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- **TV Game - Gun Circuit**
- **Computer Terminal** *(FINAL DETAILS)*
- **GSR Monitor for Bio-feedback**

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VOL.1 NO.2

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

electronics TODAY INTERNATIONAL

A MODERN MAGAZINES PUBLICATION

MARCH 1977, Vol. 7 No. 3.

Editorial Steve Braidwood
Publisher Collyn Rivers

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

SPECIAL OFFER – Full Scientific Calculator for $15.75.

COVER: *Could this be you? Do you suffer from tension? Many people have learned how to reduce tension using biofeedback so why not build up our GSR project and see if you can learn the secret . . . see page 46.*

*Recommended retail price only

PROJECTS

FEATURES

NEWS & INFORMATION

FREE INSIDE – our New Magazine, CB AUSTRALIA

NEWS

MICROVISION

The pocket TV — the Sinclair Microvision — with its 2 inch screen, has taken twelve years and a £500,000 investment to develop. It is powered by a re-chargeable batteries and, being a multi-standard receiver, operating on all VHF/UHF wavebands, picks up TV transmissions anywhere in the world.

The bulk of the circuitry is achieved in five bipolar integrated circuits, which feature a small external component count plus overall low power consumption. A total of 300 transistors are used.

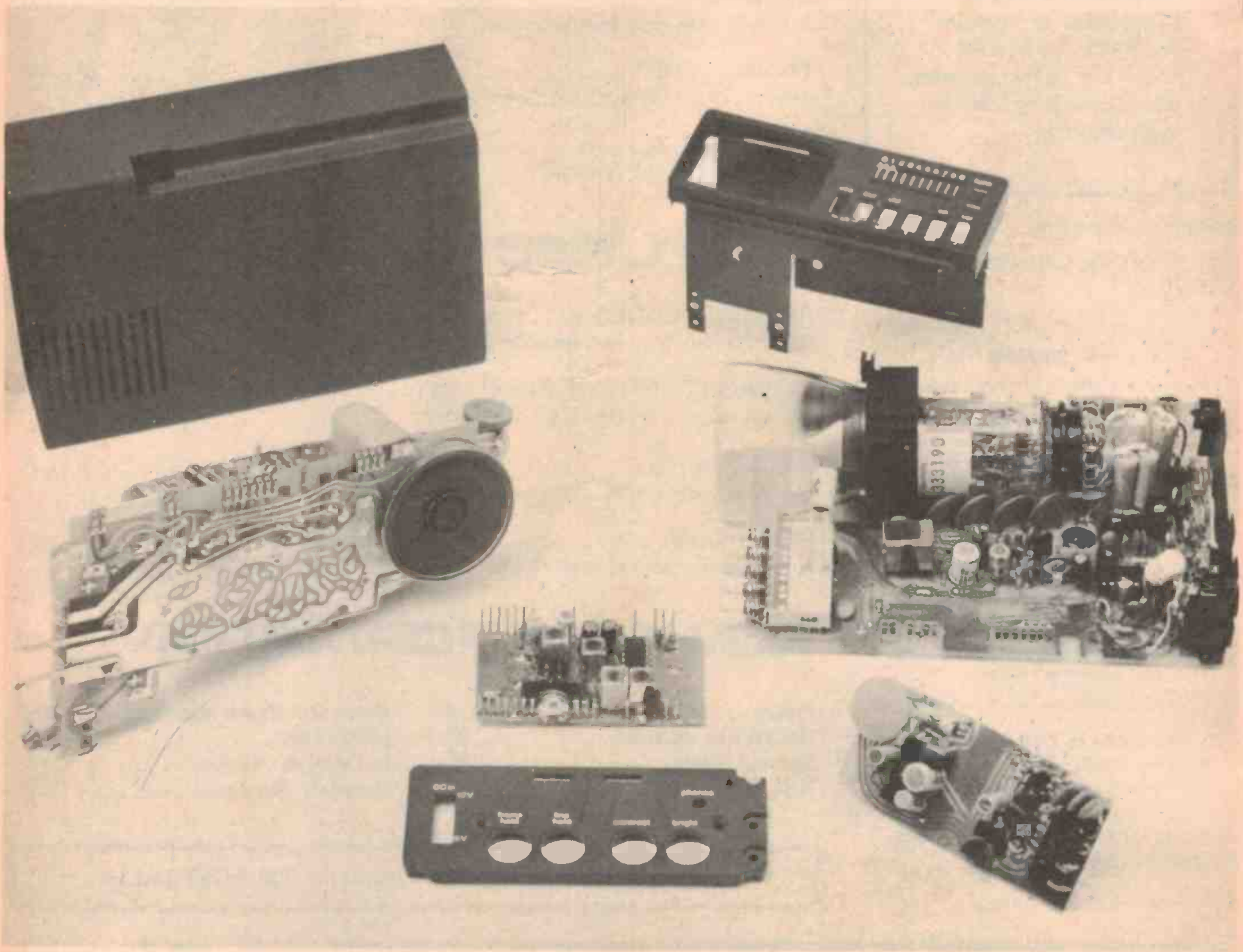
The picture tube uses electrostatic deflection of the electron beam, plus a very low power heater (15 seconds warm-up), both of which help to reduce power consumption.

Launched in London on 10th January, 1977, by the British company Sinclair Radionics, the Microvision will be available in the UK during February.

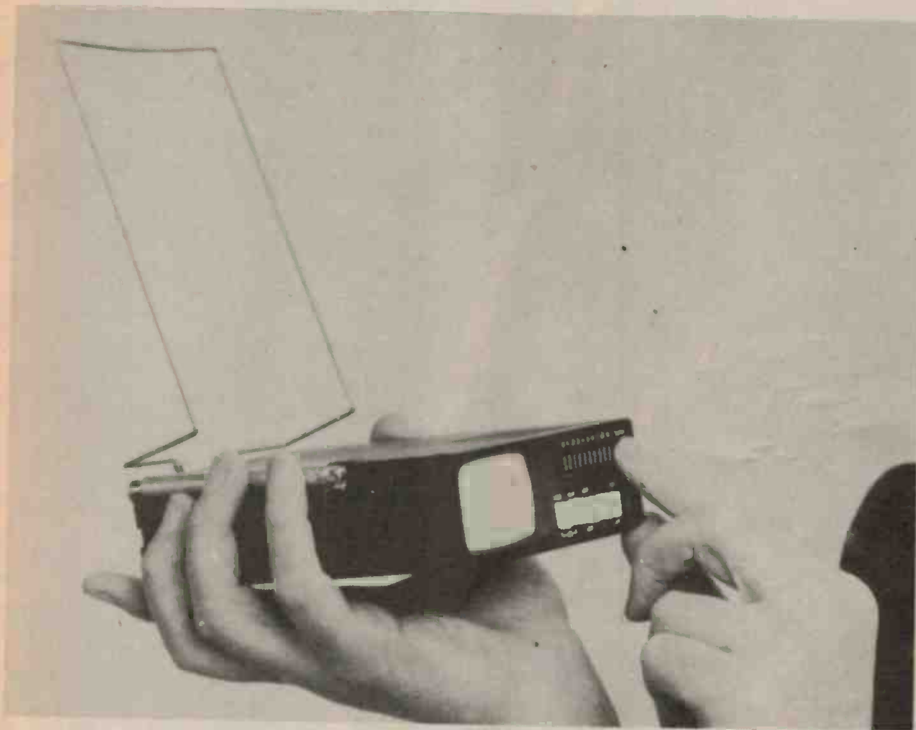
Just 4 inches wide, 6 inches long, 1½ inches deep and weighing only 26½ oz, it is priced at £175. (A$280 approx.).

According to Managing Director, Clive Sinclair, 36, the pocket TV, which runs off re-chargeable batteries, is the perfect source of information for the travelling businessman. It can be used in a car or train and is expected to become the major export earner for the Company, who are already the UK's largest manufacturers of electronic calculators.

Top: Main body case; front with tuning dial and button selectors.
Centre: Tuner board; video/IF deflector board; power deflector board with tube.
Bottom: Rear panel; audio board.



DIGEST



ETI's London staff have seen the 'pocket TV' and are very enthusiastic about the design. They say the picture is 'not the best we've seen' but before we comment we would like to get a set in our Sydney office.

No doubt this will not be the last we hear of the pocket TV.

Mr. Sinclair started business on his own at the age of 21, making radio and amplifier kits sold via mail order. Ten years later, his company moved into the present headquarters in a converted mill at St. Ives, Cambs, prior to launching its first calculator, the 'Executive', which earned the Company £2½ million in export revenue.

Since then, the Company has become the UK's leading calculator manufacturer, has won numerous design and export awards and expanded its range of products to include a digital watch and a series of electronic instruments.

For information contact –
Sinclair Radionics Limited,
London Road, St. Ives
Hurtingdon,
Cambs PE17 4HJ
UK.

Cosmic Jive

Music from space won't be just a David Bowie fantasy if the American Muzak Corp. go ahead with their plans to distribute background music to commercial and industrial buildings across the US. Tests have already been carried out using a geostationary satellite and receive stations will need a four-foot dish antenna if the scheme goes ahead.

Home Pinball

More news of the consumer amusement industry in the US — when we are getting excited about the prospect of microprocessor-controlled video games arriving in Australia hopefully by next Christmas, the Americans now have microprocessor-controlled home pinball games. The machines are virtually identical in looks, sound and feel to the commercial machines in our arcades and snack-bars. Bally Manufacturing Corporation are selling one machine for US$900 that even plays songs to the loser. For about the same price Allied Leisure have machines designed to be played sitting down, machines which double as coffee tables when not in use! Both companies use the microcomputer not only for playing the game but also in a diagnostic mode — the machine's display tells the user where the fault is.

Sydney Computer Club

The Sydney Computer Club, MEG (Micro-computer Enthusiasts Group), decided at the February meeting that in future there will be two meetings per month, one for beginners and one for systems-owners.

The meetings are scheduled for the first (systems-owners) and third (beginners) Mondays each month. They will be held at the WIA Hall, Atchison Street, Crows Nest starting at 8 pm.

Digital Fast Fourier Transform Processor

Britain's Mullard Research Laboratories have developed a digital fast Fourier transform processor capable of spectrum analysis for a small radar unit. Ten watts of FMCW radar could provide the small boat owner with radar coverage up 40 km. The arithmetic units and CCD shift registers needed for the system are still under development (by other companies).

110 20 12 11 10

This series formed the Unitrex calculator contest in our January issue – readers were invited to submit the next three numbers in the series. We know of two possible solutions based on general formulae: 6,6,6 and 70,320,957.

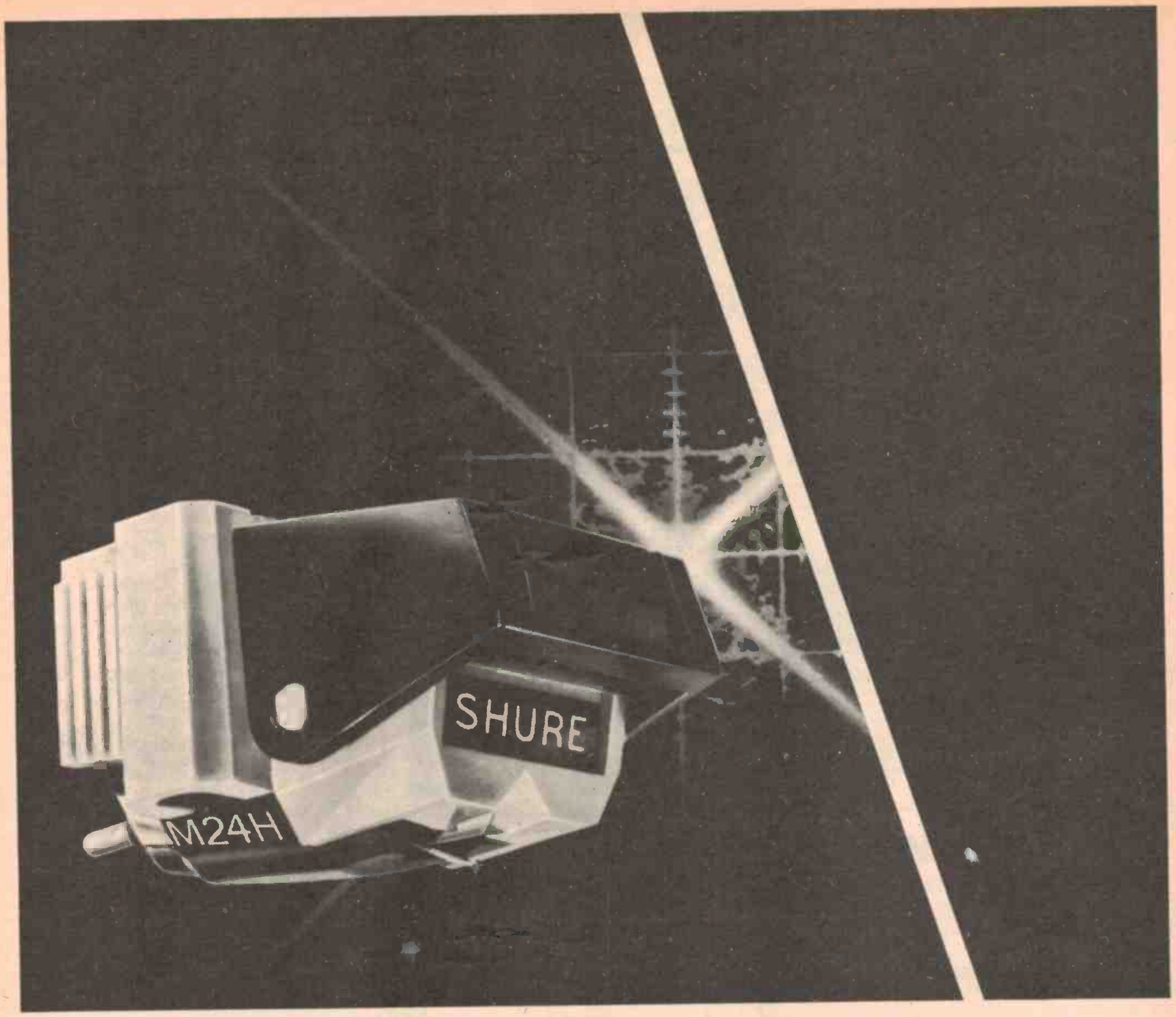
The first supposes the series to be the number six written in different number systems: 110 is to a base of two, 20 is with a base of three, 12 with a base of four, 11 with a base of five and so on.

The other solution uses the formula:

$$\frac{17n^4 - 245n^3 + 1291n^2 - 2953n + 2550}{6}$$

Then as n takes the values 1,2,3,4,5, the series starts 110,20,12,11,10, and when n is 6,7,8, the series continues 70,320, 957. Only three readers sent in this solution: Mr A. Thomas of Hobart, Mr D.H. Gapp of Somerton Park, SA, and Mr H. Moors of Bendigo, Vic.

The winner was the sender of the first correct entry picked at random – and that was R.H. Williams of Brisbane.



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Despite its compact size, B&W's DM5 speakers can be rated as a system of very high quality. This is what the experts say:

Electronics Australia, Oct. '76 . . . "Listening tests confirm the supplied frequency response curves. It is very smooth and well maintained up to the limit of audibility . . ." Stereo Buyers' Guide says . . . "The DM5 mid ranges are excellent, being smooth with a nice bite to them and the highs are well maintained and shimmering in quality . . ."
Stereo Magazine Issue 13 . . . "The DM5 is a fine, well crafted speaker of modest dimensions and price but with a standard of performance that belies both those parameters . . . the mid range response is clear and possessing a lifelike presence that left us most impressed.

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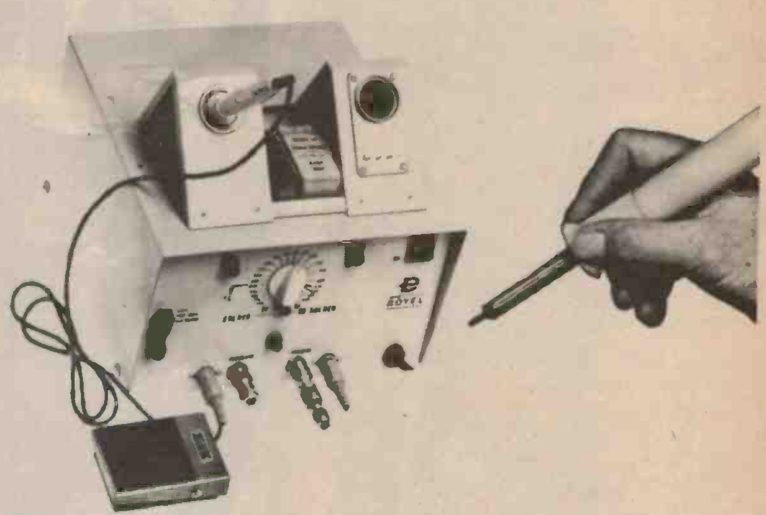
REWORK STATIONS

The latest development in the range of Royston electronics rework stations is the Model RE800. Basically, this station is designed to facilitate the desoldering and removal of an original circuit component, and the insertion and resoldering of a replacement, without degrading the original equipment.

The RE800 provides separate low voltage desoldering tool and soldering tool, both of which have electronic feedback temperature control. Also included is a line voltage, van-type vacuum/pressure pump which provides vacuum or pressure through the desoldering tool. This permits either suction or hot-air jet reflow soldering.

Where adequate controlled-temperature soldering facilities already exist, desoldering-only stations are available in two forms. The RE820 is the desoldering-only version of the RE800 described above, with the vacuum/pressure pump. The RE720 performs a similar function, but uses a vacuum transducer and footswitch-operated solenoid valve, for connection to 100 psi shop (pressure line) air supplies.

Full details of these and other rework stations are available from Royston Electronics, 22 Firth St., Doncaster, Vic, 3073.



MOTOROLA'S NEW HOBBY COMPUTER

The M6800 evaluation kit MKII comes complete with keyboard and display and cassette interface — it is a complete computer except for power supply, which need only give a single 5 V.

The keyboard enables you to enter data using hexadecimal numbers, to load data from a cassette, to unload memory onto cassette, to set and clear up to five breakpoints, to examine and change memory, to display and change registers, to calculate relative offset, to trace one instruction, to go to user's program, to proceed from a breakpoint, or to abort user's program.

The ROM and RAM are expandable from the initial 6830 J-Bug monitor and 256 bytes of user memory. The kit is available from Motorola for less than $300, including tax. Read the details in next month's Print-Out.

NS MPU COURSES

NS Electronics are now running courses in Bayswater, Vic., and Brookvale, NSW, to introduce microprocessors to electronics engineers. General tuition is given at two levels, fundamental and advanced, and there are courses dealing specifically with the SC/MP or the IMP-16/PACE processors. The courses cost $395 and NS recommend enrolling at least a month before the course to avoid disappointment. Some of the coures have already been held. Here are the details of remaining courses: Microprocessor Fundamentals (not really about microprocessors specifically, more about microcomputers in general), Melbourne March 7 to 11; SC/MP Applications (not a beginners course) Sydney April 18 to 22; Advanced Programming (using IMP-16 and PACE) Melbourne May 30 to June 3.

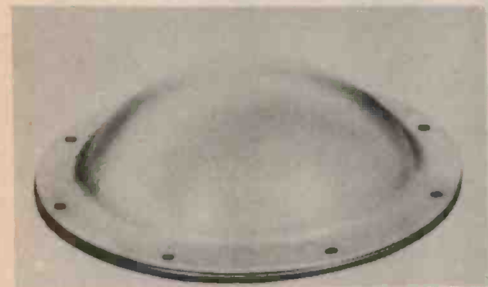
Further information from Melbourne Microprocessor Training Centre, N.S. Electronics Pty, Ltd. Cnr Stud Road & Mountain Hwy, Bayswater, Victoria, 3153. Telephone (03) 729-6333

Sydney Microprocessor Training Centre, N.S. Electronics Pty. Ltd, 2-4 William Street, Brookvale, NSW, 2100. Telephone (02) 93-0481.

The corporate office of Philips Industries Holdings Limited has moved to North Sydney. The new head office is located in Blue Street, North Sydney, telephone 922-0181.

HARD HAT Mobile Antenna

SCALAR Distributors have just released their latest innovation in low profile mobile antennas. The "Hard Hat" is a high impact plastic dome virtually immune to damage.



The (2.5 inch high 10 inch diameter) antenna which is based on a loop radiator mounted over a ground plane has a gain approaching that of a ¼ wave whip antenna. The bandwidth is in excess of 20 MHz (with 2 to 1 VSWR). The range of frequencies is between the 450-512 MHz band.

The "Hard Hat" comes with 15ft length of RG58/u cable and a PL529 plug connector plus mounting hardware. The antenna can be mounted on any flat surface (metal or non-metal as it incorporates its own ground plane) and fastened by sheet metal screws through eyelets. A gasket, included with hardware, with double sided adhesive ensures a watertight seal.

The unit's advantages are is it's to be used where low-profile is needed or where possible damage could occur to whip antennas.

Also available through SCALAR is a new vertical radiator marine antenna consisting of 23-foot 2 section of white fibreglass. The antenna is suitable for small to medium size craft using the H.F. Band (CB). Its power rating is 1000 watt and frequency range is 2.22 MHz. A coupler is required but no porcelain isulators are needed.

DAVID J REID (NZ) LTD

This new advertiser in ETI has just set up operations in Newtown. The company specialises in supplying components to industry and kits to home builders. The company was established over 25 years ago by David J Reid as an electronic component importing company servicing NZ manufacturers. Now David J Reid (NZ) Ltd claims to be the largest electronic component company in New Zealand with a multi-million dollar sales turnover. The Company has five manufacturing plants, nine branches nationwide and employs over 300 people.

FIBRE OPTIC ROAD SIGNALS

Rank Optics is supplying 122 fibre optic road signals for the Drecht Tunnel in Holland.

This is one of the largest commitments to fibre optic traffic sign technology made by a European government. Britain has also utilized fibre optic signals on 8 major road systems.

The signals are to be placed on the approaches to the Drecht Tunnel below the river Onde Maas near Dordecht. There will be for tunnels each containing two lanes. Completion of the tunnel is expected later this year.

Seven primary messages are programed for the tunnel signs, although their display capability is sixteen different messages. Intergrated with the signs are automatic message monitors and a standby facility.

The signals will be manufactured in Leeds (UK) by Rank Optics.

25,000 home computers in 1977

A study just completed in America predicts US sales of 25, 000 computers for home use in 1977. The average growth rate from 1976 to1981 is predicted to be 33 percent per year. Almost two-thirds of this year's sales are expected to be from hobby shops.

GI'S new game

General Instrument have announced three new families of TV games which allow manufacturers to make 38 different types of video game 'contest'. These include volleyball, tank warfare, and a road race. Some of the games are made up from dedicated chips and add-on option chips, others use cartridge-programmable microprocessor systems. It will not be until late this year until all the range of ICs is available.

MULTIMETER

High accuracy on 52 measuring ranges — all selected with a single switch — is the main feature of the Unigor 3n multimeter. Other features are frequency response up to 100 kHz and built-in current transformer which makes possible the separate measurement of superimposed dc ano ac components.

The push-button polarity-reversal switch of the Unigor 3n simplifies the testing of semiconductors.

The Unigor 3n multimeter is manufactured by Goerz in Austria and is available in Australia from Kent Instruments (Australia) Pty. Ltd. 70-78 Box Road (P.O. Box 333), Caringbah, NSW. 2229.

MONOLITHIC FET-INPUT INSTRUMENTATION AMPLIFIERS

National Semiconductor has designed the world's first series of monolithic JFET-input instrumentation amplifiers, utilizing its "BI-FET" process. Known as the LF52 series, these devices offer the combined advantages of high input impedance and common mode rejection, along with extremely low bias currents, at a low cost.

"What the 709 did for op amps, the LF152 will do for instrumentation amplifiers" claimed Ed Schoell, Applications Engineer at NS Electronics in Melbourne.

For further information please contact NS Electronics on, Melbourne 729-6333; Sydney 93-0481; Adelaide 46-3929; Brisbane 36-5061; Perth 25-5722; Hobart 44-1337; Auckland 49-1281.

Drake SSR-1

Communications Receiver

- **Synthesized**
- **General Coverage**
- **Low Cost — around $290**
- **Selectable Sidebands**
- **All Solid State**
- **Built-in Ac Power Supply**
- **Excellent Performance**

The SSR-1 Receiver provides precision tuning over the short wave spectrum of 0.5 to 30 MHz with capability of reception of a-m (amplitude modulated), cw (continuous wave) and ssb (upper and lower single side band) signals.

A synthesized/drift-cancelling 1st mixer injection system giving thirty tunable ranges from 0.5 to 30 MHz is derived from a single 10 MHz crystal oscillator providing frequency stability necessary for ssb operation.

A stable low frequency VFO tunes each of the 30 one-MHz ranges with a dial accuracy of better than 5 kHz which is sufficient to locate and identify a station whose frequency is known.

Separate detectors (product and diode) are used to provide for best performance whether listening to ssb or a-m signals. Narrow band selectivity for ssb and wide band selectivity for a-m reception is provided.

A manual tuned preselector provides for maximum sensitivity and maximum interference rejection.

Solid state circuitry throughout allows efficient operation from built-in ac power supply internal batteries or external 12 V-dc source.

FRONT PANEL CONTROLS

MHz: Sets the MHz range of the received frequency. This control tunes the smaller inner dial (1) and is adjusted for the center of the desired MHz range.

Signal Meter: Indicates relative rf input signal level.

Pre-selector: Adjust receiver rf tuned circuits for proper reception of signal. This control is tuned for maximum signal or noise at the selected frequency.

Frequency Display: Indicates tuned frequency.

The inner dial indicates MHz range and the outer dial indicates kHz reading. As an example 5.750 MHz.

kHz: Tunes the kHz range of the receiver. This control turns the large outer dial (2) and is adjusted for the proper frequency as displayed on the graduations. This dial has a graduated scale from 000 to 1000 and is read as 0 to 1000 kHz or .000 to 1.000 MHz.

Clarify: Provides ultra fine frequency adjustment (approximately 3 kHz range). This control is used primarily on ssb and cw signals for setting the pitch or sound accurately after the station has been roughly tuned in. It should be in the center position before any tuning is commenced.

Mode: Selects mode of reception. A-m (amplitude modulation), usb (upper single side band) and lsb (lower single side band). Cw (continuous wave) may be received on either usb or lsb position. The mode selector selects the proper detector (product detector for ssb and diode detector for a-m and i-f selectivity filter.

Band: Selects the proper range of received frequency.

Off-Volume: Turns radio on and off and adjusts audio output level.

Phone Jack: For ear phone reception or external speaker (8 ohms). Insertion of jack disconnects internal speaker.

Pilot Lamp Switch: On ac operation the pilot lamps are always lighted. The pilot lamps are normally extinguished on battery operation to conserve battery life. Pushing this momentary action switch turns on the pilot lamps.

Built-in Telescoping Antenna: The SSR-1 has such sensitivity that it operates near maximum practical limits. For optimum results, the receiver should be connected to an external antenna.

BACK PANEL CONTROLS

Record, External Battery, Mute Jack, Antenna Terminal Strip, Antenna Attenuator, Fuse.

Available from selected retailers or the Australian distributors:

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P.O. Box 30 Concord, N.S.W. 2137
736-2888
Melbourne: 233-4044; Adelaide: 42-6666
Brisbane: 36-5061
Perth: 25-3144.

Win a Calculator

This month's problem was submitted by Gordon Dodd of Jannali, NSW.

A calculating female

Horace was an incurable gambler with yet another "infallible" system. His wife Harriet was not impressed and insisted that before starting, he must place $5,506 in a special reserve. The system was to place a bet on the first horse; a bet on the second one; the sum of the two bets on the third; the sum of the 2nd and 3rd on the 4th and so on. Somehow, Horace was much better at punting than at mathematics, so when Harriet asked how the system was working after he placed his sixteenth bet, Horace produced his electronic calculator set to three decimal places. He divided the 16th bet by the 15th bet, then added the $5,506 in reserve. As Horace puzzled over the result, Harriet, standing at the opposite side of the table, read the answer *alphabetically*. "Just what I thought, you waster!" was her response.

To find out what Harriet read, make the first two bets any amounts you choose, then follow Horace's system not forgetting to add the reserve.

To enter the contest answer the following questions on the back of an empty envelope –

(1) What did Harriet read?

(2) That this holds whatever Horace's first bets were was explained nearly 800 years ago by a famous Italian mathematician . . . what is his name?

(3) A 19th Century French scientist linked the work of the Italian mathematician to various natural phenomena (sunflower heads, leaf buds on a stem, the genealogy of a male bee, snails shells, etc) . . . what is the name of this scientist?

Send the entry to Unitrex calculator contest (March), ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011, to arrive no later than April 2nd, 1977. The winner will be the sender of the first correct entry randomly picked after that date.

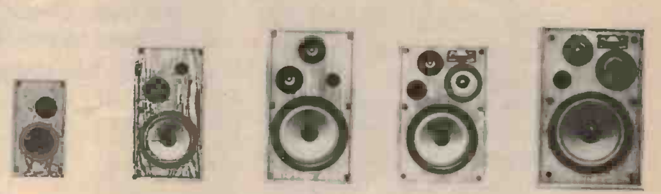
Permit number TC7585

ERRATA

See page 83 for details of errors in the VDU project.

New from Altec...

elegant in design ... outstanding in performance



From the leader in Studio Monitors ... the new standard for the discriminating listener. All cabinets are natural North American hardwood veneers, hand-rubbed and oiled. Two-way and three-way systems. Choice of grille colours on selected models.

