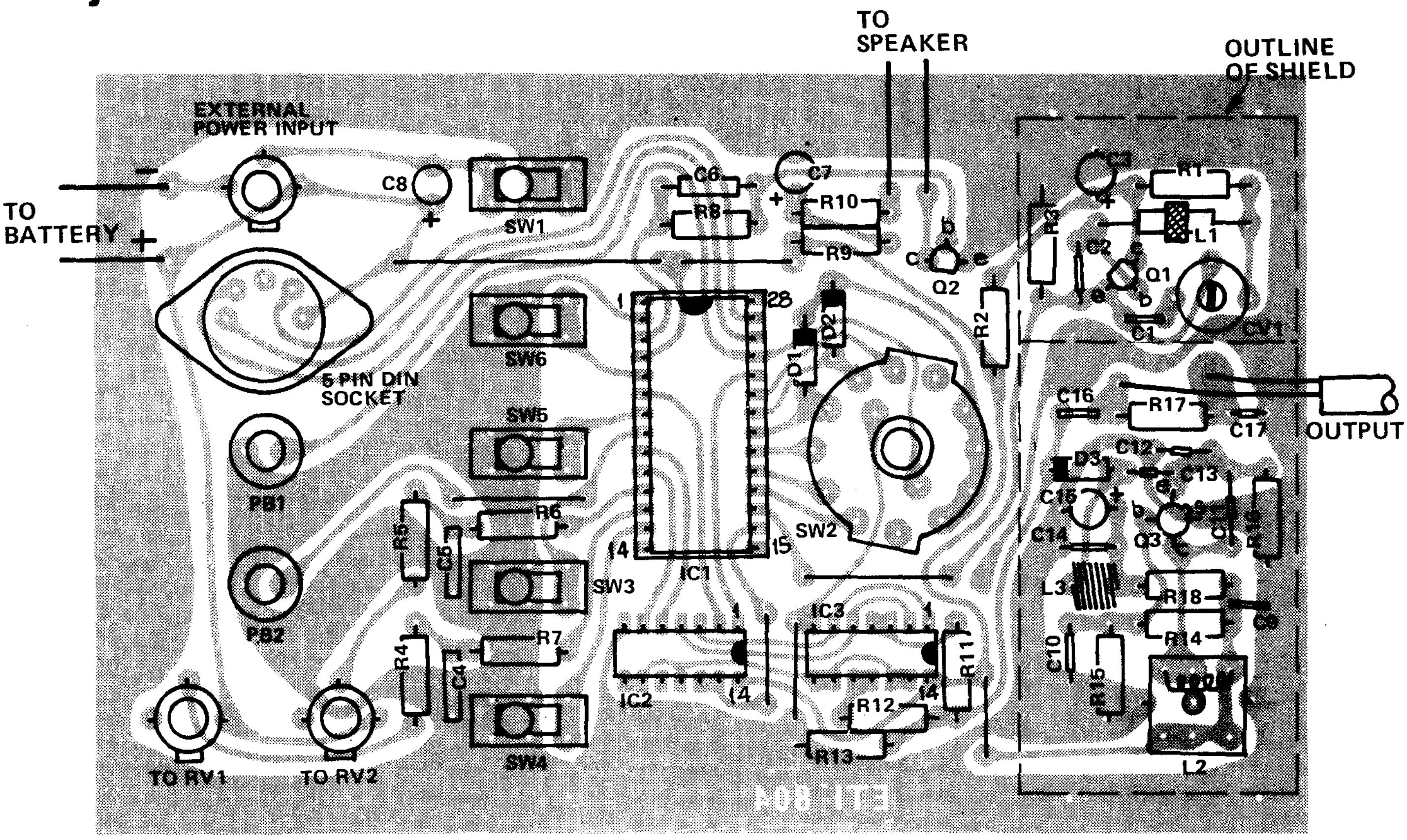



*Fig. 4 Component overlay of Selecta-game.*

## PARTS LIST ETI 804

**Resistors all ¼w 5%**

| | |
|---|---|
| R1 | 10 k |
| R2 | 100 |
| R3 | 1 k |
| R4,5 | 10 k |
| R6,7 | 220 |
| R8 | 10 k |
| R9 | 100 |
| R10 | 47 |
| R11 | 4 k 7 |
| R12 | 10 k |
| R13 | 390 |
| R14 | 4 k 7 |
| R15 | 3 k 3 |
| R16 | 1 k |
| R17 | 82 |
| R18 | 27k |

**Potentiometers**

| | |
|---|---|
| RV1,2 | 1M lin rotary |

**Capacitors**

| | |
|---|---|
| C1,2 | 82 p ceramic |
| C3 | 33 μ 16 v electro |
| C4,5,6 | 100 n polyester |
| C7,8 | 33 μ 16 v electro |
| C9,10 | 820 p ceramic |
| C11 | 1p0 ceramic |
| C12,13 | 10 p ceramic |
| C14 | 820 p ceramic |
| C15 | 33 μ 16 v electro |
| C16 | 100 p ceramic |
| C17 | 820 p ceramic |

**Variable capacitor**

| | |
|---|---|
| CV1 | 10-40p |

**Transistors**

| | |
|---|---|
| Q1,2 | BC548 or similar |
| Q3 | BF180 |

**Diodes**

| | |
|---|---|
| D1-D3 | 1N914 |

**Integrated Circuits**

| | |
|---|---|
| IC1 | AY-3-8500 |
| IC2 | 4001 (CMOS) |
| IC3 | 4011 (CMOS) |

**Inductors**

| | |
|---|---|
| L1 | 82 μ H RF choke |
| L2 | See table 1 |
| L3 | See table 1 |

**Miscellaneous**

PC board eti 804
2 pole 6 position switch
Five slide switches
8 ohm speaker
3.5 mm phone socket
5 pin DIN socket
Two miniature push buttons
Three knobs
One large box 196mm x 113mm
Two small boxes 83mm x 54mm
Single "C" size battery holderder
28 pin IC socket

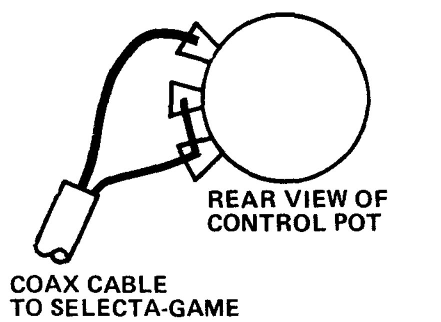



*Fig. 5. Diagram showing wiring of control pot.*

## TABLE 1 ETI 804

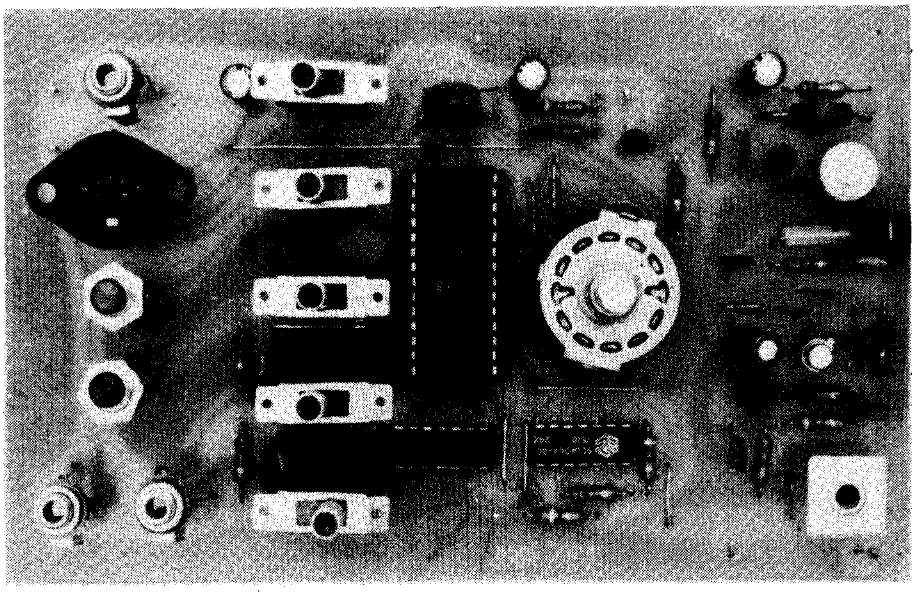
**Winding details of coils L2 & L3**

L2

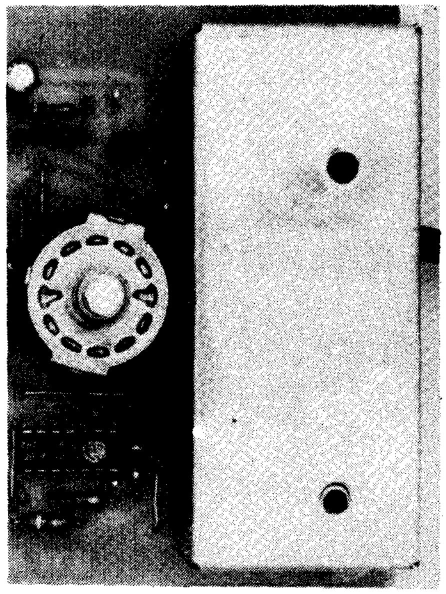
| | |
|---|---|
| Former 5mm | Neosid 722/i |
| 6 pin base | Neosid 5027/6 PLB |
| Can | Neosid 7100 |
| Slug | Neosid 4 x 0.5 x 10 F29 |

Winding 4 turns close wound 24 B&S

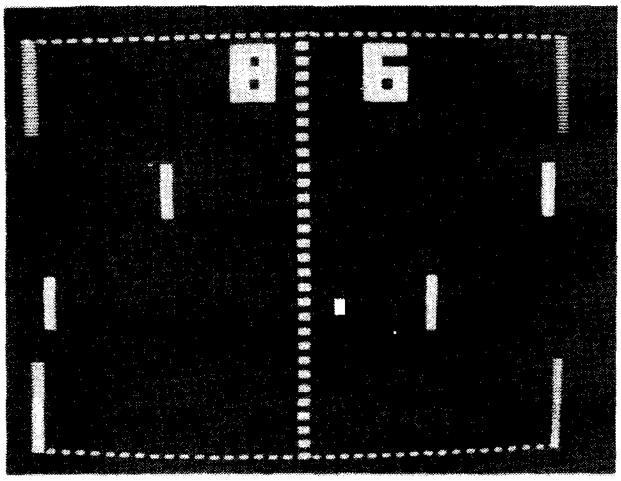
L3
6 turns 24 B&S wire close wound about 5mm diameter, air core. (wind on a former, ie a knitting needle or drill, then remove former)



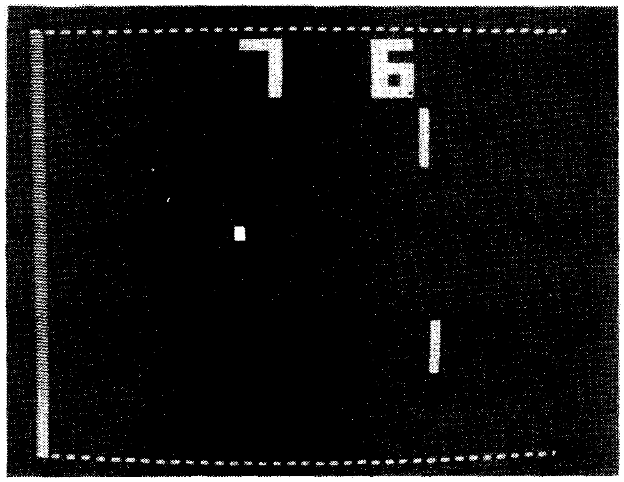
*Photograph of completed board less shield.*



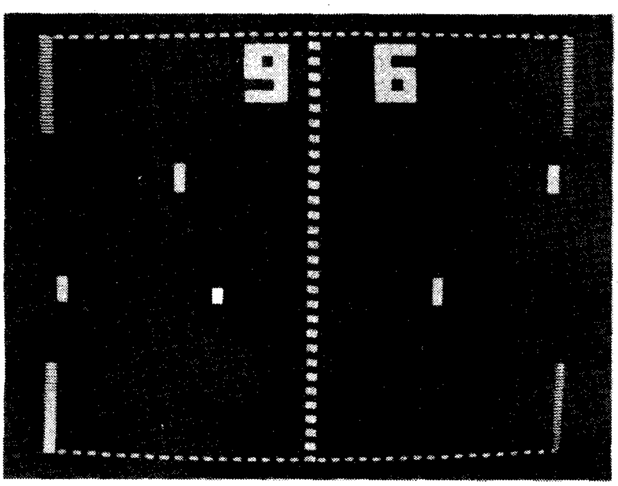
*Photograph showing shield fitted. Note two adjustment holes*



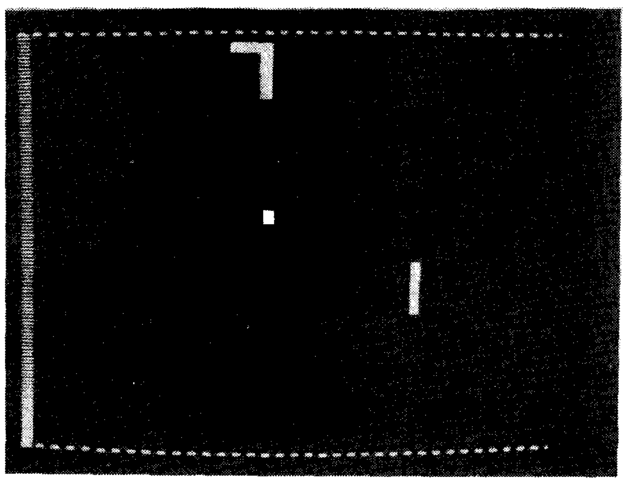
*Soccer*



*Squash*



*Soccer with small bats*



*Practice*

*These photographs show some of the games that can be played.*

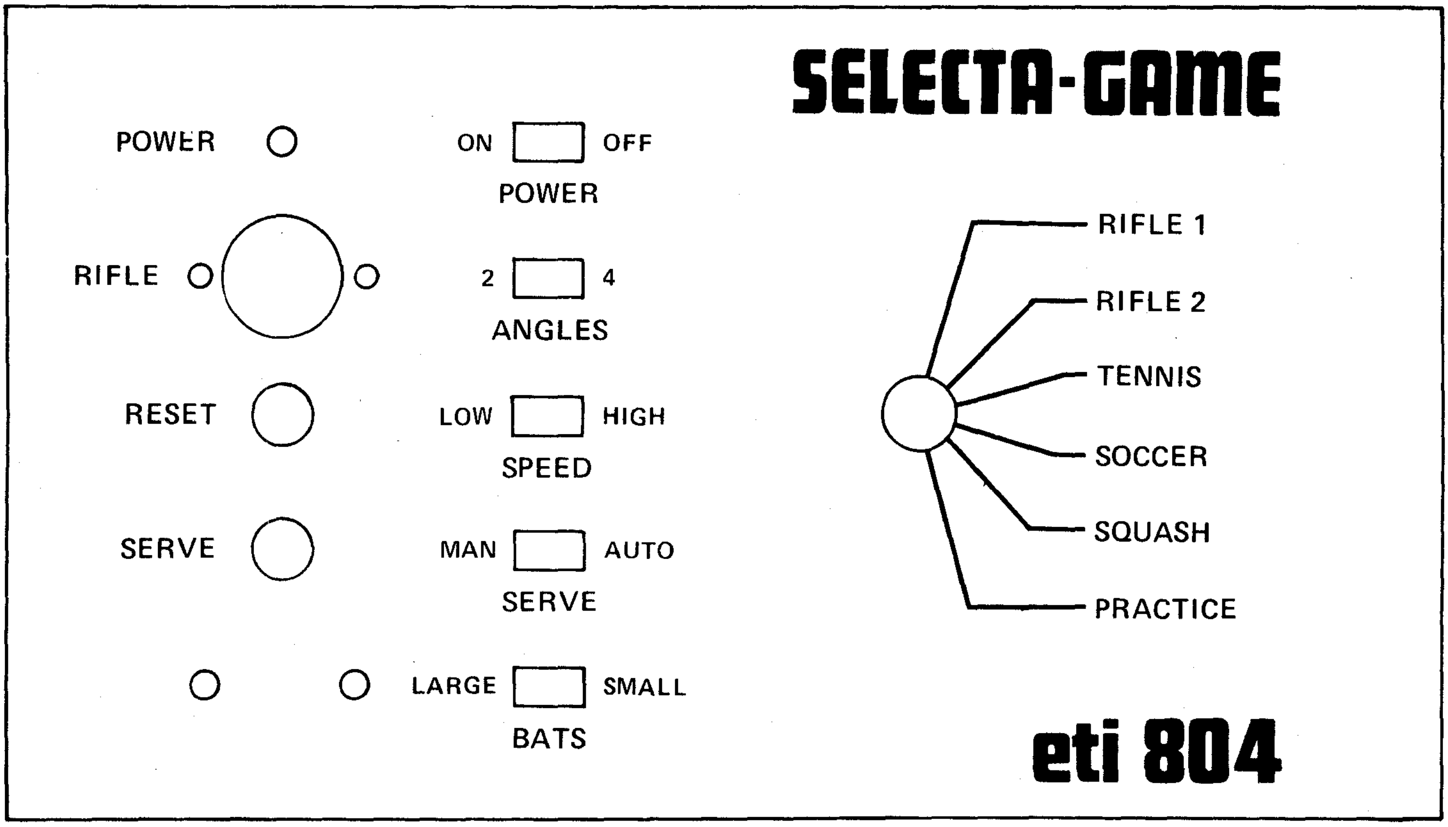



*Fig. 6. Front panel layout. Full size 190mm x 107mm.*

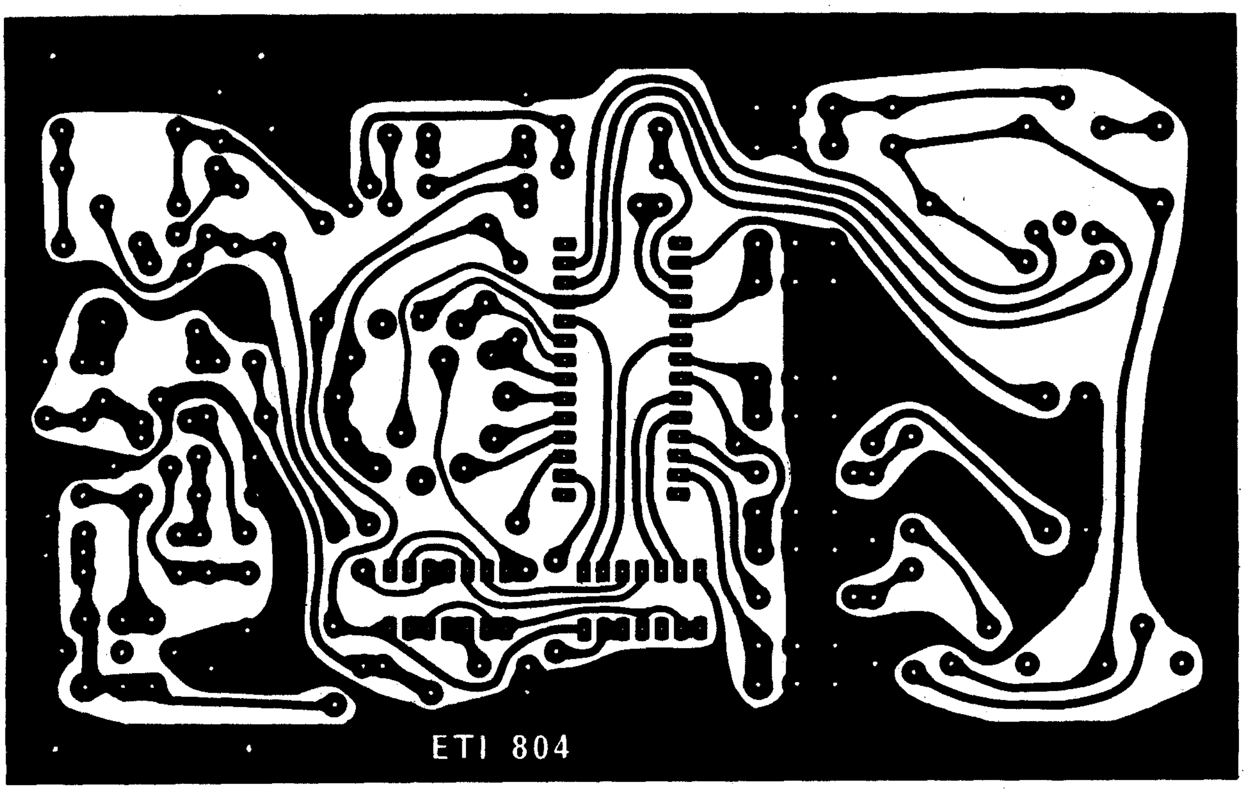



*Fig. 7. Printed-circuit layout. Full size 163mm x 102mm.*

## THE GAMES

**1) Practice:** The ball reflects off the end wall and the side walls – the player has to stop it exiting the screen on the right-hand side. This game is an electronic version of hand-ball or squash with only one player.
**2) Squash:** This game is like the practice game but now there are two players who take turns in hitting the ball. The bat has no effect on the ball when it's your opponent's turn.
**3) Soccer:** The ball reflects off all four sides of the pitch, except for the goal mouth. The goalkeeper defends this in the same way that the bats defend their court in the other games. The player has a second man on the field for soccer – the forward. This man will act like a bat when faced with a ball moving towards his own goal – the ball reflects towards his opponent's goal – but when the ball is moving in the right direction (towards his opponents side) the ball passes through him. However by careful positioning of the forward the ball can be made to deflect towards the goal.
**4) Tennis:** The game of TV Tennis is widely known and on Selecta-game the only unusual features are those listed in the specification.

### SPECIFICATIONS – ETI 804

| | |
|---|---|
| **Output** | **Picture: TV signal on channel 6 (can be set up on any other channel).**<br>**Sound: Three audio tones indicate hit, bounce and score. Reproduced from a loudspeaker in Selecta-Game.** |
| **Players' Controls** | **Each player uses a single rotary control to position his bat/men on the screen. In the practice game one control operates; for tennis, soccer and squash two players each have a control. For the rifle games a special rifle is needed (not described in this article).** |
| **Game Selection** | **Basic Games:**<br>**1) Practice 2) Squash**<br>**3) Soccer 4) Tennis**<br>**Other Games (these cannot be played without a special rifle):**<br>**5) Rifle–1 6) Rifle–2** |
| **Scoring** | **On-screen scoring up to a maximum of 15 points.** |
| **Other Features** | **Two ball speeds**<br>**Two bat sizes**<br>**Two angles ± 20°; or four angles ± 20° & ± 40°.**<br>**Manual or automatic service** |

## USING YOUR SKILL

With the 'Angles' switch at '2' the ball moves across the screen at ± 20° from the horizontal. When hitting the sides and walls of the court the laws of reflection are obeyed. When the ball hits the bat this isn't always the case: a ball hitting the top half of the bat will leave with an upward trajectory, and a ball hitting the bottom half of the bat will bounce downwards. This effect can be utilised by the skilful player – when the soccer forward is used to change the direction of the ball as it approaches the goal it usually beats the goalkeeper.

With the 'angles' switch at '4' the game becomes even more exciting. Now the bat has to be divided into quarters: starting from the top and working down the angles of the emerging ball are +40°, + 20°, –20°, –40°. And if you can cope with that try switching to small bats and high speed ball! ●

- □ - 80 dB rumble
- □ 0.04% wow and flutter
- □ continuously variable speed range through a servo controlled d.c. motor...
- □ push-button selection of 78, 45, 33⅓ r.p.m.

# does this make the ultimate turntable?

## Fons

## gives you that and more.

At $289 R.R.P. with base and cover, or only $479 complete with base, cover, S.M.E. 3009 arm and Stanton 681eee, how can you resist.

P.S. If this isn't the ultimate turntable, we'd like to know why.

* Measurements taken from authoritative U.S. "F.M. Guide" May 1976.

Sole Australian Distributors:

**LEROYA INDUSTRIES PTY. LTD.**

156 Railway Pde., Leederville, Western Australia 6007.
Phone 81 2930.

**N.S.W. Office:**
100 Walker St., North Sydney. 2060. Phone 922 4037.

**VICTORIA Office:**
103 Pelham St., Carlton 3053.
Phone 347 7620.

# BALANCED MICROPHONE AMPLIFIER

High-quality transformers for matching balanced microphones into unbalanced inputs are quite expensive. This simple preamplifier will accept balanced inputs directly.

THIS IS THE THIRD OF A SERIES OF pre-amplifiers we have published lately, and is one which has been requested by several readers. It will be especially useful to users of the Master Mixer project which we published back in 1973. Because there is no provision for balanced inputs, transformers have to be used, but they become expensive if good performance is required.

This unit provides good common mode rejection, a gain of 40 dB and low noise.

## Construction

A pc board is not necessary but it does make the assembly much easier, and it reduces the risk of mistakes. Assemble the components to the board according to the overlay in Fig. 3. Watch the orientation of the BC 549 transistors as there are two different pin-outs depending on the manufacturer. The Philips is shown on the overlay. Note also that the IC is marked on one end and this should be orientated as shown.

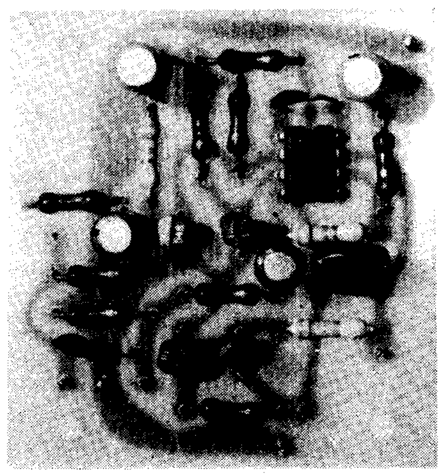
As the unit is to be used with low level inputs it will be necessary to use shielded cables on the input and it may also be necessary to shield the complete unit to eliminate unwanted pick up from the mains.

Although the unit is designed for 600 ohm input and 40 dB gain (i.e., a gain of 100) other input impedances and gains can be handled —
R1 = R4 = input impedance divided by two.
R5 = R13 = voltage gain times the value of R3.

The first equation works for impedances up to about 5k. Above this value R2 + R3 must be included in the calculation.

The connection of the Cannon socket is shown in Table 1.

The Common mode rejection ratio is determined by the accuracy of R1, R4, R5 and R13. If high rejection is needed this can be done in either of two ways: The resistors can be selected to be the same value (R1 = R4, R5 = R13) or 1% resistors can be used.



### SPECIFICATION* ETI 449

| | |
|---|---|
| **Frequency Response** | **10 Hz – 20 kHz (<5 V output) $^{+0}_{-3}$ dB** |
| | **10 Hz – 10 kHz (10 V output) $^{+0}_{-3}$ dB** |
| **Gain** | **40 dB** |
| **Equivalent Input Noise** | **–123 dB (0.5 μV)** |
| **Distortion** | **0.05% 300 mV – 5 V output 100 Hz – 10 kHz** |
| **Max Input Voltage** | **100 mV** |
| **Common Mode Rejection Ratio** | **60 dB** |
| **Maximum Common Mode Signal** | **3 V** |
| **Supply Voltage** | **±8 to ±16 V** |

***Measured performance of prototype with supply rails of ± 15 V — the figures should be typical.**

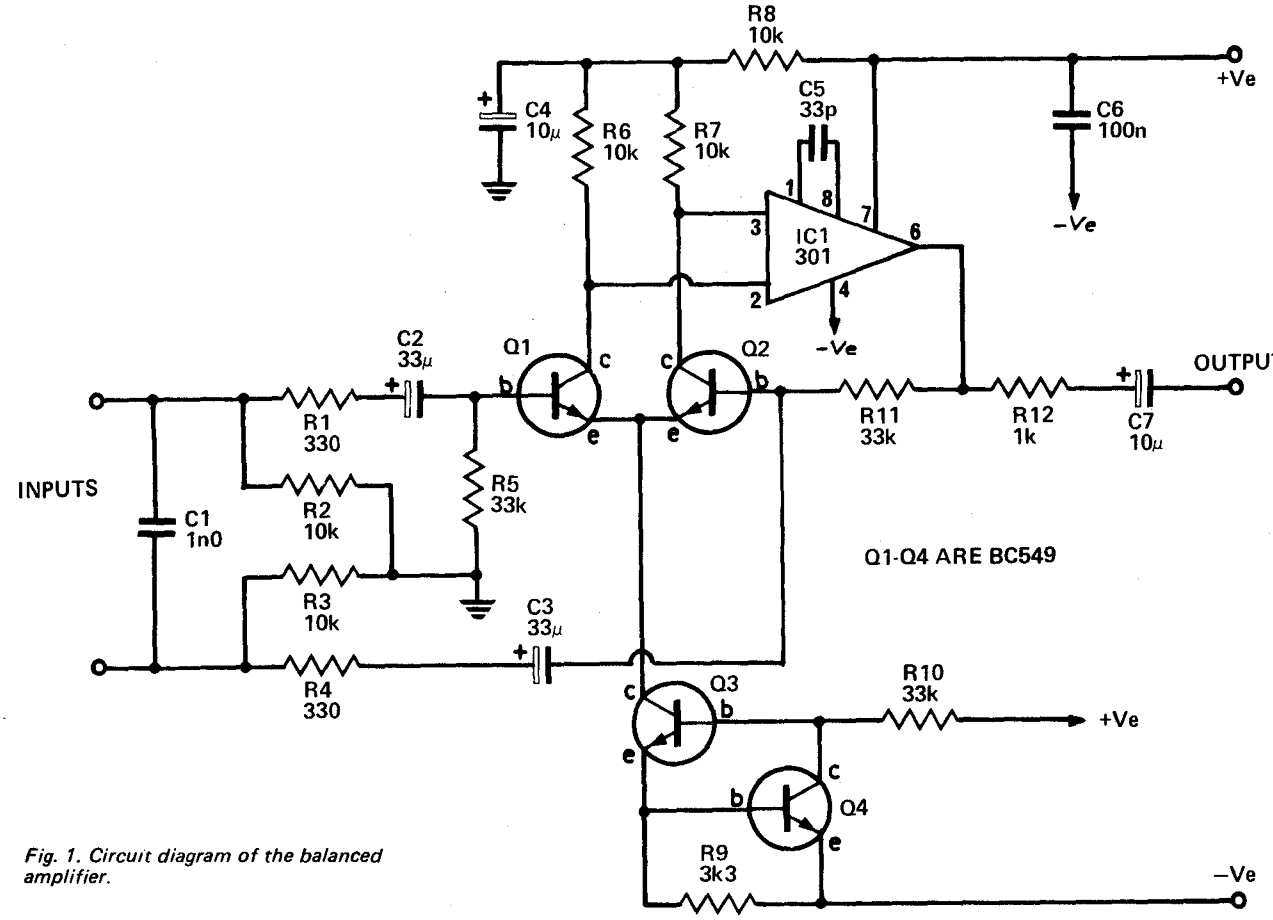



*Fig. 1. Circuit diagram of the balanced amplifier.*

## HOW IT WORKS ETI 449

A "balanced" amplifier or differential amplifier has two separate inputs and only the difference between these inputs is amplified. To explain how this works refer to Fig. 2, which is a simplified version of the actual circuit. To make the maths easier we will reduce the gain to nine by making R1 = R4 = 1 and R5 = R13 = 9. The actual units are not important, only the ratio.

We will start the explanation by looking at the case where point B is at 0V and A is at +100 mV. An ideal amplifier does two things — it does not take any current into the input terminals and it adjusts the output to maintain no voltage difference between the input terminals. We therefore must have 100 mV across R4 and consequently a voltage of 900 mV across R13 (it has 9 times the resistance and the same current as R4). This gives a gain of nine. The output is therefore –900 mV.

In the case when point A is at 0V and point B is at +100 mV, point D will be at $(V_B \times \frac{R5}{R1 + R9}) = 90$ mV

Therefore point C will also be at +90 mV. The voltage across R4 will be 90 mV and voltage across R13 will be 810 mV (9 x 90 mV)

This means the output voltage must be +900 mV. This is also a gain of nine. Notice, however, that the polarity (or phase) is different.

Now suppose both inputs are at, say, +1V, point D will be at +900 mV and so will point C. The voltage across R14 is 100 mV and R13 900 mV. This gives an output voltage of 0 V. The common signal is not amplified in any way. If, however, one input (B) is at 1 V and the other (A) is at 1.01 V the difference is amplified and the output will be –1 V.

Getting back to the actual circuit, we have used an LM301A with two low-noise transistors in the front stage. These transistors are supplied with a constant current by Q3 and Q4. A constant current is needed as this allows the inputs to move up and down without changing the voltage across R6 or R7.

We have decoupled the supply to Q1 and Q2 by C4 to improve supply rail rejection.

The input resistors are decoupled by C2 and C3 to minimise the offset voltage of Q1 and Q2 being amplified by 100 (which could be excessive if matched transistors are not used). The capacitor C1 is to ensure the inputs are terminated at high frequencies. This ensures stability which would otherwise be a problem when the microphone is unplugged.

The resistors R2 and R3 refer the inputs to 0 V but are high enough not to affect the operation in any way.

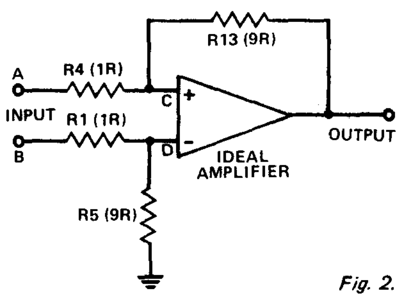



*Fig. 2.*

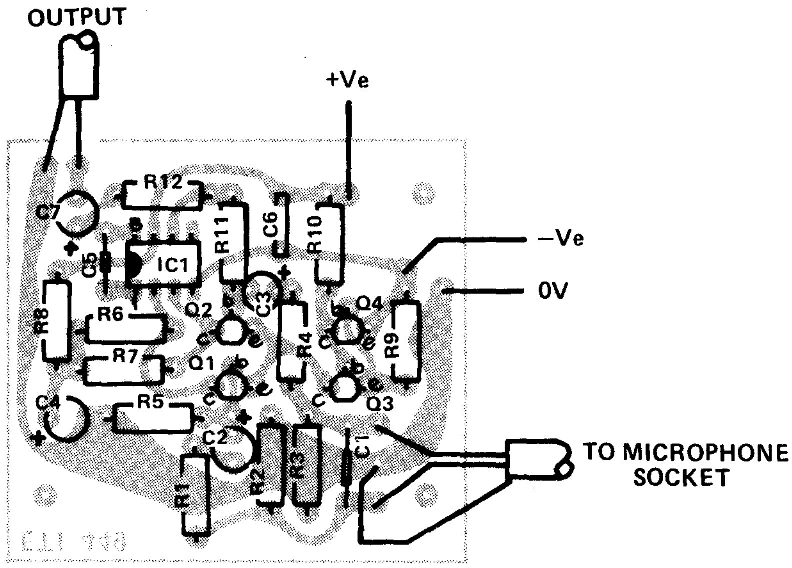



*Fig. 3. Component overlay*

### PARTS LIST ETI 449

| Resistors all 1 W 5% | | Capacitors | |
|---|---|---|---|
| R1 | 330 | C1 | 1n0 polyester |
| R2,3 | 10k | C2,3 | 33µ 10v electro |
| R4 | 330 | C4 | 10µ 16v electro |
| R5 | 33k | C5 | 33p ceramic |
| | | C6 | 100n polyester |
| R6,7,8 | 10k | C7 | 10µ 16v electro |
| R9 | 3k3 | | |
| R10,11 | 33k | Q1-Q4 | Transistors BC 549 |
| R12 | 1k | IC1 | LM301A |
| | | PC Board | ETI 449 |

**TABLE 1**
**Connection of Cannon plug for microphones**

| | |
|---|---|
| Pin 1 | EARTH |
| Pin 2 | BLACK INPUT connect to R1 |
| Pin 3 | RED INPUT connect to R4 |

FOR UNBALANCED INPUT CONNECT PIN 1 AND 2 TOGETHER ON MICROPHONE PLUG.

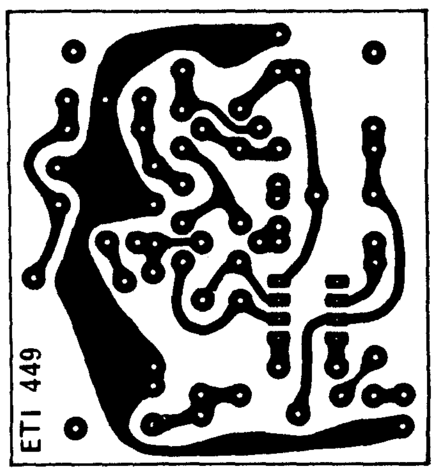



*Fig. 4. Printed Circuit board layout. Full size 60 x 55 mm*

# HUGE SHIPMENT JUST ARRIVED — PRICES SLASHED!

## NATIONAL SC/MP KIT

***DONT PAY $92·50... OR EVEN $89·50!***

***DICK'S PRICE (WHILE THEY LAST)***

COMPLETE WITH INSTRUCTION BOOK. **$84 50** INCLUDING SALES TAX.

**(TAX–FREE PRICE $75·51)**

PLENTY OF STOCK AT TIME OF GOING TO PRESS.

YES! DICK NOW HAS H-U-G-E STOCKS OF BRAND NEW, FAMOUS "NATIONAL SEMICONDUCTOR" INTEGRATED CIRCUITS, TRANSISTORS, DIODES, LEDS, DISPLAYS, ETC, ETC, ETC.

HE WILL SUPPLY ANYONE, AND ANY QUANTITY AT THE PRICES SHOWN — EVEN OTHER PARTS SUPPLIERS!!!!

## MM5024 PROM

FULLY PRE-PROGRAMMED BY NATIONAL SEMICONDUCTOR LABORATORIES FOR THE E-A ARTICLE

ONLY **$35 00** (DON'T PAY $40.00!)

TAX-FREE PRICE **$30·95**

**INCREDIBLY CHEAP** SEMICONDUCTORS FROM OUR **HIGHLY EFFICIENT** RETAIL OUTLETS & MAIL ORDER !

## INCREDIBLE BARGAINS ON C-MOS & TTL IC'S AND OTHER SEMICONDUCTORS

### C~MOS — SLASHED!

| | | |
|---|---|---|
| 4000 | Dual 3 input NOR with inverter | .30 |
| 4001 | Quad 2 input NOR | .30 |
| 4002 | Dual 4 input NOR | .30 |
| 4006 | 18 stage static shift register | 1.90 |
| 4007 | Dual complementary pair plus inverter | .30 |
| 4009 | Hex buffer (inverter) | .90 |
| 4011 | Quad 2 input NAND | .30 |
| 4012 | Dual 4 input NAND | .30 |
| 4013 | Dual D flip flop with reset | .70 |
| 4014 | 8 stage shift register | 2.00 |
| 4016 | Quad bilateral switch | .70 |
| 4017 | Decade counter/divider | 1.80 |
| 4018 | Presettable divide by N counter | 2.00 |
| 4021 | 8 stage static shift register | 2.20 |
| 4022 | Divide by 8 with 8 decimal outputs | 1.60 |
| 4023 | Triple input NAND | .30 |
| 4024 | 7 stage ripple carry binary counter | 1.40 |
| 4025 | Triple 3 input NAND | .30 |
| 4027 | Dual J-K flip flop | .90 |
| 4028 | BCD/decimal decoder | 1.60 |
| 4029 | Presettable up/down 4 stage counter | 1.80 |
| 4030 | Quad exclusive OR | .80 |
| 4049 | Hex buffer/TTL driver inverter | .80 |
| 4050 | Hex buffer/TTL driver non inverter | .80 |
| 4071 | Quad 2 input OR | .30 |
| 4081 | Quad 2 input AND | .30 |
| 4416 | DPDT switch | .90 |
| 4426 | Decade counter/7 segment dec/driver | 3.20 |
| 4449 | Economy hex inverter | .30 |
| 4511 | BCD/7 segment decoder/latch | 2.30 |
| 4518 | Dual BCD up counter | 2.00 |
| 4520 | Dual 4 stage binary up counter | 2.00 |
| 4528 | Dual retriggerable monostable multiv. | 1.50 |
| 4553 | 3 Digit BCD counter | 7.00 |
| 5411 | Osc. 16 stage divider with buffer | 3.50 |
| 74C00 | Quad 2 input NAND | .31 |
| 74C02 | Quad 2 input NOR | .31 |

### SPECIAL PURPOSE IC'S — SPECIAL PRICES

| | | |
|---|---|---|
| 723 | GP Regulator (2 – 37V) | .80 |
| 301 | Op amp | .55 |
| 308 | Op amp | 1.60 |
| 380 | Audio power amp | 1.50 |
| 381 | Low noise dual preamp | 1.90 |
| 382 | Low noise dual preamp (equalised) | 1.90 |
| 555 | Timer | .55 |
| 556 | Dual timer | 1.50 |
| 709 | Op amp | .50 |
| 741 | Op amp | .35 |
| 3900 | Quad op amp | 1.00 |
| 3909 | LED flasher | 1.10 |
| ZN414 | TRF radio chip | 3.50 |
| CA3130 | FET op amp | 1.50 |
| SAK140 | Tachometer | 1.50 |
| UAA170 | Spot-o-light analog to LED display | 2.25 |
| UAA180 | Bar-o-light analog to LED display | 2.40 |

### T~T~L — L~O~W

| | | |
|---|---|---|
| 7400 | Quad 2 input positive NAND | .31 |
| 7401 | Quad 2 input positive NAND with o/c outputs | .31 |
| 7402 | Quad 2 input positive NOR | .31 |
| 7403 | Quad 2 input positive NOR with o/c outputs | .31 |
| 7404 | Hex inverter | .31 |
| 7405 | Hex inverter with o/c outputs | .31 |
| 7408 | Quad 2 input positive AND | .31 |
| 7409 | Quad 2 input positive AND with o/c outputs | .31 |
| 7410 | Triple 3 input positive NAND | .31 |
| 7413 | Dual NAND Schmitt trigger | .75 |
| 7420 | Dual 4 input positive NAND | .31 |
| 7430 | 8 input positive NAND | .31 |
| 7437 | Quad 2 input positive NAND buffer | .55 |
| 7440 | Dual 4 input positive NAND buffer | .31 |
| 7441 | BCD to decimal decoder/driver | 1.10 |
| 7442 | BCD to decimal decoder | .90 |
| 7447 | BCD to 7 segment dec/driver with 15V outputs | 1.25 |
| 7450 | Expander dual 2 wide 2 input AND OR INV | .31 |
| 7451 | Dual 2 wide 2 input AND OR INV | .31 |
| 7453 | Exp. 4 wide 2 input AND OR INV | .31 |
| 7454 | 4 wide 2 input AND OR INV | .31 |
| 7460 | Dual 4 input expander | .31 |
| 7470 | Gated J-K flip flop | .45 |
| 7472 | J-K master slave flip flop | .55 |
| 7473 | Dual J-K master-slave flip flop | .80 |
| 7474 | Dual D type edge trig flip flop | .80 |
| 7475 | Quadruple bistable latch | .90 |
| 7476 | Dual J-K m/s flip flop w/ pres & clear | .80 |
| 7480 | Gated full adder | 1.50 |
| 7482 | 2-bit binary adder | 1.60 |
| 7483 | 4-bit binary full adder (lock ahead carry) | 1.25 |
| 7486 | Quad 2-inp excl. OR gate | .55 |
| 7490 | Decade counter | .70 |
| 7491 | 8 bit shift register | 1.10 |
| 7492 | Div by 12 counter | .70 |
| 7493 | 4 bit binary counter | .70 |
| 7495 | 4 bit right/left shift register | 2.00 |
| 7496 | 5 bit shift register | 1.80 |
| 74107 | Dual J-K master slave flip flop | .90 |
| 74121 | Monostable multivibrator | .55 |
| 74141 | BCD to decimal dec/ driver | 2.90 |
| 74192 | Preset.sync. decade up/down count. | 1.80 |
| 74193 | Preset. sync. 4-bit binary u/d count. | 1.80 |

### EXPRESS SEMICONDUCTOR MAIL ORDER →

If you order semiconductors from us by mail order, your order will be despatched within 4 hours of receipt (it's easy to fill such a simple order)

However; if you order other products from our full range, it will take just a little longer . . the difference between an express & an all stations!

