

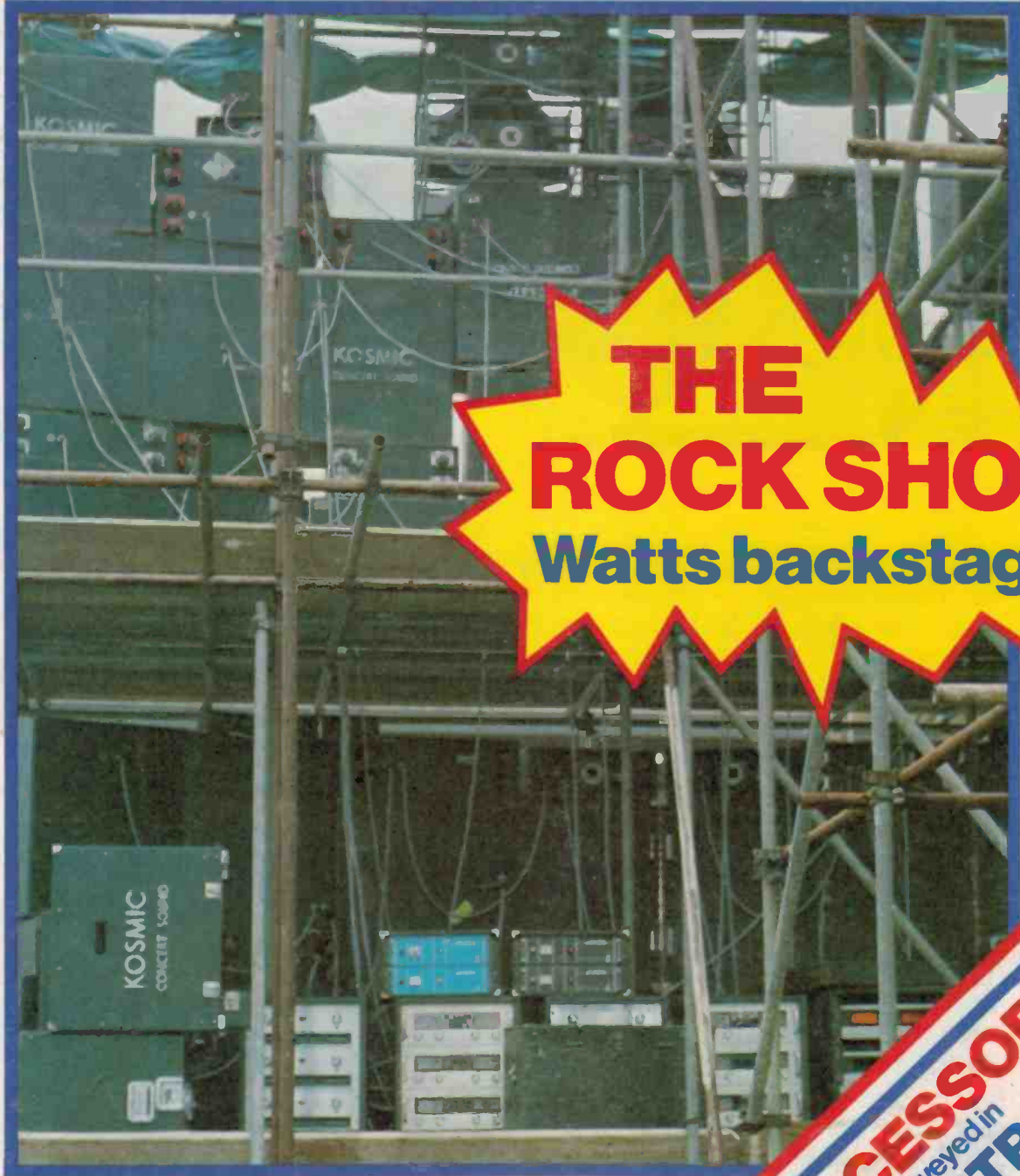
APRIL 1977 \$1.00*
NZ \$1.15

electronics

TODAY

INTERNATIONAL

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**THE
ROCK SHOW**
Watts backstage

**PROJECT:
PHASE METER**

CB ACCESSORIES
surveyed in
CB AUSTRALIA
FREE INSIDE

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.



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.

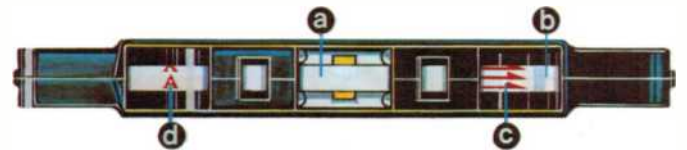
That commitment still stands today.

2 THE TAPE — This continuous research has led 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.

electronics TODAY

INTERNATIONAL



A MODERN MAGAZINES PUBLICATION

APRIL 1977, Vol. 7 No. 4

Editorial
Publisher

Steve Braidwood
Collyn Rivers

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

Next month is a
SPECIAL MONTH
for **PROJECT BUILDERS**

Look at these planned projects:

- * 100 W 12 V PA Amplifier
- * High-Power Strobe
- * Transistor Assisted Ignition
- * Induction Balance Metal Locator

all in May's ETI.

COVER: Guess how many watts — 2,000, 5,000? Suppose we tell you that these loudspeakers were one of two arrays that were used to bring the sounds of Rod Stewart to over 30,000 people at the Sydney showground, now guess — then turn to page 17 and see if you were right.

* Recommended retail price only

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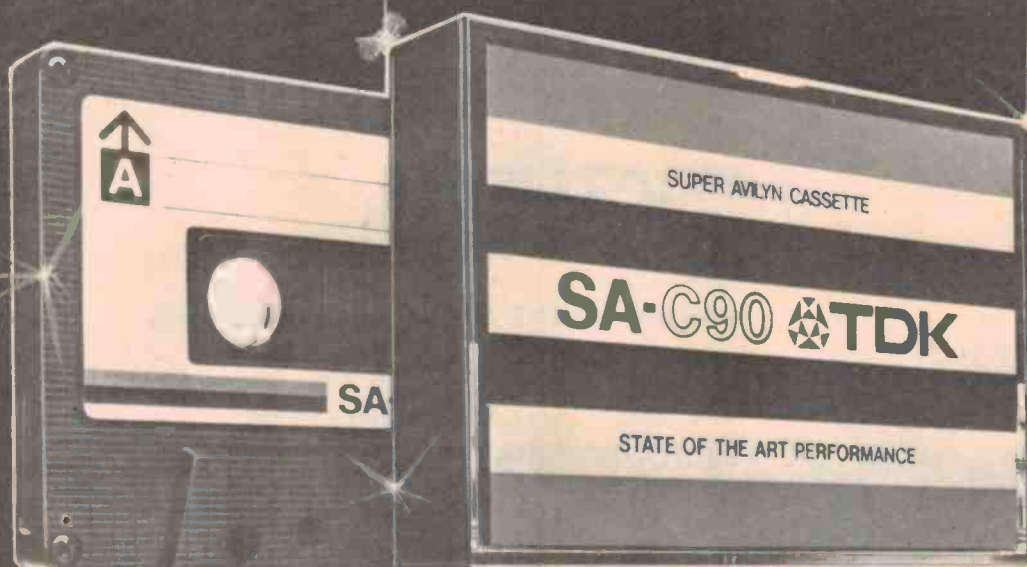
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Free Inside . . . CB Australia looks at CB Accessories

TDK SUPER AVILYN! THE EXPERT'S CHOICE



This is what the experts say:

MR. E. NAKAMICHI, PRESIDENT,
NAKAMICHI RESEARCH INC.

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

ELECTRONICS TODAY APRIL 1976

"Listening tests proved that Super Avilyn tape sounds as good as its measured performance indicates. Background noise is substantially lower than other tapes and the dynamic range is unquestionably better. Frequency response is excellent."

HI-FI REVIEW JULY 1976

"TDK Super Avilyn lived up to its reputation in these tests. For the uncompromising tape enthusiast it is one of the best cassette tapes available. Its price is very competitive making this tape good value for money in the high performance range. For the perfectionist, TDK's hard to beat."

LOUIS CHALLIS & ASSOCIATES, CONSULTING
ACOUSTICAL AND VIBRATION ENGINEERS.
NATA LABORATORY APPROVED.

"TDK Super Avilyn looks like being one of the most important advances in tape formulation in the mid 70's."



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*Wait till you hear what you've been missing.
Available at all good record bars and hi-fi stores.*

NEWS DIGEST

CB to be legalised?

Unofficial sources are predicting the legalisation of CB on the 23-channel, 27 MHz, band sometime in the next month. By the time this issue is available the NCRA and the WIA should have made their submissions to the government, and the minister for Posts and Telecommunications should be ready to put his department's proposals to the cabinet.

Most people feel that the CB service will be based on the old US system — which would mean CBers could use only equipment which is approved by the P&T department. Some publications have been advising their readers not to buy gear before the legislation is introduced and type approvals issued, because they might be buying set which doesn't meet the standards.

We feel that the P&T department is unlikely to impose standards that are stricter than those they are using for other 27 MHz gear in today's licensed services. So we're guessing that there will be very few, if any, sets banned.

However, we do not recommend that you buy gear in anticipation of legalisation. For one thing, you might have your rig confiscated and be charged in court with maintaining an unlicensed station (even if you never use the gear). And no-one is yet sure that the 27 MHz service will be legalised.

As far as UHF (or VHF) is concerned there is little speculation — many have proposed that a second band be initiated (perhaps with a phase-out of the 27 MHz service) but we'll have to wait and see.

WIN A UNITREX CALCULATOR!

February's contest was so popular that we're setting a similar puzzle this month (see page 11 for February's result). This contest was submitted by J.T. Broekstra of Gladstone, Queensland.

Each letter below represents a unique decimal digit and none of the numbers in the sum start with zero. Given that N is not equal to four, what are the numbers that correspond to each of the letters?

$$\begin{array}{r} \text{SEVEN} \\ \text{THREE} \\ \text{TWO} + \\ \hline \text{TWELVE} \end{array}$$

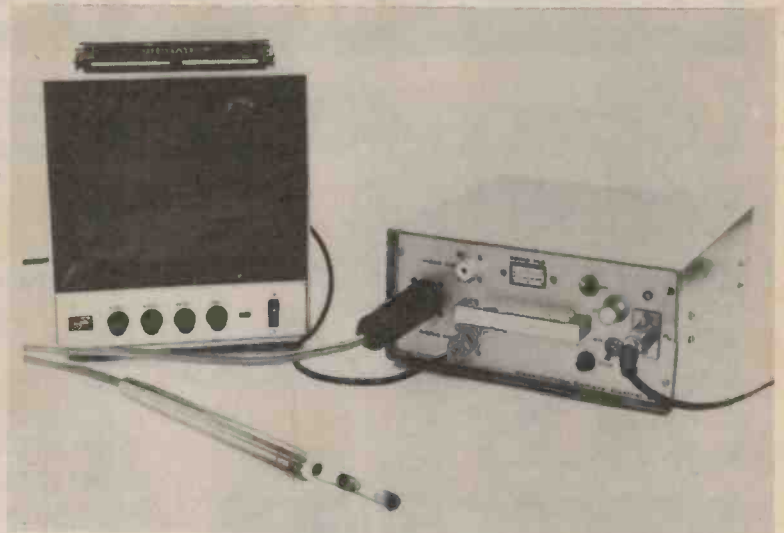
The winner will be the sender of the first correct entry drawn at random after the closing date, 15th May. Send your entry on the back of an empty envelope to ETI/Unitrex Contest, ETI Magazine, 15 Boundary Street, Rushcutters Bay, 2011.

Melbourne's Computer Club

The first meeting of the Microcomputer Club of Melbourne was held on 19th March. We have no details of future meetings but interested readers are invited to phone Roger Edgecombe during office hours, on 836 1077.

The Sydney area club is going strong with meetings on the first and third Mondays of each month at the WIA Hall, 14 Atchison Street, Crows Nest.

TINY CAMERAS



A range of the smallest industrial closed circuit television cameras in the world is now available from AWA Rediffusion who have recently been appointed agents for Rees Instruments Limited (UK).

These miniature television cameras are coming into increasing use to check faults in industrial pipelines which are otherwise inaccessible for inspection. Cameras, as small as a pocket torch and carrying their own lighting, can be inserted more than 130 metres into pipes and tubes.

One camera in the AWA Rediffusion range has a diameter of 17.3 mm. They are not only used to check for corrosion and faults, but also to locate foreign bodies and guide the placing of tools and remote handling equipment.

The cameras are also suitable for inspecting in dangerous environments, such as checking fuel elements in nuclear reactors.

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Think
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specifications.

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Electronic
Components
and Materials

PHILIPS



BENCH SUPPLIES FOR MICROPROCESSOR-SYSTEM DESIGNERS

Two new compact dc power supplies from Hewlett-Packard each provide adjustable output voltages. Output ratings of Model HP 6236B are 0 to 6 V at up to 2.5 A and 0 to 18 V at up to 1 A for Model HP 6237B. Both bench supplies also have plus and minus outputs of 0 to 20 V at 0.5 A that track one another within 1 percent. However, by using the continuously adjustable tracking-ratio control, an operator can set any negative output voltage between 5 percent to 95 percent of the positive output. As the 20 V control is adjusted, the negative output will be proportionately less than the positive output as determined by the tracking ratio setting. A three-position meter switch selects the desired output for display of voltage and current on dual panel meters.

The new supplies are for use in designing and testing electronics devices that require symmetrical operating voltages and in applications where opposite polarity but asymmetrical voltages are required.

Duty-free price of each model is \$390. Duty and Sales tax are additional, if applicable.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St. Blackburn, Victoria, 3130.

Car Cassette/Cartridge Player

Rising Electronics of 4 Wewak Place, Allambie Heights, Sydney have a novel player for motorists who are changing their tape system from cartridge to cassette: the CT702 will play your old car-

tridges and your new cassettes. Not only is the machine a tape player — it will also receive AM and FM (stereo) radio. The 10 W output unit sells for \$245.

WARNING

OPERATION ELECTRONICS

The recently published School Electronics Kit called **OPERATION ELECTRONICS IDEAS BOX** contains a number of mains-operated projects that can become *potentially lethal* under certain fault conditions.

MacMillan of Australia, the publishers, advise particularly that Project 42 'Motor Speed Controller' *should not be constructed*. Although credited to *Electronics Today International* the circuit as published by MacMillan differs substantially from the original which appeared in the Oct 1974 issue of *ETI*.

RECALL OF CIRCUIT CARDS

In the interests of safety, MacMillans are recalling all kits so that the mains-powered project cards can be removed and the kits sent back to purchasers. Teachers should note that neither the *manual* nor the battery-powered projects are affected.

PROCEDURE FOR RETURNING CARDS

Those schools in possession of MacMillan's **OPERATION ELECTRONICS IDEAS BOX** should return *the cards only* (not the *manual*) to their original supplier, together with the supplier's invoice (or an on-approval invoice in the case of inspection copies). They will be suitably credited. If you receive a kit from a bookseller, return it to him not MacMillan of Australia.

FURTHER INFORMATION

If purchasers are unsure as to what to do, they should contact Sydney 929-4278: Melbourne 699-8922: Brisbane 398-6543: Adelaide 42-2640: Perth and Hobart ring (03) 699-8922 or write to . . .

MacMillan of Australia, 107 Moray Street, South Melbourne, Vic. 3205.

COUNT CORVUS
turns a blind eye
to devaluation!

Our
No.1 rated
scientific

CORVUS CALCULATOR

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Believe it — despite devaluation this magnificent instrument is at a lower price than before. It will solve the most complex scientific and business calculations. You can just imagine what worlds we might have conquered if it had been invented 100 years ago!

THE MANY OUTSTANDING CORVUS FEATURES INCLUDE:

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- 10 x 2 Scientific mode plus sign Mant + Exp
- 12 digit accuracy
- Reverse Polish Notation (4 stack)
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- Radian mode
- To and from Radian Conversion
- Sigma plus standard deviation and mean
- Trig functions plus inverse and hyperbolic
- Range up to ± 200 exponential value
- Fixed, floating and scientific decimal point mode
- Percent — percentage difference
- π constant (11 digit accuracy)
- Natural and base 10 log and anti-log
- To polar — to rectangular conversion
- Vector additions
- All functions of X from and to
- 8 decimal conversions
- Ni-cad batteries
- AC/OC adapter charger
- Soft carrying case
- 1 year full warranty

Corvus Calculators are also available at all Sydney Wide Stores. For Victorian readers at The Calculator Supermarket, 274 Lonsdale Street.

Other Corvus Calculators available
804D for business, home and school \$14
615 Business Statistician \$19.95
610 Financial GENIUS \$74.95



Please send me by return mail the No. 1 Rated Scientific CORVUS CALCULATOR for only \$79.95 plus \$2.50 postage and handling. I am enclosing cheque money order postal note for calculator(s).

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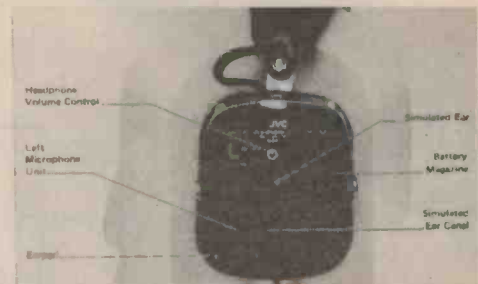
Money back guarantee if returned in original condition within 14 days.



TV Game

'Playtech by Telesport' are manufacturing and marketing this video game based on the GI IC used in the ETI Selecta-Game. The company's address is PO Box 161, Caulfield South, 3162.

Stereo microphones/ headphones



A new product from JVC (Japan), distributed by Hagemeyer, is the HM200E binaural headphone-microphone set. This way you don't need a dummy head to make stereo recordings — you use your own!

The headset looks like an ordinary pair of headphones with some strange contouring on each of the earpads. This is the simulated ear and simulated ear canal which surrounds the microphone.

Maybe someday they'll invent one which uses the real ear.

"ARIX" MULTIMETER

The 100 movement of the Arix 36FTR is protected against overload by diodes. In addition the rest of the components are protected by a fuse.

There are 34 ranges: DC from 0.5 — 1000 V (25 kV with optional HT Probe) 10 A to 10 A.

AC 5-1000 V, 10 A, Resistance 5 to 50 M Decibels, -10 to +62

A Transistor Tester is also incorporated. The meter is particularly useful for TV testing as DC readings are not affected by HF

components. This is achieved by a special circuit arrangement.

Spare parts and repair service is available in Australia and the instrument is covered by a 3 month's warranty by the sole distributor: Indeva Pty Limited, 24 Bellevue Road, Bellevue Hill, NSW 2023.



Underexposed?

In ETI's March issue we forgot to credit the cover photographer, George Hofsteters, and his model, Neville St John, for their excellent work.

Watch for Lithium Batteries

A problem with LED watches has always been the heavy drain on the small batteries — which means a short battery life. A new battery has been developed to improve this situation.

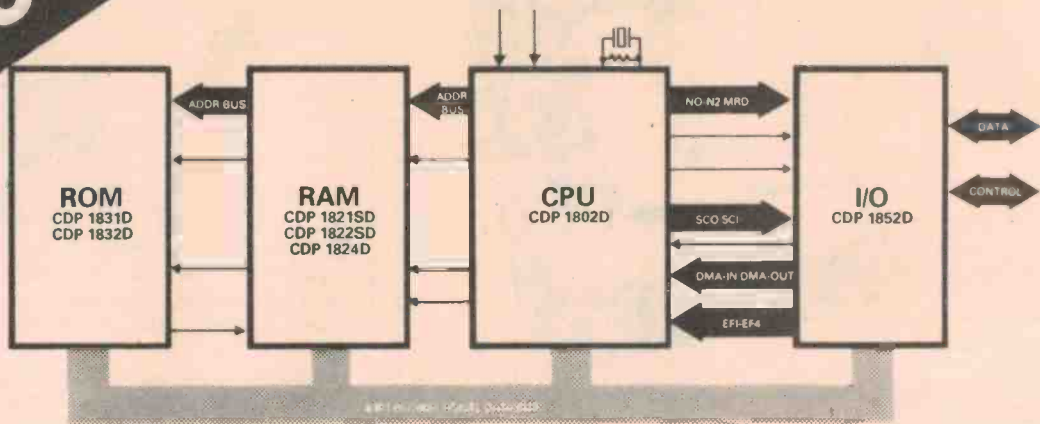
National Semiconductor have announced their intention to use lithium batteries in their future watches; these batteries give more power in less space than conventional batteries. Mallory have exhibited one miniature lithium-iodide battery which is capable of delivering 200 mA hours at two to three volts.

Progressive Stereo Radio

A new group of enthusiasts in Melbourne, who call themselves the Progressive Broadcast Service, are planning to start an FM station to provide 'professional' rather than 'commercial' programmes. Finance is expected to come from the audience and already the group has recruited the services of experienced production staff.

Their address is PO Box 275, Malvern 3144.

Announcing



the 1-chip COSMAC μP

Now, a CMOS system that really delivers the promise of the microprocessor. It's the expanded RCA 1800 family with CDP1802, our new one-chip COSMAC CPU. And it gives you an unsurpassed combination of flexibility, performance and cost effectiveness.

Simple COSMAC architecture lowers memory costs because of 1-byte instructions and internal address pointers. It also reduces I/O costs. Plus design and learning costs.

Then you have the familiar CMOS savings. Single power supply. Single-phase clock. Less cooling and other equipment, thanks to low power and high tolerances.

For all these reasons, we believe no other microprocessor matches the RCA 1800 for system cost effectiveness. What's more, you can get the whole system from us: CPU, ROM, RAM, I/O. Everything you need including complete design support.

For further information on the above and other solid state products, please contact:



Amalgamated Wireless Valve Company Pty. Ltd.
(Technical Information)

554 Parramatta Road, Ashfield, N.S.W. 2131. Phone: (02) 797 5757. Telex: 24530
Postal Address: P.O. Box 24, Ashfield, N.S.W. 2131

Dick's DIY PCB Sheet

Another 25 cent Do-It-Yourself leaflet from Dick Smith is now available. Three A4 sides and 20 illustrations show you how to make your own printed circuit boards.

RS-232 Floppy Disc

Anderson Digital Equipment has just announced the release of the Techtran 9512 Micro Disc. The 9512 is a serial RS-232 ASCII floppy disc system. It records on an IBM Compatible Diskette.

Further information from Anderson Digital Electronics, Sydney 439 5488, Melbourne 543 2077.

New 1296 MHz World Record

On February 25th this year VK6WG in Albany and VK5QR in Enfield (a suburb of Adelaide) made a world record contact on the 23 cm band. The 1886 km QSO involved VK6WG using CW and VK5QR using SSB. The previous record was 1240 km. Each station used a 3 ft dish antenna and 10 to 15 W of RF.

EEEMC'77 EXHIBITION IN SYDNEY

The 3rd International Electrical Electronic Engineering, Measurement & Control (EEEMC) exhibition (the industry's major biennial event) will be held from 18-21 October, 1977, at the R.A.S. Showground, Sydney.

The EEEMC Exhibition will now be held over four days and will include power generation, industrial process control, transmission and distribution, automated and control systems, scientific and industrial instrumentation, electrical and electronic equipment and components, security systems, lighting, accessories and supporting services. Companies or individuals who wish to have further details are invited to write to the executive director, EEEMC'77, PO Box 259, Roseville, 2069 or telephone 02 — 467 1949).

ETI READ BY MANY

The February Unitrex calculator contest asked for a solution to the following sum:

ETI
READ
BY+

MANY

There are, in fact, eighteen solutions we know of, but following B.J. Joyce's advice that each of the four numbers is divisible by three reduces the number of solutions to twelve. The following readers supplied all twelve solutions: Leon Piotrowski of Ashfield, NSW, A.G. Loveday of Toowoomba, Queensland, and R.E. Davids of St Ives, NSW.

Here are the solutions:

```
0 A B B B B N T T Y Y Y Y
1 I D D N N I D Y A A A N
2 B N R D I R A B N N R T
3 T Y N A A M R D B I M B
4 Y T N R R A M R D T D D
5 E R A M M Y B M E E E A
6 N M Y E E E E A I B I I
7 R A E T T B Y I T D T E
8 M E T I D T N E R R N R
9 D I I Y D I N M M B M
```

There were 450 entries with these correct solutions and we also received six entries with the following solutions which do not meet the divided-by-three criterion:

```
0 A A N T Y Y
1 I T A R A T
2 Y R B M B D
3 T M I N R D
4 B I Y I E M
5 E E E B M A
6 R D T D N N
7 M B D A I E
8 N Y R E R Y
9 D N M Y T B
```

These solutions were only sent in by one person each. The Unitrex calculator goes to the sender of the first correct entry drawn at random: Mr A. Hunt of Brighton Beach, Victoria.

MISCALCULATION...

'The Corvus 500 is a lot more calculator for \$79.95. Price... \$95.00. That's how the ad (ETI February and March, 1977) reads. The \$79.95 is correct but the \$95 was a mistake made by the production people, who have asked us to print this apology. The Corvus 500 is available from Electronic Concepts Pty Ltd, 52-58 Clarence St, Sydney.

SUGGESTION FOR SPEAKER MANUFACTURERS

Here is a suggestion from one of our readers:

I have constructed a pair of Magnavox MV50 loudspeakers for use with my 422 amplifier and am most pleased with the combination.

Recently one speaker developed a buzz and inspection revealed two tiny slivers of metal being held against the dome of one of the tweeters by the speaker's magnetic field. Presumably these particles came from the mounting screws used to hold either the baffle or the speakers themselves.

A suggestion in your magazine that non-ferric materials be used in these situations may prevent others from experiencing this problem.

John Rankine

ERRATA

Parts List ETI 482A Jan 77

'Q1,2 BC549' should read 'Q1-Q4 BC549'

Parts List — Circuit Diagram ETI 132 RV2 should be 10 k not 2k2.

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	1 to 9	10 to 25
IN4732 4.7V Zener	30c	25c
BA222 Silicon Diode	10c	7c
TT800, TT801 Transistor	65c	50c

- Semi-conductor data books covering all types.
- Plain and stripped Vero board, also cutting tools.
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- Wire strippers, cutters — wide range.
- Co-ax in 75 Ω , 54 Ω , mic. types.
- Hookup wire, winding wire, 3 core flex.
- Electrical House wiring, 1/044 & 1/064.
- Kynarwire for I.C. wirewrap use — assorted colours.
- P.C. boards.

OPEN SATURDAY MORNINGS

WE'VE TRIED THEM TOO

Like most companies specialising in sound reinforcement, we put electronic equipment through some rather unusual in-field testing. On the Rod Stewart tour of Australia and New Zealand the sound reinforcement system was set up and pulled down nine times. On one occasion an electronics rack containing four Jands J600S amplifiers was dropped fifteen feet from a cargo hold, on another a similar rack had six inches of water drain through it when a canvas raincover split. Equipment failure on the tour was nil. Our design philosophy on equipment is based on five years experience in the sound reinforcement field. Unlike most people we didn't stop when we perfected our electronic designs, we went on to make products that would stand up to continual use under any circumstances.



**JANDS
J600S
600 WATT
POWER AMP**

Also available: 100 and 300 watt power amps, 8, 12 and 16 channel mixing consoles, talkback systems, electronic racks.



**JANDS JX4
4 WAY X-OVER**

For product information write or call:

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Tel. (02) 516-3622

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Bentley W. Aust. 6102
Tel. (092) 618-981

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C106D1	400V 4A	\$1.50
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C122E	500V 8A	\$2.70
C106Y1	30V 4A	\$1.00

TRIACS

SC141D	400V 6A AC switch	\$1.70
SC146D	400V 10A AC switch	\$2.20
SC151D	400V 15A AC switch	\$2.20

DIACS

BR100	Trigger for SCR's	.95
ST4	Asymmetrical AC trigger	.95

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ORP12	L.D.R.	\$1.95
-------	--------	--------

Thermistor

R53		\$2.50
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7 Segment Readouts

DL704	3" Com. Cathode	\$2.75
DL750		\$2.95

ETI 131 POWER SUPPLY (See April '76 ETI)

Superb general purpose regulated power supply. 0-20V at 2.5 amps or 0-40V at 1.25 amps. See ETI April '76 for details.

FULL KIT: \$70.00 plus \$5 p&p. Includes rescaled meter, silk screened front panel, all metalwork and heatsinks. Specify which version is required when ordering.



BUILT AND TESTED UNITS
\$90.00 tax free + \$5 P&P
\$103.50 tax paid + \$5 P&P

ETI 132 POWER

An economical general purpose power supply 0-15V output at up to 1A. Regulated and short circuit protected. Kit includes rescaled meter, free scotchcal front panel, fibreglass PCB and plastic case.



Available with meter for \$40.50 + \$2 p&p or without meter for \$30.00 + \$2 p&p.

nebula

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Capacitors:

Ceramics: All preferred values from 1 pf to 0.033 uF. 10c each. 25 up 8c ea. 0.047 to 0.1 uF. 17c ea. 25 up 15c ea. 0.47 uFd 30c ea. 25 up 25c ea.

ELECTROLYTICS:

Value	Voltage	1 off	25 up
1 uFd	6.3 Axial	15c	13c
2.2 uFd	25 p.c.b.	10c	8c
3.3 uFd	25 p.c.b.	10c	8c
4.7 uFd	10 p.c.b.	10c	8c
4.7 uFd	25 p.c.b.	10c	8c
22 uFd	10 p.c.b.	10c	8c
22 uFd	50 p.c.b.	17c	15c
25 uFd	16 p.c.b.	17c	15c
33 uFd	6.3 p.c.b.	11c	9c
33 uFd	16 p.c.b.	12c	10c
47 uFd	10 p.c.b.	14c	12c
47 uFd	25 p.c.b.	16c	14c
47 uFd	50 p.c.b.	17c	15c
100 uFd	10 p.c.b.	16c	13c
100 uFd	25 p.c.b.	18c	15c
220 uFd	6.3 Axial	20c	17c
220 uFd	16 p.c.b.	20c	17c
220 uFd	35 p.c.b.	26c	22c
470 uFd	6.3 Axial	25c	22c
470 uFd	25 p.c.b.	25c	22c
			10 up
1000 uFd	10 Axial	38c	35c
1000 uFd	16 p.c.b.	40c	36c
1000 uFd	25 p.c.b.	52c	47c
1000 uFd	35 p.c.b.	52c	47c
1000 uFd	50 p.c.b.	89c	80c
2200 uFd	50 upright	\$1.80	\$1.60
3300 uFd	50 upright	\$2.05	\$1.75
3300 uFd	75 upright	\$2.70	\$2.40

SEMI-CONDUCTORS:

T. T. L.	1 off	10 up
Digital		
7400	40c	35c
7402	40c	35c
7404	40c	35c
7408	40c	35c
7410	40c	35c
7420	40c	35c
7430	40c	35c
7447	\$1.50	\$1.40
7451	40c	35c
7454	40c	35c
7474	90c	85c
7490	80c	75c
7492	80c	75c
74107	\$1.00	90c
ULM 3000S (Hall effect switch)	\$6.00	\$5.50

C/MOS

	1 off	10 up
4000	40	35
4001	40	35
4002	40	35
4006	2-50	2-25
4007	40	35
4008	2-75	2-50
4009	80	70
4011	45	40
4012	40	35
4013	1-00	90
4014	2-25	2-05
4016	85	75
4017	2-25	2-05
4018	2-50	2-25
4021	2-30	2-10
4022A	1-90	1-70
4023A	45	40
4024	1-35	1-20
4027A	1-00	90
4028A	1-90	1-70
4030A	80	70

LINEAR

	1 off	10 up
LM301	70	60
LM304	1-30	1-20
LM305	1-20	1-10
LM307	70	60
LM308	2-30	2-10
LM309K	2-80	2-60
LM319	2-80	2-60
LM324	3-20	3-00
LM339	3-20	3-00
LM377	2-80	2-50
LM380	1-50	1-35
LM382	2-45	2-30
LM3900	1-50	1-25
LM555	85	75
LM566	4-50	4-30
LM709	45	40
LM723	1-00	90
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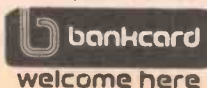
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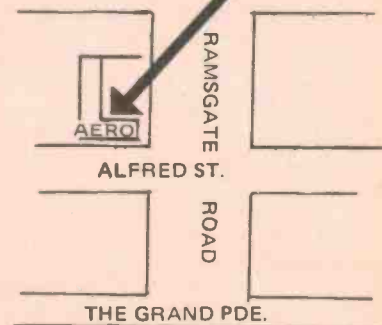
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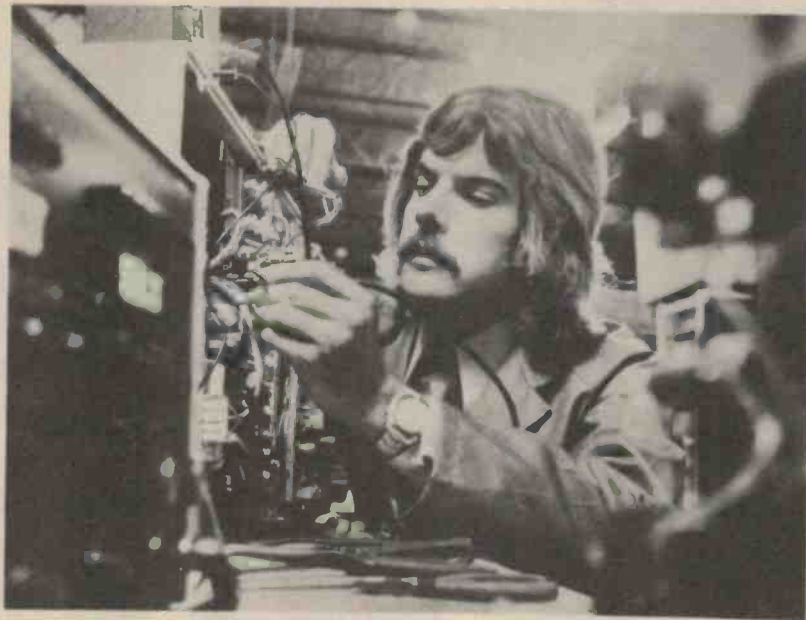


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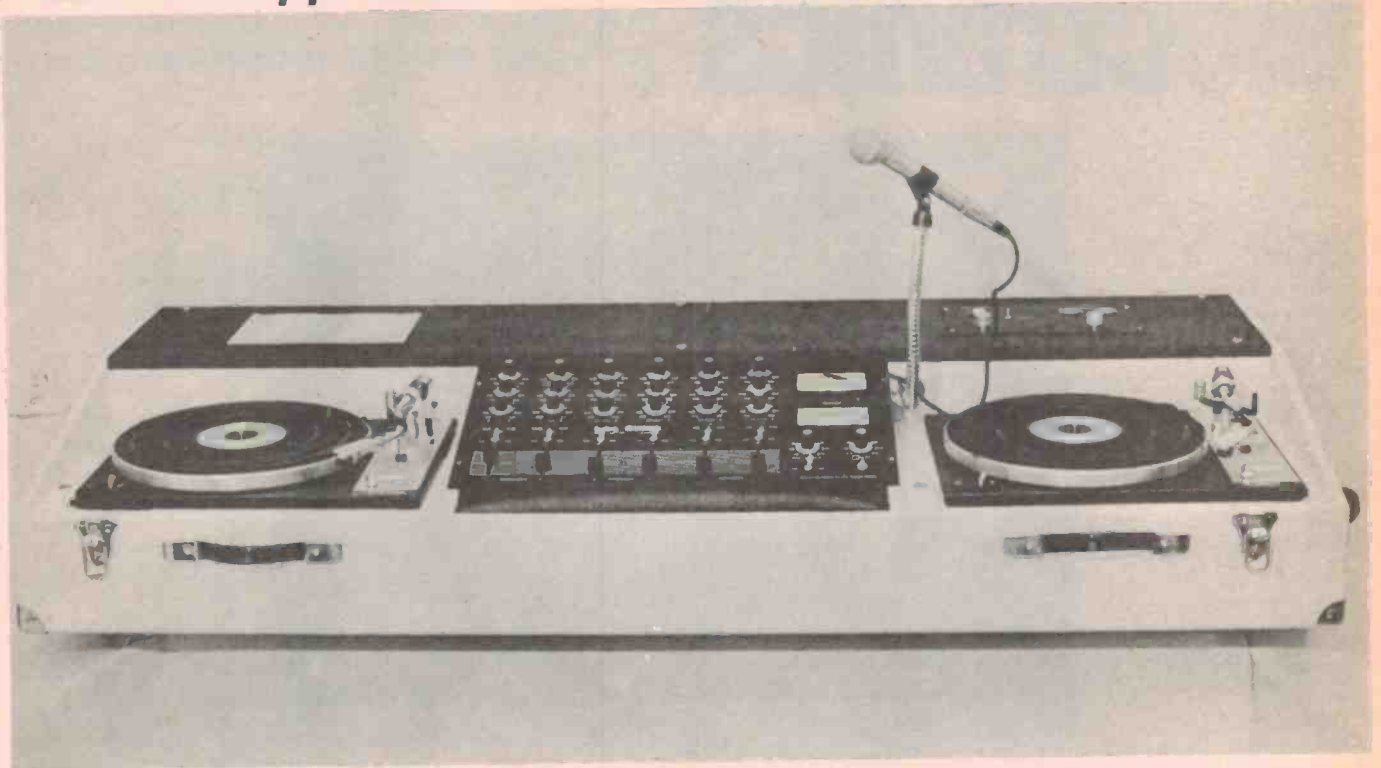
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THE ROCK SHOW

Sound System



CONCERT SOUND SYSTEMS come in many sizes, shapes and forms and I don't think I've ever heard two systems that sound identical in the same hall. The sound engineers have different design philosophies although they share a common objective.

Expressions such as 4 way cross-overs, front loaded horns, radials, dispersion angles, etc, are banded about when the crews get together on tour but what really makes a good "state of the art" sound system? A system that, given the hundreds of variables such as hall acoustics, mood of audience, time available for set-up and tuning, road damage (that must be taken into account at every concert), will consistently deliver the best possible sound to the audience.

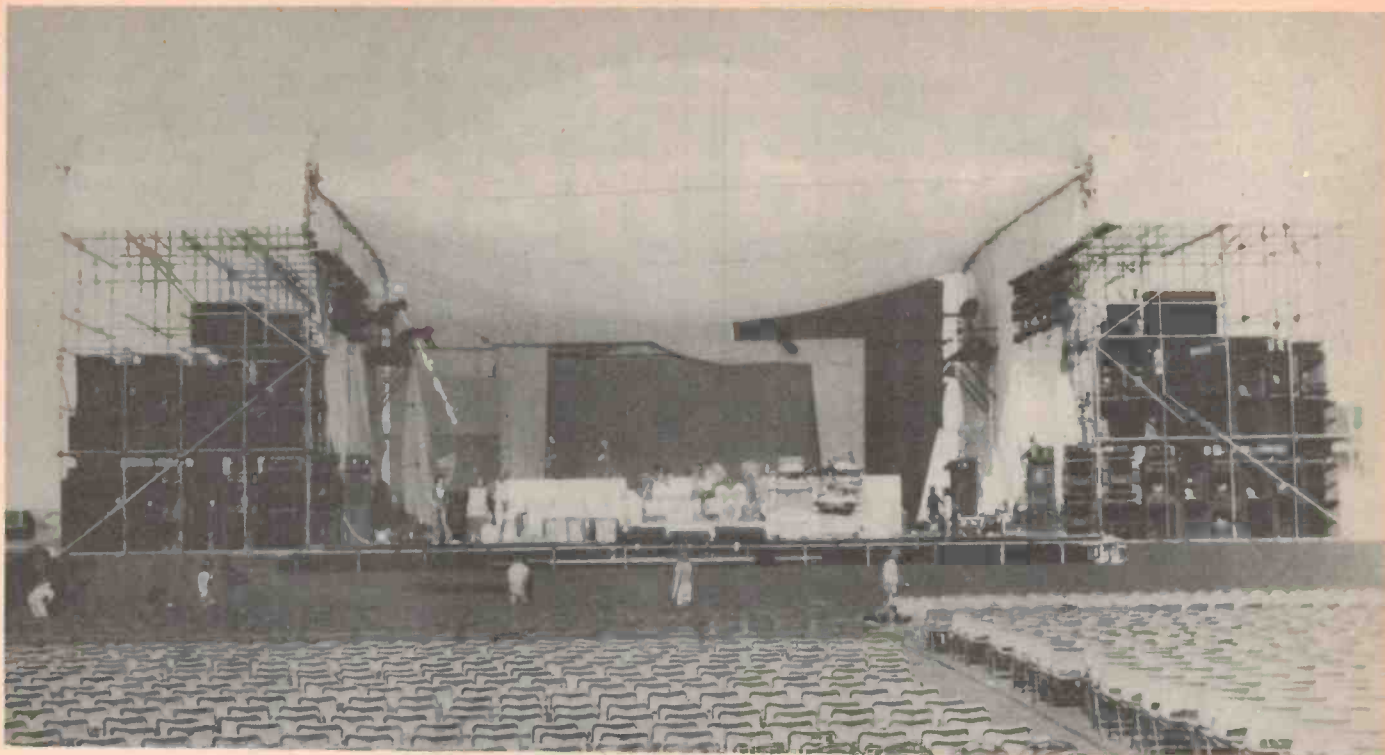
For some of the answers let's look at a system I designed for the Australian tours of Rod Stewart and Abba. The 'Jands No. 1 Touring System' weighs 28 tonnes and delivers a power output of 24,000 watts rms.

The last couple of years have brought bigger and better equipment to the concert stage ... here Howard Page of Jands Pty describes the equipment used in presenting artists like Rod Stewart and Abba to Australian crowds exceeding 30,000.

Let's follow the sound from its source looking first at microphones. The majority of these are made by Shure — type SM 58 for vocals and SM 57 for instruments. On the drums I use some other favorites such as Sennheiser

MD 421 or AKG D12. The actual set-up depends on taste and the way the kit is tuned. The mics plug into 20-way multi-core cables leading to the mixer in the hall. The multi-core input box also has splitting outputs to feed any mic to the stage monitor mixer located on one side of the stage. The house mixing console is custom designed by myself and Jands consultant 'electronic genius' Phillip Storey. This is a 24 track in, 16 track out, studio style board made super-rugged for the 'road'. It has many facilities not normally needed on a PA mixer, such as the ability to do a stereo house mix, a separate stereo recording mix, a mono TV mix and an all-up 16 track output all at one time.

Why such extravagance? It is because in Australia (due to the limited audio facilities in TV OB vans) we often get asked if we can do all the above — for a live TV show with an album to be released later, so the extra features can be readily justified.



The stereo 'house mix' outputs of the board feed to a set of one-third-octave stereo graphic equalisers. These are set up using pink noise and real time analysis to accurately 'tune' the system for both the hall and, in some cases, the type of sound required. The stereo signals then feed a set of stereo

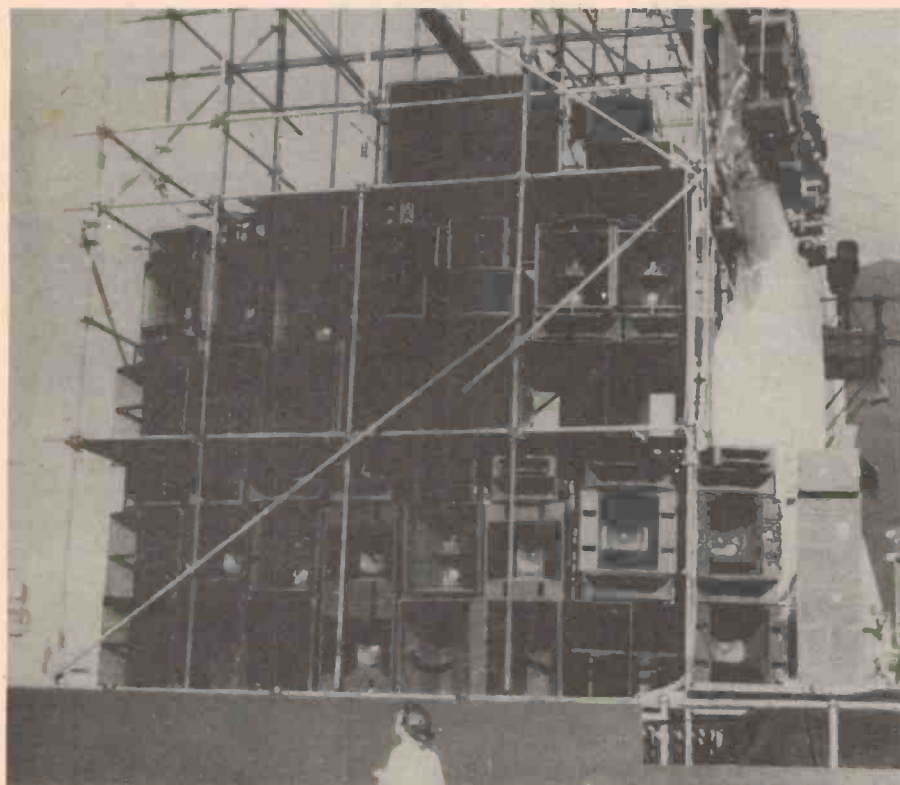
DBX 160s (Compressor/Limiter) which are set as a final safeguard on the system to ensure the amplifiers are not driven into consistent square waves, one of the primary causes of speaker system failure.