	MODEL ONE	MODEL THREE	MODEL FIVE	MODEL SEVEN	MODEL NINE
SPEAKER COMPONENTS LOW FREQUENCY: MID FREQUENCY:	8'' bass driver	10'' bass driver	12'' bass driver	12'' bass driver 6½'' frame cone driver	12'' bass driver 6½'' frame cone driver
HIGH FREQUENCY:	4'' frame cone driver	4'' frame cone driver	2 each 4'' frame cone drivers	4'' frame cone driver	5'' frame cone driver
NOMINAL IMPEDANCE:	8 ohms	8 ohms	8 ohms	8 ohms	8 ohms
CROSSOVER FREQUENCY:	3000 Hz	1500 Hz	1500 Hz	850 Hz, 8 kHz	800 Hz, 7 kHz
ENCLOSURE TYPE:	Sealed	Vented	Vented	Vented	Vented
FREQUENCY RESPONSE:	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
OPERATIONAL POWER RANGE: Recommended for use with amplifiers between these levels	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
FINISH:	Hand-rubbed oiled oak	Hand-rubbed oiled oak	Hand-rubbed oiled walnut	Hand-rubbed oiled walnut	Hand-rubbed oiled oak
GRILLE:	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	Acoustically transparent foam mounted on removable panel. Choice of black, brown, blue, or burnt orange
DIMENSIONS:	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
WEIGHT:	10.4 kg	12 kg	14.5 kg	20 kg	25.4 kg

KENT HI-FI

(WHERE THE BEST EQUIPMENT COSTS LESS)

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Resistor codes

Roger Harrison continues his series on passive components with the last article on resistors. This part looks at the various codes that have been used to mark resistors with their values and characteristics.

THE VALUE AND TOLERANCE, and other pertinent characteristics, of resistors may be marked on the body of the component in one of three ways. Viz:

(1) By marking directly on the body.

(2) By using a standard colour code – coloured bands or dots, etc, read in sequence.

(3) By using an appropriate typographic code, consisting of letters and numerals arranged according to a convention.

Which method is used depends on the type and physical size of the component to a large extent and also according to the manufacturer's preference. The larger components, such as power resistors (particularly wirewound types), usually have the value, tolerance and wattage rating marked directly on the body. Most common low power resistors, from 0.05 W to 2 W, use the standard resistor colour code. Some manufacturers use a typographic code on their resistors, physical size allowing (usually radial-lead types having wattage ratings between 0.25 W and 10 W). The special resistors (PTC, NTC thermistors and Varistors) also may be marked with a colour code or typographic code to indicate their value and characteristics.

The Standard Colour Code and Markings

The common axial-lead, composition and film-type resistors are marked with a series of coloured bands, as shown in Figure 1, which are read according to the standard colour code table in Table 1. The standard E24 (5%), E12 (10%) and E6 (20%) series components are marked with either three or four bands. Components below 10 ohms in the E6 series may have only two bands indicating the value. Resistor values in the E48 (2%) and E96 (1%) series are marked with five bands.

The bands are located on the component towards one end. If the resistor is oriented with that end towards the left, the bands are read from left to right as shown. The extreme left (or first) band colour indicates the value of the first digit of the component value; the next, or second, band indicates the second digit of the value and so on. If the bands are not clearly oriented towards one end of the resistor it is best sorted out by trying to locate the tolerance band first. As the most commonly used resistors these days are either E12 or E24 series, the tolerance band is either silver or gold respectively. If still in doubt – resort to an ohmmeter.

The body colour of modern resistors is also used to indicate the resistor type. Carbon film resistors have a very light tan body, and carbon composition resistors have a medium tan body – somewhat darker than the carbon film body colour. Metal film resistors have a brown body colour – quite distinguishable from composition resistors and metal-glazed film resistors have a light blue body colour.

High stability resistors (E48, E96, E192 series) are distinguished by salmon-pink 5th band or body colour. For those who have difficulty remembering the resistor colour code, Table 2 lists the most commonly used values in the E12 series, between 4R7 and 2M2.

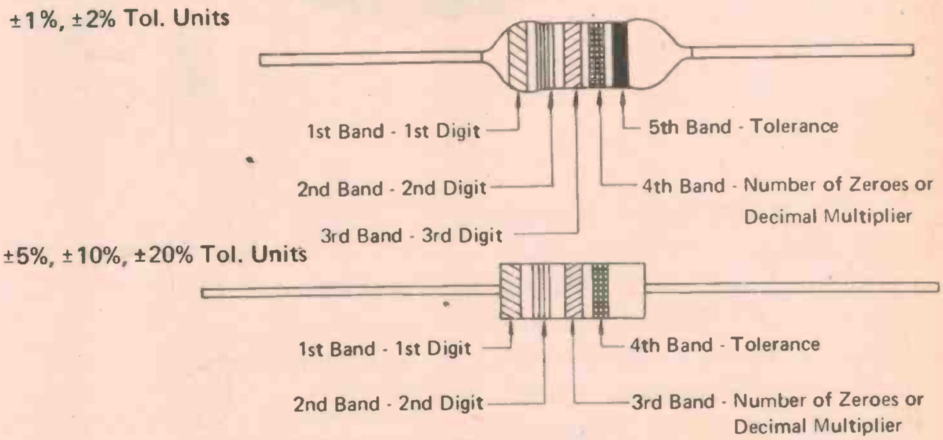


Fig. 1. The Standard Resistor colour code marking.

TABLE 1
STANDARD RESISTOR COLOUR CODE

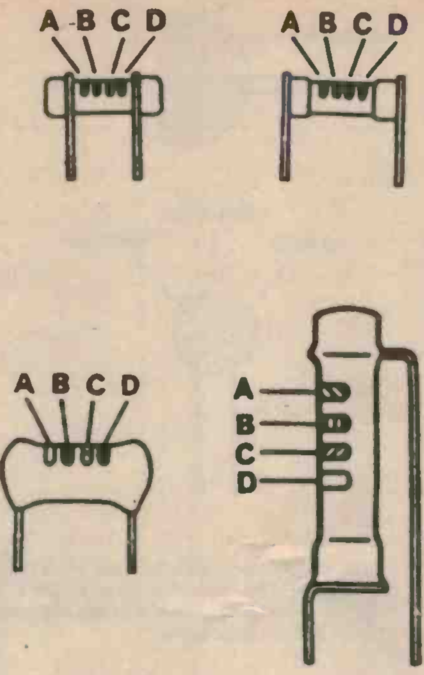
COLOUR	DIGIT VALUE	MULTIPLIER (No. of zeroes)	TOLERANCE ± %
BLACK	0	1	
BROWN	1	10	1
RED	2	10^2 or 100	2
ORANGE	3	10^3 or 1k	
YELLOW	4	10^4 or 10k	
GREEN	5	10^5 or 100k	
BLUE	6	10^6 or 1M	
VIOLET	7	10^7 or 10M	
GREY	8	10^8 or 100M	
WHITE	9	10^9 or 1000M	
GOLD	–	0.1 or 10^{-1}	5
SILVER	–	0.01 or 10^{-2}	10
none	–	– – – – –	20

* High Stability (grade 1) resistors are distinguished by a salmon-pink fifth ring or body colour.

Old-Style Resistors

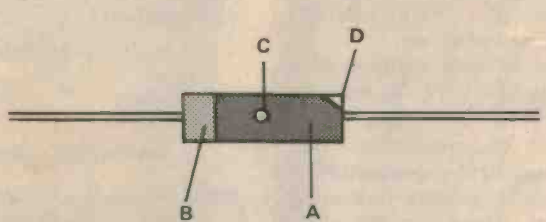
Prior to the standardisation of the banded system of resistor marking, resistors were colour coded with their value and tolerance by either one of two systems. These were the "Body-End-Dot" and the "Body-End-Band" systems, which are illustrated in Figure 2 (a) and (b) respectively. The body colour represents the first digit of the resistor value, the end colour the second digit, the dot or band colour, the multiplier. The tolerance was indicated by a coloured spot which partially covered the end of the resistor opposite the 'end' colour or a band much narrower than the 'end' colour. In the body-end-dot system, the dot was generally located midway along the body. In the body-end-band system the band was generally located closer to the 'end' colour. Omission of the tolerance colour indicated a tolerance of ± 20%.

Some other manufacturers indicate the component value and tolerance by a series of dots or small bands which do not completely encircle the resistor body. This system of marking is commonly used on radial-lead and upright mounting styles of resistor from some manufacturers (particularly the British-based Erie Co, and some Japanese firms); these are illustrated in Figure 2 (c). With the upright mounting style of resistor, the colour code is located towards the upper end of the body. The colour closest to the upper end indicates the first digit of the value; the next colour down, the second digit and so on.

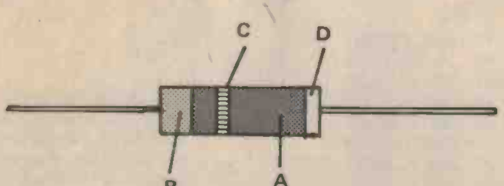


(c) Markings on radial-lead and upright-mounting resistor styles.

Fig. 2. Other styles of resistor colour code markings.
A: 1st Digit
B: 2nd Digit
C: Multiplier
D: Tolerance
(use Table 1.)



(a) The "Body-End-Dot" system of resistor marking common on many older resistors.



(b) The "Body-End-Band" system also used on many older resistors.

Direct Marking

This style of marking a resistor is commonly used on power resistors (usually from 2 W), wirewound and precision resistors. It usually includes a manufacturer's code indicating the type of resistor perhaps including a date code indicating when the component was manufactured. Figure 3 illustrates a 1 k, ± 5%, 2 W resistor.

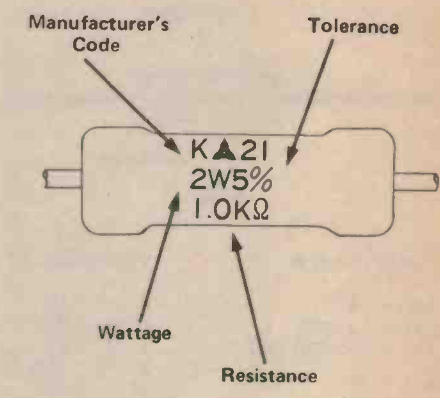


Fig. 3. Resistor with characteristics and value marked directly on the body.

Typographic Codes and Markings

Resistors may be marked with a combination of letters and figures to indicate the value, and tolerance. Alternatively a combination of direct marking and typographic code may be employed.

The typographic codes used are illustrated in Figure 4. A series of three letters, R,k,M, are used to indicate multipliers of x1, x1000 and x 1000 000. The significant figures of the value are indicated directly with figures, the position of the multiplier indicating the decimal point. For example:—

4R7 = 4.7 ohms
330R = 330 ohms
5k6 = 5.6k (5600 ohms)
68K = 68k (68,000 ohms)
1M8 = 1.8M (1.8 megohms)
22M = 22M (22 megohms)

The tolerance is indicated by one of five letters (see Figure 4) which immediately follow the value code on components which are marked completely with a typographic code. Some examples of the complete code are as follows:

2k2F = 2.2k, ± 1%
120kG = 120k, ± 2%
2M2J = 2.2M, ± 5%
150RK = 150 ohm, ± 10%
6R8M = 6.8 ohm, ± 20%

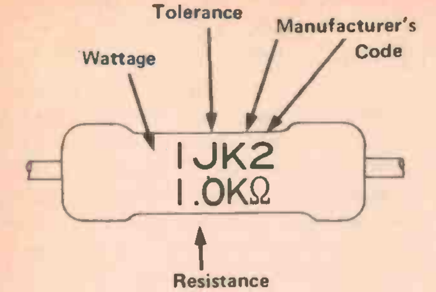
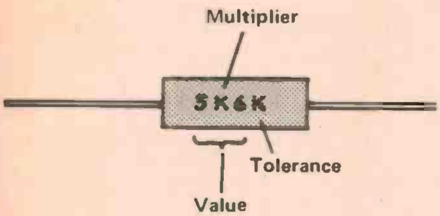


Fig. 4. Typographic codes used on resistors.



MULTIPLIER			TOLERANCE		
R	=	x1	F	=	±1%
K	=	x1000	G	=	±2%
M	=	x1 000 000	J	=	±5%
			K	=	±10%
			M	=	±20%

**Position of the multiplier indicates the position of the decimal point in the value.*

THERMISTOR MARKING CODES

Thermistors may be marked with a colour code or a typographic code, or may have no markings at all! The manner in which they are marked depends largely on their construction and the preference of the manufacturer NTC thermistors may be marked with either a colour code or typographic code (or not at all) but PTC thermistors are marked with a typographic code only — when they are marked!

Whatever marking is employed, the resistance value at 25°C (R_{25}), and its tolerance at that temperature (if included) are generally the basic characteristics indicated. Other parameters (such as the B value) may be indicated when a typographic code is employed. The manufacturer's data should be consulted for the complete thermistor characteristics.

Colour Coded NTC Thermistors

Two basic methods of colour coding NTC thermistors are used, illustrated in Figure 5. The value of R_{25} is found by reference to the standard resistor colour code table. The tolerance is sometimes omitted. The marking method illustrated on the left in Figure 5 distinguishes NTC thermistors from varistors (see Figure 8).

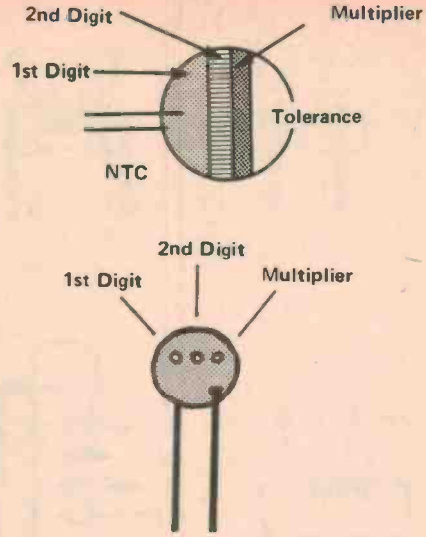


Fig. 5. Colour code systems used on NTC thermistors. The resistance value at 25°C (R_{25}) is found by reference to the standard resistor colour code table.

Typographic Coded NTC Thermistors

The typographic code occasionally employed on NTC thermistors is illustrated in Figure 6. This code is from the American EIA system of component designation. The tolerance range of NTC thermistors extends from ± 5% to ± 40% and two extra letters are added to the standard typographic tolerance code. The temperature constant B, is also indicated with the typographic code and reference to the manufacturer's data for the basic parameters is not necessary. However, if the dissipation, wattage rating, etc, are needed then the manufacturer's data will need to be consulted.

The typographic code consists of a prefix which may be 'ERT' to indicate and NTC thermistor or simply NTC. The value and characteristics may follow immediately or a manufacturer's code may precede it (usually indicating component type). However, the characteristics are always the last group.

TOLERANCE (at 25°C)			CONSTANT(B), °K		
J	=	±5%	A	=	up to 1000
K	=	±10%	B	=	1000–1500
L	=	±15%	C	=	1501–2000
M	=	±29%	E	=	2501–3000
R	=	±40%	F	=	3001–3500
			G	=	3501–4000
			H	=	4001–4500
			I	=	4501–5000
			J	=	5001–5500
			K	=	5501–6000
			L	=	over 6001

PTC Thermistor Marking Codes

The typographic code that may be used on PTC thermistors is from the EIA system code, illustrated in Figure 7. The prefix ERP indicates that the component is a PTC thermistor. The suffix is divided into three portions. The first consists of a letter and a numeral indicating the prime characteristic of the component. If it is an A-type PTC thermistor the temperature coefficient is indicated, as shown in the accompanying table. If it is a B-type, which changes resistance abruptly at a specified temperature (the 'switching' temperature), then the switching temperature is indicated as shown in the Table.

The tolerance and the resistance at 25°C (R_{25}) follow, and are read off in the same way as for NTC thermistors — see Figure 6.

PTC thermistors are often not marked, but their packaging may contain the above typographic code along with a manufacturer's component code.

Varistor Marking Codes

Both colour and typographic codes are used to mark varistors. As they are voltage dependent devices, the voltage value and its tolerance are given. The colour code that is used on ZNR and SiC varistors is illustrated in Figure 8. The value and tolerance is found from the standard colour code table (see section on Component Marking Codes). The tolerance is the first band on these components when held with the colour bands at the left as illustrated. Just to confuse matters, some manufacturers use the 1st, 2nd and 3rd digit bands to indicate the last three digits of their type number!

Text continues on page 21 . . .

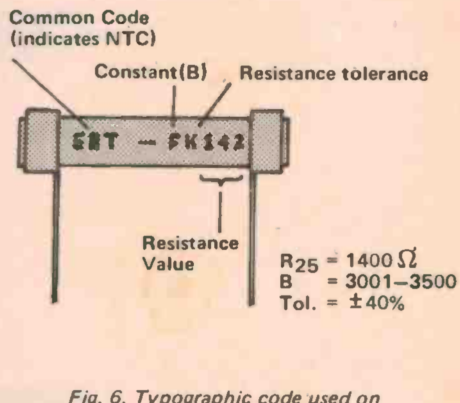
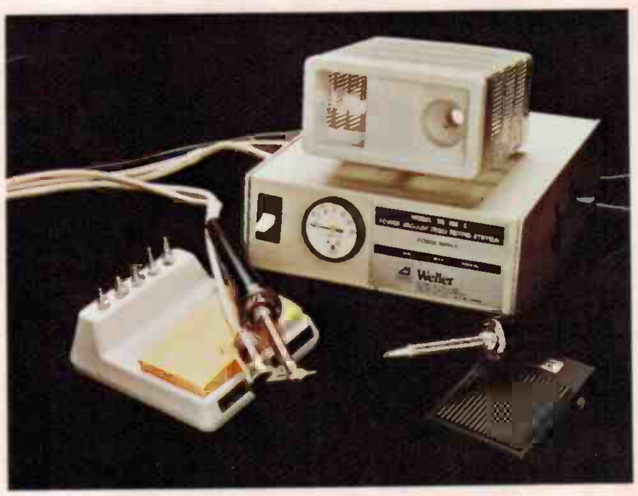


Fig. 6. Typographic code used on NTC thermistors (from EIA system standard). The first two figures of the value are the two significant figures of resistance at 25°C (R_{25}), the third figure indicates the number of following zeroes (i.e. the multiplier). If value below ten ohms, the decimal point is indicated by R (i.e. 1.5 = 1R5).

De-soldering problems?



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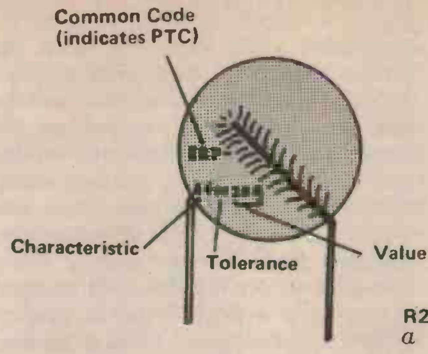
AUR19



CHARACTERISTICS

A–TYPE		B–TYPE	
A2	= 2;5%/°C	B0	= 50°C
A3	= 3.5%/°C	B1	= 75°C
A4	= 4.5%/°C	B2	= 90°C
Temp. Coeff. (a)		B3	= 120°C
		Switching Temp.	
		B3	= 120°C

R25 = 250 Ω, ± 20%
a = 4.5%/°C

Fig. 7. Typographic code used on PTC thermistors (from EIA system standard). The value and tolerance are read off as for the typographic code used on NTC thermistors.

Ceramic Diode (Variatite) Varistors

These devices have an asymmetric voltage characteristic and it is the value of the forward voltage that is of interest. They are generally made to a specified forward voltage and a colour code is used to indicate the value as illustrated in Figure 9. A single colour spot is used, and it is applied to the cathode side of the device.

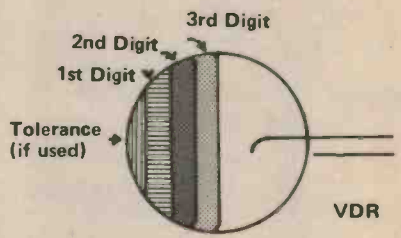
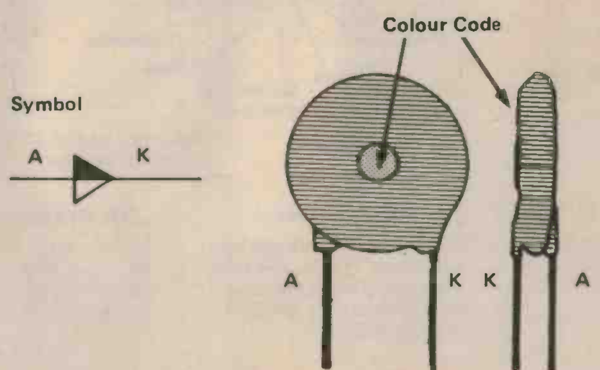


Fig. 8. Colour code used on some varistors. The tolerance refers to the voltage tolerance, and is found from the standard colour code table. The 1st and 2nd digits indicate the two significant figures of the voltage, the third digit indicating the number of following zeroes (i.e. the multiplier); the values being read from the standard colour code table. Some manufacturers indicate the last three digits of their type number. Very confusing!

ZNR Varistor Typographic Code

The typographic code used on ZNR varistors is usually arranged in one of two ways, as indicated in Figure 10. The disc-shaped varistors are generally marked in the manner illustrated, the ZNR marking directly indicating the type of component. This is followed by a single letter indicating the voltage tolerance followed by the voltage value. A 220 V, ± 15% varistor is illustrated.

The cylindrical body style of varistor is generally marked according to the EIA system standard, as illustrated on the right in Figure 10. This code gives a more complete specification of the component's characteristics. The wattage rating and shape may sometimes be omitted. Reading this sort of code on any component can be confusing – it is best to first identify the component by the prefix and then read the code groups commencing from the right. The voltage value is always indicated last – but watch it again . . . the manufacturer



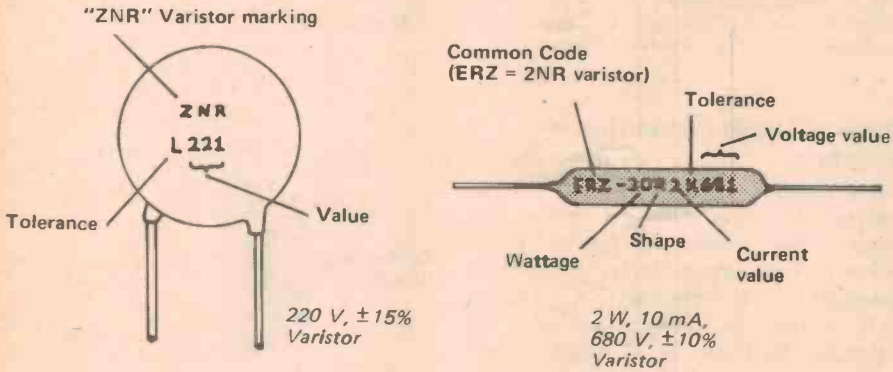
COLOUR	RATED FORWARD VOLTAGE
BLACK	1.0
BROWN	1.1
RED	1.2
ORANGE	1.3
YELLOW	1.4
GREEN	1.5
WHITE	2.2
SILVER	3.0

Fig. 9. Colour code used on Ceramic Diode (variatite) varistors. These have an asymmetric voltage characteristic and the colour code, indicating the rated forward voltage, is marked on the cathode.

may attach a suffix for his own purpose! It is usually a single letter and thus the voltage value group is easily recognised.

Silicon Carbide (SiC) Varistor Marking

These varistors are also generally marked using the EIA system code, in a similar manner to ZNR varistors. The two basic marking styles are illustrated in Figure 11. The common code signifying a SiC varistor, ERV, prefix is invariably marked on both disc and cylindrical-shaped components, the disc-shaped varistors generally having an abbreviated code indicating only the voltage value and measuring current. The cylindrical-shaped varistors have the more complete code marked on the component body, as illustrated on the right in Figure 10. The wattage rating, measuring current, voltage value and voltage tolerance are the characteristics indicated. Note that the wattage rating code differs from that for ZNR varistors in that only a single figure is used to indicate components having a wattage rating of 1 W and 2W respectively. ●



TOLERANCE	
J	= ±5%
K	= ±10%
L	= ±15%
M	= ±20%
S	= ±3%

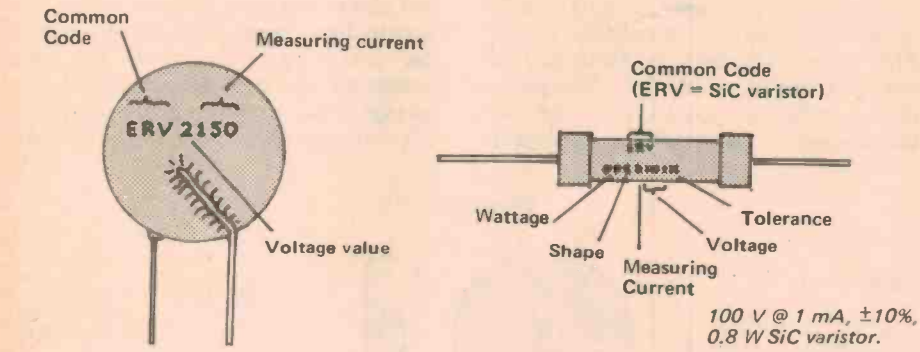
WATTAGE	
03	= 0.3 watts
08	= 0.8 watts
15	= 1.5 watts
20	= 2.0 watts
60	= 6.0 watts
80	= 8.0 watts
1A	= 10 watts
1B	= 15 watts
1C	= 20 watts

CURRENT VALUE	
2	= 10 mA
3	= 1 mA
4	= 0.1 mA
9	= 0.5 mA

VOLTAGE SUPPLY

First two digits are the two significant figures, the third digit being the number of following zeroes. Decimal point is indicated by R.

Fig. 10. Typographic code combinations used on common (ZNR) varistors. The more complete form is shown on the right. It may be abbreviated however as indicated on the left. The current value is sometimes included as well, the wattage rating is usually only included where the more complete form of the EIA code is used.



WATTAGE	
01	= 0.1 watts
02	= 0.2 watts
03	= 0.3 watts
08	= 0.8 watts
10	= 1.0 watts
15	= 1.5 watts
20	= 2.0 watts

MEASURING CURRENT	
1	= 100 mA DC
2	= 10 mA DC
3	= 1 mA DC

VOLTAGE VALUE

First two digits are the two significant figures, the third digit being the number of following zeroes. Decimal is indicated by R.

TOLERANCE	
J	= ±5%
K	= ±10%
L	= ±15%
M	= ±20%

Fig. 11. Typographic code combinations used on Silicon Carbide (SiC) varistors. The complete form of the code is illustrated on the right. It is also used in an abbreviated form, as illustrated on the left, only the voltage value and current being indicated, although the tolerance is sometimes also included.

E12 SERIES RESISTOR COLOUR CODE

OHMS	BAND 1	BAND 2	BAND 3
4.7	yellow	violet	none
5.6	green	blue	none
6.8	blue	grey	none
8.2	grey	red	none
10	brown	black	black
12	brown	red	black
15	brown	green	black
18	brown	grey	black
22	red	red	black
27	red	violet	black
33	orange	orange	black
39	orange	white	black
47	yellow	violet	black
56	green	blue	black
68	blue	grey	black
82	grey	red	black
100	brown	black	brown
120	brown	red	brown
150	brown	green	brown
180	brown	grey	brown
220	red	red	brown
270	red	violet	brown
330	orange	orange	brown
390	orange	white	brown
470	yellow	violet	brown
560	green	blue	brown
680	blue	grey	brown
820	grey	red	brown
1k	brown	black	red
1k2	brown	red	red
1k5	brown	green	red
1k8	brown	grey	red
2k2	red	red	red
2k7	red	violet	red
3k3	orange	orange	red
3k9	orange	white	red
4k7	yellow	violet	red
5k6	green	blue	red
6k8	blue	grey	red
8k2	grey	red	red
10k	brown	black	orange
12k	brown	red	orange
15k	brown	green	orange
18k	brown	grey	orange
22k	red	red	orange
27k	red	violet	orahge
33k	orange	orange	orange
39k	orange	white	orange
47k	yellow	violet	orange
56k	green	blue	orange
68k	blue	grey	orange
82k	grey	red	orange
100k	brown	black	yellow
120k	brown	red	yellow
150k	brown	green	yellow
180k	brown	grey	yellow
220k	red	red	yellow
270k	red	violet	yellow
330k	orange	orange	yellow
390k	orange	white	yellow
470k	yellow	violet	yellow
560k	green	blue	yellow
680k	blue	grey	yellow
820k	grey	red	yellow
1M	brown	black	green
1M2	brown	red	green
1M5	brown	green	green
1M8	brown	grey	green
2M2	red	red	green

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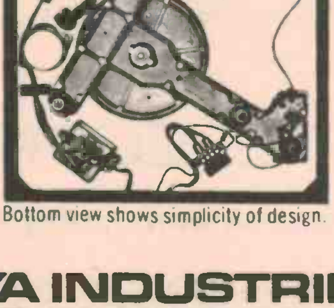

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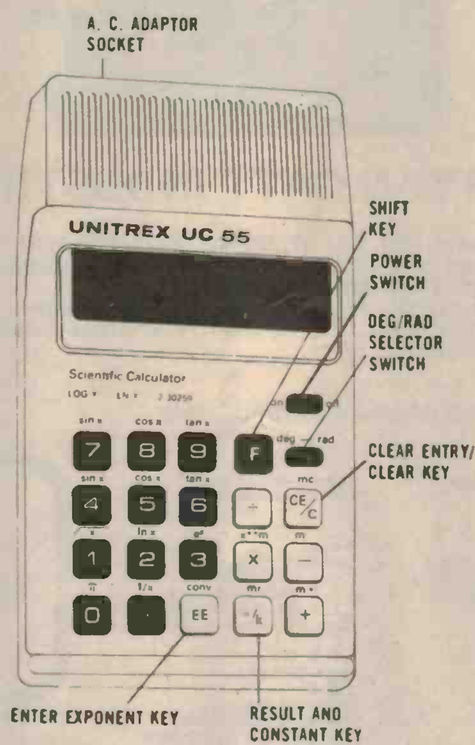

INTRODUCTION

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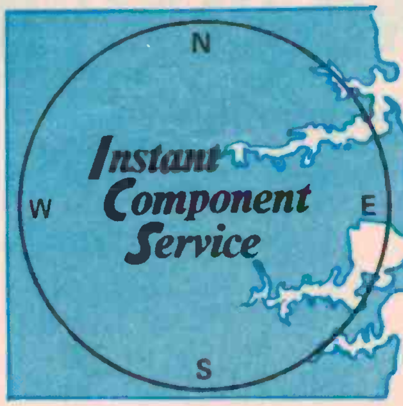

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Remote Control TV Tuner & IF Strip

LED readout of channel number, remote control, digital circuitry, etc, etc, . . . but not for the beginner.

by B. R. Lewis & T. Hobbs, Dept. of Physics, University of Adelaide.