PLEASE ALLOW PACKING AND POSTAGE AT OUR NORMAL RATES.

MINIMUM MAIL ORDER AMOUNT IS $5.00.

### DIODES — FROM 6 CENTS!

| | | |
|---|---|---|
| OA91 | GP germanium diode | .12 |
| 1N914 | GP silicon diode | .06 |
| 1N4004 | 400V 1A power diode | .08 |
| 1N4007 | 1000V 1A power diode | .15 |

### 'GARDEN VARIETY' TRANSISTORS — ALMOST GIVEN AWAY!

| | | |
|---|---|---|
| BC107/547 | NPN audio | .12 |
| BC108/548 | NPN audio | .12 |
| BC109/549 | NPN low noise | .12 |
| BC177/557 | PNP audio | .12 |
| BC178/558 | PNP low voltage | .12 |
| BC179/559 | PNP low noise | .12 |

### DRIVER & POWER TRANSISTORS — DOWN TOO!

| | | |
|---|---|---|
| BC639 | NPN 80V 1W driver | .55 |
| BC640 | PNP 80V 1W driver | .55 |
| BD139 | NPN 80V 8W driver | .75 |
| BD140 | PNP 80V 8W driver | .75 |
| MJ2955 | PNP 115W power | 1.50 |
| 2N3055 | NPN 115W power | .80 |
| 2N3638 | PNP 500mA switch | .35 |

**These special prices are only available from Dick Smith stores in Sydney, Melbourne and Brisbane; and from our mail order department in Sydney.**
**However, Dick Smith Dealers will also have special semiconductor prices this month, (though not necessarily on the same lines or at the same prices).**

NOTE: We can only hold these low, low prices until 1st December, 1976. (So buy all you need now, commercial quantities included)
IF, before 1st December, you see a lower price advertised *by an Australian company* tell us about it — and we will adjust our price even lower *if we can!*

### ZENERS — JUST 25 CENTS!

| | | |
|---|---|---|
| BZX79 XXXX | 400mW Zener diode all voltages from 3.3 – 20 | .25 |

### SCR'S — WAY DOWN

| | | |
|---|---|---|
| C122D | 400V 8A SCR | 1.50 |

### LEDS & DISPLAYS — DISCOUNTED!

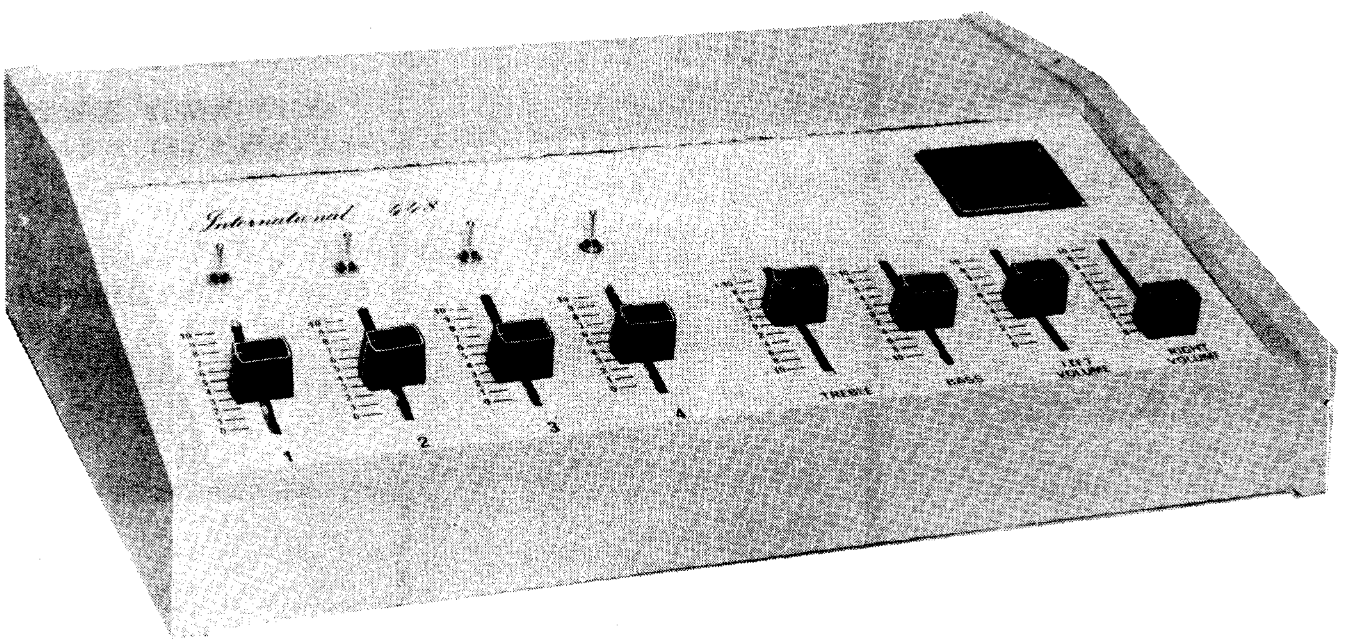
| | | |
|---|---|---|
| TIL220 | Red LED | .22 |
| RL209 | Red LED | .20 |
| DL704 | 0.3" comm. cath display | 1.20 |
| DL707 | 0.3" comm. anode display | 2.00 |
| DL747 | 0.63" comm. anode display | 3.00 |

# DICK SMITH ELECTRONICS GROUP

Mail Orders: P.O. Box 747, Crows Nest, N.S.W., 2065.
N.S.W. Branches: GORE HILL 162 Pacific Highway, 439 5311.
SYDNEY 125 York St., 29 1126. BANKSTOWN 361 Hume Hwy., 709 6600.
Interstate Branches: QLD 166 Logan Rd., Buranda, 391 6233.
VIC. 656 Bridge Rd., Richmond, 42 1614.

# DISCO MIXER

When we found out that more of our small mixer projects were being used in discos than anywhere else we decided it was about time we designed one specifically for the job.



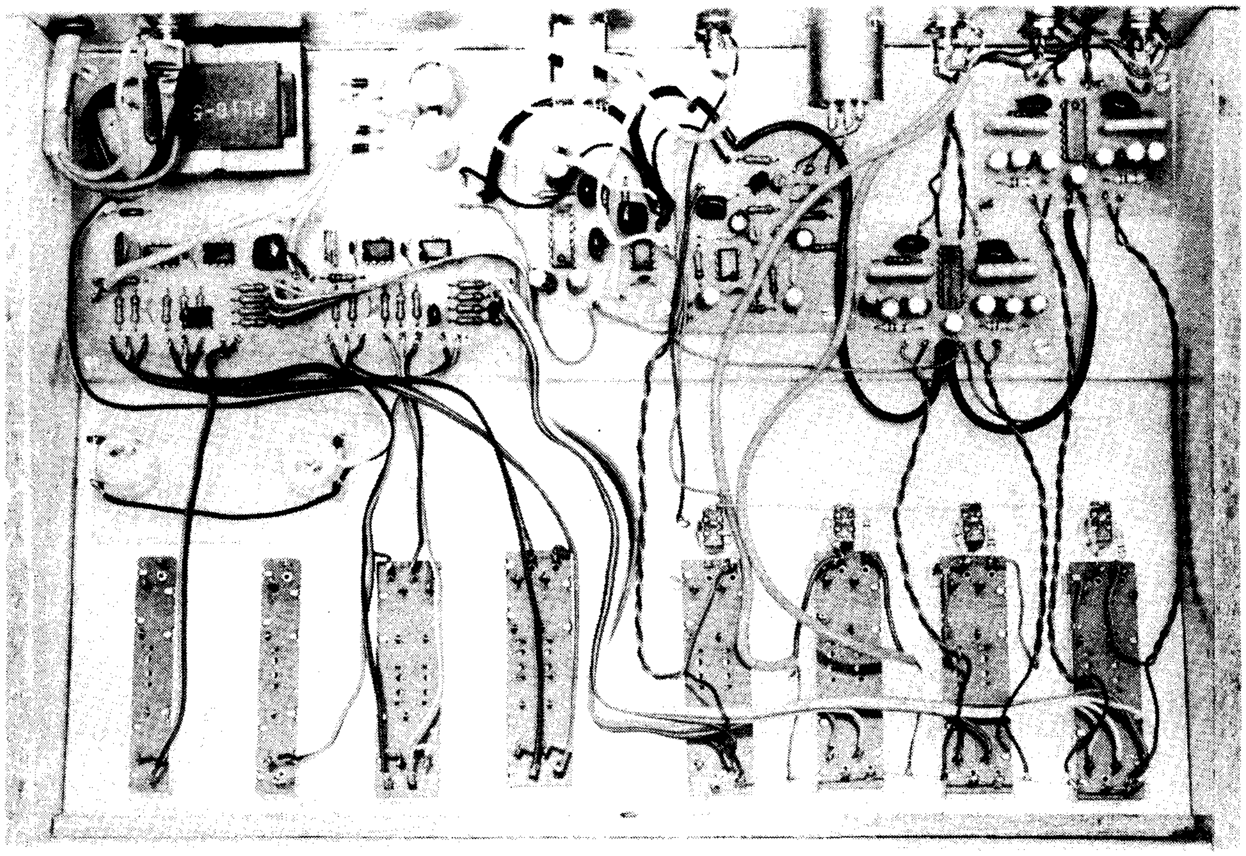
THIS IS A GENERAL-PURPOSE mixer project which can be tailored by the constructor to meet the needs of a specific application. Some of the boards used have been published in previous issues of ETI; there are three new boards. The balanced-microphone preamp board is described elsewhere in this issue and in this article we introduce our disco mixer board (containing the power supply and stereo mixer amplifiers) and the ETI 448A headphone amplifier.

Using the boards listed below virtually any audio source can be mixed by the operator to provide a stereo programme suitable for driving slave amplifiers (such as the ETI 413 100 W amps). The boards we suggest are:

ETI 448 – Power supply and main stereo mixer.
ETI 448A – Mono headphone amplifier.
ETI 449 – Balanced microphone preamplifier.
ETI 445 – General purpose stereo preamplifier (July 76 ETI).
ETI 446 – Audio limiter (in August 76 ETI).

The general purpose preamp can be configured to give a response which is flat, which follows the RIAA phono curve, or which follows the NAB tape curve. This board can be used to take the output of magnetic cartridges on the record deck, the output of a cassette head, or the input from the DJ's microphone. If a high impedance microphone is used this can be connected directly into the input of ETI 446 limiter.

The output of a cassette machine, or any other high-level source can be connected directly to the ETI 448 mixer.



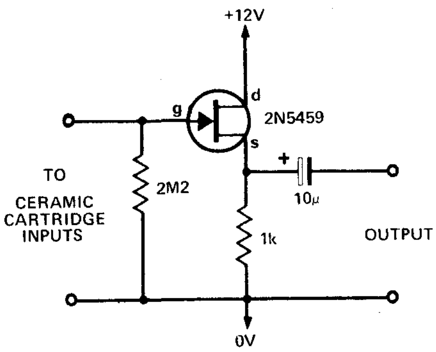



*Fig. 1. Circuit diagram of ceramic cartridge preamp.*

| TABLE 1 SUGGESTED PREAMPLIFIERS ETI 448 | |
|---|---|
| Phono | |
| Magnetic | ETI 445 (RIAA) |
| Ceramic | see Fig. 1. |
| Tape | None required |
| Tape Head | ETI 445 (NAB) |
| Microphone | |
| Low impedance | ETI 449 |
| 47 k | ETI 446 (R2 = 4 k7) |
| Microphone Limiting | |
| Low impedance | ETI 449 + ETI 446 (R2 = 15 |
| 47 k | ETI 446 (R2 = 47 k) |

## CONSTRUCTION

Before beginning construction, decide on how many inputs you need and what types. For our prototypes we chose four inputs but there is no need to limit the mixer to this size — the only consideration is the size of the box. Also decide what type of sockets you want, as this will affect the rear panel. We have not shown a drawing of the rear panel because there are too many possible ways of designing this.

Assemble the boards with the aid of the overlay drawings shown in this article and those in previous months (for the preamp boards). The photo shows the positioning of the pc boards, although this is not critical and the boards can be mounted on the top

| SPECIFICATION ETI 448 | |
|---|---|
| No. of inputs | Nominally 4 |
| No. of outputs | 2 main signal outputs<br>1 headphone amplifier output |
| Tone controls | Overall bass and treble |
| Output noise<br>(Mixer stage only) | 1 mV (mainly hum) |
| Maximum output voltage | 6 V |

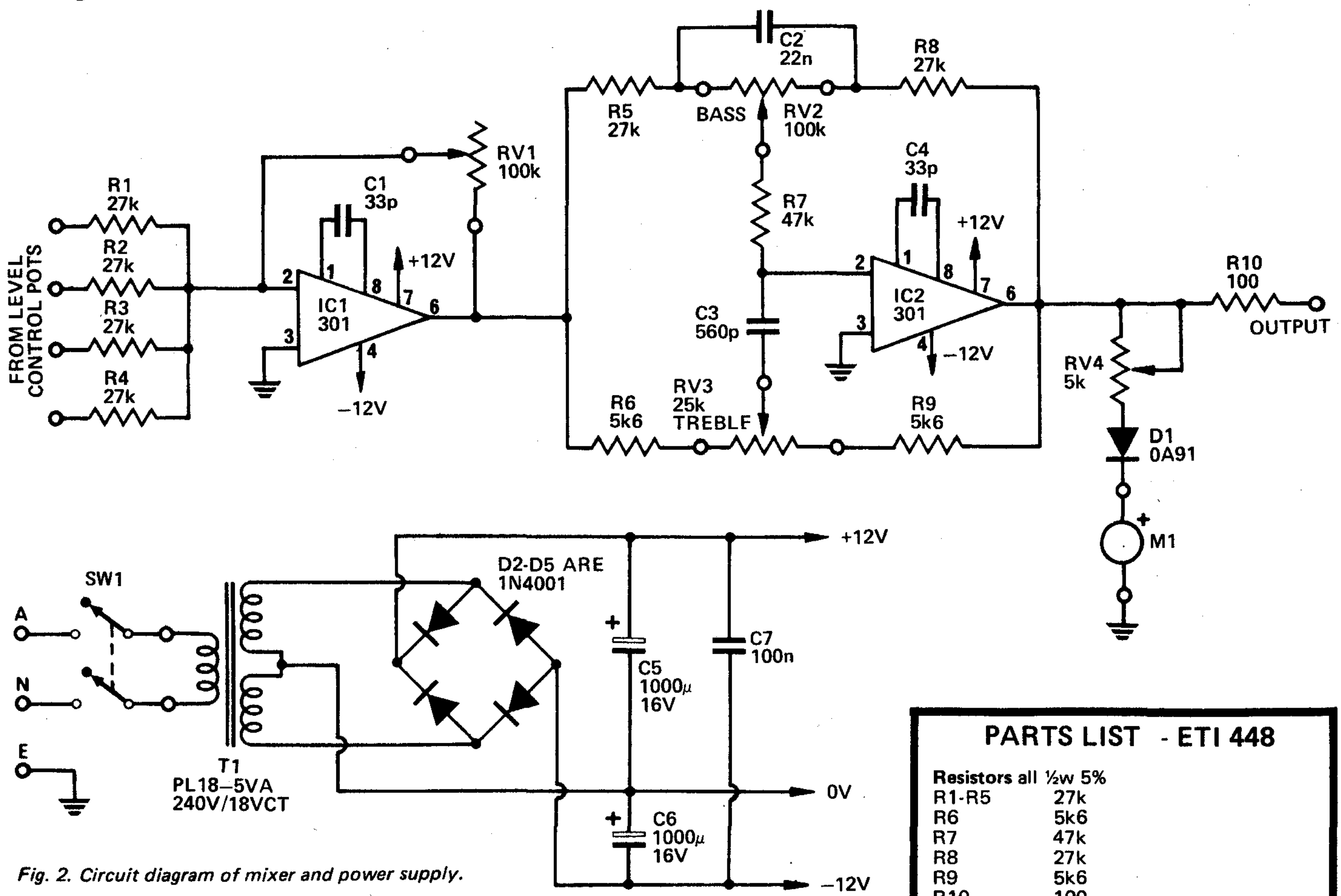



*Fig. 2. Circuit diagram of mixer and power supply.*

## HOW IT WORKS

The inputs from the turntables, tape recorders, microphones, etc., must be amplified, and if necessary equalized, by a preamplifier before any of the controls can handle them. Our recommendations for suitable pre-amps are given in Table 1. The output of each of these preamps is adjustable, by means of a volume control or fader, before being mixed in IC1. The overall gain of the mixer stage is adjusted by *means of* RV1. If different preamps have widely differing output voltages the value of R1-R4 can be changed to make them match.

The output of IC1 goes then to the tone control stage, IC2, which normally has a unity gain when the controls are centered. However, this gain is adjustable, with respect to frequency, if the tone controls are not centered. The output of the tone control stage directly drives the main power amplifiers. This output is also rectified by D1 to drive the meter circuitry.

The mixer gives stereo outputs – this is achieved by duplicating the circuitry for the second channel. The exception is the tone controls which are dual gang potentiometers. Note that the volume controls are individual units.

The output from each of the preamplifiers can be switched into a headphone mixer-amplifier to allow monitoring of any input. This enables the operator to cue inputs before they are faded. The only volume control for the headphones is on the rear panel as it is not normally adjusted. Again, if inputs of widely differing outputs are used the resistors between the volume control potentiometers and the switches can be changed.

The power supply is simply a full wave rectified supply with a centre tap giving about ± 12V dc.

## PARTS LIST - ETI 448

**Resistors all ½w 5%**

| | |
|---|---|
| R1-R5 | 27k |
| R6 | 5k6 |
| R7 | 47k |
| R8 | 27k |
| R9 | 5k6 |
| R10 | 100 |

**Potentiometers**

| | |
|---|---|
| RV1 | 100k log single gang slide 45mm |
| RV4 | 5k trim |

**Capacitors**

| | |
|---|---|
| C1 | 33p ceramic |
| C2 | 22n polyester |
| C3 | 560p ceramic |
| C4 | 33p ceramic |
| IC1, 2 | LM301A |
| D1 | OA91 |

*Two of all the above components are required for stereo operation.*

| | |
|---|---|
| RV2 | 100k lin dual gang 45mm slide |
| RV3 | 25k lin dual gang 45mm slide |
| RV5-RV8 | 10k log dual 45mm slide |
| C5, 6 | 100u 16V electro |
| C7 | 100n polyester |
| D2 – D5 | IN4001 or similar |
| Transformer | PL18-5 VA (18 V CT) (or similar) |
| pc board | ETI 448 |
| Switch | 2 pole 2 position 240 V toggle |

Dual VU meter

Four preamps to suit inputs used.
Case to suit
Sockets to suit

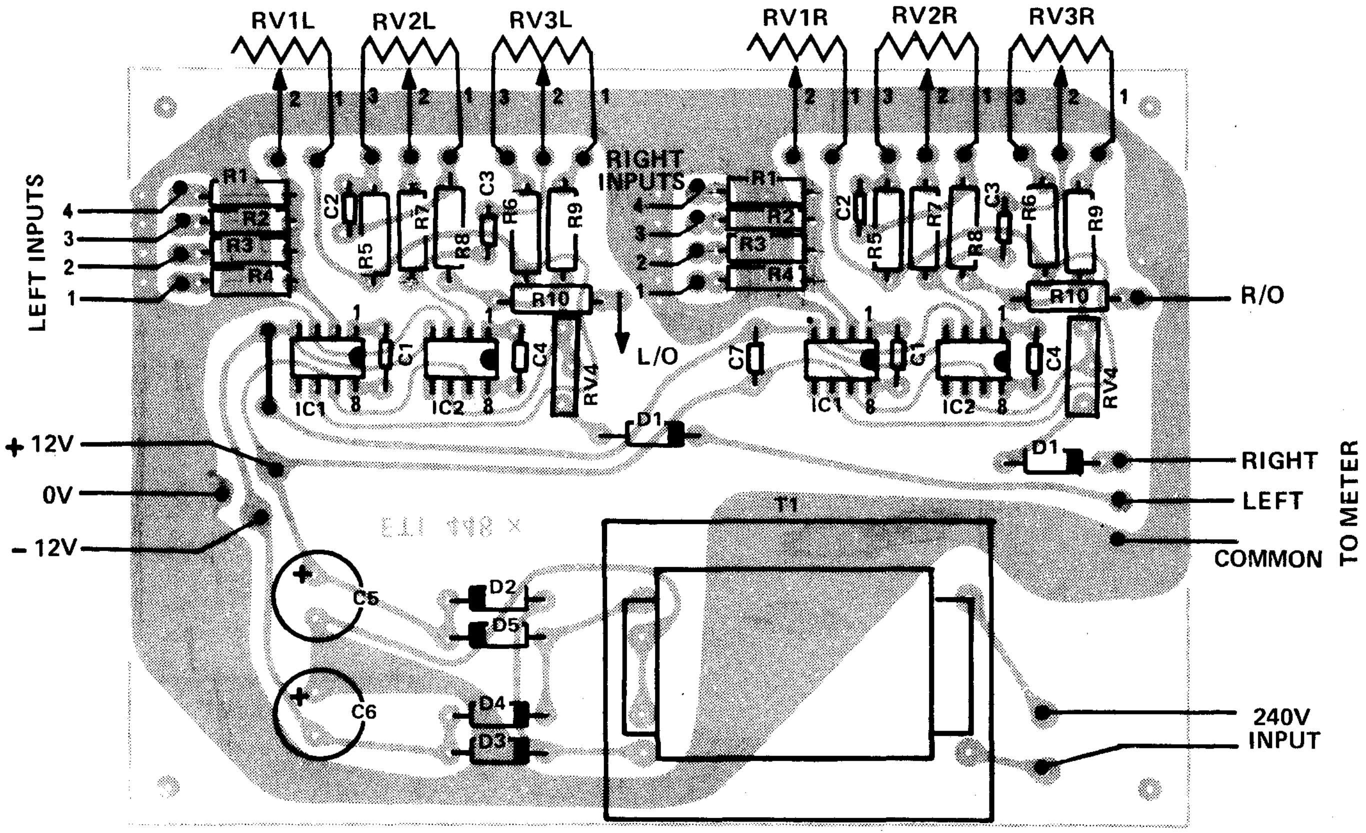



*Fig. 3. Component overlay.*

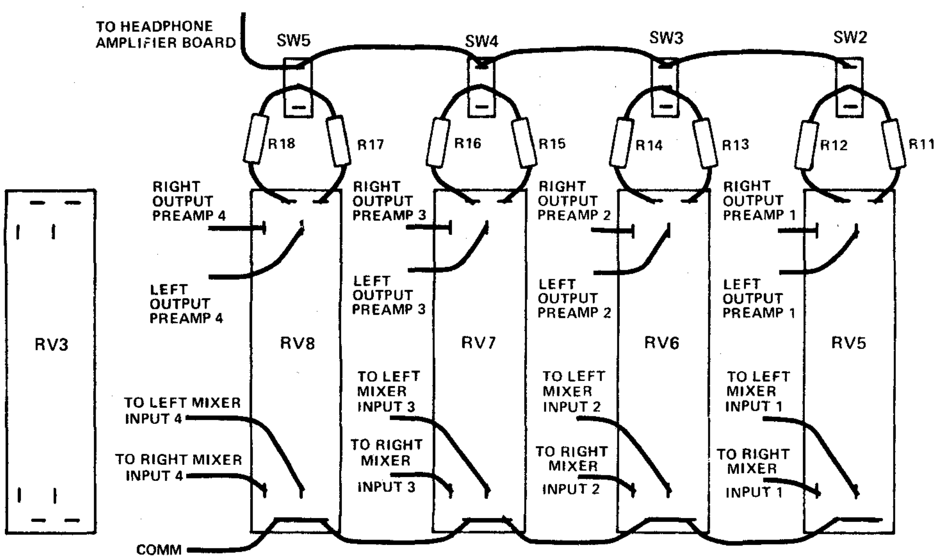
panel (as shown) or the bottom panel (if more room is needed). If operation in an electrically noisy environment is expected it may pay to line the box with "Alfoil" or similar and earth it.

The wiring of the boards can be done using the overlays or the wiring diagram.

When wiring the unit keep all the wiring as short as possible especially if shielded cable is not being used. The 240 V wiring should be kept well away from the rest of the wiring to minimise pickup. For this reason we moved the power switch from the front panel (where we originally had it) to the rear panel, next to the power cable entry. The front and rear panels should also be earthed to minimise pickup of the 50 Hz signal.

With the headphone amplifier it is suggested that if only headphones are to be driven a 100 ohm resistor be fitted in the output. This will protect the headphones and also obviate the need for heatsinks on the LM380 (otherwise this output would give about 1 W into 8 ohms). This resistor can be fitted across spare terminals on the headphone sockets.

*Fig. 4. Interconnection diagram of individual volume controls and headphone amplifier selector switches.*



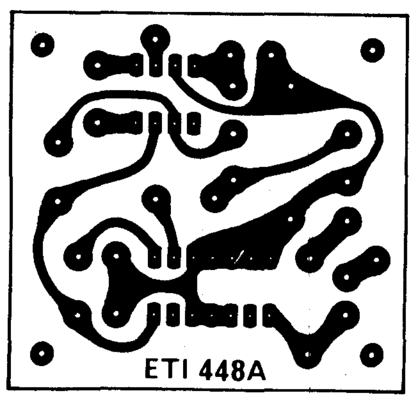
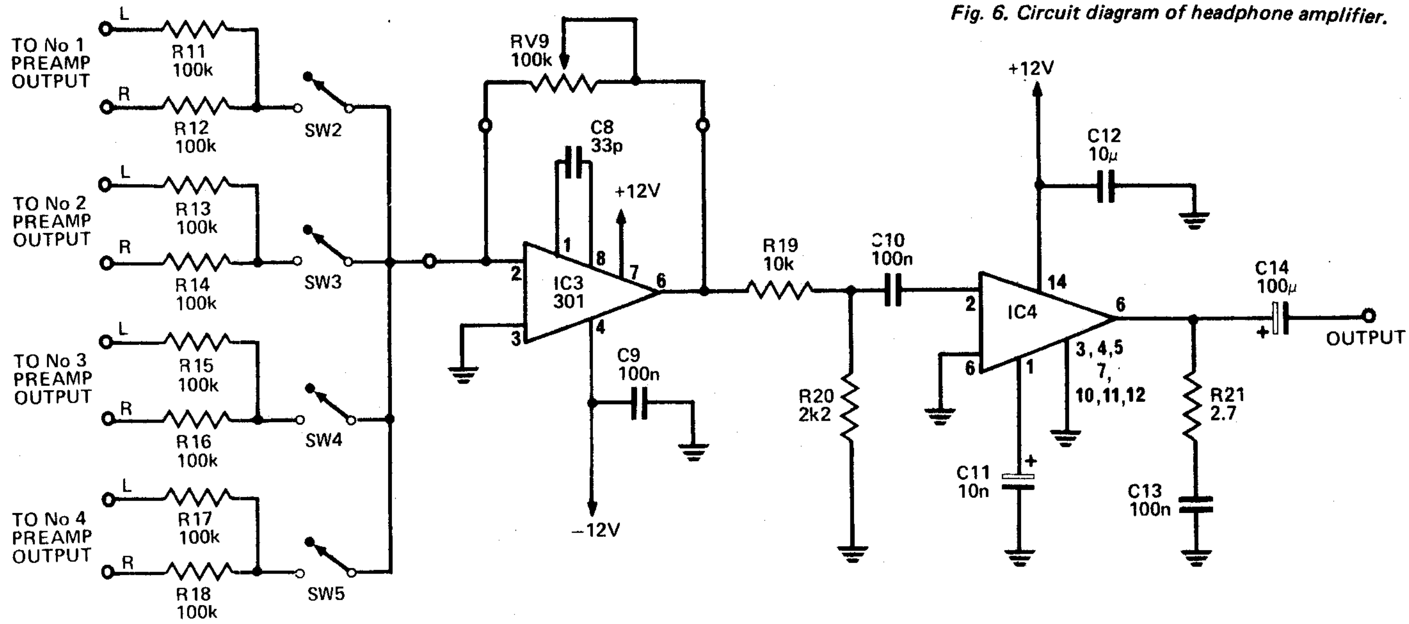




*Fig. 5. Printed circuit layout of mixer. Full size 52 x 50 mm.*

Fig. 6. Circuit diagram of headphone amplifier.




## PARTS LIST – ETI 448A

| | |
|---|---|
| **Resistors** all ½w 5% | |
| R11-R18 | 100k |
| R19 | 10k |
| R20 | 2k2 |
| R21 | 2.7 ohm |
| **Potentiometer** | |
| RV9 | 100k log rotary |
| **Capacitors** | |
| C8 | 33p ceramic |
| C9, 10 | 100n polyester |
| C11, 12 | 10μ 16 V electro |
| C13 | 100n polyester |
| C14 | 100μ 16 V electro |
| IC3 | LM301A |
| IC4 | LM380 |
| SW2-SW5 | single pole toggle |
| pc board | ETI 448A |

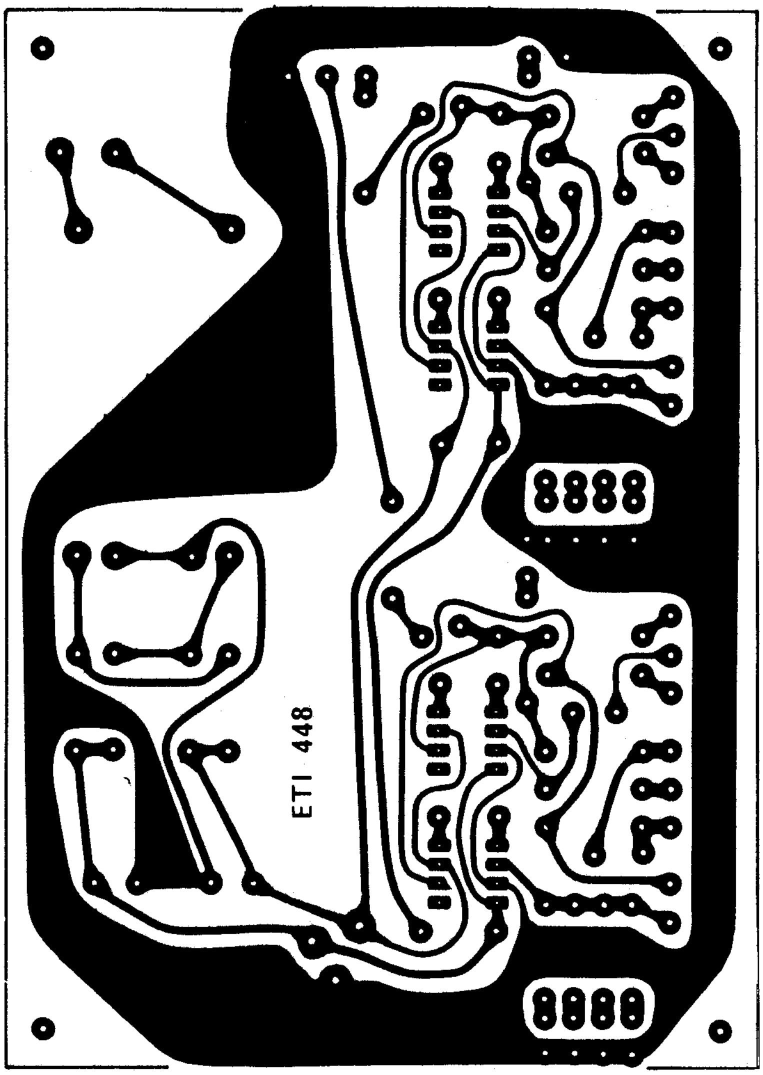



Fig. 7. Printed circuit layout of mixer and power supply board. Full size 140 x 100mm.

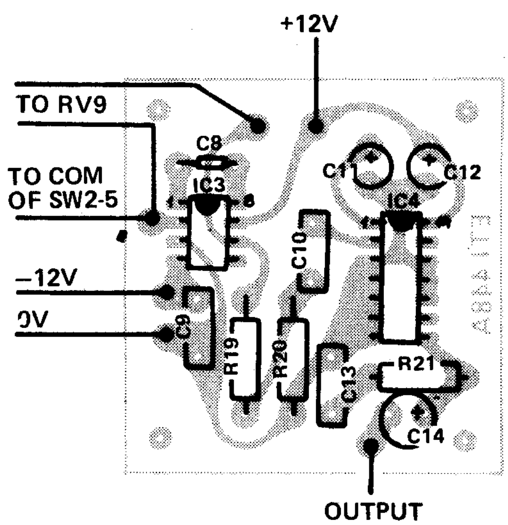



Fig. 8. Component overlay of headphone amplifier.

# DOYERWANNASAVABUK?

**Electronics for the Hobbyist Constructor**

CHECK THESE PRICES

## 10 WATT STEREO AMPLIFIER

- Ready built, not a kit
- Ceramic cartridge input
- Headphone, tape sockets
- Hi-Fi sound performance
- Rumble, scratch switches
- Slumber, loudness switches
- Australian designed and made

**IC AMPLIFIER DESIGN**
Latest up-to-date IC technology is used to give 20Hz – 50kHz response, tailored at the low and high frequency ends to optimise performance of modern ceramic cartridges so that the sound quality often surpasses that of cheap magnetic cartridges. This is achieved with the LM3900 pre-amp and dual STC TA-10B hybrid amplifiers giving maximum 15W/ch in 8-15 ohms. The attractively designed front panel features white lettering on extruded black anodised aluminium with a really professional finish. The PC board and front panel are already assembled simply wire in the power supply as directed. All parts supplied (including transformer and mains lead) – no extras to buy.
**THIS MUST BE GOOD VALUE AT $34.00.** ☐

**SPECIAL OFFER NOW!**
(Offer Open Until 11.9.76 or While Stocks Last)

**$1 EXTRA BUYS THIS DE-LUXE BASE to suit.** ☐
Available only when purchasing any amplifier on this page. Choose BSR or GARRARD cut-out and nominate with order. Perspex covers and hinges available if required (Price $10.50 set) ☐

*MATCHING TURNTABLE AND SPEAKERS*

## GARRARD 6-200 CHANGER

Full-size 3 speed auto-changer, 11" platter, de-luxe aluminium trim, lowering device, complete with ceramic cartridge. ESPECIALLY SUITED TO THE AMPLIFIERS SHOWN ON THIS PAGE. Our normal price for this turntable is $36.00, however, we want to make it easy for you to own one of these beaut systems, so with each order for an amplifier, we will knock $7 off the price of this Garrard 6-200. IT'S A GOOD BUY AT $29.00 ☐

## 8" 3 WAY SPEAKER KITS

**$33 PAIR**

Of course you can use any quality speaker system with these amplifiers, but we recommend these well-known brand Australian made speakers and they're at the RIGHT PRICE. 6 speakers for $33.00. You get 8" woofers (with specially treated cones for low bass performance), 5" dual-cone sealed-back speakers for mid-range, and 3" cone tweeters for response to over 18kHz, plus crossovers consisting of capacitors and wire wound resistors plus a set of instructions and drawings to BUILD YOUR OWN CABINET AND SAVE $$$. ☐

## CORAL SPEAKER KITS

8" 3 way 3 speaker kit 8SAI $37.90 pr. ☐ 10" 3 way 3 speaker kit 10 SAI $61.75 pr. ☐ 12" 3 way 4 speaker kit 12SAI $85.00 pr. ☐

## JUMBO BAGS $3 ea

- ☐ 400 ¼W Asst. Resistors
- ☐ 500 ½W " "
- ☐ 300 1W " "
- ☐ 100 Asst. Semiconductors
- ☐ 100 Asst. Poly Caps 160–630V
- ☐ 150 Asst. various caps
- ☐ 60 Asst. Electrolytics

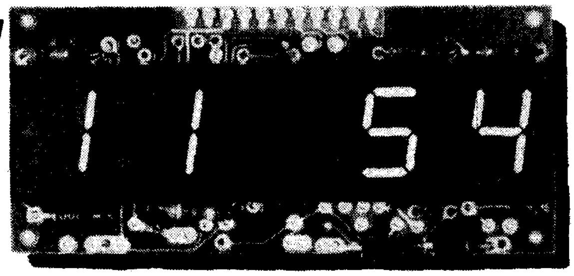
## DO-IT-YOURSELF LOW COST HI FI. 2 W STEREO AMPLIFIER

Dual LM-380's give max. 3w/ch in 8 ohms, 12 – 18v. supply. Incl. VOL, BASS, TREBLE, Ceramic Cart. input. Transformer extra $4.50 Qty. 175.
**$7.** ☐

**2W Stereo Amp with Slider Controls** –
Dual LM-380, VOL, BASS, TREBLE, 45mm Slider controls. cw. knobs, pilot lamp., 12 – 18v. input. Transformer extra **$4.50**

**NOW ONLY $8.00**

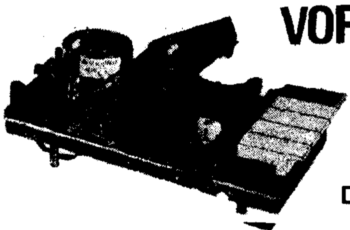
## Digital Alarm Clock



*Introductory Offer* –
**$12.50** ☐
**POST FREE**

**National Semiconductor Module MA-1002**
Latest innovative breakthrough, 'Clock on a Chip' 4 digit alarm clock. Read the time at a glance. Large ½" LED 7 segment display. Only 80x35x25mm. Ready to install, simply add transformer, switches and/or ear piece. Features adjustable brightness "snooze alarm". Fast & slow set facility, alarm on PM indicators. Supplied complete, ready wired with data sheet & application notes. No postage required. Transformer $6.50. ☐

## VORTEX



**$22** ☐

**VORTEX Stereo Cassette Deck** mechanism with tape eject facility and resettable counter. Easily operated by 5 push-button (piano key) controls, & includes high quality "ALPS" record-ing/play back head & erase head. Tape speed 4.75cm/sec. Complete with wiring diagram, etc. PC record/play 8 pole switch, $3.90. EA 74C9 record/play pre-amp PCB, $4. Playback only kit incl. PCB etc, $7.50. Transformer to suit above, $11.50.

## BONANZA JACKPOTS

For experimenters and constructors, a large assortment of new, high quality parts – samples, specials, end-of-line components incl. semiconductors.

