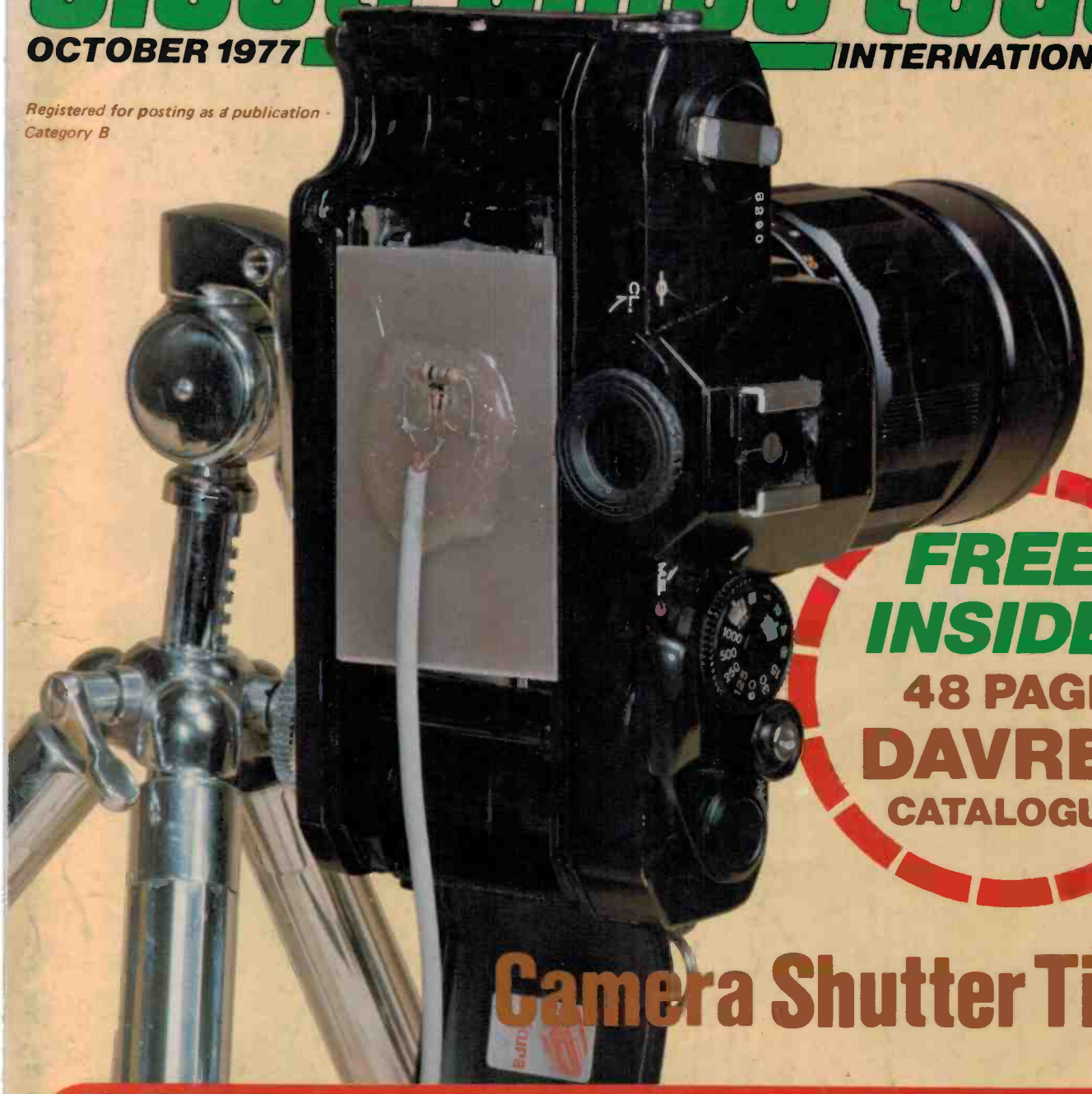
LCD DIGITAL VOLTMETER MODULE INSIDE

electronics today

OCTOBER 1977 INTERNATIONAL

Registered for posting as a publication - Category B

$1·25*
NZ $1.50



FREE INSIDE!
48 PAGE DAVRED CATALOGUE

Camera Shutter Timer

COLOUR TV GAME OFFER!

Hear no evil

Today's standards in hi fi insist on components with the highest standards of performance. JVC's speaker range is not only designed to give you this faultless reproduction, but is designed to be extremely durable as well. Years of research have ensured that all JVC speakers — whether they be omni-directional, bass reflex — together with the different types of speaker used, meet the most discriminating needs. The special materials selected in the construction of the domes, for instance, is the very finest available, and no expense has been spared at any stage of manufacture. Extensive research into sound and sound projection has also proved itself worldwide — in competition with many other brands of less critical construction. JVC — you can hear clearly now.

SK44

SK55

SK33

JVC

the right choice

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

12916

AUSTRALIAN OWNED AND PRODUCED

OCTOBER 1977 Vol.7 No. 10

electronics today INTERNATIONAL

Editorial: Les Bell

Publisher: Collyn Rivers

Our Pyral offer (August ETI) attracted an enormous number of readers (like 100,000 cassettes!). Because of this we have a huge backlog of orders which we are trying hard to clear.

At present there is a delay of 2 – 3 weeks. Please accept our apologies for the delays.

Cover: Photographer George Hofsteters discovered that his shutter speeds were just about good enough to take this shot of the phototransistor sensor in our shutter speed timer project.

A Modern Magazines Publication

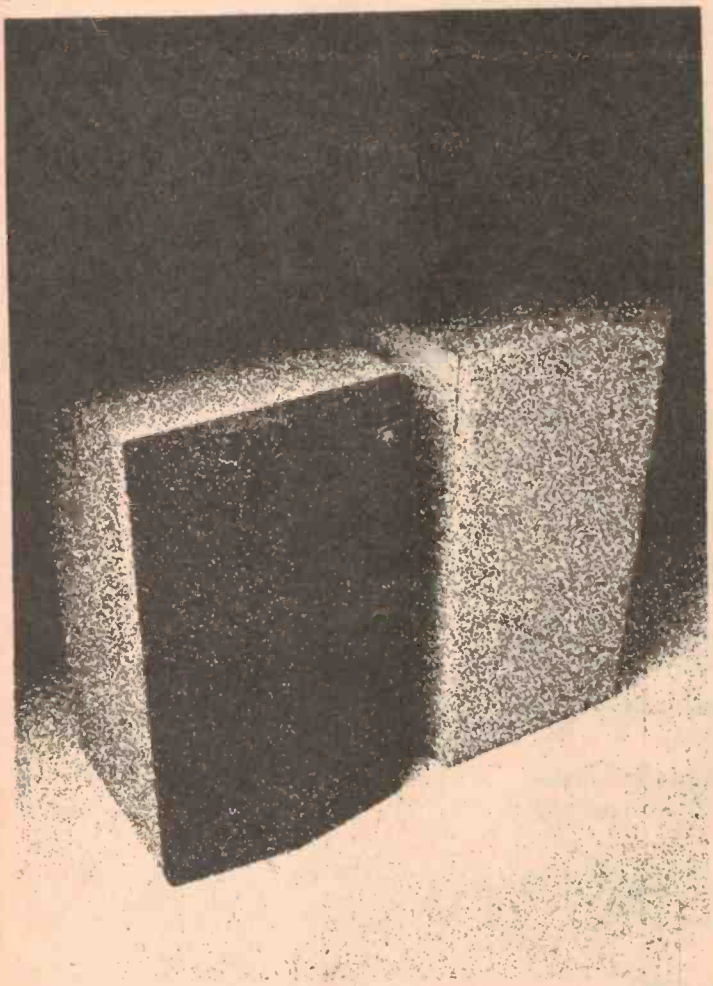
* Recomended retail price only.

PROJECTS

FEATURES

NEWS & INFORMATION

THE SALE OF THE DECADE



It's official: From NOW until December 31st, or until stocks are sold, a *limited* number of JBL L26 and L36 Decades will be available from your JBL Audio Specialist Dealer . . . at a ***Reduced Price!***

With every pair of Decades purchased during the Sale, you will receive ***Free,*** a pair of JBL Speaker Stands.

Available at your JBL Dealer . . . ***NOW!***

JBL

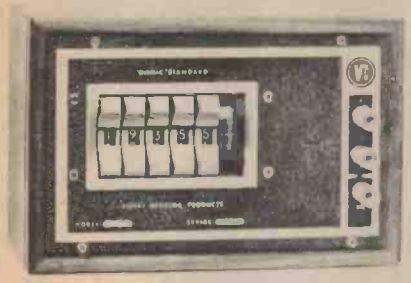
Distributed by
HARMAN AUSTRALIA PTY. LTD.,
P.O. Box 6, BROOKVALE, N.S.W. 2100
Telephone: (02) 939 2922

News Digest

Precision Decade Boxes

Vishay precision resistance decade boxes and transfer standards are now available from Promark Distributors.

The 1300 series decade boxes feature up to 7 digit resolution and total ohmic values up to 999,999 Ohms with absolute tolerance to 0.005% and temperature coefficients of 2ppm/oC. The switching is by push-button rotary action and the units are available as a free standing bench type or for panel mounting into equipment.



The 1500 series decade transfer standards consist of 11 resistors which can be linked in series or parallel arrangements to provide from 1/11 to 11x the basic resistance value. Four models are available to cover from 9.0909 Ohms to 1,100,000 Ohms. The transfer standards feature temperature coefficients of 1ppm and each resistor is factory adjusted to 2ppm of nominal with trimmers accessible to provide adjustment of 100ppm with setability of better than 0.5ppm.

Prices on the 1300 series range from about $450–600 and on the 1500 series transfer standard from $750–900.

Promark Distributors, Suite 102, 6-8 Clarke St., Crows Nest NSW 2065. Phone 439 6571.

Digital Op-amps

Until now, it has been impossible to put op-amps onto LSI digital ICs, but two researchers at the University of Dortmund in West Germany reckon they've done it. They are using an n-channel, enhancement-depletion mode technique, which results in an op-amp with a gain of 90 dB, power dissipation of 4 mW, and a unity gain bandwidth in excess of 1 MHz. Each op-amp occupies 2.5 square millimetres of the chip. This could mean some drastic changes in the design of A/D and D/A converters, as well as application of microprocessors and digital LSI to what has hitherto been the analogue realm.

Tandy 1978 Catalogue

Tandy Electronics has announced the release of its new 132 page catalogue for 1978. It is claimed to be Australia's most comprehensive electronics catalogue, with a line-up of almost 2000 items. Tandy store managers have large supplies of the catalogue on hand, and they are available to customers free on request.

New Calcs from HP

Hewlett-Packard have released two new programmable calculators, the HP19C and the HP29C. Both models feature 98 steps of program memory with HP's 'Continuous Memory' feature, which retains the program when the calculator is switched off. Each program memory step can hold up to four keystrokes (e.g. STO + . 4), and both calculators have 30 memories, 16 of which are preserved after switch-off. Other functions are similar to the HP67, without the card reader and alpha labels, but including indirect addressing, 3 levels of subroutines and 10 decision tests.

In addition, the HP19C includes a built-in thermal printer, making it the world's first handheld, printing, programmable calculator. Also new is the HP10, which is a simple handheld printing calculator. Prices: HP19C $384 inc. tax, HP29C $233 inc. tax, and the HP10 is $197 inc. tax.

Low Cost Surveillance Receiver

The Watkins-Johnson Company, who specialise in defence communications equipment, have now produced a modestly priced general purpose HF receiver which is ideal for surveillance work.

Identified as the Model WJ-8718, it is designed to be used in either a manual mode or with remote digital frequency control. It is capable of detecting AM, FM, CW, ISB, LSB and USB transmissions (A1, A2, A3a, A3b, A3j, A4, F1, F2, F3 & F4) over the frequency range.

Using the building block approach, certain features are available as options to increase the capabilities of the receiver. The mainframe provides the following:

- 5 kHz to 30 MHz Frequency Coverage
- Seven Selectable IF Bandwidths from .3 to 16 kHz (including the ISB option)
- Seven-digit Green LED Frequency Display
- AM, FM, and CW detection Modes
- Low Phase Noise Frequency Synthesizers
- 10 Hz Tuning Steps
- Tunable Synthesized BFO (±8 kHz)
- Audio Level/Signal Strength Meter

Options include the following:

- Remote Control Module (RCM)
- Manual Control Module (MCM)
- ISB Module (ISB)
- Sub-Octave Preselector Module (PRE)
- 10 Hz BFO Synthesizer Resolution (B10)

Full technical specifications are available from R.H. Cunningham Pty. Ltd., Phone (03) 329 9633.

Wire-wrap Popular

Bang and Olufsen, the Scandinavian producares of Scandinavian-style hi-fi are using wire-wrapping in the assembly of a new range of radios and radiograms to be released this autumn. Although soldering is cheaper, B & O reckon that wire-wrap is better for linking their circuit boards and have developed their own hardware to feed the wire-wrapping machine.

Power Problems

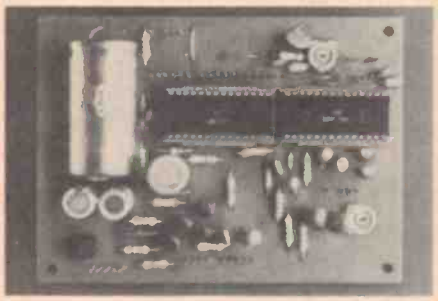
At the time of writing, it looks as though the power situation in Victoria will slow industry right down, including, of course, the printing industry. Because of this, we've had to cut down the size of this month's ETI. Sorry about that – it means we've had to cut out some great stuff, including a beaut toy car that you can race along a white line. Also in next month's ETI you'll find a howl-round stabilizer for PA work, plus all the great stuff you expect from us.

This is the safest place in the world to play your records.

We believe you should have as little as possible to do with the ADC Accutrac 4000.
So once you've placed your record on the turntable, and pressed a few buttons, you can leave the rest to the world's first computerised turntable.
The human errors that do a lot of damage to records are a thing of the past.

You get more out of it, because we put less into it.
It's a fact that when you compare the ADC Accutrac to other expensive turntables, the rest are made to look clumsy, complex and old-fashioned.
Truly superb sound reproduction can now be achieved in a much simpler way.

The turntable with a memory.
We started by replacing a lot of noisy mechanics with a neat little computer.



Out came standard components.
In went the latest breakthrough in MOS computer circuitry.
So all Accutrac's operations are controlled and programmed far more quickly and efficiently than any other automatic turntable.
The control panel is designed for you to select up to 13 tracks in any order you want to hear them, and a 24 selection memory bank allows for programmed repeats.

The motor that keeps an eye on itself.
We replaced the conventional belts, wheels and pulleys with an electronically controlled direct drive system that keeps wow and flutter to a completely inaudible .03% and rumble at −70dB.
The motor contains electronic speed-sensing circuits, which keep a constant eye on the accuracy of the massive 12 inch diecast turntable's speed, and instantly corrects any error.
There's also a speed tuning circuit that lets you vary the speed over 5%.
A glance through the stroboscope provides a reliable speed check.

The tonearm you never touch.
We did some more eliminating.
Out went the noisy linkages that power automatic arms from the main turntable drive motor.
Out went velocity-sensing mechanical arm-trip mechanisms.
Out went all the clumsy cams and gears.
Instead, Accutrac's tonearm is moved by its own electro-optically controlled servo-motor. It responds instantly and silently to your programme in the turntable's memory bank.
Tracking error is minimised by the arm's 9⅓ inch (237mm) effective length, and horizontal and vertical bearing friction has been reduced to the negligible level of 5-7mg, due to Accutrac's new ball race and pivot system.
From the instant the stylus touches the record, the arm is totally decoupled from the servo-motor and controls, so it always tracks the groove with perfect freedom.

The cartridge that knows where it's going.
Accutrac has the most advanced cartridge in the world.
The ADC LMA-1.
It scans the surface of the record with a tiny beam of light from a solid-state infra-red generator.
When the beam is focused on the record, closely spaced grooves scatter the light, while the smooth surface between the tracks reflects the light back to a detector which triggers the arm mechanism.
This system ensures that the tonearm selects the right track quickly and smoothly, while accurately guaging where it begins and ends.
The low mass cartridge with its elliptical stylus, features the *Induced Magnet* system on which ADC built its enviable reputation.
It combines a strong, accurate, signal output with a ¾ to 1½ gram tracking ability.

The integrated design of the tonearm and cartridge results in minimal arm mass and an ideal tonearm resonance between 8-10Hz.

It's all at your command.
As you see, Accutrac has some very intriguing features, quite apart from the turntable.

What looks like a pocket calculator is actually a cordless command module.
So you have remote control.
The sculptured space-age object is the receiver for the turntable's memory bank. It's 'winking eye' tells you that your commands have been received.
Then you just sit back and enjoy what we hope you'll agree is the main attraction: the sheer excellence of the sound reproduction.

ADC

Distributed by
BSR (A'asia) Pty. Ltd.,
Anne Street, St. Mary's,
NSW 2760
Phone 623 0375, 623 5410

Accutrac™ 4000

Guaranteed for 2 years.

Parameters Appointed B & K Agents

The B & K Precision product group of Dynascan Corporation, Chicago, Illinois, USA, announces the appointment of PARAMETERS PTY. LTD. as the Group's sole distribution agent for Australia.

Parameters maintain sales and service centres in Melbourne and Sydney together with an all-state distribution network and are specialists in measuring and test instruments.

"We've grown from a small, service-oriented manufacturer in Chicago, to a truly international electronics corporation with sales well in excess of $100 million, because we have good people and good products for them to sell. Our appointment of Parameters should continue this success pattern in the Australian marketplace," said Myron Bond, B & K Precision's VP of marketing.

B & K Precision markets a full range of quality instruments including oscilloscopes, digital and analog multimeters, transistor testers, power supplies, signal generators, CB service equipment, probes, accessory items and many other products.

Trade Enquiries to: Bruce McCarthy, Parameters Pty. Ltd. P.O. Box 480, Crows Nest, NSW, Australia, 2065. Phone: 439-3288.

Sennheiser Infra Red Sound

Sennheiser Electronic of Hannover, West Germany and its partner in Australia for over twenty years, R.H. Cunningham Pty. Ltd., announces the introduction into Australia of Infra-Red sound. It will be known commercially as SENNHEISER INFRA-PORT. It is claimed to be the only major innovation in high fidelity sound since the introduction of the 'compact cassette', some thirteen years ago.

The major attraction of the SENNHEISER INFRA-PORT system is that an audio signal may be received through headphones without any cables, wires or leads to get in the way or obstruct any movement. Models are available in both monophonic and sterophonic versions.

The left capsule houses a regular 9 volt battery (e.g. Eveready 216). For heavy duty use a nickel cadium rechargable may be used. The left capsule also houses the receiver electronics. Clearly visible at the front is the receiving lens of the infra-red diode.

The right capsule has a three position selector switch. The unit operates stereophonically in the centre position; in position 1 only the sound of the left channel (95 KHz) is fed into both headphone capsules. Operating in position 2, only the right channel (250 KHz) is received. This feature facilitates true two channel operation, even of completely different audio signals.

There is a twin slide control for adjustment of both volume and balance. The on-off slide switch is on the lower part of the capsule.

There is a standard mono headphone/receiver called the HDI 406, which is of the stethoscope variety with the addition of a small bar instead of the normal 'button' at the bottom of the headphone. For the existing owners of SENNHEISER headphones HD414 or HD424, this receiving unit may be plugged directly into those headphones. This latter model is catalogued the HDI 408.

The hard of hearing are particularly well taken care of with SENNHEISER INFRA-PORT. The regular mono headphone, the HDI 406 and the HDI 408 for 'add on' use are both available with a higher output, the catalogue number being the same except for the suffix of '/S'. The HDI 408/S is terminated at the ear by a small inductive loop transmitter which is connected directly to a hearing aid for optimum results.

Where the application is primarily for the hard of hearing, the corresponding transmitter should be used viz., SI 406/S. The higher powered transmitter, SI 1010 is adequate for hard of hearing in larger auditoriums. The catalogue number of the high powered stereo transmitter is SI 1012/S.

ERRATA

House Alarm ETI 582 July 1977. As the system was being finalised it was seen that SW2 could be simplified to a single pole toggle switch by inverting it. This change was not shown in circuit Fig.1. Trace out the wiring from the overlay etc. and all will be clear. Note that the circuit will work either way. B6 on SW3 should read B9, B6 beneath B7 Fig 4 should read B9. Off position on SW3 Fig 2 is also B9.

Ultrasonic Switch ETI 585, Sept.77. Power supply current and voltage Specs. for TX and RX have been transposed. Swap them and it makes more sense, i.e. Receiver; 10-20 Vac, or 14-25 Vdc; Transmitter; 8-20 Vdc (only).

INCOMPARABLE NEW TRANSCEIVER

NEW-NEW-NEW

National RJX SERIES

For every hobby there is an "ultimate" unit. For the sports car enthusiast it's the Ferrari. For the amateur photographer, it's the Hasselblad. For the amateur radio operator it's the National RJX1011.

RJX-S1011 RJX-1011 RJX-V1011

A Unique New SSB/CW Transceiver For Amateur Communications

There is no substitute for quality, performance, or the satisfaction of owning the very best.
Hence, the incomparable National RJX-1011 amateur transceiver. The RJX-1011 covers all amateur bands 1.8-30 MHz (160-10 metres). It utilizes advanced Phase-Lock-Loop circuitry with dual gate MOS FETs at all critical RF amplifier and mixer stages. There's a rotating dial for easy band-scanning and an electronic frequency counter with digital readout and a memory display that remembers frequencies at the flip of a switch. And that's just the beginning.
Matching speaker unit RJX-S1011 and complete external VFO RJX-V1011 also available.
For further information and specifications write, phone or call in!

DISTRIBUTED BY:

EMONA electronics

ROOM 208/661 GEORGE STREET, SYDNEY, NSW PHONE: 212 4815
A.H.: 398 6378 — 399 9061
P.O. BOX K21, HAYMARKET, NSW, 2000, AUSTRALIA

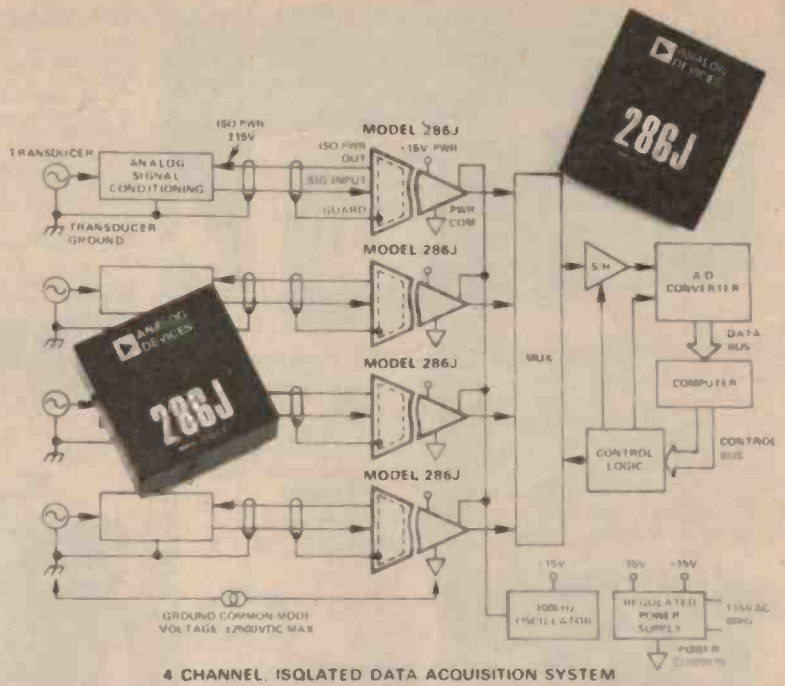
INCOMPARABLE NEW TRANSCEIVER

Low Cost Isolation Amplifier

A new generation of low cost, isolation amplifiers that is optimized for multi-channel use in data acquisition systems for industrial and medical applications, has been introduced by the Instruments and Systems Group of Analog Devices.

Up to eight of the new Model 286J isolation amplifiers can be driven by a single external synchronizing oscillator, and a virtually limitless number of Model 286J's can be configured using multiple oscillators. The oscillator circuit can be user supplied at a parts cost of less than $2.00, or specified from Analog Devices in a module, Model 281, which also includes a precision voltage regulator. Model 286J offers an internal isolated dual 15VDC @ 15mA supply which provides power for external transducers and signal conditioning devices.

In addition to providing multi-channel operation, the new Model 286J offers performance improvements over the Model 284J. Model 284J features an internal oscillator and is thus optimized for single channel operation. While Analog Devices offers a broad line of single and multi-channel isolation amplifiers for industrial and medical applications, Model 286J is "its lowest cost multi-channel isolation amplifier offering both isolated ± 15VDC power and high voltage protection for data acquisition in critical process control and patient monitoring applications," according to James Maxwell, Product Marketing Specialist, Analog System Components. For further information, call Parameters Pty. Ltd. on 439-3288 (Sydney) or 90 7444 (Melbourne).



4 CHANNEL, ISOLATED DATA ACQUISITION SYSTEM

Solar Energy System

An array of paraboloidal mirrors, controlled by computer to follow the sun, forms the heart of a new solar energy system which could power towns. The prototype of the system, developed at the Australian National University, is expected to be completed within five years, and within ten years a system will be in operation in a remote mining town.

Software Scene

Coming soon, thanks to the new 65-, 131-, and 262-kbit ROMs now under development, is good cheap software that's not on cassette, but pre= programmed into ROM. Best example is the version of Lawrence Livermore Lab's 5 Kbyte BASIC for the 8080A, which has been manufactured by Electronic Arrays in the States since May. We did consider publishing the assembly listings of this ourselves, but then thought 'Forget it! No-one's gonna sit and type it into their system now they can buy it preprogrammed in a ROM anyway'.

Electronic Arrays put LLL BASIC on two 4 Kbyte ROMs to test out the industrial market, but sold a lot to computer hobbyists, too.

What really clinched our decision is the fact that, by the time this appears, National Semiconductors will be offering the INS 8298, an 8 Kbyte ROM containing LLL BASIC as well as a hex debugger. Coming soon is another NIBL ROM, as well as as Extended BASIC for PACE, which will initially appear in two 8 Kbyte ROMs and then on one 16 Kbyte chip.

This looks like the start of a new trend for semiconductor manufacturers to supply applications software, with good implications for both hobbyists and professional users. For example, if system speed is not going to be a problem, rather than writing his software in assembly language, the designer could write it in BASIC and run it under the BASIC interpreter. Software development costs are horrendous, and for small and medium-size production runs, it may work out cheaper to build a BASIC ROM into each system than pay for expensive software development. (It also lets the customer get more for his money. Imagine running Star Trek on your DVM!)

ETI/Unitrex Calculator Contest

The August calculator contest was won by Mr. R. Wilkinson of Mt. Waverley, Vic. The correct answer to the problem is that the stream is moving at 3 m.p.h. Since the Indian paddles upstream at the same rate relative to the stream, this will take him ten minutes also and so the total elapsed time will be 20 minutes. During this time the paddle has moved one mile and so the stream is flowing at 3 m.p.h.

And so to this month's problem. Readers may be familiar with mnemonics such as 'Now I, even I, would celebrate with rhymes inept, the immortal Syracusan, rivalled nevermore, who, in his wisdom, guidance to men left, how to circles mensurate'. Now, count the number of letters in each word, string them together and you have the value of pi to 25 decimal places. This is great for micro-computer users with multiple-precision floating point math routines.

But what about the square root of two, which is also useful? To 25 decimal places, this is

1.41421356237309504880 16887

How about a good, easy-to-remember mnemonic for this? The best one received wins a Unitrex calculator, and the contest will be judged by Collyn Rivers and Les Bell, whose decision will be final.

Seal an empty envelope, write your answer on the back of it, and send it to: Unitrex Calculator Contest, (October), ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011. Closing date is 18th November.

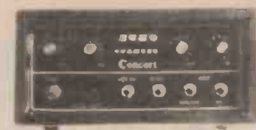
REVERBERBERBERBERBERBER

Want to really make your music COME ALIVE! Add a little reverberation . . . This kit is so very easy to build — and when finished you have a reverberation system so good you and your audience will be amazed! At a fraction of the cost of a ready-made unit. Full instructions provided, plus spring reverb unit itself.

Cat K-3424 .. .. only $15.50

$15.50

Echo: $115

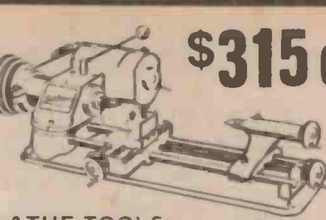


Now you can be the muso you've always dreamed of being — in complete control with this endless-tape type echo unit. Suits high or low impedance; fully solid state.

Cat F-3010 .. .. $115.00

UNIMAT LATHE

$315.00



* INCLUDES 6 LATHE TOOLS

EVERY HANDYMAN HAS DREAMED OF OWNING A LATHE — now every handyman can own a lathe! The Emco Unimat is ideal for the serious handyman, the model maker, the repair shop, the laboratory in fact, anywhere a precision job is require. And with a few options you can turn your lathe into a complete machine shop. The possibilities are endless.

Cat. T-6010 .. .. $315.00

TIDY LEADS

$1·75

Sick and tired of your meter leads always being in a mess? Solve the problem with these coiled leads that always return to shape after use. 1.5mm plugs, red & black leads. Cat W-4520

12 volt

$39.00

Cat F-2052.

START YOUR OWN PA BUSN.

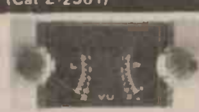
Be in demand for sports, rallys, shops, etc with a PA system. All you need is a PA amp like the one above plus speakers & mics. And we've got 'em all! Full 10W RMS out, works from car battery. 2 impedance inputs.

SPARE OUTPUT TRANSISTORS

(SUITABLE FOR MOST CB RIGS — YOU NEVER KNOW WHEN YOU'LL NEED ONE)

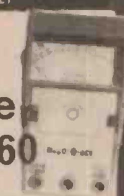
2SC-1306 — $4.50 (Cat Z-2501) 2SC-1307 — $6.50 (Cat Z-2502)

$8.50



Smart black stereo VU meter. −20 to +3VU, ideal for all stereo applications. Cat Q-2055

Megger

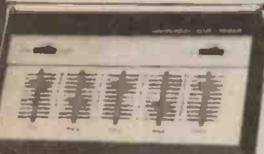


$88.60

Conserve energy — don't wind a handle! Solid state 'megger' measures to 1000M & 250V AC. Battery operated; value!

Cat Q-1430 .. $88.60

mixer

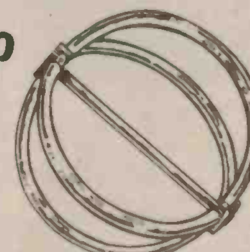


$59.50

Mix it up! This stereo/mono mixer & preamp does it for you. 4 mic inputs, take either high or low imp. mics. Master level control. Cat F-2280 .. $59.50

WHAT'S THIS?

? ?



IT'S EITHER A RUSSIAN SPACE STATION OR IT'S THE TOP OF OUR NEW CB BASE STATION 'THE SWAMPER'. SEE THE REST OF IT AT YOUR NEAREST STORE OR DEALER! Cat D-4428 .. .. $69.00

VU VALUE

Single VU meter — accurate & easy to read.

Cat Q-2050 .. . $9.15

HEY, CBers . . .

are you sure you antenna is in the best position? Check it out with a field strength meter. Tells you what direction your antenna works best in, too — great for working DX! Bargain price, too:

Cat Q-1370 .. .. $9.90

PROFESSIONAL FINISH — BY AN AMATEUR!

Give all your projects the classy finish they deserve with these rub-on word sets. Common electronic words, useable on most projects.

Cat N-1806 .. .. $4.75

LATEST FINISH: WHITE LETTERS FOR BLACK PANELS!

$4.75

ZIPPY BOXES from $1.50

Here's value for projects: Our range of plastic Zippy boxes. You can put almost anything in a Zippy box — has an aluminium top which is ideal as a front panel. This one is ideal for those small projects; (83 x 54 x 28mm) Cat H-2755.

WHEN YOU ARE A REAL 'NUT' HOBBYIST :

You'll want to make everything your self. Like printed circuit boards. Probably the easiest way to make your own PCBs is with bituminous paint. Simply paint the pattern on to the blank board and etch in ferric chloride. What could be easier?

Tube of bituminous paint.
Cat H-5654 .. ..$0.99

Ferric Chloride — 4oz jar.
Cat H-5652 .. ..$1.90

$1.20

MOLEX PINS — the easy way to use IC's.

Molex pins are a strip form of IC socket — cut off the quantity you need and solder them in. Ideal for all projects

Pack of 50 pins, Cat P-4502

WATCH THOSE IC'S!

Avoid damage to those costly ICs with IC sockets. No more soldering pins & cooking them!

14 pin model: suitable for 14 pin or 8 pin ICs.
Cat P-4140 .. .. .. 50c

16 pin model: for 16, 14 or 8 pin ICs.
Cat P-4160 .. .. .. 60c

How to avoid birds-nest wiring in 1 easy lesson:

Use a breadboard . . .

No, don't pinch the one from the kitchen — here's one designed by Dick for easy project or prototype building. Unique track pattern for utmost versatility! Remember, if it is soldered to a PCB your circuit looks and works better.

Cat. H-5606

$1·90

What's faster than a speeding bullet, more powerful than a locomotive, able to stick tall buildings together? SUPER (GLUE). A must for all hobbyists. Cat N-1220

$1·99

DICK SMITH DEALERS: Armidale: 72 1895; Griffith 62 1577; Newcastle: 69 1222; Orange. 62 6491; Tamworth: 66 1363; Bendigo: 43 1977; Geelong: 94 408; Palm Beach: 34 1248; Maryborough: 21 4559; Elizabeth Sth: 255 2249; Port Adelaide: 47 3688; Prospect: 44 5835; Perth: 328 1599; Devonport: 24 4216; Hobart: 34 8232; Wiven Hoe: 31 2560. Alice Springs: 52 1713; Darwin: 81 3491. Canberra 80 4307.

DICK SMITH CB DEALERS: Adelong: 46 4258; Albury: 21 3888, Ballina: 86 2669; Bateman's Bay: 72 4555; Bathurst: 31 1200; Bega: 22 090; Bourke: 72 2129; Bowral: 61 1861; Condobolin. 95 2625; Coolah: 84; Cooma Nth. 32 709;Coonamble: 22 1877, Cootamundra: 42 1682; Dubbo: 82 3793; Dubbo: 82 2377; Finley: 83 1611; Forbes: 52 2300; Forster: 561; Glen Innes: 1219, Gloucester: 571 1152; Gosford. 24 4644; Goulburn. 21 5440; Grenfell. 43 1733, Gunnedah. 42 0222; Inverell: 22 2443; Jindabyne 62 112; Kurri Kurri: 37 2141; Laurieton: 599 043; Lavington: 21 6058; Leeton: 532081; Lismore: 21 3741, Lismore: 21 3189, Lithgow: 51 2563, Milparinka: 4; Mudgee: 721413; Nowra: 23 628; Peak Hill: 31; Rylstone: 77; Shell Harbour: 95 1175; Sth. Grafton: 42 3400; Sydney: 31 0673; Taree: 52 1488; Tullamore: 75; Wagga: 21 2125; Walgett: 243; Wellington: 1002; West Gosford: 24 17 68; West Wyalong: 424; Wollongong: 29 2254; Wollongong: 29 5876; Drouin. 25 1342; Horsham: 82 3724; Mildura: 232438; Mildura: 23 4432; Sale: 44 2677; Shepparton: 21 9006; Wangaratta: 21 5907; Warrnam Warrnambool: 62 4070; Biloela: 26 126; Bundaberg: 72 4263; Cairns: 54 1035; Dalby. 62 2389; Edmonton: 55 4235; Gladstone: 72 3949; Gympie: 82 1327; Lota: 396 9010; Margate: 284 2341; Mackay: 511 211; Miles: 118; Nambour: 411 100; Proserpine: 45 1071; Rockhampton: 27 4004; Toowoomba: 32 3766; Townsville: 79 8844; Victoria Point: 207 7308; Adelaide: 223 6539; Cleve: 99; Mt. Gambier: 25 6404; Narrung: 11; Peterborough: 307; Port Lincoln: 82 1981; Renmark: 86 6682; Wallaroo: 211 017; Whyalla-Norrie: 45 5766; York town: 29; Bunbury: 212 777; Carnarvon: 411 362; Claremont: 862 433; Kalgoorlie: 21 1906; Paraburdoo: 89 5200 x 368, Port Headland: 732 504; Sth. Fremantle: 355 875; Tom Price: R M Dodson; Waroona: 331 595; Avoca: 842 166; Launceston: 31 5688; Launceston: 31 5815; New Norfolk: 612 553; Triabunna: 57 3135; Darwin: 81 5411.

Wharfedale: Uncompromising dedication to true fidelity.

The discerning listener has long been aware of the absolute purity of 'uncoloured' English sound.

Wharfedale – Britain's largest manufacturers of hi-fi speakers – are dedicated to the design of speaker systems that exemplify this tradition.

Now Wharfedale speakers are fully imported into Australia.

Sold and serviced nationally by Rank Australia. Available at all leading Hi-Fi Specialists.

WHARFEDALE

Glendale 3XP. Larger bass drive than Linton with increased cabinet volume. Power handling 40 watts DIN.

Linton 2XP. Separate, specially designed drive unit for bass, midrange and treble. Handles power of 40 watts DIN.

Dovedale SP. 4 drive units including 2 small bass drivers for excellent bass response. Handles power of 60 watts DIN.

(Not illustrated)

Airdale SP. Top-of-the-range model with 4 specialist drive units in reflex-loaded enclosure. Power handling 100 watts DIN.

We Keep Performing

RANK AUSTRALIA

CU152/77

eti

HOW TO ORDER

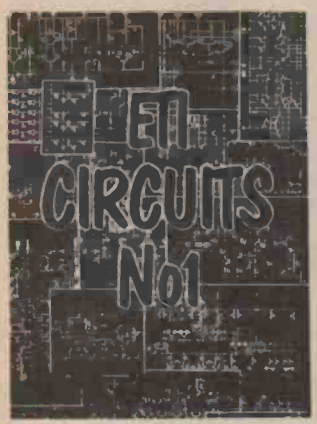
ETI Circuits No 1, the Electronics It's Easy series, and Top Projects Vol 3 are available now from most newsagents or directly from ETI. Project Electronics will be available from newsagents and ourselves from May 9th onwards (approximately).
The Transducer and the Synthesizer books are available only from us and a number of kitset suppliers, they are not sold via newsagents.

Send orders to Electronics Today International
15 Boundary St,
Rushcutters Bay
NSW 2011

ELECTRONICS IT'S EASY Vol 1/2/3.

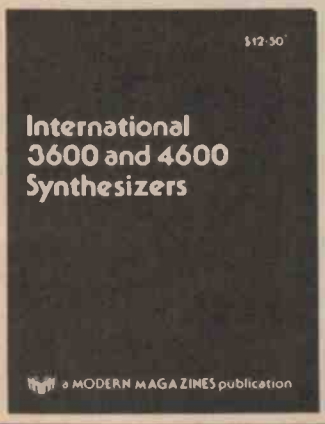
Volumes 1 & 2 now reprinted as a second edition!

Vol 1. The first 12 parts of this very successful series produced as a 100 page book. This volume takes the reader from an introduction to electronics through to operational amplifiers.
Vol 2. The 'middle-third' of the series introduces the reader to more sophisticated techniques, and includes power supplies, waveforms, filters and logic systems.
Vol 3. The final volume covers digital displays and systems, computers, transmission systems, instrumentation and the control of power.
$3.00 per volume plus 40 cents per volume post and packing (60 cents post and packing total if two or three volumes ordered at the same time.)



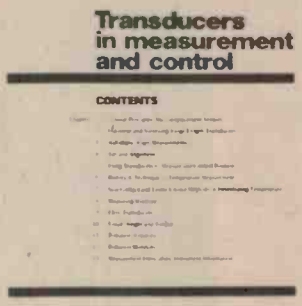
ETI CIRCUITS NO 1

Just published! Available from your newsagent or directly from us. This is a new concept in specials. ETI Circuits No 1 contains over 200 circuits largely based on the Tech Tips and data sheet sections of ETI. Great care has been taken to index each circuit carefully to enable the reader rapidly to locate the item sought. This publication is likely to be regarded as a 'bible' by the experimenter for not only does it contain complete circuits but also ideas and circuit sub-assemblies.
$2.50 plus 40 cents postage and packing.



INTERNATIONAL 3600 AND 4600 SYNTHESIZERS

A totally revised and updated reprint of ETI's phenomenally successful music synthesizer book.
This book has been beautifully printed on heavy art paper and has a sturdy cover varnished for protection.
Available only from ETI and some kit set suppliers $12.50 including postage and packing.



TRANSDUCERS IN MEASUREMENT AND CONTROL

This book is an unusual reprint from the pages of ETI. It is a compilation of a series of articles completed about two years ago – which was so highly thought of by the University of New England that they republished the series splendidly for use as a standard textbook.
Written by Peter Sydenham M.E., Ph.D., F. Inst. M.C., F.I.I.C.A., this publication covers practically every type of transducer and measuring technique and deals with equipment and methods not covered in any other book.
Enquiries from educational authorities, universities and colleges for bulk ordering are welcomed.
$4.50 plus 50 cents postage and packing. Available only from Electronics Today International directly.

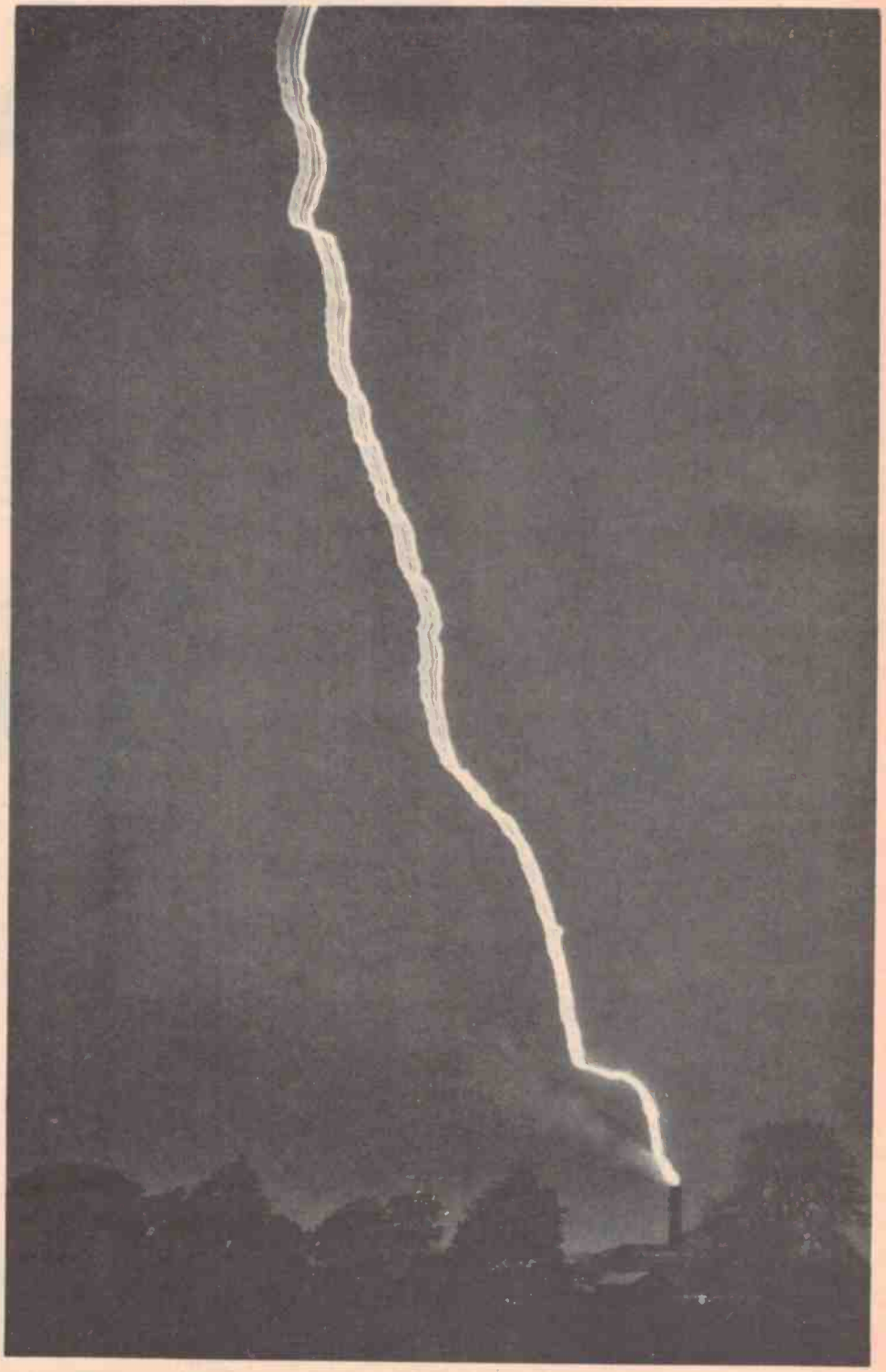
TOP PROJECTS Vol 3

Available from newsagents or directly from Electronics Today International.
Published in October 1976.
Contains FM Tuner, 25 Watt Amplifier, Active Crossover, Crossover Amplifier, Booster Amplifier, 50 Watt Power Module, 400 Speaker System, Audio Noise Generator, Cross-hatch/Dot Generator, ETI Utiliboard, Linear IC Tester, Dual Beam Adaptor, Impedance Meter, Tone Burst Generator, Digital Display, Digital Voltmeter, Frequency Counter, Logic Probe, Logic Pulser, Switching Regulator Supply, Nickel Cadmium Battery Charger, Radar Intruder Alarm, Intruder Alarm, Colour Organ, Car Alarm, Transistor Connections.
$2.50 plus 40 cents postage and packing.

We regret that due to heavy demand, Top Projects Vols 1 and 2 are no longer available.

The Danger

Because lightning is so spectacularly powerful, it has excited the curiosity and fear of man since the earliest times. Prof. W.R. Lee of the Department of Occupational Health, University of Manchester, explains just how dangerous lightning is.



The series of strokes that make up a lightning flash were revealed through the effect of the wind when this photograph was taken. A pronounced kink in the strike path shows the attraction exerted by a lightning conductor fitted to the chimney. People and animals attract flashes in a similar way.

# of Lightning

A FLASH of lightning comprises one or more lightning strokes and rarely lasts more than a second. The lightning stroke generally starts in the negatively charged region of a cloud from which a 'leader-stroke' seems to proceed towards the ground in discrete steps. The electrostatic field which develops below the leader rapidly increases in strength so that, when the tip of the leader has reached a height of some tens of metres above ground level, a short upward streamer can be initiated from a vertical conductor. This might be an isolated tree, a church steeple, a tall building, the mast of a boat or perhaps a person standing in the open with an umbrella or golf club above his head.

When the leader makes contact with the ground, or with the short upward streamer, a 'return stroke' develops which may be imagined as a positive current flowing upwards. This may reach tens of thousands or even one or two hundred thousand amperes.

The electrical potential involved in a lightning strike cannot, at present, be accurately measured but is believed to be about 10^7 to 10^8 volts. Whatever the actual voltage, a lightning stroke can immediately puncture the skin of a victim.

More is known about the characteristics of the lightning current, at least at the point of strike. This is fortunate for physiological responses depend on the current rather than the applied voltage. Characteristic waveshapes of lightning current are unidirectional with a fast rising front and a slower tail usually lasting several tens of microseconds.

In mountainous regions conditions may be different. The bottom of a thundercloud may lie only a short distance above conducting objects, such as human beings, from whom arise, as point or brush discharge, currents of several microamperes. These may be felt as a slight tingling, perhaps raising the hair on a bared head. At night they may appear as a luminous glow. In the past this glow, appearing at the tops of ships' masts during stormy conditions, was called St. Elmo's fire – after the patron saint of Mediterranean sailors. Such point discharges can develop into an upward-directed leader stroke which may last several tenths of a second and involve a current of some hundreds of amperes.

Four types

When accidents are considered, lightning strokes may be grouped in four types. A direct stroke occurs when the person or something he is holding is struck. The lightning current enters the head or upper part of the trunk, passing through the body and into the ground through the feet. If several persons are standing close together more than one may be struck.

It has been calculated that the current rises rapidly to a peak of 1000 A (amperes), immediately falling so that about 10 microseconds from the start it reaches 4 A and remains at that value for the duration of the strike. The occurrence of an external flashover is confirmed by ample evidence from accident reports. If it occurs outside the body and through or outside the clothing, the hair and beard may be singed, there may be burn marks on the soles of the feet and burn marks are found on the clothes, which may catch fire. Metals carried on the body may melt, causing burns. If the flashover is between the body and the clothing, current flowing over the body surface may convert the sweat and skin moisture into steam so that the resulting pressure causes clothes or boots to be torn off.

The second type of lightning stroke is the side flash. This is most clearly understood by considering what happens when someone is sheltering under a tree that is struck. Standing on the ground he is initially at earth potential. However, as the lightning current discharged down the tree trunk increases, the voltage drop down the lower part of the trunk, which might have a resistance of a few kilohms, may become greater than the electrical breakdown strength of the air gap between the trunk and the person. A side flash then occurs through the victim.

There is more than one report of persons struck while cycling past a tree. One victim, who was unconscious for 15 minutes, and did not need resuscitation, subsequently recalled a 'blow' and that he saw 'fire' coming to him from the tree and that the handlebars of his bicycle 'became electric'. He sustained no burn marks. Quite a number of accidents are on record of death or injury occurring in persons sheltering in a tent, and the descriptions of the circumstances and of the injuries strongly suggest side flashes from the tent pole or perhaps from the wet fabric.

One of the most dramatic and serious accidents involving side flashes in recent times occurred in the Japanese Alps in 1967. A part of 41 schoolchildren with five teachers was overtaken by a sudden thunderstorm when they were strung out along a steep ridge immediately below a mountain peak 1660 metres above sea level. Lightning killed 11 of the boys instantly and most of the remainder were temporarily paralysed, burned or blinded.

The third type of lightning stroke is the step voltage. If lightning strikes open ground, either directly or through a tall object such as a tree or post, the current is discharged into the mass of the earth. On non-uniform ground the current distribution produces differing voltages according to the distance from the site of the strike. a person, or animal, walking along a radius from the site of the strike will be subject to a potential difference between the legs. It will be seen later that quadrupeds are more likely than humans to die from this because the current, flowing between forelegs and hindlegs, traverses the heart, whereas in the human the pathway is from leg to leg and the heart escapes. When a church in France was struck during a service all the persons standing on the damp flagstones in the nave fell and could not get up for several minutes, as though their lower limbs were paralysed. But people standing in the oak choir stalls at the sides were spared, clearly because they were insulated from the ground.

The fourth type of stroke is the contact voltage, sometimes called a touch potential. It may be regarded as a particular instance of the side flash, in which the victim is actually making contact at the time of the lightning stroke. A case history from Russia

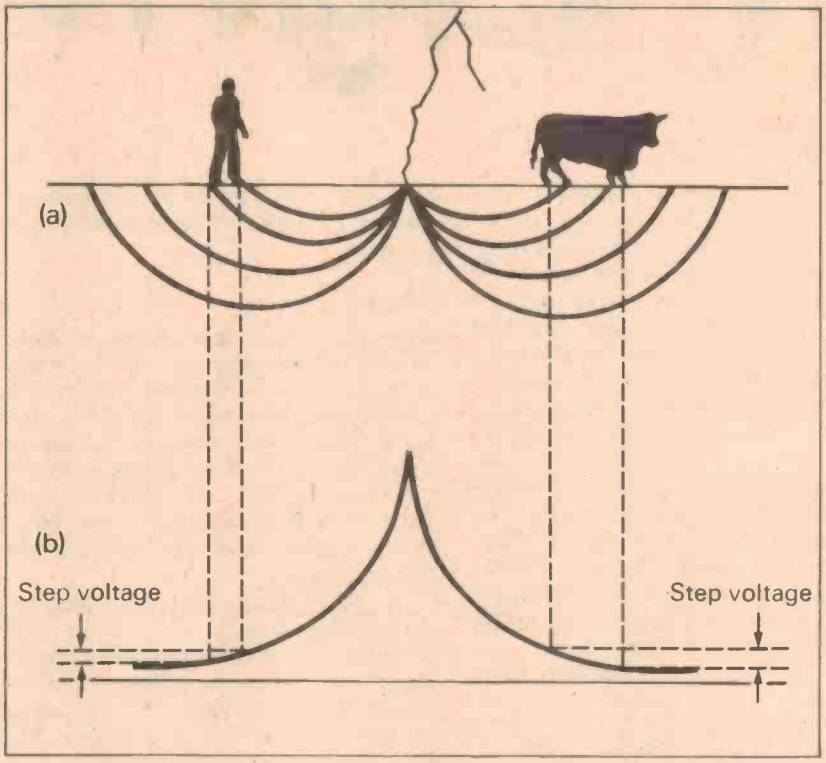
The Danger of Lightning

about 10 years ago gives a clear account of such an accident.

Two women were sheltering under a tall spruce tree which was struck during a thunderstorm. One of them, who was killed, stood with her back against the tree. Her clothing was not damaged but at the back of her head, on the right side, the hair was singed and ash grey in colour over an area of 4 cm by 4 cm. In the centre of this the skin damage was like a small abrasion. On the tree trunk there was a longitudinal strip of damage to the bark about 4 to 6 cms wide starting near the top of the tree and stopping about 158 cm from the ground, that is, on a level with the height of the victim.The other woman was holding on to the tree with her right hand. She lost consciousness for about 10 to 15 minutes and was unable to move or to feel her lower limbs for about two to three hours. She sustained some burning of the body down to the foot but was discharged from hospital after two days and resumed work after 10 days.

An intriguing theoretical study has concluded that anyone touching a lightning conductor when it is struck would not risk death because the current discharged through the body would be too weak. This is not an invitation to test the hypothesis by personal experiment!

How does lightning current produce death? Our knowledge comes from three main sources. Firstly, since the end of the last century, there has been a steady increase in our knowledge on how direct and alternating currents at mains frequency cause death. This is based, in a large part, on animal experiments. Secondly, there have been a few studies of the effects of impulse currents on animals. Thirdly, we have accounts of accidents ranging in quality from the anecdotal to the investigation which is fully and carefully documented from both the electrical and medical viewpoints. However, the accounts suffer from two main drawbacks. The obvious one is the absence of any quantitative electrical data and the other is that it is often difficult after an electrical accident to find why exactly someone died.



Regular pattern (a) of current in uniformly constituted soil, set up by a direct lightning strike to open ground. The potential distribution curve (b) shows how a 'step' voltage develops between the legs of humans or animals standing nearby.

Pathway

Lightning may be considered to produce direct effects in one of three ways: its action on the heart and on respiration, and by heat. There are other, indirect effects such as injuries from falls but they are not peculiar to lightning. For currents greater than a few milliamperes, the body behaves as a structureless gel or, for the electrical engineer, as a volume conductor. There is no 'preferred' pathway along which the current flows. It is believed that the body resistance along the path taken by the current in most direct lightning strokes, many side flashes and many contact voltage accidents is about 500 to 1000 ohms, possibly falling to the first value after the skin has been punctured. Generally, the effects are produced by direct action on the organs concerned, so it is important to trace the current's pathway through the body.

Careful examination of burn marks usually provides information on the points of entry and of exit. Sometimes these may be surprisingly small. The lightning return stroke has a central core with a diameter of a centimetre or so, which may reach a temperature of about 30 000 K, but only for the first tens of microseconds. This may save a person from extensive burning, although small metal objects on the clothing may melt. Because the skin has the highest resistance to the current, heat tends to be developed there, often causing relatively small skin burns. But if the lightning current has a long 'tail' it may have a value of several hundred amperes during that period. This so-called 'hot' lightning can cause more severe burning of the body and clothing. Examination of victims frequently reveals 'tree-like' or arborescent markings that are not true burns. They disappear after a few hours.