WHILE SEVERAL OF THE MORE expensive imported colour television receivers boast touch tuning and remote control facilities, most of the first generation Australian sets use the old reliable turret tuner. Undoubtedly, the situation is about to change since some just released second generation sets have discarded the turret tuner. In view of this, the commercial availability of vhf/uhf varicap tuned front ends, and the obvious attraction of remote control facilities, it would seem appropriate to design such a tuner-i.f. strip which could be built by the advanced hobbyist.

In commercial touch-tuned sets most of the tuner control logic is contained on a custom MOS chip (1) and very few additional components are required. Some of these special function devices are listed in fact in the latest Philips Linear IC Data Book (2). Due to lack of availability and other design considerations it was decided to forsake this approach in favour of commonly used TTL integrated circuits. This allows considerably more design flexibility and, rather than a row of touch buttons, it was decided to have a single channel change button which allows cycling through the local channels.

The heart of the design is of course the varicap tuned vhf/uhf module type ELC 2000S manufactured by Philips and imported into Australia. This tuner covers vhf band I (47-88 MHz), vhf band III (174-230 MHz) and the uhf band (470-860 MHz). Separate 75 ohm unbalanced aerial inputs are available for vhf and uhf band operation, and band switching is accomplished electronically via switching diodes. The tuner requires transistor supply voltages of +12 V, a switching voltage of +12 V, agc voltages variable from +2.4 V (normal operating point) to about +7.5 V (maximum agc) and a tuning voltage variable from +0.3 V to +28 V. The video if output from the tuner is at 38.9 MHz and the typical bandwidth is 7 MHz at −3 dB, suitable for high quality reproduction.

From these specifications it can be seen that the tuner cannot receive channels 4, 5 and 5A and has a non-standard video if frequency of 38.9 MHz rather than the 36.875 MHz recommended by the ABCB. While these discrepancies prohibit the large scale use of this particular tuner in Australian sets, the individual constructor need not be deterred if there is no channel 4, 5 or 5A in his area. The if frequency difference is probably within the range of the output slug, but in this design 38.9 MHz was kept as the standard for simplicity. (At the time of writing varicap tuners covering *all* bands are available from Philips).

CIRCUIT DESCRIPTION

Tuner Control: The heart of this circuit (Fig. 1) is the two decade channel counter IC11, 12, the output states of which are decoded by IC13, 14 and displayed on the seven segment LED indicators IC19, 20 with leading zero blanking. The system can thus display any vhf/uhf channels numbered from 0 to 99.

The outputs of the counter are also decoded by gates IC15/1, IC15/2, IC16/1, IC16/2 and transistors Q12-17 to provide band switching voltages. The output transistors act to connect (1) or disconnect (0) the +12 V supply from the tuner module according to the following truth table.

Output	Channels 0-3	4-19	20-99
X	0	0	1
Y	1	1	0
Z	0	1	1

This ensures that the tuner module will be activated in the band correctly corresponding to the channel indicated by the channel readout.

The outputs of the channel counter are yet again decoded by the one of ten decoders IC9, 10 to a set of parallel lines on one side of the circuit board. These lines may be patched via lead-throughs to another set of parallel lines on the other side of the board. These constitute the inputs to a set of eight NOR gates IC7, 8, which give an output high only if their two inputs (units and tens), corresponding to a predetermined channel number, are low. The matrix shown in Fig. 1 is wired up to detect channels 2 (IC7/1), 7 (IC7/2), 9 (IC7/3), 10 (IC7/4), and an additional four can be detected.

The outputs of IC7, 8 (A to H) drive a set of transistor switches Q3-10 such that the tuning potentiometer (RV1-8) appropriate to the pre-selected channel is activated. The lines A-H are also gated through IC5, 6, the end result being that the output of IC5 goes high only if the output of the channel scaler corresponds to any of the (up to eight) preset channels. In this case the output of IC3/1 will be low and, in the absence of a channel change signal, it follows that the clock input to IC11 will be held high, inhibiting scaling. In other words the channel counter automatically stops on each of the preset channels.

The channel change control is a momentary changeover switch SW1 which toggles the no-bounce switch IC1/1, IC1/2 whose output is NANDed with a remote channel change signal which may be any low going edge. The output of IC1/3 is differentiated by R4, C1 and then inverted by IC1/4 to provide a negative going pulse of width about 1 µs. Assuming that the counter is already stopped on a preset channel, this pulse appears initially as a negative going edge at the input to IC11 and thus increases the scaler count by one. Assuming that this does not also correspond to a preset channel, the output of IC5 will then go low, unfreezing IC3/1. IC2/2, IC2/3, IC2/4 and R5, C2 combine to form a standard TTL oscillator running at a frequency of about 100 kHz, inhibitable by a low at the output of IC1/4. Thus at the end of the 1 µs channel change pulse the oscillator pulses will be allowed through IC3 and IC2/1 to clock the channel scaler through until the next preset channel is reached. Since the oscillator frequency is fairly high, to the eye it appears as though only the local channels appear instantaneously and cyclically on pressing the channel change switch.

The output of IC5 also triggers the 0.2 sec monostable IC4 which provides outputs to mute the sound output and inhibit the afc action for a brief period following a channel change. The FET Q2 acts in the variable resistance mode

Continued on page 29 . . .

Remote Control TV Tuner & IF Strip

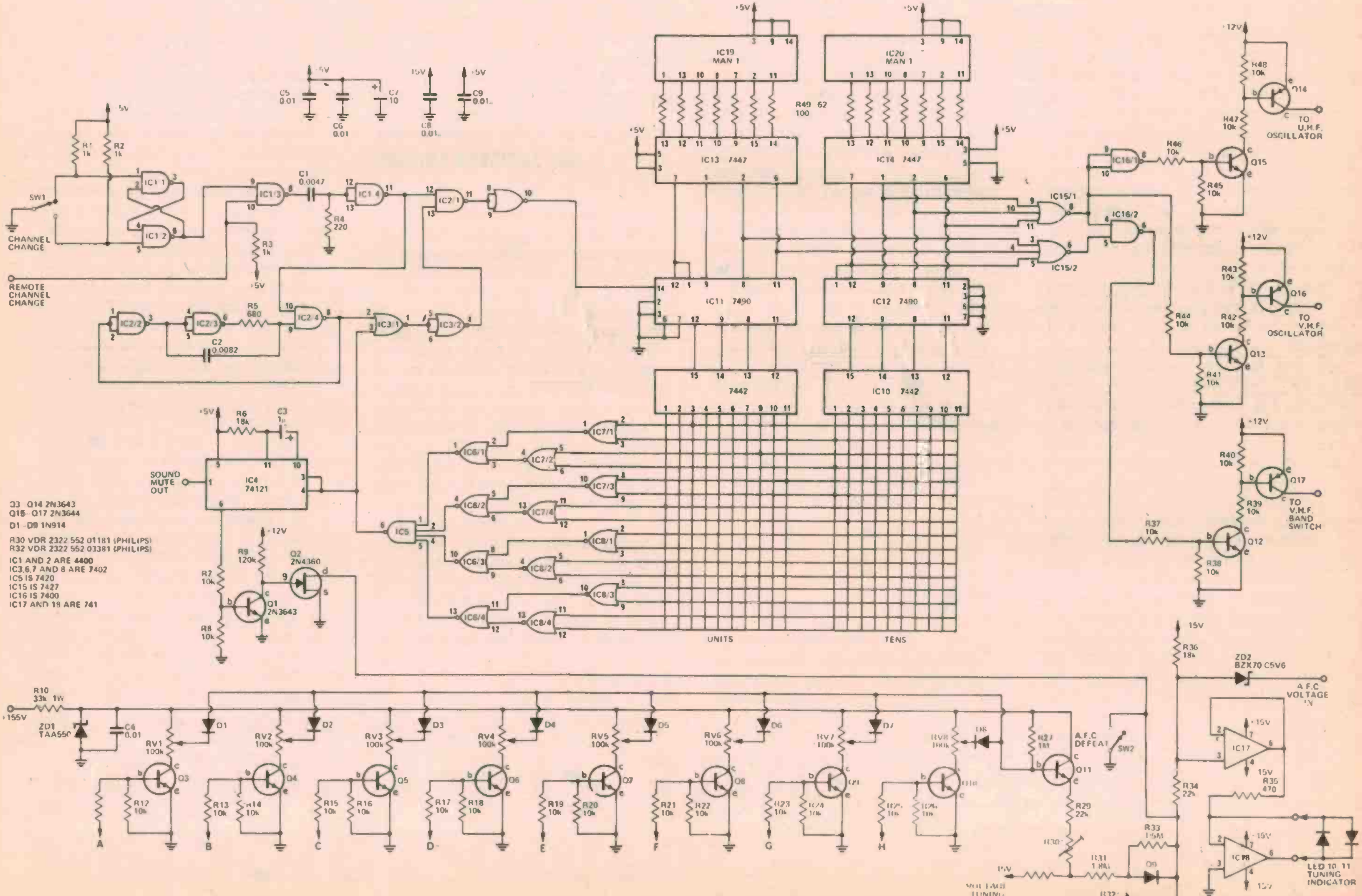

Fig. 1. Circuit diagram of the tuner control board.

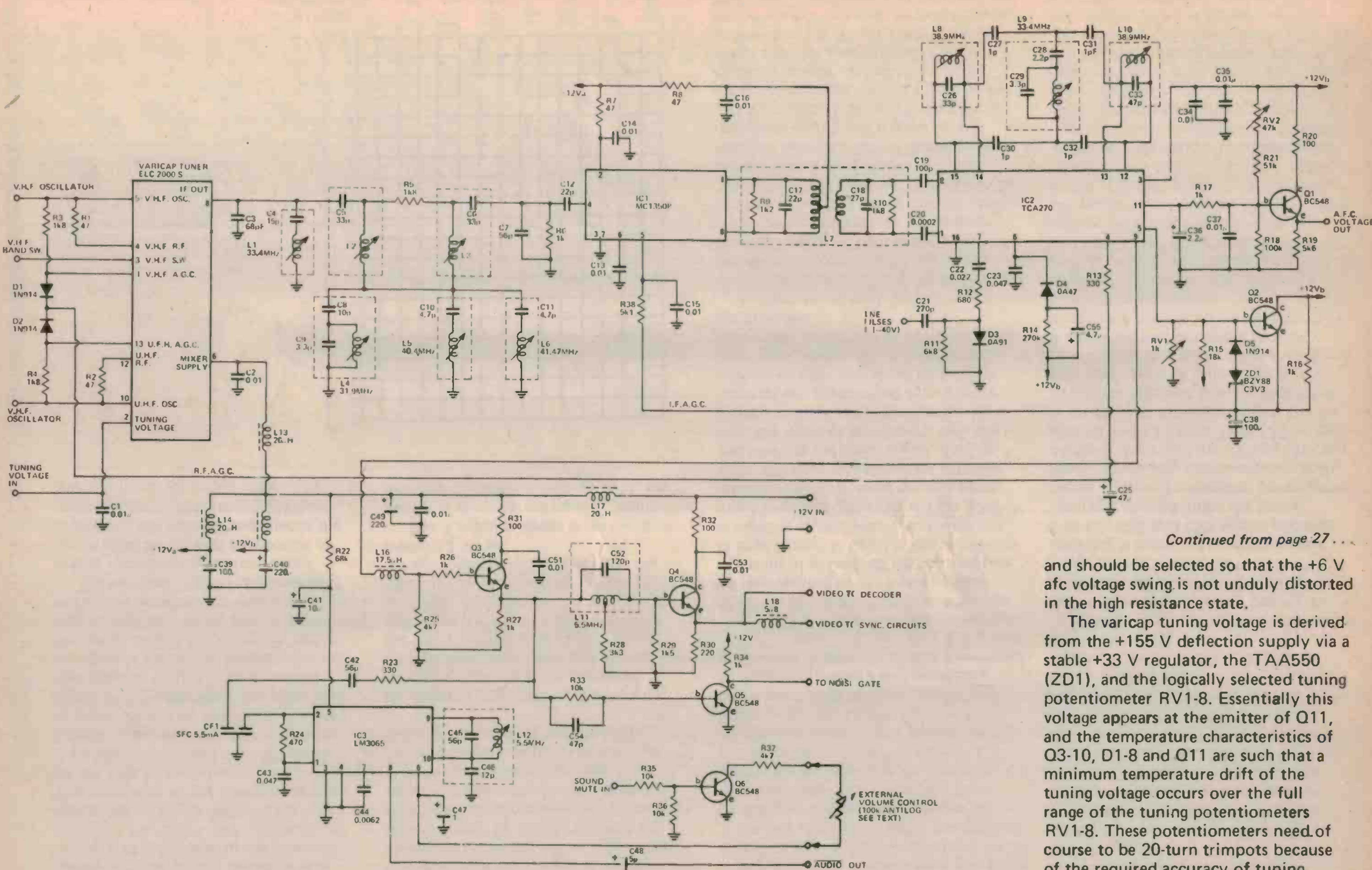

Fig. 2. Circuit diagram of the IF board.

Continued from page 27 . . .

and should be selected so that the +6 V afc voltage swing is not unduly distorted in the high resistance state.

The varicap tuning voltage is derived from the +155 V deflection supply via a stable +33 V regulator, the TAA550 (ZD1), and the logically selected tuning potentiometer RV1-8. Essentially this voltage appears at the emitter of Q11, and the temperature characteristics of Q3-10, D1-8 and Q11 are such that a minimum temperature drift of the tuning voltage occurs over the full range of the tuning potentiometers RV1-8. These potentiometers need of course to be 20-turn trimpots because of the required accuracy of tuning.

The afc voltage obtained from the if board swings symmetrically about +6 V and this is level shifted to about 0 V by ZD2. IC17 is a voltage follower which drives a voltage to current converter IC18. This gives a bi-directional current

Remote Control TV Tuner & IF Strip

through the back to back LED's D10,11 which is directly proportional to afc voltage, and hence the degree of mistuning is proportional to the intensity of one of the LED's. Correct tuning of course occurs when neither LED is lit. The sensitivity of the tuning indicator circuit may be varied simply by changing the value of R35, and the LED current is limited conveniently to a maximum of about 25 mA by the inbuilt limiter in the 741. A combined red/green LED was tried for D10, 11 but a marked variation in sensitivity between the red and green diodes was observed, and it was subjectively found that two separate red LED's provided the best indication.

The network R28-34, D9 may be simply considered a resistive adder which adds the correct proportion of tuning and afc voltages together in the correct sense so that reasonable hold and pull in ranges are achieved. The VDR's R30, 32 and diode D9 are included to optimize the hold and pull in ranges over the full range of tuning voltages[1]. The afc action may be defeated simply by closing SW2 which shorts the afc component of the tuning voltage to ground without interfering with the mean tuning voltage. The action of SW2 is duplicated electronically by Q2, the afc muting FET.

IF Circuits: The band switching and tuning voltage inputs to the tuner module have been described above. The agc input voltage is routed by diode switching (D1, 2) to either the vhf or uhf tuner according as the vhf or uhf oscillator is activated. The mixer supply voltage is choke decoupled from the main +12 V rail.

The if signal emerges from pin 8 of the tuner module and passes through the required channel sound trap (L1), the adjacent channel video trap (L4), adjacent channel sound trap (L5) and adjacent channel chrominance trap (L6), as well as the bandpass network (L2,L3).

At this stage the if signal is amplified by the gain controlled integrated circuit video amplifier IC1 which has a doubly tuned output stage. Specifications for the output transformer L7 are given in Table 1 and are similar to those on the MC1330P data sheet[3], but it was found necessary resistively to damp the primary and secondary resonances in order to obtain the correct overall if frequency response. Integrated circuit IC1 provides a typical power gain of about 50 dB at 45 MHz and the agc voltage applied to pin 5 gives a gain variation of at least 60 dB for a voltage change from 5 V to 7 V. The amplified if signal is capacitively coupled to the input stage of IC2 which is TCA 270[2,4] integrated synchronous demodulator with reference generation by filtering and limiting the input signal. This device, the heart of the circuit, includes a video amplifier with interference noise suppression, a peak level agc detector with drivers for npn tuner and if control stages, and an afc discriminator. Two video outputs of opposite polarity are provided.

A shunt tuned tank coil L8 is connected across pins 14 and 15 to provide the reference carrier filtering. The loaded Q value of L8 is something of a compromise, high values giving good limiting action but rather critical tuning. The resultant Q value of 35 obtained by using a tuning capacitance of 33 pF together with the TCA 270 damping resistance of about 6 k gives satisfactory results. Internal diodes are connected across pins 14 and 15 giving a constant amplitude switching signal which may be varied in phase by adjustment of L8. The if signal is gated by this switching signal so that alternate half cycles of if are passed. The process is essentially one of full-wave rectification and is far more linear than the normal diode half-wave envelope demodulation.

The demodulator is followed by a video amplifier and a noise blanking circuit to minimize white spot interference. The resultant demodulated video information is available from pin 9 at low impedance. The dc level at this pin is 6 V and the video output has negative going sync. with an amplitude of 3 V peak to peak. The video bandwidth of the TCA 270 is typically 5 MHz at −3 dB.

Voltage from across the demodulator tank is loosely coupled to the afc discriminator tuned circuit L10, C33 via capacitors C27, C30, C31, C32. This coupling is bypassed by the sound if trap L9, C28 and C29 which prevents incorrect afc lock onto the sound carrier. L10 and associated components form a frequency sensitive phase shift network, the resultant voltage between pins 12 and 13 of the TCA 270 varying in phase from the signal at pin 2 as its frequency changes. The afc discriminator produces a dc output signal proportional to this phase difference which is amplified and presented as a bidirectional current output at pin 11. This is filtered against modulation components by C36 and converted to a voltage output swinging between 0 V and 12 V by R18, R21 and RV2 which adjusts the afc centre reference. The afc output is buffered by Q1 and passes to the afc input of the tuner control board.

Normal agc action is accomplished with the aid of a negative line flyback pulse applied capacitively to pin 7 of the TCA 270. In this circuit 40 V negative line fly pack pulses are assumed available from the deflection circuitry, and these are differentiated by C21, R11 and applied to pin 7 giving a gating waveform which goes 5 V negative for a

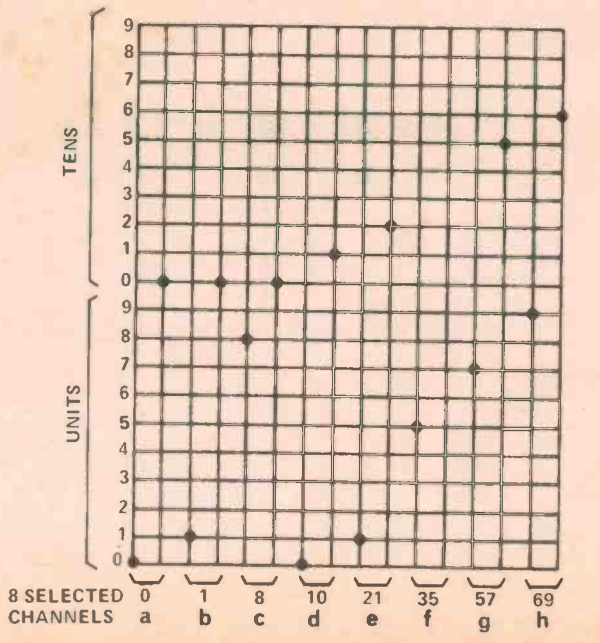

Fig. 3. The channel-selection matrix, lead-through pins join pads on each side of the pcb. This layout programmes channels 0, 1, 8, 10, 21, 35, 57 and 69. Positioning of the pins to select the tens and units can be clearly seen.

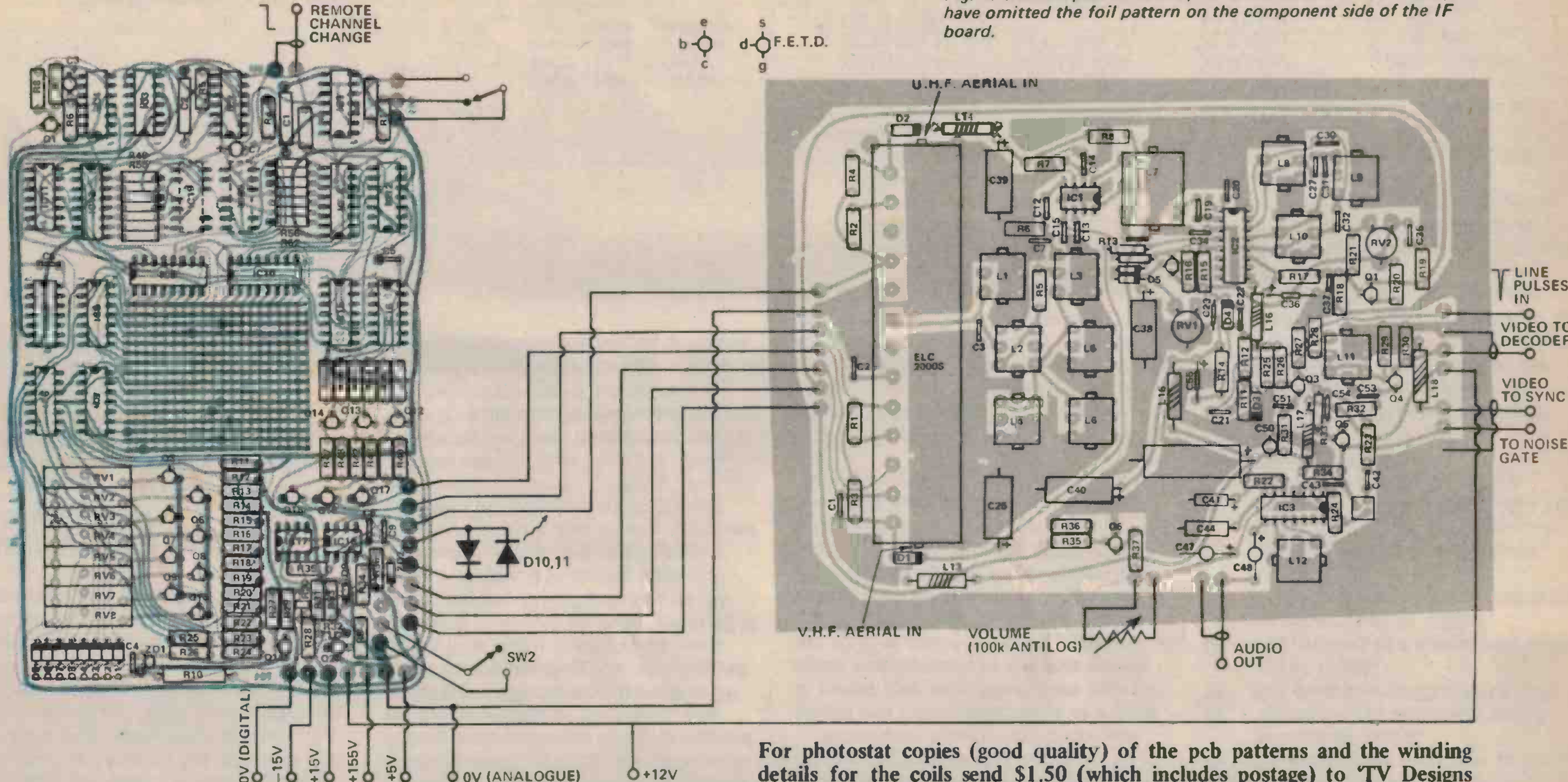

Fig. 4. The component overlay for the two boards. For clarity we have omitted the foil pattern on the component side of the IF board.

For photostat copies (good quality) of the pcb patterns and the winding details for the coils send $1.50 (which includes postage) to 'TV Designs (March)', ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011.

period equal to and coincident with the line sync. period. This gating enables the received line sync. peak amplitude to be measured and used as an indicator of signal strength. This then controls the separate if and rf agc current drain outputs available from pins 5 and 4 respectively. The agc peak detector requires an integrating capacitor connected from pin 6 to ground and in this circuit C23 removes the line rate components and D4 and associated components some of the frame frequency components.

The output from pin 4 is applied via the resistive dividers R13-R3,4 to the tuner module giving the required minimum value of about +2.5 V when the forward drop across D1, 2 is considered. This condition corresponds to maximum tuner gain and bottoming of the current output at pin 4.

The output from pin 5 is processed by Q2 and associated components and gives a resultant output voltage in the range 5 V (bottoming of pin 5 and maximum gain of IC1) to 8 V with RV1 at maximum resistance. Under normal conditions the charging time constant of C38 is determined by R16 C38, ≏0.1 sec while the discharge through D5 and Zd1, has a time constant limited essentially by the current sinking capabilities of pin 5 of IC2. These are so arranged that adequate field frequency filtering results. However if a large signal increase occurs, Q2 is turned on resulting in a rapid charge of C38, while if a sudden fall of signal level ensues C38 is rapidly discharged through D5, Zd1 back to the 5 V level. Hence, while there is a basic long time constant on the if agc line, large signal fluctuations, due for example to a passing aircraft, may be rapidly followed.[1]

The composite video output from IC2 is applied to a pair of decoupled emitter followers separated by the

Remote Control TV Tuner & IF Strip

sound trap L11, and low impedance outputs are available from the emitter of Q4. Transistor Q5 and associated components are included specifically for use with noise gated TBA240B[5] synd. integrated circuit, and may be omitted if not required.

The composite video signal is picked off from the emitter of Q3 and passes through the Murata 5.5 MHz ceramic filter SFC 5.5 mA which sees an effective impedance of 330 Ω at both input and output. The resultant 5.5 MHz subcarrier is then applied to the input of a conventional LM 3965 fm demodulator and the resultant audio output is deemphasised by C44 and controlled in level by the dc volume control at pin 6. This control can be gated off by inputting a mute signal to Q6.

CONSTRUCTIONAL AND ALIGNMENT DETAILS

The tuner control board is constructed on a double-sided printed board, actual size positives of the two sides are not shown.
A component overlay is shown in Figure 4. In/out connections on the board are designed around the 0.2"-spacing do-it-yourself connectors marketed by McMurdo. It should be noted that the seven segment LED indicators should be mounted from the non-component side of the board, preferably in IC sockets. This is to facilitate installations where the board is to be mounted directly onto a front panel with the channel number visible through a panel cut out. The pads on the matrix should be linked with lead throughs.
On the layout shown, the programmed channels are 2, 7, 9, 10, the associated tuning potentiometers being so marked on the upper side of the board. Any other (up to 8) channels from 0 to 99 could be chosen of course, and Figure3 shows how this is done. All resistors except R10 should be miniature 0.25 W types and the 741 IC's should be the mini DIP type. The tuning potentiometers are 1.25" 20-turn trimpots.

The if board is also double sided and positives of both sides of this board are available from ETI offices. The component overlay is in Figure 5. When mounting the tuner module the central mounting lug should be clipped off and the hole in the board not drilled.
The coil damping resistors for L7 should be included inside the can, as of course are all tuning capacitors indicated on Figure 2 and in Table 1. Be careful to adhere rigidly to the coil connections in Table 1. The trimpots used for RV1 and RV2 are the miniature Piher types (horizontal mounting), but, as these are no longer available, some modification of other types will be necessary to fit the available holes. Once again 0.2" connectors are used for in/out lines. Slugs for all coils should be greased and locked with small rubber strips to ensure non-cemented stability.

When both boards have been completed and interconnected as in Figure 5, power may be applied. Very approximate requirements of the two boards are +5 V at about 0.7 A, +12 V at about 0.2 A, ±155 V at 4 mA, but these of course must be viewed in the context of a complete receiver. At switch on the channel indicator should come on to one of the selected channels and it should be easy to cycle through the local channels by repetitively pressing SW1.

The if board can only be properly aligned with the aid of a sweep generator. The tuner module has an if injection point available through a hole in its cover and this should be used for most adjustments. A sufficient alignment procedure is as follows:

1. Capacitively couple a 38.9 MHz signal to pin 2 of IC2.
2. Connect a dc voltmeter to the emitter of Q3.
3. Adjust generator level to give about 3 Vdc on meter.
4. Adjust L8 to give minimum output voltage. The generator output voltage should be adjusted simultaneously so that the output at Q3 remains at 3 Vdc.
5. Connect dc voltmeter across R17.
6. Adjust L10 so that meter is nulled.
7. Connect dc voltmeter to junction of R36, Zd2 on tuner control board.
8. Adjust RV2 (if board) so that voltmeter reads zero.

(The demodulator and afc circuits are now aligned)

9. Change generator to 33.4 MHz.
10. Connect CR0 across L10.
11. Adjust L9 so that minimum signal indicated on CR0.

(This has minimized sound carrier effects on afc).

12. Connect signal generator to tuner if injection point.
13. Connect CR0 to emitter of Q3.
14. Set generator to 33.4 MHz, 30% am at 1 kHz.
15. Adjust level to a convenient value as determined by CR0.
16. Adjust L1 for minimum indication on CR0.
17. Increase generator output and adjust L4, L5, L6 for minimum indications at 31.9 MHz, 40.4 MHz and 41.47 MHz respectively.
18. Repeat steps 14–17.

(This has aligned the traps).

19. Apply 38.9 MHz and a smaller amount of sweep signal to a resistive adder (Figure 6) and connect to the tuner if injection point.
20. Connect CR0 to the emitter of Q3 via a high impedance detector probe (Figure 6).
21. Adjust L2, L3, L7 and if need be the if output coil of the tuner module to give the overall swept response of Figure 10.
22. Check the trap responses. The final result should be:

(All measurements relative to vision carrier 38.9 MHz).