**JACKPOT NO. 1**
A 500gm (approx) Lucky-dip offer, all useable parts. Up to **$25** worth for only **$5.**

**JACKPOT No. 2.**
A 2Kgm (approx) assortment in a 315 x 270 x 160mm box includes relays, edge connectors, pots, switches, semis and many others too numerous to mention. **ONLY $10**

## 10W DELUXE STEREO AMPLIFIER $27.00

Features:– VOL. BASS, TREBLE, PRESENCE Controls, H'phone, tape skts & slumber, loudness, rumble, scratch switches, all assembled on expensive looking blk. anodised panel. Dual STC TA-10B hybrid power amplifiers give max. 15w/ch in 8–15 ohms, 32v. supply. Ceramic cart. input. Transformer extra **$6.50.** Qty. 200.

**Electronic Agencies**

Trading Hours – 12.00 – 6 pm Mon–Fri. 8.30–1pm Sat.
Mail Orders – P.O. Box 1005 Burwood North 2134
Post & Pack – Add 15% up to $25 order value. 10% over.
Minimum Order Value – $3.00 C.O.D.'s Send $3.00 pre-paid
Prices & Availability – O.K. as at 21.10.76

115-117 Parramatta Road, CONCORD, N.S.W. TELEPHONE (02) 747-6472

## 15W STEREO AMP KIT $21.50

I.C. pre-amp, transistor power amps, regulated supply, VOL, BASS, TREBLE, BAL, Controls, all parts incl. transformer and instructions supplied, max. 20w/ch in 4–15 ohms, mag. cart. input only.
*Basic Kit only* – no 'extras'

**Write your Name, Address, P/Code here and send your order to P.O. Box 1005, Burwood Nth. 2134.**

**WESTERN SUBURBS NEWEST DEALER... WESTERN SUBURBS**

# It makes sense

## THE STORE WHERE OUR CUSTOMERS ARE **NOT** JUST ANOTHER

### DISCOUNTS — This page only

over

| | | | |
|---|---|---|---|
| $15 | 7½% | $70 | 17½% |
| $25 | 10% | $100 | 20% |
| $40 | 12½% | $200 | 22½% |
| $60 | 15% | $300 | 25% |

### 74 SERIES T.T.L.

| | | | |
|---|---|---|---|
| 7400 | .39 | 7476 | .75 |
| 7401 | .39 | 7480 | 1.30 |
| 7402 | .39 | 7482 | 1.90 |
| 7403 | .39 | 7483 | 1.80 |
| 7404 | .39 | 7485 | 2.50 |
| 7405 | .39 | 7486 | .70 |
| 7406 | .89 | 7489 | 3.90 |
| 7407 | .89 | 7490 | .65 |
| 7408 | .89 | 7491 | 1.55 |
| 7409 | .39 | 7492 | .95 |
| 7410 | .39 | 7493 | .95 |
| 7411 | .45 | 7494 | 1.80 |
| 7413 | .95 | 7495 | 1.30 |
| 7414 | 2.25 | 7496 | 1.70 |
| 7416 | .85 | 74100 | 2.90 |
| 7417 | .95 | 74107 | .69 |
| 7420 | .39 | 74121 | .75 |
| 7425 | .80 | 74122 | .85 |
| 7426 | .59 | 74123 | .95 |
| 7427 | .55 | 74132 | 1.50 |
| 7430 | .39 | 74141 | 2.20 |
| 7432 | .55 | 74145 | 1.95 |
| 7437 | .75 | 74150 | 2.60 |
| 7438 | .75 | 74151 | 1.70 |
| 7440 | .39 | 74153 | 1.55 |
| 7441 | 1.50 | 74154 | 2.50 |
| 7442 | 1.20 | 74157 | 1.70 |
| 7445 | 2.10 | 74160 | 2.20 |
| 7446 | 2.10 | 74164 | 230 |
| 7447 | 1.80 | 74165 | 2.30 |
| 7448 | 1.80 | 74174 | 2.30 |
| 7450 | .39 | 74180 | 2.30 |
| 7451 | .39 | 74181 | 4.90 |
| 7453 | .39 | 74185 | 3.90 |
| 7454 | .39 | 74190 | 2.50 |
| 7460 | .39 | 74192 | 2.20 |
| 7470 | .70 | 74193 | 2.20 |
| 7472 | .60 | 74194 | 1.95 |
| 7473 | .68 | 74195 | 1.50 |
| 7474 | .69 | 74196 | 2.20 |
| 7475 | 1.10 | | |

### SCHOTTKY — SPECIAL

| | | | |
|---|---|---|---|
| 74S00 | 1.15 | 74S196 | 2.80 |
| 74S10 | 1.40 | 82523 | 6.95 |
| 74S20 | 1.40 | 8281A | 3.90 |
| 74S74 | 2.75 | 82S90 | 5.95 |
| 74S112 | 2.50 | 9001 | 1.60 |
| 74S251 | 5.30 | 9368 | 3.20 |
| 74S258 | 4.75 | 95H90 | 14.50 |
| | | 11C90 | |

### DIODES ETC

| | | | |
|---|---|---|---|
| AA119 | .25 | BZX61C13 | .72 |
| BA102 | .60 | BZX61C33 | .72 |
| BB105 | .60 | BZX70C15 | $1.25 |
| C103B | 1.70 | C122E | $3.50 |
| C106D1 | 1.50 | IN751A | .35 |
| EM402 | .20 | IN752A | .35 |
| EM404 | .20 | IN753A | .35 |
| EM408 | .35 | IN754A | .35 |
| OA91 | .25 | IN755A | .35 |
| IN914 | .10 | IN759A | .35 |
| IN748A | .35 | IN5626 | .65 |
| IN749A | .35 | MB4 | 1.80 |
| BA114 | .27 | PA 40 | 4.90 |
| BZX61C12 | .72 | SC151 D | 2.50 |

***Terms: Non-account customers cash, cheque, postal order or Bankcard.***

| | | | |
|---|---|---|---|
| V413 | .95 | OA47 | .45 |
| 5082-2800 | $2.50 | OA90 | .25 |
| MEL12 | $1.10 | 2530 | .95 |
| FCD820 | $1.50 | 2530R | .95 |

+ others

### CMOS

| | | | |
|---|---|---|---|
| 74C00 | .45 | CD4006 | 1.90 |
| 74C02 | .65 | CD4007 | .45 |
| 74C08 | 1.10 | CD4008 | 1.90 |
| 74C10 | .50 | CD4009 | 1.25 |
| 74C14 | 2.25 | CD4010 | 1.20 |
| 74C20 | .50 | CD4011 | .45 |
| 74C32 | .65 | CD4013 | 1.25 |
| 74C42 | 2.95 | CD4014 | 1.90 |
| 74C48 | 4.95 | CD4016 | .75 |
| 74C73 | 1.90 | CD4017 | 1.90 |
| 74C86 | 1.60 | CD4019 | 1.10 |
| 74C89 | | CD4020 | 2.10 |
| 74C90 | 1.95 | CD4026 | P.O.A. |
| 74C154 | 4.75 | CD4027 | 1.60 |
| 74C160 | 2.95 | CD4040 | 2.10 |
| 74C162 | 3.50 | CD4051 | 1.90 |
| 74C174 | | CD4096 | P.O.A. |
| 74C901 | 1.50 | CD4502 | 2.40 |
| 80C95 | 1.75 | CD4053 | P.O.A. |
| 80C97 | 1.75 | CD4511 | 2.75 |
| CD4001 | .39 | CD4520 | 2.10 |
| CD4002 | .39 | | |

+ others

### PHILIPS LOCMOS — 4000-P

| | | | |
|---|---|---|---|
| HEF4001 | .45 | HEF4066 | 1.20 |
| HEF4002 | .45 | HEF4067 | 7.50 |
| HEF4006 | 1.90 | HEF4068 | .45 |
| HEF4007 | .45 | HEF4069 | .50 |
| HEF4008 | 1.90 | HEF4070 | .45 |
| HEF4011 | .45 | HEF4071 | .45 |
| HEF4012 | .45 | HEF4072 | .45 |
| HEF4013 | .75 | HEF4073 | .45 |
| HEF4014 | 1.90 | HEF4075 | .45 |
| HEF4015 | 1.90 | HEF4078 | .45 |
| HEF4016 | .75 | HEF4081 | .45 |
| HEF4017 | 1.90 | HEF4082 | .45 |
| HEF4018 | 1.90 | HEF4085 | 1.35 |
| HEF4019 | 1.10 | HEF4086 | 1.35 |
| HEF4020 | 2.10 | HEF4093 | 1.50 |
| HEF4021 | 1.90 | HEF4104 | 2.90 |
| HEF4022 | 1.80 | HEF4510 | 2.65 |
| HEF4023 | .45 | HEF4511 | 2.75 |
| HEF4024 | 1.45 | HEF4514 | 5.40 |
| HEF4025 | .45 | HEF4515 | 5.40 |
| HEF4027 | .88 | HEF4516 | 2.60 |
| HEF4028 | 1.50 | HEF4518 | 2.35 |
| HEF4029 | 2.20 | HEF4519 | 1.10 |
| HEF4030 | .80 | HEF4520 | 2.10 |
| HEF4031 | 3.90 | HEF4528 | 1.50 |
| HEF4035 | 1.95 | HEF4539 | 1.65 |
| HEF4040 | 2.10 | HEF4555 | 1.50 |
| HEF4041 | 2.10 | HEF4556 | 1.50 |
| HEF4042 | 1.60 | HEF4724 | 3.20 |
| HEF4043 | 1.90 | HEF40097 | 1.50 |
| HEF4044 | 1.90 | HEF40098 | 1.50 |
| HEF4046 | 2.60 | HEF40174 | 2.40 |
| HEF4047 | 1.60 | HEF40175 | 2.40 |
| HEF4049 | .75 | HEF40192 | 2.40 |
| HEF4050 | .75 | HEF40193 | 2.40 |
| HEF4051 | 1.90 | HEF40194 | 2.40 |
| HEF4052 | 1.90 | HEF40195 | 2.40 |
| HEF4053 | 1.90 | | |

***We only sell genuine components.***

***IF IT'S NOT LISTED IT DOES NOT NECESSARILY MEAN WE DO NOT STOCK THE ITEM.***

### LINEARS

| | | | |
|---|---|---|---|
| CA3012 | 2.95 | LM387N | 2.25 |
| CA3018 | 3.50 | LM395K | 6.90 |
| CA3028A | 1.95 | LM555V | .95 |
| CA3075D | 1.90 | LM556 | 2.75 |
| CA3076T | 2.90 | LM562B | 9.80 |
| CA3089E | 2.95 | LM565 | 2.95 |
| CA3090AQ | 5.90 | LM566CN | 1.95 |
| CA3130/T | 1.85 | LM567CN | 3.80 |
| CA3140/T | 1.75 | LM709CN | .95 |
| LM114H | 3.90 | LM710CN | 1.25 |
| LM301AN | .69 | LM723CN | .95 |
| LM304H | 3.80 | LM725CN | 3.95 |
| LM305AH | 3.80 | LM733N | 2.50 |
| LM307n | 1.50 | LM741CN | .49 |
| LM308V | 1.95 | LM741CN | 1.20 |
| LM/SG 309K | 2.50 | LM747CN | 2.50 |
| LM310N | 3.90 | LM748CN | .85 |
| LM311A | 3.25 | LM1303N | 2.60 |
| LM311H | 3.25 | LM1310N | 3.50 |
| LM312H | 4.95 | LM1458 | 2.50 |
| LM317K | 6.90 | LM1488 | 5.90 |
| LM318N | 5.50 | LM1489 | 4.75 |
| LM319N | 5.50 | LM1496 | 1.80 |
| LM320K5 | 4.50 | LM1496 | 2.30 |
| LM320K12 | 4.50 | LM1800N | 3.90 |
| LM320K15 | 4.50 | LM1808N | 3.90 |
| LM320T5 | 3.90 | LM3046 | 3.50 |
| LM320T12 | 3.90 | LM3086N | 3.75 |
| LM320T15 | 3.90 | LM3900N | 1.75 |
| LM322N | 3.90 | LM3905N | 3.90 |
| LM323K | 7.90 | LM3909N | 1.50 |
| LM324N | 3.90 | MC1035P | 2.90 |
| LM325N | 3.90 | MC1350P | 1.60 |
| LM326H | 4.75 | MC1351P | 2.25 |
| LM339N | 3.25 | MC1454G | 5.40 |
| LM340K6 | 3.90 | MC1468L | 6.50 |
| LM340K12 | 3.90 | MC1496K | 2.30 |
| LM340K15 | 3.90 | MC1590G | 6.75 |
| LM340K18 | 3.90 | MC1648P | 4.90 |
| LM340K24 | 3.90 | MC4044P | 4.90 |
| LM340T5 | 2.50 | NE556A) | SEE |
| LM340T6 | 2.50 | NE5623) | LM |
| LM340T8 | 2.50 | NE565) | |
| LM340T12 | 2.50 | OM802 | 3.20 |
| LM340T15 | 2.50 | SD305DE | 1.25 |
| LM340T18 | 2.50 | SD306DE | 1.50 |
| LM340T24 | 2.50 | SD6000V | 1.95 |
| LM358N | 2.60 | TAA300 | 2.90 |
| LM370H | 3.20 | TBA651 | 3.90 |
| LM371H | 4.50 | TBA810A | 3.90 |
| LM372N | 3.90 | UA720 | 3.80 |
| LM373N | 4.70 | UA723K | 1.20 |
| LM374N | 5.90 | UA757 | 3.80 |
| LM375N | 4.90 | ULN2208 | 1.95 |
| LM380N | 2.75 | ULN2209 | 1.95 |
| LM381N | 2.95 | ZN414 | 3.95 |
| LM382N | 2.25 | | |

### CERAMICS

UP to 82 pf 11c. 100 pf to 0.47 µf 12c. .1 uf 12c. .22 uf 20c. .47 uf 35c.

***Most data sheets, technical info 30c photocopy or do it yourself on our coin-op machine 10c.***

**bankcard welcome here**

### RESISTORS, POTS

| | | |
|---|---|---|
| ½W | E12 Series | 3c. |
| 5W | E12 Series | 45c. |
| S/G | LIN, Log | 59c. |
| D/G | LIN, Log | 1.25c. |
| Trimpots | Cermet | .40 |

### DIL SOCKETS

| | | | |
|---|---|---|---|
| 8 PIN | .38 | 24 PIN | .78 |
| 14 PIN | .39 | 40 PIN | 1.25 |
| 16 PIN | .45 | | |

### TRANSISTORS

| | | | |
|---|---|---|---|
| AC126 | 1.50 | TIP3055 | 1.70 |
| AD149 | 2.60 | TT800 use 2N4032 | |
| AD161/162PR | 4.50 | TT801 | .95 |
| AS322 | .18 | 2N706A | .95 |
| BC107METAL | .25 | 2N918 | 1.60 |
| BC108METAL | .25 | 2N2646 UJT | 2.25 |
| BC109METAL | .25 | 2N2905 | .95 |
| BC177/157MET | .30 | 2N3053 | 3.80 |
| BC178/158MET | .30 | 2N3054 | 1.70 |
| BC179/159MET | .30 | 2N3055 | .95 |
| BC212 | .50 | 2N3564 | .55 |
| BC327 | .55 | 2N3565 | .45 |
| BC547 | .55 | 2N3566 | .65 |
| BC548 | .55 | 2N3568 | .75 |
| BC549 | .55 | 2N3569 | .45 |
| BC559 | .39 | 2N3638 | .45 |
| BC639 | .95 | 2N3638A | .50 |
| BC640 | .95 | 2N3642 | .45 |
| BD131 use BD237 | | 2n3643 | .45 |
| BD132 use BD238 | | 2N3694 | .45 |
| BD139 | .95 | 2N4032 | .95 |
| BD140 | .95 | 2N4249 | .45 |
| BD237 | 1.50 | 2N4250 | .55 |
| BD238 | 1.50 | 2N4355 | .55 |
| BD173 | 1.25 | 2N4356 | .55 |
| BF180/200 | 120 | 2N4360P-FET | .95 |
| BF194 | .85 | 2N5245N-FET | .75 |
| BF450 | .75 | 2N 5457 use MPF103 | |
| BSX19 | .75 | 2N 5458 use MPF104 | |
| MFE131(Metal) | 1.95 | 2N 5459 use MPF105 | |
| MPF102 | .65 | 2N 5485 use MPF106 | |
| MPF103 | .85 | 2N5590 use MRF603 | |
| MPF104 | 1.10 | 2N6027 UJT | 1.25 |
| MPF105 | .85 | 40409 | 3.85 |
| MPF106 | 1.15 | 40410 | 3.35 |
| MPF121/131 | 1.50 | 40637A | 2.85 |
| MJ2955 | 2.40 | 40673 | 1.65 |
| MRF603 | 6.90 | 40841 | 1.50 |
| TIP31C | 1.00 | 7805 | 2.50 |
| TIP32C | 1.00 | 7812 | 2.50 |
| TIP2955 | 1.30 | 7815 | 2.50 |

**OUR RANGE of IC's is always expanding**

***DON'T FORGET – SUFFICIENT P/P AT LEAST 50c BALANCE REFUNDED***

## CHEAP BARGAIN COMPONENTS CAN FINISH UP VERY EXPENSIVE

First quality components and equipment from: AWA, Amidon, Elcoma, I.T.T., Motorola, National, RCA, Solid State, Signetics, Texas and others. Prices subject to change without notice. All offers genuine. Stocks subject to continued availability. All goods new to manufacturers specs. and guarantee. No rubbish, untested or unmarked devices. E.&I.O.E.

# SIMPLE INTERCOM

project electronics

This simple intercom uses the ETI 061 amplifier module, has no transformers, preset volume control and has the speakers doubling as microphones.

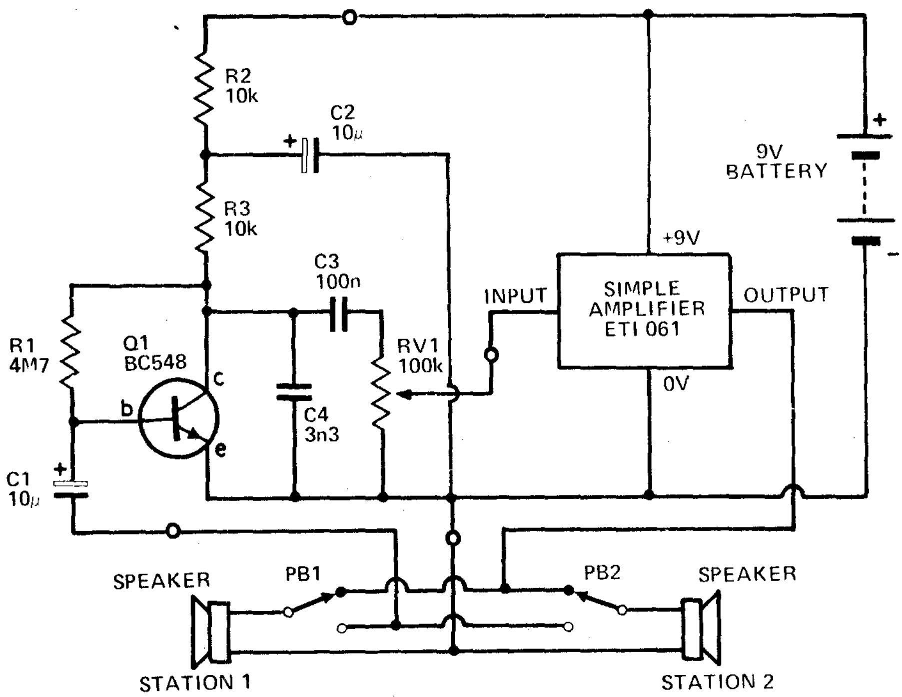



*Fig. 1 Circuit diagram of the intercom.*

PB1 AND PB2 ARE SINGLE POLE CHANGEOVER PUSH BUTTONS (PUSH TO TALK)

### How It Works ETI 064

Conventional moving coil loudspeakers double as speakers and microphones in each station. As they are not very efficient used like this we have added a single common emitter transistor amplifier to boost the output about 40 dB (100 times) before feeding it into the ETI 061 amplifier.

The collector load for Q1 is R2 and R3 with capacitor C2 to prevent supply voltage variations getting into the output. The dc biasing for Q1 is provided by R1 which causes the output of Q1 (collector) to stabilise at about 2V. The actual voltage depends on the $\beta$ (gain) of Q1.

The output is adjustable by RV1 to provide adequate volume without incurring feedback.

OUR SIMPLE AMPLIFIER PROJECT described in Electronics Today last month is a general purpose unit. It may be used just as described for innumerable experiments – or it may be used as the basis for very many other simple and practical projects, several of which will be included in this series.

Here is an intercom unit based on the simple amplifier plus a handful of further components. It is a versatile little unit that provides two-way communication over any distance ever likely to be required.

To save the cost of both microphones and loudspeakers we have used a single loudspeaker at each end and these double as microphones. Almost any 8 ohm or 16 ohm speakers may be used. Units of two to three inch diameter are readily available for not much more than a dollar or so. For the best performance these units should each be mounted in a small enclosure. The size and shape of the enclosure is not particularly important. An open backed box about the size of a shoe box would be fine.

The system may be converted for use as a baby crying' alarm simply by wiring a toggle switch across the 'push-to-talk' push button at the desired station.

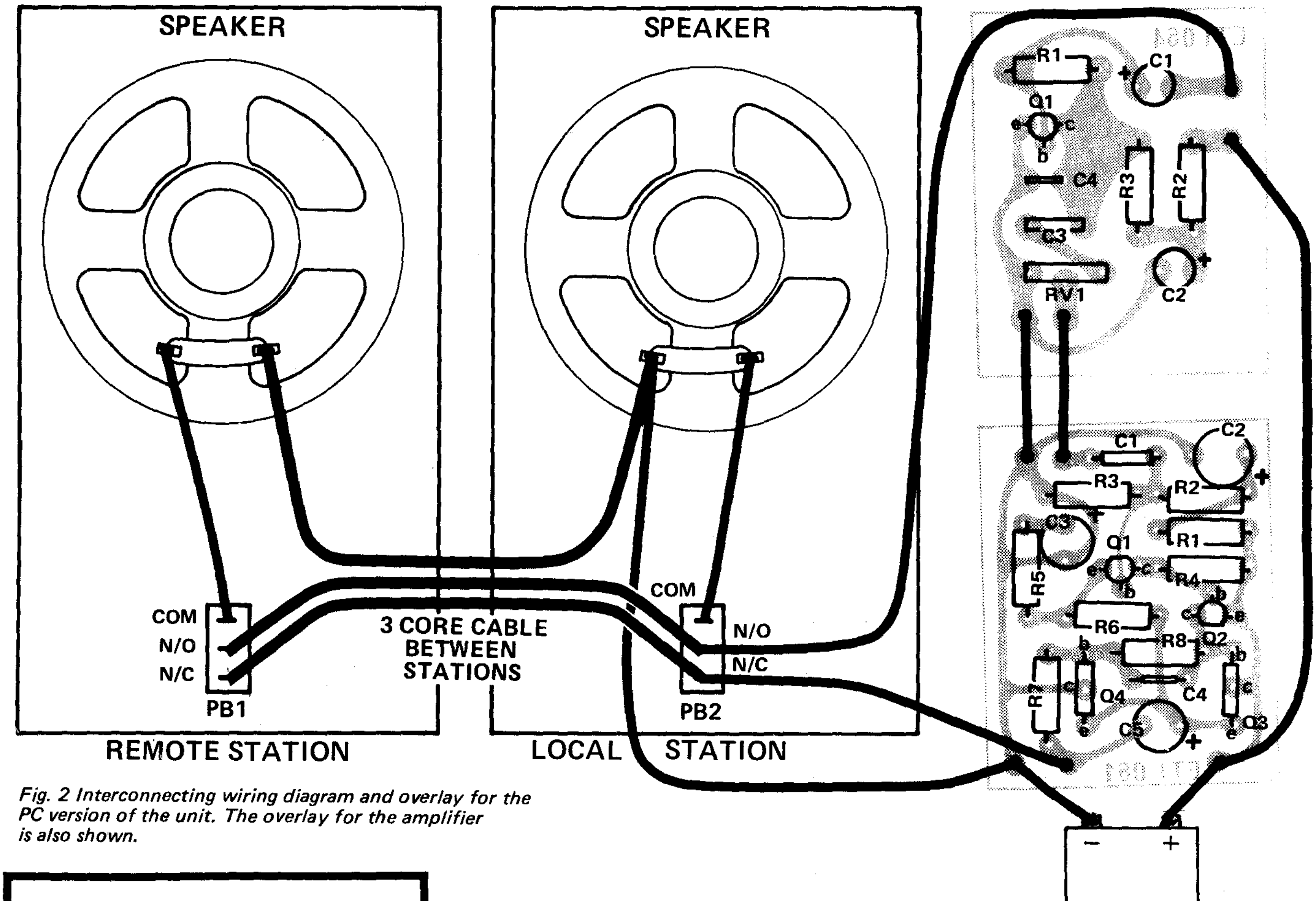
## Construction

The ETI 064 intercom consists of the previously described 061 amplifier and a handful of extra components – the latter being mounted separately on printed circuit board, Veroboard or tag strip – as desired. The 061 amplifier should be assembled, as shown on page 62 of Electronics Today last month.

The two separate assemblies should then be interconnected as shown in Fig. 2. The two speaker switches should be located whever convenient – either on the speaker enclosures or any position that is handy when using the units.

Three wires are used to connect the two speaker stations together. The wire used is not critical – bell wire or similar will be fine. Twist the wires together along their entire length to prevent picking up unwanted noise. About ten twists per metre is sufficient.

One nine volt supply is used to drive the complete unit – i.e. the simple amplifier draws into power from the battery used in the intercom. Note however that as the unit is 'on' all the time a nine volt battery eliminator should preferably be used in place of the battery shown. Suitable eliminators may be built following plans previously published in ETI or bought for a few dollars from almost any electrical supply store.



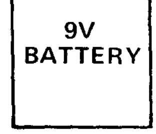
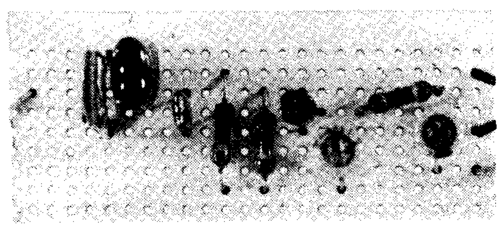




*Fig. 2 Interconnecting wiring diagram and overlay for the PC version of the unit. The overlay for the amplifier is also shown.*

## PARTS LIST – ETI 064

| | | | | |
|---|---|---|---|---|
| R1 | Resistor | 4M7 | ½ W | 5% |
| R2,3 | Resistors | 10 k | ½ W | 5% |
| RV1 | Potentiometer | 100 k | trim type | |
| C1,2 | Capacitors | 10 μF 16 V electro | | |
| C3 | Capacitor | 100 nF polyester | | |
| C4 | Capacitor | 3n3 polyester | | |
| Q1 | Transistor | BC548 | | |

2 push buttons with single changeover contact
2 speakers 8 or 16 ohm
PCB ETI 064 or Veroboard 1" x 2.5"
Suitable boxes
Amplifier module ETI 061



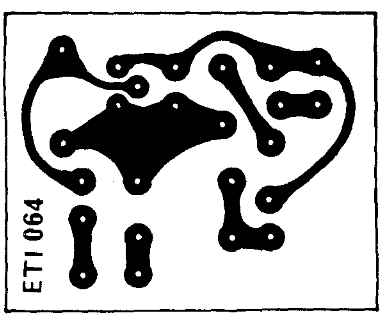
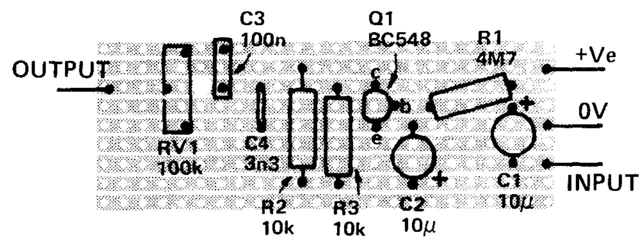



*Fig. 3 Printed circuit board layout. Full size 50mm x 40mm.*

*Fig. 4 Use this diagram to wire the Veroboard version of the unit.*



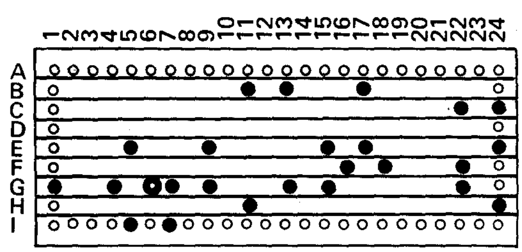
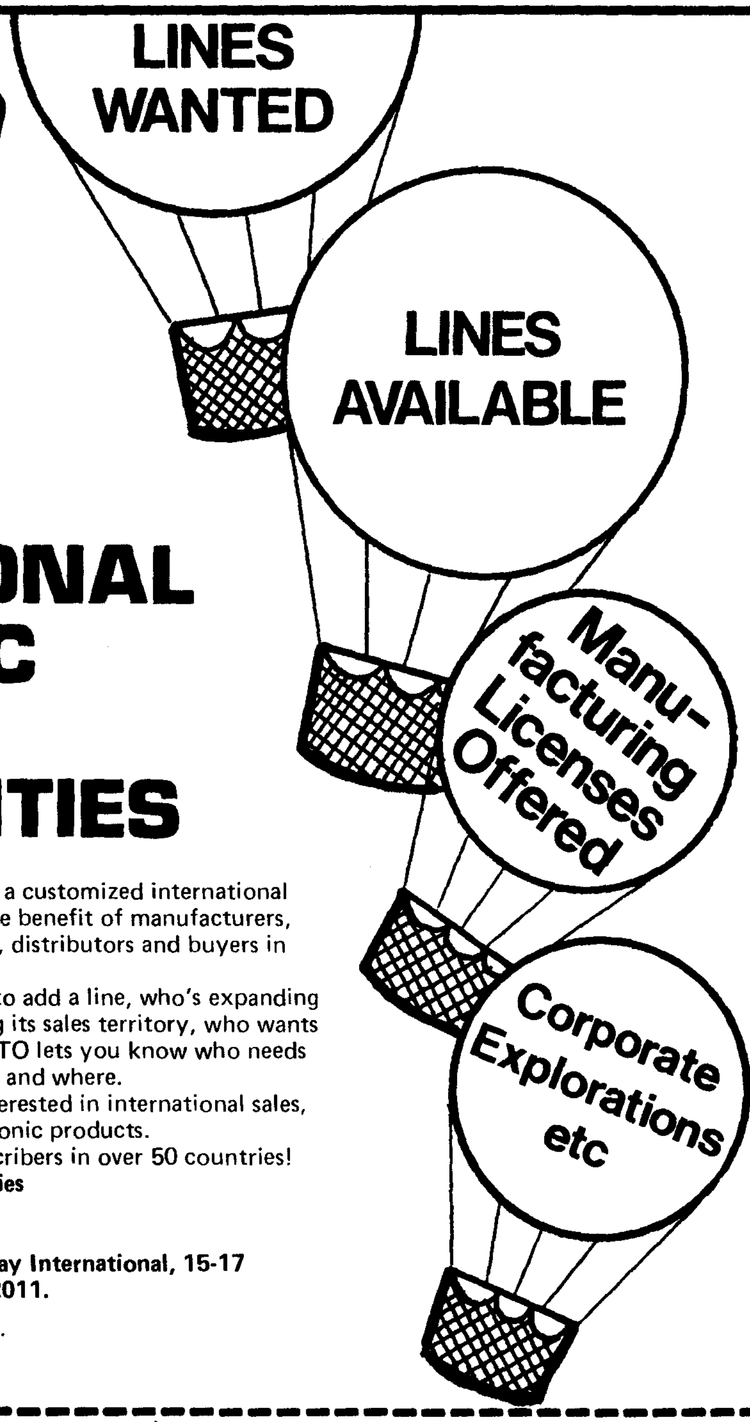




*Fig. 5 Cut the veroboard track in the place indicated by the pad with the hole. The other dots are where soldered connections are made.*

# get 'em off the ground with...




## INTERNATIONAL ELECTRONIC TRADE OPPORTUNITIES

IETO is exactly what the name implies – a customized international industry newsletter aimed specifically for the benefit of manufacturers, exporters, importers, representatives, agents, distributors and buyers in the electronic industry.

IETO lets everybody know who's seeking to add a line, who's expanding a distribution network, what firm is building its sales territory, who wants new products – and on and on. In short, IETO lets you know who needs what, and who needs *who* – and why, when and where.

Our newsletter is designed for anyone interested in international sales, marketing, distributing or licensing of electronic products.

That's why we're already at work for subscribers in over 50 countries!

**International Electronic Trade Opportunities**

**Annual subscription rate, U.S. $65.00.**

Send for sample copies by writing to:

**Elmatex International, c/- Electronics Today International, 15-17 Boundary Street, Rushcutters Bay, N.S.W. 2011.**

Free opportunities listing. Write for details.

---

## COUPON

Please enter my subscription to your "INTERNATIONAL ELECTRONIC TRADE OPPORTUNITIES" monthly newsletter starting with your next newsletter.

1 year US$65 ☐ 2 years US$120 ☐ 3 years US$160 ☐
cheque for US$ . . . . . for the subscription is enclosed
bill me later . . . . . . . . . .
bill my company P.O. No. . . . . . . . . . . . . . . . . . . . . . .
I would like to make the payment in our own currency in the equivalent amount of US$ . . . . . . . . . . . . . . . . . .
Please send instructions.

Date . . . . . . . . . . . . . Sign . . . . . . . . . . . . . . . . . . . . . .

*NAME* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

*ADDRESS* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

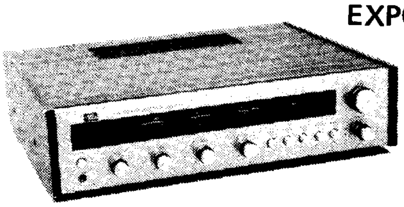
. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

*POSTCODE* . . . . . . . . . *AUSTRALIA* . . . . . . . . . . . . .

**Send to: Elmatex International, c/- Electronics Today International, 15-17 Boundary Street, Rushcutters Bay, N.S.W. 2011.**

# ACE RADIO

136 Victoria Road, Marrickville, NSW 2024 Ph. 51-3845



## EXPO FM/AM/STEREO RECEIVER

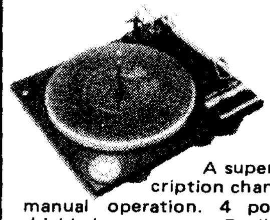
12 + 12 Watts
**$139.00**
p&p NSW $4.50
Interstate $7.50

Top-quality low-cost home entertainment. Illuminated dial, brushed aluminium panel walnut cabinet. 420 x 330 x 100mm high. Model DX 2400. Specs 12 + 12 RMS. freq. response 30-25,000 Hz. Distortion better than 0.8%. Inputs for mag. ceramic tape, aux., bass, treble, loudness controls. FM-88-108 MHz. SEN/2.5 UV.

## STEREO CASSETTE TAPE DECK with Dolby Noise Reduction Circuit

**$175.00** P&P NSW $3.00 Interstate $5.50

Features auto stop, normal or chrome tape selector switch, pause button, 3 digit tape counter, 2 large V-U meters, 2 pairs R/PB sliding volume controls per ch. Din and RCA sockets. Specs. 4 track, 2 ch. o freq. response, 40-12,000 Hz o S/N 45 dB o wow and flutter, 0.15% o cross talk 35 dB o tape speed, 1 7/8 IPS o Input SEN. Line in 30MV (100K) o MIC. 0.5MV (10K) o DIN 6MV (30K). o Output SEN. Line/Din 0.58V.



## GARRARD MODEL 82

**$57.00**
P&P NSW $2.50
Interstate $3.50

A superb 3 speed transcription changer/player auto/manual operation. 4 pole magnetically shielded syn. motor. Resiliently mounted. Counterbalanced. Elegant tone arm with slide-in cartridge carrier calibrated. Anti-skate, 265mm (10½"). Aluminium platter. Cue and pause control. Cartridge tilting lever. Magnetic cartridge diamond stylus. Sixe 375 x 335 x 170 mm (14¾" x 13¼" x 6¼ ) 4.5kg (10lbs).

## GARRARD CHANGER/PLAYERS

Model 6400 3 speed auto manual changer/player. 2 spindles. Motor 2 pole 240V 50Hz 10½" turntable cue and pause, tubular section pick up arm, Sonatone cartridge.

**Great value $28.50**

P&P NSW $3.60. Q, V, SA $4.75 T. $5.50. WA. $6.75.

## BSR STEREO PLAYER

Model P-128. Latest design speed auto or manual operation. 11 in. heavyweight die-cast turntable driven by fully shielded e pole dynamically balanced 240V motor. Noise suppressor. Silicone damped cueing device. Square section brushed aluminium pick-up arm. Adjustable counter-balance. Calibrated stylus pressure control. Anti-skate bias compensator fitted with magnetic cartridge diamond stylus.

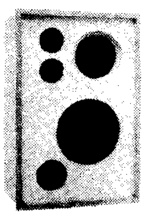
**$64.00**
P&P NSW $1.85
Q, V, SA, T, $3.50 WA $5.50

## BASE & PERSPEX COVER

**$28.50**
P&P NSW $2.50
Interstate $3.90

Base only $14.50
Cover only $14.90

Centre board pre-cut to suit BSR or Garrard Turntables. Blanks also available. The cover is fully moulded, smokey tint and the pyne-board base either teak or walnut veneer. Max. size 18¼" x 15½" x 7½".



## MAGNAVOX MV-50

CABINET KIT
**$69.00**
per pair
+ freight

The top and bottom, both sides and back, are factory assembled — there is little else left to do other than staining or oiling. The innerbond, speaker grille cloth material and vent tube is included. Cabinet wt. 30 lbs.

## MAGNAVOX MV-50 SPEAKER KIT

10-40, 6-25, 2x XJ3, 1 crossover system.

**$71.00**

P&P NSW $3.00 V,Q,SA,T. $3.95 WA $5.40

*Individual MV-50 components are available.*

| | | | |
|---|---|---|---|
| 10-40 | $22.75 | P&P | $2.50 |
| 6-25 | $15.20 | P&P | $2.00 |
| XJ3 | $ 7.50 | P&P | $1.40 |
| Cross-over | $19.40 | P&P | $1.00 |

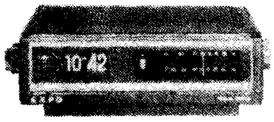
## MAGNAVOX TWIN CONE HI-FI SPEAKERS

Very latest models, 90 day full guarantee
8 or 15 ohms

| | | | | |
|---|---|---|---|---|
| 6WR | 30-16000 Hz | 12 WRMS | $9.90 |
| 8WR | 30-16000 Hz | 16 WRMS | $10.75 |
| 10WR | 30-16000 Hz | 16 WRMS | $13.00 |
| 12WR | 30-16000 Hz | 16WRMS | $14.45 |

P&P NSW $1.00
Interstate $1.75

## EXPO AM/FM CLOCK RADIO WITH ALARM

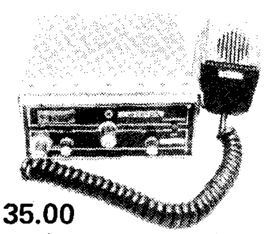


**$33.95**
P&P NSW $1.50
Interstate $3.00

Wake up to either music or buzzer. Specs: 10 transistors, 7 diodes, freq. AM 540-1600 KHz FM 88-108 MHz. Output 400 MW 3" 8 ohm speaker 240V AC 50 Hz.

## WESTON 5 WATT C-B TRANSCEIVER

Great boat or mobile rig. Auto noise limiter, squelch, A.G.C. over-mod. limiter. Low pass filter for bandwidth. Specs. T-mitter. Crystal locked, 5 watts input to RF stage. Freq. coverage, any 11 channels in 27 MHz band. Receiver, crystal locked, double superhet. 6.5 MC and 455 Kc 1 fs 3" speaker, dynamic mic. 50 ohm antenna. 20 t'sistors 8 diodes. 12 VDC operation. Sensitivity, 0.5 UV 10 dB S6n. Size 6½" x 2½" x 7¾". Wt. 4½ lbs.