Having been tuned and compressed as necessary the signals feed into a

custom-built switchable 3, 4 or 5 way stereo electronic cross-over unit, the design of which is classified information. Also feeding in and out of the mixer are what we call FX devices, ie, echo unit, flanging units, extra compressors for various instruments, digital delay devices, etc, these are used as required.

Once the sound has been divided it is sent down a separate multi-core cable called a system feeder which plugs into the amplifiers on stage behind the speaker stacks. The amplifiers we use are the finest available 'state of the art' units: Phaser Linear 700B, Crown DC 300A, SAE 17K111CM, and a new unit we're especially proud of, our own Jands J600S which is proving equal, if not superior to, anything available from overseas.

Each amplifier rack unit contains switching and matching systems to enable complete flexibility and access should a failure occur. Heavy duty speaker cables connect the amplifier outputs to the final link in the chain, the speaker units themselves. These, in the No 1 System, are for the 'Lo Boxes'



This is the tower of speakers used at one of the smaller gigs on the tour!

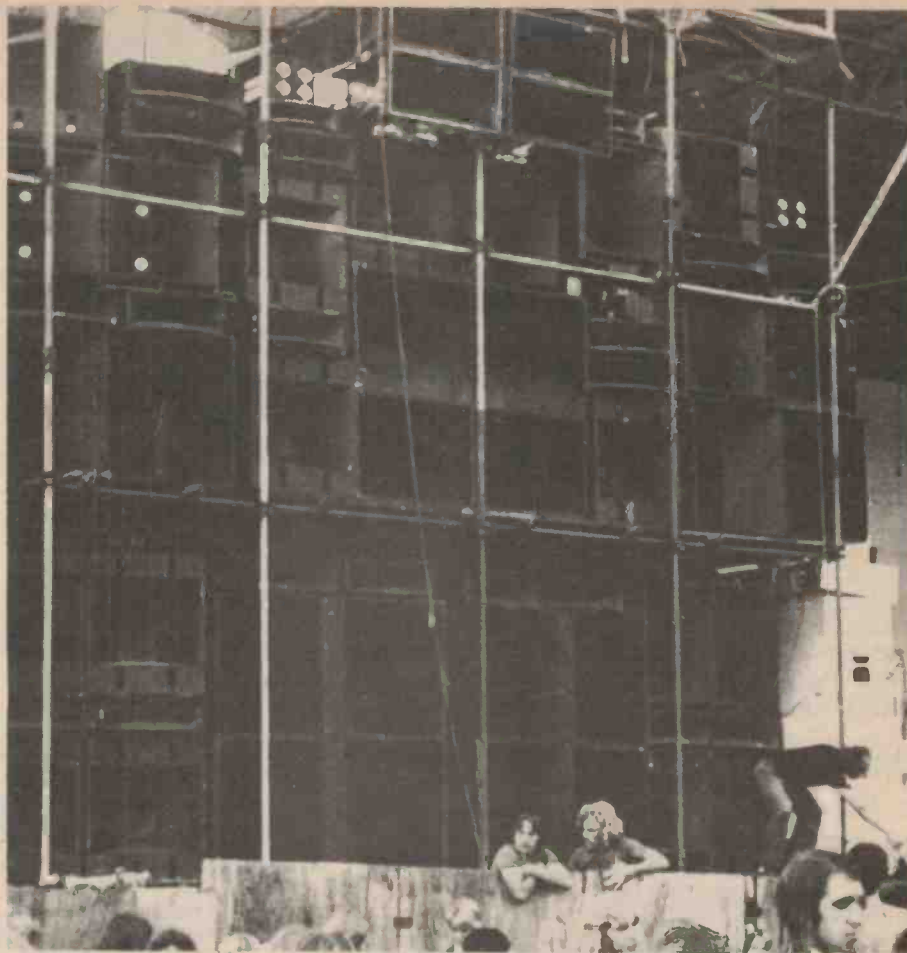
custom-designed Super 'W's containing 4 x 15" JBL (all components in the system are JBL) speakers; for the 'Hi Bass' or 'Mid Bass' another custom-designed front loaded 2 x 12" speaker box tuned reflex porting (for use as the bass unit in a 3-way system); for the 'Mids' JBL 90° and 60° Radial horn units with high powered compression drivers; and for the 'Highs' 2402, JBL 075 radiator units.

Well that's it, total cost approx. \$250,000, but it represents where concert sound reinforcement is at now. Certainly a far cry from a column speaker on each side of stage but its worth it when I hear members of the audience muttering as they file out "They sound just like their record".

LIGHTING AND POWER

One of the biggest problems now facing Jands when operating a PA and lighting rig, such as that used on the Rod Stewart tour is to ensure adequate mains supply (240 V). Simple arithmetic gives power consumption: the PA has six amplifier racks per side, and each rack has 3 stereo amplifiers each drawing four amperes. Total consumption is $2 \times 6 \times 3 \times 4 = 144$ A. Stage equipment, including special effects, can easily draw 100 amperes. The lighting system comprises 100 lamps, each drawing 4 amperes. This adds another 400 amperes to the total requirement!

To help eliminate dimmer noise in the PA system using the three phase supplies, the lights are placed across two phases with sound and stage equipment across the third phase.



This set-up shows the speakers used at the Sydney showground for the Rod Stewart concert.

THE JANDS LIGHTING SYSTEM

Control Desk:

There are forty eight channels each with two preset levels ('A' and 'B'), and a 'full' button. There are sixteen scene masters programable via a matrix patch board such that any of the 48 sliders can be put on any scene. A two-to-six way (selectable) chaser (a'sequencer') is available; any light can be placed on the chaser. The chaser has speed control, forward/reverse selection, intensity control and a chase/follow mode.

Dimmer Racks:

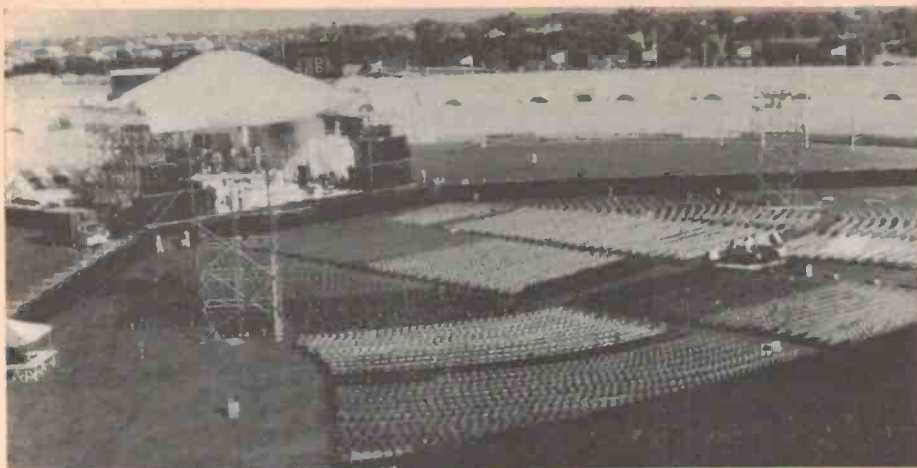
Rod Stewart used two racks, Each rack houses thirty-five 2 kW Strand Miniset cards packaged in plug-in modules. Jands have manufactured Miniset dimmers for Strand Electric since their introduction 6 years ago.

Lights:

The majority of the lights are manufactured by Jands Engineering according to an American design (they're called Altman Cans). They use 110 V 'Par 64' 1,000 watt lamps in pairs wired in series across the 240 supply. Connection to lamps is done with looms of 23/0076 3-core general-purpose flex.



George Mills brought this projection colour TV from London for the Sydney Rod Stewart concerts. Throughout the concert the audience has a close-up view of the action projected onto a massive screen.



The power supply Jands now insist on is 300 amperes per phase with a solid neutral. The electrical code permits a much lighter neutral than active in most installations, the assumption being the load can be expected to be balanced across the three phases and hence little neutral current flows back to the sub

board. With the lights full up and no PA (as occurs at the end of each song) there is a great strain to pull the neutral towards the lighting phases and with a soggy neutral it is possible to get over 300 volts appearing on the PA phase (the neutral drifting 50 volts above earth).

Power is run from the sub-board to the dimmer racks and audio equipment via 416/0178 glass-insulated rubber sheathed mining trailing cable (cable rating 320 amperes and the copper core being 14 mm diameter). Each cable is fitted with a 350 ampere connector imported from Switzerland.

Each lighting phase runs direct into a dimmer rack housing thirtyfive 2 kW dimmer modules. The sound phase runs into a 19" electronics rack containing two 150 A breakers, one to feed PA the other the stage gear. Each breaker is connected to an earth leakage detector set to trip when more than 20 mA flows to earth. The current required to cause a fatal electric shock is 50 mA. Hence if any person comes in contact with a live wire on stage they cannot receive a fatal shock.

To avoid dimmer noise in the PA system it is often necessary to get a separate earth for the audio so Jands always carry a 6 foot solid copper earth stake and 10 kg of salt (for making a brine solution for better earth contact).

JANDS CONCERT SOUND SYSTEM AS USED BY ABBA/ROD STEWART TOURS OF AUSTRALIA

MONITORS

Mixer: Twenty input and six output buses. Each mic can be mixed onto one or all of the six buses, with or without tone control. This gives up to six separate monitor mixes so that each musician can have the extra foldback mix he requires. Each feed then passes through a graphic equalizer and into a Jands J600S to feed a foldback system.

Foldback Speaker System:

Each Side	1 x JBL 4550 with two JBL 2220. 2 x JBL 4560 with one JBL 2220. 2 x JBL 90° horns. 1 x JBL 2390 horn lens.
Back Monitor	4 x JBL 4560 bass bins. 2 x JBL 90° horns.
Front	4 x wedge monitor housing one JBL 15" bass and one JBL horn and driver.

MAIN SYSTEM

2 x 20-way multicore cables feed the signal from forty microphones to the front of house mixer. A Jands 24 channel in and 16 channel out mixer.

The custom-designed 24 track, 16 track out mixer has the following facilities on each module:

1. Selectable Input Attenuation
2. Channel Mute
3. Mic Phase Reverse
4. Mic/Line Switch
5. High Pass Filter (250 cycles 18 dB/octave)
6. Equalizer Bypass
7. Lo; Mid; High; 18 dB Boost/Cut at four selectable frequencies
8. Pan Pot
9. Eight Full Stereo Group Select Buttons
10. Solo Pre/Fade Listen Button

There are eight stereo sub groups with two other sets of eight for making separate mixes of the sub group for

recordings, TV etc.

At the mixer are two 19" electronics racks.

The effects rack and the main system rack housing:

- One third octave (27 band) stereo graphic DBX 160
- 2 x limiters DBX 160
- 2 x Jands 4-way crossover

The signal passes through each item then goes via a separate multicore to the stage to drive the amplifiers.

At each side of the stage are built the sound towers. These being 24' x 12' with three levels. Better dispersion is achieved by stacking high rather than wide. Each stack has the following:

8 x Amplifier Racks each containing 3 amplifiers these being Crown DC300A, Phase Linear 700B and Jands J600S.

The Speaker System:

12 x 4130 (Jands designed W Bins with four JBL 15" speakers in each).

- 4 x W cabinets containing two JBL 15" speakers.
- 24 x JBL 4560 Bass cabinets with one JBL 15" speaker.
- 16 x Double 12" cabinets (Jands design) containing two JBL 12" speakers.

20 x JBL 90° horns.

16 x JBL 60° horns.

8 x JBL long throw horns.

48 x JBL 075 high frequency.

The total JBL count on the Rod Stewart/Abba main system Sydney Concert was:

80 x 15" speakers.

32 x 12" speakers.

44 x Horns and drivers.

48 x High frequency.

Total value at your local hi-fi shop approx. \$250,000.

The entire system is equalized before each concert using a pink noise generator and a Real Time Analyzer.

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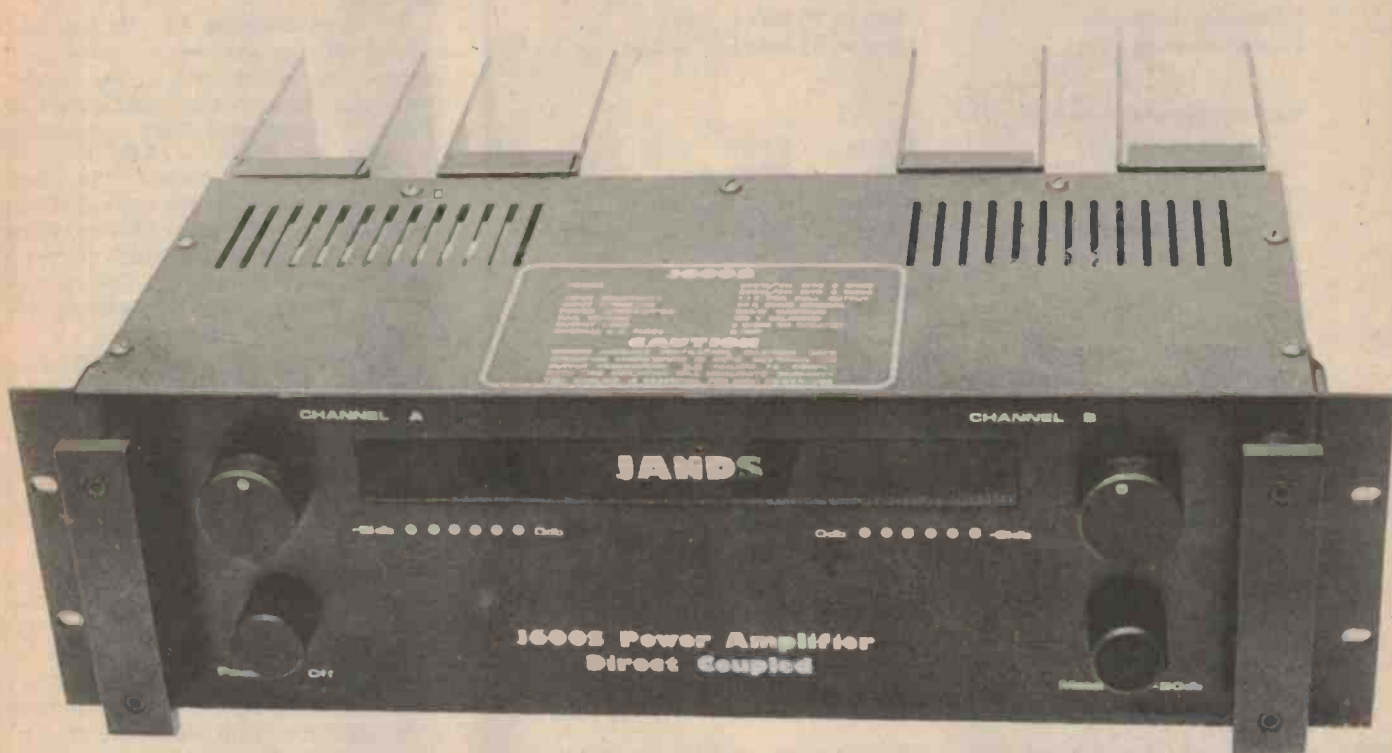
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JANDS J600S Power Amplifier



We got our acoustical consultants, Louis A. Challis and Associates, to review one of the power amplifiers used in the rock show PA system described in the preceding article. This Australian-made amplifier can deliver 800 W into eight ohms.

ONLY THOSE PEOPLE WHO HAVE attended these shows would realise the fantastic acoustical levels that are used for the public performances of artists like Rod Stewart and Abba who have been near to the stage have witnessed the monumental amounts of equipment used for the public address, lighting and fold-back sound systems.

On the recent Rod Stewart tour the combined power level of the main amplifier system was 12,000 watts (electro-acoustic power) with a fold-back system power capability of 4,000 watts. It is intriguing that anybody could contemplate using a fold-back system of 4,000 watts power capability. It is even more intriguing that this is being monitored by real-time one-third octave band analysers so that the fold back mixing engineer can continually monitor the signal and spectral balance

being fed to the musicians onstage.

With sound pressure levels in front of the musicians and in front of the stage as high as 120 decibels, and sound pressure levels at the rear of the audience area in excess of 90 decibels things seem to have gone a bit too far. If one leaves the hearing conservation and community annoyance factors aside for the moment, we are considering acoustical powers and intensities which are bordering on dangerous. Today's systems would make the public address system designer of even a few years ago quake at the thought.

High Power Amplifier

Whilst high power amplifier have been around for quite a while, until recently these were, with few exceptions, the domain of the American designer.

Recently the Japanese have released high powered amplifiers, most of which are very good, and to our surprise in the last few months one Australian manufacturer has offered a product in what is already a very competitive and technically advanced market.

We have previously reviewed the Phase Linear and the Crown amplifiers, amongst others, and found these products to be exceptionally good within the thermal limitations that all such amplifiers experience.

We were intrigued to be offered a Jands J600S Amplifier whose price must undoubtedly make it very competitive when compared to even the best of the overseas amplifiers. Having previously reviewed the Jands PS4 Amplifier two years ago, and having seen these installed in a number of discotheques and other high power installations, we were pleased to see this Australian manufacturer offering a power amplifier which offers a better *dollar per watt* performance in the high power amplifier big league. And we found that approximately one third of the amplifiers being used for both the Rod Stewart and Abba tours were Jands

MEASURED PERFORMANCE OF JANDS J600S STEREO POWER AMPLIFIER

Maximum Power Output: (Both Channels Driven)	220W 8Ω each channel 361W 4Ω each channel
Frequency Response: (1 watt output)	5Hz to 75 kHz (-3dB) 14Hz to 32 kHz (-0.5dB)
Total Harmonic Distortion:	
1 Watt:	100Hz 0.06% 1kHz 0.06% 6.3kHz 0.20%
200 Watts:	100Hz 0.068% 1kHz 0.068% 6.3kHz 0.083%
Hum & Noise: (I/P S/C)	0.6mV (Lin) -96dB (Lin) 0.088mV (A wtd) -113dB (A) 0.095mV (A wtd) -112dB (A)
Input Sensitivity:	1.1 Volts for 200 Watts into 8Ω
Slewing Rate:	Output 10V/μSec

cooling is essential for continuous high power use. It must be acknowledged that this is true for all other comparable sized amplifiers on the market.

In picking up the amplifier we found that the edges of the amplifier handles were so sharp that they ripped one guy's trousers - this already put us on the wrong footing before reviewing the amplifier.

The next thing we noticed was that instead of the VU meters which are subject to abuse, and quite often premature failure, the J600S utilises two LED arrays with 3 dB increments to cover the range - 20 dB to 0 dB by use of switch control, the range -41 dB to -20 dB, for each channel. Apart from the two nasty handles, there are two channel level controls flanking the LED arrays, a power on/off switch and a -20 dB switch for altering the sensitivity of the LED display.

The front panel is a black 10 gauge aluminium panel with white screen printing, behind which the main steel chassis is fixed. We noted a slight bow in the front panel but this would partially correct itself when rack-mounted, due to the weight of the chassis pulling this tight against the panel system.

The transformer is massive and occupies more than a third of the chassis space available for the electronics. The remaining space is occupied by the power output stages located directly behind the double heat sinks, and the main electronic chassis. This consists of a printed circuit for the driving and pre-amplifier stages overlying the power supply filter circuitry (which consists of the main power rectifiers and two large electrolytic capacitors).

J600S, so we thought the time was right to find out why.

The J600S

The Jands J600S Power Amplifier came well packed in a solid cardboard carton with simple polystyrene corner supports. When we picked up the carton, we found out why the carton needed to be so solid, with a weight of 15kg because of its shape and weight distribution it almost requires two people to pick it up. On opening the carton we found a power amplifier designed for mounting in a 19" rack with dimensions of 478 mm x 132 mm x 335 mm deep. This corresponds to a standard 5¼" module spacing in a rack and is designed for the normal screw mountings.

The unit is basically a very large transformer mounted in a steel chassis with large black aluminium heat sinks on the back. We are told that the 19" racks used for the Rod Stewart tour buckled in transit to Adelaide but the amplifiers showed no signs of distress.

The first thing that caught our eye, apart from the black facade, was a label on the top of the Amplifier which said: "Caution. Ensure adequate ventilation.

Maximum safe operating temperature is 80° measured on the output transistor". The unit obviously requires copious quantities of cooling air to be able to attain its maximum power rating and label carefully points out that fan

J600S

POWER	200W/CH INTO 8 OHMS
	300W/CH INTO 4 OHMS
INPUT SENSITIVITY	1.1V FOR FULL OUTPUT
INPUT IMPEDANCE	50K OHMS NOMINAL
POWER CONSUMPTION	950 W MAXIMUM
RAIL VOLTAGE	150 V BALANCED
OUTPUT LOAD	4 OHMS OR GREATER
INTERNAL D.C. FUSES	6 AMP

CAUTION

ENSURE ADEQUATE VENTILATION. MAXIMUM SAFE OPERATING TEMPERATURE IS 80°C MEASURED ON OUTPUT TRANSISTORS. N.B. FAILURE TO COMPLY WITH THIS CONDITION WILL INVALIDATE WARRANTY. FAN COOLING IS ESSENTIAL FOR HIGH POWER USE

The top of the amplifier carries this specification plate.



The output transistors are mounted under four covers located at the bases of each pair of cooling fins.

The main circuit board is a full dip soldered board. This has been done to inhibit the nasty problems of premature corrosion in plain copper laminate circuit boards. All the driver stage transistors are fitted with individual heat sinks to enhance their thermal dissipation. All the components utilised are normal commercial grade with the exception of the power output stage transistors which are specially selected to provide the rated power capacity. The printed circuit boards utilised for power output stages are fully masked to inhibit corrosion and provide a long commercial life.

The Technicalities

One of the first questions which we asked on seeing this unit was, is it protected from thermal or current overload? The reasons for this were that some of the other amplifiers which we have reviewed have only fuses to protect the output transistors from abuse. The best amplifiers utilise very effective but complex electronic circuits to protect the output stage from short circuits and destructive current.

In the case of the PS4 Amplifier, Jands had sensibly provided a protection circuit which allowed one to pull sparks from the output stage (this often happens in the field when using high power amplifiers). Fortunately, the circuit designers have seen fit to include similar features in the J600S and we were able to happily draw sparks without blowing up the amplifier when applying short circuits. Obviously, with extended short circuits the fuses do

blow, but this takes a few seconds.

The rear of the amplifier features two universal terminals for each output stage, a mains fuse, two RCA co-axial inputs and an array of four transistors mounted under clip-on covers on each of the four large heat sinks. The transistors utilised are RCA 2N3773s which have been individually matched by Jands in order to minimise distortion at high power levels. Before turning the unit on, we read the handbook which provides very little information, some of which is rather confusing. Whilst we must presume that this is a draft issue, we were surprised to see hand corrections, leaving us in doubt as to what are the manufacturer's final ratings for his amplifier. Whilst the handbook constitutes a good start, it does contain one worthwhile feature in that the back page comes with a complete factory test of all those major parameters which the intending purchaser would desire to have confirmed.

We submitted the amplifier to exhaustive tests which showed that, with few exceptions, the manufacturer's stated performance figures were equalled or exceeded, with the exceedance being primarily in the area of power capability into both 8 ohm and 4 ohm loads with both channels driven. We were gratified to find that the amplifier can deliver a healthy 800 watts at 1 kHz into an 8 ohm load. This, of course, is attractive for those people who need a high powered amplifier capable of providing an effectively flat frequency response from 20 Hz to 20 kHz.

The basic performance of the amplifier is very good, with the total harmonic distortion at 200 W being less than 0.1% under all operating conditions tested, and only tending to rise in the region above 10 kHz because of the type of output transistors utilised. This is one of the problems on the Australian market where at present there are very few high-powered high-frequency transistors available at a reasonable price. The hum and noise level was -96 dB linear and -112 dB (A) with respect to maximum power output with the gain controls at maximum setting.

The manufacturer quotes a slewing rate of 10 V per microsecond, which is particularly good, not that this is important unless the amplifier is to be used for high power-high frequency work (which is not the purpose for which it was intended). Even so this amplifier is capable of driving a shaker table, sonar transducers, servo systems and for a wide range of other military or industrial purposes.

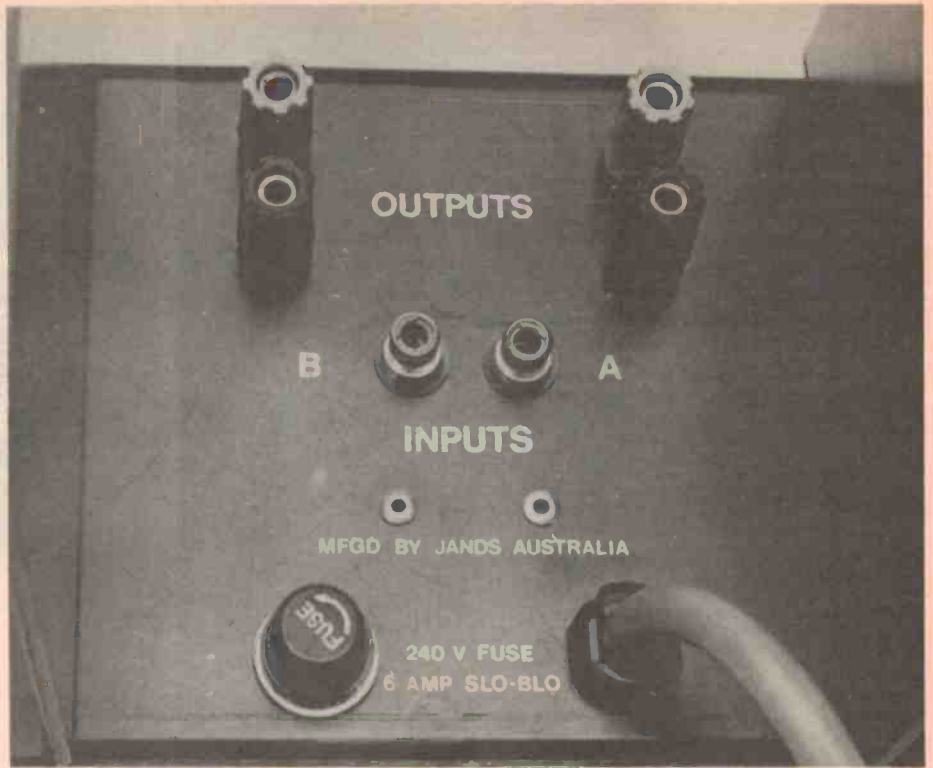
The Final Test

We subjected the amplifier to imbalance signals with the input bridged, with one side of the output load earthed and found that we were able to induce an additional protective resistor (which is incorporated to prevent earth loop problems in multiple amplifier set-ups) to start cooking. At first we thought we had destroyed the amplifier, but on lifting up the covers we found that both the amplifier and the wire wound resistor were in no way impaired. We

completed our testing without being able to blow up the amplifier although we must admit we tried!

Summary

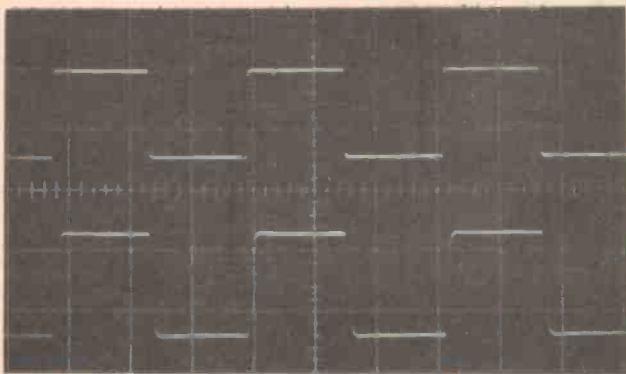
The J600S Power Amplifier is currently the best commercial high-power amplifier available on the Australian market in terms of dollars per watt and, provided the wage-price spiral does not continue, it should be readily able to compete effectively in some of the near eastern markets with the quality amplifiers currently available from America and Japan. Whilst its front finish is not as good as the imported units, its logical design features, greater ease of repair, and access to the electronics, must make it attractive for both the commercial user and the Hi-Fi fadist (or is that sadist?) who wants to run his own Rod Stewart or Abba shows at home.



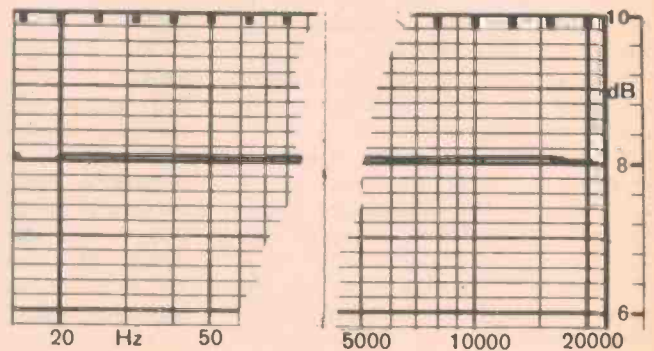
Square Wave Response @ 100Hz into 8Ω @ 200W



Square Wave Response @ 1000Hz into 8Ω @ 200W



Square Wave Response @ 6.3kHz into 8Ω @ 200W



The frequency response graph was a dead straight line — here we show the two ends but the bit missing from the middle looks like it was drawn with a ruler.

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- *Degree to radian and radian to degree conversion
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- *Power functions: $e^x, 10^x, a^x$
- *Factorial functions: $x!$ (for $x < 70$)
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- Algebraic mode operation
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- *Chain & repeat operation
- *Constant operation
- *Leading zero suppression
- *X & Y register exchange
- *X & Y memory register exchange
- *Square root & reciprocal
- *Trigonometric functions: $\sin, \cos, \tan, \sin^{-1}, \cos^{-1}, \tan^{-1}$
- *Logarithmic functions: log, ln
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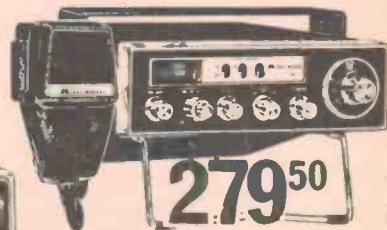
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TIMER APPLICATIONS

DESCRIBED BY R. M. MARSTON PART I

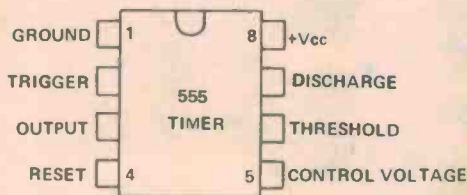


Fig. 1. Outline and pin notations of the standard 8-pin DIL version of the 555 timer I.C.

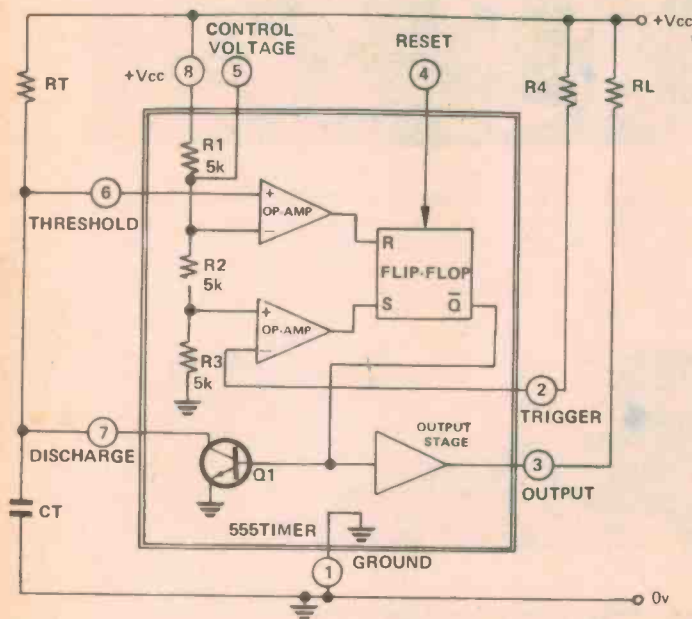


Fig. 2. Functional block diagram (within the square) of the 555 timer i.c., together with the connections for using the i.c. as a basic monostable generator or timer.

THE 555 TIMER is a highly versatile low-cost IC specifically designed for precision timing applications. It can also be used in monostable multi-vibrator, astable multivibrator, and Schmitt trigger applications. The device was originally introduced by Signetics, but is now available from many other manufacturers.

The 555 has many attractive features. It can operate from 4.5v to 16v. Its output can source (supply) or sink (absorb) any load current up to a maximum of 200 mA, and so can directly drive loads such as relays, LED's, low-power lamps, and high impedance speakers. When used in the 'timing' mode, the IC can readily produce accurate timing periods variable from a few microseconds to several hundred seconds via a single R-C network. Timing periods are virtually independent of supply rail voltage, have a temperature coefficient of only .005% per°C, can be started via a TRIGGER command signal, and can be aborted by a RESET command signal.

When used in the monostable mode, the IC produces output pulses with typical rise and fall times of a mere 100 nS. It can be made to produce pulse-width modulated (PWM) pulses in this mode by feeding fixed frequency clock pulses to the TRIGGER terminal and, by feeding the modulation signal to the CONTROL VOLTAGE terminal.

When used in the astable mode both the frequency and the duty cycle of the waveform can be accurately controlled with two external resistors and one capacitor. The output signals can be subjected to frequency sweep control, frequency modulation (FM), or pulse-position modulation (PPM) by applying suitable modulation signals to the CONTROL VOLTAGE terminal of the IC.

HOW IT WORKS

The 555 is available under a variety of specific type numbers but is generally referred to simply as a '555 timer.' The device is available in a number of packaging styles, including 8 and 14-pin dual-in-line (DIL) and 8-pin TO-99 types. Throughout this article all circuits are designed around the standard 8-pin DIL versions of the device.

Figure 1 shows the outline and pin notations of the standard 8-pin DIL version of the 555, and Fig 2 shows the functional block diagram of the same device (within the double lines), together with the connections for using it as a basic monostable generator. The following explanation of device operat-

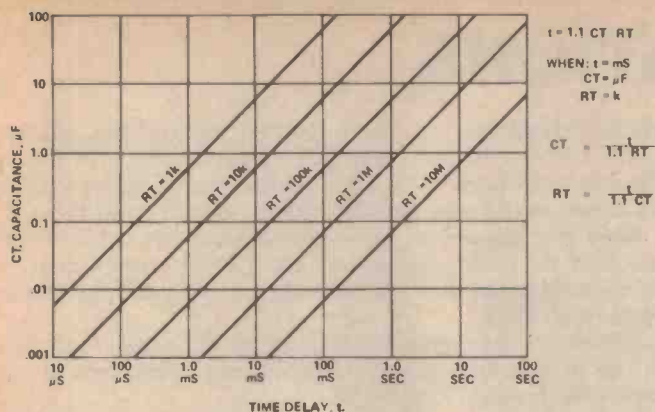


Fig. 3. 555 time delays for different values of resistance and capacitance.

ion assumes that the 555 is used in the monostable configuration shown in Figure 2.

The 555 houses two diodes, 15 resistors, and 23 transistors. These components are arranged one voltage-reference potential divider, two voltage comparator op-amps, one R-S flip-flop, a low-power complementary output stage, and a slave transistor. The voltage-reference potential divider comprises three 5 kΩ resistors in series, and is connected across the supply lines. Consequently, 2/3 Vcc appears at the junction of the upper two resistors of the potential divider, and is fed to one input terminal of the upper voltage-comparator op-amp and 1/3 Vcc appears at the junction of the two lower resistors of the potential divider, and is fed to one input terminal of the lower voltage-comparator op-amp. The outputs of the two comparators control the R-S flip-flop, which in turn controls the states of the complementary output stage and the slave transistor. The state of the flip-flop can also be influenced by signals applied to the pin 4 RESET terminal.

When the monostable or timing circuit of Fig 2 is in its quiescent state, the pin 2 TRIGGER terminal of the chip is held high via R1. Q1 is driven to saturation and forms a short circuit across external timing capacitor CT, and the pin 3 output terminal of the IC is driven to the low state. The monostable action can be initiated by applying a negative-going trigger pulse to pin 2. As this pulse falls below the 1/3 Vcc, reference value of the built-in potential divider the output of the lower voltage comparator op-amp changes state and causes the R-S flip-flop to switch over. As the flip-flop switches over it cuts off Q1 and drives the pin 3 output of the chip to the high state.

As Q1 cuts off it removes the short from timing capacitor CT, so CT starts to charge exponentially towards the supply

rail voltage until eventually the voltage across CT reaches 2/3 Vcc. At this point the upper voltage comparator op-amp changes state and switches the R-S flip-flop back to its original condition, so Q1 turns on, rapidly discharging CT, and simultaneously the pin 3 output of the IC reverts to its low state. The monostable operating sequence is then complete. Note that, once triggered, the circuit cannot respond to additional triggering until the timing sequence is complete, but that the sequence can be aborted at any time by feeding a negative-going pulse to pin 4.

The delay time of the circuit, in which the pin 3 output is high, is given as

$$t = 1.1 R C$$

where $t = \text{mS}$, $RT = \text{k}\Omega$, and $CT = \mu\text{F}$. Figure 3 shows how delays from 10μS to 100 seconds can be obtained by selecting suitable values of CT and RT in the range .001μF to 100 μF and 1 kΩ to 10 MΩ or greater than 20 MΩ, and capacitor CT must always be a low-leakage component. Note that the timing period of the circuit is virtually independent of the supply voltage but that the period can be varied by applying a variable resistance or voltage between the ground and pin 5 CONTROL VOLTAGE terminals of the chip. This facility enables the periods to be externally modulated or compensated.

The pin 3 output terminal of the IC is normally low, but switches high during the active monostable sequence. The output can either source or sink currents up to a maximum of 200 mA, so external loads can be connected between pin 3 and either the positive supply rail or the ground rail, depending on the type of load operation that is required. The output switching rise and fall times are typically about 100 nanoseconds. Having cleared up these points, let's now go on and look at some practical applications of the 555 timer I.C.

50 SECOND TIMER

This 50 second timer or pulse generator gives a direct voltage output at pin 3 which is normally low, but goes high for the duration of the timing period. Optional components R4 and LED (shown dotted) give a visual indication of the timer action. The circuit works in the same basic way as already described, except that the timing action is initiated by momentarily shorting pin 2 to ground via START switch S1. Note from the circuit waveforms that a fixed-period output pulse is available at pin 3 and an exponential sawtooth with an identical period is available at pin 7: The sawtooth waveform has a high output impedance.

The basic timer circuit of Fig 4 can be varied in a number of ways. The timing period can be made variable between approximately 1 . 1 seconds and 110 seconds by replacing

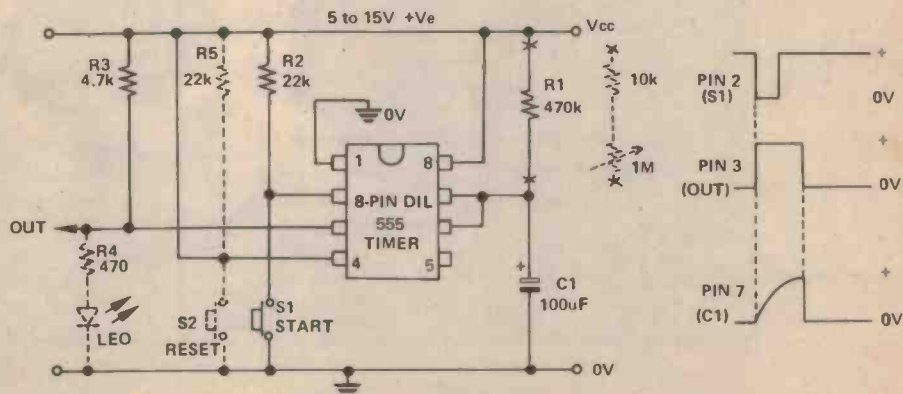


Fig. 4. Circuit and waveforms of simple manually-triggered 50 second timer or pulse generator.

555 TIMER APPLICATIONS

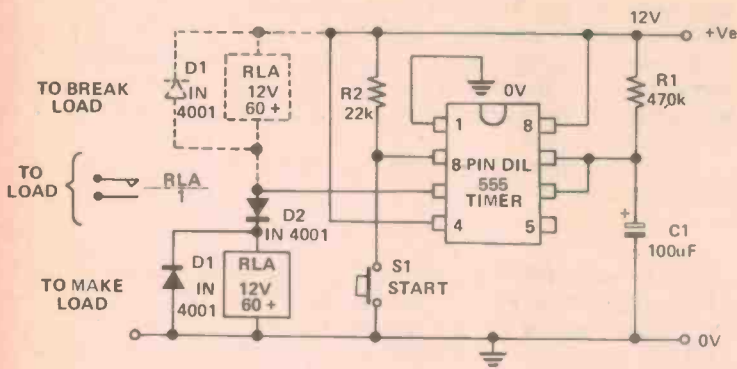


Fig. 5. Relay-output timer makes or breaks connection to load for pre-set period of 50 seconds when S_1 is momentarily operated.

coil to counteract the slight residual voltage that appears at pin 3 of the IC under the OFF condition and thus ensure that the relay turns fully off. The dotted section shows how this circuit can be used to switch off a normally-on load.

Note in Fig 5 and all other relay-output circuits described here, that the relays used can be any 12 volt types that draw ON currents of less than 200 mA, e.g., that have coil resistances greater than 60 Ω .

The basic relay-driving timer circuit of Fig 5 can be adapted for use in a variety of useful applications. Some typical examples are shown in Figs 6 to 9.

Figure 6 shows the practical circuit of a relay-output general-purpose timer that covers 0.9 seconds to 100 seconds in two decade ranges. The circuit has a RESET facility provided via S_2 , so that timing periods can be aborted part way through a cycle if necessary. A noteworthy feature of this circuit is that the maximum timing periods of each decade range of the timer can be precisely pre-set via R_5 or R_6 , which effectively shunt the built-in potential divider of the 555 and thus influence the timing periods: This facility enables the circuit to give precise timing periods even when wide-tolerance timing capacitors are used.

To set up the Fig 6 circuit, first set R_1 to maximum value, set RANGE switch S_3 to position 1, activate START switch S_1 , and adjust R_5 to give a timing period of precisely 10 seconds. Next, set S_3 to position 2, activate START switch S_1 , and adjust R_6 to give a timing period of precisely 100 seconds. All adjustments are then complete, and the timer is ready for use.

DELAYED HEADLIGHT TURN-OFF

Figure 7 shows the practical circuit of an automatic delayed-turn-off headlight control system for auto-mobiles. This facility enables the owner to use the car lights to illuminate his path for a pre-set time after parking as he leaves the garage or walks along a driveway, etc. The circuit does not interfere with normal headlight operation under actual driving conditions. It works as follows.

When the ignition switch is turned to the ON position current is fed to the coil of the relay via D_3 and the 12 volt supply rail, so the relay turns on and contacts $RLA/1$ close. As the contacts close they connect the 12 volt supply rail, so the relay turns on and the headlight switch. Thus, under this 'ignition on' condition the headlights operate in the normal way. Note that, since one side of C_2 is connected

R_1 with a 10 k Ω fixed resistor and a 1 M Ω variable resistor in series.

