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Matched stereo components are not simply components that are designed to look alike. Instead they are matched to deliver the right kind of balanced performance that will bring out their very best musicality under all conditions of use. The real advantage of owning matched stereo components is the way they work together in the areas of critical performance, such as input/output power levels, distortion and signal to noise ratio. The way they deliver what we at JVC like to call The Musical Truth.

The Musical Truth is something special in sound. It's an indication that your records sound as good in your listening room as they did when they were cut in the studio, or your tapes just as good as the original sound or music you recorded. Only superior components . . . matched to handle the fine nuances of music can create pure Hi-Fi entertainment for your enjoyment. That's why if you're serious about music, you'll want matched components . . . just like these JVC units we've pictured here.

The JL-A40 direct-drive turntable is a beauty in its own way, what with automatic operation for arm cut/shut-off, a beautifully realistic price, low 0.03% wow/flutter & high 70 dB S/N ratio.

The KD-S200 II stereo cassette tape deck matches the best-selling JVC knobless receiver line. You can stack it with the receiver, co-ordinate the design of your system, operate everything from the front. It features a wide 30-16,000Hz (chrome, typical) frequency response and a high 56 dB S/N ratio.

The JR-S300 II FM/AM stereo receiver gives you dependable power output (50W RMS per channel, THD 0.1%), advanced tuner circuitry (usable sensitivity 10.8dBf) and the unique JVC five tone-zone S.E.A. Graphic Equalizer.

JVC Hi-Fi Components beautifully matched for your entertainment!

Balanced performance!

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WT78-1

AUSTRALIAN OWNED AND PRODUCED

January 1978. Vol. 8 No. 1.

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HARKSOUND

a new name in turntables!

looks suspiciously like the celebrated CEC doesn't it?

in fact it is!

CEC, Australia's top-selling range of imported turntables,* will now be known as HARKSOUND. But don't despair . . . nothing's changed but the name.

Still the same five year warranty, still the same proven performance, and when you consider that CEC are Japan's oldest and most experienced turntable manufacturer, you know you're buying the best.

The HARKSOUND range by CEC offers everything you want and need for noise-free, Hi-Fidelity performance, plus operational ease . . . and there's a turntable for everyone in the HARKSOUND range—right from the BD2200 belt drive, up to the unique DD8200 direct drive.

The HARKSOUND features include:

- High quality, statically balanced S-shaped tone arm.
- Adjustable anti-skating.
- High quality magnetic cartridge.
- Fully decoupled motor to turntable/arm suspension.
- Low profile design with balanced acrylic dust cover.
- Excellent value and performance for the price.

*HFIA Survey figures Sept. 1977.

HARKSOUND by **CEC**
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HA109/78

News Digest

Brits Attack P.O. Monopoly

As reported elsewhere in this issue, the US Supreme Court has ruled that citizens may legally attach whatever they wish to their telephone installation just so long as the bits meet FCC requirements.

A strong move for generally similar freedom is currently being made in the UK. There, a report published by the National Association of Radio Communication Services (representing most of the message handling companies in the UK) very strongly criticises the monopolistic powers of the Post Office. The report requests the removal of the Radio Regulatory Dept. from the Home Office.

One of the report's strongest points is that the Post Office's monopoly seriously hinders development of communication services to business and the general public alike.

The report also states that the restrictions on private industry have cost the Post Office 'countless thousands of pounds in lost revenue and wasted capital investment'.

A specific request is made for 'a short and simple' Act of Parliament to remove the monopoly powers from the Post Office and transfer them to the Minister of Industry who would then be responsible for permitting and licensing specific areas of competition.

A second request calls for the removal of the Radio Regulatory Dept. from the Home Office to a separate Standing Commission which would exercise control on strictly legal lines.

Video LP's Soon?

Virtually coincident with the news that Philips are postponing test marketing their VLP videodisc is the announcement of a totally new videodisc system from Matsushita.

The new system, to be known as VISC, uses mechanical modulation rather than the capacitive and optical techniques used by RCA and Philips respectively.

The VISC disc is pressed from vinyl in much the same way as an audio LP. The information is cut into the disc by a diamond stylus connected to a piezo-electric transducer capable of reproducing pulse-code modulated signals.

The disc rotates at 450 rpm: groove depth is about 1 um. The video luminance signal is recorded as an fm carrier with a synchronized tip frequency of 4.3 MHz and a white peak frequency of 6.3 MHz. Two extra 20 kHz bandwidth audio channels are also included.

The reproducing unit is vaguely similar to an audio record player but has a stylus fine enough to track the encoded pcm signals. The cartridge is mounted on a radial mechanism which tracks the record groove with zero tracking error. A separate mechanism keeps the cartridge synchronized with the spiral groove.

We understand the system has two (possibly switch selectable) formats. VISC 1 provides 30 minutes playing time per record side and is intended for material requiring high replay definition. VISC 2 provides 60 minutes per side and is suitable for feature films etc.

The system is expected to sell for around $600 (in Japan). The discs should cost about $9-$10 each. Launch date is not yet known.

Artificial Vision

A research group at the University of Utah have made a breakthrough in the use of microcircuits to stimulate areas of the visual cortex to provide the blind with limited 'sight'. A blind volunteer was operated on in order to implant a matrix of 64 platinum electrodes inside his cranium. Electrical stimulation of the electrodes makes the subject 'see' flashes with position dependent upon which electrode is stimulated.

Using six electrodes to form Braille characters under computer control enabled the subject to read phrases at over 30 characters a minute. The electrodes can also be used with a miniature TV camera, allowing the perception of simple shapes.

I Display Your Weight

Fairchild have been awarded a US$1.65 million contract for LED display modules to be used in digital bathroom scales. The Californian opto-electronics manufacturer views the scales as a huge market, but is also looking at other areas such as digital thermometers.

Phone Freedom

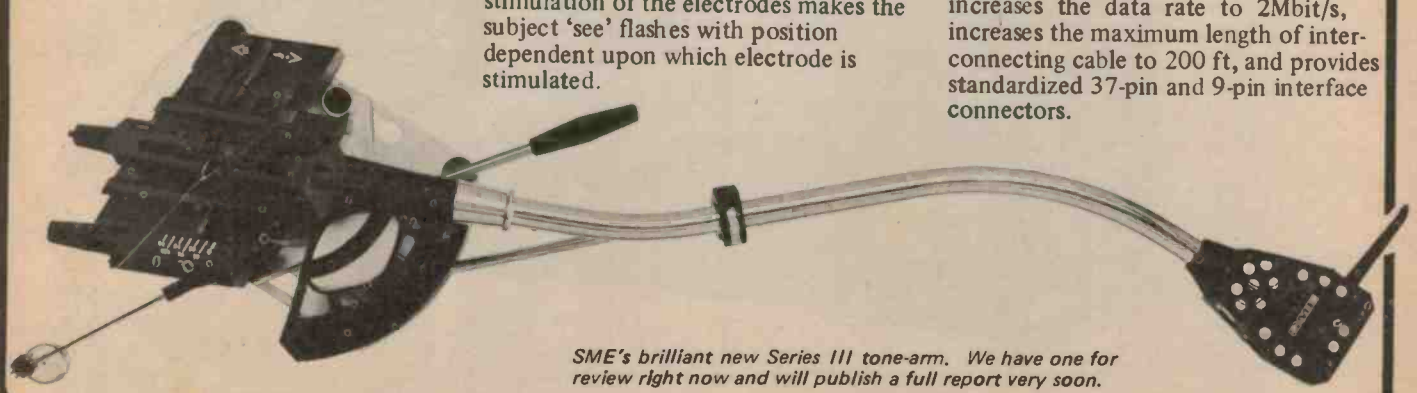
In a historic ruling, the US Supreme Court has confirmed that private individuals have the right to buy or make their own telephone equipment and connect it to the US telephone network.

Under the ruling it will be legal to hook up as many devices as the user wishes – computer controlled systems, 'phone diverters, memory diallers, picturephones etc, etc. The only restriction is that the various bits must meet the relevant FCC requirements.

Somehow we can't see this happening in Australia!

New Interface Standard

The Electronic Industries Association (EIA) RS-232C standard interface has been superseded by a new standard, RS-449, which is said to be technically superior to RS-232C but will operate with unmodified RS-232C equipment. RS-449 is claimed to offer greater noise immunity than the old standard, increases the data rate to 2Mbit/s, increases the maximum length of interconnecting cable to 200 ft, and provides standardized 37-pin and 9-pin interface connectors.



SME's brilliant new Series III tone-arm. We have one for review right now and will publish a full report very soon.

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The Ultimate Draws a Little Closer.

Every year the leading designers of fine sound equipment strive towards producing perfection in high fidelity.

Now "The Ultimate Draws A Little Closer" with remarkable British Gale loudspeakers.

Gale performance is outstanding by even the most critical standards. If you have yet to hear for yourself the amazing performance of Gale speakers, read what the experts have had to say about Gale superiority.

"I would back the GS-401A's to just beat the socks off any other speaker anywhere near their size."
(The Absolute Sound, Volume 2, No. 8).

"This loudspeaker is certainly among the five best loudspeakers available."
(Hi Fi Studio Magazine).

"This is not a cheap speaker—until you look at it on a price/performance basis. Then it starts to look like a bargain." (Vol. 7 No. 6).
(Australian Hi Fi Magazine).

"The Gale GS-401A is one of the finest sounding dynamic loudspeakers that we have heard."
(Australian Hi Fi Magazine).
(Vol. 7 No. 6).

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Gale GS-401A In Black & Chrome.

The New Gale GS-401C Concave Design Speaker.

The new Gale Ultimate Fidelity Recordings are now also available at your Gale Hi Fi dealer.

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Melbourne — The Sound Craftsman, Douglas HiFi, Instrol HiFi
Adelaide — Decibel, Instrol HiFi
Perth — Alberts HiFi, Leslie Leonard HiFi

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GALE

News Digest

New Tape System

The BBC and 3M have collaborated to develop a new tape recording system claimed to provide 90 dB noise figure. The system will accommodate 32 tracks on one-inch tape at an undisclosed tape speed.

Analogue LCD Watch

A Scottish company, Murrell Dynamics, has designed an LCD watch with an analogue-type 'dial'. The main problem which Murrell has overcome is reducing the number of connections required to address the segments which comprise the 'hands'.

The 100 mm diameter prototype (which Murrell claims can readily be reduced to 25 mm) utilises two concentric rings of 60 radial lines – the inner ones are addressed uniquely for the hours indication, the two rings together for minutes, and the outer one for seconds.

Teletext Decoder

Now available from Closed Circuit Television (PO Box 218 Eastwood, NSW 2122), the Aston TD10 Teletext decoder is built for the professional market. The unit incorporates a number of sophisticated features including double height characters, LED indicators to display concealed control bits and both contiguous and non-contiguous graphics.

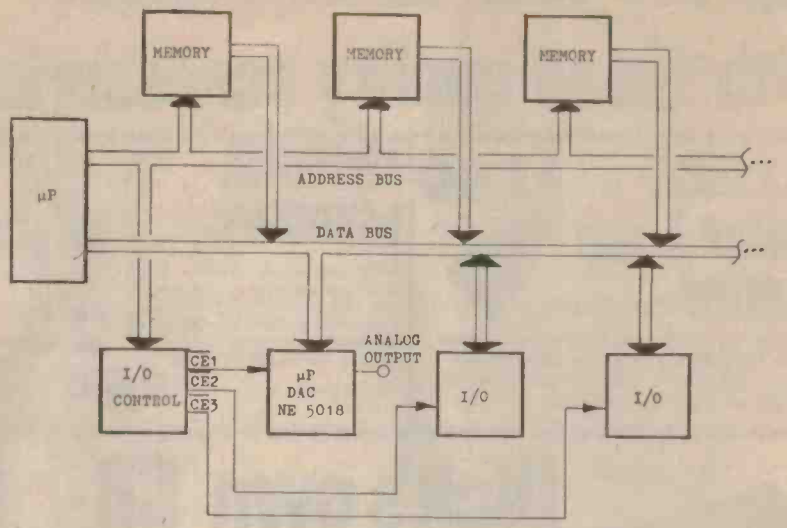
More VMOS

Suppliers of VMOS are expanding – Fairchild Australia Pty. are now supplying both the conventional N-channel and new P-channel VFETs. The 2N6657 and 2N6658 are TO3, 25W VFETs with 60V and 90V breakdown respectively, while the FVN2 and the 2N6661 are TO39, 6¼W devices with 60V and 90V breakdown. Two PMOS devices are available– the FVP1 (TO3, 25W) and the FVP2 (TO39, 6¼W), both at 60V BVDSS. Further details from Fairchild Australia Pty. Ltd., 72 Whiting St., Artarmon, 2064.

Still More VMOS

Siliconix have now obtained JEDEC registered numbers for their line of VFETS discussed in this issue. These are as follows: VMP1 is now 2N6657, VMP11 is 2N6656 and VMP12 is 2N6658. All are T03 devices.

In addition three T0202 devices are available – VN46AF, VN66AF and VN88AF. Data sheets and further information are available from *Natronics Pty. Ltd, The Crescent, Kingsgrove, NSW 2208.*



D-TO-A Converter is Fully μP Compatible

Signetics' NE5018 is the first monolithic 8-bit digital-to-analogue converter to be both self-contained and microprocessor compatible and is available from Philips Electronic Components and Materials. Most 8-bit d-a chips require an external output amplifier and sometimes even an external voltage reference. Also, so far none has included the input latches needed in a microprocessor-based system to capture and hold the digital data long enough to be acted upon by the converter without tying up the microprocessor.

Compatible with microprocessor systems that have data buses of 8 bits wide, the NE5018 has data input latches controlled by a latch-enable pin. The data and latch-enable inputs are ultra-low loading types for easy interfacing with all logic systems.

With a 200 to 400 ns latch-enable pulse width, the latches appear transparent when the enable input is in the low state. When it goes high, the input data present at the moment of transition is latched and retained until the enable input again goes low.

The chip combines a stable voltage reference (5V nominal) with a high slew rate buffer amplifier. The voltage reference can be trimmed with an external potentiometer for easy adjustment of full scale, and the output buffer may be offset so as to provide bipolar as well as unipolar operation. The NE5018 is accurate to within ± ½ least significant bit. Short-circuit protection is incorporated on the chip for both the amplifier and the voltage reference.

Further information available from *Philips Electronic Components and Materials, 67 Mars Road, Lane Cove, Tel: 427-0888.*

Outdoor LEDs

Hewlett-Packard have announced red and yellow seven-segment displays which can be viewed in direct sunlight or in ambient lighting as bright as 10,000 foot-candles. The LED packages, which use large, high-efficiency chips, are intended to compete with LCD and other display technologies in automotive, avionic and instrumentation applications.

Zilog Spoken Here

As software costs outstrip hardware development in microprocessor based systems, semiconductor manufacturers are turning to high level languages as a major incentive to buyers to go with their product. Latest moves in the software scene have come from Zilog who have recently released COBOL and FORTRAN. This month, Zilog announce two versions of BASIC for business and scientific calculations and will soon follow up with two compilers for their new PLZ family of systems languages.

CB Recession

E.F. Johnson will close its CB radio manufacturing plant early this year because of the impact of Japanese CB's imported into the US. Johnson plans to reduce CB to less than 5% of its total business and concentrate on other markets.

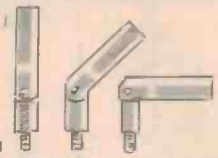
Improve your CB enjoyment with these quality accessories from Dick

AT LAST! Scalar base adaptor $1.90

Cat. D-4504.

Now the people with the Scalar-type thread on their CB antenna bases can use the universal type 3/8 24TPI threaded antennas. Just screw one of these adaptors on!

ANTENNA LAYDOWN



Don't remove your antenna when you go under something low – lay it down!
3 position lay-down eliminates the need for removing the antenna. AS EASY AS 1-2-3!

1 2 3

Quality construction, long lasting.

$6.95 D-4506.

CB RECEIVER am & fm too

Here's value. Quality CB reciever (with Australian 18 channels marked) receives all CB band, plus normal broadcast (am) and music (fm) bands. Complete with carry strap. Inbuilt antenna.

Cat. D-2842.

$29.50 inc. batteries

Cat. B-2325.

Dick's own CB radio book

YES! Finally, a book written by Australia's CB expert on Australian CB radio for Australians . . .

HUGE 128 Page

EVERYTHING YOU WANT TO KNOW ABOUT CB! This is the first book written specifically for the Australian CB scene – by the person the government took notice of! What it's all about, what to buy, what to say, what to expect.

$3.95

FREE WITH ANY CB RADIO PURCHASE!

NEW! So new we haven't got a photo yet!

CB Headset

Comfy headset with attached microphone on boom. Switch stays in hand (on steering wheel) for top safety. Call in today and see for yourself!

only $27.50

Cat. C-1120.

cb power supp. kit

Save money by building your own CB supply. As good as any you'll buy, complete with easy instructions. 13.8V @ 4A peak. Ideal for SSB too!

Cat. K-3448.

FOR THE CBER WHO'S JUST A LITTLE MORE CAPABLE . . . $27.50

Horn Speaker

Use with practically ANY CB: turns it into a loud hailer! Ideal for promotions, club days, field days, etc etc. 8 ohms impedance.

Cat. C-2705. $8.90

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FINALLY! We now have the best noise suppressor – the co-axial type. Rated at 60 amps and 50 volts, use it on anything that can make a noise on the mobile! Don't put up with electrical noise any longer!

3.75

Cat A-7928 .... $3.75

FREE PROTECTION

EXCLUSIVE D.S.N.O. SYSTEM

FULL DETAILS OF EVERY DICK SMITH CB (INCLUDING THE NON-REMOVABLE SERIAL NUMBER) ARE ENTERED INTO OUR IBM COMPUTER FROM YOUR WARRANTY REGISTRATION CARD. THEREFORE, ANY CB CAN BE INSTANTLY TRACED TO ITS RIGHTFUL OWNER IN CASE OF THEFT.

TVI is a dirty word

Protect your license with our filters!

Lo-pass for CB rig. Eliminates most of the harmonics that cause most TVI. Cheap investment for CBers.
Cat D-7082 $9.50

Hi-pass for TV set. By-passes the CB signals while allowing TV signals to get through. Simple but reliable cure in most cases.
Cat D-7084 $2.50

LEARN CODE

MOST CBERS WANT TO ADD TO THEIR KNOWLEDGE . . .
Many want to obtain their novice or amateur license. Start by learning Morse Code. It's easy with our Morse Code tapes – fit any cassette player.
Cat D-7106 .. .. .. value $7.90

MORSE KEYS: If you try to learn Morse with a bit of tin or a crook key you'll do more harm than good! Use a proper key – like the superb Himound. Adjustable, easy to handle.
Cat D-7104 .. .. $25.00

WHY DOES YOUR CB WORK?

What is radio? How does skip occur? What is the difference between AM & SSB? All these questions and many more are answered in the 'Bible' of electronics:

Cat. B-2218.

AMATEUR RADIO HANDBOOK $12.00

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SYDNEY: 162 Pacific Hwy, Gore Hill. Ph 439-5311 Ample parking at door.

SYDNEY: 30 Grose St, Parramatta. Ph 683-1133 1st floor – friendly store!

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MAIL ORDER DEPARTMENT: PO Box 747, Crows Nest, NSW 2065. Phone 439-5311. Post & Pack extra.

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Low Cost Data Collection

A new computing data acquisition device that combines a popular HP portable programmable calculator with interfacing technology to make a low-priced solution to instrument data collection and computation applications has been introduced by Hewlett-Packard.

The HP Model 97S I/O calculator, based around the HP-97 programmable printing calculator, uses BCD interfacing to gather data from a wide range of instruments. The HP-97S then manipulates the data according to user-designed programs and produces a printed hard-copy report. With the HP-97S I/O calculator, the user can take an instrument measurement and compare it to a standard or calibrate in data, do computation on each individual reading, or take multiple measurements and conduct computation and statistical analysis.

The list of products that can be used more efficiently with the HP-97S I/O calculator is large, including electronic balances, photometers, densitometers, thermal conductively measurement devices, strain gauge systems, colorimeters, devices that measure ion activity, titrators and pH meters, coordinate measuring equipment and physical parameter measuring equipment.

The HP-97S is designed to fill a need in small data acquisition operations where manual gathering and computation is far too time-consuming and error-prone and the purchase of a desktop computer/controller is unnecessary and too expensive. For example, a typical application for the HP-97S would be to take data about a

series of samples from an electronic balance and compute the high, low, average and standard deviation.

"We anticipate that the average owner would use the HP-97S to take data almost continuously from a single instrument and have a small library of specialised programs prerecorded on the calculator's magnetic programming cards. In the past, automating such an operation just was not possible without the expenditure of $3,000 or $4,000 for a small desktop controller. With the HP-97S the cost of the same operation is reduced to less than $2,000," said Fred Bode, marketing manager, Loveland Calculator Division.

The interface for the HP-97S is capable of handling a variety of instruments that have a BCD output. The logic is TTL compatible and may be configured with either positive or negative trueness. The ten BCD input lines allow entry of numeric data, sign information, the exponent, and the decimal point. Four output lines aid in the instrument control. These output lines may be set and cleared under software control. For example, when connected to a peripheral device they might open or close a relay, provide pulses for a stepper motor, signal that an event has taken place or perhaps change ranges on a measurement instrument.

For further information contact

Hewlett-Packard Australia Pty. Ltd., 31-41 Joseph St., Blackburn, Vic, 3130. Tel. 89-6351.

Denmark declares war on so-called 'superamps'

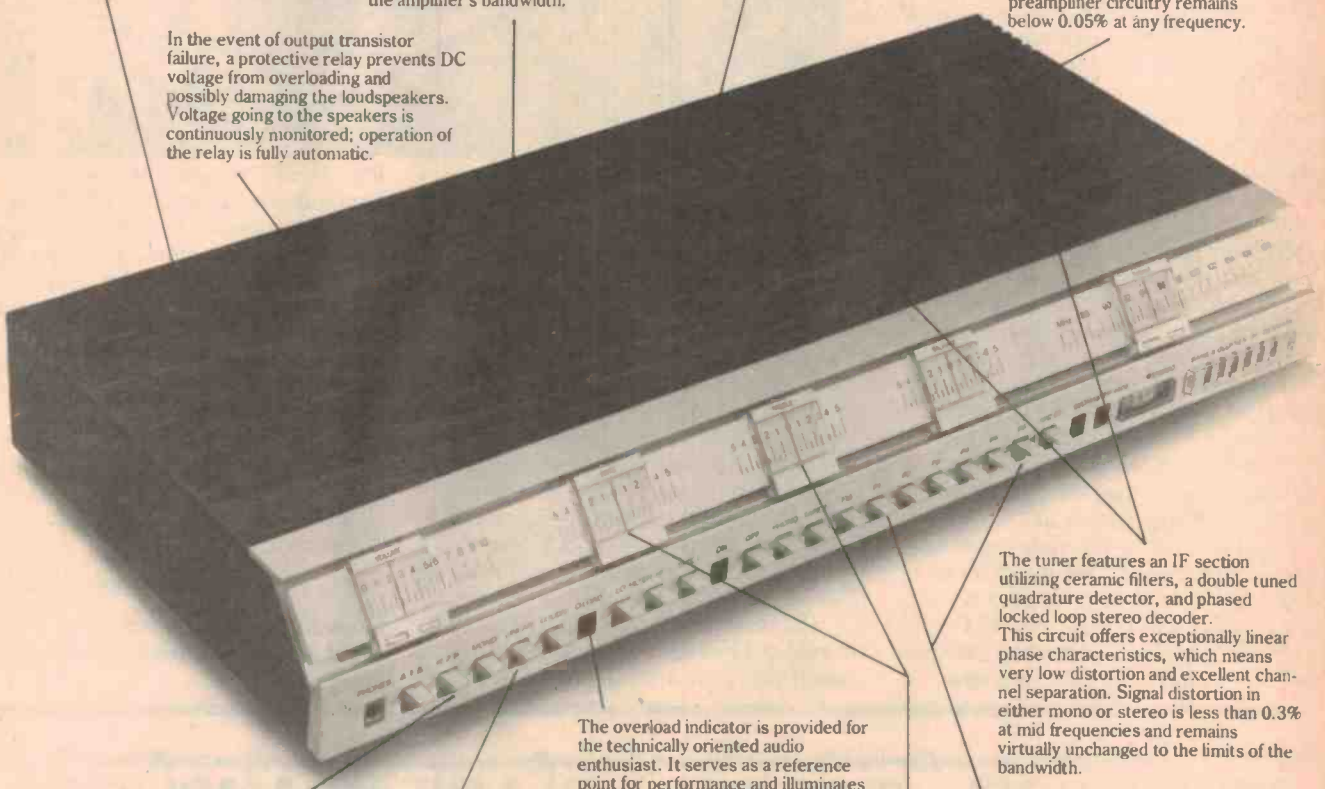
Our split power supply insures that each channel's signal remains completely independent. The power rating of the Beomaster 4400 is 2 X 75 watts RMS, with 0.05% total harmonic distortion, at full output with speakers of 4 ohm impedance.

A Bessel filter, incorporated with newly designed circuitry, eliminates Transient Intermodulation Distortion (TID) and its cause. Additionally, this new circuit gives the amplifier a virtually perfect square wave response, demonstrating that linear phase is maintained to the limits of the amplifier's bandwidth.

Eight, high power, cascade transistors eliminate crossover distortion in the output stage. They can handle the highest signal strength without performance deterioration.

Redesigned phono-preamplifier circuitry will handle any known input signal while limiting noise to more than 2 dB above the theoretical thermal noise limit of the cartridge itself. RIAA equalization is accurate to within 0.5 dB from 30-20,000 Hz. Total harmonic distortion within the preamplifier circuitry remains below 0.05% at any frequency.

In the event of output transistor failure, a protective relay prevents DC voltage from overloading and possibly damaging the loudspeakers. Voltage going to the speakers is continuously monitored; operation of the relay is fully automatic.



The tuner features an IF section utilizing ceramic filters, a double tuned quadrature detector, and phased locked loop stereo decoder. This circuit offers exceptionally linear phase characteristics, which means very low distortion and excellent channel separation. Signal distortion in either mono or stereo is less than 0.3% at mid frequencies and remains virtually unchanged to the limits of the bandwidth.

Varactor diode tuning permits up to six stations to be pre-set by the user for instant, electronically accurate recall at any time. Random FM tuning is accomplished with the smooth sliding tuning bar.

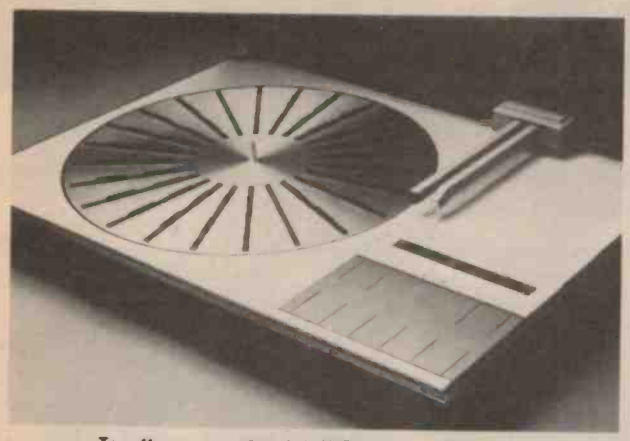
The overload indicator is provided for the technically oriented audio enthusiast. It serves as a reference point for performance and illuminates when the maximum undistorted output has been reached.

Ambiophonic circuitry, when completed with two additional side speakers, allows you to recreate much of the ambience and hidden sound information already present in stereo records, tapes, and FM transmissions. This circuitry will significantly increase your listening pleasure and the value of your present record collection.

The linear switch permits all tone control and volume compensation circuitry to be totally removed from the active circuit path. Depressing the lever eliminates all electronic noise generated by these circuits, and gives you a completely flat frequency response.

Tone controls are designed around active filter circuits. The cutoff curves were established by computer analysis and, most importantly, intensive listening tests. The controls introduce a minimum of distortion and a range surpassing the needs of any known music source.

Beomaster 4400 explodes the myth that 'power is the basis of clean sound'



It all started with "Superspinner"

Bang & Olufsen fired the first shot by introducing the "Superspinner" — Beogram 4002 — the first and still the world's only electronically controlled, automatic, straight-tracking turntable.

Beogram 4002 plays a record precisely as it was cut — from the edge to its centre in a straight line instead of tracing an arc. The result is sound quality audibly superior to all conventional turntables.

Inventiveness is one of Bang & Olufsen's best weapons.

Now the same creative engineering that produced the "Superspinner" has changed amplifier technology in such a way that power need no longer be considered a basis for producing clean, undistorted sound.

Beomaster 4400 – Here are the limits to how realistic a music system can sound

There will always be a difference between the original performance, and reproduced music.

A great many people overlook the fact that a music system can never produce better quality sound than the source material allows.

Records, tapes and radio transmissions all have inherent limitations — for example, there is rumble from the cutting machine in most record grooves.

However a great many people mistakenly believe that *all* distortion is created at the programme source. Whereas in most cases it is the components in a music system that are the weak links. Now Bang & Olufsen have produced Beomaster 4400, an amplifier/tuner with totally new circuitry that exceeds the most critical demands.

Beomaster 4400 challenges the chatter about distortion

Most makers of so-called "superamps" aggressively promote the fallacy that upwards of 2 x 150 watts RMS output, or a reversion to valve amplifiers is necessary to produce "undistorted" sound.

Many makers accept and ignore the presence of "transistor sound" — transient intermodulation distortion — so common in many of today's so-called superamps.

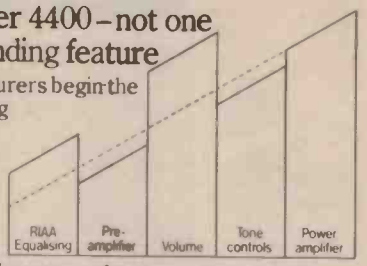
By analysing the problems mathematically instead of electronically, Bang & Olufsen have succeeded in *reducing all forms of distortion* –

total harmonic distortion,
intermodulation distortion,
transient intermodulation distortion.

This has been achieved by uniting a highly creative circuit design, numerous technical innovations and a specification that keeps touch with reality — the reality of the music you listen to.

Beomaster 4400 – not one outstanding feature

Some manufacturers begin the beguile by attempting to establish "spectacular" data in one or two areas hoping to grasp technical pre-eminence.

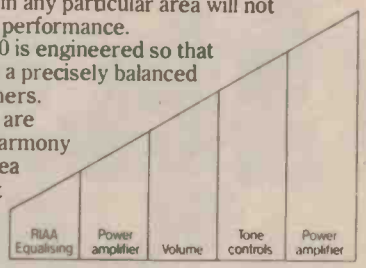


The overall performance of such products almost always suffers.

Over emphasis in any particular area will not necessarily improve performance.

Beomaster 4400 is engineered so that every function bears a precisely balanced relationship to all others.

All components are matched in perfect harmony so that no specific area receives emphasis at the expense of another.



The result is a requirement for less power to create a crisper more real sound than many more expensive (more powerful) amplifiers have been able to produce.

Beomaster 4400 – not for the novice

It may seem provocative to enter the ranks of the superamp with a distortion specification of 0.05%.

But no less than this is necessary — the human ear has no hope of distinguishing distortion beyond this point.

It may appear cheeky to stand among the "superamps" with a power rating of 2 x 75 watts RMS — yet Beomaster 4400 is (as Rolls Royce have said on the question of power) "adequate" for any domestic music system.

With its Bessel filter and reformulated circuitry eliminating Transient Intermodulation Distortion and its cause . . .

With its eight high power cascade transistors capable of handling the highest signal levels, eliminating cross-over distortion in the output stage . . .

With its newly designed phono-preamplifier capable of handling any known signal strength — while insuring a noise level of no more than 2 dB over the theoretical limit of any high quality cartridge . . .

With its split-power-supply insuring each channel's signal remains completely independent . . .

. . . Beomaster 4400 is certainly worthy of closer inspection by the serious enthusiast including those who still refuse to believe that a transistorised amplifier can compete with a valve model for sheer musical purity.

Bang & Olufsen suggest that a demonstration at any of the stockists listed below will convince even the most unbending sceptic that Beomaster 4400 exceeds the demands of the most highly trained sensitive ear, and the requirements of the most advanced audio system — without the need for bulk power or a "paper" specification.

Bang & Olufsen

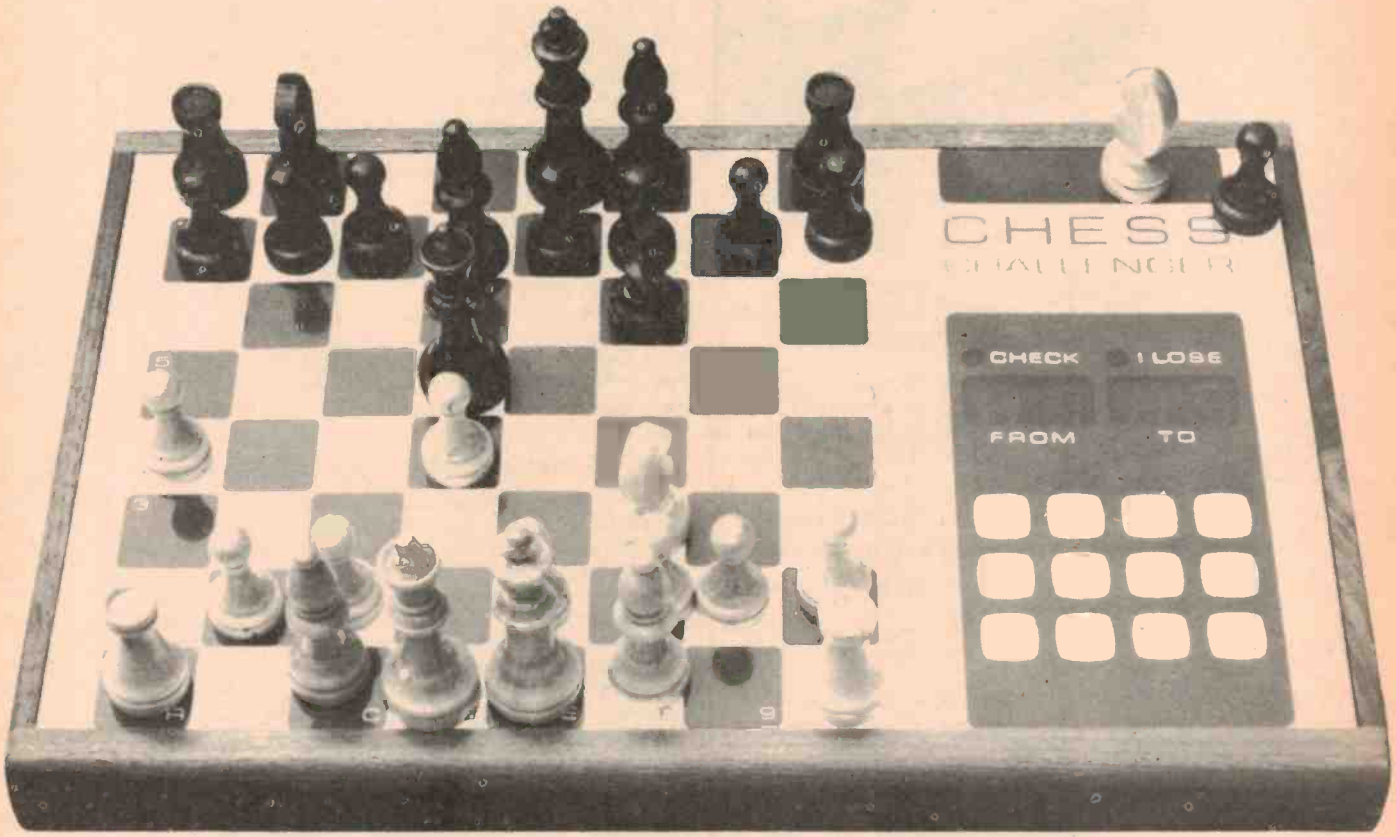
Simply the best.

Victoria. Danish Hi-Fi, Shop 9, Southern Cross Hotel, Melbourne. Tel. 63 8930. Danish Hi-Fi, 698 Burke Road, Camberwell. Tel. 82 4839. Turner Audio Systems, 35 Peel Street South, Ballarat. Tel. 32 2042. **Queensland.** Brisbane Agencies Audio Centre, 72 Wickham Street, Fortitude Valley. Tel. 221 9944. **Western Australia.** Danish Hi-Fi, 308 Walcott Street, Mount Lawley. Tel. 271 0100. **South Australia.** Ernsmiths, 50 King William Street, Adelaide. Tel. 51 6351. **Tasmania.** Bel Canto, 138 Liverpool Street, Hobart. Tel. 34 2008.

BO936

Chess goes

George Hofsteters and Les Bell examine the new all-electric 'every home should have one' chess adversary.



NOW, AS FAR AS chess is concerned, your humble narrator (George Hofsteters, that's me) is rated somewhere between Boris Spassky and Sir Henry Bolte. The variation may swing up and down like a yo-yo. Depending on the circumstances and the opposition, I can pull out a game with a few exclamation marks – or a game that's so bad a vulture wouldn't touch it. So I was a natural candidate to try out the Chess Challenger to see what the average "wood pusher" could do with it. I've played some of the best and some of the worst chess players in the country and know most of the sly, brilliant ploys as well as some of the most crassly stupid and illogical blunders human beings are capable of when playing this insane game.

As a photographer I know beans about the electronics. I can't distinguish a flip-flop from a cheese grater and can't think of a good reason why I should. It was therefore with mixed feelings that I greeted an opponent that didn't try to psyche me out, wouldn't spill a drink during crucial play as a distraction and couldn't care less if my face was like the ..... It just sat there, polite, understanding, well behaved and a thoroughly good sport at all times.

The board is roughly the area of a sheet of foolscap and about 40 mm thick. The machine will always play a defensive game from black – the player will always have the white pieces.

The translation of the traditional chess jargon is made quite effectively by a numerical and alphabetical coding system. For example, the bottom row of pieces is denoted from left to right by a row of numbers from one to eight. Traditionally this is the rank. The standard vertical rows (files) are identified alphabetically a–h. Therefore the Player's queen's rook is located at 1a, the queen's knight at 2a and so on till the king's rook at 8a. The pawns are on the next rank up and are seen as 1b, 2b, right up to 8b. The machine's pieces are similarly located on its side of the board and its pawns are standing on 1g through to 8g, and its major pieces on 1h through to 8h. By keying in the appropriate move, the Challenger responds with its own corresponding move – the game largely depends on

you to be honest and to exercise some care in the way you use the keyboard. It is quite possible to think you have programmed it correctly when in fact you haven't and all chaos breaks loose. If this happens, then the designers of the Chess Challenger have one more trick up their sleeve. It is the read-back capability. If you're playing a person in an ordinary game, and pieces are moved either by accident or sleight of hand, then it can be anyone's guess how the dispute will be resolved. With the Chess Challenger, the problem is quite simple. You have to know how *it* sees the board rather than how you *think* it should see it. If you are keying in a move and it just sits there, displaying a disconcerting 00-00, you simply press the 'enter' button and check the position of each piece as you go along. It will not read 'empty' squares, only the ones that occupy its electronic memory, and nine times out of ten there has been some kind of keying mishap. Being entirely logical, the Chess Challenger gives you a modest number of choices in the above situation. Let's say, for example, that you find one of your pawns is missing. You can either play the game again, continue minus your pawn or switch off and swear at it. I suggest the first two alternatives.

Car Crusher

If the Challenger is winning it's like a car crusher. It takes everything it can lay its hands on, including the king. If it loses, it goes to the bitter end for a drawn game, and ultimately lights up 'I LOSE'. Very sporting.

On its plus side – from a purely gaming point of view – it will play a completely undevious and logical game, weighing the value of the pieces and taking things one move at a time. This is a good feature for rank beginners. It is invaluable for schools, clubs, etc, where the standard of play is not necessarily at competition level. It's an ideal tool for learners seeking to master the fundamentals. It lets you work at whatever pace you like. Never gets tired or bitchy, and doesn't get peeved at human error. The system is quite easy to come to terms with and again the ability to place the position of any piece at any given time is a distinct advantage, and avoids a lot of confusion. Having said that it will play a completely logical and undevious game, I must comment on its tactical weaknesses. The advanced competition player has up his sleeve a number of tricks and cunning ploys. Some of these are not immediately apparent. For example, a rook or even a queen offered as 'bait' is usually disregarded with some suspicion, as the whole idea of the sacrifice is to gain a winning and usually forced advantage. When I invited some of my chess-playing cronies to have a go at it, it became obvious that the Chess Challenger was simply accepting such sacrifices and not able to come to grips with some of the more dirty, sinister and plain underhanded strategy that the advanced player normally takes for granted. I am not familiar with what other programs are available for the advanced player – I'm simply describing the unit I checked out initially. The Challenger will usually retreat from even the slightest threat when it would normally be the best policy to simply swap off and come in with all rooks blazing. This is not sour grapes – simply the way the machine works. It is not programmed to be the absolute bastard which perhaps it should be.

Large Pieces

Although the unit itself is neat, lightweight, portable and entirely compact, I found myself at first slightly uncomfortable with the size of the pieces in relation to the size of the squares on the board. They had the tendency to be a bit too big for the squares and I was often frustrated at picking up one piece and knocking down others. Whether smaller and perhaps stubbier pieces would be better I don't know. But although the long and slim design of the pieces was aesthetically nice, they were a bit uncomfortable for one used to bigger boards and nice, clunky pieces. I realise that for the sake of elegance and compactness certain sacrifices must be made, yet I was at times distracted by pieces obscuring numbers or letters, possibly contributing to keying errors. For example, when the board is initially set up for play, all the white pieces sit smack over the bottom square's number, making it necessary to either lift a piece to see which number is beneath, or to memorise the system before play can flow smoothly. Similarly, a pawn or a piece on the left hand (letter) file adds to the confusion until the piece is lifted off and the digit is identified.