**$135.00**
P&P NSW $4.50 Interstate $5.50

## WORLD FAMOUS GOODMANS LOUDSPEAKERS

| Model | Imp. | freq. Hz | Fund. Res. Hz | Power | Dia. | Price |
|---|---|---|---|---|---|---|
| AX10M8 | 8 or 15 | 40–18,000 | 35 | 15W | 205mm | $29.50 |
| AX10M 10/11 | 8 or 15 | 65–16,000 | 60 | 40 | 266 | $30.00 |
| AX10M 402 | 8 or 15 | 40–11,000 | 30 | 60 | 311 | $67.50 |
| AUD10M 200 | 8 or 15 | 30–3000 | 24 | 60 | 313x264 | $49.00 |
| AXENT 100 | 8 | 2KHz-22KHz | Dome Tweeter | 40 | 112 | $25.00 |
| HI FAX 750P | 8 or 15 | 1.4Hz-12KHz | Mid Range Horn | 50 | 158x81x242 | $55.00 |
| AUD10M 12P | 8 or 15 | 20–2000 | 85 | 50 | 311 | $45.00 |
| AUD10M 15P | 8 or 15 | 20–2000 | 56 | 50 | 383 | $66.00 |
| AUD10M 18P | 8 or 15 | 20–3000 | 45 | 100 | 459 | 149.00; |

## SANYO NI-CAD

Rechargeable Batteries

Type A $1.85 ea
4 for $ 6.90
Type C $3.20 ea.
4 for $11.60
Type D $3.65 ea.
2 for $ 6.80

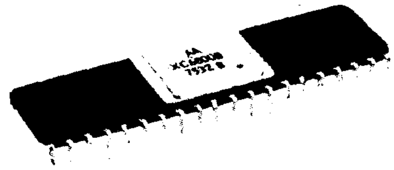
P&P NSW $1.00
Interstate $1.75

## 9 BAND PORTABLE RADIO

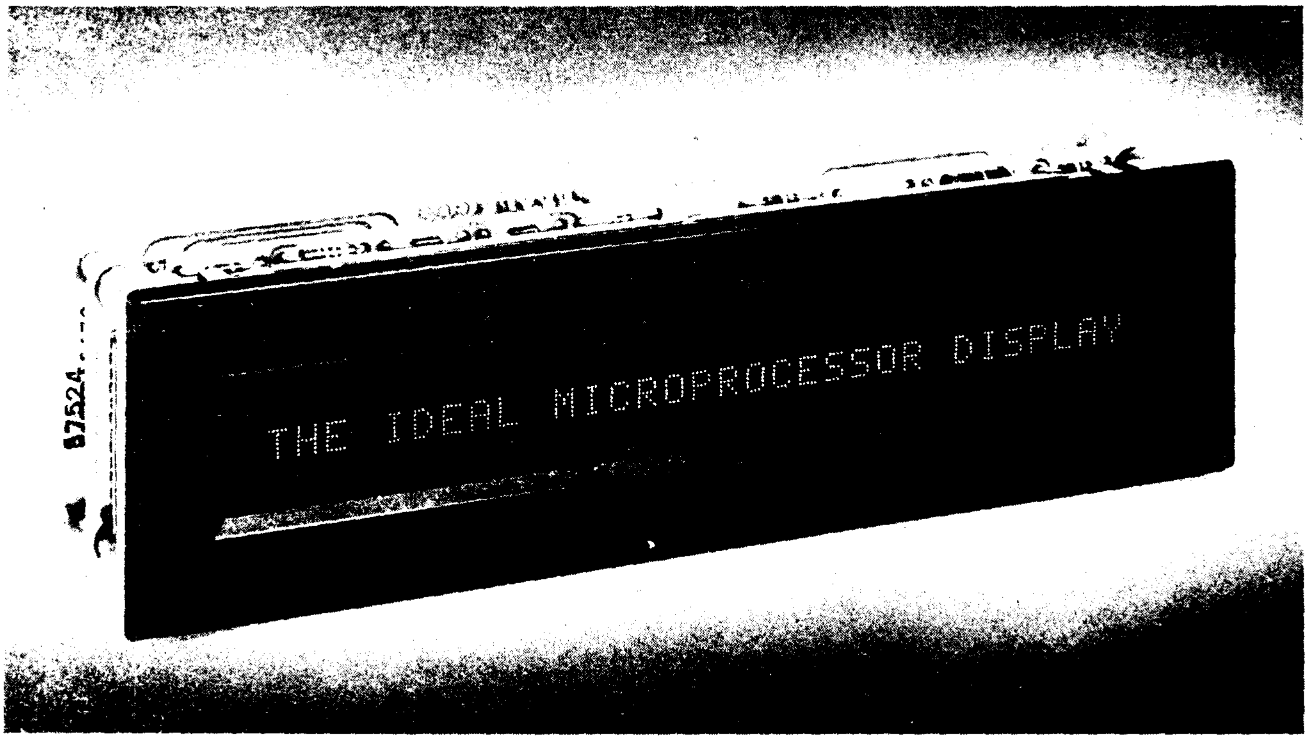
Battery — 240V AC
Solid State

Special Features Push button band selector. Sliding volume, tone, squelch controls. Time zone dial. World map. 2 telescopic antennas. Twin speaker. Fine Tuning Band 1: 535-1600KHz. 2: Marine 1.5-4MHz. 3: SW1 HAM 4-6MHz. 4. SW2 6-12MHz. 5. Police 30-50 MHz. 6: FM 88-108MHz. 7: VHF Aircraft 108-145MHz. 8: VHF2 Police 145-174MHz. 9: Weather 16 2.5MHz.

**SUPER SPECIAL**
**$52.95**
P&P NSW $1.50
Interstate $3.00



# Your microprocessor, our displays...




Your microprocessor-based system should have an alphanumeric readout device. In addition to the ability of your product to present alphanumeric information, such displays are extremely useful for debugging and for data recall during programming.

Burroughs' SELF-SCAN® panels readily interface to the I/O devices of the popular microprocessors, including the MC 6800, Intel's 8080 and 4040 series, National's IMP, and many others. An "off-the-shelf," inexpensive, dc-dc converter uses your system's low voltage (+5 or +12V) to supply the display. Your software programming effort to control the display represents a small portion of the overall program development.

It's that simple to get a bright, easy-to-see alphanumeric readout. SELF-SCAN panels feature neon-orange 5 x 7 dot matrix characters free of glare, distortion, flicker and fuzziness. Panels are available with 16, 20, 32, 80, and 256 characters, with or without memory.

**You can see the difference**

**Burroughs**

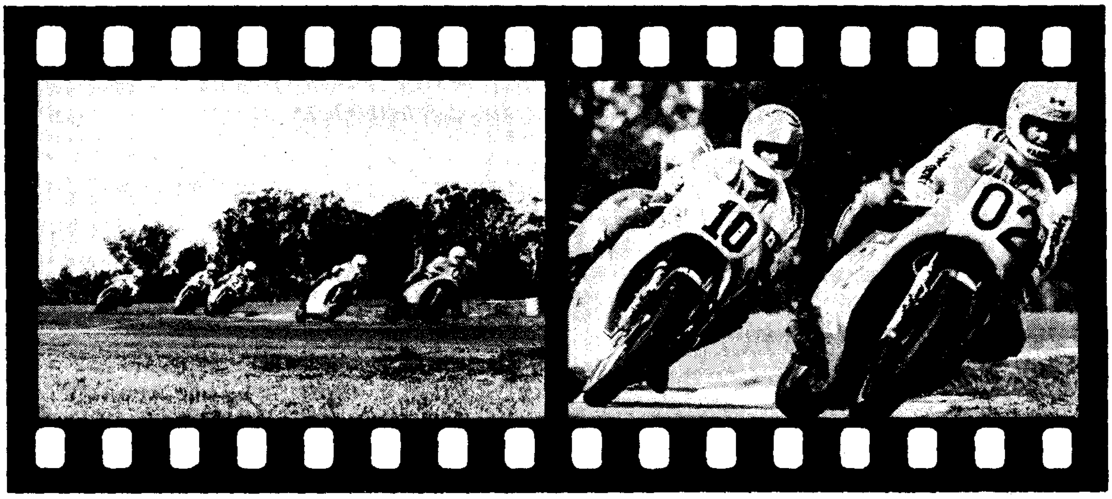
CEMA

**CEMA DISTRIBUTORS PTY LTD**

21 Chandos Street, St Leonards,
SYDNEY, NSW 2065. PH. 439 4655

208 Whitehorse Road, Blackburn,
MELBOURNE, VIC 3130. PH. 877 5311

# In just a twist of the wrist, one Tamron lens zooms from here....to here.



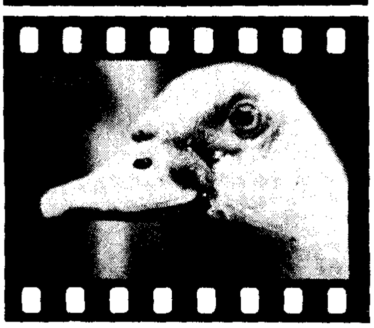

(Tamron 70-350 zoom)

The incredible range of Tamron zoom lenses covers almost every conceiveable focal length between 38mm and 500mm. In seven incredible zoom lenses. They have precision optics, and Teflon-coated zooming mechanisms for longer life and smoother action.

FROM HERE

TO HERE

TO HERE



(Tamron 38-100 zoom with close-focusing)

FROM HERE

TO HERE

(Tamron 200-500 zoom)

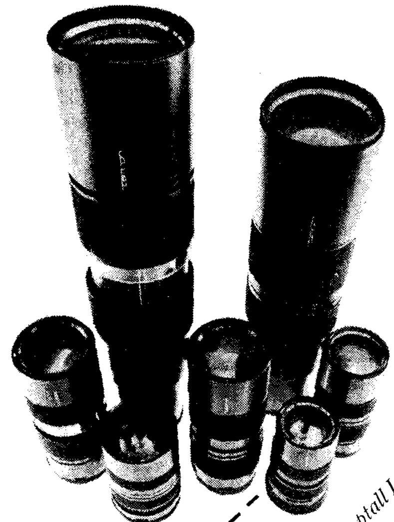
There's a Tamron zoom lens for every application. A wide angle to telephoto with close-focusing capacity; a compact medium telephoto zoom; a compact longer telephoto zoom; two fast medium-weight telephoto zooms; and extreme telephoto zoom; and the incredible Tamron 70-350 zoom with an unbelievable five times magnification! Just imagine that at a sporting event.

**tamron**

**from here to infinity**

As well as zooms, there's a superb range of Tamron fixed focal length lenses. A 28mm wide angle, 105mm portrait lens, and 135mm, 200mm and 300mm telephotos. All of them would do justice to any camera system.

All Tamron lenses have Adaptall mounts, which means the same lens can be used on almost all 35mm cameras.



Distributed by Watson Victor Limited,
95-99 Epping Road, North Ryde, 2113.
Please send me your colour brochure on Tamron Adaptall Lenses.

Name ..........................................

Address ..........................................

..........................................

Postcode ..........................................

WV.164.A.

# Is that you?

## -a computer that checks signatures

A growing need to check people's identity automatically has led to the development of a computer that verifies signatures by the speed and sequence of pen movements as well as by the finished sample – this report by R. S. Watson & P. J. Pobgee of Britain's National Physical Laboratory.

MODERN TECHNOLOGY HAS, ironically, increased the opportunities for crime and its rewards. Easier and more widespread facilities for getting goods on credit and the introduction of electronic fund trasfer systems have made it possible to make money directly by fraud.

Nowadays, too, there are many places where people cannot be allowed to enter unless they are authorised. They may house stocks of valuable or dangerous material or stores of confidential information, often in the form of computer records. Providing guards to check people's identity costs a lot of money – there is a need for some automatic system of checking that people are who they are supposed to be.

There are two ways of tackling the problem. First is the method of providing tokens such as credit cards or pass cards or even secret codes. But tokens can be lost or stolen or lent to other people. The second method is to make use of some human property such as fingerprints, body weight, or other physical dimension. Unfortunately, people often object to such things being used and, in any case, measurement can be expensive to automate. Together with voice 'prints' these visible attributes can still be imitated, another drawback.

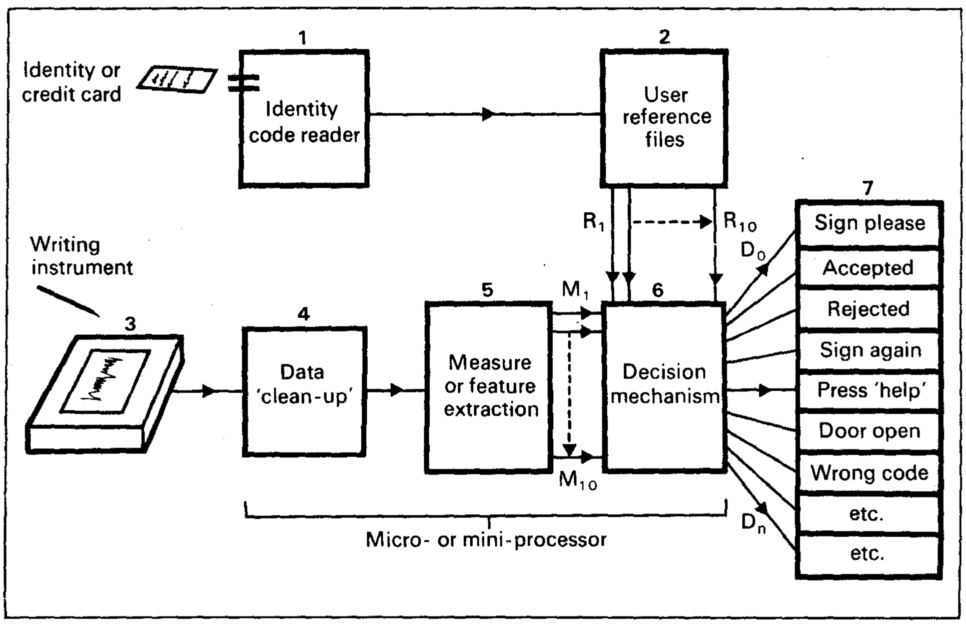



*Fig. 1. Basic signature validation machine. The numbers are referred to in the text.*

### PEN MOVEMENTS

Signing is the traditional method for authorising documents, and signatures represent a well practised human behaviour pattern. Although the visible mark can be easily copied or traced, the *way* in which it is written is also characteristic of the writer. This means that additional information can be obtained by measuring the *speed* and *sequence* with which the pen is moved across the paper.

It follows that, in any automatic system for recognising signatures as they are written, the first requirement is for an economic way of obtaining this hidden information without upsetting the writer's natural rhythm. This was obtained by inventing a simple electronic notepad that produced a sequence of electrical signals corresponding to the signing action without being connected to the writer's pen. This pad has been further developed commercially and is marketed by Quest Automation as a data entry device under the name Datapad.

The second stage was the study of a great number of signatures to choose a method of measurement that could ignore minor variations between samples from the same writer, while preserving his distinguishing features. Over 10 000 signatures were collected from more than 500 writers from all walks of life. When we examined these with a view to isolating the variables, four rather obvious factors emerged. These were name, style, context and noise.

The *name* forms the basic structure. It may be short, such as B. Nye or long, with 30 letters or more – Sir Frederick

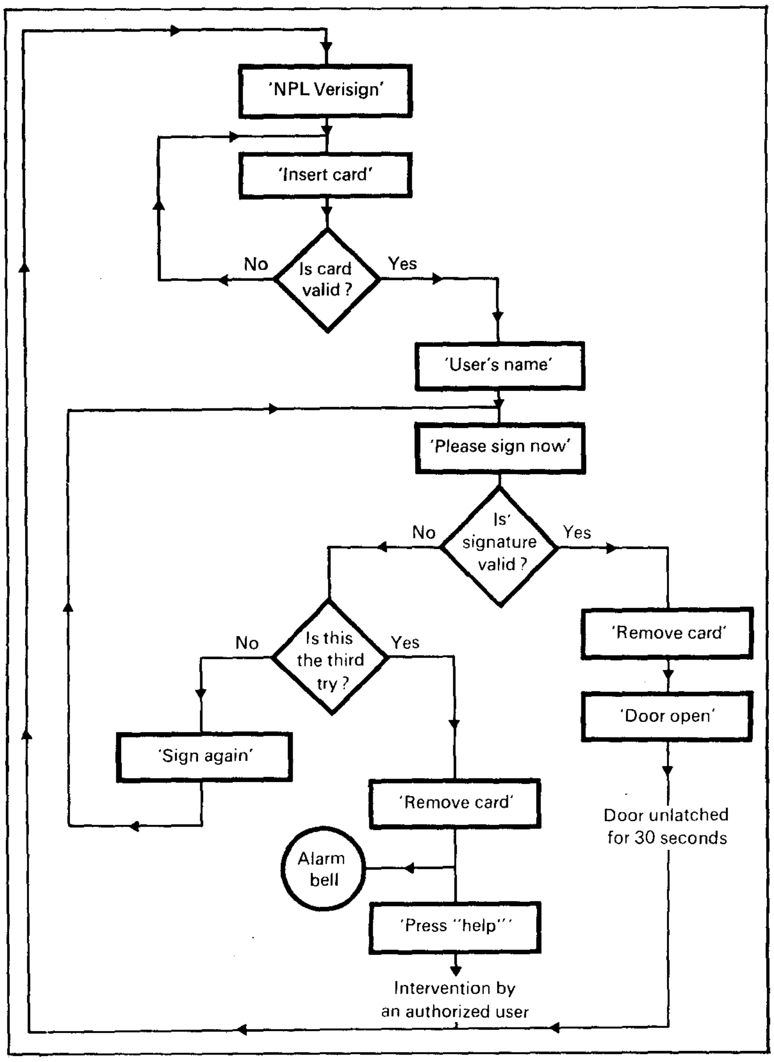



*Fig. 2. Simplified flow chart of operation.*

Marmaduke Bertwhistle. The name may be written in different languages, or scripts such as Roman, Russian, Arabic, Japanese, Hebrew or for that matter any well practised group of symbols. In some cases a person's initial are acceptable.

By *style* we mean the variations about the name form. Many people have a repertoire of styles which they use on various occasions. A number of common examples which we met were a 'working or everyday use'style, a 'cheque book' style and what might be called an 'impress the boss' style.

*Context* is the modification to a given style caused by what the individual is doing at the time. The rhythmic properties of a person's signature can vary according to his attitude to the transaction. The signing of an important document will affect the way he writes more than a trivial event such as the receipt of articles worth a few cents.

All the other influences that may affect the signing behaviour we have called the *noise* factor. The weather may be included in this category and a number of signatures were collected from people arriving at the laboratory in midwinter. Other samples were obtained from people in various states of health. In one case drugs were being taken to alleviate the symptoms of a nervous condition. Then there is the 'after business lunch effect' which can influence the signing rhythms!

Our large data bank of signatures was supported by other experiences of interaction between man and machine. This enabled a team led by Dr J. Parks of NPL to develop powerful techniques to overcome many of the difficulties.

Peter Hawkes of the UK's National Research Development Corporation and Stephen Dennis of Inter-Bank Research Organisation had been following progress with interest, and a joint venture was formed between NRDC, INRO and NPL to construct a prototype machine for VERIfication of SIGNatures (VERISIGN).

Diagram 1 illustrates the basic building blocks of the Verisign machine. A user first enters his personal identity code either through keyboard or badge reader(1). The code, which in our case is a four digit number, is used to extract the user's reference file (2) containing a set of 10 reference parameters (R1-R10). These are passed to the decision mechanism (6) and a request flashed to the output display (7) for the person to sign his name on the Datapad (3).

The Datapad has an electro-sensitive surface on which movements of the writing stylus are converted into a 'string' of interleaved x, y co-ordinates showing how far across and up or down particular points are. This 'data string' is then processed (4), to remove artifacts such as marks made accidentally by the user.

Analysis of the 'cleaned up' data occurs at (5) in which measurements are made on certain properties which characterise the signing pattern. Examples of possible measurements are the number of crossings made by the x or y co-ordinates over a datum line or the total time spent in writing. Many other functions of position and time may be chosen.

The properties or parameters can be selected 'locally', that is within certain areas, or 'globally', with the measurements taken over the whole signature.

Over 100 measures were tested for their ability to discriminate between writers, while remaining insensitive to each person's own variation. From these, ten measures were selected and used to generate the values M1-M10 which are passed to the decision mechanism (6). Here a comparison is made with those obtained from the claimed reference set (R1-R10). The degree of similarity or closeness of fit in relation to a set threshold value determines once of a number of decision (D1-Dn). A close fit, that is below the threshold value, is accepted. A poor fit causes the signature to be rejected and displays a request for further samples.

A hierarchy of decision procedures is used allowing 'context' factors such as customer importance or the value of the transaction to be incorporated. The

# Is that you?

## - a computer that checks signatures

decision mechanism can be easily organised in a number of different ways to suit individual requirements.

Establishing a set of measures to use as a reference for one person is a vital part of the smooth functioning of the machine. Security against impersonation, without the rejection of genuine attempts, will depend on how well the reference measures characterise the writer.

Anyone who will be using the machine is first asked to submit five specimen signatures. The spread of this group is then examined by the machine for any gross inconsistencies. Signatures that lie outside a given tolerance band are rejected and further samples requested to make up the number. The variation in the reference group (variability factor, VF) provides a useful means of assessing what the chances are for successful impersonation by unauthorised users. The lower this factor the higher the security and, of course, the reverse is true.

Knowledge of the degree of security is unknown to either the user or impersonator and in any case the rating value together with the reference list is updated each time a test signature is accepted. This updating mechanism can also keep track of long-term variation in the way a person writes his signature.

The basic flow chart of the Verisign machine is shown in diagram 2. Three attempts at writing a signature are permitted before some form of alert is given.

The computer program, apart from a few modules, is written in standard Fortran IV language and occupies about 12 000 words of core store. Twenty words are required for each person's reference parameters plus an extra 10 for performance logging.

We used a 16K mini-computer which provided reference file space for up to 120 people. The time to verify a signature was less than 100 milliseconds. This meant that a complete transaction, including the entry of a personal identity code, could be completed inside 20 seconds.

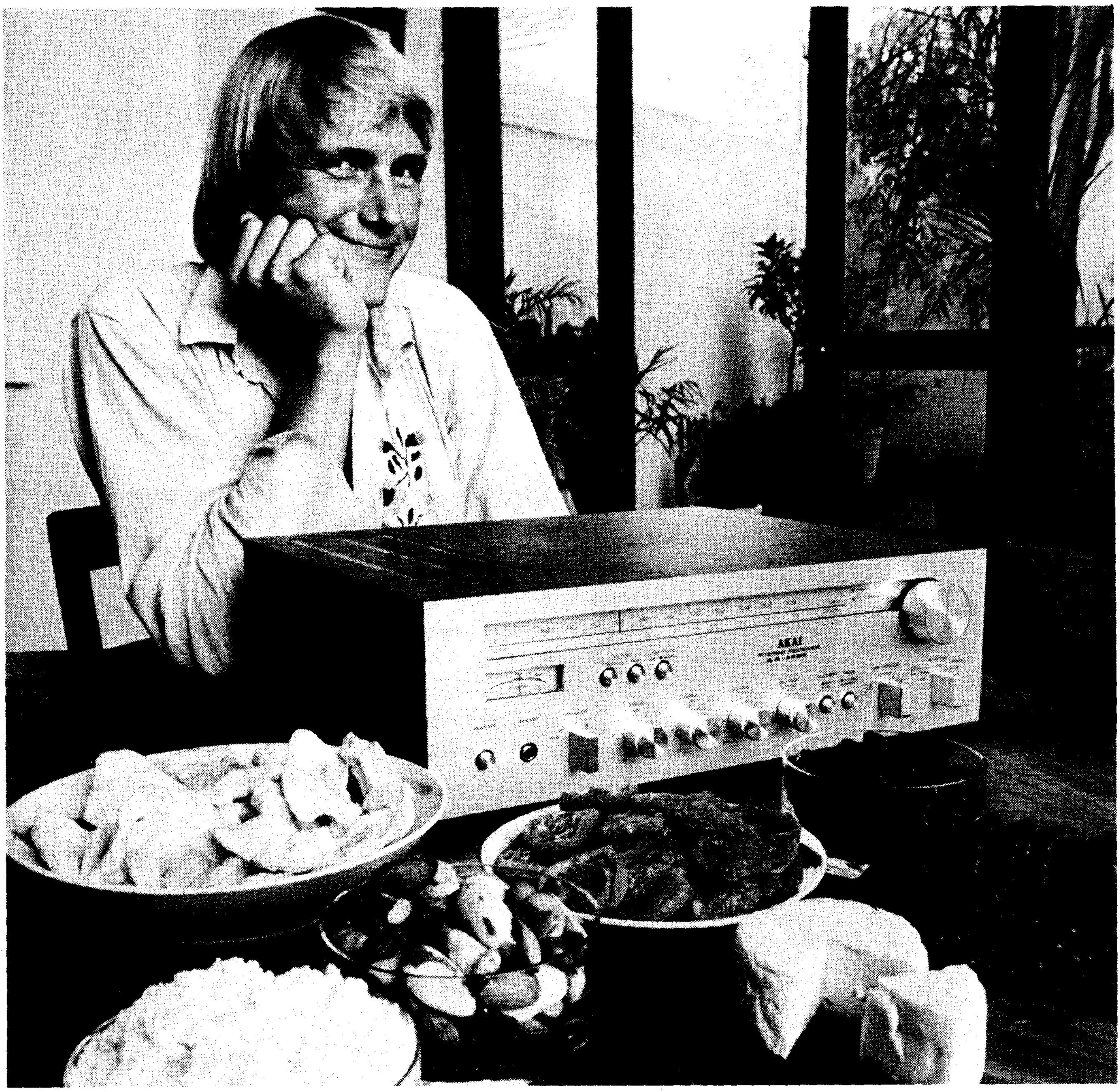
### TESTS

The system was tested in various situations including remote operation over public telephone lines. In addition, two full-scale experiments were carried out. For the first, in the entrance hall at our laboratory, the participants identified themselves as they entered and left the building. The 71 people who took part included typists, security officers, members of the services, professional engineers and scientists. Out of 2000 attempts made at identification by singing, 96 per cent were successful.

The second experiment controlled entry to the computer room of a different government establishment. Here, the 47 passholders, often carrying equipment or trays of cards, used the Verisign terminal over a period of several weeks. The results of this experiment were similar to the first.

It is, of course, one thing to ensure that the genuine person is identified correctly with the minimum fuss or bother. It is another to prevent the less scrupulous their practising art! With this in mind, at the end of both experiments we displayed a number of target signatures and invited everyone to try his hand at copying them. With the first experiment at NPL, although one or two came very close, no-one was able to obtain a 'signature valid' signal. A lower threshold was used for the second experiment and the decision scores were displayed as an incentive. No limit was placed on the number of attempts, allowed and under these less rigorous, unrealistic conditions a few people were eventually successful.

No security system is perfect but the hierarchy of this one allows the degree of security to be balanced against the possibility of rejecting an authorised user. ●




# Does your system hunger for one?

Hi fi systems also need the right kind of nourishment. One of the most effective ways of providing it is featured above: the AKAI AA-1020 AM/FM Tuner Amplifier.

It puts out 20 effortless watts RMS per channel (both channels driven, from 20 to 20,000 hz, no more than 0.4% THD into 8 ohms load). It comes with the kind of facilities that produce the best kind of sound. And at $340†, the price isn't likely to turn you off.

But maybe your system hungers for a lot more power, in which case you should see our more powerful models.

Of course, like all AKAI hi fi equipment distributed by AKAI Australia, it comes with our Complete Protection Plan*. Which simply means 12 months full parts and labour warranty on all Tape Equipment, 2 years full parts and labour warranty on all Amplifiers, Turntables and Speakers and a lifetime warranty on all GX Tape Heads.

So, if your amplifier isn't all it should be, see your AKAI dealer. He'll put your mind at ease.

The AKAI Hi-Fi Professionals are: **NEW SOUTH WALES — SYDNEY CITY AND METROPOLITAN. Sydney:** Douglas Hi-Fi, 338 George Street; Duty Free Travellers Supplies, 400 Kent Street; European Electronics, 187 Clarence Street; Instrol Hi Fi, Cnr. Pitt & King Streets; Magnetic Sound Industries, 32 York Street; Jack Stein Audio, 275 Clarence Street. **Bankstown:** Selsound Hi Fi, Cnr. North Terrace & Apian Way. **Burwood:** Electronic Enterprises, 11 Burwood Road; Edge Electrix, 31 Burwood Road. **Concord:** Sonarta Music Services, 24 Cabarita Road. **Cremorne:** Photo Art & Sound, 287 Military Road. **Crows Nest:** Allied Hi Fi, 330 Pacific Highway. **Hurstville:** Hi Fi House, 127 Forest Road. **Liverpool:** Miranda Stereo & Hi Fi Centre, 166 Macquarie Street. **Miranda Fair:** Miranda Hi Fi & Stereo Centre, Shop 67, Top Level. **Mona Vale:** Warringah Hi Fi, Shop 5, Mona Vale Court. **Parramatta:** Gramophone Shop, Shop 151, Westfield Shoppingtown; Selsound Hi Fi, 27 Darcey Street. **Roselands:** Roselands Hi Fi, Gallery Level. **South Hurstville:** Selsound Hi Fi, 803 King George's Road. **Summer Hill:** Fidela Sound Centre, 93B Liverpool Street. **Sutherland:** Sutherland Hi Fi, 5 Boyle Street. **Waitara:** Hornsby Hi Fi, 71 Pacific Highway. **Westleigh:** Sound Incorporated, 16 Westleigh Shopping Centre. **NEW SOUTH WALES COUNTRY. Albury:** Haberecht's Radio & TV, 610 Dean Street. **Bega:** Easdowns, 187-191 Carp Street. **Bowral:** Fred Hayes, 293 Bong Bong Street. **Broken Hill:** Pee Jay Sound Centre, 364 Argent Street. **Gosford:** Gosford Hi Fi, 163 Mann Street; Miranda Stereo & Hi Fi Centre, Cnr. Donnison & Baker Streets. **Moss Vale:** Bourne's Merchandising, 1 White Street. **Newcastle:** Ron Chapman Hi Fi, 880 Hunter Street; Eastern Hi Fi, 519 Hunter Street. **Nowra:** Nowra Hi Fi, Shoalhaven Arcade. **Taree:** Taree Photographics, Graphic House, 105 Victoria Street. **Wagga Wagga:** Haberecht's Radio & TV, 128 Baylis Street. **Wollongong:** Hi Fi House, 268 Keira Street; Selsound Hi Fi, 2-6 Crown Lane. **A.C.T. Civic:** Allied Hi Fi, 122 Bunda Street. **Fyshwick:** Allied Hi Fi, 3 Paragon Mall, Gladstone Street. **QUEENSLAND. Brisbane:** Chandler's, 120 Edward Street; Chandler's, 399 Montague Road, West End; Stereo Supplies, 95 Turbot Street; Tel Air Electronics, 187 George Street. **Nambour:** Custom Sound, Currie Street. **Mt. Isa:** The Sound Centre, West Street. **Rockhampton:** Chandler's, 144 Alma Street. **Southport:** Stokes Electronics, Scarborough Street. **SOUTH AUSTRALIA. Adelaide:** Ernsmiths, 48-50 King William Street; Flinders Trading Co., 55 Flinders Street; J B Electronics, 115 Gouger Street. **Blackwood:** Blackwood Sound Centre, 4 Coromandel Parade. **Glenside:** Steiner Electronics, Conygham Street. **Moana:** Bob Carmen, 185 Commercial Road. **VICTORIA. Melbourne:** Douglas Hi Fi, 191 Bourke Street; **Warrnambool:** A. G. Smith, 159 Liebig Street. **WESTERN AUSTRALIA. Perth:** The Audio Centre, 883 Wellington Street. **Calista:** Hub Hi Fi, Kwinana Hub, *Gilmore Avenue*. **East Victoria Park:** Japan Hi Fi, 889 Albany Highway. **Nedlands:** Audio Distributors, Broadway Shopping Centre, Broadway. **Midland:** Midland Audio, 16B Great Northern Highway. **Mosman Park:** Audio Distributors, 14 Glyde Street. **W.A. COUNTRY. Bunbury:** Aabel Music, 130 Victoria Street. **Kalgoorlie:** Hambley's Hi Fi, Shop 13, Central Arcade, Hannan Street. **TASMANIA. Burnie:** James Loughran & Sons, 29-31 Wilmot Street. **Hobart:** Quantum Electronics, 181 Collins Street. **Launceston:** Wills & Co., 7 Quadrant. **NORTHERN TERRITORY. Darwin:** Pfitzners Music House, Smith Street.

**AKAI**

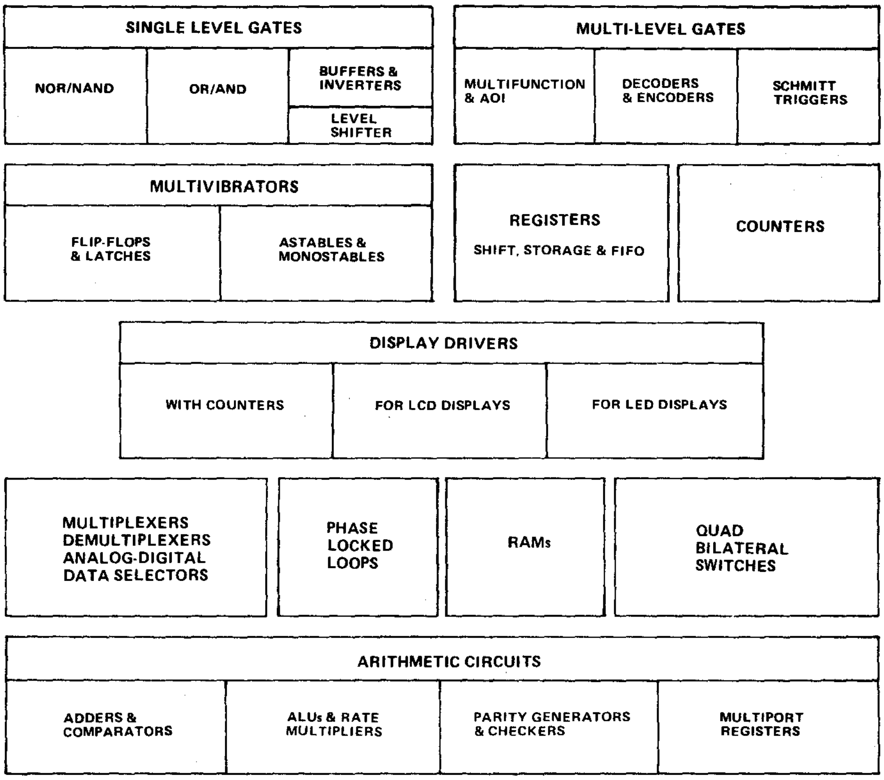
**The name you don't have to justify to your friends.**

*The Complete Protection Plan does not cover equipment purchased outside Australia. †Recommended retail price only.

70613R

# ETI data sheet

# CMOS




*The headings we used to classify the CMOS devices. The lists starts on page 80.*

## TTL to CMOS. Functionally Equivalent Types

| TTL | CMOS | | TTL | CMOS | | TTL | CMOS | |
|---|---|---|---|---|---|---|---|---|
| 7400 | 4011 | | 7475 | 4042 | | 74150 | 4067 | |
| 7401 | 40107 | | 7476 | 4027 | | 74151 | 4051 | 4097 |
| 7402 | 4001 | | 7477 | 4042 | | 74152 | 4051 | 4097 |
| 7404 | 4009 | 4049 | 7478 | 4027 | | 74153 | 4052 | |
| 7406 | 4009 | 4049 | 7483 | 4008 | | 74154 | 4514 | 4515 |
| 7407 | 4010 | 4050 | 7485 | 4063 | | 74155 | 4555 | 4556 |
| 7408 | 4081 | | 7486 | 4030 | 4070 | 74156 | 4555 | 4556 |
| 7410 | 4023 | | 7490 | 4518 | | 74157 | 4019 | |
| 7411 | 4073 | | 7491 | 4015 | 4094 | 74164 | 4015 | |
| 7420 | 4012 | | 7493 | 4520 | | 74165 | 4021 | |
| 7425 | 4002 | | 7494 | 4035 | | 74166 | 4014 | |
| 7427 | 4025 | | 7495 | 40104 | 40194 | 74167 | 4527 | |
| 7428 | 4001 | | 7499 | 40104 | 40194 | 74173 | 4076 | |
| 7430 | 4068 | | 74100 | 4034 | | 74178 | 4035 | |
| 7432 | 4071 | | 74104 | 4095 | | 74179 | 4035 | |
| 7437 | 4011 | | 74105 | 4095 | | 74180 | 40101 | |
| 7440 | 4012 | | 74107 | 4027 | | 74181 | 40181 | |
| 7442 | 4028 | | 74110 | 4095 | | 74182 | 40182 | |
| 7445 | 4028 | | 74111 | 4027 | | 74190 | 4510 | |
| 7446 | 4511 | 4055 | 74121 | 4047 | 4098 | 74191 | 4516 | |
| 7447 | 4511 | 4055 | 74122 | 4047 | 4098 | 74194 | 40104 | 40194 |
| 7448 | 4511 | 4055 | 74123 | 4098 | | 74195 | 4035 | |
| 7449 | 4511 | 4055 | 74125 | 4502 | | 74198 | 4034 | |
| 7450 | 4085 | | 74126 | 4502 | | 74200 | 4061 | |
| 7453 | 4086 | | 74132 | 4093 | | 74251 | 4051 | 4097 |
| 7454 | 4086 | | 74136 | 4030 | 4070 | 74279 | 4044 | |
| 7470 | 4096 | | 74141 | 4028 | | 74283 | 4008 | |
| 7472 | 4095 | | 74145 | 4028 | | 74290 | 4518 | |
| 7473 | 4027 | | 74148 | 4532 | | 74293 | 4520 | |
| 7474 | 4013 | | | | | | | |

# ETI data sheet

# CMOS

This is a list of commonly-available CMOS in the 4000 and 74C00 series (plus one or two other similar types). Refer to the plan on page 79 to see the headings we have used to classify the devices.

When you see a blob in front of a number this means that the device is available in LOCMOS. LOCMOS ICs are functionally identical to other CMOS but the outputs are buffered. This means that they cannot be operated in the linear mode (as amplifiers, etc). CMOS from Solid-State Scientific is also buffered.