The period can be further varied, if required, by switch-selecting decade values of timing capacitance. The dotted section shows how the circuit can be provided with a RESET facility, so that a timing period can be aborted at any time, by taking pin 4 to the positive supply rail via resistor R_5 and wiring RESET switch S_2 between pin 4 and ground.

The timing circuit of Fig 4 can be used to drive non-inductive loads at currents up to 200 mA directly. They can be used to drive inductive relay loads by using the basic connections shown in Fig 5.

The (Fig 5) circuit is designed to apply a connection to a normally-off external load for a pre-set period of 50 seconds when START switch S_1 is momentarily closed. The relay is normally off, but turns on for the 50 second period when the timing cycle is initiated. D_2 is wired in series with the relay

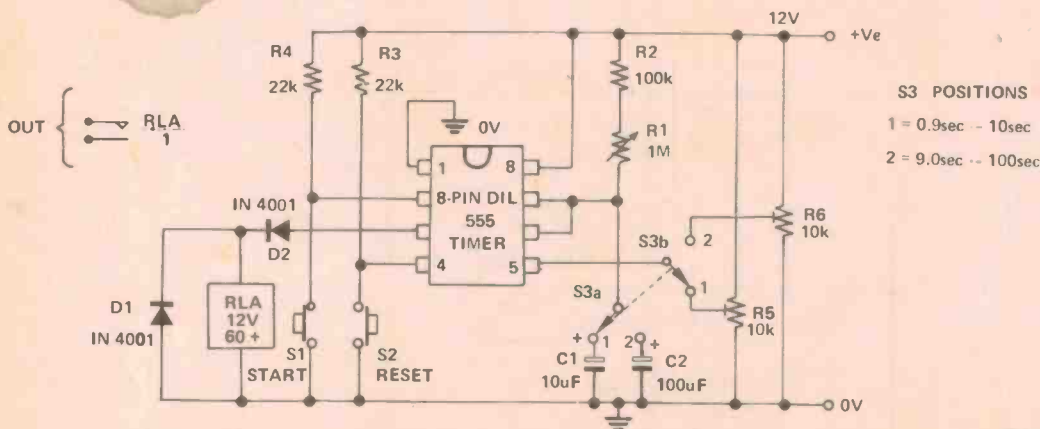


Fig. 6. Relay-output general-purpose timer covers 0.9 sec to 100 sec in two decade

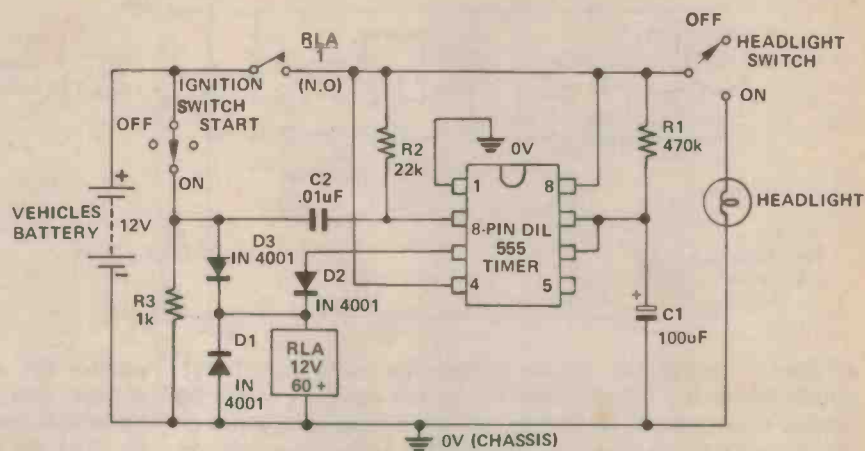


Fig. 7. Automatic delayed-turn-out headlight control system for automobiles.

directly to the positive supply rail and the other side is taken to the positive rail via R2, the capacitor is fully discharged under this condition.

The moment that the ignition switch is turned to the OFF position the D3-derived current supply to the relay coil is broken, and simultaneously a negative-going trigger pulse is fed to pin 2 of the 555 as the C2-R3 junction drops to ground volts and C2 charges up. Relays are inherently slow-acting devices, so contacts RLA/1 do not open instantaneously as the ignition switch is turned off. Conversely, the 555 is a very fast triggering device, and the instant that the trigger pulse is generated, via the turn-off action of the ignition switch a timing cycle is initiated and current is fed to the relay coil via output pin 3 of the IC as it goes high. Thus the relay remains on for a pre-set period after the ignition connected to the headlight switch for the duration of this period. With the component values shown this period is roughly 50 seconds.

At the end of the 50 second timing period, pin 3 of the 555 switches to the low state and the relay turns off. As it does so, contacts RLA/1 open and remove the supply from the timer and the headlight switch, and the headlights turn off. The operating sequence is then complete.

Readers may care to note that the above system of operation is consistent with the practice adopted in many modern

vehicles of feeding the headlight switch via the ignition switch, so that the headlights operate only when the ignition is turned on. On older types of vehicle, where headlight operation is independent of the ignition switch, a manually-triggered delayed-turn-off headlight or spotlight control facility can be obtained by using the circuit shown in Fig 8. The action of this circuit is such that, if the vehicle is parked with its lights off, they turn on for a pre-set 50 second momentarily closed, and at the end of this period turn off again automatically.

The (Fig 8) circuit uses a relay with two sets of normally-open relay contacts. The timing sequence is initiated by momentarily closing push-button switch S1. Normally, both S1 and the relay contacts are open, so zero power is fed to the timer circuit and the lights are off. C2 discharged under this condition.

When S1 is momentarily closed power is fed directly to the relay coil, and the relay turns on. As the relay turns on, contacts RLA/2 close and apply power to the vehicle lights and contacts RLA/1 close and apply power to the timer circuit, but pin 2 of the IC is briefly tied to ground via C2 and R3 at this moment, so a negative trigger pulse is immediately fed to pin 2 and a timing cycle is initiated. Consequently, pin 3 of the 555 switches high at the moment that the relay contacts close, and thus locks the relay into the ON

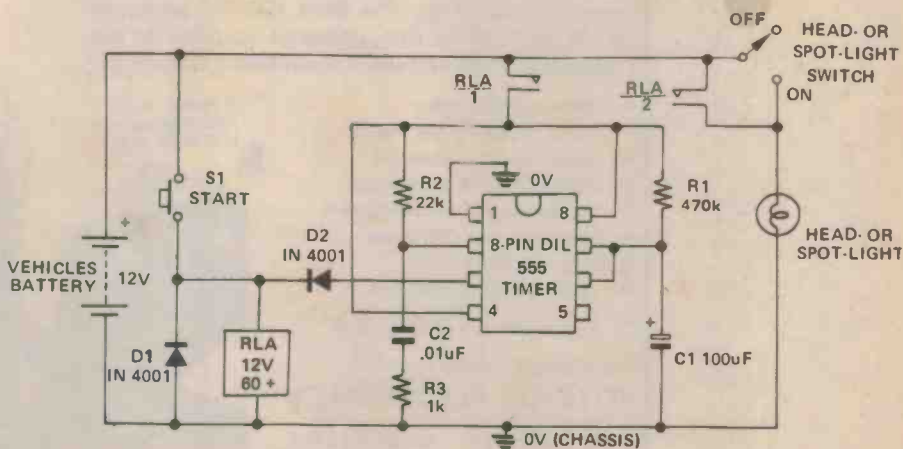


Fig. 8. Manually-triggered delayed-turn-off head- or spot-light control system for automobiles.

555 TIMER APPLICATIONS

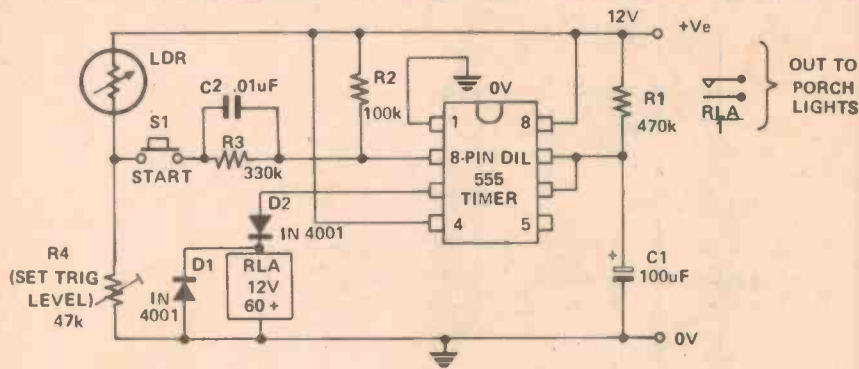


Fig. 9. Automatic porch light turns on for a pre-set period only when triggered at night.

condition irrespective of the subsequent state of START switch S1 so the lights remain on for the duration of the 50 second timing cycle. At the end of the timing cycle pin 3 of the IC switches to the low state, so the relay turns off and contacts RLA/1 and RLA/2 open, disconnecting power from the timing circuit and the lights. The operating sequence is then complete.

PORCH LIGHT

Finally, to conclude this 'Timer Circuits' section, of the 555 story, Fig 9 shows the circuit of a relay-output automatic porch light control unit that turns the porch lights on for a pre-set 50 second period only when suitably triggered at night time or under 'dark' conditions: The circuit is triggered via switch S1, which may take the form of a microswitch activated by a porch gate or a pressure-pad switch activated by body weight and concealed under a porch mat or rug.

The operation of the Fig 9 circuit relies on the fact that for correct timer operation the negative-going trigger pulse that is fed to pin 2 of the IC must fall below the internally-controlled '1/3 Vcc' voltage value of the 555. If the trigger pulse does not fall below this value, timing cycles can not be initiated by the trigger signal.

In this design, light-dependent resistor LDR and preset

resistor R4 are wired in series as a light-dependent potential divider. One side of switch S1 is taken to the output of this potential divider, and the other side of the switch is taken to pin 2 of the IC via the C2-R3 combination. Under bright or daylight conditions the LDR acts as a low resistance, so a high voltage appears at the output of the potential divider. Consequently, the act of closing S1 causes a voltage pulse much higher than '1/3 Vcc' to be fed to pin 2 of the chip, so the timer is not triggered via S1 under the 'daylight' condition.

Conversely, the LDR acts as a high resistance under dark or 'night' conditions, so a low voltage appears at the output of the potential divider. Consequently, the act of closing S1 causes a voltage pulse much lower than '1/3 Vcc' to be fed to pin 2 of the IC, so the time circuit is triggered via S1 under the 'night' condition.

In practice, the LDR can be any cadmium-sulphide photocell that presents a resistance in the range 1 kΩ to 100 kΩ under the required minimum 'dark' turn-on condition, and R4 can be adjusted to preset the minimum 'dark' level at which the circuit will trigger. Note that the trigger signal is fed to pin 2 of the IC via the C2-R3 combination, which act as a trigger signal conditioning network, that effectively isolates the d.c. component of the LDR-R4 potential divider from the trigger pin of the IC.

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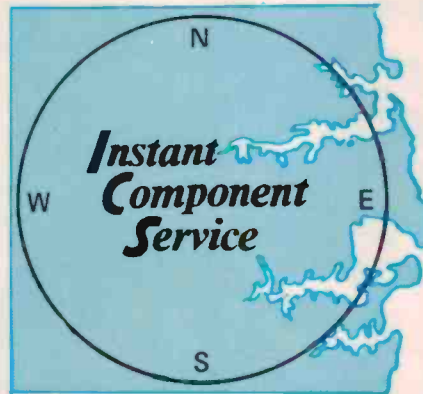


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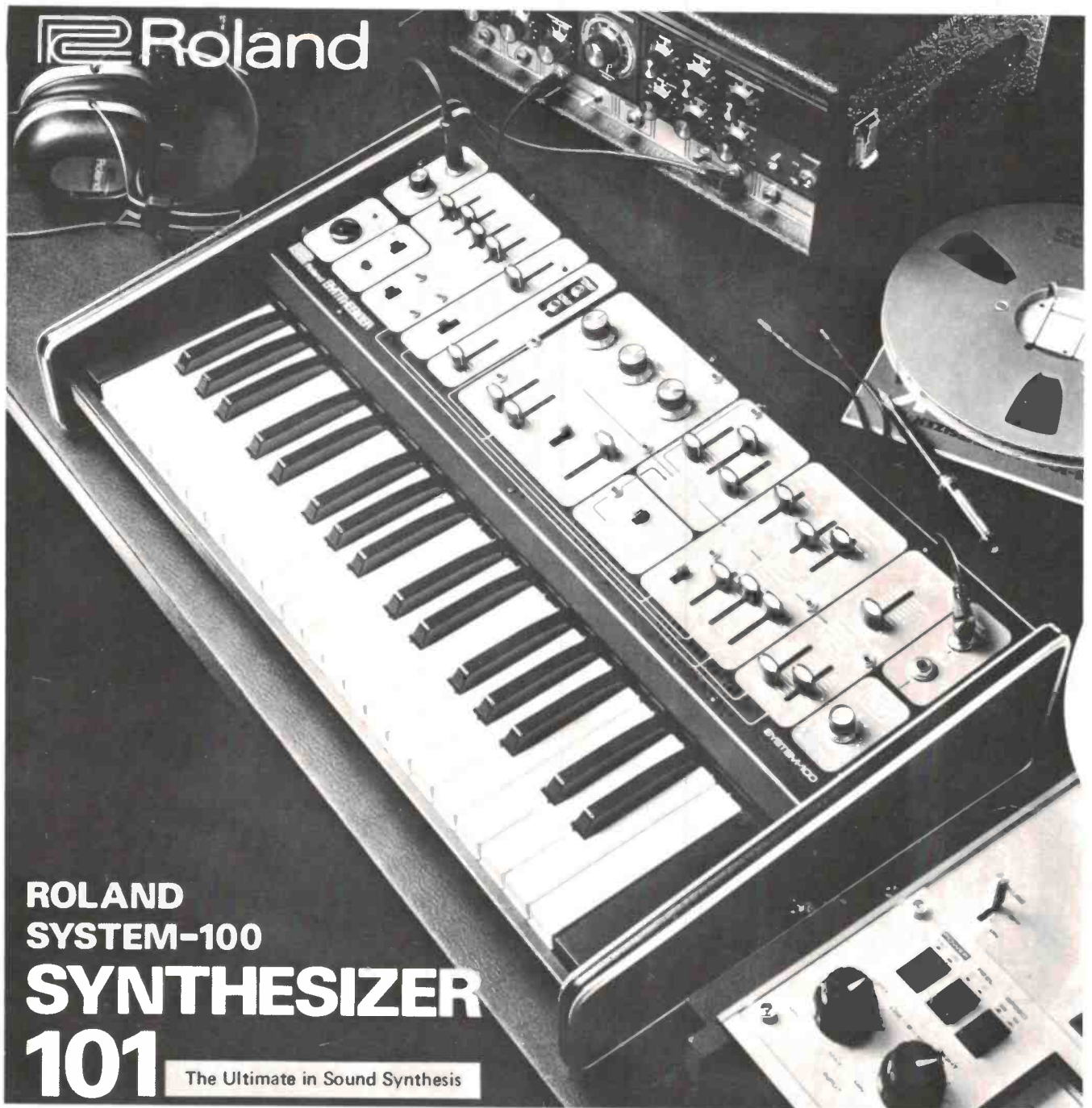
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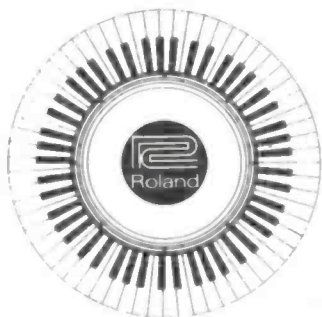
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Simple PCB drill

By A. J. LOWE

Drilling holes in a printed circuit board is not the easiest job. This project describes a simple hand drill press made of cheap available materials.

THIS PROJECT IS for the real do-it-yourself enthusiast — the one who makes his own printed circuit boards and is faced with the tedium of drilling them accurately.

There is a home-made drilling machine which, though not as fast as an electric drill press, certainly costs a great deal less, and takes a lot of the 'ill' out of drilling. This article can indicate only the general idea as final details must be settled to suit the material finally used.

As can be seen in the assembly photograph the machine is simply a support made from the base of a food mixer, with an ordinary hand drill attached. The drill does not move up and down, as in a proper drill press, but the drill table does. The table is forced upward against the drill by a spring below it. A hole in the centre of the table receives the drill bit once it has penetrated the printed circuit board.

So, to operate — you simply press down the table against the spring, slide the work into position below the drill

and let the work rise by releasing pressure on the table. When the drill centres on the centre mark you start turning the crank of the hand drill.

The upward thrust provided by the spring is enough to ensure good drilling without drill breakage. A couple of fingers remain on the work to stop it turning and ready to press down and reposition for the next hole.

Construction

The frame of the prototype is, as stated, the base of a food mixer. All you need is something with a horizontal table and a rigid upright.

It's best to start construction with the table — because the height of it determines the necessary height of the drill and the angle of the outrigger arm attached to the base.

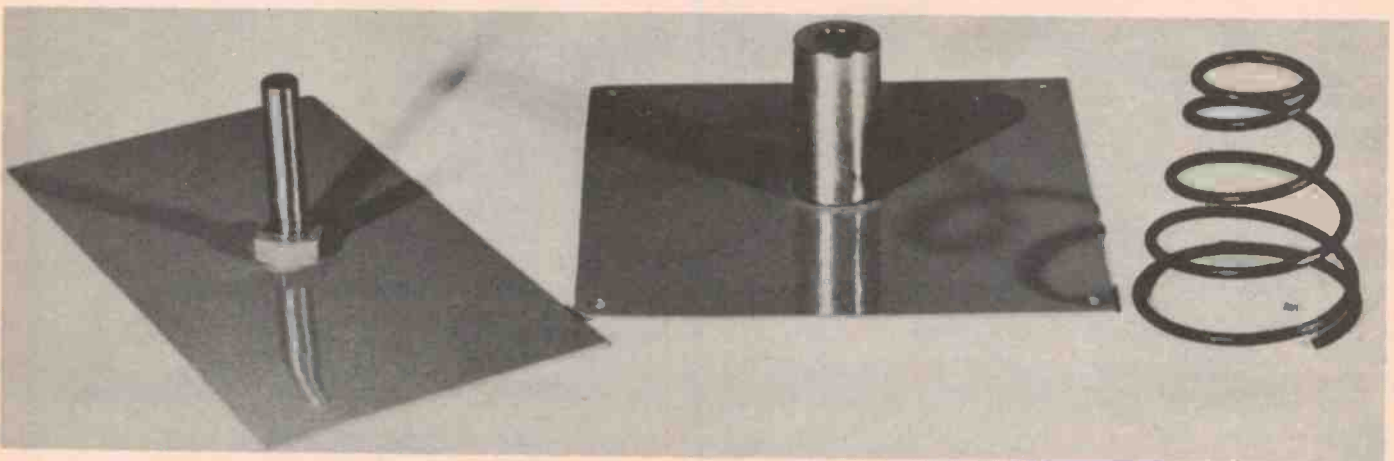
The table comprises three parts — shown in the detail photograph: the top table — on the left; the base plate and guide; and the spring.

The spring should be about 45 mm long — uncompressed. It need not be

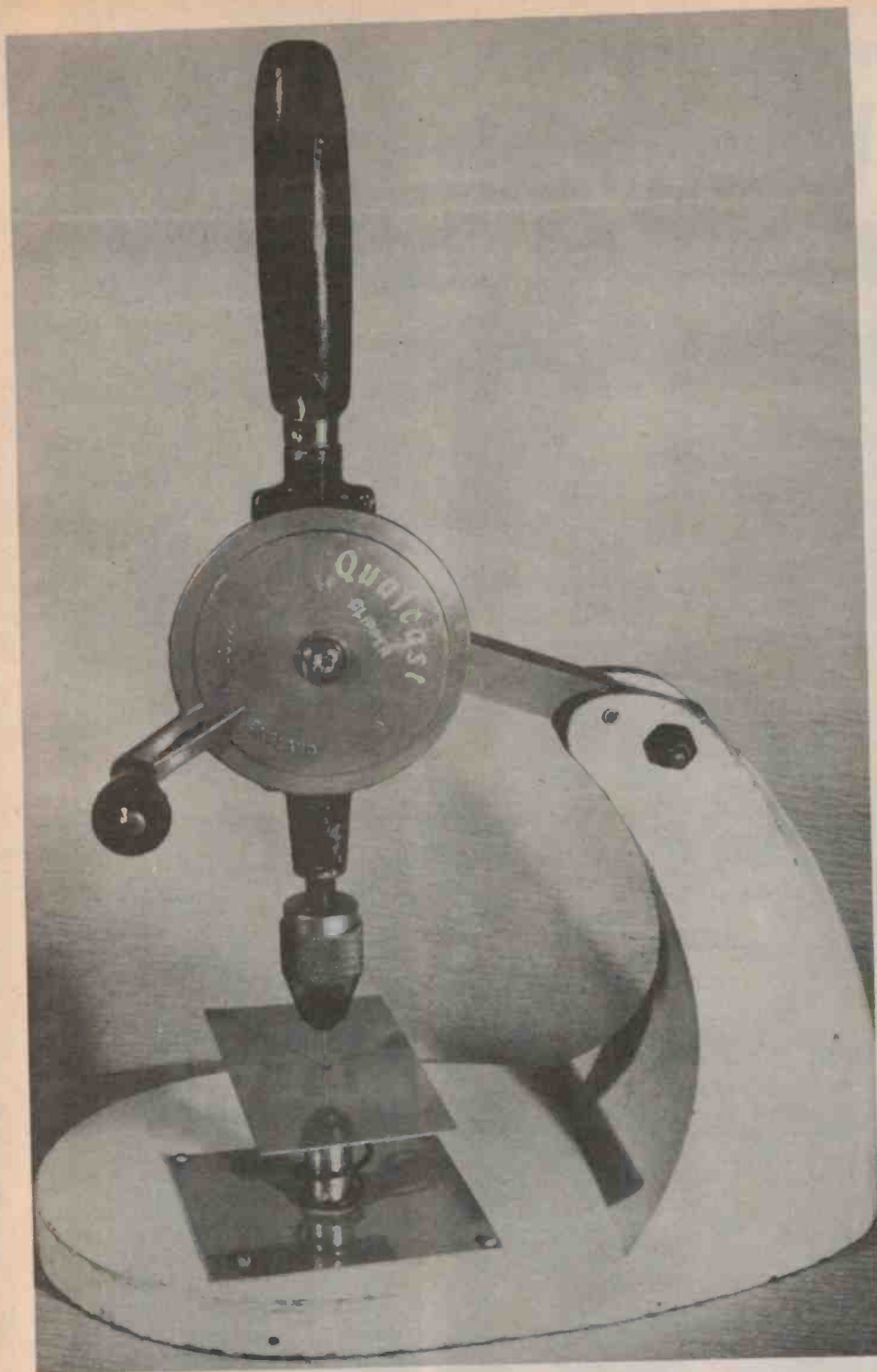
conical — the spring selected for the prototype just happened to be so. The spring should be reasonably stiff so that when it is compressed about 7 mm there's enough push in it to cause a drill to drill holes. That's a bit vague but a little bit of squeezing a few springs will give the idea. Start at the garage or auto electrician and ask for any old springs about this by this and you'll get a range of springs — free most likely. Valve springs are too stiff. The spring used in the prototype came from a car door — fitted behind the window winder handle. It's just right.

Having got your spring you need to make the top table — from sheet steel, about 1 mm x 110 x 60 mm or any size to suit, and drill a central hole in it about 3 mm diameter.

You now need a ¼" bolt with about 28 mm of unthreaded portion on it. A good quality bolt with a machined finish is desirable. The head of the bolt should be flattened, preferably in a lathe (but a file will do) and then drilled, on axis, to a depth of 8 mm or



The three main elements of the table of the drill are the top table, the base-plate and guide, and the spring.



so and 3 mm diameter to receive the drill bit. This bolt is soldered square on to the top table and directly over the hole.

The guide for the bolt is a piece of brass or steel round bar with a suitable outside diameter for the spring chosen (the prototype is 15 mm O.D.). A hole to receive the bolt on the top table is bored right through the guide. This should be done on a lathe or a drill press.

The two parts should fit together freely but not loosely. The length of the guide should be selected so that it provides adequate guidance for the top table and yet allows enough movement of the top table to get suitable spring compression. The prototype is 30 mm long. As the sliding bolt acts like a piston in the guide a small vent hole should be drilled radially through one side of the guide close to the bottom.

The ends of the guide should be

filed or turned square to its axis so that it stands upright.

The guide is then fixed by soldering or using an epoxy resin to the centre of a steel base plate. The plate in the prototype measures 1 mm x 90 mm square.

Now put the table together and see that it operates satisfactorily.

It should be stood on the base of the mixer and then the hand drill, loaded with a fine bit, held over it so that the bit enters the hole of the table when the spring is not compressed. The position of the hand drill — as far as height is concerned, should be measured carefully as it must be fixed at this height.

Having settled the height of the hand drill then the outrigger arm may be fixed to the base at such an angle that it can carry the drill at the right height.

The outrigger arm in the prototype is a 150 mm length of 16 mm square steel bar which fitted neatly into the top recess in the upright. This outrigger arm is bolted, using the original holes in the upright, and also fixed by means of a smaller bolt or spring pin so that it cannot move. Rigidity is essential.

The hand drill is then attached, at the height already determined, to the outrigger arm by means of a bolt passing through the arm and into the drill in place of the usual side handle. In some inexpensive drills the side handle is merely pressed on to a fixed steel rod. In this case the steel rod should be threaded and fixed to the outrigger arm with a nut.

Having mounted the drill adjust it until it is truly vertical and then tighten up the fixing bolt or nut.

Next place the table directly below the drill so that a drill bit centres in the hole in the top table. The position of the base plate is then carefully marked. Next, by means of four small bolts the base plate is fixed to the base of the mixer in the marked position. A coat of paint is the finishing touch.

Adjustment

A certain amount of adjustment is possible in this simple machine. The height of the bit in the drill chuck can be varied and the uncompressed height of the table can be increased by means of packing washers below or above the spring.

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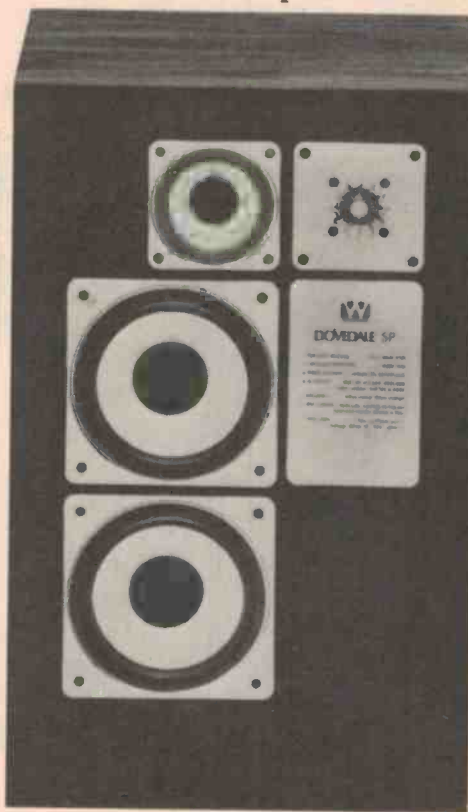
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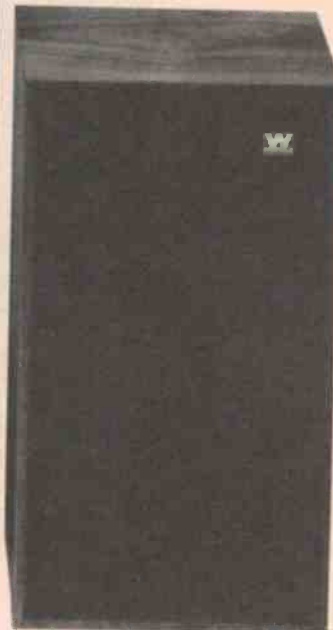


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That means the AU20000 is more compact to handle and is available at a price to please every true audiophile.

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

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PHASE METER

By Dr. P.C. Bury, Physics Dept., Victorian College of Pharmacy

This instrument measures phase angles of voltage, current or power from sub-audio frequencies to 100 kHz or beyond. Readout may be either digital or analogue.

THE POWER being dissipated in an ac circuit is one of the more difficult quantities to measure with normal laboratory equipment — unless the circuit is purely resistive. This is because the power dissipated is given by the expression $P = IV \cos\phi$ where I is current, V is voltage and ϕ is the phase angle between them. Theta (ϕ) varies from 90° for an ideal inductance, through 0° for a resistance, to -90° for a capacitance. Since $\cos \pm 90 = 0$, both inductance and capacitance dissipate no power at all. They store it during one half-cycle and release it to the source again during the following half-cycle.

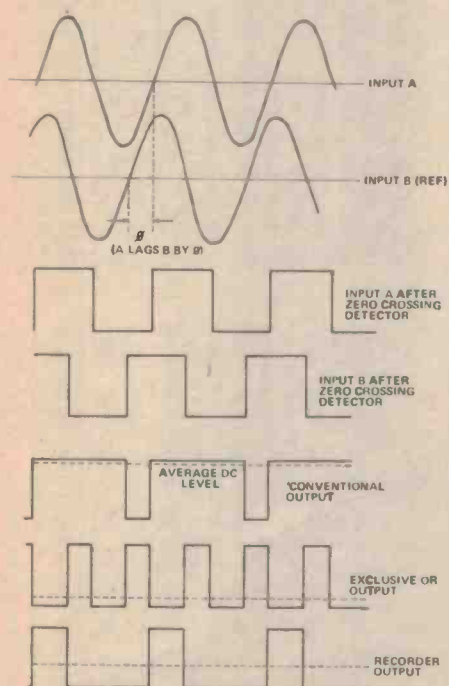


Fig. 1. Comparison of the conventional 'flip-flop' method and the exclusive-OR method used in this project.

Therefore, in order to measure power, one either needs a wattmeter — an expensive instrument if any great accuracy is desired — or a knowledge of ϕ , the phase angle. While ϕ can be estimated from a dual trace oscilloscope, this article describes a simple and accurate way of measuring it directly. In addition to power measurements, measurement of the phase difference between two voltages is useful when working on filters, feedback loops and phase-shifting networks: it can be used to measure the Q of an inductor, and hence check for shorted turns, or the loss factor in a capacitor. A further application of growing importance in the audio field is the phase of the sound from individual drive units in a loudspeaker enclosure, or members of an array of loudspeakers.

The phase relationship between two voltages is conventionally measured by detecting when each crosses zero voltage (see Fig. 1) in one direction, and arranging for one voltage to turn a flipflop ON and the other to turn it OFF. The percentage of time that the flipflop is on, and hence the average value of the flipflop output, is proportional to the phase difference between the two voltages. This method has three inherent disadvantages —

- (i) Voltages with little or no phase difference can give readings of 0° and 360° , or a reading which varies randomly between these limits.
- (ii) Any noise on either signal can cause false triggering and jittery readings.
- (iii) Any harmonic distortion can produce a shift in the zero crossing point and hence an error of 0.6° for each 1.0% of distortion.

The method used in the circuit described here is to form the exclusive-OR of the square waves

produced by zero crossing detectors from the two voltages.

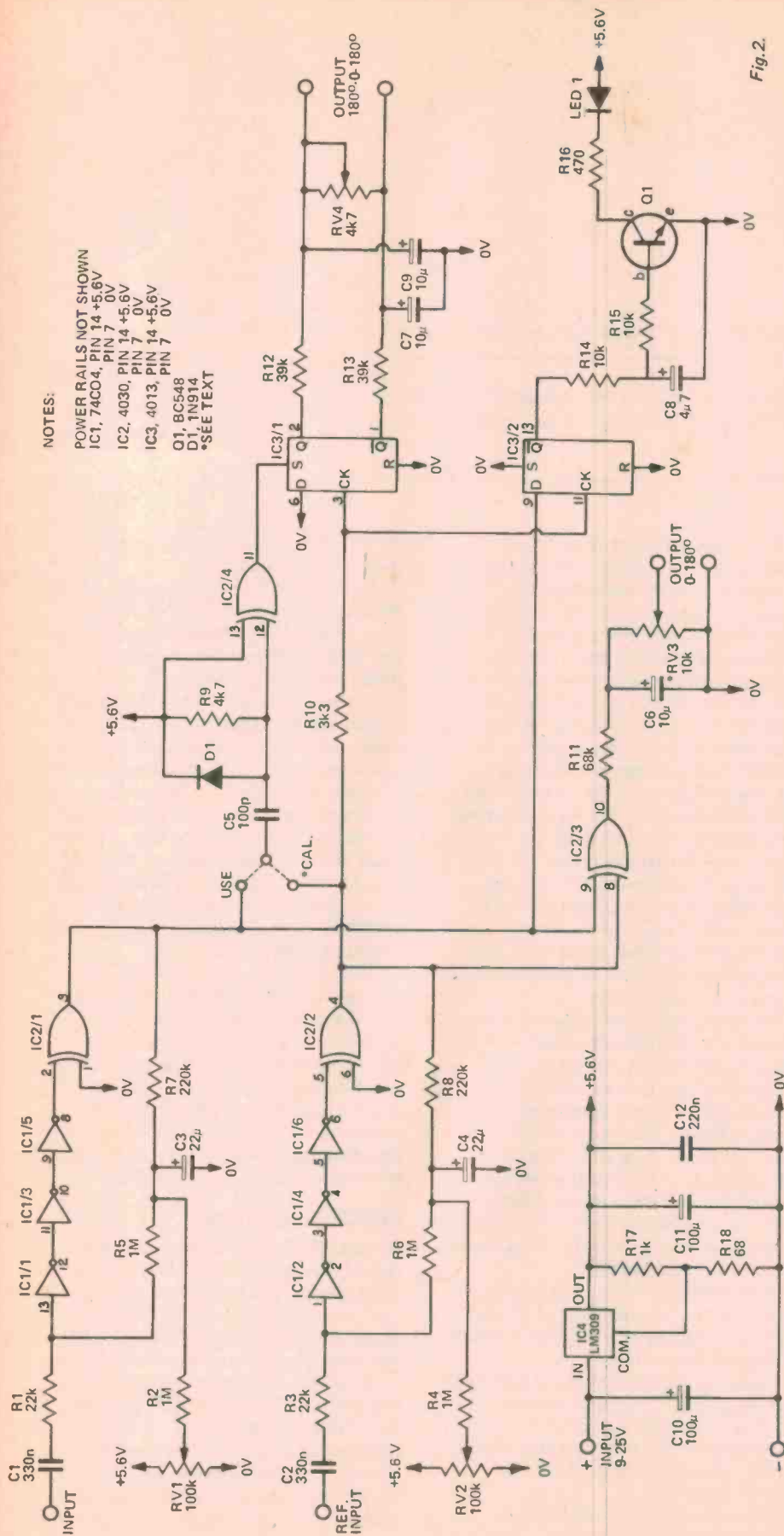
For those who have not encountered the exclusive-OR (XOR) function before, this is a logic function (in the same way that AND and OR are logic functions) that gives an output (logic 1) if its two inputs are different, but not if they are the same. Thus two square waves which are in phase will produce no output: two which are exactly out of phase will produce a maximum continuous output; and intermediate phases will produce an output proportional to the phase difference (see Fig. 1). This system has the advantage of being almost immune from noise problems since no triggering or latching circuits are involved.

Because the circuit response is symmetrical about 0° and 180° , there are no output discontinuities or ambiguities of reading. However an additional flip-flop is required to sense which voltage is ahead of the other and indicate it. The circuit is implemented with CMOS gates which have the advantage of being able to be used in either linear or digital mode.

CONSTRUCTION

We assume that only the more experienced constructor will build a somewhat specialised instrument of this type, and that they will be capable of assembling, handling the CMOS, with due care, boxing it without step by step instructions. The pc board can be copied from the diagram (Fig. 3), or hopefully will be available through commercial channels. The layout of the components is shown in Fig. 4. Some care is needed to keep the input leads as short as possible as the gain of

Text continues on page 48



NOTES:

- POWER RAILS NOT SHOWN
- IC1, 74C04; PIN 14 +5.6V
PIN 7 0V
- IC2, 4030; PIN 14 +5.6V
PIN 7 0V
- IC3, 4013; PIN 14 +5.6V
PIN 7 0V
- O1, BC548
- D1, 1N914
- *SEE TEXT

Fig. 2.

HOW IT WORKS

stance it may be set to 180 mV for a 180° phase difference and read it on a digital multimeter. Alternatively up to 50 μA can be drawn to give a reading on any suitable meter or multimeter. The use of an external meter is of course a much more economical proposition.

In order to detect which of the inputs is leading the other, the two voltages from the squaring circuits are also fed to the D type flip-flop IC3/2. One voltage is used for the clock input and the other as a data input. This type of flip-flop is really a data latch, and whatever voltage is present at the D input at the moment when the clock voltage changes from low to high is held

The two inputs are first squared. For example the reference input is amplified by gates IC1/2, IC1/4 and IC1/6 (see Fig. 2) and then applied to IC2/2, one of the spare EX-OR gates whose other input is grounded. This conveniently behaves as a Schmitt trigger type of bistable circuit. The average of the output of this gate is formed by R8 and C4, and this is inserted via R6 as the dc level at gate IC1/2.

This produces two important consequences. Firstly it forces the output of IC2/2 to a symmetrical 180°on/180°off condition which is maintained stably by almost complete dc feedback. And second-

would leave one flip-flop unused. In fact it turns out that there are two functions that these gates can usefully perform. First, for setting up the input squaring circuits: if the flip-flop is slaved to the squaring circuit, the exact 180° condition can be set when the complementary outputs Q and Q have equal average values. Secondly these gates can be arranged to turn the flip-flop on and off to give a conventional phase meter circuit output. While this does not give as accurate a reading, it does give one which is of opposite polarity for leading and lagging voltages and which can therefore be recorded graphically and unambiguously on an instrument such as a chart recorder. This is therefore des-

flip-flop is slaved to the reference input as it is set when IC2/2 goes low and reset when IC2/2 goes high, and this enables the 180° duty cycle to be set (see below). When C5 is connected to IC2/1 (the USE position) the flip-flop will have equal outputs at Q and Q if the two inputs are exactly in phase. It produces a positive value of Q relative to Q when the input leads the reference voltage and a negative value when it lags, the average voltage between them being proportional to the phase difference. R12, R13, C7, C9 and RV4 are used to filter this output and set it to some convenient value.

Of the other components, R10 is used to delay the voltage to the clock inputs

ly, because we now have a true squaring circuit rather than a zero-crossing detector, all errors due to even-order harmonic distortion are cancelled. R4 and RV2 are used to adjust for input offset and set the exact 180° condition.

IC gates IC1/1, IC1/3, IC1/5 and IC2/1 process the signal from the other channel in an identical manner, and the two squared outputs are fed to gate IC2/3 which is the gate that forms the EX.OR of them. Its output is filtered by R11 and C6 and a voltage proportional to the phase difference of the inputs may be taken from across C6. RV3 is used to set this to a convenient value - for in-

until the next clock pulse. Thus if the D input stays low until after the clock input goes high, the output Q will always remain low showing that the D input lags the clock input. The complementary output Q will be high and this is used to turn on the transistor and LED indicating this lag condition. Since any noise arriving at the clock input can cause spurious resetting of the flip-flop, it is preferable to use a clean voltage to drive it. This is why this channel has been designated the reference. Noise on the other channel is almost completely ignored.

These then are the basic EX.OR functional parts of the phasemeter, and this

ignated the recorder output.

In operation one input of the EX.OR gate IC2/4 is connected through C5 to the output of one of the squaring circuits. Its other input is tied to the positive rail so that it functions as an inverter with respect to the other input (the EX.OR is a flexible beastie isn't it?). With C5 connected to the output of IC2/2 (the CAL position), when IC3/2 goes negative C5 and R9 differentiate this, and IC2/4 gives a short (½ μsec) positive spike, which is used to set IC3/1. Since the data input of this flip-flop is always low, the clock pulse will always reset it again. Thus the

slightly to compensate for the set-up time at the data inputs, and the LM309 regulator and associated components holds the supply voltage constant at just under 6 volts. This is important as the full-scale readings from the outputs is proportional to the supply voltage. The circuit can be run from a 9 V battery and draws about 20 mA with the LED off and 40 mA with it on. Alternatively any power supply that produces between 9 and 30 volts may be used, but it should be a floating supply to simplify the measurement of the phases of currents, and R16 and the voltage rating of C10 should be increased if more than 15 volts are used.

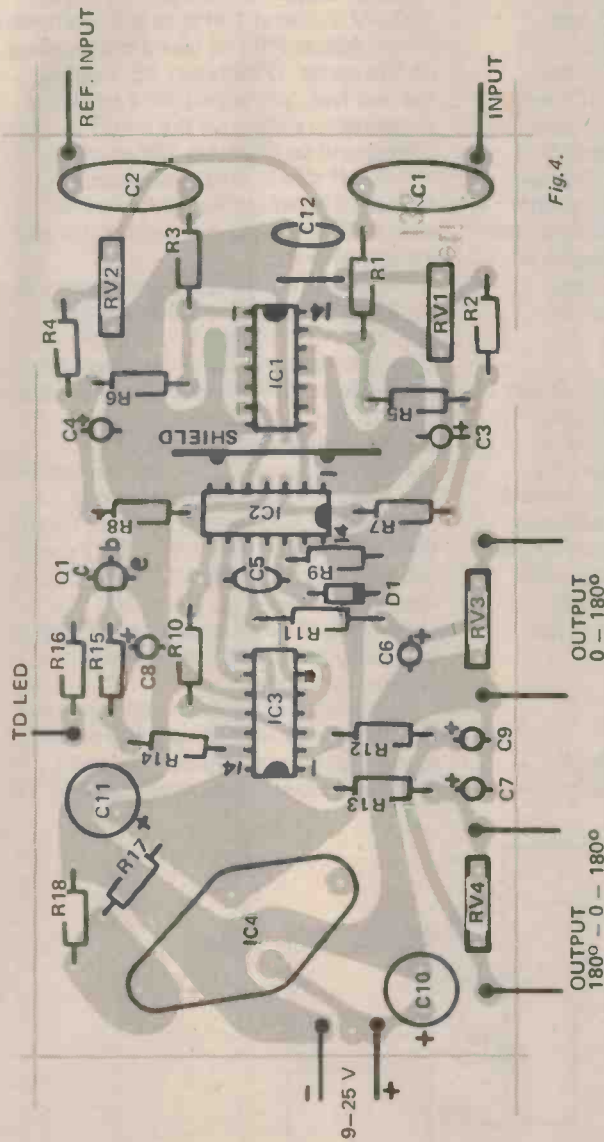
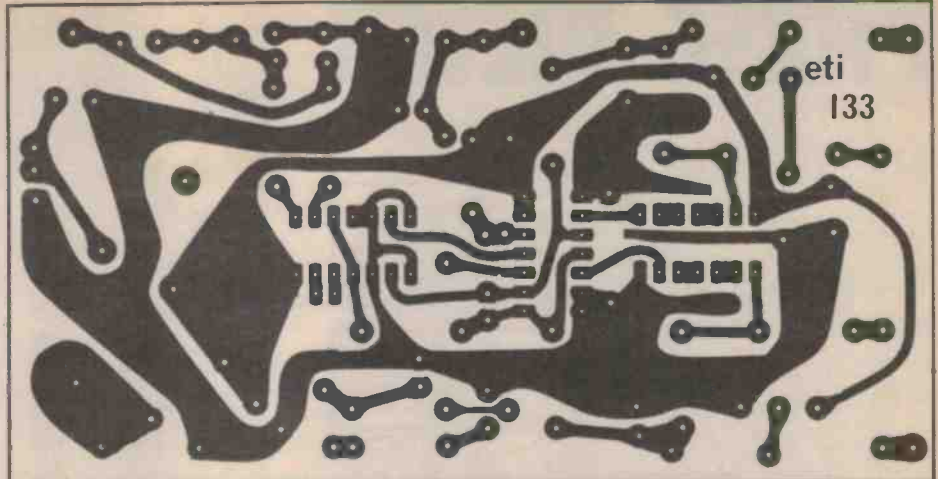


Fig. 3.