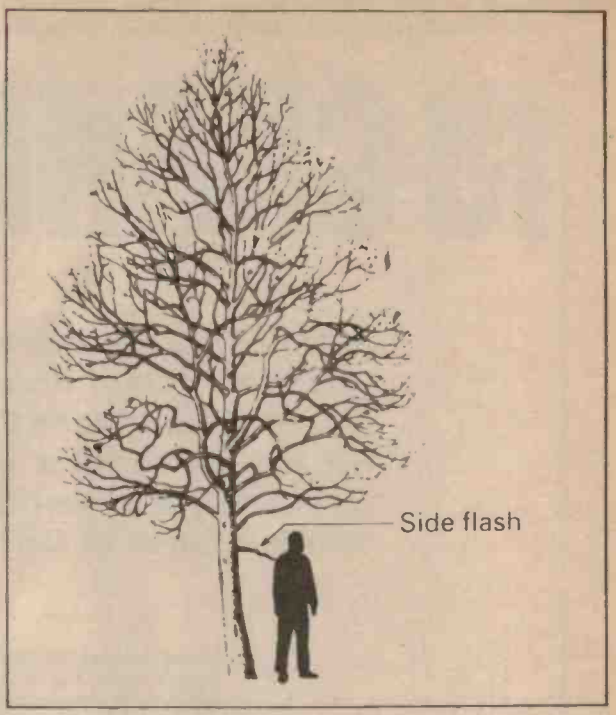
Lightning current causes death by affecting either the heart or the nervous mechanism controlling respiration. The heart has two main pumping chambers – one to pump blood around the body and the other to pump it through the lungs. The thick walls of these ventricles consist almost entirely of muscle, and the simultaneous contraction of all the individual muscle fibres provides the necessary pumping pressure. An electric current passing through the heart may disturb the concerted action of the fibres so that they contract individually and fail to establish enough pressure. When seen in this state the ventricles, instead of showing forceful regular contractions, are flaccid, with irregular twitchings (fibrillation) of the individual fibres.

Relationships

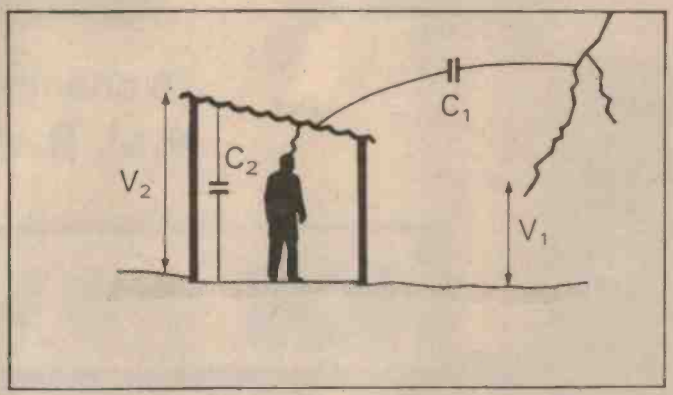
Nearly all the investigations to establish the relationships between some electrical factor or factors and perhaps time have been carried out using alternating current at mains frequency. The shortest duration studied in such investigations is about eight milliseconds, corresponding to a half-wave at 60 Hz. This approaches that of a lightning current with a long tail.

A number of relationships have been suggested. They all accept that current, or a derivative, is important. One of the most widely published relationships suggests that within certain time limits the ventricular fibrillation threshold depends on energy. Another suggestion is that it depends on charge. One theory is that the threshold is a function simply of current but that there are in fact two thresholds, one when the current lasts for less than a heart cycle and another, much lower, if it is more (about 400 to 1000 milliseconds).

Lightning currents do not last longer than a heart cycle. However, an electric current will cause fibrillation only if it falls at a certain time in the cycle, the 'T' wave, which occupies about 20 to 25 per cent of the full cycle. Once fibrillation has become established, blood circulation ceases and death follows. Finally, it has recently been stated that in many victims of lightning stroke the heart simply stops altogether – ventricular asystole. First-aid treatment for both is the same.



Side flash from a tree struck by lightning. At first the current flows through the trunk. The electrical resistance of the trunk, between ground and a point level with the head of anyone standing nearby, may be a few kilohms. Build-up of current through it may cause the potential drop across the lower part of the trunk to exceed the electrical break-down strength of the air between the trunk and the victim. At that stage a side flash occurs.



Side flash from a corrugated iron roof insulated from earth by a dry wooden structure. When a lightning stroke develops nearby, the effect of the electrical capacitances represented by C_1 and C_2 is to raise the roof to a potential V_2, with respect to earth, equal to $V_1C_1/(C_1-C_2)$. The potential difference between the roof and the head of the occupant of the shed can become high enough to cause a flashover without the shed being struck.

Nervous system

The centre for the control of respiration by the nervous system is in the lower part of the brain. There is strong evidence that the current has to go through it to stop respiration. Indeed, in so-called electric shock treatment for certain mental disorders it is extremely uncommon for respiration to remain stopped once the current has ceased to flow. There are a number of carefully reported cases in which high voltage or lightning currents passing through the respiratory centre have caused breathing to stop. Some victims have responded to prompt artificial respiration. A current pathway through the head and trunk seems to be more common in lightning than in electric shock accidents.

Using our knowledge of how death is caused by lightning, we can attempt to establish a rational basis for first aid. Simply stated, the victim's breathing or circulation – or both – might have stopped. No first-aid manoeuvre is likely to start either again, though fortunately respiration often starts spontaneously after an interval of anything from a few seconds to several hours. Obviously, except in cases of very short arrest, it is necessary to provide artificial respiration, by first aid and later perhaps in hospital, until breathing starts again. First-aid treatment for arrested circulation is, according to many authorities, not without serious dangers and should not be lightly undertaken. It would be prudent to learn from national first-aid organizations how these conditions may be diagnosed and treated.

Several simple precautions would reduce lightning accidents. An upright person acts like a lightning conductor and thus attracts a lightning strike over a distance which, as a first approximation, is proportional to the square of his height above the ground. It is, therefore, much safer to squat down than to stand up or, worse still, to stand in the top of a vehicle or structure. To increase one's effective height by carrying an umbrella or golf clubs, held upright, is foolish: better to get wet than killed. The risk of side flashes can be minimized by keeping at a distance of a few metres from other people when in a group, by *not* standing near the trunk of an isolated tree and by keeping away from large metallic objects both indoors and outdoors. Tents can be readily protected but it is a wise precaution to keep the greatest possible distance away from the tent pole or the wet fabric.

18 CHANNEL IS HERE!

From 1st September, 1977, only 16 channels on a 23-channel rig can be used legally.
Karinna introduces the KSB18, the most advanced CB on the Australian market today, manufactured by Cybernet, the world's largest and most respected manufacturer of CB.

Power input-output 5W-3W, output impedance 50 amps, synthesized frequency control, Dianamic microphone. Dimension: 150 mm x 130 mm x 40 mm.

18 channel
A.M. **RAIDER** #30500

PLL synthesized frequency, maximum output 12W-p.e.p. S.S.B, LED channel indicator, pos.-energy flowing chassis. Dimensions: 245 mm x 184 mm x 62 mm.,

18 channel
Karinna KSB18

Sole importers:

Karinna Sales Pty. Ltd.

QLD.	N.S.W.	VIC. & TAS.	S.A. & N.T.	W.A.
24 Light Street, Bowen Hills, Brisbane, 4006. Ph: 52 7916.	13-15 Newton Street, Auburn, Sydney, 2144. Ph: 648 4966	198 Burnley Street, Richmond, Melbourne, 3121. Ph: 429 1999	91-93 King William St., Kent Town, Adelaide, 5067. Ph: 42-5626	Unit 2, 4 Burgay Ct., Osborne Park, Perth, 6017. Ph: 446-9111.

STOCKS AVAILABLE SHORTLY FROM LEADING RETAILERS THROUGHOUT AUSTRALIA

TRADE ENQUIRIES ONLY TO YOUR NEAREST KARINNA STATE BRANCH

SOUND

HEIL BASS DRIVER

THE HEIL air-motion transformer first made its appearance in ESS' amt-1 loudpeaker system (reviewed and fully described) in the August 1974 issue of Electronics Today. In this application the new driver was used for mid-range and treble only.

From the time of the air motion transformer's introduction ESS apparently planned to produce a bass unit using similar principles. The fundamental difference between the Heil driver and conventional drive units is the rapid acceleration of large volumes of air from the drive radiating surface; air being squeezed out from between the Heil drive units' pleats.

The bass unit has so far not materialised as a production model. But many prototypes appear to have been made, using a wide variety of diaphragm materials and motor systems, and research has also involved enclosures and amplifier/Heil bass-unit relationships.

The first public audition of a Heil bass driver was given at the Sydney CES last year, using a specially modified ESS power amplifier. The amplifier was modified to reduce damping factor, because the drive unit itself is largely self-damped (to be discussed shortly) and additional damping from the amplifier was found to degrade performance. This prototype used a fairly conventional moving coil driver, but the coil former was not attached directly to the diaphragm but was linked to four vertical rigid rods. These rods were in turn bonded to a number of relatively small individually suspended diaphragms, made of a specially-developed formed-plastic material with integral suspension giving very long throw. Angled 'baffles' separated each diaphragm and these were so designed as to isolate front and rear outputs (of opposing phase) from the diaphragms.

The motor system operated in a vertical plane, thus causing the diaphragms to move up and down also. As the upper surfaces of the diaphragms move upwards,the volume of the cavities created by the diaphragm/baffles is reduced and so air is squeezed outwards from the cavities. At the same time, at the rear of the drive unit, the concurrent upward movement of the lower surface of the diaphragm increases the volume of the diaphragm/baffle cavity, drawing air inwards. Thus there is the same inhale/exhale characteristic of air movement as featured in the Heil high frequency drive unit.

A great advantage of this concept is excellent coupling of the diaphragm to the air. The radiating surface area is far greater than conventional speakers in which air is merely pushed or pulled by the diaphragm.

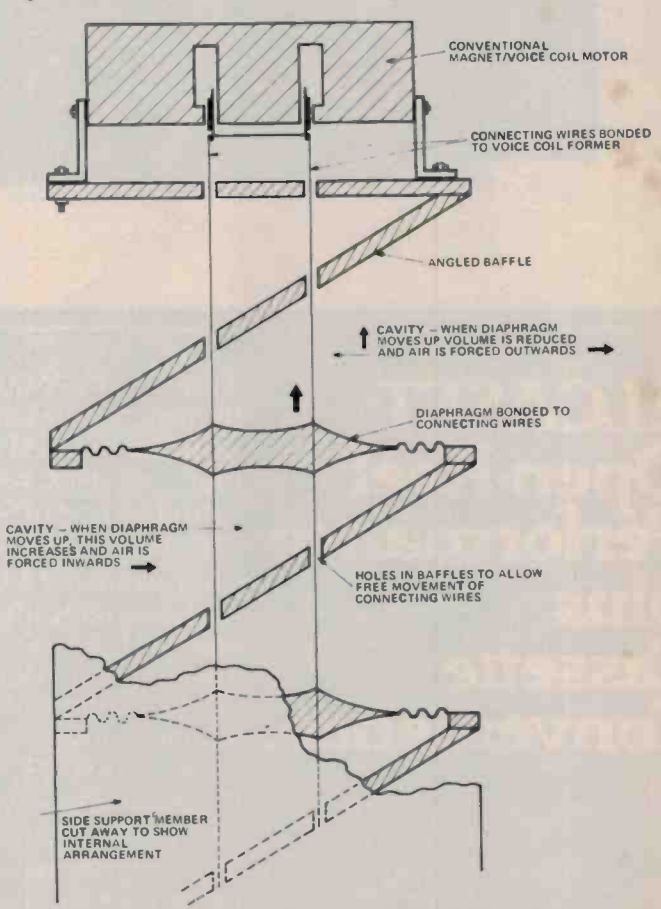
The moving mass of the Heil system relative to the amount of air displaced is far lower than in the vast majority of other speaker systems and as a consequence the air will damp the diaphragm to a greater extent than with conventional high mass dynamic cone systems.

Thus amplifier damping – which in effect shorts out the back-EMF caused by the coil's continuing movement after the signal has ceased – apparently modifies the natural motion of the Heil system sufficiently to prevent it from responding correctly to wanted output from the amplifier.

Possibly this need for an 'undamped' amplifier could be the main reason for delay in the appearance of the Heil woofer. It also seems likely that the amt-2 (which designation has been set aside for the full-range Heil system) will be a bi-amped or possibly tri-amped speaker, using suitable electronics at the bass end, fully integrated with the drive unit and its somewhat curious load demands, and a more conventional electronic arrangement for higher frequencies.

Only one Heil bass air motion transformer was available for the 1976 CES. Thus the demonstration was strictly mono, and imperfect matching between the HF system comprising a standard Heil unit, was used in the existing amt-1A, and the low frequency system did little to help matters. Nor did the crowded exhibition conditions. Nevertheless, the Heil woofer, mounted on a large open baffle, spoke more than adequately for itself, delivering the kind of bass quality expected only from the better transmission lines (and without their efficiency penalty) or uncompromised custom built systems.

The research and development carried out by Doctor Heil and his team at ESS has produced some very exciting results and it can only be a matter of time before the full range amt speaker system is a reality. When it does the unit should offer a truly first class performance at lower cost than conventional designs, dynamic or otherwise, can give at the present time.



This ETI-prepared drawing shows the most probable form of construction.

Pro. Series

ELCASET: Open-Reel Performance plus Cassette Convenience.

Technics RS-7500US tape deck is the result of the latest development in the era of taped music reproduction... the ELCASET... developed to bridge the gap between cassette and open reel decks.

The feature of ELCASET is that the tape is actually lifted out of its case onto the heads which remain stationary just like in open reel decks. This means stability in tape transport, minimising wow and flutter to 0.06% (WRMS) ±0.15% (DIN). Because the tape width is the same as standard audio tape used in open reel decks, and the tape speed is twice as fast as cassette tapes, ELCASET attains greater dynamic range and wider frequency response ratings than cassette performance and even many good open-reel decks.

Besides maintaining the same simple cassette loading and unloading operation the RS-7500US features automatic tape selection (with type indicator lights) and full auto-stop to eliminate strain on tape or transport mechanism.

In every way the Technics tape deck RS-7500US represents a very significant advance in tape technology... offering quality in simplicity.

National Technics hi-fi

T77.13

WARRANTY AND SERVICE BY HACO

For a National Technics catalogue, please write to:
National Technics Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033

ELCASET-WHAT FUTURE

IT IS DIFFICULT to be optimistic about the future success of a totally new tape format. Such is the situation with Elcaset, a compromise between the compact cassette and open reel tape, with the consequent advantages and disadvantages of both.

Elcaset has been developed by a consortium of Japanese 'heavies' including Matsushita (National/Technics), Sony and TEAC. The basic concept is to provide open-reel performance with cassette convenience. A similar idea was developed by BASF's Unisette which appears to have taken off with much the success of a concrete Zeppelin.

But Elcaset *could* be different. Already hardware is available from Technics, Sony and TEAC; tapes are also available, as yet unrecorded. But at least it's a start and makes Elcaset worthy of a long and serious appraisal by commercial recording companies, tape and equipment manufacturers and, of course, consumers.

The Elcaset itself is slightly smaller than a normal paperback book. It looks like a larger version of the compact cassette, but there are detail differences. Most are clearly the result of experience with compact cassettes – erase prevention tabs, for example, are retractable or completely removable (and replaceable) to avoid the hassles of putting self-adhesive tape over the erase prevention slots – as is necessary when a protected compact cassette is to be re-recorded. Another feature is automatic hub locking when the Elcaset is removed from the machine. This reduces the possibility of tape spillage. Yet should it be necessary to wind the tape by hand, for editing, perhaps (and this is a possibility with Elcaset, not a nightmare!) the locking mechanism can easily be released.

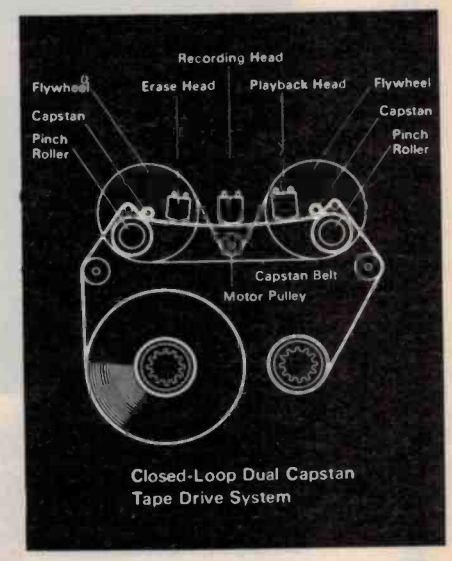
Tape/head interface in the Elcaset format is a vast improvement over the compact cassette system. Heads are fixed, thus maintaining greater stability than the moving platform of a compact cassette machine. Tape is lifted out of the Elcaset shell and, in the Sony and Technics machines we have seen, follows open-reel "wrap around" principles instead of using pressure pads for good contact. Sprung protector guide arms, closed when the Elcaset is not in the machine, swing open during use. The oxide tape surface faces outwards but is rather better protected than in compact cassettes.

The tape itself is standard open reel width, and standard tape speed is 95 mm per second. The net result of increased speed, increased tape width and more generous physical separation between tracks is to give more than three times greater contact of tape surface to head per unit of time. Presumably it would also be feasible to produce a discrete four-channel configuration to give both adequate performance and compatibility with the existing quarter-track stereo system, effectively an impossibility with compact cassettes using existing technology.

All this adds up to potential performance rivalling good open-reel standards. Both Elcaset machines we've tried compare favourably with Revoxes and the like in terms of overall response, distortion, channel separation and signal-to-noise ratio. Dolby 'B', a necessary evil with most compact cassette systems (evil because of the curious distortion it can introduce if record and replay calibrations are not entirely complimentary) would appear to be unnecessary with Elcaset because of the inherently excellent signal-to-noise performance.

And then there's convenience, Elcaset is as easy to use (possibly even easier) as a compact cassette. The size also lends itself more easily to the kind of artistic licence, available with gramophone records, that would help make the format a more attractive proposition for buyers of commercial recordings – like our publisher who has long maintained his firm preference for discs on those grounds alone: he likes looking at the pix and reading the notes.

TEAC's just-released AL-700 Elcaset deck.



Elcaset tape transport system as used by TEAC. Technique is very similar to the best reel-to-reel machines.

Sansui Stereo Integrated Amplifier: The Super Power Package.

From Sansui, the Stereo Integrated Amplifier AU20000, a super power package that pushes out 170 watts per channel. We call it integrated because it is a combination of the Definition BA-3000 power and CA-3000 preamplifier within the one unit.

That means the AU20000 is more compact to handle and is available at a price to please every true audiophile.

Specifications

Power Output: Min. RMS, both channels driven, from 20 to 20,000Hz, with no more than 0.05% total harmonic distortion 170 watts per channel into 4 and 8 ohms.

Power Bandwidth: 20 to 20,000Hz at or below rated min. RMS power output and total harmonic distortion.

Total Harmonic Distortion: Overall (from AUX) less than 0.05% at or below rated min. RMS power output.

Intermodulation Distortion: (70Hz:7,000Hz = 4:1 SMPTE method). Overall (from AUX) less than 0.05%.

Frequency Response (at 1 watt):
Overall (AUX to power output)
10 to 50,000Hz + 0dB, −1.0dB
Power Amplifier Only
10 to 70,000Hz + 0dB, −1.0dB

Damping Factor: approximately 80 to 8 ohm load

Channel Separation at rated output 1,000Hz:
Phono 1–better than 55dB
(at 3mV sensitivity)
Phono 2–better than 55dB
(at 3mV sensitivity)
Tuner–better than 60dB
Aux–better than 60dB
Tape Monitor–1,2,3 better than 60dB
Power Amplifier–better than 65dB

Available from all leading Hi-Fi specialists

Sansui

Sold and serviced nationally by Rank Australia.
Sydney (02) 406 5666
Melbourne (03) 62 0031
Brisbane (07) 44 2851
Adelaide (08) 212 2555
Perth (092) 28 3933

We Keep Performing.

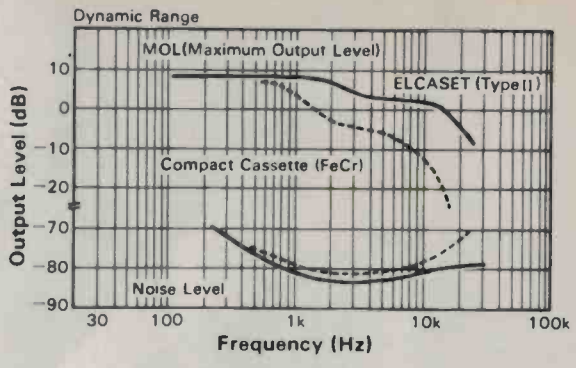
RANK AUSTRALIA

CU148/77

This can be interpreted to mean that Elcaset is likely to succeed if the commercial houses issue pre-recorded Elcasets (Music-Elcasets?) and a comprehensive catalogue at that. The technical performance, the advantages, the convenience, are unlikely to succeed unless the tangible benefits are put forward in a relatively aggressive way. This would entail issuing a good catalogue at competitive prices.

Which brings us to cost. In time it's conceivable that Elcaset software will be only a little more expensive than compact cassette equivalent. Material costs will account for most of that difference although the larger size, extra weight and presumably slightly longer manufacturing time must also be considered. Nevertheless it would appear *feasible* to issue pre-recorded Elcasets at much the same price as Musi-cassettes, although doubtless the record companies would manifestly show the falsehood of this assumption!

We ourselves hope the Elcaset format will succeed. In areas where the compact cassette is restricted — such as automatic bias/EQ switching to suit tape coating formulation, the ease of adding a third head, the potential for low wow and flutter by use of balanced dual-capstan drive systems with capstans of large diameter and so on — the Elcaset is a clear leader. It doesn't have quite the creative potential of high-speed open-reel though we doubt if its success would have any serious effect on the existing overall open-reel situation, which has settled down to a smallish but consistent portion of the market. Cost and availability of pre-recorded tapes are the barriers, and if these can be broken down, then the future of Elçaset is assured.



This graph — reproduced by courtesy of TEAC — shows the huge improvement in performance that is possible from the Elcaset format.

SME'S New Arm

It's been a long time since SME introduced a radical change in its precision pickup arm design, and in some respects the current 3009 is exactly the same as the original product. In fact, SME has always made a point of producing new models which are based fundamentally on the earlier version, to the extent that an early 3009 could be returned to the factory for modification into the latest form. Thus the owner of a series I 3009 could easily upgrade to a series II/improved without the expense of purchasing the new model.

But with the introduction of the latest model (recently released in the U.K.; no indication of date of introduction in Australia yet) SME has turned to an almost complete redesign, only certain odd bits and pieces (such as the mounting base, pivot system and bias pulley support strut) appearing to be the same as before.

The most obvious change is shape. SME has at last employed an S-shape tube, obviating the need for a lateral balance system essential with the old J-shape. The tube is constructed of titanium, potentially lighter yet more rigid than aluminium, with obvious advantages in terms of reduction of mass and suppression of resonances. A fixed carbon-fibre headshell is included, but in the interests of easy cartridge-changing SME has elected to make the entire tube detachable, using a locking-collar arrangement a la Stax; close to the pivot.

Tracking force is applied using separate weights loaded into a sliding tray. Bias compensation is still by means of the proven thread-and-weight system but adjustment is now infinitely variable between minimum and maximum limits and less hit-or-miss than the old system.

Variable viscous damping is provided and this should now enable SME's to perform adequately (not always the case with undamped 3009's) with moving coil and Decca cartridges, although arm damping should, in theory, give benefits with all cartridges.

Well, it looks like a winner, and although the British price of the new arm is considerably higher than that of the 3009, meaning the Australian price could possibly be outrageous, it seems very likely SME might once again claim rightly to be "the best pickup arm in the world" . . .

SOUND BRIEFS

HEIL WOOFER

What appears to be (at last!) a **production version of Dr. Heil's low-frequency loudspeaker system** was shown at the Summer Consumer Electronics Show in Chicago. Called the Transar, it is fundamentally similar to the Heil woofer seen at the Sydney C.E.S. in 1976, and described in this issue.

NEW TANNOY

Tannoy's new Buckingham speaker enclosure is a radical **departure from tradition.** It incorporates three drive units — two of which are woofers, the third a dual-concentric midrange/HF unit fitted with an acoustic lens for improved treble dispersion.

MARK LEVINSON

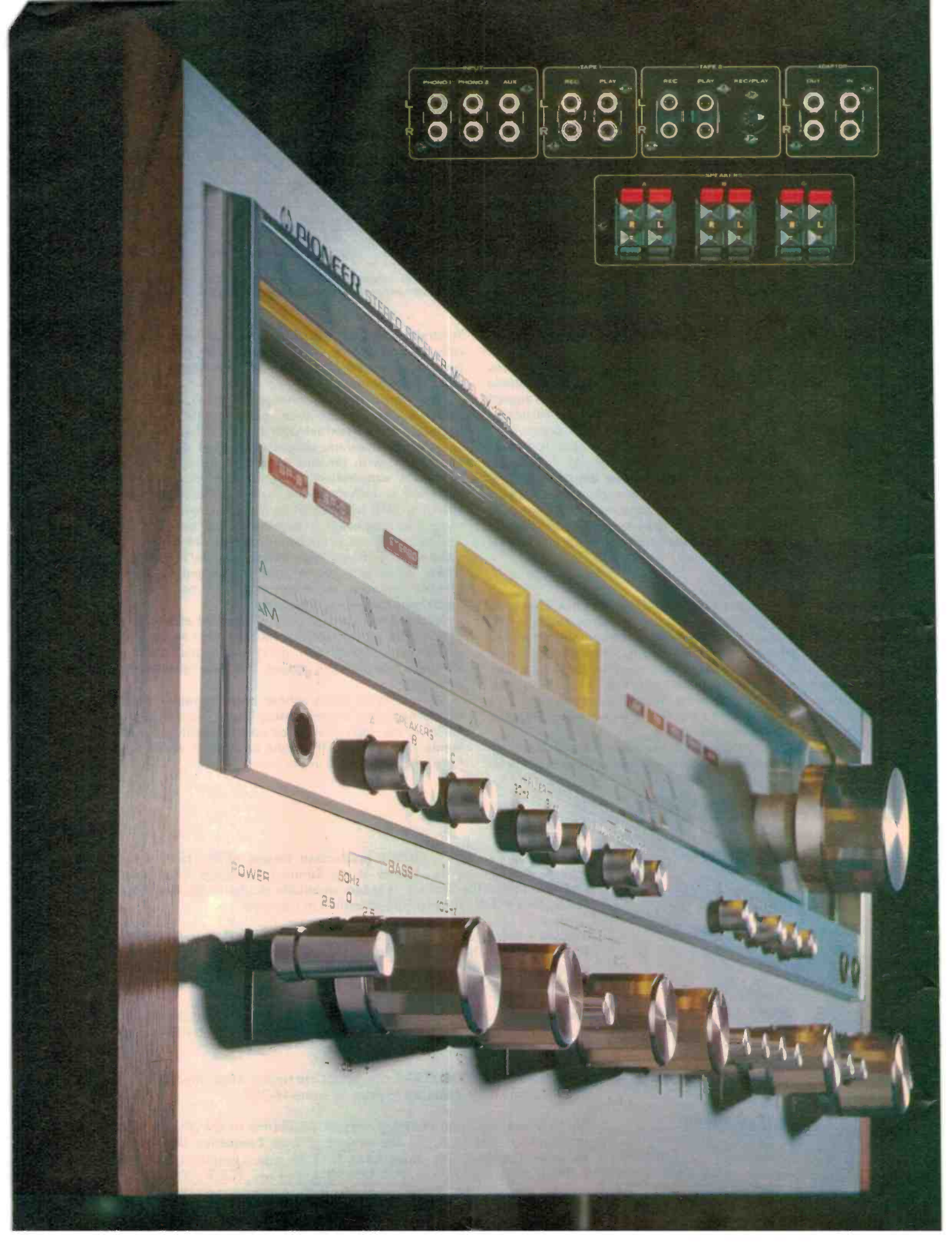
Mark Levinson, whose excellent preamp is financially beyond the reach of most of us, has introduced a **Class-A transistorised power** amp which will probably also be beyond the financial reach of most of us.

UP WITH THE POMS

Price increases on British hi-fi equipment are tipped. Most imported British equipment appears to be going **up in price** by some 15-20%.

PHILIPS PAPER

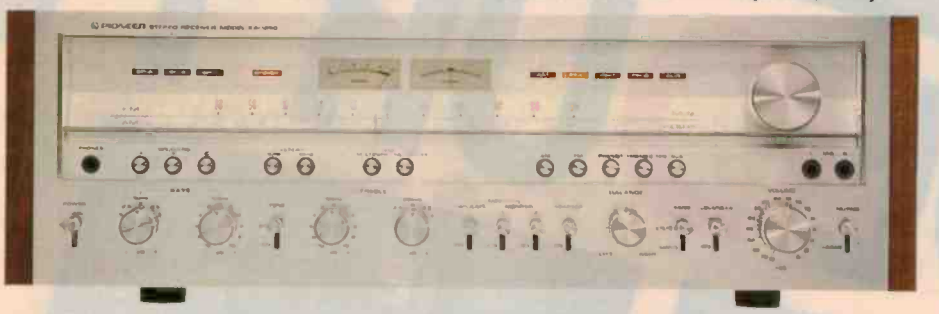
We have received from Philips a copy of an address to the AES Paris Convention in March of this year, on the subject of **Low Frequency Distortion in Loudspeakers.** The Paper was presented by Ir. D. Hermans. Enquiries should be directed to Philips, Elcoma Division, P.O. Box 50, Lane Cove, N.S.W, 2066.


PHONO 1
PHONO 2
AUX
REC
PLAY
REC
PLAY
REC/PLAY
OUT
IN
PIONEER
POWER
BASS
50Hz

"The world's first super receiver is naturally the finest."

The Pioneer SX-1250 started this trend to the so-called super receiver. And as the trend-setter, there is none other to compare with its technological artistry, stereo efficiency and total performance.

Receivers we've always had. In fact, in the United States and probably throughout the world, Pioneer's range of receivers outsells all others. But super receivers are a different matter. They were born when Pioneer combined the qualities of an exceptional tuner with those of an all-powerful amplifier.



Pioneer rates the SX-1250 at 160 watts per channel (min) RMS at 8 ohms. While Stereo Buyers' Guide* tested the SX-1250 at 190 watts per channel under the same conditions. So on this basis, there's more than ample for even the most power-hungry speakers.

Power however is only one facet of technological artistry. You must also listen closely to the SX-1250 to appreciate its wealth of features and facilities.

In the critical area of FM stereo reception, this receiver embodies the very latest in electronic circuitry. There is no skimping.

Even in the AM stage, it was and possibly still is, the only receiver (or tuner for that matter) to pay genuine attention to signal quality.

A twist of the station selector knob confirms a degree of engineering expertise possessed by few other receivers. Watch the flywheel-powered cursor travel effortlessly along the widely calibrated dial and you'll know the same attention to detail is found throughout the SX-1250.

In the same way, a glance along the control panel reveals an unusually ordered elegance. A complete command facility where power and precision come together in beautiful harmony.

In the world of stereo receivers, the SX-1250 stands supreme as the complete masterpiece.

Amplifier Section

Frequency response	5 Hertz — 100,000 Hertz + 0 dB — 1 dB
Power output	160 watts per channel min RMS at 8 ohms.
Total Harmonic Distortion	no more than 0.1% (continuous power output)

Tuner Section

Usable sensitivity	Stereo, 14.5 dBf (2.9μV)
50 dB Quieting sensitivity	Stereo, 36.0 dBf (35μV)
Alternate channel selectivity	83 dB
Distortion (at 65 dBf): 1 kHz	0.1% (m) 0.2% (s)

All Pioneer receivers are covered by warranty for two years. Excellent service facilities are available throughout Australia via a network of Pioneer outlets.

To Pioneer Electronics,
PO Box 295, Mordialloc,
VIC. 3195

Please mail me: (Tick as required)

- ☐ SX-1250 Receiver Folder.
- ☐ Folders on other components of equivalent compatibility.
- ☐ Other (please indicate).

.....

Name .....

Address .....

..... State..... P'Code.....

PN149

Australian Hi-Fi Stereo Buyer's Guide '77 Manual pages 182-184.

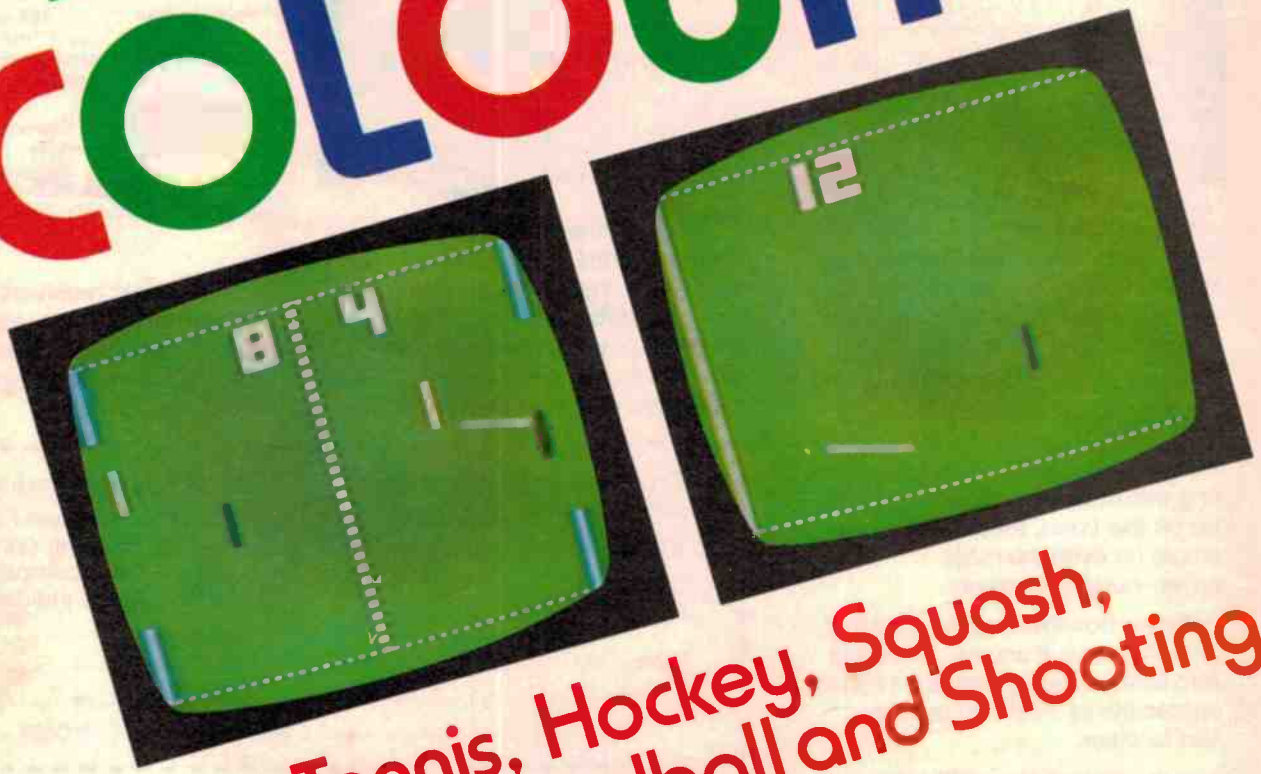
PIONEER®

leads the world in sound

SPECIAL READER OFFER!

$59

COLOUR TV



Tennis, Hockey, Squash, Handball and Shooting!

.95

Plus $2.75 postage and packing

GAME

HERE'S A TV GAME with a difference.

This one produces a full colour picture AND includes a rifle attachment that really works!

This magazine has arranged with Educal in Melbourne to supply ETI readers with these brilliant new units at the special introductory price of $59.95 (plus $2.75 post and packing).

As supplied the units are battery operated (batteries not included) however, a mains adaptor is available for a further $5.00 (incl. post and packing).

The units connect directly to the antenna input terminals at the back of your TV and are factory pre-tuned to work on the Australian Channel 8 frequency.

COLOURS
The background colour is green, one 'sides' bats are blue — the opposing ones are white.
Targets are white.

GAMES
Switching is provided for simulated tennis, hockey, squash, handball and target shooting (using the rifle supplied).
Unlike most TV games currently on the market, the rifle operates at distances of at least two metres and is not affected by ambient lighting.
In most games it is also possible to adjust target and angle — and, where relevant — bat size.

GUARANTEE
Units are guaranteed against electrical failure for a period of 90 days from date of delivery. Faulty units must be sent postage paid to Educal, 21 Wells Avenue, Boronia, Vic. 3155, not, repeat NOT to this magazine. Return postage will be paid by Educal.

DELIVERY
All orders will be despatched from Melbourne by certified mail. Please, please allow at least three to four weeks for delivery. Inspect the package when received and refuse delivery if damaged in any way.

Send to:
TV GAME OFFER
ELECTRONICS TODAY INTERNATIONAL
15 BOUNDARY ST RUSHCUTTERS BAY NSW 2011

Please forward ..... Colour TV Game/s at $62.70 each including postage and packing ..... Mains adaptor at $5.00 each Including postage and packing ..... I enclose herewith cheque/postal note total ..... accordingly. Please make cheques etc payable to 'Colour TV Game Offer'.

Name..... Address.....

..... Post code .....

Signature.....

Use plain paper if you prefer not to cut up your copy of this magazine.

Offer closes December 31, 1977

FANTASTIC OFFER!!

It's you against the computer.

The first microprocessor based chess game, using an 8080A C.P.U. It utilizes an 8224 clock generator/driver, 8228 system controller, 512 8-bit bytes of random access memory, that stores the position of the chess pieces, and a 16,384-bit read only memory. Software contains such elements as the rules of chess, the relative importance of the pieces, allowable moves and strategies. The micro computer plays by the book, working on the weighted value of the pieces, and completely scanning the board for the best available move each time. It plays aggressively, tries to control the centre of the board, and, if it's in trouble, will try for a stalemate.

The keyboard can be used to verify the position of each chess piece at any time during the game.

It's easy to play: Just plug in and bring a new dimension of suspense and excitement to this internationally famous game.

This is a beautifully finished, top-quality product at the special introductory price of $385.25 delivered free anywhere in Australia.

To order or for information contact:

Future tronics pty. ltd.

527 TOORONGA ROAD, HAWTHORN EAST, VICTORIA. AUSTRALIA. TELEPHONE (03) 82-3732

Electronics Today International

4600 and 3600

SYNTHESIZERS

Complete plans for the Electronics Today International 4600 Synthesizer are now available in book form. Many hundreds of these remarkable synthesizers have been built since the series of construction articles started in the October 1973 issue of Electronics Today.

Now the articles have been re-printed in a completely corrected and up-dated form.

The International Synthesizers have gained a reputation as being the most flexible and versatile of electronics instruments available.

They have been built by recording studios, professional musicians, university music departments and as hobby projects.

This book is available now as a limited edition of 2000 copies only.

Ensure your copy!

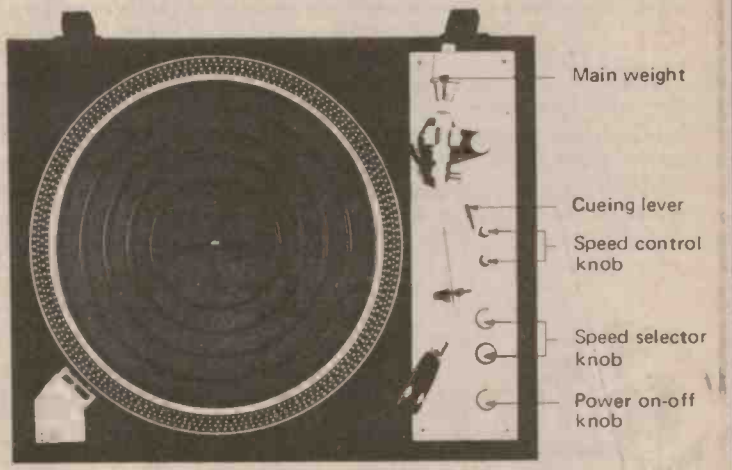
Send $12.50 to Electronics Today International, 15 Boundary Street, Rushcutters Bay, 2011.

DENON

The Professional Audio Brand

providing a direct drive system with the following features:—

- HIGH ROTATIONAL ACCURACY
- 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



In other words, the

SL-7D Direct Drive Turntable

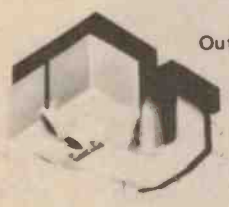
MOVING MAGNET CARTRIDGE

DL-107

Output voltage: 2.0 mV (1 kHz 50 mm/sec)
Frequency response: 20 ~ 30,000 Hz
Tracking force: 2.0 ± 0.3 gr
Compliance: 8×10^{-6} cm/dyne
Weight: 8 gr

MOVING MAGNET CARTRIDGE

DL-109D



Output voltage: 3 mV (1 kHz 50 mm/sec)
Frequency response: 20 ~ 50,000 Hz
Tracking force: 1.8 ± 0.3 gr
Compliance: 9×10^{-6} cm/dyne
Weight: 7.5 gr

INTEGRATED STEREO AMPLIFIER

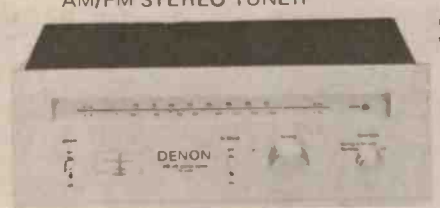
SA-3300

- Wide power band (5Hz-55kHz/-3 dB at rated output).
- Audio muting switch.

Rated output 30W 30W
Dimensions 390 (W) x 145 (H) x 258 (D) mm.

AM/FM STEREO TUNER

ST-3300



- High performance MPX circuit uses phase lock loop circuit.

Automatic muting circuit and high blend switch.

For further information please contact:

Hi-Fi Audio Equipment

554 Parramatta Rd., Ashfield. NSW. 2131 Telephone: 797-5757

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

CANBERRA	NEWCASTLE	MELBOURNE	BRISBANE	TOWNSVILLE	ADELAIDE	PERTH	HOBART	LAUNCESTON
953431	25166	5604533	441631	796155	2722366	710888	345266	445155

AD A4

Solid State Keying for Electronic Organs

Solid-state keying technique eliminates problems associated with multi-contact keyboards. This article by Nick Labordus explains the circuitry and methods used.

IN ORDER TO OBTAIN FULL sounds and a wide range of musical colouring from an electronic organ it is essential that each key initiates a number of harmonics simultaneously. In most organs this is achieved by individual keys activating a number of contacts, each of which connect a different harmonic to the audio system.

These multiple contacts are one of the major stumbling blocks for building one's own organ. They are difficult to purchase and even more difficult to make. And, unless the contact material is of very high quality, sooner or later the owner will be confronted with problems caused by contact corrosion. Another practical limitation of multiple contact systems is that once the organ is built it is difficult to extend the number of contacts under each key.

The solid state keying system described here presents an easy solution to these and other problems.

In the course of building the organ, various circuits also were used which may be of interest to other organ builders. In all circuits, a uniformity in components was aimed at, for reason of price (bulk purchase) and service in the future.

Although the emphasis of this article is on solid state keying, an overall schematic of the complete organ is given in Fig. 1. This may serve for a better

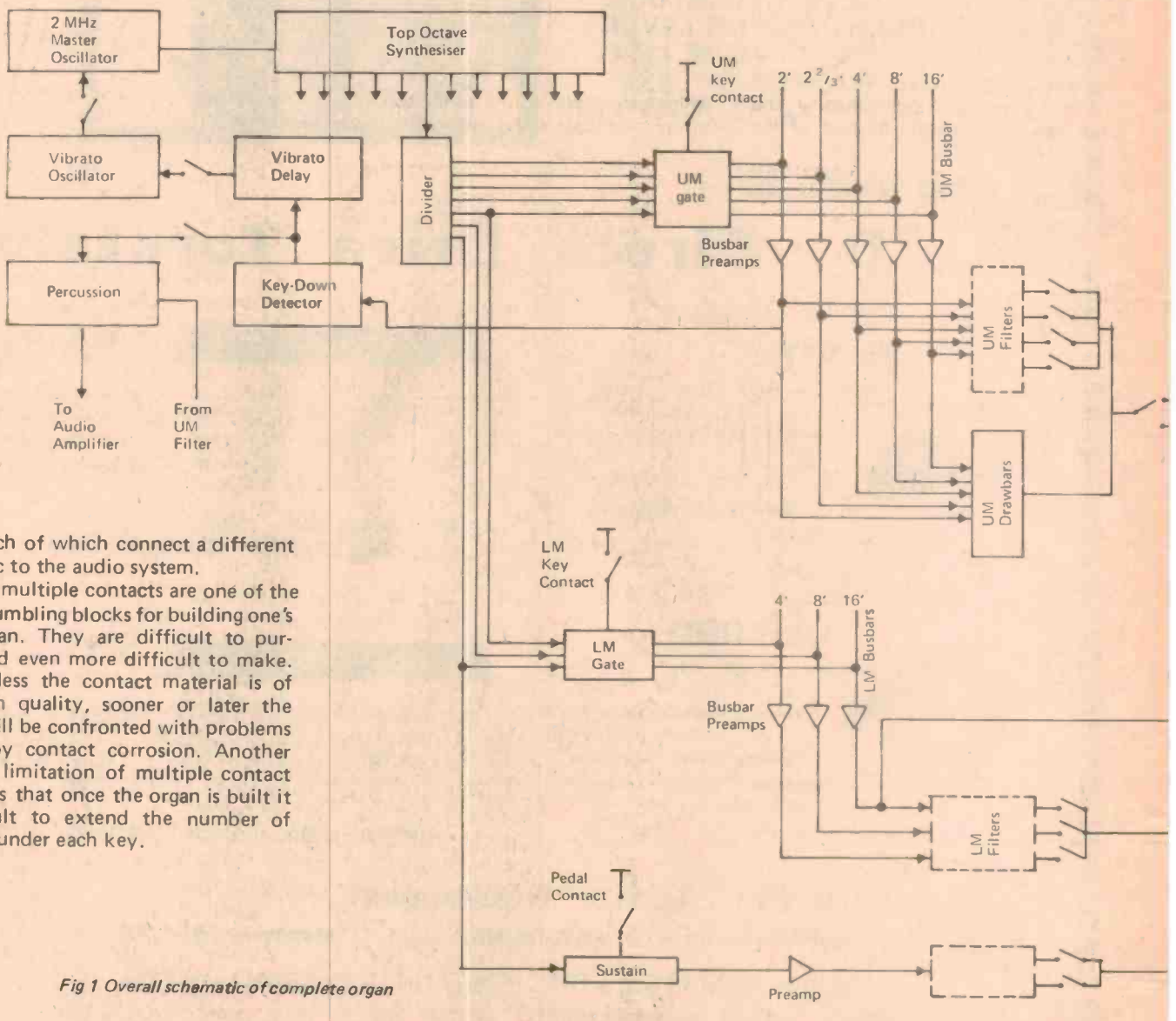


Fig 1 Overall schematic of complete organ

general understanding of the keying circuits and some other circuits described. These circuits are indicated in the diagram in full lines – other circuits – not described in detail, are indicated in dotted lines.

A master oscillator feeds a 2 MHz signal into the top octave synthesizer, which delivers at its output the 12 frequencies at the highest octave (C.....B) as block pulse signals. The master oscillator can be modulated with a low frequency signal generated in the vibrato oscillator. The vibrato signal can be applied directly or via a delay unit, triggered by the key-down detector.

Each of the 12 output frequencies of the top octave synthesizer is fed into a divider circuit. The output of each divider delivers seven tones, each a factor 2 lower than the previous one. These frequencies represent the harmonics of one tone in the octave.

The upper and lower manual keyboards have one contact under each key. All contacts close to a common earth rail if keys are pressed down. Each contact activates a solid state gate which connects simultaneously five harmonics to busbars of the upper manual and three harmonics to the busbars of the lower manual.

From each busbar, block pulse signals are fed to preamplifiers and subsequently to a series of fixed filter circuits, which give preset colour to the tones by subtracting harmonics from the block pulse signal.

The five busbars of the upper manual are also fed to a set of five sine wave shapers followed by drawbars. By selecting certain positions of the drawbars relative to each other, sine wave frequencies are added in certain ratios and an infinite range of tone colouring can be obtained.

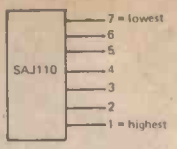
The 13 pedals have one contact each. These connect the lowest output frequencies of the dividers to filters via a sustain circuit. The output of the filters and drawbars is fed to the audio

The tone signals can be channelled through a tremolo unit, an after vibrato circuit, and/or a phasing unit to be fed directly to a preamplifier/reverberation system, that also collects signals from the rhythm unit and the auto bass. All signals are fed to a stereo power amplifier and a system of fixed and rotating (Leslie) speakers.

The upper manual 2' busbar signal is also connected to the key down detector which provides a dc signal each time a key is pressed. This signal is used to trigger the delayed vibrato circuit and the percussion circuits.

Any combination of fixed filters, drawbar settings and percussion effects is possible, giving the organ a wide range of possible sounds.

A central supply unit provides adequate power to all circuits.

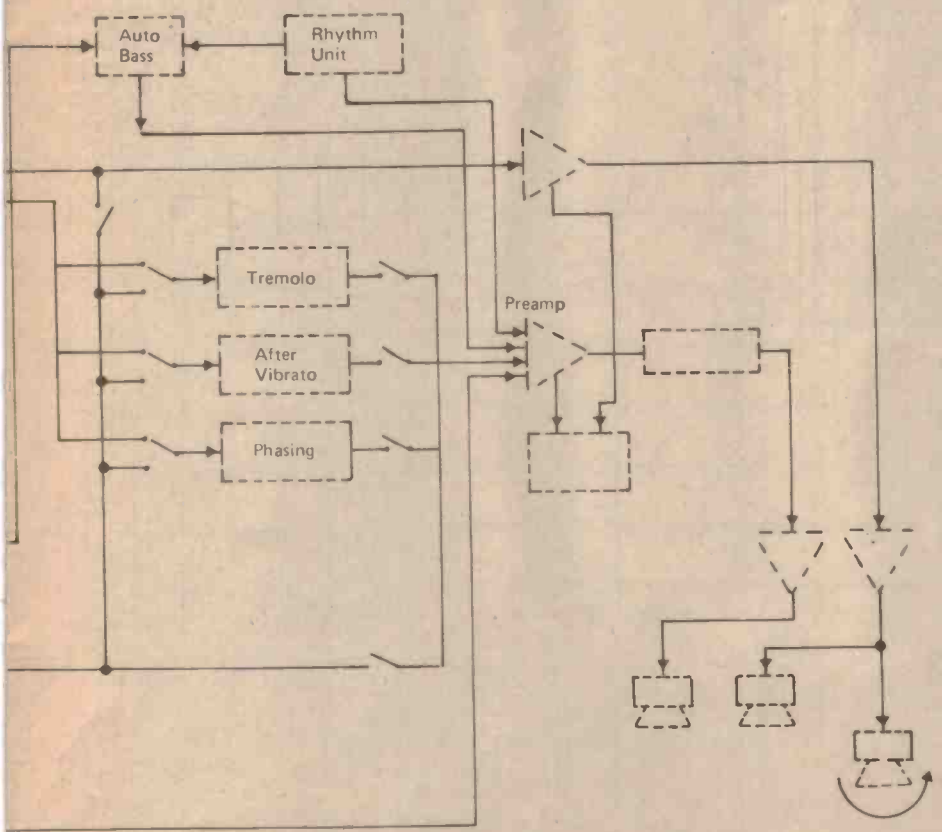


Upper Manual		F_4	B_4	C_3 ..... E_3	F_3 ..... B_3	C_2	E_2	F_2	B_2	C_1	E_1	F_1	B_1	43 Keys
Busbars	16'	7	7	6	6	5			5	4			4	
	8'	6	6	5	5 5 5	4	4	4	4	3	3	3	3	SAJ110
	4'	5		4	4	3			3	2			2	Connections
	$2^2/_3$'	C_6	$F_4^\#$	G_4	B_4 C_5 $F_3^\#$	G_3	B_3	C_2	$F_2^\#$	G_2	B_2	C_1	$F_1^\#$	
	2'	4	4	3	3	2			2	1			1	

Lower Manual		C_4 ..... E_4	F_3 ..... B_3	C_3 ..... E_3	F_2 ..... B_2	C_2 ..... E_2	F_1 ..... B_1	C_1	E_1	41 Keys
Busbars	16'	7	7	6	6	5	5	4	4	SAJ
	8'	6	6	5	5	4	4	3	3	Connections
	4'	5	5	4	4	3	3	2	2	

Pedals		C ..... B	C	13 pedals
	16'	7 7	6	SAJ110 connections

TABLE 1



THE MASTER OSCILLATOR

The central part of the organ is the top octave synthesizer Mk 5024 P/AA (Mostek). This I.C. accepts an input frequency of 2 MHz and delivers at its output the 12 frequencies representing all tones of the highest octave of the keyboard.

Karl Marx, Bertrand Russell and Maynard Keynes do not write for CB Australia.

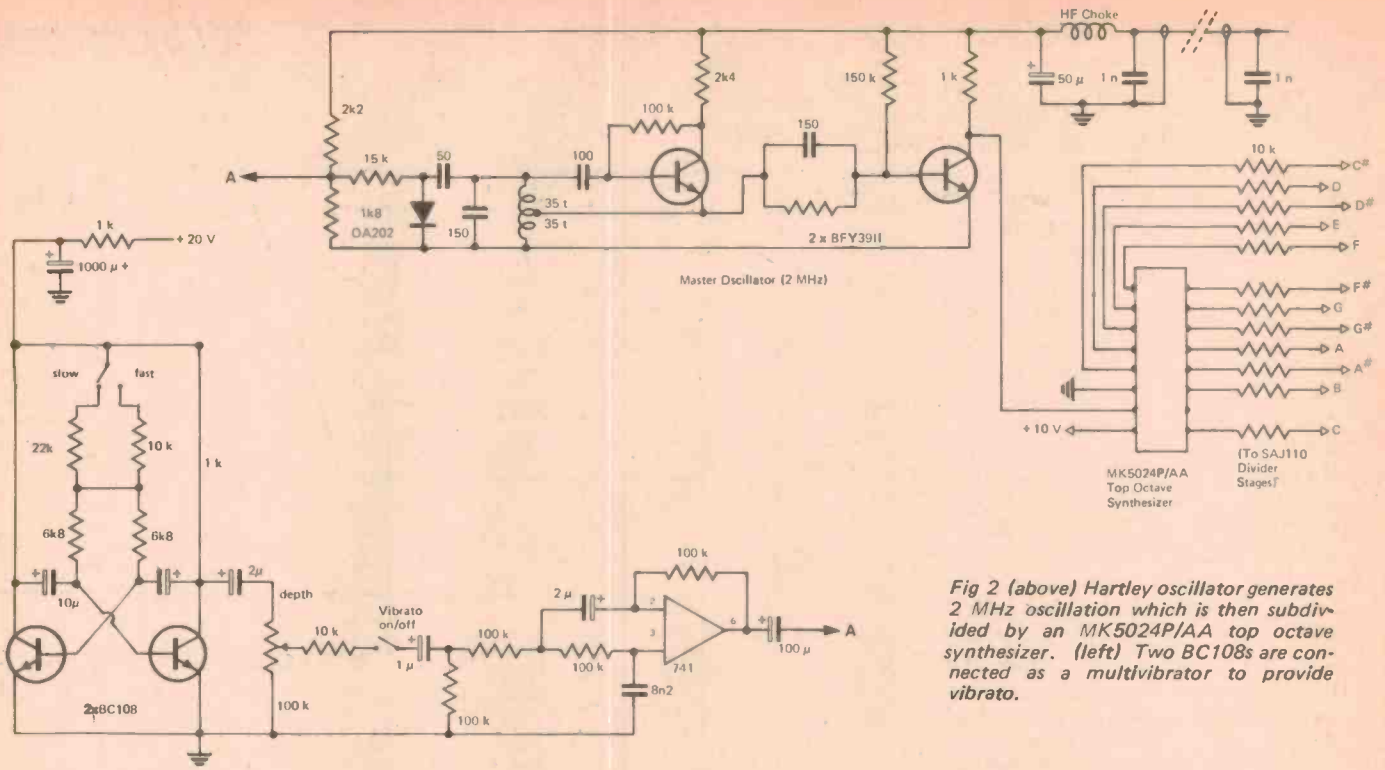


Fig 2 (above) Hartley oscillator generates 2 MHz oscillation which is then subdivided by an MK5024P/AA top octave synthesizer. (left) Two BC108s are connected as a multivibrator to provide vibrato.