I would strongly suggest a separate column away from the piece squares. Smaller symbols perhaps, but definitely separate from the pieces.

One other thing that had me slighly worried was the transformer that came with the machine. It got as hot as hell and part of the casing visibly melted. I understand the transformer is meant for 60 Hz. Whether or not this overheating caused display problems I'm not certain. But I consistently found myself minus a rook, a knight or a pawn when I had carefully written down the moves and made all attempts to program as carefully as possible. However, with some attention to this overheating problem I'm sure the machine will stand easily on its considerable merits.

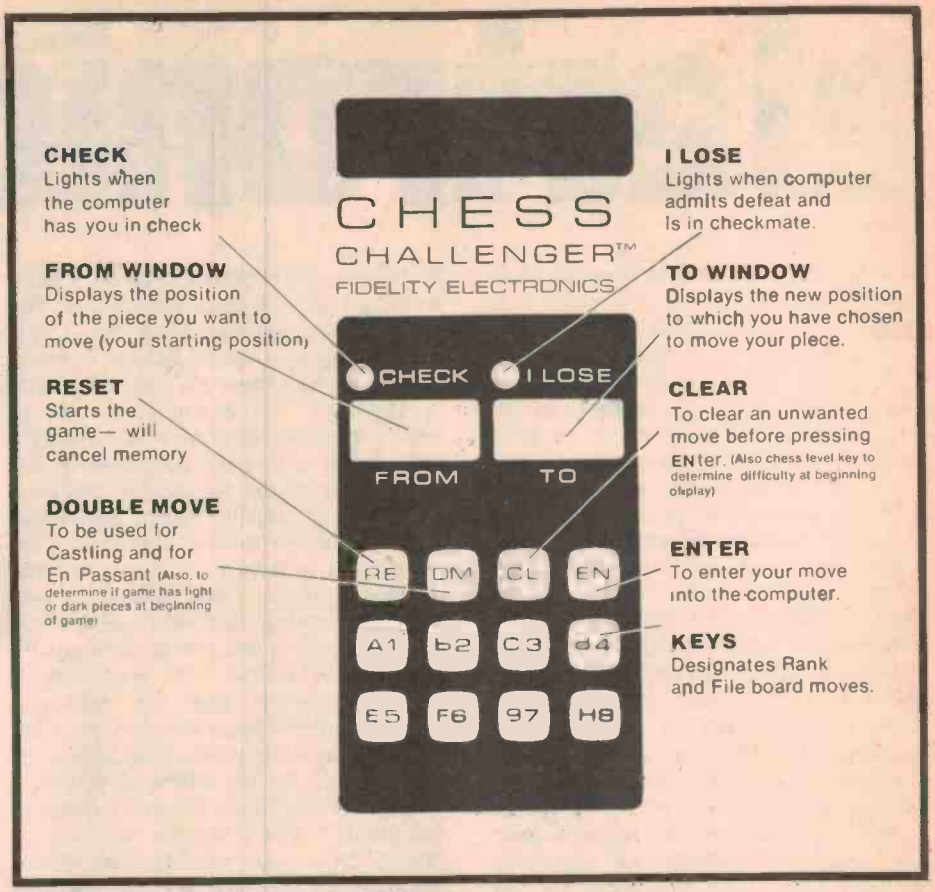
Again, the tactical program was terrific for the beginner and the learner, but a little slow and undevious for the advanced hustler. I am waiting with baited breath to see what other goodies the program designers are coming out with in the future – I can only assume things will get better and more interesting for the average chess player.

The Chess Challenger is definitely worth looking at if for no other reason than sheer novelty. For the beginner, the Challenger is a fine teaching machine. For the player without human opposition the Challenger is a fine opponent at any time – it never

The control panel occupies the right end of the case.

Chess goes electronic

loses its temper. For the eccentric yahoo like myself, an opportunity to get your sporting rocks off without fear of retaliation or loss of face. In other words, something for almost everybody. One sad note in passing. A price tag on the plus side of 400 bucks seems a little heavy. As a Christmas present it's definitely not first on the list for the kids of middle-class parents. If the price could come down to perhaps one third or less maybe a lot more parents, schools, etc. would pay it more serious attention. Almost everybody we canvassed said it was a great thing for the beginner, but not at that price.



The control panel resembles a glorified calculator.

Upgrading

Les Bell takes up the story: Intrigued by the virtuosity of the basic Chess Challenger, we obtained one of the upgraded models which plays at three different levels of skill. Owing to time pressure we weren't able to play many games against it — especially since every move we made had to be considered very carefully! We soon discovered that Chess Challenger is very adept at using its Queen — if that piece is threatened early in the game, the machine will bring it out and proceed to wage guerilla warfare. This was the cause of our demise on several occasions!

When a move is entered on Chess Level 1, the machine will respond almost immediately with its move, while on Chess Level 2, it will respond in 11 to 16 seconds and on Level 3 it can take up to 34 seconds. Fidelity Electronics obviously won't say much about the algorithms used by the machine, but we believe that on Level 1 it checks up to 20,000 possible moves, not just to see if it can take one of your pieces (or vice versa), but also for positional advantage. We also believe that on Level 3 it works out a move and then reverses the 'board' in its memory to play what it thinks is your best move, reverses the board again to make a second move and finally makes your probable reply. It then evaluates its position and if it is not ahead will reject that move. It repeats the process several times to come up with the best move.

The processor inside is an 8080 with 16K of ROM and 512 bytes of RAM. This means that Chess Challenger is a genuine, honest-to-goodness chess-playing computer. Of course, many of our readers already own a computer, and chess-playing programs are now available for the 6502 and 8080 microprocessors. The program for the 6502, which was produced by Microchess in Toronto, Canada, runs on an unmodified KIM-1 with no peripherals and only 1K (approximately) of memory. The 8080 program is rather more sophisticated and requires a teletype or VDU for operation. Both these programs will soon be available from Computerland, 55 Clarence St., Sydney.

Of course there is a lot of interest in chess-playing programs to run on large computers, as the problems involved are central to research in such areas as artificial intelligence and computer modelling. The techniques and strategies in a large chess-playing program such as Northwest University's CHESS 4.5 are extremely complex, and some programmers are trying to implement algorithms for pattern recognition.

Incidentally, Fidelity Electronics have announced a Backgammon-playing version of the Chess Challenger, and Heathkit have released the Challenger in kit form. It must be really impressive to say 'I built it myself!'.

This is the mains transformer that was supplied with the single-level machine — the upgraded machine had a much cooler type.

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Shown above is Technics receiver model SA-5370.

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SOUND

Two Speed Linn

We've just received from Audiolab a new box of tricks (as forecast in Sound Briefs in the last issue) for adapting the Linn-Sondek LP12 to a two-speed turntable. No mechanical modifications are required, and installation is as easy as plugging the Linn mains cable into the outlet in the rear of the Linn Driver, as Audiolab calls the unit.

The Linn-Sondek uses a synchronous motor which is, of course, dependent on mains frequency for maintenance of correct speed. The Audiolab unit is nothing more than a sine-wave generator, delivering 240 volts at precisely 50 Hz for 33.3 rpm platter speed and, at a flick of a switch, what we assume to be 67.5 Hz for 45 rpm. (We haven't had the opportunity to measure the 45 rpm output frequency). Like most simple ideas, the theory is the easiest part. For absolute stability, Audiolab has used a crystal oscillator as reference with a series of frequency dividers and there is a pretty massive power supply to produce all those volts at sufficient current – quite a design problem. The Linn isn't a guzzler of electricity by any means but there is a relatively high current demand at switch on and of course, this demand has to be supplied by the driver unit. Our initial suprise at seeing an enormous heatsink at the back of the Linn Driver was rapidly suppressed by thought along these logical lines.

The unit supplied to us was the first prototype and was not quite the neatest, tidiest hi-fi component we have seen. The photograph shows the Linn Driver alongside what it is supposed to drive; the LED above the right (speed-change) switch was intended as a warm-up indicator but will probably not be fitted to production models.

The question is, of course, does it work? And the answer is, yes, with no apparent audible degradation of sound. Allen Wright who engineered the device informed us that some bright spark of his acquaintance (a musician, in fact) dropped a stroboscope disc on his Linn and discovered the platter was running fast. He was apparently perplexed when advised that the light source used to read the strobe was being fed from mains frequency which was obviously not 50 Hz! Which also means that a specific 50 Hz supply is essential to check speed of the Linn Driver-operated Linn!

Well, estimated retail price is around $150–$200 which sounds rather a lot, taking the price of a complete Linn with a reasonable arm and cartridge, together with two speeds, to well above a grand. On the other hand, the unit does ensure absolutely consistent speed regardless of mains frequency fluctuation and the extra speed is a boon if you have a collection including 45 rpm direct-cut records or, like the writer, a large number of historically-interesting singles.

Presumably it would even be possible to organise 78 rpm from the unit, although one wonders if the Linn electricals (or for that matter, the mechanicals) would be happy with 117 Hz and so elevated a platter speed.

We've had the Linn-Driver running non-stop for a few days now and so far there has been no problem, which is a most encouraging start. And of course, it adds status to be able to say one can play 45s on one's Linn . . .

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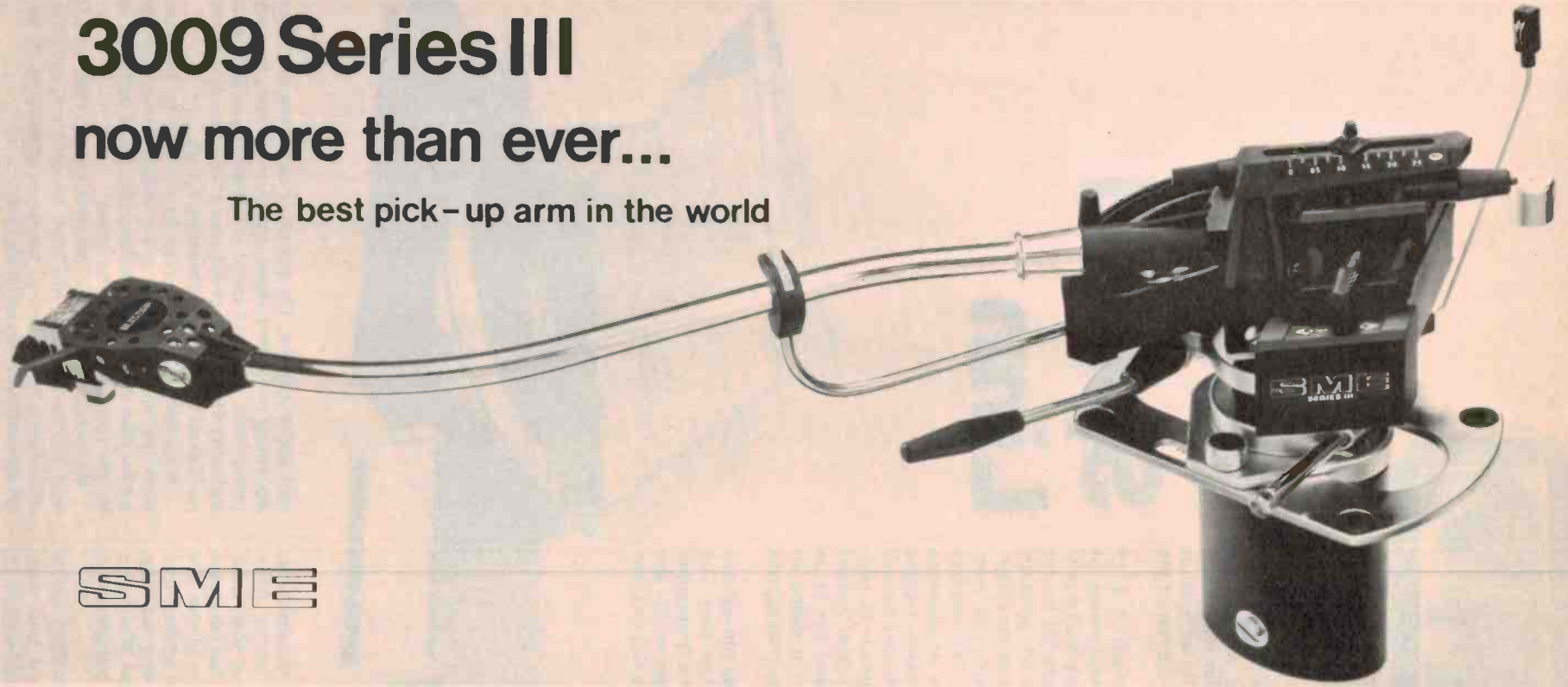

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AE127/FP

Transmission Line Loudspeaker

We have received a flood of enquiries concerning our transmission line speaker project, mainly as a result of our omitting the value of the 0.5 mH choke in parallel with the 1.8 ohm resistor R2 in the crossover circuit diagram. Several readers have also requested the names of suppliers for various components including long-haired sheep's wool (which we didn't actually recommend for this project because of its potential inconsistency of performance).

We also had a couple of letters telling us the volume of the enclosure was wrong, which it is, of course, if you're talking about a reflex but we stated clearly that this is a transmission line system.

The enclosure design is actually derived from the quarter-wave pipe principle. The proviso here is that the length of the pipe should be equal to one quarter the wavelength in air of sound at the resonance frequency of the bass driver, in this instance KEF's B139, which has a fundamental resonance of approximately 25 Hz. This gives an effective length of nearly 3.5 metres, which corresponds very closely to the axial length of the scheme described. The only other consideration affecting enclosure size is cross-sectional area of the pipe, which must be greater than the diaphragm surface area (in the instance of the B139, approximately 290 sq cm) throughout its length. Thus, with its negative taper, the design illustrated has greater cross-sectional area than this at the vent. Dimensions of transmission line enclosures are therefore related only to the size of the unit selected and, in this instance (but not always) to the fundamental resonance. The quarter wave system is purely a means of suppressing a potentially problematical resonance in a pipe of finite length.

The damping material also raised a host of queries. We recommend acoustically-absorbent fibreglass, which is available in sheet form from agents of ACI. This material will probably have to be specially ordered since it is apparently rarely requested at retail level.

Coils can be obtained from Transcap, Orchard Road, Brookvale, 2100. The fluorescent lighting ballasts (oil-filled paper capacitors) were obtained at fairly substantial expense from Plessey Ducon in Sydney, but if need be, non-polarised electrolytics can be obtained in a wide range of values – enough to make up the values published – from Audioson, Winbourne Road, Brookvale who also supply KEF drivers. The papers tend to be "lossy" and it's advisable to connect small-value polyesters of high voltage rating in parallel with the main papers to allow small musical details a passage – this refers to the capacitors in the signal path and a microfarad or so will suffice for C2 and a few picofarads with the tweeter caps, C4 and C6.

We understand from M & G Hoskins that supplies of HF1300 and HF2000 tweeters are good; KEF B139 and B110 units are easily obtained from Audioson or KEF retail outlets. We therefore advise you to use this drive unit lineup if you want the four-way systems as described, and a KEF T27 in place of the Celestion tweeters if you want a three-way.

As for the actual construction and stuffing, it is essential that all panels are accurately cut and fitted together to give an airtight seal the length of the "line" and between the main enclosure and midrange sub-enclosure. As we mentioned in the previous article, it is very difficult to quantify the precise amount of acoustic fibreglass needed to fill the line, but the best way to estimate requirements will be to calculate the volume required to fill the enclosure without compressing the material, then add another 15% so that a greater density of stuffing can be placed near folds in the tube.

Finally, for those having problems with capacitors, polarised electrolytics can be used as a last resort if wired "back-to-back" in pairs. Each capacitor should have a value of 2C and the negative tails should be joined, the result being equivalent to a bi-polar capacitor having the value of C. However, if at all possible, paper and polyester caps should be used in signal paths. The network shown gives turnover frequencies of approximately 400 Hz, 3.5 kHz and 12 kHz. Constructors may wish to design their own networks but we suggest these turnover frequencies be chosen if at all possible. And for those who may be wondering about the extra network associated with the midrange unit, this is intended to reinforce output below some 600 Hz to compensate for losses below this frequency as sound travels round the outside of the enclosure.

Component values should be fairly closely adhered to, although in the instance of items like the 1.8 ohm resistor, either 1.5 or 2.2 could be used. This value could easily be produced using jug element, of course, wound round a higher value resistor as a former – a 39 ohm, perhaps? It is then a simple matter to obtain a fairly precise value by measurement using a multi-meter.

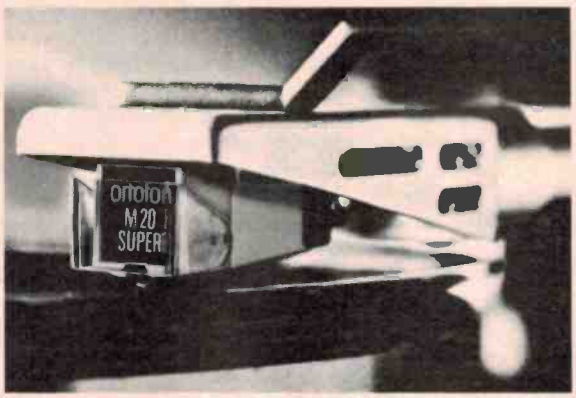
As a matter of general interest, the coils supplied by Transcap have less than 1 ohm resistance. All resistors should be ten watt types, although five watt rating will do at a pinch for tweeters. Cables connecting the crossover with the drive units should be the most suitable available and of the highest quality: we suggest 7/029 building cable for connecting bass, the same with parallel single strands of 60/0031 Litz cable (this stuff is for winding RF chokes) and plaited strands of Litz (making three-core connecting cables) for the tweeters. Litz cable in multi-strand form (you have to make this up yourself) is also excellent for connecting speakers to amplifiers although for any but a very short run it is wise to include a parallel run of, say, 7/029, to improve LF electrical damping and signal transmission.

Even if these rather specialised cables aren't used, it is essential to use adequate wiring both within and outside the enclosures. 23/0076 is our minimum recommendation.

With care and attention in construction, these speakers can provide excellent results, with truly musical bass. But if you like a lot of bass (most commercial speakers provide this; it's pretty boomy, too) the design in practical form will probably disappoint you. On the other hand, once you accustom yourself to the very accurate bass sound these speakers can provide, you'll probably find it difficult to listen to most other speakers, unless they happen to be very good infinite baffles or, of course, good transmission lines.

WHAT GOES IN MUST COME OUT.

Ortofon professional cutter head type DSS 732 in action.



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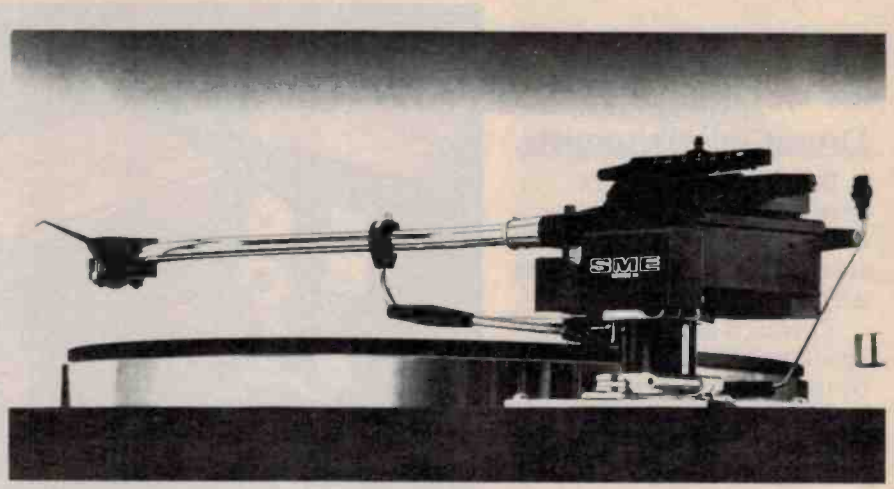
SOUND BRIEFS

The Curly SME



WE have our hot little hands on a very desirable little property, just sent in for our perusal by Audio Engineers in Sydney. It's the new **SME series three**, long awaited and at first sight a potentially good performer. Watch this space.

Lux Preamp

The new CX-1 cartridge preamp provides 2 choices of gain (20 or 30 dB) and excellent noise and distortion performance. FET's give an impedance-tolerant front-end, and this interesting new model should be available in early 1978 through International Dynamics in Melbourne.

Kenwood

A new marketing company for Kenwood hi-fi components, Trio-Kenwood Australia, has announced a new policy in connection with warranty and servicing. Kenwood has always produced highly reliable components, but it's good to see the company doesn't think it's perfect and is actively attempting to give its customers the very best available.

Grace Integrated Headshell/Cartridge

Integrated pickups (combined headshell/cartridge/arm systems) aren't at all common but Grace has gone some way to improving this situation by offering a **combined headshell/cartridge** for use with standard locking collar type arms. Based on top-of-the-line F-9L, the unit is designated SF90 and is available through International Dynamics in Melbourne.

Computer Cassette

No, it's not what you think. Optonica's new RT-3838H cassette machine has a **built-in microprocessor** covering programme location, counting and timing functions. We're told the unit also produces audio signals.

Broadcasting in Australia

We've received a very interesting news release from **the Public Broadcasting Association of Australia** and hope to reproduce the more important parts of this in the next issue.

New Marantz

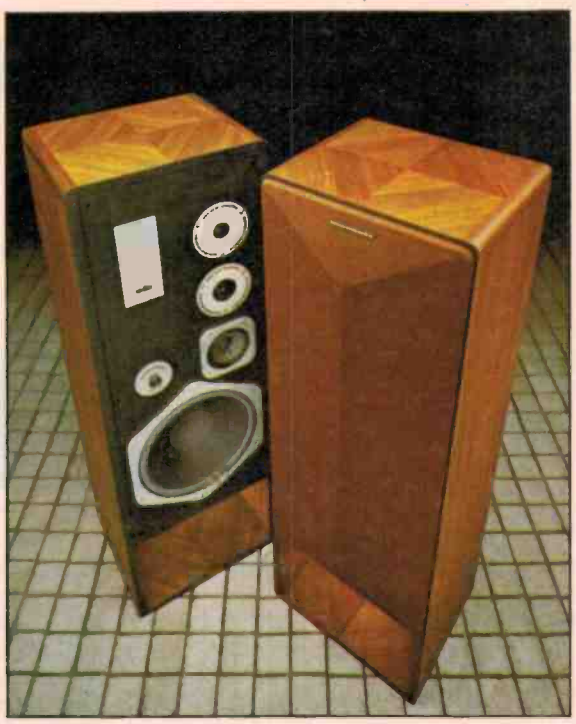
Several new **Marantz models** have been released and information on the full Marantz range can be obtained from Auriema (Australasia) Pty. Ltd., P.O. Box 604, Brookvale, NSW, 2100.

Musicality, Definition: and Next Year?

If musicality was the hi-fi word for 1975-76, and definition the word for 1977, what will we have for 1978? Don't, repeat DON'T, send your answers to us. We have enough rubbish in our office as it is.

Ultimately It's Marantz.

Go For It.



Drums-Cellos-Trumpets instead of... DrumCselloTsrumpets.

Because what you're getting is the sharpest, cleanest instrument definition you've ever heard from any speaker system.

Through ordinary speakers, music is a sound of instruments jumbled together. Yet listen to the same music played through a Marantz 940 speaker system. The difference is amazing! The music comes out exactly the way it went in—instrument by instrument.

At the heart of the Marantz 940 is the most sophisticated crossover network ever developed. Most competitive systems have only two separate level controls in their crossover network, with no inductors. Marantz gives you three level controls with six inductors! So you get more circuitry for precise crossover points. The result: a flat frequency response with smooth transition of the frequency ranges between woofer, mid-range and high-frequency loudspeakers, combining all of those cleanly defined instruments into a brilliant, meticulous blend.

And, to do the job of bringing forth each individual instrument within the divided frequencies, Marantz designs and builds more expensive, more sophisticated transducers. Marantz woofers, for example. The big bass drum is heard in all its glory because Marantz builds woofers with a rigid new cone material—rigid enough to withstand ten times the force that can destroy a light airplane. This superior structural strength enables the cone to move in an ideal piston-like motion, instead of bending. Which means a tight, low frequency response and uncolored sound quality.

The human voice—the most difficult sound to reproduce—takes on flesh and blood realism. Because the Marantz 5-inch mid-range cone transducer blends precisely with both woofer and tweeter elements. And it's completely sealed off in its own enclosure. Vibrations produced by the woofer (like the big bass drum) can't shake up mid-range reproduction.

Even crystal-shattering trumpets are a total reality thanks to the exclusive linear polyester film domes on the tweeters. The lighter weight film responds faster to high frequency vibrations: also, the small dome shape of the tweeters disperses high frequencies over a wide area. No matter where you are in the room you hear the same sound.

Is it possible to perfect the sound even further? Yes... with our exclusive Vari-Q* feature. It's a high density removable foam plug. Plug in, the system is "air suspension"—ideal for movie albums. Symphonies. Jazz. Folk. Pull the plug out and the system is "ported" to give the gutsiest low end for today's electronic rock.

Outside and inside the Marantz 940 is a work of art—the top of the Marantz Design Series. The elegant furniture styling is magnificent. The sound—all you could wish for. The truest musical sound you've ever heard from any speaker, anywhere.

Your Marantz dealer has the Model 940 as well as the full line of Marantz Design Series Speaker Systems, Marantz High Definition Speaker Systems and Marantz Imperial Mark II Speaker Systems. If you want the best—and are willing to spend a little more to get it—then go for it. Go for Marantz.

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DENON

DIRECT DRIVE TURNTABLE
SL-7D

providing a direct drive system with the following features:—

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- LARGE DIAMETER TURNTABLE EQUIPPED WITH STROBOSCOPE
- RUBBER & FELT INSULATORS
- INDEPENDENT CUEING LEVER
- HIGH SENSITIVITY TONE ARM
- WOW AND FLUTTER OF LESS THAN 0.04 PER CENT (WRMS) at 33-1/3 rpm

SPECIFICATIONS

STARTING TIME:
2.1 seconds for 0 to 33-1/3 r.p.m.

WOW AND FLUTTER:
Less than 0.04% (WRMS) at 33-1/3 r.p.m.

SIGNAL TO NOISE RATIO:
Over 60 dB.

POWER CONSUMPTION:
12 watts

The Professional Audio Brand

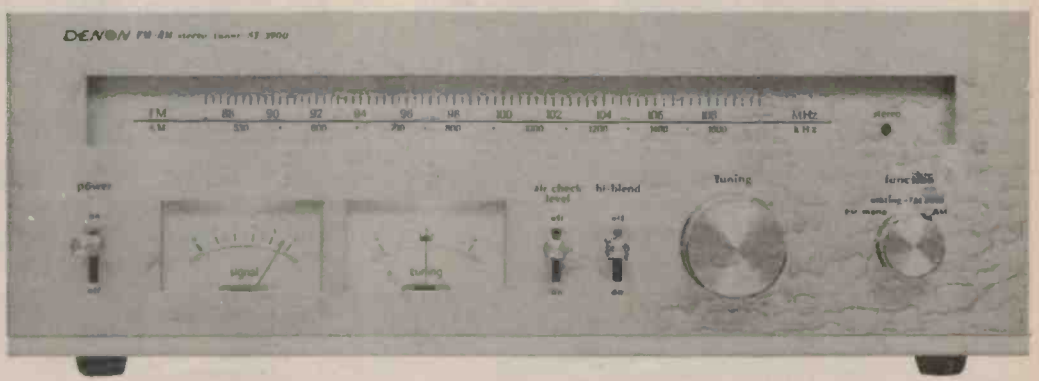
SA-3900 AMPLIFIER

This integrated stereo unit has a rated output of 40W + 40W both channels driven, and through the use of PNP-NPN transistors a pure complementary circuit has been provided, permitting improvement in driver efficiency and power bandwidth.

SPECIFICATIONS
All silicon transistor stereo premain amplifier.
Residual Noise: Lower than 2 mV (0.5 μW)
Damping Factor: More than 35
Power Bandwidth: 20 Hz – 45 kHz (–3 dB at rated output)

ST-3900 AM-FM Tuner

The design of this receiver has been co-ordinated with that of the above integrated amplifier, and features include silicon IC chip, diode limiter, and three ceramic filter elements. Also provided is a muting circuit to minimise interstation noise.



SPECIFICATIONS
Solid State AM-FM Stereo Tuner.
3-Integrated Circuit, 1-FET, 8-Transistor and 5-Diode.
Power Requirement:
AC 100, 120, 200, 220 230~240 volts changeable, 50/60 Hz

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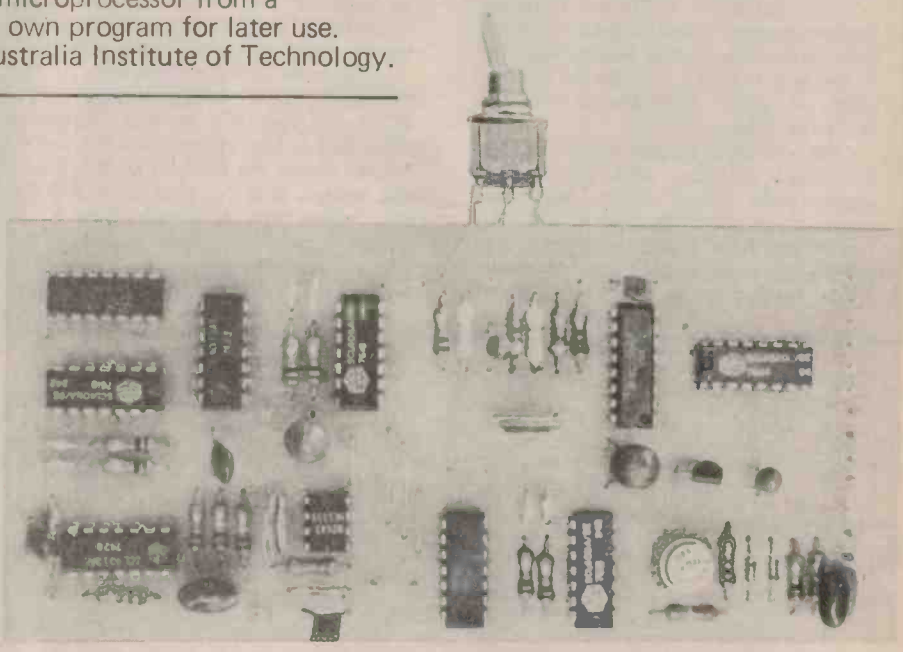
AD A18

CUTS CASSETTE INTERFACE

This unit allows you to program your microprocessor from a prerecorded cassette or to record your own program for later use. Design by Trevor Marshall, Western Australia Institute of Technology.



REPEATEDLY TYPING IN programs is not what hobby computing is about. Although most systems start life without any form of off-line mass storage, as more memory is added so more programs are written and the need for some form of storage becomes more pressing. The ideal device for this job is probably the floppy disk, but this is (a) expensive and (b) usually dedicated to one processor or bus structure. Many hobbyists are running several small systems, and a device which is less convenient but more suited to their needs (and pockets) is the humble cassette recorder.

This interface is designed to convert the digital signals from your computer to audio tones and back again, using a standard system called CUTS (Computer Users' Tape System), which is also referred to as the Kansas City or Byte format. This records data at 300 baud, with a logic '1' recorded as eight cycles of 2400Hz and a '0' as four cycles of 1200Hz. A byte of data is recorded as a start bit of logic '0', followed by eight bits of data and two stop bits of logic '1', and this is taken care of by the UART in your computer.

Although the standard is 300 baud, the monitor programs in some kits allow only 110 baud operation, and this interface will work at 110 baud. It can also be run faster (up to 1200 baud) to allow faster program loading.

We have not described a case, as most constructors will wish to mount the board either on the back panel of their computer or in their VDU. Also, switching between VDU and cassette will depend upon the user's computer – the ideal situation is to have two

SPECIFICATION ETI – 637

Code used	CUTS
Tones	
"0"	1200Hz
"1"	2400Hz
Baud rate	
nominal	300
maximum	1200
Digital output	5V CMOS level
Analogue output	100mV
Recommended recording level	–7VU
Power supply	+5V or +7V to + 30V @ 5mA

HOW IT WORKS – ETI 637

This unit records digital information on tape in serial form using two tones, 2400 Hz for a "1" and 1200 Hz for the "0". The standard transmission rate is 300 baud but it will work equally well at 600 baud. The designer has operated his unit at 1200 baud with success but with only one cycle of 1200 Hz per bit it is more prone to dropout, etc.

Decoder

We will start the explanation of how it works by assuming you have a prerecorded tape. The output of the tape recorder (alternate tones of 1200 and 2400 Hz) is "squared up" by IC1 which is connected as a schmitt trigger with R3 and R4 providing the necessary positive feedback.

The gates IC2/1, IC2/2 and IC3/3 are used to generate a positive pulse about 3μs wide on both the leading and trailing edges of the output of IC1. This gives a series of pulses at either 2400 Hz or 4800 Hz (417μs or 208μs period).

The pulse chain triggers the monostable IC4 which is 300μs wide. If a second trigger pulse occurs before the 300μs period (as it will if the input is 4800 Hz) the second pulse is simply ignored. The input pulse chain is gated with the monostable output in IC3/3, the resultant output being pulses at 2400 Hz whether the input frequency is 2400 or 4800 Hz.

These pulses are used for the reference for the phase locked loop (PLL) IC7. This IC contains a phase detector and a voltage controlled oscillator. The output of the oscillator is divided by 2^8 in IC8. After dividing by 2^4 (16) IC5/2, IC5/3 and IC5/4 are used to generate 3μs wide pulses on both leading and trailing edges and this output is the second input to the phase detector in IC7. The output of the phase detector (pin 13) is used to control the oscillator (input is pin 9) and the two pulse chains are equalized in frequency and phase. Using this technique the tape speed can be varied by up to ∓20% and the PLL will track it. The outputs of IC8 can be used to control the UART in the computer. If the UARTs own clock is used the allowable tape speed variation is ∓5%.

To decode the pulse chain into "1" and "0" and to ensure correct phasing, IC2/4, IC3/4, IC5/1 and IC6 are used. The monostable IC4 is triggered at 2400 Hz, and its output clocks the D input of IC6/2 into the output. IC6/1 is used as an R-S flip flop being "set" if a pulse from IC2/3 occurs during the "mono" period (if the input is high frequency) it is reset every 417μs by IC5/2. However, the information is clocked into IC6/2 before the reset pulse occurs. If the input is only a 1200 Hz tone the set pulse does not occur and a "0" is strobed into IC6/2. An examination of the timing diagram in fig. 1 will help clarify the sequence.

Encoder

The encoder is a little more complex than needed for 300 baud, but it allows operation at 600 or 1200 baud if needed. The output of IC9, which is a non-symmetrical 2400 Hz, triggers a 3μs monostable IC10/4 which then toggles IC11/2 giving a 1200 Hz square wave output. However, if the "data input" is a "1", IC11/1 is toggled to give a "1" at pin 1 which enables IC10/2. This then triggers the monostable IC10/4 midway between the pulses due to IC9. This then toggles IC11/2 at twice the rate to give 2400 Hz output. The clocking of the data input into IC11/1 is about 100μs out of phase with the rest of the timing to give time for the UART to settle, eliminating any errors due to propagation delays.

The phase locked loop IC is used only as an oscillator in the transmit mode and the VCO input is switched to a preset voltage giving the correct frequency.

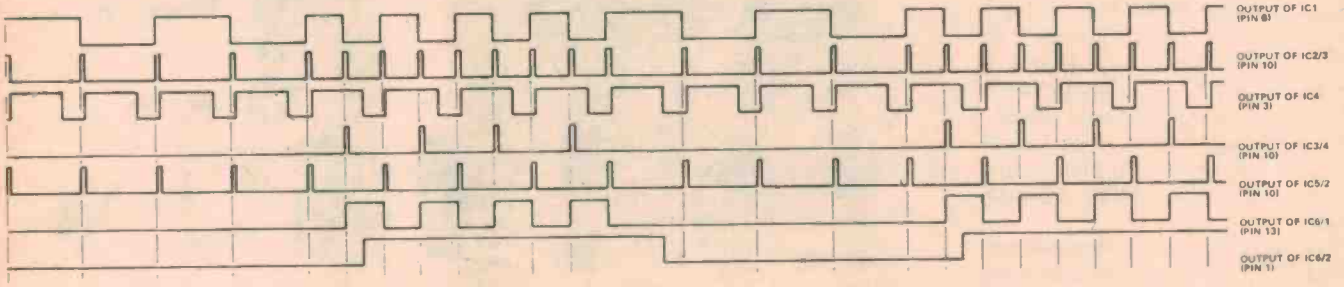


Fig. 1. The sequence of events in the decoder when receiving a '0,1,0,1' input.

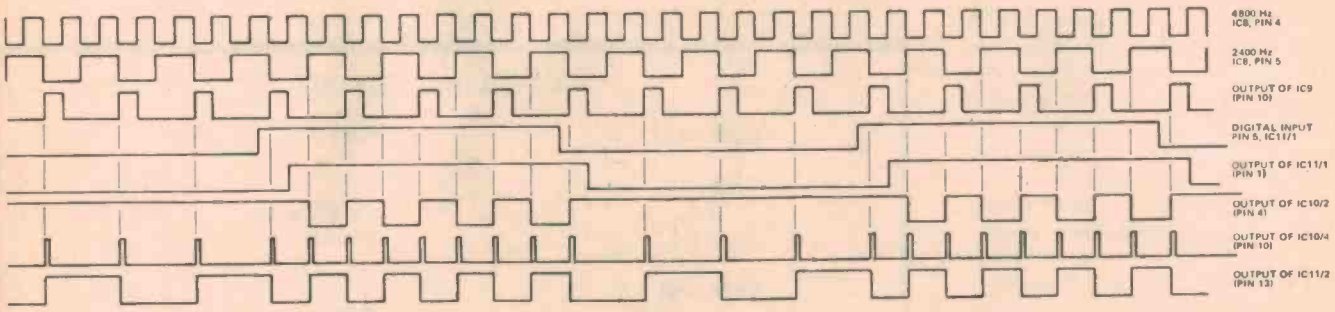


Fig. 2. The encoder waveforms when transmitting a '0,1,0,1'.

UARTs for both VDU and cassette, but many systems (or rather, their monitors) do not permit this.

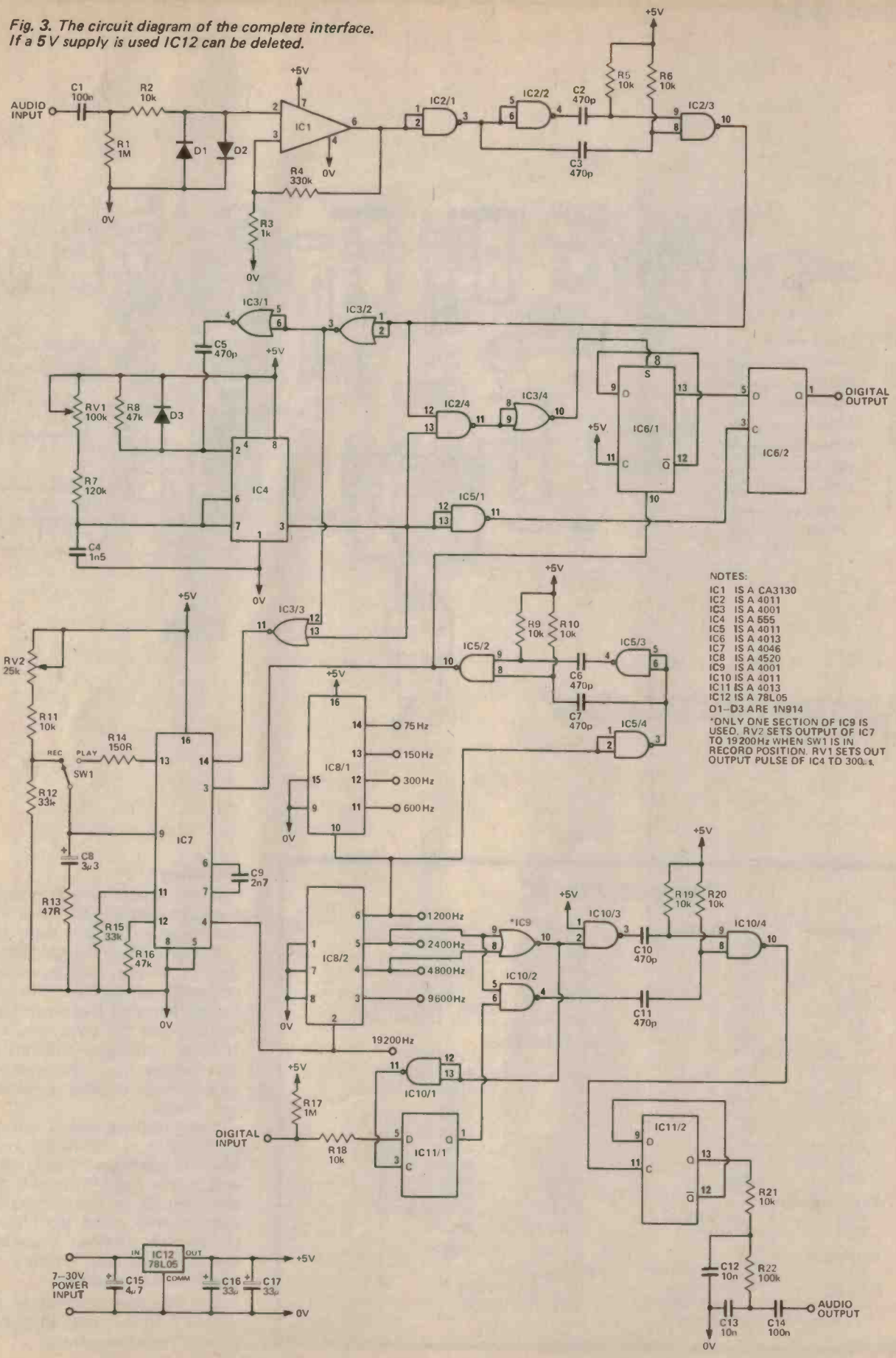
Construction

This is simply assembling the pc board. Take care when handling the ICs as most are CMOS. As the unit will probably be built into a system we have not given any mechanical assembly details. The record/play switch can be mounted remotely if desired.