Fig. 4.

PARTS LIST ETI 133

Resistors	all ½W	5%
R1	22 k	
R2	1 M	
R3	22 k	
R4-R6	1 M	
R7,8	220 k	
R9	4k7	
R10	3k3	
R11	68 k	
R12,13	39 k	
R14,15	10 k	
R16	470	
R17	1 k	
R18	68	
Potentiometers		
RV1,2	100 k	Trim
RV3	10 k	"
RV4	4k7	"
Capacitors		
C1,2	330 n	polyester
C3,4	22 μ	16 V electro
C5	100 μ	ceramic
C6,7	10 μ	16 V electro
C8	4μ7	16 V
C9	10 μ	16 V
C10,11	100 μ	25 V
C12	220 n	polyester
Semiconductors		
IC1	74C04	(CMOS)
IC2	4030	"
IC3	4013	"
IC4	LM309k	
Q1	BC548	
D1	1N914	
LED		
Miscellaneous		
PCB	ETI 133	
Case	to suit	
Terminals	and sockets	to suit



PHASE METER

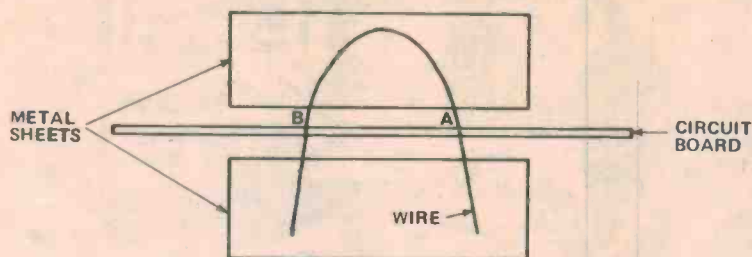


Fig. 5. Details of the shield between IC1 and IC2.

the input stage is extremely high and oscillation can occur if they become coupled to the later stages. To help isolation, small metal sheets, about $\frac{3}{4}$ " x $1\frac{1}{2}$ " should be soldered above and below the board between IC1 and IC2. These can conveniently be attached to the link between points A and B in the circuit as shown in Fig. 5. For the same reason, the CAL and USE points should not be taken to a panel-mounted switch but the connection changed on the board itself. We have used two molex pins at these points, marked X in Fig. 4, which work quite satisfactorily.

When the board is assembled, it can be mounted behind the front panel, supported directly by stout wires to the two inputs and the recorder output. Connect a power supply and check that the voltage across C11 is six volts or just under. Calibration and testing are simplified if the leads of C11 and the positive lead of C3 and C4 are left long enough to be able to clip a lead thereon.

CALIBRATION

To calibrate the instrument, first connect capacitor C5 to the CAL

position, the meter to be used to the recorder output and a signal of about 100 mV at about 1 kHz to the reference input. Adjust RV1 to give a null reading on the meter. Disconnect C5, leaving the end free, and adjust RV4 to give a convenient reading on the meter to correspond to 180° (eg 180 mV or 45 μ A). If this is hard to set exactly, connect a fixed resistance in parallel with RV4 to give better control for any individual meter.

Next connect jumper leads from the positive sides of C3 and C4 to either side of C7 (i.e. one to V+, the other to V-, it doesn't matter which), connect the meter to the main output and adjust RV3 to give a 180° reading (with parallel resistance if needed as in the previous paragraph). Finally, remove the two jumper leads and connect one between the two inputs, connect C5 to the USE position and adjust RV2 slowly and carefully until the LED is just on the point of turning on and off. The meter should now be reading less than half a degree: if not, repeat the calibration procedure.

As a check of proper operation, you should now be able to vary the communal input from millivolts to volts and from sub-audio to over 100 kHz

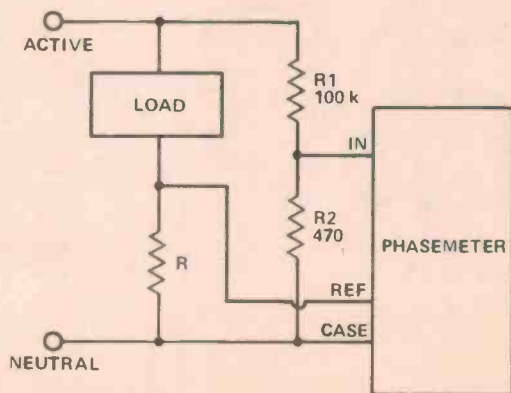


Fig. 6. How to use the meter to show the relative phase of mains voltage to mains current.

without the phase difference showing more than about one degree. Another excellent test is to connect different signal generators of different frequencies to the two inputs. The output should read exactly 90° , as the signals will be in phase exactly as often as they are out of phase. Our prototype failed this test, reading 92° , and it was only after considerable trouble that we traced this to non-linearity in our trusted (and expensive) multimeter. We guess the moral is to use a digital meter if accuracy is really important. Note that the recorder output is undefined under these conditions.

The high-frequency accuracy is limited by the rise and fall times of the CMOS outputs, by any mismatch in R1 and R3 and their stray capacitances, and by propagation delay differences between the two input and squaring circuits. These, on the two units tested, have been about 50 nsec. This would be equivalent to 1° phase error for every 25 kHz of signal frequency. Thus the meter is usable, but certainly not accurate, up to about one megahertz.

Input protection is provided by resistors R1 and R3 and the internal diodes in the 74C04. We have tested this system to inputs of 80 Vrms before any degradation of the gates occurred, but a value of say 25 Vrms (70 V p/p) should be regarded as a fairly safe working maximum. If IC1 is mounted in a socket, it can be simply changed if accidentally overloaded. Under no circumstances can 240 V be applied directly to the inputs!

When using the instrument for measuring phase in 240 V mains circuits, common sense precautions should be observed to ensure no damage occurs to the instrument or the operator! First use a mains testing screw driver to identify the active lead: secondly always switch off the power when connecting or making any alterations to the circuit under test: thirdly make sure that the resistor R makes reliable contact and cannot accidentally become disconnected, otherwise the reference input can get the full mains voltage through the load. Finally use a voltage divider or an oscilloscope X10 probe to reduce the voltage to a safe level.

The circuit shown in Fig. 6 can be set up on an insulating board with a socket for the load to be plugged into. Resistor R is chosen to give a voltage of 1 volt or less when the load current flows through it and must be rated to dissipate a few watts if large currents are to be handled. A value of 0.22 Ω , 5 W is suitable for most situations. And remember that, when set up like this, the instrument reads the phase of the voltage relative to the current.

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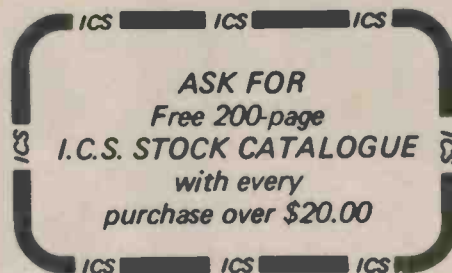
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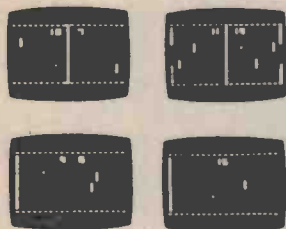
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 Circuit Type Dual conversion superheterodyne;
 Crystal frequency synthesizer provides 23
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Selectivity -6dB down at 6KHz, 50dB down at 20KHz

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Audio Output 3 watts into ext. speaker jack; 8 ohms

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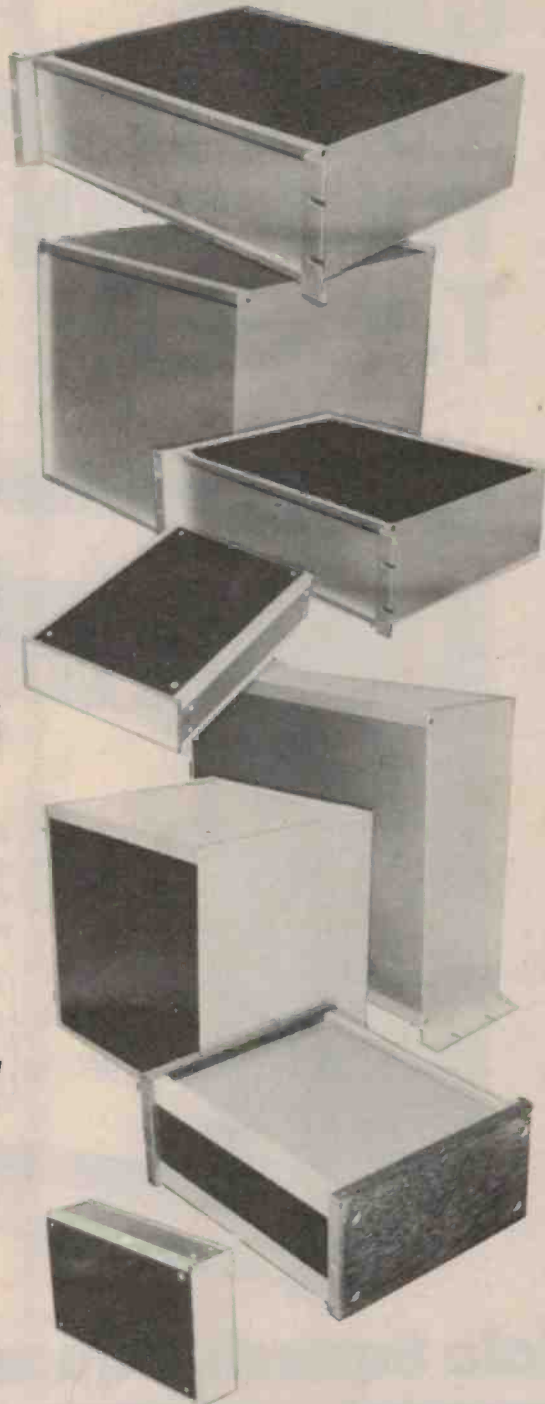
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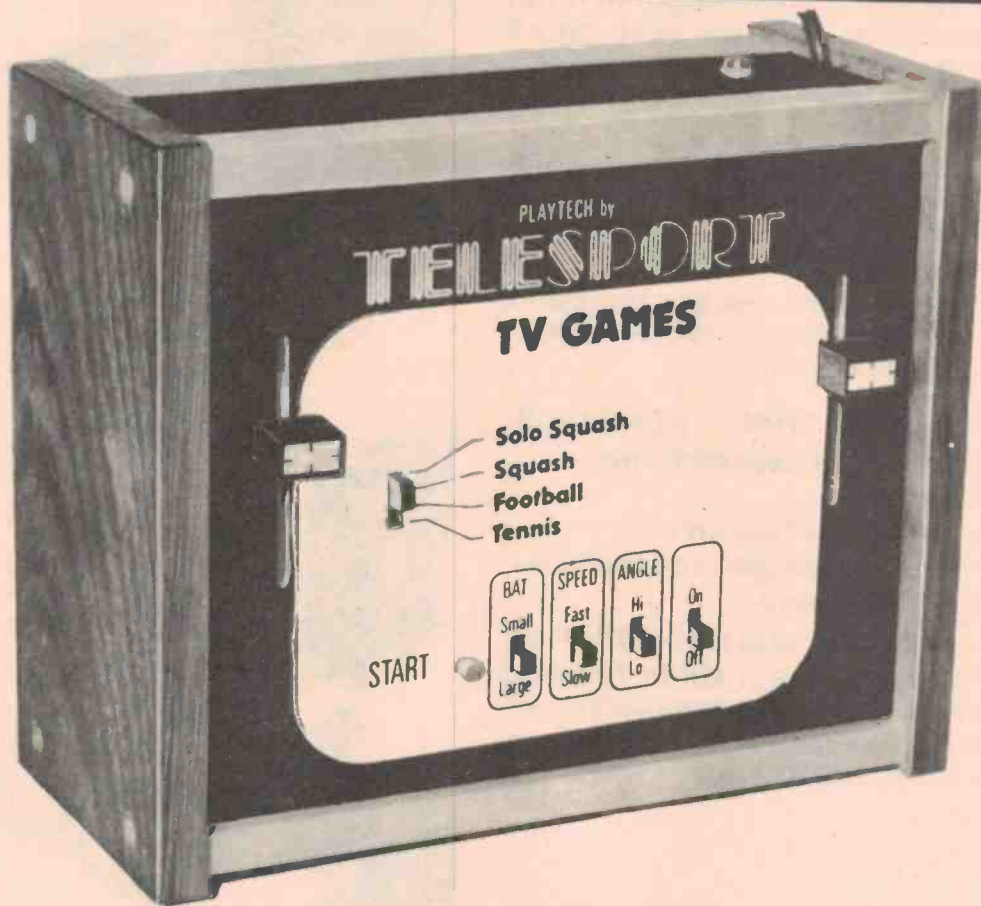
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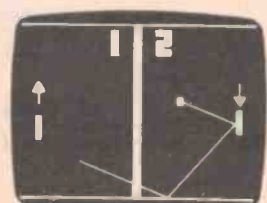
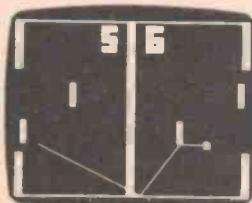
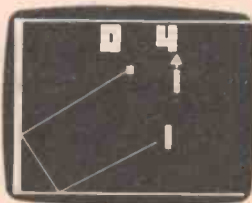
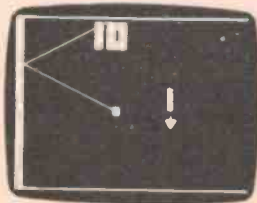


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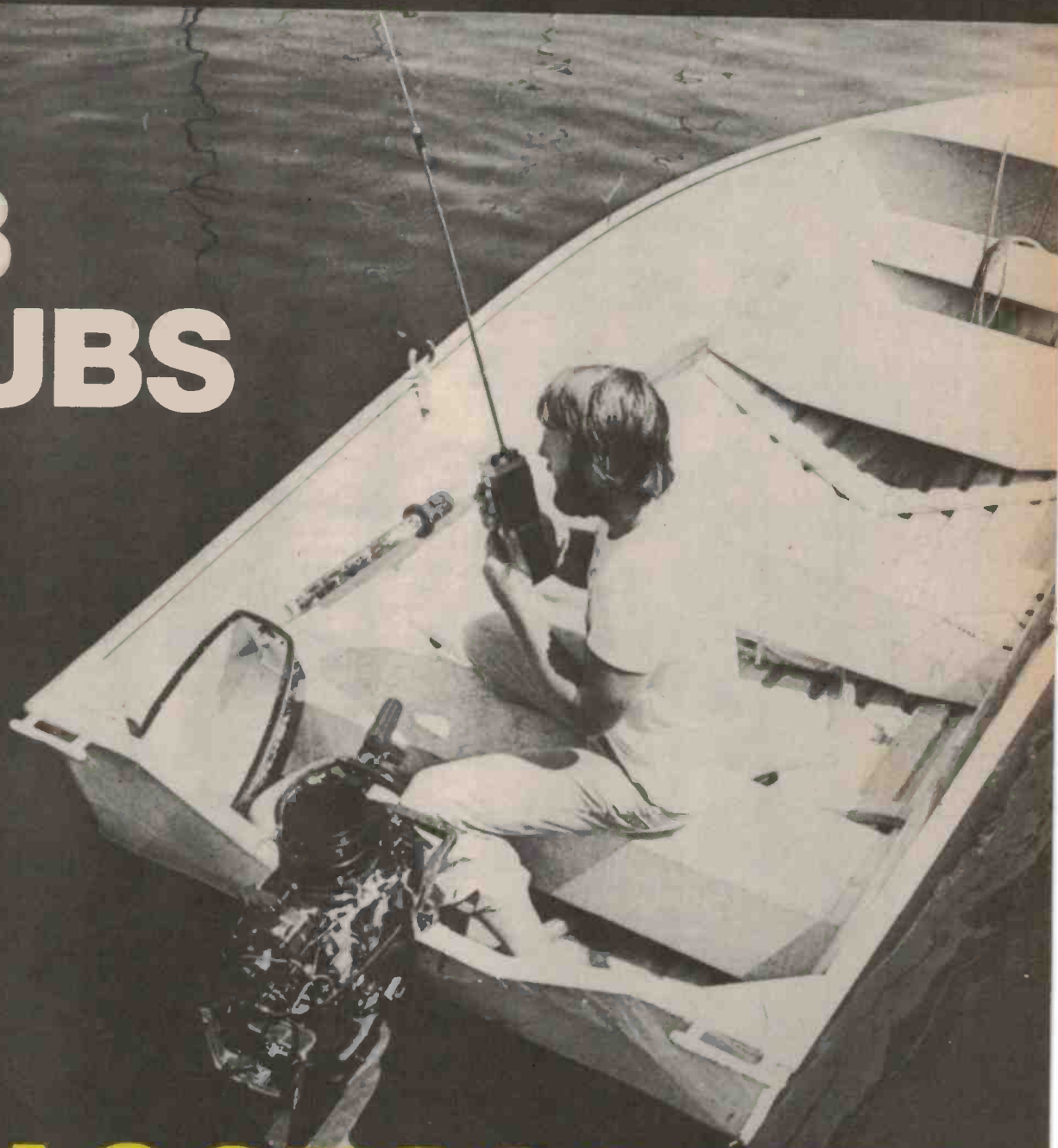
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AUSTRALIA

Vol.1 No.3 60c*

*How to
get into
CB Radio*

**CB
CLUBS**



CB ACCESSORIES

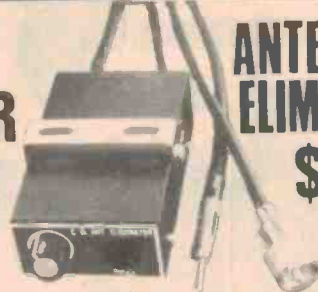
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PL259 Plug: as used in almost all CB radio equipment— sturdy construction; easy connection.
Cat P-2310 \$1.45



\$0.50

Reducing adaptor: necessary if you wish to use RG58U or sim. small dia. co-ax with the above plug. Cat P-2360 \$0.50



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Cable joiner: most cables are made with 2 x PL259 plugs. To join them, use one of these double ended joining sockets.
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Right angle adaptor. PL259 plug one end, then right angle bend, then SO239 socket. Handy where space behind a rig is limited.
Cat P-2382 \$2.85



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BASES



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Magnet Base: Incredibly powerful magnet; fits D-4615 antenna. Nylon gasket stops scratches.
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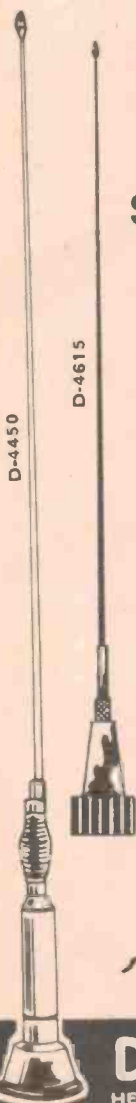
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Brand new, exclusive to Dick Smith, the 'knight of the road' helical antenna. Includes base, lead-in, PL259 plug. Value!
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WHITE FLASH

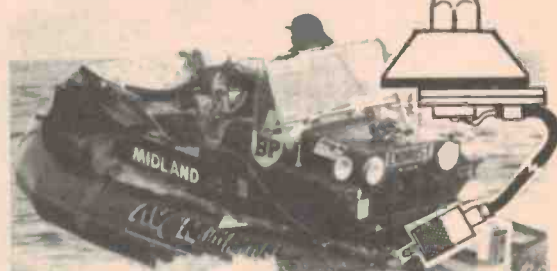


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CB

Vol.1 No3.
**How to
get into
CB Radio**

AUSTRALIA

CB *How to get into CB Radio* AUSTRALIA

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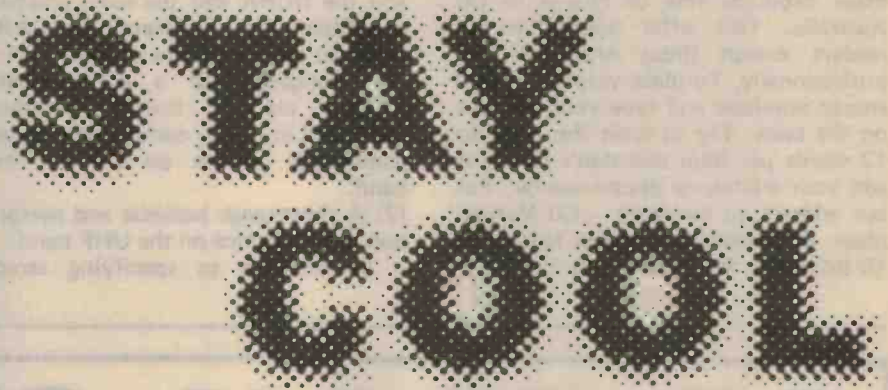
Collyn Rivers

This, the third issue of CB Australia, has been edited and produced by the staff of Electronics Today. It is presented free within the April 1977 issue of Electronics Today, and will also be available at the (recommended) price of 60 cents from all newsagents.

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A MODERN MAGAZINES PUBLICATION
15 Boundary Street, Rushcutters Bay,
NSW 2011

COVER: If your hobby is boating or fishing you can legally use 27 MHz gear – if you belong to a club that has a P&T licence (but you are limited in the channels you can use).



Things are hotting up on the CB front. With the legalisation of hobby CB expected soon some pirate operators are forgetting that they are breaking the law and they are abusing the (unofficial) 'blind eye' policy of the law enforcing agencies. They can only be a tiny percentage of the 'Legalise CB' lobby but those people who phone threats to RIs and harass them in their work are undoing the good work done by sensible campaigners.

And I think the NCRA request for an amnesty for illegal CB users shows a certain amount of naivety. Why should the government grant such a favour? Previous amnesties have involved the law-breaker *ceasing* to break the law in return for a waiving of charges. But suppose an amnesty was granted, that would mean hobby CB was 'legal' and the present problems would multiply as previously hesitant enthusiasts rushed to the shops to buy transceivers. What then would happen if the government decided that a CB service would be legalised on UHF only?

But it is not just the CBers who have been rash. The recent confiscation of CREST equipment in Sydney by Radio Inspectors took many of us by surprise. But perhaps it was the blatant way that channel nine was being used illegally that made them step in.

So stay cool, there's not much longer to wait – Mr Robinson has indicated that he will submit his department's ideas to the Cabinet in a few weeks time.

S.B.

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CB NEWS

23 Channel Rig for \$29.95!

A 23 channel AM transceiver with separate RF and squelch controls and S/RF meter for only \$29.95. But that's America — who knows, we might have prices like that in Australia soon.

CB Marketplace

Got a spare AM rig, now you've gone sideband, or a spare 108-inch whip, left over from before you sold the Landrover? You can now advertise these products free of charge in CB Australia. This offer applies to all readers except those who sell gear professionally. To place your ad seal an empty envelope and type your message on the back. Try to limit the copy to 12 words per item and don't forget to add your address or phone number. Put our address on the front — CB Marketplace, CB Australia, Modern Magazines 15 Boundary St, Rushcutters Bay, NSW

2011. We are only interested in equipment for 27 MHz stations — so don't try to send us ads for lawn mowers or trailers, etc.

Citizens'/Amateur Submission

We have received from Sam Voron, VK2BVS, the final submission from the Citizens' Amateur Radio Movement to Eric Robinson, Minister for Posts and Telecommunications. The submission was written after many meetings between officials of the WIA and the NCRA and the radio amateurs and CBers they represent. The CARM proposes two new items of legislation:

- (1) Instigation of a communicator amateur class D licence for those interested in hobby communication and community service on the 27 MHz band.
- (2) A short-range business and personal non-hobby service on the UHF band.

In addition to specifying sample

restrictions for the proposed class D licence (such as type-approval for gear, a 5W (AM), 15 W (SSB), power limit, no overseas QSOs) the submission has some interesting recommendations for the amateur licence structure as a whole. It suggests that holders of the limited licence (presently prohibited from communications below 30 MHz) be allowed to use 27 MHz — for the first time holders of all three (and all four if the fourth class is adopted) classes of amateur licence will be able to communicate on the same frequency.

And it is also suggested that the prohibition on third-party communications be dropped in relation to amateur community service activities.

That is a very brief resume of the submission. In a future issue we hope to look in more detail at some of the CB service proposals that have been submitted to the government.

CB FROM STRATO



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NCRA Goes to Canberra

On Sunday 13th March the NCRA organised a convoy to Canberra (from the state capitals) to present a petition to the government. The petition asked for a CB service to be introduced using the 23-channel 27 MHz band. And this should be followed by the introduction of a VHF/UHF CB service.

In addition the NCRA asked the government for an immediate amnesty for current CB users. A couple of days later NCRA officials met Mr Robinson. He said he was disappointed at the poor response to his request for submissions and that his department would be making recommendations to the Cabinet in a few weeks time.

NCRA News

At a national meeting on 17th February the NCRA appointed the following

CB from Electronic Agencies

Electronic Agencies sent us an interesting range of CB accessories when they read that we were featuring them in this issue. They included an interesting floor-mounting bracket that fits over the centre transmission hump of your car, an SWR bridge and field-strength meter (for \$19), a hot-line suppression filter and a coaxial lightning filter and arrester. Also included were a range of PL259 plugs, adaptors, and joiners; a press-to-talk microphone and magnetic clip holder and spare plug; plus an extension loudspeaker (with noise filter built-in) and three antennas (one base-loaded, one helical and one AM/FM/CB type).

interim club delegates to the state executive:

NSW

J. Hemsley	(BPA34)	Barrenjoey Peninsula Area CB Club
G. Rowling	(LA5)	Lakemba Area Radio Club
F. Perlenfein	(ESA5)	Eastern Suburbs Area CB Club
J. Gorgon	(CW46)	Central West CB Club - Orange
T. Jenrings	(BA100)	Bay Area CB Club
M. Braithwaite	(BC09)	Banana Club - Coffs Harbour
R. Grinly	(MA5)	Murrumbidgee Area CB Club
M. Lowe	(WD3)	4 Wheel Drive CB Club
J. Kuwahata	(NS28)	North Shore Radio Society
G. Cook	(SD21)	St George District CB Club

Victoria

Neil Langford	VCCBO	
Neil Sleep	Landcruiser Club (Vic)	
David Helyar	ACRM (Vic)	

South Australia

Phil Richards	ACRM	
George Boyd	NCRA	

Queensland

John Sands	(CR4001)	Citizens' Radio Social Club of QLD
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ACT

Mike Hurst-Meyers	(CT14)	Capital Territory CB Club
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Northern Territory

John Tate		Darwin Radio Club.
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This establishes a state-level executive responsible to the national body on behalf of the affiliated members in each state.

In another motion Mike Hurst-Meyers was empowered to create the National Citizens' Radio Directory.

The following clubs were represented: BA, BC, BPA, CARC, CRSCQ, CT, CW, DC, ESA, HV, KBW, KT, LARC, LX MA, NR, MSRS, NW, QCBSC, RD, RS, SD, ST, TCC, TLC, TR, VCCBD, WD, WWP, and XT

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23 CHANNEL MOBILE WITH 2 CHANNEL SCANNER

Sensitivity: Less than 0.5uV for 10dB (S+N). Selectivity: 6dB at 5kHz, 60dB at 20kHz, 60dB at 40kHz, Squelch Sensitivity: Threshold less than 0.5uV. T1ght 500uV 1mA, Signal to Noise Ratio 35dB min. Audio Output: More than 3W/10% distortion.

Other 23 Channel 5 Watt Units

Available A.M.

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AM/SSB 12 Watt. P.E.P. Equipment

PANTHER SSB. Top of the
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• "XTAL" XSSB10. 12W P.E.P. Clarifier Control, etc. \$239.50 • "Tram" XL5 AM/55B. Noise Blanker. USB/LSB/AM \$239.50 • 12 volt regulated power supply for above units \$39.50

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Call System
27.240 MHz

Superheterodyne system
CBT-707
\$25 each or \$49.50 a pair

HAND HELD UNITS

• "Contact" CT10 2 Channel 1 Watt with Call System. Metal Case \$44.95 each.

• "Slideband" NC310 1 Watt 3 Channel. Ext. Power. Antenna Connections. \$44.95 each.
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MOBILE ANTENNAS

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POPULAR VC2 SWR/PWR METER

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\$36 SWR/PWR METER

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Model G2 as above with gutter clamp \$29.90 + P&P

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- spring base \$13
- roof base \$17.50

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Model HW-11-6M requires no ground plane and can be operated on fibreglass, wood surface or on mast. Comes complete with matcher, coax, PL259 plug. \$65

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Ideal mobile whip, mounts on bumper bar.

Whip \$19
Mast \$26
Bumper Mount \$19
Spring \$11.50



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27MHz ground plane, superb quality, wound on strong fibreglass rod with teflon protection. \$79

1/2 wave high efficiency ground plane, solid 108 inch heat treated radials and radiator. Radials droop for 50 ohm match. Complete with S0239 socket. \$35 + P&P \$3

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ANTENNAS

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PLA-2	Adaptor for PL-259 plug, for RG59/U cable	.28
PLA-3	Adaptor for PL-259 plug, for 75 ohm cable	.31
PLA-4	Adaptor for PL-259 plug, for 75 ohm cable	.31
SO-239	Panel Socket with Range suit PL-259	\$1.25
PL-258	Panel Socket without flange, suit PL-259	.98
PL-258A	Cable joiner, double female, suit PL-259	\$1.25
M-358	Cable joiner, double male, suit SO-239	\$1.55
M-358	Cable joiner, "T" Connector	
	(Double female and male)	
L-258	Lightning Filter and Arrestor	\$3.90
	(PL-259 plug to SO-239 socket)	
D-258	Dummy Load with indicator	\$4.75
	transmitter power of 5 watts, 50 ohms impedance, PL-259 plug	
PC-258	1 metre Cable Assembly — RG 58/V cable with PL-259 plug each end — suit SWR and other test meters etc.	\$3.00
MP-4	CB 4 pin microphone plug	\$4.30
CC-2	Mic Cable 3 conductor, single shield curly-lead, colour black	\$1.75
RG-58/V	Cable, 52 ohm low loss, black-per metre or per 100 metres	.45
		\$28.50
Accessories	Description	Price
DM-95	Omnidirectional Hand held Dynamic Microphone — with 2M curly-cord imp. 500 ohms, Freq. Resp. 20Hz-10KHz, Sensitivity — 70dB	\$6.35
K-815	Extension Speaker, 8 ohms 5 watts, with mounting brackets and On/Off Microphone Holding Clip — magnetic mounting to car dash etc.	\$13.50
MH-40	Microphone Holding Clip — with 2 self-tapping screws	.75
MH-25	"Hot-Line" Filter-reduces ignition interference — comprises choke and capacitor insert in 12V line lead	\$3.10
SWR-300	In-Line SWR and Field Strength Meter Measures forward & reflected power by bridge method, SWR 1:1 to 1:3 imp. 52 ohms, Accuracy 5%, indicates transmitter power output strength & 10:1	\$19.00
	Floor Mounting Kit — clamps around centre hump on the floor, fully adjustable, suits most cars	\$6.95
CB Antennas	AM/FM/CB Lock Down Centre-loaded with splitter, cables and plugs, one for CB, one for AM/FM	\$32.00
CA-60	Magnetic Mount Whip — Centre-loaded coil with 3m. cable & PL-259 plug heavy ceramic mounting, no installation required	\$15.75
CB-100	Roof or Boat Mount Whip — Centre loaded coil, mount base for roof mount (hole) or boat mount (clamps to edge of boat lid) with cable & plug	\$19.95
CB-125	5ft Medical Whip Antennae-stagger wound, best performer, SWR down to 1:1:1 when tuned, with base	\$22.00
CB-200	12ft lead & PL-259 plug to suit, extra. Base Station Ground Plane-ring-rod radiator, 19ft long, high efficiency, vertically polarized, omni directional, aluminium construction in 4 sections accepts PL-259 plug	\$3.00

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- 219 100 ASST. 1W RESTORERS. 5/, 10/ mixed carbon composition. \$1.50
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- 214 PLESSEY 24V REED RELAY. Mini encapsulated, PCB mtg, 2pole ON-OFF. \$2.00ea.
- 215 PLESSEY 12V REED RELAY. As above, 3 pole ON-OFF. \$2.50.
- 215 PLESSEY 24V REED RELAY. As above, 3 pole ON-OFF. \$2.50.
- 330 100 ASST. SEMICONDUCTORS Trans. IC's, diodes, all tested, marked. \$3.00.
- 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.

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COME-ON!

We Hand The Mic To Our Readers...

The 'True Amateurs', Canberra CB & ACT CREST

Dear Sirs,
Well done! You have presented the Australian public with an unbiased, authoritative, work on CB radio in Australia. Whats more, edited by VKs! Already some VKs I know who have seen "CB Australia" have said 'Renegades, they are not true amateurs', and other assorted things.

To tell you how CB radio is spreading in Canberra I can quote some simple figures. There now exists in the Canberra area three CB radio clubs. They are the "Bravo Whiskey" club more properly known as Belconnen Wireless, in Canberra's northern suburbs, "Sierra Whiskey" club, Struggletown Wireless, being the CB club in Queanbeyan just across the border, and the "Charlie Tango" club, Capital Territory, being Canberra's first and biggest club. In last count the CT club had five new members per day and callsigns in the 640 region had been allocated (as at 15.02.77).

Actually here in Canberra we are very proud about the headway that has been made in organising the CB scene. Already Crest in Canberra operates 24 hours a day, 7 days a week and 365 days a year. It has also assisted in an average one emergency per day since its commencement. Also the ACT police, Fire Brigade and Ambulance all accept any call from a Crest monitor in good faith.

Also a legalisation working party, consisting of local CBers and WIA members, has been formed to bring pressure to bear on the correct authorities.

Every second Tuesday night a club news broadcast is held with callbacks and every Monday night there is a "Committee on the Air" with the club's President and Committee taking any questions asked about local CB events and ideas. It is not uncommon to hear Canberra CBers talking about the WIA news broadcast and Canberra WIA

members talking about the CBers news broadcast.

It may be of interest for you to note that since Crest started in Canberra many CBers have been prepared for anything: I carry a small 1 watt unit with 3 channels to work in my briefcase each day (since I travel by bus and not by my private car), so that if on my way to or from work I should come across an emergency situation I can call Crest on Channel 9.

Fortunately I have not had to use it yet, but I have the reassuring knowledge it is there.

Colin
Charlie Tango 142

Roger's Reply

Not a real amateur, eh! License VB390 was issued to me on 20-1-64, callsign VKZRY. I was issued VKZTB in 1972. First active on 6m with both converted ex-taxi gear and homebrew Tx and Rx. I was an HF and VHF (52,144,288 MHz) listener for some five years prior to that. Over the years I have



Roger Harrison

constructed gear for the bands 52,144, 432,576,1296 MHz and 10 GHz (but no QSOs on last two bands), apart from HF receiving gear. My special interests have been propagation, antennas and circuit



Roger in his VK-zero days... Casey, Antarctica.

techniques. I have been President of the Royal Melbourne Institute of Technology Amateur Radio Club and was first President of the RMIT Astronautical Society. I have been a WIA member since 1962. I won first place for VK3 in the Tx Phone section of the 'John Moyle Memorial National Field Day' in 1965 – the first (and only?) Z-call and VHF-only station to do so.

I was a member of the Vic. Div. WICEN for five years and passed through the Government-sponsored signals service course at Mt Macedon Emergency Services School in 1965. I attended callouts to bushfires in Victoria in 1965 and 1967. I have been on the NSW state WICEN committee for the past two years.

During a stay at Casey, Antarctica, in 1970 I had extensive experience with mobile and field communications as I spent about six months on a geophysical field survey. While there I operated VK0GR on 7,14 and 21 MHz and established the first (?) 6 metre beacon on Continental Antarctica. The Ionospheric Prediction Service subsequently constructed and operated 6m beacons at Casey (VK0GR) and Mawson (VK0MA) from 1972. VK0GR has been heard in southern and eastern Australia on several occasions. I was subsequently involved with the establishment of the VK2WI VHF beacons and an currently the VK2 Div. beacon officer.

I was publicity officer for the VK2 VHF and TV Group during 1972. I operated a 6m beacon from Cocos Is during late 1972, early 1973. In 1973 my wife and I commenced the independent publishing of '6UP MAGAZINE' for VHF enthusiasts. It became well known for its racy, controversial style, good technical articles and news. We initiated a 'State of the Art' contest to foster the more difficult modes and techniques.

I have been writing articles on amateur radio since 1964 and have twice won the 'Best Technical Article' award from the WIA journal 'Amateur Radio'. First, for a series on Transistor Amplifier Design and then for a two-part article on 'Transequatorial Propagation' – the last was reprinted in the English and foreign language editions of the prestigious international journal 'VHF Communications' published in Germany. A short version also appeared in ETI. I have also had articles published in Ham Radio, 73 Magazine and Break-In (NZART Journal), as well as local club newsletters – apart from numerous ones in ETI, which you've all seen, no doubt.

R.H.



Steve Braidwood

Who're the True Amateurs?

Who's not a true amateur? In my view it is the VKs who oppose the legalisation of CB that are the renegades. They appear to renounce the altruistic principles of amateur radio only to protect their selfish ends. And I'd be one of them if this really was the case – if it really meant opposing a threat to amateur radio as a hobby. But legalising CB is not going to impinge on the freedom of the radio amateur. No, I believe it is not self-interest which makes some VKs anti-CB, it is simply bloody-mindedness. Like the child who suddenly becomes possessive about the toy that's been forgotten for months, just because his brother wants to play with it, so certain VKs feel that, simply because they are the only people who currently have legal rights to use radio transmitters for hobby purposes, no other people should be granted these rights in the future.

Could they be frightened that in future no-one will become a radio amateur because of the soft-option CB licence? If this is how they feel then they themselves are not true radio amateurs, presumably they are bitter because in the past they have had to pose as radio-experimenters (and force themselves to learn the technicalities of radio) because under current laws this pretence is the only legal outlet for the desire to communicate by radio (a desire equally common among the technical and non-technical public).

If I am right then these VKs have some cause to be bitter. But it is the system which denied them CB that they should be angry with. Imagine their plight when they first discovered the pleasure of radio communication – listening in on amateur QSOs, dying to go back to that unanswered CQ. And think of the struggle it must have been

for them to learn the technicalities of radio (not necessarily out of genuine interest, but as a means to an end). The desire to communicate driving them on when others fall by the wayside.

But in a world where people are taking up their rights without having to buy or earn them, those people who have invested in old values are bound to get hurt in the course of social progress.

S.B.

Note: We have found that there are very few radio amateurs who actively oppose the legalisation of CB. Despite the antagonistic view of the WIA, most of the amateurs we know are in favour of CB.

My amateur radio background is not as impressive as Roger's, but for those who doubt my authenticity here goes: Call-sign G3WKE was granted to me ten years ago in England and my activities were largely on the HF bands. VK2BSY was issued after I was transferred from the UK edition of ETI to the parent edition in Australia. When I get time I operate on 2m and, of course, on 27 MHz.

US Channels 23,24 & 25 – The Correct Frequencies

*Dear Sirs,
I feel the first issue of CB Australia was an excellent effort on your part.*

At the moment, because of the relative "newness" of CB many people buying CB gear have been ripped off. Two examples that come to mind are:

(1) A friend of mine was charged \$50 installation fee on his Weston 5W transceiver.

(2) I was recently in a shop where a salesman said "Six channels is enough to start off with. It's cheaper than a 23 channel one."

The thing is the rig was \$90 and crystals at \$7.95 a pair (CB frequencies, not fishing club) which would have cost \$138. The "23 channel one" he was talking about cost \$110.

There is one mistake you have made on page 19 of CB Australia. The frequency allocations for the 40 channels are correct however three of the channel numbers are wrong. According to the FCC the list should read:

Frequency	Channel
27.225	22
27.235	24
27.245	25
27.255	23

Channel 23 remains 27.255 MHz to avoid confusion on QSO's between a 40 channel transceiver and a 23 channel transceiver.

Paul Fuller

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Realistic TRC-124 State-of-the-art circuitry with innovative phase lock loop frequency system plus bright LED digital channel indicator. Also has large RF/S meter, PA facility, Push button noise blanker, delta tune and squelch. Ready to go on 23 channels with mike and mounting hardware. **169.95.**



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*Note: Channel 23 is outside the Australian Amateur Band. Users of Walkie Talkie/CB equipment require a P.M.G. novice or amateur licence.



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OUR PRICE \$285

AMERICAN REVIEW: This New Model GTX2325 from Gemtronics is there BEST YET, it will OUTSELL all other models & continue to lead the Field for some time yet. Like all fine Quality Products it cost a little more but in this case it is well Justified. ONE OF THE FEW TOP BRANDS THAT BY FAR EXCEEDS THE REQUIREMENTS OF THE NEW FCC RULES.

AM/5 watts Double Conversion Superheterodyne. Supurious Radiation BELOW 50DB. of Carrier. HUM & NOISE below 40DB of Signal. SSB/25 Watts (12w PEP) Single Conversion Superheterodyne. Modulation by Filter method & 3Rd. order Distortion is more than 20 dB below either signal of 2 tone. DESIGNED FOR LONG DISTANCE/Used by Operators who want distance NOT NOISE

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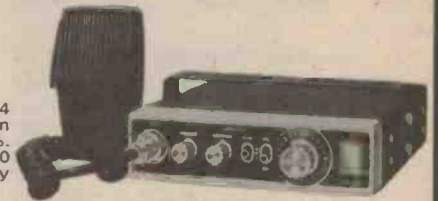
23 CHANNEL MOBILES



Model SR-76
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CB ACCESSORIES

Roger Harrison looks at the accessories now on sale to help you achieve the best installation and performance from your CB station. See the advertisements in this issue for details of suppliers.

Accessories for CB installations can be broken down into about four categories:

(a) **Antenna Accessories** such as connectors, patch cables coax switches, couplers, filters, etc.

(b) **Receiver Accessories** such as RF amplifiers, hash filters, converters, remote speakers, etc.

(c) **Transmitter Accessories** such as SWR meters, power meters, field

strength meters, dummy loads, etc.

(d) **Operator Accessories** such as headphone/mic combinations, mic holders, transceiver mounts, power supplies, test sets and accessory operators(!) etc.

Accessories are items that are not necessarily essential for an installation but are usually convenient additions, or they extend the operating convenience, or they allow checking of the

equipment performance, etc. It's possible to spend more on accessories than you paid for your transceiver!

Exactly what you get in accessories depends greatly on individual circumstances. You may have to get some accessories because you find they are necessary — a low pass filter, for example, to prevent TVI (or help anyway). Some accessories are simply 'dressing' and could never be envisaged as 'necessary', while others simply improve the convenience of an installation.

Whatever your excuse, or perhaps your need, browse through the survey and you'll get an idea of what's around.

Antenna Accessories

The simplest of antenna accessories are probably the humble connectors. Apart from the common-or-garden-variety PL-259 plug which you have no doubt already met, there are a whole host of plug/socket 'adaptors' (as they are called). These are useful in situations that suggest themselves when you don't have them on hand. I tell you — Murphy and his crazy laws sure get around!! There you are, you've just put the finishing touches to installing the transceiver in your new car — it fits great. Now just plug the antenna in and give it a burl . . . but the connector won't go in the socket — there isn't enough clearance at the back of the set (even if the set is removed and the antenna plugged in before mounting the transceiver). Call Murphy the magic word. And then get a 'right angle adaptor', put that on the transceiver antenna socket first — the antenna can then be plugged in from below. A right angle adaptor is simply a PL-259 plug, a right angle bend and then an SO-239 socket. Handy, no?