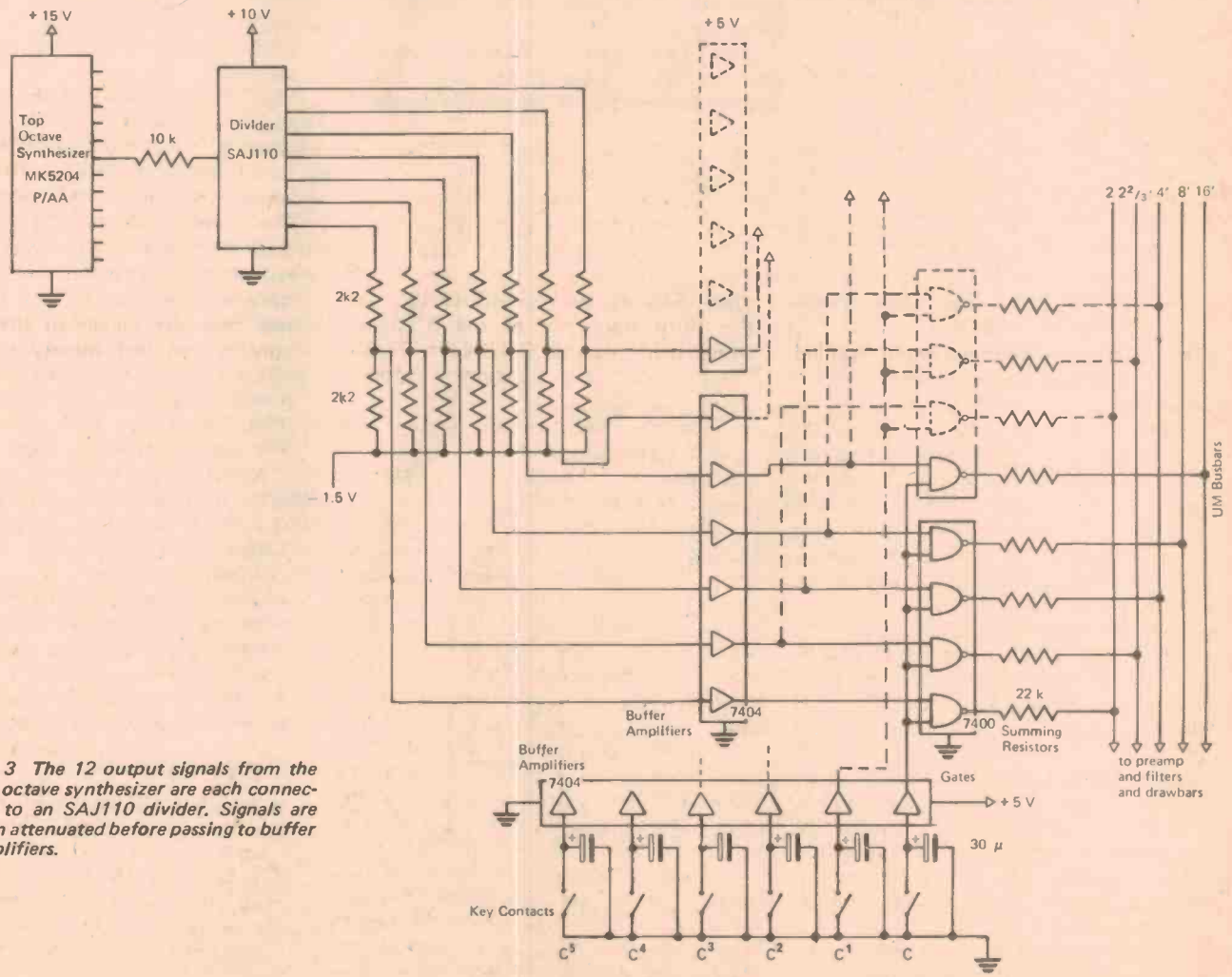


Fig 3 The 12 output signals from the top octave synthesizer are each connected to an SAJ110 divider. Signals are then attenuated before passing to buffer amplifiers.

The 2 MHz frequency is generated by a Hartley oscillator with buffer-amplifier (2 x BFY39), which delivers a 15 V amplitude blockpulse signal. Frequency adjustment (tuning of the whole organ) is achieved by varying the core of the oscillator coil.

Parallel to the oscillator tuning capacitor is a diode, which acts as a parallel capacitor. A dc signal, applied to this diode, will change its capacity and slightly alter the frequency of the master oscillator. By applying a 7 Hz ac signal to this diode, a vibrato effect (frequency modulation) is obtained for the total organ. The low frequency vibrato signal is obtained from a multivibrator (2 x BC108) which frequency can be set in two speeds by altering the base resistors. The block pulse signal of this multivibrator is fed through a sine filter before being applied to the master oscillator.

SOLID STATE KEYING

As stated before, the problems with key contacts are many:

- they are difficult to purchase and when purchased, are difficult to install,
- they are even more difficult to make,
- they tend to give problems due to corrosion,
- once installed, it is difficult to extend the number of contacts per key,
- long cable trees are necessary to connect all contacts with the circuitry,
- these cables carry tone signals which may result in "singing".

The solid state keying system applied here overcomes these problems to a large extent.

The 12 output signals from the top octave synthesizer are each connected to a divider SAJ 110. This IC provides seven output signals, each half the frequency of the previous one. This means, that in total seven octaves of each of the 12 tones in an octave are available (e.g. E1–E7).

As the output signals from the SAJ110 have an amplitude of 0–+10 V, and where the following buffer amplifiers and the gates only accept 0–+5 V, each output is fitted with an attenuator 1:2 (2 x 2K2), the bottom end of which is connected to –1.5 V to ensure a signal zero level that is below the minimum trigger level of the following buffer-amplifier 7404. These buffer-amplifiers are necessary to provide enough power to feed several gates simultaneously.

In order to get a full sound from an organ, it is necessary to switch (with one key) a number of harmonics simultaneously to the audio system. With this organ, five harmonics were chosen for the upper manual and three were chosen for the lower manual. So, if the middle C is pressed on the upper manual, not only the corresponding 262 Hz (8') signal is connected but also the 131 Hz (16'), 524 Hz (4'), 1048 Hz (2') and the third harmonic of the 8' signal, which is in this case G (784 Hz, $2^2/3'$). Table 1 gives all connections as applied in the organ.

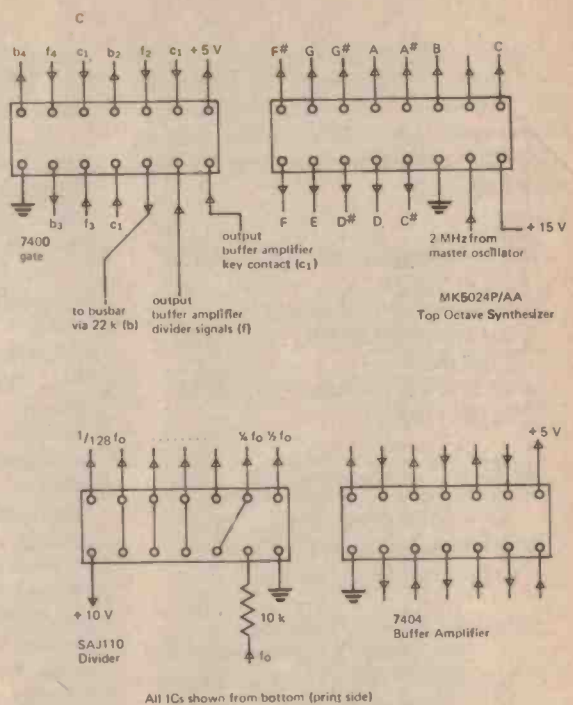


Fig 4 Connections of ICs referred to in this article.

It is thus necessary to activate five switch contacts simultaneously per key for the upper manual and three for the lower. Instead of making five switch contacts per key (which must each be double-pole to provide short circuit to mass in order to prevent undesired singing), the solid state keying system needs only one common rail (mass) and one "make" contact under each key. In the organ described, the contacts and common rail are chromium plated. As they switch a control signal (0, 5 V), corrosion effects can be neglected.

In the rest position all contacts are floating. When a key is pressed down, the contact touches the mass-rail and connects the input of one of the six inverting amplifiers of a 7404 IC to mass. The output signal from the amplifier in the rest position of the key is 0 V, simulating the mass position of the conventional key contact. When the input of the amplifier is connected to mass, the output shows +5 V. This +5 V signal is fed simultaneously to five gates (combined of 1 1/4 7400 IC's with four gates in each IC). These gates open and allow five signals from the divider SAJ110 and the buffer amplifier to pass to the relevant busbars via 22 k summing resistors. In fact, the gates do not pass the signals in the same way contacts do but merely react to the block pulses at the input, producing an equivalent signal at the output.

In order to avoid keying clicks, miniature capacitors are connected between contacts and the common rail. In the organ described, all IC's are mounted on Veroboards, which are plugged into sockets. This allows extremely short cabling and the only long cable tree necessary leads from the single pole key contacts to the sockets. As this cable does not carry tone frequencies, any interference (singing) is avoided. Although the number of IC's needed seems quite staggering, the total cost is lower than for an equivalent contact system.

Extension of the number of contacts at a later stage is easy. The only change necessary is connect some more 7400 IC's to the system. It is important to design the power supply in such a way that such future extensions are possible. The 7400 and 7404 need approximately 5 V – 20 mA.

Solid State Keying for Electronic Organs

In the organ described, the upper manual has 43 keys with five gates each and the lower manual 41 keys with three gates each. This means that in total the following quantities of IC's were required.

Dividers:
SAJ110 buffer amps: 12 x SAJ110 (84 outputs)
Key contact buffer amps:
upper manual 43 keys – 8 x 7404 (6 per chip)
lower manual 41 keys – 7 x 7404 (6 per chip)

Gates:
upper manual 43 keys x 5 gates 54 x 7400 (4 per chip)
lower manual 41 keys x 3 gates 31 x 7400 (4 per chip)

Total: 12 x SAJ110 dividers
29 x 7404 TTL hex inverters
85 x 7400 TTL quad 2 input nand gates

Consequently, the power supply for the keying system was laid out to provide
+ 10 V 0.5 A (for SAJ110)
+ 5 V 4 A (for 7400 and 7404)
– 1.5 V 0.5 A (for SAJ110 attenuators)
Figure 4 gives the connections of the IC's used in the circuits.

BUSBAR AMPLIFIERS, FILTERS, DRAWBARS

Each of the five UM busbars and three LM busbars is connected to a pre-amplifier (Fig. 5).

Each amplifier has a volume control with which the output signals from each busbar can be balanced relative to each other before being applied to filters and drawbars.

The output signals from the amplifiers are directly applied to the filters, which consist of the usual LCR networks. For the upper manual the same signals are also fed to drawbar circuits. (Fig. 6).

Drawbars originate from pipe organs and were always applied in Hammond organs. For economy reasons they were hardly used in other commercial designs. Nevertheless, the drawbar system is preferred by many organists over the filter system.

In Hammond organs, pure sine waves are generated which are fed to volume controls (drawbars) which, by different settings relative to each other, add harmonics together to obtain certain sound characters. This is in contrast to the filter systems, where harmonics are subtracted from block pulse signals.

In an electronic organ with a top octave synthesizer – as the one under discussion – another approach has to be made to obtain an equivalent drawbar system.

The optimum way to obtain an equivalent to the Hammond system is to convert each output frequency of the dividers from block pulse into sinewave by individual filter circuits (total 84-96). This system requires key contacts which are able to connect these analogue signals to the audio system. (Actual mechanical contacts or diode keying are described under 'Pedal Sustain' below).

An equally elaborate system can be applied to solid state keying systems as described. In this case, each busbar is divided into half octave steps. Each of these half octaves is provided with a specific sine filter. Depending on the number of drawbars (harmonics) and the number of octaves in the keyboard, the number of filters can reach 50–80. Although complex block pulse signals arrive at the input of these filters (created by playing several keys at the same time), these are converted into equivalent complex sinewave signals in an acceptable way.

For the organ under discussion it was decided to go for a simpler system of drawbars, avoiding the expensive and complex multi-filter system. This was done by applying one sine filter per complete busbar, converting all signals over the whole keyboard. This sine filter consists of an integrator circuit that basically converts block pulses into triangle pulses. Although these come already close to the mellow sound of sine waves, the sharp pitch of the block pulse is still audible. The following RC filter takes away the sharp edges of the triangle pulse and although no pure sine waves are obtained, the sound is close enough to it. The actual drawbar is a slide potentiometer which acts as volume control fitted between the integrator and the RC filter.

The disadvantage of this system of only five filters (one for each busbar (16', 8', 4' 2 2/3, 2') is higher attentuation at higher frequencies. This means that high keys sound softer than low keys. For this reason a correction amplifier is applied which has a higher gain at higher frequencies. Despite this, the oscilloscope still shows a considerable difference in amplitude between low and high keys. The ear however seems to compensate for this to a large extent: if the result is not acceptable, a simple remedy can be found in replacing the 22 k busbar summing resistors behind the gates by staggered values (eg 10 k for high frequencies to 100 k for low frequencies).

PEDAL SUSTAIN

The sustain circuit for the pedals represents another way of solid state keying (Fig. 7). The tone signal is steadily available at the input of two diodes in opposite connection. A negative dc bias signal applied to the midpoint of the two diodes ensures that these are blocked. A pedal contact closure results in a cancellation of the bias voltage by application of a positive voltage to the midpoint. The diodes will now start to conduct the signal to the filter and audio system. At the same time, a capacitor is charged. When the

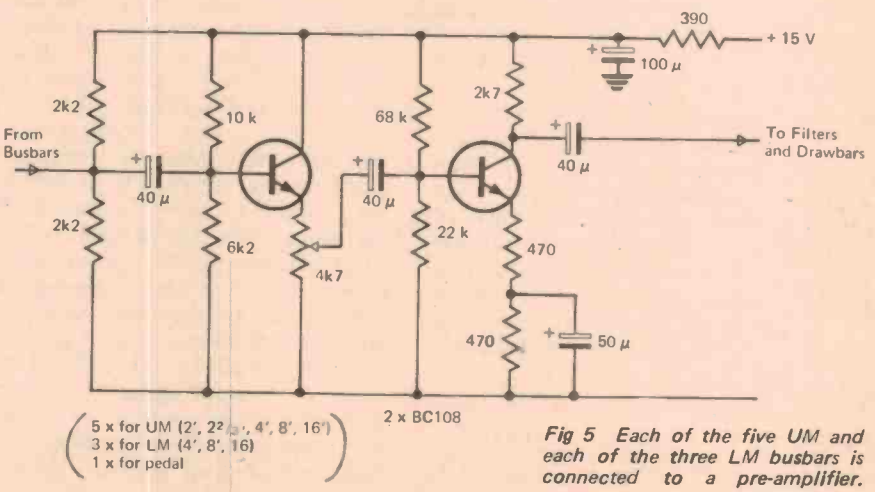
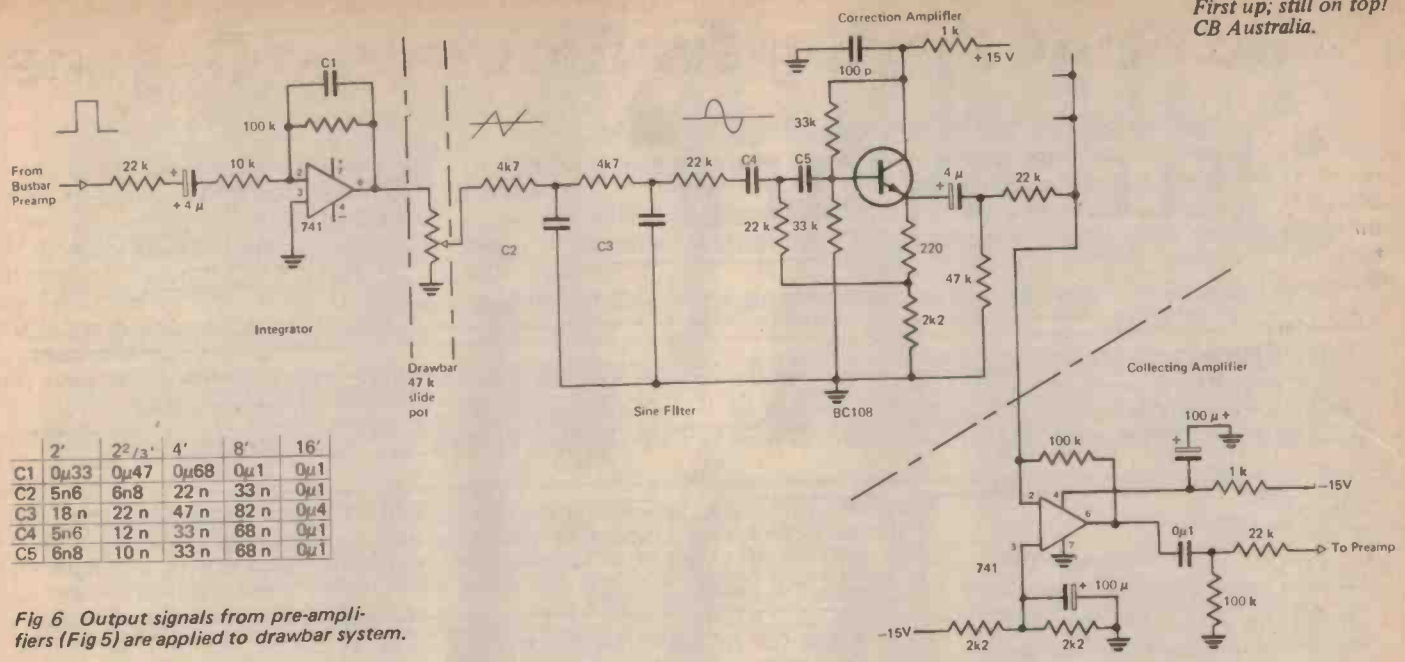


Fig 5 Each of the five UM and each of the three LM busbars is connected to a pre-amplifier.



	2′	2⅔′	4′	8′	16′
C1	0µ33	0µ47	0µ68	0µ1	0µ1
C2	5n6	6n8	22 n	33 n	0µ1
C3	18 n	22 n	47 n	82 n	0µ4
C4	5n6	12 n	33 n	68 n	0µ1
C5	6n8	10 n	33 n	68 n	0µ1

Fig 6 Output signals from pre-amplifiers (Fig 5) are applied to drawbar system.

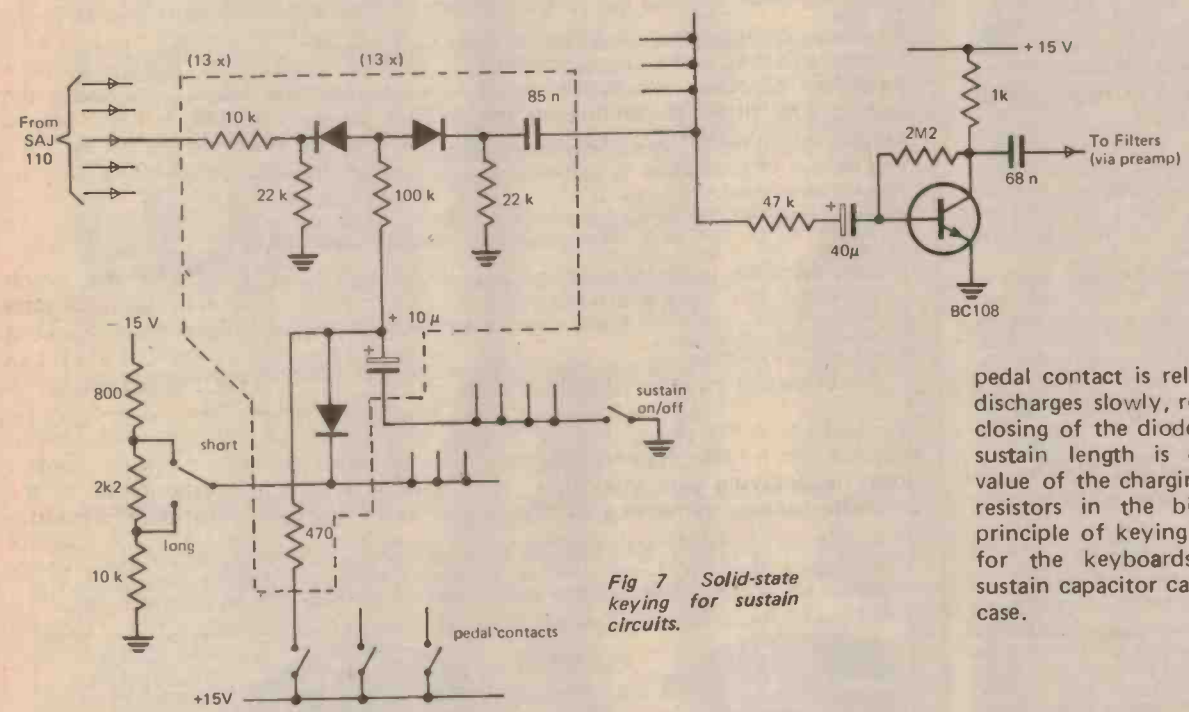
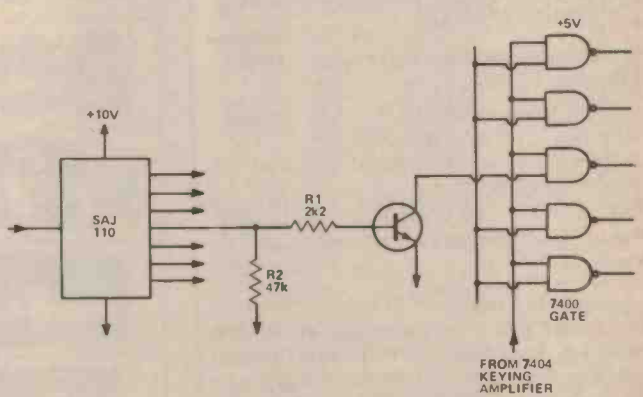


Fig 7 Solid-state keying for sustain circuits.

pedal contact is released this capacitor discharges slowly, resulting in a gradual closing of the diode gate (sustain). The sustain length is determined by the value of the charging capacitor and the resistors in the bias line. The same principle of keying can also be applied for the keyboards, if required. The sustain capacitor can be omitted in that case.

NOTE.
Different makes of 7404 hex inverters may show tolerances that can create problems in the application as buffer amplifier between SAJ 110 and gate 7400 (see Fig. 3). One way to overcome this is to make the +5V supply of each individual 7404 adjustable by inserting a small 100 ohm potentiometer in series. Adjustment of this pot to a certain position will allow the amplifier to operate satisfactorily.
An alternative circuit, using individual transistors (almost any type) that avoids these problems altogether is given below.



SHERIDAN ELECTRONICS PTY. LTD.

THE GREAT NAME FOR ELECTRONIC SE COMPONENTS IN AUSTRALIA

164-166 REDFERN ST., REDFERN, P.O. BOX 156 REDFERN, N.S.W: 2016 TEL: 69-5922 or 69-6912

TRADING HOURS

MON-TUES-WED & FRI: 9am-5.30pm.
THURS: 9am-7pm. SAT: 9am-12 noon.
C.O.D.'s: Please add $2.40 to posting fee. NO ORDERS UNDER $4.00 accepted. For replies please send S.A.E. Post and Packing $1.00 where not included in price. PLEASE PLEASE PRINT YOUR NAME AND ADDRESS ON ALL ORDERS AND CORRESPONDENCE.

Valued friends and patrons of M.S. Components, we take great pride and pleasure in advising you that in future our Company will be known as SHERIDAN ELECTRONICS. For some time now our Directors have felt that our previous title had outlived its usefulness. COMPONENTS apply to many diverse trades, such as in the Motor, Electrical and Engineering industries, and at times much confusion arose as to our component capability in these particular spheres. Consequently we felt that a change of name, more closely allied to ELECTRONICS had become more appropriate. So dependant have we become upon this science of ELECTRONICS, without it, our economy, our way of life, our civilisation would collapse overnight. TO STUDY ELECTRONICS IS TO STUDY THE FUTURE. SEE THE POSSIBILITIES OF ELECTRONICS AND YOU SEE THE FUTURE. . .

"KICK OFF" SPECIALS!!

SPEAKER CLOTH

We have seven types of speaker cloth available at the time of writing; from sombre through conservative to positively racey. We can't do them justice here with a photo, but we will send small samples to those already using our mail order service if requested, with complete prices too. All are ABOUT $6.00 for TWO SQUARE METRES. At this price, they're WHAT EVERY WELL DRESSED SPEAKER SHOULD WEAR.

POWER TRANSISTORS . . . 2N3054, at a never again price. These are the real McCoy, tested, marked, about $1.50 anywhere else. But at SHERIDAN ELECTRONICS a lousy 45 cents each . . . 45c . . 45c . . . POWER TRANSISTORS . . . 2N242, Ge PNP 2 amp 25W . . . In a heavy T03 package, tested, marked, yours for 95c.

SLIDER POTS. . . We have several values of sliders going real cheap to clear them out. We will go even cheaper again for volume buys. Check our stock list below. ALL SINGLES are only 15 cents, that's right 15c . . . 15c . . . 15c each. Duals are ALL going for 20c. . . 20c . . . 20 cents each. It's almost criminal . . .

SINGLE	DUAL
10K Standard	50K Standard
25K Super long	50K B curve
200K Standard	100K Shorties
500K Standard	
500K Super long	

P & P 75c – 1 to 10
" $1.20 10 to 25
Over 25 FREE . . .

EGEN WIRE WOUND POTENTIOMETERS, very handy values, solid square construction PCB mounted with adjusted knob. A must for any one bread boarding projects. Values are 100ohm, 220ohm, 470ohm and 1Kohm. Average three watts. GOING FOR 50 CENTS EACH or 4 for $1.75. Plus Post and Packing.

CAPACITOR SPECIALS

			TYPE
10,000uf electro's	6vwdc	45c.	Pigtail
22uf elec bi-pole	40 vw	25c	"
100uf elec	160vw	20c.	CAN
2200uf elec	50 vw	75c.	PCB
.01uf poly	160vw	3c.	
.001uf disc	12Kvw	15c.	

SWITCH SPECIALS

2 pole Rotary (AEROSTAT) 12 v at 10 amp 240 vac at 2 amp 20c.
2 pole 2 pos PCB MOUNT. . . cheap at 10c.
2 pole 4 pos rotary . . . . . gift at 45c.
2 pole 2 pos rocker good . . . . . at 15c.

OUR SPECIALS LIST

MULTIMETERS . . . 2 kohm/volt, 15 ranges, large 9 x 7cm meter, complete with leads, battery, instruction for a lousy $11.00 + $2.00 MAGNAVOX speakers, 10 x 6 cm, 8 ohms, 3 watts, a gift at $1.50 P & P $1.00

HEAT SINKS aluminium 12 x 6cm, 8 sets fins, c/w. Germanium PNP Transistor, Type 108 (ADZ11) To clear at $1.50 each. P & P $1.00

TO GET OUR NAME OFF TO A GOOD START WE HAVE COMPILED TWO PAGES OF NEW STOCK LINES AND SPECIALS; AND TO SELL THEM TO YOU AND ADVISE, WE HAVE PRACTISING AUDIO AND ELECTRONIC BUFFS, NOT PART NUMBER PARROTS. COME AND MEET MIKE, BARRY, ROD, AND GARY NEXT TIME YOU'RE PASSING BY . . .

NEW CB ACCESSORIES STOCK

Good news . . . we've got some accessories you can't get anywhere else for love or money, bread or honey. We CAN't guarantee continuous stocks so get in for your slice . . .

STANDARD HELICAL WHIPS, WITH BASE, by Lapstick, ... cheap at $22
MINI HELICAL WHIPS, also WITH BASE, ... these at $22
SUPER HELICAL SIG PUSHERS, six foot beauties, these bang out like the proverbial dunny door, worth every cent at just $37.00
or with heavy duty base . . . . . $42.00 (above sent by COMET FRT FWD)

AMPHENOL CO-AX SWITCHES TYPE 83-2SW. Chrome finish, good for 1Kw, low loss. A well known good brand unit for a good value price. . . . . $13.00.

EXTENSION SPEAKERS, and not little anaemic three by three square things, but 18 x 10cm solidly encapsulated units with stand, ... $10!

SWR METERS, HANSEN brand, uprights, 10 and 100 watt switch. Measures SWR, POWER, FIELD STRENGTH with this one. . . . . Only $21

SWR METER, HANSEN brand, dual meters both 6 x 6cm. Solid home base unit, handles up to 100 watts. . . . . Yours for $34

CB CRYSTALS, CRYSTALS, Check these out for that handheld or six channel unit. Matched sets of the below for 455Kc I.F. sets . . .

27,065	27,185	27,235	27,880
27,155	27,195	27,245	27,900
27,165	27,225	27,265	27,910

All these crystals the same price, get them now while they last. Until cleared all these crystals are just $8.50 a set . . . 40c P & P.

PL 259's AND CO-AX HARDWARE, BUT, we have, GOLD, GOLD, GOLD plated fittings too. No more corrosion worries. No more loss because of contact resistance. Now a better, more efficient skin effect. Gold is a CB's best friend. Look at these prices.

PL259/G
UHF HF PLUG
$2.50

M.359/G
RIGHT ANGLE CONNECTOR MALE TO FEMALE
$4.00

PLA.1/G
(ADAPTOR FOR PL259)
65c

MP.4/G
4 PIN MICROPHONE PLUG
$2.50

PL.258/G
DOUBLE FEMALE JOINER
$1.75

LC.3/G
R.C.A. SOCKET
$1.20

PL.258/G/M
DOUBLE MALE JOINER
$2.70

LC.2/G
R.C.A. PLUG
$1.20

M.358/G
'T' DOUBLE FEMALE & MALE CONNECTOR
$4.45

P.4/G
6.3mm METAL PHONE PLUG
$2.35

P & P ea item 40c or 5 for $1.00

NORTH SOUTH EAST OR WEST S.E. Prices are the Best!!

7 TRANSISTOR 2 DIODE RADIO by BENDIX

Completely ready wired with volume control and switch. Large tuning dial and complete with 3½" 8 ohms 6 watt speaker. Battery container included. (Batteries not included) — Ready to go!! **S.E.'s crazy price $3.85 each or 2 for $6.50.** P&P $1.50

NEW STOCK LINES

Scope soldering irons, temperature adjusting. TC60/240V AC/60 watts. Power on neon on handle, finned forward of handle, great. $30.00. P & P $2. BDY 96 high voltage ignition transistor, $9.00. P & P 40c. CMOS 4050 Hex buffer, $1.00. P & P 30c. Four drawer multi purpose cabinets. A must for storage of those tiny components, slip and stack them, $2.50 each. P&P $1.50. Array . . .Array . . .Array . . .Good News, we now have LED Arrays, slim-line in 0.1" pitch. Super Bright, high efficiency in 3 colours. 5 in a Row Red . . .$2.35 Green . . . $2.20 Yellow . . .$2.40. 10 in a Row Red only $4.40. Beautifully made by SIEMENS. with Super High Brightness for just 10mA per LED.

BOXES...BOXES...BOXES

We have a very good range of folded aluminium boxes. Each box in two halves. One half consisting of three sides and the other one side and the two end pieces. When slipped together and screwed a very strong box is formed, yet a type of box that allows easy access if MURPHY gets into one of those experimental projects. Size and prices and order numbers are below.

Order No.	Size CM	Price
2	7x6x4cm	$2.50
3	8x6x4cm	$2.50
4	8x5x4cm	$2.60
6	10x5x4cm	$2.70
7	10x6x6cm	$2.80
8	11x6x4cm	$2.80
9	12x6x6cm	$2.90
10	12x10x7cm	$3.40
12	11x11x9cm	$5.00
14	17x15x11cm	$5.70

P&P 1 to 4, $0.75
P&P 6 to 9, $1.00
P&P 10 to 14, $1.25

"PLAYMEC" KEYBOARD SWITCHES

NEW

An indispensable necessary component in developing handy electronic calculators and microprocessors. Can also be adapted for electronic games. Ultra thin, ultra compact.

Current Cap. 20 mA, 24 VDC. Contact resist 1 max. Insul. res.: 100 m MIN & 24 VDC. Chattering time 2 m SEC MIN. Size 60 mm x 80 mm. Complete with mounting bracket set at 160 deg. approx.

ONLY $13.95 P&P $1.00

READY MADE MODULES

We can't all be like the clock in the TOWER OF PIZA, with both the time and the inclination. If you lack one or the other, or both, then these modules are for you. All are well built on PCB, and factory tested. Maybe with the help of your junk box you could build one as cheaply, but not when you haven't the time to spite or scratch yourself, and the fifty cents you might save yourself couldn't justify your labour. All have instructions. **One watt amp** with slider controls, uses IC amp. Dual **high impedance mike pre-amp,** 12 volts drives it. **Dual low impedance mike pre-amp,** this one too. **Dual guitar pre-amp,** for you pickers out there. **Stereo tape head pre-amp,** for you audio buffs. **Stereo magnetic cartridge pre-amp,** you got it. **Sound operated switch,** with IC and power transistor. **Light operated switch,** for cutting off TV commercial sound. **Variable time switch,** from milli seconds to thirty minutes. **SQ Decoder,** IC used at 12 volts. All these ready made minor miracles are the same price and that's just a measly

$7.00 each.
P&P $1.00

TV GAMES

GAME CHIP AY-3-8550

with two joy stick controls, this advanced unit comes complete with joy sticks — all games (6) and scoring etc are the same as game chip AY-3-8500 **BUT** the bats not only move up and down but forward and backward too. Complete with **data sheet.** Yours for a value packed **$24.00**

GAME CHIP AY-3-8500

6 selectable games. Tennis, soccer, squash, practise and rifle shoot. Auto score on screen 0 to 15. Selectable bat size, speed, angles, ball speed and sound. Complete with 7 pages of instructions to build game using easy to buy parts. BC108 etc. A gift at **$12.50.**

P.C. BOARDS AVAILABLE IN LIMITED QUANTITY AT
$3.50 ea. for AY-3-8500 and AY-3-8550

MEMORIES ARE MADE OF THIS WE MUST HAVE THE BEST PRICES IN TOWN

1702a—128 x 8 Eprom. A gift at only **$9.00.**
2101a 256 x 4 Static Ram. Just **$4.50.**
2102n 1024 x 1 Static Ram. Should be a law against it at only **$1.50.** Limited stocks, so get in now. No future stocks at these prices. Soon it will just be a memory.

RADAR DETECTOR UNITS

Why mess with inferior, back yard brands, when you can buy the very best cheaper, cheaper, cheaper. That's right, Snooper is the best unit in Australia at the present moment. Read the independent tests conducted by 'Wheels Magazine'.

A great unit at only **$109**

The Super Snooper is available too for a reasonable **$185**

MICROPHONES

Crystal mike, very neat, about the size of a small egg, high impedance. Complete with shielded lead. Great value **$2.50. Dynamic mike,** same size as the above crystal mike but with a 50K impedance. A steal at only **$3.00. Please note: the above mikes come with a heavy duty mike stand with felt lined mike holder and an angle adjustment screw. Dynamic mike,** a flat, square unit with stand up prop for use with 50K impedance cassette recorders, PA systems, and projects. We want to clear these quickly, so while they last, **$2.00**

Now our super mike specials. Philips Dynamic mikes, model LBB9002/10, designed for tropical use. Impedance is 500 ohms, sensitivity 0.3mV/ubar (—70dB). Dimensions, 145 mm x 32 mm. Supplied with stand and shielded lead. These fine mikes are imported, made in Holland, the home of **Philips.** We don't want $18, not even $10, we ask only **$5.95** each.

LBB 9002

FM/Electret OHMI Directional Mike. That's right, a mike that performs as two mikes, FM or ELECTRET. This unit comes complete with wind cover, battery, adjustable frequency peg, mike cord and socket, also instructions for its use; all packed in foam. Check the prices for such a mike around town, $29.50, no; $18.50, no; $15, not even fifteen. Almost a present at only **$13.85** each. Please add P&P $1.00 for top 3 mikes and $1.50 for Philips and FM.

"FLUKE" THE STATE OF THE ART MULTIMETERS

And it's no fluke that they are. Good design, attention to our needs, excellent workmanship, and superb backup service makes the Fluke three and a half digit, liquid crystal, multimeter, the best available in this country today. This unit is not just accident proof, it's idiot proof. How many meters can you switch to resistance range then plug to the mains. How many run for two hundred hours on a 9 volt (gold) tranny battery. How many offer accessories so your VOM can read 600 amps/ 40KV/250 MHz or even temperatures to 150 centigrade. Fluke does, say no more. With soft case, probes, battery, instruction manual. $216.00 plus P & P $3.00 (includes insurance).

CLOCKS—CLOCKS—CLOCKS

H1: SECOND, A SOLID STATE, LED READOUT, 12 HOUR mains clock. This requires a small transformer to be complete and running. The transformer is $5.50. This unit comes with instructions for assembly and ways of using the clock. This solid state device is just **$11.50.** Model MA10028. P&P $1.00

H2: THIRD. A SOLID STATE, LED READOUT, 24 HOUR mains clock. This chip is ideal for Ham radio operators, military personnel, and pilots. Apart from the 24 hour instead of 12 hour display this unit is identical to the above model and requires the same transformer. It also has the alarm facilities of the above unit with fast and slow time set, and brightness controls. Just **$12.50.** Model MA10020. P&P $1.00.

H3: FOURTH, A SOLID STATE, FLURO READOUT, 12 HOUR, 12 volt CAR CLOCK. That's right. This unit will operate from your 12 volt car supply, and is designed to withstand the spikes on the supply rails when ignition is switched off, display dims and follows instrument brightness control. Display goes extra bright during the day and dims when driving lights are turned on. The display is large and green and maybe filtered readily to red or blue. The unit, complete with instructions for use, only **$30.00.** Model MA1003. P&P $1.00

H4: FIFTH, CLOCK CHIP, MM5316n (NS/416). To clear these we are letting them go really cheap, data supplied, just **$6.90** each. P&P 50c.

SCOOP PURCHASE OF DIGITAL CLOCK MECHANISMS

All new and unused . . . fully imported. Complete with time-setting control, denoting HOURS, MINUTES & SECONDS. Clearly visible figures of 5/16" ht. Also incorporated are two remote micro-switches for setting alarms, radios or television etc. With 240V 50Hz motor. Amazing value at $10.25 each. P&P $1.25

COMPUTERS FOR SMALL BUSINESSES

Les Bell looks at small business computers, what they do, and the different types that do different things.

Fig. 1 The Altair 8800b is a well-known microcomputer.

Fig. 2 This Altair business system can perform a wide range of accounting tasks.

THE LAST DECADE'S ADVANCES in computing technology have had two effects. Firstly, in the ease with which large volumes of data may be handled, and secondly, in the accuracy with which calculations may be performed. Although these effects have been in evidence for ten years, it is only now that a final factor is combining with these to fire a revolution. Recently MOS LSI technology has begun to bring down the price of processing power and make it available to everyone.

Although large companies have long used computers, (the corporate computer centre is almost a cartoon character), these monolithic monsters have always been screened from the user by a staff of programmers, operators, analysts and other staff who together with the costs of special air-conditioning would place such a system beyond the financial reach of the smaller organization. Then along came the minicomputer, and things started to change. But for a long time, the mini was regarded mainly as a scientific tool and not developed to handle large databases. The need was there, however, and so such systems have been developed and refined to the point where they are now efficient and simple to use.

SMALL BEGINNINGS

The next development was a generally unforeseen one — the simple pocket calculator. Although the computer can digest vast quantities of data, the calculator is the tool which has affected accuracy so much. If you are offered a 14% discount on $600.00, the chances are that you don't say "around $500.00"; you take your calculator from your pocket and say $516.00 exactly. The pocket calculator is an instant-access, simple to operate, tool for decision making. It can give you instant, accurate figures wherever you are. Fairly sophisticated analysis can be performed on a pocket calculator, such as mean and standard deviation, curve fitting, linear regression, trend line analysis etc. Some financial or business calculators are pre-programmed with these functions as well as loan repayment and investment functions.

The programmable calculator can be used to solve all of the above problems. In addition, the programmability feature may be used to solve optimization problems. For example, a model may be prepared which relates costs to certain variables, such as raw materials costs, production volumes, warehousing etc. This is then programmed into the calculator and run repeatedly until a combination of variables which minimizes costs is found. This trial and error method of solution is both simple to use and intuitively helpful.

The pocket calculator is the best value in computing power available today. Used to its full capability, even the simple four-function machine can perform amazing feats.

MICROCOMPUTERS

The next step up from the calculator is the microcomputer. The micro has been in use by hobbyists and engineers for around two years now, but it is only beginning to appear in small business systems. One of the most popular microcomputers is the Altair 8800, which uses the Intel 8080 as CPU. Because this computer uses a standardised card size and bus structure, it can carry a wide range of memory and interface cards made either by

BUSINESS COMPUTERS

MITS (who make the 8800) or other manufacturers. The latest version, the 8800b (shown in fig. 1), costs $1,100 (US price), plus extras such as memory, terminal interface, etc.

MITS have set up a new subsidiary company, the Altair Software Distribution Company, to provide Altair users with quality applications software. Their first product is a set of software packages for the small business system market, covering accounting, word processing and inventory management. The software may be licensed for use in individual packages to accommodate the needs of retail stores, small wholesale distribution centres, and other commercial and industrial users.

The hardware required for the system is fairly straightforward. The central unit in fig. 2 is the computer, and to the left is a stack of floppy disks, each of which (depending on formatting) can hold around a quarter million bytes of data. On the right is a CRT terminal which is used to control the system, and just visible on the far right is a line printer which is used for all printed output.

The important part of a business system is not so much the hardware as the software. It is fairly easy for any programmer to write code which will perform the desired calculations — the important point is the apparent simplicity of the system to the user. At this point we should point out that, though it is possible for a computer hobbyist to buy the hardware and sit down to write his own business software, the chances are that he will be the only person who could use it. If a clerk, or any non-technical staff wii have to use the system, then considerable thought should be given to prompting messages, output formatting etc. This is really what you are paying for when you buy business software.

Fig.3. This beauty contest photo shows General Automation's LSI-2 minicomputer which is typical of the types finding their way into business systems.

ACCOUNTING

The Altair Business System Software consists of modular packages which allow the user to select the components of a system that will most closely fit his needs. There are four modules in the accounting package — general ledger, receivable, payables and payroll. The General Ledger module is the central part of a financial reporting system for a small business. It allows a firm to keep a detailed monthly general ledger of all its transactions by generating a monthly balance sheet and income statement. The Payroll module prepares periodic payroll for hourly or salaried employees while accumulating the necessary information for tax reporting. The Receivables module is a complete invoicing and monthly statement generating system that keeps track of the current and aged accounts receivable. The Payables module performs the same function for accounts payable and incorporates a cheque writing feature.

Fig. 4 NCR's 499 is a purpose-built office system.

WORD PROCESSING

Another important function which can be performed by computer is Word Processing. The Altair Software Distribution Company have available a text editor system that allows large volumes of text material, such as contracts, to be stored, easily edited or updated, and printed. Documents can also call for inserts from other files, so that repetitive letters and complicated documents can be produced. The text material is stored in a file without regard to pages or margins so that additional text material may be inserted later and page heading, number, margins, spacing and other format may be specified at the time of printing. A draft copy may be corrected and then a final printed with different margins.

A single document may contain up to 120,000 characters (that's about 35 single-spaced pages), and documents

may be linked for longer text. The text editor allows simple in-line corrections and extremely powerful global editing to be accomplished. As we mentioned above, this system contains a complete set of prompts so that even an inexperienced operator can use the system with only minimum instruction.

INVENTORY MANAGEMENT

The Inventory Management package offered by Altair is a flexible system which can be configured by the user to store, and present, the information in the form required by the particular business. In its off-the-shelf form, it is structured for a typical retail store who reorder when quantities reach a minimum.

These packages, like much business software, are available under a one-time fee licensing arrangement, which includes three years of software maintenance.

TIP OF THE ICEBERG

Things are only beginning to move in the microcomputer end of the business systems market. Many computer stores are now arranging to provide their own software, and a variety of packages will be available in the near future. In particular, we can expect to see commercial computer languages like COBOL and TOTAL implemented on microcomputers, as well as hardware developments such as multi-user systems and larger disks.

Fig. 6 Note the paper-handling hardware on this NCR 299

TIMESHARE

While we're on the subject of multi-user systems, there is a possibility open to firms who do not have to perform much in the way of invoicing, or other paper-handling, but want to use the computer as a high-level decision-making tool, by generating reports and models on a grander scale than on the calculator. General Electric, for example, offer a time-sharing computer service which enables you to use a larger computer with vast applications software without investing in hardware.

Fig. 5 This Hewlett-Packard HP9896 Business Information Management System is especially attractive to small engineering companies.

Typical of this software is FAL II, a financial analysis language which can be used to prepare forecasts, cash flow and capital structure analyses, tax analyses, operations summaries, inventory reporting and analyses, sales reporting, expense budgeting . . . the list could go on and on. GE's Mark III Information Services, as the whole intercontinental set-up is called, supports various languages, including FORTRAN, COBOL, ALGOL and BASIC.

Another big advantage is that the network extends over 500 cities in four continents so that a local sales office, for instance, could rent a terminal with modem for around $300.00 per month, do all their local computing, generate reports and these would be instantly available to head office. Charges for the system are based upon the amount of computer time and storage used, and will generally be in the region of $30-$40 per hour.

ALL IN A BOX

Another type of system, if you have got a lot of invoicing and accounting to do, is the business machine which is built into a single desk, perhaps with an

BUSINESS COMPUTERS

additional cabinet for some of the hardware. These often incorporate sophisticated paper handling hardware. For example NCR's 299 system incorporates a multi-forms handler which can process invoices, ledgers, cheques, journal rolls — you name it!

Programming on the 299 is not in a high level language — instead it's in a form of assembly code, done on special forms and then transferred to a program assembly card which is read by an optical scanner. Higher performance models such as NCR's 399 and 499 have considerably more power, incorporating such peripherals as disk units (10 million bytes of storage), punched card I/O, paper tape I/O, magnetic ledger reader, and tape cassette.

Manufacturer-supplied software at this level is very sophisticated. For example, Nixdorf Computer offer, for their 8870 computer, a system called NIDAS (Nixdorf Integrated Distribution Accounting System). This system can generate 54 different reports, including some graphic analyses. These system is rather larger than the NCR's mentioned above; the basic memory is 48K bytes and it can support up to nine terminals.

OFFICE SYSTEM 6

This is IBM's latest offering in the small business market. Primarily an information processing system rather than an accounting machine, the basic console is a desk-styled unit with a central CRT terminal which displays six lines of text and two lines of status and prompts. Extensive use of prompts and options guides the operator through each task, and in fact initial operator training is mainly conducted by the machine itself.

Text editing is very simple with the CRT display; text can be easily accessed for revision by character, word, line or paragraph. Segments of text can be moved from place to place, line endings and page lengths can be adjusted automatically to accommodate revision. Addition of headers, footers and page numbers is also automatic.

REPORTS

But word processing is only one application for this system. Another important use is in the maintenance of tabular files of data — sales reports, etc. System 6 can be programmed to work through a file, looking for any, say, sales figures below a certain value. It will then compile these into a report.

In fact we should not have used the word "programmed" above, as no program has to be written. It already exists within the system and is selected and run by responding to the system's prompts, so that no programming skill is needed.

Fig. 7 IBM's Office System 6.

RECORDS PROCESSING

Personnel and inventory records, lists of customers and suppliers, schedules and reports, project or case records and many other kinds of information generated by an organization can conveniently be kept on floppy disks. Once in the form, System 6 can change, select, sequence, qualify or reformat records automatically to generate listings, reports and documents.

The printer on System 6 is IBM's high-speed ink jet printer, which can operate at up to 92 characters per second. Three pitches are available, with electronically changeable type styles. Up to five fonts can be installed at one time, with three being standard. Automatic paper handling makes possible continuous operation, so that jobs can be queued to the printer while the operator utilizes the keyboard and display for other assignments.

A magnetic card reader is available on System 6, and various sources in the industry regard this as a strategic move by IBM to keep magnetic card typewriter business going. A version of System 6 is available without the ink jet printer; in this case output could be on magnetic cards for print-out on a typewriter. The top-line IBM 6/450 would set you back over $37,000, and $28,000 for the printer.

ENGINEERING DESIGN

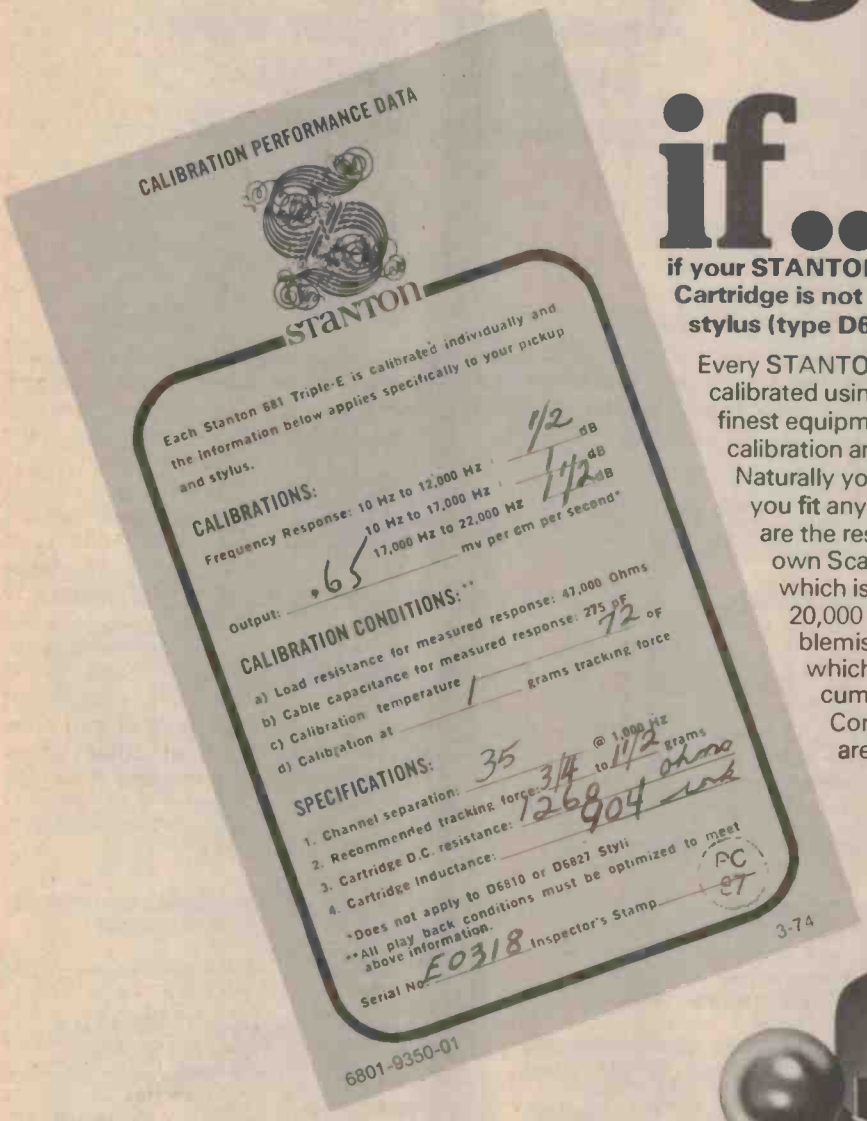
If your business is involved in engineering design of some kind, such as mechanical engineering, you may with to have some kind of computational facility available for design, such as stress analysis. In this case your best bet is to go for a microcomputer based system with a high level language such as BASIC, or perhaps a desk-top calculator computer like IBM's 5100, HP's 9831 or the Tektronix 4051. The latter is extremely interesting in having graphics capability, which enables the use of charts and graphs for computer-aided design. The system can then do double duty, by doing accounting or stock control part-time, and scientific work at other times. Avoid compromise situations, however. If either facility can't get enough machine time, you need another machine, and the chances are you can afford it.

ADVANTAGES

Because this world is encounter ıg what can only be described as an information explosion, it is impossible for human hands and eyes to handle all of it. The routine work now has to be done by computer, and this can be used to advantage in the preparation of reports, so that information is condensed and presented in a readable and intelligible form. Stock level control can be much tighter, and fairly rigorous procedures can be adopted. The general feeling is that introduction of computer-based systems results in a "tight-run ship" — good systems today are not so tight as to be constricting! They are also more affordable — there are going to be some interesting developments in the next few months.

●

This data is meaningless!



if...

This data is meaningless if your STANTON 681EEE Calibration Standard Cartridge is not fitted with a genuine STANTON stylus (type D6800EEE).

Every STANTON 681EEE Cartridge is individually calibrated using a STANTON D6800EEE stylus. The finest equipment in the world is used for this calibration and this is your guarantee of performance. Naturally you cannot get the same performance if you fit any other type of stylus. STANTON styli are the result of intensive use of STANTON'S own Scanning Electron Beam Microscope which is used to examine styli tips at up to 20,000 times magnification to reveal minute blemishes in the highly polished surface which could ultimately lead to distortion and cumulatively significant record wear. Conventional high powered microscopes are hopelessly inadequate for such a task.

Protect your performance guarantee, and your records.
Insist on Genuine Stanton Replacement Styli for your Stanton Cartridges,

Sole Australian Distributors

LEROYA INDUSTRIES PTY LTD

Head Office, W.A.: 156 Railway Pde., Leederville 6007. Phone 381 2930.
N.S.W. Office: 100 Walker St., North Sydney. 2060. Phone 922 4037.
VICTORIA Office: 103 Pelham St., Carlton. 3053. Phone 347 7620.

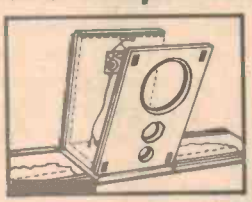
LER 195

Save on top quality European speakers

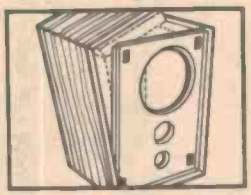
– assemble your own system with this – complete Philips kit.

All you need is a couple of hours, a pair of scissors and a screwdriver.

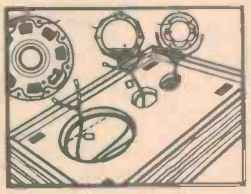
1 *Screw the crossover networks to the baffle boards.*



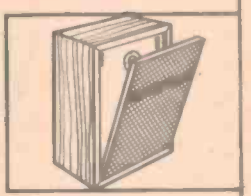
2 *Apply glue to the case and fit baffle boards in grooves.*



3 *Wrap sides of case around baffle board.*



4 *Insert speakers in holes and screw into position.*



5 *Clip fascia panel in place.*

By assembling these Philips speaker kits yourself you can either save yourself a packet on what you were expecting to pay – or achieve a much higher quality system for the same money.

No need to make excuses about not being an electrician. These kits are complete. All components are genuine Philips units. Every part is ready to install. Every step is covered in simple illustrated stages. It's as easy as assembling a simple model kit from a hobby shop.

Now simply connect up to your amplifier and turntable and you're in business.

For information about your nearest dealer contact your state office or send in this coupon.

Sydney 42 1261, 42 0361, **Melbourne** 699 0300
Brisbane 44 2471, **Adelaide** 223 4022
Perth 654 199

Philips
Electronic Components and Materials,
P.O. Box 50, Lane Cove. N.S.W. 2066.
Please send me details on your High Fidelity Loudspeaker kits.

Name_____

Address_____

_____ Postcode_____

PHILIPS

Electronic Components and Materials

PHILIPS

153.0193

SHUTTER SPEED TIMER

Many electronic enthusiasts are also amateur photographers — here's a project just for them.

THE NUCLEUS of good photography is correct exposure. This is a combination of shutter speed and lens aperture as determined by an exposure meter. If either speed or aperture is not as indicated on the camera the results will be less than perfect.

While the lens aperture is a simple mechanical operation and unlikely to be in error the same cannot be said about the shutter with its springs and things. *(Typical electronic engineer's attitude!—Ed.)* Not only may the speed not be exactly as indicated on the dial, it may (probably) change as the camera gets older. Therefore it is desirable that a simple method of determining the actual speed should be available.

This project describes the design and construction of a unit which is capable of measuring times from 1/10000 sec. to 10 sec. This allows the actual speed to be measured and then used to calculate the correct aperture when taking those important photos.

It is suitable for checking cameras with a hinged or removable back so that the sensor can be placed in the film plane. For cameras where the film fits into a slot this unit cannot be used.