Alignment

The only adjustments on the unit are the record frequency and the monostable period. Switch the unit to record and monitor the frequency at any of the baud rate outputs and adjust RV2 to give the correct frequency. Now inject a 1200 Hz tone into the audio input (take of from the baud rate outputs when in the record mode) and adjust RV1 to give a 300μs wide pulse at pin 3 of IC4. If an oscilloscope is not available, setting RV1 to mid position should be close enough.

Fig. 3. The circuit diagram of the complete interface. If a 5 V supply is used IC12 can be deleted.



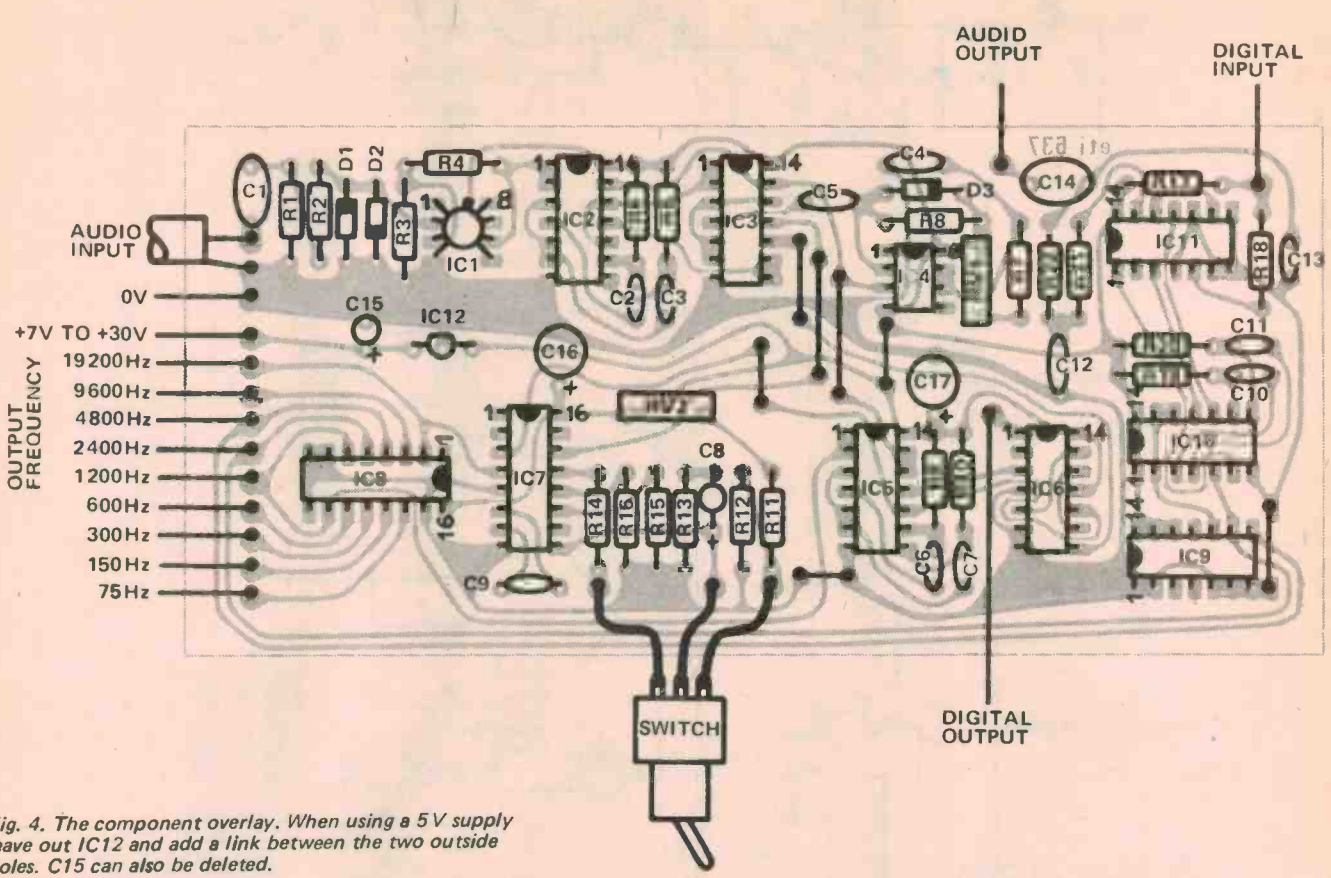


Fig. 4. The component overlay. When using a 5 V supply leave out IC12 and add a link between the two outside holes. C15 can also be deleted.

PARTS LIST ETI – 637

Resistors all ½ W, 5%
R1 . . . . . 1M
R2 . . . . . 10k
R3 . . . . . 1k
R4 . . . . . 330k
R5,6 . . . . . 10k
R7 . . . . . 120k
R8 . . . . . 47k
R9–R11 . . . . 10k
R12. . . . . 33k
R13. . . . . 47R
R14. . . . . 150R
R15. . . . . 33k
R16. . . . . 47k
R17. . . . . 1M
R18–R21 . . . 10k
R22. . . . . 100k

Potentiometers
RV1 . . . . . 100k trim
RV2 . . . . . 25k trim

Capacitors
C1. . . . . 100n polyester
C2,3 . . . . . 470p ceramic
C4. . . . . 1n5 polyester
C5–C7 . . . . . 470p ceramic
C8. . . . . 3µ3 25V electro
C9. . . . . 2n7 polystyrene
C10,11 . . . . . 470p ceramic
C12,13 . . . . . 10n polyester
C14 . . . . . 100n polyester
C15 . . . . . 4µ7 35V electro
C16,17 . . . . . 33µ 10V tantalum

Semiconductors
IC1 . . . . . CA3130
IC2 . . . . . 4011 (CMOS)
IC3 . . . . . 4001 (CMOS)
IC4 555
IC5 . . . . . 4011 (CMOS)
IC6 . . . . . 4013 (CMOS)
IC7 . . . . . 4046 (CMOS)
IC8 . . . . . 4520 (CMOS)
IC9 . . . . . 4001 (CMOS)
IC10 . . . . . 4011 (CMOS)
IC11 . . . . . 4013 (CMOS)
IC12 . . . . . 78L05

D1–D3. . . . . 1N914

Miscellaneous
PC board ETI 637
SW1 SPDT toggle

Recording

For best results recording should be done at a relatively low level. We found that about –7 VU gave the best result.

Unfortunately the use with a recorder with an automatic level control did not prove satisfactory. This is because the level control logic is designed for music where the peak level is about 10dB or more higher than the average. This cannot cope with a continuous tone without it being recorded at too high a level.

One method which has been suggested to us is to record a high level high frequency tone (about 18kHz) as well as the signal. Theory is that this tone will adjust the automatic level control while being too high to be reproduced. However it can beat with the bias oscillator causing more problems than it solves.

We therefore recommend that the unit be used only with a recorder with a manual recording control.

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Specify width .031", .050", .062"
.080", .100", .125", .150", .200"

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CCD101 88 pads .10" O.D.
CCD102 125 pads .125" O.D.
CCD103 125 pads .150" O.D.
CCD138 125 pads .187" O.D.
CCD139 125 pads .200" O.D.
CCD141 125 pads .250" O.D.

DUAL IN LINE: $1.20

CCD6014 16 only 14 pin
CCD6004 16 only 16 pin

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THEATRICAL LIGHTING CONTROLLER

Pt. 3 Construction

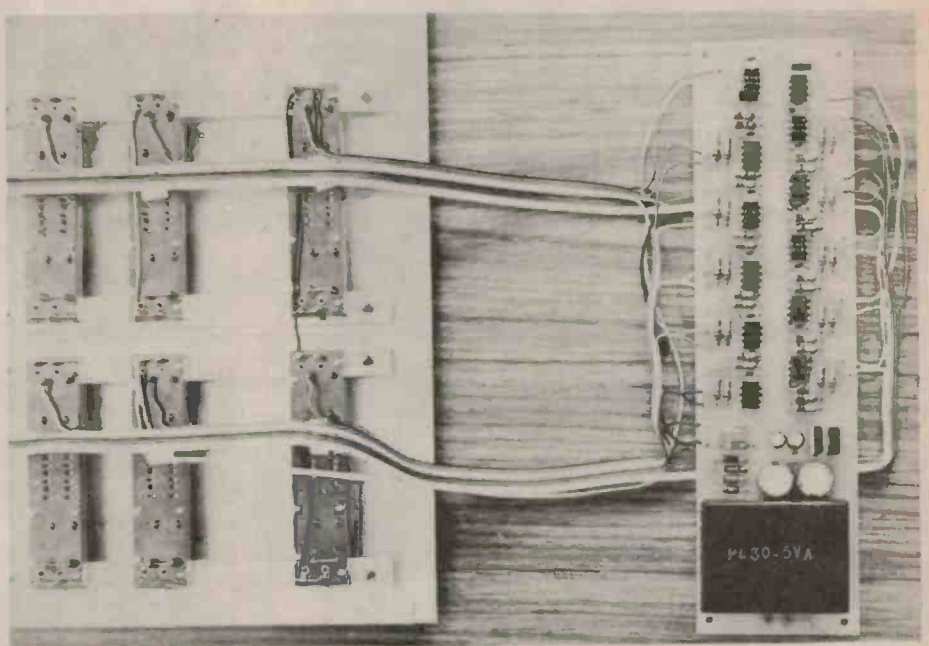
Dimmer Module

ASSEMBLE THE PC board with the aid of the overlay in Fig. 1. The heatsink should be drilled and tapped for the triac to allow easy replacement if ever necessary. Note that the mounting of the fuse is different for the 10 and 20A dimmers.

The choke is bolted onto the PC board using the long clamping bolts, preferably using rubber grommets in the holes in the pc board (they may have to be drilled out to do this). The leads from the choke should be bent such that they go into the holes provided without going near the mounting bolts which are at earth potential. The leads can now be soldered (both sides on the 20A unit).

The pulse transformer can now be wound according to Table 1. Be careful when winding this transformer not to damage the insulation on the wire as there is 240V between windings. The transformer is mounted using a 19mm long 6BA bolt with a 12mm dia. piece of pc board material acting as a clamp.

After soldering the power transformer in, melt the plastic studs which protrude through the PC board to give mechanical support. We also recommend some epoxy between the transformer and the PC board.



The printed circuit boards for the two versions of the dimmer board (ETI 588/10 for the 10A version and ETI588/20 for the 20A board) are identical in layout and differ only in that the connector end of the 20A board is double sided to present a greater area of contact with the connectors.

The component numbering system used on the controller drawings is designed to indicate which channel a particular component is part of. The printed circuit board drawing for the dimmer board is too large to publish in the magazine at full size; however, negatives of the pattern are available from Nebula Electronics, 15 Boundary St., Rushcutters Bay, 2011 for $5.00 each.

THEATRICAL LIGHTING CONTROLLER

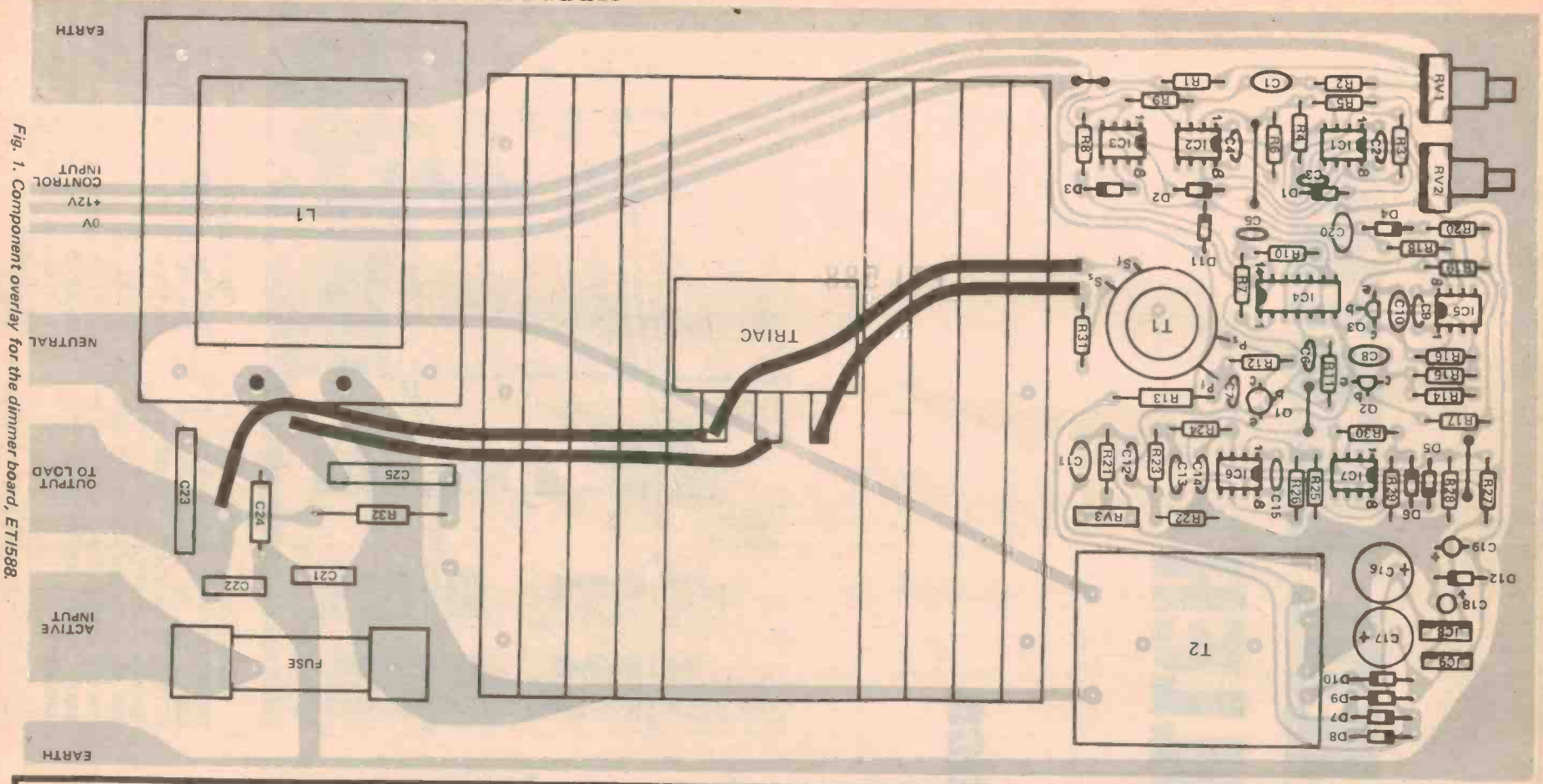


Fig. 1. Component overlay for the dimmer board, ETI588.

PARTS LIST – ETI 588

Resistors all ½W 5%

R1,2	100k
R3	4M7
R4	22k
R5,6	47k
R7	10k
R8	100k
R9,10	10k
R11	2k2
R12	1k
R13	470R 1W
R14,15	100k
R16	2M2
R17	100k
R18	15k
R19,20	100k
R21	4k7
R22	220k
R23–R26	100k
R27	4M7
R28,29	3k3
R30	4M7
R31	10R
R32	47R 1W

Potentiometers

RV1	1M lin rotary
RV2	100k lin rotary
RV3	25k trim

Capacitors

C1	100n polyester
C2	33p ceramic
C3	10n polyester
C4	33p ceramic
C5	330p ceramic
C6	100p ceramic
C7	10n polyester
C8	100n polyester
C9	33p ceramic
C10,11	100n polyester
C12,13	22n polyester
C14	33n polyester
C15	33p ceramic
C16,17	220µ 25 V electro
C18,19	10µ 25 V electro
C20	100n polyester
* C21,22	1n0 polyester
C23	33n 250 V ac
* C24	1n0 polyester
C25	33n 25 V ac

* These capacitors must be specified as suitable for connection between active and earth.

Semiconductors

IC1–IC3	LM301A
IC4	4011B (CMOS)
IC5–IC7	LM301A
IC8	7812
IC9	7912
Q1	2N3643
Q2,3	BC559
TRIAC	BTW41–400
D1–D6	1N914
D7–D10	1N4001
D11,12	1N914

Miscellaneous

Transformer (T1) see text
Transformer (T2) PL24/5VA
Metal bracket
Front panel

Additional components for 10A module
PC board ETI 588/10
100mm 35D heatsink
10 Amp choke
10 Amp fuse (ceramic body '0' size)
Fuse holders

Additional components for 20A module
PC board ETI 588/20
100mm 40D heatsink
Three 30mm long spacers
20 Amp choke
20 Amp fuse Philips A25X 20 Amp-trap
2 fuse holders Philips F30–2

PARTS LIST – ETI 588C

For 10 way 2 preset console

Resistors all ¼ W, 5%

R1	4k7
R11,12	150k
R13	220k
R14	100R
R21,22	150k
R23	220k
R24	100R
R31,32	150k
R33	220k
R34	100R
R41,42	150k
R43	220k
R44	100R
R51,52	150k
R53	220k
R54	100R
R61,62	150k
R63	220k
R64	100R
R71,72	150k
R73	220k
R74	100R
R81,82	150k
R83	220k
R84	100R
R91,92	150k
R93	220k
R94	100R
R101,102	150k
R103	220k
R104	100R

Potentiometers

22 off	25k lin. 60mm slide
RV3	5k trim

Capacitors

C1,2	33p ceramic
C3,4	220µ 50 V electro
C5,6	10µ 25 V electro
C11,21,31,41	33p ceramic
C51,61,71,81	33p ceramic
C91,101	33p ceramic

Semiconductors

IC1,2	301A
IC3	7815
IC4	7915
IC11,21,31,41	301A
IC51,61,71,81	301A
IC91,101	301A
Q1,2	BD140
D1–D4	1N4001

Miscellaneous

PC board	ETI 588C
Transformer	PL30/5VA
Box and front panel	
Knobs to suit	

TABLE 1

WINDING DETAILS OF PULSE TRANSFORMER T1

CORE	PHILIPS 4322-020-36630
PRIMARY	50 TURNS 7/0076 PLASTIC COVERED WIRE
SECONDARY	12 TURNS 7/0076 PLASTIC COVERED WIRE

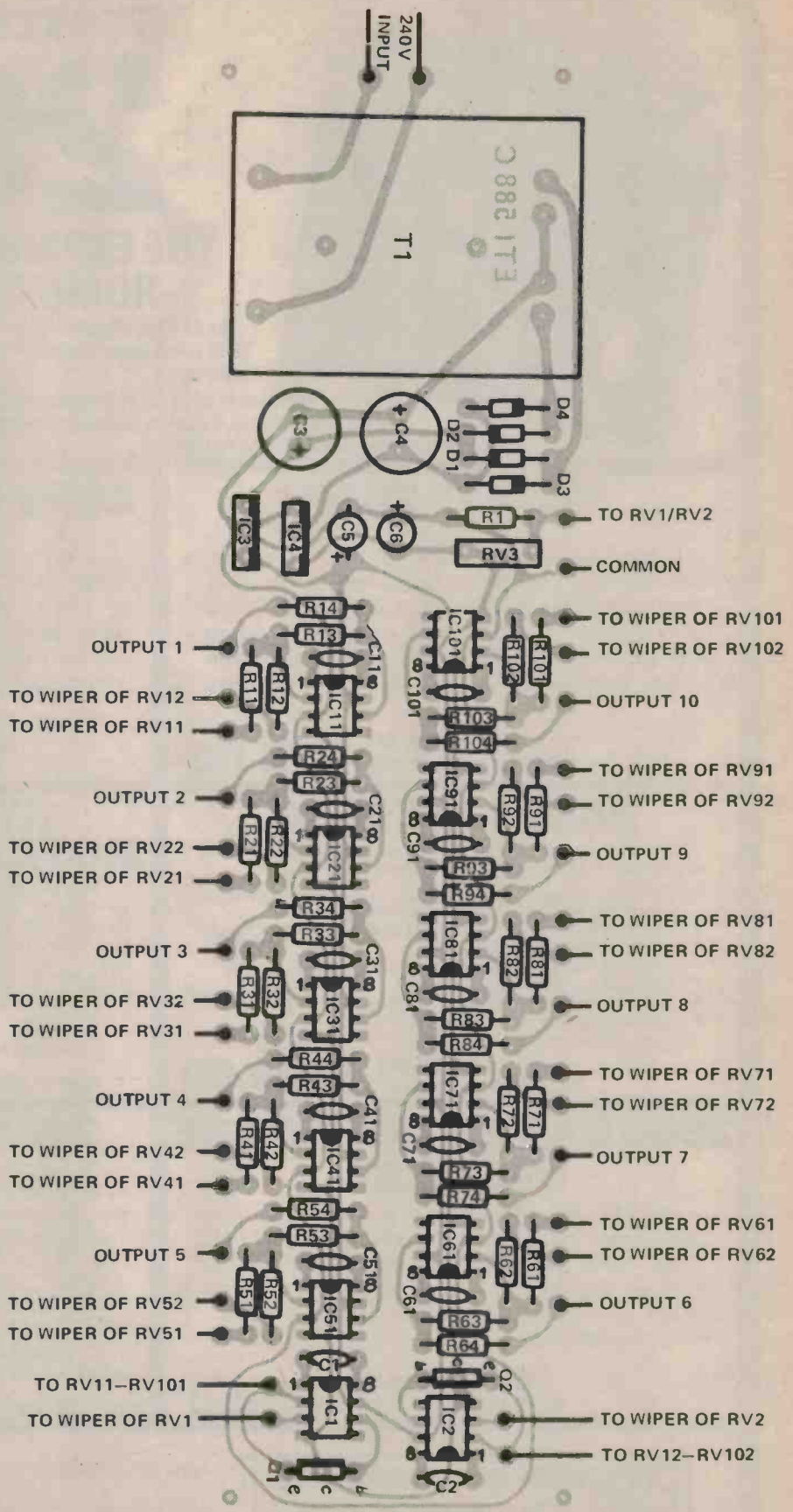
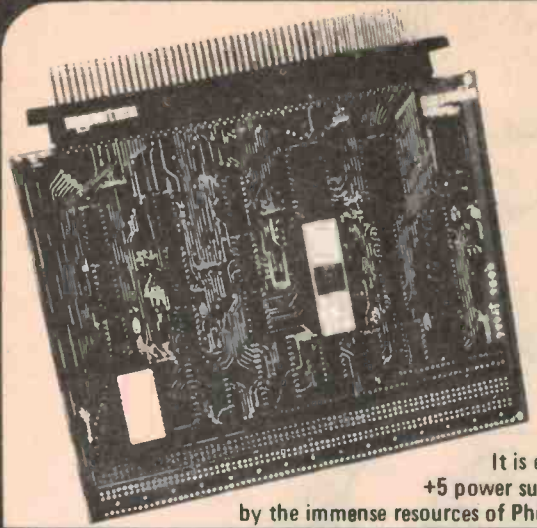


Fig. 2. Component overlay for the controller board, ETI588C.



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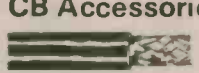

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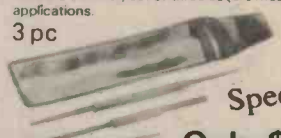

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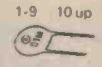

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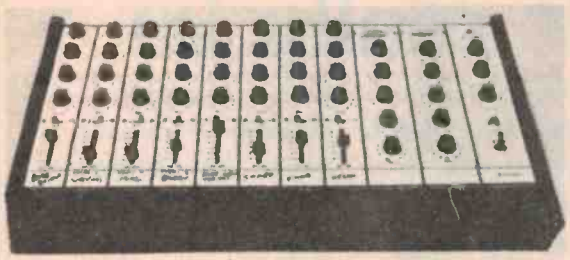

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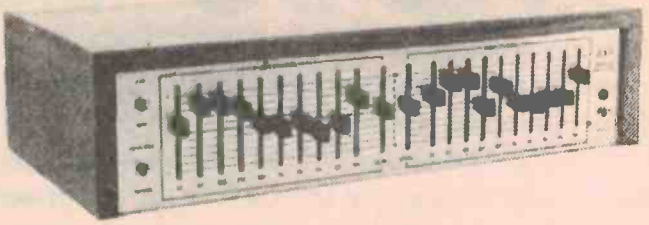

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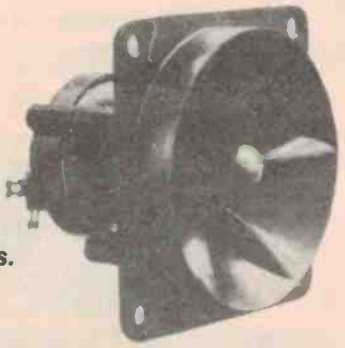

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VFETS FOR EVERYONE

Wally Parsons looks back to valves to explain VFETs.

A DIODE VALVE emits electrons from a heated cathode and these are then attracted by an electric field to the positive anode. Since only the cathode is heated, current can flow in only one direction. The diode will thus act as a rectifier, conducting only on alternate half-cycles of an AC voltage (see Fig. 1).

If a grid structure is placed between these electrodes, it can be used to control current flow. A negative potential will repel electrons, opposing their flow to the anode, and by placing the grid close to the cathode, a small change in grid potential will have the same effect on anode current as a much larger change in anode potential. Therefore, the device will amplify. Since the anode current is controlled by the electric field in and around the grid, the triode is, in a sense, a field effect device.

The action is direct, and electron flow responds rapidly to changes in control potential. Moreover, in switching applications it can switch an inductive load rapidly, because the back EMF sees an extremely high impedance and no reverse current flows.

Figure 2 shows the relationship of anode voltage, grid volts, and anode current for a triode. It can be seen that anode current can be controlled by both anode volts and grid volts. If a load is inserted in the anode circuit, current changes will cause voltage changes across the load. These can be plotted in the form of a load line as shown, and also as a transfer curve for the specific load.

The amplification is quite linear, but gain and output are limited – as shown by the semi-vertical slope of the curves.

Inserting a second grid between the control grid and anode and applying a fixed positive voltage somewhat lower than on the anode further accelerates

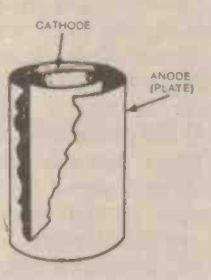


Fig 1. Basic diode tube construction and operation.

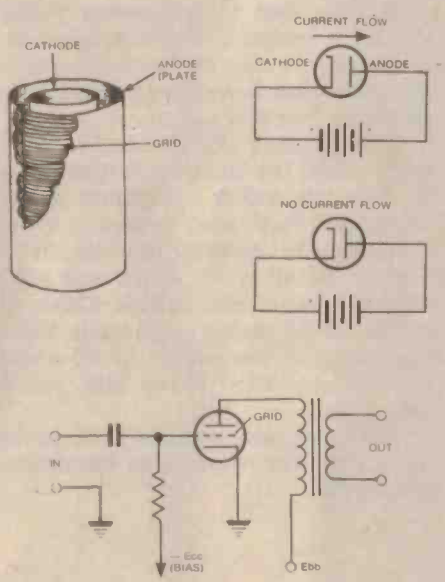
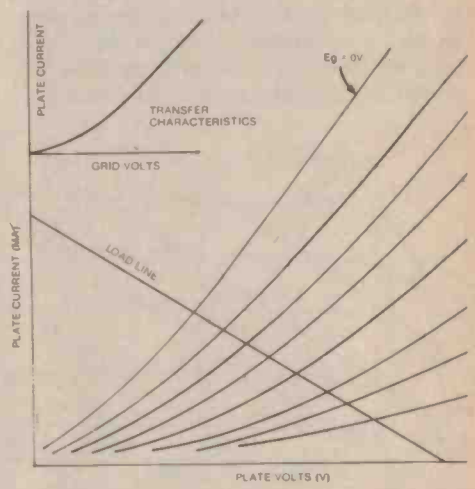


Fig 2. Triode construction, circuit and characteristics.

electrons, but because of the grid's open structure, most of them continue on to the anode. Note the screen voltage takes precedence over the anode in controlling current. And we can swing the anode voltage further for more output, and get higher gain too.

The addition of the second grid with a fixed high potential results in a current flow essentially independent of anode voltage, but still subject to the action of the control grid. (Figure 3). Trouble occurs, however, when we try



to produce an anode voltage swing lower than the screen voltage. Electrons are moving so fast that when they strike the anode they dislodge other electrons, which are attracted to the higher potential screen grid, thus reducing current through the load.

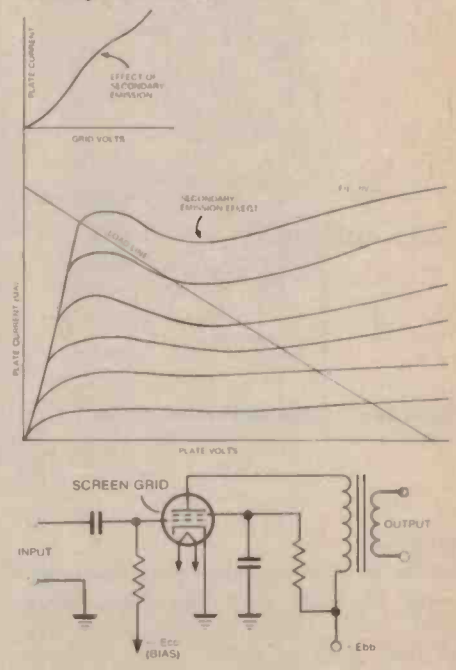


Fig 3. Series output arrangement.

VFETS FOR EVERYONE

This problem was overcome by adding a third grid between the screen and plate and tied to the cathode. Because it is at cathode potential the grid pushes the secondarily emitted electrons back to the anode, resulting in a family of curves as in Figure 4.

Distributed loading is also possible by dividing the load between screen and anode, and results in Figure 4a. This kind of flexibility makes it possible to design circuits of exceptional linearity.

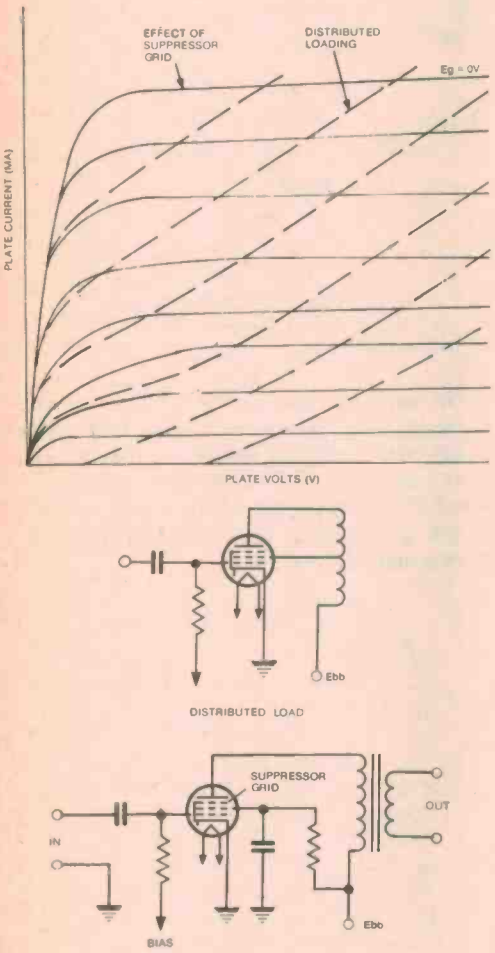


Fig 4. Single ended output with current source.

Problems

So far so good – except for a few problems. To begin with, the valve, like a light bulb, converts more electricity to heat than to useful work. It's very inefficient – for example the author (who is associated with the Canadian version of ETI) uses two 75 watt output class AB valve amplifiers to keep his studio at 25° C. without any additional heating in a Canadian mid-winter!

Also like a light bulb, a valve's performance deteriorates from the moment power is applied. Thus, direct coupled circuits can give real headaches in maintaining correct operating characteristics.

And then there's the output transformer. In order to match the thousands of ohms impedance to a low impedance load such as a loudspeaker, a transformer is virtually a necessity. With the inefficiencies already involved we can't afford the resultant impedance mismatches if we try to eliminate transformers. And we can't use gobs of feedback to reduce the resulting distortion. It's bad enough that, if we don't opt for a delicately balanced direct coupled circuit we have a low frequency roll-off and 90° phase shift at every R-C coupling point, but we have in any case the additional phase shift and internal resonances of the transformer. In practice, we are limited to between 20 and 26 dB of overall feedback. Obviously, a high level of open loop linearity must be designed into such an amplifier.

A great deal of engineering energy was spent designing output transformerless amplifiers, but few were successful, and those that were often created more problems than they solved.

Some legendary amplifiers *were* built using tubes. The Williamson, (I have one in daily use and it still sounds great), Quad, Leak Point One, MacIntosh Unity Coupled. The Quad, for example, delivered all of 15 watts – and was rock stable driving an electrostatic (Quad, of course) at live performance levels. Mac's drove a lot of disc cutters (at 60 watts) to produce discs which still sound spectacular.

But many were anxious to do something with the new-fangled transistors, and we did.

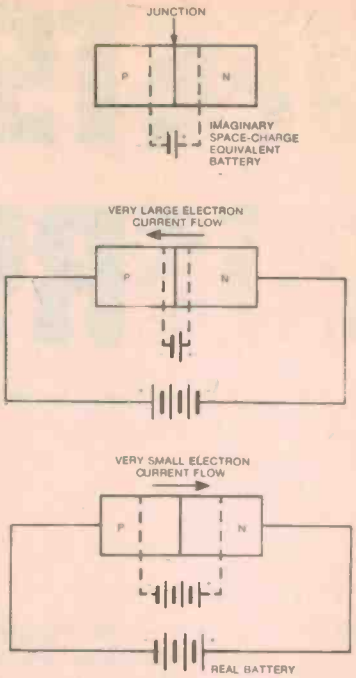


Fig 6. Drain to source resistance against temperature (Siliconix).

Transistors

The bi-polar transistor is composed of three materials, either a p-type semiconductor between two n-types, or an n-type between two p-types, (Figure 7a). A semiconductor such as silicon or germanium has a crystalline structure in the form of a diamond lattice with each atom having four adjacent neigh-

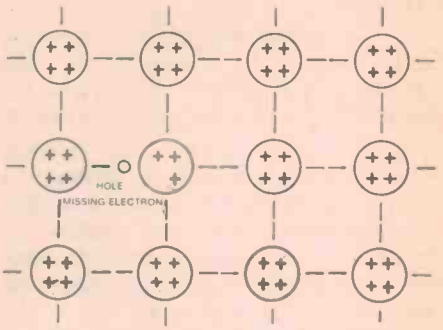


Fig 5b. P-type lattice structure.

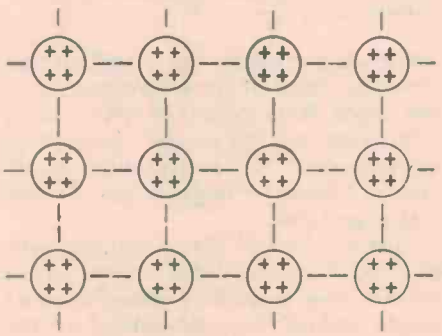


Fig 5a. Basic lattice structure

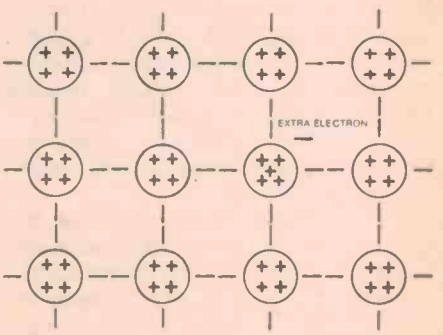


Fig 5c. N-type lattice structure.

bours, held together by co-valent bonds, each bond involving a shared pair of electrons. These electrons are not available for conducting current, so conduction is very semi. Indeed, resistance being around 100 million times that of copper.

However, if we introduce an impurity such as phosphorus or arsenic which has five valency electrons four of which form bonds while the fifth is only lightly held and is available for conduction. This is an n-type material (negative as it has an excess of electrons). If we add an impurity such as aluminium, only three valence electrons are available. Therefore, one of the valence bonds is not completed, resulting in a vacancy or hole in the lattice structure (Fig. 5). An electron from an adjacent electron pair bond may absorb enough energy to break its bond and fill the hold. This is a p-type material. This doesn't look like much of a big deal, but the result is quite dramatic.

Note that the atomic structure is in equilibrium – there is no net charge. However, if a free electron breaks its bond, it leaves behind a positive net charge; if it completes a bond by entering a hole, a negative net charge results. Current flow is produced by bringing about this carrier mobility. What was originally a very high resistance is now, under the right conditions, able to conduct substantial current, just as a small impurity (e.g. sulphuric acid) added to non-conductive pure water, makes electrolytic conduction possible.

When p and n-type materials are joined together, a p-n junction is formed (Fig. 6). Some of the free electrons from the n-type material diffuse across the junction and recombine with holes of the p-type material. The opposite process takes place with holes from the p-type material, producing a space charge or depletion region on either side of the junction, giving the p-type material a slight negative charge, and the n-type a slight positive charge. This process is finally limited by the resulting potential gradient.

If a battery is connected, as shown in Figure 6a, free electrons from the n-type material are attracted to the positive terminal, while holes from the p-type material are attracted to the negative terminal, widening the space charge region and increasing the potential gradient until it approaches that of the external battery. There is now little or no voltage difference across each region and little or no current flow. The junction is reverse biased.

If we reverse these polarities (Fig. 6b) electrons in the p-type material break their bond and enter the battery

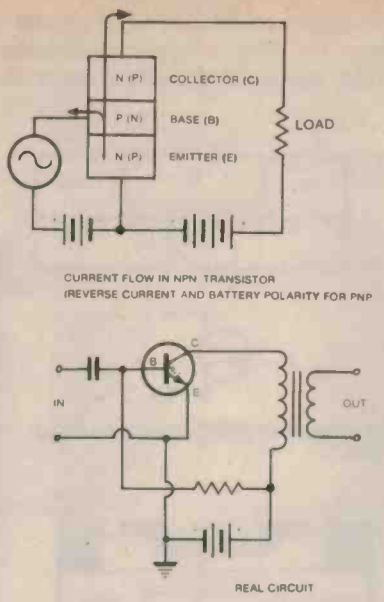


Fig 7a. Current flow in a semiconductor and circuit diagram.

creating new holes, while electrons from the battery negative terminal enter the n-type material and diffuse toward the junction. The space charge region narrows and the energy barrier becomes insignificant, so that excess electrons from the n-type material can penetrate the junction and move via the p-type holes to the positive battery terminal, for as long as voltage is applied. The junction is now forward biased.

Work!

In the device shown in Figure 7, the forward-biased emitter-junction injects electrons into the base region. The impurity or doping levels chosen are such that almost all the emitter current is composed of these electrons, and very few holes are injected into the emitter. The base region is very thin so that nearly all injected electrons diffuse to the edge of the depletion region of the reverse-biased base-collector junction where the field sweeps them across the collector bulk. Since for an equal current more power is developed across a high resistance than a low resistance, amplification occurs as a result of current being transferred from the low-resistance emitter-base junction to the high resistance collector junction.

The curves show that, as with the pentode tube, current is controlled mostly by the control electrode (base), but in this case the controlling parameter is current, not voltage. We have an inherently low-impedance device, and since it requires current into its input impedance, its signal source must be capable of delivering power. An ideal transistor requires input current, unlike an ideal vacuum tube. This reduces efficiency but we don't have to heat up a cathode to shake a few electrons loose, so our overall efficiency is vastly greater.

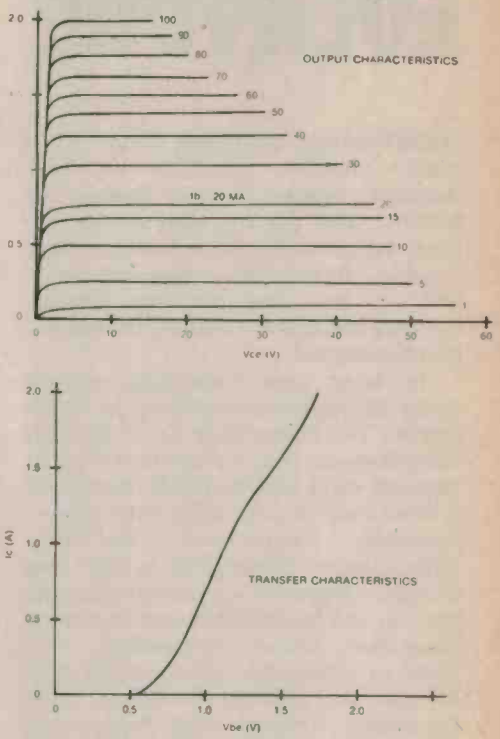


Fig 7b. Output and transfer characteristics of the 2N3054.