## SINGLE LEVEL GATES

### NOR/NAND

●4000 Dual 3-Input NOR Gate Plus Inverter
●4001 Quad 2 Input NOR Gate
●4002 Dual 4 Input NOR Gate
●4011 Quad 2 Input NAND Gate
●4012 Dual 4 Input NAND Gate
●4023 Triple 3 Input NAND Gate
●4025 Triple 3 Input NOR Gate
●4068 8-Input NAND Gate
●4078 8-Input NOR Gate
40107 Dual 2-Input NAND Buffer Driver
74C00 Quad 2-Input NAND Gate
74C02 Quad 2-Input NOR Gate
74C10 Triple 3-Input NAND Gate
74C20 Dual 4-Input NAND Gate
74C30 8-Input NAND Gate

### OR/AND

●4071 Quad 2 Input OR Gate
●4072 Dual 4 Input OR Gate
●4073 Triple 3-Input AND Gate
●4075 Triple 3 Input OR Gate
●4081 Quad 2 Input AND Gate
●4082 Dual 4-Input AND Gate
74C08 Quad 2-Input AND Gate
74C32 Quad 2-Input OR Gate

### BUFFERS & INVERTERS

●4007 Dual Complementary Pair Plus Inverter
4009 Hex Inverting Buffer
4010 Hex Buffer
●4041 Quad True Complement Buffer
●4049 Hex Inverting Buffer
●4050 Hex Buffer
●4069 Hex Inverter
●4502 Strobed Hex Inverter Buffer
4503 Hex Bus Driver
●40097 3-S Hex Non-Inverting Buffer
●40098 3-S Hex Inverting Buffer
40107 Dual 2-Input NAND Buffer Driver
74C04 Hex Inverter
74C901 Hex Inverting Buffer (TTL Interface)
74C902 Hex Buffer (TTL Interface)
74C903 Hex Inverting Buffer (MOS Interface)
74C904 Hex Buffer (MOS Interface)
74C906 Open Drain Buffer (Active Pull-down)
74C907 Open Drain Buffer (Active Pull-down)
74C908 Dual 30V Buffer
80C95 TRI-STATE Hex Buffer
80C96 TRI-STATE Hex Inverting Buffer
80C97 TRI-STATE Hex Buffer
80C98 TRI-STATE Hex Inverting Buffer
88C29 Quad Line Driver (Single Ended)
88C30 Dual Line Driver (Twisted Pair)

### LEVEL SHIFTER

40109 Quad Low-to-High Voltage Level Shifter

## MULTI-LEVEL GATES

### MULTIFUNCTION & AOI

●4019 Quad AND/OR Select Gate
●4030 Quad EX OR Gate
4037 Triple AND/OR Bi-Phase Pairs
4048 Expandable 8-Input Gate
●4070 Quad Exclusive OR Gate
●4077 Quad Exclusive NOR Gate
●4085 Dual 2 Wide 2-Input AND/OR INVERT Gate
●4086 Expandable 4-wide 2-Input AOI
4507 Quad EX OR Gate (74C86)
74C86 Quad EX-OR Gate

### DECODERS & ENCODERS

●4028 BCD to Decimal Decoder
●4514 4-Bit Latch/4 to 16 Line Decoder (High)
●4515 4-Bit Latch/4 to 16 Line Decoder (Low)
●4532 8-Input Priority Encoder
●4555 Dual 1-of-4 Decoder/Demultiplexer (Outputs High)
●4556 Dual 1-of-4 Decoder Demultiplexer (Outputs Low)
74C42 BCD-to-Decimal Decoder
74C48 BCD-to-7 Segment Decoder
74C154 4 to 16 Line Decoder
74C915 7-Segment to BCD Decoder
74C922 16 Key Keyboard Encoder
74C923 20 Key Keyboard Encoder

### SCHMITT TRIGGERS

●4093 Quad 2-Input NAND Schmitt Trigger
40106 Hex Schmitt Trigger
4584 Hex Schmitt Trigger (74C14N)
74C14 Hex Schmitt Trigger
74C914 Hex Schmitt Trigger

## MULTIVIBRATORS

### FLIP-FLOPS & LATCHES

●4013 Dual D Flip-Flop
●4027 Dual JK Flip-Flop
●4042 Quad D Latch
●4043 Quad 3 State NOR R/S Latch
●4044 Quad 3 State NAND R/S Latch
●4076 TRI-STATE Quad D Flip-Flop
4095 Gated J-K Non-Inverting Inputs
4096 Gated J-K Inverting and Non-Inverting Inputs
4099 8-Bit Addressable Latch

| | |
|---|---|
| ●40174 | Hex D Flip-Flop |
| ●40175 | Quad D Flip-Flop |
| 4508 | Dual 4-Bit Latch |
| ●4724 | 8-Bit Address Latch |
| 74C73 | Dual JK Flip-Flop |
| 74C74 | Dual D Flip-Flop |
| 74C76 | Dual JK Flip-Flop |
| 74C107 | Dual JK Flip-Flop |
| 74C173 | TRI-STATE Quad D Flip-Flop |
| 74C174 | Hex D Flip-Flop |
| 74C175 | Quad D Flip-Flop |

## ASTABLES & MONOSTABLES

| | |
|---|---|
| ●4047 | Monostable-Astable Multivibrator |
| 4098 | Dual Monostable Multivibrator |
| ●4528 | Dual Retriggerable/Resettable Monostable Multivibrator |
| 74C221 | Dual Monostable Multivibrator |

## REGISTERS

### SHIFT, STORAGE & FIFO

| | |
|---|---|
| ●4006 | 18-Bit S/R |
| ●4014 | 8-Bit S/R |
| ●4015 | Dual 4-Bit S/R |
| ●4021 | 8-Bit S/R |
| ●4031 | 64-Bit S/R |
| 4034 | 8-Bit S/R |
| ●4035 | 4-Bit P-In P-Out S/R |
| 4094 | 8-stage Shift-and-Store Bus Register |
| 40100 | 32-Bit Left/Right S/R |
| 40104 | 3-state 4-Bit Left/Right S/R |
| ●40194 | 4-Bit Left/Right S/R |
| ●40195 | b-Bit Universal S/R |
| ●4076 | TRI-STATE Quad D Flip-Flop |
| 4099 | 8-Bit Addressable Latch |
| 40108 | 4x4 multiport register |
| 40105 | 4-word 4-Bit FIFO Buffer |
| 74C164 | 8-Bit S-In P-Out S/R |
| 74C165 | 8-Bit P-In S-Out S/R |
| 74C195 | 4-Bit Parallel S/R |
| 74C95 | 4-Bit R-S L-S Register |

## COUNTERS

| | |
|---|---|
| ●4017 | Decade Counter Divider |
| ●40108 | Presettable Divide by "N" Counter |
| ●4020 | 14-Bit Ripple Carry Binary Counter/Divider |
| ●4022 | Divide by 8 Counter Divider |
| ●4024 | 7-Bit Binary Counter |
| ●4029 | Presettable Up/Down Counter |
| 4040 | 12-Bit Binary/Ripple Counter |
| 4045 | 21-stage Clock Timer |
| 4059 | Programmable Divide-by N Counter |
| 4060 | 14-Stage Ripple Carry Binary |
| ●4510 | BCD Up/Down Counter |
| ●4516 | Binary Up/Down Counter |
| ●4518 | Dual BCD Up Counter |
| ●4520 | Dual Binary Up Counter |
| 40102 | BCD Presettable 8-Bit down Counter |
| 40103 | Binary presettable 8-Bit down Counter |
| ●40192 | Sync Up/Down Decade Counter |
| ●40193 | Sync Up/Down Binary Counter |
| ●40160 | Sync Decade Counter |
| ●40161 | Sync Binary Counter |
| ●40162 | Fully Sync Decade Counter |
| ●40163 | Fully Sync Binary Counter |
| 74C90 | Decade Counter |
| 74C93 | 4-Bit Binary Counter |
| 74C160 | Sync Decade Counter |
| 74C161 | Sync Binary Counter |
| 74C162 | Fully Sync Decade Counter |
| 74C163 | Fully Sync Binary Counter |
| 74C192 | Sync Up/Down Decade Counter |
| 74C193 | Sync Up/Down Binary Counter |
| 74C925 | 4 Decade Counter Divider |
| 74C926 | 4 Decade Counter Divider with Display Select |
| 74C927 | Minutes and Seconds Counter Driver |
| 74C928 | 2-1/2 Decade Counter Driver |

## DISPLAY DRIVERS

### WITH COUNTERS

| | |
|---|---|
| 4026 | Decade Counter/Divider with Seven-Segment Display outputs and Display Enable. |
| 4033 | Decade Counter/Divider with 7-Segment Display Outputs and Ripple Blanking. |

### FOR LCD DISPLAYS

| | |
|---|---|
| 4054 | 4-Line Liquid Crystal display Driver. |
| 4055 | BCD-to-Seven-Segment Decoder/Driver with 'Display-Frequency' Output, for Liquid Crystal Displays. |

# ETI data sheet

## DISPLAY DRIVERS cont'

4056 BCD-to-Seven-Segment Decoder/Driver with Strobed-Latch function, for Liquid Crystal Displays.

### FOR LED DISPLAYS

●4511 BCD-to-7-Segment Latch/Decoder/Driver

## MULTIPLEXERS/ DEMULTIPLEXERS ANALOG-DIGITAL DATA SELECTORS

●4016 Quad Bilateral Switch
●4019 Quad AND/OR Select Gate
●4051 Single 8 Channel Multiplexer
●4052 Differential 4 Channel Multiplexer
●4053 Triple 2 Channel Multiplexer
●4066 Counter Divider and Oscillator
●4067 16-channel Multiplexer/Demultiplexer
4097 Differential 8-channel Multiplexer/Demultiplexer
●4519 4-Bit AND/OR Selector
●4539 DUAL 4-Input Multiplexer
●4555 Dual 1-of-4 Decoder/Demultiplexer (Outputs High)
●4556 Dual 1-of 4 Decoder/Demultiplexer (Outputs Low)
40257 Quad AND/OR Data Selector with Three-State Outputs
●4512 8-Channel Data Selector
4529 Dual 4-Channel Analog Data Selector
74C150 16 to 1 Multiplexer
74C151 8-Channel Digital Multiplexer
74C157 Quad 2-Input Multiplexer
82C19 TRI-STATE 16 to 1 Multiplexer

## PHASE LOCKED LOOP

●4046 Phase Locked Loop

## RAMs

4039 4-word, 8-bit, direct word-line addressing
4061 256-word by one bit static RAM
4036 4-word, 8-Bit, binary-addressing
40108 4x4 multiport register
●4720 256 x 1 BIT RAM (15V)
●4721 256 x 4 BIT RAM (15V)
74C89 64-Bit RAM
74C200 256-Bit 256 x 1 (RAM)
74C910 256-Bit (74 x 4) RAM
74C920 1 k (256 x 4) RAM
74C921 1 k (256 x 4) Common I/O RAM
74C929 1 k 16-Pin RAM
74C930 1 k 18-Pin RAM

## QUAD BILATERAL SWITCHES

●4016 Quad Bilateral Switch
●4066 Counter Divider and Oscillator

## ARITHMETIC CIRCUITS

### ALUs & RATE MULTIPLIERS

4057 4-Bit ALU
4089 Binary Rate Multiplier
4527 BCD Rate/Multiplier
40181 4-Bit ALU
40182 Look-ahead carry block

### ADDERS & COMPARATORS

●4008 4-Bit Full Adder with Parallel Carry
4032 Triple Serial Adder (+logic)
4038 Triple Serial Adder (—logic)
4063 4-Bit Magnitude Comparator
●4030 Quad EX OR Gate
●4070 Quad Exclusive OR Gate
●4077 Quad Exclusive NOR Gate
74C83 4-Bit Binary Full Adder
74C85 4-Bit Comparator
74C909 Linear Comparator

### PARITY GENERATORS & CHECKERS

40101 9-Bit parity generator and checker

### MULTIPORT REGISTERS

40108 4x4 multiport register

# PRINT-OUT

## ETI's COMPUTER SECTION

CONTENTS



**THIS IS A NEW MONTHLY SECTION FOR ALL COMPUTER ENTHUSIASTS**

This is the first edition of our new computer section so we want lots of feedback telling us what you want in future issues. Please write in if you have any problem, any suggestions, any technical hints . . . or any criticisms!

We re interested in hearing from companies — we want to know about any new developments or products. And if any of you have any interesting projects or software you want published we'd be keen to hear from you too.

We prefer to get typed letters (but we'll accept those written with a thumbnail dipped in tar!).

STARTING THIS MONTH ETI HAS a new section to cater for the increasing number of people involved with microcomputers. By now most readers are aware of the revolution in the electronics industry caused by the availability of microprocessors. Not since the development of the transistor in 1948 has a new product offered such exciting promise (or possibly frustration — if people try to ignore it, as some did with the transistor).

The computers built around microprocessors are already pushing into areas where previous computer technology has been unable to go. One such area is the hobby market. Costing between 100 and 1000 dollars, these machines are finding their way into more and more homes where people have discovered the delights and benefits of computing. While some machines are used just for fun, many are used to enhance another hobby: a more realistic model train system or an automatic ham station.

Another reason to become involved in home computing is to keep abreast of changes occurring in the electronics industry.

### ETI's CONTRIBUTION

Watching the rapid emergence of this new technology it became clear that ETI would have to become involved, eventually, in computing. The question was how we could best contribute to this new field. Obviously a successful magazine gives its readers what they want, so the question became what do the readers want.

After considerable thought it was decided to provide a self-contained section within ETI with the aim of assisting you, the reader, to get the most enjoyment possible out of this new and exciting pastime, or to get the maximum benefit for your company if you are employed in the electronics industry. As time passes, computing will most certainly mature and change, and we intend that *PRINT-OUT* should develop along with it. But we intend to cover all aspects of computing and to give a balanced presentation of any interesting material.

### USING MICROCOMPUTERS

Well then just what do we mean by interesting material? To give you an idea let's look at some general topic headings, but first let me make this point. The really exciting thing about computing is that the hardware is cheap enough and simple enough for you to buy and use yourself. This means your involvement can go much deeper than just reading about it and *wishing* you could do it to. And I think because of the computer's great versatility the excitement means, doing just about anything.

Consider the examples of an electric organ and a train controller. Once built each has only one use: the organ produces music and the controller controls trains. The computer can do both (a clever programmer can even make it do both at the same time). Some extra hardware is required for the interfacing but it is small compared to the amount used in a discrete hardware design. The computer offsets this disadvantage with its ease of program change.

A difficult change in the hardware-designed controller is a relatively simple change to the program in the computer.

### HARDWARE

There will be many readers who want to build their systems from scratch, or at least they'll want to do their own modifications. These are the people who enjoy building things themselves and they realise the advantages of less cost and more experience. Quite often a system purchased already assembled will need some hardware modification to allow for expansion. So we intend to publish articles on the use and misuse of hardware components. Of course you will also be kept up-to-date on the latest hardware releases and how to use them.

### SOFTWARE

After having spent a lot of money and time getting your system into working condition, what happens next? You start feeding it software.

Well, yes, if you have a program. But before you have a program you have to write one, or get one of them from somewhere else. Unfortunately although most of us are born with the potential to be able to write programs we all have to learn how first, and this takes time.

It is generally accepted that writing good programs is an art; this means to get the best out of your system, you need to go beyond just learning the computer's instruction set. To make this happen for you we intend to include in *PRINT-OUT* features on programming as well as practical software hints and ideas.

## EQUIPMENT REVIEWS

Many people prefer to buy their computer systems already assembled, or at least in kit form. By doing this they can save valuable time and reduce the possibility of something going wrong during the construction. Those outside the electronics industry who have little knowledge of electronics might also like to get into computing. Overseas many such enthusiasts are catered for by companies that specialise in hobby systems that need only 10 minutes reading and plugging into a wall socket to get going . . . Thus we see a place in *PRINT-OUT* for reviewing computer products in both assembled and unassembled form. Such reviews take on added emphasis when one considers that for a while to come those buying these systems will be pretty unfamiliar with computers and could make an unsuitable purchase. Already offered on the Australian market are several designs from overseas and we hear on the grapevine that there are to be released a couple of local designs. We are hoping to be able to bring you some interesting and revealing reviews in coming months.

## I/O

Once the computer is going and the program is written, the most important part of the system becomes the interface. Sometimes its limitations will force you to go back and modify the program (sometimes even the hardware). Like a weak link in a chain no matter how fast or how powerful the computer is, without an effective interface the system is severely degraded. Computers are at their best when they do something, and if what you want to do is not explained in the supplied application note, quite likely the interface will become your own little problem. The interface is an important subject that will receive special attention in *PRINT-OUT*.

## CONTRIBUTIONS

The greatest potential (and probably the most interesting aspect) of *PRINT-OUT* will be the exchange of ideas. Ideas on all areas of computing. We hope to make these exchanges a two-way happening, not only from us to you, but from you to us, so we can pass your ideas on to other computer enthusiasts. Often the problem you have just solved has been bugging another enthusiast for months. He might have even reached the stage where he is ready to give up or smash his computer. And all it could take is a short note from you to straighten him out. Chances are he has also solved a problem that's had you stumped. So with a little bit of co-operation you both benefit.

This co-operation needs one more thing, common ground. Somewhere where you can find his solution and he yours. We want *PRINT-OUT* to be such common ground, so if you have some neat solution to a tricky problem, write us a short letter discribing what you have achieved. If it looks good to us we will show it to the world!

# THE STORY OF THE HOBBY COMPUTER

OVER THE LAST FEW MONTHS WE have used the word "computer" quite a lot. PRINT–OUT is very much concerned with small computers and how their owners use them. Unfortunately, to many readers the word computer conjures up multiple images of machines ranging from slide rules to IBM 370s.

Because they are sufficiently powerful and versatile, many professional computer users prefer to buy a ready-made microcomputer rather than have the expense and problems of designing and manufacturing their own. These machines are available to the amateur enthusiast, but he is normally limited to buying a machine made specifically for the hobby market. This article looks at how these machines have developed and how companies have made available kits and low-cost systems to meet the demand.

## How the hobby started

Historically it must be pretty fair to say that there have been individuals playing with computers since they first became a practical reality some 25 years ago. These would have been the lucky few who had access to the commercial computers: the engineers, operators and programmers employed to keep the machines running.

Although membership to this group must have been small, there were enough to support a newsletter – 1976 marks the 10th anniversary of the Amateur Computer Society Newsletter', which claims to be the oldest computer hobby publication in the world. But the big explosion came in early 1974 with the microprocessor, so that by late 1974 there were three microcomputer kits on the market, the Scelbi 8H, Radio-Electronics Mark 8 and the RGS 008A.

These were different to earlier designs (that had drifted into obscurity) because they offered reasonably powerful performance at a low price. Then at the beginning of 1975, thanks to the availability of the Intel 8080 microprocessor chip, came the Altair 8800. Because of the formidable performance of the 8080, the Altair computer established itself as the T-model Ford of the hobby computer industry. That was 18 months ago and since then there have been a number of refinements to the hobby computer.

## The early machines

The early microprocessor-based computers were very much scaled-down versions of the mini-computers that appeared in the mid-60s. Programs and data were entered one bit at a time from toggle switches mounted on the front panel. This meant a program of 20 bytes required something like 100 key togglings (+9 to set up the initial address). This unfortunately got more tedious as the program became longer (5000 for 1000 byte program!).

Many users went to first loading a short program (called a bootstrap), of no more than 20 bytes, that would carry out the loading of larger programs (making the computer do the work). The main program would then be kept on magnetic or paper tape. This saved much wear and tear on the fingers, but it meant you had to first obtain a cassette interface or paper tape reader and punch and you still had to load the main program at least once so that you could get it onto tape.

One other problem with this switch register method was the difficulty of outputing, for inspection, the contents of the microprocessor's internal registers. On the early mini-computers this was no problem because the CPU was made up of many chips and it was easy to run a few wires with lamps on the end to the particular registers. Unfortunately the microprocessor has only a limited number of pins and it is impossible for each register to have its own output for display purposes.

The only way around this problem is to load a special little program into memory that will output the contents of the internal registers. This method works fine until a fault in your program overwrites all of the RAM with garbage and you have to reload. Unfortunately this happens many times when you are debugging a program.

## The operating system

The latest generation machines overcome this problem by including a ROM which comes with the computer. This ROM contains a small operating system that continually controls the operation of the computer when your user program is not running. It is very similar to the monitor program found in an evaluation kit but it does not require a terminal to operate.

Instead it scans a low-cost calculator-style keyboard and LED display. The combination of the ROM's operating system and the cheap keyboard can provide all the functions offered with the evaluation boards and sometimes more, but at a fraction of the cost since a terminal isn't needed. Also included in the ROM are routines that allow easy examination of the internal registers' contents.

Since the program in ROM is permanent, these special routines are protected against corruption by a runaway program (your program gone wrong) and are also immediately available when the power is turned on.

## Everything you wanted to know about hex . . .

With this operating system the latest generation computers also allow data manipulation in half-bytes of the older method of single-bit movement. In practice this means that the finger-sore operator loading his program has to press two switches, where before he had to press five. (In terms of 1000 or even 100 bytes that's a lot of finger presses). Not only is data entry simplified but also data output. Where earlier machines used a row of eight LEDs the present generation types display the byte as two hex characters.

That's where the hobby computer is today but who knows what it might become in a couple of years? Maybe a simple pen with a lead to plug in the back of your TV set?

# PRINTOUT NEWS

## TINY FLOPPY DISCS

At last manufacturers are doing something to overcome the big problem of expensive peripherals. Two American companies will soon be announcing tiny floppy disc drives using discs roughly 5" in diameter as opposed to the present 8". The discs are expected to hold something like 250k bytes and will be offered on the personal computer market at about half the present cost.

## WHAT INTEL HAVE UP THEIR SLEEVE

With the announcement of the Z80 (see ETI News Digest last month) the days of the 8080 are numbered. Recently, however, Intel revealed that they have three new processors for the 8080 family. These are only a small part of an LSI product push scheduled for the next eighteen months.

The 8085 is a more powerful version of the 8080A, but twice as fast. Then there will be another processor which will be five times as powerful as the 8080A and Intel's first 16-bit processor which will beat the 8080A ten times over! As you can see these devices are aimed at the upper end of the microcomputer market.

For the low end of the market we are promised two minimum chip families: the MCS48 and the MCS41. The MCS48 family includes two processors, the 8048 and the 8748. Both of these contain, in addition to the CPU, ROM, RAM, and enough I/O capability for simple single-chip control applications. The chips in the family work with many of the 8080 peripheral chips. The 8748 contains a 8,192-bit field erasable ROM (it can be altered in the field with a UV light source).

## RAM CUTS

RCA America is reported to be about to drop the price of their SOS RAMS by around 50%. These are the RAMs which are offered as part of the 1802 CMOS microprocessor system. They include the 256 x 4 & 1024 x 1 bit devices.

## BRITISH BIPOLAR PROCESSOR

Ferranti of Great Britain have announced the release of the F100-L, a 16-bit single-chip microprocessor. Unlike the majority of other microprocessors, the F100-L is a bipolar device. Built on a 5.8mm square chip it contains approximately 7000 components and includes some six feet of aluminium interconnecting track!

Ferranti claim that the F100-L is the first microprocessor to be wholly developed, designed and manufactured in Europe. Released in conjunction with the device are the first two of a range of associated support chips, the F111-L control interface chip and the F112-L Data Interface chip for software support there is development software and a library of application programs.

## COMPUTER CHAIN STORES

Riding on the growth of the computer hobby in America have come computer shops. These are retail shops where the potential customer can go to look at and actually have demonstrated (before buying) the different brands of computers and their support equipment.

So successful were the early stores that one man has set up a chain of computer shops across the USA. Paul Terrell, an ex-IBM engineer, opened his first 'Byte' shop in Mountain View, California in December 1975. Now, less than 12 months later, there are 17 Byte shops.

One report puts the number of computer shops in the United States at over 50 and growing. Before they came along, hobbyists were forced to buy via mail order. Delivery was often slow and when equipment did arrive the purchasers had no-one to turn to for help if they had problems.

Here in Australia mail-order remains the only way to get a wide range of products, but things are improving as the electronics hobby shops start to catch on to the new trend. Many shops now sell evaluation kits; and Applied Technology seems to be well into things with a new computer Showroom at Hornsby.

## AWAITING THE HOBBYISTS' CONTRIBUTION

". . . we have every reason to forsee some really interesting and important technical developments coming out of the computing hobbyist activity" — July 1976 issue of the American IEEE journal, 'Computer'. Not only has the hobby side of computing gained acceptance by the professional, but it seems that hobbyists are being actively courted by the professional institution. And who can blame them? All those brainy people working away in their leisure time must be capable of developing all sorts of goodies that even the wealthiest of computer companies would not be able to afford if they had to pay for the labour!

## A CASE FOR A MICROCOMPUTER

Microcomputers are finding their way into many strange places, but how about suitcases? Now offered is a microcomputer complete with microperipherals that comes in an attache style case. The peripherals include a 96-character keyboard, a miniature cassette-tape system and a 20-column alphanumeric display.

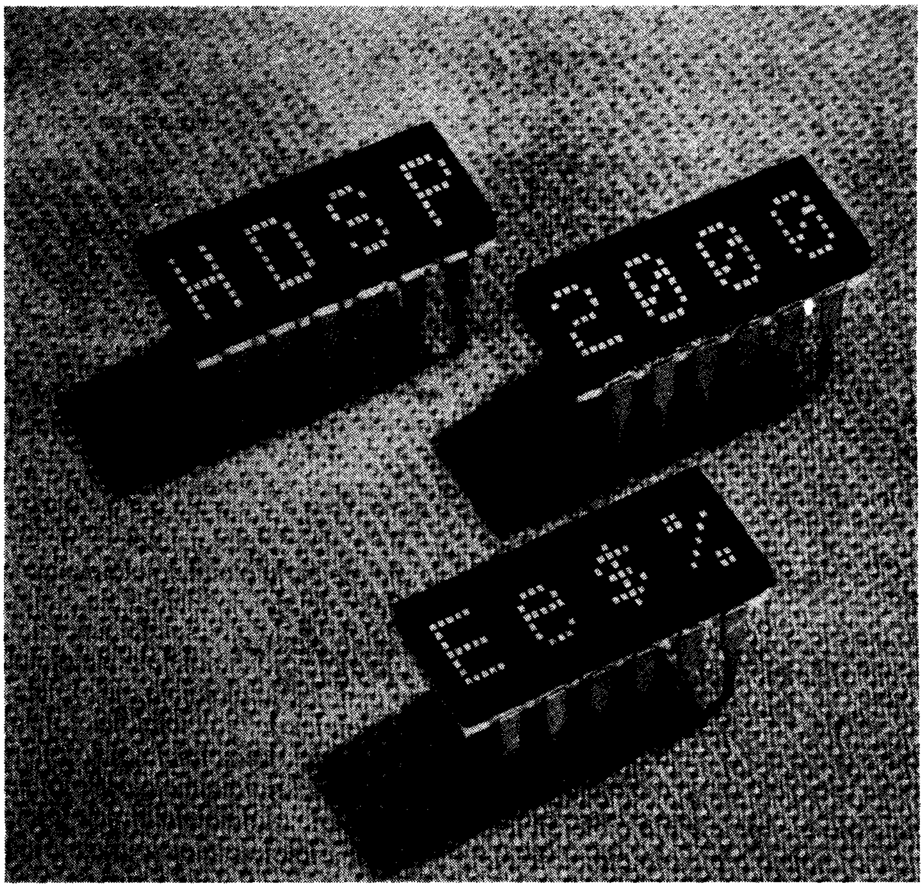
## ALPHANUMERIC LED

Compact and complete with on-board electronics, HP's new LED alphanumerics are offered in standard DIPs, four characters in each package; they are end-stackable. On-board are shift registers and externally-programmable constant-current drivers, so associated circuitry is simplified. Compared with the circuitry required for earlier and more costly alphanumeric LED displays, the parts count for a typical 32 character system has been reduced by a factor of 36 to 1. It takes only 12 pins to address each four-character set. These low-voltage LED displays are directly TTL-compatible and readily microprocessor-controlled. Each HDSP-2000 character is formed with a 5 x 7 dot matrix, capable of displaying the full ASCII fount, lower-case as well as upper-case letters, punctuation marks, mathematical and other symbols, as well as numerals. Each four character package measures 17.7mm (0.699 in.) long by 7.25mm (0.290 in.) high.

For further information contact Amphenol Tyree.

NSW: Ray Gudgeon, 176 Botany Street, Waterloo, 2017. Telephone: (02) 69 5264.

VIC: Richard Knehans, 115 Highbury Road, Burwood, 3125. Telephone: (03) 288 7099




*The Hewlett-Packard HDSP 2000 alphanumeric LED displays.*

## 6800 COMPILER

Motorola Semiconductors have announced that they will soon offer a resident Fortran compiler for use on the 6800 Exorciser development system. The compiler requires 16 kilobytes of memory and is close to the ANSI standard.

## THREE NEW LOCMOS MEMORIES

Philips Electronic Components and Materials announce the release of three new 256 x 1 random access memories as part of their range of LOCMOS integrated circuits. These are the HEF4720, HEF4720V and HEF4720V/S1.

The HEF4720 and 4720V are static RAMs with a stand-by power consumption of typically 5 $\mu$A. They are specially suitable for memory systems in battery-operated equipment. The HEF4720 has a supply voltage range from 3 to 15 V and an access time at 5V of 550 ns.

## MICROS MOVE INTO AUTOMOBILES

The US auto giant General Motors is expected soon to name the prime source of the microprocessor it will use in its cars of the future. Four companies are apparently on the short list Intel, Motorola, National Semiconductor and Texas Instruments.

**NEXT MONTH'S PRINTOUT**

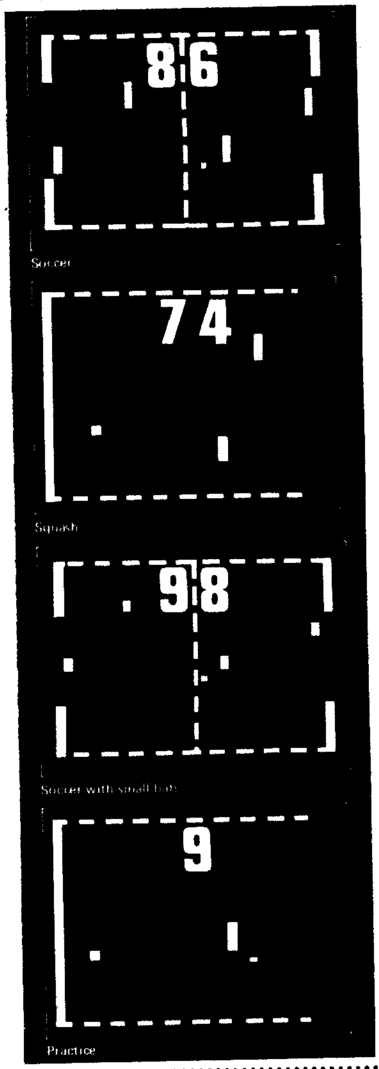
- What is a 'systems approach' and why should you know about it before you buy or build your computer?
- How should you choose which microprocessor to base your system on?
- What is an operating system and how should this affect your choice of computer?
- Plus other advice, news, and features.

**APPLIED TECHNOLOGY PTY. LTD.**

# HOBBY NEWS
## NOVEMBER, 1976

# ETi PROJECT 804 SELECTA TV GAME

— play 6 different games with on-screen digital scoring and sound effects.




As described in November 1976 Electronics Today, this must be one of the most popular TV game projects yet published. Designed around the AY-3-8500 IC by General Instruments this single control chip offers a choice of six games together with ON-SCREEN scoring and sound effects.

Although not a project for absolute beginners the kit can be assembled by anyone with reasonable experience in electronics.

The HOBBY KIT SELECTA TV GAME comes complete including all parts as listed in the article, full instructions and pre-wound coils for the modulater circuit.

NOTE: AS A SPECIAL SERVICE WE HAVE PRETESTED EACH AY-3-8500 IC FULLY BEFORE DISPATCH.

We guarantee that each device is fully operational when it leaves our factory.

**PRICE WHILE STOCKS LAST $49.50**
**+ $3.50 pack, post and insurance.**

**PLEASE NOTE:**
We have a large but limited quantity of these kits available. All orders will be promptly despatched in strict priority of receipt. Naturally any order received after stocks are depleted will be refunded immediately. Sorry, no phone orders or C.O.D. please.

# AUDIO PRODUCTS

Our HOBBY KIT audio products have proven very popular with hobbyists everywhere. You can enjoy building these exciting projects and save a fortune over the cost of equivalent mass produced products.

For full details write for our free catalogue.

TWIN TWENTY FIVE 25W RMS AMPLIFIER $85.00
TWIN FORTY 40W RMS AMPLIFIER $99.50
ETI 740 VARICAP FM TUNER $120.00.
AD8K40 40W SPEAKER KIT (PR) $125.00
AT1265 30W 3 WAY WRAP AROUND SPEAKERS (PR) $195.00

**SPECIAL OFFER (Closes December 31, 1976)**

**STR100 PROFESSIONAL STEREO TEST RECORD**

Evaluate your Hi Fi system with this exceptional record. Included with the record is a 16 page booklet by Audio's Edward Tatnall Canby explaining how to use the record to improve the performance of your system.

Catalogue price $12.50 but if purchased with one of the above kits $6.25.

# POPULAR HOBBY KITS

**MICROPROCESSORS**

We still have stocks of the incredible SC/MP INTRO KIT and have developed a number of peripheral kits to use with the SC/MP. Our extensive range of microprocessor components has now been enlarged with LOW POWER SCHOTTKY TTL (see next page) as well as PROMS, RAMS, UARTS, CHARACTER GENERATORS AND VOLTAGE REGULATORS.

SC/MP INTROKIT $89.50
AT1250 SC/MP POWER SUPPLY $37.50
PC2102/8 1K x 8 RAM KIT $32.50
PC900 PROTOTYPE PCB $9.50

# MICROCOMPUTER TERMINAL -PART TWO

Last month we announced our plans for a microcomputer terminal project. Constructional details will start next month but in the meantime here are details of some of the components and techniques used...

LAST MONTH WE ANNOUNCED our plans for a computer terminal project; we showed how the terminal would be in three main parts so you do not need to build the whole thing if you already have a keyboard or a printer, or if you want parallel interfacing rather than the teletype interface we are proposing.

We will start to publish constructional details of this project next month, but now we'll give you an idea of the basic concepts behind the design.

## The Keyboard

We want this part of our terminal to give out the codes you get when you use a commercial teletype machine. These codes appear on an eight-line data bus and they correspond to the codes given in Figure 1. There is another output from the keyboard which is used to tell the computer when to read the data on the bus.

From Figure 1 you will see that there are more symbols on the computer keyboard than you find on the common typewriter. Apart from the usual alpha characters in upper and lower case and the numeric characters and their corresponding upper case symbols, there is a further shift which enables control codes to be entered. These codes will be explained later.

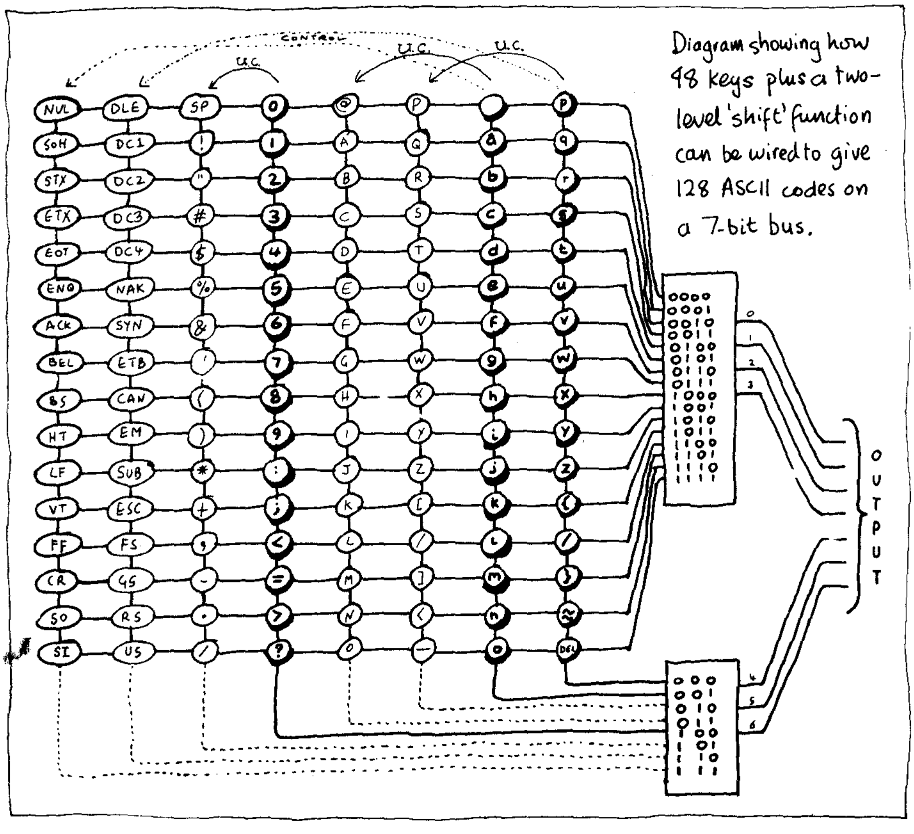



Figure 1 also shows that there is a maximum of 128 codes, and that these are put out on seven parallel lines. The eighth line of the bus carries the parity bit. This bit is high or low according to the status of the other seven bits and is used as a check against errors.

The TV display part of the computer is only able to display 64 characters — upper case alphas plus the numerics and a few symbols. So that these characters can be inputted from the keyboard without having to operate the shift control we will incorporate a special switch on the keyboard to give 'upper case only' on alpha characters.

The electronics will centre around a special keyboard encoder IC which has a 16-line input and a 4-line output. The outputs range from 0000 to 1111 when the inputs are activated one at a time. This IC gives four of the lines for the output bus; the others are taken from logic which looks which part of the keyboard you are using and wether or not you have operated the shift key.

The connections to the switches on the keyboard will have to be made using wire links — we considered designing a double-sided pcb but we thought that the cost of the board was too high to make it worthwhile.

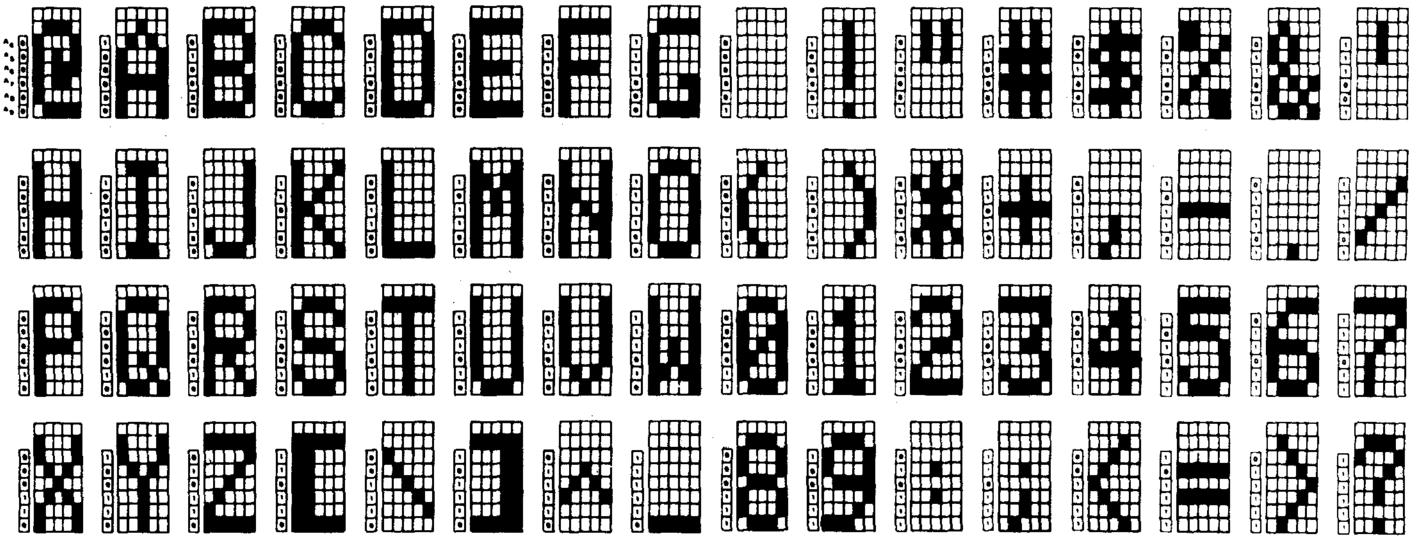


*Fig.2. This table shows the fount of 64 charaters that the 2513 IC can put onto a TV screen. To the left of each 5x8 matrix the six-bit code which specifies the character is given. This code is derived from the seven-bit ASCII code from the keyboard.*

## The VDU

This part of the terminal takes in data on a parallel bus and stores up to 256 bytes in RAM. Then it decodes the characters and generates the video necessary for them to be displayed on a TV screen.

The electronics centres on the Signetics 2513 character generator IC. Figure 2 shows the characters as they appear on the TV screen when any of the 64 possible codes (only 6 lines of the bus specify characters) are inputted. The characters are made up of dots on a 5 x 7 matrix —the device has to specify five bits of information at exactly the right place on seven consecutive TV lines. The eighth line has to have a blank space to give spacing between lines of text.

Figure 3 shows how each of these eight lines is given an address from 000 to 111 and it shows how the five bits of data leave the IC in parallel. In all the IC has nine pins for inputting data and five pins for outputting data. The first three input pins carry the row address (the line address) and the other six specify the character.

Figure 4 shows that the project we are designing includes counters to set up the row address. There are counters too, to find the right address in the RAM so that the data fed into the 2513 changes as the electron beam scans across and down the screen.

The parallel data coming out of the character generator has to be serialised and made into a proper video signal before the TV can handle it. This means it has to has line and frame sync pulses inserted and the timing of the data which draws the characters on the screen has to be precisely fixed in relation to these pulses. A crystal oscillator will be used to keep everything in step.

If you intend to build this project and want to getting on with something useful you can start by converting your TV set into a video monitor. We recommend this approach rather than trying to use a modulator — if you can't modify your TV now wait until next month and we'll tell you how to do it.