SPECIFICATION — ETI 586

Timing range	0.1 ms to 9.99 sec.
Sensor	Photo transistor
Display	3 digit LED
Power supply	9 Volt batteries 65 — 160 mA LEDs on 20 mA LEDs off
Battery life	≈6 hours — normal ≈20 hours — alkaline

SHUTTER SPEED TIMER

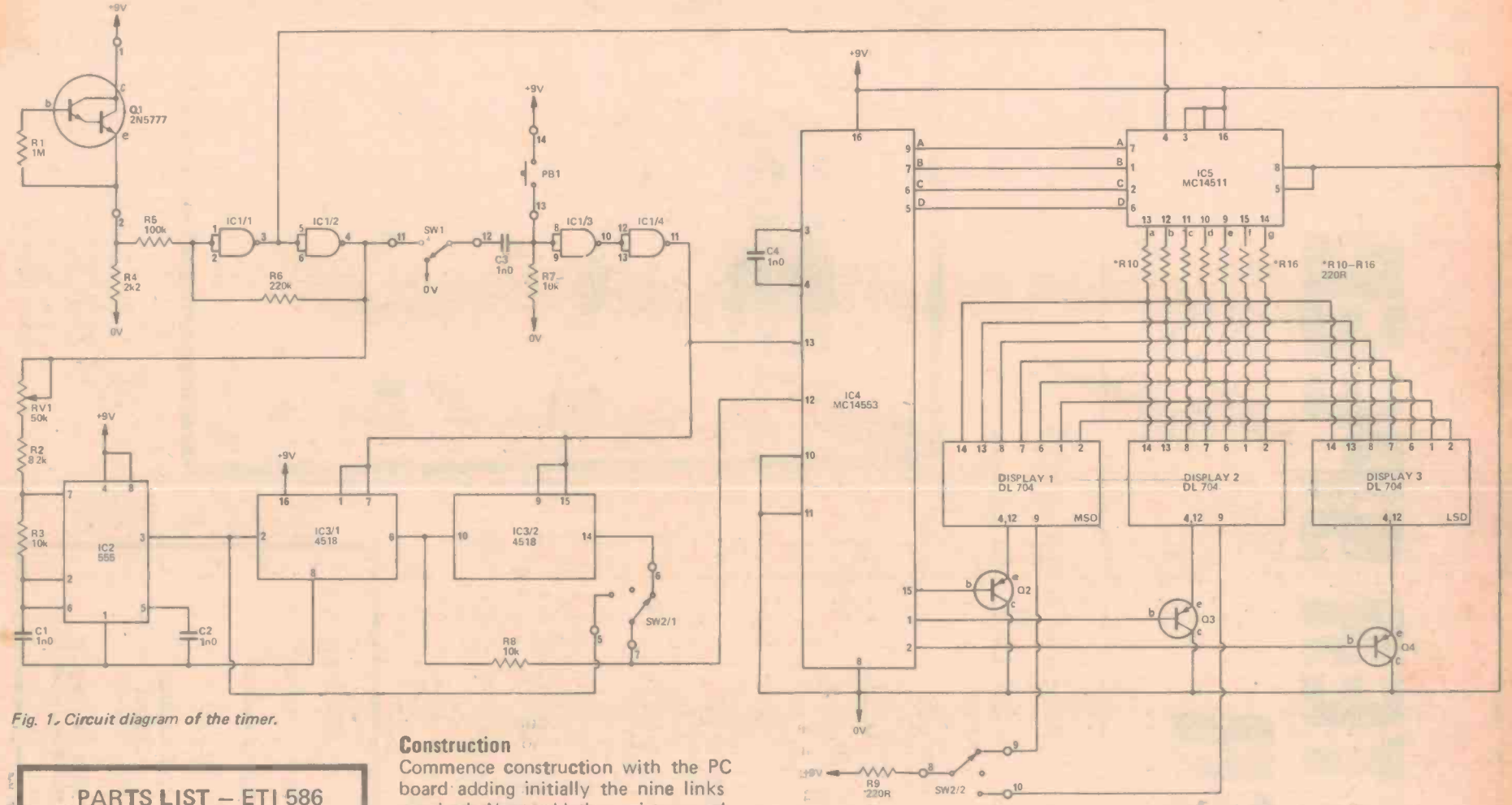


Fig. 1. Circuit diagram of the timer.

PARTS LIST – ETI 586

Resistors all ½ W, 5%
- R1 . . . . . 1M
- R2 . . . . . 82k
- R3 . . . . . 10k
- R4 . . . . . 2k2
- R5 . . . . . 100k
- R6 . . . . . 220k
- R7,8 . . . . . 10k
- R9–R16 . . . 220R

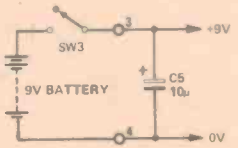
Potentiometer
- RV1 . . . . . 50k trim

Capacitors
- C1–C4 . . . . 1n0 polyester
- C5. . . . . 10µ 16 V electro

Construction

Commence construction with the PC board adding initially the nine links required. Next add the resistors and capacitors in the appropriate locations as shown in the component overlay. Note that capacitor C5 is polarised and must be inserted the correct way round.

The transistors and the displays can now be soldered in place taking care with orientation of the transistors. If Philips or Siemens transistors are used this will be as shown in the overlay, but if a different brand is used the transistors must be rotated 180 degrees from those shown.



HOW IT WORKS – ETI 586

To measure the time the shutter is open we use a phototransistor, Q1, positioned in the film plane in the camera. When the shutter is operated and if the camera is focusing a bright light on to the transistor, the voltage across R4 will rise to about 7 V for the duration of the

Semiconductors

IC1 . . . . . 4011 (CMOS)
IC2 555
IC3 . . . . . 4518 (CMOS)
IC4 . . . . . 14553 (CMOS)
IC5 . . . . . 4511 (CMOS)
DISPLAY 1–3 DL704
Q1 . . . . . 2N5777
Q2–Q4. . . . BC559

Miscellaneous

PC board ETI 586
plastic box
Scotchcal panel
polaroid plastic
SW1,3 toggle switch SPDT
SW2 toggle switch DPDT center off
push button
phone jack & plug
six way AA size battery holder
battery clip
support bracket
spacers, nuts, bolts, wire etc.

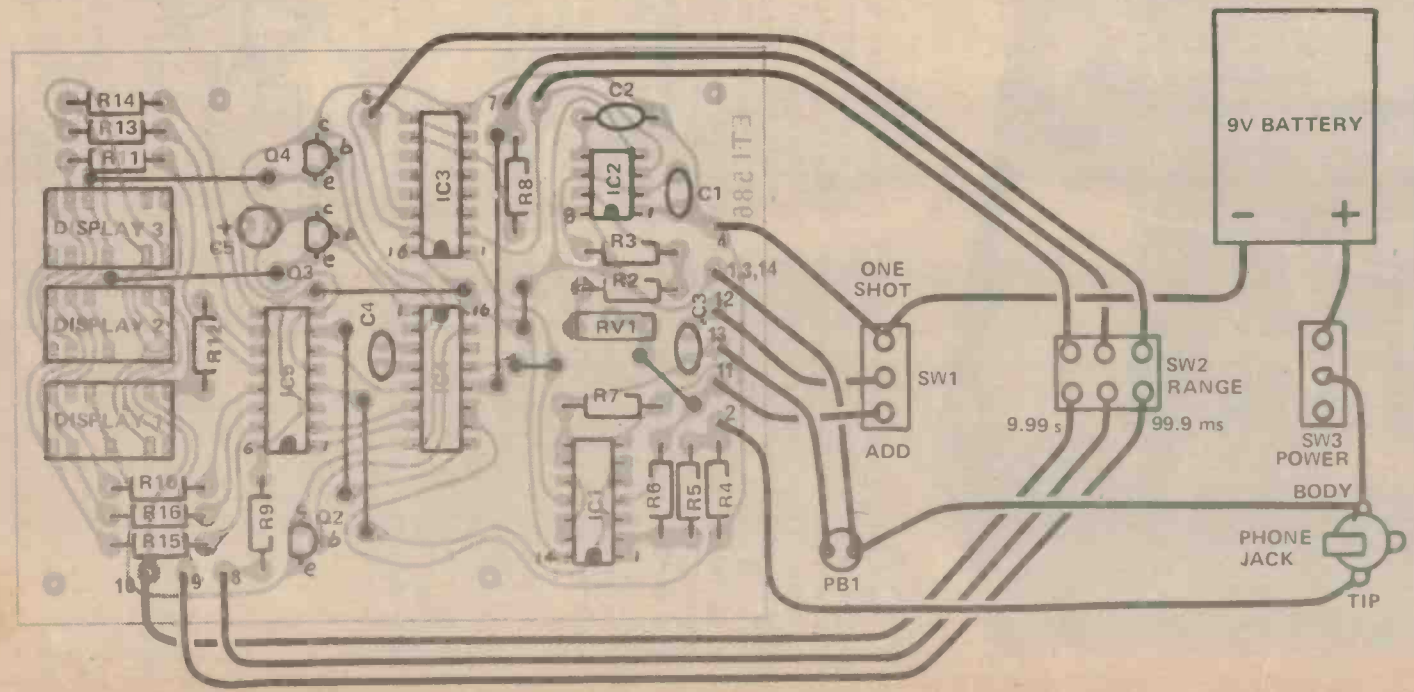
The ICs are the last components to be installed and these must be in the correct location and orientation. As they are all CMOS devices (except IC2) the pins should not be handled if possible to minimise the danger of static electricity damaging them. When soldering them in, solder the corner pins (the power supplies), pins 7 and 14 or 8 and 16 first as this allows the internal protection diodes to work while you solder the other pins.

The front panel can now be drilled, cut and if required a Scotchcal panel fitted. A piece of polarised plastic helps as a display window. The switches, pushbutton and phone jack can now be fitted and connected to the PC board as shown in the component overlay. The only point which could cause problems here is that the phone jack connections sometimes vary, and you should check yours before connection.

The PC board can now be mounted onto the support bracket with 6 mm spacers and the bracket into the box with two screws. When positioned correctly, the display will be visible through the window and the battery holders will be held in position at the other end.

The sensor plate which contains Q1 and R1 can now be made. We used a piece of PC board material although any non-conductive material which is opaque or translucent may be used. Start by cutting the plate to size and drilling a 6 mm hole in the centre. The photo-transistor Q1 should be mounted with the curved surface (which is the active side) into the hole and R1 soldered to the leads, the whole assembly then being glued onto the plate with quick dry epoxy. Ensure that all conductive parts are covered with epoxy to prevent touching when in use.

Fig. 2. Component overlay and wiring diagram.

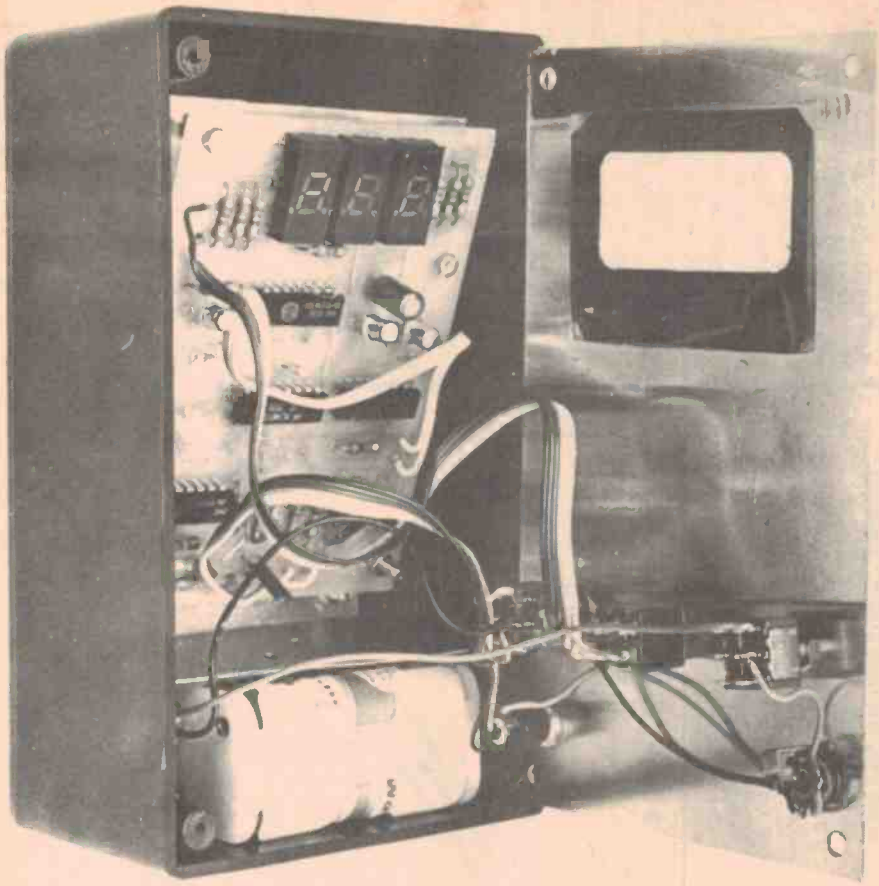


shutter being open. The transistor used is a Darlington type and is normally too slow for measuring times shorter than 1 ms. The addition of R1 increases the speed at the expense of sensitivity – hence the need for a bright light.

The output across R4 is squared up by the Schmitt trigger formed by IC1/1,2. The output of this controls the input to the 10 kHz oscillator IC2. This is an ordinary 555 oscillator where the frequency is set by C1, R2, R3 and RV1. The output of IC2 is divided by 10 in IC3/1 and again by 10 in IC3/2. We use the enable inputs of IC3 as they give clocking on the negative edges, which is what we need. We now have three outputs of 10 kHz, 1 kHz and 100 Hz. One of these outputs is selected by SW2/1 which is a centre off toggle switch. When it is in the off position, 1 kHz is selected via R8, while in the other positions the 1 kHz signal is swamped by the low output impedance of the other dividers.

Whichever frequency is selected clocks IC4 which is a 3 decade counter-latch-multiplexer. We are not using the latch in this application. This IC simply counts the number of pulses it receives and with the help of IC5 (7 segment decoder-driver) and Q2 – Q4 displays the result on the LED displays. During the counting period the display is blanked to prevent ripple on the supply rail upsetting the 555 timer. The ripple would occur as the current changes with different digits displayed. The decimal point is controlled by SW2/2.

Two modes, single-shot and add, are provided. In the single-shot mode when light hits Q1 operating the Schmitt trigger the monostable formed by IC1/3 gives a pulse about 50 μs long which resets the main counter IC4 and the /10 dividers, IC3. Pins 1 and 9 on IC3 which have to be low to allow clocking are taken high during the reset pulse only because it made the PC board easier and does not affect the operation. In the 'add' mode the reset pulse does not occur and unless the reset button is pressed the second and successive counts will simply add on to the previous count. This allows say ten tests to be made and the total divided by ten to find the average.



Calibration

The unit can be calibrated accurately enough with the aid of a stopwatch with a second hand. Set the camera up as detailed in the operational notes and using the single-shot mode, open the lens for 5 seconds using the 'bulb' setting. By adjusting RV1 get the reading close to 5.00 seconds. Now use a longer time, say 20 s, noting that the first digit will be missing (i.e. a reading of 8.52 represents 18.52 s while 2.31 would be 22.31 s) and finally adjust RV1.

If the camera does not have a bulb position a push button can be substituted for the phototransistor but the 'add' position should be used and the timer manually reset as contact bounce can cause the display to reset on release of the button.

Operation

While the camera can be hand-held it is recommended that a tripod be used. Mount the camera on the tripod pointing at a light of 100 – 500 Watts about 2 – 3 feet away. Open the back of the camera and position the sensor plate so that the light is focused on the sensor. Initially, have the lens wide open; if enough light is hitting the sensor, the display will be blanked. Stop the lens down until the display comes on then go back one stop.

This sets the sensitivity and by selecting the appropriate range the shutter speed can be checked.

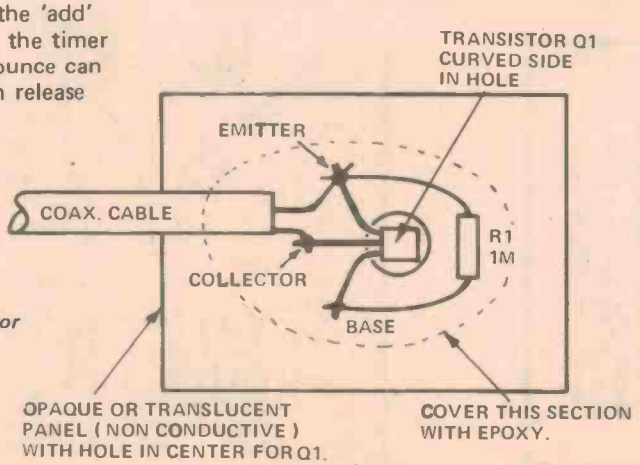


Fig. 3. Connection of the transistor on the sensor plate.

Fig. 4. Graph showing the relationship between time and shutter speed. Each of the small divisions on the right hand side corresponds with a ¼ stop.

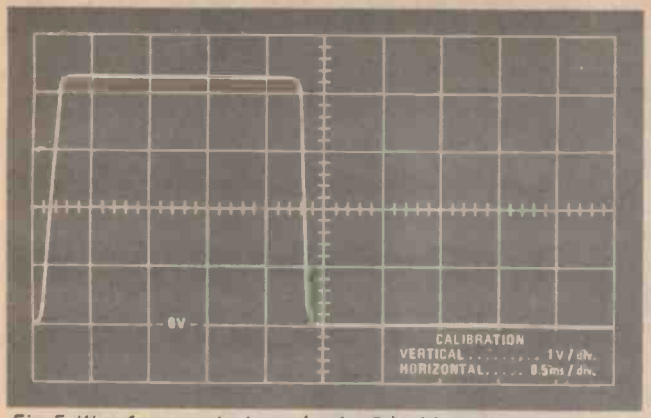


Fig. 5. Waveform on the input (point 2) with the camera on 1/500 sec. The actual time was 2.1ms.

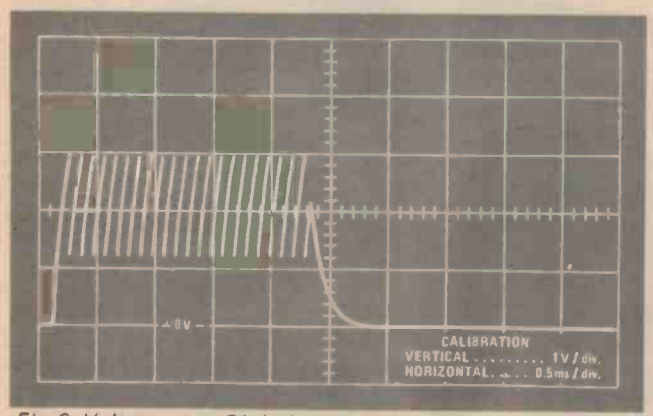


Fig. 6. Voltage across C1 during operation.

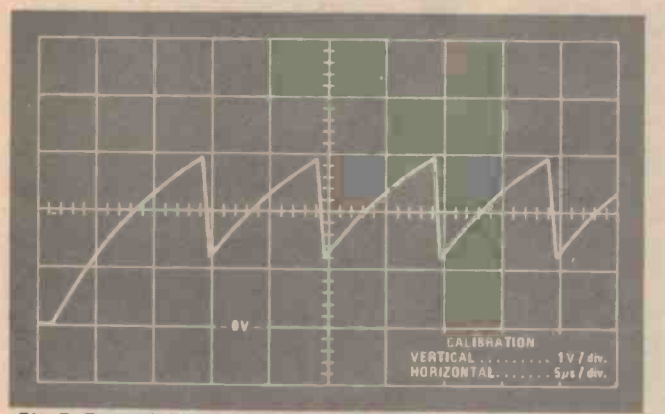


Fig. 7. Expanded view of the start the above waveform.

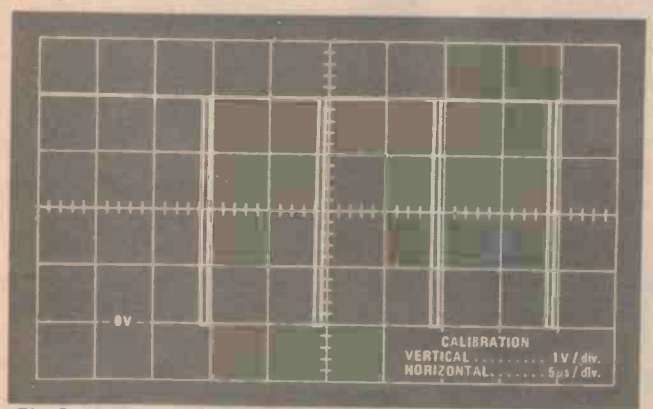
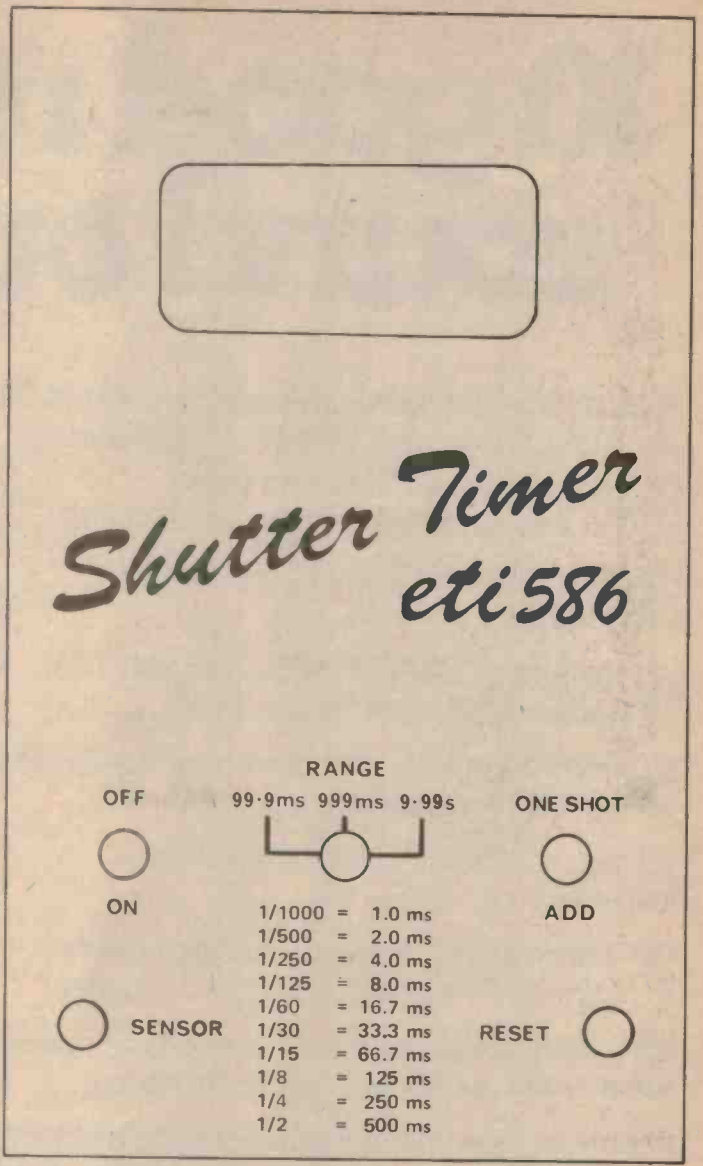


Fig. 8. The output of the 555 showing the first four pulses.



The printed circuit board layout for this project is on page 92.

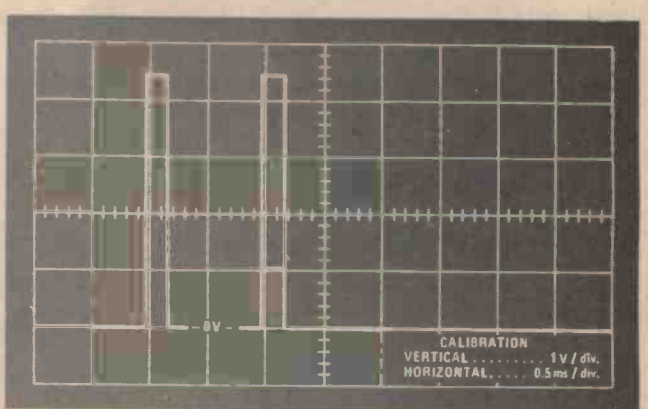


Fig. 9. The output of IC3/1.

10 good reasons to sound out Luxor.

1. Luxor's advanced design incorporates the latest in Swedish electronics technology.
2. 12 months guarantee on parts. 10 years guaranteed parts availability.
3. 20 watts per channel (sine wave) amplifier.
4. Sensitive AM/FM radio, 5 preset FM stations, accepts stereo FM.
5. Semi automatic belt driven turntable with excellent cartridge.
6. A pair of highly responsive bass reflex speakers.
7. Three in one also incorporates easily operated top class cassette recorder.
8. Luxor music centres – convenient operation without sacrificing quality in sound.
9. Luxor have been manufacturing electronic goods for over 50 years and are Sweden's leading manufacturers in this field.
10. Luxor have a comprehensive range of sound equipment as well as colour TV's.

Luxor 2064
Two in one Music Centre

Luxor 2065
Three in one Music Centre

LUXOR Electronics

Swedish quality at its best.

Ring or write for our free colour brochure.

A Division of O.B.C. (Imports) Pty. Ltd. 29-31 Winterton Road, Clayton, Vic. 3168 Ph: 543 3300

LUX 1068

Leak 3000 Series: Computer designed for superior audio accuracy.

From the originators of high fidelity speaker design – the Leak 3000 Series.

A fully imported range of loudspeakers computer designed to reproduce your sound with authentic accuracy and the utmost clarity.

The 3000 Series is the result of an intensive research programme to evaluate and correct various audible distortions in such key areas as intermodulation, doppler and delayed resonance.

Now the Leak 3000 Series can deliver:

- Design control to compensate for time delay.
- Bass/mid range driver with no audible doppler distortion.
- Special compensating crossover network for improved treble performance.
- Treble unit with range up to 22kHz.
- Superb stereo imagery.

Hear the difference now at your leading Hi-Fi Specialist. Leak loudspeakers have never looked better, never sounded so accurate.

LEAK

NEW. FULLY IMPORTED.

We Keep Performing

RANK AUSTRALIA

CU151/77

Electronics is where it's all happening

...if you're into it you've got it made!

It's the world's fastest growing industry... with new discoveries...new products every day. And, every day, there are more jobs...bigger salaries...better opportunities...for people who are trained.

You can be part of this boom now by training with International Correspondence Schools. Learn to design, build, install, test, control and maintain modern electronic equipment...from your own colour TV or hi-fi set to a digital computer.

Your career opportunities are limitless...in broadcasting, industry, the military, aerospace programs, medical science and communications. With your enthusiasm and ICS tuition, a well paid job and a secure future in electronics is well within your grasp.

How do I get into it? ICS have put together a FREE Electronics Career Folder. It tells you all about the many courses open to you including Communications and Broadcasting, Industrial Electronics, Computer Servicing and Audio/Radio Servicing...courses endorsed by the Television and Electronics Technicians Institute of Australia. Post the coupon and the career folder will be on its way to you without obligation. Don't wait another minute...progress won't. The big developments in electronics are happening now and the demand for skilled people is growing all the time.

Special Colour TV repair course.
Colour TV is booming all over Australia, beyond the expectations of all the manufacturers, resulting in a shortage of qualified people to fill the service gap.

You could make a successful career in this growing field with the help of the ICS School of TV Servicing. You can benefit by this course – all you need is the enthusiasm to learn and enjoy rewarding work.

Your ICS course could be a start of an exciting new career or you can use your new-found knowledge to earn extra money in your spare time.

This special course is endorsed by the Television and Electronics Technicians Institute of Australia.

Send the coupon today. It could be the first step in an exciting new future for you.

Find out how you can be where it's all happening – in Electronics. Fill in the coupon and post today!

ICS Home Study ...your passport to success in life!

Your invitation to join the thousands of successful ICS graduates.

To: International Correspondence Schools
400 Pacific Highway, Crows Nest. NSW. 2065
18-20 Collins Street, Melbourne VIC. 3000
182 Wakefield Street, Wellington. N.Z.

YES!

Please send me, entirely without obligation, a copy of the:
☐ ICS Electronics Career Guidance Kit
☐ ICS Colour TV Servicing Career Guidance Kit.

MR/MRS/MISS _____

ADDRESS _____

_____ POST CODE _____

PRESENT OCCUPATION _____ AGE _____

Take the first step – Fill in and mail this coupon today! 276500

ICS

PKB54430

Active Filter Cookbook

Design your next filter the easy way – this article by Tim Orr shows you how.

THERE ARE THREE main types of filter – low-pass, band-pass, and high-pass. Each does more or less what its name implies. A low pass filter passes all frequencies below the so-called 'roll-off' point and increasingly blocks all frequencies above this point. A band-pass filter passes all frequencies above a lower 'roll-off' point and below a higher roll-off point. A high-pass filter passes all frequencies above the roll-off point.

Firstly, consider the simple low-pass filter shown in Fig. 1a. The frequency response (shown in Fig 1b) is nearly flat until the break point – shown as fb. Above this point the response rolls off at 6 dB/octave. The break point is defined as the frequency where the resistance equals the capacitive reactance. At this point the output is attentuated to 0.707 (–3 dB) of the input. Although the resistance equals the capacitive reactance, the output is not half of the input. It is the vector sum of the two and hence is 0.707 of the input.

As the frequency response is a complex curve it is commonly approximated by a straight line. Such a line is called an asymptote (Fig. 1c). Note the frequency response graph uses logarithmic scales, octave or decades along the frequency axis, and dBs along the vertical axis representing output voltage divided by input voltage.

Phase shift with respect to frequency is often plotted as in Fig. 1d. Phase and frequency response plots are also known as Bode diagrams and are most useful in showing a filter's performance.

Note that for the low-pass filter of Fig. 1a, phase shift starts at 0°, is 45° at fb and approaches 90° as frequency approaches infinity. This is not an active filter. It is made up from passive components and its output cannot be loaded substantially without changing its performance.

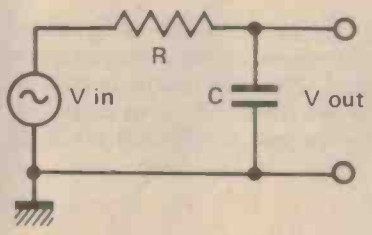


Fig. 1a. Simple low pass filter.

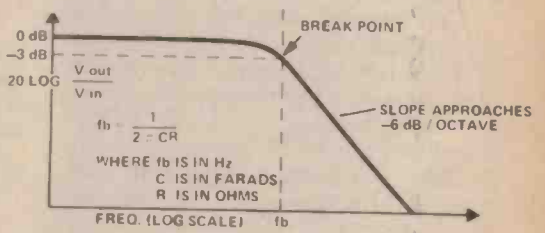


Fig. 1b. Frequency response

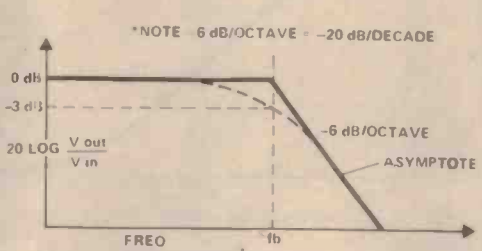


Fig. 1c. Approximation to response.

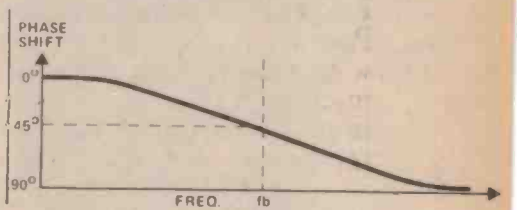


Fig. 1d. Phase shift v Frequency plot.

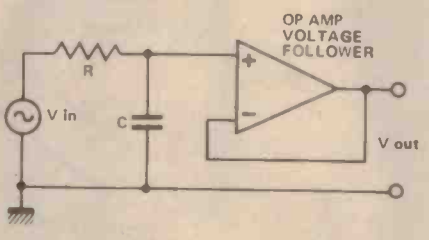


Fig. 1e. Active filter to perform the same task as the passive circuit of Fig. 1a.

Figure 1e shows the same filter in active form, the op amp being used as a voltage follower serving only to isolate the filter's output. This configuration is known as a first order filter –

Summary of low pass filter of Fig. 1

Filter type	Low pass
Filter order	First order
Roll off slope	–6dB/octave
Breakpoint fb	fb = 1/2πCR Hz
Phase shift at fb	45°

Washington Irving is not the editor of CB Australia.

Active Filter Cookbook

the expression 'first order' being an indication of the roll-off slope.

When a steeper slope is required, a higher order filter (that is, one with more elements) must be used. These are dealt with later.

Passing Highs

The simple high-pass filter shown in Fig 2a is the complement of the low-pass filter – the elements have simply been interchanged. Hence the complementary curves of Fig 2b. Note the break point and roll-off slope are similar.

Passing bands

A simple band-pass filter is shown in Fig 3a. Although it uses an inductor this is only to illustrate the band-pass theory.

The frequency response (Fig 3b) is symmetrical, rolling off at 6 dB/octave on either side of its peak. This filter is called a second order filter because it has two reactive sections (L and C). The C produces the +6 dB/octave portion of the slope, the L the -6 dB portion. The response of the filter peaks, and the slopes become much steeper where these two slopes meet.

The sharpness of the peak determines the quality of the filter (Q). Resonance occurs at the frequency known as the centre frequency – shown on our drawing as fc.

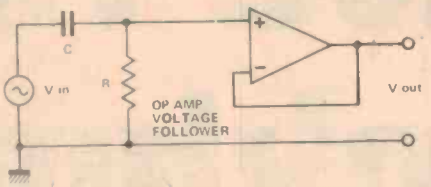
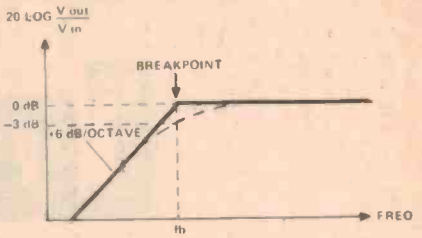


Fig. 2a. Simple high-pass active filter.



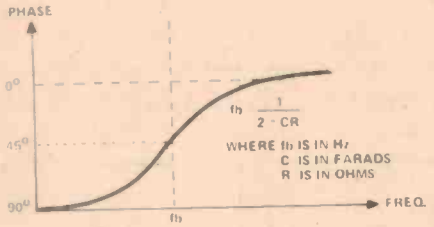


Fig. 2b. Frequency response (above) and phase response (left) of the high pass filter.

The band-pass filter is so-called because it passes signals within a certain bandwidth. This bandwidth is defined as being the frequency range contained between the two points that are 3 dB below the resonant peak. Thus there is a fixed relationship between centre frequency (fc), bandwidth (fbw), and Q. The centre frequency is fc = $1/2\pi\sqrt{LC}$.

Summary of the high pass filter of Fig. 2

Filter type	High pass
Filter order	First order
Roll off slope	+6dB/octave
Break point fb	fb = 1/2πCR Hz
Phase shift at fb	45°

TABLE 2

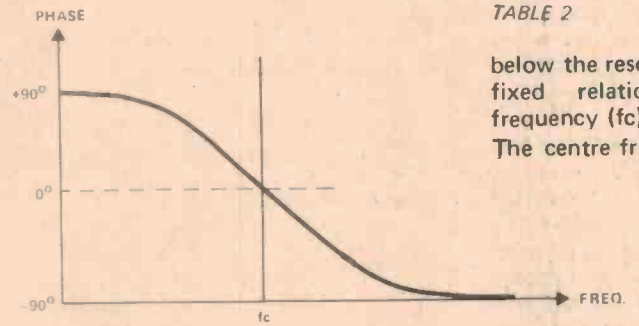


Fig. 3c. Band-pass phase response.

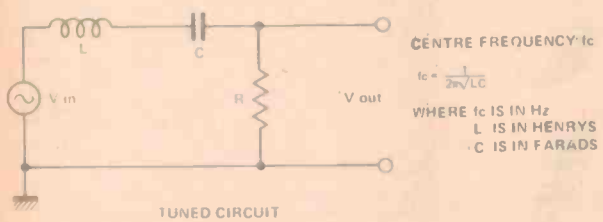


Fig 3a Simple band-pass filter

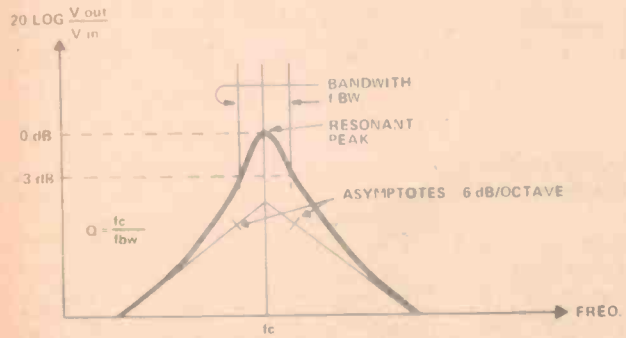


Fig. 3b. Band-pass frequency response.

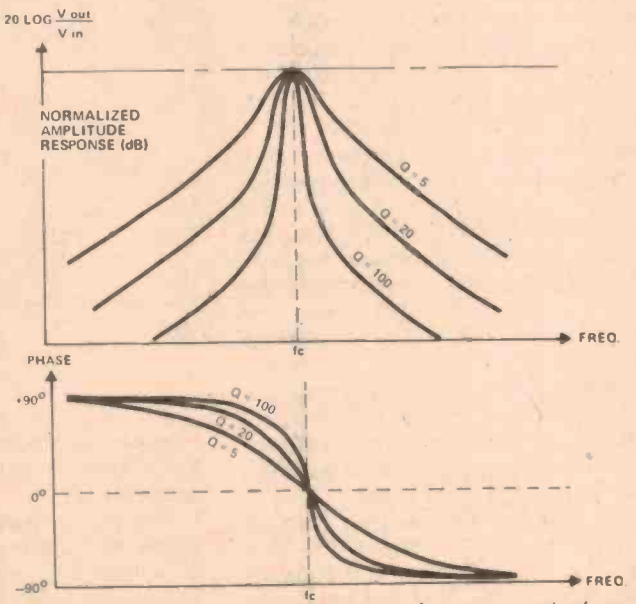


Fig. 3d. Effect of varying Q on the frequency and phase characteristics.

This is only approximate as it assumes that the value of R is relatively low. As R decreases, the Q increases. Thus R has the effect of damping the resonances, and as it approaches zero ohms, Q approaches infinity.

The phase shift is shown in Fig 3c. As this filter is a second order structure the total phase movement will be twice that of a first order structure, i.e. 180°. Figure 3d shows the phase and frequency responses for different values of Q. Note that a high Q has a very rapid rate of change of phase, a low Q has only a slow rate of change.

Time response

Band-pass filters have a time response as well as a frequency response. When an impulse is applied to a band-pass filter it rings (Fig 3e). The filter oscillates at the centre frequency (fc), the amplitude of oscillations decaying exponentially with time. The ringing time Tr is the time taken for the oscillations to decay to 37% of their initial value.

Ringing time is related to Q and fc by the following equation:—

$Tr = Q/2\pi fc$

In practice it may prove difficult accurately to measure the Q of a high-Q filter because the band-width is narrow. However if the filter can be made to ring a reasonably accurate measurement of Q can be obtained by measuring Tr and fc.

Notch filters

Another common type of filter is the band-reject or notch filter. There are many ways of building these, one way is shown in Fig 4. The input signal is subtracted from the band-pass output.

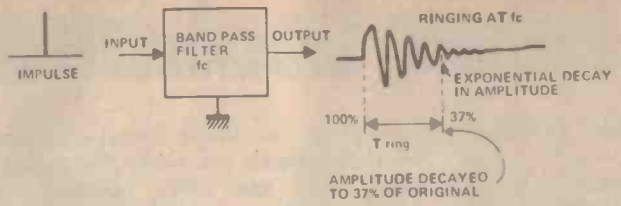


Fig. 3e. Ringing in a band-pass filter.

TABLE 3. Summary of band-pass filter.

Filter type	Band pass
Filter order	Second order
Roll off slopes	+ and −6dB/octave greater near to resonance
Centre frequency fc	$fc \sim 1/2\pi\sqrt{LC}$
Phase shift at fc	0
Q factor	fc/fbw where fbw is the 3dB bandwidth
3dB bandwidth fbw	fc/Q
Ringing time Tr	$Q/2\pi fc$

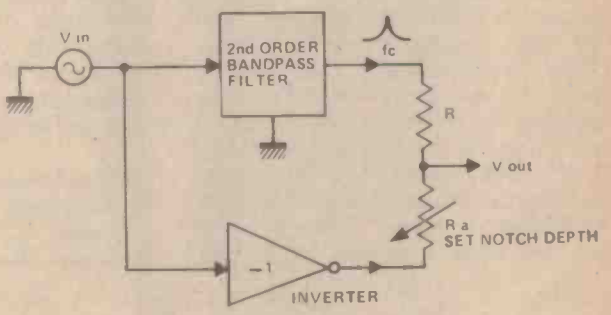


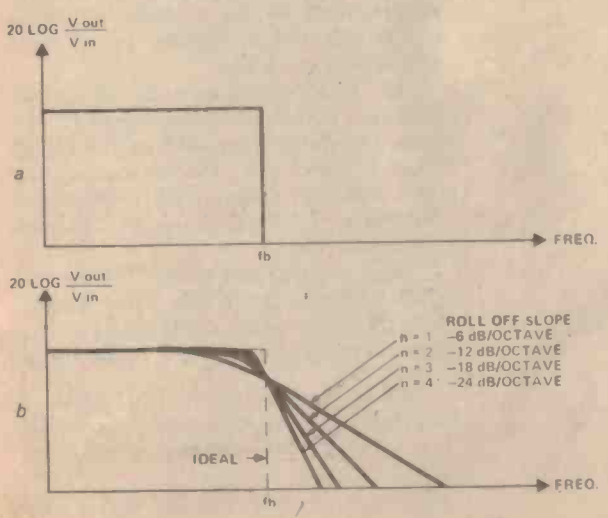
Fig. 4. Notch filter using Op-Amps.

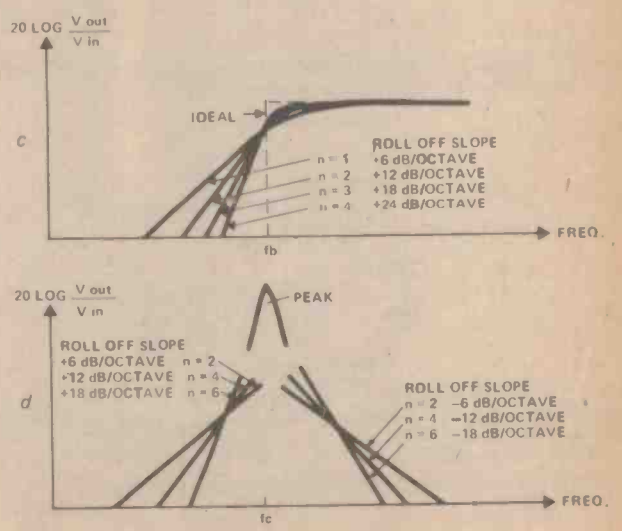
By adjusting Ra with respect to R, complete cancellation can be obtained at fc. Thus the centre frequency of the band-pass filter is the centre frequency of the notch. The depth of this notch can be varied by altering the value of Ra. Very deep notches are possible: 50 dB being readily obtainable. As the Q of the band-pass filter is increased so is the Q of the notch filter. Note that Ra must be adjusted for each value of Q.

Filter orders

Consider the ideal filter shown in Fig 5a. Its response is flat right up to the break frequency with frequencies above fb attenuated to zero. It looks really

Fig. 5a. Ideal low-pass response;
b,c. Examples of maximally flat filter responses;
d. Effect upon band-pass filter of increasing order number.





Active Filter Cookbook

good but in real life filters like this don't exist!

There is nevertheless a frequent need to design filters with very steep roll-off slopes. This is achieved by designing filters with lots of sections — thus increasing the filter order.

Each reactive element in a filter increases the filter order by one, therefore a low pass active filter with three capacitors is known as a third order filter and will have an ultimate roll-off of three times 6 dB/octave i.e. 18 dB/octave.

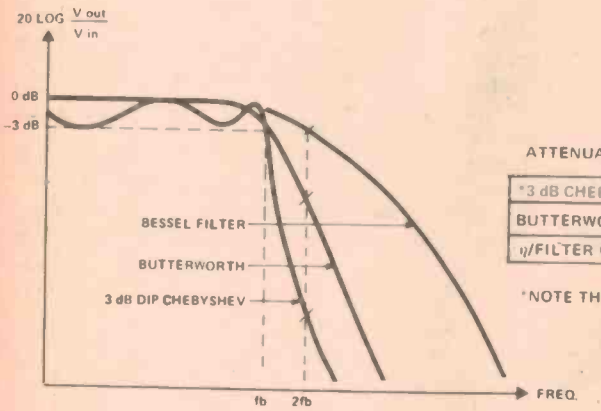
Unfortunately there is more to designing a third order low-pass filter than just sticking three first order circuits in line astern. That merely results in a very soggy curve! The filter should be flat in the pass band, then it should turn over and rapidly assume its roll-off slope. Examples of maximally flat filters are shown in Figs 5b and 5c. The effect of order number on a band-pass filter is shown in Fig 5d.

Later in this article circuit diagrams and design charts are shown for various filter types and order numbers. It might seem that to persuade a filter to approach its ideal response all that is needed is to increase the order number. This is of course so — but there are problems in obtaining components of sufficient accuracy. An eighth order filter for example needs components having values within 1% — possible with resistors but virtually impossible for capacitors.

Filter Shape

The type of filter required to do a certain job will depend on what parameters are most important. Three basic characteristics must be considered (high-pass and low-pass only).

1. Good transient response
2. Maximum flatness within the pass band
3. Steep roll-off slope.

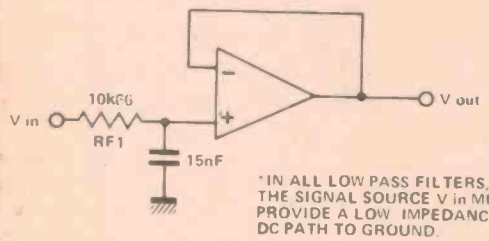


ATTENUATION AT FIRST OCTAVE (2 fb)

*3 dB CHEBYSHEV	17	28	39	51	62	75
BUTTERWORTH	12	18	24	30	36	42
n/FILTER ORDER	2	3	4	5	6	7

*NOTE THE IMPROVED ATTENUATION

Fig. 6. Response of all three types of filter discussed, with table showing variation in attenuation between them.



	RF1	GAIN IN dB	COMPONENT TOLERANCES
BESSEL	10k66	0	10%
BUTTERWORTH	10k66	0	10%
CHEBYSHEV	10k66	0	10%

ALL THE RESPONSES ARE THE SAME FOR A FIRST ORDER FILTER

Fig. 7. A general circuit for a first order low-pass filter.

Filters have been categorised into three basic types for simplicity.

BESSEL FILTER: phase changes almost linearly with frequency, useful for systems where a good transient response is required — such as joining all the little pulses on the output of a digital-to-analogue convertor. Very poor initial roll off.

BUTTERWORTH FILTER: This has the flattest pass band possible. Its two other parameters are a compromise — a reasonable overshoot and a fairly fast initial roll-off.

CHEBYSHEV FILTER: This has a small amount of ripple in its pass band, a very fast initial roll off but a poor transient response.

Rolling your own

In all the examples which follow the filters have been designed for operation at 1 kHz. To change the operating frequency resistor/s RF must be scaled accordingly (note: resistors RD are not changed).

For example if the filter is required to operate at 250 Hz then RF must be multiplied by $\frac{1000}{250}$. Figure 7 shows a first order low pass filter.

Figure 8a, b, and c shows second, third and fourth order filters.

The total design procedure is as follows:

1. Decide which type of filter is required — low, band-pass or high.
2. In the case of low or high-pass decide which type of response is required, Bessel, Butterworth of Chebyshev.
3. Decide what filter order is needed. This will lead you to a particular order filter with components shown scaled for 1 kHz.
4. Scale the resistors RF accordingly.
5. Build and test the filter.

As an example let us design an audio scratch filter having a break frequency of 7.5 kHz and an attentuation of more than 20 dB at 15 kHz.

The first decision is type of response required. A roll-off of more than 20 dB/octave is quite steep and so the Bessel filter is ruled out. The Chebyshev has poor transient response and we'd hear it ringing at 7.5 kHz. So we're left with the Butterworth.

Next comes filter order. Third order gives −18 dB/octave: this is not enough. Fourth order gives −24dB/octave. So a fourth order Butterworth filter it is.

Break frequency is 7.5 kHz so resistors RF and RF2 must be divided by 7.5. This gives the following rather funny values —

RF1 = 1k42, RF2— 1k42, RD1 = 5k9,

RD2 = 48k7, C = 15 nF with component tolerances of 5%. We must now fit preferred values to our theoretically derived numbers.

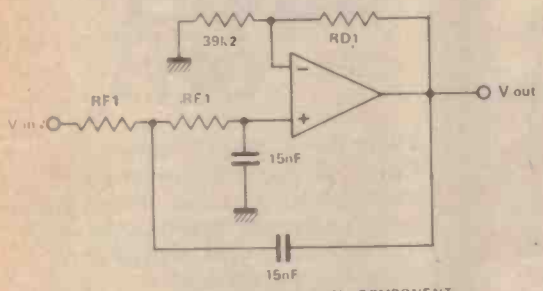
Resistor RD2 can be 47k, RD1 6k2 (just over the limit of tolerance). Resistors RF1 and RF2 are a bit of a problem. The solution is to use the nearest 1% tolerance resistor or use 1K5. This will lower the break frequency by 6% but as this is an audio filter it won't matter too much.

Figure 9 provides design data for high-pass filters. The design procedure is exactly the same as for the low-pass designs.

A few problems may occur with the final results. One is that these filters have a voltage gain in their pass band – so you might find that although you have the required frequency response there is unexpected signal gain.

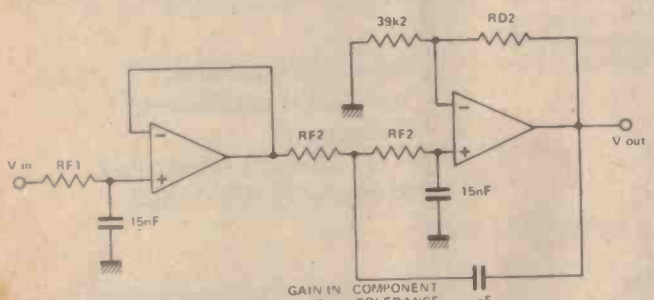
This may cause some problems with op amp band-width. As a rule of thumb, op amps should have 10 to 100 times more band-width than the product of the filters' maximum operating frequency multiplied by the individual stage gain of each section. If the op amp runs out of band-width or introduces a phase shift the filter won't work properly. For the examples given if you use a 741 as the op amp the frequency limit is about 10 kHz. With an LM 318 the limit can go right out to 200 kHz.

Another problem is the range of values of RF. If RF is too small large currents flow from the op amp and this may affect filter performance. If RF is too large there may be hum pick-up, and dc offset voltages due to bias currents. So keep RF between 1 k and 100 k. If RF appears to need to exceed this range scale the capacitor accordingly.



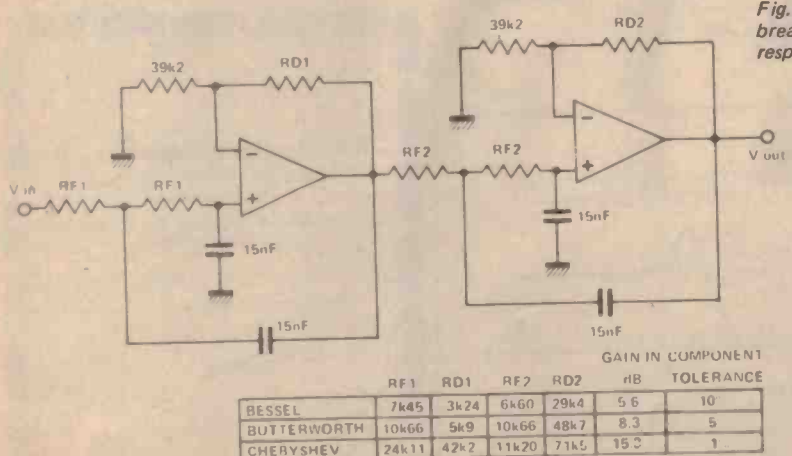
	RF1	RD1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	8k39	10k5	2.3	10%
BUTTERWORTH	10k66	27k6	4.1	10%
CHEBYSHEV	12k6	48k7	6.8	5%

Fig. 8a. Second-order low-pass filter design, break frequency = 1 kHz.



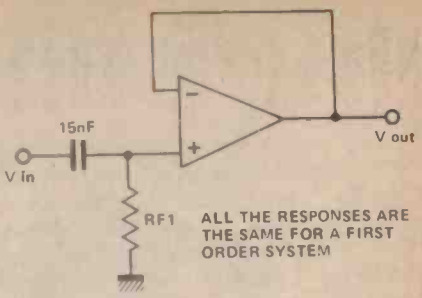
	RF1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	8k	7k26	21k5	4.1	10%
BUTTERWORTH	10k66	10k66	39k2	6.0	10%
CHEBYSHEV	35k41	11k73	66k5	8.6	2%

Fig. 8b. Third order low-pass filter. To alter break frequency (in this case 1 kHz) scale resistors accordingly.

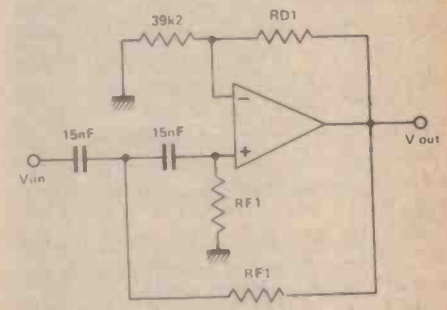


	RF1	RD1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	7k45	3k24	6k60	29k4	5.6	10
BUTTERWORTH	10k66	5k9	10k66	48k7	8.3	5
CHEBYSHEV	24k11	42k2	11k20	71k5	15.3	1

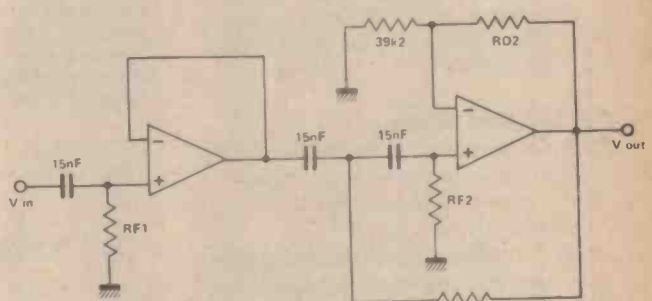
Fig. 8c. Fourth order low-pass filter.



	RF1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	10k66	0	10%
BUTTERWORTH	10k66	0	10%
CHEBYSHEV	10k66	0	10%



	RF1	RD1	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	13k35	10k5	1.3	10%
BUTTERWORTH	10k66	22k6	1.6	10%
CHEBYSHEV	9k01	48k7	2.2	5%



	RF1	RF2	RD2	GAIN IN dB	COMPONENT TOLERANCE
BESSEL	14k19	15k68	21k5	4.1	10%
BUTTERWORTH	10k66	10k66	39k2	6.0	10%
CHEBYSHEV	3k21	9k76	66k5	8.6	2%

Fig. 9. From the top: First, second and third order high-pass filters, break point 1 kHz. Final roll-off is 6, 12, and 18 dB/octave respectively.

Life, liberty and the pursuit of DX – all in CB Australia.

Active Filter Cookbook

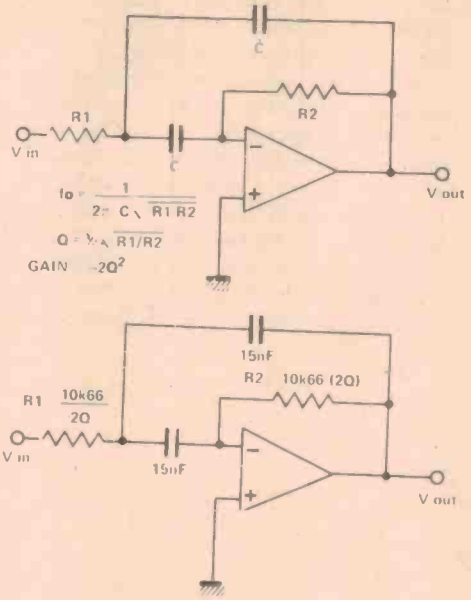
Band-pass filters

Several second order band-pass filters can be cascaded to produce a different response shape, which, like those discussed earlier for low and high-pass filters, can be optimised to give maximum roll-off or maximum pass-band flatness. Such filters do however tend to be difficult to design and so only second order filters will be discussed.