Disadvantage

The major disadvantage of this type of device lies in the nature of the depletion layers at the junctions, particularly the emitter-base. When current flows in a transistor, excess charge is stored in the base region. If the base-emitter junction is changed from a forward to reverse bias state, as in the negative swing of a class B or AB stage, or when a class A stage is overdriven, the junction cannot immediately switch to the reverse blocking state due to the presence of these excess charge carriers. They have the effect of allowing current to flow in reverse as if forward biased, until these charge carriers are removed.

In addition, there is capacitance effect associated with the barriers of a reverse-discharge time. The result is a switching transient during part of a cycle, sometimes erroneously referred to as crossover distortion (the latter occurs in any device in push-pull and is due to a discontinuity in the transfer function, usually caused by incorrect bias). This can be reduced by reducing the junction area but this reduces the dissipation capability. In fact, a transistor design favouring one characteristic usually does so at the expense of others.

Also, as temperature rises in the

VFETS FOR EVERYONE

device (due to current flow, for example) carrier mobility at the junctions increases, causing further increase in current. The current increase further raises temperature, which raises current — which further raises temperature — and so on. The resulting thermal runaway can quickly destroy the device. In milliseconds!

In large area transistors, current tends to become nonuniform in distribution. The temperature rise in the high current region leads to localized thermal runaway until equilibrium is reached by a sharp drop in collector voltage, (called secondary breakdown) frequently destroying the device. This is more true at high voltage and low current than the reverse, and frequently means that rated dissipation cannot be reached. This leads to overdesign, unnecessarily high voltage and dissipation ratings (and remember, a design which favours one characteristic often does so at the expense of others) plus elaborate protective circuits.

High levels of feedback are generally used to control distortion, and this in conjunction with the excess charge condition in the base, leads directly to transient overload, and resultant transient intermodulation. Output is delayed during this charge/discharge, which delays application of feedback. It simply isn't available. The input signal is not immediately reduced by feedback, and passes through at high initial level.

The millenium has not quite arrived after all!

The FET

Since a semi-conductor is precisely that, a battery connected across the ends of a p-type or an n-type bar will cause current to flow through the material, just as it does through a vacuum tube. We discussed earlier the characteristics of a pn junction. If, for example, a p-type material is joined to the surface of an n-type bar, located between the battery terminals, a pn junction is formed, and if this junction is reverse biased, a space charge or field is produced of opposite polarity which will inhibit current flow, just as the control grid inhibits current flow in a vacuum tube. Changing this reverse voltage causes a large current change, and amplification results.

A simple junction FET is shown in Figure 8. With a given drain-source voltage, maximum current flows at zero

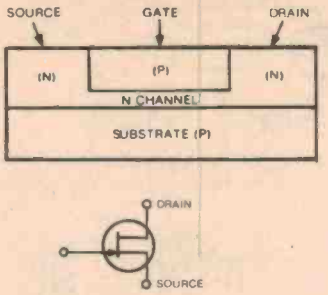


Fig 8. N-channel JFET construction and symbol.

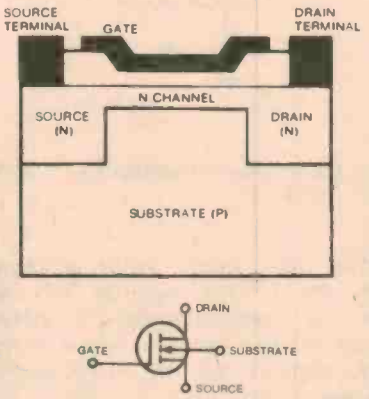


Fig 9a. N-channel depletion horizontal MOSFET construction and symbol.

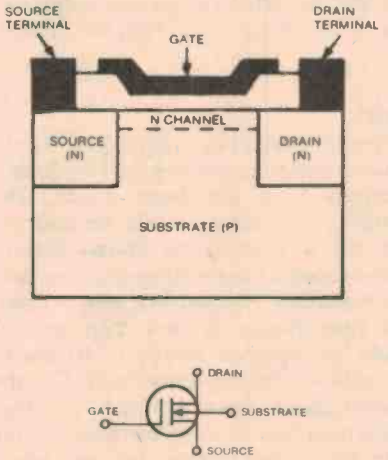


Fig 9B. N-channel enhancement horizontal MOSFET construction and symbol.

gate voltage, and at some reverse voltage, determined by device geometry and doping levels, no current will flow. Also, as in the vacuum tube, load characteristics are not reflected to the input circuit, because current is not controlled by carrier injection as in bipolars, but by voltage levels.

A variation is the Metal Oxide Semiconductor Field Effect Transistor. (MOSFET) (Fig. 9) a far more versatile device whose technology is virtually the cornerstone of modern computer technology, although it has had less use to date in linear applications such as audio amplification.

MOSFETS come in two basic types. In both the gate consists of a metal electrode separated from the channel by a thin oxide layer. In the depletion type current flow is controlled by the electrostatic field of the gate when biased. When a depletion MOSFET is so biased the device may be driven on both sides of the zero volts point as with vacuum tubes. Unlike vacuum tubes, under these conditions, the gate draws no current, therefore does not require the driver to deliver power.

The enhancement type MOSFET shown in Figure 9b, is more widely used. The source and drain are separated by a substrate of opposite material, and under zero gate volts no current flows. However, when sufficient forward bias is applied to the gate the region under the gate changes to its opposite type (e.g. p-type becomes n-type) and provides a conductive channel between drain and source. Carrier level, and conduction is controlled by the magnitude of gate voltage.

Although MOSFETS are handy devices they are not capable of handling high power levels. The channel depth available for conduction is limited by the practical limits on gate voltage. The lower current density has been the primary limitation due to the horizontal current flow.

VFETS

Recent years have seen the introduction and commercial use of Vertical Channel J-FETS, notably by Sony and Yamaha (Fig. 10). The vertical channel permits a very high width-length ratio, permitting a decreased inherent channel resistance and high current density. Unfortunately it suffers the same disadvantages as the small signal J-FET, plus, in currently available devices, a very high input capacitance, ranging from 700 pF to around 3000 pF, limiting high frequency response. In addition, since they must be biased into the off condition, bias must be applied before supply voltage and removed after the supply if it is to be operated anywhere near its maximum ratings. This problem doesn't exist with vacuum tubes because of heater warm-up time, although some

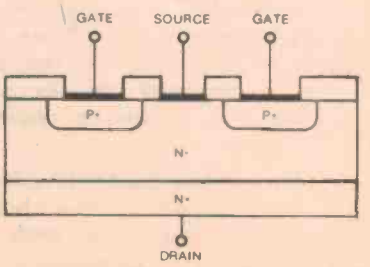


Fig 10. Vertical junction FET construction.

"instant-on" circuits impose heavy turn-on surges.

This necessitates a complex power supply, and Yamaha, for example, uses more devices in the supply than it does in its amplifier circuits. However, the construction does make possible the design of complementary types and both Nippon Electric and Sony have high power devices available. Unfortunately, neither company seems anxious to make detailed information available, so there is little to disclose here beyond the fact that they are said to have characteristics similar to those of triode tubes.

However, the Vertical MOSFETS by Siliconix are readily available, at reasonable prices, and the manufacturer most generous in providing data. The following information is extracted from their application note AN76-3, Design Aid DA 76-1, plus device data sheets.

The Device

Notice in Figure 11, that the substrate and body are opposite type materials separated by an epi layer (similar to high speed bi-polars). The purpose of this structure is to absorb the depletion region from the drain-body junction thus increasing the drain-source breakdown voltage. An alternative would have involved an unacceptable trade-off between increasing the substrate-body depth to increase breakdown voltage (but increasing current path resistance)

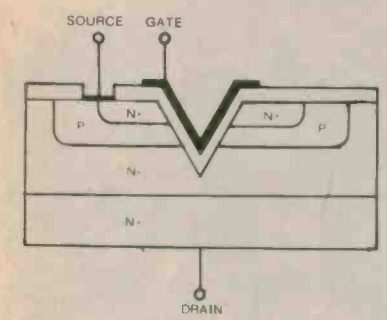


Fig 11. Vertical MOSFET construction (Siliconix).

and lengthening the channel. In addition, feedback capacitance is reduced by having the gate overlap n-epi material instead of n+.

In manufacture, the substrate-drain and epi layer are grown, then the p-body and n+ source diffused into the epi layer, in a simiar manner as the base and emitter of a diffusion type transistor. A V groove is etched through the device and into the epi layer, an oxide layer grown, then etched away to provide for the source contact and an aluminium gate deposited. This type of device allows current flow in one direction only; this is not always so with a similar type of horizontal FET, where source and drain may be identical in structure and of the same material. Therefore, no reverse current flows (we hope) when used in switching applications, as was also the case with vacuum tubes.

In-circuit operation is refreshingly simple: Supply voltage is applied between source and drain, with the drain positive with respect to the source, under which conditions no current flows, and the device is off. This is an enhancement type device, and is turned on by taking the gate positive with respect to the source and body. The electric field induces an n channel on both surfaces of the body facing the gate, and allows electrons to flow from the negative source through the induced channel and epi and through the substrate-drain. The magnitude of current flow is controlled almost entirely by the gate voltage, as seen in the family of curves (Fig. 12) with no change resulting from supply voltage changes above 10 V.

Advantages

The vertical structure results in several advantages over horizontal MOSFETS.
1) Since diffusion depths are controllable to close tolerances, channel length, which is determined by diffusion depth, is precisely controlled. Thus, width/length ratio of the channel, which determines current density, can be made quite large. For example, the VMP1 channel length of about 1.5 μ, as against a minimum of 5 μ in horizontal MOSFETS, due to the lower degree of control of the shadow masking and etching techniques used in such devices.
2) In effect, two parallel devices are formed, with a channel on either side of the V groove, thus doubling current density.
3) Drain metal runs are not required when the substrate forms the drain contact, resulting in reduced chip area, and thus reduced saturation resistance.
4) High current density results in low chip capacitance. Also, unlike horizontal MOSFETS, there is no need to provide extra drain gate overlap to allow for shadow mask inaccuracies, so feedback capacitance is minimized.

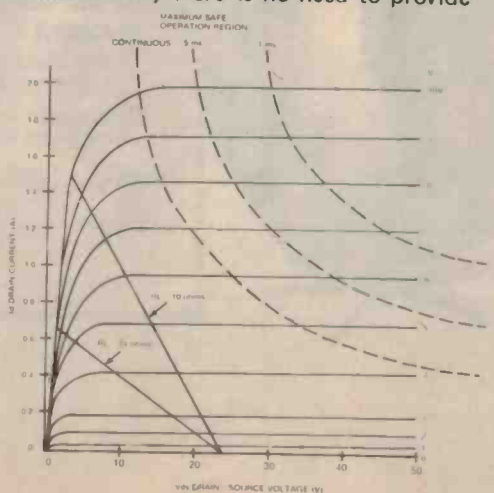


Fig 12a. Output characteristics VMP1.

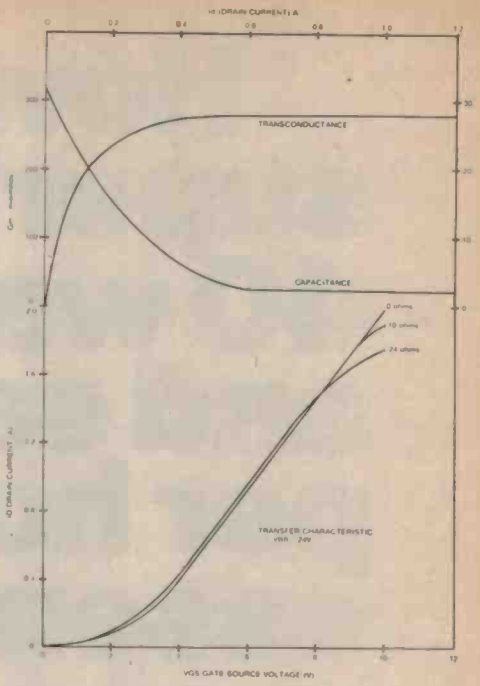


Fig 12b. Other VMP1 characteristics.

In comparison with bi-polars, especially power devices, the advantages are even more impressive.
1) Input impedance is very high, comparable to vacuum tubes, since it is a voltage controlled device, with no base circuit drawing current from the driver stage. A 7 V swing at the gate, at virtually 0A, represents almost 0W of power, but can produce a swing of 1.8 A in output current. This represents considerable power gain and will interface directly with high impedance voltage drivers.
2) There is no minority carrier storage time, no injection, extraction, recombination of carriers, resulting in very fast switching and no switching transient in class B and AB amplifiers. Switching time for a VMP1 is 4 ns for 1 A, easily 10-200 times faster than bi-polars, and rivalling many vacuum tubes.
3) No secondary breakdown, and no thermal runaway. VMOS devices exhibit a negative temperature coefficient with respect to current, since there is no carrier recombination activity to be speeded up with temperature. Thus, as current increases so does temperature, but the temperature rise reduces current flow. It is still possible to destroy the device by exceeding its maximum ratings, but a brief near-overload does not result in an uncontrollable runaway condition. Usually, simple fusing and/or thermistor protection is sufficient for maximum safety, and even this may be unnecessary with conservative design. Absence of secondary breakdown means that full dissipation can be realized even at higher supply voltages. In this respect they resemble vacuum tubes. ■

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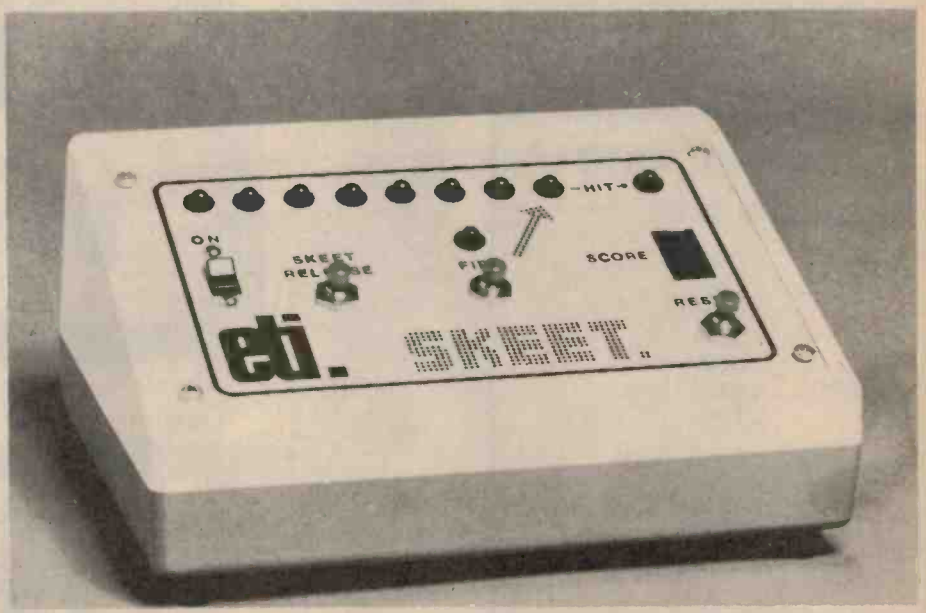
Skeet

Electronic clay pigeons, yet! Play the game!

GAMES, BE THEY electronic or otherwise, may, in general, be divided into two broad categories. There are those which entertain by stimulating the mind and those that involve the more mechanical of skills. In general all games will involve a mixture of these two elements.

The game described here cannot claim to tax the grey matter to any great extent, but certainly provides a test of hand/eye coordination.

We have also introduced an element of luck which helps the game meet, perhaps, the most important requirement of any game — it is fun play!



Game Bird

Before going on to describe the game it might be best to explain just why we called it Skeet.

Skeet is the term used in the USA to describe the sport we know as Clay Pigeon Shooting. We thought that a title like "Clay Pigeon Shoot" would be too much of a mouthful, and nobody wants a mouthful of clay pigeon. We therefore chose the American name for the sport that our game attempts to emulate — hence Skeet.

Flight Of Fancy

The line of LEDs, seen in the photographs of the game, represent the flight path of the Skeet. The "gun" of our game is permanently aimed at the last LED of the flight path. This means that there is no aiming involved, the object of the game being to correctly estimate the delay between "firing" the "gun" and the "shot" reaching the Skeet. This delay represents the time of flight for a real shot.

When the firing button is pressed the "shot" LED lights and the time that this remains on indicates the travel time of the "shot."

At the instant that the LED turns off, if the Skeet has just reached the end of its flight, a "hit" is registered and the "hit" LED lit.

Whether or not a "hit" was scored the LEDs representing the flight path will stay off until pressing the skeet release button starts another "bird" on its way.

Score With A Bird

The game is made more interesting because the speed of the Skeet varies from one flight to the next, this is where the luck, and skill come in. You cannot become used to firing the gun at the same position in the flight path as the "bird's" speed can be any one of eight different values determined randomly.

After eight shots the score display, blanked until now, lights up with your score out of eight. This signals the end of a round. In a competitive game, make a note of your score, press the reset button and pass the game to the "hot shot" competing against you. For practice games, the score need not be reset, the counter continuing to register.

Building Birdie

The majority of parts are mounted on the PCB and should be assembled according to the overlay shown. We recommend that sockets are used for mounting all of the ICs as this makes the task of any fault finding that may be necessary far easier than would be the case if the ICs were soldered directly to the PCB.

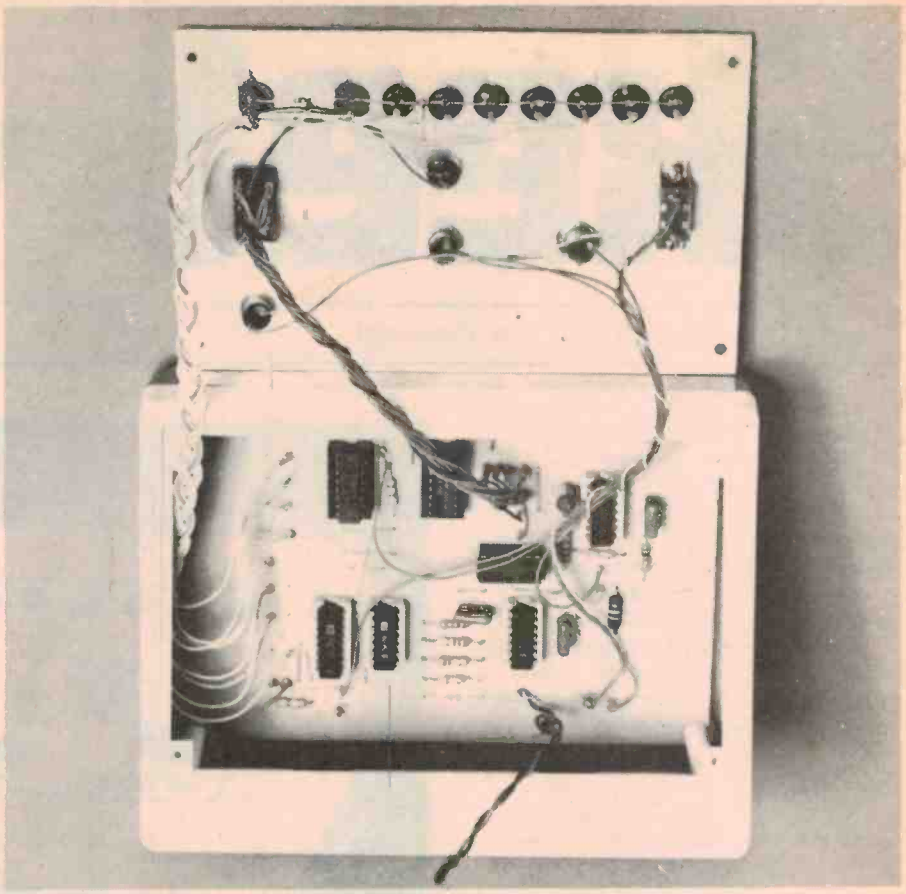
Note that the link from IC1 pin 16 to IC2 pin 16 is insulated.

The switches, seven segment display and LEDs are all mounted off-board on the front panel and wired to pins on the PCB. The layout of our game can be seen in our pictures.

Space inside the box was, as is usual in our designs, at a premium and the PP6 battery was squeezed into the back of the case, insulated from the PCB by a piece of foam rubber.

An internal view of completed unit. The wiring of the front panel switches and display to the PCB board can be seen. Note the insulated sleeve from IC1 pin 16 to IC2 pin 16 and the insulation on the wires to the display.

Below right we show the full size PCB foil pattern (140 x 105mm). ▶



The first pull

When power is first applied the condition of the various counters is undetermined. To start a game, press the skeet release button first and allow the skeet to complete one cycle. Press the reset button and you're ready to begin shooting Skeet.

PARTS LIST - ETI 806

RESISTORS all ¼W 5%

R1,9	10k
R2,7	1M
R3	220k
R4	390k
R5	820k
R6,8,11	470k
R10	10M

CAPACITORS

C1,3	100n polyester
C2	1u0 35V tantalum
C4	220n polyester

SEMICONDUCTORS

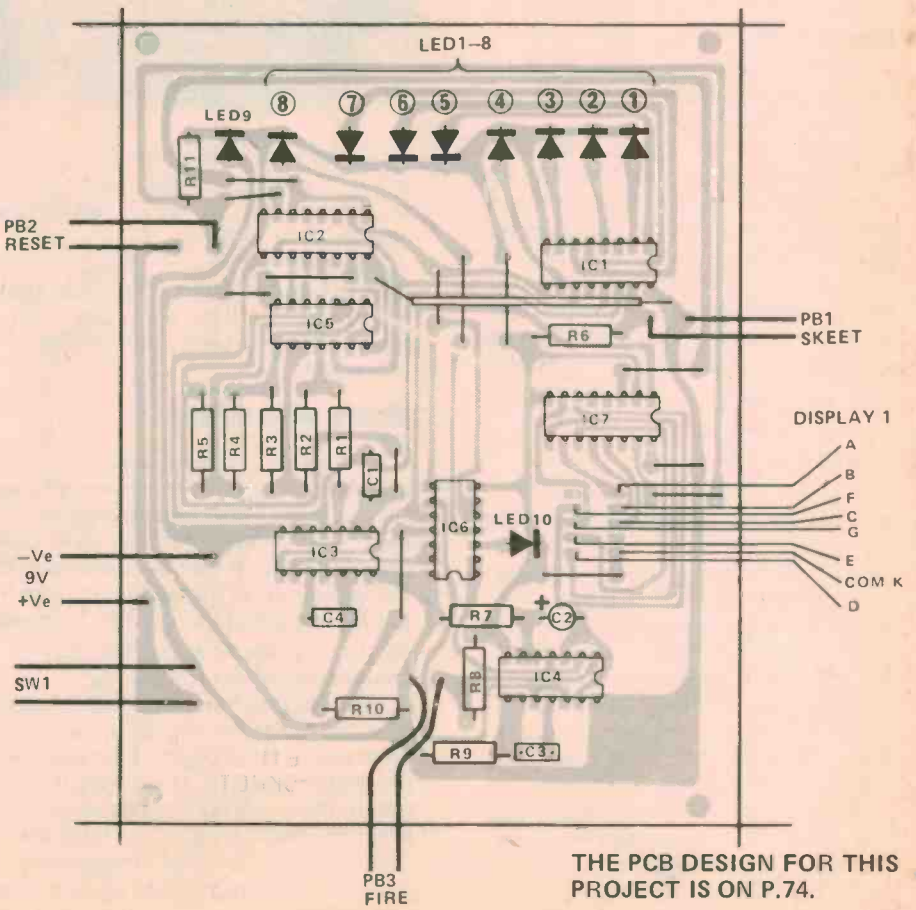
LED 1-9	.2" type red
LED 10	.2" type green
DIS 1	DL704 common cathode or similar
IC1	4017
IC2	4518
IC3,4	4001
IC5	4016
IC6	4081
IC7	4026

SWITCHES

PB1-3	Push to make push type
SW1	Single pole on/off type

MISCELLANEOUS

PCB as per pattern, PP6 battery and clip, flexible connecting wire.



Right: the component overlay for the skeet game. All the links but for that between IC1 pin 16 and IC2 pin16 may be made from uninsulated wire.

THE PCB DESIGN FOR THIS PROJECT IS ON P.74.

IC1 is a one of ten decoded counter. The "Zero" output from this IC is not used while the next eight outputs are connected to LEDs 1-8, these LEDs represent the flight of the Skeet. The "nine" output (Pin 11) is coupled to the enable input (Pin 13). This means that the counter will be disabled after it has completed one count cycle.

Pressing the skeet release button PB1 resets the counter, removing the inhibit and allows another cycle to take place.

The pulses which clock IC1 through its count cycle are derived from the CMOS oscillator formed by IC3a and IC3b.

This oscillator has the resistor which forms one of the elements in the timing chain split into five sections. Four of these sections are shunted by the transmission gates of IC5 so that they may be bypassed as required and so control the frequency of the oscillator. The remaining resistor, R1, ensures that there is always some resistance in the oscillator circuit.

The oscillator is running at all times when power is applied to the circuit.

Three of the transmission gates of IC5 are coupled to the outputs of IC2b. IC2b is one half of a dual BCD counter and is clocked by the CMOS oscillator. As IC2b clocks through its count sequence the resistance of the timing element changes altering the frequency of the oscillator.

The enable line of IC2b is tied to that of IC1, and since the enable lines of these counters require signals of opposite logic level, when one is running, the other is halted.

This enable line is also tied to the fourth gate in IC5. This straddles the largest resistor in the timing chain and so has the greatest effect on oscillator frequency.

The sequence of events during play is as follows.

PB1 is operated and so disables IC2b and latches its output. This sets the "random" speed of the skeets flight as IC1 is now enabled and is clocked by the oscillator's output.

When IC1 reaches the count of nine, it is disabled and IC2b in turn enabled. IC2b then cycles through its count sequence changing the oscillator's frequency ready for the next skeet flight.

The fact that IC5d is tied to the enable line means that the oscillator runs much faster when performing its "random" frequency selection function than when controlling the flight of the skeet.

The "gun" consists of two CMOS monostables in series (IC4). The first one has a time constant representing the time of the shot travel to the target. It drives a LED via buffer IC6a to allow timing judgements during play.

The second one shot provides a short pulse after the first is complete. This is the "shot" pulse.

This pulse is AND-ed (IC6c) with that from the "eight" output of IC1 to produce the "hit" pulse.

This pulse is applied to the score counter (IC7) and, via a pulse stretcher (IC3c, IC3d), to the hit LED (LED 9).

IC2a is the other section of the BCD counter and is clocked from the "eight" output of IC1. This IC is used to count the total number of skeet flights.

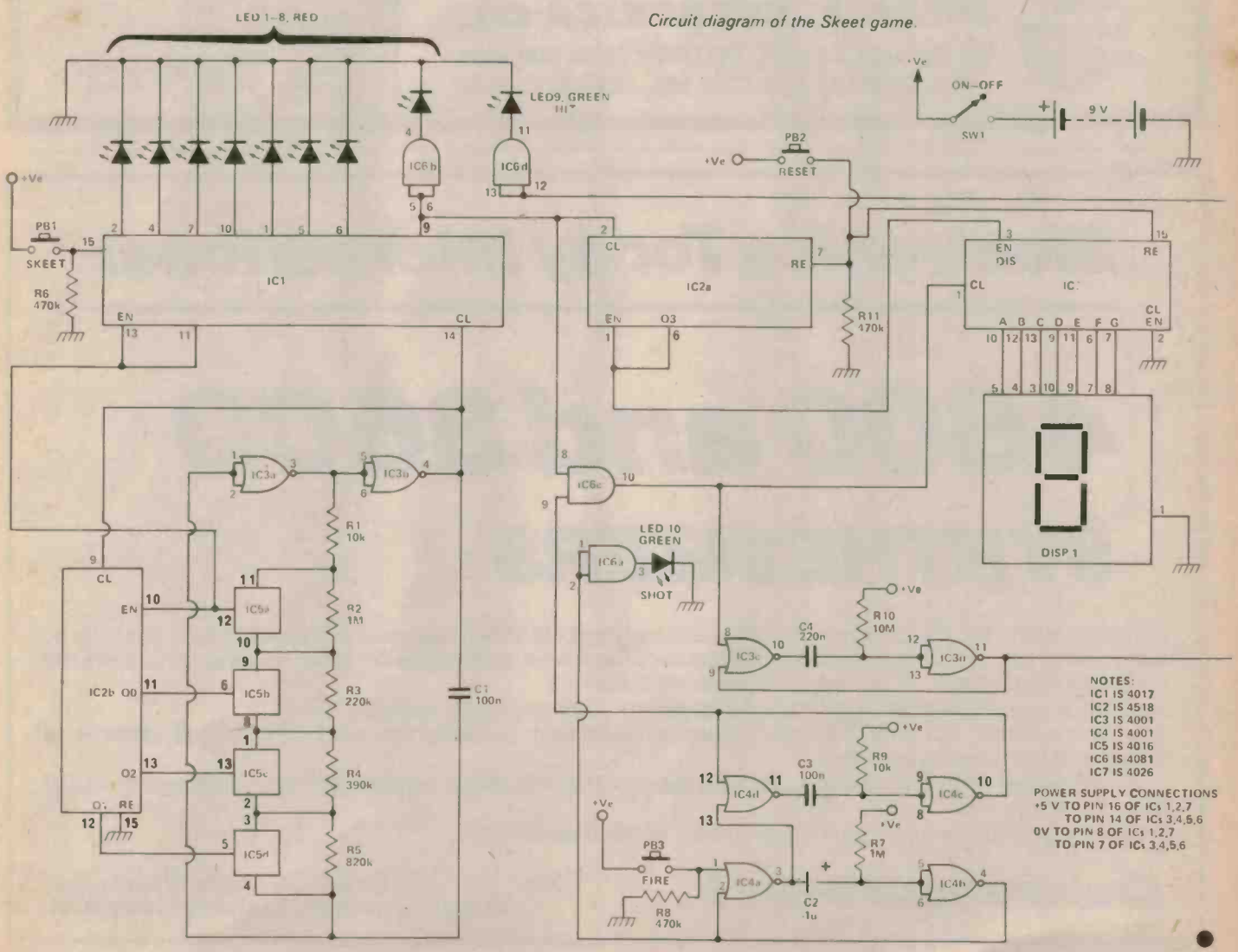
This BCD counter is arranged to blank the score display, via the enable display pin of IC7, until it reaches a count of eight. At this stage the Q3 output will enable the display and inhibit further clocking of the counter.

Lighting of the score display signals the end of a game.

The buffers (IC6a, IC6b and IC6d) are required because while a CMOS output will drive a LED directly, as LEDs 1-8 are driven from IC1 the load that the LED presents brings the CMOS output to below an acceptable "1" level.

Thus if the output is not used elsewhere in the circuit we can drive a LED directly, but where the signal is required to drive other gates we have used a buffer. ■

Circuit diagram of the Skeet game.



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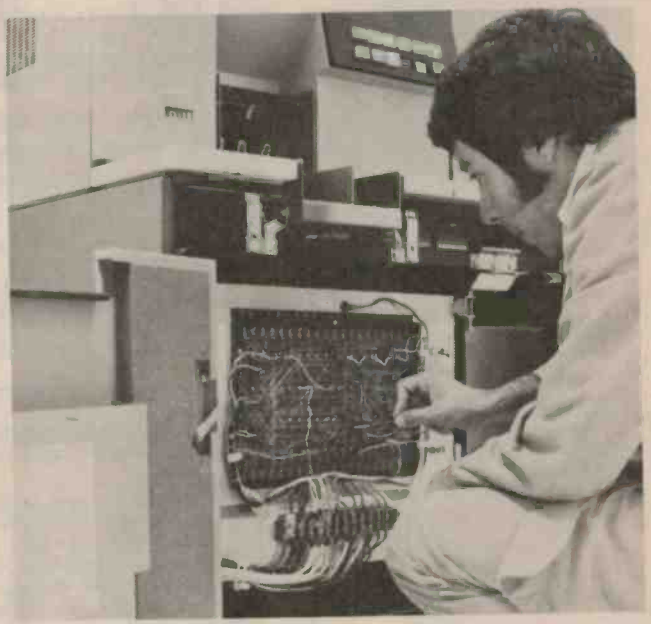

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VHF POWER AMPLIFIERS Part 2

High power amplifiers using stripline techniques — by Roger Harrison, VK2ZTB and Phil Wait, VK2ZZQ.

IN THE FIRST PART of this article we covered the ETI 715 series from A to E, with the exception of ETI 715D. This is the 3W 15dB two metre amp, which we shall describe first.

The ETI 716 45W two metre stripline amp follows. This model completes the project series. But, drool, drool, slurp, slurp — this series ends with descriptions of two state of the art stripline power amps which we constructed from CTC evaluation kits kindly supplied by Ampec Engineering. They are not intended as projects as such, but for those hardy souls with oceans of tomato resources and ingenuity (remember the amateurs' code?) who may be interested in borrowing the techniques if not attempting reproduction.

ETI 715D, 3 W 2 m amp.

Homebrewer' delight! From your prissy little 50—100 mW or so output you can start off at the bottom rung of the real power ladder. No matter if you've built yourself an FM driver run by an all-singing, all-dancing you-beaut type synthesizer or a solid state transverter with push-pull, shove-grunt type FET mixer.

The usual construction order prevails Component layout is in figure 12. Mount the transistor first according to the details given earlier. Then mount RFC1. This may be a 0.22 μH moulded choke or 10 turns of 34 or 36 B & S enamel wire wound on a low value ¼W resistor. Follow this by winding L1, L2 and RFC2 and mounting them.

Complete construction by mounting all the trimmers and other components. Diode and stub switching is not used as this is not an 'add-on' amplifier.

Mount the assembly on the chassis/heatsink in the usual manner previously described for the other amps.

Tune-up follows the general procedure previously described.

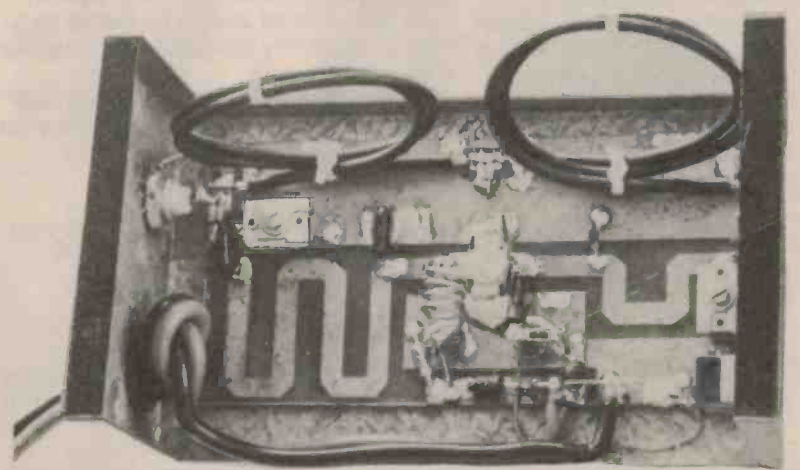
ETI-715D Performance

Yes, well, these little B3-12's have plenty gain! More than you'd expect from your common or garden variety device. Power output of 3 watts was obtained from the prototype with only 80 mW drive. Up to 5 watts can be obtained from most devices. In linear service, the B3-12 has a little less gain than in class C but it seems to produce the same peak power output.

Prototype performance, ?, look at this:—

Power output = 3 watts
Gain = 15.5 dB
Efficiency = 62.5%
Collector current = 400 mA 12.5 volts (class C) (max. Ic = 1A) (max. Vs = 36 V)
Collector dissipation = 1.8 watts (at full carrier)
Maximum recommended voltage = 16 volts
Bandwidth = 7 MHz (to -3 dB points)

In linear mode, quiescent collector current should be around 30—50 mA (class AB) or around 200—250 mA if you want to operate in class A.



The ETI 716 stripline 45 W 2 m amplifier prototype. Input is on the right, output on the left. Both input and output matching lines are 'folded' to reduce board size. Note the 'dipped mica' capacitors at the beginning and end of the output stripline (C6 and C7). Only two tuning adjustments are required, at the input and the output.

PARTS LIST – ETI 715D

L1	2 turns, 20 g tcw wound on 3 mm dia mandrel, 3 mm long.
L2	6 turns, 20 g tcw wound on 6 mm dia mandrel, 15 mm long.
C1,2,3,4	4-40 p Philips film trimmer or mica compression type.
C5,6,7	as marked
RFC1	10 turns, 36 or 38 g enamel wire wound on low value ¼ W resistor.
RFC2	8 turns, 20 g tcw, wound on 3 mm dia mandrel, 15 mm long with low value ¼ W resistor mounted inside.
Q1	B3-12 (CTC)

Note: 47 pf ceramic or mica capacitor in parallel with C2, as shown above.

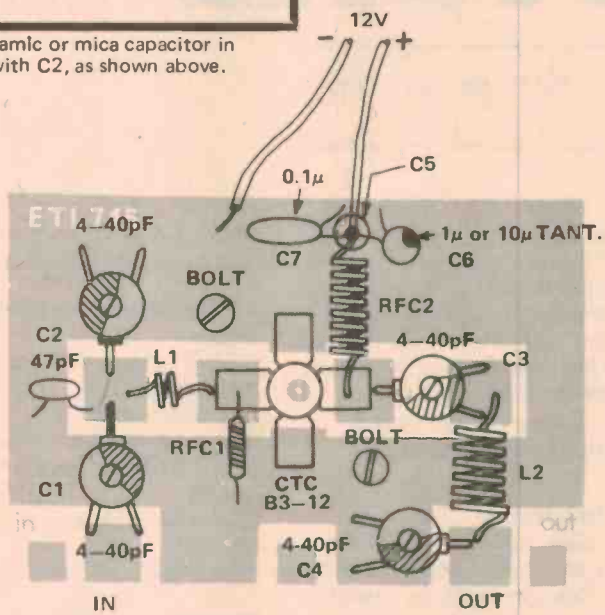
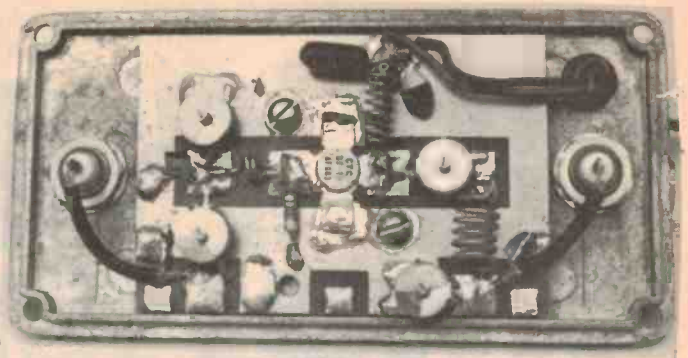


Fig. 12. Construction and component layout of the ETI-715D 3 W two metre amp.



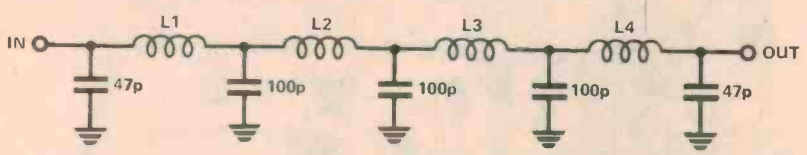
The 3 W, two metre amp, ETI 715D mounted on the lid of a small diecast box which serves as a heatsink. The coax leads to the input and output sockets sockets have the braid terminated only to the board groundplane.

Output Filter For 6 Metre Amps

Anyone who has operated on 6 metres will know the hazards of TVI. The output filter of Fig. 13 can fit into the transmission line to the antenna and provides 48dB/octave attenuation with a cut off frequency of 63 MHz.

The filter can be constructed on a printed circuit board or in a copper or tin box. Shields should be placed so they completely eliminate stray coupling between the coils.

This filter will not reduce overload type TVI but it will make sure that your harmonic output is low.



L1,2,3,4 250 nH, 5 turns 16 g tinned copper or enamel wire, 13 mm i.d., 13 mm long.

Fig 13. Four-section low-pass filter for 6 m power amps described in Nov 77 issue of ETI. Two sections are adequate (input and output capacitors should be 47 p of course) but four sections are better! Each individual coil should be well-shielded and the input kept away from the output to achieve maximum stop-band attenuation. Capacitors should be dipped mica or metal-clad types.

Microstripline

UNLIKE THE PRECEDING amplifiers, which use lumped constant matching networks, the next three use *microstrip transmission line* matching.

Here, sections of transmission line are used to match the transistor impedance to the input and output impedance, in the same way as sections of transmission line and stubs are used to match a line to a complex load impedance. The stubs are replaced by fixed capacitors (C3, C6, Fig. 14) in circuits up to a few hundred MHz.

A microstrip line is formed with a conductor etched onto one side of a double sided pc board, the opposite side being left as a copper plane. Characteristic impedance is determined by strip width, thickness of the board and type of material used, so the type of pc board used is critical. Only use the type and grade specified.

Stripline matching in power amplifiers usually involves several sections of line in series, with one or more intermediate impedance points selected. The ETI 716 uses two sections in each network while the 140 W amp uses three.

ETI 716 45 watt 2 Meter Amplifier

This amplifier was designed as a replacement for the ETI 710 booster amplifier (April 1976 issue). A CTC B40-12 transistor is used to give an output of around 40 watts with 5.5 dB gain. This makes it ideally suited for use with most of the 10 watt transceivers around.