The common connectors/adaptors are illustrated in Figure 1. It is wise to keep a selection on hand. Most are quite cheap, less than \$3 generally, so

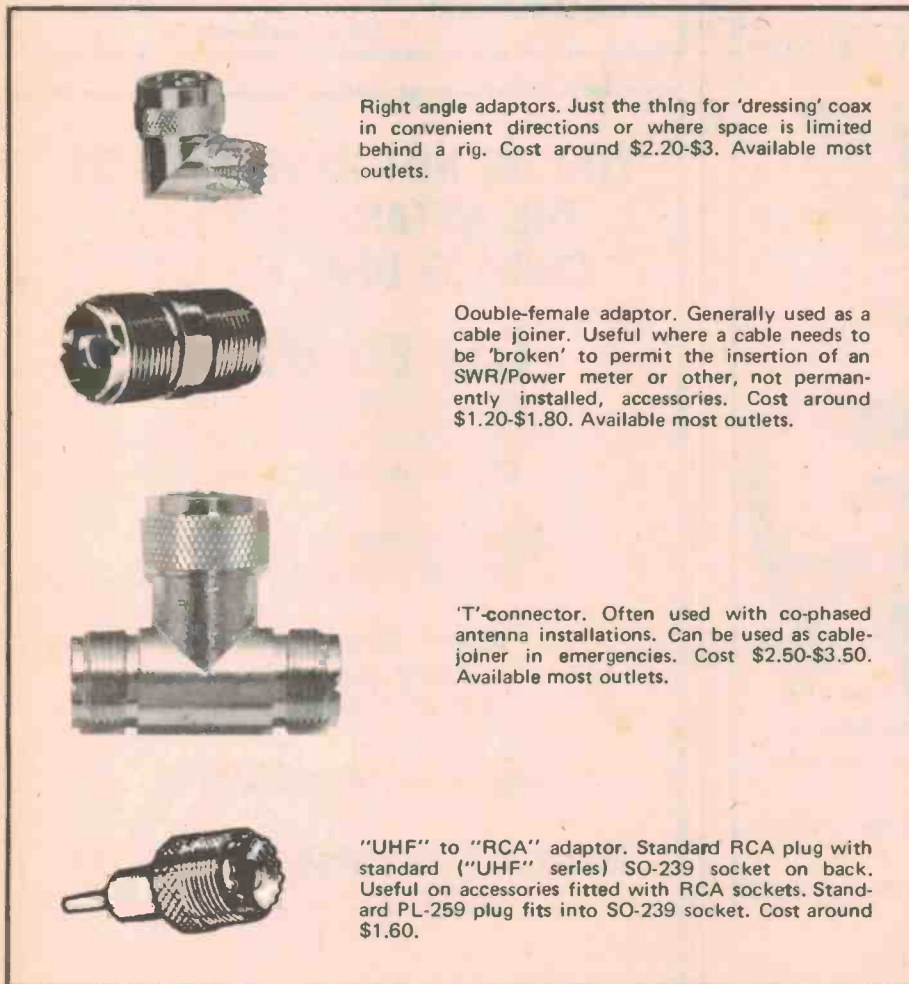


Fig. 1. Common connectors/adaptors.

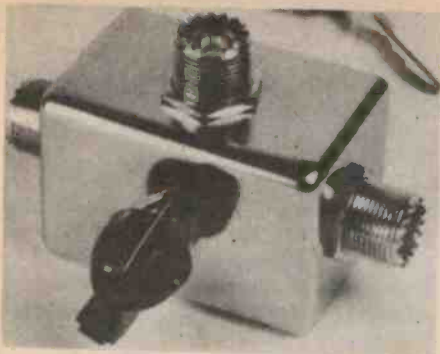


Fig. 2. Typical coaxial switches of the single-pole, two-way variety. Prices vary, but expect to pay around \$20 or more.

it won't break the bank to stock up.

Coaxial switches are often used in base station installations so that the operator can select different antennas, or perhaps switch between an antenna and dummy load/power meter to check transmitter performance. Alternatively, it may be used to switch an antenna between several transceivers or between a transceiver and a monitor or scanning receiver.

Coaxial switches are available in several combinations. Perhaps the most common, and certainly the least expensive, are the single-pole, two-way (or two-position) variety. Several are illustrated in Figure 2. Some types come with a rotary switch, some with a slide switch. A rotary, single-pole, two-way coax switch will set you back around \$20. A slide switch of the same variety will cost around \$12. A single-pole, three-way rotary switch will cost almost \$30, (there are some cheaper ones however, around \$10 mark) maybe more in some places, while a five-way rotary style will cost around \$32-\$35. But that's getting a bit extravagant — what would you do with all those five sockets? . . . Don't tell me, I can imagine!

What do you do when your antenna won't match? Why, you get a matchbox of course!! Now, there are a whole raft of devices on the market that will purportedly match a cranky transceiver to anything you can conjure up. Well, not quite perhaps, but you get my drift. They can be useful. For installations where there is not a long feedline run to the antenna, these devices can be quite useful where the antenna either refuses to be matched and produce an SWR within reason (see last month), or where the antenna has no provision for adjustment.

These device go under a whole variety of names such as 'matchers' (not the red-headed variety that your-old-man-told-you-to-trust-in-that-crazy-TV-advertisement); 'couplers' (and that's not what you think); 'antenna eliminator' (I know it's crazy but it really says that!) and the ubiquitous 'black box'.

Basically, they consist of circuitry that adjusts the antenna-feedline system for optimum resonance and matching to the correct impedance (50 ohms) to suit the transceiver. Some types may include an SWR/power meter for convenience. Various different types are illustrated in Figure 3. The simpler types sell for around \$12 to \$15, up to \$20 or so. If you really want to go to town, you can pay more for a coupler than for a transceiver (people

do!?) — as the Daiwa models from VICOM in Figure 3 show. These types would be more use to amateurs, though.

The 'antenna eliminator' type is really a matching and tuning system for standard car radio antennas. They permit the car radio and transceiver to be connected to the antenna simultaneously. Internal circuitry disconnects the car radio from the circuit when you go to transmit. Some types are simply a 'black box' without adjustments (such as the 'CB blackbox' from Peter Shalley) and these are preset. Other types (such as the 'Antenna eliminator' from Dick Smith) include a knob to allow adjustment of the tuning for best SWR. Sounds alright — but tempting for the inevitable 'knob twiddler' — mount this type out of their way. The Antenna Eliminator from Dick Smith



The simpler type of antenna matching devices generally include two controls: 'tune' and 'load' to effect correct resonance and matching of the antenna and feedline system. They cost around \$12-\$15. This model 140 matcher from CONTACT is \$15.

Somewhat more sophisticated is this Model CL-66 coupler by Daiwa. It is claimed to cover 3.5 MHz to 29 MHz and to match 10 through 600 ohms (unbalanced) to 50-70 ohms. It includes a four position coax switch and costs around \$120.

This deluxe model, also by Daiwa, includes an SWR and power meter. It also covers similar ranges as the CL-66 and sells for \$175. More useful for amateurs really.

The 'antenna eliminator'; similar units referred to as 'black box', for obvious reasons. These allow you to use a standard car radio antenna for CB. They permit both the transceiver and the car radio to be plugged in at the same time. The car radio is disconnected by the internal circuitry when you go to transmit. Some provide a tuning knob to obtain best match (low SWR) while others are pre-set. Cost depends on type and supplier; varies between \$25 to \$35.

Fig. 3. A variety of antenna matching or coupling devices.

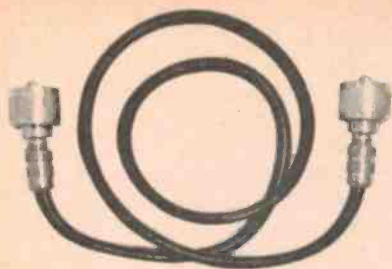


Fig. 4. A typical patch cable consisting of a short length of RG58 coax with PL-259 connectors on each end. Useful for patch connections to SWR meters, filters, couplers and other accessories. Obtainable in 0.5 m, 0.6 m and 1 m lengths. Cost depends on length — generally \$2-\$3.

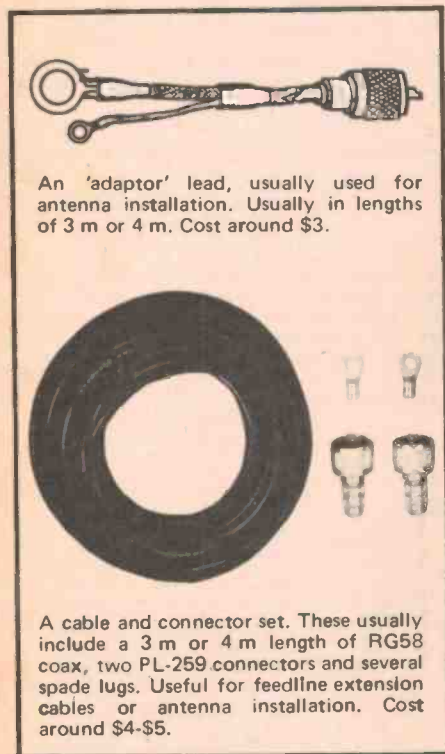


Fig. 5. Cable accessories suitable for various feedline applications.

costs under \$30 at present while the CB Blackbox from Peter Shalley is \$35.

There are a number of other antenna couplers about but they are generally for the amateur market and their operating features, etc, are geared that way. However, that does not mean to say that they are unsuitable for CB applications.

One advantage that goes along with the use of a coupler (except perhaps for the antenna eliminator variety) is the reduction of harmonics from the transmitter (weak transmissions from the transmitter at 2,3,4, etc, times the actual transmit frequency, generated in the transmitter circuitry). Harmonics can cause TVI. The very nature of the

tuned circuits generally employed in couplers/matchers effects the reduction.

If you don't use a coupler or matching device, or even if you do, it is a wise precaution to fit a 'low pass filter' in the feedline. This, as its name implies passes all frequencies below a given 'cutoff' frequency, usually around 34-36 MHz. It attenuates (severely reduces) any signals or transmissions above the cutoff frequency. Harmonics from 27 MHz transmissions fall at 54 MHz (near channel 1 TV), 81 MHz (in low-band VHF land mobile service), and 108 MHz (top end of FM band); these would probably be the strongest (2nd, 3rd and 4th harmonics). Some sets are worse than others regarding the radiation of harmonics.

Low pass filters should be installed close to the set with as short a length of feedline between the transceiver and the filter as possible. A low pass filter will set you back anything from less than \$10 to more than \$30. If you have a good quality transceiver ('top of the line', particularly an SSB transceiver) then one of the less expensive filters will probably be sufficient as the more expensive transceivers generally have lower harmonic output than the economy transceivers. For the latter, one of the more expensive filters, which provides higher degree of attenuation to harmonics, is a safer bet. Funny that, isn't it!

Now, to plug all your accessories in the feedline to the antenna you're going to need a short length of cable with two PL-259 plugs on each end — a 'patch' cable. These are quite inexpensive and can be obtained in a variety of lengths, generally 0.5m, 0.6m and 1m. Cost depends on length and varies from distributor to distributor — generally around \$2-\$3.

Apart from patch cables, 'adaptor' leads and cable/connector sets are available. An adaptor lead consists of a length of RG58 coax with a PL-259 connector on one end and a set of spade lugs attached to the inner conductor and braid at the other end. They are obtainable in lengths of about 3 m or 4 m for around \$3. They are often used for installing antennas, particularly those that comes without a cable.

A cable and connector set generally consists of a 3 m or 4 m length of RG58, a pair of PL-259 connectors (usually the solderless or crimp-on type), and a set of spade lugs. They come in handy when installing antennas as they can be made up in the same manner as an adaptor cable. They are also useful as a feedline extension cable, using double-female connectors to 'splice' in the extension.

Before leaving antenna accessories, I

guess one should mention coaxial lightning arrestors. These are inserted in the feedline to prevent damage to the transceiver etc during electrical storms when high voltages are induced on antennas — this situation is usually worse with base station antennas as they are generally mounted much higher than mobile or marine antennas. Even if lightning does not strike nearby, quite high voltage may build up on the antenna. If they discharge through the transceiver's receiver input circuitry then it may be damaged. The lightning arrestor will cause these high voltages to be passed to earth without harm to the transceiver — if installed according to instructions. They will not protect against a direct strike.

A coaxial lightning arrestor will cost you about \$10. They aren't available everywhere though. You might have to hunt around a bit. Bail Electronics Services have one, a model LA-72, for \$9.50.

Receiver Accessories

To improve receiver performance an RF amplifier may be connected in the antenna lead to boost the strength of the signals. These are useful where only an inefficient antenna system can be used, which affects receiver performance. Unfortunately, while you can 'hot-up' the receiver like this and hear all those signals you couldn't copy previously, transmitting efficiency is still poor.

The 'RF Signalizer' model Rp-10, which is available from Dick Smith and MS Components (at least) is a typical device for these sort of applications. It includes a very handy 'RF Gain' control that allows the operator to vary the sensitivity of the unit over a range from full gain of 15 dB (amplification of about 30) to an attenuation of 20 dB (attenuation of 100). This permits you to adjust for maximum gain on weak



Fig. 6. A CB converter. This model comes from Dick Smith for \$33.



Fig. 7. Typical remote speakers. The one on the left is best suited to cars whereas the horn speaker on the right is weatherproof and best suited to boats. Cost, around \$9-\$10.

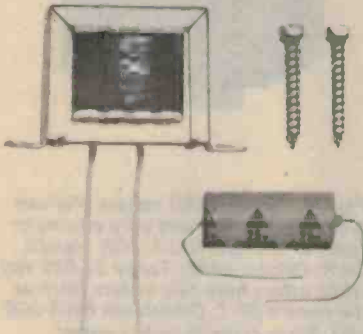


Fig. 8. 'Hot Line Filter' components to reduce ignition system and alternator noise in transceivers etc. Cost around \$3.

signals and lets you reduce the gain for strong local signals that would normally overload the receiver in your rig. Dig in for around \$40 to \$48 for this little accessory — depending on where you shop.

A popular 'accessory', if it could be classed as such, is a CB converter. Intended for mobile operation, these convert CB band signals down to the broadcast band range so that you can hear them in a clear spot on your car radio. It makes use of the existing car radio antenna and connects into the antenna feedline between the antenna and car radio. A front panel switch is included to switch it out and the car radio to normal operation. They cost \$33 to \$35 depending on where you shop. Even less on special!

A remote speaker can improve intelligibility of received signals (but not the intelligence of the other operator, more's the pity too often!) as the loudspeakers used in most CB rigs are quite small. In addition, the rig's speaker is often obscured somewhat (depending on the mounting position of the transceiver) and the actual sound output is restricted. A remote speaker can make quite a difference. Figure 7 shows two typical remote speakers. The square one

is best suited to installation in a car and can be mounted either under a dash or on top of it — or any other convenient place. Remote speakers are also very handy in base station installations. The horn speaker is weatherproof and ideal for mounting in a boat installation. Make sure you get a weatherproof type and not a 'weather-resistant' type (unless it can be mounted in a sheltered position). Either type cost around \$9-\$10.

Getting rid of hash generated by a vehicle's electrical system was generally covered in 'Installing a Transceiver in Your Car' (CBA Vol 1, No 1). However, even if the ignition system is fitted with suppression components along the lines set out, it is sometimes found that interference still gets through. Often it is conducted via the battery connections to the transceiver. Such cases call for a 'hot line filter'. It consists simply of an iron-cored inductance and a large value capacitor. It is connected in the 'hot' lead (i.e. the un-earthed lead) from the transceiver to the vehicle battery. The sort of components supplied are illustrated in Figure 8 and they should be connected in accordance with the instructions supplied. In addition to reducing ignition system noise conducted via the power lead these devices also reduce alternator/generator hash that is often conducted along the same path. A hot line filter will cost you about \$3. As they are usually constructed to operate on currents up to 20A, one filter can be used for several appliances.

Alternators and generators produce electrical noise that can be troublesome to eliminate and can severely interfere with clear reception — even on strong signals. This sort of noise sometimes appears on transmission as well! A coaxial capacitor, such as the one illustrated in Figure 9 is best for eliminating alternator whine and other noises. It should be installed as close as possible to the 'hot' output terminal of the alternator using as short a lead as possible. Some vehicle accessory shops carry these components.

Cars fitted with generators need a different sort of filter to reduce the electrical noise produced by the generator brushes — which can be quite considerable.

The generator filter illustrated in Figure 10 is a broadly tuned circuit that can be optimised to provide maximum noise reduction over a small band between 3 MHz and 30 MHz. It is suitable for any vehicle electrical system from 6 V to 24 V. It needs to be mounted as close as possible to the 'hot' output lead of the generator and connected with a short lead to the

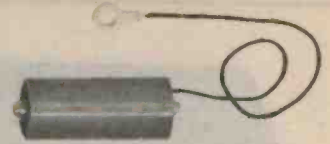


Fig. 9. A coaxial capacitor suitable for suppressing alternator whine and other noises. It is installed as close as possible to the 'hot' output terminal of the alternator.

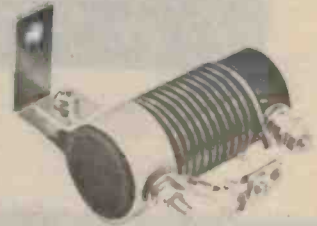


Fig. 10. A generator hash suppressor. It should be installed close to the generator and connected in series with the 'hot' lead from the generator. The trimmer is tuned to minimise hash in the receiver.

generator terminal. With the receiver on and the engine running somewhat above idle, the trimmer is adjusted to minimise any generator noise in the receiver.

Transmitter Accessories

The most common instrument used to check transmitter and antenna performance is the SWR meters is illustrated in Figure 11. Those types having a single meter are fitted with a 'Forward-Reverse' switch. The dual meter types have one meter to measure forward energy and one to measure reflected energy, in order to obtain the standing wave ratio. All types have a 'sensitivity' control.

To measure SWR, the 'Forward-Reverse' switch (where it is incorporated) should be switched to 'Forward'. The sensitivity is then adjusted, whilst transmitting, to give full scale deflection (or full scale deflection on the 'Forward' power meter for dual-meter types). Then switch to 'Reverse' while still transmitting and read the standing wave ratio, or read the SWR scale on the dual-meter type.

Many SWR meters have small switches on the back marked '50' and '75', or something similar. These should normally be switched to '50' as they set the instrument to measure correctly the SWR in a 50 ohm transmission line. Those that do not incorporate these switches are generally made for 50 ohm systems.

An SWR meter can be left permanently installed, if convenient, so that the performance of the transmitter and antenna system may be constantly monitored.



Fig. 11. Typical SWR meters. Various types and models have only one meter (such as the Kyoritsu K-109, Handic SWR, Calcom 9856, Tandy 21-525 etc) while others have two meters (such as the Handic SP-1, Oskerblock SWR-200 etc). Some types include a power measurement scale (like the Handic SP-1 or Oskerblock SWR-200) while others, usually the small inexpensive types, incorporate a field strength meter (like the Calcom 9856 or Handic SWR). Operation is explained in the text.

The simple style, combined SWR and field strength meter, cost between \$12 and \$18. The single meter SWR meters vary in price from about \$18 to \$25. The dual-meter, combination power and SWR meters cost anything from \$27 right up to about \$90 and more.

The power measurement facility on many SWR meters is very handy, but an accurate reading can only be obtained when the transmitter is connected to a dummy load via the SWR/power meter (unless the SWR is fairly low, say 1.5:1, or less). It is best to get one that has a 5 W or a 10 W scale. Trying to read 3 W or 4 W on a 20 W or 50 W scale is somewhat difficult, as you may appreciate.

Field Strength meters are useful for checking that an antenna is really radiating and they allow comparisons to be made between antennas operated under similar conditions. You can also get a rough idea of the radiation pattern of your mobile antenna. Park your car in a large, open paddock and, maintaining a constant distance from

the vehicle, walk around it in a circle noting relative signal strength readings at a number of points. This can then be plotted up on a graph. The field strength meter sensitivity should be set at some arbitrary point first, by trial and error if necessary, and then not touched. We might explain how to go about this in more detail in a later article.

A very handy accessory when checking a transceiver's performance is a 'dummy load'. It is simply a small power resistor of 50 ohms mounted in a PL-259 fitting. Some types add a small light that turns on when you transmit and which flickers to indicate modulation when you talk. On SSB, it will only light up when you talk — or something is very wrong! They are quite inexpensive, costing around \$2.50 to \$3.

The advantage of a dummy load is that it provides a load of correct impedance (no standing waves) and does not radiate (or pick up signals!) while tests are being conducted.

Operator Accessories

About the most useful operator accessory is an accessory operator! Capital outlay is virtually nil but upkeep and maintenance costs may stretch the budget on occasions. They are readily available — you don't even have to go down to your local CB shop to get one. The choice is yours.

A useful accessory in high noise situations, such as mobile, is a combination headphone/mic. A typical example is illustrated in Figure 12. It consists of a single headphone (you're got to hear what is going on around you), a microphone on a short boom, positioned to one side of your mouth and an in-line push-to-talk switch that can be clipped to your clothing. This feature is convenient as you don't have to reach for the usual push-button mic. The earphone blocks out external noises to give you clearer reception and the mic can be located for best voice pick up and least background noise pick up. Very

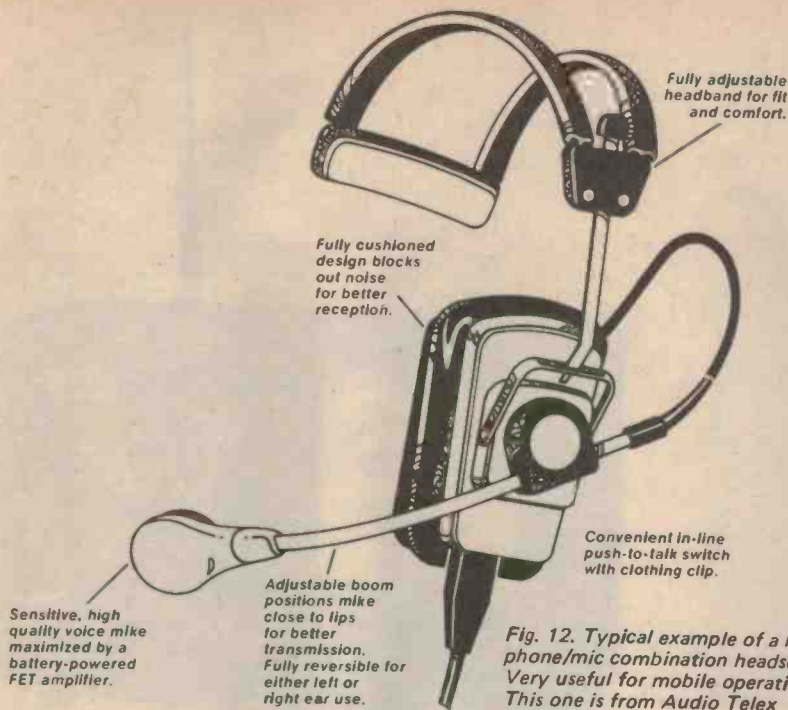


Fig. 12. Typical example of a head-phone/mic combination headset. Very useful for mobile operation. This one is from Audio Telex Communications.

useful in multiple-operator situations where transceivers are located near other transceivers, telephones, etc.

Keep losing your mic because it falls on the floor from the seat beside you when you go around corners? Well get a mic holder and attach it to a convenient spot on the dash in front of you. Then the mic is within easy reach all the time.

There are two basic types available — the screw-on type and the magnetic type. Both are self-explanatory. Either costs less than a dollar, so there's no excuse.

Having a transceiver permanently

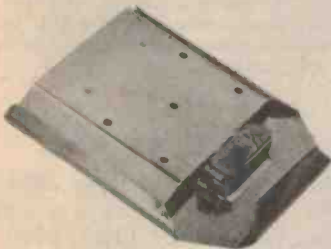


Fig. 13. One type of transceiver mount that allows the transceiver to be locked in and out of the mount easily for storage or portability away from a boat or car.

mounted in a boat or vehicle can be both an inconvenience and a risk. It is inconvenient to remove it if you want to use the equipment elsewhere and it is vulnerable to burglary.

The solution is to mount the transceiver on a 'lock-in' mount that is permanently bolted to the vehicle or boat but allows the transceiver to be installed or removed easily for storage (out of harm's way) or for transporting the equipment to another place. For what they are, they're quite inexpensive, costing around \$5 to under \$10.

Most CB transceivers are designed to operate from a nominal 12 V supply, specifically a vehicle battery. However, if you want to use your mobile as a base station a suitable supply is necessary. Sure, you can keep a car battery under the kitchen table but they are bulky, heavy and somewhat of a nuisance in that situation. And how are you going to keep it charged?

Power supplies that deliver a fixed output at around 12 V, or variable ones that can be set to the required voltage are suitable to power a mobile transceiver for a base station installation. It should be capable of delivering 3 A to 5 A, certainly no less than 2 A, if adequate performance is to be obtained.

Suitable power supplies are available that deliver a regulated fixed 12 V or so, or have a variable output, regulated, that can be varied between 0 V and 15 V. The fixed voltage types generally sell

Continued on page 18 . . .

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Manufacturer's Specifications Handic FS117 CB Tester

Makes it possible to carry out checks of
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2. Standing wave ratio (SWR) 1:1—1:3.
Min. 1 Watt
3. Modulation meter 0—100% $\pm 10\%$.
Min. 1 Watt
4. Relative field strength
5. 27 MHz signal generator. Output: 300 mV
min. no load.
6. Crystal condition test (bad or good
indication)

7. 27 MHz signal generator with tone mo-
dulation, 1000 Hz
8. Tone frequency generator. 1000 Hz.
Output: 1 V min. no load
9. 5W dummy load

Data:

Frequency: 27 MHz
Impedance: 50—52 ohm
Connectors: HN-210 (coaxial connectors)
Measuring instrument: 100 μ A
Power: 9 V (battery)
Size: 180 x 120 x 80 mm (W x H x D)
Weight: 0,8 kg

*Fig. 14. The 'Universal' test set marketed
by Handic, available from Peter Shalley
and M & K Communications. These sort
of instruments cost around \$45-\$55, the
specification above indicating the various
tests that can be performed.*

for a little less than \$30 while the
variable supplies are priced at around
\$40.

For the man who has not quite every-
thing, there is the 'universal' test set.
The Handic FS-117 instrument, illus-
trated in Figure 14, is typical of this
sort of 'accessory' (?). As can be seen
from the specification, a wide variety of
functions and checks can be carried out
using one of these. The Handic FS-117
is available from both Peter Shalley and

M & K Communications. Bail Elec-
tronics Services also carry a universal
test set, type RS-107, listed at \$57.

Apart from the main sorts of acces-
sories detailed in this article, other
accessory components such as micro-
phone, plugs and sockets, microphone
'curly' cords, in-line fuse holders, etc,
etc, can be obtained from many outlets
if you happen to need a replacement
component for one of these items or if
you wish to change one.

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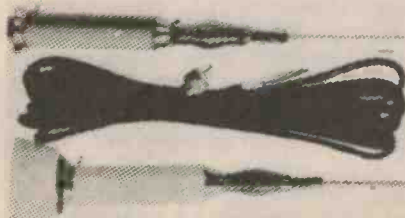
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CB CLUBS



Since the influx of cheap CB gear many clubs have been started to coordinate the efforts of those citizens who want to be able to use their equipment legally. But the clubs are not just political pressure-groups: some organise social events and provide ways for new members to learn more about citizens' radio.

Here Stephen Wagstaff, president of what is claimed to be the largest of these clubs, writes about what the clubs have to offer to the enthusiast.

THE ADVENT AND growth of CB radio in this country has attracted a lot of citizens from various walks of life. These citizens, their numbers vary from 12,000 to 15,000 (government sources) to the staggering sum of 250,000 (CB sources) all have a common problem in that many of their members are running against the present laws of the land. The law (Sec. 61A of the Commonwealth Act No. 8) has as its maximum penalty 5 years hard labour or \$1,000 fine.

The situation, in which these people are under threat of legal charges for what they think is a harmless hobby, has resulted in many of these individuals forming organisations and clubs to give themselves solidarity and support in their quest for legality.

Some of these clubs provide financial assistance for any of their members who are unlucky enough to be charged. And of course it is a good feeling to know that you have the close support of your club when faced with various charges under the Act.

When all the clubs joined together in November last year to participate in "The Great CB Convoy Rally" the public was made aware for the first time that a large number of citizens from all walks of life were involved in CB.

Clubs also make it easier when you are putting your case to police or various government departments. Who takes notice of one individual? Not too many people. But they can't turn a deaf ear to

the voices of hundreds and even thousands.

Clubs have been formed for many reasons. The most common one is the coming together of large numbers of people who are interested in legally operating transceivers on the 11 metre band.

Most clubs have electronics experts amongst their members. Most of these people are only too interested to go out of their way to help the other club members who need technical help.

The FX CB Club

In Sydney FX club has various printed sheets which are distributed to the members. These sheets have radio codes, the phonetic alphabet, the list of

THE FOX-TROT X-RAY CITIZEN'S BAND RADIO CLUB SYDNEY AUSTRALIA 21 MHz



From: Call Sign:
 To: Call Sign:
 Confirming our QSO on Time:
 C.S.T.: Mode: U.S.B.:
 L.S.B.: AM: Channel:
 Frequency
 Your Sigs were S R
 My rig is a running watts
 into a ant.
 Remarks:

P.S.E. / T.N.X. / Q.S.L.
 Box 509, BANKSTOWN 2200, N.S.W.

This is the QSL card used by pirate operators who are members of the club. This one looks a bit too like an amateur QSL card, surely the recipient would be more interested in twenty (base or mobile) than in which sideband was being used. But it's a start - no doubt the legalisation of hobby CB would mean more personal details (such as home address) could be exchanged.

frequencies and other necessary information to help the newcomer in adapting to his pastime.

To help the CB community as a whole the clubs have their own clean air rules (CAR). If their members follow them their relationships with other CBers will be cordial and relaxed.

Most of the clubs have versions of the CAR rules similar to those of the FX club. The FX Clean Air Rules are as follows:

1. The home channel is Ch7 (27.035 MHz). This channel is used solely for club contact. Members are requested to QSY (leave the channel) after 30 seconds.
2. Do not QSO (talk) on channels 7, 14 and 11 and 9 (this last channel is set up as an emergency channel).
3. Recognise breakers at the first possible opportunity, and ask them to standby if you are busy in conversation.
4. If you want to join in on the conversation wait until there is a break in the transmission, then say breaker, give your call sign, and say standing by.
5. At all times use your own call sign and handle while talking to other stations.
6. Keep a reasonable distance (ie, 50 metres) from all television transmitters, radio stations, and private houses to minimise interference.
7. Club members shall not transmit while under the influence of alcohol to the point whereby they cannot operate their rigs to the club standards.
8. No swearing or heavy slang words are permitted on air.
9. No whistling or playing music or any other interfering with QSOs is permitted.
10. There is a complete and total ban on giving out on air other people's telephone Nos., Home 10-20s (addresses), vehicle descriptions, etc, unless you

have that person's permission (preferably in writing).

NB: Any serious breach of these rules will result in a fine determined by the club committee.

Looking at these you will see that the clubs are trying to promote a responsible set of standards for their members to follow. If these standards are followed the club and members will, in their own right, be an asset to the community.

The FX club was the first full-time club to hold regular meetings of its members where they could meet each other and swap ideas. It reflects the new attitude to CB whereby CBers are not criminals but people who want to help each other. The days are gone when people were afraid to go on eyeballs and meet each other for fear of being caught by the law enforcement agencies.

Club Organisation

Most clubs are non-profit organisations whereby all money collected from members is put back into the club or into the battle to get CB legalised.

The FX club has various pieces of equipment available for members' use. Such equipment includes aerials, SWR meters and power meters. It also has a small library of magazines and technical books which members can use to gain information to build various accessories for their hobby.

The FX club also invites special guest speakers to meetings to instruct the clubs on subjects related to CB. Some of these speakers have been licensed amateurs, members of government departments, and representatives of rescue groups. From these speakers we learn a lot about our hobby and how we can help other organisations who use the 11 metre band for the benefit of the community.

CB clubs all over Australia have their own policing system for keeping nuisances off the air. No club member will converse with a known station who abuses the air waves and these nuisances soon become despondent when nobody will QSO with them. Of course in the eventuality that a club member abuses the air waves he will in most cases be chastised by his club and in cases that warrant it he will be expelled from the club.

With legislation and the policing of the air waves by clubs we can look forward to members using the air waves responsibly. With the large acceptance of the community towards CB more people are buying CB gear without giving thought to what to do with it. It is the aim of most clubs to give these people the benefit of experience gained by the older club members. It is much better for a person without CB experience to join one of the larger clubs and so gain information, than to try and learn by himself. At clubs he has a pool of information to draw from.

As well as the technical knowledge available to members, some clubs have a social committee whereby various outings are planned. The FX club encourages its members to mix with each other and we have organised many activities to achieve this. Over the last year our activities have included BBQs, picnics, boat rides, bowling nights, film nights and observation car rallies. All the people who attended these outings have had a good time and they have proven very popular with the members.

Some of the clubs are only QSL clubs (such as the KT club) where there are no social outings or meetings. However these clubs offer the benefit of using a PO Box number whereby people contacted by club members can write in while their identities are preserved.

Some of the social CB clubs also

CB CLUBS

have their own PO Box number for QSL and for contacting the club members. The FXCBRC has as its QSL Box, PO 509 Bankstown. The FX club also has an added advantage for its members: printed club QSL cards available at a small cost (5c). This enables the members to use a club card to send interstate or overseas and so save themselves the hassle and expense of having their own cards printed.

The FXCBRC also has a multi-coloured t-shirt with the club emblem printed on it with the club member's call sign and handle (if requested). The t-shirts give the members their identities and are very popular with both the male and the female members of the club.

There are many female members of the FXCBRC and they take an active part in the committee and the ladies auxiliary. We have many young ladies and married women and mothers who participate both in CB and organising club activities. Also set aside is a special FX number for the children of members. We promote the involve-

ment of the family in CB activities.

People from all walks of life are members of our club; we have teachers, public servants, business men, shopkeepers, clerks, policemen, truck drivers, factory workers, etc. The response by truck drivers to our club has resulted in us giving them a special suffix after their call sign so they can recognise each other on the long haul from Sydney around the "Circle".

The FXCBRC has a special service to SWR a CBer's antenna for him, free of charge, to enable him to obtain the optimum from his or her CB rig.

If after reading this article you decide to join a club bear in mind that there are many clubs in different areas. Contact a CBer in your area and he will discuss with you the advantages of joining the local club.

The address of the Foxtrot Xray Citizens' Band Radio Club is Box 509 PO Bankstown 2200 or you can ring 70-5515 and speak to the club president (Stephen Wagstaff). The FXCBRC has members in country areas as well as interstate and anyone is welcome to join.

Other clubs can be contacted by writing to the NCRA, PO Box M101 Sydney Mail Exchange 2012.

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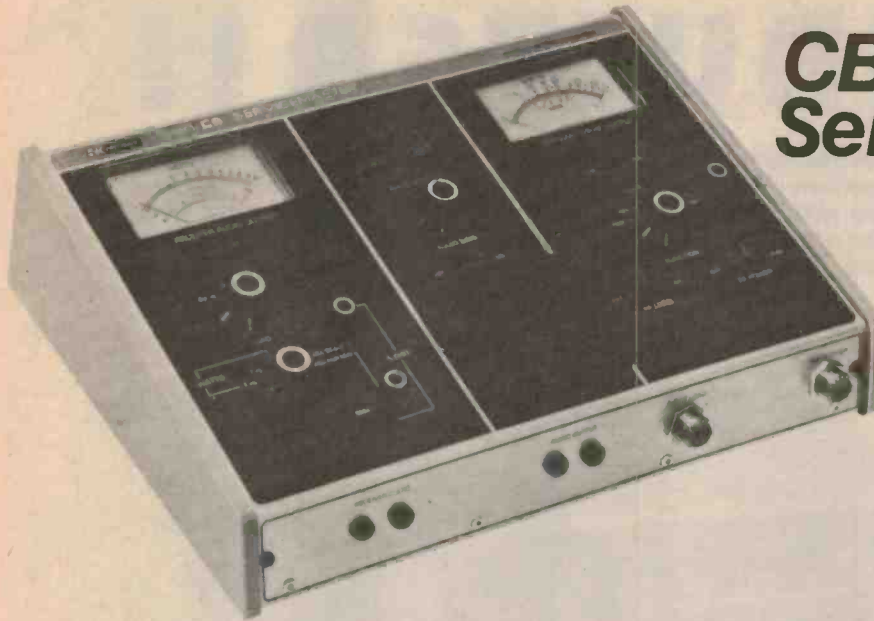
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	166 Logan Road, Buranda, BRISBANE	QLD
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	and many distributors throughout Australia	
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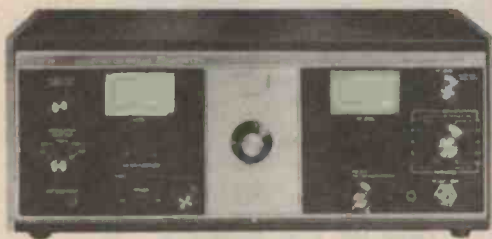
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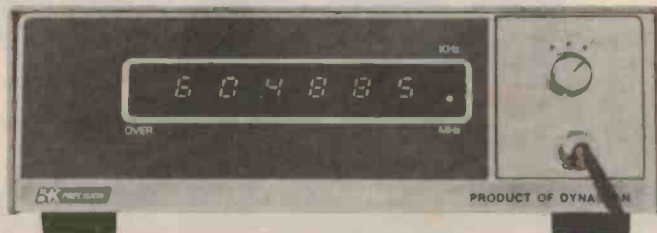
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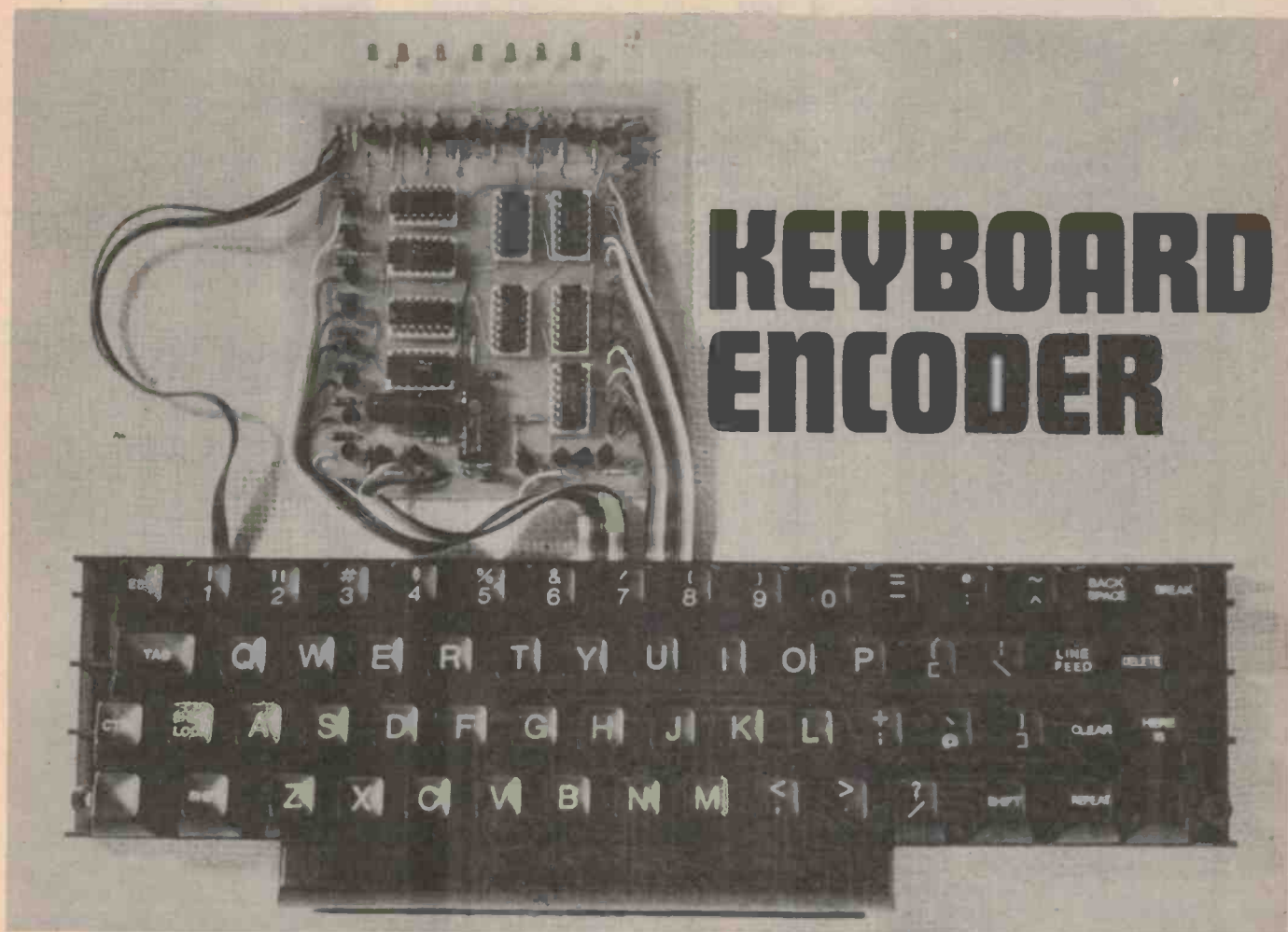
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KEYBOARD ENCODER

Last December we published details of an ASCII encoder, Project 631, which used an HD0165 encoder IC. For a few months this device has been difficult to obtain, but that didn't deter one of our readers, David Kinny, who redesigned the project to overcome this problem. Here David describes his project, ETI 631-2.

**COMPUTER
TERMINAL
PROJECTS**

ONE OF THE most frustrating problems that can confront designers of electronic equipment is that of component availability. Often the problem only occurs after a magazine design has been finalized and published, despite the fact that component suppliers may have given assurances of availability.

This project was designed as an alternative to the ETI 631 Keyboard Encoder, which has had its share of these problems. I soon realized that it would in fact be somewhat cheaper to build than the previous design. The prototype

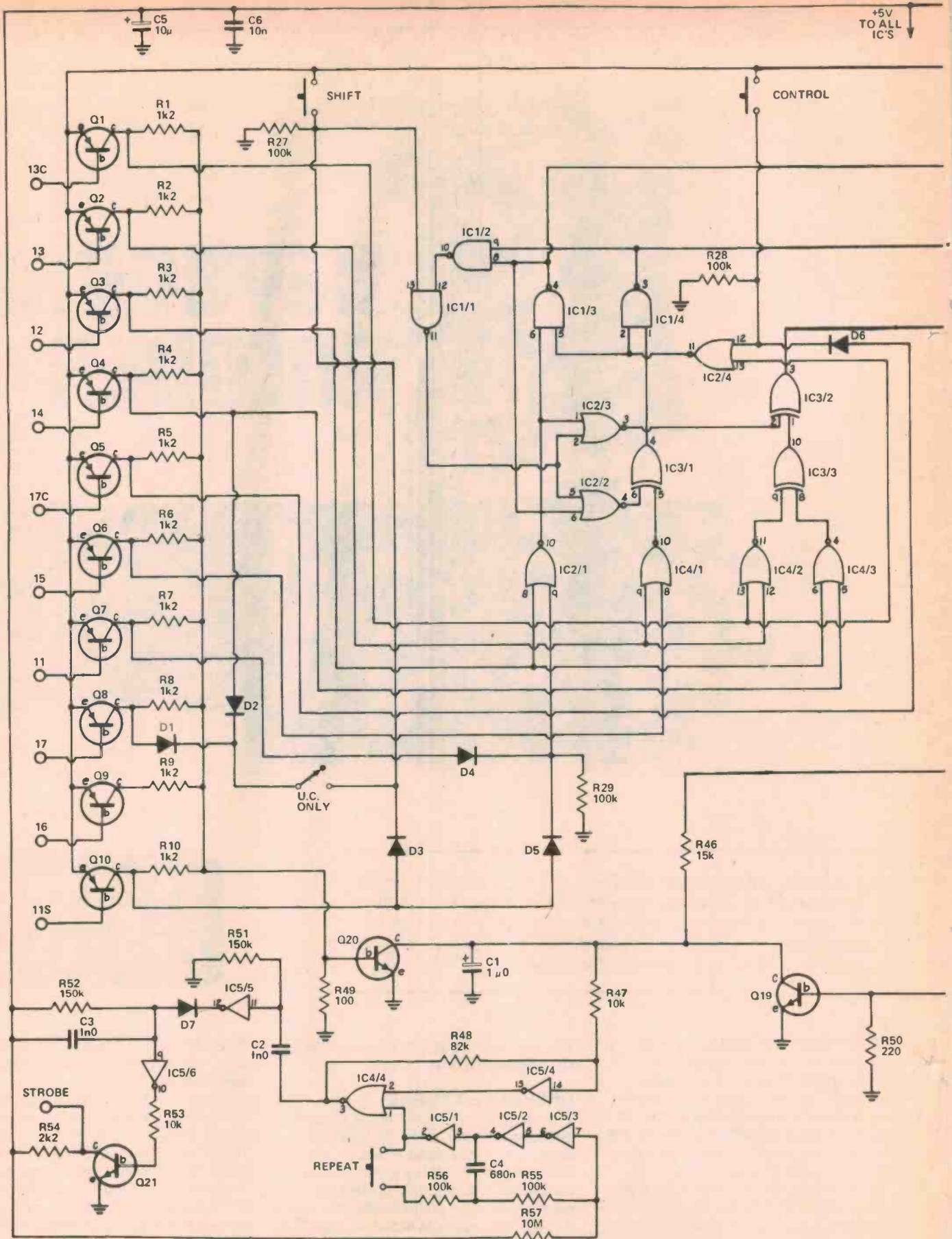
was built for about \$10 plus the cost of the printed circuit board.