Figure 10 shows a simple band-pass filter known as a multiple feedback circuit. This circuit can provide only low orders of Q (up to about 5). It will probably oscillate if designed to provide higher Q. Note that a high Q implies a large gain at centre frequency. Care must therefore be taken to ensure that the op amp has sufficient band-width to cope.

The design chart is shown in Fig 10 — once again all values are shown for 1 kHz. The design procedure is to first choose the Q factor and then perform the frequency scaling. For instance if the centre frequency is to be 250 Hz then multiply both R1 and R2 by four.

If a high Q is required then you must use a multiple op amp circuit such as the 'state variable' or 'Bi-Quad' circuits shown later. Both circuits can achieve Qs as high as 500.



Q	R1	R2	GAIN IN dB
1	5k33	21k32	6 dB
2	2k66	42k66	18.1dB
3	1k77	60k40	25.1 dB
4	1k33	85k33	30.1 dB
5	1k06	106k66	34.0 dB

Fig. 10. A multiple feedback bandpass filter. The centre circuit is normalised for 1 kHz. The table is the design table for this circuit. To change the design frequency change R1 and R2 by an equal factor.

State-variable filter

A state-variable filter is shown in Fig 11. This filter has three main features —

1. It can provide a stable high Q
2. It is readily tuned
3. It is versatile, providing band-pass, low-pass and high-pass outputs all at the same time.

The Q of this filter is determined by the ratio of resistors RA and RB where RA/RB=3Q-1. The resonant frequency fc is $1/2\pi RC$

Note that there are two Cs and two RFs in the circuit. If the filter is to be tunable then both RFs should be changed by an equal amount (the RFs can of course be a dual potentiometer). Note too that Q and fc are independent of each other so as the resonant frequency is changed Q remains constant — and vice versa.

The requirements placed on the op amps in the state-variable filter are less than those for the multiple feedback circuit. The op amps need only have an open loop gain of 3Q at the resonant frequency. Suppose we have a Q of 100 and an fc of 100 kHz. Then the open loop gain is 300, the frequency is 10 kHz and so the gain band-width product needed is 3 MHz.

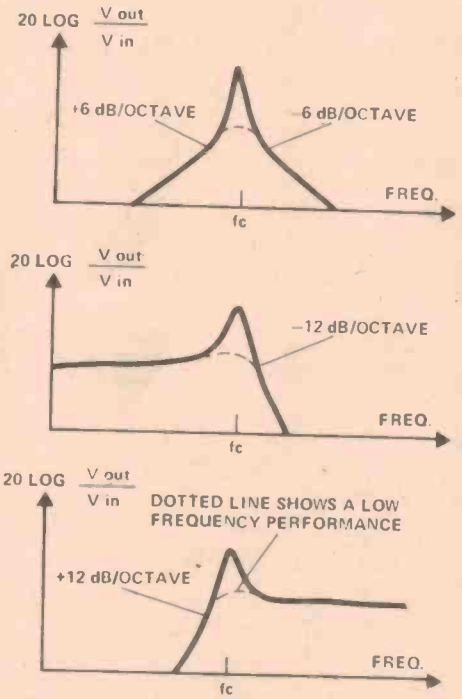


Fig. 11b. The state variable filter is called a universal filter because it can give band-, low- and high-pass outputs — as shown above. Note that all these responses are second order in nature.

Bigger, brighter, better, what? CB Australia!

When using a high Q, care must be taken with signal levels. The gain of the filter is +Q at resonance so if you are filtering a 1V signal with a Q of 100 you could expect a 100 V output signal!

National Semiconductor manufactures an active filter IC which is a four op amp network which can be used to make up state-variable filters with Qs of up to 500 and frequencies to 10 kHz. The device is designated AF 100.

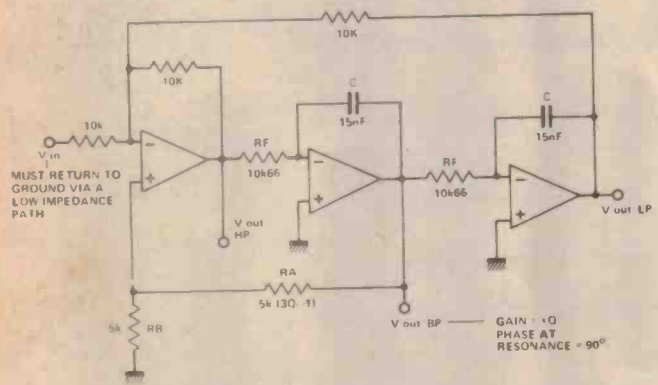
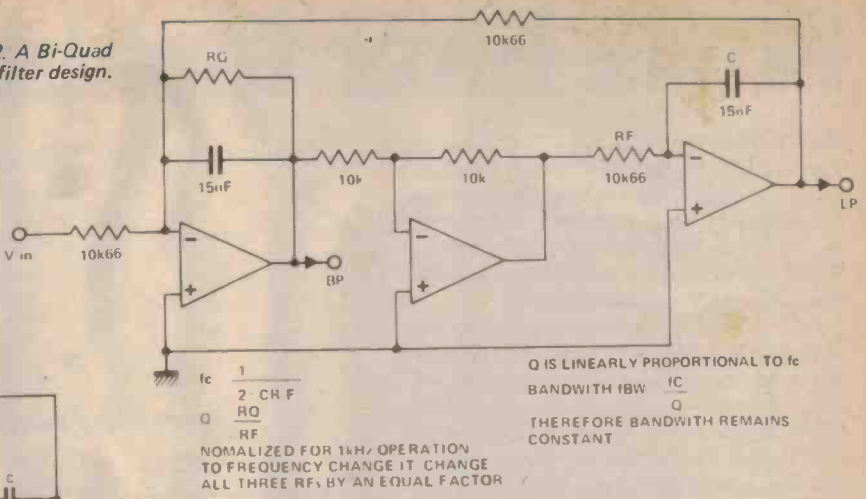


Fig. 11a. The state variable filter.

Fig. 12. A Bi-Quad active filter design.



Bi-Quad filter

Figure 12 shows a Bi-Quad active filter. It looks very similar to the state-variable filter but the minor changes cause it to behave quite differently. Unlike the state-variable filter it has only a band-pass and a high-pass output. The resonant frequency is

$$fc = \frac{1}{2\pi CRF}$$

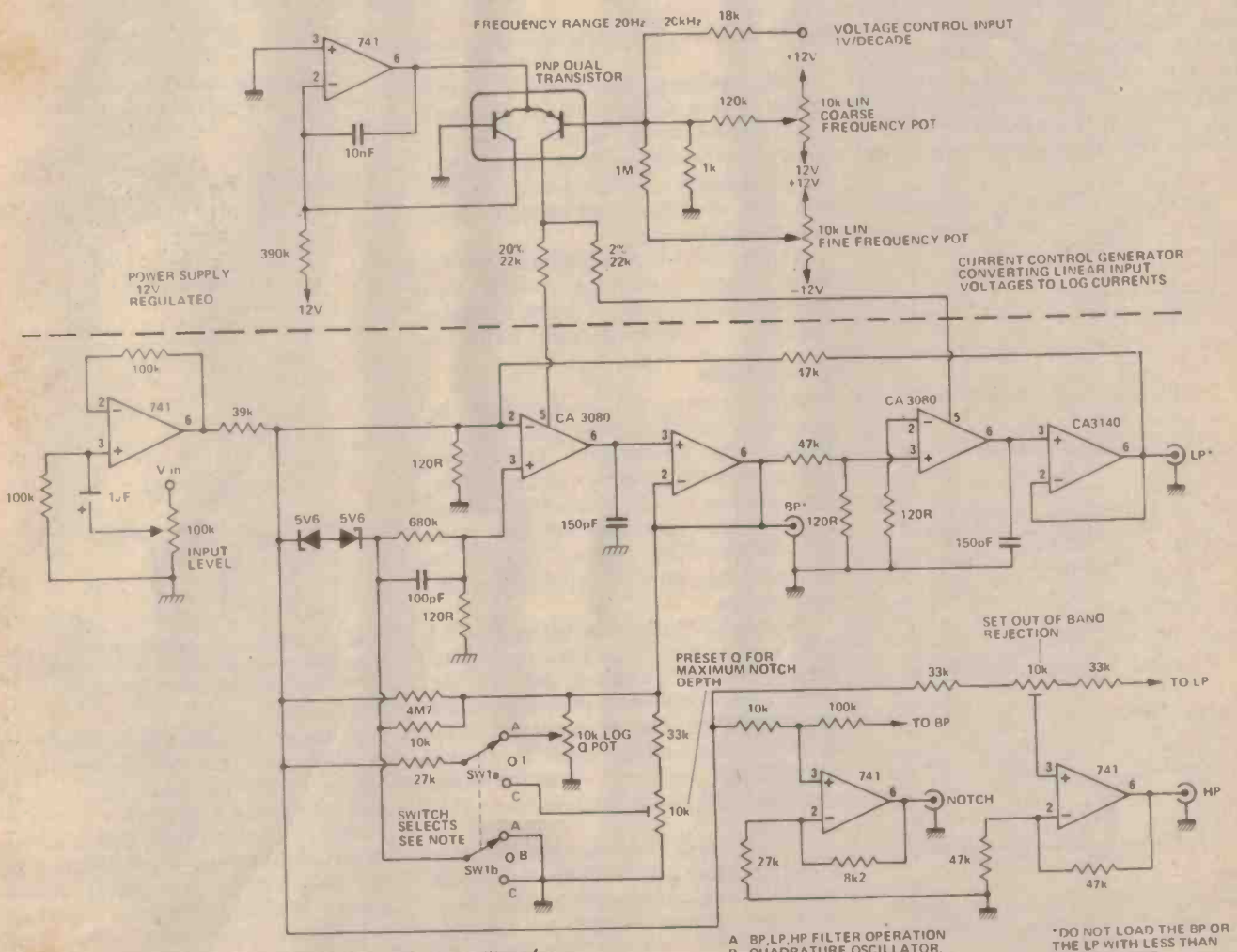


Fig. 13. The state variable filter can also be made to oscillate (as above). It has a variable resonant frequency, and so becomes a variable frequency oscillator. This circuit produces two low-distortion sinusoids in phase-quadrature: i.e. sine and cosine waveforms.

Active Filter Cookbook

Notch filters

Two notch filters were shown earlier in this article. These worked by mixing a band-pass signal with the original or by mixing the low and high-pass outputs. There are however many other methods of producing a notch response.

The twin-T circuit shown in Fig 14 is very interesting – a notch response is obtained using resistors and capacitors only. However as this is purely a passive device only a low Q can be obtained. The circuit is not used a great deal – perhaps because no less than six components determine its notch frequency. However it is of interest to note that when the twin-T is placed in the feedback loop of a high-gain amplifier a band-pass response will be obtained. If R is made variable it is possible to move the centre frequency, although in doing so the Q varies. This effect has been exploited as the basis of many wah-wah effects units!

All-pass filter

Another way of obtaining a notch is the all-pass filter shown in Fig 16. The frequency response might at first sight make this the most useless of all possible filters – it's flat! However the circuit produces a phase shift which goes from 180°, through 90° at fc – to

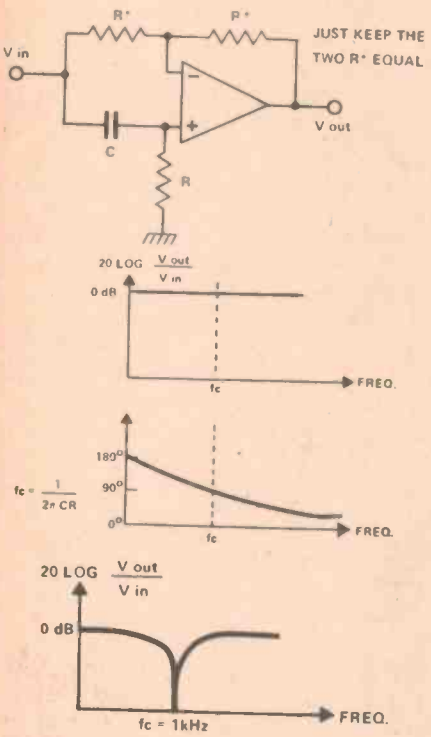


Fig. 16. All-pass filter. At the top is the circuit for such a device. Its frequency and phase responses are shown below it, with the obtainable notch at the bottom.

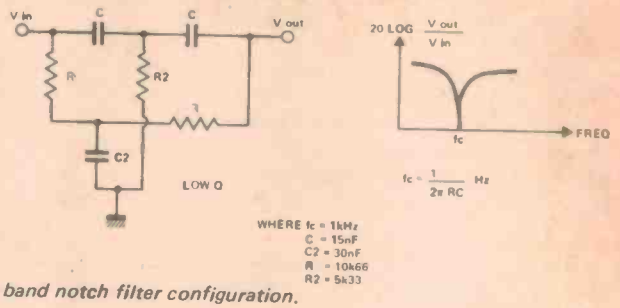


Fig. 14. Twin T band notch filter configuration.

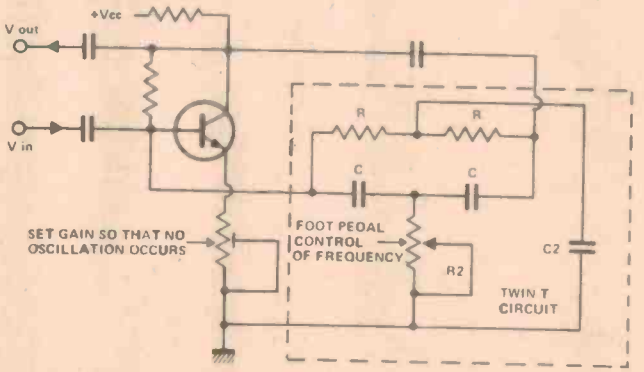


Fig. 15. Block diagram of a typical Waa-Waa pedal.

0°. By cascading two such filters the phase shift is doubled: if we then mix the phase-delayed signal with the original a notch response is obtained. This is because at fc the two signals have the same magnitude but opposite phase and so cancel out.

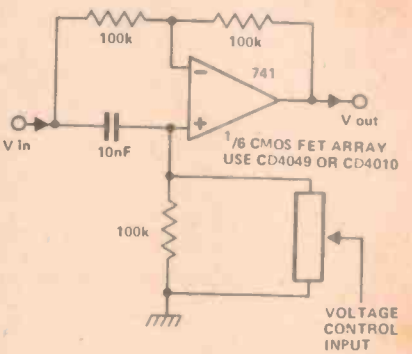
If the notch is to be tunable the RC time constants must be variable. Just one R may be varied if a small range is required – otherwise vary both Rs.

Comb filter

Several notches can be produced by cascading notch filters. This type of filter is called a comb filter. Every notch in the comb requires two all-pass filters. The notches can be made to move up and down in frequency by making the Rs variable. This method is used to produce the 'phasing' effect used by rock groups.

Figure 17 shows a small section of such a unit. Here a CMOS chip is used to provide a matched set of six MOSFETS. A common voltage controls the MOSFET's channel resistance. Thus as the control voltage varies so do the six MOSFET resistors – and the three notches move along the frequency axis in unison.

Another type of comb filter is shown in Fig 18. Here a time delay line is used instead of a phase delay line. This produces a large number of notches linearly spread along the frequency axis, their spacing being determined by the



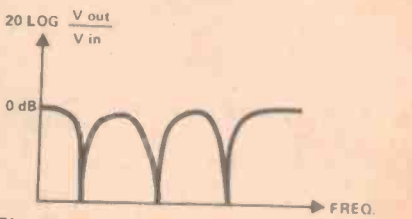


Fig. 17. One section of a comb filter. The response produced by the full (six times above) circuit is shown below the circuit.

delay times.

A bucket-brigade device may be used to implement the time delays (which can of course be made variable). This type of filter is known as a flanger and is used to generate high quality phasing effects. An even more impressive sound can be produced by adding feedback around the delay line: this produces a multi-peak, high-Q filter which makes very interesting 'musical' sounds when swept through its range.

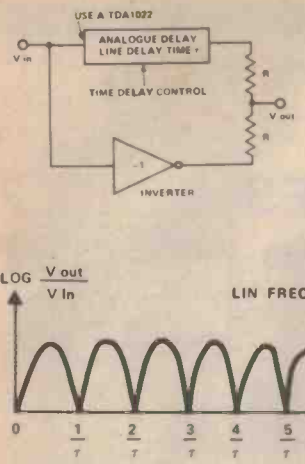


Fig. 18. Alternative method of producing a comb filter using a Mullard delay line.

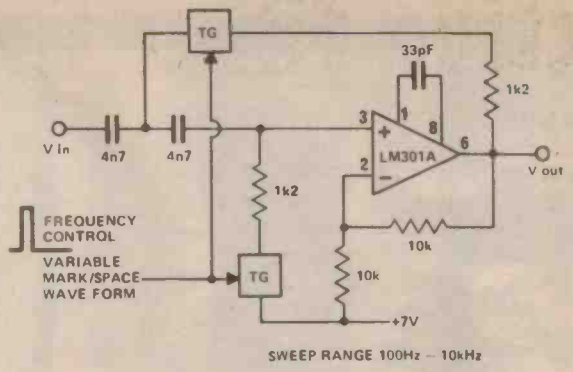
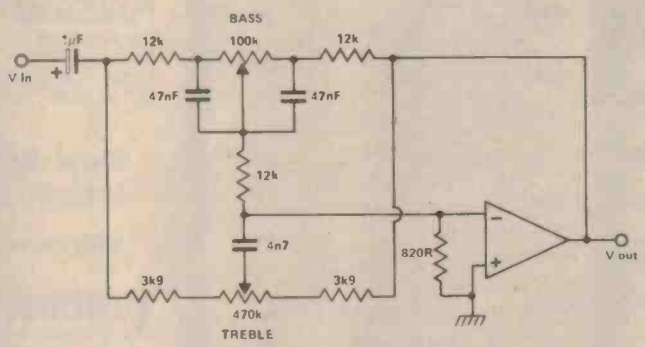


Fig. 19. Another method of varying the notch frequency, mark / space ratio modulation, and has the advantage of possessing a wide range.



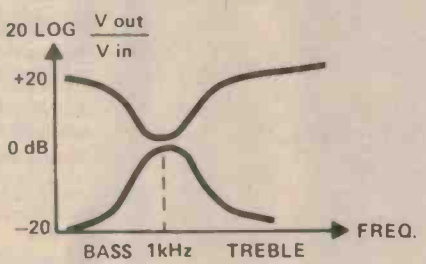


Fig. 20. Simple tone control circuit, with the lift and cut responses shown beneath it.

Variable tuning

A common requirement is for a variable centre or cut-off frequency. This causes problems with filters of orders more than two simply because it is difficult to obtain potentiometers with more than two ganged sections. Lots of companies make them but just try to buy one when it's needed!

One solution is to use mark/space ratio modulation (Fig 19). This has the advantage of offering continuously variable control over a range of about 100:1. Lots of sections may be used and they'll all track. As an example an eighth order four transmission-gates/pack variable frequency filter can be made using a couple of CD4016s. Note though that –

1. The switching waveform must be several times higher in frequency than the highest frequency to be filtered.
2. More circuitry, to generate the switching waveform is required.
3. Switching noise tends to be generated.

Audio circuits

Active filters are widely used in equalising audio signals in applications varying from simple tone controls in hi-fi systems to parametric equalisers in recording studios. Figure 20 shows a commonly used tone control with bass and treble functions. Cut and lift ranges are 20 dB. More flexible control can be obtained by using a multi-band graphic equaliser such as that described as a constructional project in ETI's June 1977 issue.

Testing

Once the process of designing active filters has been reduced to a simple procedure, testing should be made as simple as possible too. The most basic method is to use a swept sinewave oscillator (Fig 21).

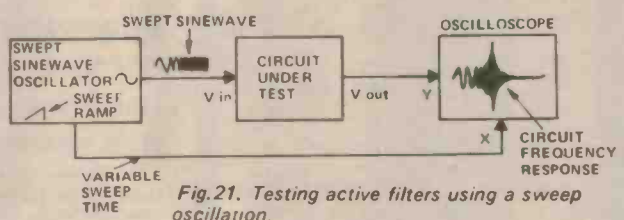


Fig. 21. Testing active filters using a sweep oscillation.

An XY oscilloscope is used to display frequencies logarithmically against amplitude (displayed linearly). The ideal display would be log amplitude but this is hard to do. The beauty of this method of testing is that the display is in real time so any changes appear instantly on the oscilloscope. If high Qs or rapid roll-offs at low frequencies are involved, then the sweep time will have to be reduced, otherwise the effects of ringing will 'time smear' the display. The harmonic distortion of the sinewave can be quite large (0.5 to 2.0%) without causing too much of a display problem for most filter designs.

CB HEADQUARTERS

PLUGS, CONNECTORS AND CABLES

Part No	Description	Price
PL-259	Hf Co-Axial Plug	$1.20
PLA-1	Adaptor for PL-259 plug for RG58-U cable	28c
PLA-2	Adaptor for PL-259 plug for RG59/U cable	28c
PL-259 D	Plug "Pushon", not "screw-on" type	$1.35
PL-259/WA	Plug with inbuilt adaptor for RG58-U cable	$1.25
PL-259/R	Solderless PL-259 for RG58/U cable	$1.25
SO-239	Panel Socket with flange, suit PL-259	$1.25
SO-239A	Panel Socket without flange suit PL-259	98c
PL-258	Cable joiner double female suit PL-259	$1.25
M-258	Cable joiner double male suit SO-239	$1.65
M-358	Cable joiner "T" Connector (Double female and male)	$3.90
M-358/A	Cable joiner "T" Connector (3 female)	$3.90
NC-568	In-line splice for RG58/U cable	85c
NC 569	In-line splice for RG8/U cable	$1.20
M-359	Elbow or right angle connector (1 male, 1 female)	$2.80
L-258	Lightning Filter and Arrestor (PL-259 plug to SO-239 socket)	$4.75
D-258	Dummy load with indicator lamp for transmitter power of 5 watt 50 ohms impedance PL-259 plug	$3.00
D-258/A	Dummy load with resistor, non-inductive	$1.30
NC-535-1	14 Cable Assemble or SWR set etc	$2.85
PC 258	1 metre cable Assembly RG58/U cable with PL-259 plug each end — suit SWR and other test meters etc	$4.30
MP-4	CB 4 pin microphone plug	$1.50
MS-4	CB 4 pin microphone panel socket	$1.65
NC-512	CB 3 pin microphone plug	$1.65
NC-557	Universal jack adaptor	$1.10
Nf 830	In-line fuseholder with wire	40
CC-2	Mic cable 3 conductor, single shield curly cord, colour black	$1.75
RG-58/U	Cable 52 ohm low loss black per metre or per 100 metre	45c $28.50

MICROPHONES, METERS ETC.

Part No	Description	Price
DM-95	Omni-Directional hand held dynamic microphone — with 2M curly cord Imp 500 ohms Freq Resp 20 Hz — 10 Hz Sensitivity — 70 dB	$7.95
DM-780	Base Station Microphone	$49.00
DM-1487	Base Station Microphone with "push-to talk" switch and lock, dual impedance 600/50K ohms	$29.95
DM-1005L	Dynamic Headphone with Boom microphone (impedance 200 ohms) ideal for motor bikes, tractors, racing etc	$32.95
K-815	Extension speaker, 8 ohms 5 watt, weather proof with mounting bracket	$13.50
K-816	Public address speaker 5" horn type, 8 ohms 5 watt weather proof with ring bracket	$11.50
MH-40	Microphone Holding Clip — magnetic mounting to car dash etc	75c
MH-25	Microphone Holding Clip — with 2 self-tapping screws	75c
SWR-300	In-line SWR and Field Strength meter Measures forward & reflected power by bridge method SWR 1:1 to 1:3 into 52 ohms Accuracy 5 percent indicates transmitter power output strength	$19.00
SWR-400	In-line SWR, PWR and field strength meter PWR 0-10, 0-100W, specs as SWR-300	$26.50
JD-310	In-line SWR and PWR meter to 10 watt	$19.95
JD-171	In-line SWR, PWR and field strength meter, deluxe with 2 metres for continuous measurement 0-10, 0-100 watts specs as SWR 300	$29.50
JD-175	In-line SWR and Field strength meter with in-built Antenna Matcher, spec as SWR-300 and JD-140	$32.80
JD-140	In-line Antenna, Impedance matcher, use to 100 watts, with tune and load controls, low loss type, now lower your SWR by correct matching of CB transceiver and aerial	$16.50
SM-1	CB Transceiver slide mount kit, with lock, 2 keys etc. Suits all types, for easy service, adjustment, security	$9.50
HL-1	Hot-line "Filter-reduces ignition interference — compresses choke and capacitor insert in 12V pos lead	$3.50
HL-2	Hot-line Filter-heavy duty 7 amp	$4.95
HL-3	Generator Noise Filter	$3.65
HL-4	Alternator Noise Filter	$2.90
HL-5	Turnable Generator Noise Filter	$2.90
HL-6	Low Pass Filter-reduces TVI from Transceiver	$9.50
TVI-1	TV interference filter — mounts on TV	$1.90
HL-7	Co-ax Antenna Switch with dummy load for 3 aerials to 1 transceiver or vice versa	$11.50

CB ANTENNAS

CA-60	AM/FM/CB lock down centre-loaded with spatter, cables and plugs, one for CB one for AM/FM	$39.95
CA-65	AM/FM/CB motorised Lock Down (as CA-60)	$49.00
CA-70	Magnetic Mount Whip — Centre-loaded coil with 3m cable & PL-259 plug heavy ceramic mounting, no installation required	$21.90
CB-100	Roof or Boot Mount Whip Base loaded coil, mount base for roof mount (hole) or boot mount (clamps to edge or boot lid) with cable and plug	$19.95
CB-105	"Firefly" Roof or Boot mount whip — Base loaded, luminous yellow fibreglass with flashing red light on top	$27.50
CB-110	Full length 8' Fibreglass whip — Terrific performer, power plus	$29.50
CB-115	Full length 9' stainless steel whip with heavy duty spring and swivel ball mount — deluxe	$39.50
CA-80	Gutter-grip Centre-loaded Antenna — with lead and PL-259 plug	$19.50
CB-125	5ft Helical Whip Antennas-stagger wound best performer, SWR down to 1:1:1 when tuned with base	$22.50
	12ft Lead & PL-259 plug to suit, extra	$3.00
CB-200	Base Station Ground Plane-ring-rod radiator 17'6" long high efficiency verticasy polarized, omni-directional aluminium construction in 4 sections accepts PL-259 plug, ½ wave	$49.95
CB-220	Base Station ⅝ wave ground plane antenna 4 x 9ft radials, 9ft centre radiator, very low SWR, accepts PL-259 plug	$39.00
CB-225	Base Station ½ wave ground plane solid aluminium, screw together, 3 x 9ft radials, 9ft centre radiator, imported	$35.00

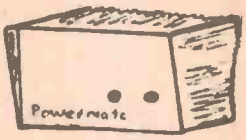
POWER SUPPLIES

Kit 1	Powermate Kit, you build it, 240V mains input, 13.6V 1.5A DC max output for all AM rigs	$18.50
Kit 2	As above, but 2.5A DC output, for SSB rigs	$23.50
Kit 3	Regulated and overload protected, 2.5A DC output, as in June ETI — 712 project	$29.50

Largest range of...

CB POWER SUPPLIES

POWERMATE I KIT 1.5A $18.50



Based on the EA Jan '77 design, input 240V AC, output 13.6V 1.5A continuous (2.5A peak), fully regulated and fitted, low hum, suits all AM transceivers. Size 120 x 95 x 155mm.

POWERMATE II KIT 2.5A $23.50

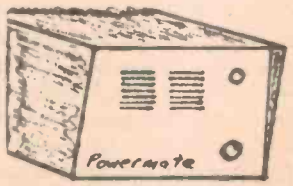
Larger version of the Powermate 1, as above except output 13.6V 2.5A continuous, (4A peak), suit SSB transceivers. Size 120 x 95 x 155mm.

POWERMATE III KIT 2.5A $29.50

Based on the ETI-712 project in June '77 this de-luxe kit has fold-back current limiting protection against overload or short circuit. Output is 2.5A continuous (4A peak) and adjustable from 12V to 14.5V. Size. 120 x 95 x 155mm.

Now Available with Inbuilt Ext. Speaker

with noise reducer switch



POWERMATE Ia KIT 1.5A $26.50

Complete base station supply with large 5" x 4" inbuilt extension speaker for increased efficiency, higher volume and reduced noise with the useful noise cancelling switch. Power supply as Powermate I. Size 184 x 115 x 195.

POWERMATE IIa KIT 2.5A $31.50

Incorporates the same facilities above, with Powermate II power supply.

POWERMATE IIIa KIT 2.5A $37.50

Incorporates the same facilities above, with Powermate III power supply.

and with DIGITAL CLOCK MA-1002 built-in!

De-luxe base station with inbuilt speaker (with noise reducer switch) and electronic digital clock with adjustable brightness, "sleep" and "Snooze" timers, bright 4 digit ½" display (red LED) plus your choice of power supplies, I, II or III. Size 260 x 115 x 195mm

POWERMATE Ib KIT.....$40.50
POWERMATE IIb KIT.....$55.50
POWERMATE IIIb KIT.....$61.50

and 2 SUPER HEAVY DUTY SUPPLIES . . .

POWERMATE IV KIT 10A $75.00

If you're running more than one rig or a H.F. Linear Amplifier up to 125W PEP, then you need this super heavy duty power supply with 10 Amps output at 13.6V DC, fully regulated and filtered.

POWERMATE V KIT 20A $110.00

This JUMBO 20 Amp power supply is suitable for H.F. Linear Amplifiers up to 250W PEP and is otherwise similar to the Powermate 1V.

Heavy-Duty Ready-Built 3A Power Supply $39.50

With Electronic Overload Protection

This heavy duty industrial type power supply is ready-built for immeidate use and is conservatively rated at 3 Amps continuous, 5A peak output at 1.36V DC potential. Foldback current limiting protection safeguards the equipment against overload on short circuit.

CB/AM/FM MONITOR

You can copy all 40 American CB channels with this great little 3 in 1 radio. Use with an earpiece for monitoring your own transmissions and for on-air tests.

$23.95 ***New!***

TRADE & RETAIL

All the good gear is at:

Electronic Agencies

115-117 PARRAMATTA RD., CONCORD
NSW Telephone (02) 747-6472

Trading Hours — 12.00 — 6 pm Mon-Fri. 8.30 — 1 pm Sat.
Mail Orders — P.O. Box 1005 Burwood North 2134.
Post & Pack — Add 15 per cent up to $25 order value. 10 per cent over.
Minimum Order Value — $5.00 C.O.D.'s Send $3.00 pre-paid

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

value PLUS buys

It's your hobby . . . but we make it cheaper! . . . for your enjoyment.

DOLLAR STRETCHERS $1 PACS

- ☐ 337 10 Asst. Mini Preset Pots.
- ☐ 338 2 Bourns 2K Cermet Trimpots
- ☐ 234 4 DPDT Medium Slide Switches
- ☐ 235 6 DPDT Mini Slide Switches
- ☐ 232 5 TO5 Black Finned Heatsinks
- ☐ 220 100 Asst. ½W RESISTORS. 5/, 10/ mixed carbon composition.
- ☐ 169 5-16 PIN DIL PLUGS. Gold Pins, suit 16 Pin IC Sockets
- ☐ 170 5-14 PIN DIL PLUGS.
- ☐ 167 10-IN914 Silicon Diodes.
- ☐ 166 3-6V 1W Zener Diodes.
- ☐ 163 1 Valve Output Transformer G.P.
- ☐ 148 1-1 Watt Audio IC Amplifier-with circuit diagram
- ☐ 142 10-0.0022 Feedthrough Capacitors
- ☐ 87 3 FERRITE RODS 3/8" diam x 8" long
- ☐ 306 15-0.22uF 160V Polyester Capacitors.
- ☐ 307 15-0.0047uF 400V Polyester Capacitors.
- ☐ 308 10-0.1uF 400V Polyester Capacitors.
- ☐ 309 15-100uF 10V Pigtail Electros
- ☐ 310 12-22uF 63V Pigtail Electros
- ☐ 311 10-470uF 16V Pigtail Electros
- ☐ 312 5-1000uF 10V Pigtail Electros
- ☐ 3-3300uF 6.3V Pigtail Electros
- ☐ 313 15 Asst. Lamps-low voltage 6-50V.
- ☐ 314 3 Sub-min Painton Preset Pots 1K.
- ☐ 315 3 Sub-min Painton Preset Pots 2.2K
- ☐ 316 2-90mfd 300VW Can Electros
- ☐ 317 1-200mfd ⅛ 100mfd 200VW Can Electros
- ☐ 138 2-12 Pin PCB Connectors.

DOLLAR STRETCHERS $2 PACS

- ☐ 137 30 Asst. ELECTOLYTICS. All good quality low voltage.
- ☐ 180 5 WAFER SWITCHES MSP rotary, std.mtg. ¼" diam. shaft, 1to4 bank, various positions, all new.
- ☐ 319 MSP. CAR SPEAKER 5"x4" — 150hms.
- ☐ 320 8 ohm TWEETER 75mm-8 ohms.
- ☐ 321 3 Edge Connectors, 46 way, double sided 0.156" pitch, Plessey.
- ☐ 300 1-12V MINI RELAY — PCB mtg, 2A c/0 contacts, 200ohm coil.
- ☐ 217 10-TIC44 SCR's -40V 600mA rating, mini T092 plastic pkge.
- ☐ 181 1-SUPER SENSITIVE MICROPHONE. Hearing aid type by Shure, 1" diam.x¾" high, low imp. Ex. Govt. use.
- ☐ 318 15 Neons, 60-90V pigtail.
- ☐ 231 2-10 Amp Microswitches.
- ☐ 193 10 Asst. Switches:- Toggle, slide, rotary, all new, useful.
- ☐ 266 2-2SB337 Germ.Power Transistors.
- ☐ 198 50 TO-18 Asst. TRANSISTORS PNP&NPN, tested OK, marked.
- ☐ 218 250 Mixed Bulk RESISTORS:- 1/8W, ¼W, ½W, up to 10W.
- ☐ 156 10-20pf TRIMMER CAPS. Air-spaced, mini, cer. base.
- ☐ 154 4-100pf CERAMIC TRIMMERS. High Quality Air-Spaced, PC or chassis mtg., communications specs.

"SUPA" SPECIALS for SEPT.

- ☐ 322 MOTOR SPEED CONTROL KIT. Suits most electric motors. 240V 750W max. $4.50
- ☐ 323 TRANSISTOR RADIO REPAIR KIT. Gang, speaker, semis, caps, pots etc. $4.50
- ☐ 324 5" B&W SHARP TV TUBE. New, ideal servicemen, experimenters. $5.95
- ☐ 199 600V 25A SILICON RECTIFIERS. International Rectifier. 10 for $6.50, 25 for $15.00 ea. .75
- ☐ 205 VHF Trans. TV TUNER. Miniature Sharp, 12 channels, 9 with biscuits, new, 2 for $11.00. $6.00 ea.
- ☐ 219 100 ASST. 1W RESISTORS. 5/, 10/ mixed carbon composition. $1.50.
- ☐ 331 30 A 400 PIV SILICON RECTIFIERS. Heavy duty STC RS640 stud mounted. $1.50.
- ☐ 332 CATHODRAY COND. 0.5mfd 2KV. Stud mtg. hi qual. special purpose. $1.00 ea.
- ☐ 249 HP 5082-7300 LED DISPLAY. 7 Segment 4x7 dot matrix, in built decoder-driver and memory, L.H. decimal pt. 0-9 Readout, buy 4 for $26.00. $7.00 ea.
- ☐ 9 'BONANZA' JACKPOT. A 500 gm (approx) lucky-dip offer, all useable parts, samples, specials, end-of-line components incl. semis. $5.00 ea.
- ☐ 333 3 PIN MINI PLUG & SOCKET .60pr.
- ☐ 334 7 PIN MINI PLUG & SOCKET 1.00pr.
- ☐ 335 14 PIN MINI PLUG & SOCKET 1.20pr.
- ☐ 336 37 PIN MINI PLUG & SOCKET 1.80pr.

NEW PRODUCTS FOR MICROPROCESSOR USERS

NUMERIC KEYBOARD KITS

Ideal for keyless entry systems, burglar alarms, micro processors etc Keys 0 to 9, blue with white lettering and CLR key, red with white lettering. Giant key-top 18 x 18mm, long life (10-6 guaranteed operations), made in Germany by Rafi, PC mount ing, very low profile. **$5.90 Full Kit or 75c per key. 10 kits $5 ea 25 kits $4ea.**

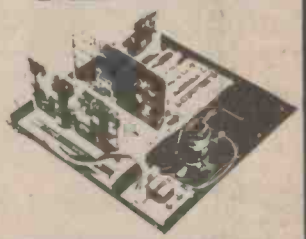
SWTPC 6800 COMPUTER SYSTEM

from South West Technical Products Corp USA

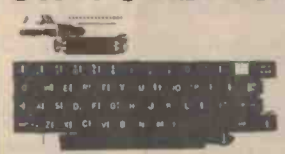
Orders now being accepted for SWTPC products — working display model of 6800 system now available at our showroom, hours as below. All kits are fully documented for hobbyist builders, technical backup service avail.

6800 Computer System CPU...$598.00
CT 1024 Terminal System $420.00
PR-40 Alphanumeric Printer....$395.00
AC-30 Cassette Interface.....$149,00

Technical data and further information is available — send 50c PER ITEM to cover costs.

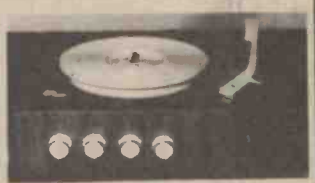


SWTPC KEYBOARD KIT $89.50 ☐



56 key full professional keyboard with one chip ASC11 ENCODER. Selectable upper and lower case, or TTY style outputs, unique character repeat feature, gold plated contacts, power requirements 5V DC at 15MA and — 12V DC at 10MA, connection via 15 pin edge connector, size 11 5/8" x 61/8". **(with tac $77.85)**

3W MINI-STEREO

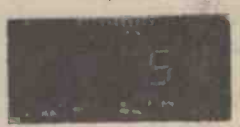


Great idea for beginners — home economy sound system features BSR turntable, dual 3W output (LM380 IC's), volume, bass, treble controls, 240V AC operation, add only speakers. Easily assembled in one evening.

Was $24.98, to clear at $19.98 Perspex cover to suit $5 extra.

$19.98 ☐

BUILD YOUR OWN DIGITAL CLOCK



MA1002	MA 1010	MA 1003
now only	now only	now only
$12 ☐	**$17** ☐	**$27.50** ☐

All clock modules include display, IC chip, ready assembled, add only switches etc, with application data. The MA1002 (½" digits) and MA1010 (000 digits) feature add on brightness control, radio/alarm output, require only transformer ($6 extra) and switches. The MA1002 is available in 12 hour (MA1002B) and 24 hour (MA1002D) versions. The MA-1002 (0.3" digits) operates from 9-15V DC, designed for car or portable use, includes crystal.

POWER SUPPLY KIT

Very popular with hobbyists, servicemen — easy to build. Save $$$ on ready-made units.

Battery Charger 4A $16.50 ☐ 240V input, 4A peak output, self-regulating, low-priced and easily built.

Regulated Bench Supply $18.50 ☐ ETI project 111, 240V input, 1.5 to 15V DC output up to 1.5 AMPS, fully regulated with fold-back current limiting protection.

10W STEREO AMP

$19 ☐

Few only Available

Sounds great, many features — bass/treble controls, 5 pin din rec/play & h'phone sockets, loudness, rumble and scratch switch ceramic cart, input, 35V 1.2A req, transformer, extra $4.00

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

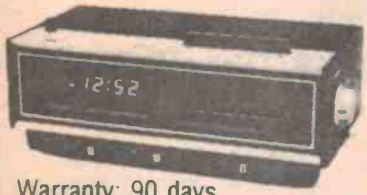
EMONA enterprises

FOR PROMPT MAIL ORDER SERVICE!

EMONA electronics

SALES: Room 208, 661 George St., Sydney. Phone: 212-4815 — C.B.C. Bank Bldg., Haymarket.
REG. OFFICE: 21 Judge St., Randwick. Phone: 399-9061.

STILL THE BEST VALUE!



CR-102, ALL SOLID STATE AM/FM 12 & 24 HOUR DIG. CLOCK RADIO. SLIDING BRIGHTNESS, VOLUME & TONE CONTROLS, ETC EXCELLENT VALUE.

Warranty: 90 days
$45.95 (p&p Int. $4.00; NSW $2.50)

ALSO AVAILABLE o EMONA E-4 stereo FM/AM 24 HOUR DIG. CLOCK RADIO. $79.95 (P&P Int. $4.50. NSW $3.50). o EMONA E-2, All solid state AM/FM 24 HOUR DIG. CLOCK RADIO. $49.95 (P&P Int. $4.00, NSW $2.50). Unique design.

OUR SCIENTIFIC CALCULATORS

NEW! SCIENTIFIC/ENGINEERING/STATISTICAL/BUSINESS CALCULATOR-NATIONAL SEMICONDUCTORS MODEL 4640 (see August ETI for details) only $49.95 (P & P Int. $3.00, NSW $2.00)

- ELCON SC-44F (recharg. battery & charger) Now only $32.50
- PANASONIC — SCIENTIFIC, JE 84D1U $25,00, Adaptor optional $6.00.

To above prices add 15 per cent ST if applicable (P & P Int. $3.00 NSW $2.00)

SPECIALS! LIMITED STOCK!

NEW — MINI CASSETTE RECORDER-DICTATING MACHINE

$45.00
NOW ONLY
$39.99
(P & P $2.00)

EMONA DHM-95 SOLID STATE — (9 transistors) AM/FM POCKET RADIO

~~$12.50~~
NOW ONLY
$9.50
(P & P $1.00)

With large speaker — excellent sound. Earphone and battery included. Warranty 90 days.

AM SHORT CHASSIS PUSH BUTTON CAR RADIO

~~$38.00~~
NOW ONLY
$33.00
(P. & P. Int. $3.50, NSW $2.30)

EMONA, MODEL 12, BATTERY ELIMINATOR

9V, 150mA
$5.00
(P & P $1.00)

C3-11 STEREO CAR CASSETTE

~~$59.00~~
NOW ONLY
$53.00
(P. & P. Int. $4.50, NSW $3.50)

Complete with round flush mount or convertible type speakers. Supply: 12V Neg ground. Excellent value!

HAM-WORLD TIME CLOCK

Battery operated. New design from Japan.

$28.00
(P. & P. Int. $3.50, NSW $2.50)

NEW-LCD WATCH, by NATIONAL SEMICONDUCTORS

CHRONOGRAPH
In the timekeeping mode: Continuous Read Display of Hours, Minutes, Seconds Counter; Day of Week Indicator; Month/Date Calendar and Night Viewing Light. In the stopwatch mode: Continuous Counting Six Digit Display of Minutes, Seconds and Hundredths of a Second, plus Lap and Split Timing.

$85.00 (P & P $2.00) Full 12 month warranty!

FAIRCHILD, 5 FUNCTION LED WATCH

DISPLAYS — HOURS, MINUTES, SECONDS, MONTHS/DATE

ONLY $19.00 (P & P $2.00)
Full 3 months & limited 12 months warranty!

AMATEUR RADIO EQUIPMENT!

- YAESU FRG-7 GENERAL COVERAGE RECEIVER-WADLEY LOOP SYSTEM — $289

TRANSCEIVERS:

- YAESU FT-101E AC-DC TRANSCEIVER — $789
- YAESU FT-301 TRANSCEIVER — $910
- YAESU FT-301D TRANSCEIVER — $1050
- YAESU FT-301SD TRANSCEIVER — $839
- TRIO KENWOOD TS 520S
- TRIO KENWOOD TS 820
- TRIO KENWOOD TS 600
- TRIO KENWOOD TR 7400A
- PRICE ON ALL KENWOOD EQUIPMENT TO BE ANNOUNCED

LINEAR AMPLIFIERS:

- YAESU FL 2100B — $505
- DENTRON MLA 2500 — $899.50
- DENTROL MLA 1200 — $489
- DENTRON 160-10L/572 — $755
- SCS HF3-100L2 — $219

NEW!
MEDIUM SIZED HAM ANTENNA ROTATOR — FJ400. CONSTRUCTED FOR LONG TROUBLE-FREE OPERATION. 200KG VERTICAL WEIGHT CAPACITY. EXTRA HEAVY DUTY DISC BRAKE THAT PREVENTS WIND-MILLING! **$105**

ANTENNA TUNERS:

DENTRON MT-3000A	— $399
DENTRON 160-10AT	— $179
DENTRON 80-10AT	— $ 89
A5IS FOR BCL	— $ 34
RF PREAMPLIFIER SXf	— $ 49
RF PREAMPLIFIER SX59	— $ 79

ANTENNAS:

HUSTLER 4 BTV ALL BAND VERT. TRAP ANTENNA
HUSTLER ALL BAND MOBILE ANTENNA.

FREQUENCY COUNTERS:

MODEL C-401BS, HIGH QUALITY FREQ. COUNTER, ~~1Hz~~ to 67MHz, 670 MHz with UHF SCALER BA-6

NEW MODEL DX-555P COUNTER-GENERATOR

NEW Counter-Generator Two vital pieces of test equipment in one

Counter: 5 digit display, 7 digit readout capability. 10 Hz to over 30 MHz (250MHz with prescaler) Input level 20m Vrms to 5 Vrms (Prescaler 200m Vrms to 2 Vrms). Base oscillator beats directly against WWV.
Generator: 440 KHz to 30 MHz in 3 ranges. Output displayed on counter and available at jack on rear panel 600 Hz modulation for AM receivers.
General: VAC fused supply Size (in.) 2.3H x 6.3W x 8.5D Weight (lbs) 4.4

$198.00

CB RANGE:

SEIKI, HA-23 CHANNEL, AM TRANSCEIVER	— $ 78.00
MECAO, BCB-6, 23 CHANNEL, AM TRANSCEIVER	— $ 78.00
SBE — SIDEBANDER IV, AM/SSB TRANSCEIVERS	— $209.00
KRACO, MOBILE, AM/SSB TRANSCEIVER	— $209.00
IN-LINE DIGITAL FREQ. COUNTER FOR CB	— $ 79.00
CB MOBILE HELICAL WHIP ANTENNAS	— $ 27.50

ALL AMATEUR RADIO EQUIPMENT IS AVAILABLE ON 10 PERCENT DEP. TO APPROVED BUYERS!

T.T.L.		C.M.O.S.	
7400	40c	4000	45c
7401	40c	4001	45c
7402	45c	4002	45c
7404	45c	4006	2.07c
7405	45c	4007	45c
7410	45c	4009	1.08c
7413	60c	4011	45c
7417	74c	4012	45c
7420	45c	4013	81c
7430	45c	4014	2.70c
7437	80c	4016	1.06c
7440	45c	4017	2.62c
7441	1.40c	4018	1.72c
7442	1.20c	4021	2.60c
7445	1.20c	4022	1.89c
7446	1.70c	4023	45c
7447	1.65c	4024	1.50c
7450	45c	4025	45c
7460	90c	4027	1.25c
7470	75c	4028	2.00c
7472	1.20c	4029	2.00c
7473	1.00c	4030	45c
7474	1.00c	4049	95c
7475	1.15c	4050	1.00c
7476	1.76c	4071	45c
7480	2.10c	4081	45c
7482	1.60c	4416	86c
7483	1.60c	4426	3.40c
7490	94c	4449	45c
491	1.40c	4511	2.65c
7492	1.00c	4518	2.60c
7493	1.00c	4520	2.80c

THIS MONTH'S SPECIALS

MATCHED MOTOROLA
MJ.3055 MJ. 2955
UNBELIEVABLE VALUE AT ONLY
94c EACH

1000uf 16v. PT. ELECTRO'S
44c
470uf 50v. PT. ELECTRO'S
52c
2500uf 16v. PT. ELECTRO'S
62c
2500uf 50v. PT. ELECTRO'S
1.47c
ALL ¼WATT AND ½ WATT RESISTORS
STILL ONLY 04c
ALL 1 WATT RESISTORS
STILL ONLY 07c

14 PIN I.C. SOCKETS
ONLY 40c
16 PIN I.C. SOCKETS
ONLY 48c

KITSETS FOR SOUND QUALITY AT A REASONABLE PRICE CHECK THE COMPETITION FOR THESE PRICES . . .

K.S.I. BUDGET PRICED
8" 2 way speaker kit
$59.92c
K.S 2. HIGH QUALITY
8" 2 way speaker kit
$76.80
K.S.3. BUDGET PRICED
10" 3 way speaker kit
$97.34c
K.S.4. HIGH QUALITY
12" 3 way speaker system
$129.36c
K.S.5. HIGH QUALITY
12" 3 way speaker system
$174.40c

ALL KITS LISTED AS COMPLETE SYSTEMS HAVE CABINETS AS OPTIONAL EXTRAS.
THIS MONTH'S SPEAKER SPECIAL, K.S.2, COMPLETE WITH CABINETS AND INNERBOND.
FOR ONLY $138.80c
INCREDIBLE VALUE

PHILIPS AD12K12 AND AK8K40 ALWAYS IN STOCK, AND A FULL RANGE OF PHILIPS SPEAKER COMPONENTS, RING AND GET OUR PRICES.

657 Pittwater Road,
Dee Why. 982 7500

KITSETS

293 St. Pauls Terrace
Brisbane 528 391

---

electronics today INTERNATIONAL

BINDERS HOLDS 12 COPIES OF eti

Protect and file your back issues of Electronics Today with these attractive binders. Price: $4.50 plus postage and packing (80c NSW-$1.70 other states).

SUBSCRIPTION DEPARTMENT

ELECTRONICS TODAY INTERNATIONAL
MODERN MAGAZINES (HOLDINGS) LTD.,
15 BOUNDARY ST., RUSHCUTTERS BAY, 2011

DISCOUNT COMPONENTS

LINEARS:

555	50c
10 for	$4.50
uA741	40c
uA723	50c
556	$1.90
IN4004 DIODES	8c

REGULATORS:

780 5uc 5v. 1A	$1.90
780 8uc 8v. 1A	$1.20
781 2uc 12v. 1A	$1.90
781 5uc 15v. 1A	$1.90
781 8uc 18v. 1A	$1.50
782 4uc 24v. 1A	$1.20

CAPACITORS
GREEN CAP ..... 100 VOLT
.001, .0012, .0015, .0018, .0022, .0027, .0033, .0039 ..... 8c
.0047, .0056, .0068, .0082, .01 ..... 8c
.012, .015, .018, .022, .027, .033 ..... 10c
.037, .047, .056 ..... 12c
.068, .1, .12, .15 ..... 15c

ZENERS
400 MW. 5 percent E24 valves 3u to 33u 16c

I.C. SOCKETS:
8 PIN 25c. 14 PIN 33c. 16 PIN 35c

RESISTORS:
I.R.H. metal glaze G.L.P. GL ½ watt
2.2 OHM TO 1 MEG. 2.5 cents each or mixed 2 cents for 100 plus.

FAIRCHILD
C.B. Regulator uA 78CB 13.8 u at 2 AMP $2.90

WELLER CORDLESS SOLDERING IRON KIT. MODEL WC 100 DK15W. INCLUDES BATTERIES, SOLDER, 4 INTERCHANGEABLE TIPS, BATTERY CHARGER, PLUS INSTRUCTIONS FOR ONLY $28.00

ALL GOODS NEW AND GUARANTEED. PRICE LIST ENCLOSED WITH EACH ORDER. PACKAGE AND POSTAGE CHARGE OF 40c PER ORDER.

ROD IRVING ELECTRONICS
P.O. BOX 135, NORTHCOTE VIC. 3070

EDGE ELECTRIX

31 BURWOOD RD., BURWOOD, SYDNEY, 2134. Tel: 747 2931

THE SPEAKER KIT SPECIALIST

AWA CORAL

● 12SAI	30W RMS	
● 10SAI	25W RMS	
● 8SAI	18W RMS	
● 6SAI	15W RMS	
● 12SA5		30W RMS
● 10SA5	Improved	25W RMS
● 8 SA5		18W RMS
● 12SA7		40W RMS
● 10SA7	Dome Series	30W RMS
● 8 SA7		20W RMS

PLESSEY FOSTER

● 3016	12"	3way	40W RMS
● 3003	12"	3way	40W RMS
● 2503	10"	3way	40W RMS
● 2510	10"	3way	30W RMS
● 2010	8"	3way	20W RMS
● 2006	8"	2way	12W RMS

PHILIPS

● 07	12"	3way	40W RMS
● 06	10"	3way	40W RMS
● 04	8"	3way	40W RMS
● 14	12" 3way Dome Series		40W RMS
● AD12K12	12" 3 way Incl. Cabinets		40W RMS
● AD8K40	8" 2 way Incl. Cabinets		40W RMS

KEF

● SK3 Concerto Kit 50 WRMS

WRITE OR RING TODAY! (02) 747 2931.

MAIL ORDER BY BANKCARD

JUST QUOTE NUMBER

CORAL (FROM AWA) * SPECIAL *

10" 3 WAY SPEAKER KIT INCLUDING QUALITY CABINET.

This magnificent kit includes very good looking dark walnut finished cabinets in knock down form with accoustic foam fronts. (Note: Freight on via carrier).

25 cm (10") 3-way 3-speaker SYSTEM KITS (One pair) 10SA-1

● Speaker: Two 25 cm (10") woofers, two 12.5 cm (5") cone squawkers, two 6.5 cm (2½") cone tweeters ● Impedance: 8Ω Cross-over frequency: 2,000Hz, 6,000Hz Output sound pressure level: 93dB Program source input: 50W ● Frequency responce: 4020,000Hz (38l Air-tight enclosure)

NOW ONLY **$129** (OFFER CLOSES END NOVEMBER)

* OVER 25 DIFFERENT SPEAKER KITS STOCKED!
* 100's OF TYPES OF INDIVIDUAL SPEAKERS INCLUDING X'OVERS, CABINETS & ACCESSORIES.

PHILIPS SPEAKERS KITS

Kit AD12K12 40W RMS contains:
2 x AD0140/TS 1" tweeter
2 x AD5060/SQ8 5" mid range
2 x AD1265/W8 12" woofer
2 x ADF500/4500/8 crossover
2 x sets of leads
2 x ADF12 K12 level control modules.
2 x tubes of wood glue.
44 woodscrews 16 x size 4, 28 x size 8
Innerbond damping material
Stripcalk caulking compound
Speaker System $197.50
Timber Kit $89.00
Post & Packing included.

ETI 583 GAS ALARM KIT

This versatile alarm prevents the motor being started or electrical equipment used if there is a build up of petrol vapour or LP gas, thus protecting your boat against fire.
Kit Price $33.00 + P & P.