33.4 MHz	–20 to –24 dB
31.9 MHz	⩾ – 44 dB
40.4 MHz	⩾ –54 dB
41.47 MHz	⩾ –54 dB

23. Inject a 5.5 MHz fm modulated signal at the base of Q3.
24. Connect CR0 to emitter of Q4.

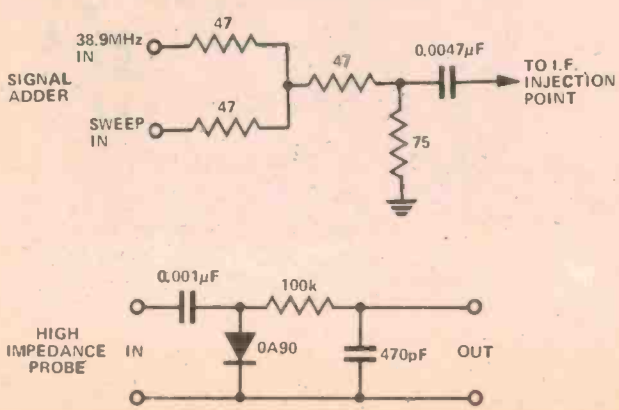

Fig. 5. Circuit of Signal Adder and High Impedance Detector Probe, both these are needed for alignment.

25. Adjust L11 for minimum indication on CRO.
26. Set volume control to maximum output and connect CRO to pin 8 of IC3.
27. Adjust L12 for maximum audio output on CRO.

This completes alignment of the tuner. An aerial may now be connected to the tuner module by 75 Ω coaxial cable. The vhf aerial connection is the lower of two pins protruding from the ends of the module. Select a channel and adjust the appropriate tuning potentiometer. When the station is correctly tuned both LED's of the tuning indicator will be extinguished, a 3 V peak to peak composite video signal will be visible, and a clean audio signal should be apparent. Repeat this procedure for all desired channels and the tuner is ready for use.

A final check should be made on the agc circuits. For a strong aerial signal pin 5 of IC1 should read about +8 V and pin 4 of IC2 should read greater than +1.7 V. If this is not so some improvement of picture quality may be obtained by adjusting RV1, the agc takeover control.

CONCLUSIONS

The above tuner and if strip has been in use in the author's colour television receiver for over a year, and has performed faultlessly. Particularly noticeable is the excellent resolution compared with all commercial receivers of the author's experience. The tuning procedure is found to be very convenient and the tuning indicator very useful. One small inconvenience lies in the dc volume control. Although this is of course necessary for remote control, even when an antilog potentiometer is used there is some cramming of the volume control action. This can be minimized by various shunt resistor combinations, but this results in a non-zero minimum volume. This difficulty is a direct consequence of using the popular LM3065 sound demodulator chip, and it is felt that some of the more recent chips should not exhibit this characteristic.

ACKNOWLEDGMENTS

The authors would like to thank Mr J. Simpson of PHILIPS, Hendon, South Australia, for advice regarding varicap tuners and for providing some of the PHILIPS reprint series. Mr D. Crago of ELCOMA (Adelaide) should also be thanked for managing to provide several very difficult components in the face of adversity.

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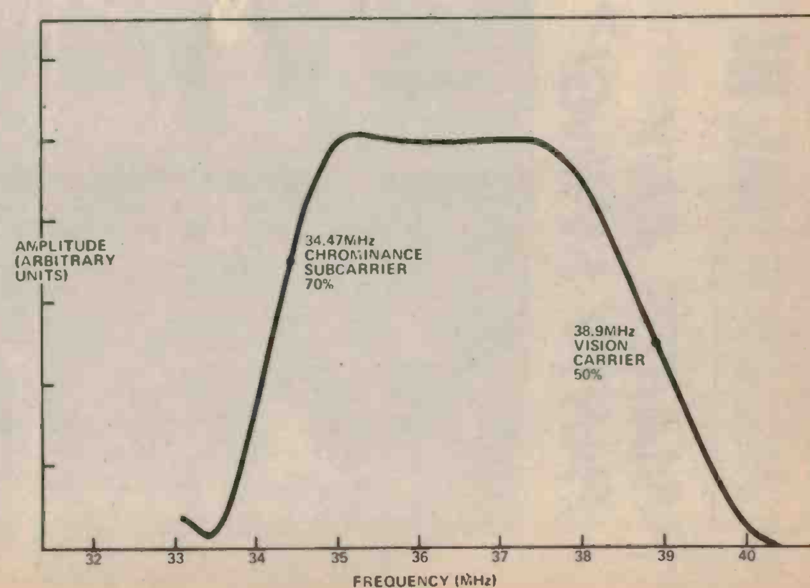

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ETI data sheet

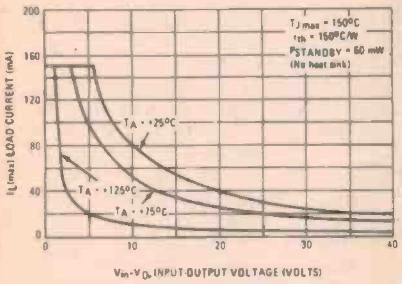
723, Universal Voltage Regulator

723 Universal Voltage Regulator
The 723 is a positive or negative voltage regulator designed to deliver load currents to 150 mA. The output current can be increased to several amps using one or more external pass transistors. The output voltage is adjustable from 2 to 37 V. Short-circuit protection is adjustable.

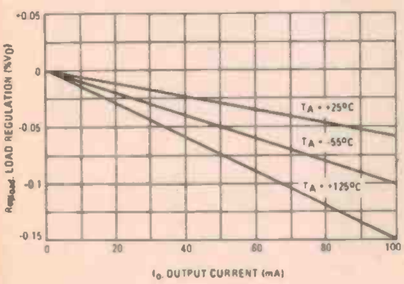
ELECTRICAL CHARACTERISTICS

Unless otherwise noted: $T_A = +25^oC$, $V_{in} = 12$ Vdc, $V_O = 5$Vdc, $I_L = 1$ mAdc, $r_{sc} = 0$, C1 = 100 pf, $C_{ref} = 0$ and divider impedance as seen by the error amplifier $\leqslant 10\ k\Omega$ connected as shown in Figure 1, $T_{low} = 0^oC$, $T_{high} = +75^oC$.

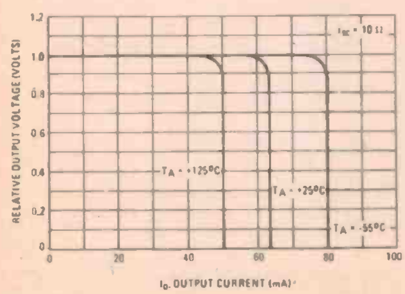
Characteristics	Symbol*	MC1723C Min	Typ	Max	Unit
Input Voltage Range	V_{in}	9.5	–	40	Vdc
Output Voltage Range	V_O	2.0	–	37	Vdc
Reference Voltage	V_{ref}	6.80	7.15	7.50	Vdc
Average Temperature Coefficient of Output Voltage ($T_{low} < T_A < T_{high}$)	TCV_O	–	0.003	0.015	%/^{o}C
Line Regulation	Reg_{in}				$\%V_O$
($T_A = +25^oC$) $12\ V < V_{in} < 15\ V$		–	0.01	0.1	
$12\ V < V_{in} < 40\ V$		–	0.1	0.5	
($T_{low} < T_A < T_{high}$) $12\ V < V_{in} < 15\ V$		–	–	0.3	
Load Regulation (1.0 mA $_L$ < 50 ma)	Reg_{load}				$\%V_O$
$T_A = +25^oC$		–	0.03	0.2	
$T_{low} < T_A < T_{high}$		–	–	0.6	
Ripple Rejection (f = 50 Hz to 10 kHz)	Rej_R				dB
$C_{ref} = 0$		–	74	–	
$C_{ref} = 5.0\ \mu F$		–	86		
Short Circuit Current Limit ($r_{sc} = 10\ \Omega$, $V_O = 0$)	I_{sc}	–	65	–	,Adc



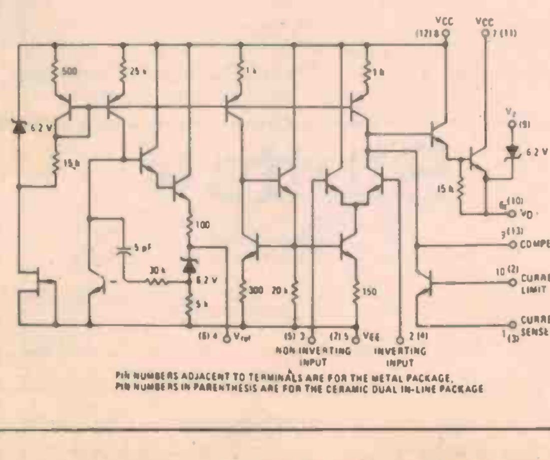
Graph 1 Maximum load current as a function of input-output voltage differential.

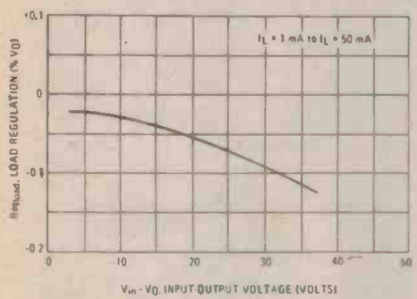


Graph 2 – Load regulation characteristics without current limiting.

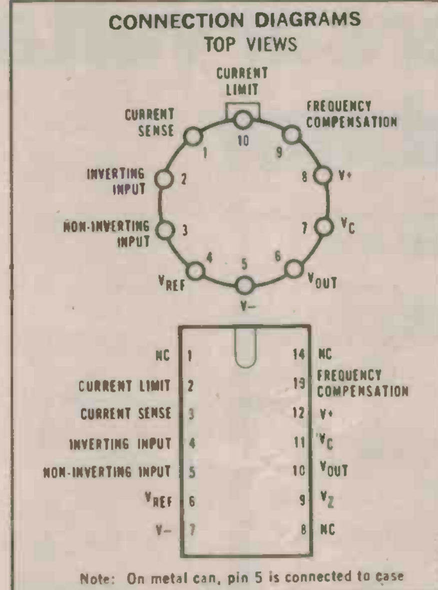


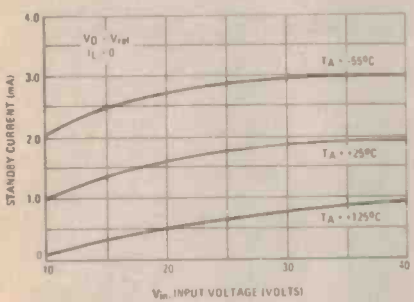
Graph 3 – Current limiting characteristics.



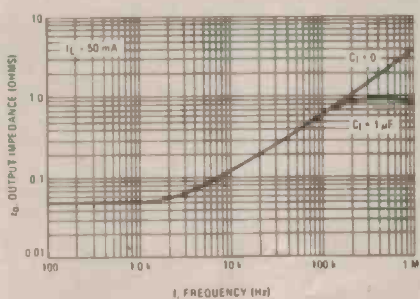


Graph 4 Load regulation as a function of input-output voltage differential.





Graph 5 Standby current drain as a function of input voltage.



Graph 6 – Output impedance as function of frequency.

RESISTOR VALUES (kΩ) FOR POSITIVE OUTPUT VOLTAGES

POSITIVE OUTPUT VOLTAGE	APPLICABLE FIGURES	FIXED OUTPUT ± 5 percent		OUTPUT ADJUSTABLE ± 10 percent		
		R_1	R_2	R_1	P_1	R_2
+3.0	1, 5, 6, 7, (4)	4.12	3.01	1.8	0.5	1.2
+3.6	1, 5, 6, 7, (4)	3.57	3.65	1.5	0.5	1.5
+5.0	1, 5, 6, 7, (4)	2.15	4.99	.75	0.5	2.2
+6.0	1, 5, 6, 7, (4)	1.15	6.04	0.5	0.5	2.7
+9.0	2, 4, (5, 6, 7)	1.87	7.15	.75	1.0	2.7
+12	2, 4, (5, 6, 7)	4.87	7.15	2.0	1.0	3.0
+15	2, 4, (5, 6, 7)	7.87	7.15	3.3	1.0	3.0
+28	2, 4, (5, 6, 7)	21.0	7.15	5.6	1.0	2.0

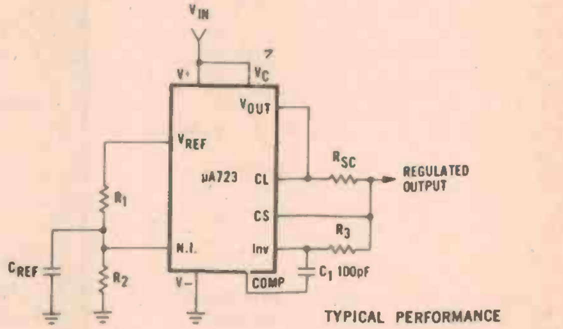
ETI data sheet

723, Universal Voltage Regulator

RESISTOR VALUES (k Ω) FOR NEGATIVE OUTPUT VOLTAGES.

NEGATIVE OUTPUT VOLTAGE	FIXED OUTPUT ±5%		5% OUTPUT ADJUSTABLE ±10%		
	R_1	R_2	R_1	P_1	R_2
−6	3.57	2.43	1.2	0.5	.75
−9	3.48	5.36	1.2	0.5	2.0
−12	3.57	8.45	1.2	0.5	3.3
−15	3.65	11.5	1.2	0.5	4.3
−28	3.57	24.3	1.2	0.5	10

See Figs. 3 and 8 for negative voltage regulation circuits

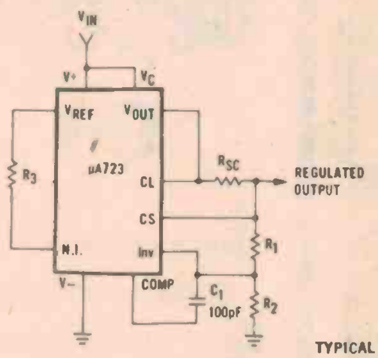


TYPICAL PERFORMANCE

Regulated Output Voltage	5 V
Line Regulation (ΔV_{IN} = 3 V)	0.5 mV
Load Regulation (ΔI_L=50 mA)	1.5 mV

Note: $R_3 = \frac{R_1 R_2}{R_1+R_2}$ for minimum temperature drift.

Fig.1. Basic low voltage regulator (V_{out} = 2 to 7 volts)



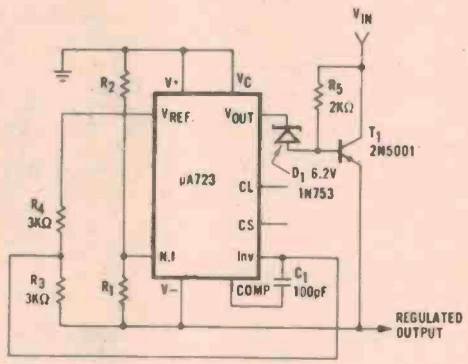
TYPICAL PERFORMANCE

Regulated Output Voltage	15 V
Line Regulation (ΔV_{IN} = 3 V)	1.5 mV
Load Regulation (ΔI_L=50 mA)	4.5 mV

Note: $R_3 = \frac{R_1 R_2}{R_1+R_2}$ for minimum temperature drift.

R_3 may be eliminated for minimum component count.

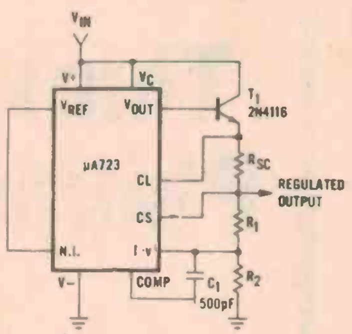
Fig. 2. Basic high voltage regulator (V_{out} = 7 to 37 Volts).



TYPICAL PERFORMANCE

Regulated Output Voltage	−15 V
Line Regulation (ΔV_{IN} = 3 V)	1 mV
Load Regulation (ΔI_L = 100 mA)	2 mV

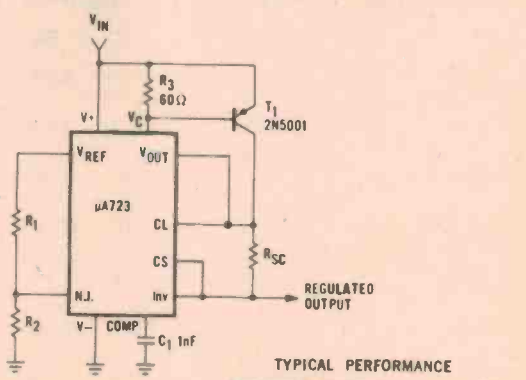
Fig. 3. Negative voltage regulator.



TYPICAL PERFORMANCE

Regulated Output Voltage	+15 V
Line Regulation (ΔV_{IN} = 3 V)	1.5 mV
Load Regulation (ΔI_L = 1 A)	15 mV

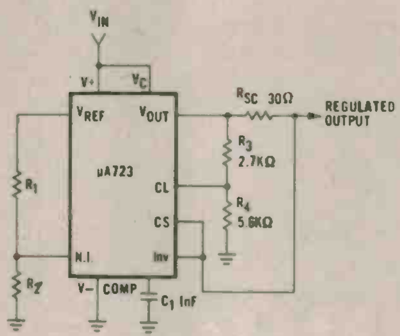
Fig. 4. Positive voltage regulator (External NPN Pass Transistor).



TYPICAL PERFORMANCE

Regulated Output Voltage	+5 V
Line Regulation (ΔV_{IN} = 3 V)	0.5 mV
Load Regulation (ΔI_L = 1 A)	5 mV

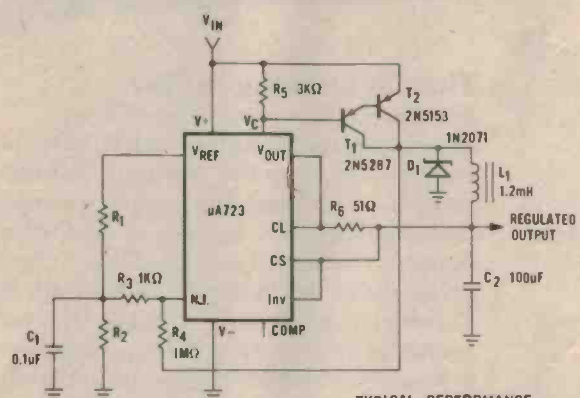
Fig. 5. Positive voltage regulator (External PNP Pass Transistor).



TYPICAL PERFORMANCE

Regulated Output Voltage	+5 V
Line Regulation (ΔVIN = 3 V)	0.5 mV
Load Regulation (ΔIL = 10 mA)	1 mV
Current Limit Knee	20 mA

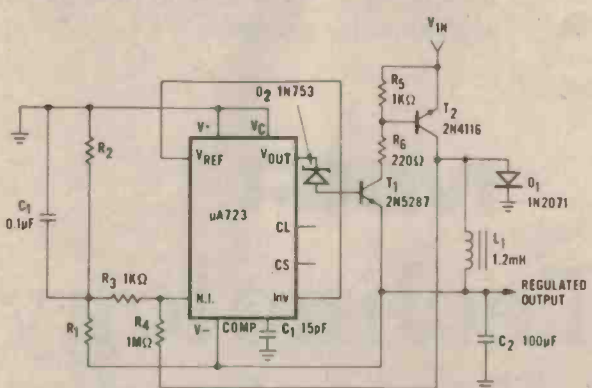
Fig. 6. Foldback current limiting.



TYPICAL PERFORMANCE

Regulated Output Voltage	+5 V
Line Regulation (ΔVIN = 30 V)	10 mV
Load Regulation (ΔIL = 2 A)	80 mV

Fig. 7. Positive switching regulator.



TYPICAL PERFORMANCE

Regulated Output Voltage	−15 V
Line Regulation (ΔVIN = 20 V)	8 mV
Load Regulation (ΔIL = 2 A)	6 mV

Fig. 8. Negative switching regulator.

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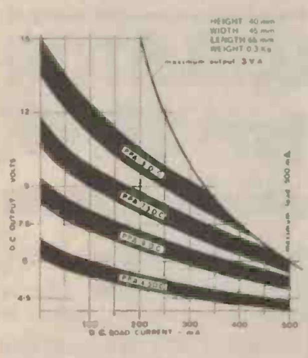
HEIGHT 40mm
WIDTH 45mm
LENGTH 65mm
WEIGHT 0.3kg



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– Popular Hi-Fi, 1975.

"The first impression one gets when listening to the MA3 is one of physical presence, and this quality seems to be independent of the closeness of the recording. This may be attributable to the exceptional smoothness of its mid-range unit, together with the use of a very analytical tweeter".

– Hi-Fi and Audio, May 1975.

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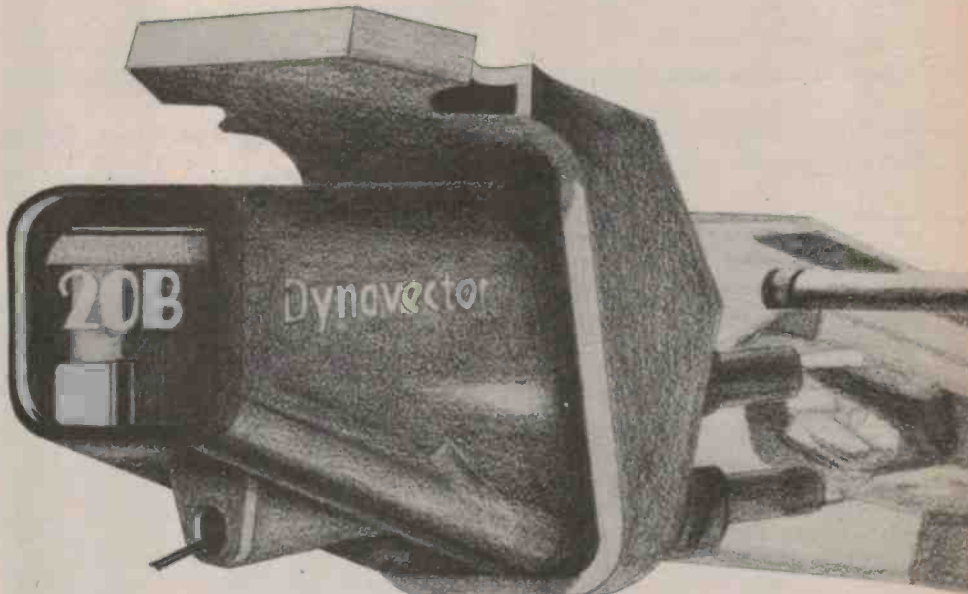
LER 154

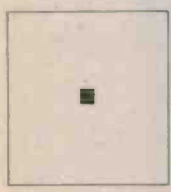
At last. Dynavector.

A moving coil cartridge that doesn't need a transformer — and won't cost you the earth.



It's often said that the cartridge and the speakers are the most essential elements in any hi-fi system. What you put in between is of secondary importance. The aim, always, is linear performance across the audible frequency spectrum. And here's a little number that makes it infinitely more achievable — the Dynavector moving coil cartridge.

The concept of moving coil cartridges is by no means new. Many a mature audiophile will remember them as being "the best" in the good old days of valve amplifiers. Dynavector is entirely new in what is unquestionably the most significant area of development in moving coil cartridges; the elimination of the need for a step-up transformer. Dynavector output is 2mV at 1kHz, 5cm/sec and is fed directly to the magnetic cartridge inputs of amplifiers. This high output value is made possible by the development, through Onlife Research (Dynavector's Japanese manufacturer), of a winding device that enables an extra thin (.0115mm in diameter) copper alloy wire to be wound 200 times into a single coil.



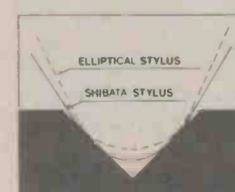
The black dot in the box at left is the actual size of the coil former used — around which two separate coils are wound at right angles to each other. A further benefit of this micro coil technology is Dynavector's low inductance, rendering it insensitive to load impedence.

But what does Dynavector give you in the sound department? We borrow from **Hi-Fi Answers, August 1976** where Dynavector (called Ultimo in the U.K.) was appraised.

"Listening tests on the cartridge told us what we could do with our theories. Immediately noticeable was the deep rich bass character, a gain claimed to be the consequence of the moving coil design. The top end possessed a sweet, silky quality and the bass was well controlled and extended."

Dynavector also gives you an indication of what it will do before you use it. Each cartridge is individually performance recorded as a final process of manufacture, and is packaged with its very own B & K frequency response graph. A photo-reduction of a typical graph can be seen below.

Dynavector uses the Shibata diamond stylus with an option of either a tapered aluminium or rigid beryllium cantilever — models 20A and 20B respectively.



The Shibata diamond stylus shape permits greater surface contact with the groove, which not only provides CD-4 capability but reduces record wear. The illustration above is a detailed impression of the degree of surface contact the Shibata stylus provides.

So, it's up to you. Take in a Dynavector versus moving magnet cartridge demonstration at one of the better hi-fi dealers in your area. Or write to Sonab (enclosing a stamped self-addressed envelope) for a copy of the Dynavector colour brochure. But if you possibly can, HEAR the Dynavector difference. It's really quite amazing.

Dynavector 20A.20B

Distributed by Sonab of Sweden Pty Ltd **13 Rickard Road, Narrabeen North N.S.W. 2101 Telephone: 913-2455**

GSR MONITOR

Learn to reduce tension levels with ETI's galvanic skin response meter. Design by Barry Wilkinson — editorial by Jan Vernon.

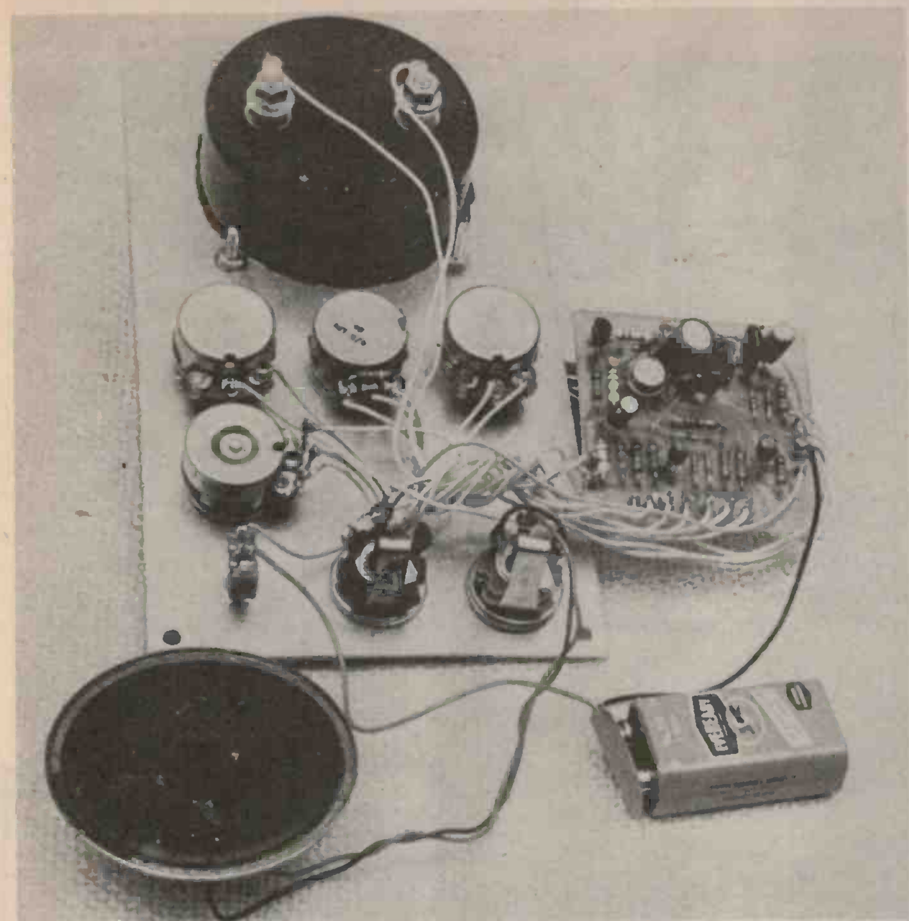
THE BEST WAY TO START EXPERimenting with biofeedback is to use a galvanic skin response monitor, a device which measures changes in skin resistance. In September 1976, we published an article which covered the background and theory of biofeedback and we discussed the various types of biofeedback instruments which are available. The GSR monitor is the most simple to use, the electrodes can be simply attached to the fingers with Velco straps and the technique of using the machine can be quickly learned.

Skin resistance changes with changes of emotional state. When tension increases, the skin resistance falls — when tension decreases there is an increase in skin resistance. (Some biofeedback instruction manuals speak in terms of conductivity rather than resistance and state measurements in mhos, and the meter we use gives a positive deflection for decreasing resistance.)

The connection between skin resistance and tension is not fully understood. Tension affects sweat glands and with the changes in the sweat glands there is a change in the membrane permeability of the skin and this change in permeability is the major cause of changes in electrical activity.

Almost a century ago, a scientist named M. Ch. Fere discovered the resistance of the skin to a small electric current changed in response to aroused emotions. This information has since been used in various ways; one obvious example is the polygraph, or lie detector, which responds to the tension generated when a person is lying.

It was not until 1961 that Dr. J. Kamiya, whilst conducting a series of



experiments with brain waves, found that with feedback his subjects developed the ability to produce 'Alpha waves' at will.

Dr. Kamiya's experiments created considerable interest and started investigations into whether other bodily functions could be brought under conscious control. Since that time it has been demonstrated that with feedback it is possible for people to control heart beat, blood pressure and temperature — all previously considered to be automatic bodily functions mostly beyond conscious control.

Of course it should be stated that various mystics and yogis have previously demonstrated this type of ability but the fascination of biofeedback is the speed and ease with which this type of control can be learned.

Biofeedback has exciting medical possibilities. GSR machines are being used by therapists for the treatment of many disorders related to tension. The average person will find a GSR machine mainly useful for relaxation training. With the GSR machine it is possible to recognise tension and learn how to decrease tension levels. This type of training is so effective that the machine quickly becomes unnecessary.