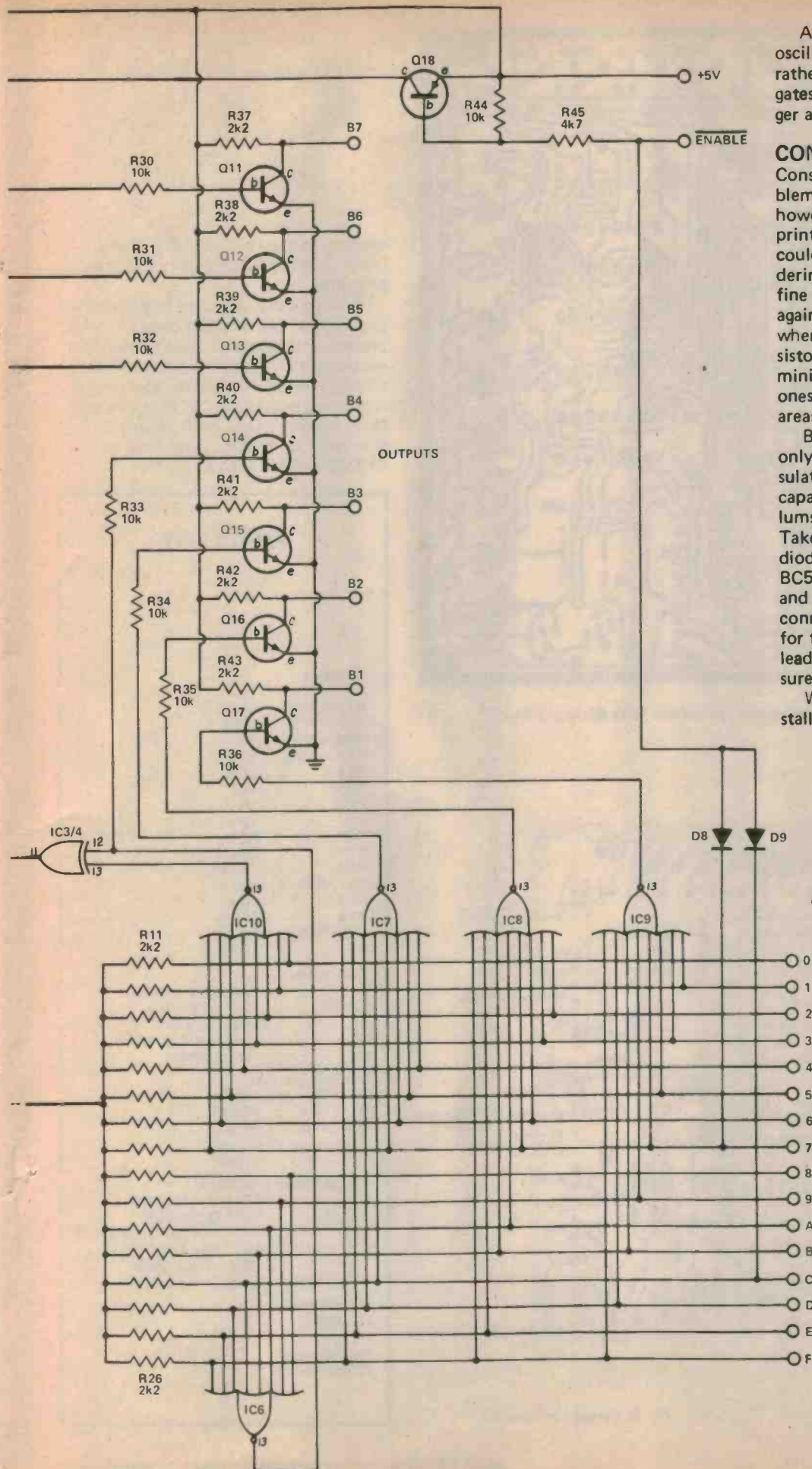
DESIGN FEATURES

The design has the same input and output specifications as the ETI 631 encoder, and can be used directly with ETI 632 Video Display Unit. All the components used in this project are readily available. A single sided pc board is used; this results in a cost saving since these are cheaper to manufacture than double sided boards. The board is almost the same size as that used in the

ETI 631, so no problems should arise if you have already designed a chassis to take that board.

How this design differs from the previous design is that Small Scale Integrated CMOS or LOC MOS ICs are used for all logic functions. Whereas the 631 used the HD0165 IC to encode the 16 keyboard lines O to F, we now use four 4078 8-input NOR gates to generate output bits 1 to 4. A fifth 4078 is used along with a spare EXCLUSIVE-OR gate to generate the "key pressed" signal.





Another difference is the repeat oscillator, which uses 3 INVERT gates rather than a 555 timer IC. INVERT gates are also used for the Schmitt trigger and monostable.

CONSTRUCTION

Construction should present no problem to the experienced constructor, however take care, as some of the printed circuit tracks are very fine and could be damaged by heavy-handed soldering. Use a miniature type iron and fine gauge solder. Normal precautions against static damage should be taken when soldering the ICs. Note that resistors, if 1/2W types, should be the new miniature ones, not the older larger ones, which could cause problems in areas of high component density.

Begin by soldering in the wire links, only two of which needed to be insulated. Then solder in the resistors and capacitors making sure the two tantalums, C1 and C5, are correctly oriented. Take similar precautions with the diodes. Beware, there are two types of BC548/558 transistors, the Philips type and the other. They have different lead connections. This board was designed for the Philips type (with offset base lead), so if you use the other type make sure you orient them correctly.

When all other components are installed, solder in the ICs. Do not use IC

Fig. 1. Circuit diagram of the encoder.

KEYBOARD ENCODER

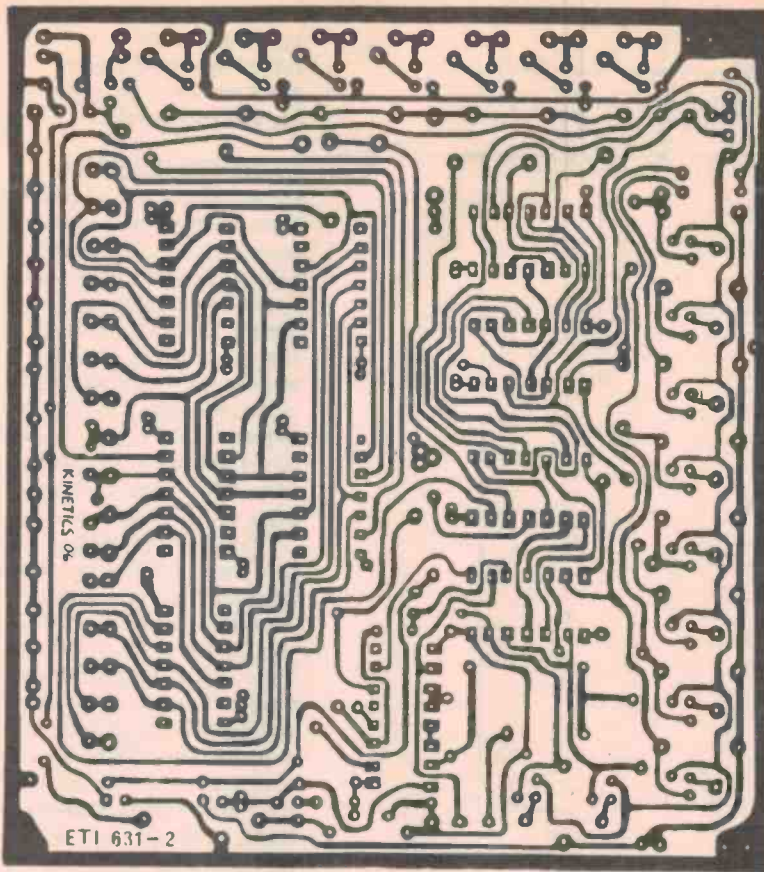


Fig. 2. Artwork for the printed circuit board (note: ETI 631-2 is a single-sided board).

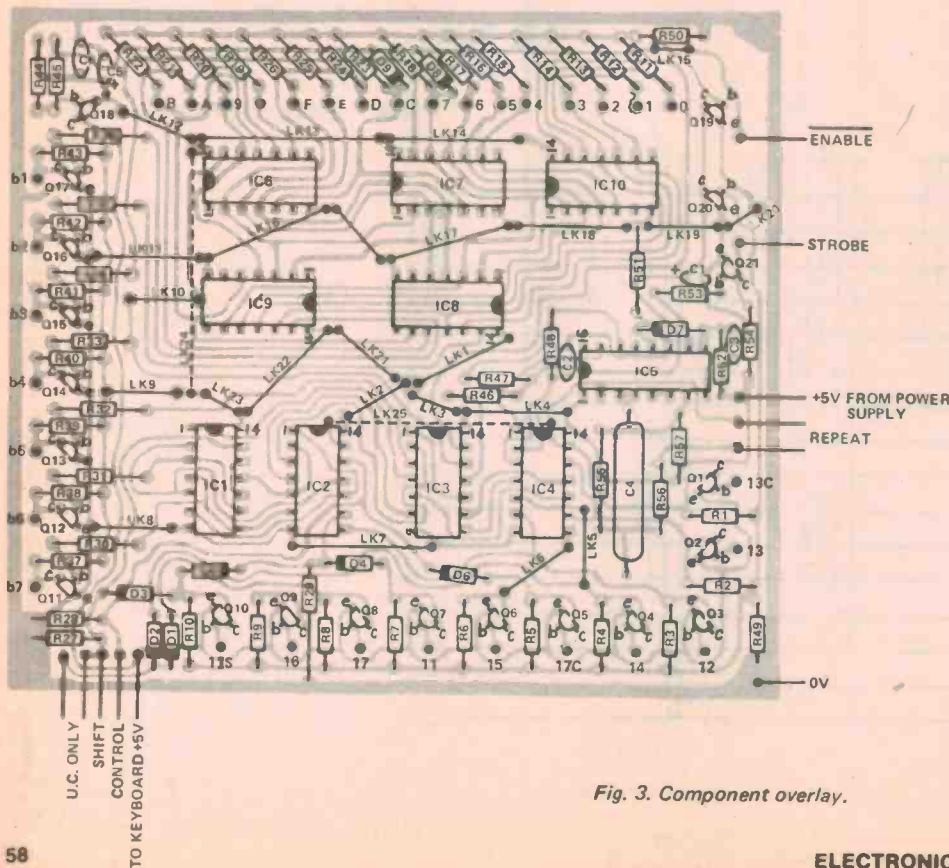


Fig. 3. Component overlay.

sockets, as they tend to take up more room than the ICs and can create space problems.

Ribbon cable was used to wire up the keyboard — being colour coded it helps prevent wiring errors. The keyboard connections are identical to those of the ETI 631, except that both sides of the repeat key must be wired to the board. Note that lines O to F do not run in that order on the pc board; they run 01234567CDEF89AB.

PARTS LIST

Resistors:

R1 — R10	1k2
R11 — R26	2k2
R27 — R29	100k
R30 — R36	10k
R37 — R43	2k2
R44 —	10 k
R45	4k7
R46	15 k
R47	10 k
R48	82 k
R49	100 ohms
R50	220 ohms
R51, R52	150 k
R53	10 k
R54	2k2
R55, R56	100 k
R57	10 M

Capacitors:

C1	1 μ 0 10 V tantalum
C2, C3	1 n0 polyester
C4	680 n polyester
C5	10 μ tantalum 10 V
C6	10n ceramic

Semiconductors:

D1 — D9	1N914
Q1 — Q10	BC558
Q11 — Q17	BC548
Q18	BC558
Q19 — Q21	BC548
ICs, CMOS or LOC MOS	
IC1	4011 Quad NAND
IC2, IC4	4001 Quad NOR
IC3	4030 or 4070 Quad X-OR
IC5	4049 Hex INVERT
	(Do not use 4009)
IC6 — IC10	4078 8 - input NOR

Miscellaneous

- PC board
- PC pins
- Hookup wire
- Ribbon cable

TESTING

To test the unit, seven LEDs can be connected from the output pins to earth, to provide a visual output check. Ground the ENABLE input, and power up. A 1110000 code should be present on the output, this is inherent in the design and no cause for worry. If a keyboard has been wired, check to see the correct outputs are generated for all keys, including two-key (Control and Shift) functions. If a mistake is noted it is almost certainly a keyboard wiring fault. Connect the ENABLE input to +50V, this should give output 1111111, which should be unaffected by all keys.

If a keyboard has not yet been wired up, a jumper lead can be used to connect one of lines O to F to one of the other ten lines to check outputs. The Strobe output cannot easily be checked except with an oscilloscope, this should not however be necessary.

How It Works

This encoder is a 16-line by 10-line matrix encoder. When a character key is pressed one of the 16 lines O to F is connected to the base of one of the 10 transistors Q1 to Q10. This biases the transistor on, giving a high logic level on that line and on the collector of the transistor. ICs 6 to 9 encode lines O to F, generating the lower 4 output bits. ICs 1 to 4, connected to the collectors of Q1 to Q10, generate the upper 3 output bits, as well as providing control and shift functions. The outputs of all these ICs are negative logic levels, since transistors Q11 to Q17 are used to buffer the IC outputs.

Q18 switches the +5 V rail supplying Q1 to Q10 and the control and shift keys. When the enable input is high, Q18 will be turned off and the emitters of Q1 to Q10 will be floating, disabling the upper 3 output bits. The enable input is also connected via diodes D8 and D9 to lines 7 and C, which disables output bits 1 to 4.

Shift functions are created by inverting bit 5 if bit 7 is low, and inverting bit 6 if bit 7 is high. This occurs whenever the shift key is pressed, or if the 'upper case only' switch is closed, whenever an alphabetical key is pressed. Line 11s is used for the space key, and gives an automatic shift. Control functions are created by setting bits 6 and 7 low, this occurs either when the control key is pressed, or when a key on line 13c or 17c is pressed. Control functions always override shift functions: if the shift key

has been locked and a control key is pressed the correct control output code will be generated.

To create a 'key pressed' signal, the output of IC 6 is EXCLUSIVE-ORed with the output of IC10. The output of the EXCLUSIVE-OR gate charges C1 via R46. C1 connects via R47 to a schmitt trigger formed by IC4/4 and IC5/4. The output of the schmitt trigger goes high about 15 ms after a key is pressed, causing the monostable, formed by IC5/5 and IC5/6, to generate a 200 microsecond pulse, which is buffered by Q21, providing the strobe (Data Available) output.

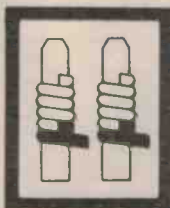
Keyboard entering errors are detected by Q20 and Q19. When one key is pressed voltages are developed across R49 and R50, both of these voltages are about 400 mV, insufficient to bias Q19 or Q20 on. If two keys are pressed simultaneously the voltage across either R49 or R50 is sufficient to turn the respective transistor on, preventing C1 from charging and disabling the strobe output.

The three spare gates of IC5 are connected as a ring oscillator with a frequency of about 10 Hz. When the repeat key is pressed the oscillator runs, clocking the schmitt trigger. If no key has been pressed, however, this has no effect upon the strobe output. R57 prevents gates IC5/1, 2 & 3 from operating in the linear mode when the repeat key is not pressed.



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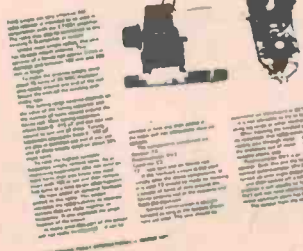
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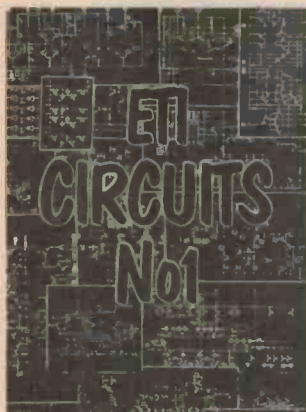
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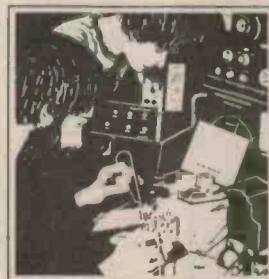
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THE AVERAGE HOBBYIST IS often daunted at going "digital" due to the cost and complexity of the conversion of the analogue signal to a digital signal. However, the A-D conversion can be performed in cases where great accuracy is not required by the use of a voltage controlled oscillator whose output is gated, for a known time interval, into a counter. It is on this principle that a simple digital thermometer was constructed, utilizing the ET1533 counter display module.

The thermometer is designed to operate over the range from 0°C to 50°C with an accuracy of ±0.2°C. The ultimate accuracy and sensitivity of the instrument is primarily a function of the sensor used, the input amplifier and the linearity and frequency stability of the VCO. The measurement of the temperature is based on the fact that the forward voltage-temperature coefficient of a silicon diode is linear with temperature (in the temperature range of interest). This voltage (approximately) -2mV/°C is amplified by a dc amplifier whose output controls the VCO. The VCO's output is then fed to a gate which is controlled by a second oscillator which determines the sampling time of the instrument. The output from the gate is finally fed to the counter display unit.

The circuit is relatively simple,

consisting of four integrated circuits. A bridge consisting of resistors R₁, R₂, R₃, R₄, RV₁ and the temperature sensing diodes (two used, to improve the sensitivity) is used in conjunction with a DC amplifier, IC₁, to detect the temperature variations. As the input voltage to the op amp is only -4mV/°C it is necessary to select an amplifier with a low temperature drift characteristics, such as the LM308. The output of the DC amplifier feeds directly into the VCO which is a single-chip VCO (LM566) which has both square and triangle wave outputs. The VCO has a frequency stability of approximately 200 ppm/°C when used with a silver mica timing capacitor. The frequency of the VCO is given by

$$f_0 = \frac{2(V_s - V_c)}{R_5 C_1 V_s}$$

$$\text{where } \frac{3}{4} V_s < V_c < V_s$$

thus the maximum frequency for a V_s of 12 V occurs at a V_c of 9 V (being dependent on R₅C₁). For the circuit values given, f₀ = 50 kHz at 9 V. Note that, as it is necessary to swing the control voltage between 9 V and 12 V to obtain a 0 kHz to 50 kHz frequency

variation, the VCO's supply is adjusted to 12 V by the zener diode whilst the rest of the circuit uses a 15 V supply. The output of the VCO is fed via a buffer amplifier, T₁, to one input of a CMOS NAND gate. The sampling times are controlled by an astable multivibrator formed by IC₃, a 555 timer. The multivibrator enables the NAND gate for 0.01 then disengages the gate for 0.8s. The resultant pulse train is fed to the clock input of the counter. A reset pulse to reset the counter is derived from the differentiator R₁₂C₂. Thus if we have a 20 kHz signal on a gate held open for 0.01s, we get 200 pulses which correspond to a temperature of 20°C. The count time is then 0.01s and the sample update time 0.81s.

The setting-up procedure is as follows; initially the sensors are placed at 0°C in an ice bath and RV₁ adjusted to give 12 V at the output of the op-amp with RV₂ set at midrange. It is necessary to then place the sensors in a warm water bath at 50°C and adjust RV₂ for 9 V at the output of the op-amp. This procedure may need to be repeated several times to ensure accurate calibration. Finally the gate-open time is adjusted by varying RV₃ so the display indicates the correct temperature.

The power supply requirements are satisfied by the use of 15 V three-terminal regulators.

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Model PP-30-2 Power Supply

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MODEL	PP-18-2	PP-18-3	PP-18-5	PP-30-1	PP-30-2	PP-30-5	PP-30-10	PP-30-20
OUTPUT VOLTAGE	0-18V	0-18V	0-18V	0-30V	0-30V	0-30V	0-30V	0-30V
OUTPUT CURRENT MAXIMUM	2A	3A	5A	1A	2A	5A	10A	20A
CONSTANT CURRENT	YES	YES	YES	YES	YES	YES	YES	YES
PRICE	\$99	\$130	\$108	\$101	\$137	\$276	\$316	\$374
MODEL	PP-60-2	PP-60-3	PP-15-10	PP-10-40	PP-100-1	PP-30-1-2	PP-30-2-2	
OUTPUT VOLTAGE	0-60V	0-60V	0-15V	0-10V	0-100V	2x (0-30V)	2x (0-30V)	
OUTPUT CURRENT MAXIMUM	2A	3A	10A	40A	1A	2x (1A)	2x (2A)	
CONSTANT CURRENT	YES	YES	YES	YES	YES	YES	YES	
PRICE	\$291	\$374	\$221	\$366	\$291	\$222	\$267	
MODEL	PAD-260-60	PP-100-2A						
OUTPUT VOLTAGE	0-130V AC 0-60V AC 0-260V AC	0-100V						
OUTPUT CURRENT	1A AC 1A DC	2A						
CONSTANT CURRENT	YES DC ONLY	YES						
PRICE	\$328	\$347						

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BFY51.....	.71c
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BIP BEACON

A. J. Lowe designed this project to help a friend from his local Blind Association. All the device does is emit a continuous series of 'bips' to enable a blind person get his bearings. So if you know anyone who might like one, have a go at making this simple project.

WHEN BLIND PEOPLE put something down, working around the house or garden, they sometimes have difficulty in locating it again. The Bip Beacon provides a sound signal on to which they can 'home'.

When two blind people arrange to meet at a certain place, each has difficulty in knowing when the other has arrived. The Bip Beacon provides an innocuous signal that says 'I'm here'.

You can build a beacon for about \$3. If you don't know any blind people contact your local Blind Association, they'll be glad to hear from you. Many of these beacons have been built and eagerly accepted by blind folk.

What It Does

The beacon simply emits a series of 'bips' (a 'bip' is a short 'beep') at four second intervals. That's all, but it's enough.

How It Works

The circuit, shown in Fig. 1, is based on one IC, a quad two-input NOR gate. Two of the gates form a slow-running multivibrator the output of which enables the other two gates to form an oscillator whose output is amplified by transistor Q1. Component values are chosen so that a short duration audio note is produced every four seconds or so.

These beacons are most conveniently built in transistor radio cases. Most readers will be able to find one or two of them in which the radio is dead and not worth fixing. As long as the case and speaker are intact that's all that matters.

A suitable printed circuit board design is shown in Fig. 3. The actual circuit is in the middle of a board measuring 65 x 50 mm. This size is large enough to reach the support posts in the typical pocket radio.



The board should be cut and shaped to suit the exact shape of the case. A good way of doing this is first to make a cardboard template and get that right, and then use it to mark the pc board for cutting.

Care must be taken in locating the holes in the board for the mounting screws. Holes are not shown in Fig. 3 as they must be drilled to suit each individual case. A good way of finding hole positions is to make a transparent template from stiff plastic film, using the card template as a guide. The support posts can be seen through this clear template and it is easy to mark the hole positions and transfer them to the pc board.

All this cutting, shaping and drilling should be done before mounting any components.

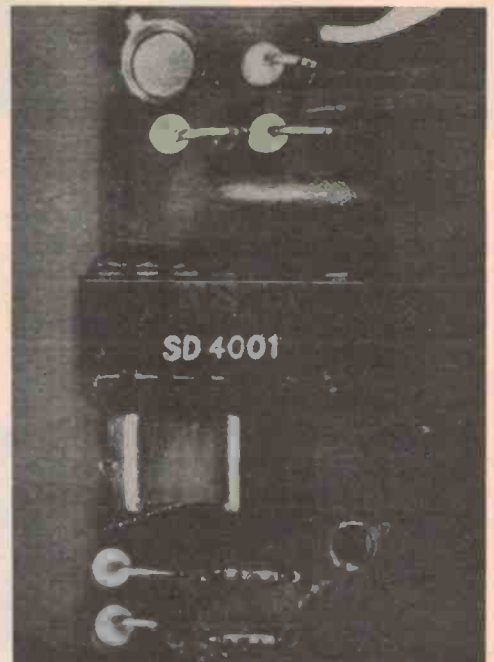
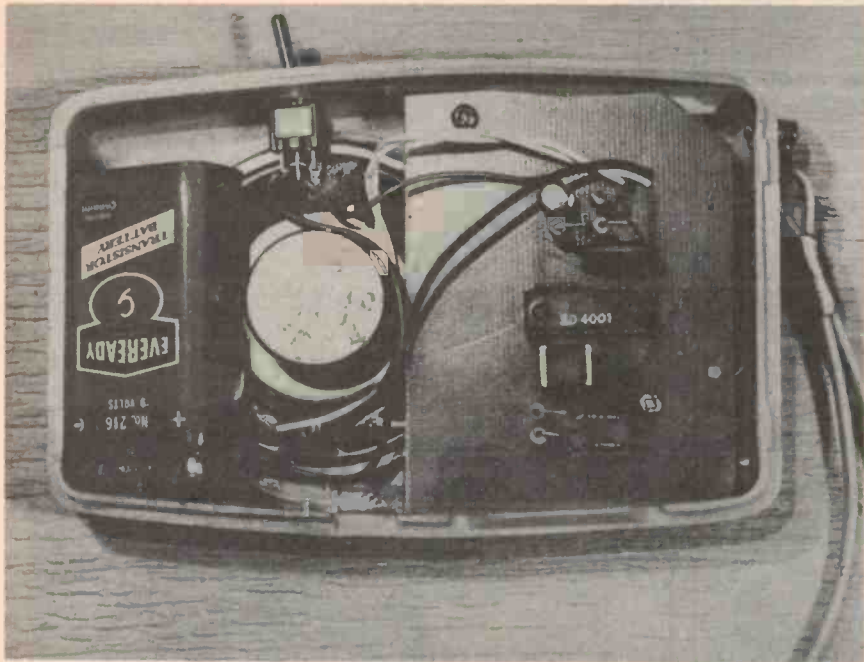
Next mount all the components except R2, whose value must be determined on test to allow for variations in the value of C1. Take care with the correct orientation and handling of IC1 which is a CMOS IC.

The board, with all components except R2 mounted, is then hooked up to the battery and speaker and a value of R2 selected so that the bips occur every four seconds. As R2 is a high value resistor 5.6 megohms or more, it must not be held between hands during this test or spurious results will be obtained. Use test leads with clips.

Finally insert R2 and assemble the board, switch and battery in the case. See the photos.

As these beacons are needed by people who can't repair them themselves, they should be made very

Project 243



The photographs above show the construction of the Bip Beacon on a pcb which fits inside a cheap transistor radio case.

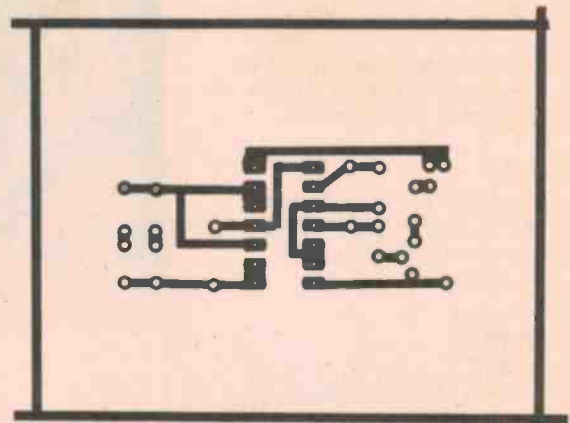
thoroughly — with first class soldered joints.

The photo of the prototype shows one of the Siemens type capacitors in the C1 position. If these are difficult to obtain then a 0.47 μF ceramic capacitor can be used instead. The diodes D1 and D2 can be any small signal diodes.

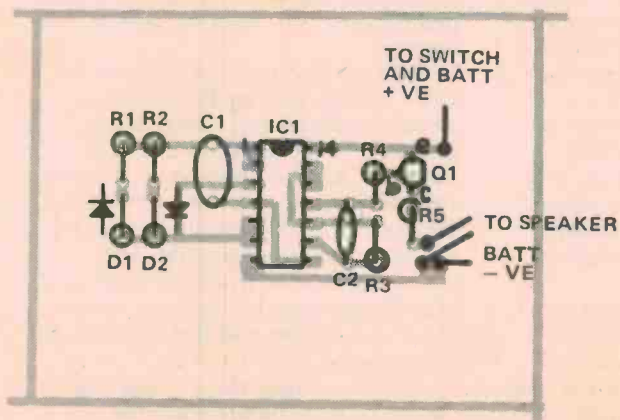
Clubs

Electronic clubs who undertake production of beacons for local blind associations might approach local chain stores to see whether they can provide any new but 'dud' radios which they might otherwise throw away.

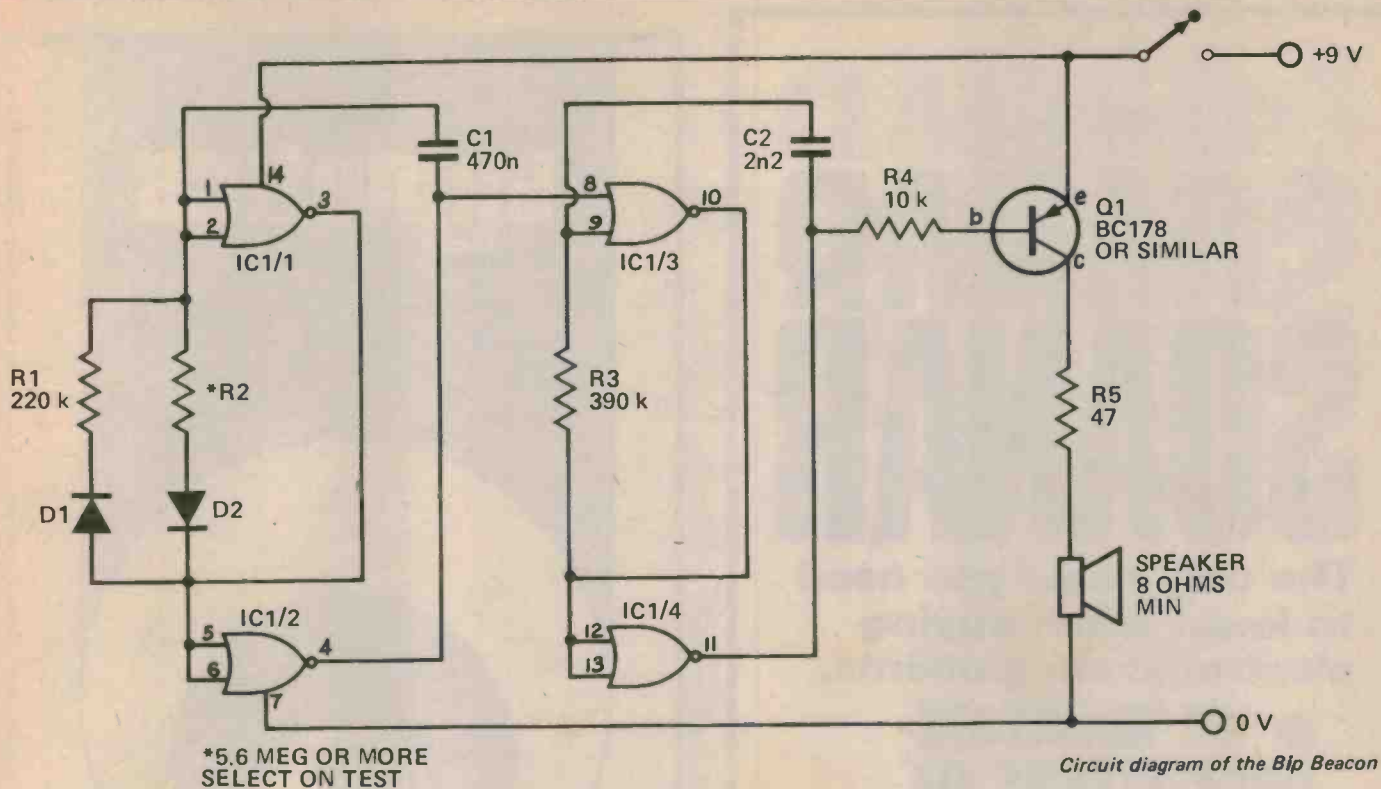
Well there it is — a not very difficult project, but a worthwhile one to help the sightless to 'see'.



The pcb artwork.



The component overlay.



PARTS LIST - ETI 243

Resistors all 1/4 watt

R1 220 k
R2 5M6 or more - select on test
R3 390 k
R4 10 k
R5 47 ohms

Capacitors

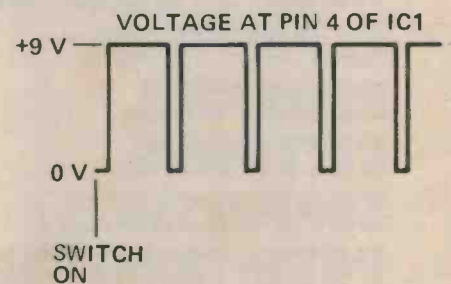
C1 470 n non polarised - Siemens

C2 type or ceramic
2n2 ceramic

Semiconductors

D1 and D2 diodes 1N914 or similar
Q1 transistor PNP type BC 178 or similar
IC1 4001 CMOS

Transistor radio case with speaker and 9 volt battery.
Miniature toggle switch.



How It Works

The IC contains four (hence its name QUAD) NOR gates which are separate from one another except for the power supply connections. Consider any of the NOR gates, such as gate 1, which has its input terminals connected to pins 1 and 2 of the IC and its output terminal connected to pin 3. The NOR description is a short way of saying NOT OR, and it means that - only when the input voltage on pin 1 or pin 2 or both pin 1 and pin 2 is high, (i.e. above about 3½ volts) then the output voltage at pin 3 is low (i.e., at the level of the negative rail). If neither pin 1 nor pin 2 is high i.e. both are low, then the output voltage on pin 3 is high.

That's all there is to a NOR gate. Now, applying this knowledge to the interconnection of the four gates, the description goes as follows:

Consider gates 1 and 2. Immediately after 'switch on' there is no reason why there should be any voltage at pins 1, 2, 5 and 6. So if 1 and 2 are low, then pin 3 must go high. As this pin 3 is connected to pins 5 and 6 they must go high, and so pin 4 goes low. Now capacitor C1 charges

fairly rapidly from pins 3, 5 and 6 through diode D1 and resistor R1. As C1 charges, the voltage at its top end, and hence on pins 1 and 2, increases. When that voltage is high enough gate 1 inverts (because with pins 1 and 2 connected it is an inverter) and its output pin 3 goes low. This makes pins 5 and 6 go low, and hence pin 4 goes high.

Next, C1 discharges through diode D2 and resistor R2 - slowly, as R2 is a very high value resistor. Ultimately the voltage of the top of C1 has fallen to a low value and so it takes pins 1 and 2 down low. So pin 3 goes high, 5 and 6 go high, and 4 goes low, and the process repeats over and over.

From this description it can be seen that the voltage at pin 4 would follow the graph shown in Fig. 2.

Now consider gates 3 and 4. A moment after 'switch on' pin 8 is low because it is connected to pin 4 which is low. Also pin 9 is low because there is no reason why it should be high. So pin 10 goes high, and, following the earlier description, pins 12 and 13 go high and 11 goes low, C2 charges through R3 and when it is

charged, which doesn't take long as it is a very small capacitor, then its top end is high. So pin 9 is high. This then sends pin 10 low (that's the NOR gate action), pins 12 and 13 low, and 11 high. The capacitor discharges rapidly through R3 and the cycle repeats at an audio frequency. Its output, pin 11, turns on and off transistor Q1 and so a note is produced by the speaker.

However, at any time when pin 8 is high gate 3 ensures that pin 10 is held low. Hence 12 and 13 go low and pin 11 goes high and transistor Q1 is turned off.

Now pin 8 is connected to pin 4, which, as already seen is high for most of the time and low for only a small fraction of the time - while C1 is charging. Thus the audio output occurs for only short intervals when pin 4 is low.

By suitable choice of R1 and R2 the device has been made to give a short bip every four seconds or so.

The pitch of the audio note can be adjusted by selection of R3 and C2.

As the IC used is of the CMOS type its current drain is very low and a long battery life can be expected.

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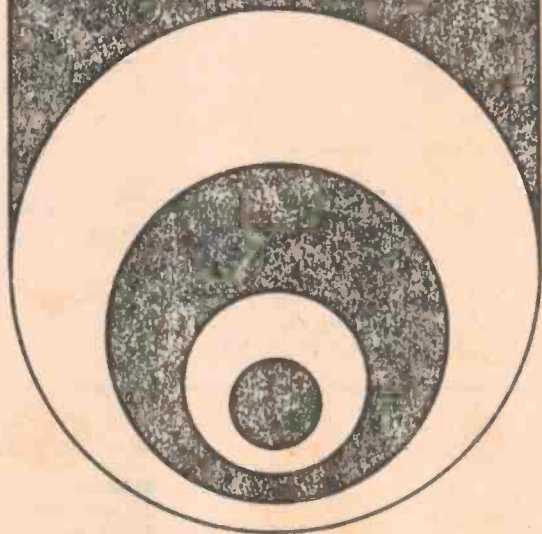
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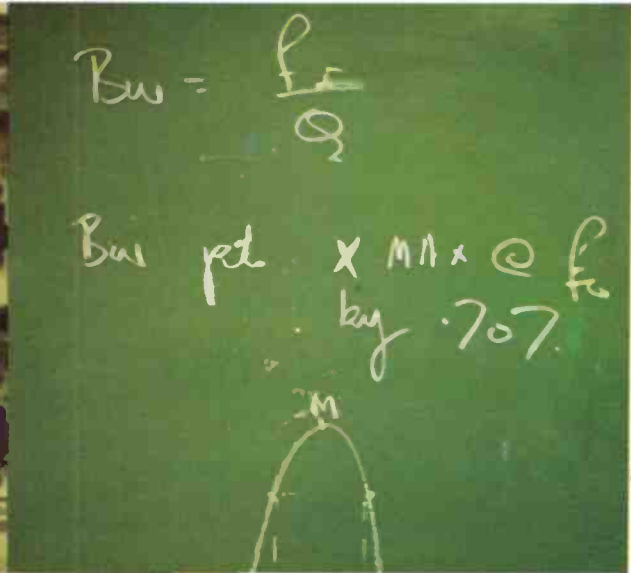
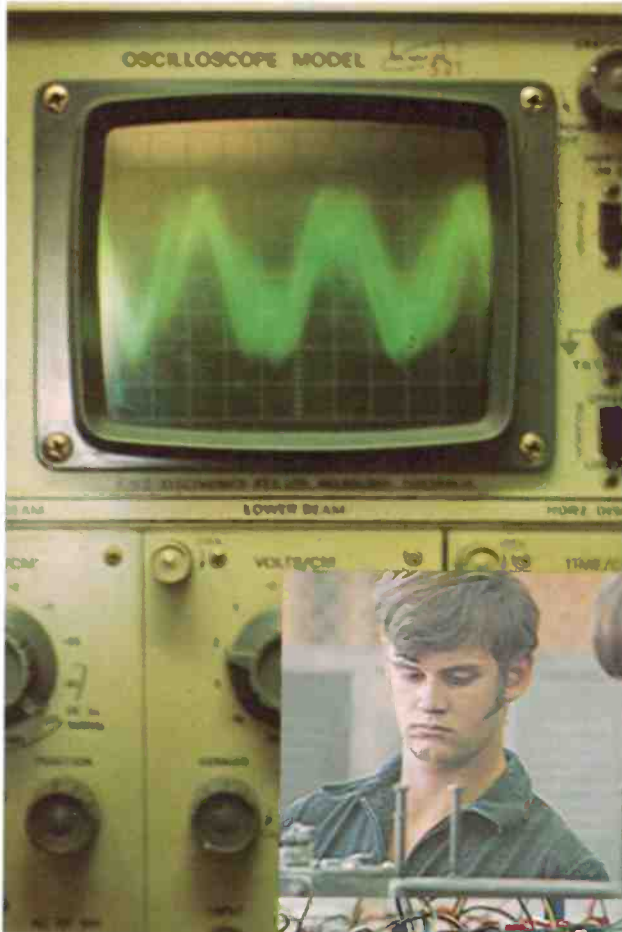
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NAP89/FR.27

ETI data sheet

LM 3909, LED flasher/oscillator

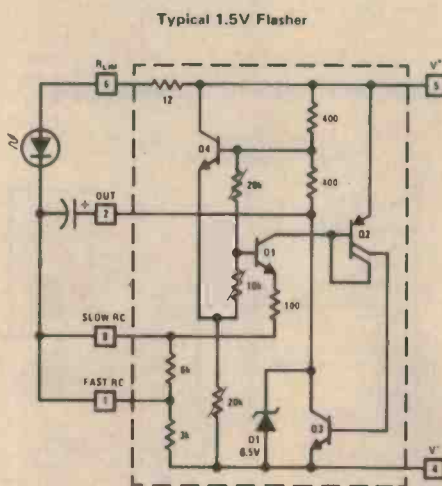
The LM3909 is a monolithic oscillator specifically designed to flash Light Emitting Diodes. By using the timing capacitor for voltage boost, it delivers pulses of 2 or more volts to the LED while operating on a supply of 1.5 V or less. The circuit is inherently self-starting, and requires addition of only a battery and capacitor to function as a LED flasher.

Packaged in an 8-lead plastic mini-DIP, the LM3909 has been optimized for low power drain and operation from weak batteries.

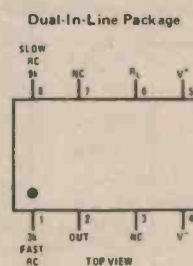
Application is made simple by inclusion of internal timing resistors and an internal LED current limit resistor. As shown in the first two application circuits the timing resistors supplied are optimized for nominal flashing rates and minimum power drain at 1.5 V and 3 V.

Timing capacitors will generally be of the electrolytic type, and a small 3 V rated part will be suitable for any LED flasher using a supply up to 6 V. How-

schematic diagram



connection diagram



ever, when picking flash rates, it should be remembered that some electrolytics have very broad capacitance tolerances, for example -20% to +100%.

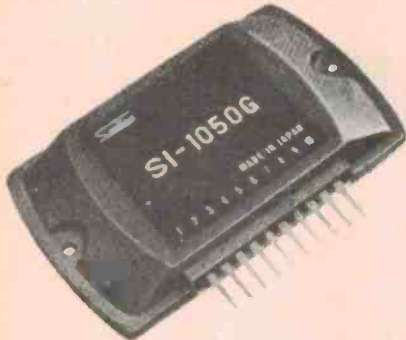
ABSOLUTE MAXIMUM RATINGS

Power Dissipation	500 mW
V ⁺ Voltage	6.4 V
Operating Temperature Range	-25° to +70°C

ELECTRICAL CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage	(In Oscillation)	1.15		6.0	V
Operating Current			0.55	0.75	mA
Flash Frequency	300 μ F, 5% Capacitor	0.65	1.0	1.3	Hz
High Flash Frequency	0.30 μ F, 5% Capacitor		1.1		kHz
Compatible LED Forward Drop	1 mA Forward Current	1.35		2.1	V
Peak LED Current	350 μ F Capacitor		45		mA
Pulse Width	350 μ F Capacitor at 1/2 Amplitude		6.0		ms

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S1-1030G, S1-1050G

ELECTRICAL CHARACTERISTICS

Characteristic	S1 1010G	S1 1020G
Maximum rms Power	10W	20W
Output Load	8 ohms	8 ohms
Supply Voltage	34V or '17V	46V or '23V
Absolute Max. Supply Voltage	45V or ±22.5V	55V or '25V
Supply Current (ave.)	0.50A	0.72A
Protective Fusing	1A Quick Blow	1A Quick Blow
Harmonic Distortion at Full Output	0.5% max.	0.5% max.
Maximum Input Voltage (p-p)	10V	10V
Voltage Gain Full Feedback (P ₀ = 1W)	30dB typ.	30dB typ.