SEND FOR FREE PRICE LIST ON CB COMPONENTS

SWR METER

Compact and rugged unit for CB and amateur radio antenna installations, also for field strength measurements (mobile or base.
V.S.W.R.: 1:17010:1
Power 0-20 watt
F.S. scale 0-10
Model SWR300
$19.60 + P & P

DYNAMIC MICROPHONE

Omni directional for CB use press to talk switch with 2M shielded curl cord W/O plug.
Imped.: 500 OHM
Freq.: 20-10kHz
Sensit.: 70 dB
Model DM95
$6.35 + P & P

BOOTLID MOUNT ANTENNA

Base Load Coil
Heavy duty base complete with 3 metre cable and PL259 plug no holes to drill.
Model DA90
$21.56 + P & P

CERAMIC MAGNET MOUNT ANTENNA

Centre load coil — complete with 3 metre cable and PL259 plug for mounting without drilling holes or scratching paint-work.
Model CA70.
$20.76 + P & P

GUTTER MOUNT ANTENNA

With quick fit bracket.
Centre load coil complete with 3 metre cable and PL259 plug.
Model CA80
$18.42 + P & P

S.W.R. POWER FIELD STRENGTH METER

Excellent in the field multi-purpose meter for antenna, tuning, repairs-use while installing base or mobile or peaking transceivers.
V.S.W.R.: 1:1 1:3
Freq.: 1.5MHz to 220MHz
Power Range: 0-10 watt 0-100 watt
Model SWR400
$27.53 + P & P

HIGH FREQUENCY FITTINGS

CB installations to 200MHz

PL259 HF plug	$1.30
PL259 WA HF plug with 58U cord outlet	$1.30
PL259 quick connect HF plug	$1.40
SO239 panel socket with flange	$1.30
SO239A panel socket	$1.10
PL258 double female connector joiner	$1.30
M258 double male connector joiner	$1.70
M358 T type connector double female & male	$4.15
M359 right angle connector male to female	$2.80
MP4 4 pin microphone plug	$3.10
MP4A 4 pin panel microphone socket for MP4	$1.10

POSTAGE & PACKING CHARGES

Order Value $	Charge
$5 $ 9.99	$1.00
$10 $24.99	$2.00
$25 $49.99	$3.00
$50 $99.99	$4.00

MODE

MODE ELECTRONICS CO

44 TREVELYAN ST. BOTANY 2019 666 6324
MAIL ORDERS P.O. BOX 365, MASCOT 2020

INTERSIL ICL7106/7107 Digital Panel Meter IC

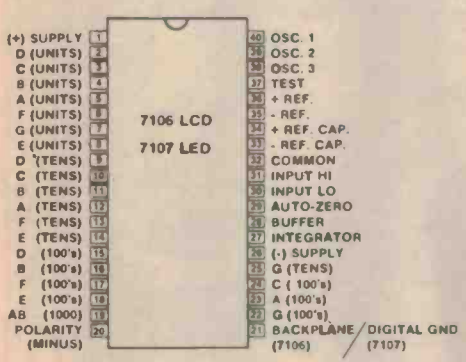


Fig. 1. Pin Configuration.

THE ICL7106 and 7107 are high performance, low power, CMOS 3½ digit A/D converters that contain all the necessary active devices on a single monolithic IC. Each has parallel seven-segment outputs which are ideal for use in a digital panel meter. The ICL7106 will directly drive a liquid crystal display including the backplane drive. The ICL7107 will directly drive instrument size LEDs without buffering. With seven passive components, display and power supply, the system forms a complete digital voltmeter with automatic zero connection and polarity (see figs. 3 and 4).

Both ICs use the time-proven dual slope integration technique with all its advantages, i.e. non-critical components, high noise rejection, non-critical clock frequency and almost perfect differential linearity. Both the ICL7106 and 7107 can be used not only with its internal reference, but true ratiometric reading applications may also be accomplished over a full scale input range of 199.9 mV to 1.999 V.

The accuracy of conversion is guaranteed to plus or minus 1 count over the entire plus or minus 2000 counts and the auto-zero facility provides a guaranteed zero reading for 0 volts input. However, the chip does provide a true polarity output at low voltages for null detection. Both chips have an on-board clock and reference circuitry, as well as overrange detection.

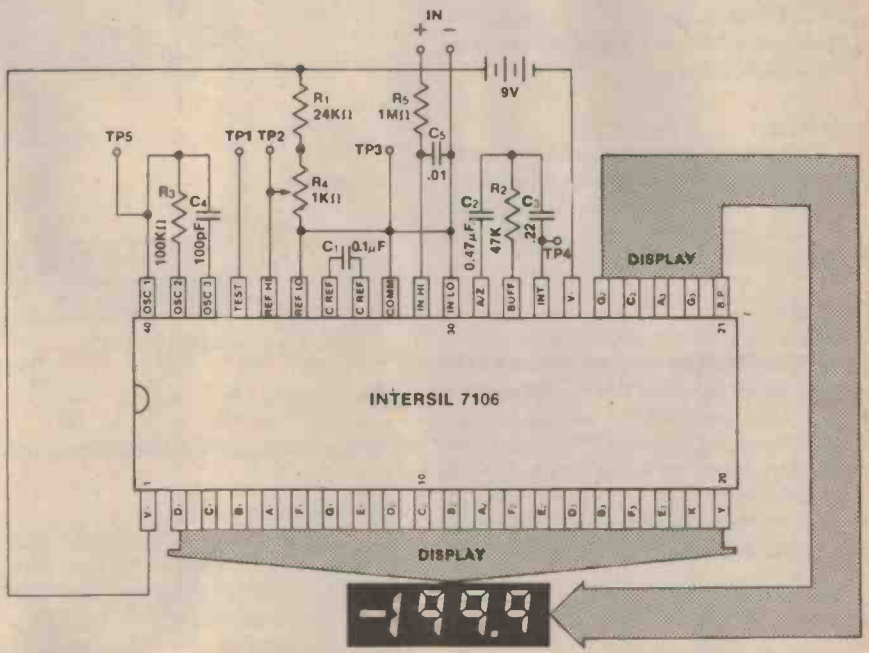


Fig. 3. LCD Digital Panel Meter Using ICL7106.

Displays and DPs

The additional components required to build a DPM are a display (either LCD or LED), 4 resistors, 4 capacitors, and an input filter if required. Liquid crystal displays become polarised and damaged if a DC voltage is continuously applied to them, so they must be driven with an AC signal. To turn on a segment, a waveform 180 degrees out of phase with the backplane drive (but of equal amplitude) is applied to that segment. The 7106 generates the segment drive waveform for all digits internally, but does not generate segment drive for the

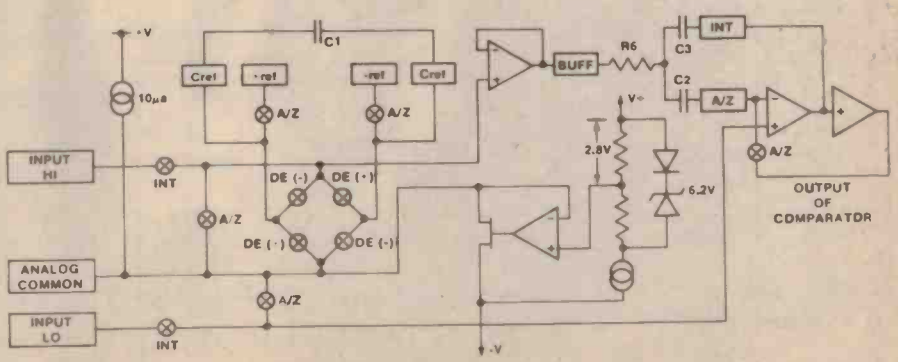


Fig. 2. Analogue Section Block Diagram.

decimal point. This must be done using an inverter or exclusive-OR logic (see figs. 5 and 6). For use with LED displays the 7107 pull-down FETs will sink about 8 mA per segment, which produces a bright display suitable for almost any indoor application. A fixed decimal point can be turned on by tying the appropriate cathode to ground through a 150 ohm resistor.

Capacitors

The integration capacitor should be a low dielectric-loss type, such as a polypropylene. Mylar capacitors are suitable for the reference and auto-zero capacitors.

The Clock

The chip carries the active parts of an RC oscillator which runs at about 48 kHz and is divided by 4 for use as the system clock. The integration period (1000 clock pulses) is therefore 83.3 ms. Each conversion requires 4000 clock pulses, i.e. 3 readings per second. For optimum 50 Hz line frequency rejection, the clock should be set to a multiple of 50 Hz, e.g. 50 kHz.

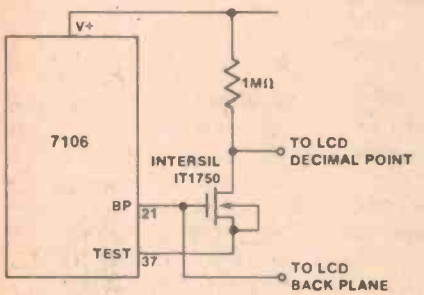


Fig. 5. Simple Inverter for fixed decimal point.

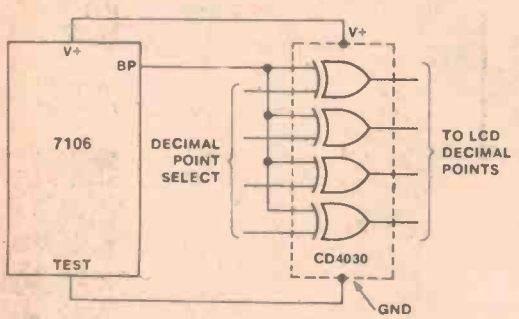


Fig. 6. Exclusive-OR gate for DP drive.

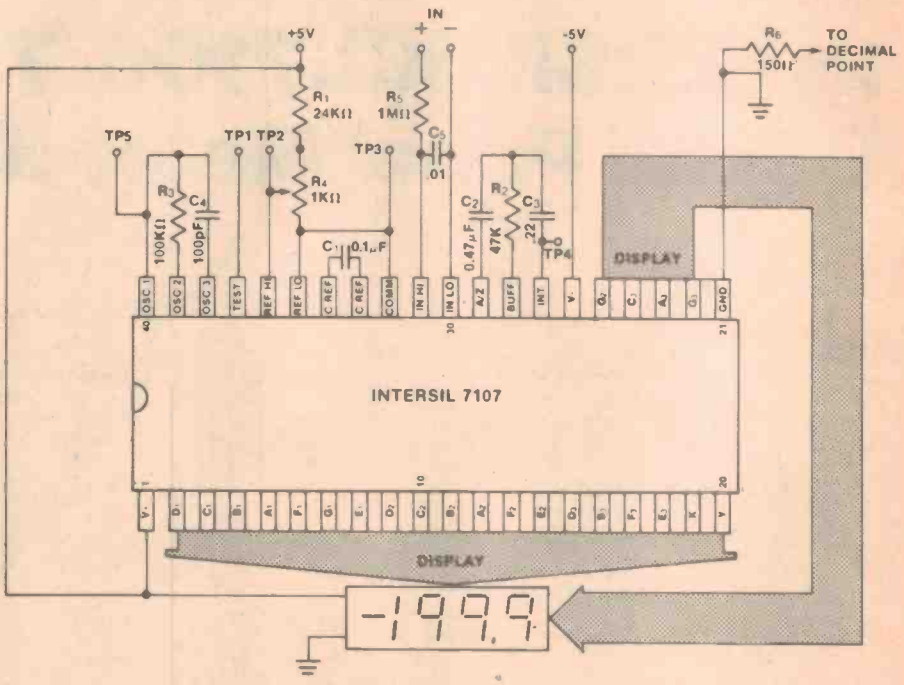


Fig. 4. LED Digital Panel Meter Using ICL7107.

The Reference

For 200.0 mV full scale, the voltage applied between REF Hi and REF Lo should be set at 100.0 mV. For 2.000 V full scale, this should be 1.000 V. The reference inputs are floating, and the only restriction on the applied voltage is that it should lie in the range V– to V+.

For many applications, the internal reference of 2.8 V between V+ and COMMON is adequate, but power dissipation in the 7107 LED version can wreck this. However, an external reference can be added as shown in fig. 7.

Power Supplies

The 7106 will run from a single 5 to 12 V supply. If INPUT Lo is shorted to COMMON, this will cause V+ to sit 2.8 V positive with respect to INPUT Lo, and V– at 6.2 V negative with respect to INPUT Lo.

The 7107 requires dual supplies, +4.5 to +6 V and –3 to –6 V at 1 mA. A negative supply may be derived from +5 V using the circuit given in fig.8.

Further Information

Evaluation kits for the 7106 and 7107 are supplied with a data sheet and application note. In addition, Intersil produce three other Application Bulletins: A016 'Selecting A/D Converters', A017, 'The Integrating A/D Converter', and A018 'Do's and Dont's of Applying A/D Converters'.

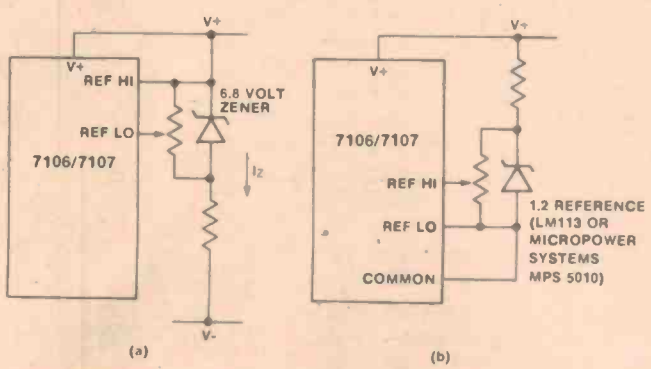


Fig. 7. Using an external reference.

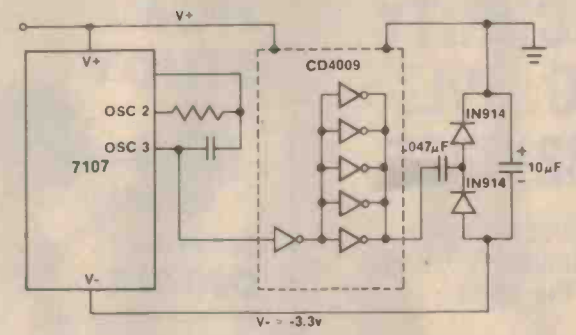


Fig. 8. Generating a negative supply from +5 V.

Electrical Specifications: ICL7106/7107

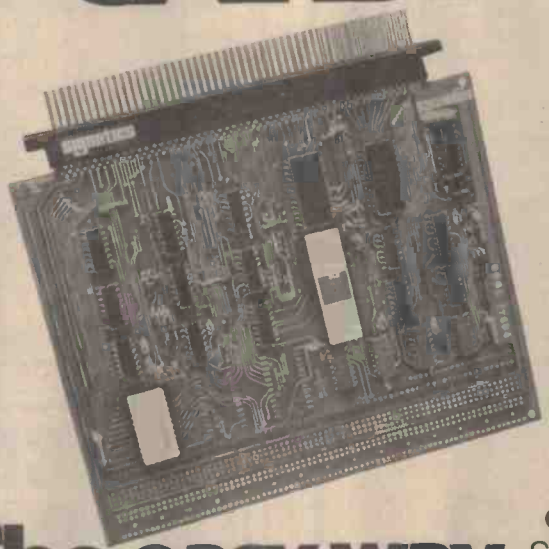
Full Scale Voltage Rating	∓200 mV (5.0 V min V+ to V–) ∓2.0 V (6.0 V min V+ to V–)
Full Scale Digital Range	∓2000 counts
Accuracy with external reference 10° to 50° C	<½ count
Noise referred to input	15 μV typical
Input circuit	Differential
Input Bias Current	2 pA
Input Impedance	>1 TΩ
Reference (Internal)	2.8 V, referenced to V+ Temperature Coefficient 100 ppm typical
Conversion Characteristic	Dual Slope with Auto-zero Integrating Time = 1000 counts Reference Time = 0 – 2000 counts Auto-zero time = 1000 + 2000 – Ref. Time

Recommended External Components:

	200 mV full scale	2 V full scale
Integrating Cap (C3)	0.22 μF	0.22 μF
AZ Cap (C2)	0.47 μF	0.047 μF
Ref. Cap (C1)	0.1 μF	0.1 μF
Clock Cap (C4)	100 pF	100 pF
Integrator Resistor (R6)	47 kΩ	470 kΩ
Clock Resistor (R3)	100 kΩ	100 kΩ

Clock Frequency	48 kHz, internally divided by 4
Power Requirements	LCD: 1 mA at 4.5 – 6 V LED: 1 mA at 4.5 – 6 V, plus LED current
Read Rate	Accurate from .1 to 15 readings per second

ADAPTABLE BOARD COMPUTER PROTOTYPING CARD.



The easy way to start in Microprocessors

Two easy steps:
Plug in, Hook up
+ 5 volts, ground, and
a teletype,...and you're
in business!
Here is a short
list of features.

- 1 K BYTES ROM (PIPBUG EDITOR AND LOADER) BOARD EXPANDABLE TO 2 K BYTES ROM/PROM
- 512 BYTES RAM (2112B – 256 x 4 STATIC NMOS RAMS) BOARD EXPANDABLE TO 1 K BYTES OF RAM
- ON BOARD TTL CLOCK
- TWO – 8 BIT PARALLEL B1/D1 I/O PORTS
- RS232/TTY SERIAL I/O PORT
- CONNECTOR SUPPLIED
- AVAILABLE PRE-ASSEMBLED AND TESTED – 2650 PC1500 OR IN KIT FORM – 2650 KT9500

Ask your local Philips stockist to show you the 2650 PC1500 Adaptable Board Computer Prototyping Card, and get an easy start in Microprocessors.

PHILIPS ELECTRONIC COMPONENTS & MATERIALS,
P.O. Box 50, Lane Cove, 2066.
Sydney 427 0888,
Melbourne 699 0300, Brisbane 277 3332
Adelaide 223 4022, Perth 65 4199.

PHILIPS

Electronic
Components
and Materials

153.0198

Electronics Today International

4600 and 3600 SYNTHESIZERS

NOW FOR SOMETHING MORE AMBITIOUS!

Here are full plans for building two full-scale electronic music synthesizers.

Many thousands of these remarkable units have been built world-wide since the series of constructional articles started in Electronics Today late in 1973.

Since then, the two units have gained a reputation as being among the most flexible and versatile of electronic instruments available.

They have been built as school and university group projects, by recording studios, professional musicians, university music departments and as home hobby projects.

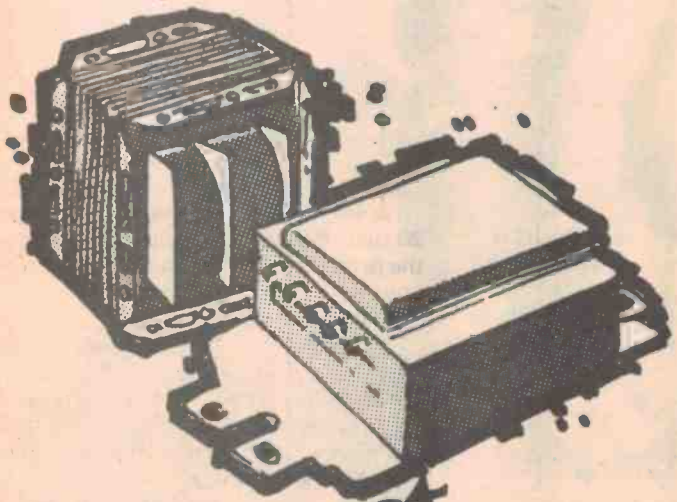
Here, the complete series has been reprinted in a completely corrected and up-dated form.

The book is available in a limited edition of 2000 copies only.

ENSURE YOUR COPY NOW!

Send $12.50 to Electronics Today International, 15 Boundary Street, Rushcutters Bay NSW, 2011.

PRODUCT OF THE MONTH



low cost transformers

- easy to install
- low profile

Distributors of Electronic Components to Industry

ELECTRONIC ENTHUSIASTS EMPORIUM

SHOPS 2 & 3 POST OFFICE ARCADE • JOYCE STREET
PENDLE HILL • NSW 2145 • TELEPHONE 636 6222

Convert your CB into a base station

Power your rig direct from mains electricity with an SEC approved power supply.
These small portable units provide a factory-set 13.8V DC regulated output for maximum transmitting power.
High performance integrated circuitry guarantees clean, hum-free reception.
Quick-connect terminals facilitate rapid changeover from static-mobile-static operation.

ARLEC CB radio power supplies

ELECTROPAK PS352

For CB Radios up to 5 Watts Rating

1.8 Amp peak capability. Automatic overload protection.
1.0 Amp continuous output. Size: 140 x 80 x 133mm

SIDEBAND 4 PS353

For CB Radios up to 15 Watts Rating

4 Amp peak capability. Automatic overload protection.
2 Amp continuous output. Size: 140 x 80 x 133mm

See them at your local CB Store or write to A&R Electronic Equipment Co. Pty. Ltd. for further details

A+R ELECTRONIC EQUIPMENT CO. PTY. LTD.
A MEMBER OF THE A+R-SOANAR ELECTRONICS GROUP
30 Lexton Road, Box Hill, Vic. 3128
Australia. Telex 32286.
SALES OFFICES VICTORIA 89 0661
N S W 78 0281
S AUST 51 6981
QUEENSLAND 52 5421
W AUST 81 5500

A+R SOANAR GROUP

DIGITAL PANEL METER

This simple, economical yet highly accurate voltmeter uses a large liquid crystal display for easy reading and low power consumpion. It will be the basis of future projects as well as being a useful meter in its own right.

WE INITIALLY purchased a number of Intersil evaluation kits for our own use but soon realised that while they were very good electronically, the physical layout wasn't too hot. We therefore redesigned the PC board, reducing the size dramatically, adding the decimal point drive circuitry and some dropping resistors and zener diodes to allow the board to run from a dual power supply of +/– 5V or more (e.g. with op-amps). This resulted in a very useful device which we decided to run as a project. While it is basically a panel meter suitable for DC voltages and current (with a shunt) it will be the display module for several future projects.

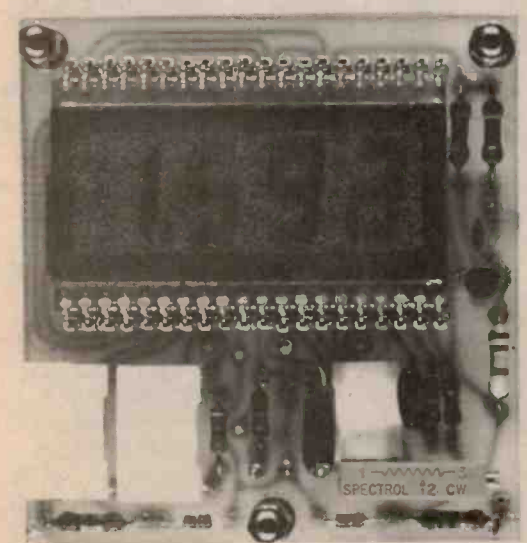
Construction

To save on real estate, the main IC is mounted under the display. We used the Molex connectors supplied with the evaluation kit for the display and soldered the IC directly into the board. If you want to mount the IC in a socket a low profile type should be used, with a high one for the display. As a socket is not available for the display a standard 40 pin one can be cut up to fit.

However before fitting either the display sockets or the IC, fit all the other components first. The over lay in fig. 3. shows the positioning of the components. Most of the components come with the evaluation kit. The large capacitors are laid on their side to minimise height.

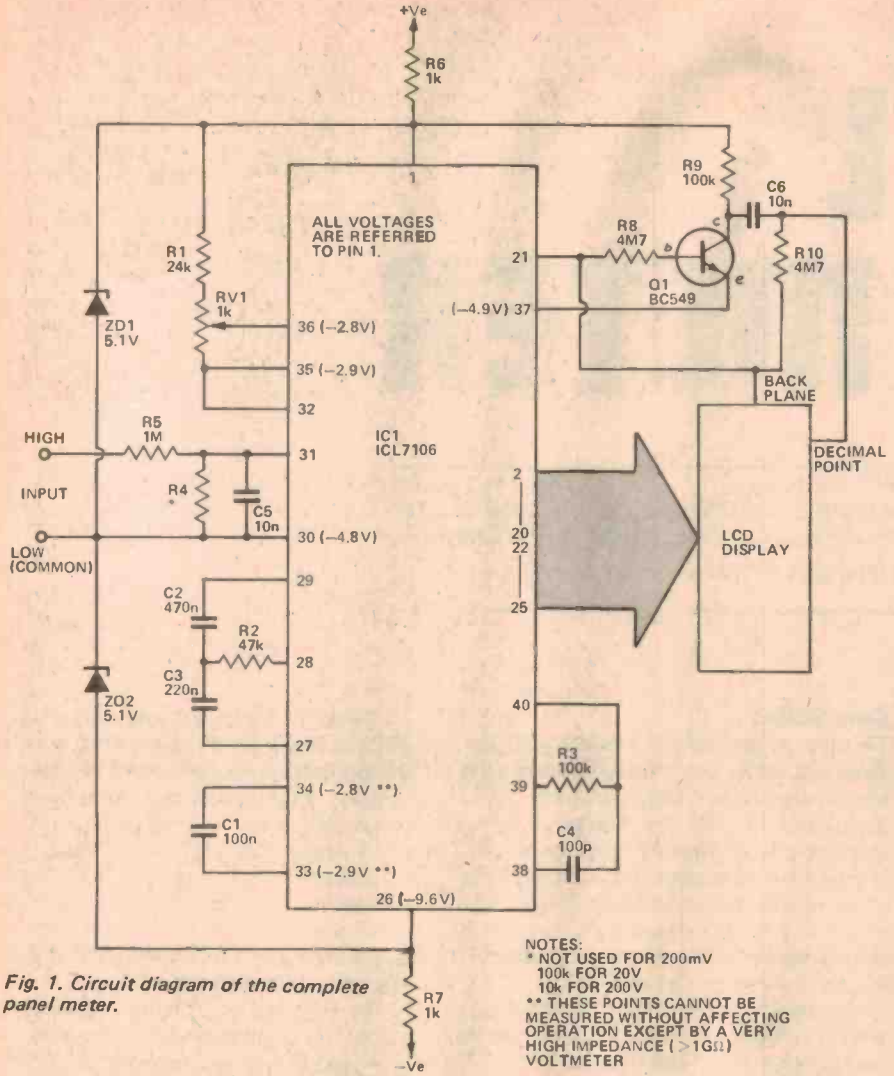
When fitting the IC solder pins 1 and 26 first (the power supply pins) so that the protection diodes on the inputs can operate, thus preventing damage by static electricity. It is necessary that a small tipped iron and fine solder be used to prevent bridging tracks. The Molex sockets can now be fitted in two strips of 20 with the top connecting pieces being broken off using long nosed pliers after they are soldered in.

As there are no polarity marks on the display it is necessary to hold it at an angle to the light and look for the outline of the digits. The full format of the display is shown in fig. 2. In this unit the arrow, semicolon and the vertical part of the + sign are not used.



SPECIFICATION – ETI 135

Full scale reading	200mV
Resolution	100μV
Accuracy	$<$1 digit
Display	3½ digit LCD
Input impedance	$>10^{12}$ ohms
Input bias current	$\approx$2 pA
Polarity	automatic
Conversion method	dual slope
Reference	internal $\pm$ 100ppm
Power supply	$\pm$5V to $\pm$ 15V dc 1mA @ $\pm$5V



NOTES:
* NOT USED FOR 200mV
100k FOR 20V
10k FOR 200V
** THESE POINTS CANNOT BE MEASURED WITHOUT AFFECTING OPERATION EXCEPT BY A VERY HIGH IMPEDANCE (>1GΩ) VOLTMETER

Fig. 1. Circuit diagram of the complete panel meter.

HOW IT WORKS – ETI 135

Not much can be said on how this project works as everything is done by one IC and if anything goes wrong it is usually the IC. We have included some waveform diagrams and voltages for reference purposes. The conversion works on the dual-slope integration technique, which is the most reliable of the simple methods available. A capacitor is charged up at a rate proportional to the input voltage for a predetermined time (in this case 1000 clock pulses), then it is discharged at a constant rate until it reaches the starting point again. The time taken to do this (i.e. the number of clock pulses) is proportional to the input voltage.

It is a true dual polarity system where the integration direction depends on the polarity of the input voltage. Provided AC ripple on the input averages to zero over 1000 clock pulses it will be rejected, hence where 50 Hz mains is to be rejected a 50 kHz clock should be used, giving 80 ms sample time (4 cycles of 50 Hz). The clock can be adjusted by varying R3 if desired.

For further details of the IC see the data sheet in this issue.

The printed circuit board layout for this project is on page 92.

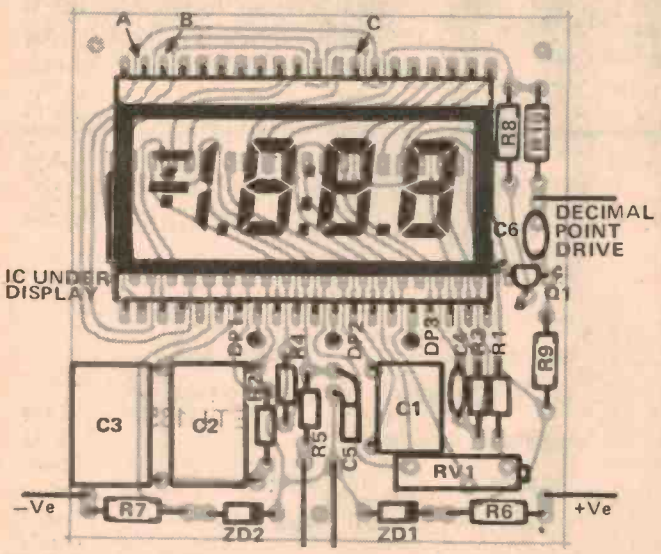


Fig. 2. Component overlay with the display in place. Points marked A, B and C are the unused display segments – the vertical part of the + sign, the arrow and the semicolon respectively.

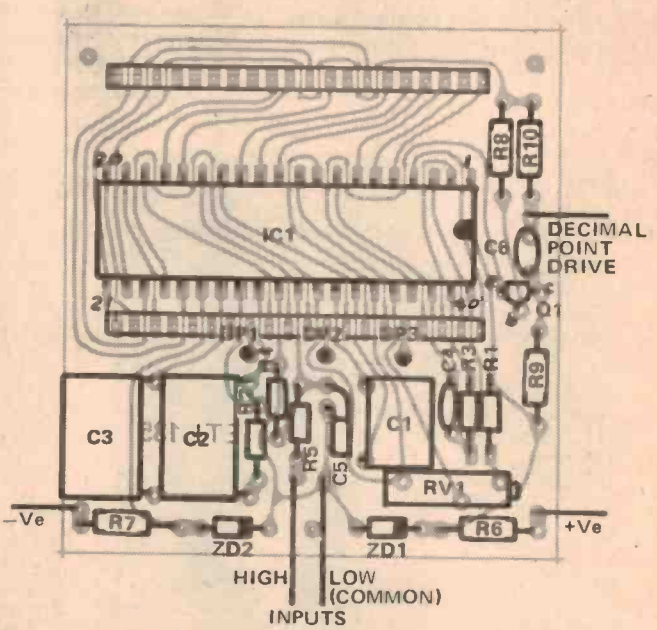


Fig. 3. The component overlay without the display showing the positioning of the integrated circuit.

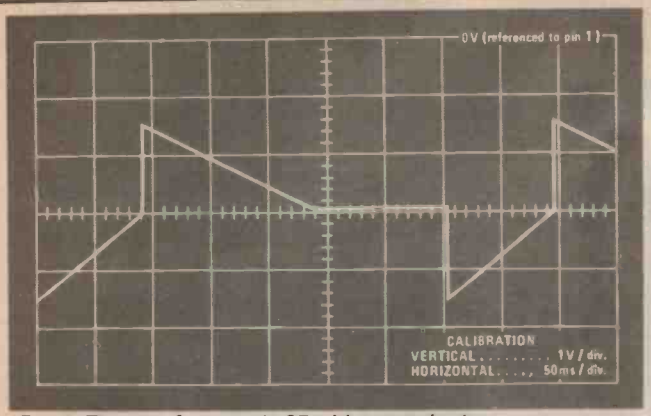


Fig. 4. The waveform at pin 27 with a negative input voltage of about 170mV.

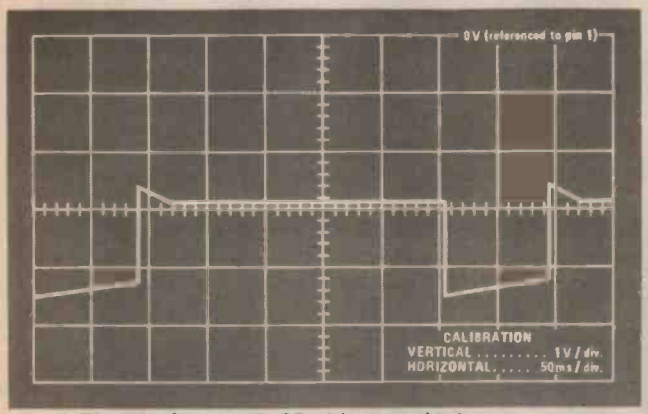


Fig. 5. The waveform at pin 27 with a negative input voltage of about 30mV. Compare this with Fig. 4.

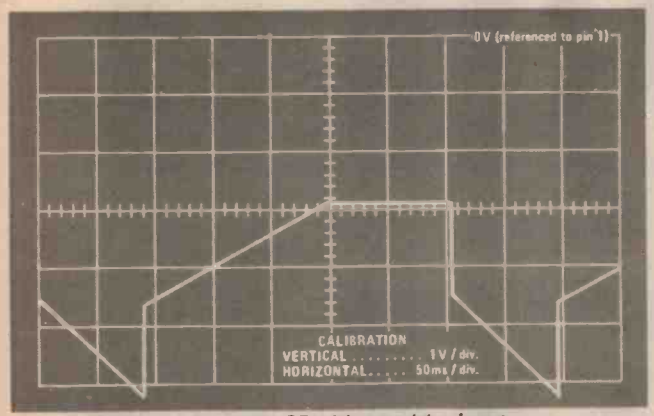


Fig. 6. The waveform at pin 27 with a positive input voltage of about 170mV.

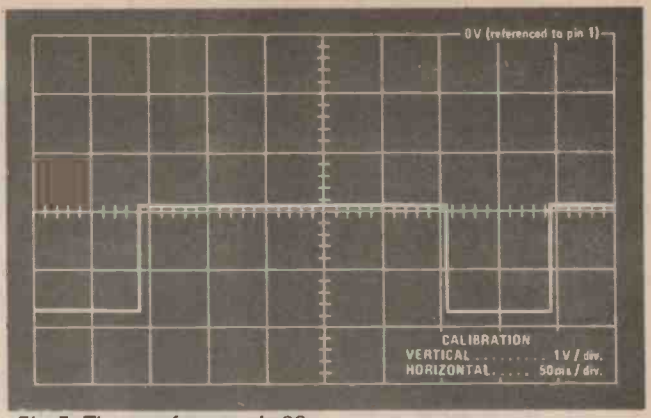


Fig. 7. The waveform at pin 28.

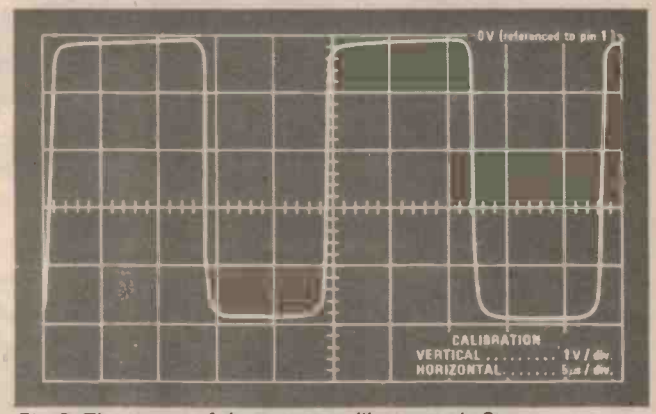


Fig. 8. The output of the master oscillator on pin 38.

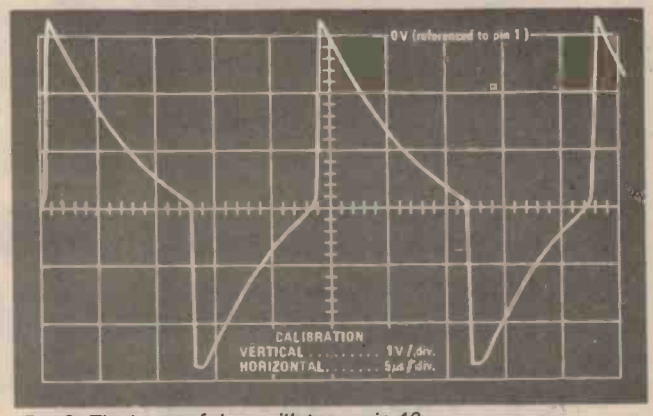


Fig. 9. The input of the oscillator – pin 40.

PARTS LIST – ETI 135

Resistors all ¼ or ½ W, 5%

R1*	24k
R2*	47k
R3*	100k
R4	see circuit diagram
R5*	1M
R6	1k
R7	1k
R8	4M7
R9	100k
R10	4M7

Potentiometers

RV1*	1k 10 turn trim

Semiconductors

IC1*	ICL7106
Q1	BC549
ZD1,2	5.1V 300mW

Miscellaneous

PC board ETI 135
LCD display
* Socket for LCD display

* These components are supplied with the Intersil ICL7106EV evaluation kit.

The Intersil evaluation kit which contains most of the components for this project is available from R & D Electronics, 23 Burwood Road, Burwood, Victoria 3125 and Semcon Microcomputers, P.O. Box 61, Pennant Hills, NSW 2120. The printed circuit board and all other components to complete the project is available from Nebula Electronics, 15 Boundary Street, Rushcutters Bay, NSW 2011, for $4.50 + .50c p & p.

Here's all you need to order 3-terminal IC voltage regulators

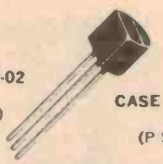
Motorola 3-Terminal Voltage Regulators

Nominal Voltage	Positive			Negative	
*	Maximum Current			Maximum Current	
	1500 mA	500 mA	100 mA	1500 mA	100 mA
2	—	—	—	7902	—
3	—	—	—	—	*79L03C
5	*7805	*78M05	*78L05	*7905	*79L05C
5.2	—	—	—	7905.2	—
6	7806	78M06	—	7906	—
8	*7808	78M08	*78L08	7908	—
12	*7812	*78M12	*78L12	*7912	*79L12C
15	*7815	*78M15	*78L15	*7915	*79L15C
18	*7818	*78M18	*78L18	7918	*79L18C
20	—	78M20	—	—	—
24	*7824	*78M24	*78L24	*7924	*79L24C
Package	K = TO-3 P = 199	P = 199 G = TO-39	P = TO-92 G = TO-39	P = 199 K = TO-3	P = TO-92 G = TO-39

CASE 11
TO-3
(K Suffix)

CASE 199-04
(P Suffix)

CASE 79-02
TO-39
(G Suffix)



CASE 29-02
TO-92
(P Suffix)

*indicates stock items

Cut it out, hang it up— It'll save you lots of time.

Cema has 3 terminal IC Voltage Regulators from Texas Instruments and Motorola.

TEXAS INSTRUMENTS

MOTOROLA Semiconductors

To order, just call your nearby Cema office or Cema Agent and be prepared for a pleasant surprise when they quote you the new low prices.

CEMA

CEMA ELECTRONICS PTY. LTD.

SYDNEY
21 Chandos Street,
Crows Nest, NSW 2065
Phone: 439-4655

MELBOURNE
208 Whitehorse Road,
Blackburn, VIC 3130
Phone: 877-5311

AGENTS

BRISBANE: Electronic Components (QLD) Phone: 371-5677
CANBERRA: Daicom Phone: 82-3581
ADELAIDE: Protronics Pty. Ltd. Phone: 51-4713
PERTH: Reserve Electronics Phone: 87-1026
HOBART: Tasmanian Electronic Supplies Phone: 44-1337
WOLLONGONG: Macelec Phone: 29-1455

Mini-Mart

send your ad to —
ETI MiniMart,
Modern Magazines,
15 Boundary Street,
Rushcutters Bay,
NSW 2011.

We'll print your 24 words (maximum) totally free of charge. Copy must be with us by the 7th of the month preceding the month of issue. Please, please write or preferably type your adverts clearly, using BLOCK LETTERS.

CONDITIONS

Name and address plus phone number (if required) must be included within the 24 words allowed.

Reasonable abbreviations, such as 25 Wrms, count as one word.

Private adverts only will be accepted. Please let us know if you find a commercial enterprise using this service.

Every effort will be made to publish all adverts received — however, no responsibility for so doing is accepted or implied.

'MECHANICAL CALCULATOR.' 32 digit, typewriter size, for parts. Nice 240V motor, loads of gears and springs. $15. N.Martin 38 Fourth Ave, Campsie N.S.W. 2194

FOR SALE Rotel tuner Amp RX402 $220 Pioneer 2121 cassette deck $220, contact Ian Mc Gill 198 Moorapool St, Geelong VIC 3220.

SELL solartron double beam CRO. Delayed sweep timebase. One beam needs repair. $150 O.N.O. with manual. A.Freed 20 Ingra Ave. Miranda 2228, Phone 525-8102.

SWAP Yunker universal counter 1032u and /or Marconi TF1064 VHF-UHF FM Sig. Genl. for scope wideband 15MHz 50mV/cm sensitivity or sell offers to P.O. Box 533 Albury. 2640 NSW (060) 213372.

SELL set Assbl'd boards Patchboard, wired keeboard, ETI 4600 $1200 O.N.O. I.L. Miller. 35 Gilford Ave, Prospect 5082.

RADIOS for sale collectors item Pre 1928 in working order. Anderson. Whyte. St Clunes VIC. 3370 Phone (053) 453225.

SALE HP25 good as new. 2 Handbooks, charger and box INC. $140 cost $160. Henry Secchi. 7 Blackwood St. LAYOR 3075 VIC. Phone 465 5396.

WANTED circuit for Pioneer Prelude 4000 Amplifier. S.Lane, 1 Myrtle Rd, Canterbury, VIC., 3126.

TRANSCEIVER Yaesu FT-75B SSB/CW 5 band 80-10m AC/DC power supplies comprehensive accessories spares new condition $450 ONO A.Kitchener 75 Brunswick St Fitzroy 3065 Ph. 419 7055.

WANTED copy circuit DFM. 'ELECTOR' Nos. 7&8 Oct. Nov. 1975. G.F.Jones 40 Victoria St, Fairfield. NSW 2165. Phone 727 9712.

WANTED circuit diagrams, manuals for A510, AN/PRC10/9, WS62, W/SETS C11/RZ10, C42/45. De Quincey, Box 132, Bairnsdale. 3875. (051) 524380. Related odds & ends welcomed.

AWA TELERADIO 80 marine transceiver. Six channels plus broadcast band. 2182 2201 2284 2524 4136.3 frequencies fitted. C/W mic and bracket. $30, P.O. Box 57 Rozelle 203 2039.

INCREDIBLE OFFER!

2 new revolutionary, portable electronic games!
No TV set needed!

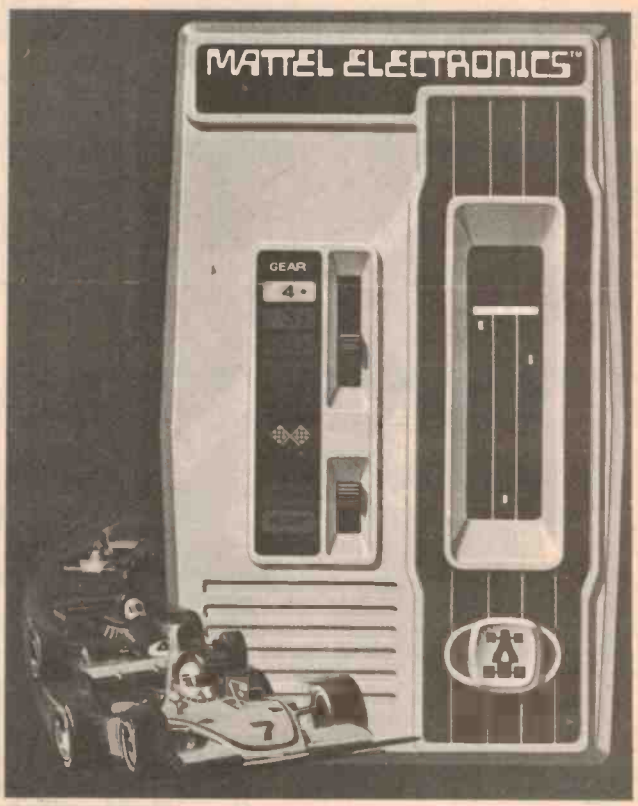
FUTURETRONICS HAVE DONE IT AGAIN. THE PEOPLE WHO BROUGHT TO YOU THE WORLDS FIRST MICROPROCESSOR BASED CHESS GAME NOW BRING YOU THE ULTIMATE IN PERSONAL ENJOYMENT AND RELAXATION. TWO NEW PORTABLE HAND HELD ELECTRONIC GAMES FULLY ASSEMBLED, WITH L.E.D. DISPLAY, PRECISION LENS, SOLID STATE CIRCUITRY AND REALISTIC SOUND EFFECTS. USES STANDARD 9 VOLT BATTERY (NOT INCLUDED). IT'S YOU AGAINST THE COMPUTER FOR A WHOLE NEW KIND OF EXCITEMENT, FUN AND CHALLENGE.

MISSILE ATTACK

ICBM alert! Computer-controlled missles attacking! You command anti-missile missiles! Push the fire button. Intercept. Save "Your City"! (Lose and you'll hear part of "Taps".)
Game features automatic digital scoring, launch and guidance controls, and realistic sounds.

AUTO RACE

The race is on! Computer-controlled cars coming straight at you. Steer! Shift! Avoid a collision and beat the clock! (Hear the sound of victory!).
Game features automatic digital timer, steering and gear shift controls, plus realistic race sounds.



To order or for information contact:

Future tronics pty. ltd.

527 TOORONGA ROAD, HAWTHORN EAST, VICTORIA, AUSTRALIA TELEPHONE (03) 82-3732

☐ PLEASE SEND AUTO RACE I ENCLOSE $49.65
☐ PLEASE SEND MISSILE ATTACK I ENCLOSE $49.65

NAME: .....

ADDRESS: .....

..... STATE ... P/CODE ....

☐ PLEASE SEND BOTH GAMES I ENCLOSE $89.90

PHONE 823732

$4.75*

PROJECT ELECTRONICS

OUT NOW

an ELECTRONICS TODAY publication

PROJECT ELECTRONICS

This unique project book has been designed specifically for the newcomer to electronic circuit construction, and in particular to fulfill the needs of schools' current three-segment technics syllabus in electronics.

Available at most major newsagents, kitsets and component suppliers or directly from Modern Magazines, 15 Boundary St, Rushcutters Bay. NSW 2011 -$4.75 (special prices available for bulk orders from schools).

CONTENTS INCLUDE

CONSTRUCTING PROJECTS
SOLDERING
ELECTRONIC COMPONENTS
CONTINUITY TESTER
SOIL MOISTURE INDICATOR
HEADS OR TAILS
TWO TONE DOORBELL
500 SECOND TIMER
MORSE PRACTICE SET
BATTERY SAVER
BUZZ BOARD
BASIC AMPLIFIER
AM TUNER
ELECTRONIC BONGOS
SIMPLE INTERCOM
TEMPERATURE ALARM
SINGING MOISTURE METER
TAPE NOISE LIMITER
TWO OCTAVE ORGAN
LED DICE
TACHOMETER
OVER REV ALARM
INTRUDER ALARM
CAR ALARM
TRAIN CONTROLLER
FM ANTENNA
OVER LED
HI FI SPEAKER
ELECTRONIC SIREN
PROBLEMS?
COMPONENT CONNECTIONS

DELSOUND PTY. LTD.

BRISBANE
32 Amelia St. Fort Valley 4006
35 Logan Rd. Wooloongabba 4102
Prices & Availability OK as at 15-3-77. Minimum order $3.00

Mail Orders Welcome
Post & Pack 15 percent up to $25.
10 percent over.

SUPA SPECIALS

SWITCHES		
S.P.S.T. miniature toggle switch MIYAMA	50c ea	40c ea./100
S.P.S.T. toggle switch spun aluminium lever coloured tip	40c ea	35c ea./10
D.P.D.T. toggle switch spun aluminium lever	50c ea	45c ea./10
D.P.D.T. McMurdo black rocker switch 50 series 15A 250V	1.20 ea	1.00 ea./10
D.P.D.T. McMurdo white rocker switch 50 series red neon	1.50 ea	1.30 ea./10
Bag 10 assorted toggle switches	5.00 ea	4.50 ea./5 packs
Bag 10 assorted rocker switches	4.50 ea	4.00 ea./5 packs
S.P.S.T. rocker switch marked ON & OFF, white surround	45c ea	40c ea./10
S.P.S.T. toggle black 10A 250V	85c ea	75c ea./10
D.P.D.T. toggle black 16A 12V D.C. 15A 250V	1.95 ea	1.75 ea./10
MISCELLANEOUS SPECIALS		
3 A.G. fuse holders chassis mtg	60c ea	50c ea./10
Screw terminal 4 mm banana top racket, with crosshole	40c ea	35c ea./10
Cable clamp suit 3 core flex	50c ea./10	
9 pin plug and chassis socket (octal size)	40c pair	
11 pin plug and chassis socket (octal size)	40c pair	
12 pin plug and chassis socket (octal size)	50c pair	
2 x 4 pin sockets and 1 plug to suit	45c	
16 pin D.I.L. test clips	3.50 ea	3.00 ea./10
Magnetic earpieces 2.5 mm and 3.5 mm plugs	30c ea	25c ea./10
Fiber Optics 360 feet 10 mm	2.50 ea	Per packet
ET1-440 printed circuit board	3.00 ea	
Printed circuit extender boards 44 way 8" x 7" approx.	9.90 ea	
Printed circuit board donuts assorted sizes	2.40 roll	
Printed circuit board tapes	2.40 roll	
Printed circuit board knife for tapes etc	65c ea	
Printed circuit board pins .040"	1.00 ea./100	
Printed circuit board pins .050"	1.50 ea./100	
12AU7 valves	90c ea	
6 BL8 valves	90c ea	
5 mfd DC working oil filled	3.00 ea	
HI-FI SPECIALS		
Scotch c90 cassettes	2.95 ea	2.40 ea./10
'Forward' brand AM/stereo cassette and pair 5¼" door speakers	99.00 ea	
Palmer AM/FM M.P.X. stereo hi-fi tuner, was $95.00, now	75.00	
Conic A.M./F.M. radio	19.95 ea	
2 station intercom complete with battery, wire and instructions	11.50 ea	

ARE THE POWER POINTS IN YOUR HOME SAFE?
Check NOW with the SWANN Power Point Safety Tester
SIMPLE AND SAFE TO USE
ONLY $3.99 ea.

CLOCK KITS
MODEL P109 $29.50
P AND P $3.00
- AM/PM INDICATOR
- AUDIO ALARM
- LARGE DISPLAY

MODEL 702 $55.00
P AND P $3.00
- 120 RED LED DISPLAY 6 DIGITS
- AM/PM INDICATOR
- HOURS MINUTES SECONDS
- MONTH AND DATE FLASH 7 SEC. INTERVALS

KITS INCLUDE A.C. TRANSFORMER, CASE AND INSTRUCTIONS

COMPREHENSIVE RANGE AT COMPETITIVE PRICES OF
RESISTORS— ½W, ½W, 2 percent, 1W, 5W, 10W, etc.
CAPACITORS — Polyester, Polycarbonate, Polyester, Greencap, Polystyrene, Ceramic, Electrolytics, Bi-Polar, Tantalum, Trimmers, etc.
POTENTIOMETERS — Carbon single and double A&C rotary. Carbon single and double A&C 45 mm slider. Switch pots single. Wire wound pots.
KNOBS — Most types (metal and plastic)
BEZELS — Neon and Incandescent.
P.C. BOARD AIDS — tapes, pads, etch pens, ferricchloride, knives, blank P.C. board, pre coated sensitized board, many more.
TRANSFORMERS — Most types of Ferguson and A&R.
PLUGS AND SOCKETS — audio, cannon, edge connectors, transistor, I.C. etc.
SWITCHES — Most types.
RELAYS — 6, 12, 24V S.P.D.T., D.P.D.T.
CABINETS AND HARDWARE — Large range.
INSTRUMENTS — Multi-meters, panel meters, test instruments, generators and accessories.
P.A. EQUIPMENT — Amplifiers and speakers, mics and stands, accessories, etc.
TOOLS — Range including soldering irons and solder.
C.B. RADIO — Range of good value P and T approved sets and accessories.

SEMI CONDUCTORS

BC547-8-9	Silicon	NPN	14c
BC557-8-9	Silicon	PNP	14c
BC182L	Silicon	NPN	25c
BC337	Silicon	NPN	30c
BC338	Silicon	NPN	30c
TT800	Silicon	PNP	70c
TT801	Silicon	NPN	70c
2M3638A	Silicon	PNP	45c
AC128	Germanium	PNP	60c
AC127	Germanium	NPN	60c
AC188	Germanium	PNP	70c
2M3055	Silicon	NPN	1.20c
Lge. Red LEDS	(INC. mtg)		25c
Lge. Green LEDS	(INC. mtg)		40c
Lge. Yellow LEDS	(INC. mtg)		40c
Lge. Clear (Pink) LEDS	(INC. mtg)		40c
1A 200V Diodes			10c
1A 400V Diodes			12c
1A 800V Diodes			16c
0A91	Germanium		12c
IM914	Diodes		10c
1A 1000V Diodes	Silicon Diodes		20c

Large range of Semi Conductors I.C.S. Diodes etc. Zener Diodes, Triacs, Diacs, SCR's, 7 Segment displays.

SORRY, WE DON'T PRODUCE A CATALOGUE, THE SAVING IS PASSED ON TO YOU

PUZZLE OF THE DRUNKEN SAILOR

Here's a simple-to-make but hard-to-solve puzzle.

by A.J. Lowe

THE MODEL REPRESENTS a ship which has four navigation lights on the port (left) side and four on the starboard (right) side. Unfortunately, a drunken sailor installed 4 green lights in the sockets on the port side and four red lights on the starboard side – which, as everybody knows, is the wrong way round. Everybody knows too that you don't have four navigation lights on each side – but never mind that, this is a puzzle.

And the puzzle is to get all the green lights on to the starboard side, and all the red lights on to the port side – where they belong. That would be easy if you just unplug them and swop them around, but the rules of the game are that:–

a) only one lamp can be moved at a time;
b) a lamp can be moved only along the black line and must be put into a vacant socket at the end of the move,
c) a lamp can be moved as far as desired on any move, including going round corner;
d) a lamp cannot jump over another lamp.

Well that's the puzzle. If you think it's easy – try it. Just draw the lines on a sheet of paper, use dots for the sockets and use 4 5c and 4 2c coins as lamps.

Actually that's all you really need for the puzzle, but to make it more attractive and electronic we used red and green LEDs which light up in the sockets.

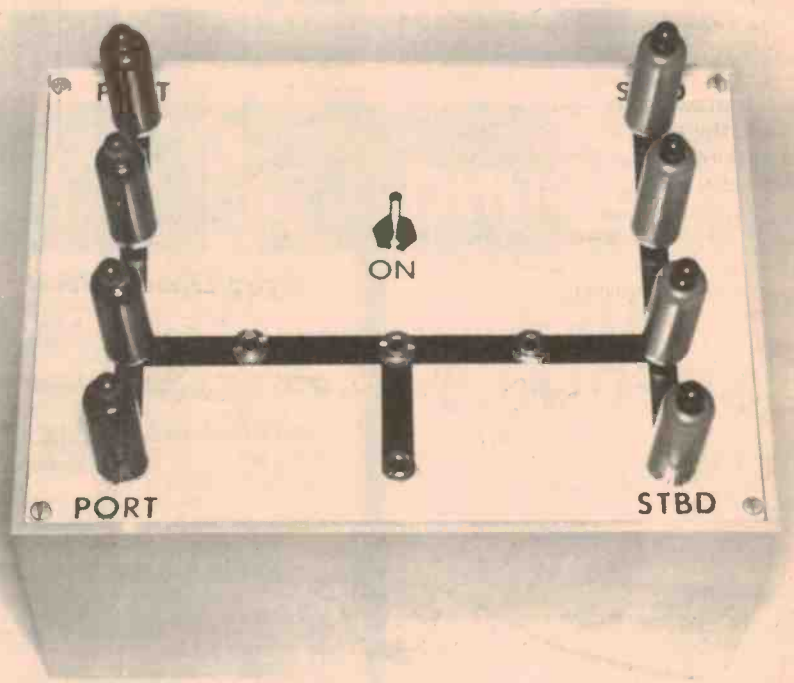


Photo 1: The finished puzzle

Construction

The circuit of course is simple – just 12 audio sockets connected in parallel, a 3 volt battery, a current limiting resistor, a switch and 8 LEDs which can be plugged in.

The prototype was constructed in a plastic box measuring 140 x 100 x 75 mm with an aluminium panel. Any box about that size would do; construction is not critical.