However not everyone suffers from tension. The biofeedback machine can be a fascinating toy to play with. Discovering that you can bring an internal bodily function under conscious control with the same ease that you can twitch your nose is most interesting. And of course you can then perfect this ability just as you perfect your ability at a game like tennis. For many people this is reason enough to build this machine.

What you do with it once you have built it

The ETI GSR monitor has an on/off switch, a sensitivity control and fine and coarse level controls. The machine also has a connection for headphones.

To start relaxation training, you'll need a comfortable chair, low lighting and no distractions. Taking any type of drug can interfere with your ability to relax. This applies to alcohol and cigarettes. Attach the electrodes to the fleshy part of the first two fingers on one hand — firm but not too tight (the non-dominant hand is recommended). Set the sensitivity control to minimum and the 'fine' level control to mid-range. Turn the volume control to minimum. Now you have to set the level with the 'coarse' level control (when the sensitivity is set low the 'fine' level control need not be used). Start with the 'coarse' control at full anticlockwise and turn it up until the meter needle starts to move. Carefully set the needle to mid-range. Now the instrument is set-up in its minimum sensitivity position.

Having mastered setting up with minimum sensitivity try to set the GSR monitor with the sensitivity set halfway. It will require delicate adjustment of the 'coarse' level control. Now the effect of the 'fine' level control can be seen. This control enables you to set the level on a high sensitivity setting.

Although the GSR machine measures minute changes in skin resistance, the level of skin resistance varies considerably from person to person so a wide range of settings is provided.

Now turn up the volume and observe that the meter reading is accompanied by a medium pitched tone. (A convention has developed to link high-pitched tone with tension increase and low pitched tone with a decrease in tension.) Now you relax and bring the tone down and the needle back to zero.

How? Basically you are supposed to find this out for yourself. After watching the needle for some time you will notice it move up or down. Something has happened to cause a change in your skin resistance. You would be barely aware of what had caused the change but aware enough to try to reproduce the effect. Eventually your awareness grows and so does your ability to control your tension. Many people find that relaxation of the stomach muscles makes the difference. It varies from person to person.

There are several relaxation techniques which work very well. One method is to tense all the muscles of the body as hard as possible, hold them tense for several seconds then very deliberately relax all muscles. There are several books and cassettes available which describe relaxation techniques. The techniques work. The biofeedback machine makes it possible to monitor progress.

As you relax, the needle on the meter and the audible tone will decrease. When the needle reaches zero, reset it again towards the fsd end of the scale and repeat the procedure.

Twenty minutes is the recommended time for a training session. After about one or two weeks of daily relaxation training, it should be possible to produce the same level of relaxation without using the machine and the machine can simply be used occasionally as a reference.

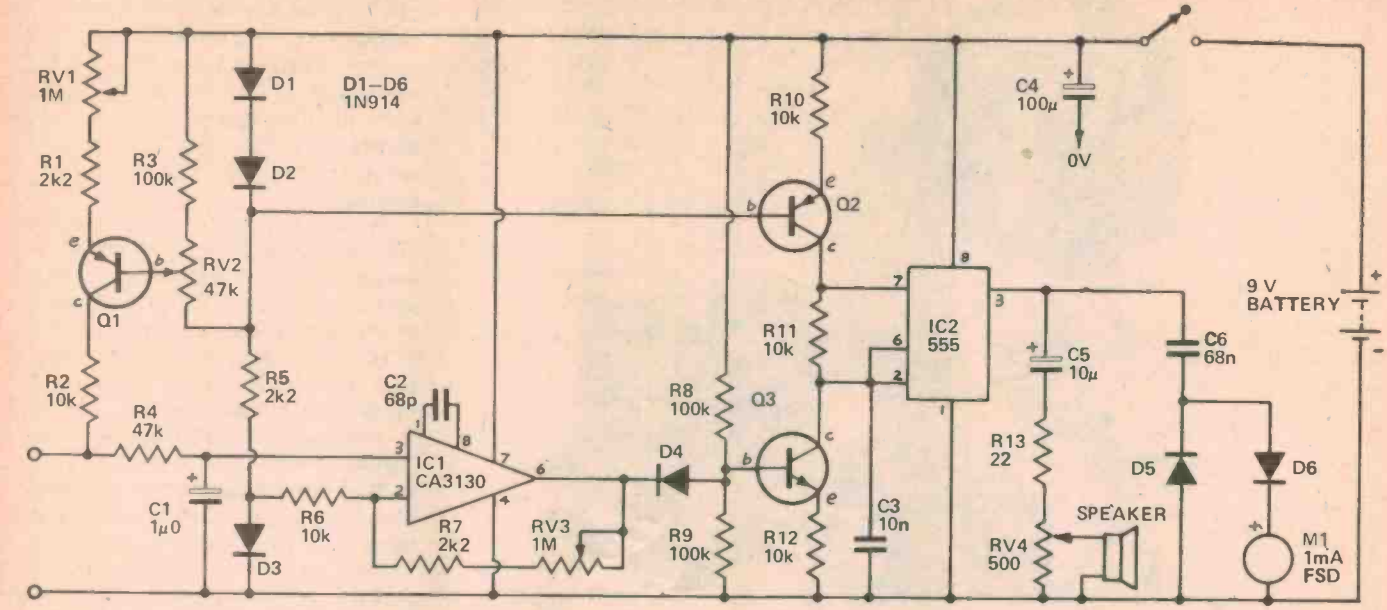
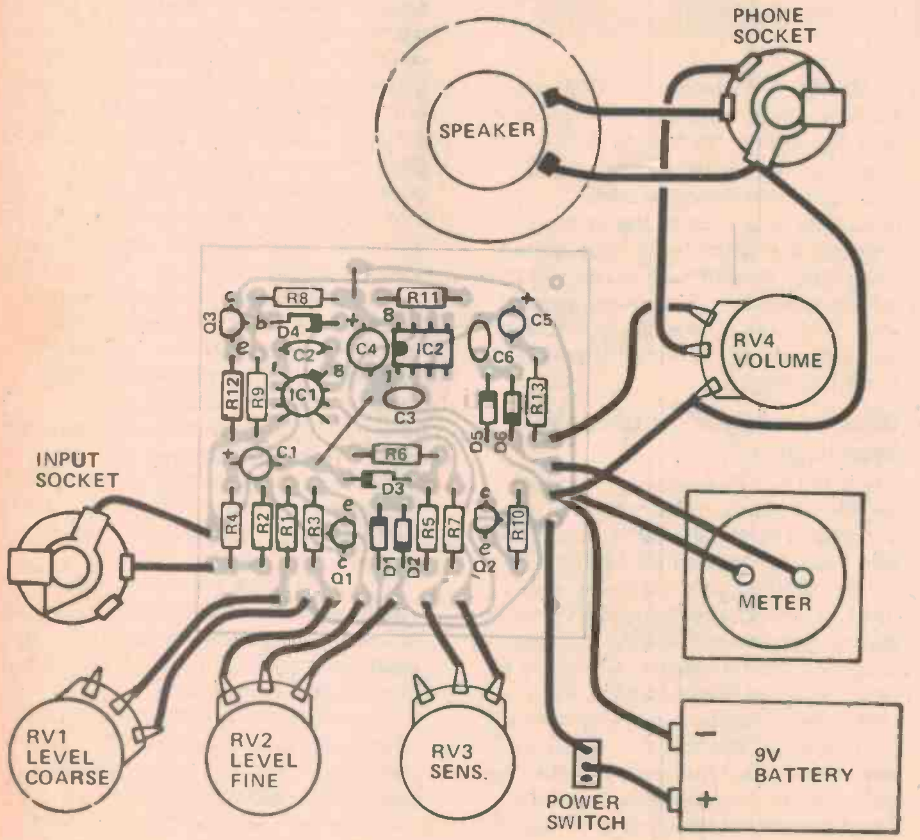


Fig. 1. Circuit diagram of the GSR monitor.

Fig. 2. Component overlay and interconnection diagram.



PARTS LIST ETI 546

Resistors all ½ W 5%

R1	2k2
R2	10 k
R3	100 k
R4	47 k
R5	2k2
R6	10 k
R7	2k2
R8,9	100 k
R10–R12	10 k
R13	22 ohms

Potentiometers

RV1	1 M log
RV2	47 k lin
RV3	1 M log
RV4	500 ohm lin

Capacitors

C1	1 μ 16 V electro
C2	68 p ceramic
C3	10 n polyester
C4	100 μ 16 V electro
C5	10 μ 16 V electro
C6	68 n polyester

Semiconductors

D1–D6	Diodes 1N914
Q1,2	Transistors BC559
Q3	Transistors BC549
IC1	Integrated Circuit CA3130
IC2	Integrated Circuit NE555

Miscellaneous

PC board ETI 546
Meter 1 mA FSD
Zippy Box 196 x 113 x 60
Two phone jacks
Four knobs
Small speaker
Six AA battery holder
Pickup probes

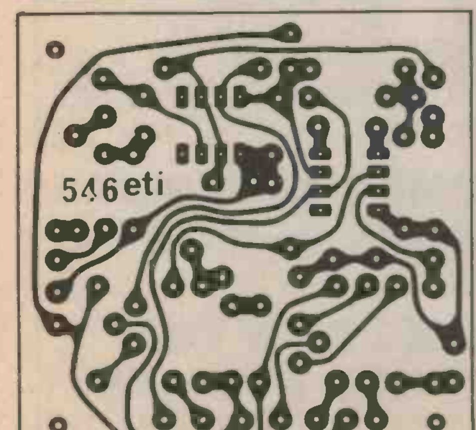
How It Works — ETI 546

This project measures the skin resistance and displays it on a meter. An audio tone gives an aural indication of the meter reading. The meter operates in reverse sense to a usual resistance meter: low resistance gives full scale (or high tone) and high resistance gives zero (or low tone). Skin resistance can vary over a large range but the variations studied in biofeedback experiments are small — so an offset is needed.

Transistor Q1 acts as a constant current source — the actual value can be varied over a large range by RV1 and over a limited range by RV2. These act as the coarse and fine level controls. This current is passed via R2 to the probes. The voltage developed across the probes is proportional to the skin resistance and is fed to the input of IC1. This amplifies the signal with reference to 0.6 V (drop across D3) and the gain is variable by RV3.

The second IC is an NE555 oscillator where Q2 provides a constant current (about 60 μA) to the capacitor C3. When the voltage on C3 reaches 6 V the IC detects this and shorts pin 7 to ground, discharging C3 via R11. This continues until the voltage reaches 3 V at which point the short on pin 7 is released allowing C3 to recharge. The output of the oscillator is connected to a speaker via the volume potentiometer RV4 and the meter via C6 and the diodes D5 — 6.

We vary the frequency of the oscillator and the meter reading by robbing some of the current supplied by Q2 into Q3. In this way the frequency can be lowered and actually stopped. Transistor Q2 is controlled by IC1 completing the connection between the probes and the output.



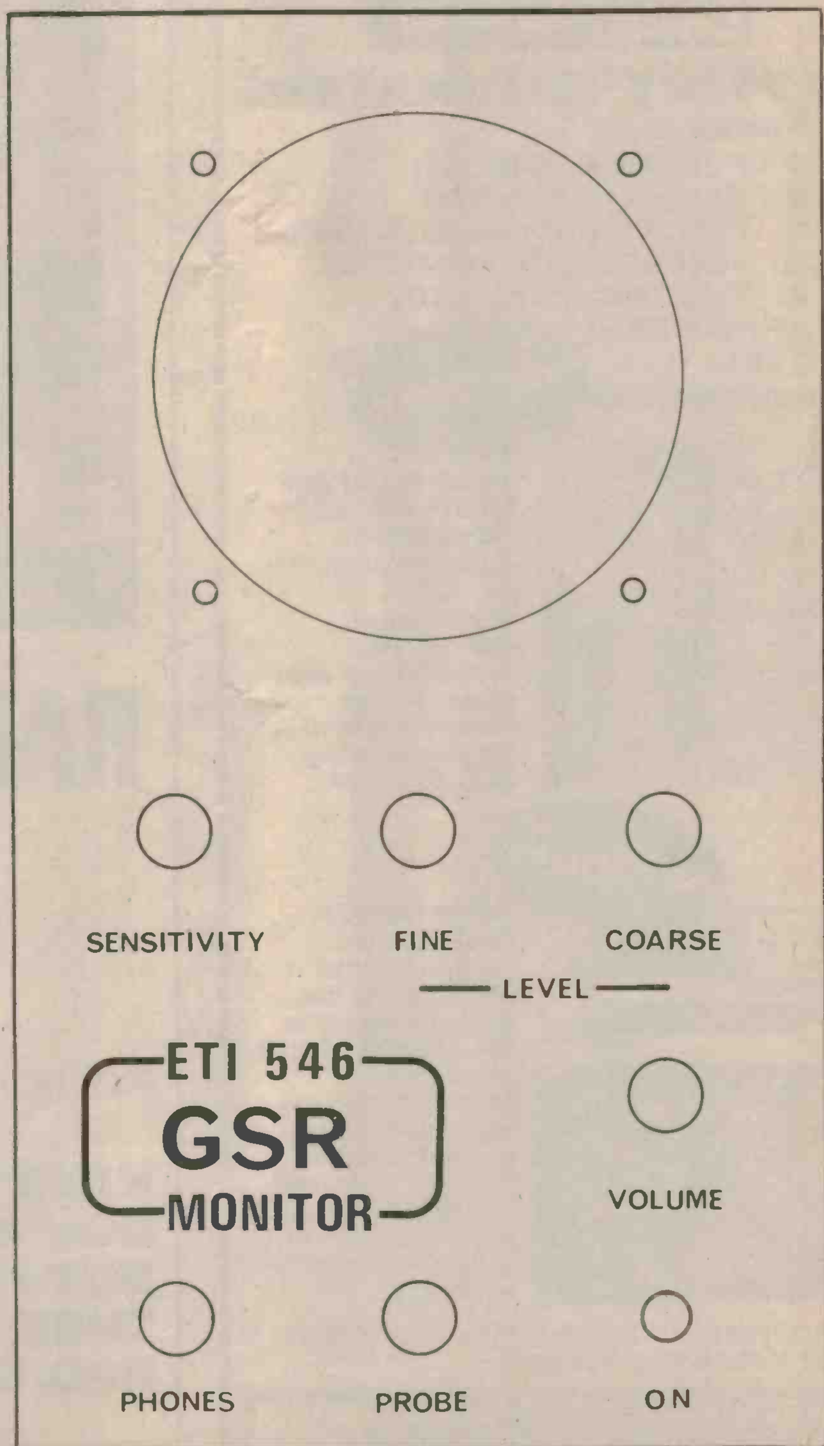
Construction

Construction is not critical although we recommend you use the pc board as it makes things easier. Before soldering the components made sure they are orientated correctly. External wiring can be done with the aid of the overlay-wiring diagram.

Probes

Probe construction and electrical contact is not nearly as critical as with most other biofeedback machines.

Commercial GSR machines use a pad of soft steel wool which is held firmly onto the finger by a short length of Velcro strap (Band-Aids work fine!). However, any method ensuring a firm contact between probe leads and the fleshy part of the finger will do. One method which works very well is to bind tinned copper wire around a guitar finger pick (or solder to a steel pick). Two probe connections are of course required — one for each of the first two fingers.



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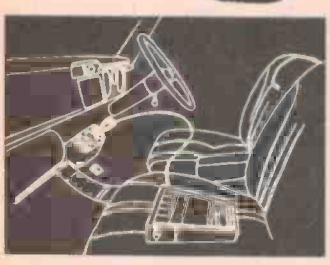

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ELECTROLYTICS:

Value	Voltage	1 off	25 up
1 µFd	6.3 Axial	15c	13c
2.2 µFd	25 p.c.b.	10c	8c
3.3 µFd	25 p.c.b.	10c	8c
4.7 µFd	10 p.c.b.	10c	8c
4.7 µFd	25 p.c.b.	10c	8c
22 µFd	10 p.c.b.	10c	8c
22 µFd	50 p.c.b.	17c	15c
25 µFd	16 p.c.b.	10c	8c
33 µFd	6.3 p.c.b.	11c	9c
33 µFd	16 p.c.b.	12c	10c
47 µFd	10 p.c.b.	14c	12c
47 µFd	25 p.c.b.	16c	14c
47 µFd	50 p.c.b.	17c	15c
100 µFd	10 p.c.b.	16c	13c
100 µFd	25 p.c.b.	18c	15c
220 µFd	6.3 Axial	20c	17c
220 µFd	16 p.c.b.	20c	17c
220 µFd	35 p.c.b.	26c	22c
470 µFd	6.3 Axial	25c	22c
470 µFd	25 p.c.b.	25c	22c
			10 up
1000 µFd	10 Axial	38c	35c
1000 µFd	16 p.c.b.	40c	36c
1000 µFd	25 p.c.b.	52c	47c
1000 µFd	35 p.c.b.	52c	47c
1000 µFd	50 p.c.b.	89c	80c
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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
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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
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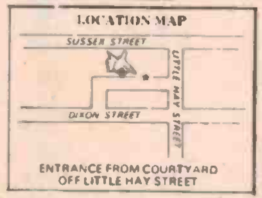

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CB AUSTRALIA

Vol. 1 No. 2 60c*

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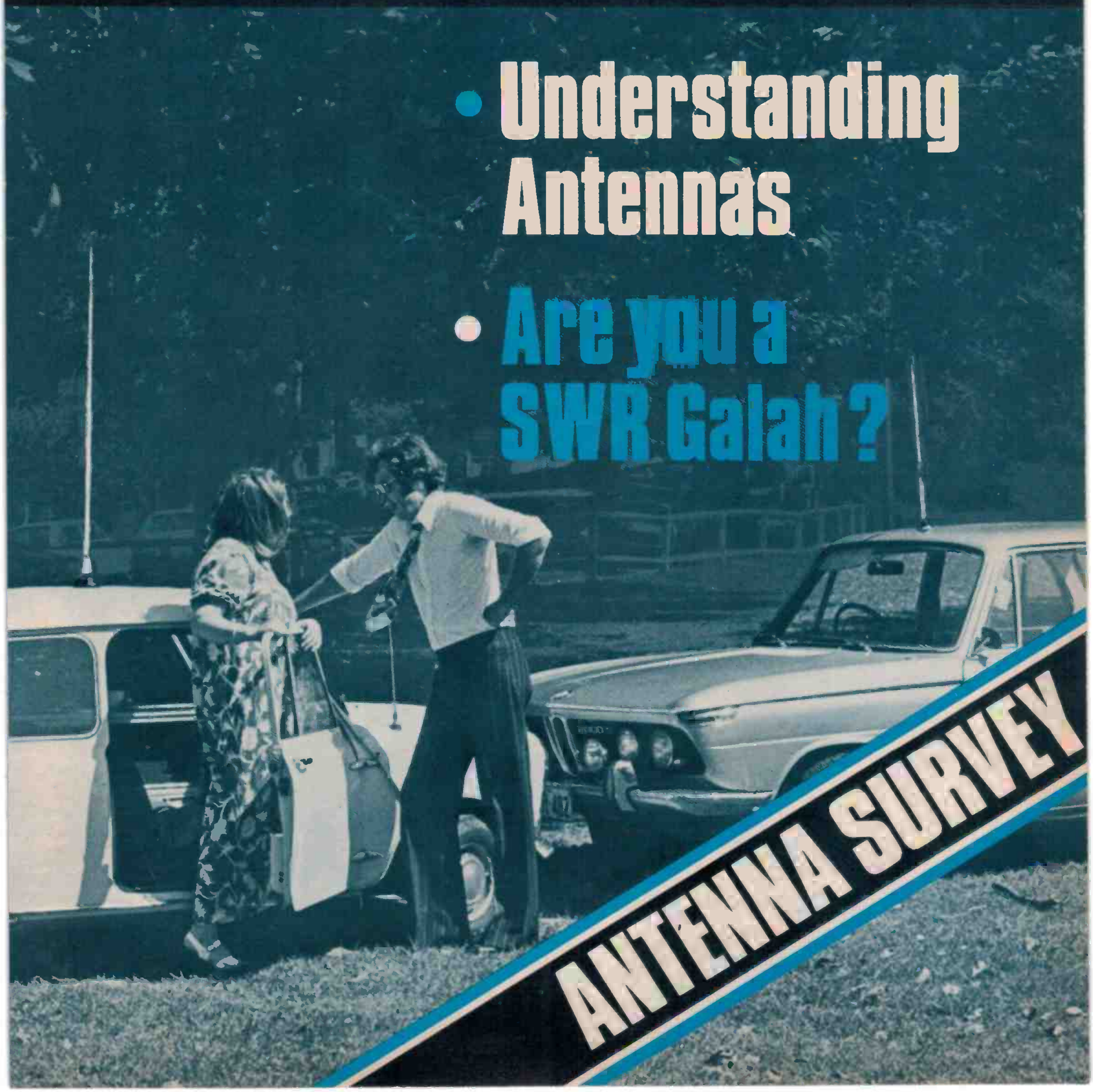

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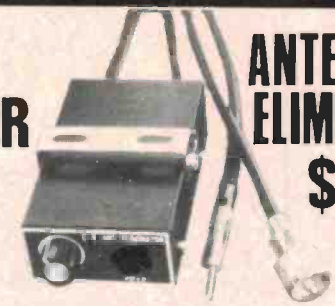

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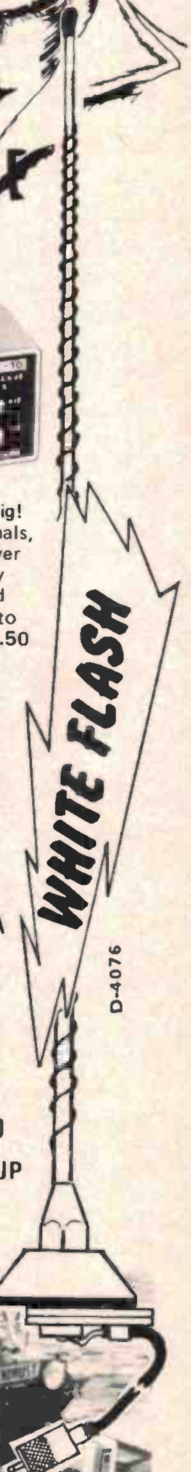

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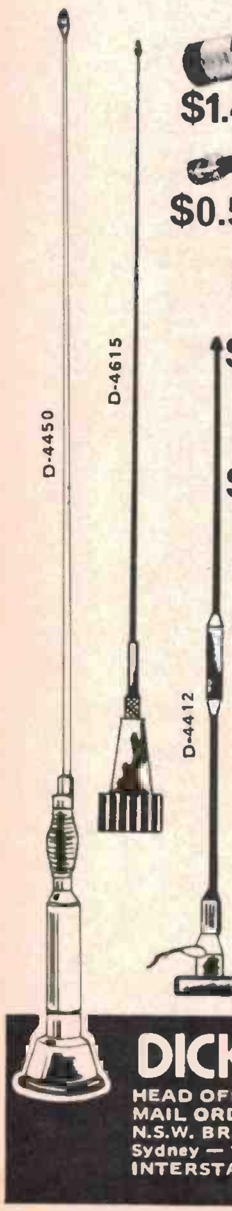

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CB AUSTRALIA

Vol.1 No2.

How to get into CB Radio

CB *How to get into CB Radio* AUSTRALIA

Editorial:

Steve Braidwood, BSc (Hons), VK2BSY
Roger Harrison, VK2ZTB

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Melbourne — Tom Bray, Poppe Davis, Tel 51-9836

Publisher:

Collyn Rivers

This, the second issue of CB Australia, has been edited and produced by the staff of Electronics Today. It is presented free within the March 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: 'THE EYEBALL'
One of the pleasures of CBing is the eyeball. Take this young couple, they first met a couple of weeks ago on channel 8 and then again they QSOed the other day. He said how about an eyeball, she agreed and they lived happily everafter.

ROBINSON CALLS CQ . . .

The Minister for P & T, Mr Eric Robinson, has released the Department's report on CB — and it's a document well worth reading. Submissions from individuals and groups are called for, so now's your chance to be heard. Copies of the report are obtainable from local Australian Government Publications offices.

The CB report suggests a number of alternatives ranging from the introduction of a scheme along the lines of the old US 23 channel system to an exclusive (and unique!) UHF service. It is argued that UHF sets would cost about the same as top of the line 23 channel 27 MHz SSB units and that the local electronics industry would thereby gain a much-needed boost. Bears thinking about . . .

There are numerous ways that a CB service could be envisaged — many equally as good, or better than those discussed in the P & T report.

The time to examine ideas is now. Read the P & T report, have a think about your ideas and write a submission. Then, screw it up and discard it. Think about it again, then make a submission.

Remember, there really is no all-fired, best way to have a CB service. There are many alternatives, dogmatism on the subject is bad news.

CONTENTS

CB NEWS

The Cheapest and Best CB Antenna

The antenna on this Moke cost nothing to make, the cable and connector for the transceiver , however, are worth a buck or so. The antenna was made by one of the editors of CB Australia and it took five minutes to manufacture and erect. Another couple of minutes and I had it SWRed – and how! A beautiful1.05 to 1 (which, we explain elsewhere in this issue, is not worth striving for, but if you can get it without trying it does make you feel good).

All it took was ten feet of wood – in this case seven feet of surplus quadrant plus a three-foot cane, held together with plastic tape. This was wedged in the battery compartment of the moke and secured with two pieces of string (attached to the hood frame). The antenna itself was made from eight and a half feet of hook-up wire soldered at one end to a stiff piece of steel wire and at the other to the inner conductor of the short piece of coax. This wire was then sellotaped to the wood so that the short steel spike cleared the top of the cane by a few inches. The screen of the coax was connected to the car chassis via a large screw (conveniently located by Leyland) and the assembly and installation was complete.

Trimming the length of the radiator was simple – I used an SWR bridge and a pair of side-cutters. The antenna then worked magnificently – bringing in good reports from any station I could hear (using a 4 W AM rig) and in Sydney it was pulling in stacks of traffic on all channels. I compared the antenna to a couple of commercially available types, one base loaded and one centre loaded, and the difference was staggering. From the chockablock band using the quarter wave I was lucky to hear anything on many bands and only locals on others using the loaded antennas.

Not that I am trying to say that loaded antennas don't work well – on big vehicles, especially where they are mounted atop a large ground-plane of metal, they work well. But the Moke doesn't have any suitable metal planes and it is very low (the highest flat area is the bonnet) and it is with this type of vehicle that the benefits of a full quarter-wave vertical are best seen.

You should be able to pick out the guys in the photograph. These were added as an extra precaution before setting out on a long trip one weekend. And after driving to Victoria and back the antenna was still working perfectly (it did come in handy along the way, as those readers living near the Princes Highway will testify).

And the guys make the the antenna stand out more and bring it to the notice of the public that I have a 27 MHz station in my car.

Bendigo Bust

In the midst of what seemed to be a peaceful period as far as RIs seizing CB gear is concerned, we received an unhappy report from a couple of our readers in Bendigo, Vic. The secretary of the Bendigo District Radio Club, Arthur Robins, and one of the club members, John Carr, both had their radio equipment confiscated and the report says Mr Carr lost a battery charger and three tapes of Abba!

Cinema CB

Paramount are now filming a full-length feature film in the United States, and the film is called 'Citizens Band'. It stars Candy Clark and Paul Le Mat and it is said to be a love-story with CBers as the characters.

Correction

In the transceiver survey in CBA No1 we credited the Midland 13-698 1 W hand-held transceiver with Call Tone facility. This should have been attributed to the Contact CT10 and not to the Midland unit.

Citizens Amateur Radio Committee

CARC is a new CB lobby group which has prepared a submission for the P & T Department in which they suggest that those people who are using CB for hobby purposes should be incorporated into the Amateur Radio licensing structure. Virtually anyone who is using CB for any other purpose can get a licence under the current system. The CARC report suggests a fourth class of amateur licence be established. CARC have a petition with several pages of signatures, among them some notable surprises (the best being Bill Payne and the Crests).

Send Us More Information

That applies to all of you. If you are selling CB gear and didn't get into our survey in the last issue send us details of what you've got ... we're planning to do another survey in a couple of months.

If you are just a CB hobbyist then send us large photographs of any interesting activities going on in your area, send details of your CB club, any ideas you have or any questions you want us to find the answers to, etc.

Citizens' Band in Australia

Now in your local government publications office is the report of the enquiry into CB which has been made by the Postal and Telecommunications Department. It sells for $1.50 and makes interesting reading for any CB fanatic.

The report invites further submissions so read it carefully and discuss it with your friends (it'll give you something interesting to talk about on the air) and then write in with your view.

A GUIDE TO CB ANTENNAS

Roger Harrison discusses radiation pattern, standing wave ratio, polarization, radiation angle and gain to give a basic idea of the operation of an antenna. Many people do not realize the importance of an antenna as the most critical component between transmitter and receiver.

THE MOST IMPORTANT COMponent in any transceiver installation is the antenna system. The power available from 27 MHz transceivers is quite low, around 600-700 mW for most hand-held transceivers and generally 3 W to 4 W for most AM mobiles and base stations, and thus a lot of reliance is placed on the antenna system for best communications and coverage.

In this article I will discuss a little of the theory of antennas in order to help you understand something of how they work, as well as what various terms mean – so that you know a little about them when you run into them in the literature and in advertising, etc, apart from the fact that a lot of rubbish is often expounded by 'instant experts', general know-alls and salesmen.

Waves and Wavelength

An antenna radiates and receives electromagnetic energy, radio waves. This energy is carried to and from the transceiver via a cable called the feedline. Antennas have the same basic characteristics for both transmission and reception.

You can get some idea of radio waves radiating out from an antenna by analogy with waves created on the surface of water when a stone is dropped into the water. The waves of water travel outwards, expanding in rings. The further the waves are from where the stone was dropped, the weaker the waves. The radio waves radiated by an antenna are strong near the antenna and weaker at further distances from it.

If the waves created on the surface of the water, by the dropped stone, meet a wall they bounce off it – are reflected – and travel in different directions, some radiating across the path of the other waves causing 'peaks' and 'nulls' in the height of the waves. A similar thing happens with radio waves. Reflection from objects causes peaks and nulls in signal strength at certain positions. This effect is particularly noticeable when the transceiver is mobile.