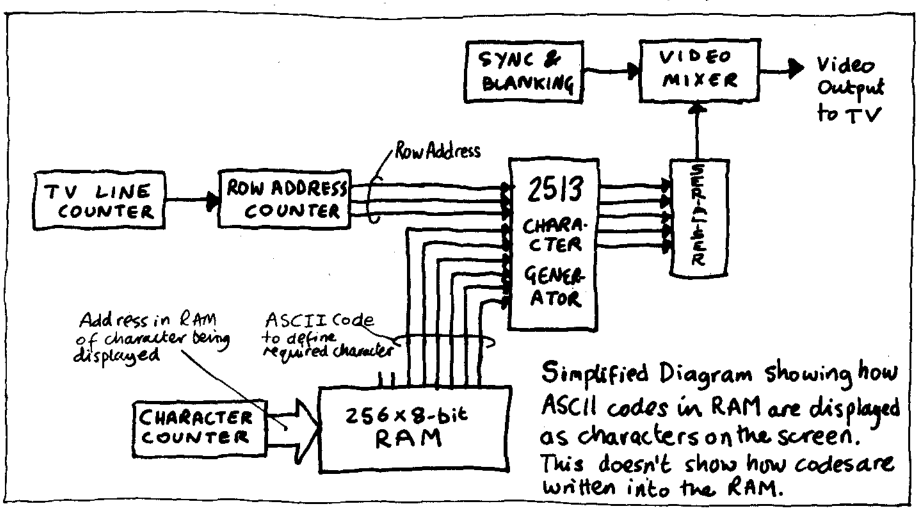
**ROW ADDRESS**

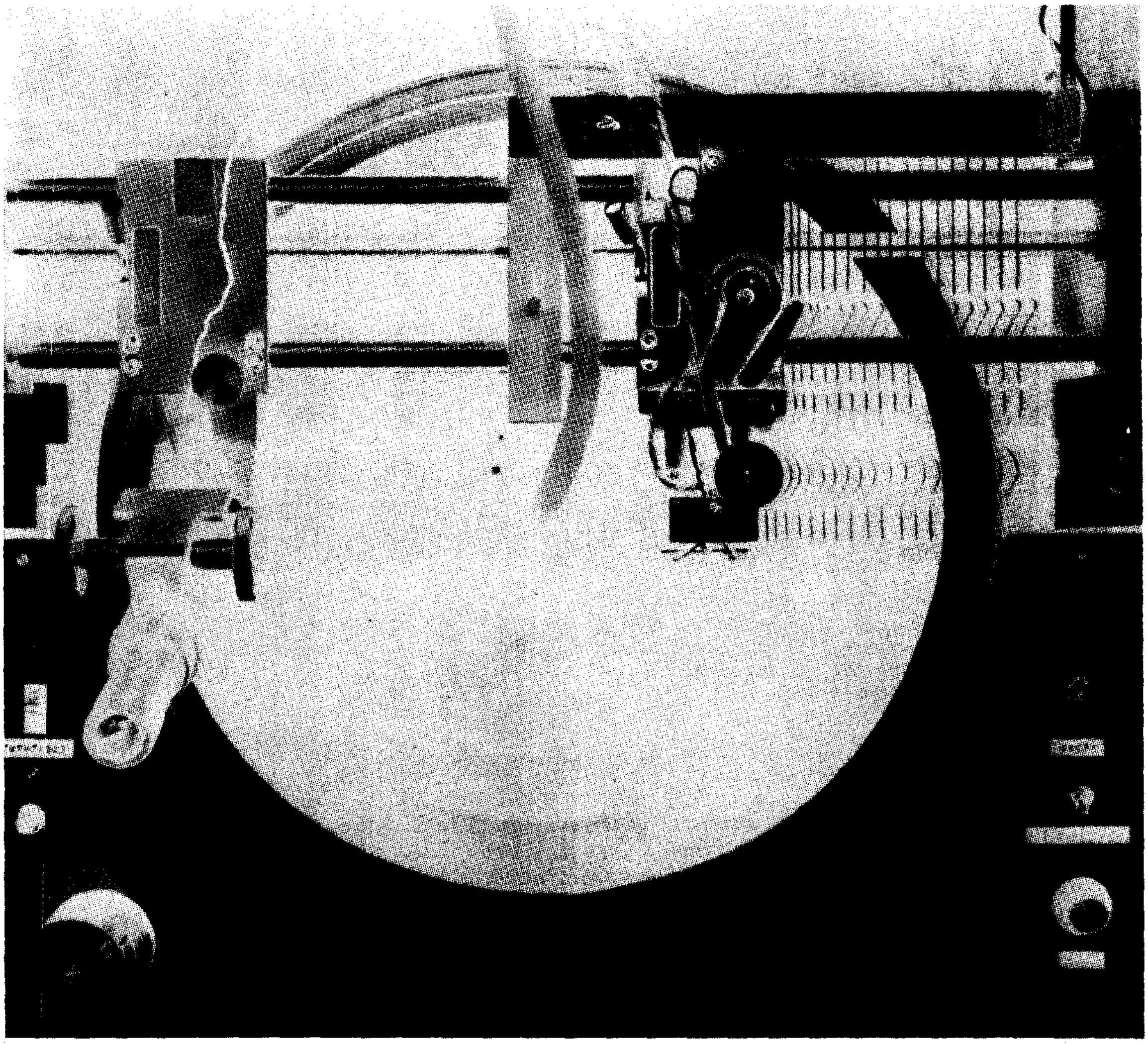
| ROW ADDRESS $A_3$ | $A_2$ | $A_1$ | OUTPUTS $O_5$ | $O_4$ | $O_3$ | $O_2$ | $O_1$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |

EXAMPLE 'S'

FIGURE 1

*Fig 3. To put a character on the screen the character generater outputs seven rows of data on its five output pins.*



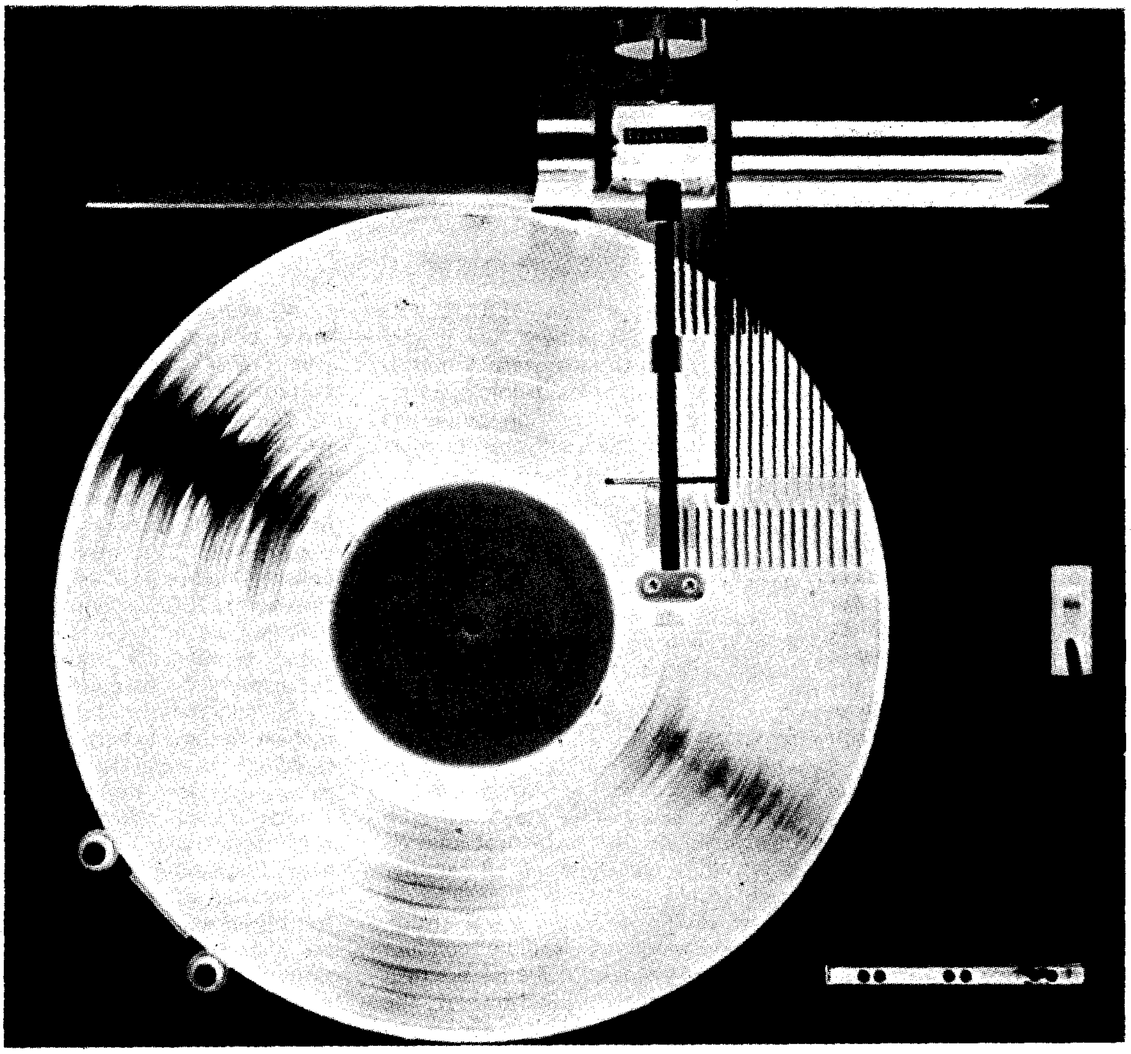


# This is how discs are made.

A master disc is cut on a special lathe. The cutting head moves across the master in a straight line from the edge to the center. The special stylus inscribes a groove in the surface of the disc.

Ideally, a turntable system should enable the stylus in your cartridge to meticulously follow the "path" inscribed during the cutting process. That is, it should play your record precisely as the master disc was originally cut.

A "straight line tracking" turntable system, properly designed, engineered and manufactured, could eliminate problems such as skating force, tracking error, and the resulting excessive record wear, all of which are *inherent* in pivoted arm systems in all their forms and modifications.



# ELECTRONICS —it's easy! PART 36

## Control of power

**This is the 36th and last part of this series.**
**The intention has been to provide introductory information about modern electronics for intelligent people who had no prior training in the subject. Surveys conducted throughout the series have established that we have achieved this aim.**
**The author wishes to thank Brian Chapman, formerly Technical Editor of Electronics Today International for his patient and conscientious job of editing the whole series. Maree Breen has made a wonderful job of the author's rough sketches; Colleen Drummond typed the first manuscript drafts, Jan Vernon turned the original monthly articles into the final three-volume form.**
**Finally, Electronics Today International wishes to give its heartiest thanks to the very many companies who provided information and illustrations used. We are most grateful for their willing and prompt cooperation.**
**Peter Sydenham,**
**Armidale, October, 1976**

IN PART 10, WHEN DISCUSSING the types of amplifiers, we briefly mentioned the power stage found at the output end of electronic systems. Typical devices requiring amplifiers to drive them are loudspeakers, electric motors, and heaters.

The power handling capability of the various designs of these special amplifiers can range from one watt to many kilowatts. In this final part we introduce the special semiconductors and techniques used in electronic power control.

### HEATSINKS

As some power is lost as heat in power transistors they may usually be recognized by the large heatsinks on which they are mounted. A rectifier stage using flat-plate heatsinks is shown in Fig. 1. These metal structures are needed to rapidly conduct away and dissipate to the air the heat generated at the junction of the device — this is a critical design requirement. The approach to designing heatsinks is common to all power components.

All semiconductors used in analogue control will have heat losses (the power lost as heat equals the current through the device multiplied by the voltage drop across it) which will cause the junction temperature to rise above the case outer temperature. For example, a transistor power amplifier stage may have at half output power (say) 10 V drop and 10 amp collector current. The heat loss is, therefore, 100 W and this must be liberated in order to keep the transistor temperature lower than its recommended maximum value.

All materials resist the conduction of heat to some extent — this property is called 'thermal resistance' and its value depends upon the material (copper is less resistive to heat flow than iron) and the cross-sectional area (increasing the area decreases the resistance). In practice catalogues for power components usually quote the thermal resistivity $\theta$ (which has units $^{o}$C/W ) between two points on the device. For example, typical measured temperatures for a certain power transistor mounted on a heatsink are as shown in Fig. 2. From these temperatures we can see that:—

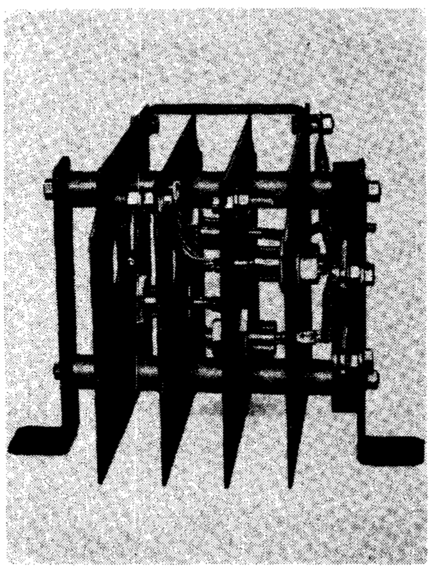


*Fig. 1. Power handling stages are easily identified by the heatsink assemblies on which they are mounted — a 35 A, 60 VDC rectifier stack is shown here.*

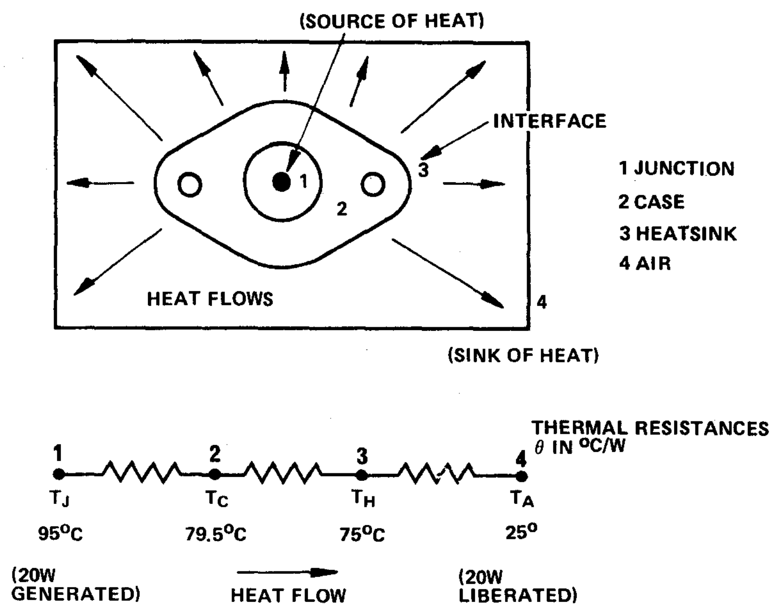



*Fig. 2. Thermal resistances for a 20 W power transistor.*

TABLE 1

$\theta_{J\text{-}C} = (95 - 79.5)/20 = 0.77\ ^{o}C/W$
$\theta_{C\text{-}H} = (79.5 - 75)/20 = 0.23\ ^{o}C/W$
$\theta_{H\text{-}A} = (75 - 25)/20 = 2.5\ ^{o}C/W$
$\theta_{J\text{-}A} = (\theta_{J\text{-}C} + \theta_{C\text{-}H} + \theta_{H\text{-}A}) = 3.5\ ^{o}C/W$

Where J = junction, C = case of device, H = heatsink and A = air.

| Material used between device and heat sink (for insulation) | Thermal Resistance Dry | $\theta_{C\text{-}H}$ in $^{o}C/W$ with heat conducting grease |
|---|---|---|
| Direct contact (TO3) | 0.20 | 0.10 |
| Teflon insulator shim (TO3) | 1.45 | 0.80 |
| Mica shim (TO3) | 0.80 | 0.40 |
| Anodized aluminium (TO3) | 0.40 | 0.35 |
| 0.25in stud mount (direct) | 0.40 | 0.25 |
| 0.50in stud mount (direct) | 0.12 | 0.07 |
| 0.75in stud mount (direct) | 0.07 | 0.04 |

*Fig. 3. Table of thermal resistances $\theta_{C\text{-}H}$ for typical mounting methods. Values can vary widely.*

From this example we can see that the thermal resistance within the device — the parameter the user has no control over — is larger than the case-to-the-heatsink value. This means it is not worth improving the contact and heatsink material. The important thermal resistance is that between the junction and the air (presumed to be at constant ambient value); in many cases a different shape heatsink, one that transfers heat better to the air (finned for example) would make an improvement. The thermal restivity (heatsink to air) can also be reduced by forcing air past the heatsink and/or by increasing the heatsink surface area. The latter measure, however, also has its limits because the thermal resistance between the device connection point and extremities of larger plates rises with increasing dimensions (reducing the effectiveness of outer areas).

The above example illustrates how a heatsink stage can be designed using the concept of series thermal resistances. In practice the design procedure must be worked in reverse. The aim is to ensure that the junction temperature remains less than a specified maximum limit. Beyond this quoted value the junction will be destroyed. A practical difficulty is that the junction temperature cannot be measured to ensure that the design is adequate so selection of mounting and heatsink type must be made with care using manufacturers' quoted thermal resistance values as the basis of a design. The following steps are given as a guide but full detail should be sought from more detailed accounts — see reading list.

**Step 1:** Assess the maximum power (W max) to be dissipated by the device. This will be the worst case of V.I product remembering to allow for temperature effects and maximum values. In switching designs the base to emitter junction voltage of a transistor is significant.
**Step 2:** Establish $T_J$max, $T_A$max from data sheets and expected ambient conditions. This enables the minimum required value of $T_{J\text{-}A}$ to be calculated.
**Step 3:** Calculate the overall thermal resistivity needed from $\theta_{J\text{-}A} = T_{J\text{-}A}/W_{max}$.
**Step 4:** Establish $\theta_{J\text{-}C}$ and $\theta_{C\text{-}H}$ from device table charts and the mount thermal resistivity for the device clamping method. Fig. 3 lists typical $\theta$ values for various clamping methods.
**Step 5:** Calculate $\theta_{H\text{-}A}$ required
$\theta_{H\text{-}A} = \theta_{J\text{-}A} - (\theta_{J\text{-}C} + \theta_{C\text{-}H})$
**Step 6:** Use heatsink tables to find

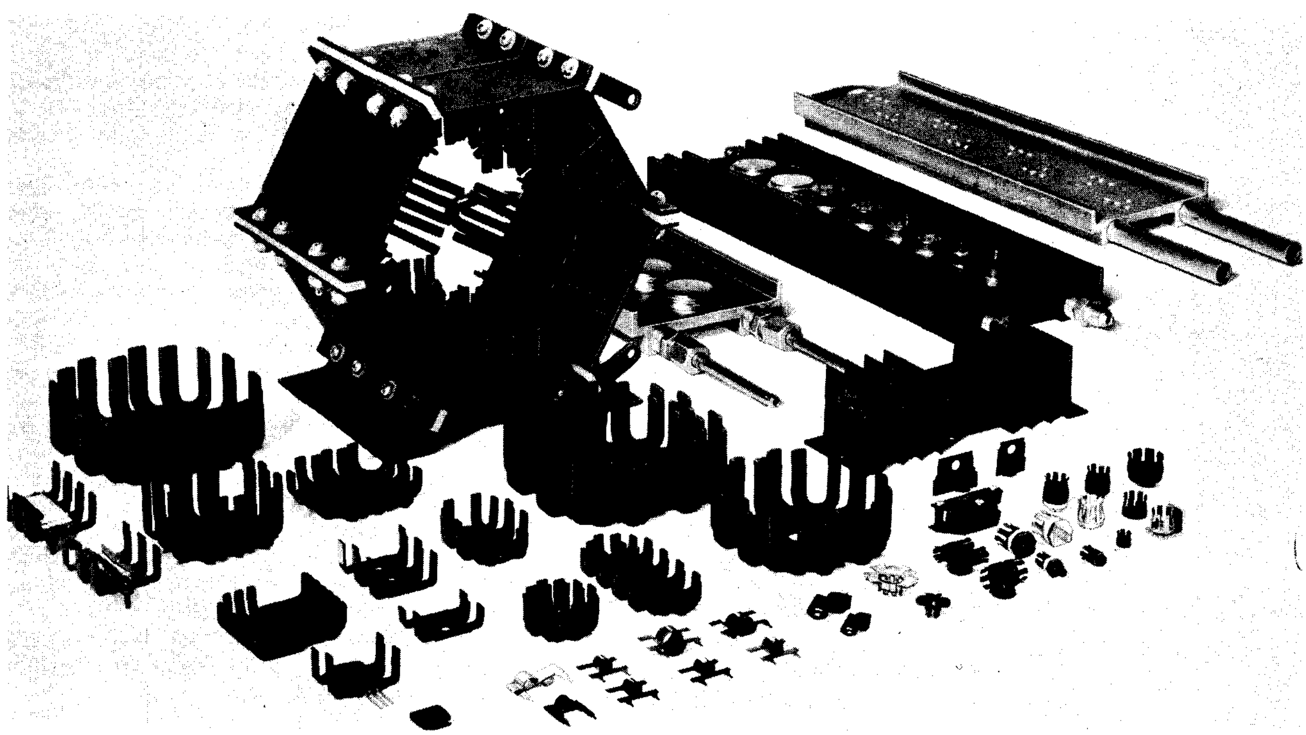


*Fig. 4. Range of heatsinks for dissipating excess heat in semiconductors over a range from milliwatts to kilowatts.*

suitable design having $\theta_{H\text{-}A}$ value or smaller.

In general if $\theta_{H\text{-}A}$ needs to be less than 2 to 5 °C/W the heatsink becomes prohibitively bulky. Design of the whole system is usually limited by the manufacturer's value of $\theta_{J\text{-}C}$, which cannot be reduced. The interface coefficient $\theta_{C\text{-}H}$ is usually around 0.15–0.20 °C/W for direct contact using the recommended heat conducting silicon grease. Mica insulation degrades this value a little, poor heat conducting insulators should be avoided as they contribute a quite high value of $\theta_{C\text{-}H}$.

Heatsinks for analogue control power units will need to be much larger than those of switching designs such as the switching regulator and normal rectifier stacks. This is because the latter need only dissipate the V.I product of the two extremes of V and I. The voltage drop across a power diode running at many amperes is around one volt: when reverse biassed the voltage is high but the current negligible.

Figure 4 shows a wide selection of heatsinks including units for fluid cooling applications. Fins should always be positioned to assist the vertical convective flow of air over the surfaces. Total immersion of the electronic circuit in cooling liquid is not used.

## POWER TRANSISTORS

Power transistors are little different to small-signal devices in their basic semiconductor principle of operation: the distinguishing factors are the heavy-duty design which enables high collector currents and voltages to be controlled. The junction areas are much larger and the case design is made to keep the thermal resistivity as low as possible (around 0.8 °C/W) in order that the losses can be removed. Collector currents being higher and the gains being lower than small-power transistors means the base currents are also large. Thus, high power stages have to have lesser power stages driving them. They are available for several hundred volts operation and current levels exceeding a 1000 A. Cut-off frequencies into the gigahertz region are available (with less gain than that of lower frequencies). At RF frequencies gains range from 4-13 dB for powers in the range 0.1–80 W. There are few power applications that transistor devices cannot handle. In practice, however, certain other semiconductor devices are often a better choice.

## SCRs, THYRISTORS AND TRIACS

Semiconductors and diodes have one p-n junction and transistors have two junctions, p-n-p or n-p-n. A logical progression is the three-junction device, p-n-p-n. This family contains such devices as the silicon-controlled rectifier SCR, the silicon-controlled switch SCS, the gate-turn-off switch GTO, the light-activated, silicon-controlled switch LASCS, and the Shockley diode. Of these, the SCR (also called a thyristor) mainly concerns us as it is able to control high-power levels (they were introduced in Part 16). The SCR has an anode and cathode and a gate lead (which when held positive prevents the unit from conducting).

By controlling the gate voltage it is possible to control when power begins to flow during an ac cycle. Once the SCR is triggered (or fired) it remains on until the anode-cathode voltage falls to zero again. SCRs are, therefore, extremely useful when an alternating current source is available as this automatically provides the necessary switch-off conditions at each half cycle.

TRIACS are special SCRs that can be switched on to allow both positive and negative half cycles to pass. This action can also be arranged by using two SCRs.

This class of device cannot control the flow of dc power from a dc source, because once turned on they remain on, acting like an adequately low-resistance contact. They are, however, invaluable for controlling loads which can be energised by ac power – heating coils, motors, lighting and furnaces.

The operating circuitry for an SCR is designed to provide the appropriate gate on-voltage level at the correct time during the half cycle. Fig. 5 shows five basic forms of phase control. A typical trigger circuit is given in Fig. 6. One difficulty in this kind of control is that large line transients are generated, along with RF interference, when the power begins to flow during each cycle.

A more refined type of control derives the required average output power as the mean of a series of complete whole-cycles rather than in

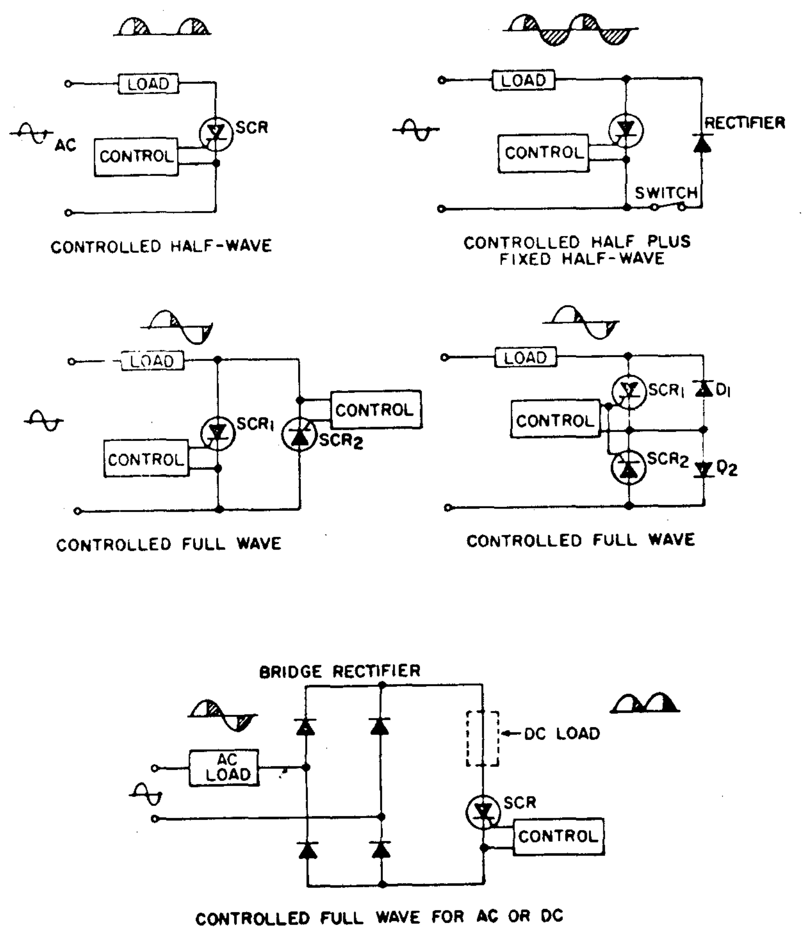



*Fig. 5. Five arrangements by which a load can be fed with power flow controlled by SCR devices.*

the mean of many partial cycles. This method generates substantially reduced line transients and RF interference because switching always occurs at the zero voltage condition: Figure 7a shows one form of proportional zero-voltage-switching controller using a TRIAC to control the heat produced in the element. Figure 7b is a typical output signal burst of gradually increasing power.

Capabilities of SCR devices range to hundreds of amperes, reverse voltages to as much as 2000 V. The maximum voltage drop across the turned-on SCR lies in the range 1.3–2.5 V, with leakage currents being in the region of 40 mA in the turned-off state.

These characteristics may make SCR devices appear extremely robust. Design of reliable, high-power, units, however, is a matter for a specialist. Many pitfalls can occur if their operation is not understood in detail. Designed properly they will, however, give utmost reliability.

Fuses for SCR circuitry also need special consideration because semiconductor junctions when overloaded will blow more rapidly than simple wire fuses or electromagnetic circuit breakers. The criterion is that the $I^2t$ rating of the SCR must be greater than that of the fuse. $I^2t$ values are usually provided in maker's data sheets. During the turn-on period of the SCR this value may drop significantly. Selection of adequate protection fuses is a matter that must be studied in some depth. Care must be taken to mend blown fuses in SCR units with the correct replacement — this invariably means carrying the correct spare ready to use.

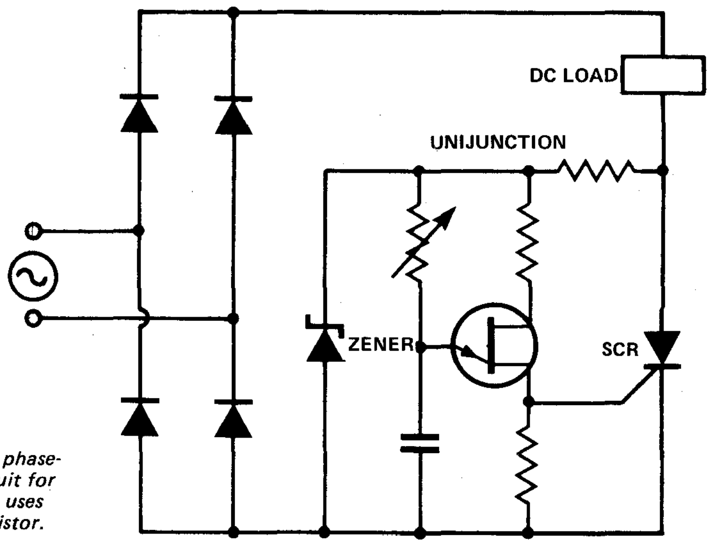



*Fig. 6. This typical phase-control trigger circuit for controlling an SCR uses a unijunction transistor.*

## SWITCHING REGULATORS AND CONTROLLERS

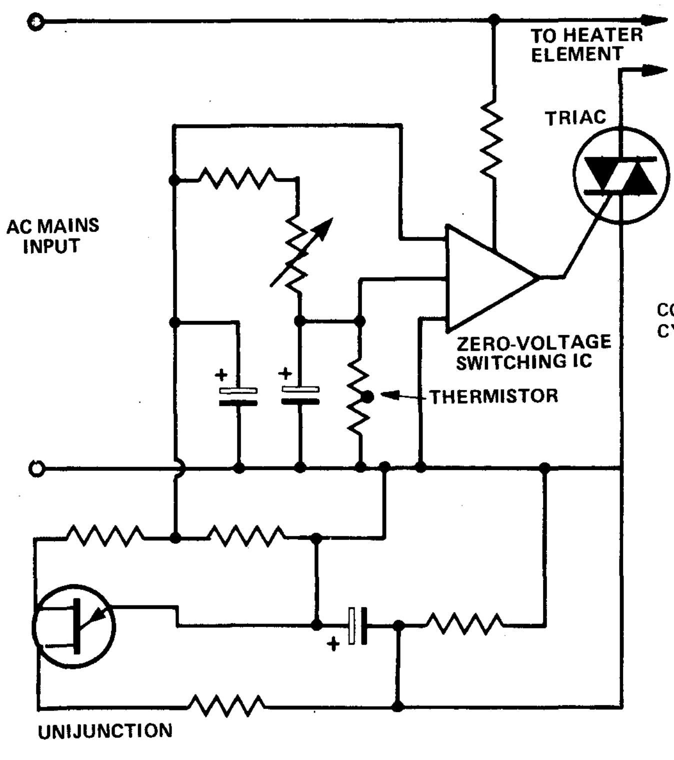
Parts 15 and 16 discussed methods used to regulate dc power supply output voltages or currents. For small power levels — a few watts — the series regulator and zener diode arrangements are acceptable because the power they dissipate is not an economic factor. The controlling transistor (as is shown diagrammatically in Fig. 8) can, instead, be used as a switch varying the on-to-off time ratio (mark-space is the term used) in order to vary the average dc power obtained after smoothing.

The switching method has the significant advantage of very small losses in the regulator stage. The transistor is either fully-on (high current but very low voltage) or fully-off (highest voltage but minimal current). As well as reducing the losses the method also can use a smaller capacity transistor. The price paid is the need for a filter stage and for a pulse generator to drive the switch.

Switching regulators are especially necessary when the voltage drop between the source and the load requirements becomes large.

Modern designs often make use of an integrated circuit as the basic control unit adding an additional switching transistor to cope with the output current needed. Fig. 9 is a high-current switching regulator which can supply 3 A continuously at 30 V input with losses sufficiently small to allow the use of quite small heatsinks.

Switching is also a suitable method to efficiently control output loads — the difference between this and regulator design is that the feedback loop (dotted in Fig. 8) is not used; the mark-space ratio of the generator being controlled instead by the input



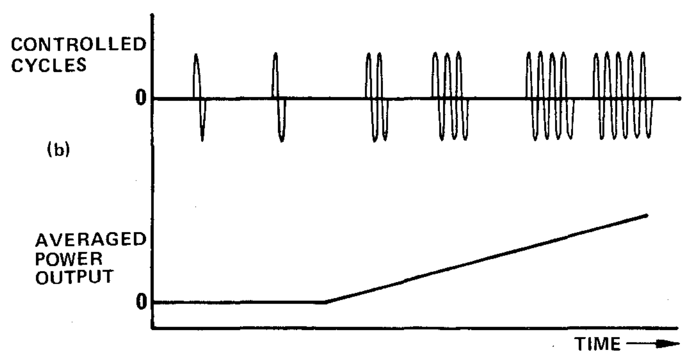




*Fig. 7.*
*(a) Zero-voltage-switching temperature controller using a zero voltage switching IC driving a TRIAC from a thermistor sensor.*
*(b) Output signal with gradually increasing power.*

signal to be amplified. This principle is used in high-current dc motor control and in advanced forms of audio amplifier.

## INVERTERS AND CONVERTERS

A converter, in the electrical power engineering sense, is a machine (or a circuit) that changes current from one kind to another, or from one frequency to another. An inverter, in the same sense, is a machine that specifically converts dc to ac — being one kind of converter. Originally rotating machines were used but today the trend is to use static solid-state equipment.

There are many instances where these are required — providing a 240 V ac 50 Hz supply when only 12 V batteries exist, providing a 200 V dc supply from 12 V dc and to change frequency such as where a 240 V ac 50 Hz mains might be needed to drive aircraft equipment operating at 400 Hz.

The basic principles used in each are based on the technology discussed before in this part. These are now summarised with examples of the procedures used.

**AC to DC:** This conversion path has been discussed when we dealt with rectification in Part 14. A transformer is used to obtain the required ac voltage; this is then rectified with diodes and smoothed to provide dc.

**DC to AC:** This path first changes the dc into a suitable ac signal which can then be transformed to the desired signal level. The frequency of the ac signal is decided by the output load requirement for once produced it must remain at that frequency. (In some cases it is preferable to make use of a higher frequency than 50 Hz).

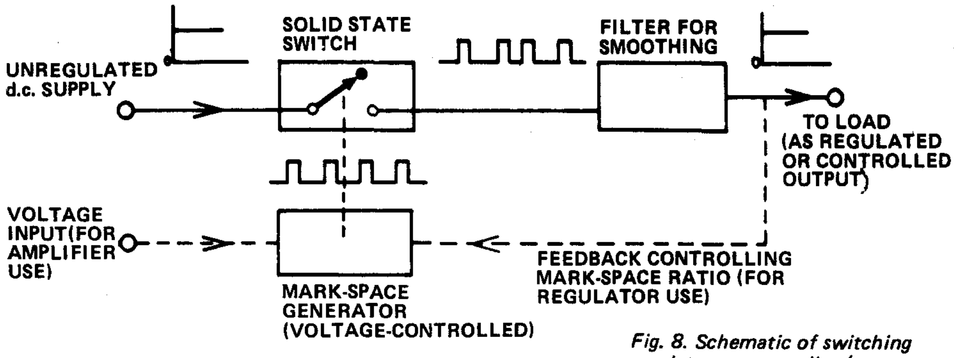



*Fig. 8. Schematic of switching regulator or controller (see text).*

Figure 10 shows a number of configurations used to produce ac power from a dc supply.

Switching produces square-wave energy after inversion and in many instances this roughly square-wave output waveform is satisfactory. Where the output must be sinusoidal more complex circuitry is required to obtain an undistorted wave shape. When choosing a commercially made inverter it is important to verify if the output waveshape is suitable for the task.

Crystal oscillators can be incorporated into an inverter design where the output frequency must be kept within exacting limits.

**DC to DC:** The procedure here is to first form the dc to ac conversion. After transformation to the correct voltage (usually the need is a voltage increase) with a double-wound transformer the output is full-wave rectified and smoothed. The transformers used use special iron laminations material to get the best out of the square-wave input waveforms. Figure 11 is a typical 200 W dc to dc up-converter. The transistors, in conjunction with the transformer primary, form a square-wave oscillator circuit causing flux changes in the transformer which induce the higher output voltage needed for rectification back to dc current.

**AC to AC:** Some mains equipment can run on either 50 or 60 Hz frequency with little change in performance. Occasionally, however, it is necessary to use the correct frequency specified. To change frequencies the simplest procedure is to convert the original ac supply to a suitable dc value inverting this back to ac at the other frequency. This procedure is easiest to implement because it makes use of standard rectification and inverter packages.

The cost of semiconductor converters has fallen rapidly over the 1970 decade. This has brought about new philosophies in power electrical engineering. In the future there will be more use made of dc electrical transmission. Speed-changing motors are becoming easier to implement using frequency-varied supplies to drive conventional ac machines. Large dc motors are also becoming useful again because regenerative braking of large units — using them as a generator driving into a load — can be put to use

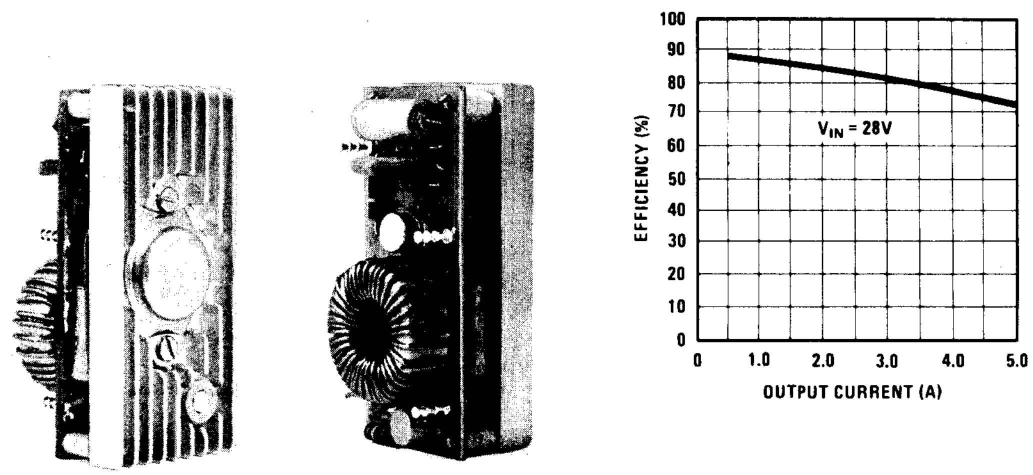



*Fig. 9. Switching regulators provide the smallest overall package due to the greatly reduced heatsink needed. They are also the most efficient form of regulator.*

to charge power into the ac mains by the use of dc to ac inverters.

Revolutions have occurred in both power and signal electronics. Attitudes to problem solving are now quite different to just a decade ago. No doubt this trend will continue.

## FURTHER READING

**Heatsink Design:** Several articles were published in **Electronics** October – December, 1973. Most power semiconductor device manufacturers have design sheets available. Heatsink makers usually provide graphs and design procedures. Forced-air cooling is discussed in "Cooling high-power equipment by forced-air convection", L. Katz, **Electronics,** September 21, 1964. A good basic treatment of design is "Heatsinks for power transistors" **Miniwatt Digest,** December, 1962. A deeper discussion is "Design of cooling fins for silicon power rectifiers" **Mullard Tech. Comm. Vol.5,** June, 1960. "Silicon Rectifier Handbook" Motorola, 1966, devotes a chapter to heatsink design.

**Power Devices** The above Motorola handbook is most useful on power diode design. A companion volume "Power transistor Handbook 1961" deals with transistors. SCRs are covered in "SCR Manual", General Electric, 1964.

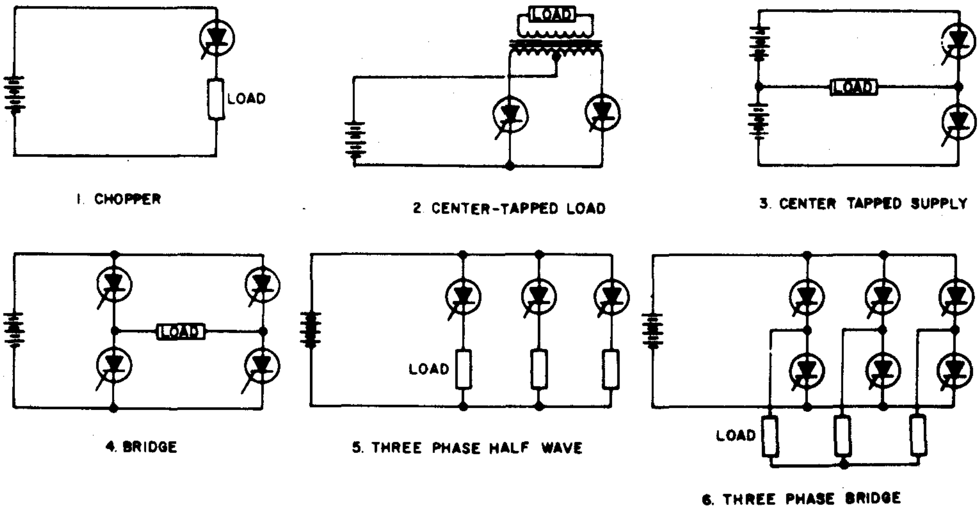
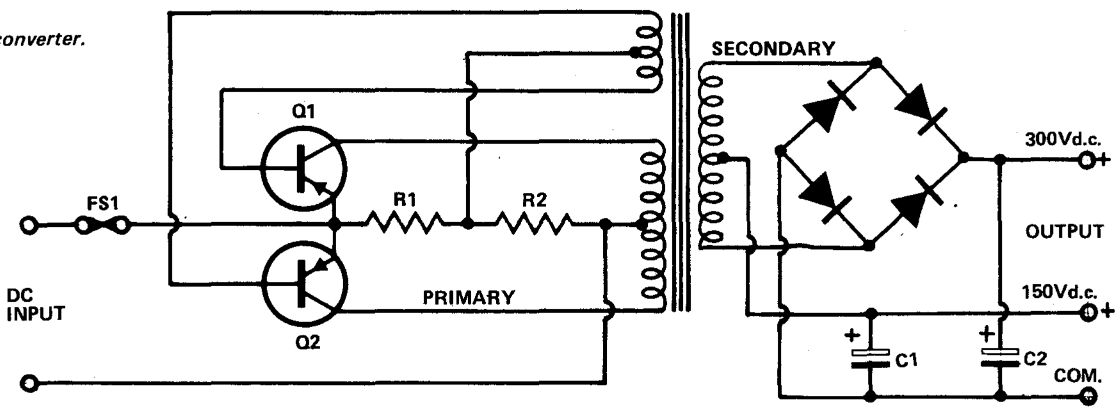



*Fig. 10. Various inverter configurations using SCR switches. Triggering methods have been omitted for clarity.*

**Converters and Inverters:** An early paper "Self-excited inverters" W.J.R. Farmer and R.J. Spreadbury, **AFI Engng.,** March, 1965 provides a tutorial summary. Many power engineering companies can provide papers and articles.