The lamps are 4 red and 4 green LEDs soldered straight on to the terminals of 2.5 mm audio plugs. Care must be taken that all LEDs are soldered in the plugs the same way round, so that the positive side of each LED is connected to the centre contact of the plug. There are

available several lengths of 2.5 mm plug but the best for this project has a 'handle' measuring 22 mm and a hole in the top which is just right for a LED. The plugs should have colours to match the LEDs if possible – red and green – or at any rate red and black. Take care to get all LEDs protruding by the same amount.

The sockets mounted in the panel must all be wired the same way round too so that in every one the positive wire is connected to the contact which meets the centre contact of the plug. In this way any LED will light up in any socket.

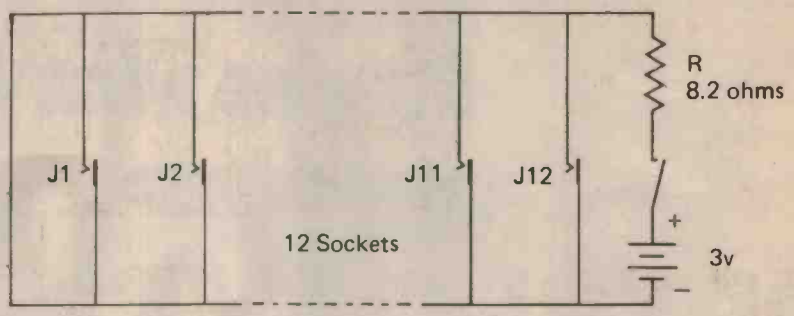
The resistor R in the prototype was chosen to limit the current drain on the battery to a reasonable value – 100 mA, and still give adequate brightness to the LEDs.

The battery comprised two D cells soldered together in series and to the wiring on the panel. They were held in the box with suitable packing, but a clip could be made instead.

The black line on the panel was made by cutting a strip from a sheet of black contact which was on hand. Scotchcal, paint or drawing ink would do instead.

Well, there you are, that's the puzzle and nothing else need be said about its construction.

Its solution is another matter. The answer will be published next month. Suffice it to say for the present that it requires several moves!



Circuit diagram Fig 1: The value of current limiting resistor R should be found by trial to keep total battery drain to about 100 mA.

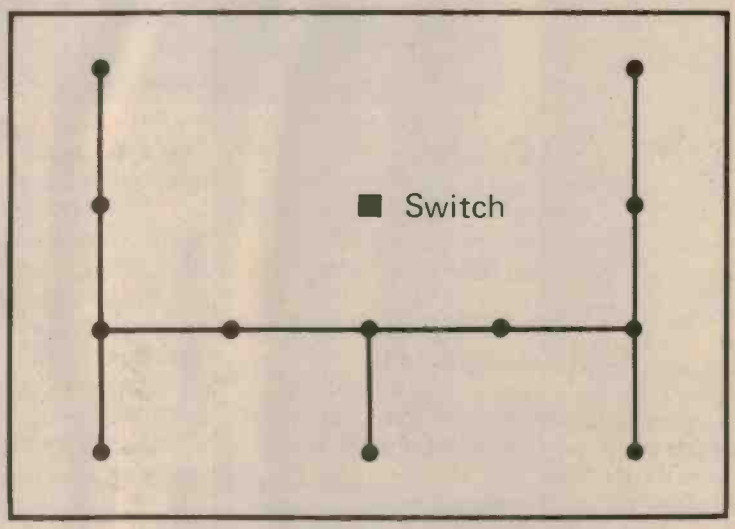
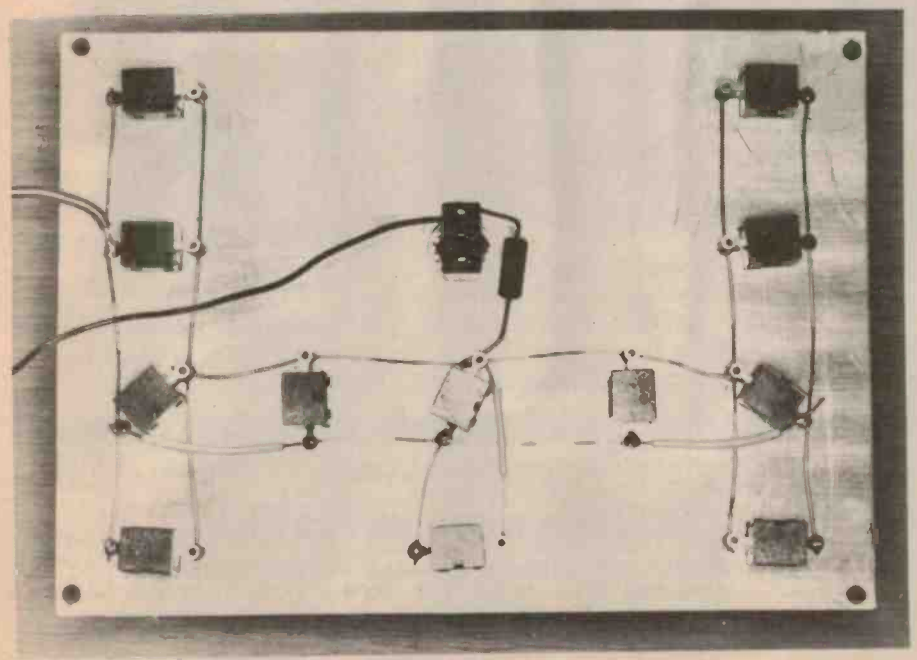


Fig 2: Layout of the panel.



PARTS LIST 805

Resistor
R 8.2 ohm ½ watt (but select on test)
12 2.5 mm audio sockets
8 2.5 mm audio plugs with long handles – see text.
1 on/off switch any type
4 Red LEDs
4 Green LEDs
Hook up wire, suitable box, 3 volt battery

Photo 2: The underside of the panel. Wiring was done with bare wire fitted with sleeving at crossover points.

If you can see a difference, imagine what you'll hear.

Magnified, you can see record vinyl wearing away.

With same magnification, record vinyl shows no wear.

You're looking at the solution to one of the oldest problems in audio—how to protect records from wear, while at the same time preserving full fidelity.

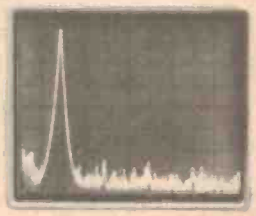
It's called Sound Guard,* and it's remarkable.

Independent tests show that discs treated with Sound Guard preservative played 100 times display the same full amplitude at all frequencies and the same absence of surface noise and harmonic distortion as "mint condition" discs played once.

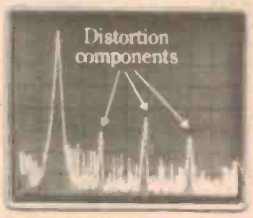
A by-product of dry lubricants developed for aerospace applications, Sound Guard preservative is so smooth it reduces friction, yet so thin (less than 0.000003") it leaves even the most fragile groove modulations unaffected.

Len Feldman in Radio Electronics reports "At last! The long awaited record-care product has arrived. It preserves frequency response while reducing distortion and surface noise." It's effective and safe for all discs, from precious old 78's to the newest LP's.

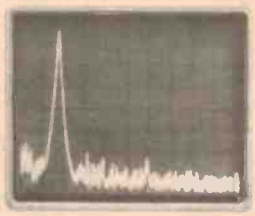
Sound Guard preservative, in a kit complete with a non-aerosol pump sprayer and velvet buffing pad, is available in audio and record outlets.



Test record played first time.



After 100 plays without Sound Guard.



Identical test record after 100 plays with Sound Guard.

Sound Guard keeps your good sounds sounding good.

*Sound Guard is Ball Corporation's trademark for its record preservative. Copyright © Ball Corporation, 1976.

Sound Guard is distributed throughout Australia by

LEROYA INDUSTRIES PTY LTD

Head Office, W.A.: 156 Railway Pde., Leederville 6007. Phone 381 2930.
N.S.W. Office: 100 Walker St., North Sydney. 2060. Phone 922 4037.
VICTORIA Office: 103 Pelham St., Carlton. 3053. Phone 347 7620.

LER 196

How to crack a highly paid job as an electronics technician.

We'll give you excellent training - as good as you'll get anywhere in Australia.

We'll give you free medical, dental and hospital treatment.

We'll provide plenty of good tucker and a comfortable place to stay.

We'll give you substantial leave, and on top of all that, we'll pay you well while you're training.

On your side, you'll give us a period of hard, but interesting and rewarding work. And, when eventually you leave us, you'll find yourself a fully qualified and experienced Electronics Technician. Not a bad thing to be, these days.

So, if electronics is your idea of a great career and you are (at time of entry) approx. 15 to 17 for apprenticeship and over 17 for an Adult Trainee, join the Navy, Army or Air Force.

Phone us at:
Adelaide 223 2891. Brisbane 226 2626.
Canberra (Navy) 66 4697.
Canberra (Army or Air Force) 47 6530.
Hobart 34 7077. Melbourne 61 3731.
Perth 322 4355. Sydney 212 1011.

Write to either the Navy, Army or Air Force Electronics Technician Counsellor, GPO Box XYZ in your nearest State Capital City (please include your date of birth).

Learn Electronics with us.

Get into hi-fi photography. Get onto Minolta.

Looking at the beautiful colour prints produced by your amateur photographer friends can make you green with envy. Looking at slide shows can be even worse. Now there's a way to get even.

With a Minolta Hi-matic camera and a little bit of practice, you can produce photographs that even pro's would be proud of. Even if you've never handled a camera before.

You don't need to learn anything about 'f' numbers or apertures, or exposures. Do your own thing. The camera will do the rest.

With or without flash attachments you can take pictures that will make your friends sit up, for a change.

For free colour brochures, write, enclosing two 18 cent stamps to Photimport (Australia) Pty Ltd, 69 Nicholson St, East Brunswick, Vic 3057.

Minolta

PM19948J

DEPEND ON IT IT'S FROM PHOTIMPORT

PRINT-OUT

ETI's COMPUTER SECTION

NEWS

New NS bits

National Semiconductor have released a new 16-bit NMOS microprocessor, the INS8900. The design philosophy of this chip is similar to that of the Intel 8085, in that it will be supported by two sophisticated peripheral chips which can easily be configured into a powerful minimum system. One of the chips will combine RAM with I/O and the other will be a ROM I/O set. The 8900 will be completely software compatible with PACE, National's current 16-bit micro.

In the 8-bit area, National will not second-source the Intel 8048 single-chip microcomputer. Instead, National are developing a version of the SC/MP II, with on-board ROM, RAM, and I/O. Plans for the 8080A include a very broad line of peripheral chips, which will include most of Intel's devices, as well as new National designs and redesigns of peripherals from other microcomputer families.

New England Computer Club

The University of New England is the base for the newly-formed New England Computer Club, but membership is in no way limited. Headquarters is in a lab in the Geophysics Dept. and a club project is being planned. Membership is $10 p.a. and interested persons should contact the Secretary at the address in the Directory below.

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.

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)

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.

ASCII, UART, Monitor Explained

A few problems you could help me with:
1. What are ASCII and Baudot? (I know their codes but??)
2. What is a UART?
3. What use is a monitor program?

G.M., Riverstone.

I hope this will sort things out.

1. Baudot, otherwise known as the Murray Code or International Teletypes Code No. 2, is used for communication between telex machines and radio teletypes. It is not commonly used with computers for computation applications, only in telecommunications. ASCII (American Standard Code for Information Interchange) is used with computers for input/output, and has a number of non-printing (control) codes.

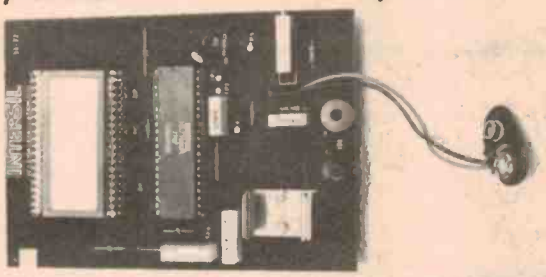
2. A UART is a Universal Asynchronous Receiver Transmitter. Its function is to take parallel data from the data bus of a computer, convert it to serial data, and transmit it at the correct speed. It also performs the opposite function of reception, and usually includes logic to check for parity errors, framing errors and over-run errors. It may also include logic to permit interfacing to a MODEM. For further information, see the data sheets on common types, such as the SI883, AY-5-1013, TMS6011.

3. When a microcomputer is switched on and RESET it will normally start looking for instructions at a particular location (e.g., 0000 on the 8080 and Z-80). If there is no program in memory, the processor will encounter the random rubbish in un-cleared memory, and it may well be impossible to stop it and make it do something useful. Alternative 1 is to halt the processor (using its HALT input) and when its address and data lines go into the high-impedance state, you can use switches and LED's as a front panel. To my mind this is no alternative at all. Alternative 2: When the processor starts, it jumps immediately to a monitor program in ROM, which makes it idle round a loop waiting for an instruction. Examples of such instructions may be 'Examine Memory' 'Change Memory', 'Execute', 'Load Tape', 'Punch Tape' and 'Insert/Remove Breakpoint'. Each of these functions is accomplished by a subroutine, or group of subroutines, within the monitor program, and all are very useful when writing and debugging programs at the machine code level. Even if you only ever use BASIC, your BASIC interpreter would be loaded by the 'Load Tape' command in your monitor.

SEMCON MICROCOMPUTERS PTY. LTD.

SPECIAL INTRODUCTORY OFFER TO E.T.I. READERS

This is a genuine offer and priced well below the price of the discrete components.



INTERSIL DIGITAL VOLTMETER

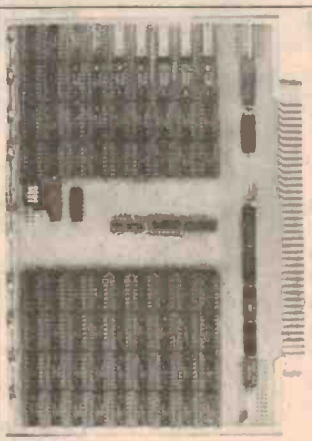
7106 EV KIT — ONLY $29.95+tax.

Features

- ½", 4 digit liquid crystal display.
- Intersil 7106 A/D converter.
- P.C.B. & all resistors & capacitors needed for a very compact & attractive 3½ Digit voltmeter.

Additional $3.90 buys the conversion kit for the DVM featured in this issue. Limited number ex stock. Delivery may be up to four weeks.

Positive 1 Amp REGULATORS at 5, 6, 8, 12, 15 & 18 Volts all at $1.60 each. 78H05K 5V at 5 amps — $8.90



8K BYTE, STATIC MEMORY CARD

- Fast Access 350 ns Chips (2102LF)
- Low Current – 1.3 Amps
- Motorola 8us Compatible
- Write Protect
- Parity Generation/Checking available
- Professional Finish
- Australian Designed & Built
- Plated through Holes
- $275 assembled board
- $219 in kit form
- 298 Assembled with Parity

AVAILABLE SOON:

1. 10 AMP + 5V SWITCHING REGULATED POWER SUPPLY.

with additional ± 12V Outputs – this compact supply is very efficient and provides plenty of power to allow you to expand your system to its full potential.

2. INTELLIGENT VDU CARD

with dedicated 6800/Upper and lower case letters/coarse and fine graphics capability/self contained software for complete on screen editing facilities/programmable characters per line and lines per page – a great advantage if you decide to up-date to a higher quality monitor in the future.

• 2708 1k x 8 EPROM's $25.00 • 2102LFPC 350ns 1k x 1 STATIC RAM $1.90 • Z-80 $38.00 • 8080 $15.90 • 6800 $22.00

MONSANTO RECTANGULAR RED LEDS – light is focused on a flat front surface, giving an aesthetically pleasing effect to front panels – $0.99 each.

MONSANTO & FAIRCHILD 7 segment display. Liquid crystal displays in a variety of sizes and digits from L.C.D. inc.

MOSTEK SDB80 – $995. Delivers Z-80 power & 16 k Bytes Dynamic RAM on a single board. It provides mosteks Z-80/8 x 16 k RAMs/2 x p10's 1 CTC/serial ASC11 interface/Sockets for 5k or PROM or 20 k or ROM plus a fully buffered system bus. For soft ware developments: a complete package of software in 10 k of ROM, is available optionally, to provide ability to edit, assemble & debug programs for all types of 280 applications.

• CMOS • TTL • CRYSTALS • VOLTAGE REGULATORS • CLOCK MODULES • SPRAGUE CAPACITORS • RESISTORS • COMPLETE LINE DIGITAL & LINEAR I.C.'s.

LOW POWER SCHOTTKY

74LS 0.33	74LS 20 .....0.33	74LS 86 .....0.58
74LS 01 .....0.33	74LS 21 .....0.33	74LS 90 .....1.17
74LS 02 .....0.33	74LS 27 .....0.33	74LS 92 .....1.17
74LS 03 .....0.33	74LS 28 .....0.51	74LS 93 .....1.17
74LS 04 .....0.37	74LS 30 .....0.33	74LS 109 .....0.53
74LS 05 .....0.37	74LS 32 .....0.35	74LS 113 .....0.53
74LS 08 .....0.33	74LS 37 .....0.40	74LS 114 .....0.53
74LS 09 .....0.33	74LS 38 .....0.40	74LS 138 .....1.00
74LS 10 .....0.33	74LS 40 .....0.37	74LS 151 .....1.00
74LS 11 .....0.33	74LS 42 .....1.31	74LS 157 .....1.00
74LS 13 .....0.74	74LS 74 .....0.53	74LS 163 .....1.00
74LS 14 .....1.33	74LS 85 .....1.58	

• CARD CAGES & BACKPLANES • EDGE CONNECTORS 43 x 2 x 0, 156" – $9.75 • COMPUTER POWER SUPPLIES • HEX DISPLAY

We supply a wide variety of components from FAIRCHILD, AMD, INTERSIL, SPRAGUE, MOSTEK, SILICONIX & MONOLITHIC MEMORIES at very competitive prices. We offer an efficient mail order service and can offer very favourable rates on quantity purchases.

SHOWROOM: 1 CHILVERS ROAD, THORNLEIGH 2120 NSW

Phone 848-0389 or 848-0800. Mail order: P.O. Box 61, Pennant Hills 2120

(Add $1.00 P&P). Add 15 percent tax where applicable. Catalogue: Free with purchase or send thirty cents stamp. Distributors wanted in all States.

FULL HOUSE!

DR. DOBB'S
mainly software

PEOPLES COMPUTER COMPANY
for education and the futuristics

PERSONAL COMPUTING
easy reading for newly converted

BYTE
the small systems magazines

INTERFACE AGE
the real thing for hobbyists

Up to the minute news — product evaluations — software — projects, applications

Creative computing is back — and you should take part in it —

- **PERSONAL COMPUTING**
'an idea whose time has come'
- place your order for your subscription now!
- airmail copies for the impatient — issues hot off the press from us to you
- surface mail directly from the US for those who have friends with airmail copies
- single copies and/or back issues are available
- complete subscription form — indicate the magazine of your choice — and you'll have your first issue in your letter box before you can say 'disc crash'

BONUS OFFER

- and if you make more than three annual subscriptions —
we will send you complete free of charge a valuable book on micro computers — either from the stable of Sam's or Scelby's

Computerland/
Electronic Concepts
bring you the five most respected micro-systems magazines servicing the exploding personal computer industry.

RETURN TO ELECTRONIC CONCEPTS PTY LTD 52 - 58 Clarence Street, Sydney, NSW 2000. Phone: 29 3753

Please supply me with the following subscriptions —

☐ CHEQUE ☐ MONEY ORDER ENCLOSED ☐ CHARGE MY BANK CARD

1 Year Subscription

		Surface	Jet speed from US
Byte	12 issues	☐$22.60	☐Add $23.40
Dr. Dobb's	10 issues	☐$13.00	☐Add $ 8.00
Interface	12 issues	☐$21.60	☐Add $23.40
PCC	6 or more issues	☐$10.00	☐Add $ 8.00
Personal Computing	12 issues	☐$20.00	☐Add $23.40
*PC will be issued monthly starting January 1978		$	$

Current Issue

Surface	Air Freight
☐$2.30	☐$4.50
☐$1.70	☐$3.00
☐$2.30	☐$4.50
☐$1.70	☐$3.00
☐$2.30	☐$4.50
$	$

TOTAL REMITTANCE $

Please send to:

Name .....

Address .....

City ..... State ..... P.C. .....

BANK CARD
Acc. No. . . . . .
Expiry Date . . . . . .
Signature. . . . . .

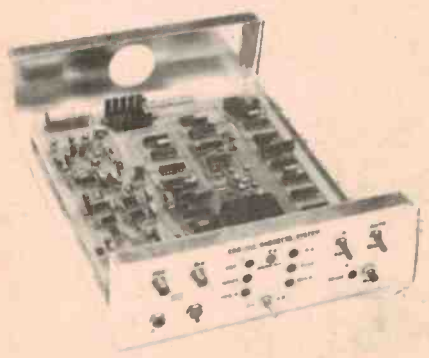
☐ Please send me information about back issues as marked
☐ Please send me more information about Computerland.

ACS/CCAE MICROPROCESSOR CONFERENCE

Les Bell reports on the Australian Computer Society's Canberra gathering.

FOR TWO DAYS in late September, Canberra College of Advanced Education played host to almost 300 engineers and enthusiasts for a conference on you-know-whats. As a journalist who reads stacks of technical mags, seemingly full of articles on the beasties, and who occasionally puts finger to typewriter to produce the odd thousand words, I often wonder (and occasionally feel guilty!) at the amount of exposure microprocessors are getting. Yet, there are always new tricks to find out, and no matter how long you've been in the game, lectures and seminars always turn up new and interesting information. (Hopefully some of our articles do the same!)

So it was with a light heart and a blank notepad that I set off to Canberra and I was not disappointed. The conference, which was co-sponsored by the Australian Computer Society and the CCAE, was a tremendous success — originally the organizers planned for 180 attendees, but almost 300 people signed up!



Pennywise Peripherals' CDB-150 cassette interface.

The conference was opened by Dr. D. Overheu, the Head of the School of Information Sciences at the CCAE, whose opening remarks mainly concerned the potential of the micro in Computer Aided Instruction. The tireless and enthusiastic Conference Convenor, Dr. Bill Caelli, then welcomed the attendees and outlined the arrangements for the conference and associated exhibition.

The first paper concentrated on the basics of the historical development of the microprocessor, what it is, how it works, etc. Dr. Dave Boulton of Monash University illustrated his talk by showing boards from a series of computers, starting with the Siliac computer which was built at Sydney University. This was (by modern standards) a horrendous device which used around 30,000 12AU7's and had a mean time between failures that was measured in hours, rather than years! Dr. Boulton also discussed the lower costs offered by microprocessors compared with LSI as a function of overhead per IC. He also had a specific beef against semiconductor manufacturers — their evaluation kits do not fully decode addresses for on-board RAM and I/O, thus making expansion difficult. In addition, Dr. Boulton also made the point that RAM constitutes a major part of system cost compared to the processor — therefore it is worth spending money on a more powerful processor which allows you to save RAM.

Bob Klein of the Australian National University spoke next — Mr. Klein also believes processors are a small part of system cost, and in fact advocates breaking one's system into a number of 'Task-oriented Processors', which can be designed independently to perform a specific task such as I/O control. This is in fact the trend in new devices, such as Intels' 8041/8741 Universal Peripheral Interface, which is a complete microcomputer.

The first part of the afternoon was devoted to a forum on "Intelligent Terminal Systems — Now and the Future" — although not very relevant to the hobbyist scene — it is interesting to ponder just how intelligent terminals need to be and could become.

The final paper of the first day was by Dr. Brian Stone of CCAE, and dealt with "Software and other Support for Microprocessors". Dr. Stone broke down the range of software available to both professional and hobbyist users. An interesting point made by Dr. Stone is that "there are several BASICs available for micros and they all run like lame dogs". On this point we agree — pure interpreters (i.e., most BASICs) run fairly slowly, but offer a degree of interactiveness and ease of use not offered by compilers. More on this later. Dr. Stone also reinforced a point made by Dr. Boulton in the morning — why do manufacturers make life difficult for users by not fully decoding addresses on evaluation boards? This is the main reason why evaluation kits are so awkward to expand.

On the next morning the lectures were split into two streams, so I can only write of one here. The first paper, by I. McLeod of the Engineering Physics Department of the ANU, dealt with "Microprocessor Aids for the Intellectually Handicapped". A range of fairly simple toys/games were described, all intended to improve hand/eye coordination. More sophisticated hardware was employed to improve handwriting. The authors are in the process of redesigning the system so that instead of being run by a PDP11 computer, the units will be self-contained and use a dedicated microprocessor.

D. Gray and N. Nimmervol of RMIT took the floor next to describe "A Microprocessor CAI System with Graphics Capability". This Computer-Aided Instruction system uses a Tektronix graphics terminal to pose the student questions in Network Theory and checks his answer. The software is written in BASIC, which the authors admit is not perfect, but makes the software transportable so that it will run on many computers.

The next paper, 'Simple Music Generation as a Measure of Micropro-

cessor Capabilities' by R. Frizzo and I. Jenkins of Telecom Research Labs, described an algorithm for reproducing music from stored data. Best part was the demonstration of a 6800 playing in stereo!

Dr. Paul Goldsborough of CCAE described 'An 8080 Educational/Prototyping Microcomputer' which he developed while working in the US with the authors of the popular 'Bugbooks'. This uses an SDK80 as the basic board and also provides hex keyboard/7 seg. I/O as well as a Teletype interface and powerful monitor. The system will also support an assembler and text editor.

C. Vance of the ANU Engineering Physics Department next discussed the possibilities of using micros in large multiprocessor systems for state-space simulations. Not many hobbyists doing this yet, but you never know.

Last paper of the morning, by R. Truin of the ANU, was on 'A General Purpose Microcomputer System'. The trick here, says the author, is to design the I/O and memory first, in the process defining your bus structure and then designing the processor card to fit.

The afternoon session was devoted to hobby and personal computing, and micros in consumer products. Jim Rowe of Electronics Australia was first up with 'A Personal Overview' of the hobby scene, followed by P. Harris on "A 6 Mbyte Address/Memory Scheme for my 6800 system". Going flat out, it is going to take a 6800 at least 12 seconds to cycle through 6 Mbytes, longer if it is doing a character search – I mean, what can you do with 6 Mbytes? $90,000 worth?

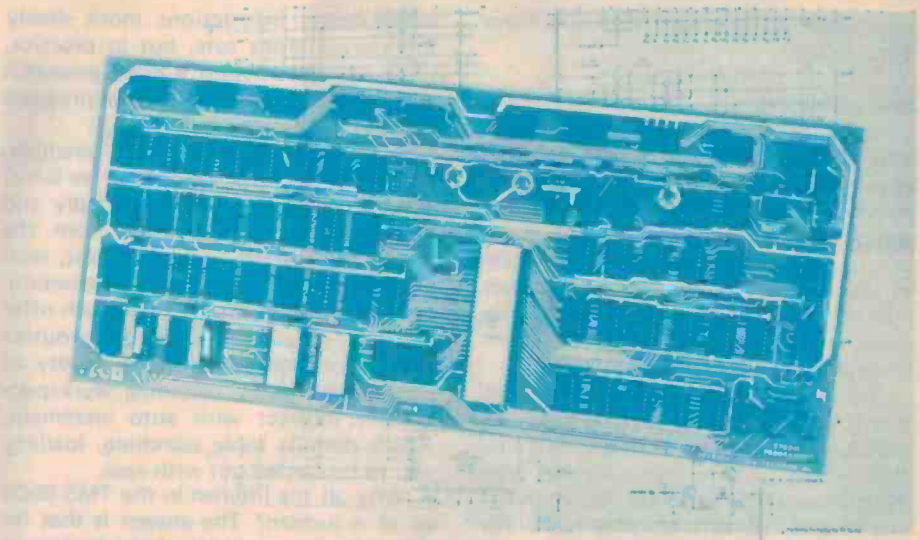
Singer Australia's Mr. West followed with a talk on the Futura 1000 electronic sewing machine. The problems associated with changing from production of a mechanical product to an electronic one are enormous..

Ed Schoell of NS Electronics next talked about his hobby PACE system.

Dr. Bill Caelli gave a talk on the 'Social Implications of the Microprocessor Revolution'. The ACS is preparing a report on this topic which appears extremely comprehensive, and may be in advance of work done elsewhere in the world. The ACS is to be encouraged in this work.

A final discussion on social issues rounded up a very successful conference. Many interesting ideas were put forward and I am certain all who attended found it worthwhile.

Probably the star performer at the exhibition was Hewlett-Packard's multicolour graphics plotter. This device has its own microprocessor and can print letters in different sizes and italics, it can change colours whilst plotting, can scale drawings – wow I could really use one of these! HP also had their range of calculators on display, including the HP19C and HP29C programmables.



The Technico 9900-SS computer board uses the TMS 9900 microprocessor.

Pennywise Peripherals were exhibiting their stackable 4k x 8 RAM plane as well as the CDB-150 Audio Cassette Interface. They have just introduced a Motherboard kit which will accept 1 to 4 RAM planes. This can be configured as 8 bits or 16 bits wide.

Dynetics Pty. were exhibiting some nice gear, including the Poly 88 microcomputer system. They are now stocking the Godbout 10 slot motherboard.

Tektronix had their 4051 desk-top computer on display, as well as a selection of logic analysers and literature, while National Semiconductor exhibited a selection of development systems for their PACE and SC/MP micros.

Processor Update

Informed opinion (ahem!) is that while 8-bit microprocessors are fine for many applications, there are some which can only be handled by a 16-bit machine. In fact, 16-bit processors can do everything an 8-bit machine can do, usually better, so that the 8-bit micros will gradually be supplanted by the 16-bit types. Intel, for example, have announced their intention of producing a 16-bit micro, and many other manufacturers are already producing them, such as National Semiconductor with PACE, and the General Instrument CP1600. (I deliberately exclude from this discussion chip sets such as the LSI-11 and the microNova, which are perpetual exceptions to whatever rules I try to make up).

One of the most powerful 16-bit micros is the Texas Instruments TMS 9900. This is quite an impressive chip visually as instead of the conventional 40-pin package, this one has 64 pins. (First worry – how do you get it into a socket?).

The electronics inside and its performance is quite impressive too, as it is quite unlike the conventional (6800/8080) type of microprocessor. Instead of a bunch of registers, accumulators, stack pointer, etc. on the microprocessor chip itself, this one (despite its size) has only three registers on the chip. There is the program counter (as expected), the status register (fair enough) and a workspace pointer (what's that?). There are no general-purpose registers on the chip. Instead, the workspace pointer (WP) points to the first of 16 locations in memory which serve as general-purpose registers. This has two advantages: firstly, you now have sixteen register whereas only a few could have been managed on-chip; and secondly, by simply reloading the WP, you have now created a completely new workspace while the old one is still preserved intact in memory. This is especially useful in processing interrupts, as instead of dumping all registers onto the stack (as 6800 does, for instance), you just reload WP and go. In case you are wondering, the old WP value automatically appears in R13 of the new

workspace, so it is easy to return from the interrupt.

Instruction Set

I must confess that I am not easily impressed by descriptions such as 'most minicomputer-like of the microprocessors'. If truth be known, there are several improvements over minis in many micros, for example the use of a stack to maintain subroutine return addresses and other information – anyway, who cares, except the died-in-the-wool mini programmer?

The TMS 9900 *is* minicomputer-like in architecture and instruction set, mainly because it is a 16-bit machine. You can't cram minicomputer-type instructions into an 8-bit word and if you've got 16 bits to play with it's difficult to do anything else.

The memory-to-memory architecture of the 9900 means that the processor has an extra memory reference in each instruction cycle when compared with the memory-to-register architecture of other processors. This means that it will execute instructions more slowly for a given clock rate, but in practice, since each instruction is more powerful and operates on 16 bits, overall program execution is faster.

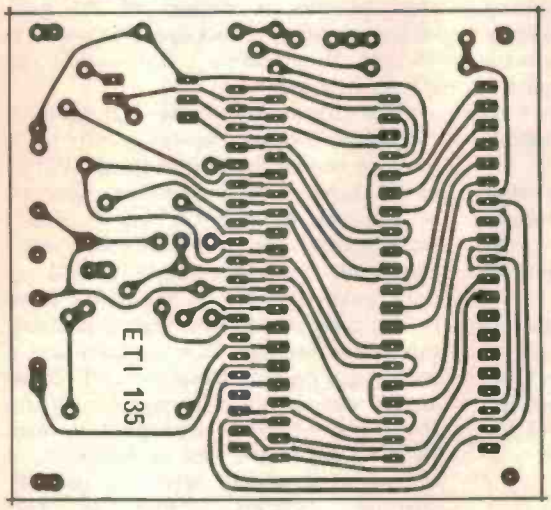
In number-crunching, for example, there are instructions for 16-bit (or 8-bit) add, subtract, and 16-bit multiply and divide. Other tricks derive from the more powerful 16-bit instructions, such as multiple shifts in a single instruction, extended operations (XOP), which offer a user-definable macro/subroutine instruction and of course a variety of addressing modes, including workspace register indirect with auto increment, which permits table searching, loading, etc. to be carried out with ease.

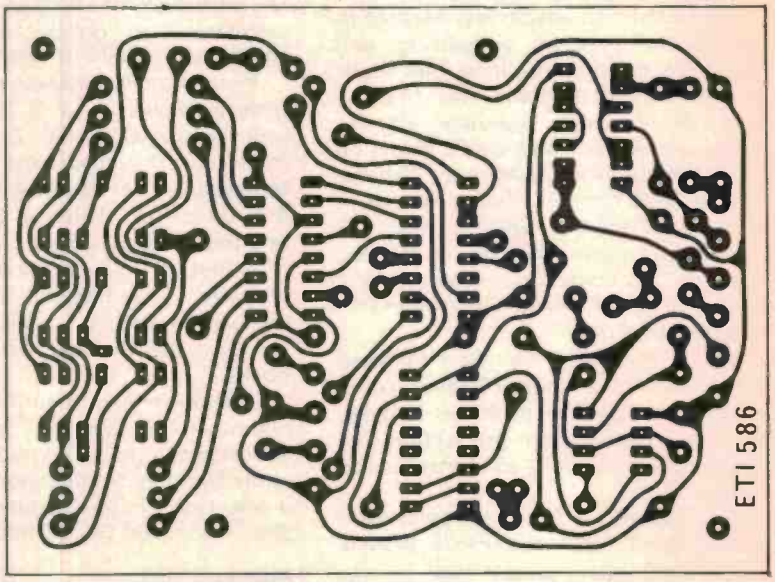
Why all the interest in the TMS 9900 all of a sudden? The answer is that (in this writer's case at least) the interest is not sudden, there just haven't been any 9900-based designs on the market. Things have now changed with the availability of the Technico (US, not Australia) 9900-SS computer board through Innovative Micro Processor And Computer Technology of Petersham, NSW.

We've put one of these together and were quite impressed by the ease of assembly (yes, the TMS 9900 went into the socket OK!), but as yet we haven't even had time to apply power. However, a browse through the copious documentation revealed a monitor program with an impressive list of commands, and the hardware has many interesting features, on which we shall report in greater detail later.

Add a power supply and terminal and you're up and running with quite a powerful system with some unusual features, e.g. built-in PROM programmer. But also available are memory boards containing 32 Kbytes of RAM, and of course, the board can be interfaced to all the usual peripherals, including floppy disks (if you call floppies usual!). By the way, languages available for the 9900 from TI include COBOL, BASIC, FORTRAN IV and business BASIC. And if that doesn't make your mouth water, nothing will!

PCBs





THIS MONTH we are publishing the PC board artwork separately from the projects. You may also have noticed that the reverse side of this page has been printed in blue. Why?

Well, it's all to make the life of the hobbyist easier. If you read last month's article on Scotchcal, you will have seen that a film is available (8007) for reversing masters so that a Scotchcal panel can be made. This film is exposed with UV light and can be used an daylight and developed simply. So?

This film is also good for making printed circuit boards using a negative photo-resist method. By exposing the film through this page (film to this surface) with a UV light for about 10 times the normal exposure (experiment!) a good negative will result.

The reason for the reverse side being blue is that this allows the UV light to pass through the text on the back so that it does not appear on the negative.

At the moment this is only an experiment. Please let us know if it is worthwhile to you, and please let us know if you have any problems. We have used one of the glossy pages normally used for colour printing to do this, which costs us a bit of money, and so if nobody appears to be using it we shall scrap the idea. On the other hand it does offer an easy, no-special-equipment needed method for producing PCBs at home, and it may prove popular. We don't know. Please tell us.

Whose idea was all these silly lines about CB Australia anyway?

SPECIAL READER OFFER

CHIBA

18 Channel Transceiver

** Suggested retail price $249.95*

$199·95*

PLUS $5.00 POST AND PACKING

CHIBA COMMUNICATIONS (Australia) Pty. Ltd., are offering our readers a chance to buy their great new 69-A transceiver for the reduced price of $199.95 (plus $5.00 post and packing).

This is a really beaut 18 channel SSB/AM rig made specially to meet the Australian specs (P & T RB 249). The rig has the exclusive Chiba PLL frequency synthesizer constructed as a single large-scale integrated circuit. This way of making it improves performance and reliability.

The receiver has an amplified automatic gain control circuit which allows you to hear both very low and very high signals clearly and without distortion. The receiver is a dual-conversion unit and has a mechanical filter which gives really good adjacent channel rejection and superb clarity on SSB. Four ceramic filters help ensure good quality AM.

The transmitter even has a mic compressor for good punchy modulation. The transceiver is covered by a full 90 day warranty and has the great advantage over many of its competitors of being backed by local service from Chiba's own company here in Australia.

We've tried this rig ourselves and are most impressed. At the suggested retail price of $249.95 it's excellent value – at $199.95 it's a steal.

SPECIFICATIONS

General

1.	Frequency Range	27.015 MHz – 27.225 MHz
2.	Modes of Operation	AM, Lower Sideband and Upper Sideband
3.	Controls	Volume Control with power on-off switch Variable Squelch Control Mode Selector Switches (3) Clarifier Control Channel Selector Switch PA-CB Switch
4.	Connectors and Jacks	Microphone Connector Coaxial type Antenna Connector Public Address Speaker Jack External Speaker Jack DC Power Jack
5.	Dimensions	207mm x 60mm x 260mm

Receiver

1.	Sensitivity at S/N 10 dB	AM . . . 0.7µV SSB . . . 0.2µV
2.	Selectivity	AM . . . 5kHz SSB . . . 2.2kHz
3.	AGC Figure of Range	80dB
4.	Squelch Range	0.5µV – 500µV
5.	Audio Output Power	4 watts
6.	Distortion at input 100µV	6%
7.	Audio Frequency Response	300 – 2200 Hz
8.	Spurious Response	More than 45 dB spurious signal is required to produce the same amount of audio output as the desired receive signal.
9.	IF Frequency	1st IF 10.695 MHz and 2nd IF 455kHz
10.	Current Drain no audio	600mA

SSB Transmitter

1.	RF Output Power	12 watts PEP
2.	Carrier Suppression	More than 40dB
3.	Unwanted Sideband Suppression	More than 60dB
4.	Harmonic Suppression	More than 60dB
5.	Current Drain	850 mA

AM Transmitter

1.	RF Output Power	4 watts
2.	Modulation Capability	More than 75%
3.	Harmonic Suppression	More than 60dB
4.	Current Drain	1500mA

PLEASE NOTE: This unit can only be ordered via mail as outlined below. They cannot be supplied directly from Electronics Today International.

WARRANTY

Ninety days (parts and labour) from date of delivery. Please return faulty units to Chiba Communications, 12 Terra Cotta Drive, Blackburn, Vic. 3130, not, repeat not, to this magazine.

ORDER FORM

CB OFFER,
Electronics Today International,
15 Boundary Street,
Rushcutters Bay,
NSW 2011

Please forward . . . . . Chiba C13 69A transceivers at $199.95 plus $5.00 each postage and packing. Please make cheques/postal notes payable to 'CB OFFER'.

Name . . . . . .

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

All units will be sent from Chiba by certified mail. Please allow at least 30 days for delivery. We regret we cannot accept company purchase orders.

OFFER CLOSES NOVEMBER 21ST 1977

CB NEWS

UPPER HUNTER CB CLUB

The Upper Hunter CB Club was formed on the first of April this year and now has a membership of over 80 CBers. Callsigns start with the prefix UH which stands for Upper Hunter Valley.

The membership fee of $5 provides the Member with a callsign, membership card, six pages of CB information, including a list of members' handles and callsigns. Members also have the use of the Club Post Office Box, and QSL cards are available for a small charge. Members can obtain discounts from 10 retailers in the area, ranging from 7½ percent to 30 percent.

The club recently purchased a TVI filter for members' use, and at the moment is negotiating the purchase of name badges, T-shirts and car stickers.

Their first raffle is now in progress with the first prize a power supply. Second prize is a ¼-wave ground-plane antenna.

The club is affiliated with the NCRA.

All enquiries to *Lee Noonan (UH-01), P.O. Box 231, Scone 2337, NSW.*

SKIPMASTER GROUNDPLANE

Melbourne manufacturer, E.P. Draffin P/L., is making a groundplane antenna kit for CBers. Called the 'Skipmaster' it is a full-size quarterwave groundplane. It features sloping radials for best match to fifty ohm feedline, solid rod elements (not tubing), sturdy construction and simple assembly. It mounts with U-bolts to any pipe up to 25 mm dia.

Designated part number 110-0 it is available from a number of outlets in Victoria. Our information came from *Truscott Electronics of 27 The Mall, South Croydon, Melbourne, 3136.*

THE GOLD CONNECTION

For the rig that has everything – gold-plated connectors! Yes folks, all the popular RF and audio connectors are now available in gold! Well, gold-plated anyway.

Ralmar Agencies have introduced a series of gold-plated connectors, called 'Goldies', which are superior to standard cadmium or chrome plated connectors. Gold has one third the electrical resistance of cadmium or chrome and will not tarnish or corrode. In addition to providing excellent signal transfer, gold-plated connectors have a long life.

The 'Goldies' series of connectors includes PL-259/G high frequency coaxial plug, PLA1/G cable adaptor for RG58 coax, PL258/G double female connector for PL259 plug, M258/g double male connector for PL259, M358/G Tee-connector, M359/G right-angle connector, MP4/G four-pin microphone plug, P4/G 6.3 mm phone plug, LC2/G standard RCA plug and the LC3/G RCA panel socket.

Ralmar also market an extensive range of CB accessories including SWR and field strength meters, extension and PA speakers, antennas and mounts, filters, connectors and microphones. Further information can be obtained from *Ralmar Agencies P/L, 23 Atchison Street, ST. Leonards. 2065, NSW (439-4352 or 439-6174).*

CANBERRA CREST HQ

The general meeting of CREST-Australia, held in Canberra on 3 September, agreed that CREST National Headquarters be located there and the following office bearers were elected:

National Director
Bill Payne
Tel: 02 660-2182 (H)

National Secretary
David Wynn
Tel: 062 47-8307 (H)

THE VKCB CLUB

Novices and other amateurs who formerly operated on the 27 MHz band, have formed the VKCB club in Sydney and operate as CBers under the new CB regulations.

On the air, club members are giving examples of good operating techniques, helping the newcomer who is having equipment problems and CBers who want to know more about amateur radio.

In the US, 80 per cent of newcomers to amateur radio come up from CB. The VKCB club recognises the interest in amateur radio from within the CB ranks and the club aims to promote this. At the same time the club believes that amateurs should also put their experience and skills back into CB.

Membership of the VKCB club is open to all amateurs, those studying for an amateur licence and those who wish to become amateurs. The aim of the club is to assist citizens in the use of their CB radios and encouraging interested CBers into becoming organised. It is affiliated with NCRA, the WIA and the YRS. A delegate represented the VKCB club at the NCRA National Convention.

Club callsign commences with "amateur radio" followed by a number indicating the State in which the member resides (eg: 2 for NSW, 3 Victoria etc) plus a suffix. The calling/listening channel is new channel 10 (27.125 MHz), all modes.

Further information on the VKCB club can be obtained from *Sam Voron, 2 Griffith Ave, East Roseville, NSW, 2069.*

HERE'S A TOP 'CONTACT'

PETER SHALLEY has just released details of an 18 channel AM/SSB rig to be available from early October under his own brand name of 'Contact'.

Designated the PSC-301, the transceiver is designed to meet the Australian specification and includes many features. The LED digital channel display includes an exclusive "da-lite" control to brighten the display for easy daytime viewing.

The receiver incorporates dual filters for both SSB and AM, both a noise blanker and ANL plus the usual clarifier, RF gain and squelch controls. A mic gain control is also included to allow the operator to adjust the modulation level on both SSB and AM. It also serves as the PA facility volume control.

The front panel is finished in matte black and includes a 30 mm – scale meter to indicate signal strength and RF output. All the knobs are easy to use thumb-and-forefinger types to provide maximum convenience for the operator. The transceiver operating mode is selected by means of push-button switches, along with the noise blanker and PA-CB selection.

Overall size of the PSC-301 is 200 mm wide by 60 mm high by 270 mm deep. It is supplied complete with all mounting brackets, mic and instruction book.

Further information available from *Peter Shalley, 554 Pacific Highway, Killara, 2071 (498-2611).*

CB Australia . . . . . nudge, nudge, wink, wink – says it all!

CB NEWS

LOCALLY MADE ANTENNA

FLEURY ENGINEERING of Dickson, a Canberra suburb, are manufacturing a half-wave base-station antenna called the CT-150 Sky Stick.

The Sky Stick is 5.5 m in length and includes built-in lightning protection. It is constructed from strong, heavy gauge aluminium tubing, the insulated fittings being machined from high density polypropylene which is claimed to have great resistance to the extreme climatic variations experienced in Australia. The matching coil in the base is wound from heavy gauge copper wire on a machined delrin former.

The vertical sections of the antenna fit into one another to a pre-determined depth. The ends of the sections are slotted and assembled with heavy duty hose clamps.

The Sky Stick is pre-tuned at the factory to give a low SWR over the 27 MHz band, eliminating the need for subsequent adjustments. The CT-150 half-wave antenna has an omnidirectional radiation pattern, with a claimed gain of 3.7 dB. It carries a guarantee against high wind damage and will be repaired at cost in case of lightning damage.

A.C.T. representatives of Fleury Engineering are *Associated Electronics P/L of Shop 7, Molonglo Mall, Fyshwick.*

TWO FOR TASC

An AM and an AM/SSB rig, made by TASC and designed to meet the Australian specification, were released in September by C. Huppert & Co.

The TM2100 is an 18 channel AM only rig featuring a PLL synthesizer, double conversion receiver, variable delta-tune control and a three-function meter that measures signal strength, RF output power and SWR. It includes the usual complement of front panel controls.

The TM3100 is an 18 channel AM/SSB transceiver similar in style to the TM2100 and features the TASC PLL synthesizer, lattice crystal filter in the receiver for good adjacent-channel rejection, a three-function panel meter as on the TM2100, plus the full complement of controls.

Further enquiries on these two new TASC rigs can be made from: *C. Huppert & Co., 175 Gratton St., Carlton 3053 (347-7166).*

Roadhounds in the Running

Remember Nipper, the little Fox Terrier staring down the horn of the old wind-up gramophone? Well, now he's roaring around with a Roadhound rig, SWRing, QSOing and ragchewing on CB!

Yes folks! that familiar name in home entertainment electronics, HMV, (a division of EMI Australia), is marketing CB rigs. There are three rigs in the Roadhound range – the TX44, the TX55 (both AM rigs), and the TX77 sideband.

All three rigs meet the Australian 18 channel specification and feature a PLL frequency synthesizer. The two AM rigs feature double conversion receivers, and the TX77 AM/SSB has a single conversion receiver for SSB and double conversion on AM.

The TX44 is an economy AM rig designed for the budget-conscious or the newcomer. It has a minimum of controls but includes such useful adjuncts as a delta-tune control, ANL switch and a panel meter. Recommended retail price is $119.

The TX55 is the deluxe AM Roadhound. It features all the controls you could wish to want! RF gain and tone controls are included along with separate ANL and noise blanker switches, LED channel display and a panel meter. All that for only $139 recommended retail.

Top of the line is the Roadhound TX77. It features the full complement of controls usually expected on an SSB rig, including clarifier and a tone control. Separate ANL (for AM) and noise blanker (for AM and SSB) switches are included on the TX55. Recommended retail price is $239.

The HMV Roadhound range of transceivers will be available from electrical shops and department stores, backed up by HMV's national chain of service centres.

HMV will also be marketing a range of Roadhound antennas, including gutter grips centre-roof types, trunk-mount, etc.

CB AUSTRALIA

Oct, 1977 80¢*

Strike causes chaos!

By ROGER HARRISON

THOUSANDS of CBers can not get licences because of bans imposed by public service unions.

No licences have been issued in NSW but a total of about 14,000 have been issued in the other States.

About 10,000 were issued in Victoria during the three weeks before the bans were imposed there.

No more have been issued since the bans came into force throughout Australia in June, less than one month after the legalisation of CB.

The bans affect not only licensing but also interference complaints and type approval applications.

The chaotic situation results from a long-standing dispute on staff shortages within the Regulatory and Licensing Branch of the Postal and Telecommunications Department.

The situation has angered many CBers who have been frustrated in their attempts to obtain a licence to legitimise their formerly illegal activities.

Suppliers are upset because they cannot obtain type approval for equipment brought into the country.

On top of all this, many private people have protested that they cannot get anything done about interference from neighbouring CB sets.

The P & T in Sydney receives about 40 TVI interference complaints a day.

"The Government was asking our people to do the impossible," said Danny Dwyer of the Professional Radio and Electronics Institute, the union that initiated the bans.

Government to blame, says union

whole of Australia when CB was introduced. The Radio Frequency Management Division had a staff deficiency of 85 in October last year and needed another 94, according to the PREI.

Such an increase in staff would cost the department about $1 million but would gather another $2 million in revenue.

"The Government is losing even more money with the situation," Dwyer said.

"Unless the Government gives the department more staff it will be impossible to provide adequate service in any area of the licensed services, not just CB.

"The work bans in the CB area were imposed as a protest.

"The Government jumped into CB with their eyes closed and expected our members in the P&T to cope with the problems — and there are many problems."

There is considerable intereference to other services on 27 MHz, some deliberate, some as a result of the technical limitations of equipment.

Portable busts out!

This versatile go anywhere unit can be used as a portable mobile or base rig. Dick Smith Electronics says it's very popular with hiking and camping enthusiasts in the USA. We've had one for review this month and took it with us to the NCRA convention in Canberra where it performed very well. We're doing bench and field trials right now and will report in full next month.

THE RIG: Midland's 13-861 ... three channe... output.

THE MOD... Taylor.

cause spuri... their transce... these channe...

The interfe... boating safety services ... become so serious that the various clubs and organisations involved formed the Marine Safety Radio Association in Sydney recently.

The chairman, Nat Cohen, says that the boating safety services would be unworkable when CB licencing got underway because the interference problem would increase enormously.

Cont. p 14.

Change in regs

Hot off the Press!

Tandy Electronics 1978 Catalogue

Yours FREE

Hurry for your FREE copy of Australia's most extensive consumer electronics catalogue. It's out now and it's yours free. 132 pages big —packed with exclusive items, many available for the first time. You'll see the latest CB equipment and accessories, hi-fi gear, turntables, cassette portables, parts and pieces for the hobbyist! Get your FREE copy at the Tandy store nearest you!

111 Stores in Australia

TANDY ELECTRONICS

Instant Component Service

DISTRIBUTORS:–

NORTH.
J. A. SEVERN
P.O. Box 47
Epping 2121
869-1058

SOUTH.
BRYAN CATT INDUSTRIES.
105 Miranda Road South,
(Near Motor Registry)
Miranda.
Phone: 524-4425
Telex AA27266

EAST.
RADIO DESPATCH SERVICE.
869 George Street,
Sydney, N.S.W. 2000
Phone: 211-0191

WEST.
ELECTRONIC (DISTRIBUTORS)
(A Division of Electronic Enthusiasts Emporium).
2-3 Post Office Arcade,
Joyce St., Pendle Hill,
N.S.W. 2145. Phone
636-5222

NEWCASTLE:
DIGITRONICS
186 Parry Street,
Newcastle West, 2302
Phone: (049) 614991

QUEENSLAND:
FRED HOE & SONS PTY LTD.,
246 Evans Road,
Salisbury Nth., 4107
Phone: (07) 2774311

REPEATERS for UHF CB

What is a repeater?

A repeater consists of a receiver tuned to a particular channel or frequency (the 'input channel') which controls a transmitter. The transmitter is tuned to a different channel (the 'output channel').

Signals detected by the receiver are retransmitted, hence 'repeated', by the transmitter.

For a mobile transceiver to use the repeater, the transceiver's transmitter must be tuned to the repeater input channel and the transceiver's receiver must be on the repeater output channel.

Switching in the transceiver's circuitry arranges for it to transmit and receive on the seperate frequencies required.

As signals received by the repeater are re-transmitted instantaneously, repeaters are often refered to as 'talk-through' repeaters.

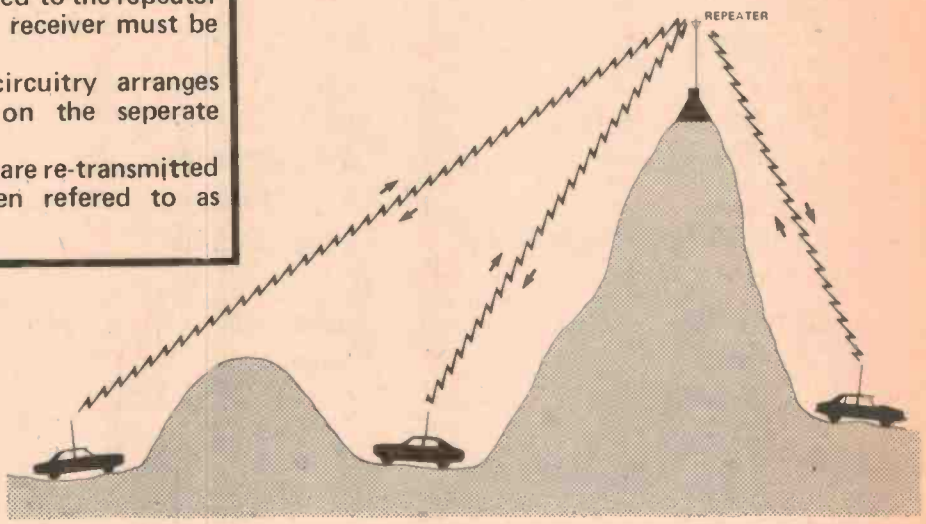


Fig.1. A repeater can extend the range of mobiles and provide communications in situations where it would otherwise be impossible.

Here, the repeater sited on the highest peak provides contact between three mobiles which normally could not communicate directly in this situation.

REPEATERS ARE USED to provide considerably extended coverage and range for mobile transceivers. A repeater can be situated in a favourable location usually high on a mountain or on a suitable ridge, thus increasing the 'line-of-sight' range of the device. Mobiles and base stations that would not otherwise be able to communicate can use the repeater to communicate over a much greater area or in 'difficult' locations such as river valleys, hilly country etc.

The subject of repeaters for the 476 MHz CB band was raised at the NCRA's National Convention. Mr. Jim Wilkinson, 1st Assistant Secretary of the P&T Department, was asked if the Dept. supported the idea of repeaters for the UHF CB band. He replied that the Dept. considered CB as primarily a short range service and therefore repeaters did not enter into the definition of the service. However he did say that if a properly organised emergency service demonstrated a need for repeaters then they could most likely be approved for the service.

Apart from Mr. Wilkinson, several industry representatives were asked the same question. Ian Millar, Philips Industries' Personal Communications Manager, supported the concept of repeaters for UHF as did well-known Sydney businessman and national CB wholesaler/retailer, Richard umm...err.. I can't quite recall his name....

Repeaters are in widespread use in other communications services that use VHF and UHF allocations. The police use UHF hand-held transceivers to maintain contact with a communications HQ via a repeater, when on foot. Taxis using VHF and UHF allocations use repeaters to maintain contact with a central headquarters, whilst radio amateurs operate their own VHF and UHF repeaters in many areas around Australia. In the USA, there are over 3000 amateur VHF and UHF repeaters!