When you look at the waves in the water you can see that they have a peak and a trough followed by another peak, etc. The distance from one peak to another (or one trough to another) is called the wavelength. In the same way, radio waves have wavelength. The wavelength is related to the frequency transmitted or received. The wavelength of a radio signal on a frequency of 10 MHz is 30 metres. The wavelength of a 30 MHz signal is 10 metres. Thus, as the frequency increases, the wavelength decreases. Signals on, or close to, 27 MHz have a wavelength of about 11 metres.

The number of waves that occur in a period of one second is called the frequency. The waves repeat themselves over and over, and are thus called cycles. One complete wave is one cycle. But, frequency is referred to by the term hertz in honour of Heinrich Hertz, one of the pioneers of radio science. One cycle per second is referred to as one hertz, fifty cycles per second is referred to as fifty hertz. In writing this down, hertz is abbreviated to 'Hz'. Thus, fifty hertz is written 50 Hz. Higher frequencies are referred to by the terms 'kilohertz' meaning one thousand hertz, and 'megahertz' meaning one million hertz. Thus, 3000 Hz is called three kilohertz or written 3 kHz. Similarly, 7000 000 Hz is called seven megahertz and written 7 MHz. It may sometimes be referred to as 7000 kHz.

A group of frequencies having specified upper and lower frequency limits is referred to as a band. A number of different channels may be specified within the band, each is on a separate frequency, but all are within the specified frequency band. Thus we have the 27 MHz band and there are a number of channels in this band, each on a different frequency. The American citizen's band extends from 26.96 MHz to 27.41 MHz.

BASIC ANTENNA CHARACTERISTICS

Radiation

For the sort of short range communications required by 27 MHz band users, an antenna that radiates and receives signals towards all directions of the horizon, providing general coverage, is desirable; radiating or receiving little energy from directions generally overhead or below. This is referred to as omnidirectional radiation and antennas that provide this sort of pattern are called omnidirectional antennas. The radiation pattern can be imagined as a sort of doughnut shape, with the antenna at the centre, as illustrated in Figure 2(a). The strongest signals are received or radiated from a range of directions more or less at right angles to the line of the antenna, weakest straight up and down, in line with the axis of the antenna.

If you imagine looking straight down on top of the antenna, the directions in which it best radiates will appear as a circle, as shown in Figure 2(b). If you imagine looking directly at the antenna from the side, from any direction, the directions and strength of its radiation would appear as in Figure 2(c).

The patterns illustrated in Figure 2 are termed radiation patterns. The radiation pattern of an antenna describes its radiation characteristics and two antennas can be compared for certain applications by comparing their radiation patterns.

In practical situations, most antennas work in close proximity to the ground or require a groundplane, a system of radial elements at the antenna base or a large area of metal such as a vehicle body, in order to work properly. For practical antennas, the radiation pattern, when looking from the side (as in Figure 2(c)) will be more like that in Figure 3. This is referred to as the vertical radiation pattern (as it is in the vertical plane). If you look down on

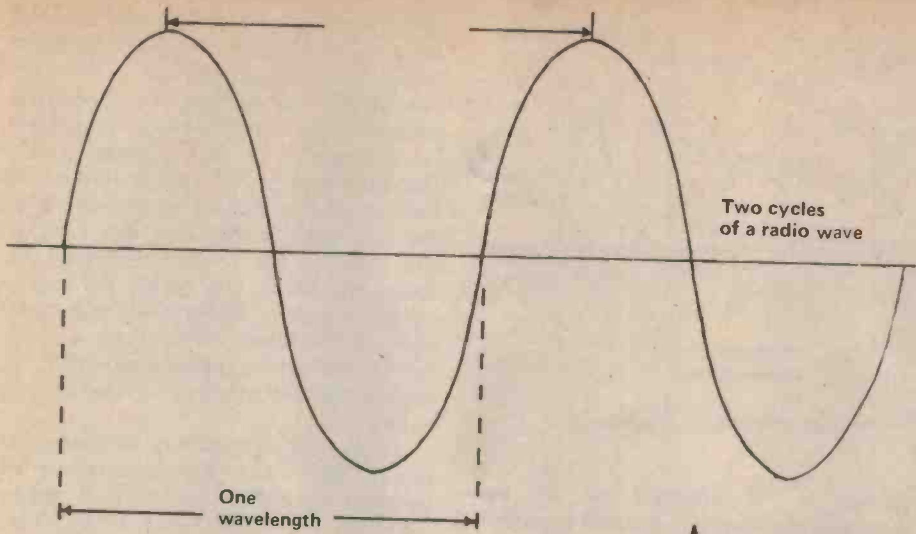

Fig. 1. Illustrating the definition of wavelength.

top of the antenna (as in Figure 2(c)) then the pattern is referred to as the horizontal radiation pattern as it is depicted in the horizontal plane.

In Figure 3, note that the best directions of radiation is slightly above ground, and not directly along it. The angle above ground is called the radiation angle. The lower this is for the best radiation from the antenna the stronger the signal transmitted to or received from the horizon. Of course, the signal strength does not vary a great deal over a range of angles above and below the direction specified, but it decreases very rapidly as he angle gets very close to ground and very high angles.

Polarization

Radio waves are polarized according to the manner in which they are radiated. A whip antenna, commonly used in CB installations, radiates vertically polarized radio waves. For the reason that whip antennas and other simple types have omnidirectional radiation, vertical polarization is commonly used for CB. The TV stations in Australian capital cities, and many country stations, have horizontally polarized antennas radiating their transmission. TV receiver antennas to pick up these signals are consequently horizontally polarized. Some country TV stations radiate waves that are vertically polarized and viewers in their service area have vertically polarized antennas.

Gain

Some antennas are designed so that they receive and radiate signals over a narrower range of angles than that shown in Figure 3, the signal decreasing in strength more rapidly at higher angles particularly. Generally, the radiation angle is lowered as well.

The effect of this is to put more of your signal power where you want it, as well as providing a similar improvement on received signals. Such antennas are said to have gain. The gain must be referred to something and it is usually to a theoretical antenna called an isotropic antenna, or simply referred to isotropic. This is an imaginary antenna that radiates equally in all directions — the radiation pattern would represent a sphere, a circle no matter which particular direction you looked at the antenna. Sometimes antenna gain is referred to a dipole — which radiates as illustrated in Figure 2. A dipole is a practical antenna and allows gain to be actually measured directly.

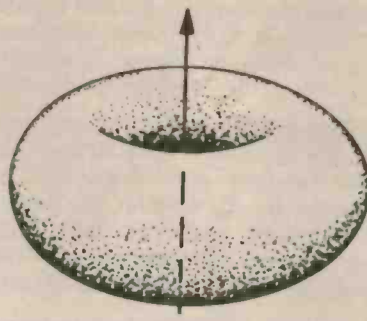

Fig. 2 (a). How an omnidirectional antenna radiates and receives signals. The doughnut shape represents the directions and signal strength in which the antenna best radiates or receives, strongest in all directions at right angles to the antenna, weakest from directions straight up or down.

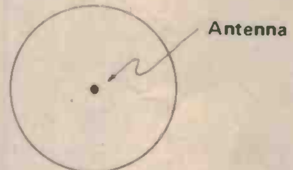

Fig. 2 (b). Looking down on top of the antenna, it is seen that it radiates equally in all directions in the plane of this page.

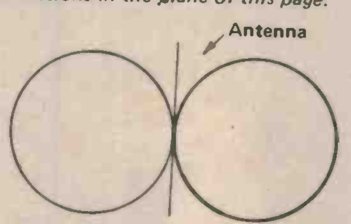

Fig. 2 (c). Looking at th antenna from the side, from any direction, the radiation is best straight out from the antenna, decreasing in directions up or down from this.

The gain of antenna is expressed in decibels — a convenient way of comparing quantities on a logarithmic scale. A power gain of two times is equal to three decibels — written 3 dB. If a station you were listening to doubled his power output, you would only be just able to discern this. Quadrupling the power gives a gain of 6 dB — which is generally considered a worthwhile increase. However, antenna gain generally results in somewhat improved coverage, particularly if gain antennas are used at each end of a communications path. Gain antennas generally give a worthwhile improvement in communications largely because they have a low radiation angle, rather than because they provide actual power gain.

Antenna Length

An antenna is most efficient when its length has some definite relationship to the wavelength of the radio signal being transmitted or received. For practical reasons, especially with simple whip antennas and other types used on CB, most antennas are ¼ or ½ wavelength long. One antenna that provides gain and a low radiation angle is the 5/8 wave vertical.

Antennas which have this definite relationship between their length and the wavelength of the transmitted or received signal are called resonant antennas.

The physical length of the antennas is actually a little shorter than its required electrical length (i.e.: ¼ wave, ½ wave etc). A half wavelength at 27 MHz is 5.56 metres, a quarter wavelength is 2.78 metres. A half or quarter wave antenna for 27 MHz may be actually 5% — 7% shorter than this due to factors in the construction which necessitate shortening the antenna so that it resonates at 27 MHz.

A quarter wave whip for 27 MHz is quite large — 259 cm (102") and may be inconvenient. For this reason, mobile whips are often electrically 'loaded' which results in a physically shorter antenna that is still resonant. The most common form of loading is a coil placed as part of the antenna, usually either at the base, somewhere near the middle or at the top of the antenna element. Typical examples are illustrated in Figure 4. The length of loaded antennas depends on the amount of loading used and their intended application. Generally they are between 90 cm and 112 cm long for those intended for mounting on

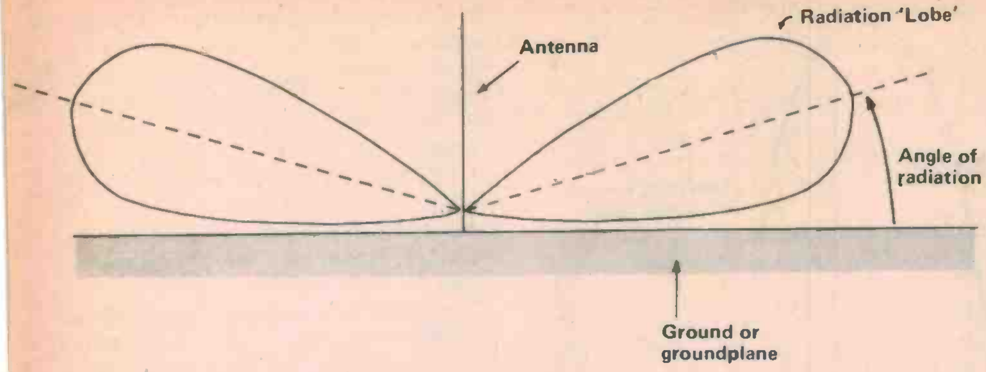

Fig. 3. Typical radiation pattern of a practical antenna working near ground or against a ground plane.

the body of a vehicle or boat. Those intended for mounting on a vehicle roof or gutter-grip types are much shorter — usually around 45 cm long.

Loaded antennas are not as efficient as full-sized resonant antennas of the same type, the top loaded and centre-loaded types are generally the most efficient. The shorter a loaded antennas — the more loading used — the less efficient it is compared to a full-sized antenna.

Antenna Impedance and Matching

The connection point of an antenna is called the feedpoint and its electrical characteristic is called its impedance. The impedanace is measured in units called ohms.

The feedline and transceiver antenna connection also have a characteristic impedance and manufacturers have generally standardised on a value for this impedance of '50 ohms'. This is often quoted in specifications and literature relating to antennas, feedlines, etc. Most manufacturers construct their antennas so that the feedpoint impedance is 50 ohms and thus matches the characteristic impedance of the feedline and transceiver antenna terminal.

The problem can be thought of by analogy to connecting garden hoses together. Connecting a large diameter hose to one of a smaller diameter impedes the flow of water. Connecting hoses of the same diameter together ensures maximum flow of water. With hoses, matching the diameters achieves maximum water flow. With antennas and feedlines etc, matching the impedances achieves maximum power flow.

If the antenna feedpoint impedance is not 50 ohms the antenna does not accept all the power flowing from the transmitter. The unused power is reflected back towards the transmitter. Think back to the waves on water. If those waves impinge upon a soft sponge (like a bath sponge for example), all the wave energy is absorbed by the sponge — it absorbs all of the transmitted energy. If the soft sponge is replaced by a much firmer sponge only some of the wave energy is absorbed, that part not absorbed being reflected.

When an impedance mismatch occurs with the antenna, RF (radio frequency) waves will flow in the feedline in both directions simultaneously. The outgoing (or forward) waves to the antenna react with the reflected waves and stationary peaks and nulls of the RF power occur in the feedline. These are referred to as standing waves. The peaks produce higher than normal voltages in the feedline which can damage the transmitter power output transistor under certain circumstances. If the voltage at the standing wave peaks is compared to the voltage at the nulls a measurement of the mismatch is obtained and is called the standing wave ratio or SWR. The lower the SWR, the better the match to the antenna. Instruments are available to measure SWR. They can be connected in the feedline between the transceiver and antenna and indicate on a meter.

A lot of rubbish is promulgated about SWR and the importance of having a low SWR. Certainly, any power reflected is not radiated — and you lose it. But, it takes a big mismatch to lose a significant amount of power, very low SWR values are fine, but chasing the ultimate (1:1) is like trying to extract gold from seawater — it's not worth the effort. (There is about one gram of gold per 250 million litres of seawater — go get your gold diggers!)

Have a look at Table 1 and stop worrying. Obviously an SWR of 1.5:1 is

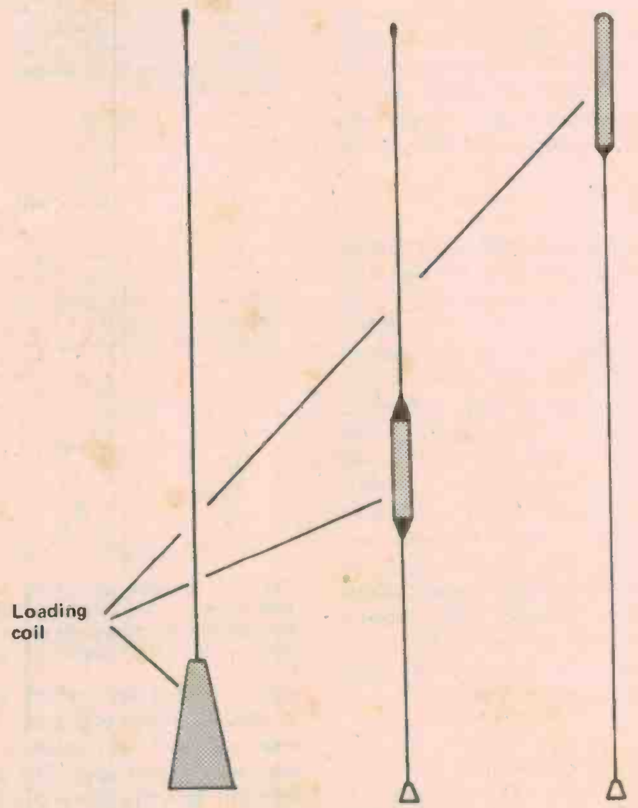

Fig. 4. Typical examples of bottom loader, centre-loaded and top load whip antennas. The loading coil is placed in the antenna element to physically shorten the antenna while maintain its electrical length.

perfectly acceptable. You only lose 4% of your power and the voltage peaks generated in the feedline are not likely to cause trouble with your transmitter. At SWRs around 2:1 and above the voltage peaks are likely to cause trouble, even though many transceivers are protected against such eventualities it is not a good idea to tempt fate.

If you tell someone you have an SWR of 1.1:1 (why you would want to do that I don't know, but let's just say you do . . .) and he tries to go one better and says he's got an SWR of 1.05:1 (I mean, it sounds real, doesn't it?) then you go back and tell him to stick the extra 0.15% of his power back up his antenna socket — that'll even things up!

Some antennas require a matching device at the feedpoint and this is often included as an integral part of the antenna.

As antennas are installed under a wide variety of circumstances, particularly mobile whips etc, it is often necessary to 'tune' the antenna to get best performance. This usually involves a simple adjustment of the length of the antenna — most manufacturers supply adjustable details. This is discussed in a little more detail later.

TABLE 1

It is almost impossible to have a perfectly matched antenna system and a standing wave ratio of 1:1 is virtually impossible. Anyone who claims an SWR of 1:1 for his antenna is either Superman or a liar. And we all know Superman only exists in comics! Here's what happens to your transmitter power for various standing wave ratios — plus comments.

SWR	PERCENTAGE POWER INTO ANTENNA	COMMENTS
1:1	100%	Perfection! But, remember what I said above.
1.05:1	99.93%	Occasionally achieved. Don't bother to attempt any improvement.
1.1:1	99.78%	Some well-tuned mobile antennas and often base station antennas achieve this
1.2:1	99%	Lots of well-tuned and properly installed antennas make this. If you get it — be happy!
1.5:1	96%	This sort of SWR is pretty common — and really quite satisfactory. If you get it — great!
2:1	88%	Encountered more often than you think. No cause for alarm. Get it down a bit — for your transmitter's peace of mind.
2.5:1	82%	Losing 18% of your power is like spilt milk, not worth crying over. But, reduce it if possible for reasons given above.
3:1	75%	Your transmitter is likely to get a little unhappy at this.

THE FEEDLINE

This has been mentioned briefly in the article on installation. Let's have a closer look.

The standard type of feedline used is coaxial cable. Have a look at Figure 5. Coaxial cable consists of a centre conductor of copper (or stranded copper wire), which is flexible, surrounded by a plastic insulating material. Over this is a woven wire braid which serves as the other conductor, called the outer conductor, which completely encloses the insulation and centre conductor. A plastic sleeve encloses the whole cable to keep out moisture etc which affects the efficiency of the cable.

There are two common types of coaxial cable, in different diameters, to meet the majority of requirements. These are designated RG58 and RG8. The smaller diameter cable, RG58, is used in the majority of mobile and marine installations. It is 6-7 mm in diameter and several types of connector are available that can accept this cable. Owing to its small diameter it is very flexible and can be run in small diameter tubes, along corners and in grooves etc which makes for ease of installation.

The other type, RG8, is about twice the diameter — about 13 mm — and is best used where very long runs of cable are necessary, as less power is lost than in the thinner RG58 cable. RG8 is also much more robust than RG58, if somewhat less flexible, and is suited also to installations where the feedline may have to survive some wear and tear.

A typical SWR bridge. Similar units are available at most retail outlets. Note on the right hand side the Forward and Reflected switch. When set on the Forward mode you adjust the sensitivity control (for different power inputs) to give full scale deflection. Then, still transmitting, switch to the Reflected position and read the Standing Wave Ratio.

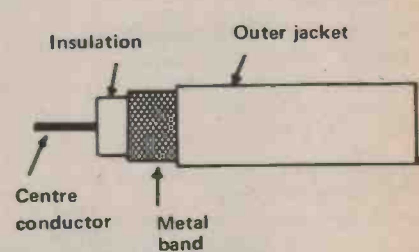

Fig. 5. Coaxial cable. The most common feedline. The two common types are RG58 (6 mm dia) and RG8 (13 mm dia).

CB AUSTRALIA Vol. 3

ACCESSORIES

a look at what's available, how it works, and how to use it.

see April ETI

Are You an SWR Galah?

Score five points for a yes, one for a no, and ten for a don't know ...

Q1 Does SWR stand for short-wave radio?

Q2 One-to-one is a two-way conversation, one-point-five-to-one is the same but with a breaker on the side. Right?

Q3 Do you give your SWR number before your call-sign?

Q4 Have you ever spoken of SWR on the air? (Double your score on this one)

Q5 If you are speaking to a CBer who says he's running five watts into a helical with an SWR of one-point-two do you go back with your power, your antenna and your SWR?

Q6 If your contact says his SWR is 'two' do you make a note not to speak to him again?

Q7 Do you think CBers who don't understand SWR should not be allowed on the band?

Q8 If your SWR is 1.5 to 1 this means that only two-thirds of the transmitter power is being radiated effectively. Right?

Q9 The other third of your power in Q8 is radiated locally and causes TVI, so if you have a high SWR you should not operate near houses, right?

Q10 Have you ever had a QSO in which you discussed nothing but technical topics (after the usual rat-bagging about the twenty the handle, and the possibility of an eyeball)?

HOW TO EVALUATE YOUR SCORE . . .

If 'S' is your total score, substitute in the following formula: Your Standard Galah Ratio is $\frac{S + 11}{22}$ to one!

'CONTACT' MOBILE SSB·AM

New stocks have just arrived of our beefed up version. Now puts 6.5 watts AM into aerial. Fully synthesized. 23 Ch AM plus upper and lower sideband. Dual conversion AM power and S meter. P.A. facility, xtal lattice filter. For Novice or Ham use. 12 volt operation.

$239 P&P $4.00

'CONTACT' BASE SSB·AM

Back again for Feb. delivery 'THE CONTACT' AM-SSB Base Station. 240 volt or 12v operation. Large R.F. & S. Meter. also gives S.W.R. A.M. blanker. Dual conversion 7 I.F. T.s and 6 I.F. stages. Delta tune sensitivity. .5UV @ 6 dB. Sixe 33" x 24.5" x 13.5". Weight 7¾ KG. Designed for Novice or Ham operation.

$299 P&P $5.00

'XTAL' SSB·AM 25 WATT P.E.P.

XTAL is still one of the top names in the U.S. so no one but Tokai is qualified to make their S.S.B. Transceiver for them. Specs are identical to the Tokal TC 1001 but extra XTAL features are R.F. gain control and remote volume control fitted to hand mike. For novice or amateur use only. **$309 p.p. $4.**

TOKAI SSB·AM 25 WATT P.E.P.

TOKAI'S NEW TC1001 has also gone for more power. The SSB section now delivers 25W P.E.P. The price is commensurate with the quality. Full metal case. 96 semiconductors including F.E.T's. Triple AM and dual SSB conversion. P.A. facility. Power and S meter. Delta tune on AM. Noise blanker. This one is loaded with features. For the discriminating Novice or Ham. Porta pak available makes it into portable. **PORTA PAK $69** incl. aerial. **MOBILE $289.** P&P $4.00

2 CHANNEL SCANNER

'XTAL' 23 CHANNEL AM 5 WATT

This high quality 23 channel A.M. Transceiver features a two channel scanner. Both channels are sampled at half second intervals. Automatic locking onto incoming signal. This is a most sophisticated high performance A.M. rig. It would appeal to the novice who wants a touch of class with some very useful features not found on many rigs. For novice or amateur licence holders. **$199 p.p. $4.**

KRACO 23 CHANNEL AM 5 WATT

SPECIAL BUY LIMITED QUANTITY

This exciting American style CB Transceiver is loaded with features. Apart from its smart black all metal cabinet it has a functional and attractive chrome control panel surround. Heavy duty control knobs with finger grips. Positive push button controls for automatic noise limiter. Public address. A most useful map lite is also incorporated. Illuminated channel indicator, variable squelch etc. 29 semiconductors plus I.C. dual conversion. FOR NOVICE OR HAM USE.

PRICE $149.00 P&P $3.00

sensational! CB BLACKBOX — USES EXISTING CAR AERIAL!

This is every novice's dream device. Thieves can no longer detect your C.B. because you have no tell tale C.B. aerial. No extra holes to drill either. With our 'BLACK BOX' Aerial Matcher you can operate your C.B. using the existing car aerial. S.W.R. of 1 to 1 possible with suitable car antenna. Scan your C.B. channels while listening to your car radio. Go straight into transmit without a worry. Fitted in minutes, L.E.D. signal indicator also acts as S.W.R. meter. (Owing to limited supplies this unit is not available through our wholesale division yet). $35 p.p. $2.

PETER SHALLEY
CB SPECIALIST

554 PACIFIC HWY KILLARA
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CB ANTENNA POSITIONING

Where you mount your antenna has a big effect on how well your signal gets out in various directions. Roger Harrison explains the significance of the common set-ups.

A range of different antennas are made for mobile, marine and fixed station installations, each having their own particular advantages and disadvantages.

Making a wise selection of your antenna is part of good planning for your installation and it pays to consider a number of factors before purchasing your antenna. Compromises are almost inevitable, particularly in mobile installations, but it's not too difficult to make a choice once you have assessed your situation.

In mobile and marine situations the rule of thumb is: **the biggest antenna mounted in the highest position.** Now that can be a tall order (Oh dear — those puns keep slipping in) Overhead clearance needs to be taken into account, especially with car and truck installations. Here's where you have to start making compromises. An inefficient antenna mounted high on a vehicle may be better than a full-sized whip mounted low. The position of a short, loaded whip may make up for its deficiencies, even though a larger whip should perform better — but you may not be able to mount the larger whip in the best position. Then again, you may not wish to drill holes in your vehicle or boat, etc and a different style of mounting is called for.

Let's have a look at a few pointers on where to mount antennas, what is the effect of different positions on a vehicle to the radiation pattern of the antenna, things to avoid etc.

Pointers on Antenna Mounting

Base or fixed station antennas are best mounted high and clear of any nearby structures or trees where possible. Don't take this to extremes though. If the base antenna is mounted too high and far from the transceiver a very long feedline is necessary. This usually means that some power will be lost in the coax to the antenna, thus losing any advantage you may have gained. A feedline run more than 30 or 40 metres is not really desirable unless it is quite unavoidable. Where possible, a base station antenna should be mounted somewhere between 5 and 15 metres above the average terrain within a radius of 1km. See Figure 1. Use R68 coax where long feedline runs are necessary.

Mounting an antenna on a car, or similar vehicle, can alter the radiation pattern you would normally expect from an antenna, depending on just where you mount it. There are about seven basic ways you can mount a whip on a car — each produces a different radiation pattern.

Centre-roof mounting results in a somewhat egg-shaped radiation pattern, as shown in Figure 2., but it's about the closest you can get to omnidirectional radiation in this situation. Overhead clearance is a problem, as with any roof-mounted antenna, so make some assessment of the clearance you are going to need. Some antenna mounts have a 'lay-down' or 'flip-over' action allowing the use of a larger whip — depending on the mount itself. Loaded whips suitable for roof mounting range in size from about 50 cm to about 110 cm long (20" — 44").

The most obvious problem you're likely to encounter is getting into your own garage, carport, etc. If it's too low to accommodate a short, loaded whip then either a lay-down type mount will be necessary or another mounting position will have to be considered. You could park in the street!

Some antennas are sufficiently flexible to be pulled down and held in a rain gutter clip.

Mounting an antenna in the centre-roof of your vehicle can be done in a variety of ways. Through-the-body mounts require a hole to be drilled. If you don't mind doing this to your vehicle then it is probably about the all-round best way to do it. This style of mount can be obtained in two basic forms — under-side fastening and top-

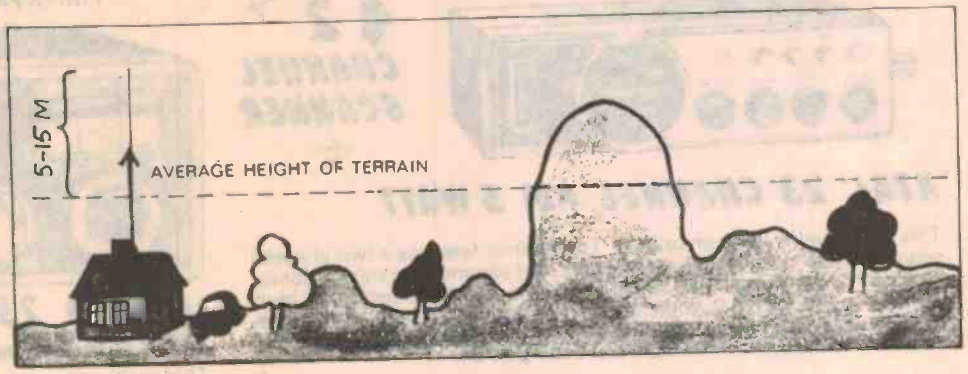


Fig. 1. A good rule for base or fixed station antennas is to mount them about 5-15m above the surrounding terrain within a radius of 1 km. (Picture courtesy of Handic).

side fastening. You'll have to shop around for the latter as the underside mounting seems to be the one most readily available. A variety of mounts obtainable on the market are discussed later. Another method of centre-roof mounting is to mount the antenna base on a ski-bar or roof rack. A distorted radiation pattern may result but this may only be slight, depending on how far above the roof the ski-bar or roof rack projects on its own mounting. Generally speaking, this can be an adequate compromise.

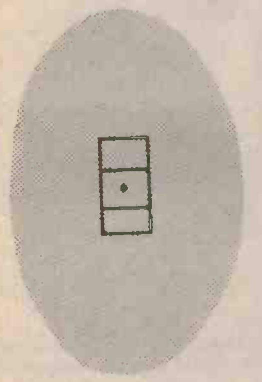


Fig. 2. Mounting the antenna in the centre of your car roof produces about the best radiation pattern — but, overhead clearance is a problem. Good transmission front and rear is obtained with some reduction off to the sides.

Mounting the antenna on the vehicle rain gutter gets it high and in the clear but the radiation pattern is angled across the opposite side of the vehicle as illustrated in Figure 3. Good reception forward and backward is still achieved, as with centre-roof mounting, but it is biased toward the opposite side of the vehicle, reduced signals being experienced off the same side as the antenna is mounted.

Overhead clearance is still a consideration, the same goes for gutter-mounted antennas as for centre-roof mounts. Lay-down or flip-over mounts are available — as discussed later. Clip-on gutter-grip mounts are available also enabling you to unclip the antenna to garage your car, or whatever, but they cannot support a very large whip.

The radiation patter of trunk mounted antennas favours the forward direction. Positioning the antenna on the centre-line of the vehicle gives quite an acceptable radiation pattern as illustrated in Figure 4. Good signals are obtained off to the sides but response to the rear is degraded. If the antenna is positioned to one side the radiation pattern is skewed diagonally across the car as illustrated in Figure 5. A magnet-

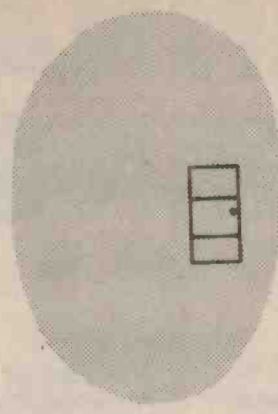


Fig. 3. Gutter mounting places the antenna high up but distorts the radiation pattern. Good transmission and reception front and rear is still obtained with good signals across opposite side of vehicle, somewhat reduced on same side as antenna.