Linear operation is possible using one of the bias circuits described in the Nov. 1977 issue and in this circuit the diode switching can be retained without any noticable distortion of the output.

Refer to Fig. 15. After the hole has

been drilled for the transistor base, the earth planes on each side of the board must be connected together at several places around the edge of the board and under each emitter lead. Suitable lengths of shim stock or tinplate about 5mm wide can be folded around the edge of the board and soldered in place. The transistor hole will have to be filed to accomodate the transistor and the thickness of the shim.

All other components are assembled in position as in Fig. 15 using *absolute minimum* (none if you can manage it!) lead lengths on all components.

The base choke RFC1 is made up of a 0.22μH choke with an F14 suppression bead slipped over the earthy end. This choke can be of the moulded type or made by winding 15 turns of 34 B & S wire around any suitable medium value 1/4 W resistor.

A metal clad mica capacitor is shown for C6 in Fig. 14. This is a difficult component for hobbyists to obtain and can be replaced with a mica dipped type. Ceramics or any other type of capacitor will very quickly self-destruct.

C9 and C10 are standoff or feed-through capacitors used as standoffs. Be careful when mounting the assembled amplifier in a box to drill a clearance hole in the metalwork if a feedthrough is used.

ETI 716 Performance

A maximum output of 50 watts CW or 40 W SSB was achieved with this amplifier.

Peak output power – 50 watts
Gain – 6.5dB
Efficiency – 65%
Withstands infinite VSWR at 40 W output

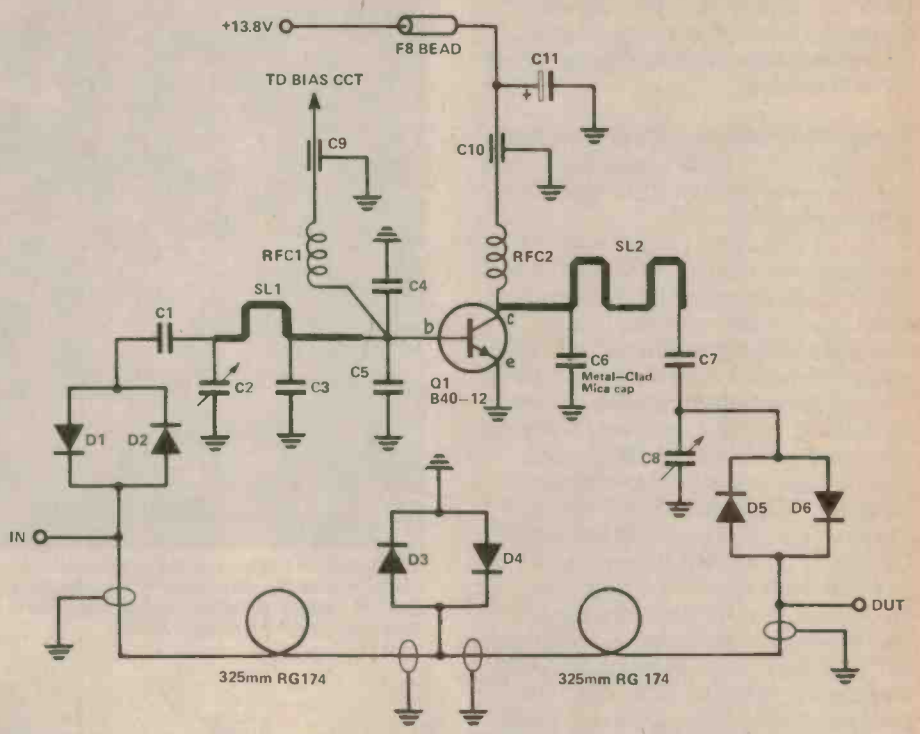


Fig. 14. Circuit of the ETI 716 45W 2m power amplifier. The diode switching is omitted for SSB linear operation. Suitable bias circuits were given in the Nov. '77 issue of ETI. Diode stub switching details were also included in that issue. See text and overlay for notes on C6.

PARTS LIST – ETI 716

C1,7	220 to 1000 pF ceramic or dipped mica cap.
C2	4-40 p mica compression trimmer (Elmenco)
C3	47 p NPO ceramic or dipped mica cap.
C4,5	100 p NPO ceramic or dipped mica cap.
C6	100 p metal-clad mica or dipped mica cap.
C8	4-40 p or 4-60 p mica comp. trimmer (Elmenco)
C9,10	680-1000 p button ceramic stand-off or feedthrough cap. used as component standoff.
C11	1 μ to 10 μ tantalum cap.
D1 – 6	1N914, 1N916, BAX13 or BAV10 (recommended)
Q1	CTC B40-12
SL1,2	50 ohm *stripline* on pc board
F8 bead	4 x 1.5 x 9.5/F8 Neosid suppression bead
RFC1	see text. F14 bead obtainable from Neosid suppliers.
RFC2	4 turns, 18 g tinned copper or enamel wire, 6 mm i.d., 15 mm long.

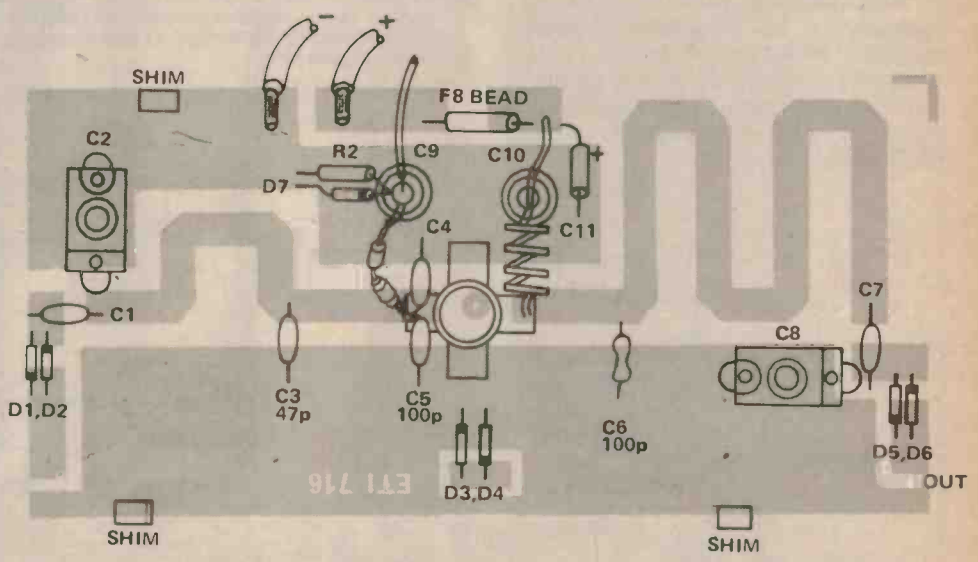
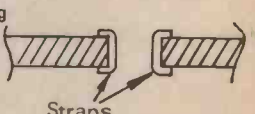


Fig. 15. Component overlay for ETI 716 45W 2m power amplifier. Note the use of shim grounding straps and their location. Two straps are used, one each under the transistor emitter leads as illustrated, as well as three around the board edge. A metal-clad mica or dipped mica capacitor may be used for C6. Pay careful attention to the location of all the components, particularly the capacitors.

Emitter Grounding



These are made by folding the straps over the edge of the board. Two to four mil copper shim stock will make excellent ground straps.

supply voltage – 12.5V
Maximum supply voltage – 16 V
Maximum collector current – 7 A

For linear operation a quiescent collector current of 100 - 300 mA is necessary. Most of the 8-10 W transceivers will drive this amplifier to its full 40 W of output.

3 Stage 40 W Stripline Broadband Amp

Fig. 16 is a three stage broadband power amp for use in the 144 - 174 MHz band, without retuning.

The B3-12, B12-12 and B40-12 transistors are used in a microstripline circuit in conjunction with high quality metal clad mica capacitors. Low-frequency stability is achieved by using parasitic suppressors in the base circuits.

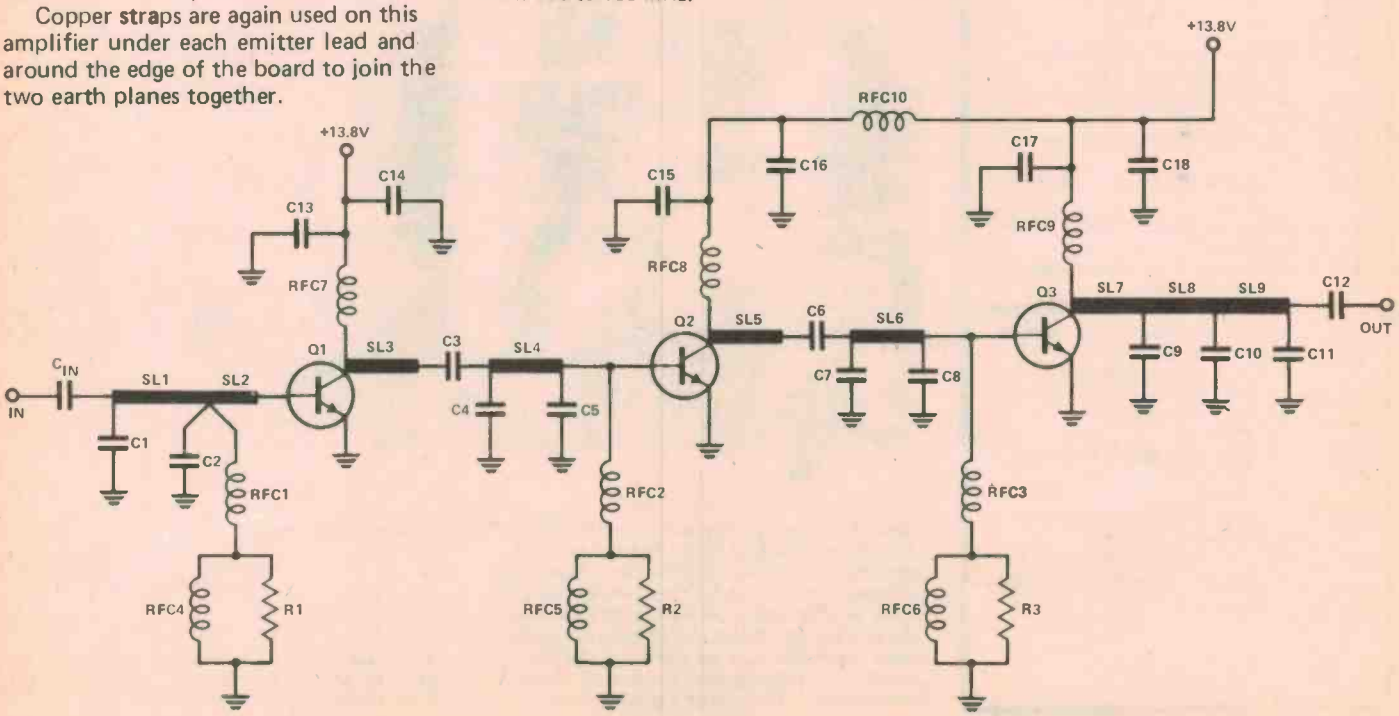
Impedance transformations are made by discrete, low-Q, L sections. These are composed of a series of 50 Ω transmission lines and a high quality shunt capacitor. The maximum Q for each section is limited by desired bandwidth. Capacitors C5 and C8 are used in conjunction with the series base lead inductance to raise the impedance of the device to a real value, simplifying circuit design. The interstage networks include DC blocking (C3, C6). This reactance has been compensated for in the design of the series line. Low frequency parasitic oscillation is controlled by using a parallel RL circuit in the bases. This presents a low impedance at low frequencies where oscillation is likely to occur.

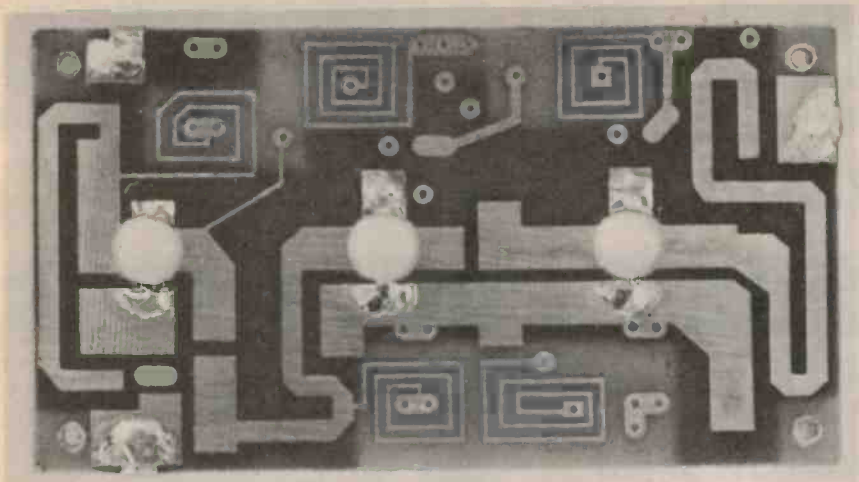
Copper straps are again used on this amplifier under each emitter lead and around the edge of the board to join the two earth planes together.

Close view of the output stage showing the placement of the metal-clad mica capacitors and RF chokes. Note the jumper from Q3 base to printed RF choke, RFC3.

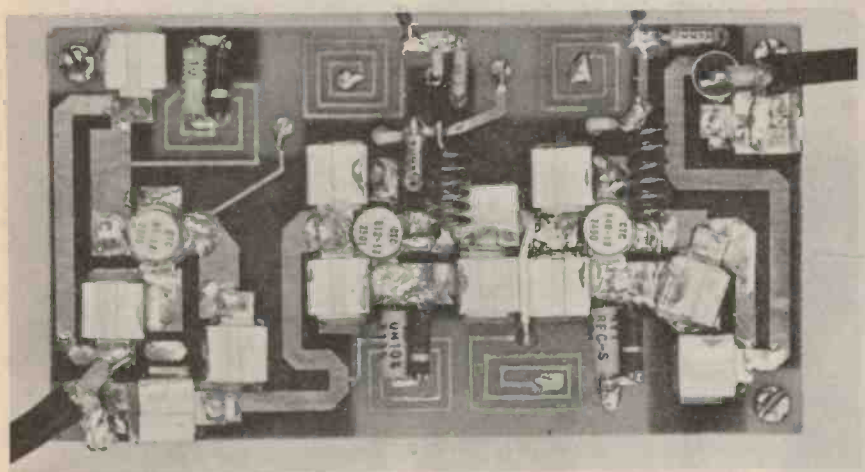
PCB's for this project (716) are on pages 74, 75.

Fig. 16. Circuit of the three stage, 40W VHF stripline broadband power amplifier. Overall size of the assembly is 65 x 120 mm making it an excellent proposition for a homebuilt 2m FM transceiver output section. Around 300 - 500mW drive will deliver 40W output. Low-frequency stability is critically dependent on base and collector decoupling circuitry. Bandwidth extends from 140 to 180 MHz.

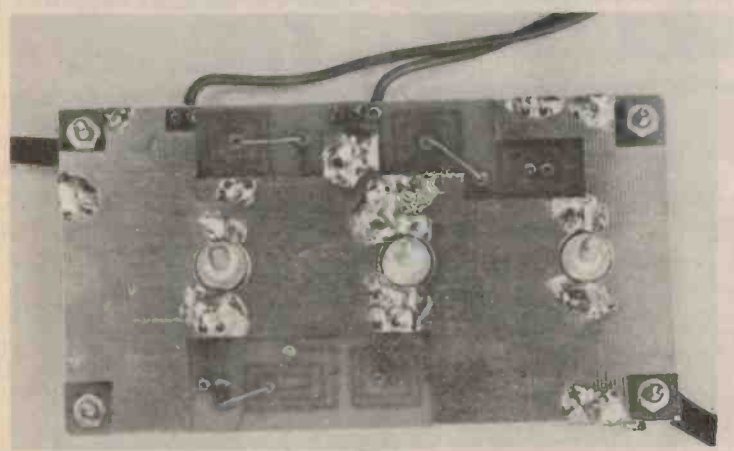




Top view of pc board following drilling and installation of emitter and topside ground area grounding straps.



View of completed assembly showing placement of all metal-clad mica capacitors, RF chokes and base decoupling components. Input is on the left, output on the right.



Under view of completed pc board showing interconnecting straps between the base RF chokes (printed inductors) and low frequency decoupling components.

Performance

The amplifier was tested on 146 MHz from a 0.5 W driving source.

Power output	40 watts
Power input	0.5 watts
Efficiency	52%
Spurii	Better than -60dB

This amplifier will withstand an infinite VSWR on the output when operated at the rated output up to the maximum supply voltage.

To optimise performance at two metres, C9 was moved along the line to obtain highest overall gain at 40 W output.

Note on mica caps.

These are expensive, but indispensable and certainly worth it for the performance obtainable from the stripline amps.

Dipped-mica capacitors, carrying the Sangamo brand name, were obtained from Amtron-Tyree of 176 Botany St, Waterloo, 2017. They are component importer/distributors and a minimum quantity/price applies.

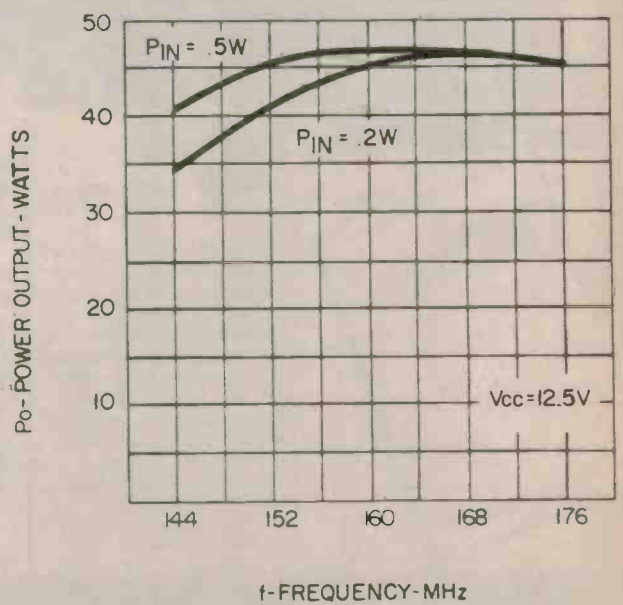
Metal-clad mica capacitors, made by Underwood in the USA, were obtained through the same company.

Metal-clad mica capacitors made by Elmenco of the USA, may possibly be obtained through RIFA at P.O. Box 95, Preston, Vic.

The address of Underwood in the United States is:— Underwood Electric (division of Standex Electronics), 148 South Eight Avenue, Maywood, Illinois, 60153, USA.

The USA address of Elmenco is:- Elmenco Capacitors, 316 South Service Road, Melville, N.Y. 11746.

Next month we shall conclude with a description of a 140 W stripline amp.



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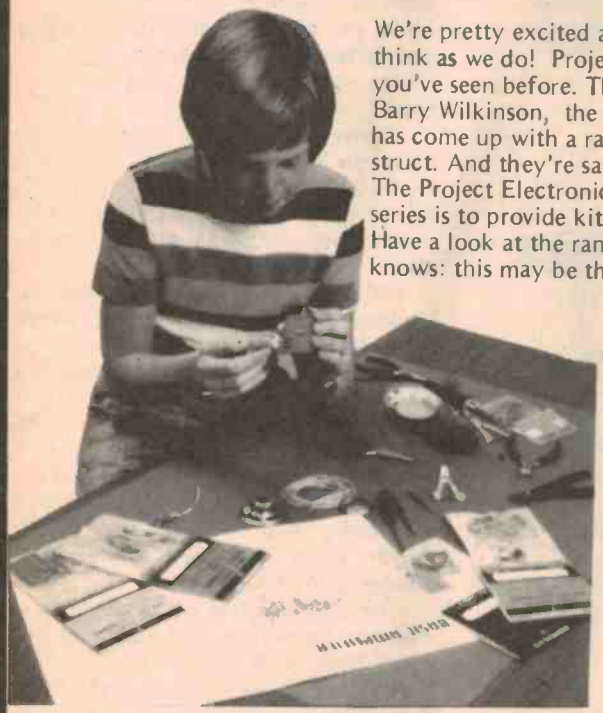

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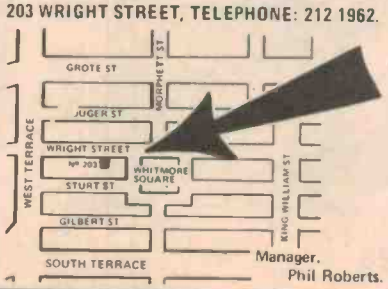

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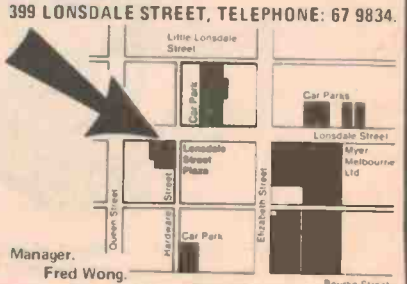

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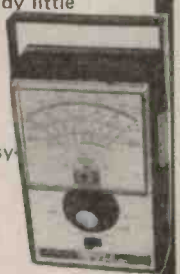

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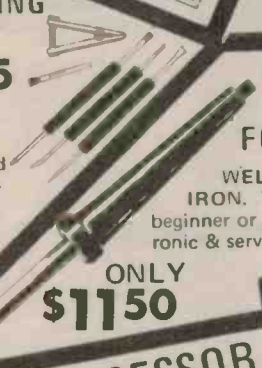

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TL080 family circuit description

The following sections should be read in conjunction with Fig 1, the basic schematic for one channel.

Bias circuits

EFT Q16, zener D2, transistors Q14/Q15 and resistor R6 establish the bias currents for the input differential amplifier and the second gain stage. Epitaxial FET Q16 provides a fixed current to D2 establishing 5.2V on the base of Q15. The resulting 317uA collector current of Q15 flows through Q14 and sets the current levels in Q1 and Q9.

Resistor R1 causes 196uA current in Q1 that is divided between the input stage JFETs Q2 and Q3. The second-gain-stage bias current, about 600uA, is derived from E9.

Input circuit

Input JFETs Q2 and Q3 operate into the active load circuit consisting of Q4, Q6, and Q7. Current imbalance and input offset voltages may be adjusted on the TL081 and TL083 through connections to the emitters of Q6 and Q7. External offset controls for the TL080 connect to the collectors of Q6 and Q7. The C1 compensation capacitor is internal on the TL080, TL082 and TL083, and TL084. For the TL080 connections for external compensation are provided which allow user adjustment of AC characteristics.

Ion-implanted input devices provide very high input impedance, controlled pinch-off voltage for maximum common-mode input range, and matched characteristics for control of the input offset voltage. JFET inputs also allow adequate drive to the second stage resulting in maximum output peak-to-peak capability and wide power band widths.

Output stage

Q10 and Q11 provide Class AB bias to the output transistors Q12 and Q13. This allows near zero crossover distortion and produces a low total harmonic distortion at the output. The simplicity of the output circuit results in minimum silicon area requirements keeping manufacturing cost down while maintaining quality performance. R2, R3 and R4 form the output short-circuit protection network.

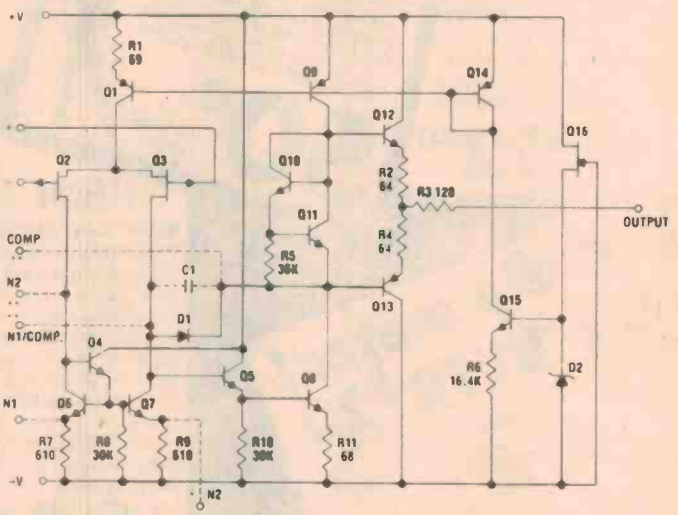

Fig 1. Schematic diagram for TL080 family.

Second stage

Drive from the input stage is single-ended from the collector of Q7. D1 provides a clamping action across Q5 and Q8 preventing saturation of Q8 and excessive current in Q5. Q5 and Q8 form the high-gain second stage. The second stage output, collector of Q8, drives the output stage consisting of bias transistors Q10 and Q11, and output drivers Q12 and Q13.

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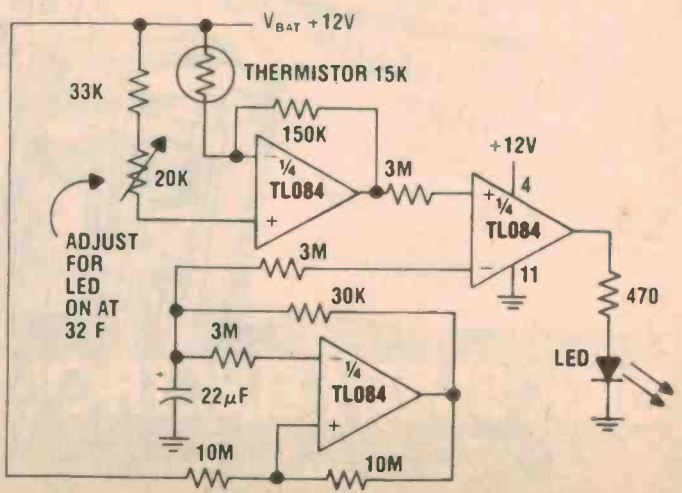
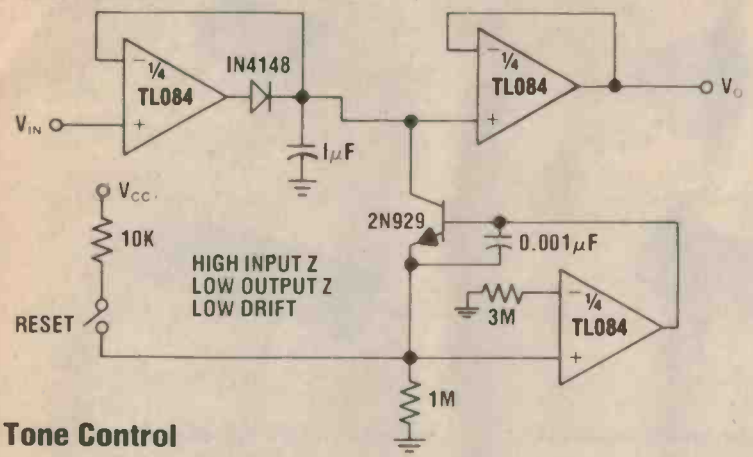
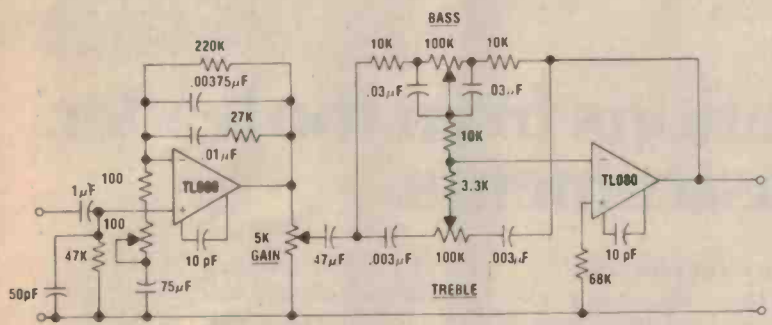


Peak Detector



Tone Control



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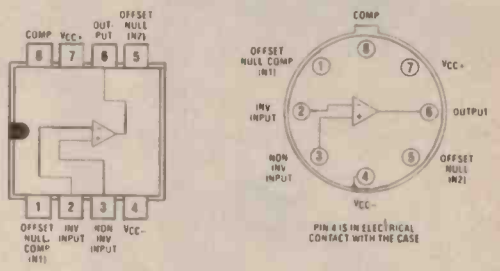
● LOW POWER CONSUMPTION	Only 2.8 mA per operational amplifier. Less system power required and battery operation is practicable.

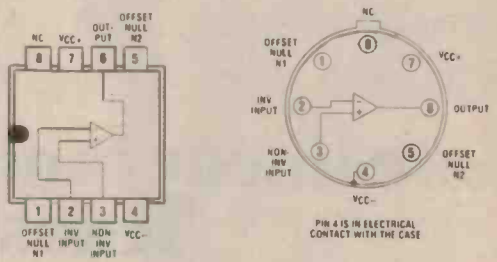
absolute maximum ratings		TL08_C TL08_AC TL08_BC
Supply voltage, V_{CC} (see Note 1)		18 V
Supply voltage, V_{CC} (see Note 1)		−18 V
Differential input voltage (see Note 2)		±30 V
Input voltage (see Notes 1 and 3)		±15 V
Duration of output short circuit (see Note 4)		Unlimited
Continuous total dissipation at 25°C free-air temperature	J,JG,N, or P Package	680 mW
	L Package	625 mW
Operating free-air temperature range		0 to 70°C

PIN OUTS

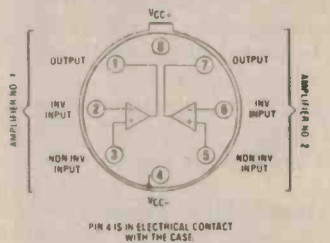
TL080



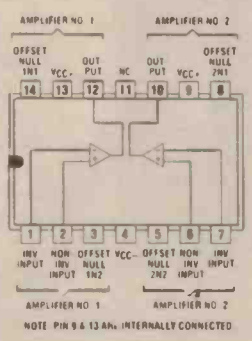
TL081



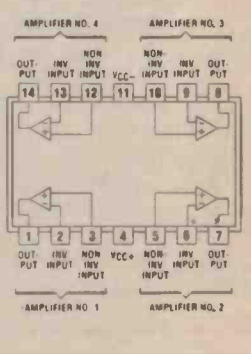
The TL082



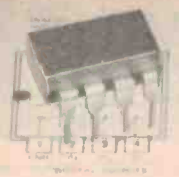
The TL083



The TL084



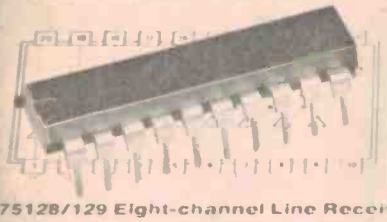
NOTES:
1. All voltage values, except differential voltages, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between V_{CC+} and V_{CC-}.
2. Differential voltages are at the noninverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
4. The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.



SN75489 Line Level Detector

TL505 A/D Converter

SN75375 Quad
TTL-to-MOS/Peripheral Driver



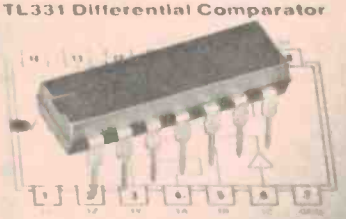
SN75128/129 Eight-channel Line Receiver

TO-202 Power Package

TL331 Differential Comparator

TL170 Hall Effect Switch

TL321 Operational Amplifier



SN75159 Dual Differential Line Driver

More linear innovations from the leader. Texas Instruments.

Here are nine more innovative circuits from TI, your most complete source for linear circuits.

Linear level detector/indicator
Five comparators in the SN75489 translate analog inputs to digital outputs for a variety of level-sensing applications. Outputs can drive display elements, TTL, CMOS or high-level logic.

Eight-channel line receivers
Designed to meet the IBM 360/370 I/O specification, the SN75128/129 feature Schottky-clamped transistors and ratio specification for t_{PLH}/t_{PHL}. SN75128 strobe is active-high, active low for the SN75129.

Hall Effect switch
The TL170 is a low-cost bipolar magnetically activated switch with no moving parts or mechanical contacts. Switching hysteresis is 200 Gauss typ. Output can be directly interfaced with TTL and MOS logic circuits.

A/D converter for μPs
The TL505 has the analog elements for a unipolar auto-zeroing dual slope converter. Logic can be performed by the μP as a software routine or through discrete devices. High-impedance MOS inputs permit conversion speeds of 0.05 to 20 seconds.

Low-cost TO-202 package
Now the μA78M00 and μA79M00 are available in the TO-202 package exclusively from TI, about half the cost of the TO-220. No mylar insulator is required. Plugs into the same socket as the TO-220.

Operational amplifier
The TL321 is a single version of the LM358 that operates from a single supply over a wide range of voltages. Features low supply current drain, low input bias and offset parameters, internal compensation.

Peripheral driver
The SN75375 is a monolithic quad TTL-to-MOS circuit that can drive high-capacitance loads. Individual V_{CC2} supplies for each driver variable to 24 V. Allows for separate adjustment of high-level output voltages. Offers high-speed switching and low standby power dissipation.

Differential comparator
The TL331 is a single version of the LM393 that operates from single or dual supplies from 2-36 V. Current drain is independent of the supply voltage. Output is compatible with TTL, DTL, CMOS and MOS.

Dual differential line driver
The SN75159 with 3-state outputs meets EIA RS-422. Single 5 V supply. Offers individual control for each driver, balanced line operation, short-circuit protection and high-impedance in the power-off mode.

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CEMA Electronics Pty., Ltd.
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St. Leonards, NSW 2065
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Victoria:

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Moorabbin, Vic. 3189
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CEMA Electronics Pty., Ltd.
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Blackburn, Vic. 3130
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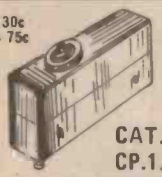
EXPLOSIVE VALUES

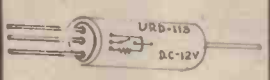
P&P 30c
10 — 75c



CAT. No: CP.1.

SUB-MIN. MICRO-SWITCH. Single pole change-over. 250V 5A. Size: 18mm x 9mm x 7mm. U.S.A. manufacture. 5 for $4.50.

P&P 40c 10 — 75c



CAT. No: CP.2.

REED RELAY, Min. type. 12VDC on/off switch. Size of body — 20mm Dia: 7mm Overall Length — 45mm. 3 for $2.95.

P&P 5 — 40c

CAT. No: CP.3.

BYF50 Gen. Purpose NPN Silicon transistor in TO-39 case. Vcb 80V 1 amp. 5 for $2.95.

P&P 5 — 40c

CAT. No: CP.4.

BD135 NPN silicon Power transistor in TO-126 Flatpak. 8W. 5 for $3.00.

P&P 10 for 40c

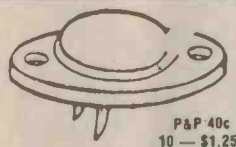
CAT. No: CP.5.

BC209C Low noise high gain transistor in plastic TO-18 case. Silicon NPN. Vcb 30 100mA. 10 for $2.50

CAT. No: CP.6.

P&P 30c
10 — 75c

R.F. TRANSISTORS. Type 2N5944. Good to 470 megs at 2W output. Perfect as drivers for that FM LINEAR. 5 for $7.50. with data.



P&P 40c
10 — $1.25

CAT. No: CP.7.

2SB337 PNP germanium PNP Power transistor in TO-3 case. Sim. to OC28. Vcb 40 12W 7amp. 5 for $4.95.

P&P 30c ea. 10 $1.00

CAT. No: CP.8.

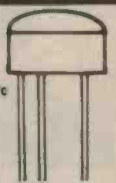
2N3054 Silicon NPN Audio O/P transistor in TO-66 case. Vcb 90 4amp. 5 for $2.00.

P&P 30c

CAT. No: CP.9.

2SB367 Germanium PNP Power transistor in TO-66 case. Vcb 25 1amp 4W. 5 for $3.50.

P&P 10 for 40c



CAT. No: CP.10.

2N3643 Silicon NPN transistor in TO-105 plastic case. G.P.Amp. and switch. Vcb 60 500mA. Sim. to BC337. 10 for $2.95.

CAT. No: CP.11.

P&P 75c

RELAYS Miniature P.C. mounting type. Made by F.I.R.E. with 8amp contacts, single pole change/over. In the following values: 750 Ω, 2.1K and 7K . Look at this for value . . . the 3 for only $6. All new and unused.

P&P 75c

CAT. No: CP.12.

RELAY Miniature P.C. mounting type. 12VDC double pole change-over with 5amp contacts. REAL VALUE HERE . . . 3 for $7.00.

P&P 10 for 40c

CAT. No: CP.13.

COS/MOS Operational Amplifier with MOS/FET output. In 8 lead TO-5 case. Only $1.95 each or 5 for $9.00 TYPE CA3130.

P&P 10 — 40c

CAT. No: CP.14.

CMOS Wide-band Amplifier-Discriminators . . . Type CA3013. In 8 lead TO-5 case. GRAB 'EM WHILE YOU CAN . . . ONLY LIMITED STOCKS at the silly price of 5 for $4.75.

P&P 10 — 30c

CAT. No: CP.15.

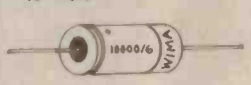
BC177 S.S.Amp. transistors in TO-18 metal can. Can say no more about this popular and well tried PNP Silicon semi-conductor. OUR PRICE ONLY 10 for $1.50.

CAT. No: CP.16.

P&P 5 — $1.00

ELECTROLYTIC CAPACITOR. Can type with mounting bracket. Made by DUCON 100mfd 160VW. Tremendous and unrepeatable value at only 5 for $1.00.

P&P Single 30c
10 — 90c



CAT. No: 17.

ELECTROLYTIC CAPACITOR: Top brand by WIMA (Germany) 10,000mfd 6VW. Axial leads. ONLY AT S.E. at 40c each or 10 for $3.50.

P&P 10 — 30c
50 — 60c

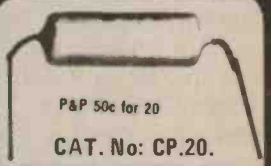
CAT. No: CP.18.

RECTIFIER DIODES. Unmarked S.T.C. brand, but guaranteed. Wire ended type. 100V 3amp. 10 for 75c

P&P 75c

CAT. No: CP.19.

DISC CERAMICS. High voltage type with axial leads. 0.01mfd 12KV. Tremendous value of this hard-to-get Cap. Only limited quantities available. LOOK AT THIS 18c each or 10 for $1.50.



P&P 50c for 20

CAT. No: CP.20.

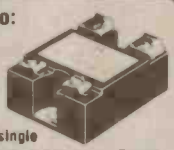
POLYESTER CAPACITOR. Philips tubular foil type 315. 0.01mfd 160VDC. Axial leads. WOW! Look at our price. 20 for 75c. Never again like this.

CAT. No: CP.21.

30c single
P&P $1.50 for 20

ARROW TOGGLE SWITCHES. Single pole double throw with moulded switch lever. Rated 250VDC at 3amp. HOW'S THIS FOR VALUE . . . 25c each or a carton of 20 for just $4.00.

CAT. No: CP.22.



P&P 75c single

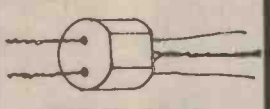
SOLID STATE RELAYS . . . They'll carry 10 amps and 250V switch and need 3 to 32 volts to operate efficiently. A third of the normal price. ONLY AT S.E. for a paltry $5.50 each.

P&P 40c for 10

CAT. No: CP.23.

FERRITE BEADS. 6 holes. Size 10mm x 7mm dia. Ready wired. 45c anywhere else but at SHERIDAN'S only 12c each or 10 for $1.00.

P&P 10 — 40c



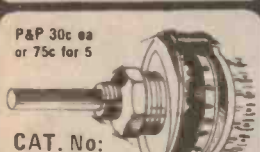
CAT. No: CP.24.

FERRITE BEADS . . . Size 5mm x 6mm dia. 2 holes. Ready wired. Another great BUY from us. Only 10c each or 10 for 90c.

CAT.No. CP25.

NEON LAMPS, Clear. For 240VAC. Suitable for Utilux clip-on connectors. Length (overall) 38mm x 13mm dia. Normally about 60c each. From us only 30c each or 10 for $2.50.

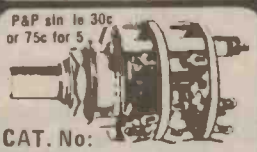
P&P 30c ea
or 75c for 5



CAT. No: CP.26.

ROTARY SWITCH, OAK type. 2 pole 4 position, single wafer. Shaft size: 20mm x ¼". IMPOSSIBLE TO BEAT PRICE of 45c each or 5 for $2.00.

P&P sin le 30c
or 75c for 5



CAT. No: CP.27.

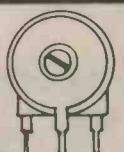
ROTARY SWITCH, miniature OAK type. 2 section 8 pole 2 position. Nylon wafers. Shaft size. 10mm x ¼". HOW'S THIS FOR VALUE? 90c each or 5 for $4.00.

P&P
10 — 40c

CAT. No: CP.28.

MINIATURE TRIMMING CAPACITORS . . . rotary Vanetype. 2 values available. 12 — 75pf and 9 — 60pf. Only 10mm dia x 15mm deep (overall) 5 of each for only $2.25. REAL VALUE HERE.

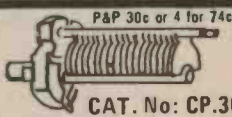
P&P
6 for 30c



CP.29.

MINIATURE TRIMPOTS. Made by PIHER. P.C.B. Mounting. 10mm dia x 15mm long. 2 each of the following values: 50 Ω — 200 Ω — 100K The 6 for 75c.

P&P 30c or 4 for 74c

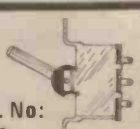


CAT. No: CP.30.