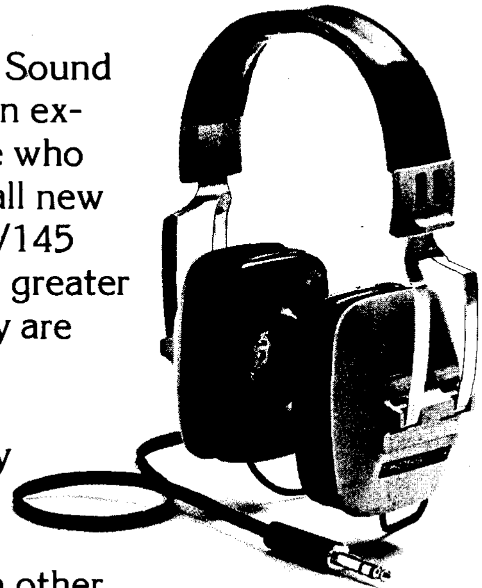
**Switching regulators:** Low to medium power units based on an IC are discussed in "Designing switching regulators" R.J. Widlar, **National Semiconductor AN-2,** 1969. See also "Switching regulators: the efficient way to power", R.S. Olla, **Electronics,** August 16, 1973, and application notes of Motorola, Delco Radio, RCA, Kepco, and others. ●

*Fig.11 Circuit of dc up-converter.*



# The famous Sound of Koss takes on a new look.

Koss K/135

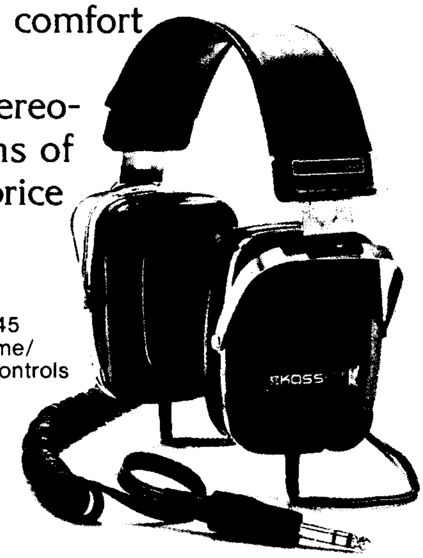


Koss K/125

Slipping into the beautiful Sound of Koss has always been an exciting experience for those who love music. And with the all new Koss K/125, K/135 and K/145 Stereophones, it's an even greater pleasure. Because not only are these new dynamic Koss Stereophones lighter and more comfortable, but they also reproduce the musical program material with greater accuracy than other dynamic phones in their price ranges. Indeed, everything from the lilting enchantment of a flute solo to the pulsating roll of a kettle drum will take on an unbelievable clarity and crispness.

But then, the superior performance of these new stereophones isn't all that they have to offer. Because Koss engineers gave the new Koss "K" series a distinctive low silhouette shape and slimline styling. They added the exclusive Koss Pneumalite® earcushions that seal out ambient noise and extend the bass range to below audibility. And they designed the new "K" series with wide, glove-soft, vinyl headbands for easy wearing comfort during long listening sessions.

All in all, the new Koss K/125, K/135 and K/145 Stereophones are in a class by themselves. Not just in terms of sound quality and superb styling, but in terms of price value as well. Ask your favorite Audio Specialist to show you the new look to the famous Sound of Koss. If the new look doesn't blow your mind, the sound will.



Koss K/145 with volume/ balance controls

**KOSS® stereophones**

If your Hi-Fi dealer is out of stock contact the distributors who will advise your nearest stockist.

## AUDIO ENGINEERS PTY. LTD.

342 Kent Street, Sydney, N.S.W. 2000. Telephone 29 6731.

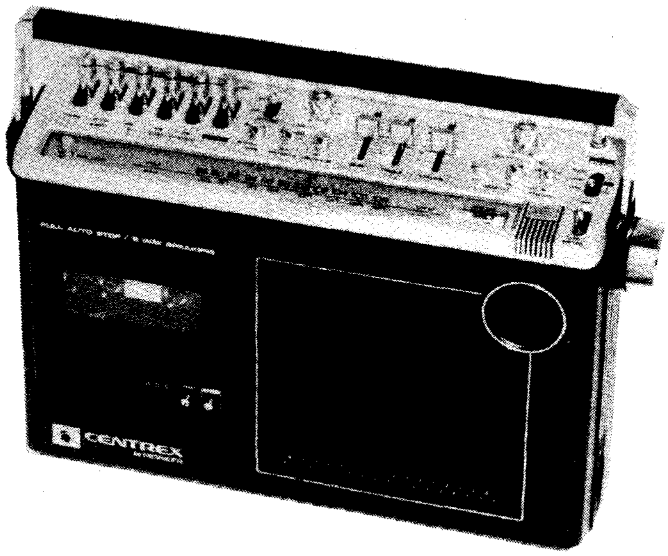
AUDIO ENGINEERS (Vic.)
2A Hill Street,
Thornbury. 3071. Vic.

AUDIO ENGINEERS (Qld.)
57 Castlemaine Street,
Milton, 4064. Qld.

ATHOL M. HILL P/L.
33-35 Wittenoom Street,
East Perth. 6000. W.A.

AE113.FP

# AUDIO FACTS



*Pioneer recently announced the launch of a new division – Centrex – and with it a new range of audio products under the name 'Centrex by Pioneer'.*

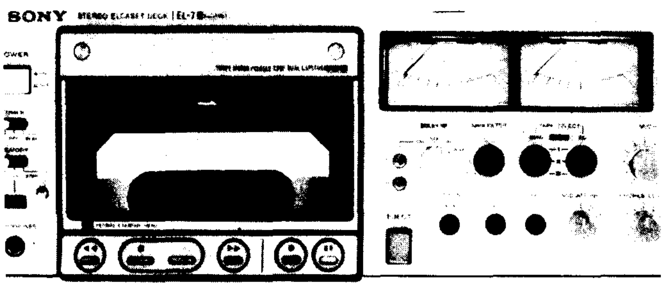
*The initial Centrex product release consists of three radio cassette recorders and a complete home stereo system.*

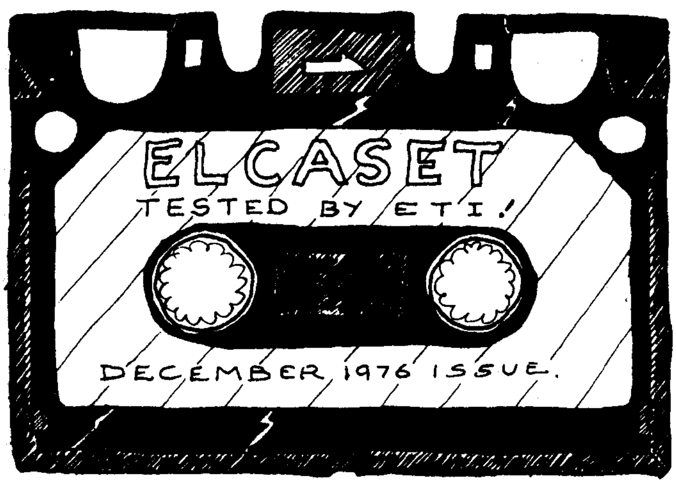
## ELCASET

The new large format Elcaset system described in Audio Facts last month really is for real. We know because we've had one for appraisal throughout the past month.

How well does it work?

Next month's ETI will carry a full review and technical description of this fascinating new audio development.




## AUSTRALIAN CES – 1977

Following the outstanding success of the 1st Australian Consumer Electronics Show held recently at the Sydney Hilton, the organisers, Riddell Exhibitions advise us that plans are now well ahead for a similar but larger show in 1977.

Riddells advise us that the 1977 show will again be held at the Sydney Hilton from Thursday 4th August through Tuesday 9th August. The Thursday, Friday and Saturday will be public days – Sunday, Monday and Tuesday will be for the trade.

## IREE AUDIO GROUP

This month is the fourth anniversary of the Audio Group sponsored by IREE Australia.

Since its beginning in November 1972, the group has since grown to well over 100 active participating members. The Group was formed to promote and serve the special interests of both IREE members and others in the areas of audio-frequency engineering and technology. Membership is open to all person interested in audio.

Regular meetings include lectures and demonstrations on all audio topics and frequent technical tours of industrial and scientific establishments involved in the audio field.

Details of membership from
P. Garde, Hon Secretary, School of Electrical Engineering University of NSW P.O. Box 1 Kensington, NSW 2033

## LOW DISTORTION OSCILLATOR FOR CHECKING HI-FI EQUIPMENT

The problem of measuring distortion in equipment which itself has very low distortion places considerable importance on the distortion present in signal sources themselves. The Meguro Denpa MCR-402 Low Distortion Oscillator has been developed for use as a test source in such applications.

Output distortion in the range from 100 Hz to 10 kHz is less than 0.01% and only rises to 0.1% at 100 kHz. Three decade switches and a multiplier set frequencies from 0.2 Hz to 100 kHz. A fine control for closer adjustment of output is also provided.

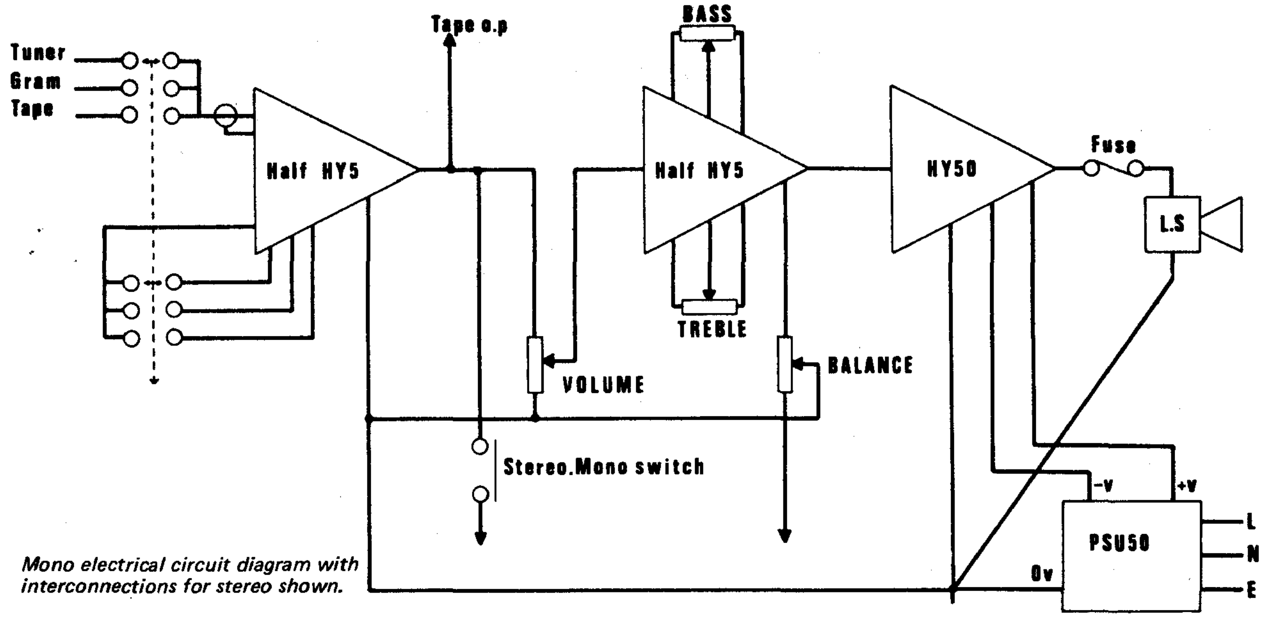
A calibrated meter provides output level indication and the level can be adjusted over a wide range by a stepped attenuator with fine control. In addition to the main output a quadrature output is also provided.

Frequency can be synchronised with an external source where higher accuracy or stability are called for. It is also possible to use the MCR402 as a "convertor" for distorted signals.

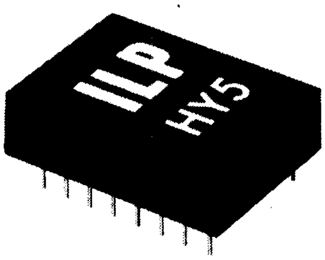
Full information on the Meguro Denpa MCR-402 and other specialised broadcast test equipment is available from Parameters Pty Ltd. 68 Alexander Street, Crows Nest 2065.

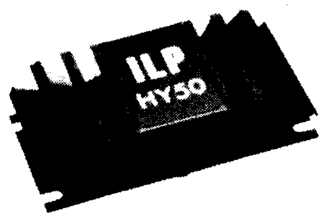
I.L.P.

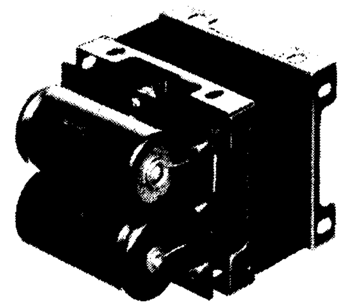
# SHEER SIMPLICITY!




*Mono electrical circuit diagram with interconnections for stereo shown.*



The HY5 is a complete mono hybrid preamplifier, ideally suited for both mono and stereo applications. Internally the device consists of two high quality amplifiers—the first contains frequency equalisation and gain correction, while the second caters for tone control and balance.

**TECHNICAL SPECIFICATION**

**Inputs**

| | |
|---|---|
| Magnetic Pick-up | 3mV.RIAA |
| Ceramic Pick-up | 30mV |
| Microphone | 10mV |
| Tuner | 100mV |
| Auxillary | 3-100mV |
| Input impedance | 47kΩ at 1kHz. |

**Outputs**

| | |
|---|---|
| Tape | 100mV |
| Main output | Odb (0.775 volts RMS) |

**Active Tone Controls**

| | |
|---|---|
| Treble | ±12db at 10kHz |
| Bass | ±12db at 100Hz |

| | |
|---|---|
| **Distortion** | 0.05% at 1kHz |
| **Signal/Noise Ratio** | 68db |
| **Overload Capability** | 40db on most sensitive input |
| **Supply Voltage** | ±16–25 volts. |

PRICE $16.06 P&P. $0.30

The HY50 is a complete solid state hybrid Hi-Fi amplifier incorporating its own high conductivity heatsink hermetically sealed in black epoxy resin. Only five connections are provided: Input, output, power lines and earth.

**TECHNICAL SPECIFICATION**

**Output Power** 25 watts RMS into 8Ω
**Load Impedance** 4–16Ω
**Input Sensitivity** Odb (0.775 volts RMS)
**Input Impedance** 47kΩ
**Distortion** Less than 0.1% at 25 watts typically 0.05%
**Signal/Noise Ratio** Better than 75db
**Frequency Response** 10Hz–50kHz ± 3db
**Supply Voltage** ± 25 volts
**Size** 105 x 50 x 25 mm.

PRICE $20.27 P&P $0.40

The PSU50 incorporated a specially designed transformer and can be used for either mono or stereo systems.

**TECHNICAL SPECIFICATIONS**

| | |
|---|---|
| **Output voltage** | 50 volts (25–0–25) |
| **Input voltage** | 210–240 volts |
| **Size** | L.70, D.90, H.60 mm. |

PRICE $20.41 P&P $2.00

P&P $2.00 FOR 1 COMPLETE SET OF HY5 + HY50 + PSU50

TWO YEARS GUARANTEE ON ALL OUR PRODUCTS

**K. D. FISHER & CO.**
**P. O. Box 34, Nailsworth, S.A. 5083.**
**Telephone 269-2544.**

Please Supply__________
Total Purchase Price__________
I Enclose Cheque ☐ Postal Orders ☐ Money Order ☐

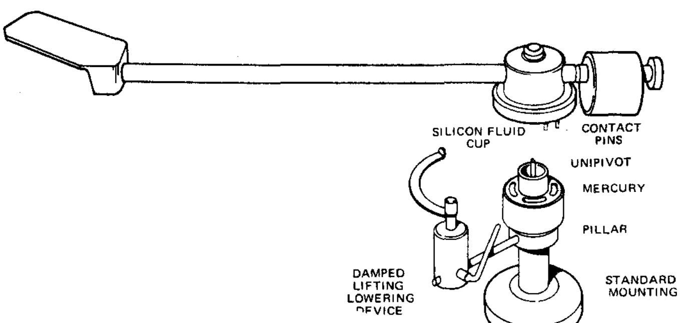
__________
Name & Address__________
Signature__________

# AUDIO FACTS

## KMAL LABORATORY PICK-UP ARM

In past few years a number of companies have produced pick-up cartridges having very low mass and high compliance and designed to track at pressures of a gram or so.

In many cases purchasers of these cartridges have run into problems due to the large mass and correspondingly high inertia of the conventional pick-up arms to which the cartridges were fitted.




Basically a pick-up arm must have low effective mass — that is the moving bit as seen by the stylus must be light, the fundamental resonance of the arm must not coincide with audio frequencies, nor frequencies of record surface irregularities nor motor rumble; the arm must have low friction and inertia so that little load is applied to the record groove, and so that the stylus may faithfully follow warped records; and the arm must be adequately damped and accurate anti-skating bias provided.

These requirements are hard to meet. Most high quality arms are in fact very complex engineering structures indeed.

The KMAL arm produced by Britain's Keith Monks Audio solves most of the problems inherent in arm design in a simple and elegant fashion. The arm is a unipivot design intended specifically for use with low mass ultra-high compliance gartridges. The arm itself is pivoted on an inverted needle, the point of which sits in the centre of a precision ball race. A metal collar protuding downwards from the race rests in a small container of a viscous silicone fluid.

Unlike other arms, the audio output from the cartridge is transferred from the arm assembly via four metal pins immersed in tiny baths of mercury. Anti-skating bias is applied via a simple magnetic device acting on the pins.

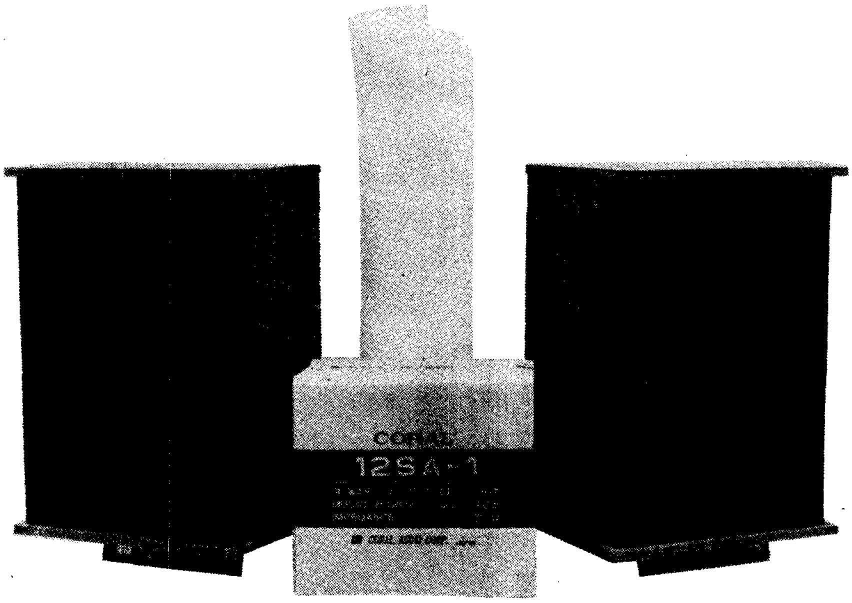
Brief tests showed that the stiction and friction in both planes was virtually identical at 3-4 mg — about the lowest we've ever seen quoted before.

Frankly the KMAL arm won't win any prizes for appearance — it's not badly made but it's not a patch on the SME (for example), to look at. Aesthetics aside however it does work very well indeed and will no doubt appeal to those who have an affinity for its *totally straight*forward and elegant engineering approach to solving fundamental problems.

Further details may be obtained from W.C. Wedderspoon Pty Ltd., 3 Ford St Greenacre NSW 2190

# PRE·PAK electronics

SYDNEY: 718 Parramatta Road, CROYDON, N.S.W. 2132, P.O. Box 43, CROYDON, 2132. Phone: 797-6144.
SYDNEY (CITY): 432 Kent Street, Sydney. Phone 29-7426
NEWCASTLE: Shops 3-6 West End Arcade, 810 Hunter Street, WEST NEWCASTLE, 2300. Phone: 69-2103.




## PRE PAK PRESENTS FOR YOU

*Our 12PK30 speaker unit which has the following features:*

- 125A1Coral kit which is a 3 way 4 speaker system with 8 ohms input impedance, cross over frequencies of 1,000 and 10,000 Hz, frequency response of 30 Hz to 20 kHz, sensitivity of 95 dB and a capacity of 60 W.
- 2 yds 1" innerbond.
- 2 Closed type cabinets of 1.6 cubic feet capacity, finished with a rustic teak Duraline D.A.P covering. Wrap around front grill, baffles ready cut to suit speakers.
- *Also available Magnavox and Philips Systems.*

PRICE **$165.00** By Rail only — P.P.N.S.W. $20.00 — P.P. Interstate $30.00

## PRE PAK FOR KITS

| | | | P.P. |
|---|---|---|---|
| 1 | Hi power strobe ETI 505 | $22.50 | $3.00 |
| 2 | Electronic mosquito repeller | $ 7.50 | $1.50 |
| 3 | Drill speed controller | $ 9.95 | $2.00 |
| 4 | Variwiper | $10.00 | $1.50 |
| 5 | Intruder alarm ETI 528 | $15.95 | $2.00 |
| 6 | 100 W Guitar amp | $69.50 | $6.00 |
| 7 | Guitar amp preamp | $ 7.50 | $1.50 |
| 8 | Magnetic preamp without power supply | $ 7.50 | $1.50 |
| 9 | Magnetic preamp with power supply | $13.25 | $3.00 |
| 10 | Musicolor III | $57.00 | $7.50 |
| 11 | Fet 4 Input mixer | $26.50 | $4.50 |
| 12 | Light dimmer kit | $ 4.50 | $1.50 |

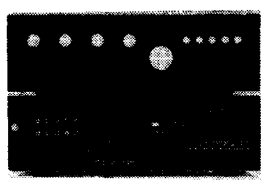
## PRE PAK FOR CHEMICAL SPRAYS

| | Qnty 1-9 | Qnty 10-99 | P.P. |
|---|---|---|---|
| CRC 226 6oz can | $1.75 | $1.40 | $1.50 |
| CRC 226 16oz can | $3.85 | $3.08 | $1.50 |
| CRC Rapid Freeze 26oz | $4.14 | $3.31 | $1.50 |
| CRC Go Contact Cleaner 6oz | $2.99 | $2.39 | $1.50 |
| CRC Go Contact Cleaner 16oz | $5.18 | $4.14 | $1.50 |
| CRC Zinc It | $3.04 | $2.43 | $1.50 |

## PRE PAK FOR AMPLIFIERS

Sansui AV2900 featuring modern styling 15W RMS per channel output, frequency response 40 Hz to 20 kHz, harmonic distortion maximum .3%.

**$155.00**
P.P. $10.00



*ALSO AVAILABLE*

Sansui AU3900 22W + 22W RMS
Sansui TU3900 Stereo FM/AM Tuner

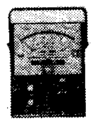
## MAIL ORDER ADDRESS 432 Kent Street, Sydney.

# 29-7426

## BANK CARD WELCOME

P&P Interstate add 50%

CROYDON STORE OPEN 7 DAYS
Monday to Saturday



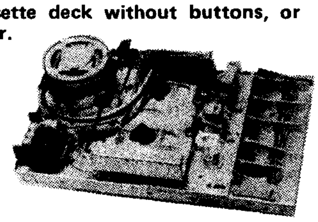
## PRE PAK FOR TEST EQUIPMENT

- MVA 100 CN multimeter 100k ohms per volt with the following ranges:— 7xDC volt; 5xAC volt; 6xDC amp; 5xResistance.
  **$42.50** P.P. $5.00
- Kamoden HM35 Digital multimeter with power supply.
  **$159.00** P.P. $7.50
- MVA50 50K ohms per volt 46 ranges.
  **$31.95** P.P. $5.00
- C.T. 500MP 20K ohms per volt — real value.
  **$22.50** P.P. $3.00

## PRE PAK FOR VALUE

Vortex cassette deck without buttons, or AC capacitor.

**$22.00**
P.P. $4.00



# 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.

## Extra facilities on the HP21

Although the Hewlett-Packard HP21 is very versatile, it does lack a key which allows the contents of the memory to be interchanged with those of the x register. This can be achieved in the following manner:–
First press the blue function key once.
Then press the 'minus' key and the '7' key, at the same time,

*i.e., Step 1 (F)*
*Step 2 (–) (7) simultaneously*

This should interchange the number stored in the memory with that in the display.

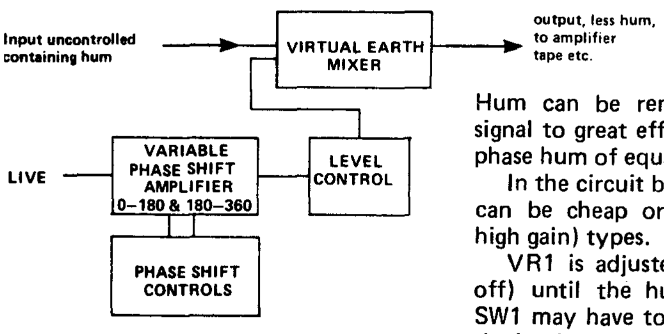
Also if pressing the function key and then the $\pi$ key seems a bit slow to obtain $\pi$, pressing (÷) and (0) simultaneously will yield the constant. With a bit of practice this can be done quicker than the conventional way.

Finally a number can have its inverse calculated and stored in the memory while the number which was previously in the memory is now displayed, merely by pressing the function key and then simultaneously pressing (1/x) and (cos). However, this feature is probably not very important.

So far I know of no way to get a timer as can be obtained on the HP45.

## Hum stopper

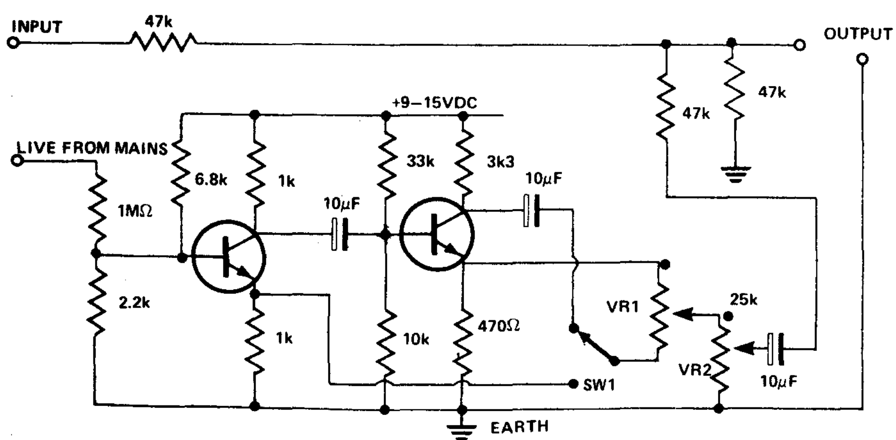
*BLOCK DIAGRAM OF SYSTEM*




Hum can be removed from an audio signal to great effect by mixing an anti-phase hum of equal level.

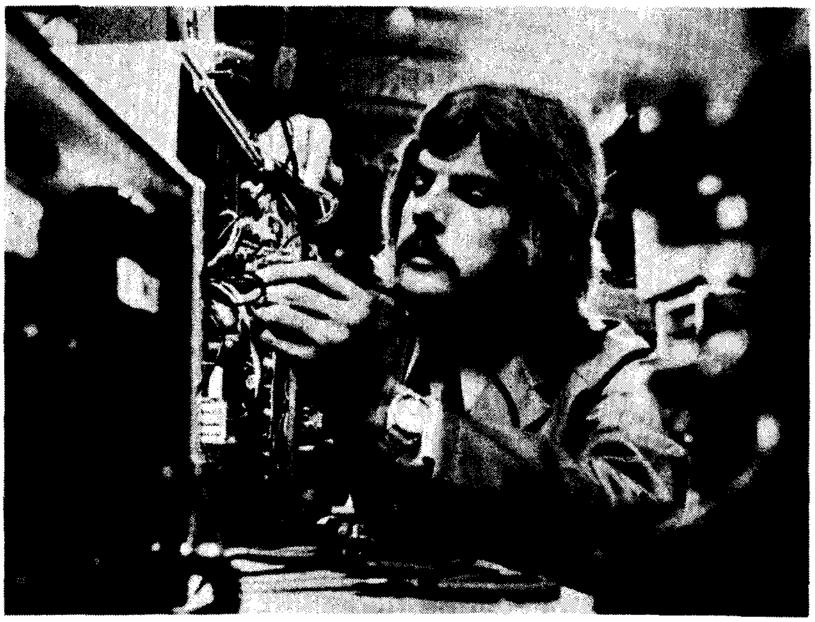
In the circuit below all the transistors can be cheap or surplus npn (low or high gain) types.

VR1 is adjusted with VR2 low (not off) until the hum is at a minimum, SW1 may have to be changed over, then the level VR2, is altered until the hum is removed.



# Six top careers in electronics

A top salary, job security and positive success. That's what a career in the exciting and rapidly expanding electronics industry can give you—if you have the right qualifications. An ICS course can give you the training you need for the rewarding career you deserve. With ICS, you learn at home, at your own pace. There's no time lost travelling to classes; ICS provide you with everything you need by mail. You're ready for success in electronics now, so select your course, then fill in and post the coupon today.



## INDUSTRIAL ELECTRONICS SPECIALIST

If you're interested in specialising in industrial electronics, this course offers technical-level training. It is an ICS Diploma Course, with a full list of subjects ranging from Circuits, Electronic Diagrams and AM/FM Radio Receiving Systems to Ultrasonics and Computer Principles. The full range from the most basic to the most sophisticated technology.

## ELECTRONICS TECHNICIAN

This Diploma Course will give you a particularly thorough knowledge of Electronic Technology. You will learn the principles, applications and maintenance of electronic equipment in industrial and other fields, including instruction on radio principles. Major sections cover electrical and electronic measuring instruments, telemetering, facsimile and radio-electronic telemetery.

## COMMUNICATIONS BROADCASTING SPECIALIST

This course prepares students wishing to sit for the P.M.G. examinations for the various proficiency certificates—Commercial Operator's Certificate of Proficiency (Aust.), Radio-Telegraph Operator's Certificate of New Zealand, Broadcast Station Operator's Certificate of Proficiency and Certificate in Radio Technology (New Zealand). Sections covered include: Electrical Theory, Radio Theory, Regulations, Telegraphy Tests, Practical and Oral Questions.

## ELECTRONIC COMPUTER SERVICING SPECIALIST

A specialist course designed to provide a sound knowledge of the technical aspects of computers; how they function and their practical applications, including programming. The course covers Number Systems and Digital Components; Organisation and Maintenance of Computers: Servomechanisms and Fundamentals of Computer Programming.

## COMPUTER TECHNICIAN

This compact Diploma course will be of special value to technical people who are likely to be concerned with the installation, maintenance and operation of digital computers. It provides a sound introduction to Electrotechnics, Electronic Theory, Electronic Computers and Digital Computer Programming. Practical applications are stressed throughout.

## COLOUR TV

If you already have a knowledge of the principles and practice of TV, this course will prepare you for the introduction of colour TV. Subjects covered in detail include: Colour in TV, the Colour TV system, Picture Tubes and Receiver Circuits for Colour TV, Troubleshooting Colour TV, Alignment of Monochrome and Colour Receivers and the PAL System.

POST THIS COUPON TODAY TO

ICS

**International Correspondence Schools**
**400 Pacific Hwy. Crows Nest NSW 2065. Tel: 43-2121**
**18-20 Collins St. Melbourne 3000. Tel: 63-7327**
**New Zealand: 182 Wakefield St. Wellington.**

Please provide me with information about the Career on__________

Mr/Mrs/Miss__________ Age_____

Address__________

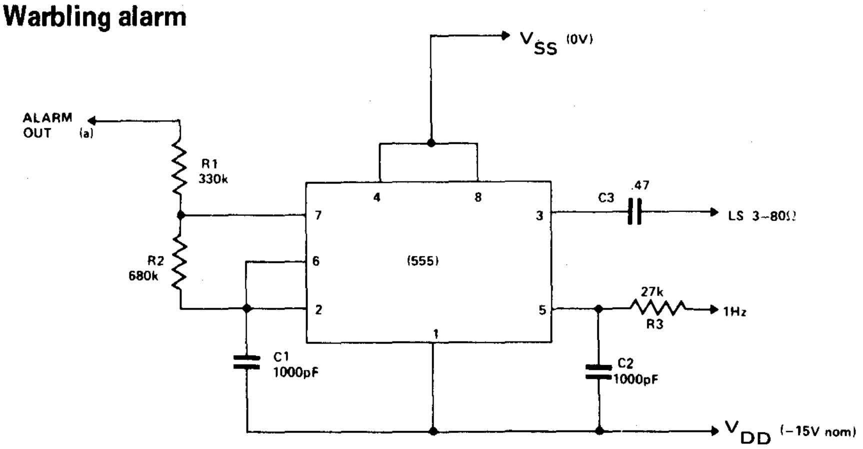
__________ Postcode_____

Occupation__________

EAO

# Ideas for experimenters

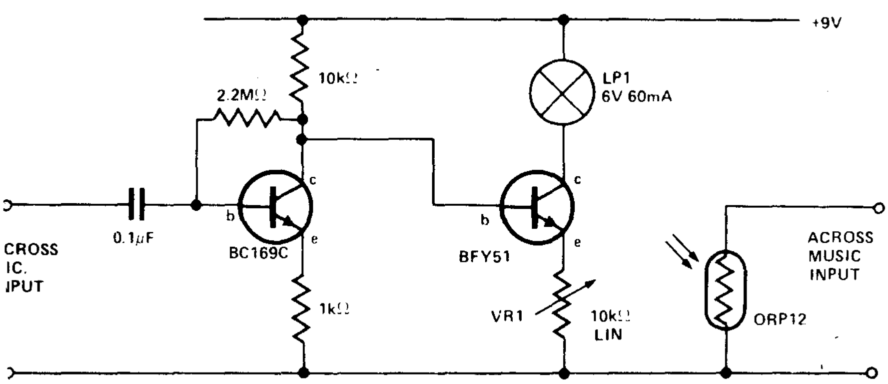
## Warbling alarm




This device gives a two-tone alarm from a digital clock. It may be used with any CMOS alarm clock chip having an active high alarm output and 1 Hz (optional) output. It was built to work with a CT7001 chip and requires no interface components.

The 555 operates in normal astable mode when the alarm goes high (ie point [a] approaches Vss). Pin 5 is the normal control voltage input and swings from almost Vss to VDD via the 27 k resistor at a 1 Hz rate. This causes the audio output to switch between high and low tones, above and below the frequency determined by R1, R2 and C1. To vary the frequency difference, R3 may be altered within wide limits, but it is inadvisable to keep it below 15 k. The basic frequency is best varied by chaning C1. Audio output may be varied by changing C3 (depending on LS impedance). In the original, a 35 Ω speaker was used with –12 V VDD and was sufficient to rouse an expert heavy sleeper.

## Simple disco auto fade




Vhen a DJ has to make an announce-nent over a record, the normal ırocedure is to fade out the deck, fade ı the microphone, and vice versa at the nd. If this unit is used, however, the ıperator need only speak into the ıicrophone, the deck being faded out utomatically.

The lamp and LDR need to be taped ɔgether, preferably with black tape, to xclude light. VR1 is used to set the brightness of the lamp. With no signal on the input, VR1 is set for no attenuation of the music signal. When speaking at normal volume through the mic. the music should fade down until it can be heard quietly in the background. Some microphones may not produce enough signal to do this. If this happens, a simple pre-amp can be added to the input stage, as was done in the prototype.

# 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. These kits include hardware as well as electronic components. There are many suppliers who can provide you with all the electronics for a project (companies like Techniparts in Brisbane) so it is not necessary to buy a kit provided you can find a suitable case etc.

Any companies who want to be included in this list should phone Steve Braidwood on 33-4282.

Key to the companies:

- **A** Applied Technology Pty. Ltd. of Hornsby, NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW.
- **E** E.D. & E. Sales, Victoria.
- **J** Jaycar Pty. Ltd. of Haymarket, NSW.
- **N** Nebula Electronics Pty. Ltd. of Rushcutters Bay, NSW.

| | | |
|---|---|---|
| ETI 101 | Logic Power Supply | E |
| ETI 102 | Audio Signal Generator | E,D |
| ETI 103 | Logic Probe | E |
| ETI 107 | Widerange Voltmeter | E |
| ETI 108 | Decade Resistance Box | E |
| ETI 109 | Digital Frequency Meter | E |
| ETI 111 | IC Power Supply | E |
| ETI 112 | Audio Attenuator | E |
| ETI 113 | 7-Input Thermocouple Meter | E |
| ETI 116 | Impedance Meter | E |
| ETI 117 | Digital Voltmeter | E,A |
| ETI 118 | Simple Frequency Counter | E,A |
| ETI 119 | 5V switching regulator supply | E |
| ETI 120 | Logic Probe | E |
| ETI 121 | Logic Pulser | E |
| ETI 122 | Logic Tester | E |
| ETI 123 | CMOS Tester | E |
| ETI 124 | Tone Burst Generator | E |
| ETI 128 | Audio Millivoltmeter | E |
| ETI 129 | RF Signal Generator | E |
| ETI 131 | General Purpose power supply | E,N |
| ETI 206 | Metronome | E |
| ETI 218 | Monophonic Organ | E,D |
| ETI 219 | Siren | E |
| ETI 220 | Siren | E |
| ETI 222 | Transistor Tester | E |
| ETI 232 | Courtesy Light Extender | E |
| ETI 234 | Simple Intercom | E |
| ETI 236 | Code Practice Oscillator | E |
| ETI 239 | Breakdown Beacon | E |
| ETI 301 | Vari-Wiper | E |
| ETI 302 | Tacho Dwell | E |
| ETI 303 | Brake-light Warning | E |
| ETI 309 | Battery Charger | E |
| ETI 312 | CDI Electronic Ignition | E |
| ETI 313 | Car Alarm | E,D |
| ETI 401 | Audio Mixer FET Four Input | E |
| ETI 403 | Guitar Sound Unit | E |
| ETI 406 | One Transistor Receiver | E |
| ETI 407 | Bass Amp | E |
| ETI 408 | Spring Reverb. Unit | E |
| ETI 410 | Super Stereo | E |
| ETI 412 | Music Calibrator | E |
| ETI 413 | 100 Watt Guitar Amp | E,J |
| ETI 413 | x 2 200 Watt Bridge Amp | E |
| ETI 414 | Master Mixer | E,J |
| ETI 414 | Stage Mixer | E |
| ETI 416 | 25 Watt Amplifier | E |
| ETI 417 | Amp Overload Indicator | E |
| ETI 419 | Guitar Amp Pre-Amp | E,D |
| ETI 420 | Four-channel Amplifier | E |
| ETI 420E | SQ Decoder | E |
| ETI 422 | International Stereo Amp | E |
| ETI 422B | Booster Amp | E |

| | | |
|---|---|---|
| ETI 422 | 50 Watt Power Module | E,D |
| ETI 423 | Add-On Decoder Amp | E |
| ETI 424 | Spring Reverberation Unit | E |
| ETI 425 | Integrated Audio System | E |
| ETI 426 | Rumble Filter | E |
| ETI 427 | Graphic Equaliser | E,J |
| ETI 430 | Microphone Line Amp | E |
| ETI 433 | Active Crossover | E,J |
| ETI 435 | Crossover Amp | E,J |
| ETI 436 | Dynamic Noise Filter | E |
| ETI 438 | Audio Level Meter | E |
| ETI 440 | Simple 25 Watt Amp | E |
| ETI 441 | Audio Noise Generator | E |
| ETI 443 | Compressor-Expander | E,J |
| ETI 444 | Five Watt Stereo | E,N |
| ETI 445 | Preamp | E.N,D |
| ETI 446 | Phaser | E,J |
| ETI 447 | Audio Limiter | E,N |
| ETI 502 | Emergency Flasher | E |
| ETI 503 | Burglar Alarm | E |
| ETI 505 | Strobe | 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 | E |
| ETI 522 | Photographic Timer | E |
| ETI 523 | Sweep Generator | E |
| ETI 525 | Drill Speed Controller | E |
| ETI 526 | Printimer | E |
| ETI 527 | Touch Control Light Dimmer | E |
| ETI 528 | Home Burglar Alarm | E |
| ETI 529 | Electronic Poker Machine | E |
| ETI 533 | Digital Display | E,A |
| ETI 534 | Calculator Stopwatch | A,D |
| ETI 539 | Touch Switch | E |
| ETI 540 | Universal Timer | E |
| ETI 541 | Train Controller | E |
| ETI 601 | | |
| 4600 | Synthesiser | J |
| 3600 | Synthesiser | J |
| ETI 602 | Mini Organ | E,A,D |
| ETI 701 | TV Masthead Amplifier | E,D |
| ETI 702 | Radar Intruder Alarm | D |
| ETI 703 | Antenna Matching Unit | E |
| ETI 704 | Crosshatch/Dot Generator | A,D,E |
| ETI 706 | Marker Generator | E |
| ETI 707 | Modern Solid State Converters | C,E |
| ETI 740 | FM Tuner | A |
| ETI 708 | Active Antenna | E |
| ETI 710 | 2 metre Booster | C E |
| ETI 780 | Novice Transmitter | E |

HEATHKIT®

# Build your own test equipment.

## Famous 2700 Series power supplies

## Save Money!!

**Ideal for powering breadboard circuits, electrical component testing, or as a power source for bench use. All feature remote programming and voltage sensing; simplified front panel operation. Digital readout types have two decade auto-ranging for high resolution on low voltage and current settings. Choose from four DC models: 0-7.5 V @ 10 A; 0-15 V @ 5 A; 0-30 V @ 3A; 0-60 V @ 1.5 A.**

**IP/SP-2700 SERIES SPECIFICATIONS**
(NOTE: Specs measured in accordance with NEMA standards (PYI-1972) after 30-minute warmup period.)