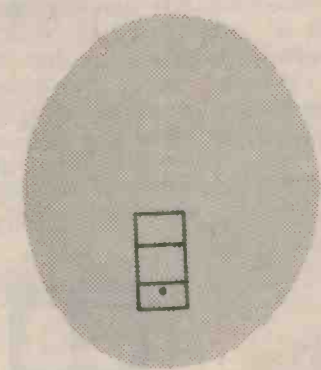


Fig. 4. A trunk mounted antenna positioned on the centre-line of the vehicle produces a radiation pattern that favours the forward direction. Good signals are obtained off to both sides.

mount whip placed centre rear-deck is a good performer if it can't be put on the roof.

Trunk mounting enables a larger, and possibly more efficient whip to be used, apart from reducing the overhead clearance problem . If you have little or no overhead clearance problem a base loaded 2.6 m whip may be mounted on the trunk lip, usually giving an excellent account of itself. A light-weight, flexible whip is recommended in these circumstances.

Cowl-mounted antennas are often convenient as they are simple to mount, robust, can be fitted in an existing car-radio antenna hole and allow the larger whips to be used. Mounting the antenna on one of the front cowls results in a radiation pattern that favours the rear directions, diagonally across the vehicle, as illustrated in Figure 6. Placing the antenna on one of the rear cowls puts the best radiation forward, again diagonally across the car, similar to Figure 5.

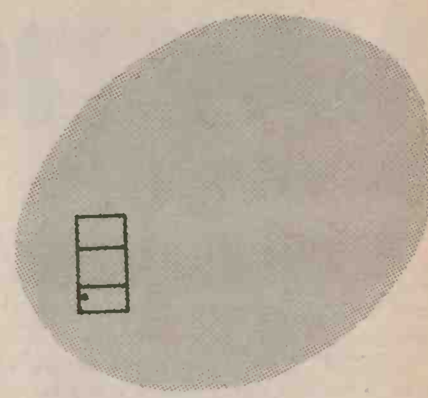


Fig. 5. A trunk mounted antenna positioned to one side angles the radiation pattern diagonally across the car in the forward direction.

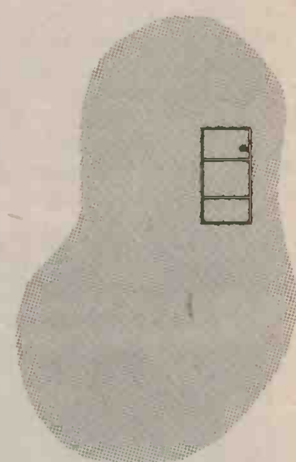


Fig. 6. An antenna mounted on the forward cowl puts most signal across your left shoulder but has advantages in convenience apart from allowing larger whips to be used.

If you favour a long whip, a bumper mount is probably the best. The most popular position for bumper mounted antennas is on the rear bumper as they tend to be distraction on the front of a vehicle. Although positioning the antenna on the centre line of the car is possible it restricts access to the boot, or engine if you have a rear engine machine! Generally they are placed towards one side, resulting in a radiation pattern that places the signal forward, diagonally across the car, similar to Figure 5 or Figure 7. Bumper mounted antennas are unfortunately exposed to damage from other people's bumpers.

Mirror-mounted antennas give similar results to gutter mounted antennas. They are handy on trucks or other vehicles that have projecting wing

CB ANTENNA POSITIONING

mirrors. A particular style of base mount is available to suit this method of mounting.

When positioning an antenna on the side of a vehicle don't place it too far down so that the bottom portion of the whip etc is close to a mass of metal as this adversely affects the operation of the antenna, severely reducing its efficiency. This should also be remembered with bumper-mounted antennas as proximity to the body or fenders of the car can have the same effects. If mounting a whip on the rear deck or cowl of a car, position it away from the roof supports for the same reasons. A bumper-mounted whip on the rear of a Land Rover or a station wagon is not a very good idea. A large portion of the whip will be in close proximity to the body mass of the vehicle, reducing its efficiency. That is why you often see such vehicles with a bumper-mounted whip at the front.

On boats, mounting a whip with portion of it in close proximity to a metal mast is not a good idea for the same reasons just outlined. Position the antenna, as far as is possible, away from mast guy wires as well.

All-wooden or fibreglass boats do not provide a "ground plane", which is automatically provided by the metal body of land vehicles, which is necessary for the proper working of many antennas. Some sort of ground plane may be constructed but as whips are available especially for applications such as this it is hardly worth going to the trouble.

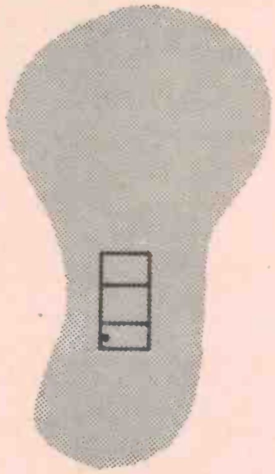


Fig. 7. Mounting the antenna on a rear cowl puts the best signal forward, diagonally across the car.

ANTENNA MOUNTS AND FIXTURES

Mounting a mobile antenna can be a straightforward business, but if you want something special – a big antenna, a removeable or relocatable antenna – then there is a range of special fittings available.

A WHOLE RANGE OF ANTENNA mounting fixtures are available to suit the widely varying circumstances that are encountered in mounting antennas. Most of the range are for mounting on vehicles and I will deal with these in this article. Fixtures for mounting base station antennas are another subject altogether.

Mounting fixtures can be divided into two casic categories: those that are mounted through a hole and those that are attached to a fixture on the vehicle (which sort of leaves magnetic mounts somewhere out on their own, but I'll get on to them later).

Mounting fixtures that attach through a hole include the simple 'universal' mount and swivel mounts. Those that attach to vehicle fixtures include gutter mounts, trunk or boot mounts, rack and mirror mounts and bumper mounts.

Mounting fixtures may come as part of an antenna assembly or may be obtained separately. Many fixtures are supplied with a length of coax and a PL259 plug.

The Universal Mount

This basically consists of a strong, insulating plastic cone which mounts through a hole in the vehicle body. The fastening also provides a connection to the vehicle body (which acts as a ground plane for the antenna) and a coaxial cable connection, the outer conductor connecting to the vehicle body via the fastening and the centre conductor to the antenna element. A threaded bolt is usually provided on the top of the cone insulator to accept the base of the whip. A gasket provides a watertight seal between the insulator and the vehicle body.

A typical mounting fixture of this type is marketed in Australia by Scalar, it costs around $5 through distributors. They are widely used for mounting VHF whips on taxis.

The universal mount is generally secured by several screws underneath but may also be obtained in a style that is secured from the top. This is convenient as it saves working in tight spaces, such as beneath car fenders. However, you'll have to shop around for the top-secured type.

The Swivel Ball Mount

These mounts are secured via several body holes and consist of a split stainless steel or chrome-plated ball which accepts the antenna and is insulated from the body of the vehicle. It allows the antenna to be laid flat or swivelled into any convenient position. A typical mount with hardware is illustrated in Figure 8. The feedline cable is attached from beneath. The cost ranges from about $8 to $25, depending on material and size. The expensive ones are usually stainless steel.

The big advantage of swivel mounts is that they can be mounted on a horizontal, vertical or angled surface. They are great for boats as well as land venicles, caravans, etc.

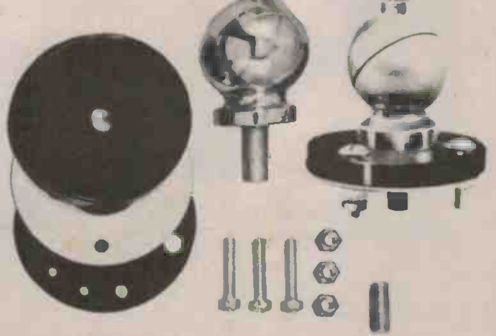


Fig. 8. Swivel ball mount and hardware. This type of mount allows a large whip to be laid down to obtain clearance, for garaging a vehicle or whatever. They can be mounted on horizontal, vertical or angled surfaces.

Gutter Mounts

Gutter mounts come in two basic styles – screw-on and clip-on. The screw-on types are secured with two small screws and are more-or-less a permanent fixture. This style generally has a pivot arrangement so that the antenna may be angled to stand vertically, as the attachment to the rain gutter of the vehicle is often at an inconvenient angle. A typical screw-on gutter grip is illustrated in Figure 10. They cost around $8 to $15. They are made to fit either an insulated bolt assembly which accepts the antenna base, or more usually, a type S0239 socket.

The screw-on gutter-grip can generally accept a larger whip than the clip-on type, but neither will support the longer loaded whips. Generally whips suitable for gutter mounting are around 45 cm to 55 cm long, and are usually centre-loaded types. Base loaded types are not recommended because of the greater strain they place on the mount. Screw-on gutter-mounts are also available in a style that allows the antenna to be folded down – see Figure 9.

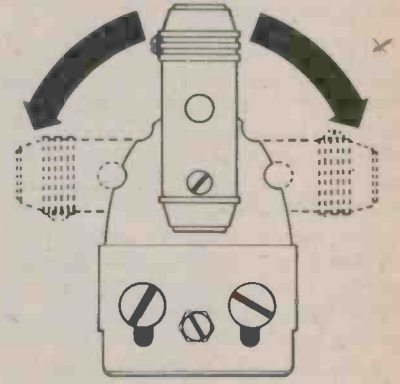


Fig. 9. The Flip over or 'quick flip' style of gutter mount allows the antenna to be laid over for garaging or head clearance without requiring removal of the antenna.

ANTENNA MOUNTS AND FIXTURES

Screw-on style mount

Fig.10. Gutter mount fixtures come in two basic styles; screw-on and clip-on. They are quick and easy to mount and require no holes. Either type allows quick and easy removal of the antenna.

The clip-on style of gutter-mount is also illustrated in Figure 10. This style allows the antenna to be mounted or detached quickly and conveniently. With the screw-on mount the antenna itself can be detached, leaving the mount and feedline in place.

The clip-on mounts are generally supplied as part of an antenna assembly, but they can be obtained separately. An S0239 socket is fitted to accept the antenna base which is usually fashioned as a PL259 plug. Clip-on mounts are obtainable from distributors for approximately $5 to $8.

The feedline from a gutter-mount is usually taken part way down the rain gutter and through the door at a point where it won't be squeezed too much (some protection being afforded by the rubber door gasket) to avoid damage to the coax.

The particular advantage of gutter mounts is that they are very easy to fit to a vehicle. Note, though, that the vehicle must have metallic rain gutters. The clip-on types require a spot of bare metal to make an electrical connection to the vehicle body (which is required to act as a ground-plane). Chrome strips along the rain gutter may not provide a good connection.

Not all rain gutters can support a gutter-mounted antenna. It is wise to check this point before buying. Another point to watch is that not all rain gutters are the same depth. Be careful when mounting screw-on types that clearance is sufficient for the door to open.

Trunk Mounts

These come in two types: trunk-lid mounting and trunk-groove mounting (also known as a trunk-lip mount). The trunk-lid mount slips over the edge of the lid and is secured with a couple of small screws. The coax feedline is passed into the boot and squeezed between the lid and the rubber gasket. It is necessary to chose a position for the mount such that the antenna doesn't foul the vehicle roof when the boot lid is raised. It is also a good idea to bond the boot lid to the body of the vehicle with a length of flexible braid (obtainable from most equipment suppliers or from some auto accessory shops) to ensure that the lid is part of the general ground-plane formed by the vehicle.

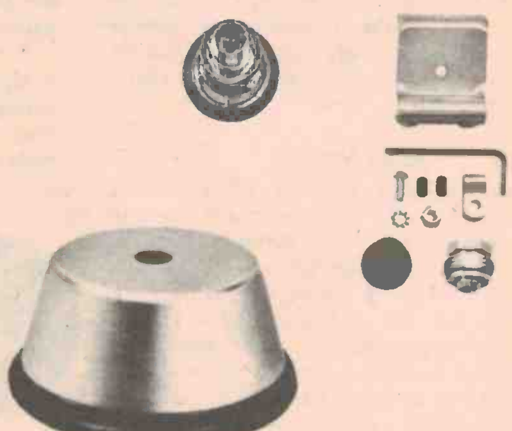
Trunk-lip or groove mounts attach to the recessed groove surrounding the trunk opening and are secured either by several screws or by a clamp arrangement that requires no holes. These mounts are particularly suited to hatchback vehicles and those having little clearance between the open lid and the rear window. Both the screw-on and clamp-on (no hole) types are illustrated in Figure 11. The coax is passed in the boot and squeezed between the lid and the rubber gasket, as for the trunk-lid mount. Some pass the cable through the bracket, affording extra protection against damage.

Most screw-on types of trunk-lip mount have an adjustable bracket enabling the antenna to be tilted so that it can be repositioned when the boot lid is raised.

With either type of mount ensure that a good contact to bare metal is obtained with the mounting or securing arrangement.

Trunk mounts can accept loaded whips up to a length of 120 cm and you should expect to pay around $20 to $25 for the mount.

Screw-on type of trunk-lip mount



No hole type of trunk-lip mount(clamps on).

Fig. 11. Two types of trunk-lip or groove mounts. The screws on type at the left allows the antenna to be positioned vertically or so that it does not foul the boot lid when it is opened. Some makes have a 'snap-in' fixture to accept the antenna — a feature that allows the antenna to be mounted or detached quickly and easily.

Rack or Ski-Bar Mounts

These consists of a simple screw-clamp that can be attached to tubing or or square-section material. They generally fit onto anything up to a maximum size of about 20 mm diameter or square section. They are usually supplied with a length of coax with a PL259 connector attached. A typical example of this type of mount is shown in Figure 12.

The coax is taken into the vehicle in a similar fashion to that of a gutter-grip mount. The wing-nut should contact bare metal which is in good electrical contact with the body of the car. The advantages of this type of mount are its simplicity and cheapness.

Fig. 12. A luggage rack or ski-bar mount. These are inexpensive, simple and quick to install. They are also suitable for wing-mirror mounts.

Mirror-Mounts

These are similar to the rack-mount. Details are illustrated in Figure 13. They consist of a simple, robust, clamp arrangement that can be attached to a vertical or horizontal bar that supports a wing mirror. The coax feedline is routed in the same manner a for a gutter-grip. The clamp should contact bare metal. The mirror struts should be well bonded to the vehicle frame with 'co-phased' antennas (also called 'dual-trucker' antennas; covered later).

As for the rack-mount, mirror-mounts are inexpensive and quick to install. Snap-in base fixtures to accept a whip can be used with these mounts so that the whip may be attached or taken off quickly and easily. These mounts are usually sold complete with coax and PL259 connector attached.

Magnet-Mounts

Probably the simplest, fastest way to mount an antenna. Requires no tools, just pop it on! You can mount the antenna anywhere you like. The antenna can be placed so that you get the radiation pattern you want.

Magnet-mounts are best suited to loaded whips or helical antennas and can accept whips as long as 120 cm. However, they only stick to steel or ferrous metal surfaces, fibreglass and aluminium and are a dead loss! They work quite well on vinyl covered metal roofs, however.

Magnet-mounts consist of a circular ferro-nickel magnet with a fitting on the top to accept a whip and a thin gasket underneath to prevent scratching of the surface it is placed on. An integral coax cable feedline enters at the side of the base, and a length of coax (about 3 metres long) terminated in a PL259 connector is normally supplied. The whole assembly (less whip) costs in the vicinity of $25.

As there is no electrical connection to the vehicle body a magnet-mount antenna is generally not as efficient as other types, especially those that mount through a hole in the body.

The coax may be taken into the vehicle in the same manner as for gutter-grip types.

Holding power depends largely on the length of the whip used, the thickness of paint on the mounting surface — vinyl covered car roofs particularly reduce holding power.

A magnet-mount should not be placed on a wet metal surface, particularly if it is painted or vinyl covered, as the water also reduces the holding power.

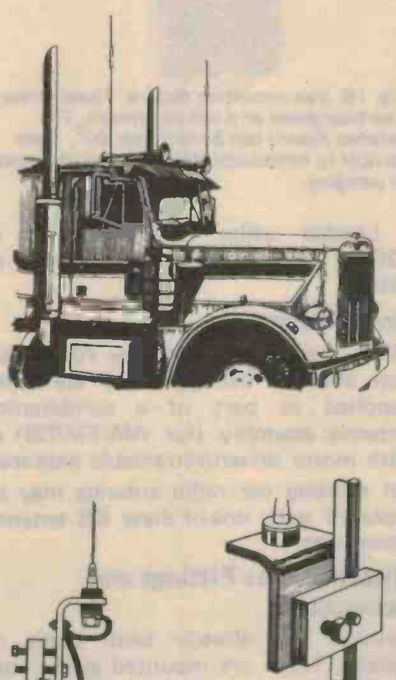


Fig. 13. Mirror-mounts consist of a simple, robust clamp arrangement that attaches to the tubing struts of wing mirrors.

Fig. 14. Magnet base mounts are the fastest and easiest mounting arrangement available.

Bumper Mounts

These are normally used with very long whips. They consist of a base that accepts the antenna fitting which is held on to the vehicle bumper by dual chains or metal straps. See Figure 15. They can be awkward to fit to the small bumpers on old small cars. There is a slight disadvantage with bumper mounting in that the base of the antenna is low so the lower portion of the antenna runs fairly close to the vehicle body, possibly impairing the efficiency.

However, a full-sized quarter-wave whip (almost 3 metres long!) can be mounted in this way, and such an antenna generally gives better performance over loaded whips mounted up on the vehicle body. Long whips have the disadvantage that they literally 'whip' around somewhat, especially at speed. Quick-disconnect fittings can be bought to allow quick mounting and detachment of the antenna.

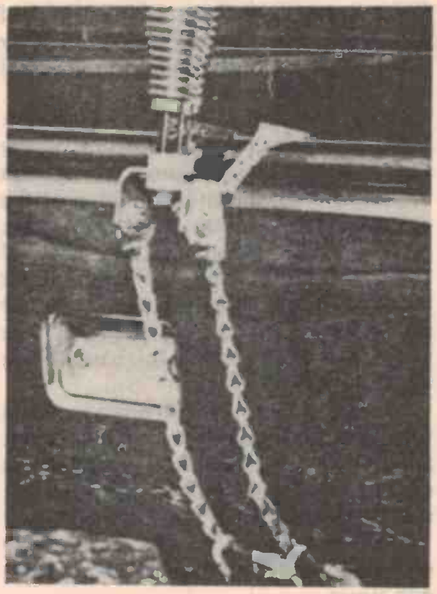
Bumper mounts range in price from about $8 to $18, excluding extras such as spring or quick-connect fittings. If a long whip is to be mounted on a bumper mount a heavy-duty shock spring should be used to add some flexibility (to avoid undue strain on the whip itself).

The bumper should be electrically bonded to the body of the vehicle for reasons outlined previously. The coax may be taken through the trunk, squeezed between the lid and the rubber gasket. Alternatively, it may be passed through a hole in the adjacent body panel.

Van Mounts

This sort of fitting mounts on a vertical metal panel such as on the side or front wall of a caravan or van cabin. It consists of a plate that can be screwed on to the required surface, with a right-angle bend on which mounts the antenna fixture — see Figure 16. The latter is made so that the antenna may be laid over from vertical to horizontal for overhead clearance or vehicle garaging.

ANTENNA MOUNTS AND FIXTURES



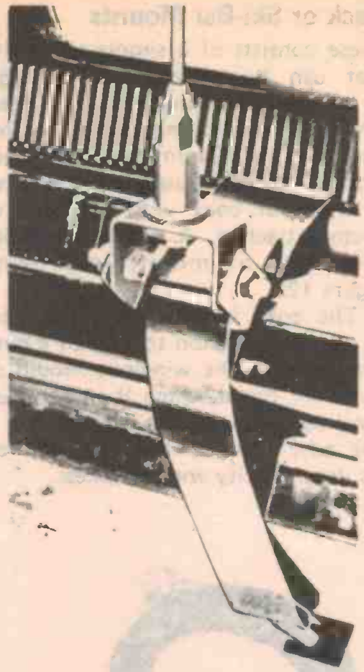


Fig. 15. Bumper mounts attach the whip to the vehicle bumper with dual chains or metal bands. The mount on the left exposes the antenna to damage.

Fig. 16. Van mounting fixture. These screw to a vertical panel or a van or caravan. The antenna mount can be laid over 90°, from vertical to horizontal, for overhead clearance or garaging.

Loaded whips or helicals up to 120 cm are best suited to this type of fitting.

Cowl Mounts

These are like the ordinary AM broadcast antenna fittings. They are often supplied as part of a combination antenna assembly (for AM/FM/CB) or with motor driven/retractable antennas. An existing car radio antenna may be replaced with one of these CB antenna assemblies.

Miscellaneous Fittings and Accessories

Mention has already been made of springs. These are mounted at the base of the antenna, directly on the mount. They are available in a range of sizes from light-duty to heavy-duty. They prevent your whip from being siped off if you accidentally run under something with insufficient clearance. They add flexibility also, avoiding possible damage to the whip or mount when travelling at speed. A typical heavy-duty spring is illustrated in Figure 17. Springs add some height to your antenna so it will be necessary to retune the system to account for the extra length. Antenna manufacturers usually provide an antenna tuning guide. If you don't feel confident to do it yourself then have it done by a technician.

Fig. 17. Heavy duty shock spring adds flexibility to antenna and absorbs shocks if the antenna accidentally strikes something.

Quick-connect fittings are available to fit on most antenna mounts to enable the antenna to be mounted or detached quickly. They generally consist of push-on type of socket that mates with the antenna fitting.

Whip **clips** that attach to the vehicle rain gutter and hole the tip of a bent-down whip are very handy for permanently-mounted whips. The whip can be bent down and secured by the clip for garaging or for overhead clearance.

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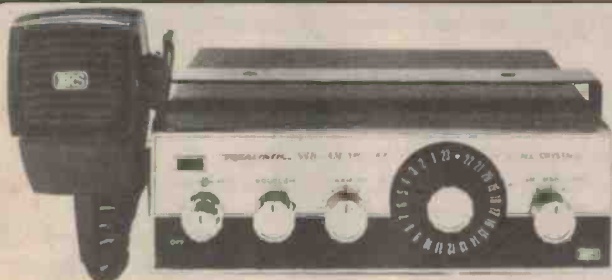

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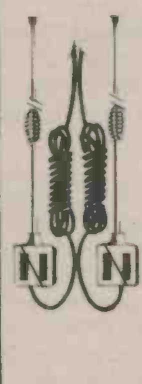

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1.11m (44") Stainless steel whip. Mounts on boot without drilling.

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CB ANTENNA SURVEY

Roger Harrison looks at the antennas available in Australia and gives some guide to prices and suppliers. Undoubtedly there are many more antennas available — here we publish only those that we received data on.

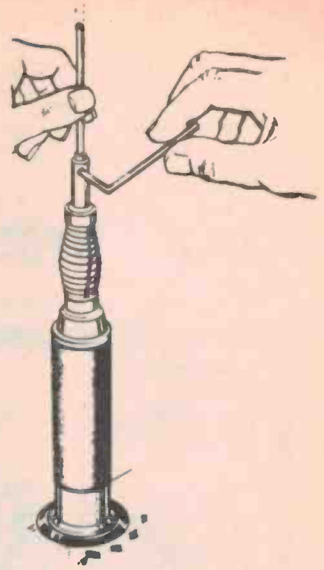


Fig. 2. The set screw is loosened and the antenna tip moved only 3 mm to 5 mm, then check the SWR.

Fig. 1. Loaded antennas require adjustment after installation. The antenna tip above the loading coil is held in by a small screw.

MOBILE ANTENNAS

PROBABLY THE WIDEST RANGE OF ANTENNA TYPES and styles are made for mobile application. Many come complete with mount, spring and coaxial cable. Alternatively, you can buy just the whip itself and separately obtain the other fixtures. Naturally, you can't mount a full size quarter wave whip on a gutter grip mount. It would be equally as silly to mount a 50 cm centre-loaded whip on a bumper mount.

Loaded whips require adjustment after installation, the antenna tip is moved up or down slightly and the SWR checked until a minimum is obtained. The antenna tip is usually set in the top of the loading coil with a small set screw, as shown in Figure 1. Loosening this allows the tip to be moved up or down until you find the optimum length. Move the antenna tip only 3 mm to 5 mm at a time. Tighten the set screw each time and check SWR reading. An acceptable minimum SWR reading would be 1.5:1 to 1.8:1. Try and get better if possible. If you can't achieve these figures look for troubles with connections or the mounting.

Quarter Wave Whips

These are generally 2.59 or 2.74 metres in length. Most come complete with a base spring and a mount. The whip itself is either fibreglass (with a wire through the centre) or stainless steel, the fibreglass whip being somewhat lighter weight. Fibreglass whips have the advantage of being super flexible — but they 'detune' as they move around, and they move around a fair amount at speed. Stainless steel whips are considerably more robust, and more stable on a moving vehicle.

A fibreglass whip by itself may cost between $17 and $24, whereas the stainless steel whip by itself may cost between $10 and $18. A ball mount and spring may set you back another $17 to $25, depending on the size and durability of the spring and the particular swivel ball mount. These items have been discussed in the previous section.

A fibreglass whip complete with ball mount and spring will cost in the vicinity of $20-$25 (Thunderstick and Superstick, from Bail Electronic Services, for example) or maybe as much as $35. The Tandy body mount antenna No. 21-1094 comes somewhere in between this at around $28. This one consists of a 2.59 m stainless steel whip and includes a swivel ball mount and chrome-plated steel spring.

Plastic gutter clips to hold down the antenna tip to improve overhead clearance are available for around $2.50.

With antennas there's no doubt that "biggest is best", so if you can fit one of these whips don't bother reading any further.

Base-loaded Whips

These are generally intended for mounting on the vehicle body with a 'universal' type of mounting. Often the mounting is integral with the antenna assembly.

The length varies from 103 cm for the shortest type, up to 125 cm. They can be obtained by themselves to fit a variety of bases or as a complete, ready-to-mount assembly with base, coax etc. Some include a small steel spring at the top of the loading coil on which the whip top mounts.

A single whip may cost around $12 to $15, such as the No. D-4615 from Dick Smith. A magnet base may set you back between $12 and $25, or a universal mount as little as $5. They have to have compatable fittings though.

Complete assemblies cost somewhere between $28 and $42 and all include some style of body mount and are complete with a length of coax terminated in a PL-259 connector. The largest, 125 cm long, is made by Handic and comes from M & K Communications. Peter Shalley has one at 117 cm long which includes a body mount and 'quick grip' fitting which the antenna snaps into for easy mounting and removal; price — about $30, including spring and coax. Similar base-loaded whips are available from Dick Smith and Tandy, but are slightly shorter — 111 cm. The Dick Smith No. D-4450 is $27.50 and the Tandy No. 21-908 is $35. The latter features a trunk lid mount. Tandy also have a shorter base-loaded whip only 106 cm long with a similar trunk lid mount for only $30 which does not include coax. A 103 cm whip suitable for a screw-on gutter-mount is available from Vicom for about $28 for the whip and spring, the gutter mount to suit for about $20.

The shortest base-loaded whip available is only 51 cm long. Surprisingly, there are two models — for different applications. The two I spotted come from Peter Shalley. One is a down type meant for a gutter-grip mount and sells for about $48. The whip snap-locks in automatically when raised. The whip and loading coil assembly may be removed for stowing. The other 51 cm base-loaded whip is for slipping over hand held transceiver telescopic whip assemblies, with the integral antenna closed down. It sells for around $15.

Centre-loaded Whips

Centre-loaded whips are the smallest and the cheapest mobile whips available. They range in size from 43 cm up to 55 cm and are generally suited for gutter mounting, low profile roof mounting or small, tight pockets. As they are very small, don't expect big things from them. Prices range from around $20 (for the longer ones!) up to $42 (for the shortest!).

So much for the gloom and doom; there are several whips of respectable size marketed. Peter Shalley has a centre-loaded, trunk-lid mounted fibreglass whip that is all of 123 cm long — rivalling the longest bottom loaded whips. Priced around $30. MS Components have a 110 cm gutter mount type for about $20, including mount, coax and connector.

Typical of the longer short whips are the two 55 cm models from Dick Smith; the D-4411 is a gutter-mount type and includes a clip-on gutter-mount and costs around $20; the D-4412 is a magnetic base centre-loaded whip — see M & K for price.

Peter Shalley has a 51 cm centre-loaded whip that includes a body mount and features a 'quick-grip' fitting for easy removal and mounting of the antenna — similar to the base loaded whip sold by him. The assembly goes for around $20 complete.

If 50 cm isn't enough headroom then either the 46 cm whip from Tandy (No. 21-909) or the 43 cm Cal-Com whip from Command Auto Accessories should suit you. The Tandy centre-loaded whip includes a stainless steel spring at the bottom of the whip, gutter clamp mount and three metres of coax for around $25. The Cal-Com whip is similar, featuring a very sturdy gutter clamp mount and sells at around $32.

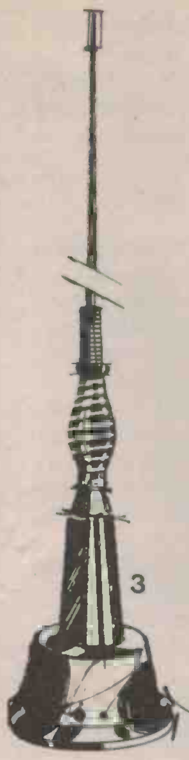
Dual Truck or Co-Phased Whips

This type of antenna assembly consists usually of two centre-loaded whips about 120 cm to 130 cm long and these are intended for mirror mounting either side of the cabin of a large vehicle. They are connected together by a special coaxial cable 'phasing harness'. The result is a reinforcement of the signal forward and backward resulting in a figure-8 radiation pattern as shown in the illustration. To work correctly, the two antennas need to be separated by at least 2.4 to 2.75 metres. They may be spaced closer together but the effectiveness is lost. The advantage of having a radiation pattern such as this is fairly obvious for highway travelling, as most contacts desired will be ahead or behind.