Characteristic	S1 1030G	S1 1050G
Maximum rms Power	30W	50W
Output Load	8 ohms	8 ohms
Supply Voltage	54V or '27V	66V or '33V
Absolute Max. Supply Voltage	60V or '30V	80V or '40V
Supply Current (ave.)	0.86A	1.1A
Protective Fusing	1.5A Quick Blow	2A Quick Blow
Harmonic Distortion at Full Output	0.5% max.	0.5% max.
Maximum Input Voltage (p-p)	10V	10V
Voltage Gain Full Feedback (P ₀ = 1W)	30dB typ.	30dB typ.

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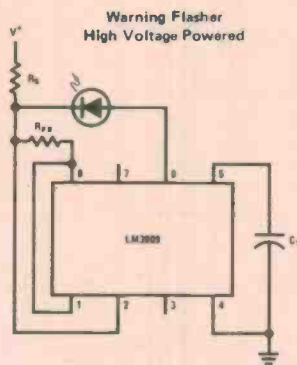
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- Minimum external parts.
- Low voltage operation, from just over 1 V to 5 V.
- Low current drain, averages under 0.5 mA during battery life.
- As an oscillator directly drives an 8Ω speaker.

Applications:

- Finding flashlights in the dark, or locating boat mooring floats.
- Sales and advertising gimmicks.
- Emergency locators, for instance on fire extinguishers.
- Toys and novelties.
- Electronic application such as trigger and sawtooth generators.
- Siren for toy fire engine, (combined oscillator, speaker driver)
- Warning indicators powered by 1.4 to 200 V.

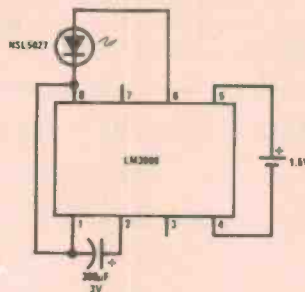
additional typical applications



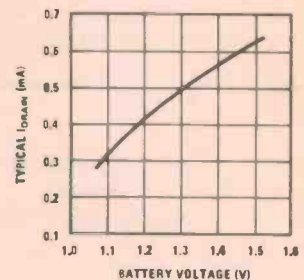
Typical Operating Conditions

V ⁺	NOMINAL FLASH Hz	C _T	R _S	R _{FB}	V _{RANGE}
6V	2	400µF	1k	1.5k	5-25V
15V	2	180µF	3.9k	1k	13-50V
100V	1.7	180µF	43k	1k	85-200V

1.5V Flasher



Note: Nominal flash rate: 1 Hz.



Estimated Battery Life (Continuous 1.5V Flasher Operation)

SIZE CELL	TYPE	
	STANDARD	ALKALINE
AA	3 months	6 months
C	7 months	15 months
D	1.3 years	2.6 years

Note: Estimates are made from our tests and manufacturers' data. Conditions are fresh batteries and room temperature. Clad or "leak-proof" batteries are recommended for any application of five months or more. Nickel Cadmium cells are not recommended.

APPLICATIONS NOTES

Note 1: All capacitors shown are electrolytic unless marked otherwise.

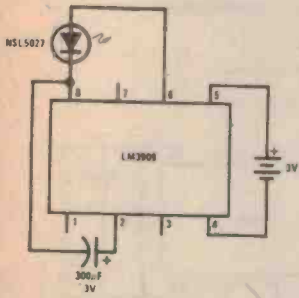
Note 2: Flash rates and frequencies assume a ±5% capacitor tolerance. Electrolytics may vary -20% to +100% of their stated value.

Note 3: Unless noted, measurements above are made with a 1.4 V supply, a 25°C ambient temperature, and a LED with a forward drop of 1.5 V to 1.7 V at 1 mA forward current.

Note 4: Occasionally a flasher circuit will fail to oscillate due to a LED defect that may be missed because it only reduces light output 10% or so. Such LEDs can be identified by a large increase in conduction between 9.9 V and 1.2 V.

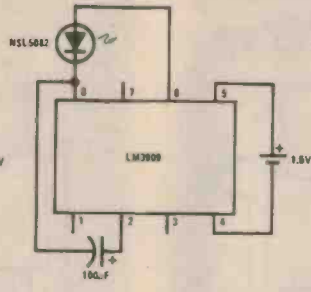
typical applications

3V Flasher



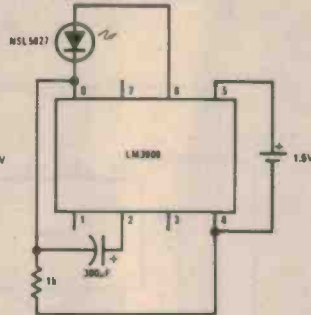
Note: Nominal flash rate: 1 Hz.
Average $I_{DRAIN} = 0.77$ mA.

Minimum Power at 1.5V



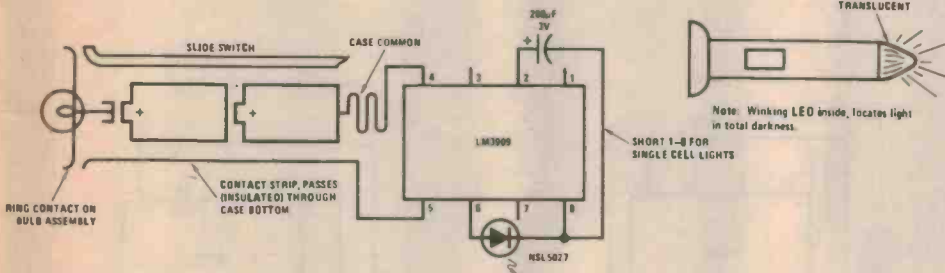
Note: Nominal flash rate: 1.1 Hz. Average $I_{DRAIN} = 0.32$ mA.

Fast Blinker



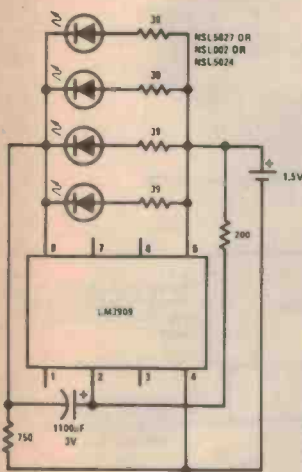
Note: Nominal flash rate: 2.6 Hz.
Average $I_{DRAIN} = 1.2$ mA.

Flashlight Finder



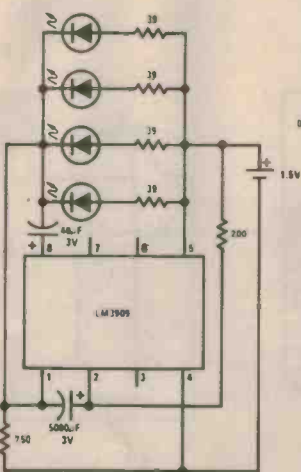
Note: LM3909, capacitor, and LED are installed in a white translucent cap on the flashlight's back end. Only one contact strip (in addition to the case connection) is needed for flasher power. Drawing current through the bulb simplifies wiring and causes negligible loss since bulb resistance cold is typically less than 2Ω .

4 Parallel LEDs



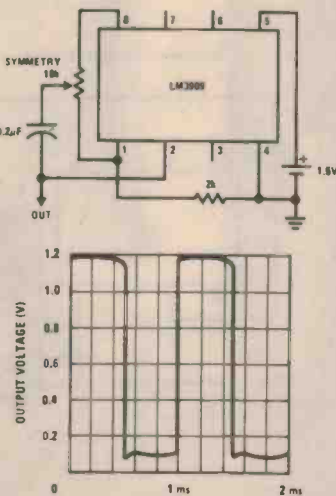
Note: Nominal flash rate: 1.3 Hz. Average $I_{DRAIN} = 2$ mA.

High Efficiency Parallel Circuit



Note: Nominal flash rate: 1.5 Hz. Average $I_{DRAIN} = 1.5$ mA.

1 kHz Square Wave Oscillator



Note: Output voltage through a 10k load to ground.

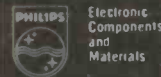


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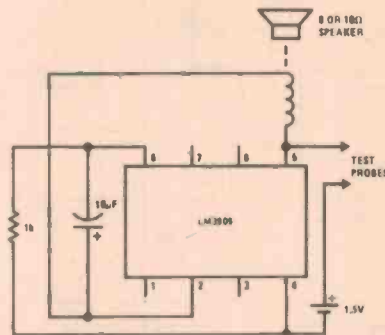
Electronic Components and Materials

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ETI data sheet

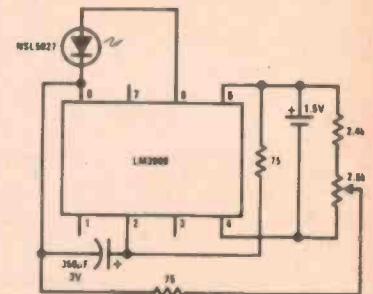
typical applications (con't)

"Buzz Box" Continuity and Coil Checker



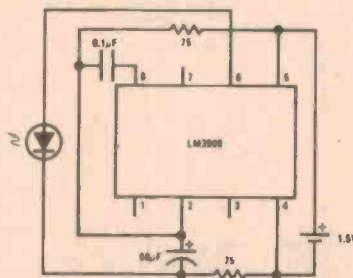
Note: Differences between shorts, coils, and a few ohms of resistance can be heard.

Variable Flasher



Note: Flash rate: 0-20 Hz.

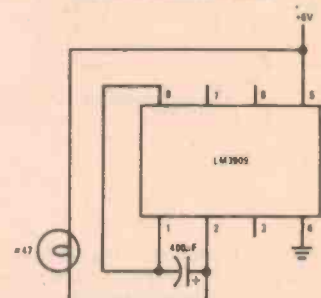
LED Booster



Note: High efficiency, 4 mA drain.

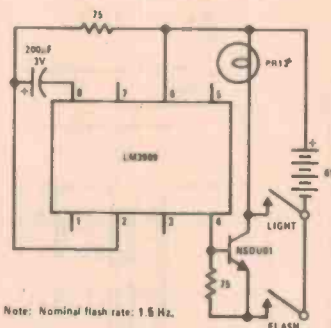
Note: Continuous appearing light obtained by supplying short, high current, pulses (2 kHz) to LEDs with higher than battery voltage available.

Incandescent Bulb Flasher



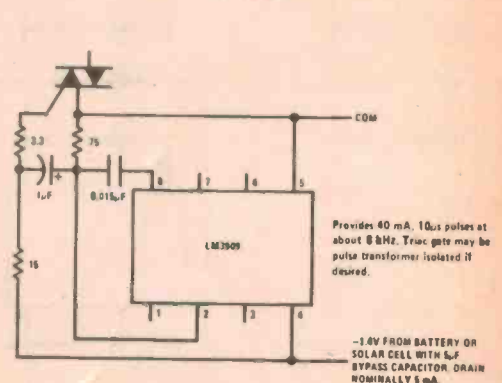
Note: Flash rate: 1.5 Hz.

Emergency Lantern/Flasher



Note: Nominal flash rate: 1.5 Hz.

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Potentiometers

Roger Harrison continues his series on components with a look at potentiometers. He looks at the different types and styles and how they are used.

POTENTIOMETERS ARE MADE in such a bewildering array of sizes, shapes, styles, and combinations that it is difficult to sort out what best suits a particular situation and what alternatives there may be. Apart from that, they come in a variety of wattage ratings, voltage ratings, resistance variation 'laws', etc — and how are you going to sort through that lot?

Potentiometers perform some control function by varying a resistance element on by tapping off a voltage from a fixed resistance. The variable resistor may need to be varied continuously so that some control function is performed, or it may be a 'preset' control which is only required for some calibrating or 'trimming' function. Preset potentiometers are generally called 'trimpots'.

So, potentiometers are generally split into two broad categories — continuously variable types, which are equipped with a shaft for the attachment of a knob, and trimpots which are generally equipped with a screw-driver slot.

TYPES

There are five basic types of potentiometer, classified according to the type of resistance element employed:

- (1) Carbon composition
- (2) Carbon Film
- (3) Hot-Moulded Carbon

- (4) Cermet
- (5) Wirewound

Carbon composition pots have a composition element moulded to the required size and shape and generally employ a metallic spring-wiper. They are generally quite inexpensive but have the disadvantage that they become noisy after use. Carbon film pots consist of a resistive film that is sprayed or screened onto a phenolic former of the required size and shape. A metallic spring-wiper is also generally used in this type of pot, and the element will withstand many more rotations than a composition type before noise problems. Carbon film pots are also inexpensive and are the commonest types in use, along with Hot Moulded Carbon types. Carbon film pots have a good degree of resolution whereas the composition types are poor in this respect.

Hot Moulded Carbon potentiometers are manufactured by a process wherein the resistive element, insulating base, and terminations are moulded into one integral part. A carbon wiper contact is usually employed. They have a high wattage rating on a size-to-size basis and a high degree of conformity between units. This factor, together with their very high resolution, has led them to be increasingly used as precision controls. They exhibit low noise levels in operation compared with carbon film and wirewound types.

Cermet potentiometers find wide application in precision controls, as trimpots and in many stringent applications (the element is rugged, exhibits low noise levels in use, and has good resolution). Wattage ratings are similar to those for hot moulded carbon pots of a similar size. They are generally somewhat more expensive. A metallic wiper is usually employed.

Wirewound potentiometers consist of a resistance wire wound on a former with a metallic wiper, although a graphite wiper contact is sometimes used on low value, high wattage types. They have the disadvantage of being noisy, the resistance changes in small 'steps' as the wiper passes over the turns of wire, and they are usually more bulky than other types of equivalent value. However, they can be made in very low resistance values and they are able to dissipate much more power than other types of equivalent value.

STYLES

The most common, basic style of potentiometer is illustrated in Figure 1. Many variations on this style are possible as is illustrated in the following figures.

A miniature, transistor-radio style pot is illustrated in Figure 3. They are commonly used as volume or tone controls in transistor portables and as 'zeroing' controls for the ohms range on



Fig. 1. The common, basic style of potentiometer. It has a threaded bushing and nut for panel mounting through a single hole and standard solder lug terminals.

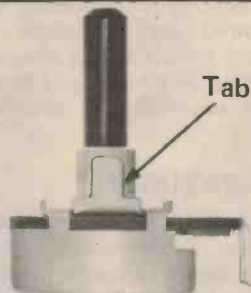


Fig. 2. Another common style is the tab-mounted pot. It has two tabs on opposite sides of the shaft which pass through corresponding panel slots, being secured either by twisting the tabs or laying them flat against the panel.



Fig. 3. A miniature, transistor-radio style pot. It is generally mounted firmly to a printed circuit board or other suitable support with bolts through the large lugs.

Potentiometers

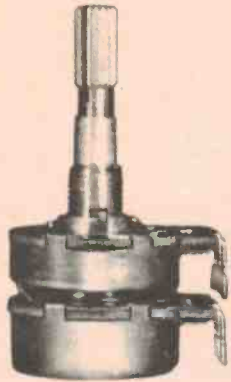


Fig. 4. 'Tandem' or 'ganged' potentiometers consist of several potentiometers controlled by one shaft. 'Dual-concentric' type are similar to the one on the left except that they are separately controlled by concentric shafts, one inside the other — the inner shaft controlling the 'back' pot and the outer shaft controlling the 'front' pot.

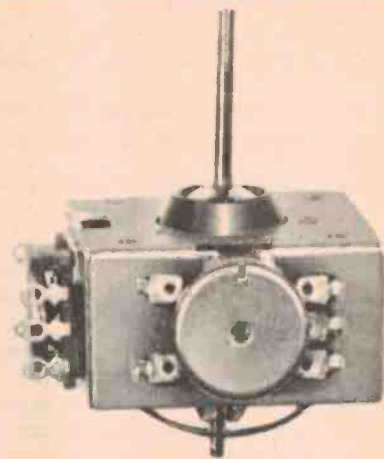


Fig. 5. Lever-controlled 'quad' pot assembly. These assemblies are used for complex control functions such as quadrophonic sound 'balance' and in model control applications etc.

on multimeters, etc. This style of control is generally mounted firmly to a printed circuit board or other support via bolts through the two large lugs. An edge-operated knob is generally fitted to the shaft.

In some applications, 'Tandem' or 'Ganged' potentiometers are required (for example for stereo tone and balance controls). They consist of several potentiometers all connected to the one shaft and stacked one behind the other, as illustrated in Figure 4. 'Dual-Concentric' potentiometers appear similar to the dual-ganged pot on the left in Figure 4. However, in this case, each pot is separately controlled by means of two concentric shafts. Dual-concentric pots are often used where there is limited space (e.g., for the RF and audio gain controls on a communications receiver).

The assembly illustrated in Figure 5 consists of four potentiometers mounted on the four sides of a metal box and connected by means of a special linkage to the lever which may be moved in any direction in a circular pattern. These assemblies are used for complex control functions such as quadrophonic 'balance' controls, radio controlled models etc.

Switches are often mounted on the rear of potentiometer assemblies and connected (mechanically) to the control shaft so that the one control knob may serve several functions. There are three basic types of switches generally used: the rotary type, the push-pull type and

push-push type. A standard pot with switch attached is illustrated in Figure 6. The rotary style of switch is often employed as a mains-power switch on a control, such as a volume control. It has the advantage that when the switch is operated to the ON position that the control is at minimum. But, it has the disadvantage that anything up to the first 15% or 20% of the control cannot be used. On many controls this is of little consequence. Push-Push and push-pull (or, more strictly, pull-push) switches have the advantage that the control may be left in a certain position and the switch operation does not disturb it. With a volume control however, this may be disastrous as the equipment may be turned on while the volume control is unwittingly at a high setting, or, worse still, full on!

While solder-lug terminals are commonly found, potentiometers are also manufactured with terminals suitable for printed circuit board mounting, as illustrated in Figures 7 and 8, or with wire-wrap terminals, as illustrated in Figure 9.

POWER RATINGS

With the exception of wirewound types the majority of standard potentiometers are obtainable in ratings of 0.1, 0.2, 0.25, 0.5 and 1 watt. Potentiometers are derated in much the same manner as fixed resistors. If this information is desired it is best to consult the manufacturer's literature.

Wirewound potentiometers are

obtainable in ratings up to 100 watts (!!) but more usually they are available in ratings (depending somewhat on their resistance value) of 0.5, 1, 2, 5, 10, 15 and 20 watts. The higher power ones are usually quite bulky. Cermet and hot moulded carbon types are generally the smallest size for a given rating.

RESISTANCE LAW

The resistance 'law' or 'taper', as it is called, of a potentiometer refers to the manner in which the resistance changes (as measured between an end terminal and the wiper terminal) with rotation of the shaft. There are a considerable number of different 'laws' in common use. The main ones however are: linear, logarithmic, reverse logarithmic, and 'S' taper. These are illustrated in Figure 10. Note that various log tapers are used, the 20% log taper is the more common one however. The tapers for both clockwise (CW) and counter-clockwise (CCW) log are illustrated, as the potentiometer may be connected to operate in reverse fashion if desired (often as not though, it's a mistake!). The various common laws are given a letter code which is stamped or marked on the body of the assembly along with the resistance value. The code is quite straightforward, as follows:

- A = linear law
- B = logarithmic law
- C = reverse logarithmic (or anti-log)
- S = 'S' law.

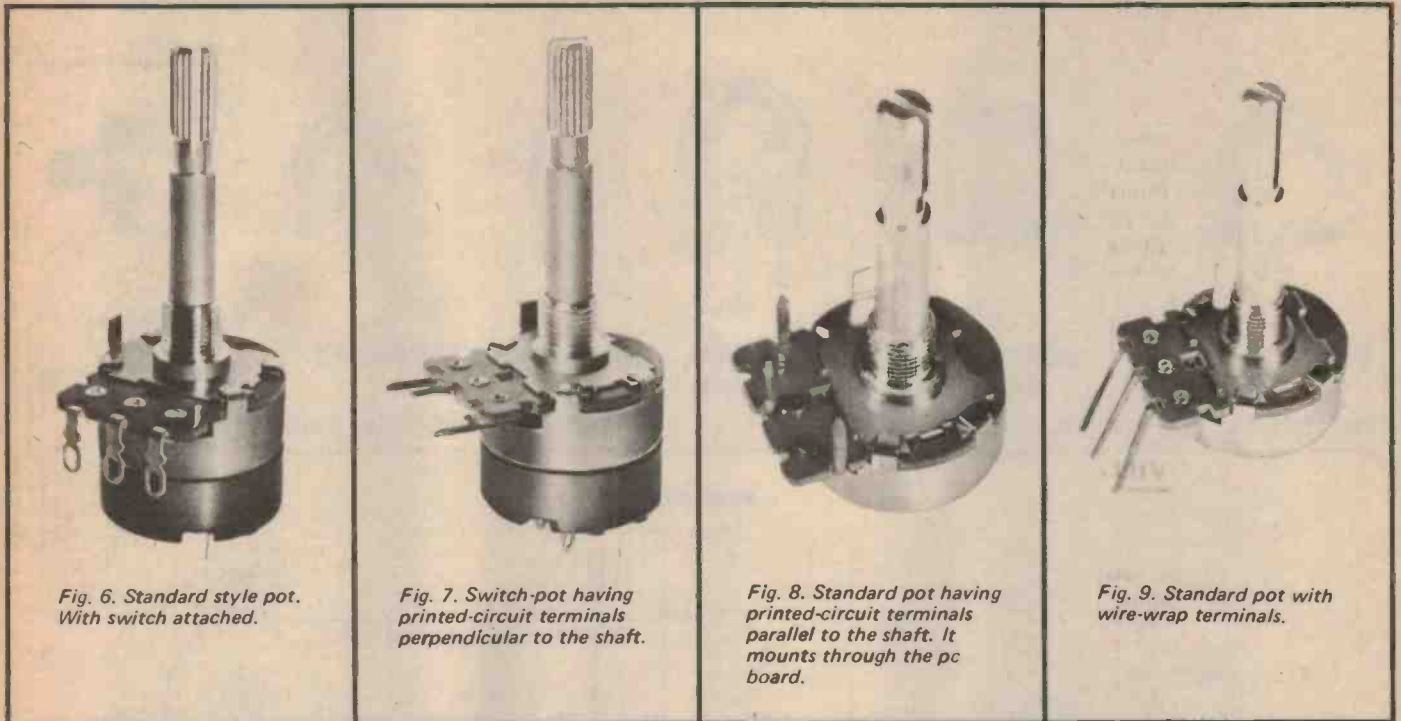


Fig. 6. Standard style pot. With switch attached.

Fig. 7. Switch-pot having printed-circuit terminals perpendicular to the shaft.

Fig. 8. Standard pot having printed-circuit terminals parallel to the shaft. It mounts through the pc board.

Fig. 9. Standard pot with wire-wrap terminals.

A pot may be marked 25kA, which is a 25k ohm, linear law potentiometer. Another may be marked 1M/C, which is a one megohm, reverse logarithmic pot.

The linear taper control varies resistance in direct proportion to the rotation of the shaft. This type of pot is commonly used in voltage control applications, on tone controls and other applications which require a straight-forward voltage division.

With a log law control, the resistance increases very gradually during the initial rotation of the shaft, most of the resistance change occurring in the last 20-30% of the rotation. This type of law approximates the natural sensation of loudness as our ears follow a logarithmic law in their sensitivity to sound amplitude. Consequently, such controls are frequently used as volume controls so that they produce an apparent linear increase in sound output as the shaft is rotated. If a linear control were used, the greatest change in perceived volume would occur within the first 10-20% of shaft rotation.

Anti-log tapers provide the reverse, the greatest change in resistance takes place in the early portion of the shaft rotation, the least change occurs in the last 30-40% of shaft rotation.

The 'S' taper provides only a small change in resistance for the initial and

final 20% of shaft rotation and provides a linear variation between these extremes.

Other laws include semi-log and linear-tapered. These have curves that lie between the log and linear curves on the graph in Figure 10. The semi-log law provides a somewhat greater change of resistance-versus rotation over the first 40% of shaft rotation than with the log curve. The linear-tapered provides a nearly logarithmic variation over the

first 50% of shaft rotation and a linear variation thereafter.

If the law of a pot is unknown the resistance-versus-rotation may be measured and the result plotted on graph paper.

Resistance Ranges

Most types of carbon element potentiometers are made in values ranging from 50 ohms up to 2 M. Some older types

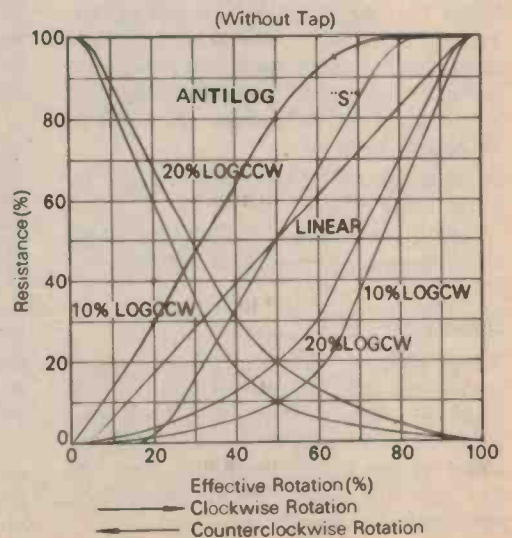


Fig. 10. The common resistance-versus-rotation 'laws' as 'tapers' for potentiometers.

Potentiometers

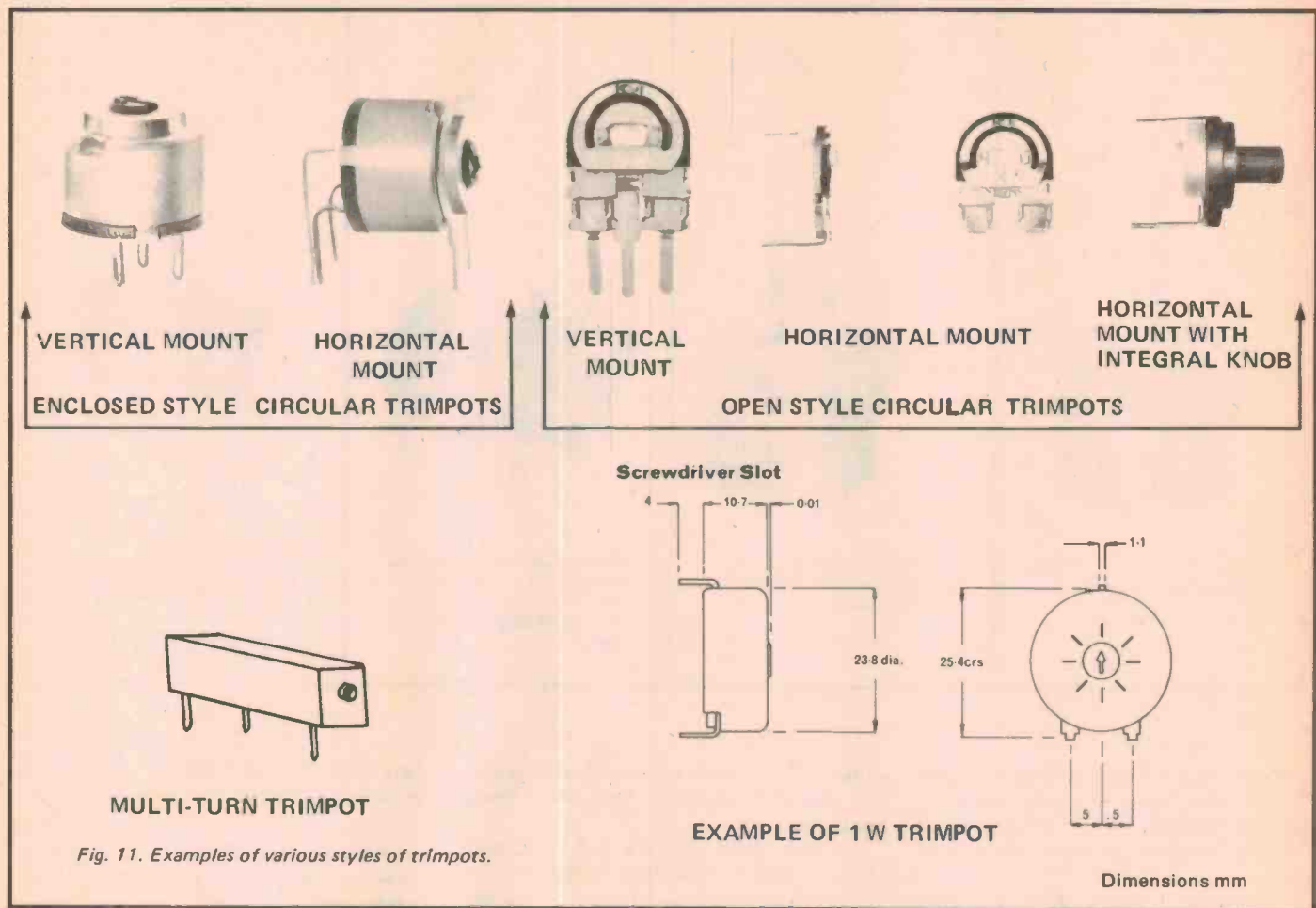


Fig. 11. Examples of various styles of trim pots.

were made in values as high as 500 M. Cermet potentiometers are made in values ranging from 10 ohms to 10 M.

Some manufacturers make their pots to values in the standard E6 (20%) series (i.e.: 47 ohms to 2M Ω for carbon types). However, many pots are made with values according to the following decade series: 10, 15, 20, 25, 50 & 100. i.e.: 2 k Ω , 5 k, 10 k, 15 k, 20 k, 25 k, 50 k, 100 k etc . . .

Some (typically of US make) include 75 in the value range.

Wirewound potentiometers are made in values ranging from 10 Ω to 100 k.

Slide Pots

These are pots having a linear element rather than a circular element as in standard pots. They are available generally with a carbon element having slider ranges of typically 50 mm, 75 mm, and 100 mm in the various laws as previously illustrated.

Slide pots have particular advantages of their own. One being that it is easier to see the proportional position of the control at a glance than with standard potentiometers. In some circumstances the slide pot provides a much more convenient form of control, for example in multi-channel audio mixer applications.

Trim pots

Trim pots are usually 'preset' controls. That is, they are only adjusted occasionally to set certain circuit parameters or conditions, for calibration purposes etc. Consequently they are generally adjustable by means of a screwdriver slot on the control shaft, although some have an integral knob to allow finger adjustment.

Trim pots are made in a wide variety of styles and sizes, as illustrated in Figure 11. Some types are enclosed to prevent the ingress of dust etc which

can cause the control to become noisy in operation. Many types are only single-turn controls with the wiper covering only 180 $^\circ$ in some cases, while others cover the more conventional 270-280 $^\circ$ of rotation. Other trim pots are made for more critical applications and have a multi-turn control which allows a much finer and more accurate adjustments.

Manufacturers make trim pots in values ranging from 50 ohms to 5 M for carbon element types, and typically up to 30 M for Cermet types.

Wirewound types are made in values typically ranging from 100 ohms to 5 k. Wattage ratings for the various types are typically 0.1, 0.2, 0.25, 0.5 up to 1 W. Trim pots are available in the same range of laws as are standard potentiometers, although most common styles have a linear law. Other characteristics are the same as for the type of element employed.

Connecting Potentiometers

One thing that baffles electronics project constructors is the 'correct' way to connect a potentiometer.

The best way to illustrate how to do it is by example. The most common application of a potentiometer is that where it is required to vary a quantity (signal, voltage, etc) so that an increase occurs when the control shaft is rotated *clockwise*. The best example of this is a volume control.

In Figure 12 a pot is illustrated typically as you would see it when you come to make the connections. The arrow indicates the direction in which the control shaft will be turned to increase the output. **THE TERMINAL IN THE CENTRE IS ALWAYS THE WIPER CONNECTION.** So, terminal 1 (on the left as you view it to wire it up), connects to 'ground' or minimum.

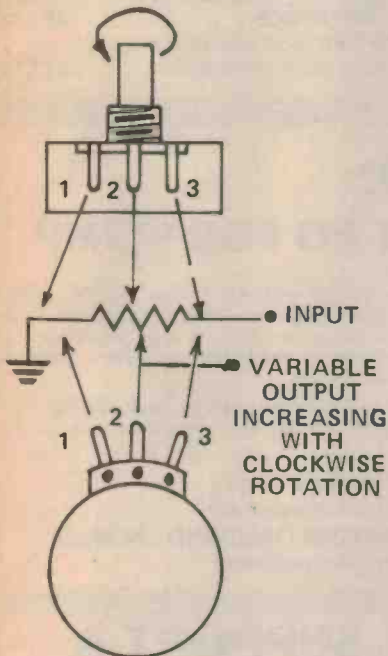


Fig. 12. Connecting a pot as a simple 'increase clockwise' control (e.g. volume).

Terminal 2 (the wiper) connects to the output (in some cases it can also be the input terminal; operation of the pot still remains the same). Terminal 3 (the one on the right) connects to the input (or the output if the input is connected to the wiper).

Try it out for yourself. Get a 1 k (linear is best) pot and a battery (anything from 1.5 V to 9 V will do), hook up the battery with the positive to terminal 3, and the negative, to terminal 1. Connect a voltmeter (multimeter or what-have-you) with the negative to

terminal 1 and the positive lead to terminal 2. Commence with the control shaft at the fully anti-clockwise position (hard left!). As you slowly rotate the shaft clockwise, the reading on the multimeter will rise. True! It's easier to do it than it is to read about it. The wiper, in this case, commences at terminal 1 and moves towards terminal 3.

Some applications require the pot to work in the reverse fashion. For example, as a frequency or pulse rate control in an oscillator or multivibrator. In such cases, an increasing effect occurs as the wiper traverses towards the 'minimum resistance' end of the control. The pot is simply connected so that terminal 1 is the 'maximum resistance' end of the control and terminal 3 the minimum.

In some applications the circuit shows that the wiper is shorted to one of the 'end' terminals. But which one? Terminal 1, or 3? In such cases it depends on whether the 'maximum effect' occurs at minimum or maximum resistance. Look at Figure 13. The circuit shows that as the wiper traverses the element it shorts out the section of the track it has just traversed, decreasing the resistance as it moves towards the terminal which is not connected to the wiper. Leaving one 'end' terminal unconnected achieves the same purpose.

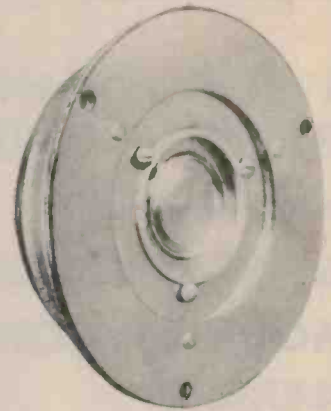


Fig. 13. Pots in some applications require only a variation in resistance. Which terminals are connected together depends on the circuit effect.

If the *maximum* effect (from the circuit in which the pot is to be connected) occurs at *minimum* resistance then terminals 1 and 2 are connected together. Maximum resistance (and thus minimum effect) occur at fully anti-clockwise rotation (hard left!). The effect increases as the control is rotated clockwise.

On the other hand, if the *maximum* effect occurs at *maximum* resistance then terminals 2 and 3 are connected together. Thus, as the control is rotated clockwise from the fully anti-clockwise position the resistance, and thus the effect, increases.

What speaker designer Michael C. Phillips has to say on the Coles 4001 supertweeter



"With many so-called high-frequency units, response falls off rapidly after 12 to 14 kHz. Response may seem smooth, but because they do not reproduce the last octave, the overall sound image lacks definition.

"This is why I recommend the use of a high-frequency unit like the Coles 4001. To maintain definition.

"There is usually a compromise in trying to extend response in the lower frequencies so the unit can be used in two- and three-way systems, and this requires a large diameter dome.

"The reason the 4001 achieves such extended frequency response at the top end is because no such compromise has been made. It has a small diameter dome, a low-mass diaphragm and a high-energy fine-gap magnet. This also gives it exceptional transient response.

"Correctly integrated in a 4-way system, the 4001 is capable of wide, smooth response even off axis."

Other designers who have chosen the Coles 4001 Super-Tweeter in their speakers include B. Webb, who designed Cambridge speakers and then his own Webb marque, John Bowers of B. & W. and Spencer Hughes, late of the BBC — who designed the Spender studio monitors which the BBC now uses.

Now, you can use it too, and add the missing highs to your speakers.

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MICROPROCESSORS



ETI 632 VIDEO DISPLAY TERMINAL

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- ★ **EASY TO BUILD!**
- ★ **MODULAR CONSTRUCTION!**
- ★ **FLEXIBLE!**
— TV Terminal or Graphics
- ★ **FULL SERVICE BACKUP AVAILABLE!**

Now available: complete terminal described in March ETI. This is an ideal project for home computer builders as it offers long term flexibility. Start with a keyboard operated TV typewriter and later convert it to a computer controlled graphics terminal as well.

Now with a BUILT IN MODULATOR as well as direct VIDEO for maximum convenience. Modulator will operate on any unmodified TV by developing a signal at the aerial inputs.

We supply this project as a set of individual component kits — each complete with all components, PCB and Molex connectors. You can build it on a board by board basis or attack it as a complete project. Our full service and technical support is available (see below).

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PACK 3	632 M	1K x 8 MEMORY	\$32.50
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PACK 5	632 PS	POWER SUPPLY (for Motherboard)	\$5.25
PACK 6	632 U	SERIAL INTERFACE	\$21.75
PACK 7	633 SYNC	GENERATOR (now with built in modulator and direct video)	\$17.75

"BABY" 2650 SYSTEM (EA MARCH 1977)

By special arrangement with Philips Elcoma we can now offer this simplest and lowest cost way of getting to know the 2650 Microprocessor. The kit comes complete with all components (including sockets for all IC's) and extensive documentation.

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ALTERNATIVE KEYBOARD ENCODER

Having trouble obtaining the HD0165 IC for the 631 encoder. We now have stocks of the 631-2 keyboard encoder as described in the April issue of Electronics Today.

Based on a single sided printed circuit board and utilizing CMOS technology the 631-2 is a direct replacement for the ETI631 encoder. It is ideal for the 632 video display terminal.

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SCMPIO:

LOW COST I/O FOR SC/MP

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SC/MP INTROKIT WITH SCMPIO \$139.50

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16 PIN DIL	.65
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This general purpose board will accept up to 40 16 pin wire wrap sockets yet measures 4.5" x 6.5" (same size as SC/MP introkit).

The WR987 is a doublesided PCB with Vcc on the component side and ground plane on the reverse side. The board terminates with gold plated 72 way connectors (0.1" pitch double sided).

WR987 PROTO BOARD \$9.50
Socket to Suit \$6.50

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SPECIALS OF THE MONTH

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7404 TTL		.30
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LM381 LOW NOISE PREAMPS		\$1.60
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NEW PRODUCTS JUST RELEASED

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The NE571 is a versatile low cost dual gain control circuit in which either channel may be used as a dynamic range compressor or expander. Each channel has a full wave rectifier to detect the average value of the signal, a linearized temperature compensated variable gain cell and an operational amplifier.

One obvious application for the home HI-FI constructor is a stereo variable slope compressor expander and a typical circuit is given in the applications data.

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PRINT-OUT

THIS MONTH PRINT-OUT has a look at Motorola's new evaluation kit, the D2 page 84

MICROBIOLOGY. The conclusion to the discussion on the 8080 scheduled for this issue has been delayed and will be in next months ETI.

NEXT MONTH we look at a locally available 8080 microcomputer kit and fight a battle in space when we try out a space war program.

THE D2 - YOUR PERSONAL COMPUTER?

Now available in Australia, Motorola's new evaluation kit is causing quite a bit of excitement. It seems that many of the kits are being bought for other than evaluating the 6800. Instead they are finding their ways into their owners homes to be used as personal computers. So we at ETI decided to have a closer look at the kit and here is what we found.

WHEN THE MICROPROCESSOR was developed a few years ago those involved in marketing it realised they faced a more than difficult task in gaining industry acceptance for it.

The instrument chosen to break down the resistance was the 'evaluation module' or 'evaluation kit'. Usually these kits contained just enough hardware to get a microprocessor working and a rather basic monitor program to operate the system through a teleprinter.

Looking back, it has to be admitted that the evaluation kit is a success. It has helped many people come to grips with the microprocessor. Realising this, at least one company has not left the evaluation module in a static state of development, instead that company, Motorola, has found ways of improving

their first evaluation kit the D1, and now have released the Evaluation Kit II (or D2 as it is more commonly known).

The D2 had its Australian debut at the Motorola exhibition held in the US Trade Centre in December last year.

But it was not until February this year that the D2 became generally available and Print-Out was able to put one together to check it out. Having done so we say we are impressed with it, for just about all areas of the D1 have been improved upon and some new features added.

The most striking of these features is the new Keyboard/display module. With this module and a 5 volt power supply the evaluation kit becomes a completely self contained microcomputer with input/output facilities that allow the operator to enter and debug his pro-

grams. That's to say no additional terminal is required for the user to operate the D2 microcomputer.

To keep the cost as low as possible



How it comes. Between the covers of this book there's enough 'bits and pieces' to build a working microcomputer. All you have to add is a 5 volt power supply.

PRINT-OUT

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the D2 evaluation kit is supplied as a kit of parts — it has to be assembled before it can be used. The method of packaging is interesting as it comes in three sections sandwiched between the covers of a rather large three-ring binder. One 'section' contains the microcomputer printed circuit board and components, another 'section' contains the keyboard/display printed circuit board and its components, while the remaining 'section' is a set of three manuals.

In the manuals section the System Design Data manual is a collection of data sheets on the 6800 family of chips. The Programming Reference manual is the basic software reference documentation that explains what each instruction in the 6800 repertoire does and provides brief notes on pertinent techniques of programming the 6800.

The remaining manual is called the Evaluation Kit II manual and it contains the information needed to assemble the kit and operate it. This takes the form of circuit diagrams and pc board overlays and for the operator there is detailed explanation of each of the keyboard commands. The Evaluation Kit II manual also has a complete source listing of the D2's monitor program and a set of flow charts for easy understanding of how the monitor functions. With this information it is relatively easy for the programmer to use the monitor routines as subroutines in his own program. This lets him use the keyboard and display to input and output data to this program.

A good monitor program is essential for ease of actually operating a microcomputer (and for the operator's sanity). Motorola have apparently recognized this when they designed the D2 and produced Jbug because it certainly is an improvement over Mikbug. Eight of the 24 keys provided on the keyboard/display module are command keys used by the operator to control Jbug. A summary of their functions follows.

The M key permits examination and, if necessary, changing of the contents of any memory location. The memory location to be examined is first opened by entering its address (a 4-digit hex number) then pressing the M key. The display will now show the memory address on the four left-hand displays and the contents of the memory on the two right-hand displays. New data may now be entered by pressing the appropriate hex keys. Or the next memory location can be displayed by pressing the G key.

The E Keys forces the microcomputer to stop executing your program and to start executing Jbug instead. In doing this the current contents of the microprocessor's internal registers (accumulators, program counter, etc.)

are saved in memory so the operator can examine them to find out what part of his program was being executed when the E key was pressed. The saved values can also be re-entered into the microprocessor to continue the user's program from the exit point.

The R key permits examination of the MPU's registers. Once pressed the display shows the contents of the program counter. Then the Index register, accumulators A and B, Condition code register and Stack Pointer may be displayed sequentially by pressing the G key. If required the contents of any register can be changed by using the M key's memory changing function.