**Max. Rated Output:** Models IP/SP-2700 & 2701; 60V, 1.5A; models IP/SP-2710 & 2711: 30V, 3A; models IP/S-2720 & 2721: 15V, 5A; models IP-2730 & 2731: 7.5V, 10A. **Load Regulation:** Voltage: ±0.05% + 1 mV, Current: ±0.10% + 3.5 mA. **Line Regulation:** Voltage: ±0.05% + 1 mV. Current: ±0.10% +1 mA. **Ripple & Noise:** Voltage: 1 mV RMS; 0.03% of rated output, peak-to-peak. **Voltage/Current Readout (Switchable):** Analog: 3½", 100°, meter, Digital: 3½-digit (1999), two-decade, auto-ranging, digital meter. **Readout Accuracy:** Voltage: Analog ±3% of rated output; Digital ±0.5% of reading ±1 count using lab standards, ±1.0% of reading ±1 count using built-in calibrator, Current: Analog – ±3% of rated output: Digital – ±1.0% of reading ±4 count using lab standards, ±1.5% of reading ±4 count using built-in calibrator. **Readout Response Time: (Digital):** 2 seconds to within 5 counts. **Stability at Output Terminals:** Voltage: ±(0.01% + 1 mV)/hr. Current: ±(0.05% + 1 mA)/hr. **Stability as Displayed (Digital):** Voltage: ±(0.01% + 1 mV + ½ count)/hr. Current: ±(0.01% + 1 mA + ½ count)/hr. **Operating Modes:** Constant voltage, constant current, auto-series, auto parallel. **Programming Mode:** Voltage: A—zero to rated output with 0 to 5.0 VDC applied; B—zero to rated output with 0 to 5000Ω external resistor. Current: Zero to rated output with applied voltage of 1.0 volt/amp (0.1 volt/amp for IP-2731). Programming transient response: 0.1 ms for low current to high current changes: 1.0 ms for high to low. Load resistance less than 10 x (E Rated/I Rated). **Power Requirements:** 120/240 ± 10/20 VAC; 60/50 Hz, 2.0/1.0 Amps max. **Overall Dimensions:** 5.5" H x 15" W x 13.5" D.

Post now for your free CATALOGUE.

# order NOW from

WF WARBURTON FRANKI

ADELAIDE 356-7333 • BRISBANE 52-7255 • HOBART 23-1841
MELBOURNE 699-4999 • PERTH 65-7000 • SYDNEY 648-1711
• WELLINGTON N.Z. 698-272

**WARBURTON FRANKI HEATHKIT CENTRE**
**220 Park St., Sth Melbourne, 3205**
**Ph. 699 4999**

IP-2700

Name ..............................

Address ..............................

.................... Postcode .....

# Please Explain

This new feature is our response to the many requests we get from readers who want explanation or information on topics they read about in the magazine. If you have a question please send it to Please Explain, ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW. 2011.

## 422 Power Amp

**In order to adjust the bias current on a 422 amplifier I connected 220 ohm resistors across the fuseholders and switched on the power. I get a full 40 V across the resistor in the positive side and no voltage across the resistor on the negative side. The presets RV1 and RV2 have no effect. Can you help me find the fault, please?**

**G.M., Manly, NSW.**

These symptoms indicate that one of the output transistors is fully turned on and the other is fully off. This suggests you have inserted one of the components incorrectly. Check the BC548s and make sure that they are Philips types — if they are from another manufacturer they must be inserted in a different way to that shown on the overlay.

## 4k7 = 47 k or 4.7 k?

**In the parts list of ETI project 122 R7 is quoted as 4k7. It is also coded this way on the circuit diagram. Shouldn't this be 47 k?**

**H.G.M.,Dangenong, Victoria.**

When these codings are used it is in conformity with an international standard devised to overcome certain printing errors (the obliteration or eroneous inclusion of the decimal point). In these examples the multiplier occupies the position normally taken by the decimal point. So 4k7 is 4.7 k, 3M9 is 3.9 M, 5n6 is 5.6 nF or 0.0056 μF. We have decided to adopt this standard for all future ETI projects.

## Toroidal transformers

**Recent hi-fi advertisers in ETI have mentioned that their amplifiers have toroidal power transformers. What does this mean, and what advantages do these types offer?**

**D.J., Melbourne.**

Toroidal coils and transformers are wound on a ring-shaped core made from compressed alloy dust. Their advantages lie in the high Q values obtainable (as much as several hundreds). Toroidal coils are used in equalisers because of the high efficiency — an added advantage is that they are largely unaffected by external magnetic fields so they can be mounted close together.

When used in hi-fi amplifiers as mains transformers they have two advantages. First, the closed magnetic circuit keeps down hum fields, and second, the flat construction means that a low-profile case design can be used for the amplifier.

## Remote Control Receiver

**Two questions about this project —**
**(1) Does it matter if the receiver crystal is 455 kHz lower than the transmitter frequency (instead of 455 kHz higher)?**
**(2) Why does IC3 (4001 CMOS) have to be an SCL4001 or an HEF4001? Why not any old 4001 CMOS IC?**

**H.A., Mt Waverley, Vic.**

(1) It doesn't matter.
(2) The Signetics and Solid-State Scientific devices must be used because they are faster than the usual CMOS.

## K or k?

**In ETI I have seen references to memory chips with 1K bytes capacity and on other occasions I've seen the expression 1k used. Is there any difference?**

**K.D., Sydney.**

A memory with 1K byte storage capacity has room to store 1024 words. This number is two to the power of ten and it is symbolised by the capital letter K (when used to specify large numbers in computer articles). Rather than referring to numbers like 65 536 ($2^{16}$) we say 64K (or 65k).

When the small k is used as a multiplier it introduces a factor of 1000, as in kg, km, kW, etc. Sometimes it is used *incorrectly* to indicate $2^{10}$.

## Expander Compressor

**In project ETI 443 I can't work out how the connections between the IC sockets and the pcb tracks on the component side of the board are made.**

**Also could you put me straight as to where the unit connects into the audio chain?**

**R.D.D., Bendigo, Victoria.**

Ordinary IC sockets cannot be used with the double-sided pcb design published for this project. If you really want to use sockets they need to have extra-long pins (try using wire-wrap types).

The Expander-Compressor needs to be connected at a level of at least 100 mV to work properly. It should go between the preamp and the main amplifier and ideally it would come after the volume control. Connection between the Tape Out and Tape In sockets would probably be satisfactory.

## Digital Display DPs

**On the ETI 118 frequency counter project the range-switch wiring diagram refers to DP1 and DP2. What are these connections?**

**A.S., Sydney.**

These refer to the decimal points on the seven-segment displays (actually on display 1 and display 2) of the digital display module.

**UNIVERSAL BREADBOARD**
Silver plated copper circuit board 3-3/16" x 5-3/16", 2 rows of 27 holes for DIP IC's • space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuitry **$1.50 ea.**

**TTL**

| | | | | | |
|---|---|---|---|---|---|
| 7400 | .13 | 7451 | .17 | 74153 | .89 |
| 7401 | .16 | 7453 | .17 | 74154 | 1.20 |
| 7402 | .15 | 7454 | .17 | 74155 | .97 |
| 7403 | .15 | 7460 | | 74156 | .97 |
| 7404 | .16 | 7464 | .35 | 74157 | .99 |
| 7405 | .19 | 7465 | .35 | 74158 | 1.79 |
| 7406 | .20 | 7470 | .30 | 74160 | 1.23 |
| 7407 | .28 | 7472 | .30 | 74161 | .97 |
| 7408 | .18 | 7473 | .35 | 74162 | 1.39 |
| 7409 | .19 | 7474 | .28 | 74163 | 1.09 |
| 7410 | .16 | 7475 | .49 | 74164 | .99 |
| 7411 | .25 | 7476 | .30 | 74165 | .99 |
| 7413 | .43 | 7483 | .68 | 74166 | 1.25 |
| 7414 | .65 | 7485 | .88 | 74170 | 2.10 |
| 7416 | .35 | 7486 | .40 | 74173 | 1.49 |
| 7417 | .35 | 7489 | 2.25 | 74174 | 1.23 |
| 7420 | .16 | 7490 | .43 | 74175 | .97 |
| 7422 | .30 | 7491 | .75 | 74176 | .89 |
| 7423 | .29 | 7492 | .48 | 74171 | .84 |
| 7425 | .27 | 7493 | .48 | 74180 | .90 |
| 7426 | .26 | 7494 | .78 | 74181 | 2.45 |
| 7427 | .29 | 7495 | .79 | 74182 | .79 |
| 7430 | .20 | 7496 | .79 | 74184 | 1.90 |
| 7432 | .23 | 74100 | .98 | 74185 | 2.20 |
| 7437 | .25 | 74105 | .44 | 74187 | 5.75 |
| 7438 | .25 | 74107 | .37 | 74190 | 1.15 |
| 7440 | .15 | 74121 | .38 | 74191 | 1.25 |
| 7441 | .89 | 74122 | .38 | 74192 | .95 |
| 7442 | .59 | 74123 | .65 | 74193 | .85 |
| 7443 | .73 | 74125 | .54 | 74194 | 1.25 |
| 7444 | .73 | 74126 | .58 | 74195 | .74 |
| 7445 | .73 | 74132 | .89 | 74916 | 1.25 |
| 7446 | .81 | 74141 | 1.04 | 74197 | .73 |
| 7447 | .79 | 74145 | 1.04 | 74198 | 1.73 |
| 7448 | .79 | 74150 | .97 | 74199 | 1.69 |
| 7450 | .17 | 74151 | .79 | 74200 | 5.45 |

**LOW POWER**

| | | | | | |
|---|---|---|---|---|---|
| 74L00 | .29 | 74L51 | .29 | 74L90 | 1.40 |
| 74L02 | .29 | 74L55 | .29 | 74L91 | 1.20 |
| 74L03 | .23 | 74L71 | .29 | 74L93 | 1.50 |
| 74L04 | .29 | 74L72 | .45 | 74L95 | 1.50 |
| 74L06 | .29 | 74L73 | .56 | 74L98 | 2.25 |
| 74L10 | .29 | 74L74 | .56 | 74L164 | 2.25 |
| 74L20 | .29 | 74L78 | .75 | 74L165 | 2.30 |
| 74L30 | .29 | 74L85 | 1.09 | | |
| 74L42 | 1.39 | 74L86 | .65 | | |

**LOW POWER SCHOTTKY**

| | | | | | |
|---|---|---|---|---|---|
| 74LS00 | .36 | 74LS32 | .38 | 74LS95 | 2.09 |
| 74LS02 | .36 | 74LS40 | .45 | 74LS107 | .59 |
| 74LS04 | .36 | 74LS42 | 1.40 | 74LS164 | 2.20 |
| 74LS08 | .38 | 74LS74 | .59 | 74LS193 | 2.20 |
| 74LS10 | .36 | 74LS90 | 1.30 | 74LS197 | 2.20 |
| 74LS20 | .36 | 74LS93 | 1.30 | | |

**HIGH SPEED**

| | | | | | |
|---|---|---|---|---|---|
| 74H00 | .25 | 74H22 | .25 | 74H61 | .25 |
| 74H01 | .25 | 74H30 | .25 | 74H62 | .25 |
| 74H04 | .25 | 74H40 | .25 | 74H74 | .39 |
| 74H08 | .25 | 74H50 | .25 | 74H101 | .58 |
| 74H10 | .25 | 74H52 | .25 | 74H102 | .58 |
| 74H11 | .25 | 74H53 | .25 | 74H103 | .60 |
| 74H20 | .25 | 74H55 | .25 | 74H106 | .72 |
| 74H21 | .25 | 74H60 | .25 | 74H108 | .72 |

**SCHOTTKY**

| | | | | | |
|---|---|---|---|---|---|
| 74S00 | .38 | 74S08 | .52 | 74S22 | .38 |
| 74S02 | .45 | 74S10 | .38 | 74S32 | .52 |
| 74S03 | .38 | 74S20 | .38 | 74S74 | .38 |
| 74S04 | .45 | | | | |

**8000 (NATIONAL)**

| | | | | | |
|---|---|---|---|---|---|
| 8091 | .61 | 8220 | 1.49 | 8811 | .65 |
| 8092 | .61 | 8230 | 2.19 | 8812 | 1.02 |
| 8095 | 1.25 | 8288 | 1.49 | 8822 | 2.19 |
| 8121 | .80 | 8520 | 1.16 | 8830 | 2.19 |
| 8123 | 1.43 | 8552 | 2.19 | 8831 | 2.19 |
| 8200 | 2.33 | 8563 | .62 | 8836 | .29 |
| 8214 | 1.49 | 8810 | .70 | 8880 | 1.19 |

**8000 (SIGNETICS)**

| | | | |
|---|---|---|---|
| 8263 | 5.79 | 8267 | 2.59 |

**9000**

| | | | | | |
|---|---|---|---|---|---|
| 9002 | .40 | 9309 | .79 | 9601 | .61 |
| 9301 | 1.03 | 9312 | .79 | 9602 | .79 |

**DVM CHIP 4½ DIGIT**
MM5330 — P channel device provides all logic for 4½ digit volt meter. 16 pin DIP with data **$9.95**

Zener Diodes, Diodes & Rectifiers

| | | | |
|---|---|---|---|
| IN 486B | Diode | 250V | $ .25 ea. |
| IN 747A | Zener | 3.6V | .25 |
| IN 754A | Zener | 6.8V | .25 |
| IN 756A | Zener | 8.2V | .25 |
| IN 904 | Sw. Diode | 30V | .10 |
| IN 914 | Sw. Diode | 100V | .10 |
| IN 4858 | Zener | 120V | .25 |
| IN 5230A | Zener | 4.7V | .25 |
| IN 5242B | Zener | 12V | .25 |

**Data included with order on request. Add $.30 ea. if item is priced below $1.00**

**SHIFT REGISTERS**

| | | |
|---|---|---|
| MM5013 | 1024 bit accum. dyn. | 1.75 |
| MM5016 | 500/512 bit dyn. | 1.59 |
| SL5-4025 | Quad 25 bit | .99 |
| 2504 | 1024 bit multiplexed dyn | 3.95 |

**IC SOCKETS**
**Solder Tail - low profile**

| | | | |
|---|---|---|---|
| 8 pin | $ .17 | 24 pin | .42 |
| 14 pin | .20 | 28 pin | .59 |
| 16 pin | .22 | 40 pin | .69 |
| 18 pin | .29 | | |

**WIRE WRAP - gold plate**
14 pin .49

**CMOS**

| | | | | | |
|---|---|---|---|---|---|
| 4000A | .26 | 4018A | 1.39 | 4066A | .89 |
| 4001A | .25 | 4020A | 1.72 | 4068A | .44 |
| 4002A | .25 | 4021A | 1.18 | 4069A | .44 |
| 4006A | 1.35 | 4022A | .94 | 4071A | .26 |
| 4007A | .26 | 4023A | .25 | 4072A | .35 |
| 4008A | 1.52 | 4024A | .89 | 4073A | .39 |
| 4009A | .57 | 4025A | .25 | 4075A | .39 |
| 4010A | .54 | 4027A | .59 | 4078A | .39 |
| 4011A | .29 | 4028A | .98 | 4082A | .35 |
| 4012A | .25 | 4030A | .44 | 4518A | 1.56 |
| 4013A | .45 | 4035A | 1.27 | 4528A | 1.56 |
| 4014A | 1.27 | 4040A | 1.39 | 4585A | 2.10 |
| 4015A | 1.27 | 4042A | 1.47 | | |
| 4016A | .48 | 4049A | .59 | | |
| 4017A | 1.01 | 4050A | .59 | | |

| | | | | | |
|---|---|---|---|---|---|
| 74C00 | .19 | 74C74 | 1.04 | 74C162 | 2.49 |
| 74C02 | .26 | 74C76 | 1.34 | 74C163 | 2.66 |
| 74C04 | .44 | 74C107 | 1.13 | 74C164 | 2.66 |
| 74C08 | .68 | 74C151 | 2.62 | 74C173 | 2.22 |
| 74C10 | .35 | 74C154 | 3.15 | 74C195 | 2.26 |
| 74C20 | .35 | 74C157 | 1.76 | 80C95 | 1.15 |
| 74C42 | 1.61 | 74C160 | 2.48 | 80C97 | .96 |
| 74C73 | 1.04 | 74C161 | 2.49 | | |

# NOVEMBER SPECIALS

**TTL**

| | |
|---|---|
| 7432 | $ .19 |
| 7437 | .20 |
| 7438 | .18 |
| 7474 | .22 |
| 7490 | .39 |
| 74121 | .29 |
| 74123 | .49 |
| 74164 | .85 |
| 74165 | .85 |
| 74193 | .73 |
| 9602 | .59 |

**CALCULATOR CHIPS**
5738 8 digit multiplexed — five function — chain operation 2 key memory — floating decimal — independent constant — interfaces with led with only digit driver — 9 V batt. oper. 24 pin ............ **$3.95**
5739 9 digit — 4 function — chain operation — 9V battery operation — 16 sec turn-off 22 PIN **$3.95**

**8038 FUNCTION GENERATOR**
Voltage controlled oscillator — sine, square, triangular output. 16 pin DIP with data **$3.95**

**JUMBO LED**

| | |
|---|---|
| Red | .12 |
| Green | .12 |
| Yellow | .12 |

**CMOS**

| | |
|---|---|
| 4001 | $ .19 |
| 4002 | .20 |
| 4009 | .39 |
| 74C00 | .14 |
| 74C73 | .69 |

**LINEAR**

| | |
|---|---|
| 301 | $ .21 |
| 311 | .59 |
| 309K | .89 |
| 340T+5v | .99 |
| 340T+15v | .99 |
| 741 | .21 |
| 3900 | .33 |
| 75491 | .59 |
| 1310 | 1.79 |

**2102 RAM**
1024 bit fully decoded static RAM
DTL/TTL compatible — 16 pin DIP 1.69

**IC BREADBOARD**
Accommodates 5 16 pin IC's with additional interconnection holes. 1/16" phenolic with silver plated copper circuits. 2 5/16" x 6 9/16" **$1.50 ea.**

**CALCULATOR CHIPS**

| | |
|---|---|
| 5002 | 1.19 |
| 5005 | 1.29 |
| 5738 | 1.95 |

**DISPLAYS**

| | |
|---|---|
| MAN1 | 1.39 |
| NSN71L | 1.19 |
| NSN74 | 1.19 |
| MAN8 | 1.39 |

**MEMORIES**

| | |
|---|---|
| 1103 | $ .95 |
| 1702 | 8.95 |
| 5203 | 8.95 |
| 5260 | .95 |
| 5261 | .95 |
| 5262 | 1.19 |
| F93410 | 1.39 |

**SPECIAL DEVICES**

| | | |
|---|---|---|
| 372 | AF-IF Strip Detector DIP | 2.93 |
| 546 | AM Radio Receiver Subsystem DIP | .75 |
| 1310 | FM Stereo Demodulator DIP | 2.90 |
| 1496 | Balanced Modulator-Demodulator | .99 |
| 1800 | Stereo multiplexer DIP | 2.48 |
| ULN2208 | FM Gain Block 34db (typ) mDIP | 1.18 |
| ULN2209 | FM Gain Block 48db (typ) mDIP | 1.35 |
| 2513 | Character Generator 64x8x5 DIP-24 | 10.20 |
| 3046 | Transistor Array DIP-14 | .73 |

**LINEAR CIRCUITS**

| | | |
|---|---|---|
| 300 | Pos V Reg (super 723) TO-5 | $ .71 |
| 301 | Hi Perf Op Amp mDIP TO-5 | .29 |
| 302 | Volt follower TO-5 | .53 |
| 304 | Neg V Reg TO-5 | .80 |
| 305 | Pos V Reg TO-5 | .71 |
| 307 | Op AMP (super 741) mDIP TO-5 | .26 |
| 308 | Mciro Pwr Op Amp mDIP TO-5 | .89 |
| 309K | 5V 1A regulator TO-3 | 1.35 |
| 310 | V Follower Op Amp mDIP | 1.07 |
| 311 | Hi perf V Comp mDIP TO-5 | .95 |
| 319 | Hi Speed Dual Comp DIP | 1.13 |
| 320T | Neg Reg 5, 12, TO-220 | 1.39 |
| 320K | Neg Reg 5.2, 12 TO-3 | 1.39 |
| 322 | Precision Timer DIP | 1.70 |
| 324 | Quad Op Amp DIP | 1.52 |
| 339 | Quad Comparator DIP | 1.58 |
| 340K | Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3 | 1.69 |
| 340T | Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220 | 1.49 |
| 370 | AGC/Squelch AMPL DIP | 1.20 |
| 372 | AF-IF Strip detector DIP | 2.93 |
| 373 | AM/FM/SSB Strip TO-5 | 2.42 |
| 376 | Pos V Reg mDIP | .68 |
| 380 | 2w Audio Amp DIP | 1.30 |
| 380-8 | .6w Audio Amp mDIP | 1.25 |
| 381 | Lo Noise Dual preamp DIP | 1.75 |
| 382 | Lo Noise Dual preamp DIP | 1.75 |
| 531 | High Slew rate Op Amp | 2.95 |
| 540 | Power driver TO-5 | 2.95 |
| 550 | Prec V Reg DIP | 1.02 |
| 555 | Timer mDIP | .45 |
| 556A | Dual 555 Timer DIP | 1.19 |
| 560 | Phase Locked Loop DIP | 3.39 |
| 562 | Phase Locked Loop DIP | 3.39 |
| 565 | Phase Locked Loop DIP TO-5 | 1.18 |
| 566 | Function Gen mDIP TO-5 | 1.95 |
| 567 | Tone Decoder mDIP | 1.95 |
| 709 | Operational AMP TO-5 or DIP | .26 |
| 710 | Hi Speed Volt Comp DIP | .35 |
| 711 | Dual Difference Compar DIP | .26 |
| 723 | V Reg DIP | .62 |
| 733 | Diff. video AMPL TO-5 | 1.02 |
| 739 | Dual Hi Perf Op Amp DIP | 1.07 |
| 741 | Comp Op Amp mDIP TO-5 | .32 |
| 747 | 741 Dual Op Amp DIP or TO-5 | .71 |
| 748 | Freq Adj 741 mDIP | .35 |
| 1304 | FM Mulpx Stereo Demod DIP | 1.07 |
| 1307 | FM Mulpx Stereo Demod DIP | .74 |
| 1456 | Op Amp mDIP | 1.83 |
| 1458 | Dual Comp Op Amp mDIP | .62 |
| 1800 | Stereo multiplexer DIP | 2.48 |
| 3900 | Quad Amplifier DIP | .49 |
| 7524 | Dual core memory sense Amp | .71 |
| 7525 | Dual core memory sense Amp | .90 |
| 8038 | Voltage contr. osc. DIP | 4.16 |
| 8864 | 9 DIG Led Cath Drvr DIP | 2.25 |
| 75150 | Dual Line Driver DIP | 1.75 |
| 75451 | Dual Perepheral Driver mDIP | .35 |
| 75452 | Dual Peripheral Driver mDIP | .35 |
| 75453 | (351) Dual Periph Driver mDIP | .35 |
| 75491 | Quad Seg Driver for LED DIP | .71 |
| 75492 | Hex Digit driver DIP | .80 |

THESE DISCOUNTS APPLY TO TOTAL OF ORDER — SPECIALS INCLUDED

## 10% OFF ON ORDERS OVER $25
## 15% OFF ON ORDERS OVER $100

LARGE QUANTITY PRICING AVAILABLE ON REQUEST
PLEASE SPECIFY ITEM AND QUANTITY

**MEMORIES**

| | | |
|---|---|---|
| 1101 | 256 bit RAM MOS 16 pin | 1.39 |
| 1103 | 1024 bit RAM MOS dynamic 18 pin | 1.95 |
| 1702A | 2048 bit PROM static electrically programmable UV erasable 24 pin | 10.95 |
| 2102 | 1024 bit RAM static 16 pin | 1.95 |
| 5203 | 2048 bit PROM static electrically programmable UV erasable 24 pin | 10.95 |
| 5260 | 1024 bit RAM MOS dynamic 16 pin | 1.95 |
| 5261 | 1024 bit RAM MOS dynamic 16 pin | 1.95 |
| 7489 | 64 bit ROM TTL 16 pin | 2.25 |
| 82S23 | 256 PROM-SCHOTTKY 16 pin | 3.69 |
| F93410 | 256 bit RAM bi-polar 16 pin | 1.95 |
| 74187 | 1024 bit ROM TTL 16 pin | 5.75 |
| 74200 | 256 bit RAM tri-state 16 pin | 5.45 |

**CLOCK CHIPS**

| | | |
|---|---|---|
| MM5311 | 6 digit multiplexed BCD, 7 seg, 12-24 Hr, 50-60 Hz — 28 pin | 4.45 |
| MM5312 | 4 digit multiplexed BCD, 7 seg, lpps. 12-24 Hr. 50-60 Hz — 24 pin | 3.95 |
| MM5314 | 6 digit multiplexed 12-24 Hr, 50-60 Hz 24 pin | 4.45 |
| MM5316 | 4 digit, 12-24 Hr, 50-60 Hz, alarm 40 pin | 4.95 |
| 537AA | 4-6 digit, 12 hour, 60 Hz snooze alarm brightness control capability, alarm tone output — 24 pin | 4.95 |
| CT7001 | 6 digit, 12-24 Hr, 50-60 Hz, alarm, timer and date circuits — 28 pin | 5.95 |

**CALCULATOR CHIPS**

| | | |
|---|---|---|
| CT5002 | 12 digit, 4 function fixed decimal battery operation — 40 pin | 1.95 |
| CT5005 | 12 digit, 4 function plus memory, fixed decimal — 28 pin | 2.49 |
| MM5725 | 8 digit, 4 function, floating decimal 18 pin | 1.98 |
| MM5736 | 6 digit, 4 function, 9V battery operation — 18 pin | 2.95 |
| MM5738 | 8 digit, 5 function plus memory and constant floating decimal, 9V battery operation — 24 pin | 3.95 |
| MM5739 | 9 digit, 4 function, 9V battery operation — 22 pin | 3.95 |

**TANTALUM CAPACITORS**
**Solid dipped ±20%**

| | | | | | |
|---|---|---|---|---|---|
| .1 mfd | 35V | $ .25 | 10 mfd | 16V | $ .40 |
| .33 mfd | 35V | .25 | 10 mfd | 25V | .45 |
| 1 mfd | 35V | .25 | 15 mfd | 10V | .40 |
| 2.2 mfd | 20V | .25 | 15 mfd | 20V | .45 |
| 2.2 mfd | 35V | .30 | 22 mfd | 16V | .45 |
| 3.3 mfd | 35V | .30 | 33 mfd | 10V | .40 |
| 4.7 mfd | 16V | .30 | 47 mfd | 6V | .40 |
| 6.8 mfd | 6V | .30 | 56 mfd | 6V | .45 |
| 6.8 mfd | 50V | .40 | 150 mfd | 15V | .50 |

**CLOCK KIT**
6 Digits (NS71L)
MM5314 Clock Circuit
2 PC Boards Clock & Display
All Transistors, Resistors
Capacitors & 3 switches with Schematic & Instructions **$14.95**

4 Digits (NS74)
MM5312 Clock Circuit
1 PC Board
All necessary transistors, resistors, capacitors, diodes & switches.
With schematic & instructions **$10.95**

**DISPLAYS**

| | |
|---|---|
| MAN1 | $1.95 |
| MAN2 | 3.95 |
| MAN3A | .19 |
| MAN5 | 2.25 |
| MAN6 | 2.49 |
| MAN7 | 1.49 |
| MAN8 | 2.25 |
| MAN66 | 2.25 |
| DL10A | 2.19 |
| FND500 | 1.89 |
| NS71L | 1.39 |

**DISCRETE LED'S**

| | |
|---|---|
| ME4 | $ .29 |
| MV50 | .12 |
| NSL100 | .12 |
| NSL101 | .12 |
| NSL102 | .15 |
| MV5020 | |
| RED | .15 |
| GREEN | .15 |
| AMBER | .15 |
| CLEAR | .15 |

**MULTIPLE DISPLAYS**

| | | |
|---|---|---|
| NSN33 | 3 digit .12" red LED | 1.79 |
| HP5082-7405 | 5 digit .11 red LED | 3.49 |
| HP5082-7414 | 4 digit .11 red LED | 3.25 |
| SP-425-09 | 9 digit .25 gas disch. | 1.79 |

**OPTO ISOLATORS**

| | | |
|---|---|---|
| MCD2 | Opto isolator diode | 1.09 |
| MCT2 | Opto isolator transistor | .70 |

**FREE CATALOG AVAILABLE ON REQUEST**

Duty may be payable on products imported.

The prices as listed are in Australian dollars. Send bank cheque with order. If international postal money order is used send receipt with order. Shipment will be made via air mail – postage paid – within three days from receipt.
Add $1.00 to cover shipping and handling if order is less than $10.00.


**INTERNATIONAL ELECTRONICS UNLIMITED**
P.O. BOX 3036 / MONTEREY, CA. 93940 USA
PHONE (408) 659-3171

# Mini-Mart

We'll print your 24 words (maximum) totally free of charge. Copy must be with us by the 11th of the month preceding the month of issue. Please, please write or preferably type your adverts clearly, using BLOCK LETTERS.

If, like many of our readers, you'd prefer not to cut up your copy of ETI, just make a copy of the relevant part of this page. Please make it the same size as the original – and write your copy using BLOCK LETTERS.

send your ad to –
ETI MiniMart,
Modern Magazines,
15 Boundary Street,
Rushcutters Bay,
NSW 2011.

**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.*

**WANTED** Portable Stereo tape Recorder. Nagra, Uher or similar Pro. Reel to Reel. New/S.H. J. Yelland, F2/11 Baker Street, Grange, 5022. 356-3864 A/H.

**KENWOOD KR9340** four channel tuner-amplifier, 4x40 wrms, sq, rm & CD-4 4 ch. Decoders, pair Sansui AA100W speakers. Contact Richard Hill, 54 Sixth Ave., St. Peters, S. Aust, 5069. 42-2065.

**SHARP RD-712D** reel to reel tape deck stereo 4-track with large number of tapes, $110. Phone Chris (02) 44-3602, Turramurra.

**ORGAN PEDAL BOARD** (new), "Farfisa", with zippered case. Ready to plug into any organ with socket, 16 pin. $90. Morrow, 52 Morotai Av, Ashburton, Melb., 25-2119.

**SHIN-EI PSYCHEDELIC MACHINE.** Fuzz, Tremelo, Vibrato, Revolvo. Sits atop amp. (New). Bargain $5750. Described Advert. E.A. p. 42 May 1976. Morrow, 52 Morotai Av, Ashburton, Melb. 25-2119.

**TWO PIONEER** rear deck speakers impedance 4OHM, size 6"x9" double cone type. Grill included, $15 for both. Mr. P. Steffania, Box 411, Griffith, NSW, 2680.

**AMERICAN SUPER AMPLIFIER** 250W. rms, matching pre-amplifier, new, 5 year guarantee, $599. S.Q. 4-channel decoder/amplifier, 60 W rms $139. Connoiseur turntable, Technics tonearm, Empire catridge, $139. 439-5595 evenings.

**PAIR AKG D202-C5 MICROPHONES** little use $150. Two studio model stands with boom $80. Cvetro, 4 Tivoli Rd, Sth. Yarra, Vic. Phone 418-1304 B.H.

**FLEXOWRITER:** Typewriter/Punch/Reader, 5 hole code, spaces for 8 pins $75. Maddever, 5 Cameron Close, Corio, Vic, (052) 75-1108.

**RECEIVER** 12W per channel rms, FM fine tuning. Garrard belt drive turntable. Two way bass reflex speakers. $250.00. Greg Wightman, 31 High Street, Bankstown.

**PLAYMASTER** 36 amp with crook output stages, suitable more advanced amateur than me. Neat in/out woodgrain cover, $25. Chris Gronlund, 48 Felton Rd, Carlingford, 871-7582.

**PENDING MOVE** necessitates selling majority of Hi-fi gear — Junk box parts. Hundreds of items for Hobyist. G. Sankowsky (Butterfly farm), Long Rd., Mt. Tamborine, Q. Ph. 075—45-1353.

**SPEAKERS**, excellent condition, half price, 2xRola 12U50, 8Ω, 2xMSP 12PQ 15Ω, 2xMagnavox 8W 15Ω, never used for guitar work. L. Murakami, Colwyn St. Mt. Gravatt.

**BRISBANE HOBBYIST** wishes to start general electronic hobby club in Mt. Gravatt area. Ham radio, experimentation, etc. If interested please ring Frank Halliwell at Brisbane 349-9834.

**WANTED:** March 1975 E.T.I. magazine. Will pay $5.00. Write Alan Lay c/- Mackay Tech College, P.O. Box 135 Mackay 4740.

**PLEASE USE BLOCK LETTERS**

| | | | |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |



## READERS' LETTERS

We make no charge for replying to readers' letters, however readers must enclose a foolscap-size stamped addressed envelope if a reply is required. Queries concerning projects can only be answered if the queries relate to the project as published. We cannot assist readers who have modified or wish to modify a project in any way, nor those who have used components other than those specified.

## TELEPHONE QUERIES

We regret that we cannot answer readers' queries by telephone.

## SUBSCRIPTIONS

Electronics Today International can be obtained directly from the publishers for $14.00 per year (including postage) within Australia.
The cost for countries outside Australia is $14.65 including postage (surface mail). Airmail rates will be quoted on application. Subscription orders and enquiries should be sent to the address below.

## BACK ISSUES

Our subscriptions dept can supply most back issues of ETI for the twelve months preceding the date of this current issue. Some earlier issues are also available.
The price of back copies is currently $1.00, plus 40 cents postage and packing. Please address orders to Subscriptions Dept, Electronics Today, 15 Boundary St, Rushcutters Bay, NSW 2011.

## PHOTOSTATS

Photostats of any article ever published in ETI can be obtained from our subscription dept (address above). The price is currently 45 cents per page including postage.

## CONTRIBUTORS

Material is accepted from time to time from outside contributors. Payment is based on quality and is paid 30 days after the date of publication. Constructional projects will be considered for publication but the standard of design must be to fully professional level. All material must be typed using double spacing and wide margins. Drawings, circuit diagrams etc need not be to professional standards as they will be redrawn by our staff. It is advisable to contact the Editor before submitting copy.
A large stamped addressed envelope must be included if unsolicited material is required to be returned.

## ADVERTISING QUERIES

Queries concerning goods advertised in ETI should be addressed directly to the advertiser — not to ourselves.

## NEWS DIGEST

News Digest items are published free of charge. Manufacturers and importers should send material at least four weeks before the date of publication. Photographs should be of high contrast and preferably at least 100 by 150 mm. Press releases must be of a factual nature — these pages are not free advertising. The Editor reserves the right to accept or reject material at his discretion. Preference will be given to components and equipment of an essentially practical nature.

## BINDERS

Binders to hold 12 issues of ETI are available from our subscription dept (address above). Price is $4.50 (plus 80 cents postage NSW & ACT — or $1.50 all other States)

## COPYRIGHT





## ADVERTISING

**Sydney:** Bob Taylor (Advertising Manager)
Geoff Petschler (NSW Manager)
15 Boundary St., Rushcutters Bay, 2011.
Tel 33-4282. Telex AA27243 (MODMAGS)

**Melbourne:** Dax Ramos, Suite 24, 553 St. Kilda Rd, Melbourne. Tel 51-9836

**Brisbane:** David Wood, 11-14 Buchanan St, West End. Brisbane. Tel 44-3485

**Adelaide:** Ad Media Group, 68 North Terrace, Kent Town, 5067. 42-4858.

**Perth:** Aubrey Barker, 38 Mounts Bay Rd. Tel 22-3184

**Tokyo:** Genzo Uchida, Bancho Media Service, 15 Sanyeicho, Shintuku-Ku, Tokyo 160.

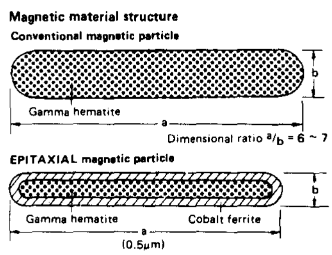
**London:** Electronics Today International, 25-27 Oxford Street, London W1R 2NT. Tel (01) 434 1781/2.

**Acoustical Consultants** — Louis A. Challis & Associates.

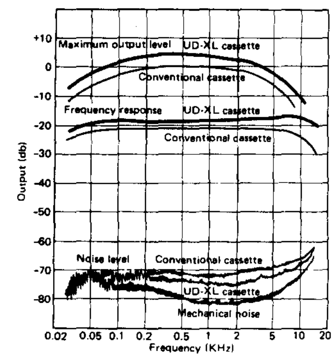
Electronics Today International is published by Modern Magazines (Holdings) Ltd, 15 Boundary St, Rushcutters Bay, NSW 2011. It is printed (in 1976) by Wilke & Co, Browns Road, Clayton, Vic and distributed by Australian Consolidated Press.
*Recommended price only. Copyright.

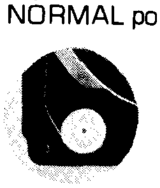

# Introducing the revolutionary UD-XL EPITAXIAL cassette

Developed by MAXELL this completely new EPITAXIAL magnetic material combines the advantages of the two materials (gamma-hematite and cobalt-ferrite): the high sensitivity and reliable output of the gamma-hematite in the low and mid-frequency ranges and the excellent performance of the cobalt-ferrite in the high-frequency range. The result is excellent high-frequency response plus wide dynamic range over the entire audio frequency spectrum.

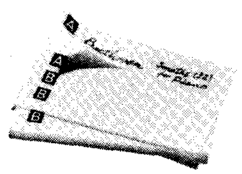



Compared to chrome tape, sensitivity has been improved by more than 3.5dB. Because EPITAXIAL is non-abrasive, it extends to the life of the head. Consequently, the UD-XL delivers smooth, distortion-free performance during live recording with high input. When using UD-XL it is recommended that tape selector be in the NORMAL position.



Fidelity is also ensured by a precision-manufactured cassette shell with a special anti-jamming rib that provides smooth tape travel and helps eliminate wow and flutter.

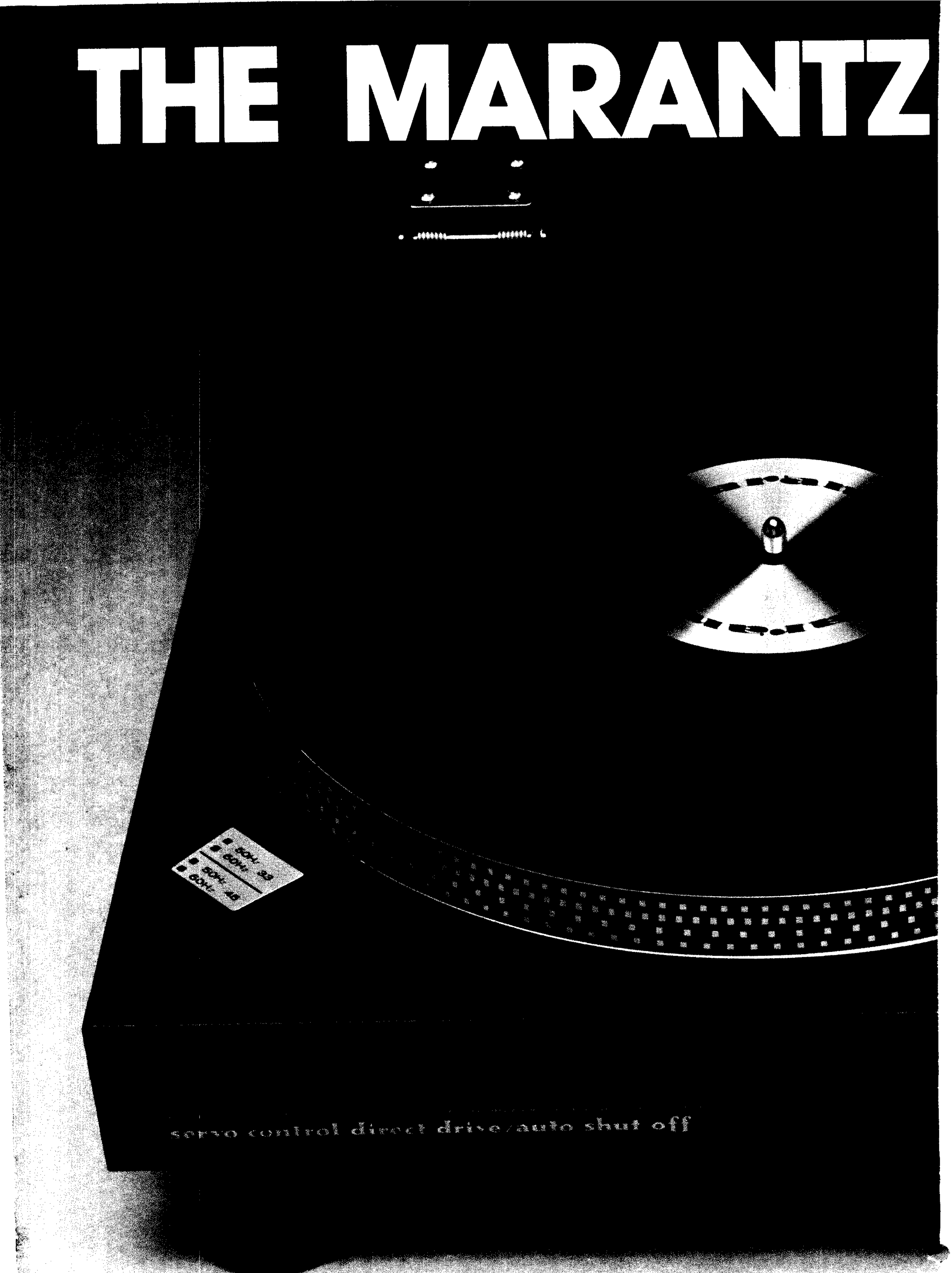


Another good idea of the UD-XL cassette is a replaceable self-index label. Simply peel off the old label and put on a new one when you change the recording contents. No more mess on the label.

maxell®

*For further information please write to Maxell Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033.*

WT. GD. 76M


THE MARANTZ
servo control direct drive/auto shut off