AIR-SPACED VARIABLE CAPACITOR. Top quality by JACKSON BROS (UK). 150pf. Silver plated Vanes & Ceramic end plates. TOP QUALITY. LIMITED QUANTITIES ONLY . . . Worth $5 each. From us only $1.25 each or 4 for $4.75.

CP.31.

PRECISION MINIATURE TRIMPOTS . . . 20 TURN Wire wound. Made by RELIANCE. In the following values: 20 Ω — 100 Ω and 1K . The 3 for $2.50. A REAL GOOD-BUY. . . or 10 asstd. for $7.50.

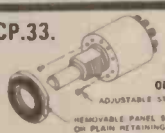


CAT. No: CP.32.

P&P 5 for 60c

SWITCHES . . . 2 hole fixing with satin finished lever, 2 pole change/over. 35mm hole centres. Cannot be bought under 65c each. S.E. price 35c or 5 for $1.50.

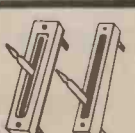
CP.33.



P&P single 30c or 75c for 5

ROTARY SWITCH . . . Subminiature sealed with adjustable stops 10 pos 2 pole. Overall length: 33mm. Dia: 12mm. Shaft: 10mm x 3mm. EXPLOSIVE VALUE AT ONLY $1.95 each or 5 for $8.50.

CAT. No: CP.34.



SLIDER POTENTIOMETER . . . 3 singles in 1K — 10K and 500K and 2 duals in 5K and 50K Total normal retail approx. $4.75. but from us only $1.00.

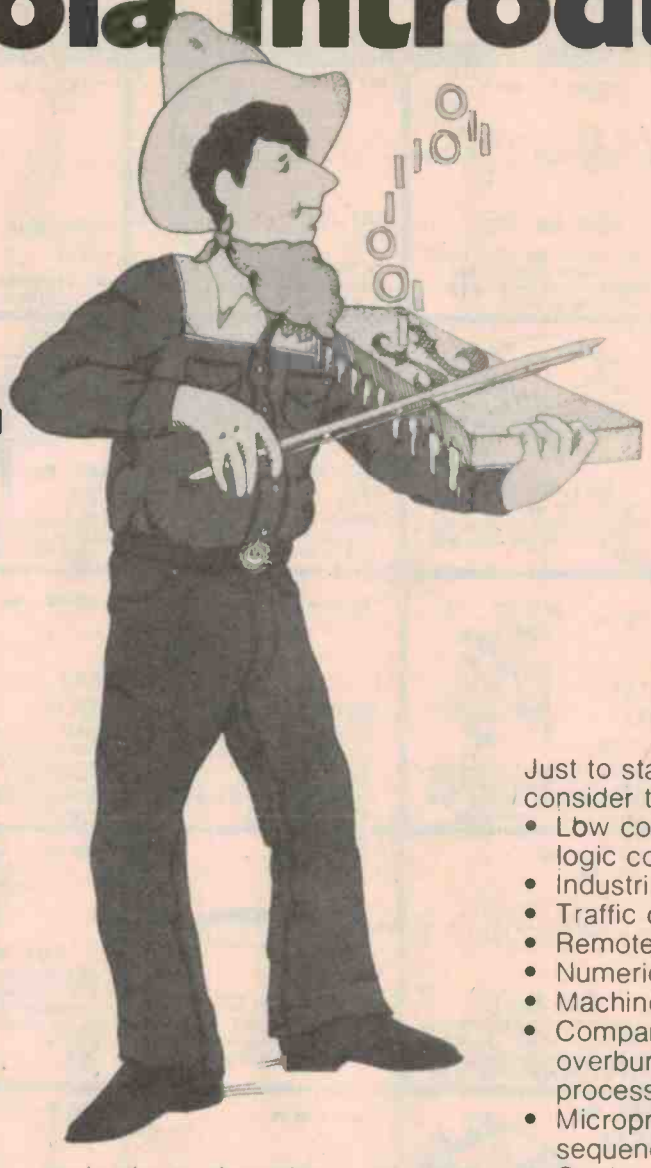
P&P 60c

CAT. No. CP.35.

WIRE WOUND TRIMMING POTS . . . Made by EGEN (G.B.) 4 watts. Precision standards complete with integral knob. In the following values: 100 Ω — 220 Ω — 470 Ω and 1K. The 4 for $1.75. YOU CAN DO NO BETTER.

For the infinite repertoire of one-bit tasks

Motorola introduces the bit fiddler



Our new MC14500B single-bit static CMOS processor is designed expressly for the cost-effective bit fiddling or simple one-bit decision and command oriented tasks. On formal occasions, it's called the Industrial Control Unit, or ICU. Until now, designers have been forced to use inflexible hard-wired logic or wastefully over-qualified multi-bit processors to perform the vast repertoire of single-bit jobs that abound in the digital world. Our bit fiddler changes that for good.
The MC14500B is essentially the monolithic equivalent of a programmable logic controller central architecture, with the inherent CMOS qualities of high noise immunity, microwatt power dissipation, adaptability to low-cost, low-current power supplies, and a wide 3 to 8 volt operating range.
Yes, the range of applications for the ICU is nearly unlimited.

Just to start you thinking, consider these.

- Low cost programmable logic controller
- Industrial controls
- Traffic controller
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- Numerical controller
- Machine controller
- Companion for unloading overburdened micro-processor
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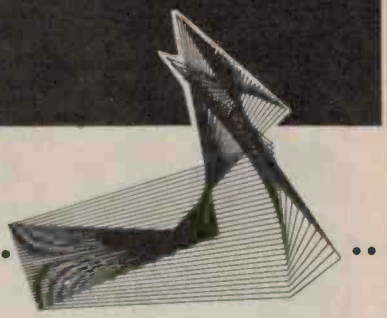
ETI's COMPUTER SECTION



NEWS

Self-Study System

Integrated Computer Systems, Inc. of 4445 Overland Avenue, Culver City, California 90230, USA, has introduced a self-study microcomputer software/hardware training course. ICS are well known for their courses presented at various locations in the US and Canada. This course (No. 126) is based on a single board 8080-type microcomputer with 512 bytes of CMOS RAM, 24 bits of I/O and an educational monitor program which drives an 8-digit display and 25-key keyboard. The 650-page workbook covers hardware and software fundamentals, the 8080 instruction set, I/O techniques including interrupts, program organization and subroutine structures, advanced maths routines including trig, logs, floating point etc., and advanced I/O such as DMA. The total price is US$545, and further details are available from ICS.

Epic 68

Motorola have introduced what they describe as 'The Last Terminal At Last' – a video terminal based on their EXORciser/Micromodule bus. The basic VDU incorporates a 6800 CPU and five other modules. Six optional keyboards are available, and the innards are expandable up to stand-alone computer level. Naturally enough, Motorola are also touting it as a personal computer.

Hardware Interchange

The use of a standard bus permits the replacement of individual boards from a system – usually memory or I/O, but the CPU can often be replaced in the same way. Thus an S100 system may be supplied with an 8080 CPU, but this could be updated to an 8085 or a Z-80, and now 6502's can be fitted onto S100! The latest upgrade CPU is for owners of the SWTPC 6800 system, which has now become a 'standard' bus called the SS-50. National Multiplex Corp. of 3474 Rand Avenue, South Plainfield, New Jersey, USA have introduced an 8085-based CPU board for SS-50, so now SWTPC owners can run some of the enormous volume of software that is available.

COMPUTER CLUB DIRECTORY

Sydney: Microcomputer Enthusiasts Group, P.O. Box 3, St. Leonards, 2065. Meets at WIA Hall, 14 Atchison St., St. Leonards on the 1st and 3rd Mondays of the month.

Melbourne: Microcomputer Club of Melbourne, meets at the Model Railways Hall, opposite Glen Iris Railway Station on the third Saturday of the month at 2 p.m.

Canberra: MICSIG, P.O. Box 118, Mawson, ACT 2607 or contact Peter Harris on 72 2237. Meets at Building 9 of CCAE, 2nd Tuesday of month at 7.30 p.m.

Newcastle: contact Peter Moylan, Dept. of Electrical Engineering, University of Newcastle, NSW 2308. (049) 68–5256 (work), (049) 52–3267 (home).

Brisbane: contact Norman Wilson, VK4NP, P.O. Box 81, Albion, Queensland, 4010. Tel. 262 1351.

New England: New England Computer Club, c/- Union, University of New England, Armidale, NSW 2351. (New club; not restricted to students)

Auckland: Auckland Computer Club, P.O. Box 27206, Auckland, N.Z.

Computer clubs are an excellent way of meeting people with the same interests and discovering the kind of problems they've encountered in getting systems 'on the air'. In addition, some clubs run hardware and software courses, and may own some equipment for the use of members. Try one – you'll like it!

If your club is not listed here, please drop us a line, and we'll list you. The same applies if you are interested in starting a club in your area. Also, if established clubs know their programme of forthcoming events, we can publicise them.

Product Review: Technico 9900SS

Single board computer offers multi-board facilities.

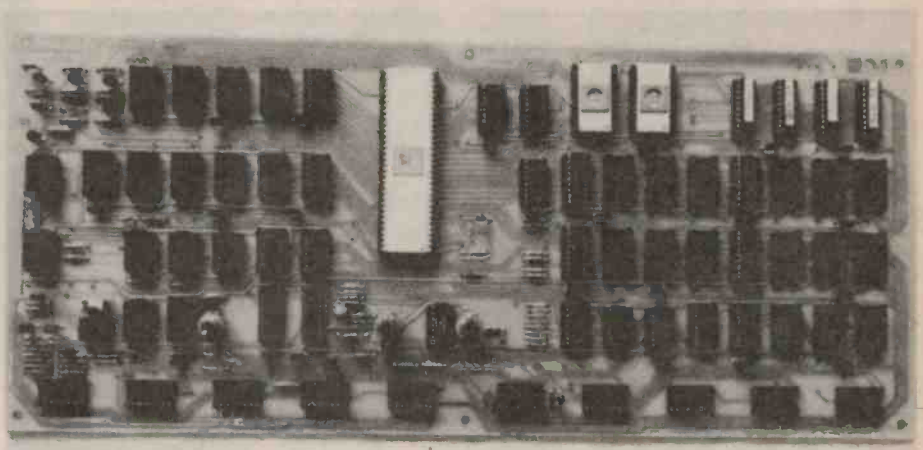
Technico 9900SS Microcomputer Board

Although at present most hobbyists are using 8-bit microprocessors, there is a trend amongst manufacturers towards the production of 16-bit devices. This is the result of advances in technology which are allowing micro manufacturers to effectively bridge the gap between microcomputers and minicomputers. At present, observers are able to vaguely distinguish between minicomputers and microprocessors on the basis of the technology used in the CPU – if it is totally contained on 4 LSI chips or less (say), then it is a micro.

The advent of top-end microprocessors like the LSI-11 and Zilog's Z-800 render this distinction not only impossible but irrelevant – their computing power puts them in what has traditionally been the minicomputer league, yet their physical size and construction makes them microprocessors. It is likely that this particular dividing line will lose importance as minicomputers and microcomputers share the same construction, and the salient characteristics will be word length and instruction set.

The move to 16-bit microprocessors is of interest to the hobbyist, who is often a student of processor comparisons. We have been fortunate in being able to evaluate a 16-bit microcomputer, the Technico 9900-SS, courtesy of Innovative Micro Processor and Computer Technology of Petersham. This 400 mm x 180 mm (approx.) board uses a Texas Instruments TMS9900 as the CPU and provides the memory, clocks, I/O and monitor necessary to get it to run and do sensible things.

The TMS9900 is an example of how a 16-bit processor decodes instructions. Conventionally, an 8-bit processor like 6800 uses one, two or three byte instructions with the op-code occupying the first byte and subsequent bytes containing an address, value or displacement. Taking the example of an extended



LOAD or STORE instruction: the instruction gives the complete source or destination of the data as the two-byte address and the accumulator (A or B) is implicit in the op-code.

Not so withthe 16-bit TMS 9900. To start with, the 9900 does not have an accumulator as such, but a bank of 16 general-purpose registers. This means that a MOV instruction must specify both source and destination, either of which may be register or memory. The op-code for this instruction is only 3 bits long (110) – this is sufficient to inform the processor of the instruction type. The next bit tells the processor whether it is dealing with a byte or a full word to be moved. Now this is where the story really starts; with the next twelve bits.

Six bits are allocated to defining the source, and six to the destination. The first two indicate which addressing mode is being used, and the following four bits indicate the register being referred to. The breakdown of a typical MOV instruction is shown in Fig. 2. In this example a word is moved from the location pointed to by R5, into R1. At the same time R5 is incremented so that it points to the next location in the table. As you can see, this method of forming single-word instructions, together with the extremely powerful addressing modes of the 9900, can produce some very, very effective instructions in only 16 bits.

Architecture

Of course, a large part of the power of the TMS9900 comes from its architecture. We have already observed that it has 16 general purpose registers which can be used as accumulators, temporary registers, index registers or table pointers. What makes the TMS9900 different from other microprocessors is the fact that it has only three registers on the chip and the 16 registers mentioned above are actually located in external RAM, not on the chip.

The three registers on the chip are the program counter (PC), the status register (ST) and the workspace pointer (WP). PC and ST operate in a similar way to the equivalent registers in 8-bit processors, except that ST has extra bits for the interrupt mask. WP has no counterpart in other micros, since its function is to point to the workspace, or register file, in memory, which contains those 16 registers. For example, if WP contains the hex value 00B0, then any reference to register 0 (R0) will access memory location 00B4, etc.

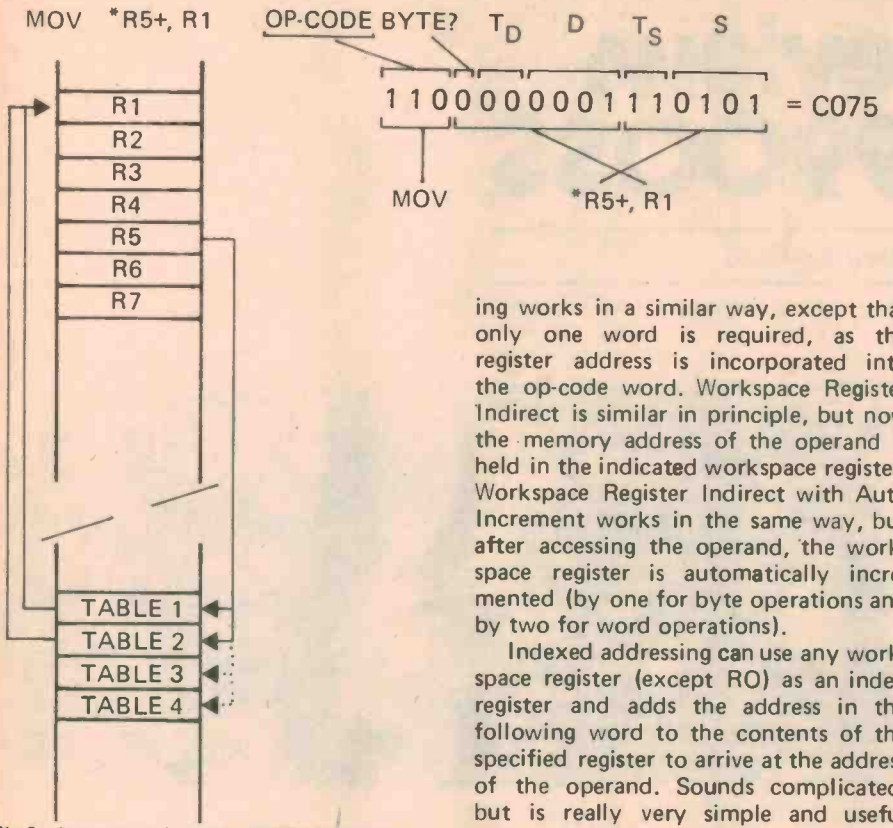


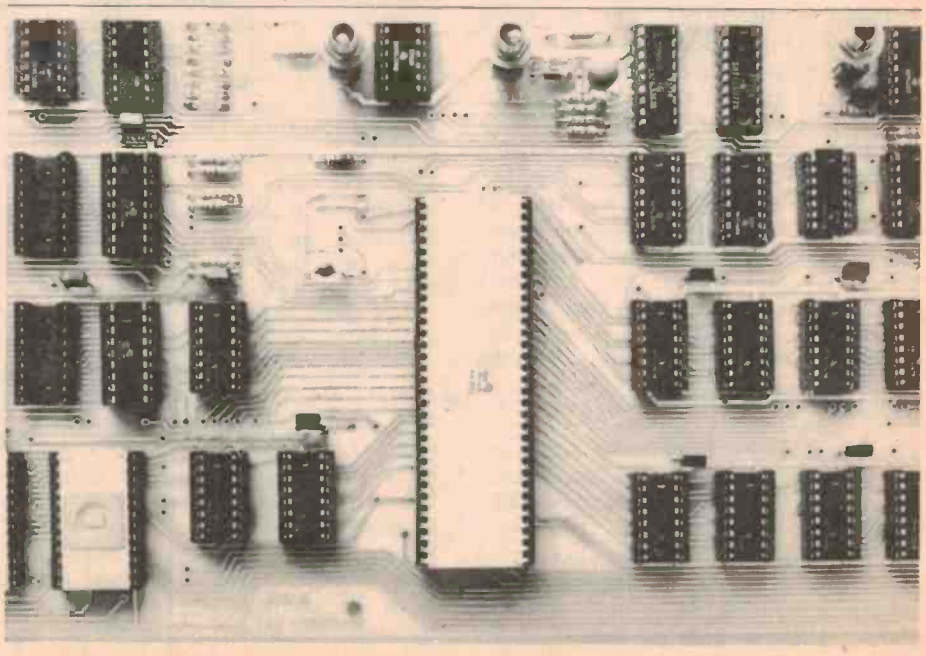
Fig.2. Anatomy of a typical 9900 instruction. This one repeatedly moves words from the table (pointed to by R5) into R1.

The reason that R1 is not 00B1 is that the 16-bit addresses used by the TM9900 refer to bytes, not words. Therefore R0 occupies the two bytes 00B0 and 00B1. 9900 only has a 15-bit address bus, although it has 16-bit addresses. The 15 bits it puts out on the bus address a word uniquely and the remaining bit is used internally to select either the left-hand or right-hand byte. This means that 9900 is quite good at byte manipulations as well as working with full words. For example, changing the instruction in Fig.2 from MOV *R5+, R1 (C075) to MOVB *R5+, R1 (D075) means that the pointer register, R5, will point to consecutive bytes, not consecutive words, as required when outputting strings of ASCII data.

Another major feature of 9900 is its use of addressing modes. Seven addressing modes are possible, and they can even be mixed within individual instructions. Direct addressing operates the same way as on other microprocessors — the word following the instruction contains the memory address of the operand. Workspace Register addressing works in a similar way, except that only one word is required, as the register address is incorporated into the op-code word. Workspace Register Indirect is similar in principle, but now the memory address of the operand is held in the indicated workspace register. Workspace Register Indirect with Auto Increment works in the same way, but after accessing the operand, the workspace register is automatically incremented (by one for byte operations and by two for word operations).

Indexed addressing can use any workspace register (except R0) as an index register and adds the address in the following word to the contents of the specified register to arrive at the address of the operand. Sounds complicated, but is really very simple and useful when accessing tables, Immediate addressing uses the word following the instruction as the operand, and finally, in relative addressing the 8-bit displacement incorporated in the instruction is added to the updated program counter in jump instructions.

Fig.3. The TMS 9900 is a very large chip.



There are some interesting instructions in the 9900's repertoire, including hardware multiply and divide. The MPY instruction multiplies two 16-bit integers and places the 32-bit result in destination and destination +1. DIV divides (destination) and (destination +1) by (source) and places the result in destination with the remainder in destination +1. As you may imagine, these instructions are useful in all kinds of applications outside straight number crunching.

Execute is a novel instruction used to perform instructions out of line; the instruction XS will execute the instruction at location S and then continue with the next instruction after XS. Great for emulator routines!

The 9900SS Kit

The Technico 9900SS Super Starter kit includes all the components and information required to get a TMS9900 up and running — all the user has to supply is a power supply and teletype. The board is neatly laid out, and is made of 1/10" fibreglass with 2 oz. tinned copper tracks.

The documentation supplied with the kit is very good and following the instructions supplied, we had no difficulty in putting the board together. Getting it to work first time proved to be more difficult, however. After puzzling over a hot 'scope for several hours, we decided to play the part of a typical hobbyist with only limited facilities and experience, and rely on IMPACT's familiarity with the board to get us out of trouble.

The TMS9900 Instruction Set

A	Add (Word)
AB	Add (Byte)
ABS	Absolute Value
AI	Add Immediate
ANDI	Add Immediate
B	Branch
BL	Branch and Link
BLWP	Branch and Load WP
C	Compare (Word)
CB	Compare (Byte)
CI	Compare Immediate
CKOF	Clock Off
CKON	Clock On
CLR	Clear
COC	Compare Ones Corresponding
CZC	Compare Zeros Corresponding
DEC	Decrement (By One)
DECT	Decrement (By Two)
DIV	Divide
IDLE	Idle
INC	Increment (By One)
INCT	Increment (By Two)
INV	Invert (One's Complement)
JEQ	Jump on Equal
JGT	Jump on Greater Than
JH	Jump on High
JHE	Jump on High or Equal
JL	Jump on Low
JLE	Jump on Low or Equal
JLT	Jump on Less Than
JMP	Jump Unconditional
JNC	Jump on No Carry
JNE	Jump on Not Equal
JNO	Jump on No Overflow
JOC	Jump on Carry
JOP	Jump on Odd Parity
LDCR	Load CRU
LI	Load Immediate
LIMI	Load Interrupt Mask Immediate
LREX	External Control
LWPI	Load Workspace Pointer Immediate
MOV	Move (Word)
MOVB	Move (Byte)
MPY	Multiply
NEG	Negate (Two's Complement)
ORI	Or Immediate
RSET	External Control
RTWP	Return Workspace Pointer
S	Subtract (Word)
SB	Subtract (Byte)
SBO	Set CRU Bit to One
SBZ	Set CRU Bit to Zero
SETO	Set Ones
SLA	Shift Left
SOC	Set Ones Corresponding (Word)
SOCB	Set Ones Corresponding (Byte)
SRA	Shift Right (MSB Extended)
SRC	Shift Right Circular
SRL	Shift Right (Leading Zero Fill)
STCR	Store from CRU
STST	Store Status Register
STWP	Store Workspace Pointer
SWPB	Swap Bytes
SZC	Set Zeros Corresponding (Word)
SZCB	Set Zeros Corresponding (Byte)
TB	Test CRU Bit
X	Execute
XOP	Extended Operation
XOR	Exclusive OR

Fig. 4. 9900 Instruction Set.

```
?GF800

0100:  04C2    CLR R2
0102:  2C42    IN R2
0104:  0201    LI R1,>128      ;Load message pointer
0106:  0128
0108:  2C91    OUT *R1         ;Output character
010A:  D031    MOVB *R1+,R0    ;Is next char. zero?
010C:  16FD    JNE >108        ;If not, output it
010E:  2C41    IN R1           ;Input guess
011A:  9081    CB R1,R2        ;Compare
0112:  1304    JEQ >11C        ;If equal
0114:  1106    JLT >122        ;If less
0116:  0201    LI R1,>138      ;Must be too high
0118:  0138
011A:  10F6    JMP >108        ;Print high message
011C:  0201    LI R1,>152      ;Load message pointer
011E:  0152
0120:  1033    JMP >188        ;Print message
0122:  0201    LI R1,>146      ;Load message pointer
0124:  0146
0126:  10F0    JMP >108        ;Print message
0128:  0D0D    +>0D0D          ;CR, LF
012A:  594F    $YOUR GUESS:
012C:  5552
012E:  2047
0130:  5545
0132:  5353
0134:  3A20
0136:  0000    +0              ;End of message
0138:  0D0A    +>0D0A
013A:  544F    $TOO HIGH!
013C:  4F20
013E:  4849
0140:  4748
0142:  2120
0144:  0000    +0
0146:  0D0A    +70D0A          ;CR, LF
0148:  544F    $TOO LOW!
014A:  4F20
014C:  4C4F
014E:  5721
0150:  0000    +0              ;End of message
0152:  0D0A    +>0D0A
0154:  4752    $GREAT, YOU GOT IT! HIT ANOTHER
0156:  4541    KEY AT RANDOM . . .
0158:  542C
015A   2059
015C:  4F55
015E:  2047
0160:  4F54
0162:  2049
0164:  5421
0166:  2048
0168:  4954
016A:  2041
016C:  4E4F
016E:  5448
0170:  4552
0172:  2020
0174:  4B45
0176:  5920
0178:  4154
017A:  2052
017C:  414E
017E:  444F
0180:  4D2E
0182:  2E2E
0184:  0D0A    +>0D0A
0186:  0000    +0              ;End of message
0188:  2C91    OUT *R1         ;Print routine
018A:  D031    MOVB *R1+,R0
018C:  16FD    JNE >188
018E:  10B9    JMP >102        ;Start again
```

Fig. 5. Example Program.

Technico 9900SS

Within 48 hours of their receiving the board, they had pinpointed the trouble, and the board was on its way back to us. For our part, we had installed the RAMs in the wrong sockets (i.e. at the wrong address) and the manual omitted to tell us to install R29, a pull-up resistor on the CRU IN line. Full credit to IMPACT for a quick turn-around.

The Monitor

The resurrected board, upon connection to an ETI 630 VDU and a power supply was immediately off and running. Our first job was to experiment with the monitor.

Although contained in only 512 words of PROM, the monitor is a very complete and powerful one. It will run with any speed terminal up to 9600 Band, and automatically calculates the terminal speed when a carriage return is entered. Once the monitor is entered, one can key in one of twelve command codes (A, B, C, D, G. H, I, L, M, P, S, W).

The ALTER command enables one to examine and alter locations in memory. A BREAKPOINT may be set in a user program so that it will halt execution at a particular instruction, enabling examination of user registers and memory. This is especially useful when coupled with the SNAP command, which will automatically print out the contents of user-selected registers and memory, PC, WP and ST, repeatedly.

The COPY command copies a block of memory into another area of memory, while DUMP can be used to output a block of memory to the VDU. The GO command is used to commence program execution. Calculations of offsets for JMP instructions can be done using the H (for HEXADECIMAL ARITHMETIC) command. LOAD will reload programs punched onto paper tape by the DUMP command (incidentally, we've tried the 9900SS with the 637 CUTS interface and it works). The condition of a particular CRU bit can be examined using the INSPECT command and altered using the MODIFY command

The board has a built-in EPROM programmer, for 2708s, which operates under control of the monitor's PROGRAM command. In order to avoid accidents, the programmer can be disabled by a separate switch once the 2708s are programmed and in use. Finally, the WORKSPACE DUMP command can be used to print the contents of selected workspace registers.

The monitor provides a lot of useful functions when debugging programs – the BREAKPOINT and SNAP functions are particularly valuable. In addition, the monitor contains a number of useful I/O routines which can be called by the user's programs.

But the monitor isn't much help when you are writing programs – you have to go through the process of writing assembly language routines, and then hand-assembling. This isn't so difficult with practice, and in fact some people prefer to work this way, but an assembler is very much more efficient.

We were fortunate enough to be able to try out Technico's PROM-resident Instant Input Assembler. This is crammed into only 512 words of memory, but it accepts the standard 9900 mnemonics and operands – in fact about the only thing it won't accept is symbolic addressing, as there's no way you could manage a symbol table with only 512 words. Besides, using absolute numeric addresses avoids problems in resolving forward references.

Upon starting, the assembler prints '100:' then tabs across and waits for the first line of code. When carriage return is hit, the assembler returns to the beginning of the line, advances past the '100:' and prints the object code in the right place for a correctly-formatted assembly listing. The object code is also placed into location '100:' in memory, the assembler advances to the next line, prints '102:' and tabs across to wait for the second line. We have given a short program example, in which user input is underlined, to demonstrate the operation of the assembler. This isn't an actual printout, since we used a VDU, so we have typeset the display.

This demo program isn't terribly well written, but it does illustrate the way a small program would be written using the 9900SS and assembler. The > signs indicate hex values, + indicates insertion of a constant and the $ sign precedes text in ASCII to be converted to hex.

The use of an assembler simplifies programming the TMS9900 considerably, especially since the instructions are so complex in structure. Assembly language enhances the logical structure of the 9900 instruction set and also cuts down on mistakes made when entering data.

Hardware

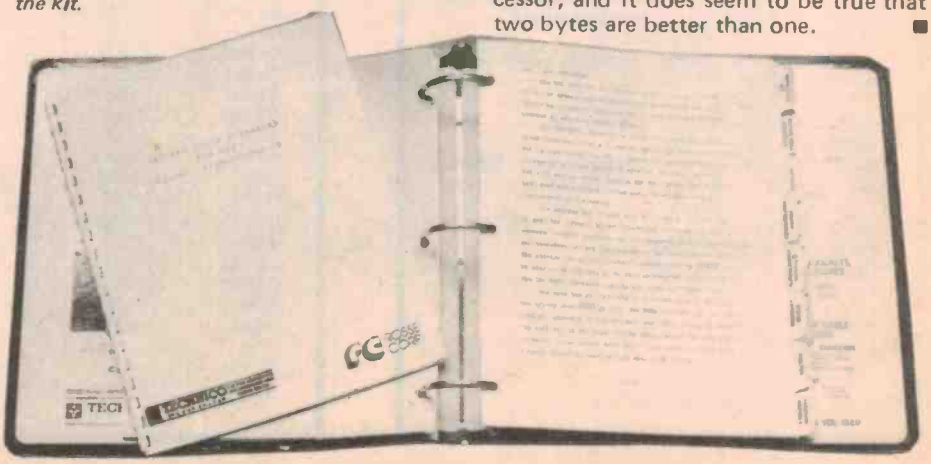
On the hardware side, the 9900SS board implements 32 bits of the 9900's Communications Register Unit, which is its I/O scheme. There is also a Real Time Clock, eight levels of prioritized interrupts and the board is fully buffered and expandable through a row of DIP sockets on its top edge.

Matching memory boards are available for the 9900SS, carrying up to 32K on each board, and Technico also produce a VDU and floppy disk unit, as well as a BASIC interpreter. Expansion into a full-sized 'bells and whistles' system should be no problem.

We found the 9900SS to be easy to use, and (apart from our own stupidity and the mysterious R29) easy to build. Particularly using the Instant Input Assembler, it was easy to write short programs and run them. The large ring binder supplied with the kit covers construction, system configuration, the monitor (including listing), 9900 instruction set, software (including a 1K games package), data sheets and a chapter on basic concepts which includes detailed information on number crunching (would you believe a sin and cos routine?)

Summing up, the 9900SS is a very fine computer board which can form the basis of a large system. The TMS9900 is a very powerful microprocessor, and it does seem to be true that two bytes are better than one. ■

Fig.6. The documentation supplied with the kit.



9900 MICROCOMPUTER COMMENTS AND EVALUATIONS

It is only five years since the microcomputer revolution began. The earliest microcomputers to capture widespread attention all used 8-bit processors — and 8-bit processors still continue to dominate the microcomputer scene.
But is a change on the way?

OSBORNE'S EVALUATION

A small number of 16-bit microprocessor chips have now been produced, outstanding amongst them the TMS9900 from Texas Instruments.

"The TMS9900, manufactured by Texas Instruments, is a single chip central processing unit, which can compete effectively with minicomputers in interrupt-driven signal processing applications.

Look upon the TMS9900 as a product well suited to complex, low volume applications that require a significant amount of program generation . . .

"The Workspace register is a unique and powerful programming feature of the TMS9900. This register identifies the first sixteen 16-bit memory locations which act as 16 General Purpose registers . . . Each of the 16 General Purpose registers may be used to store data or addresses. Thus, each General Purpose register may serve as an Accumulator or as a Data Counter . . . Having 16 General Purpose registers in read/write memory, rather than in the CPU, is the single most important feature of the TMS9900 . . .

EARLIEST TEC 9900 REVIEW

In 1976 Technico Inc. produced a microcomputer using the TMS9900. It was reviewed by Terry Dollhoff in "Interface Age", December 1976. Some extracts:

"The entire kit is on one single 7 x 16 inch printed circuit board. . . At the heart of the system is the new 16-bit processor — the TI9900. The TI9900 is the most significant new microprocessor development of the past year. It has a full 16-bit word minicomputer instruction set including a hardware multiply and divide. In fact, the TI9900 is software compatible with the TI990 series minicomputer.

"The Super Starter kit provides three different types of user memory . . . (The PROM, EPROM and RAM are then described) . . . the Super Starter (also) includes an EPROM programmer. Actually, it includes two of them. Since the TI9900 is a 16-bit machine, both EPROMs are programmed simultaneously. The only thing required to program EPROMs is a + 28V power supply.

"The 512 word monitor included with the kit makes it immediately usable with your terminal. The monitor includes all of the following commands . . . (these are then given) . . . All of the above commands are implemented in 512 words (1K bytes). This is a good testimonial to the power of the TI9900 repertoire. As an option, the Super Starter also offers a 512-word mini-assembler called the Instant Input Assembler. This program is distributed in two additional fused-link PROMs which may be plugged into the on-board expansion area. This mini-assembler allows the user to enter programs in assembly language.

"The Super Starter kit may well be the most complete single board kit on the market, but Technico also plans a series of add-on boards. Like the basic kit, the add-on boards include more than the minimum necessary circuits. For example, their add-on RAM board (same size as the kit) will have 32K . . . of memory! They will also offer a fused-link programmer, an expansion I/O board, and expansion EPROM and PROM boards. It looks like the TI9900 has finally reached the hobby market — in a big way."

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7405	.31	7442	.75
7406	.77	7443	1.75
7407	.77	7444	1.75
7408	.28	7445	1.39
7409	.28	7447	1.15
7410	.25	7451	.25
7411	.31	7454	.25
7412	.25	7470	.59
7413	.47	7474	.55
7414	.86	7475	.66
7416	.78	7491	1.01
7417	.78	7492	.61
7420	.25	7493	.61
7421	.25	74107	.50
7423	.44	74121	.51
7425	.44	74123	1.25
7426	.38	74141	1.14
7427	.44	74175	1.60
7430	.25	74367	1.25

VOLTAGE REGS.

7805	5v	1A.	1.30
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7815	15v	1A.	1.30
7818	18v	1A.	1.30
7824	24v	1A.	1.30
7912	-12v	1A.	2.00
723	14 PIN DIL		.45

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XLP-3-31	$2.95
XLP-3-32	$2.70
XLR-LNE-11c	$2.75
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NKK Ultraminiature	
U2012 SPST	.75
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U2022 DPDT	.90
U2023 DPDT (Centre off)	1.20

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4001	.25	4021	1.40
4002	.25	4023	.25
4006	1.40	4024	.86
4007	.25	4027	.83
4008	1.32	4028	1.25
4011	.25	4040	1.30
4012	.25	4049	.60
4013	.55	4066	.85
4014	1.40	4069	.30
4015	1.20	4510	1.46
4016	.55	4511	1.46
4017	1.40		
4018	1.40		

LINEARS

uA311	.80	uA339	.85
uA3401	.85	uA555	.45
uA556	1.10	uA741	.35
9368	1.75	LM380	1.25
RL4136	3.60		

DIODES

OA91	.15	OA95	.16
1N4002	1A	200V	.07
1N4004	1A	400V	.08
1N5625	5A	400V	.45
1N 4148			.05
30 AMP 400V Bridge			4.75

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BC549	.20	FT3055	.80
BD139	.60	TIP31B	.75
BD140	.60	TIP32B	.75
BF180	.60		

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FND 357	.375"	c.c.	1.30
FND 500	.5"	c.c.	1.40
RED LED			.22
GREEN LED			.35
YELLOW LED			.40

ELECTROLYTICS

4.7uF	25V	PCB	.07
10uF	25V	PCB	.08
10uF	50V	PCB	.09
22uF	16V	PCB	.07
22uF	35V	PCB	.09
33uF	16V	PCB	.08
33uF	50V	PCB	.10
47uF	16V	PCB	.09
47uF	35V	PCB	.11
100uF	10V	PCB	.10
100uF	16V	PCB	.11
220uF	25V	PCB	.14
470uF	16V	PCB	.16
1000uF	25V	PCB	.36
2500uF	50V	Axial	1.85

TANTALUMS

1uF 35V	.18	2.2uF 35V	.20
4.7uF25V	.22	10uF 16V	.20
15uF 16V	.27	22uF 16V	.30

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.25 watt rotary carbon single gang, Log or Lin. 1K, 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M. .45

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- SNOOZE SETTING
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- COMMERCIAL CASE

The kit contains one case, transformer, mains cord, 3 PC Boards, 13 transistors, 1 clock module, 10 diodes, 9 IF coils, 8 other coils, 47 capacitors, 51 resistors, speaker, knobs, connectors, wire, etc.

MODEL EDUCAL DCR-77

ONLY $32.50 COMPLETE
P&P $2.50

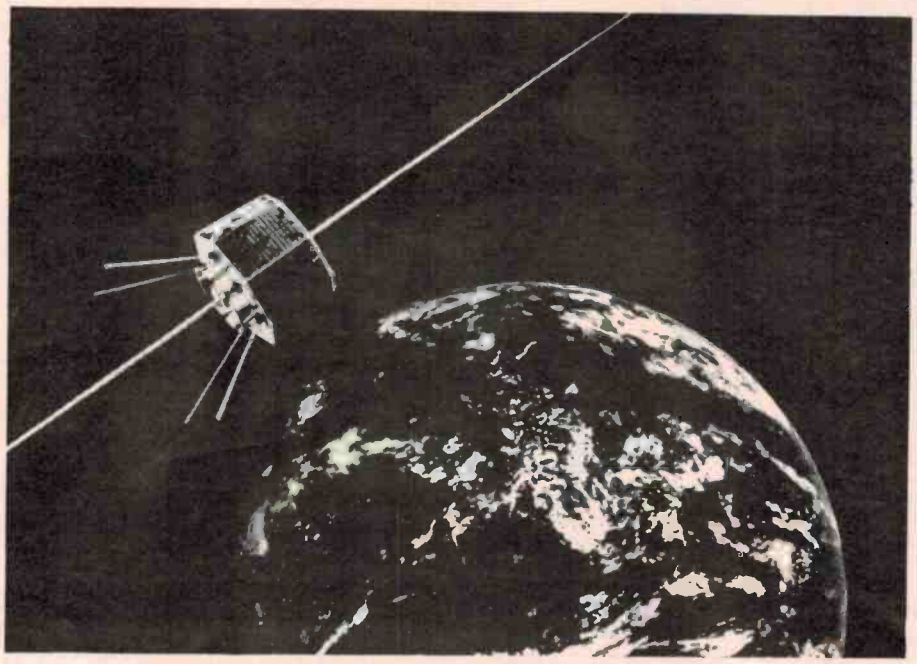
Why pay $30.00 for just a clock in an instrument case? Only an extra $7.00 gives you an AM-FM radio plus a moulded plastic case as sold in Europe. (We get English version).

We are trying to obtain the AM-FM modules pre-aligned for you!

ONLY EDUCAL HAS THE DCR-77

CB – Where Next

The hassles of being a 'technical CB'er' – and how to get out.



OSCAR 7 was built and is operated by amateurs.

THE CB SCENE in Australia seems to have evolved in a totally different way from the Stateside setup. In the US, CB is almost totally a social phenomenon, with the technicalities of aerial installation regarded as a necessary chore. Here, the situation is very different – the AM channels are used in a similar way to the US ones, but up the band, especially on SSB, many operators seem to be interested in comparing notes on CB's, antennas, and asking for reports.

These operators view CB as a hobby, as an end in itself, which conflicts with the American view of CB as an appliance, just like a fridge or washing machine, or a telephone. Now, nobody has ever taken up operating a washing machine or a telephone as a hobby, yet many (perhaps most) CB'ers in Australia view their CB that way.

This situation is causing a few problems. Firstly, the original 'pirates' who campaigned vigorously for CB espoused this view of 'CB-for-its-own-sake', and this was reflected in some of the submissions to the Department of Posts and Telecommunications early last year. Activity on 27MHz gave observers the impression that what was wanted was an intermediate service between the US-style CB service and the amateur service, and this has served to confuse the issue.

The creation of such a service is, if not impossible, at least fraught with difficulties. It has never been done before, so there is no base of experience or statistics on interference and other problems which would serve to guide an administration faced with this problem. The ITU regulations would almost certainly conflict with such a service, as an important principle of the ETI regs is that the more control an operator has over his station (in terms of frequency, power output, filtering, etc.), then the more qualified and trained that operator must be. This is why CB rigs are crystal-controlled and simple to operate; and also why amateurs have to pass exams to get their licences.

Yet 'pirate' CB'ers were already showing disconcerting tendencies to mess around with aerials, power microphones, compressors, etc., as well as operating on frequencies where they shouldn't. Obviously, the P & T Department, in licensing a CB service, had to safeguard against any abuses of the service by spelling out the regulations in detail, and this is, perhaps, why Australia has what many CB'ers view as 'repressive' CB regulations.

Peer Judgements

Another area where the 'technical' CB'er is running into a bit of a problem is on the band itself, where a number of 'US-style' CB'ers resent the activities of other operators who they feel are 'playing hams' on the band. They regard this as 'kid's stuff', since they hold the view of 'CB-as-an-appliance', and aren't much concerned with how it works, or DX and similar topics.