In pressing the G key the operator directs the MPU to go and execute the user's program. This function is evoked by first entering the starting address of the program in memory and then pressing the G key. The user's program now has total control of the microcomputer.

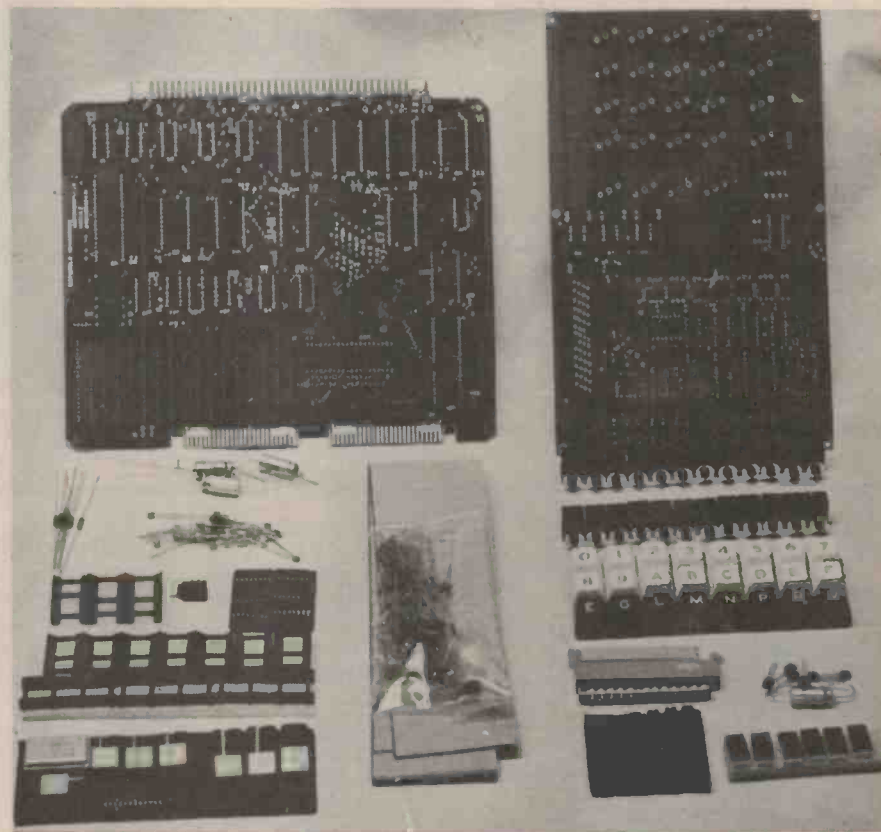
We now look at the key labelled P. The P stands for punch, which is a bit of a misnomer because the D2 doesn't punch the operator (for his heavy hand), the programmer (for his faulty programs) or paper tape. The punch label is a leftover from the D1 where it

was used as a command to punch holes in paper tape for a permanent record of memory.

Punchers, unfortunately, are expensive, usually costing more than the D2, so the family audio tape recorder is used instead. To save a block of data currently in memory, the audio recorder's microphone input is connected to the corresponding point on the keyboard/display module, the stop and start address of the block is entered and the P key pressed.

Making taped copies of memory is of no value unless what is on the tape can be transferred back into memory. This is performed by routines in Jbug evoked by pressing the L or load key. The L key then complements the P key for permanent storage of programs and data.

Interestingly the D2 uses the 'Kansas City Standard' recording format that is very popular with personal computerists in the US. With this standard, data is recorded at 300 baud (approximately 30 bytes per second) using eight cycles of 2400 Hz to represent a logical 1 and four cycles of 1200 Hz to represent a logical 0. A feature of the Kansas City Standard is its wide tolerance to speed variations in the audio tape recorder.



To keep the cost as low as possible the D2 comes as a kit of parts as shown in this layout. On the top left is the microcomputer pc board and on its right the Keyboard/display pc board. Bottom left shows the MOS LSI chips inserted in conductive plastic foam. In the centre is the cable that connects the two modules and on the bottom right is the keytops and seven segment LED displays.

This allows the use of low cost (\$50) cassette recorders. In fact a note in the evaluation kit manual claims the D2 accommodates speed variations of approximately 25%.

The V key is for setting and removing up to 5 break points. These are temporary stops in the program that enable the user to run only part of his program to test whether it is performing correctly. Once encountered you proceed to the next part of the program by first pressing the E key then the G key.

The T key evokes the Trace function which permits stepping through your program one instruction at a time. This gives you adequate time between the execution of each instruction to monitor the result of executing that instruction.

The remaining feature of Jbug is a short routine that calculates the offset to a branch instruction.

What I/O is there on the D2?

Two PIAs and a ACIA come as standard on the microcomputer module. These are two 6800 family chips designed for interfacing to the external world. The PIAs provide 32 single I/O ports each capable of acting as an input or an output and eight other lines that can be programmed to act as interrupt inputs. Four of the eight can also act as outputs that are convenient to use as strobe signals to let the peripheral know that there is data ready to be used.

The ACIA is there to provide data formatting and control to interface serial asynchronous peripherals to the 8 bit data bus of 6800. Software control of the ACIA provides variable word length, transmit and receive control, interrupt control and parity control and checking.

Note, however, one of the PIAs and the ACIA are used for interfacing to the keyboard/display module. This does not mean they cannot be used to interface to other peripherals just that it's difficult to do both at the same time.

How much memory is there?

The kit comes with 384 bytes of RAM of which 128 bytes is allotted for Jbug's use (note you can use some of this, at a pinch). There are holes on the pc board (with tracks to them) for two more memory chips to give a RAM capacity of 512 bytes.

For those who want more the appropriate address, data and control signals are taken via holes that accommodate buffer chips (which you have to add) to a Exorciser-compatible edge-connector where up to 65K bytes can be addressed.

The only ROM supplied with the D2 is a 1K byte mask-programmed device containing Jbug. However holes are provided with strapping option to accommodate more ROM.

For those who would like to extend the memory there is always the vacant wire wrap area (see photo).

Construction

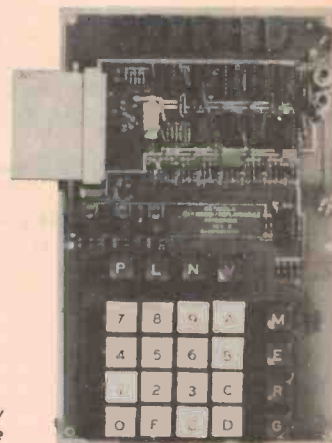
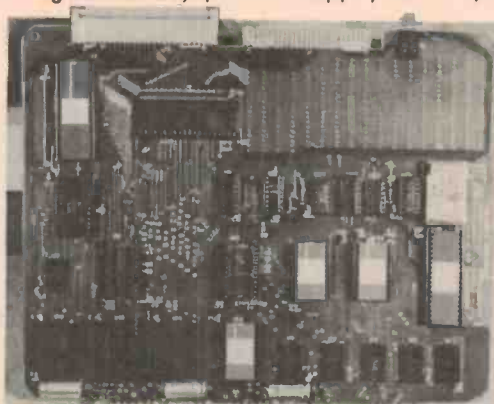
Assembly of the kit proved quite easy, especially easy since one of us gave it to his younger brother who was eager to work on a microcomputer. Being somewhat less experienced in construction technique he had a greater chance of coming across any pitfalls. Happily he

found none, although he did find a few spare 10k resistors. It should also be pointed out he was threatened with dire consequences if he did not study (in depth), the assembly manual first, an exercise essential for this type of kit.

There is very little written text on how to assemble the kit, but there is a pc board overlay (and circuit diagram) to tell you where everything goes. A page is devoted to advice on handling MOS devices and a six-step program is included on making up the 50-wire interconnecting cable. Some people have had difficulty with this cable, so be careful. The problem appears to have been caused by lack of attention when positioning the wire over the pins in the plug, and so causing shorts.

Even for the veteran kit builder, there was still that feeling of excitement as power was applied to the finished kit and an air of anticipation as we watched with our eyes glued to the display for the first observable proof that the kit worked.

Excitement grew as each command was tried and pronounced working till finally all the keys had been checked and the D2 pronounced fully operational.

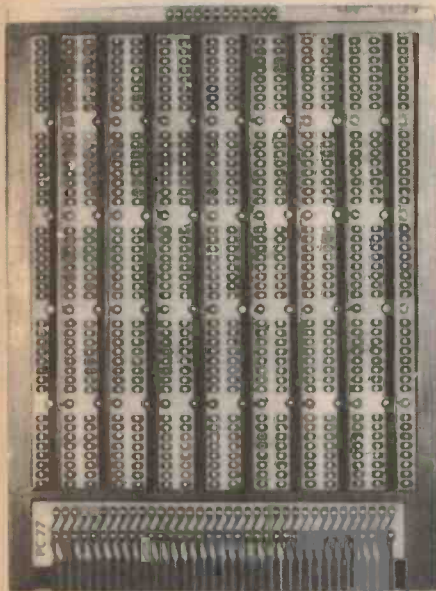


Put together correctly the finished kit looks like this. Now all you have to do is connect up a power supply, learn the 6800 instruction set and get set for hours and hours of computing fun.

D2's PARTS LIST

2	Printed Circuit Boards		6	7 Segment LED Display	DL704
1	Microprocessing Unit (MPU)	MC6800	1	Dual 4-Channel Data Selector	MC14539BCP
1	MCM6830 (JBUG)	SCM44520P	1	Dual Monostable Multivibrator	MC14538BCP
1	3-State Hex Driver	MC8T96	2	Dual D Flip-Flop	MC14013BCP
1	One-of-Eight Decoder	MC74155P	1	Quad 2-input AND Gate	MC14081BCP
3	Random Access Memory (RAM) (128 x 8)	MCM6810	1	Quad Analog Switch	MC14016BCP
1	614.4 kHz Clock	MC6871B	1	Quad Op-Amp	MC3301P
1	12-Bit Binary Counter	MC1404BCP	1	Dual Line Receiver	MC75140P1
2	Peripheral Interface Adapter (PIA)	MC6820	1	Seven Stage Ripple Counter	MC14024BCP
1	Quad 2-Input NAND Gate	MC7400P	1	Analog Multiplexer/Demultiplexer	MC14053BCP
1	Asynchronous Communications (ACIA)	MC6850	8	Transistors	
1	Dual D Flip-Flop	MC7479P	70	Resistors	
1	Binary Counter	MC8316P	25	Switches	
3	Peripheral Driver	MC7542P	49	Capacitors	
			13	Sockets	
			1	Cable, 50-Conductor, 3-Foot Length	

NEW PRODUCTS



Applied Technology seems to have taken last month's wrap article to heart and has made available a new low-cost wire wrap board.

It's designed to hold up to forty 16-pin IC sockets and has tracks on both sides of the board for the different power rails. The board plugs into a 0.1 inch pitch, 72 pin (2 x 36) socket and is 110 mm wide (same width as the SC/MP evaluation kit board) by 165 mm high. According to Applied Technology, an IC count of forty was chosen as this is the number of ICs required to implement a 4K memory board of 2102 static RAMs. The board is priced at \$9.50.

Also new from Applied Technology is a cassette interface for recording data with the family tape recorder. It uses the CUTS format of 1200 Hz for a logical zero, 2400 Hz for a logical one and a transfer rate of 300 baud.

However, due to its design, it can also handle data at the 100 baud rate which makes it suitable for use with microprocessor evaluation kits.

There was insufficient time this month for a full report, but it's currently hooked up to the Editor's computer and we will report on its performance in the next issue, after it has transferred a few million bytes!

THE INTEL MEMORY DESIGN HANDBOOK (1975) contains information on the use of Intel's memory and memory support ICs. It is intended for those who want to design memories for computers and so tries to provide a thorough understanding of the operation and characteristics of Intel memory devices.

The book of some 230 pages is divided into six chapters:

This book can be best summed up as a data book on memory ICs with considerable and valuable application information. The book was published in 1975 and so contains no details on the newer 16K dynamic and 4K static RAMs.



THE INTEL 8080 MICROCOMPUTER SYSTEM USER'S MANUAL is a 220 page book packed with data on the 8080 microprocessor chip and the support ICs that turn the 8080 chip into a microcomputer. It's a book for those who want a complete and detailed understanding of the 8080.

A number of timing charts are used to aid understanding and there is a section with a full explanation of the instruction set. Chapter 1 has four pages describing the functions of a computer. Chapter 2 has twenty pages on the operation of the 8080 IC. Chapter 3 has ten pages on interfacing the 8080. Chapter 4 has fifteen pages on the 8080 instruction set. Chapter 5 has one hundred and seventy four pages of data sheets on the 8080 and it's twenty six support ICs.

Each book is available by mail from the Sydney office of A.J. Ferguson 34 Herbert Street, West Ryde, NSW 2114 for \$5.00 plus \$1 post and packaging.

NEWS

WHATS IN A NAME?

People quite often choose company names to be distinctive and to be representative of the products they deal in. If this is the case what are we meant to make out of the name of this magazine: it's a reference journal for users of home computers and carries the name 'Dr Dobbs Journal of COMPUTER Calisthenics & Orthodontia'. It's a magazine heavily into software and publishes things like complete source listings of Tiny BASIC and computer games. Single copies cost \$1.50 and can be obtained from Box 310, Menlo Park, CA 94025, USA.

MORE MPUS MOVE INTO CARS

Now Chrysler Corp (USA) have announced that RCA and Texas Instruments are to supply improved versions of their standard MPU with memory and custom I/O for engine control, possibly for the 1979 range of cars.

Although no production contracts have, as yet, been awarded the announcement means both RCA and Texas have strong possibilities of becoming the eventual volume suppliers. With this volume expected to exceed one million chip sets per year by the early 1980s competition between suppliers must only be described as fierce.

IT DOES COMPUTE

Compute is the monthly publication of the national semiconductor microprocessor user group, for which a life-time subscription is available for the measly sum of \$15. Through Compute, subscribers are advised of the latest in software and hardware innovations for IMP, PACE, SC/MP and now the 8080 microprocessors.

National Semiconductor of Australia have advised us that software mentioned in Compute is now kept on file in Australia and is available from NS Electronics Pty Ltd, Cnr Stud Road & Mtn Highway, Bayswater, Victoria 3153.

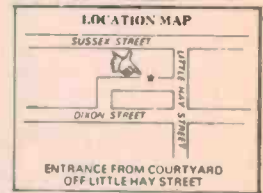
One example of this software is NIMBOL, National's tiny BASIC interpreter for SC/MP, of which an object code version is available for \$15.

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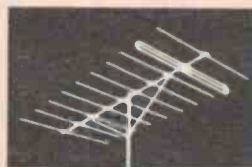
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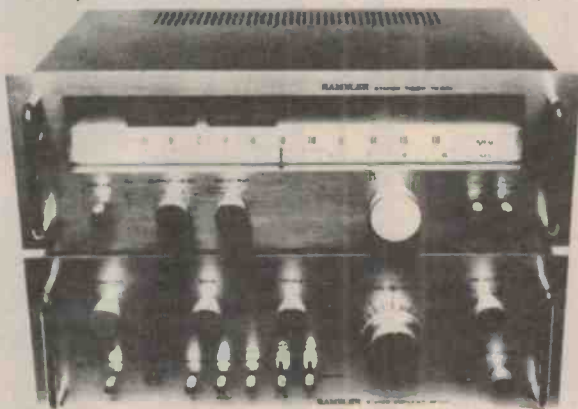
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DIMENSIONS:

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4" frame cone driver

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2 each 4" frame cone drivers

4" frame cone driver

5" frame cone driver

8 ohms

8 ohms

8 ohms

8 ohms

8 ohms

3000 Hz

1500 Hz

1500 Hz

850 Hz, 8 kHz

800 Hz, 7 kHz

Sealed

Vented

Vented

Vented

Vented

50 Hz to 20 kHz

50 Hz to 20 kHz

45 Hz to 20 kHz

45 Hz to 20 kHz

40 Hz to 20 kHz

12 watts to 75 watts,
30 watts continuous

10 watts to 100 watts
35 watts continuous

12 watts to 150 watts
45 watts continuous

15 watts to 200 watts
50 watts continuous

12 watts to 250 watts
60 watts continuous

Hand-rubbed oiled oak

Hand-rubbed oiled oak

Hand-rubbed oiled walnut

Hand-rubbed oiled walnut

Hand-rubbed oiled oak

Acoustically transparent brown knit fabric mounted on removable frame

Acoustically transparent black knit fabric mounted on removable frame

Acoustically transparent black knit fabric mounted on removable frame

Acoustically transparent foam mounted on removable panel. Choice of black, brown, blue, or burnt orange

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53.3cm H x 29.2cm W x 26.4cm D

60.9cm H x 31.8cm W x 29.2cm D

64.8cm H x 36.8cm W x 30.5cm D

63.5cm H x 40.6cm W x 35.9cm D

67.3cm H x 44.5cm W x 38.1cm D

10.4 kg

12 kg

14.5 kg

20 kg

25.4 kg

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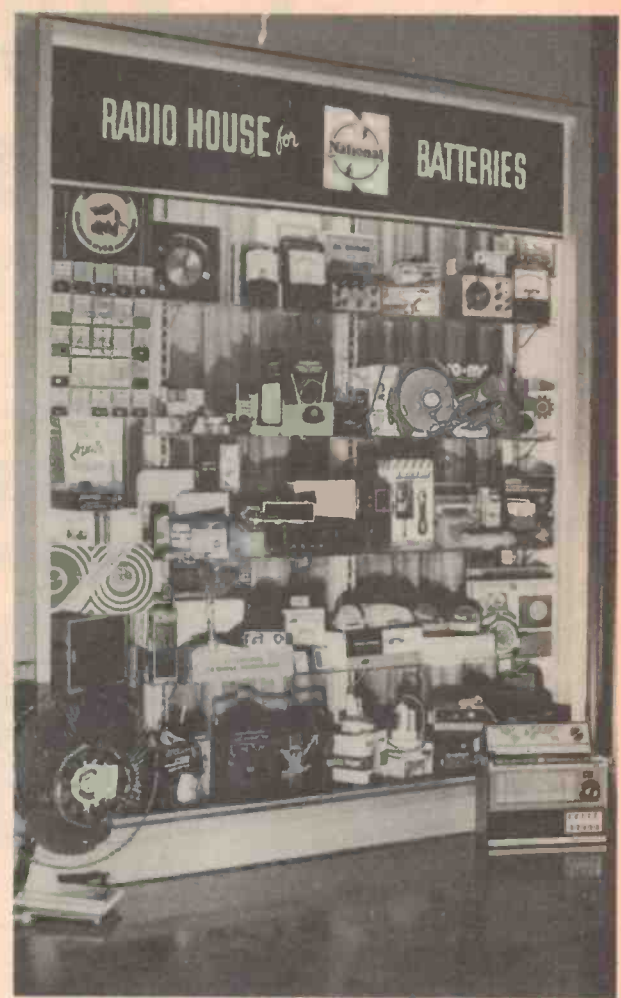
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CA3023	6.80	CD4075	.55	LM381N	3.20	SL630C	6.90	7402	.48
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CA3035	5.20	CD4078	.55	LM387N	2.75	SL641C	10.60	7404	.48
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CD4006	2.30	CD40174	2.90	LM1458N	2.50	ULN2208	2.45	7445	2.60
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CD4008	2.35	CD40192	2.90	LM1489N	5.75	ULN2111	2.10	7447	2.60
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CD4019	2.25	LM307N	1.60	MC1314P	6.90	74C160	3.60	7475	1.35
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CD4021	2.25	LM309K	2.60	MC1350P	1.95	74C174	2.50	7480	1.60
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CD4023	.55	LM311A	3.60	MC1454G	5.40	74C901	1.95	7483	2.30
CD4024	1.75	LM311H	3.60	MC1458	LM1458	74C925	16.70	7485	2.95
CD4025	.55	LM312H	4.90	MC1488	6.50	80C95	2.20	7486	.85
CD4026	3.30	LM317K	6.90	MC1488	LM1488	MISC	7489	7489	4.50
CD4027	1.05	LM318N	5.90	MC1496K	2.75	ALS352	.50	7490	.90
CD4028	1.90	LM319H	7.25	MC1590G	6.75	GL4484	1.80	7491	1.90
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CD4030	.95	LM320K	6.90	MC1648P	4.90	OL31	.90	7493	1.20
CD4031	4.70	LM320T	4.50	MC4044P	4.90	RL4484	.39	7494	2.20
CD4035	2.35	LM322N	4.50	OM802	3.20	RL5023	.35	7495	1.65
CD4040	2.50	LM323K	7.90	SAJ110	2.50	FND357	3.50	7496	2.15
CD4041	2.50	LM324N	4.50	SAK140	2.50	FND500	3.50	74100	3.65
CD4042	1.95	LM325N	4.50	SD3050E	1.30	9001	1.80	74107	.95
CD4043	2.25	LM326H	4.50	SD3050E	1.50	9368	3.85	74121	1.20
CD4044	2.25	LM339N	3.70	SL415A	2.70	9601	2.90	74122	1.90
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CD4046	3.20	LM340T	2.70	SL437D	3.60	NSN74	2.90	74132	1.90
CD4047	1.95	LM349N	4.50	SL440	1.90	TL306A		74141	2.75
CD4049	.90	LM358N	3.20	SL442	2.90	11C90	18.50	74145	2.95
CD4050	.90	LM370H	4.95	SL447	4.90	95H90	14.50	74150	3.25
CD4051	2.25	LM371N	3.90	SL449	1.60	2102-2	3.75	74151	2.20
CD4052	2.25	LM372H	7.50	SL610C	7.25	2513N	17.50	74153	1.95
CD4053	2.25	LM372N	4.50	SL612C	7.25	S1883		74145	3.20
CD4066	1.45	LM373N	4.70	SL613C	12.50	S50242	15.00	74157	2.20
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SEMICONOS	BC549C	.55	In some instances pin for pin substitutes will be supplied.						
AC125	1.80	BC559	.55	MPF102	.65	2N3053	1.20	2N5458	MPF104
AC128	1.80	BC638	1.20	MPF103	.85	2N3054	1.70	2N5459	MPF105
AC127	1.80	BC640	1.20	MPF104	1.10	2N3055	1.35	2N5485	MPF106
AC126	1.80	BD131	1.20	MPF105	.65	2N3564	.65	2N5590	MPF603
AC132	1.50	BD132	1.60	MPF196	1.15	2N3565	.55	2N5591	11.30
AC187	1.50	BD139	1.20	MPF121	1.60	2N3566	.95	2N6027	1.35
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AD149	2.80	BD237	1.80	TIP31C	1.20	2N3569	.50	BA102	.80
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AS322	.16	BP437	2.80	TIP120	3.20	2N3638A	.60	0A90	.35
AT116	2N301	BD438	2.80	TIP125	3.30	2N3642	.55	0A91	.35
AS17	2.65	BF173	1.25	TIP141	4.70	2N3643	.55	S082-2800	3.20
BC107	.35	BF180	1.20	TIP2955	1.70	2N3694	.65	40440	2N3731
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BC178	.40	BFY51	1.50	2N301	2N2669	2N4037	1.25	40841	1.90
BC179	.40	BPX25	4.90	2N705A	1.20	2N4249	.65	0X91	.75
BC182	.40	BSX19	.75	2N918	1.60	2N4250	.85	BX370	1.50
BC212	.50	BU126	3.85	2N2222A	1.20	2N4355	.65	BZY91	12.50
BC327	.55	MFE131	1.95	2N2646	2.50	2N4356	.65	PA40	.85
BC337	.55	MJ802	8.80	2N2669	2.70	2N4360	.95	PB60	3.50
BC547	.55	MJ2955	2.60	2N904A	1.20	2N5245	.75	MEL12	1.40
BC548	.55	MJ4502	8.80	2N2905	1.50	2N5457	MPF103	FC0820	1.90



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Ideas for experimenters

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

SOUND EFFECT GENERATOR

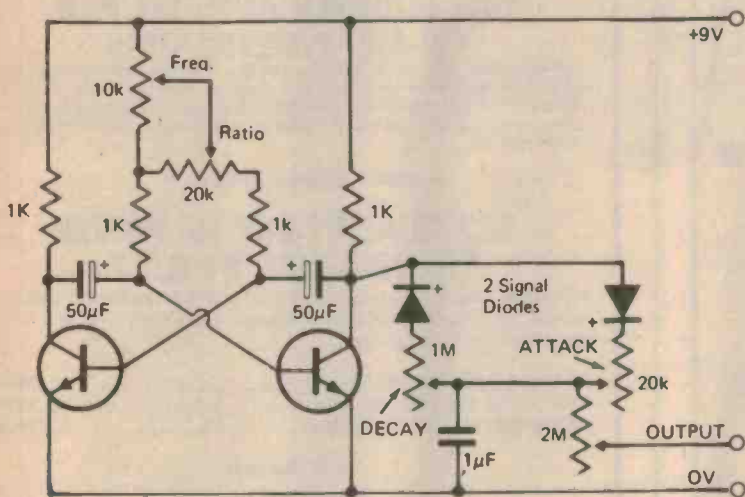


FIG 1

The waveshape generator shown in this circuit will interest those readers experimenting with sound effects.

Basically the circuit is a slow running oscillator with variable attack and decay. A variable amplitude (high impedance) output is available via the 2 meg potentiometer. Figure 2 shows an add-on circuit which should be used if a low impedance output is required.

Some of the output waveforms that can be produced are shown in Fig 3.

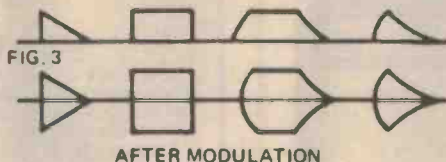


FIG 3

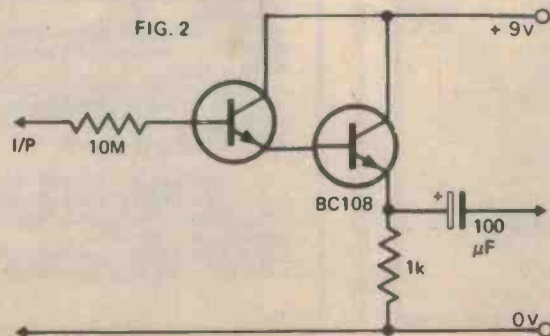


FIG 2

FERGUSON "DEVELOPMENTS"

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The range of output voltages is: 1.5V, 3V, 4.5V, 6V, 7.5V, 9V, 10.5V, 12V, 13.5V, 15V and 18V.

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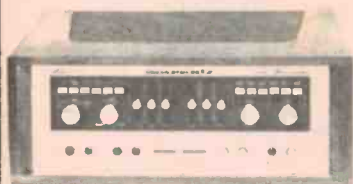
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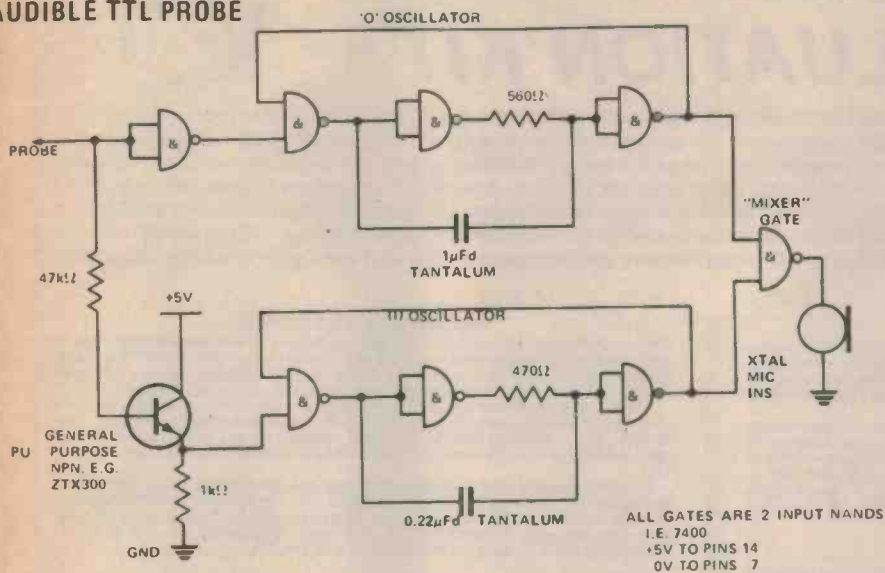
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Ideas for experimenters

AUDIBLE TTL PROBE



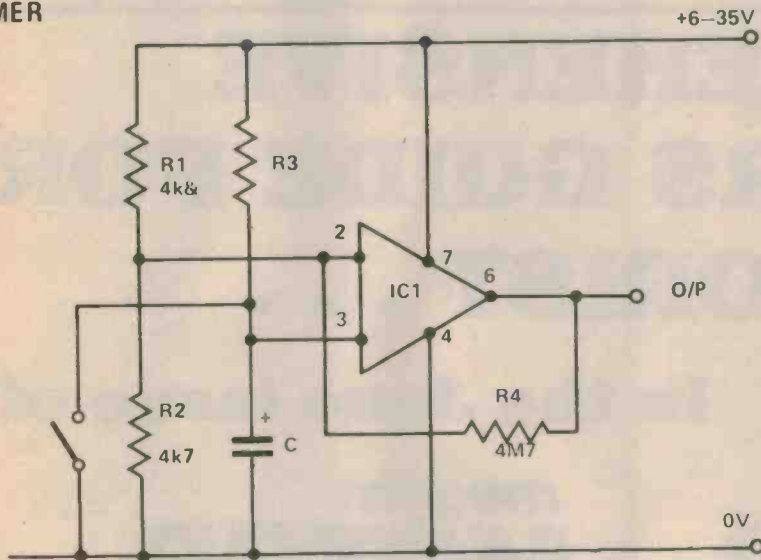
With many LED TTL logic probes it is difficult to watch the LEDs and the circuit one is testing. The following circuit is an attempt to produce a new sort of probe.

When the probe is in contact with a TTL low (0) the probe emits a low note. With a TTL high (1) a

high note is emitted.

The whole circuit uses only two TTL ICs and several auxiliary components. This low component count makes it easy to miniaturise the unit. The power is supplied by the circuit under testing so no battery is required.

741 TIMER



The circuit shows a very simple timer based on a 741 op amp.

R1 and R2 hold the inverting input at half supply voltage. R4 applies some feedback to increase the input impedance at pin 3, but its value is such that negligible damping of pin 2's voltage occurs. Pin 3, the non inverting input, is connected to the junction of R3 and C. After S1 is opened and C charges via R3. When the capacitor has charged up sufficiently for the potent-

ial at pin 3 to exceed that at pin 2 the output abruptly changes from 0V to positive line potential. If reverse polarity operation is required simply transpose R3 and C.

R3 and C can be any values and time delays from a fraction of a second to several hours can be obtained by judicious selection. The time delay is $0.7CR$ seconds where C is in Farads and R in ohms and hence is completely independent of supply voltage.

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MOTOROLA M6800 EVALUATION KIT



MEK6800D2 provides a useful and expandable tool for those who wish to develop systems with the M6800 Microprocessor without investing in expensive terminals. All parts needed to complete the system and get up and running are provided in the kit with the exception of the power supply. In addition to the expansion available on the basic microcomputer module, additional RAM, ROM and I/O parts can be accommodated at a later date to implement more complex systems. Machine language programs can be entered through the system keyboard or via a built-in audio cassette interface system. Hexadecimal LED displays are provided for monitoring data and address information. A crystal-controlled clock generator is used to eliminate timing adjustments • JBUG Monitor. Trace One Instruction. Set up to Five Breakpoints. Examine and Change Memory and Registers • Parallel and Serial Interface Capability. • 16 I/O Lines, 4 Control Lines.

FIRMWARE FEATURES

The monitor firmware included with this system sets a new standard of performance for evaluation kits. The function of the JBUG monitor is to allow the user to communicate with and hence control the M6800 microcomputer by using the hexadecimal keyboard and display module. The intelligence and diagnostic capability of JBUG is provided in the 1K x 8 ROM.

The system keyboard uses 24 keys with the following functions. 1. Punch designated memory to audio cassette (Kansas City Standard), 2. Load cassette to memory, 3. Trace 1 instruction (implemented in hardware so programs in ROM or PROM as well as RAM can be traced), 4. Set and clear up to 5 breakpoints, 5. Examine and change memory, 6. Display and change registers, 7. Go to user's program, 8. Proceed from breakpoint, 9. Abort user's program, 10. Calculate relative offsets, 11. Hexadecimal number entry (0 thru F).

TOTAL ELECTRONICS

MELBOURNE 96 2891; SYDNEY 439 6722; BRISBANE 229 1633; ADELAIDE 268 2922; PERTH (ATHOL HILL P/L) 25 7811; NEWCASTLE (DIGITRONICS) 69 2040; CANBERRA (ELECTRONIC COMP) 95 6811.

MOTOROLA SYDNEY — 438 1955, 43 4299, MELBOURNE — 581 3555, MOTOROLA DISTRIBUTORS

HARDWARE FEATURES

Three I/O devices are provided in the kit. One Peripheral Interface Adapter (PIA) is dedicated to the hexadecimal keyboard and display module. A second PIA is made available exclusively for the user. An Asynchronous Communications Interface Adapter (ACIA) is also included to interface with your audio cassette tape recorder.

This kit also permits several different memory configurations. Two MCM6810s (128 x 8-bit) RAMs provided with the standard kit will accommodate programs of up to 256 bytes in length (a third MCM6810 is reserved for use by the monitor program). Additional memory expansion with RAM and ROM is left to the user's discretion.

The MPU module card is prewired for ease of expandability and is capable of accepting the following devices: 2 MCM6810 (128 x 8) RAMs, 3 MC8T96 Address Buffers, 2 MC8T26 Bidirectional Buffers, and any two of the following (by utilizing strapping options): MCM68316E (2K x 8) ROM, MCM68708 (1K x 8) EPROM, MCM68308 (1K x 8) ROM, or HA7640 (512 x 8) PROM.

CEMA

MELBOURNE 877 5311; SYDNEY 439 4655; BRISBANE (ELECTRONIC COMP) 371 5877; ADELAIDE (WOOLLARD & CRABBE) 51 4713; CANBERRA (CUSTOM SCIENTIFIC) 47 6179; WOLLONGONG (MACELEC) 29 1276; PERTH (RESERVE ELECTRONICS) 87 1026



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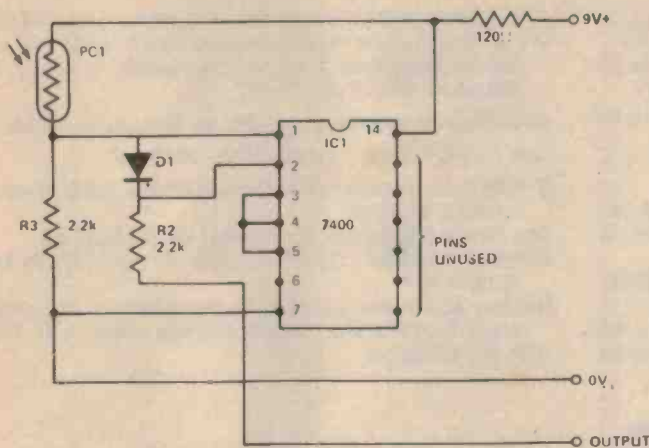
In the June issue of

modern
MOTOR

on sale, April 27.

Ideas for experimenters

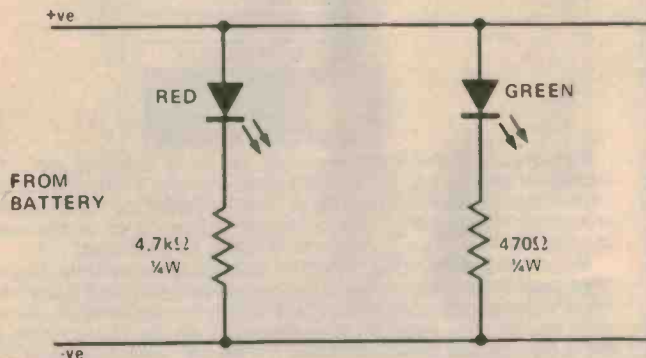
INTRUDER ALARM



Here two gates of a 7400 are used to provide photoelectric control in conjunction with an ORP 12 photocell. When light falls on PC1 the potential is applied to the trigger circuit consisting of $\frac{1}{2}$ the 7400. The feedback provided ensures a positive output change at pin 6. The output, whilst PC1 is under illumination, is equal to the

supply voltage. R1 enables a small 9V battery to be used. If PC1 is shaded the output at pin 6 is 0V. This may now be used to trigger a relay for an intruder alarm. If this is the case it is wise to use a small mains supply and to incorporate a diode across the relay coil, to prevent high back EMF from destroying the IC.

GOOD/NO GOOD BATTERY TESTER

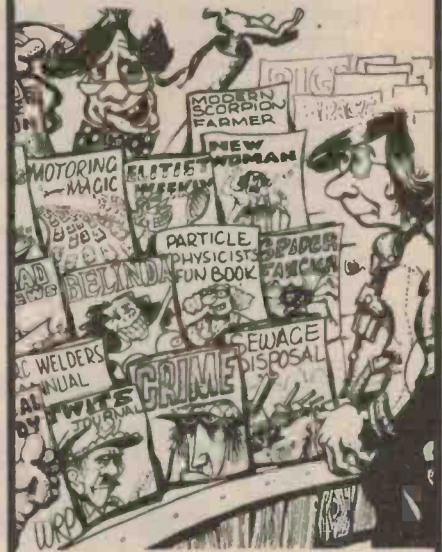


This is a simple tester for use with a PP3 or similar battery.

It is wired to a PP3 battery clip remembering that red is connected to -ve of battery and black to the +ve. It uses 3 small LEDs of the same size: one red, one green. Due to the

fact that the green LED needs a far greater current, the green will glow only if the battery is in reasonable condition. The red will glow even if battery is down. If the red glow is very faint the battery is no good.

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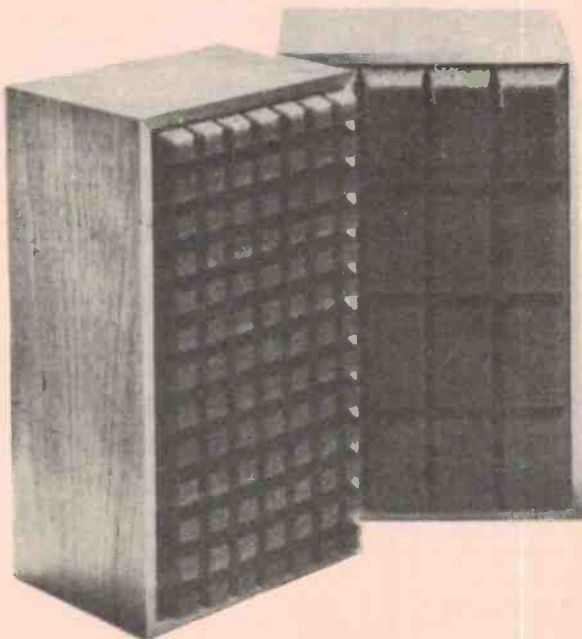


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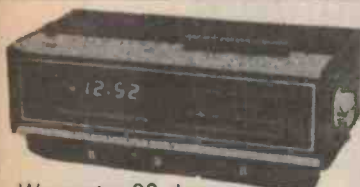
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Please Explain



Decibels

What is a dB in terms of a percentage increase in power? What is dB and dBm?

T.J., Melbourne

One decibel increase in power means an increase of approximately 26%. Thus $3 \text{ dB} = 1.26 \times 1.26 \times 1.26 =$ approximately twice the power.

When the effect is logarithmic (such as the effect of sound power changes on the ear: the brain hears the same 'volume difference' between 5 W and 10 W as it does between $\frac{1}{2}$ W and 1 W or 40 W and 80 W) it is useful to measure power differences on a logarithmic scale. Rather than using a sequence like 1, 1.26, 1.6, 2, 2.5, 3.2, 4, 5, 6.35, 8, 10, (which show equal ratio increases) the series 0 dB, 1 dB, 2 dB, 3 dB, 4 dB, 5 dB, 6 dB, 7 dB, 8 dB, 9 dB, 10 dB, can be used.

The number of decibels corresponding to the difference in two power levels = $10 \log \frac{P_2}{P_1}$ (Using base 10 logarithms).

The series above can be used to find the power ratio for any number of decibels. You can see directly that 4 dB corresponds to a ratio of 2.5. So if you want to know what 14 dB means consider this as two ratios, 4 dB and 10 dB, which give 2.5 and 10, a total ratio of 25. Or you could have regarded 14 dB as two 7 dB ratios, an increase of five times followed by another of the same ratio, $5 \times 5 = 25$. It doesn't matter how you split up the 14 dB, you still get a ratio of 25.

In practice if you have a signal-to-noise ratio of 90 dB it means the signal is 1 000 000 000 times more powerful than the noise. Or if you have a radio

receiver with an S-meter calibrated every 6 dB, an S3 station radiating 5 W will have to radiate 20 W to make S4. Similarly a 100 W station would have to find another 300 W to have the same effect.

The relationship between decibels and the ear's 'loudness' response is roughly as follows: one decibel is about the smallest change the ear can detect, and 9 dB comes over as a doubling in loudness. So if you choose between two hi-fi amplifiers, one rated at 40 W and one at 50 W, bear in mind that the difference is only just perceptible. And if you buy the 40 W amplifier and discover it's only half as loud as you want, you'd better start saving for a 300 W system!

In audio you don't normally hear of much above 110 dB. That's because the range of hearing from its lower threshold to the threshold of discomfort is only about 110 dB. But without decibels we'd have to talk of power ratios up to 10^{11} . In measuring actual sound levels, such as when checking noise pollution, an absolute scale can be made by referring sound levels to the threshold of hearing (corresponding to a sound-pressure level of 0.0002 micro-bars).

Another absolute scale is used in audio to compare levels — this time to compare audio signals. Here levels are referred to 1 mW of power (in a 600 ohm line) and the units are called dBm. The VU meters on audio equipment use units also derived from the decibel, when measuring a sinewave a change of 1 dBm produces a metered change of 1 VU.

So a 1 W signal corresponds to 30 dBm, and on a 600 ohm line this would be 24.5 V.

ELECTRONIC DISPOSALS

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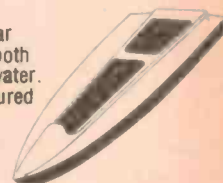
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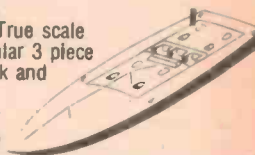
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where leadership
has become a tradition



In 1970 Technics introduced the world's first direct-drive turntable. Since then we have developed a range of turntables universally accepted by professional studios and discerning audio buffs alike.

The heart of the original direct-drive turntable was the precise, low-speed DC servo motor with performance characteristics equal to that of fine record-cutting equipment.

In developing phases a competitively priced tone-arm equipped direct-drive unit brought professional features within the reach of the discriminating hi-fi enthusiast. Then fully automatic operation was combined with the direct-drive principle. A major innovation was the quartz phase-locked SP-10 Mark II — a thoroughly professional unit with amazing

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In 1976 new generation technology such as the Back Electromotive Force Frequency Generator improved speed stability under varying loads. One chip 321-element integrated circuitry to drive and control the DC motor was also implemented.

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Model	Cassette Position	Drive System	Control Operation	Tape Selection	Wow & Flutter	Signal/Noise Ratio	Frequency Response
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CT-F7070	Vertical	1 motor	Mechanical	Independent BIAS, EQ (automatic chrome-tape selector)	Within 0.19% (DIN)	Dolby OFF: 52dB Dolby ON: 62dB (normal tape over 5kHz)	30 - 14,000Hz 40 - 13,000Hz ($\pm 3dB$)
CT-F6060	Vertical	1 motor	Mechanical	Independent BIAS, EQ (automatic chrome-tape selector)	Within 0.2% (DIN)	Dolby OFF: 52dB Dolby ON: 62dB (normal tape over 5kHz)	30 - 14,000Hz 40 - 13,000Hz ($\pm 3dB$)

*Dolby is the trademark of Dolby Laboratories, Inc.

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