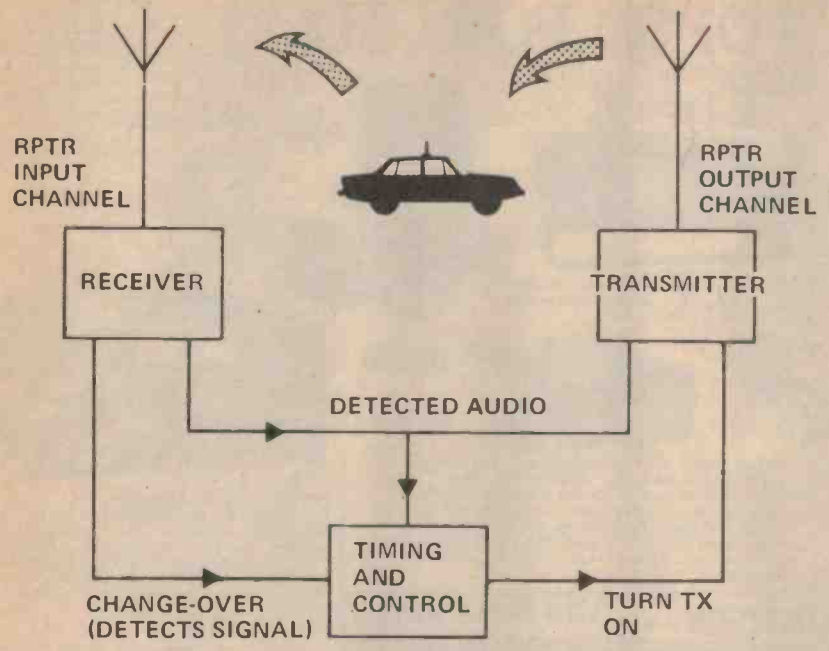


Fig.2. Block diagram of a repeater. Many useful facilities can be added as explained in this article.

A repeater normally transmits and receives on relatively close-spaced frequencies. Normally, the repeater receiver would be affected by the very strong signal from the transmitter, and the receiver will suffer from 'blocking', which greatly reduces the sensitivity. No sooner does the repeater pick up a signal than it loses it again! Bit of a problem that. Even if the signal is strong enough to overcome the repeater receiver desensitization (now there's a word to conjure with), the transmitter signal is then likely to cross-modulate the repeater receiver. Yet another problem! Sounds horrible too!

To avoid these problems a very narrow bandwidth filter is inserted in the transmission line between the antenna and the receiver. The filter is tuned to the input channel and attenuates the transmitter signal by a large amount. In addition, a 'notch' filter, tuned to the transmitter frequency is also included. This further attenuates the strong transmitter signal that would otherwise affect receiver performance.

Apart from the above-mentioned receiver problem, the transmitter output itself is not 'exactly' clean. All transmitters generate a certain amount of 'noise' output which is close to the output frequency. A 'notch' filter, tuned to the repeater input frequency, is inserted between the transmitter output and the antenna. This attenuates the noise output from the transmitter on the receiver frequency. In addition, a bandpass filter tuned to the transmitter frequency is is included to attenuate other spurious outputs from the transmitter.

By appropriate arrangement of the filter and transmission line system, only one antenna need be used for the repeater system. Such a scheme is called a 'diplexer'. Some repeater installations use separate antennas for transmit and receive, and separate filter systems. Some use one antenna and a diplexer. Each has different advantages and disadvantages, depending on the situation.

Many facilities can be added to a repeater. For a start, use of the repeater can be limited to authorised users only. A repeater with 'free access' can be used by anyone who transmits on the input channel. Repeaters with restricted access are generally called 'tone access' types. That is, a station wishing to use the repeater must first transmit a series of coded tones on the repeater input channel. Thus only those stations fitted with a special transmitter accessory to accomplish this can use the repeater. This gets rid of useless transmissions from irresponsible stations in the form of monkey-chatter, button-pushers, carrier-droppers, pigs, ducks, geese, roosters, and other assorted kerfuffle. You may have noticed that taxi networks are plagued with such f----ts.

To reduce the length of long-winded transmissions, or to prevent faults 'holding up' the transmitter, a 'time out' facility can be added. This times the length of a transmission received and turns off the transmitter if it goes beyond a predetermined limit. "...well, I'd better cut it short before this machine ti...".

This time may be set at, say, two minutes or as long as six or seven minutes. The time-out control circuitry is usually arranged to keep the repeater transmitter off until a few seconds after the input transmission ceases. Operators soon learn to limit the length of their transmissions!

The repeater can also be arranged to transmit a number of useful items of information for operators. For example, a time code could be transmitted that could be decoded in the mobile transceiver and displayed on a digital readout. Signal strength of the mobile's transmission as received by the repeater could be indicated in a similar fashion. Any relevant local information that can be displayed in digital form could be transmitted also.

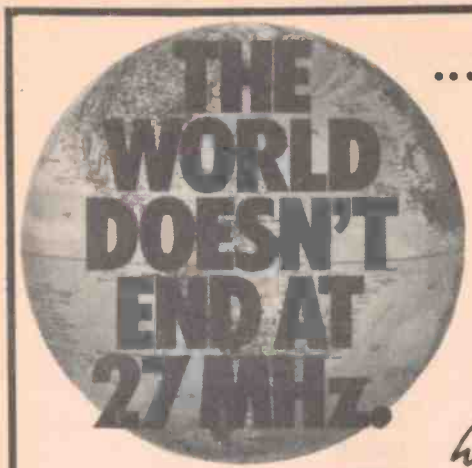
All this can be accomplished by means of a 'touch-tone' facility added to an authorised mobile or base station. This consists of a small key-pad, rather like a calculator keyboard, that transmits the appropriate coded tones when a particular code is punched up on the pad. Circuitry in the transceiver decodes the information actuated from the repeater and displays it on a suitable display. In the future, this could be expected to be an alpha-numeric display!

Another useful facility that could be added to a repeater is 'phone patch'. By using his touch-tone pad, an operator could dial a telephone number from his mobile via the repeater. This facility is common on amateur repeaters throughout the United States. Of course, it could be arranged that only a limited group of numbers could be dialled.

It is also possible to link two or more repeaters via another communications channel so that widely separated stations may communicate where the situation demands. This would have great advantages in certain emergency situations that require direct contact over a large area or long distance that would otherwise be impossible. The clarity of FM transmissions has obvious advantages here where other forms of transmission, such as HF radio, could also be used but are subject to noise, fading and interference.

Repeaters have many advantages, particularly with the sort of facilities that modern electronics and communications technology can offer. As far as emergency communications are concerned repeaters offer improved communications, greater range and coverage and enhanced reliability.

....TOPS FOR HAM GEAR



... It's just the beginning

At VICOM we provide a whole World of communications products including CB, Military and Amateur Radio, our speciality. VICOM didn't reach the top without providing Amateurs in Australia with the technical back-up and support demanded in marketing specialised sophisticated commercial equipment. Come and see our wide range of transceivers and accessories and receive some of that friendly personalised service for which VICOM has become famous!

DISTRIBUTORS OF QUALITY ICOM PRODUCTS

ICOM

IC22S 2m fm synthesised with programmable matrix. ICOM quality with back-up technical support. Price $279.

WARNING: The law requires that a licence be held for all transmitting equipment. Purchasers may be asked to produce a licence when buying equipment.

HANDY ICOM PORTABLES

IC202 2m ssb/cw	$199
IC502 6m ssb/cw	$219
IC215 2m fm	$199
BC-20 nicad pack	$57
IC50L 10w linear 6m	$98
IC20L 10w linear 2m	$98
Rubber Ducky for IC215	$13

ICOM

IC-245

VICOM brings the VFO revolution to you with the IC245 mobile 144 thru 148MHz transceiver. The IC245 features accurate tuning over 50 detent steps, digital display in 5KHz steps, modes: fm, ssb (with optional adapter only) and cw. Carrier suppression better than 40dB. TX output 10w fm. Comes complete with mic, bracket, manual and VICOM 90 day warranty.

ICOM IC211 2m fm transceiver

The new IC211 from VICOM is the last word in digital 2m, all-mode transceivers. Fully synthesised in 100Hz or 5KHz steps, has dual tracking, optically coupled VFOs with 7 digit LED readout. One knob controls all frequencies. Modes fm, usb, lsb, cw. Internal 240vac and 13.8vdc power supply. Comes complete with VICOM 90 day warranty. freight and insurance.

UNIDEN .... the best value

The fabulous UNIDEN 2020 p11 transceiver offers separate usb, lsb and cw 8-pole filters as STANDARD and 6146Bs in the final with screen grid voltage stabilisation for minimum distortion products. Features pcbs and even the front panel can be swung out for easy servicing! A comprehensive range of spare parts is available together with back-up service support. Overseas this rig sells for at least $65 more than the FT101E! Compare the features of the UNIDEN 2020 with other HF transceivers and you'll quickly be convinced that it offers the best value!

Yaesu FT101E transceiver 160-10m including speech processor, VICOM 90 day warranty. Price $839.

The FL2100B linear uses two rugged 572B carbon plate tubes in class B grounded grid circuit with individually tuned input coils for each band. Covers 80 thru 10 metres at 1200W pep input. Price $624.

FL-2100B linear amplifier

KENWOOD

The TS820S from VICOM is the rig that is the talk of the Ham bands. Too many built-in features to list here! What a rig and only $990 complete with digital display! Many accessories available to increase your operating pleasure and station versatility.

Popular VC2 swr/pwr meter operates 3 150 MHz with power measurement 12/120 watts. Will handle up to 1000 watts. 50 ohms impedance, twin meters. A bargain!

VC2 SWR $38

TS520S the transceiver that has made the Kenwood name near and dear to amateur operators around the World. Reliability is the name of the rig in capital letters! 160 metres thru 10 metres with many built-in features.

ATLAS 350-XL

The ATLAS 350-XL from VICOM is the new, all solid state ssb transceiver, 350w pep input with coverage 160 thru 10 metres. Plug in options include digital display, auxiliary VFO and auxiliary oscillator. Superb selectivity for which ATLAS have become famous.

ANTENNAS

BASE & MOBILE

Space 2m ¼wave model 42S, complete with assembly	$14
Space 2m 5/8 wave model 82D, complete with assembly	$26
Lindenow 5/8 wave quality 2m (ecl base)	$26
Ringo Ranger ARX-2 for 2m	$45

VHF/UHF BEAM ANTENNAS

JAYBEAM

5Y/2M 2m 5el 7.8dBd gain	$29
8Y/2M 2m 8el 9.5dBd gain	$35
10Y/2M 10el 11.4dBd gain	$59
10XY/2M crossed yagi 11.3dBd	$68
D8/70cm twin 8el 12.3dBd	$48
PBM18/70 cm 18el 70cm 14.9dBd	$59
MBM88/70cm 88el 70cm 18.5dBd	$75
MBM48/70cm 48el 70cm 14.5dBd	$59

PARABOLIC DISH ANTENNA
For 430 and 1296MHz $349

NOISE BRIDGES

Te7-01 up to 100 MHz	$39
Te7-02 up to 300 MHz	$49

MORSE KEYS

Economy model KH708	$19
Operator model HK706	$20
Deluxe model HK702	$35
Electronic Keyer EK103	$159
Manipulator MK701	$38

RECEIVERS

Yaesu-Musen FRG-7	$325
Barlow-Wadley with FM	$339
NRD-505 Professional	$2499

ROTATORS

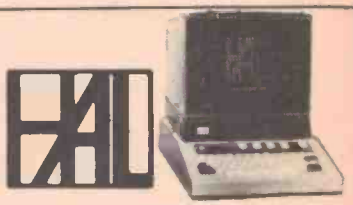
ART3000C Heavy Duty with 240v con box	$199
ART9000 Super Heavy Duty 240v con. box	$478
CDE CD44 medium duty 240v control box	$192
CDE AR22XL light duty 240v control box	$109
8 core cable per meter	$1.40

TRAP DIPOLES

AL48DXN 40/80 metres	$49
AL24DXN 20/40 metres	$47
MIDY VN 80 thru 10 m	$65

BALUNS

AS-BL (Asahi) for beams	$30
BN-86 (Hy-Gain) for beams	$30
BL50A 50 ohms, 4kW model	$24
BL70A 70 ohms, 4kW model	$24



The new HAL KSR3000 send/receive RTTY terminal including keyboard and video display, features scrolling, continuous, word or line transmission and firmware for word wrap-around and blankfill. Handles Baudot and ASC11 (8-level) with a screen size up to 1152 chs. List price $1499. Write (including SAE) for complete specifications.

A whole world of communications products.

VICOM

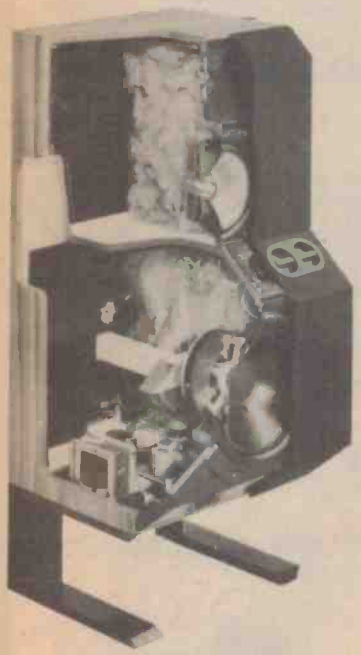
Head Office & Mail orders—

139 AUBURN RD. AUBURN. VIC. 3123
Phone: (03) 82.5398, (03) 813.2355 Telex: AA30566
Adelaide (437981) Brisbane (3844480)
Canberra (823581) Perth (4633232)

Direction: Russell J. Kelly VK3NT
Peter D. Williams VK3IZ

Each B & W speaker comes with its own written proof of superb performance:

B&W's reputation is based on producing clean natural sound without distortion, even at low volume. Each B&W speaker is tested in an Anechoic Chamber and issued with its own individual pen graph. You know exactly the performance of the speaker you are buying



B&W DM6 Monitor
A brand new design. A high powered dynamic loud-speaker with low colouration and very high transient performance.

B&W DM2A Monitor
A more conventional design, utilising B&W research into acoustic line rear loading.. Brilliant clarity and lack of distortion.

B&W DM4 Monitor
A speaker with large B&W Monitor characteristics; its performance surpasses speakers of much greater size.

B&W DM5
A speaker for small living areas. It has above average performance at moderate cost.

Hear B & W Speakers at:

N.S.W.: CONVOY SOUND WOOLLOOMOOLOO SHOWROOM 357 244; CONVOY SOUND CITY SHOWROOM 29 1364: INSTROL HI-FI PTY.LTD. (CITY) 232 5233 (EASTWOOD) 85 2726; MILVERSON PTY. LTD. (CHATSWOOD) 412 2122 (PARRAMATTA) 635 3588: RIVERINA HI-FI 938 2663/4; UNITED RADIO DISTRIBUTORS PTY. LTD' 232 3718; ARROW ELECTRONICS 29 8580; RUSSIN HI-FI 799 2421; PITMAN'S RADIO & T.V. (WAGGA) 25 2155; ALBURY AUDIO CENTRE 25 1712; WROTH CENTRE HI-FI (BATHURST) 31 2088. A.C.T.: DURATONE 82 1388; VICTORIA: ALLANS MUSIC (AUST) LTD. 63 0451; ENCEL ELECTRONICS PTY. LTD. 42 3761; INSTROL HI-FI (VIC) PTY. LTD. (CITY) 67 5831 (FRANSTON) 783 7535; SOUTHERN SOUND (CITY) 67 7869 (MOORABBIN) 97 7245; TIVOLI HI-FI 81 2872; THE SOUND CRAFTSMAN 509 2444; BUY RITE ELECTRIX 42 6200; OMNISOUND 24 2428; QUEENSLAND: JOHN GIPPS SOUND 36 0080; PREMIER SOUND (NTH. ROCKHAMPTON) 27 4004; TARGA ELECTRONICS (CAIRNS) 53 2715; RUSS ADAM (TOWNSVILLE) 71 5618. TASMANIA: BEL CANTO (HOBART) 34 2008. WEST AUSTRALIA: TECHNICAL SERVICES PTY. LTD. 31 5455. SOUTH AUSTRALIA: BLACKWOOD SOUND CENTRE 278 1281; ALLANS MUSIC (AUST) PTY. LTD. 223 5533; SOUND SPECTRUM 223 2181.

B&W

Sole Australian Agents
Convoy Invernational Pty. Ltd.
4 Dowling Street, Woolloomooloo, 2011
Sydney, N.S.W. Tel: (02) 357-2444
387 George Street, Sydney, NSW.
Tel: (02) 29-1364

XENON WORLD IMPORTS

Shop 2 Byron St., Glenelg

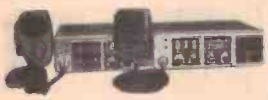
ADELAIDES CB & CAR STEREO CENTRE.

7 DAY OPENING SPECIALS or TILL STOCKS SOLD

30 percent Off all CB Radios & Car Stereo's

This Is definitely not a continuing sale so be QUICK. Mail Order sent same day if bank cheque or money orders received. C.O.D. orders accepted Add $5 P&P.

GUARANTEED IN STOCK ON OPENING DAY OF SALE



IAJ. PD500
DIGITAL READOUT
UP DOWN CONTROL
ON MIC
23 or 40 CHANNEL

$265 Less 30 percnet
You pay $185.50

50 ONLY AT THIS PRICE

PACE 144
$144
30 PERCENT
DISCOUNT
$87.55

20 ONLY

ALFA W60
BASIC RECEIVER
BUT GOOD VALUE
$85.00 30
PERCENT
YOU PAY
$59.50
10 ONLY

S.S.B.
SILTRONIX
$255
30 PERCENT
DISCOUNT
NEED WE SAY MORE! **$178.50**
100 AT THIS PRICE
HURRY OR YOU WILL MISS OUT

ANTENNAS AUTO/MATIC AM/FM/CB **$25** ● HELICAL WITH SPRING BASE **$29** ● BASE LOADED WHIP **$15** ● LINEAR AMP RF BOOSTERS IN STOCK

CAR STEREO'S

Made for the German market where quality Is priority

$195 30 PERCENT DISCOUNT SALE
$136.50 25 ONLY
ALPINE CM 630 9 WATTS

STEREO CASSETTE
GALAXY NS307
SEPERATE VOLUME
CONTROL
50 - 10,000 Hz
50 ONLY

$69.30 30 PERCENT DISCOUNT SALE
YOU PAY $48.30

SEUTONE
HS117
IC STEREO
COMPACT
MODEL
5 ONLY

$48 30 PERCENT DISCOUNT SALE
YOU PAY $33.60

BIG DISCOUNTS

ON ● CALCULATORS ● STEREO PORTABLES ● R/C MODELS ● WORLD TIME CLOCKS ● PVC BLOW UP FURNITURE ● VIDEO RECORDERS S/H ● COLOUR $625

ELECTROCRAFT PTY. LTD.

106A Hampden Rd.
Artarmon, 2064
Phone 411-2989

Distributors of Belling Lee, Channel Master, Ecraft, Hills, Hl.Q, Lab Gear, Kingray, Matchmaster. Largest Television range of aerial equipment in Sydney.

TELEVISION AERIALS, DISTRIBUTION AMPLIFIERS, EQUIPMENT AND ACCESSORIES WHOLESALE, TRADE AND RETAIL SUPPLIED.

NEW FROM ECRAFT A range of Medium & High gain R.F. DISTRIBUTION Amplifiers, suitable for all TV & FM Radio transmissions within the VHF & UHF Bands 1 to V.

APPLICATION Suitable for small home unit, showroom or household type installations. D16 & D25 amplifiers have good signal to noise ratio. As such this makes them suitable as a booster in semi-fringe or fringe areas.

1.75.D16 16 dB gain $45.90 1.75.D25 25 dB gain $53.55

All type coaxial cables in stock from 30c per yd. 50 ohm—75 ohm.

HILLS	ANTENNA'S	CH's	$
CA16	High gain phased array	Multi	45.94
215/2710	8 EL	Multi	25.29
2010/2710	Airways	Multi	58.26
E.F.C. 1	75 ohm for colour	Multi	36.00
E.F.C. 2	75 ohm for colour	Multi	50.96
E.F.C. 3/24	75 ohm for colour	Multi	75.50
E.F.C. 4/24	75 ohm for colour	Multi	82.00
207/45A	. . . . .	3 4 & 5A	40.71

HILLS FM ANTENNA'S		
FM.1	300 ohm	9.35
FM.3	75 ohm	26.11

CHANNEL MASTER		CH's	$
3110	2 EL Coloray	0 to 11	27.96
3111	6 EL Super Coloray	Multi	41.98
315	2 EL City Vee	0 to 11	15.68
3615A	9 EL Crossfire	Multi	43.64
3614A	13 EL Crossfire	Multi	54.97
3613A	17 EL Crossfire	Multi	68.17
3612A	21 EL Crossfire	Multi	78.54
3610A	24 EL Crossfire	Multi	99.84
3617A	28 EL Crossfire	Multi	134.98

CHANNEL MASTER FM		
700 FM	8 EL 300 ohm.	19.68
FM	2 EL 300 ohm.	8.31

MATCHMASTER FM ANTENNA's		
FMG.	300 ohm	19.68
FMG/2	300 ohm	18.30
FMG/6	Fringe area 300 ohm . .	40.93

For the best in CB performance, there's single sideband. And for the best in mobile single sideband, there's Grant. It has unsurpassed sensitivity, and has a powerful 12 watt PEP transmitter. Features include a variable mike gain control, a true RF noise blanker with manual override, a huge S/RF meter, and an easy-to-read and use upper and lower sideband selector/indicator.

A big voice in a small package. The Cobra 19M $110.00.
If you've ever heard a Cobra 26, you'll know it's hard to believe all that talk-power is legal. Cobra found the way to make their radios really talk and still obey the rules. Now you can talk just as loud and far with a smaller package. Cobra 19M is thin and narrow enough to mount conveniently in any car, even the latest subcompacts. And the 19M has other features you'd expect from a Cobra, such as a plug-in dynamic mike, external speaker jack, and now, even an illuminated RF/signals metre. The Cobra 19M has the same receiver sensitivity and selectivity as its big brother, Cobra 26. It has an efficient automatic noise limiter too; you'll hear clearly in the heart of heavy traffic. Dimensions: 1½" H x 5⅛" W x 8" D. Power Output: Factory adjusted to 4 watts legal maximum. Modulation: 100%. Sensitivity: Less than 1.0uV for 10dB (S+N)/N. Selectivity dB—6dB at 4kHz, 40dB at 20kHz. Image Rejection:—30dB. IF Rejection:—80dB. Audio Output: 2.5 watts into 8 ohms.

CB AERIALS Belling Lee: 5ft Fibreglass vertical helical whip aerial with base (Guard Mount) complete with 12ft cable & plug. $24.00.
5ft Helical home base aerial for mast mounting $33.
CB2600 Gutter Clamp aerial complete with lead & plug. $20.70.

ALL TYPES OF HARDWARE IN STOCK Wall Brackets, Chimney Mounts, J Brackets, Guy Rings & Guy Wire. Masts from 8ft to 50ft. ETC.

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	6.3V 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
AL5	240V,3A SPST AL.TOGGLE	35c	3	for $1.00
PPT	PNG 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
W08	2A 800V BRIDGE	@ $1.60	2	FOR	$ 3.00
SC141D	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
AFZ 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 8	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.

MM5395 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	$ 8.95
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

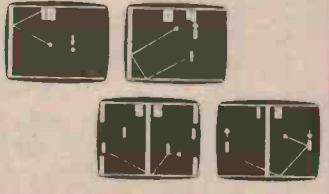
TEST GEAR KITS

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

ETI 438	AUDIO LEVEL METER	
ETI 116	IMPEDANCE METER	$13.50
ETI 128	AUDIO MILLIVOLTMETER	$47.50
ETI 533	DIGITAL DISPLAY	$49.50
ETI 117	DIGITAL VOLTMETER	$19.50
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 124	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
	LM379S	$ 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	$29.50
	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
	PP 3577 for above	$19.50
	ETI 481 KIT	$12.50
	ETI 445 KIT	$ 4.95
	ETI 446 KIT	$ 7.95
	ETI 449 KIT	$ 6.95
	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 AMPS 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 $12.00

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

BHN Electronics Supply Service

179 VICTORIA ST., KINGS CROSS N.S.W. 2011

POSTAL ADDRESS :

BKX ELECTRONICS SUPPLY SERVICE,
PO BOX 787, POTTS POINT,
SYDNEY, 2011.

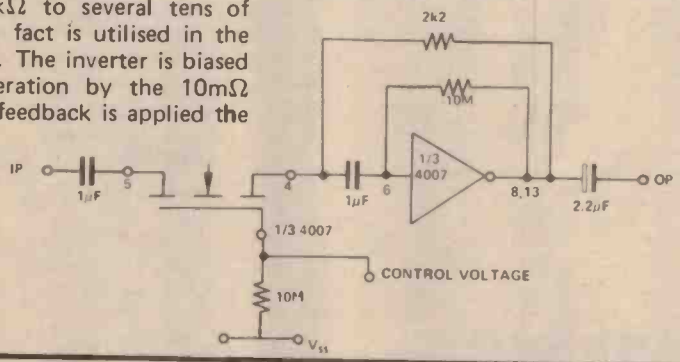
MAIL ORDER.....MINIMUM.....$8.00.
PACK AND POST.....FREE IN AUSTRALIA.
TELEPHONE ENQUIRIES.....(02) 358 2420.

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.

VOLTAGE CONTROLLED AMPLIFIER

When the voltage at the gate of a n-channel MOSFET is varied from OV – supply volts its resistance varies from about 1kΩ to several tens of megohms. This fact is utilised in the following VCA. The inverter is biased into linear operation by the 10mΩ resistor. When feedback is applied the gain is set by $\frac{RF}{RIN}$. By allowing a MOSFET to be RIN and RF fixed, with the values shown as the control voltage varies from $V_{DD} - V_{SS}$ the gain of the amplifier varies from cut-off to just over unity.



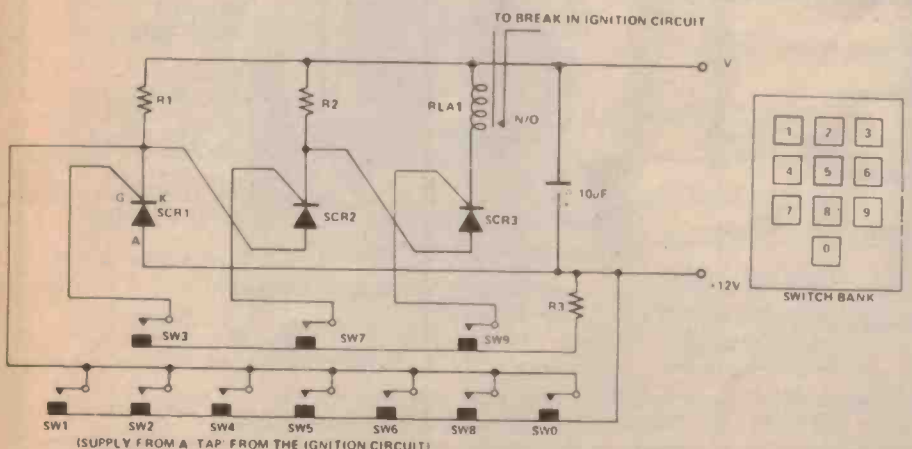
CODE SWITCH

When button 3 is pressed R3 'Gates' SCR 1, which remains on with a load of R1. It also supplies voltage to the anode of SCR 2.

When button 7 is pressed SCR 2 is 'Gated' by R3 also, and held on by R2, thus supplying the anode of SCR 3, which when 'Gated' by button 9 closes the relay and makes an external circuit.

It can also be used to switch a circuit off depending on how the relay is wired. This would be an advantage in a home intruder alarm.

Components: The Thyristors can be any type and values for R1 and 2 selected to hold the SCR's in conduction. R3 is selected to suit the thyristors. The remaining buttons, 1,2,4,5,6,8,0 when pressed short out SCR1, thus switching off any following SCR.

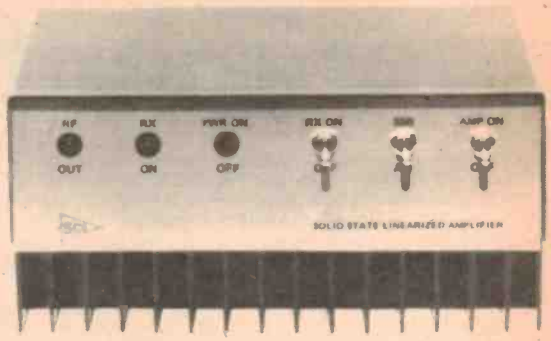


NEW MODEL, 3-30 MHz BI-LINEAR AMPLIFIER

HF-3-100L2

Frequency Range 3-30 MHz
Input Power: 10W Nom, 5-20 W PEP range
Output Power: 100W Nom ± ½ dB across band 200-250W PEP output
Input Impedance: 50 Ω nom, adjustable to match exciter range under 2 1 across band
Output Impedance: 50 Ω nom, up to 3:1 VSWR acceptable with little degradation
Current Drain: 16A nom. 20 A supply recommended at 13.6 VDC
Power Supply: 13.6 VDC recommended for best results, 11.14 VDC acceptable positive or negative ground

Pre-amp: 18 dB nom. gain across entire HF band, 15 dB typ at 50 MHz, 3-4 dB NF
Size: 19 1 x 16.5 x 8.9 cm wt 1½ Kg



DEALERS ENQUIRIES WELCOME

SOLE AUSTRALIAN DISTRIBUTORS FOR SCS LINE OF LINEAR AMPLIFIERS

EMONA electronics

PHONE 2124815
P.O. BOX K21,
HAYMARKET, N.S.W. 2000

SOVEREIGN CITY ELECTRONICS

P.O. Box 623 Ballarat
Victoria 3350

signetics

Linear:

LM 309H	.56
LM 309K	2.56
LM 308	1.43
LM340	2.10
NE555	.64
NE556	1.43
LM380N	3.03
LM382N	2.69

TTL Low Schottky:

74LS00	.36
74LS01	.36
74LS07	.36
74LS03	.36
74LS04	.38
74LS05	.36
74LS08	.36

74LS09	.36	74LS51	.36	74LS123	1.99
74LS10	.36	74LS54	.36	74LS125	.82
74LS11	.36	74LS55	.36	74LS132	1.74
74LS12	.36	74LS73	.47	74LS136	.54
74LS13	.69	74LS74	.49	74LS138	1.53
74LS14	1.80	74LS75	.76	74LS139	1.53
74LS15	.36	74LS76	.47	74LS145	1.46
74LS20	.36	74LS78	.47	74LS151	1.51
74LS21	.36	74LS83A	1.79	74LS153	1.51
74LS27	.36	74LS85	1.99	74LS155	1.77
74LS26	.41	74LS86	.76	74LS156	1.77
74LS27	.36	74LS90	1.21	74LS157	1.59
74LS28	.41	74LS92	1.49	74LS158	1.44
74LS30	.36	74LS93	1.21	74LS161	1.20
74LS32	.49	74LS95B	1.70	74LS163	2.86
74LS33	.61	74LS107	.69	74LS164	1.76
74LS37	.49	74LS109	.59	74LS174	1.63
74LS38	.41	74LS112	.53	74LS175	1.63
74LS40	.41	74LS113	.53	74LS181	3.87
74LS42	1.42	74LS114	.53	74LS192	2.79
				74LS193	2.79

74LS244	1.84	74LS490	1.62
74LS247	1.70	74LS533	1.42
74LS251	1.74	74LS669	1.99
74LS253	1.74	74LS670	2.42
74LS257	1.74	74LS673	4.88
74LS258	1.74	74LS674	4.88
74LS266	.57	74LS688	1.99
74LS273	1.99	74LS783	4.88
74LS279	1.42	74LS784	4.88
74LS283	1.59	74LS785	4.88
74LS290	1.62	74LS786	4.88
74LS293	1.42	74LS787	4.88
74LS365	1.19	74LS788	4.88
74LS366	1.19	74LS789	4.88
74LS367	1.19	74LS790	4.88
74LS368	1.19	74LS791	4.88
74LS386	.54	74LS792	4.88

General Electric:

CX20001	1.98
CX20D	2.91
CX22E	2.54
SC1410	1.95
SC1510	1.77
ST2	.33
ST4	.50
D1ST1	4.88
D1ST2	4.88

PHILIPS

HEF 4000	.30
HEF 4001	.30
HEF 4002	.30
HEF 4006	1.78
HEF 4007UB	.30
HEF 4008	1.74
HEF 4011	.30
HEF 4012	.30
HEF 4013	.50
HEF 4014	1.28
HEF 4015	1.24
HEF 4016	.49
HEF 4017	1.24
HEF 4018	1.28
HEF 4019	.73
HEF 4020	1.44
HEF 4021	1.28
HEF 4022	1.27
HEF 4023	.30
HEF 4024	.99
HEF 4025	.30
HEF 4027	.57
HEF 4028	.99
HEF 4029	1.50
HEF 4030	.50
HEF 4035	1.28
HEF 4040	1.57
HEF 4041	.99

HEF 4042	1.06
HEF 4043	1.24
HEF 4044	1.24
CD4046AE	2.97
HEF 4047	1.24
HEF 4049	.50
HEF 4050	.50
HEF 4051	1.24
HEF 4052	1.24
HEF 4053	1.24
HEF 4066	.60
HEF 4068	.33
HEF 4069UB	.30
HEF 4070	.32
HEF 4071	.30
HEF 4072	.32
HEF 4073	.32
HEF 4075	.32
HEF 4076	1.86
HEF 4077	.30
HEF 4078	.32
HEF 4081	.30

Monthly Specials

Pin for Pin Substitute may be supplied where original not available

signetics
NE555 Timers
$5.86/10

FAIRCHILD
FLV117 Red Leds
$2.00/10
$2.50/10 with mount

MINI DPDT TOGGLE
6A 115V
$1.00/1
80¢ each / 10

FAIRCHILD
CB 2A 13.8V Reg.
UA78C8 $2.97

SENCORE

A NEW BREED OF DIGITAL MULTIMETERS

With exclusive features backed by 25 years of all American craftsmanship!

SPECIFICATION:

DC VOLTAGE
Range 0 to ±2,20,200,1000V
Accuracy 0.5% ±1 digit
Input Impedance 15 Megohm/60pF

AC VOLTAGE
Range 0 to 2,20,200,1000V
Accuracy 1.0% ±2 digits
Input Impedance 15 Megohm/60pF
Frequency Response 40Hz-1 KHz (±1 dB)

SPECIAL FEATURES
- DCV x 2 button in probe extends DCV range to 2000V
- "PUSH ON" button in probe to turn unit on only during measurement
- Automatic negative sign. Decimal. Overrange.

DC/AC CURRENT
Range 0 to 2,20,200,2000mA (Total avg sum DC±AC)
Accuracy DC: 1% ±1 digit AC: 1.5% ±2 digit

HI-LO POWER OHMS
Range 0 to 200, 2K, 20K (Lo) 200K, 2000K, 20M (Hi)
Accuracy 1% ±2 digit
Max Test Voltage Lo: 200m Hi: 2V

GENERAL
Display 3½ digit 0.3" L.E.D.
Input protection 1000V (DC ↔ peak) any range
Mechanical Cycolac case; tilt stand
Size (HWD) Weight 6" x 4" x 1¼"; 1.1 lb.
Power Six 1½V "AA" cells or with PA202 for AC/rechargeable operation

DVM36
LAB ACCURATE POCKET PORTABLE

DVM 36

LAB ACCURATE
POCKET
PORTABLE

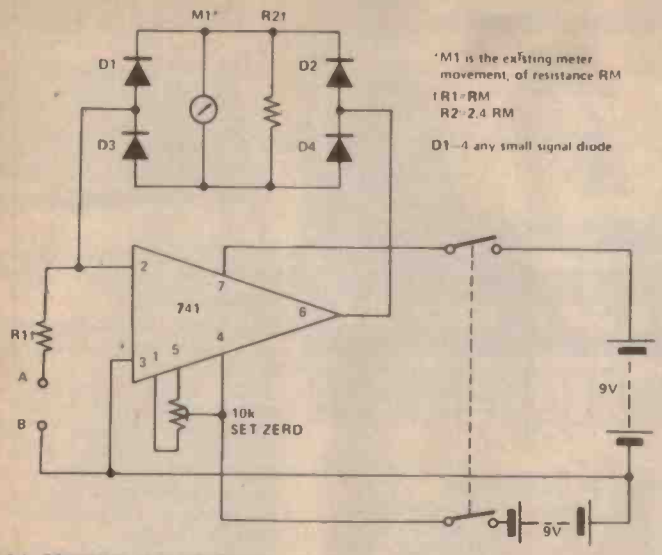
3½ DIGIT
DIRECT READOUT
.5% DCV ACCURACY
POCKET PORTABLE
DIGITAL MULTIMETER

THAT FITS EVERY BUDGET

$149* (P & P $3.00)
* Add Sales Tax if applicable

Available from:
EMONA ENTERPRISES, Room 208, 661 George St., Sydney – C.B.C. Bank Bldg., Haymarket, Ph 212 4815 (A.H. 399 9061) Mail Orders: Box 188, COOGEE, N.S.W. 2034.

Ideas for experimenters



UNIVERSAL METER RECTIFIER

This circuit can be built for about $2 but could save dollars in multimeter repair costs.

The meter movement is removed from the meter circuit, it's place being filled by the input (terminals A and B) of the circuit shown. Pin 2 of the 741 remains at the same potential as pin 3, so the input signal "sees" R1 as its load. However, the current which flows through R1 does not flow into pin 2, but through D1–D4, the original meter movement M1 and RMS correction resistors R2, to pin 6. Hence the circuit is current controlled, and so unaffected by the non-linearity of the rectifier, D1–D4.

R2 should only be in the circuit if it is desired to measure RMS AC values, all measurements are made on the DC ranges of the instrument.

R1 and R2 should be close tolerance types for accuracy; the circuit is accurate up to 100kHz.

AUTOMATIC CASSETTE TURN OFF

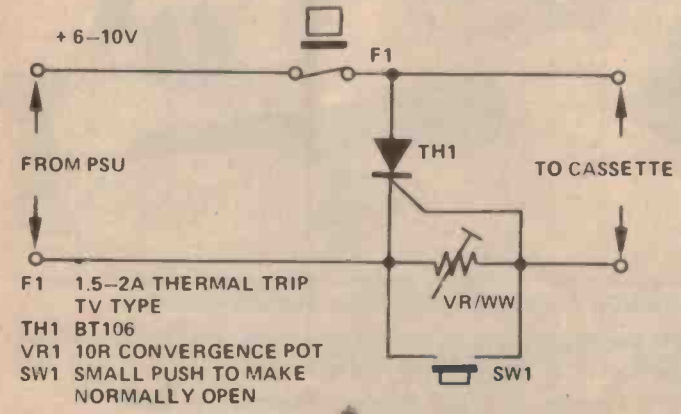
This circuit was designed to turn off a cassette when it reached the end of the tape.

It works because a cassette takes a great deal more current in the 'stall' condition than while actually running.

The components used are by no means critical those listed were closest to hand when the device was first constructed.

When using the device SW1 closes at the instant of switch on. This is due to the motor being stationary, and passing excessive current.

The power from the PSU passes through the trip and flows through the motor. This gives a PD across the resistor, and when this rises to the trigger point of the thyristor it will 'short' the HT line triggering the trip.



ECHOCORD-MINI, echo/ reverberation unit with endless tape system and sliding sound head: two inputs, tone controls, two outputs; weight: 15½lbs; dimensions: 15¼ x 5½ x 10½ ins.

Dynacord

SOUND EQUIPMENT

EC 280, Electronic Ech/Reverb System, does not have any mechanical wearing parts.

Max. echo length 280 msec.; built in "chorus effect" allows very special sound effects.

Quick switching from echo to reverb, also presetting of desired effects by push buttons; speed control for echo spacing; echo duration and echo return controls; robust casing of polyurethane foam plastic.

Dimensions: 12¾ x 3¼ x 9¼ Ins

Weight: 6½ lbs.

EMINENT 200, Solid state portable sound system consisting of: mixer unit, power amp. and multi-head echo/reverb. unit 8 separately mixable inputs, separate volume, bass, treble, and reverb controls, master controls for volume and echo return; 7-stage equalizer; controls for echo tone and duration, echo/reverb. switch for preset reverberation; V.U. meter switchable for power amp. and reverb. output:

FACTS ABOUT DYNACORD

For more than two decades DYNACORD had been the leading European manufacturer of sound reinforcement equipment. Operations comprise of the manufacture of three different lines of products:

Musical amplication systems: hifi-stereo mixers, power amps, and allied accessories for discotheque systems; and last but not least PA sound systems for hotels, schools, hospitals, and a great variety of other applications.

About 350 people are employed in two different manufacturing plants. Headquarters at the main plant covering an area of 100,000 square feet provide facilities for the different departments, such as: home sales, export division, buying, accounting, electronic data processing, stocks, service, administration, etc.

Above all there is the research and development department employing 30 graduated engineers and technicians, some of them having a thorough musical experience of their own. They also have an experience inthe field of long standing and apply latest and highly advanced technologies. Almost 50 percent of the total production are being exported to over 100 different countries throughout the world.

MC 1030, 10-Channel Mixer for P.A. systems, housed in aluminum flight case, 10 unbalanced microphone inputs, each with bass, treble, monitor, panorama, volume, and echo control; 3 output jacks with seperate controls left/right, and monitor; outputs left/ right with separate bass and treble controls; one echo return control; two illuminated VU meters. Connectors for tape deck, echo, and docking systems for extensions or sub-mixers.

Dimensions: 22 x 7 x 15 Ins

Weight: 14¼ lbs.

CITRONIC

CITRONIC — One of Englands leading professional Disco equipment with a full range of complete Discos and Mixing panels.

MARUNI & TURNER MICROPHONES

Professional microphones at very competitive prices.

Leaflets of all equipment available from; Sole Australian Distributors:

FREEDMAN ELECTRONICS PTY LTD

Tel: 797 9941 — 797 0986 89-91A Liverpool Road Summer Hill NSW 2130

Trade Enquiries Invited

FANTASTIC OFFER!!!

THE LATEST TECHNOLOGY 100 STEP PROGRAMMABLE SCIENTIFIC CALCULATOR

Beautifully gift packed with strong adjustable desk stand, Carry Case, Pens, Note Book, Battery.

WHILE STOCKS LAST

- Fully Computer Programmable
- Simple Keyboard Programming
- Full Scientific Keyboard Functions
- Program Examination & Editing
- Popular R.P.N. Logic for speed
- Automatic Brackets Equations
- Multiple programs up to 100 steps
- Separate Addressable Memory
- 4 Level Operational Stack
- Programmable Hatls for Data entry of Readout
- Load your own Maths Physics Chemistry or Finance & Commercial Programs with as many stops as you need for intermediate answers

★ **PLUS BONUS**

AT NO EXTRA CHARGE

6 FUNCTION DIGITAL WATCH

Hours, Mins, Secs, Day, Month Date

IN GOLD OR SILVER METAL CASE AND BAND

(Normal rec. retail is $39.95)

★★ **PLUS LATEST A.C. ADAPTOR**

for power to keep your programs intact without using your battery (Normal Rec. Retail is $7.99)

ONE YEAR WARRANTY

ALL INCLUDED AT AN AMAZING

$59.95

Calculator pack
Digital watch
A.C. Power adaptor

order now while stocks last

Please send me my model 2000 Programmable CALCULATOR PLUS MY BONUS 6 FUNCTION DIGITAL WATCH IN GOLD .....

SILVER.....

PLUS BONUS A.C. ADAPTOR

NAME .....

ADDRESS.....

..... POST CODE .....

ENCLOSED $59.95 PLUS $2.00 Post & Handling

SHEEN

AUSTRALIA'S HOTTEST SELLING DIGITAL PRODUCTS

14 Freight Road, Tullamarine. Melbourne. 3043. PH: 03-338-7223

MICROCOMPUTER

8080A SUPPORT DEVICES

8212	4.00
8214	12.95
8216	5.25
8224	6.00
8228	9.25
8238	8.20
8251	12.00
8253	28.00
8255	12.00
8257	22.00
8259	22.00

6800 SUPPORT

6810P	6.00
6820P	8.00
6828P	9.60
6834P	21.95
6850P	12.00
6852P	17.00
6860P	15.00
6862P	18.00
6880P	2.70

Z80 SUPPORT DEVICES

3881	15.95
3882	15.95

F-8 SUPPORT DEVICES

3851	14.95
3852	14.95

FLOPPY DISC CONTROLLER

PD372D	65.00
1771	69.95

DYNAMIC RAMS

414D (16P)	5.50
1103 (16P)	1.50
2104 (16P)	6.50
2107B (22P)	4.50
2107B-4 (22P)	4.00
TMS4050 (18P)	4.50
TMS4060 (22P)	4.50
4096 (16P)	5.50
MM5262 (22P)	3.00
MM5270 (18P)	5.00
MM5280 (22P)	6.00

STATIC RAMS

31L01	2.00
91L11A	4.25
91L12A	4.25
1101A	1.00
2101	3.00
2102 (10S)	1.25
2102-1 (5.00NS)	1.50
2111A-4	4.45
2112A-4	3.00
2501B	1.45
3107	2.95
*4200A (250NS)	13.75
410D (200NS)	11.95
*4804	20.00
5101	20.00
74C89	3.00
74S201	4.75
91L02A	2.00
7489	2.25
8225	1.50
8599	1.50
82S09	9.00

*Limited supply.

MISC OTHER COMPONENTS

NH0025CN	1.75
NH0026CN	3.00
N8T20	4.00
N826	3.25
N8T97	1.45
74367	1.00
DM8098	1.00
1488	1.95
1489	1.95
3205	6.20
D-3207A	2.50
C-3404	3.95
P-3408A	6.75
P-4201	4.95
MM-5320	7.50
MM-5369	2.00
DM-8130	3.00
DM-8131	2.50
DM-8831	2.50
DM-8833	2.50
DM-8835	2.50
SN74LS367	1.00
SN74LS368	1.00

MICROPROCESSOR'S

F-8	19.95
Z-80	36.95
Z-80A	49.95
CDP1802DC	29.50
AM2901	22.95
6502	24.95
6800	24.95
8008-1	8.75
8080A	15.95
8080B	16.95

SHIFT REGISTERS DYNAMIC

1404AN	3.00
2405	4.95
2505K	3.00

SHIFT REGISTERS STATIC

MM506	.89
2509K	1.00
2518B	3.95
2533V	2.00
TMS3002	1.00
TMS3112	3.95
MM5058	2.00

FIFO

3341A	6.75
2812-D	11.95

KEYBOARD CHIPS

AY5-2376	14.95
AY5-3600	14.95

TV GAME CHIPS

TMS 1955 (6 Games)	10.95
AYSS-8500 (6 Games)	10.95

USRT

S-2350	13.50
IM-6403	10.80
TMS-6011 (TI)	6.25
TR-1602A (WD)	6.25

UARTS

AY5-1013	6.75
AY5-1014A	9.95

CHARACTER GENERATORS

2513	6.75
2513	6.75
3257	18.00
MCM6571	10.80
MCM6571A	10.80
MCM6572	10.80
MCM6581	8.75

WAVEFORM GENERATOR

8038	4.50
MC4024	2.75
566	2.00

KITS

MEC 6800 DZ	Design Kit	235.00
8080A Kit	Parts Kit (All Parts to Build 8080A System)	100.00
Educator II	Computer hobbyist Beginners kit by Motorola	169.95
Educator II	Power Supply by Motorola (Designed for Educator II)	29.95

SPECIALS OF THE MONTH

2708 E-PROM
Price $24.00 ea.

			1-24	25-99	100-499	500-999
21L02	(350NS)	(Low Power)	1.58	1.48	1.43	1.33
21L02	(250NS)	(Low Power)	2.00	1.80	1.65	1.50

8K RAM BOARD KIT $159.95

FEATURES

- S–100 Connector compatible.
- Low power static RAM's (350 ns).
- Low-power Schottky support chips.
- Dip switch selection of memory address assignment and wait cycles.
- Memory protect can be set for increments of 256 bits, 512 bits, 1K, 2K, 4K or 8K by DIP switch.
- Low profile sockets provided for all RAMs and ICs.
- Gold plated edge connector contacts.

Discounts available at OEM quantities. All prices above are quoted in US $F.O.B. Lawndale, Calif. USA. To expedite shipments please include international money order or bankers check payable against any USA bank in US$, or affiliated credit cards of Bank America or Master Charge welcome (include card No., expiration date and signature). Add 10% of total order for postage. For orders less than $10 add $1.50 service charge.

master charge

your BANKAMERICARD welcome

CONNECTORS

EDGE CONNECTORS		
10	Dual .156 W W Gold	50
15	Dual .156 W W Gold	.75
22	Dual .156 Solder Gold	2.25
50	Dual .125 Solder Gold	8.00
50	Dual .125 Solder Gold (For IMSAI)	3.80
50	Dual .156 Solder Gold (For Altair)	5.00
SUBMINITURE CONNECTORS for RS232		
25	Solder type DB(25-S) (Female)	3.90
25	Solder type DB(25-P) (Male)	3.50
	Male & female (25-P & 25-S)	6.50
	Cover Each	1.50

JADE CO

Electronics for the Hobbyist and Experimenter

5351 WEST 144th STREET
LAWNDALE, CALIFORNIA 90260 U.S.A.
(213) 679-3313
Free Catalogue with each order!

SOCKETS

I C SOCKETS		
8	Lo Pro Tin	.20
10	Transistor IC-10 Gold	.25
14	Lo Pro Tin	.25
14	Wire Wrap Gold	.30
16	Lo Pro Tin	.25
16	Standard P C Tin	.30
16	Wire Wrap Tin	.30
18	Lo Pro Tin	.25
18	Wire Wrap Tin	.85
20	Wire Wrap Tin	.95
22	Lo Pro Open Frame Tin	.50
22	Wire Wrap Tin	.95
24	Standard P C Tin	.50
24	Wire Wrap Tin	85
24	Lo Pro (Open Frame) Tin	.40
28	Lo Pro (Open Frame) Tin	.40
28	Standard P C Tin	.60
28	Wire Wrap Tin	.95
40	Lo Pro (Open Frame) Tin	.50
40	Wire Wrap Tin	1.65

electronics today SERVICES ADVERTISERS INDEX

READERS' LETTERS

No charge for replies but a foolscap-size stamped addressed envelope must be enclosed. Project queries can only be answered if related to item as published. We cannot assist if project is modified nor if components are otherwise than specified.
We regret we cannot answer readers' enquiries by telephone.

SUBSCRIPTIONS AND BACK ISSUES

ETI subscriptions cost $17.00 per year (inc. postage) within Australia. Cost elsewhere is $17.65 (inc. postage -- surface mail). Airmail rates on application.
Back issues cost $1.00 each plus post and packing.
We can supply only the following issues.
1975: April, Nov., Dec.
1976: May, Nov., Dec.
1977: All issues except March and Jan.
Photostats are available of any article ever published in ETI. We charge a flat $1.00 regardless of page quantity from any one issue of ETI. Thus if the article is in three issues the cost is $3.00. Send orders to address below.

COPYRIGHT

LIABILITY

Whilst every effort has been made to ensure that all constructional projects referred to in this edition will operate as indicated efficiently and properly and that all necessary components to manufacture the same will be available, no responsibility whatsoever is accepted in respect of the failure for any reason at all of the project to operate effectively or at all whether due to any fault in design or otherwise and no responsibility is accepted for the fallure to obtain any component parts in respect of any such project. Further no responsibility is accepted in respect of any injury or damage caused by any fault in the design of any such project as aforesaid.

A MODERN MAGAZINES PUBLICATION

Managing Director: Arnold Quick
Secretary: Charles O'Leary
Publisher: Collyn Rivers

PRODUCTION

Art Director: Jim Hattersley
Artist: Maree Stanley
Production Manager: Bob Izzard
Subscriptions & Circulation: John Oxenford
Project Design: Nebula Electronics
Acoustical Consultants: Louis A Challis & Assoc.

ADVERTISING

37 Fullarton Rd, Kent Town 5067. Tel: 42-4858.

Sydney: Bob Taylor (Manager), Geoff Petschler (NSW Manager), 15 Boundary St, Rushcutters Bay 2011. Tel: 33-4282.
Melbourne: Tom Bray (Manager), Poppe Davis, Suite 24, 553 St. Kilda Rd, Melbourne. Tel: 51-9836.
Brisbane: David Wood, 11-14 Buchanan St, West End Brisbane. Tel: 44-3485.
Adelaide: Ad Media Group of SA,
Perth: Aubrey Barker, 38 Mounts Bay Rd, Perth. Tel: 22-3184.
Hobart: H.W. Lincolne Advance Publicity, 281 Elizabeth St, Nth Hobart 7000.
Tokyo: Genzo Uchida, Bancho Media Service, 15 Sanyeicho, Shintuku-Ku, Tokyo 160.
London: Electronics Today International, 25-27 Oxford St, London W1R2NT. Tel: 01 434-1781/2.

Electronics Today International is published by Modern Magazines (Holdings Ltd, 15 Boundary St, Rushcutters Bay NSW 2011. It is printed (in 1977) by Wilke & Co, Browns Rd, Clayton, Victoria and distributed by Australian Consolidated Press.

ADVERTISERS' INDEX

WHY YOUR NEXT CASSETTE SHOULD BE A MAXELL UD

3 THE SHELL — Even the best tape can get mangled in a poorly constructed shell. That's why Maxell protects its tape with a precisely constructed shell, made of lasting heavy-duty plastic.

No fixed guide posts are used. Instead Maxell uses nylon rollers on stainless steel pins thus eliminating the major cause of skipping, jumping and unwinding.

A tough teflon (not waxed paper) slip sheet keeps the tape pack tight and flat. No more bent or nicked tape to ruin your recording.

Maxell doesn't use a welded seal, but puts the cassette together with precision screws. Result — Maxell doesn't jam.

ULTRA-DYNAMIC UD

1 THE RESEARCH — More than twenty years ago, Maxell produced their first reel of magnetic tape. At that time, Maxell made a commitment to produce and sell only the finest magnetic products their technology could create.

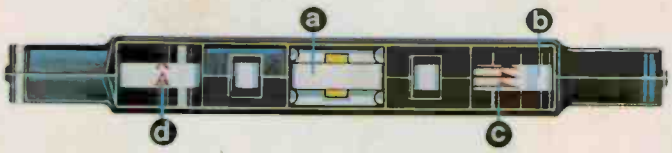
That commitment still stands today.

2 THE TAPE — This continuous research has lead to the development of the Maxell UD (ultra dynamic) cassette. A tape that has a coating of super-fine PX gamma ferric oxide particles with an extra smooth mirror-finish surface.

All of this adds up to high output, low noise, distortion free performance and a dynamic range equaling that of open reel tapes.

4 THE LEADER — A leader tape that has a four function purpose.

a) Non-abrasive head cleaning leader (cleans recording head for 5 secs.).
b) 5 second cueing line (recording function starts 5 seconds after the line appears).
c) Arrows indicating direction of tape travel.
d) A/B side mark (indicates which side is ready for play).



Now you know why your next cassette should be a Maxell UD (ultra dynamic).

maxell®

The sound expert's cassette. UD available in C60, C90 and C120. Distributed by **Hagemeyer (Australasia) B.V.** Branches in all States.

WT GD 127M

TEAC's impressive value. It automatically includes precision TEAC performance.

Our A-150 won't break your audio equipment budget, but it may break the record for value. It includes a very impressive list of performance features: FG servo controlled DC motor with guaranteed wow and flutter of 0.07%, separate two-stage Bias and EQ switching, expanded scale VU meters, Dolby* NR circuitry, Mic/Line mixing, memory function, timer control capability, and more. Perhaps the most important feature is the rugged excellence our name assures. TEAC quality is something you can trust.

TEAC A-150

TEAC

AUSTRALIAN DISTRIBUTORS

Australian Musical Industries Pty. Ltd., 155 Gladstone Street, South Melbourne. VIC. 3205. Ph: 699 6455

INTERSTATE AGENTS

BTS Sales, 55 Dickson Avenue, Artarmon. N.S.W. 2064. Ph: 439 6262
BTS Sales, 51 Norma Road, Myaree. W.A. 6154. Ph: 30 1255
BTS Sales, 53 Robertson Road, Fortitude Valley. QLD. 4006. Ph: 52 8900
P.G.A. Associates Pty. Ltd., 62 Hindmarsh Square, Adelaide. S.A. 5000. Ph: 223 3024

RETAILERS

VIC: Brashs, Allans, Douglas Hi-Fi. QLD: Jeff's Stereo Shop, Stereo Supplies.
N.S.W. Autel Systems, Douglas Hi-Fi, Miranda Hi-Fi. S.A. Truscott Electronics.
W.A. Albert's Hi-Fi, Audio Centre, A. D. Urquhart. (SEA)1634