But the 'CB-for-its-own-sake' operator, usually to be found on sideband, on the high channels, is also under fire from the group he often seems to be

emulating – radio amateurs. Some amateurs distrust CB'ers because they are worried about losing sections of their bands, others because they feel a loss of status now the simplicity of operating a radio transceiver is revealed (anyone can do it!). Of course many amateurs, understanding the problems of TVI (and how to prevent it), quite plainly do not like anybody who is stupid enough to illegally operate such equipment as linear amplifiers without thought for the consequences on both TVs and CBs in the vicinity. This is a perfectly reasonable viewpoint, which I personally hold and which this magazine fully endorses.

The 'I worked hard to get my licence – why should CB'ers get on the air without an exam' argument just doesn't hold water. Given CB rigs of adequate standard, as most 'top-line' 27 MHz rigs are and as should happen on UHF, there is no requirement for technical competence or theoretical knowledge on the part of the operator. Amateur radio is a different matter – here the licensee will be running high power, on several bands with a variable frequency oscillator (not crystal-locked on channels), and will probably build, or at least modify, his equipment, so that a high level of technical competence is required. CB'ers are not permitted to do this, and many would not want to, anyway.

Do You?

If you do want to delve into the innards of your rig, if you want to run high powers and work DX, then in the eyes of many amateurs you are ripe for picking and ready for introduction to the world of amateur radio. In the US and Australia especially, radio amateurs are coming to view CB as a source of new recruits to their ranks.

What I have said so far can be summarized like this:

If you want to work DX, if you want to run high power, if you are interested in radio as a hobby, or if you are not satisfied with what CB has to offer, then many of your fellow CB'ers, many radio amateurs, and very probably the P & T Department would all be very pleased and relieved (and you would be too) if you would take a little time to get an amateur Novice licence.

The Citizens Radio Service and the Amateur Radio Service are two completely different things. Radio amateurs are not elite CB'ers with special privileges, and CB'ers are not an inferior grade of ham, to be kept at bay.

In amateur radio, it is not hard work to learn a group of facts or swot to pass the exams since all the information is stuff which will constantly be used in experiments, construction and on-air discussion. In short, it is easy to get a ticket – easier than you think.

The World of Amateur Radio

Ham radio is a multi-faceted hobby. It has a social side, which is in many ways similar to CB. Many amateurs meet socially and occasionally manage to talk for half-an-hour without mentioning technicalities, but never without using callsigns! Club meetings provide a rendezvous which is both of a technical and social nature, and the opportunity to seek advice on that transmitter you're building.

Few hams today build their own gear for the HF amateur bands, which is where the main DXing takes place. Mostly, amateurs will choose a commercial, often Japanese-made, transceiver as the 'prime-mover' of the station, building their own accessories and ancillary equipment. Many operators are interested in specialized communications techniques such as radio teletype and slow-scan television.

Many amateurs, in the attempt to improve their signals and work more DX have undertaken comprehensive studies of antennas and propagation, and have contributed enormously to our understanding of the ionosphere, as well as working a lot of DX in the process.

But it is on the VHF and UHF bands that a lot of attention is focussed. Here, many new techniques are being tried which are revolutionising amateur radio. The VHF 2 metre band is now channelised in much the same way into amateur gear. The biggest revolution on 2 metres is probably the introduction of repeaters which retransmit signals from a high point, giving widespread coverage to low-powered stations such as mobiles.

Extend the idea of a high point to what must be its ultimate conclusion and you have AMSAT OSCAR 7, an amateur designed and built satellite which provides DX communications on 2m and 70cm. This year OSCAR 7 will be augmented by the first Phase III satellite which will orbit much more slowly, largely reducing problems with tracking.

In the States and Canada, repeaters are often connected to the telephone system, enabling mobiles to make telephone calls. Sometimes repeaters can be linked together by landlines, so that greater distances can be covered, especially in city areas.

Amateur radio is a hobby which is so broad in its scope we just can't describe it here. But if you feel you're 'outgrowing' CB, why not get in touch with your local amateur radio club and find out what it's all about. Their addresses are in the box in this page.

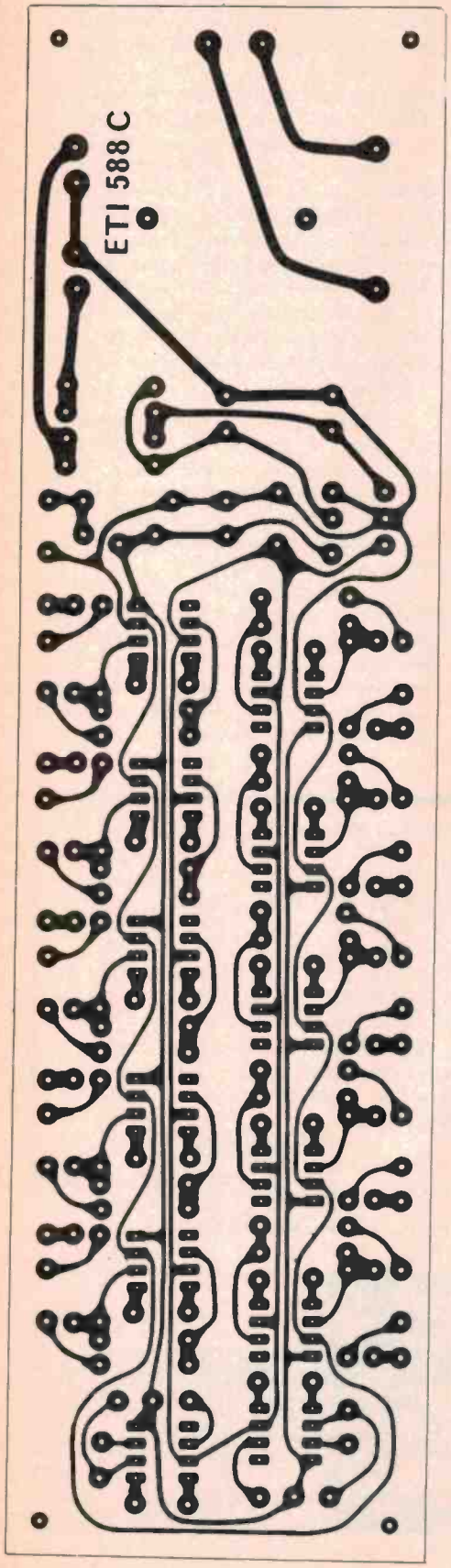
WIA Divisional Offices

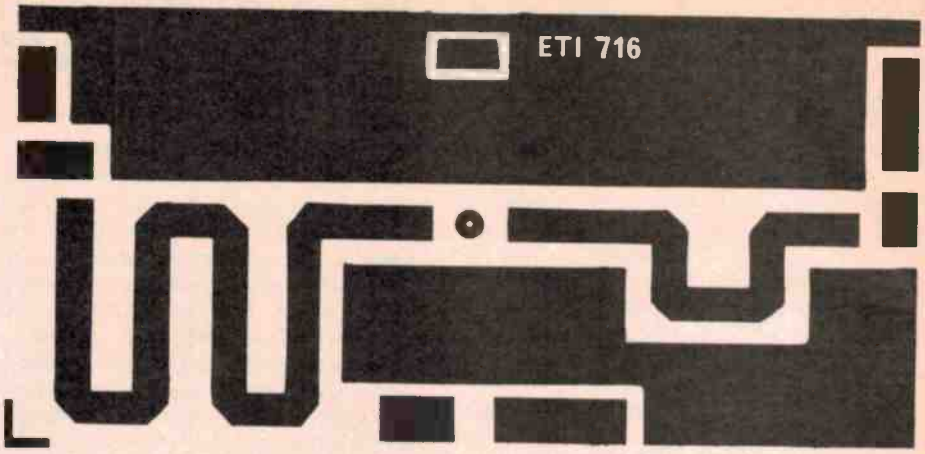
NSW: 14 Atchison St., Crows Nest, 2065
VIC: 413 Brunswick St., Fitzroy 3065
QLD: P.O. Box 638, Brisbane, 4001
SA: P.O. Box 1234K, Adelaide, 5001
WA: P.O. Box N1002, Perth, 6001
TAS: P.O. Box 869J, Hobart, 7001
ACT: P.O. Box 1173, Canberra, 2601
NT: P.O. Box 1418, Darwin, 5794

In New Zealand, contact the New Zealand Amateur Radio Transmitters Society at: NZART, P.O. Box 1459, Christchurch.

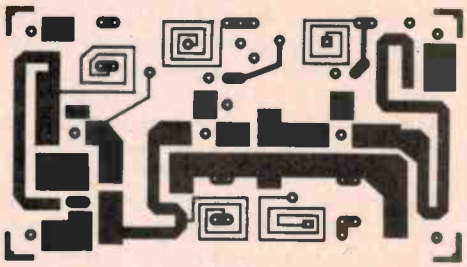
The station of well-known VHF/UHF amateur, Les Jenkins, VK3ZBJ, comprises home-built gear. Pic courtesy of 'Amateur Radio' magazine.

PCB's



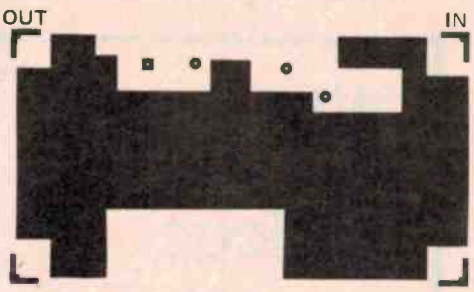


ETI 716 45 W stripline 2 m power amplifier pc board, component side. This is a double-sided board, other side is complete ground-plane.

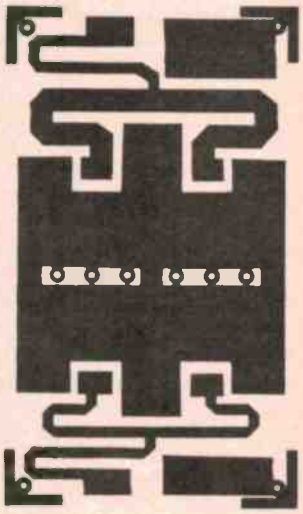


Component side.

40 W, three stage broadband stripline VHF power amplifier pc board. 50% actual size.

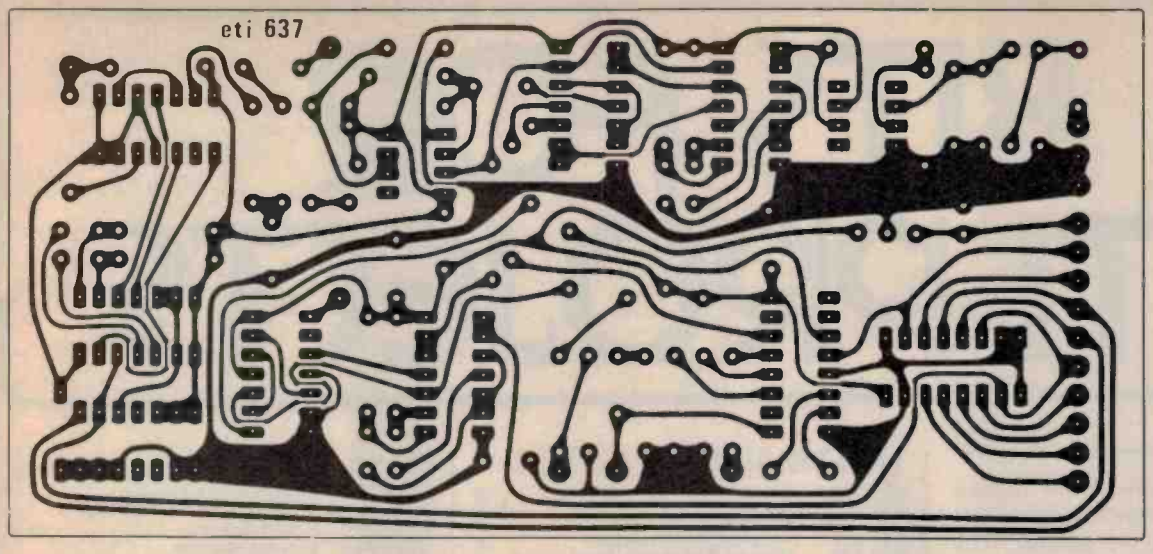


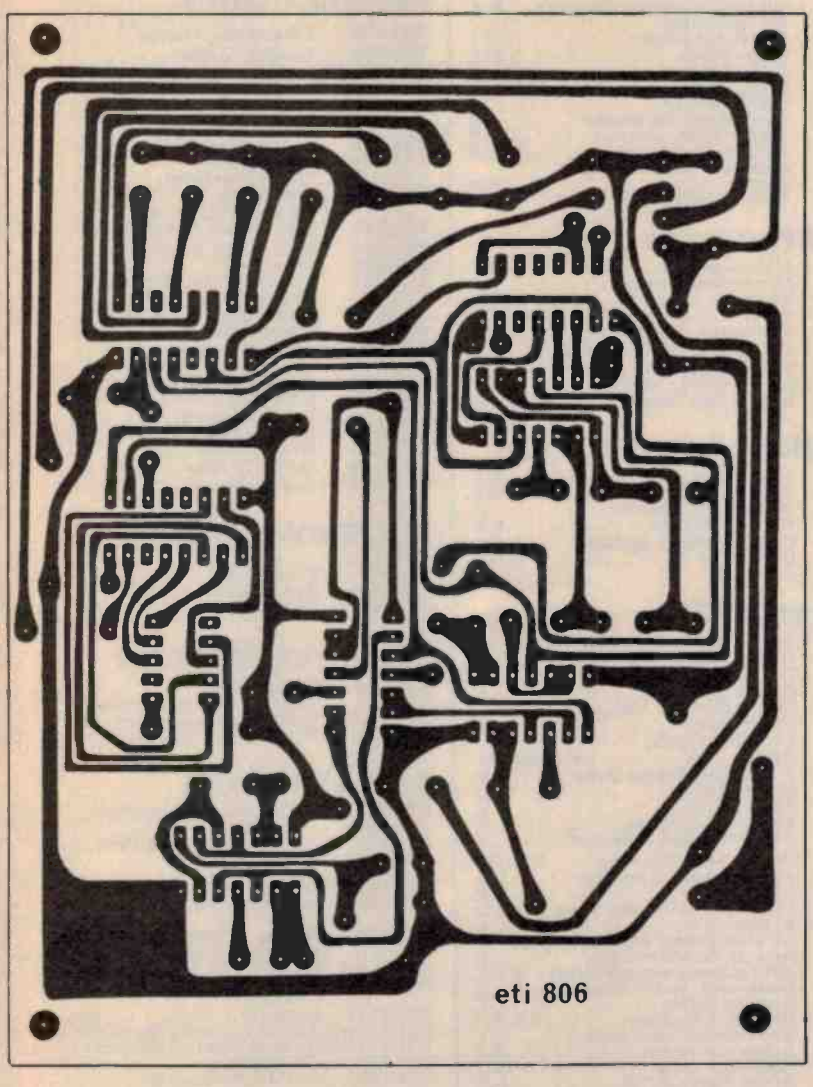
Groundplane side.



140 W stripline broadband VHF power amplifier pc board. This is double-sided board, component side. Other side is complete groundplane. 50% actual size.

The reverse of these pages is printed in blue so that the page can be used to directly make Scotchcal negatives and hence (using photo-sensitive resist) finished printed circuit boards. The method of doing this was described in the December 1977 issue of ETI. Back issues are available – see the information on the Reader Services page.





ETI/Unitrex Calculator Contest

The November problem really drew the crowds, we reckon it must have been too easy! The correct answer to the problem of the oranges is seven (7). It's obvious, now that you think about it! Our winner, M. Stuart of Traralgon, Vic. receives a Unitrex calculator.

This month's problem stems from an incident which took place in deepest, darkest Papua New Guinea many years ago, and was prompted by a suggestion from Mr. C. Carpenter of Girrawheen in South Australia.

ETI's communication/propagation expert, researching ground wave propagation in humid jungle, was captured by a horde of hostile natives. Imprisoned in a hut with two doors, our man in PNG was told that he could leave by either door, but that only one led to freedom – the other led to a gently simmering stewpot.

His two guards, one at each door, were chosen by the native chief (who was obviously a betting man) because of their unique personal traits. One was a fantastic liar, who never spoke a true word, and the other was as honest as the day he was born. Our man was allowed to ask one direct question of either guard to help him decide. Needless to say, our hero escaped – what question did he ask?

Seal an empty envelope, write your answer on the back of it with your name and address, and send it to: Unitrex Calculator Contest (January), ETI Magazine, 15 Boundary St., Rushcutters Bay, NSW 2011. The closing date is the 18th of February.

KITS FOR ETI PROJECTS

We get many enquiries from readers wanting to know where they can get kits for the projects we publish. The list below indicates the suppliers we know about and the kits they do.

Any companies who want to be included in this list should phone LES BELL on 33-4282.

Key to companies:

- A Applied Technology Pty. Ltd. 109-111 Hunter St, Hornsby. 2077. NSW.
- C Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- D Dick Smith Pty. Ltd. of Crows Nest, NSW. (see Ads. for address).
- E E.D. & E. Sales, Victoria.
- J Jaycar Pty. Ltd. 405 Sussex St., Sydney 2000.
- L Delsound Pty. 1 Wickham Terrace. Queensland.
- M Mode Electronics. PO Box 365, Mascot 2020.
- N Nebula Electronics Pty. Ltd. 15 – 19 Boundary St., Rushcutters Bay 2011. NSW.
- O Appollo Video Games of Hornsby, NSW.
- P Pre-Pac Electronics. 718 Parramatta Rd., Croydon NSW 2132.
- S BKX Electronics Supply Service. 179 Victoria St., Kings Cross. NSW 2011.
- T Townsville Electronics Centre. 281E Charters Towers Rd, Rising Sun Arcade, Hermit Park. 4812

PROJECT ELECTRONICS

ETI 041	Continuity Tester	D
ETI 043	Heads or Tails	DAT
ETI 044	Two-Tone Doorbell	DAT
ETI 045	500 Second Timer	D
ETI 047	Morse Practice Set	D
ETI 048	Buzz Board	D
ETI 061	Simple Amplifier	DAT
ETI 062	Simple Amplifier Tuner	D
ETI 063	Electronic Bongo's	D
ETI 064	Intercom	AT
ETI 065	Electronic Siren	D
ETI 066	Temperature Alarm	ADT
ETI 067	Singing Moisture Meter	D
ETI 068	Led Dice	AD
ETI 072	2-Octave Organ	D

TEST EQUIPMENT

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	P,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	ET
ETI 120	Logic Probe	L,E
ETI 121	Logic Pulser	L,E
ETI 122	Logic Tester	E
ETI 123	CMOS Tester	E
ETI 124	Tone Burst Generator	E
ETI 128	Audio Millivoltmeter	L,E
ETI 129	RF Signal Generator	L,E
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	N

SIMPLE PROJECTS

ETI 206	Metronome	ET
ETI 218	Monophonic Organ	ET
ETI 219	Siren	ET
ETI 220	Siren	ET
ETI 222	Transistor Tester	ET
ETI 232	Courtesy Light Extender	E
ETI 234	Simple Intercom	ET
ETI 236	Code Practice Oscillator	E
ETI 239	Breakdown Beacon	E

MOTORISTS' PROJECTS

ETI 301	Vari-Wiper	ET
ETI 302	Tacho Dwell	ET
ETI 303	Brake-light Warning	E
ETI 309	Battery Charger	P,E
ETI 312	CDI Electronic Ignition	P,ET
ETI 313	Car Alarm	E,DT

AUDIO PROJECTS

ETI 401	Audio Mixer FET Four Input	E
ETI 403	Guitar Sound Unit	E
ETI 406	One Transistor Receiver	ET
ETI 407	Bass A,p	E
ETI 408	Spring Reverb. Unit	E
ETI 410	Super Stereo	E
ETI 413	100 Watt Guitar Amp	P,L,E,J,DT
ETI 413	x 200 Watt Bridge Amp	SE
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	P,E,DT
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	S L,E,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
ETI 423	Add-on Decoder Amp	E
ETI 424	Spring Reverberation Unit	S L,E
ETI 425	Integrated Audio System	E
ETI 426	Rumble Filter	E
ETI 427	Graphic Equaliser	S L,E,J
ETI 430	Microphone Line Amp	E
ETI 433	Active Crossover	E,J
ETI 435	Crossover Amp	E,J
ETI 438	Audio Level Meter	L,E
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,E
ETI 443	Compressor-Expander	E,J
ETI 444	Five Watt Stereo	E
ETI 445	Preamp	J,E,D
ETI 446	Audio Limiter	J,E
ETI 447	Phaser	E,J
ETi 449	Balanced Mic Preamp	J
ETI 480	50 W, 100 W Power Amp	A
ETI 480P	Power Supply	DAT
ETI 482A	Preamp Module	A
ETI 482B	Tone Controller	A
ETI 485	Graphic Equalizer	J
ETI 480	50W, 100W Power Amp	A,D

MISCELLANEOUS

ETI 502	Emergency Flasher	E
ETI 503	Burglar Alarm	ET
ETI 505	Strobe	L,E,D
ETI 506	Infra-Red Alarm	E
ETI 509	50-Day Timer	E
ETI 512	Photographic Timer	E
ETI 513	Tape Slide/Synchroniser	E
ETI 514	Flash Unit — Sound Operated	E
ETI 515	Flash Unit — Light operated	E
ETI 518	Light Beam Alarm	ET
ETI 525	Drill Speed Controller	E
ETI 526	Printimer	E
ETI 527	Touch Control Light Dimmer	E
ETI 528	Home Burglar Alarm	P,ET
ETI 529	Electronic Poker Machine	E
ETI 533	Digital Display	L,E,A
ETI 539	Touch Switch	E
ETI 540	Universal Timer	E
ETI 541	Train Controller	ET
ETI 543	Double Dice	A
ETI 544	Heartrate Monitor	A
ETI 528	Home Burglar Alarm	P,E
ETI 583	Gas Alarm	M

ELECTRONIC MUSIC

ETI 601 4600	Synthesiser	J
3600	Synthesiser	J
ETI 602	Mini Organ	E,A,D

COMPUTER PROJECTS

ETI 630	Hex Display	A
ETI 631	VDU Keyboard Encoder	A
ETI 632	VDU 1 k x 8 Memory Card	A
ETI 633	VDU Sync Generator	A

RADIO PROJECTS

ETI 701	TV Masthead Amplifier	E,D
ETI 703	Antenna Matching Unit	E
ETI 704	Crosshatch/Dot Generator	L,A,D,E
ETI 706	Marker Generator	E
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 710	2 metre Booster	DC,E
ETI 711B	Single Relay Remote Control	A
ETI 711C	Double Relay Remote Control	A
ETI 711R	Receiver	A
ETI 711AR	Remote Control Transmitter	A
ETI 711DR	Remote Control Decoder	A
ETI 740	FM Tuner	A
ETI 780	Novice Transmitter	E

ELECTRONIC GAMES

ETI 804	Selecta-Game	O,A,D

CB NEWS

Sydney CB Radio Show

Sydney's first full-scale CB radio show was held over the weekend of November 26-27 at Hollywood Park, Lansvale, near Liverpool, on the south-western side of Sydney.

The show was organised by Tom Trustrom of CB Radio Shows Australia, in conjunction with the International Radio Club, The Fox Tango and Black Opal CB clubs.

Featuring what was the largest gathering to date of CB equipment suppliers and CB enthusiasts in Australia (indeed anywhere outside the USA) the show was housed in an enormous 70-metre long circus tent.

Over 20 exhibitors attended and set up an exciting series of displays of equipment, antennas and accessories.

Prominent among the exhibitors were Cadet Engineering, Hatadi Electronics, Dick Smith Electronics, Chiba Communications, President Electronics, Philips Industries, Mobile One and quite a number of local retailers.

Tom Trustrom, organiser of the Sydney CB Radio Show, said about 3000 enthusiasts passed through the show which was disappointing considering the huge CB population in Australia's largest city.

This may have been due to a number of reasons. According to a number of CBers who spoke to ETI and CB Australia's staff, there was little prior publicity locally and Hollywood Park was not really centrally located or well-serviced by public transport.

Highlight of the weekend was a barbeque and country'n'western show hosted by Australian performer, Lucky Starr.

All who attended agreed that it was a great show and, as Tom Trustrom is planning bigger and better things for 1978, everyone's looking forward to the next one.

The Power Wing

The 'Power Wing' is the latest thing in antennas, from the Channel Master company in the US.

Claimed to be ideal for boat, car, van or truck, the Power Wing CB antennas will be distributed in Australia by O'Donnell Griffin Television and Channel Master outlets throughout Australia.

The Power Wing is a high capacity, top-loaded antenna which uses a high-Q coil for superior performance.

The unique design is claimed to give better overall current distribution on the antenna resulting in better efficiency.

Completely weather protected, the all alluminium aircraft-type surface of the unit is protected by a marine acrylic coating, with the fine tuning tip being made of stainless steel.

The rigid aerodynamic design of the antenna means that it will not 'de-tune' when the vehicle on which it is mounted travels at high speed.

The antenna is easy to install and comes in kit form with full directions.

A single coin-operated screw allows the top section wings and base to be removed and put in a safe place.

That's life!

Along with your TV, fridge, blender, toaster oven, deep cooker, microwave oven, hi-fi system etc – you can now equip your lifestyle with Sanyo CBs!

Sanyo have released a range of three 18 channel AM rigs all featuring attractive styling with sloping, wood-grain front panels.

All three feature digital LED channel readout, PLL frequency synthesizer and a large illuminated S/FR meter.

Each model also includes a LED modulation indicator.

The economy rig is the TA2100 which includes only the basic controls plus a switchable automatic noise limiter for the receiver.

The TA4100 is a mid-range rig that includes an RF gain control and a delta-tune switch in addition to all the controls provided on the TA2100.

Top of the line in the Sanyo range is the TA6100. This rig includes an RF gain control, Mic gain control, LED display dimmer, delta tune switch and an ANL/NB switch to provide maximum operating convenience.

In addition to the transceiver range, Sanyo have a base-loaded mobile whip for 27 MHz CBers.

Just over one metre long, the whip features a heavy, chromed spring for maximum flexibility and a mounting which can be fitted on the roof, trunk or cowl of a vehicle.

Designated the TAS 512B, the whip has a simple SWR adjustment and comes complete with a length of coax terminated in a standard PL259 connector as do most whips these days.

The three rigs and the mobile antenna should be available through the usual Sanyo outlets Australia wide.

Unique new Xtal rig

Arriving just a little late to be included in last month's issue was the news that Xtal – a very early brand name on the Australian CB market, recently eclipsed by the rush – have released a P & T approved SSB/AM transceiver, the XSSB-10-18.

This rig includes a unique feature that no other rig on the market has – a dual channel indicator that shows both the Australian channel numbers along with the corresponding US 23 channel system numbers!

Another feature that would appear to be unique so far is a priority switch for the emergency channel, channel five.

The Xtal XSSB-10 includes a full complement of controls and is currently available from Farad Electronics P/L, of 212 Balaclava Rd, Caulfield Vic, (509-7085, 509-1321).

Scalar UHF antennas

Scalar have ready a range of UHF mobile and base station antennas to suit the 40 channel 476 MHz CB band.

A range of three UHF base station antennas can provide gains of 3dB (a factor of two), 4.5dB (a factor of three) and 6dB (a factor of four).

The model CB470 provides a gain of 6dB.

The antennas consist of radiating elements in a 'collinear' (all in line) arrangement, fed in phase and encapsulated in a weatherproof fibreglass housing.

The Scalar model M39 is a mobile UHF antenna designed for operation over the 470 to 500 MHz band. It has a gain of 4.5dB and stands about 600 mm high.

For further details, price etc, contact Scalar at 18 Shelley Ave, Kilsyth Vic (727-9677).

ARE YOU AWARE??

THAT WE HAVE PROBABLY THE LARGEST RANGE IN AUSTRALIA OF TOP-BRAND, QUALITY PRODUCTS AT CURRENT MARKET PRICES WITH OFF-THE-SHELF AVAILABILITY.

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Telex AA27266

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Phone: 211-0191

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ELECTRONIC (DISTRIBUTORS)
(A Division of Electronic Enthusiasts Emporium).
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N.S.W. 2145. Phone
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Newcastle West, 2302
Phone: (049) 614991

Top Quality British Made Re-an products limited

CONTROL KNOBS

R621 body

Available for ¼" or 6mm skirt. Available in black or grey or plated chrome or gold.
15.5mm dia. base x 19mm high.

R622 knob top

Available in red, green, blue, yellow, mauve, white, black, grey or plated chrome or gold.

R624 nut cover

To hide potentiometer fixing nuts. Available in black, grey or chrome plated. 19mm dia. x 4mm high.

R623 skirt

Available in clear, black, grey, chrome or gold plated. 26.5mm dia. x 3mm total height.

slider knobs

to fit either vertically or horizontally onto most of the sliding potentiometer blades. Available in most colours, inc. black and white.

R72E

R72 11mm x 18mm x 13mm high.
R72/E with line across (as illustration).

CABINET FITTINGS

SR69
Corner Piece

SR 30
Socket Recess Cup
to fit hole size 27mm

SR 35E
Grille
142mm x 36mm

SR38E
Bar Handle
10½" x 6"

SR 31E
Pocket Handle
to fit hole size 48mm x 105mm

SR70E
Castor Cup

SR 32
Foot
38mm x 15mm

BLACK GRILL CLOTH 1 metre wide $9.00 1 metre
BLACK VYNIL 1.25 metres wide $4.00 1 metre

GUITAR SPEAKER CABINET ACCESSORY KIT
FOR THE HOME CONSTRUCTOR CABINETS SIZE
UP TO 30" x 15" (QUAD TYPE CABINET)

BLACK GRILL MATERIAL
BLACK VYNIL MATERIAL
SCREWS
8 CORNERS PIECES (R69)
1 SOCKET RECESS CUP (R 30)
1 INPUT SOCKET
4 FEET (R32)
2 LARGE HANDLES (R38)

$34.90 plus postage

A FREE CATALOGUE AND PRICE LIST AVAILABLE:
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SUPERSCOPE®

Story Teller Offer

WITH the possible exception of a recent Australian recording of Peter and the Wolf the very worst recordings ever made are those of childrens' fairy tales. Many are so bad that the sheer cynicism of the producers boggles the imagination.

Because of this we were delighted to receive a set of cassette/book packs produced by Superscope which really are truly excellent. Each pack consists of a beautifully recorded cassette which for ease of handling has identical recordings on each side plus an equally well produced hard-bound book which a child can follow as he listens to the words. The books are very attractively produced — illustrated throughout in full colour — and printed on a heavy stock.

Many of our staff members' kids have 'tested' the cassettes and the only problem has been wresting them back again afterwards!

Auriema (Australasia) Pty Ltd, who are the local Superscope agents, have arranged to supply our readers with these Story Teller cassette packs at the extraordinarily low price of five packs for $11.99 (plus $1.50 post and packing). The normal retail price of these packs is $3.95 each.

Many readers will buy all twelve cassette packs — the price of the complete set is $28.80 (plus $2.00 post & packing).

This offer is made by Auriema (Australasia) Pty Ltd of Brookvale NSW. Cheques should be made out to Auriema Pty Ltd and sent together with the order to Auriema Cassette Offer, Electronics Today International, 15 Boundary St, Rushcutters Bay, NSW, 2011.

Please allow at least three to four weeks for delivery.

Offer closes March 15th 1978.

GENERAL

The titles offered are listed on the order form. Please **tick** your choices. Also please **mark with a cross** two or three alternatives in the event of your first choice not being available.

In the event of none of your original choices being available the sponsors reserve the right to substitute any others from the list below. They're all good!

ORDER FORM

- Cinderella ☐
- Sleeping Beauty ☐
- Jack and the Beanstalk ☐
- Hansel and Gretel ☐
- Aladdin ☐
- Snow White ☐
- The Ugly Duckling ☐
- Rumpelstiltskin ☐
- Little Red Riding Hood ☐
- Pinocchio ☐
- The Elves and the Shoemaker ☐
- Tom Thumb ☐

Mark you first preferences with a tick — your second preferences with a cross.

PRICES

Five packs	$11.99
Post & packing	$1.50
Total	$13.49
Ten packs	$23.98
Post & packing	$2.00
Total	$25.98
All twelve packs	$28.80
Post & packing	$2.00
Total	$30.80

Please forward ..... qty of Story Teller Packs. I enclose my cheque/postal note accordingly.

NAME.....

ADDRESS.....

.....POSTCODE.....

Please make cheques/postal notes payable to Auriema Pty Ltd and send together with order to Auriema Cassette Offer, c/o Electronics Today International, 15 Boundary St, Rushcutters Bay, NSW 2011.

SUPERSCOPE®

RECORDER OFFER

COMPLEMENTING the 'fairy tale' cassette offer Auriema have also arranged to offer readers Superscope's excellent Model C101A mains/battery operated cassette recorder at the specially reduced price of $49.95 (plus $3.00 post & packing). Normal retail price of this unit is $69.95.
And what's more — the sponsors will include two Superscope Story Teller cassette packs free of charge (choice of units to be at Auriema's discretion.

The Superscope C101A is a good compact robust unit with excellent features including built-in condenser microphone, decent size inbuilt speaker, mains/battery operation, automatic record level, automatic shut-off, locking fast forward/rewind buttons etc etc.

We've been using one ourselves for several months and thoroughly recommend it as a good all-round useful device. This offer is made by Auriema (Australasia) Pty Ltd of Brookvale NSW. Cheques should be made out to Auriema Pty Ltd and sent together with the order to Auriema Recorder Offer, Electronics Today International, 15 Boundary St, Rushcutters Bay, NSW, 2011.
Please allow at least three to four weeks for delivery.
Offer closes March 15th 1978.

ORDER FORM

Please forward one Superscope Model C101A mains/battery cassette recorder at $49.95 (plus $3.00 post & packing).
I understand that I will also receive two Story Teller cassette/book packs free of charge.

Name .....

Address .....

.....

..... Post Code .....

I enclose my cheque/postal note for $ ..... accordingly.

Signed.....

Please make cheques/postal notes payable to Auriema Pty Ltd and send together with order to 'Auriema Recorder Offer', c/o Electronics Today International, 15 Boundary St, Rushcutters Bay, NSW 2011.

It's Crystal Clear

the FAMOUS MACHINE !

IT'S CRYSTAL CLEAR! The Icom IC22S synthesised 2m FM mobile transceiver features programmable ROM for any frequency multiple of 25KHz from 146 thru 148 MHz. Your new IC22S comes complete with 90 day warranty, mic, mobile mounting bracket and instruction manual. Price $279.

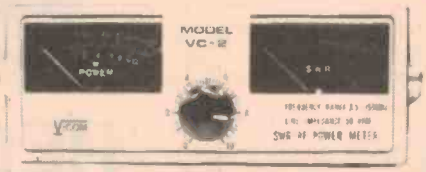
ALL-MODE for TWO

The IC211 is the all-mode ac/dc 2m station featuring twin optically coupled LED readouts, handles FM, USB, LSB and CW operation. Complete with mic, handbook and VICOM 90 day warranty. Price $785.

DIGITAL IC-245

The IC245 fm mobile is synthesised with 4 digit readout. Covers 144 thru 148MHz in 5KHz steps! This is the ultimate 2m rig. Price $489.

The popular VC2 swr/pwr meter for ham and CB use covers 3-150MHz. Each unit is individually calibrated for the Australian ham bands plus CB, high accuracy with power measurements 12/120 watts with total capability 1000 watts. Comes complete with informative instructions. Price $38



Hold it!

Take hold of the great pair of SSB twins, the IC202 and IC502 tranceivers. Three portable watts on two metres or six!

HELLO 6M DX

Yes, the 6m DX season is now on. The IC502 is ideal for your own experimentation on this band. The IC502 covers 52-53MHz with VFO control, RIT, effective noise blanker, provision for external power and antenna and comes complete with carry-strap, mic and English manual. Backed by VICOM 90 day warranty. Price $219.

2M SSB PORTABLE

The IC202 is the ideal 2m exciter for those long-haul DX contacts or to work OSCAR. 3 watts ssb and cw. VXO control, quality manufacture and comes complete with English manual, carry-strap, mic and VICOM 90 day warranty. Price $219.

ACCESSORIES FOR THE PORTABLES:

Rubber Ducky 2m antennas	$13
Mobile bracket for portables	$18
BC-20 nicad battery pack and reg.	$57
IC3PS power supply stand	$115
IC50L 6m linear, 10w out	$98
IC20L 2m linear, 10w out	$98

ICOM

WRITE FOR THE ICOM CATALOG

MORSE KEYS

HK702 deluxe, marble base	$35
HK708 economy model	$19
HK706 operator's model	$20
MK701 manipulator	$38
ED103W electronic keyer	$159

MICROPHONES

VM-1 ptt lowZ, noise-cancelling	$8.90
VM-2 base with preamp, low Z	$29.80

L.P. FILTERS

FD30M 32MHz cut-off, 1KWpep max	$35
FD30LS 32MHz cut-off, 200w max	$20

Purchasers of ham equipment may be asked to produce evidence that he/she is a holder of an Amateur Certificate of Proficiency.

Australia's TOP ham supplier ! * *

YAESU

FT101E HF transceiver 160m thru 10m	$859
FL2100B HF linear amplifier	$578
FRG-7 Receiver	$338
FT301D HF solid-state transceiver	$1149

KENWOOD

TS820S HF digital transceiver	$1105
TS520S HF 160-10m transceiver	$705
VFO820 vfo for TS820S	$115
TV502 2m transverter	$260
TV506 6m transverter	$229
TR7400 2m fm digital transceiver	$450
MC50 desk mic, dynamic	$54

SPEECH PROCESSORS

MC330 audio mic compressor, ac/dc	$71
RF550 rf speech processor	$112
RF440 rf speech processor	$149

ROTATORS

ART3000C heavy duty with control box	$199
ART8000 super heavy duty	$478
AR22XL light duty for small beams	$109

Direction: Russell J. Kelly
Peter D. Williams

NOISE BRIDGES

TE7-01 Omega, up to 100MHz	$40
TE7-02 Omega, up to 300MHz	$55

BALUNS

AS-BL(Asahi) for beams	$31
BN86 (HyGain) for beams	$30
BL50A (Rak) 50 ohm, 4Kw, dipole	$25
BL70A (RAK) 70 ohm, 4Kw, dipole	$26

couplers

CL65 500w, 2.5 thru 20MHz	$134
CL99 200w, 2 metres	$61
CSW216 incl swr/pwr meter, 3.5-28MHz	$219

$849 uniden

The fabulous Uniden 2020 phase-locked-loop transceiver offers separate usb/lsb/cw 8-pole crystal filters as standard and 6146B's in the final with screen voltage stabilisation for minimum distortion products. Features plug-in pcb's and even the front panel can be swung out for easy servicing. A full spares catalogue is available together with change-over pcb's. Compare the Uniden 2020 with other HF transceivers and you'll be quickly convinced that it offers the best value!

Antennas!

You know you can count on

hy-gain

TH6DXX 6el 10/15/20m Thunderbird	$320
TH3MK3 3el tribander 8dB gain	$249
TH3Jr 3el tribander, 12' boom	$199

TRAP VERTICALS

V5Jr 6.7m high, 80 thru 10m, no guys	$109
V4Jr 4.25m high, 40 thru 10m, no guys	$89

TRAP DIPOLES

MidyVN 80 thru 10m	$67
AL48DXN 40 & 80 metres, 2Kw	$54

TWO METRES

ARX-2 Ringo Ranger base antenna	$49
Lindenow wave mobile whip	$26
42S ¼ wave mobile whip with cable	$14
82D wave mobile whip with cable	$28

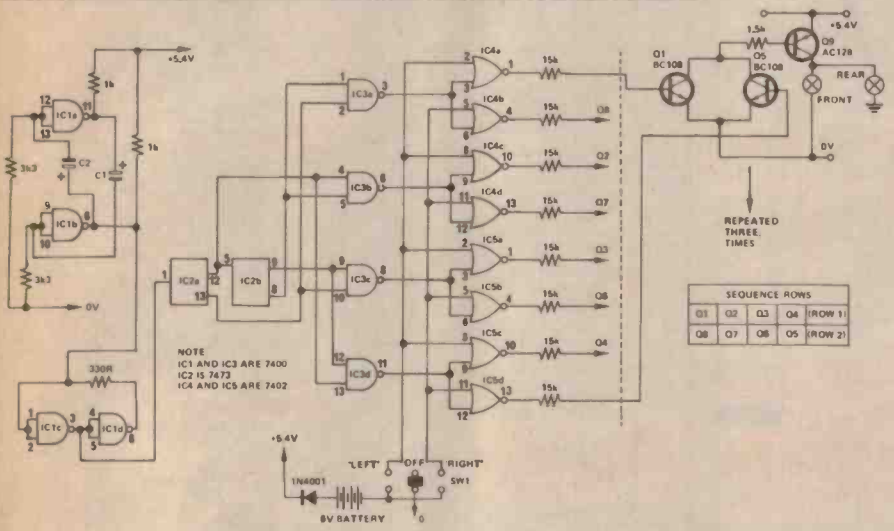
Prices and specifications subject to change without notice.

VICOM

Head Office and Mail Orders:
139 AUBURN ROAD, AUBURN, Vic.
Telephone: (03) 82.5398, (03) 813.2355
TLX 30566
Adelaide: 43.7981 Brisbane: 38 • 4480
Canberra: 82.3581
Perth: 446.3232

Ideas for experimenters

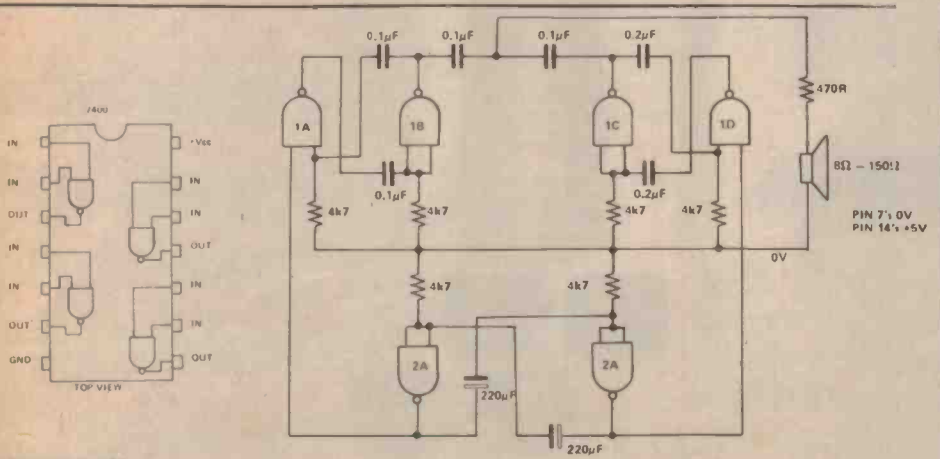
These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we 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.



NOVEL INDICATORS

Since a bicycle has no effective width, normal indicator lamps placed on each side do not give a clear indication of direction when seen from a distance, especially at night.

The circuit shown is a-four stage ring counter which sequentially drives four yellow lamps giving an impression of movement i.e. towards the left or right. Lamp sequencing rate can be altered by changing C1 and C2. (50uF was found to be about right). Oscillator pulses are shaped by schmitt trigger IC1b. The decoding and output gating are performed by ICs 3, 4, and 5. Driver transistors Q1 to Q8 can be any low current, medium gain NPN silicon.



7400 SIREN

The siren consists of two oscillators which generate the tones. A third oscillator is used to switch the others on and off alternately, giving the two tone affect.

By changing the capacitor values different tones can be produced.

HARDWARE

PC15	15 WAY,.15"PCB CONN.	30c	4	for $1.00
PS1	ROCKER SWITCH SPST	30c	4	for $1.00
RN1	240V NEON PUSH-FIT	30c	4	for $1.00
B21	6-13V BEZEL,RED & GREEN	30c	4	for $1.00
MS1	MICROSWITCH SPDT	50c	3	for $1.00
K10	ASSORTED PLASTIC KNOBS	25c	10	for $2.00
DS2	2PIN DIN SOCKETS	35c	10	for $2.00
DP2	2PIN DIN PLUGS	25c	10	for $2.00
RCA5	5 WAY RCA SOCKETS	60c	2	for $1.00
RCA6	6WAY RCA SOCKETS	60c	2	for $1.00
PN216	9V BATTERY SNAP	12c	10	for $1.00
FH1	3AG PANEL FUSEHOLDER	60c	10	for $5.00
ALS	240V,3A SPST AL.TOGGLE	35c	3	for $1.00
PPT	PMG TOGGLE 4PDT MOM.	30c	4	for $1.00
TC120	12-120PF TRIMMER	25c	5	for $1.00

TRANSISTORS

W04	1A 400V BRIDGE	@ $1.20	2	FOR	$ 2.00
PD8	2A 800V BRIDGE	@ $1.60	2	FOR	$ 3.00
SCR41D	6A 400V THYRISTOR	@ $1.20	2	FOR	$ 2.00
MAC11-6	6A 400V THYRISTOR	@ $1.20	2	FOR	$ 2.00
AD 161	$1.60	EACH	OR	2	FOR	$ 3.00
AD 162	$1.60	EACH	OR	2	FOR	$ 3.00
AF2 12	65c	EACH	OR	2	FOR	$ 1.00
ASZ 18	$2.20	EACH	OR	2	FOR	$ 4.00
BC 309	9c	EACH	OR	15	FOR	$ 1.00
BC 350	8c	EACH	OR	15	FOR	$ 1.00
BFY 50	40c	EACH	OR	3	FOR	$ 1.00
BFY 51	40c	EACH	OR	3	FOR	$ 1.00
BFY 90	$1.20	EACH	OR	2	FOR	$ 2.00
BF 337	80c	EACH	OR	3	FOR	$ 2.00
SE7055	55c	EACH	OR	2	FOR	$ 1.00
TIP3055	80c	EACH	OR	3	FOR	$ 2.00
2N2904	36c	EACH	OR	3	FOR	$ 1.00
2N2904A	36c	EACH	OR	3	FOR	$ 1.00
2N3566	36c	EACH	OR	4	FOR	$ 1.00
2N3568	45c	EACH	OR	3	FOR	$ 1.00
2N3638	30c	EACH	OR	4	FOR	$ 1.00
2N4355	45c	EACH	OR	3	FOR	$ 1.00

BC 350

PNP GENERAL PURPOSE SMALL SIGNAL. 40 V, 100 mA. 1 WATT DISSIPATION AT 25 DEGREES CASE TEMP. DC CURRENT GAIN OF 40 TO 400. LOW SATURATION VOLTS f_T OF 200 MHz AT 20mA. MADE BY MOTOROLA

8c EACH, 15 FOR $1.00, 100 FOR $6.00 AND ONLY $25.00 FOR 500.

ZENERS

400mW ZENERS IN THE FOLLOWING VALUES :

8.2V, 12V, 22V, 24V, 27V, 30V.

18c EACH OR 7 FOR $ 1.00

500mW ZENERS, MOTOROLA BRAND :

8.2V, 12V, 30V. 100 FOR $10.00

SE 7055

NPN HIGH VOLTAGE VIDEO OUTPUT TRANSISTOR, 220V., MAXIMUM DISSIPATION OF 7 WATT AT A CASE TEMP. OF 25 DEGREES. DC CURRENT GAIN OF 20 TO 75. f_T OF 40 TO 50 MHz. MANUFACTURED BY FAIRCHILD.

55c EACH, 10 FOR $5.00, 100 FOR $40.00 AND ONLY $90.00 FOR 300.

COILS

VPC1	1uH RF CHOKE	15c	10	for $1.00
VPC2	2.2uH RF CHOKE	15c	10	for $1.00
VPC3	3.3uH RF CHOKE	15c	10	for $1.00
VPC5	4.7uH RF CHOKE	15c	10	for $1.00
VPC7	6.8uH RF CHOKE	15c	10	for $1.00
VPC33	33uH RF CHOKE	15c	10	for $1.00
VPC100	100uH RF CHOKE	15c	10	for $1.00
VPC330	330uH RF CHOKE	15c	10	for $1.00

25gm COILS OF WIRE 18 B&S TO 40 B&S each $1.20

ST45C	455kHz. IF COIL	$1.50	10	for $9.00
S203	OSCILLATOR COIL	$1.50	10	for $9.00
S195	RF COIL	$1.50	10	for $9.00
FR1	FERRITE ROD COIL	$1.50	10	for $9.00
SCO.2	.2mH CROSSOVER COIL	$1.80	3	for $5.00
SCO.35	.35mH CROSSOVER COIL	$1.90	3	for $5.00
SCO.5	.5mH CROSSOVER COIL	$2.00	3	for $5.00
SCO.75	.75mH CROSSOVER COIL	$2.10	3	for $6.00
SC1	1mH CROSSOVER COIL	$2.20	3	for $6.00
SC1.2	1.2mH CROSSOVER	$2.30	3	for $6.00
SC1.5	1.5mH CROSSOVER	$2.40	3	for $7.00
SC1.75	1.75mH CROSSOVER	$2.50	3	for $7.00
SC2	2mH CROSSOVER COIL	$2.60	3	for $7.00
SC2.25	2.25mH CROSSOVER	$2.70	3	for $8.00
SC2.5	2.5mH CROSSOVER	$2.80	3	for $8.00

TAG TANTS

3.3	uF	35V	25c	EACH OR	5	FOR $ 1.00
33	uF	10V	25c	EACH OR	5	FOR $ 1.00
47	uF	6V	25c	EACH OR	5	FOR $ 1.00
68	uF	3V	25c	EACH OR	5	FOR $ 1.00
100	uF	3V	25c	EACH OR	5	FOR $ 1.00

OPTO - electronics

FN 300	0.3 inch	COMMON CATHODE	$ 1.65
FN 307	0.3 inch	COMMON ANODE	$ 1.65
FND500	0.5 inch	COMMON CATHODE	$ 1.95
FND507	0.5 inch	COMMON ANODE	$ 1.95

VALVES

GR110	Small nixie tube, long leads	45c
GR111	Large nixie tube, long leads	45c
ZM1000	Nixie tube, PC board mount	50c
12AU7		40c

CAPACITORS

PIGTAIL TYPE

22	uF	50V	11c	EACH	OR	10	FOR $ 1.00
22	uF	63V	12c	EACH	OR	10	FOR $ 1.00
100	uF	50V	15c	EACH	OR	6	FOR $ 1.00
220	uF	25V	20c	EACH	OR	6	FOR $ 1.00
220	uF	50V	30c	EACH	OR	4	FOR $ 1.00
470	uF	25V	30c	EACH	OR	4	FOR $ 1.00
470	uF	63V	30c	EACH	OR	4	FOR $ 1.00
1000	uF	50V	40c	EACH	OR	3	FOR $ 1.00
2500	uF	25V	49c	EACH	OR	3	FOR $ 1.00
2500	uF	35V	65c	EACH	OR	2	FOR $ 1.00
3300	uF	16V	49c	EACH	OR	3	FOR $ 1.00

PC BOARD TYPE

22	uF	50V	11c	EACH	OR	10	FOR $ 1.00
47	uF	50V	15c	EACH	OR	8	FOR $ 1.00
330	uF	50V	30c	EACH	OR	4	FOR $ 1.00
470	uF	50V	30c	EACH	OR	4	FOR $ 1.00
1000	uF	35V	40c	EACH	OR	3	FOR $ 1.00

POLYSTYRENE

120 pF	15c	EACH	OR	10	FOR	$ 1.00
270 pF	15c	EACH	OR	10	FOR	$ 1.00
470 pF	15c	EACH	OR	10	FOR	$ 1.00
820 pF	15c	EACH	OR	10	FOR	$ 1.00
.0047 uF	20c	EACH	OR	8	FOR	$ 1.00

POTENTIOMETER

10K	LINEAR 30mm	25c	5	for	$1.00
20K	LINEAR 30mm	25c	5	for	$1.00
1M	LOG 30mm	25c	5	for	$1.00
1K	LINEAR 45mm	40c	3	for	$1.00
470K	LOG ROTARY	35c	4	for	$1.00
25K	DUAL LINEAR	59c	2	for	$1.00
50K	DUAL LINEAR	59c	2	for	$1.00
100K	DUAL LINEAR	59c	2	for	$1.00
50K	DUAL LOG	59c	2	for	$1.00
50K	DUAL LOG TAP	59c	2	for	$1.00
470K	DUAL LINEAR	59c	2	for	$1.00

POLYCARBONATE

.082 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.047 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.1 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.33 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.47 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.56 uF	100V	12c	EACH	OR	10	FOR $ 1.00
.47 uF	250V	12c	EACH	OR	10	FOR $ 1.00
.56 uF	250V	12c	EACH	OR	10	FOR $ 1.00
1 uF	100V	25c	EACH	OR	5	FOR $ 1.00
1.5 uF	250V	55c	EACH	OR	2	FOR $ 1.00

VU METER SPECIAL 1.80

VU METER 4 cm square. Black face, white and red scale suitable for back lighting. Fantastic value while they last.

30W RMS 12INCH 16.00

PLESSEY C12P SPEAKERS 8 and 15 ohm available. A steal at this price. Suitable for guitar, PA and HiFi use. Price includes P&P.

6 DIGIT COUNTER

SIX DECADE COUNTER, DISPLAY AND TOTALIZER IC CHIP. DATA SUPPLIED, AN ECONOMICAL SOLUTION TO COUNTERS, UP - DOWN COUNTER, PRESETTABLE, INTERNAL REGISTER, AND COMPARATOR. SEVEN SEGMENT OUTPUT.

MK50395 CHIP PLUS DATA..... $19.50

SIX FND357 .3" READOUTS..... $10.00

SIX FND500 .5" READOUTS..... $11.00

PC BOARD

PC64	6"x 4" LAMINATE	@ 45c OR 10 FOR	$ 4.00
PC82	8"x 2" APPROX.	@ 35c OR 10 FOR	$ 3.00

BOARDS FOR ALL PROJECTS ARE AVAILABLE, PRICES AS FOLLOWS FOR EACH BOARD :

SINGLE LAMINATE : 90c + 6c PER SQUARE INCH
SINGLE FIBREGLASS : $1.20 + 8c PER SQUARE INCH
DOUBLE FIBREGLASS : $1.80 + 12c PER SQUARE INCH

BOARDS TO YOUR OWN POSITIVE OR NEGATIVE ARTWORK AVAILABLE AT THE SAME COST PROVIDED ARTWORK IS SUITABLE FOR PHOTOGRAPHY.

EA CDI 18.50

Complete kit with prewound secondary coil. High quality components and undrilled metalwork. Buy now for easy winter starting and running.

EA SQ 29.00

This is the three I.C. SQ decoder kit as featured in EA February 1977. Complete with board, rotary pots and IC's. No case or power supply. This is a very popular kit. See below for conversion kit.

EA SQS 22.00

As above but excluding MC1312 and associated bits Convert your existing simple SQ system to full SQ with wave matching logic. Outstanding performance

PROJECT ELECTRONICS KITS

ALL THESE KITS INCLUDE BATTERIES IF 3, 6 OR 9 V. A FOUR INCH EIGHT OHM SPEAKER SUITABLE FOR SCREW MOUNTING, PC BOARD IF ILLUSTRATED IN THE PROJECT BOOK, AND PARTS AS PER PARTS LIST.

PROJECT ELECTRONICS FROM ETI. (With P&P) $ 5.00

ETI 041	CONTINUITY TESTER	$ 4.95
ETI 042	SOIL MOISTURE INDICATOR	$ 2.95
ETI 043	HEADS OR TAILS	$ 3.95
ETI 044	TWO TONE DOORBELL	$ 6.95
ETI 045	500 SECOND TIMER	$ 5.95
ETI 047	MORSE PRACTICE SET	$ 7.95
ETI 511	BATTERY SAVER	$ 3.95
ETI 048	BUZZ BOARD	$ 5.95
ETI 061	BASIC AMPLIFIER	$ 6.95
ETI 062	SIMPLE AM TUNER	$ 9.95
ETI 063	ELECTRONIC BONGOS	$ 4.95
ETI 064	SIMPLE INTERCOM (ONE SPEAKER,MOMENTRY TOGGLE SUPPLIED)	$ 4.95
ETI 066	TEMPERATURE ALARM	$ 6.95
ETI 067	SINGING MOISTURE - METER	$ 5.95
ETI 071	TAPE NOIS LIMITER	$ 3.95
ETI 072	TWO - OCTAVE ORGAN	$ 9.95
ETI 068	LED DICE	$ 6.95
ETI 081	TACHO	$ 9.95
ETI 085	OVER - REV ALARM	$ 5.95
ETI 528	INTRUDER ALARM	$ 9.95
ETI 084	CAR ALARM	$ 8.95
ETI 083	TRAIN CONTROLLER	$17.95
ETI 086	FM ANTENNA	$
ETI 087	OVER LED	$ 3.95
ETI 065	ELECTRONIC SIREN	$12.95

TEST GEAR KITS

TEST GEAR FROM ETI (WITH P&P) $ 3.50

ETI 438	AUDIO LEVEL METER	$13.50
ETI 116	IMPEDANCE METER	$47.50
ETI 128	AUDIO MILLIVOLTMETER	$49.50
ETI 533	DIGITAL DISPLAY	$19.50
ETI 117	DIGITAL VOLTMETER	
ETI 118	SIMPLE FREQUENCY COUNTER	$32.50
ETI 133	PHASE METER (with case)	$15.50
ETI 130	TEMPERATURE METER	$12.50
ETI 102	AUDIO SIGNAL GENERATOR	$29.50
ETI 441	AUDIO NOISE GENERATOR	$ 9.50
ETI 424	TONE BURST GENERATOR	$21.50
ETI 121	LOGIC PULSER	$11.50
ETI 122	LOGIC TESTER	$59.50
ETI 123	SIMPLE CMOS TESTER	$24.50
ETI 222	TRANSISTOR TESTER	$17.50
ETI 115	LINEAR IC TESTER	$21.50
ETI 111	IC POWER SUPPLY	$27.50
ETI 105	DUAL POWER SUPPLY	$99.50
ETI 221	BASIC POWER SUPPLY	$21.50
ETI 132	POWER SUPPLY (with out meter)	$32.50
ETI 132M	POWER SUPPLY (with meter)	$39.50
ETI 119	SWITCHING REGULATOR SUPPLY	$49.50
ETI 108	DECADE RESISTANCE BOX	$25.50
ETI 106	OSCILLOSCOPE CALIBRATOR	$17.50
ETI 114	DUAL BEAM ADAPTOR	$25.50
ETI 112	AUDIO ATTENUATOR	$23.50
ETI 540	UNIVERSAL TIMER	$59.50
ETI 704	CROSS HATCH AND DOT GENERATOR	$17.50
ETI 129	RF SIGNAL GENERATOR	$29.50
ETI 706	MARKER GENERATOR	$29.50
ETI 120	LOGIC PROBE	$13.50

ETI 804

ETI804	TELEVISION GAME This kit includes the new games chip that has both vertical and horizontal movement. To use it pan pots are required and these are included in this kit. AY 3 8550 chip and two pan pots	$ 49.50 $ 23.50

KITS AND PARTS

MAY

ETI549	INDUCTION BALANCE DETECTOR	$ 29.50
	ETI549A BOARD	$ 1.60
ETI548	PHOTOGRAPHIC STROBE	Enquire
	ETI548 BOARD	$ 1.50
ETI316	TRANSISTOR ASSISTED IGNITION	$ 16.50
	ETI316 BOARD	$ 1.30
ETI481PS	12V to 40V 100WATT CONVERTER	$ 29.50
	ETI481PS BOARD	$ 2.00
ETI444	FIVE WATT STEREO	$ 19.50
	ETI444 NEW BOARD	$ 2.00
	LM382	$ 2.95
	LM3795	$ 8.50

JUNE

ETI 581	DUAL POWER SUPPLY	$17.50
	ETI 581 BOARD	$ 1.40
	PL30 - 5VA	$ 8.75
	7815 IC	$ 2.55
	7915 IC	$ 2.55
ETI 547	TELEPHONE BELL EXTENDER	$16.50
	ETI 547 BOARD	$ 1.60
	CA 3130 IC	$ 2.25
	NE 555 IC	70c
ETI 712	CB POWER SUPPLY	$9.50
	ETI 712 BOARD	$ 1.60
	PL30 - 60VA	$15.00
ETI 481	HIGH POWER PA/GUITAR AMP	
	ETI 480 BOARD	$ 1.60
	ETI 480PS BOARD	$ 1.60
	ETI 481M BOARD	$ 1.60
	ETI 445 BOARD	$ 1.20
	ETI 446 BOARD	$ 1.40
	ETI 449 BOARD	$ 1.20
	ETI 438 BOARD	$ 1.60
	ETI 480 /50W KIT	$14.50
	ETI 480 /100W KIT	$18.50
	ETI 480PS KIT	$16.50
	PF 3577 for above	$19.50
	ETI 481 KIT	$12.50
	ETI 445 KIT	$ 4.95
	ETI 446 KIT	$ 7.95
	ETI 449 KIT	$ 4.95
	ETI 438 KIT	$13.50
	CA 3140 IC	$ 2.25
ETI 485	GRAPHIC EQUALISER	
	ETI 485 BOARD	$ 2.00
	LM 4136 IC's	$ 4.50
	5K LINEAR 45mm POTS	90c
	250K LOG 45mm POTS	90c
	PN 4093 KNOBS	35c
	MODULE KIT (illustrated)	$26.00

JULY

ETI484	COMPRESSOR EXPANDER	$ 49.50
	ETI484 BOARD	$ 2.00
	NE571	$ 13.95
ETI317	REV MONITOR, COUNTER	$ 12.50
	ETI317 BOARD	$ 1.50
	METER (Not included in kit)	$ 8.50
ETI582	HOUSE ALARM (A AND B)	$ 79.50
	ETI582A	$ 2.70
	ETI582B	$ 1.50

AUGUST

ETI583	MARINE GAS ALARM	$ 27.50
	TGS812	$ 10.50
	TGS813	$ 10.50
	ETI583 BOARD	$ 1.50
ETI134	TRUE RMS VOLTMETER	Enquire
	CA3140	$ 1.95
	ETI134 BOARD	$ 1.70
ETI603	SEQUENCER (No case included)	$ 49.50
	CA3130	$ 1.95
	ETI603 BOARD	$ 1.80

ELECTROKITS

JUMBO 7 SEGMENT DISPLAY $8.00

THIS CONSISTS OF A BOARD,, TWENTY TWO LARGE LEDS AND A SEVEN SEGMENT DRIVER. IT IS IDEAL WHERE LARGE BUT BRIGHT DISPLAYS ARE REQUIRED. APPROXIMATELY THREE CENTIMETRES HIGH.

STEAM WHISTLE KIT $8.00

THE PITCH OF THE NOTE CAN BE VARIED, OPERATION OF THE SOUND CAN BE MADE WITH LAMPS SINCE THE UNIT IS SWITCHED BY A LIGHT DEPENDENT RESISTOR.

STEAM TRAIN SOUND KIT $ 8.00

THE RHYTHM OF THE SOUND IS REGULATED AUTOMATICALLY AND IS PRACTICALLY PROPORTIONAL TO THE SPEED OF THE TRAIN. THIS UNIT REQUIRES AN AMPLIFIER.

BASIC 1WATT KIT $ 5.00

AMPLIFIER AND MIXER FOR ABOVE SOUNDS, OR FOR USE IN ANY GENERAL PURPOSE APPLICATION REQUIRING A LOW BUT USEFUL AUDIO AMPLIFIER. SPEAKER NOT SUPPLIED.

DIGITAL REV COUNTER KIT $15.00

DEVISED TO MEASURE THE SPEED OF A CAR ENGINE IN RPM WITH TWO DIGIT READOUT. THIS ALLOWS MEASUREMENT AT AN ACCURACY OF BETTER THAN ONE PERCENT. THE CASE IS NOT SUPPLIED.

WE REGRET THAT IT IS SOMETIMES NECESSARY TO ALTER PRICES WITHOUT NOTICE

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MAIL ORDER.....MINIMUM.....$8.00.
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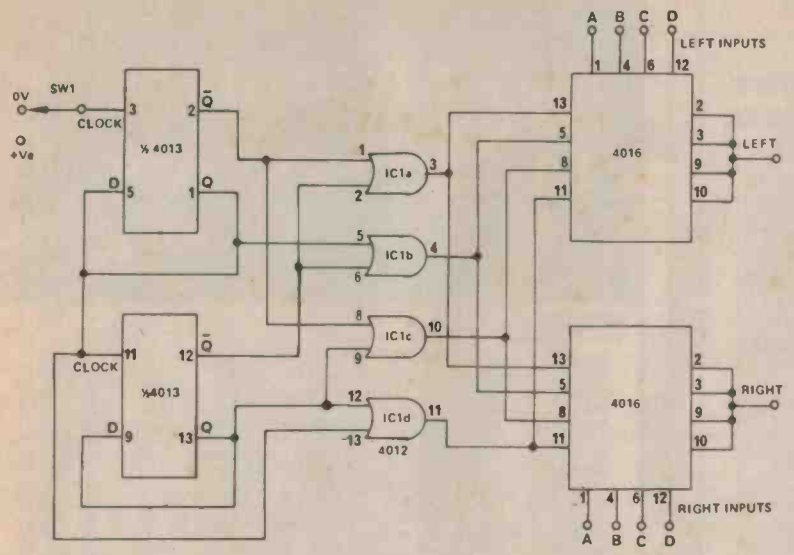
TELEPHONE ENQUIRIES.....(02) 358 2420.

Ideas for experimenters

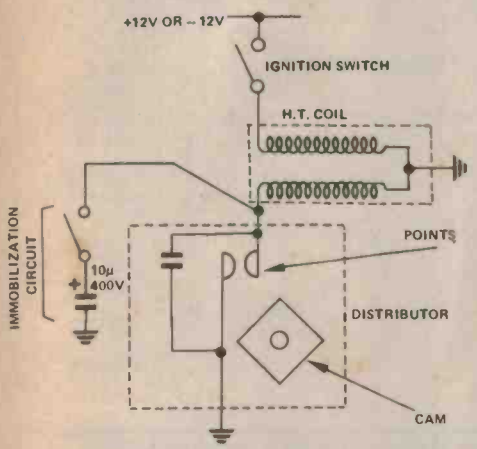


SINGLE POINT STEREO INPUT SELECTOR

Four different inputs can be switched through by the continual pressing of SW1.

IC1 is a dual 'D' type flip flop. The Q outputs are connected to the D inputs so that the clock inputs are divided by two. The two flip flops are connected in series, giving a two-stage binary counter.

IC2 is a quad AND gate. This is used to decode the four states of the counter. The outputs are used to control the quad switches at IC3 and IC4 (4016AE).

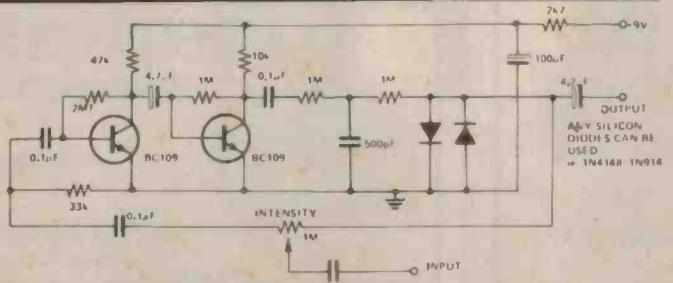


AUTOMOBILE IMMOBILISATION

In order to discourage theft of an automobile, many people incorporate a 'secret' switch to break the ignition circuit (usually in series with the key switch). This system is very easily bypassed using 'jumper' leads.

A more effective method of immobilisation is shown in Fig. 1, also using a 'secret' switch. A 10uF/400V capacitor is switched across the points preventing the ignition being started; at the same time this prevents the use of 'jumper' leads.

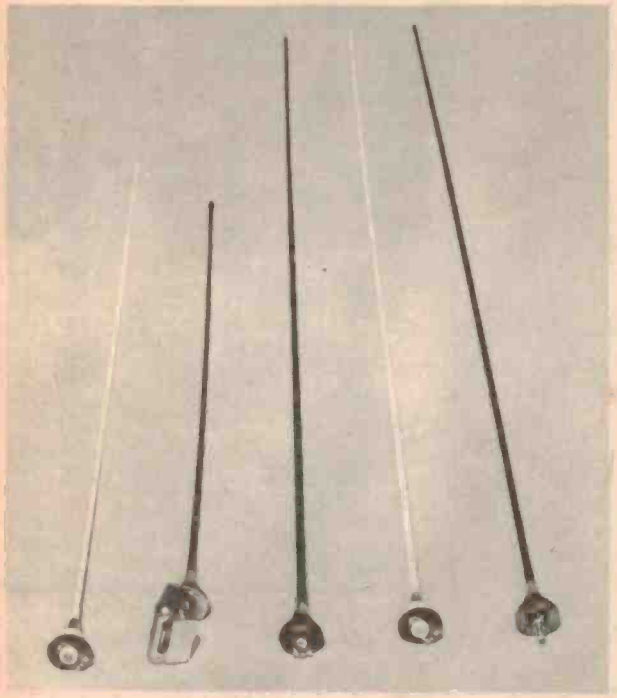
GUITAR FUZZ



The input signal is amplified by the two transistors. The distorted output is then clipped by the two diodes and the high frequency noise is filtered from the circuit via the 500pF capacitor. The 1M pot adjusts the intensity of the fuzz, but this tends to make the unit oscillate, so a 33k resistor is put between the input and ground to stop this. When the pot is at minimum intensity the unit may be switched off to allow normal playing.

CITIZENS BAND ANTENNAS

Made in Australia by SCALAR Industries, suppliers of communication antennas to Government, Industry and Commerce.

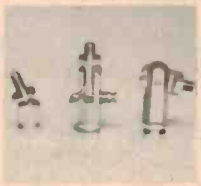


CB 1220 CB1120 CB1420 CB1520 CB1320

CB 1220	42" centre loaded
CB 1120	30" centre loaded
CB 1420	60" helical
CB 1520	60" helical/sector/top loaded
CB1320	60" centre loaded

SCALAR Citizen Band antennas are designed to provide efficient performance with reduced length. Either helical, centre or top loading on fibreglass rods, many thousands are already efficiently in use throughout Australia in vehicle, marine and base installations.

Dipole Simulator meets the need of installations of 27 MHz antennas where a ground plane is not available. It can be used with any **SCALAR** 27 MHz whip top and is particularly useful in installations on fibreglass and wooden boats and vehicles having fibreglass cabins. The hellpole converts the whip into a 1/2 wave centrefed dipole, assuring a very stable and efficient antenna system.



Modified CB accessories, for use with any **SCALAR** mobile whip top: o GUTTER GRIPS
- SLOPE ADJUSTERS
- MARINE KNOCK DOWN
- VEHICLE KNOCK DOWN

Available from leading retailers and distributors throughout Australia.
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18 Shelley Ave, Kilsyth, Vic. 3137.
Tel: (03) 725 9677. Telex: AA 34341. Cables: Welkin.
NSW: 20 The Strand, Penhurst, 2222.
Tel: (02) 570 1392
QLD: 969 Ann Street, Fortitude Valley 4006. Tel: (07) 52-2594. Telex AA43007

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PHILIPS — LOCMOS

HEF 4000	.30	HEF 4021	1.28	HEF 4050	.50	HEF 4082	.32
HEF 4001	.30	HEF 4022	1.22	HEF 4051	1.24	HEF 4085	.94
HEF 4002	.30	HEF 4023	.30	HEF 4052	1.24	HEF 4086	.94
HEF 4006	1.28	HEF 4024	.99	HEF 4053	1.24	HEF 4093	.96
HEF 4007UB	.30	HEF 4025	.30	HEF 4066	.80	HEF 4510	1.34
HEF 4008	1.24	HEF 4027	.57	HEF 4068	.33	HEF 4511	1.76
HEF 4011	.30	HEF 4028	.99	HEF 4069UB	.35	HEF 4512	1.86
HEF 4012	.30	HEF 4029	1.50	HEF 4070	.32	HEF 4516	1.76
HEF 4013	.50	HEF 4030	.52	HEF 4071	.30	HEF 4518	1.56
HEF 4014	1.28	HEF 4035	1.28	HEF 4072	.32	HEF 4519	.74
HEF 4015	1.24	HEF 4040	1.37	HEF 4073	.32	HEF 4520	1.41
HEF 4016	.52	HEF 4041	.99	HEF 4075	.32	HEF 4528	1.02
HEF 4017	1.24	HEF 4042	1.96	HEF 4076	1.86	HEF 4531	2.74
HEF 4018	1.28	HEF 4043	1.24	HEF 4077	.39	HEF 4539	1.12
HEF 4019	.73	HEF 4044	1.24	HEF 4078	.32	HEF 4555	1.02
HEF 4020	1.41	HEF 4046AE	2.92	HEF 4081	.30	HEF 4556	1.02

GENERAL ELECTRIC

SCR's		TRIACS & DIACS		UJT's & PUT's	
C 1038 .8A 200V	1.14	SC1410 10A 400V	1.95	2N2646	1.24
C 10601 4A 400V	1.19	SC1510 15A 400V	1.37	2N2160	3.65
C 1220 8A 400V	2.11	ST2	.33	013T1 [2N6028]	1.88
C 122E 8A 500V	2.54	ST4	.60	013T2 [2N6027]	1.18

signetics TTL LOW SCHOTTKY

74LS00	.36	74LS30	.36	74LS74	.49	74LS93	1.23
74LS02	.36	74LS42	1.42	74LS78	.47	74LS95A	1.70
74LS04	.38	74LS51	.36	74LS85	1.99	74LS164	1.76
74LS10	.36	74LS55	.36	74LS86	.56	74LS196	1.70
74LS20	.36	74LS73	.47	74LS90	1.73	74LS367	1.19

signetics LINEAR

UA 741	.56
LM 301	.56
LM 308	1.43
LM 381	3.04
LM 382	2.69

TIMERS

NE 555	.64
NE 556	1.43

REGULATORS

LM 309K	2.56
LM 340T[V]	2.10
LM 723	.65
UA 78CU[V]	2.10

PCB ELECTRO-CAPS

CAPACITY uF	63V	10V	16V	25V	50V
0.47	—	5c	—	—	8c
1	—	—	—	—	8c
2.2	—	6c	—	—	6c
3.3	—	6c	—	—	8c
4.7	—	6c	—	6c	7c
10	—	—	6c	6c	8c
22	6c	8c	8c	8c	10c
33	6c	—	—	—	10c
47	—	—	8c	8c	10c
100	8c	8c	—	12c	12c
220	8c	—	9c	12c	—
330	9c	—	10c	12c	20c
470	—	—	12c	15c	26c
1000	15c	—	—	—	—
2200	18c	—	26c	—	—

2N3055
Including complete mounting kit and TO3 transistor socket
$1.10 set

0.5 ohm 5W
wirewound resistor
20c ea.

IN4003
1A 200V diode
5c ea.

uA78CB
13.8V 2A C8 reg.
$2.45 ea.

Pin for Pin Substitute may be supplied where original not available

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2200uF PIGTAIL ELECTRO'S 56c ea.
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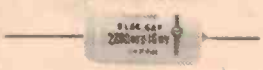
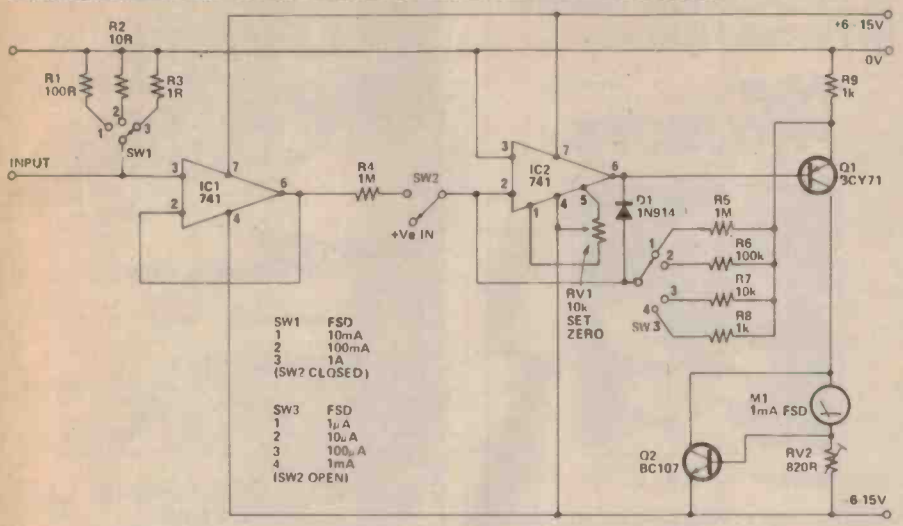


PHILIPS AD8080/M8 6W 8Ω $6.65
8" Twin cone loudspeaker

P.O. Box 623
Ballarat Victoria 3350

Ideas for experimenters



WIDE RANGE AMMETER

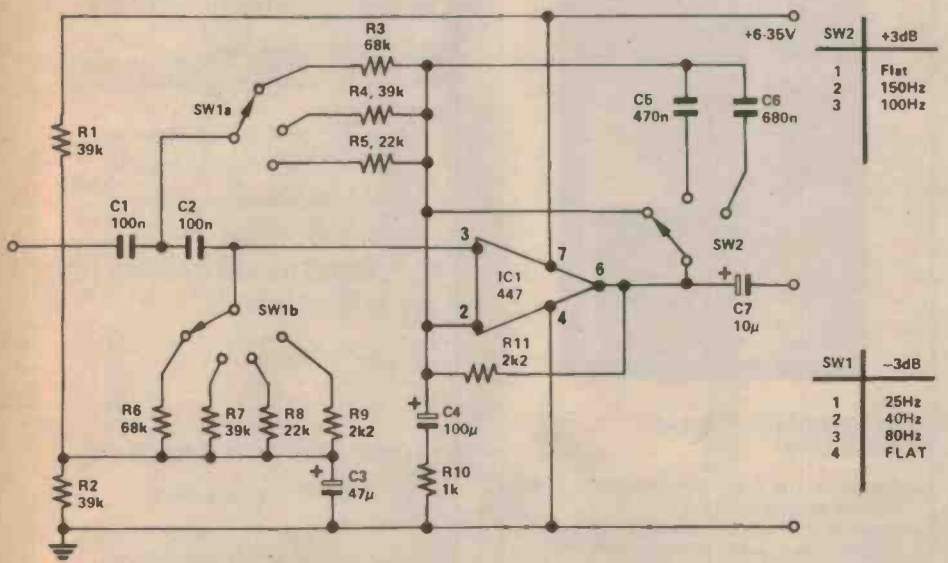
The instrument shown will measure currents from 1μA to 1A F.S.D. in seven ranges.

IC1 is connected as a unity gain buffer and the input current flows through the resistor selected by SW1 to earth. In so doing a voltage proportional to the input current is developed across the resistor and this appears at the output, pin 6.

Small currents are measured by IC2. In this mode the current flows into the non-inverting input. Since this is a virtual earth, the output will generate a voltage proportional to the input current.

In practice, this voltage is developed across R9 and hence provides a proportional current through Q1 and M1.

Q2 and RV1 form a meter protection circuit and the latter component should be adjusted so that Q2 starts to conduct at F.S.D. D1 is included to prevent damage to the base emitter junction of Q1 in the event of an input of wrong polarity.



SWITCHABLE RUMBLE FILTER

The circuit shown provides a cut-off at 25, 40, or 80Hz. C1 and C2 in conjunction with R3-9, form second order Butterworth filters with 12db/octave roll-off below the turnover frequency.

Unlike most designs, the feedback is taken from the inverting input. In practise this works well once the signal at this point follows exactly that at the non-inverting input.

A useful feature is the deep bass boost provided by the feedback loop proper.

S2 in position 3 gives a +3db point at 100Hz whilst position 2 provides a +3db point at 150Hz. A supply 6-35V DC at 10mA is required.

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.10
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.25
Molex pins .01		To-3 Sockets		.45
2 Amp Bridge		100-prv		1.20
25 Amp Bridge		200-prv		1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN	(Plastic .10)	.15
2N2907	PNP		.15
2N3906	PNP		.10
2N3054	NPN		.35
2N3055	NPN	15A 60v	.50
T1P125	PNP	Darlington	.35
LED Green, Red, Clear			.15
D.L.747	7 seg 5/8" high com-anode		1.95
XAN72	7 seg com-anode		1.50
FND 359	Red 7 seg com-cathode		1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	.95
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.60
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.70
4050	.50
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45

— T T L —

7400	.15	7473	.25	74176	1.25	74H72	.55
7401	.15	7474	.35	74180	.85	74H101	.75
7402	.20	7475	.35	74181	2.25	74H103	.75
7403	.20	7476	.30	74182	.95	74H106	.95
7404	.15	7480	.55	74190	1.75		
7405	.25	7481	.75	74191	1.35	74L00	.35
7406	.35	7483	.95	74192	1.65	74L02	.35
7407	.55	7485	.95	74193	.85	74L03	.30
7408	.25	7486	.30	74194	1.25	74L04	.35
7409	.15	7489	1.35	74195	.95	74L10	.35
7410	.10	7490	.55	74196	1.25	74L20	.35
7411	.25	7491	.95	74197	1.25	74L30	.45
7412	.30	7492	.95	74198	2.35	74L47	1.95
7413	.45	7493	.40	74221	1.00	74L51	.45
7414	1.10	7494	1.25	74367	.85	74L55	.65
7416	.25	7495	.60			74L72	.45
7417	.40	7496	.80	75108A	.35	74L73	.40
7420	.15	74100	1.85	75110	.35	74L74	.45
7426	.30	74107	.35	75491	.50	74L75	.55
7427	.45	74121	.35	75492	.50	74L93	.55
7430	.15	74122	.55			74L123	.55
7432	.30	74123	.55	74H00	.25		
7437	.35	74125	.45	74H01	.25	74S00	.55
7438	.35	74126	.35	74H04	.25	74S02	.55
7440	.25	74132	1.35	74H05	.25	74S03	.30
7441	1.15	74141	1.00	74H08	.35	74S04	.35
7442	.45	74150	.85	74H10	.35	74S05	.35
7443	.85	74151	.75	74H11	.25	74S08	.35
7444	.45	74153	.95	74H15	.30	74S10	.35
7445	.65	74154	1.05	74H20	.30	74S11	.35
7446	.95	74156	.95	74H21	.25	74S20	.35
7447	.95	74157	.65	74H22	.40	74S40	.25
7448	.70	74161	.85	74H30	.25	74S50	.25
7450	.25	74163	.95	74H40	.25	74S51	.45
7451	.25	74164	.60	74H50	.25	74S64	.25
7453	.20	74165	1.50	74H51	.25	74S74	.40
7454	.25	74166	1.35	74H52	.15	74S112	.90
7460	.40	74175	.80	74H53J	.25	74S114	1.30
7470	.45			74H55	.25		
7472	.40						

74S133	.45
74S140	.75
74S151	.35
74S153	.35
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