Owing to the special nature of this type of antenna they are normally sold complete with all coaxial cables, mirror mounts and connectors. They are available from at least three local suppliers: Vicom have one at $42, Tandy have a model (No. 21-942) for about $43 and a Cal-Com model (No. 9805) is available from Command Auto Accessories for about $45.

Top-loaded Whips

These antennas are pretty rare on the Australian market at the moment, the only one we could find (why does everybody want to hide their antennas?) is from Handic, distributed by M & K Communications. This is a 125 cm long whip and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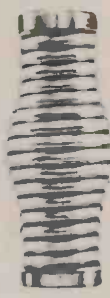
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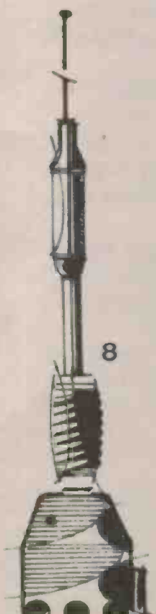
(3) Tandy's 1.06 m trunk-grip base-loaded antenna, $29.95. (4) A typical gutter-grip. (5) Heavy-duty spring, many suppliers. (6) Dick Smith's stainless steel trunk-mount base-loaded antenna, $27.50. (7) 550 mm mini-whip with magnetic base, $22.50 from Dick Smith. (8) 457 mm gutter-clamp stainless steel type from Tandy at $24.95. (9) Radiation pattern of the co-phased antennas shown in (10).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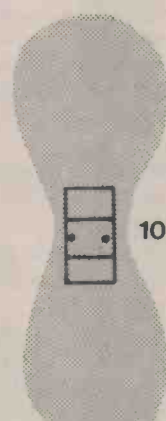
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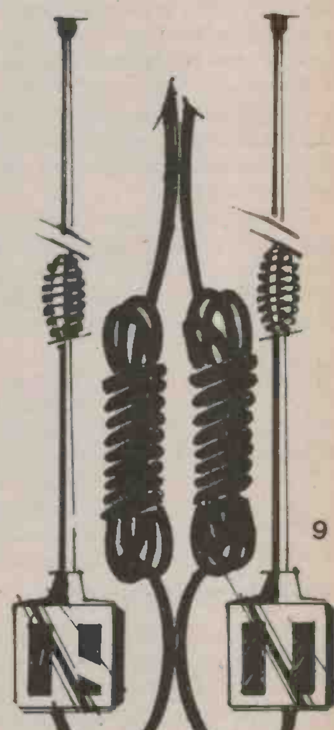
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includes a 'universal' type of mount with a swivel base that allows the whip to be adjusted in all directions. It can be adjusted after installation, as with the other types of loaded whips, to tune the antenna for lowest SWR. The assembly is designated type MA-1 and 2.65 m of coax terminated in a PL-259 connector is included. Price from M & K.

Helical Whips

These consist of a fibreglass whip with a length of wire wound in a helix from the base to the tip of the whip (puns, yes — poetry, no!). They can be thought of as a loaded whip with the loading coil spread out over the length of the whip! They range in length generally from about 102 cm to 160 cm. The helical whips can be obtained alone for about $20 and can then be mounted with a universal mount or one of the trunk mounts. A suitable universal mount will set you back about $5 to $10. The Dick Smith helical whip D-4141, made by Mobile One, is pretty representative and is suitable for mounting on a universal Scalar base. The whole assembly will set you back $25, cable and connectors extra.

The 'White Flash' (??) helical, also from Dick Smith (No. D-4076) is a complete assembly that includes whip, Scalar universal mount, coax and connector for $29. MS Components have a 152 cm helical available for $22, including the base (universal mount).

Mobile One, a local manufacturer and distributor, stock a 102 cm helical, the DX-38, a 152 cm helical, DX-1B and a big 183 cm helical — the DX-1S. Price on application.

Helical whips are renowned for their efficiency — being second only to a well-mounted, quarter wave whip.

Combination CB-AM/FM Antennas

These resemble an ordinary car radio antenna and mount with a similar cowl mount. They are meant to either replace an existing car radio antenna or to be used as a combination antenna instead. The cowl mount usually requires a 24 mm hole and adaptors are available to fit holes up to 32 mm diameter. They are available with either a telescopic whip or a detachable whip. A 'dividing harness' is included with leads for the car radio and transceiver. They are often known as 'disguise' antennas for obvious reasons.

Peter Shalley has a CB-Am combination antenna with a 117 cm telescopic whip that collapses down to 78 cm. The complete assembly including coupling divider and cables sells for around $35.

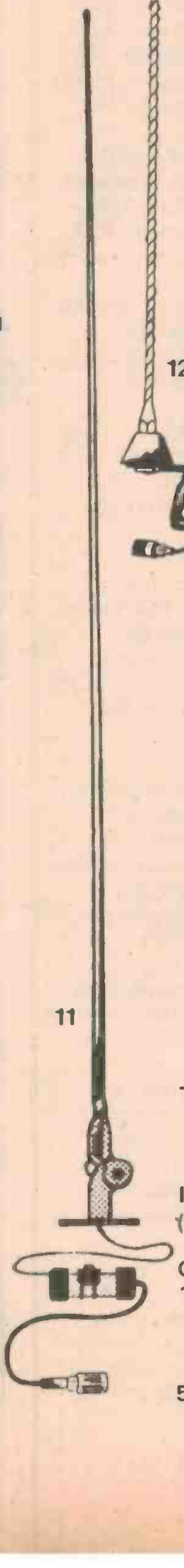
Cal-Com have a CB-AM/FM combination or disguise antenna (No. 9813) which fits the standard radio cowl mount hole. It includes a tapered whip, 122 cm long, that is detachable along with the divider wiring harness and connectors. It is available from Command Auto Accessories for around $54.

Naturally, an antenna such as this is somewhat of a compromise. It can't off the same performance as a proper 27 MHz whip, but is at the same time satisfactory — while having the advantage of being useful for two vehicle appliances.

Dividing harnesses designed to match a 27 MHz transceiver to a standard car radio antenna as well as provide a connection for the car radio antenna input are also available, but these will be discussed in a later article on accessories.

MARINE ANTENNAS

Most mobile antennas can be used in marine applications on metal-hull boats or where a 'ground plane' — large area of metal etc, is available. However, fibreglass construction boats are very popular and no ground plane — essential for the correct operation of most mobile antennas — exists. The same is apparent with wooden vessels also. You can of course make



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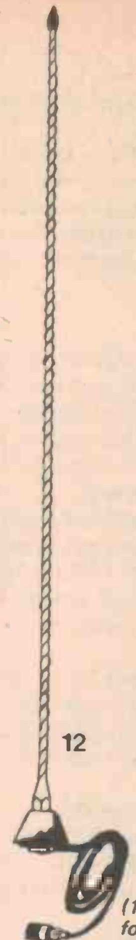

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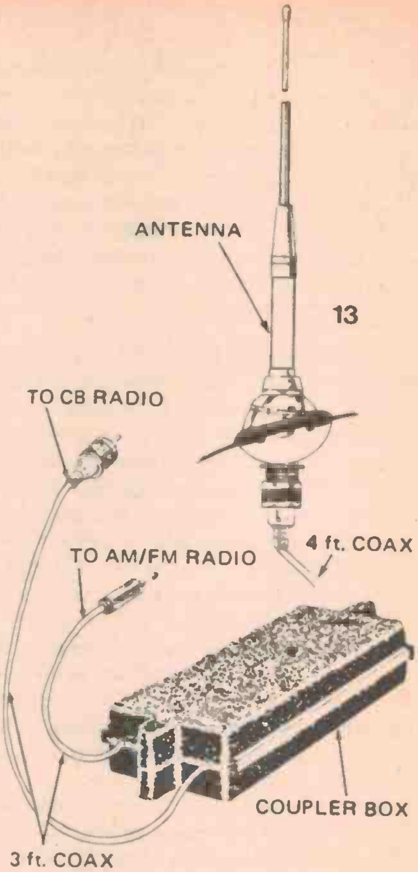

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(11) The Scalar CB-13 Marine antenna designed for fibreglass boats (needs no ground-plane). Available from Dick Smith for $59.90. (12) The White Flash helical antenna, $29 from DS. (13) What an AM/FM/CB antenna looks like.

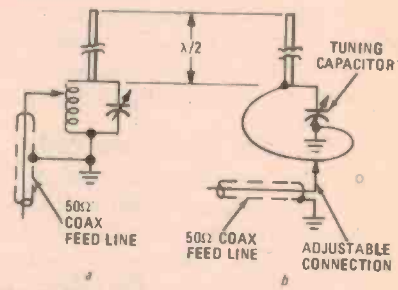


Fig. 14. Above: Two common methods of feeding half-wave verticals. The first method uses a coil tapping to match the feeder into the resonant circuit and the second method uses a tapping on a special type of coil in the resonant circuit, this coil is a horizontally mounted single-turn helix.
Below: The chart compares common base-station antennas to the theoretical isotropic source.

Type	Gain Over Dipole (dB)	Gain Over Isotropic (dB)	Radiation Angle
Isotropic (theoretical)	−2.1	0	All angles
Ground plane	−1.8	0.3	Low
1/2-wave vert	0	2.1	varies inversely with mounting height
5/8-wave vert	1.2	3.3	Gen. low

CB ANTENNA SURVEY

your own ground plane — but that's really the subject for a construction article.

A number of special antennas are produced to meet this situation. In general they consist of a quarter-wave or wave whip fed at the bottom. A special feeding and matching system is employed. Often the feeding system incorporates a loading coil and a shortened half-wave antenna is used. The whip or antenna element itself is generally about 2.4 to 2.6 metres long in this case rather than 5.5 m for a full-sized half wave antenna.

The Scalar CB-13 is typical of marine antennas designed especially foruse with fibreglass boats. It comes complete with a separate loading coil and tuning box. The 2.6 m whip is mounted on an adjustable mount that allows the antenna to be laid over. Complete assembly from Dick Smith costs around $60.

Bail Electronics Services have a 2.7 m marine whip which requires no ground plane, selling at $76. They also have a shorter one, only 1.5 m long, no ground plane required, selling for $40.

Handic, from M & K Communications, have a 2.4 m marine antenna that also required no ground plane. It has a black anodised aluminium whip mounted on a swivel mount, allowing the antenna to be adjusted in all angles. It comes complete with 3.65 m of coax. Price from M & K.

Handic also have a masthead mount that accepts their range of base antennas. It consists of a 50 cm tube of anodized aluminium, 38 cm diameter.

BASE ANTENNAS

There are three basic types of base station antennas: Half-Wave Verticals, Ground Planes and 5/8-Wave Verticals.

Base station installations lend themselves to the use of large size antennas with gain. Omnidirectional coverage is desirable and so vertical polarization is commonly employed.

Half-Wave verticals are inevitably fed at the bottom (end-fed or bottom fed) as this is obviously the simplest mechanical method with an antenna of this type. There are two common ways of feeding a half-wave vertical: A tuned circuit at the base of the antenna has the coax tapped up the inductance, as illustrated in Figure 14 (a).This may actually be part of the structure. The tuning is generally factory pre-set by the manufacturer and should not need adjustment. The second method (Figure 14 [b]) employs a single turn helical coil with an integral capacitor tuning adjustment, the coax being tapped on to the helical coil. This type is generally known as a 'Ringo' from a proprietry name. (The term Ringo is derived of course from the single turn helical coil.)

Ground plane antennas consist of a quarter wave vertical rod with horizontal radial ground plane elements at the base of the rod. The coax inner conductor connects to the base of the vertical rod and the outer conductor connects to the ground plane elements. They are mechanically simple antennas and generally inexpensive. Sometimes, the radial elements, instead of being horizontal, are 'drooped' down. This improves the impedance match, ensuring a low SWR.

5/8-Wave verticals are similar to the ground plane with the important exception that the vertical radiating element is 5/8 wave long (about 6 m). This results in gain over a standard ground plane antenna and the half-wave vertical. Comparisons of the different vertical plane radiation pattern is shown in Figure 15. Figure 14 compares their general characteristics.

Half-Wave Verticals

These are getting rather large at 5.5 m and are usually provided with a mount that is designed to clamp to the top of a

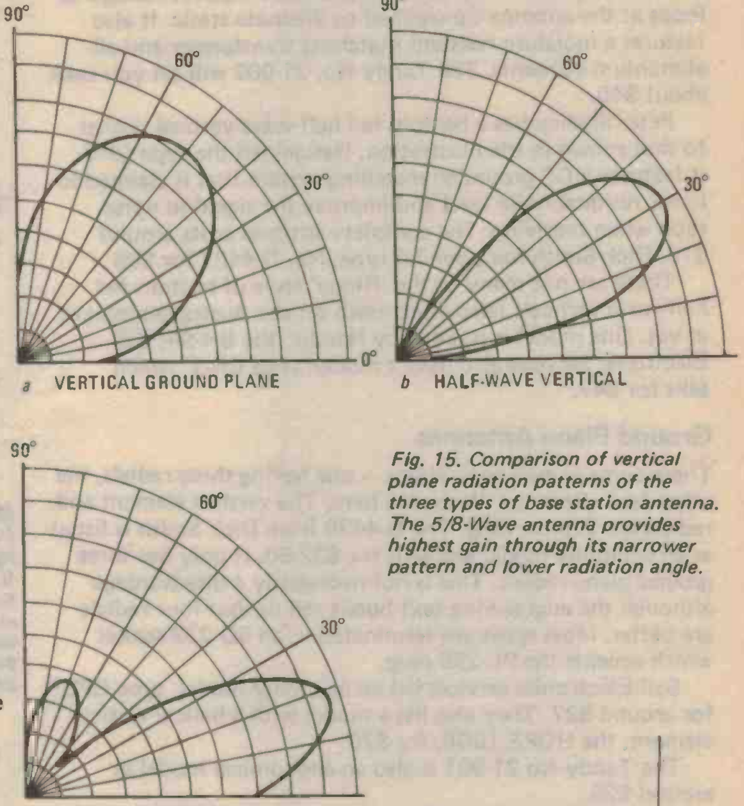
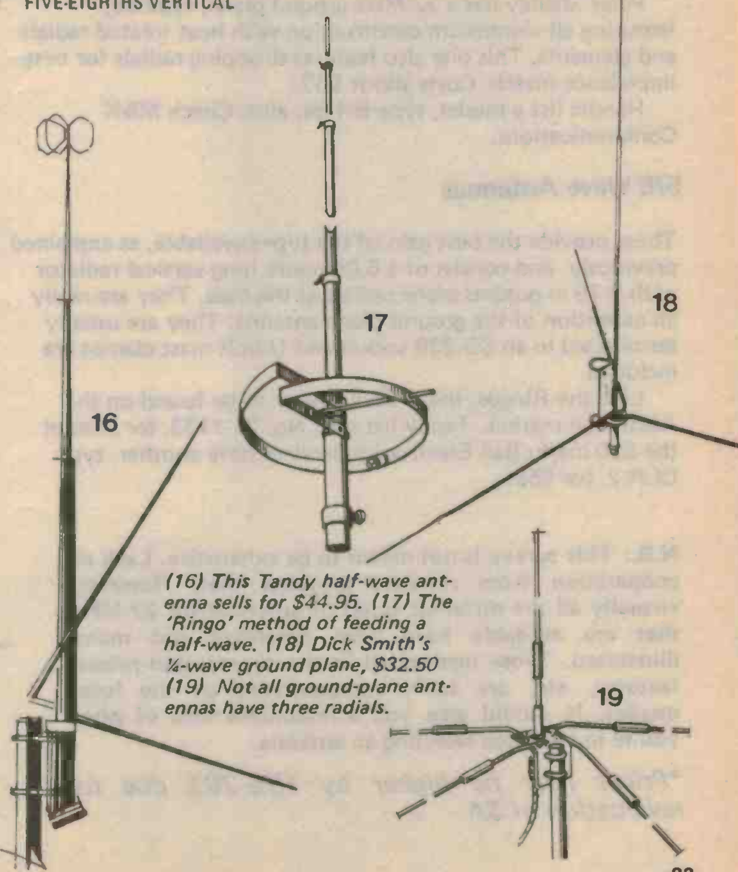


Fig. 15. Comparison of vertical plane radiation patterns of the three types of base station antenna. The 5/8-Wave antenna provides highest gain through its narrower pattern and lower radiation angle.



(16) This Tandy half-wave antenna sells for $44.95. (17) The 'Ringo' method of feeding a half-wave. (18) Dick Smith's ¼-wave ground plane, $32.50 (19) Not all ground-plane antennas have three radials.

CB ANTENNA SURVEY

pipe or pole support with U-bolts. Prices range from $37 for the 'Million V1' from Bail Electronics Services, to $85 for the Dick Smith model (D-4427).

Bail Electronic Services also have a 'Silver Rod' half-wave vertical for $40. Tandy have a model that features hexagonal loops at the antenna tip claimed to dissipate static. It also features a moisture resistant matching transformer and all-aluminium elements. The Tandy No. 21-902 will set you back about $45.

Peter Shalley has a bottom fed half-wave vertical similar to that shown in the illustration. Designated the type GPV it features a DC grounded matching system that is claimed to lower residual noise level and improve the signal to noise ratio when receiving. The complete antenna costs around $79. Dick Smith has a similar type, No. D-4427 for $85.

There are not many of the 'Ringo' style of bottom fed half-wave verticals (also illustrated) on the Australian market as yet. One model is put out by Handic, the BH-94; Bail Electronic Services also have a model, type CR-1, which sells for $47.

Ground Plane Antennas

These come in two basic styles – one having three radials, the other four. Both are illustrated here. The vertical element and radials are 275 cm long. The D-4430 from Dick Smith is listed as an economy model and sells for $32.50. It only has three ground plane radials. This is not necessarily a disadvantage although the engineering text books tell us that four radials are better. Most types are terminated in an SO-239 socket which accepts the PL-259 plug.

Bail Electronics services list an economy model, type GPGP for around $27. They also list a model with a helical vertical element, the HOPE 10GP, for $70.

The Tandy No 21-901 is also an economical model at around $25.

Peter Shalley has a 27 MHz ground plane, type 36, featuring all-aluminium construction with heat treated radials and elements. This one also features drooping radials for best impedance match. Costs about $60.

Handic list a model, type BH-84, also. Check M&K Communications.

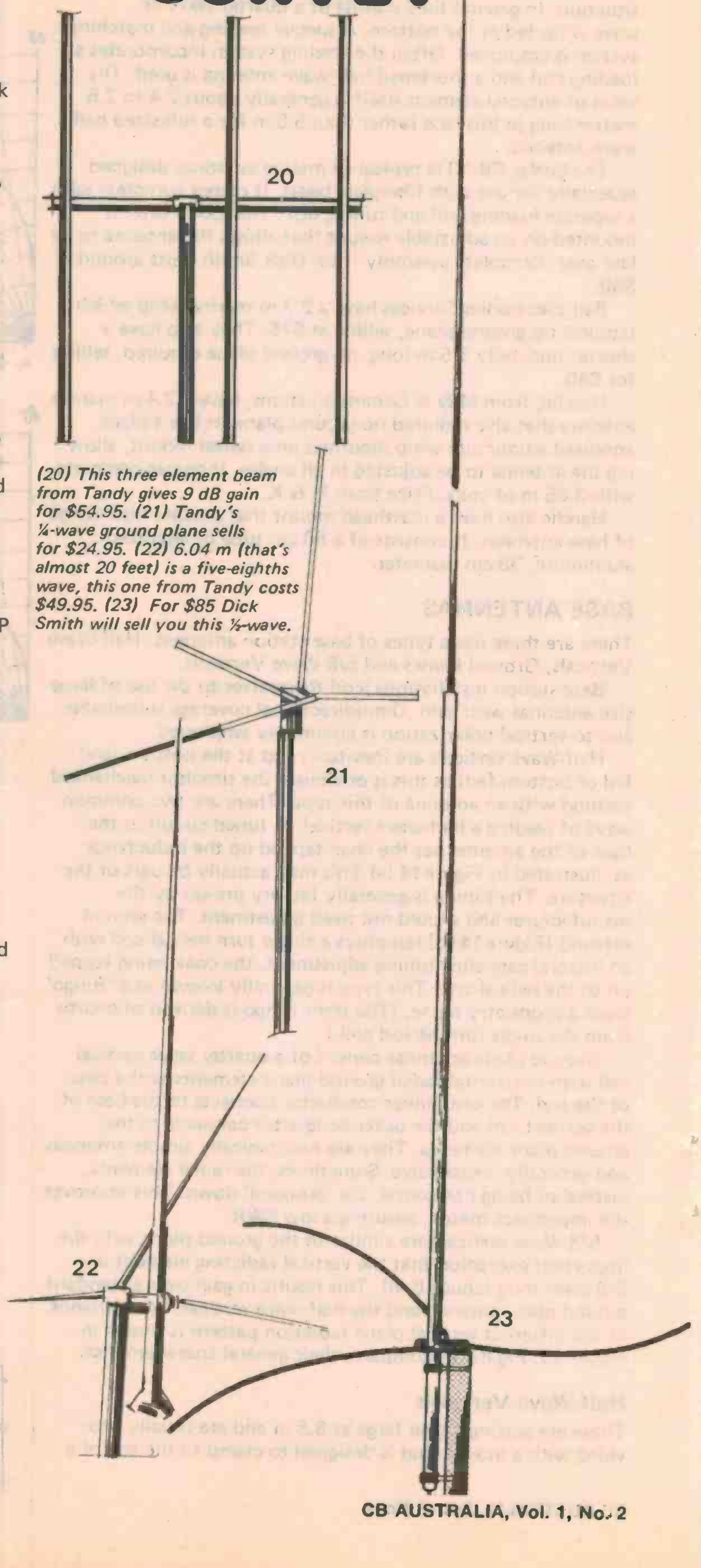
5/8 Wave Antennas

These provide the best gain of the types available, as explained previously, and consist of a 6.04 metre long vertical radiator with 2.75 m ground plane radials at the base. They are really an extension of the ground plane antenna. They are usually terminated in an SO-239 socket and U-bolt mast clamps are included.

Like the Ringos, there aren't many to be found on the Australian market. Tandy list one, No. 21-1133, for around the $50 mark. Bail Electronics Services have another, type CLR-2, for $53.

N.B.: This survey is not meant to be exhaustive. Lack of cooperation from retailers prevents that. However, virtually all the different types of antennas for 27 MHz that are available have been described and many illustrated. Those mentioned in the survey, and prices, features, etc, are fairly representative of the local market. It should give you a reasonable idea of what you're in for when selecting an antenna.

**Prices may be higher by 15%-20% due to revaluation of $A.*



(20) This three element beam from Tandy gives 9 dB gain for $54.95. (21) Tandy's ¼-wave ground plane sells for $24.95. (22) 6.04 m (that's almost 20 feet) is a five-eighths wave, this one from Tandy costs $49.95. (23) For $85 Dick Smith will sell you this ½-wave.

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DICK SMITH 'MIDLAND' DEALERS: Dubbo (82 2377) Goulburn (21-5440) Keiraville (29 5876) Walgett (243) Wollongong (29-9522) Gloucester (152) West Wyalong (721 2424) Batemans Bay (72 4555) Armidale (72 4955) Nelsons Bay (82 1274) Fairy Meadow (29 1455). Sale (44 1615) Lavington (21 6058) Geelong (94 408) Katanning (21 2053) Claremont (86 2433) Wickham (87 1089) South Fremantle (39 1879) Carnarvon (41 1362) West Hindmarsh (46 1547) Port Lincoln (82 1981) Port Adelaide (47-3933) Margate (84 2341) Bundaberg (72 4263) Mackay (51 1211) Townsville (79 8844) Dalby (62 2389) Adelaide (87 3119) Alice Springs (52 1717) Launceston (31 5688) Salisbury North (258 1267)

ADVERTISERS INDEX

SUPPLIERS

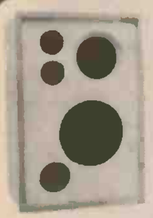
These are suppliers who stock stock CB equipment some of which is listed in the market survey, some supplied the information included in the listings. Some of the firms listed here have distributors in other areas and states, too numerous to mention. Omissions are not deliberate – but you should advertise your presence a little more boldly.

ACE RADIO	136 Victoria Rd, MARRICKVILLE 2004	NSW
AERO ELECTRONICS	Shop 13, 191 Ramsgate Road, RAMSGATE	NSW
AURIEMA	PO Box 604, BROOKVALE, 2100	NSW
BAIL ELECTRONIC SERVICES	60 Shannon St., BOX HILL NORTH 3129	VIC
BRIGHT STAR CRYSTALS	35 Eileen Rd., CLAYTON	VIC
COMMAND AUTO ACCESSORIES	11 Salisbury St., BOTANY 2019	NSW
DEITCH BROS.	70 Oxford St., SYDNEY 2010	NSW
DICK SMITH ELECTRONICS	162 Pacific Highway, GORE HILL	NSW
	125 York Street, SYDNEY 2000	NSW
	361 Hume Highway, BANKSTOWN	NSW
	166 Logan Road, Buranda, BRISBANE	QLD
	656 Bridge Road, RICHMOND	VIC
	and many distributors throughout Australia	
EDGE ELECTRIX	31 Burwood Road, BURWOOD 2134	NSW
ELECTRONIC AGENCIES	117-115 Parramatta Rd, Concord.	NSW.
FOUR WHEEL DRIVES	304 Middlebrough Rd., BLACKBURN SOUTH	VIC
HACO	PO Box 49, KENSINGTON, 2033	NSW
HAM RADIO SUPPLIERS	323 Elizabeth Street, MELBOURNE 3000	VIC
HOSE & EQUIPMENT	11 Salisbury St, BOTANY 2019	NSW
INTAG MARKETING	42 Grantham St., WEST BRUNSWICK	VIC
	34 Sydenham Rd., MARRICKVILLE	NSW
LAFAYETTE ELECTRONICS	94 St Kilda Rd., ST. KILDA 3182	VIC
M&K COMMUNICATIONS	561 Pittwater Rd., BROOKVALE 2100	NSW
MS COMPONENTS	164-166 Redfern Street, REDFERN	NSW
MOBILE ONE	227 Victoria Rd., MARRICKVILLE	NSW
NEW ELECTRONIC	57A The Centre, SEVEN HILLS 2147	NSW
PETER SHALLEY	554 Pacific Highway, KILLARA 2071	NSW
RADIO DESPATCH SERVICE	869 George Street, SYDNEY 2000	NSW
RADIO HOUSE PTY. LTD.	306-308 Pitt Street, SYDNEY 2000	NSW
	760 George Street, SYDNEY 2000	NSW
RADIO PARTS	562 Spencer St., WEST MELBOURNE 3003	VIC
SIDEBAND ELECTRONICS SALES	23 Kurri St., LOFTUS 2232	NSW
STRATO COMMUNICATIONS	25 Wentworth St., PARRAMATTA 2150	NSW
TANDY	throughout Australia (almost)	
CHS TAYLOR WAREHOUSES	169 Johnson St., COLLINGWOOD 3066	VIC
TELEVIEW	218 Chapel Street, PRAHAN 3181	VIC
UNITREX	414 Collins St., MELBOURNE 3000	VIC
VICOM	139 Auburn Rd., AUBURN 3123	VIC
	23 Whiting St., ARTARMON 2064	NSW
WILLIS TRADING	429 Murray St., PERTH 6000	WA
XENON WORLD IMPORTS	P.O. Box 33, WARRADALE 5046	SA

164-166 Redfern St, Redfern. P.O. Box 156,
Redfern, NSW 2016. Ph: 69-5922 or 69-6912.

ACE RADIO

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



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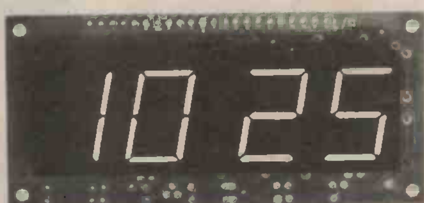
For Bass Guitar, Organ, Guitar. 5.1cm Voice Coil Dia. 6.1 kg Magnet, Freq. Response, 40-5000 Hz. Wt. 9.5 kg.

ONLY $117.00 plus freight.

SUPER CLOCK FROM TECHNIPARTS

New from National



MA1010A

- ★ Same as Popular MA1002B except with .84" Digits
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- ★ Price $23.50 Post Free
- ★ Transformer JT197 $6.50 Post Free

NATIONAL MA1003 CAR CLOCK MODULE

- ★ 12VDC operation
- ★ Maintains Timekeeping Down to 5VDC
- ★ Display Blanking with Ignition off Draws 5MA.
- ★ Draws 100MA with Ignition on.
- ★ Just add 3 switches + DC 12V.
- ★ On board 2MHZ crystal.

PRICE $32.00 Post Free.

TECHNIPARTS LOW COST CRYSTAL TIMEBASE KIT

- ★ Using National MM5369 3.58 MHZ to 60HZ Divider
- ★ Includes PCB, Crystal, Divider, Trimmer etc.
- ★ PCB has allowance for ÷ 6 and ÷ 10 Counters also TTL buffered output = 3 IC'S.
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PADDINGTON. 4064
Ph: Brisbane (07) 36 1474
Trading Hours (8.30am – 5.00pm Mon. - Fri., 8.00am – 11.15am Sat.)

SELECTA-GAME

Many readers have asked us to design a gun project for the Selecta-Game. However this is not economically worthwhile if designed to our standards. Here we look at a commercially-available gun and give sufficient details for the experimenter to build up a similar unit.

SINCE PUBLICATION OF THE TV game project in November 1976 many thousands have been built by our readers. Many of these people have asked us to publish the rifle circuit for use with this unit. The trouble with designing a rifle or gun is that it involves mechanical work and optics. Also the quantity of light obtainable from the TV screen is very small and the differential between being on-target and off is very small.

We had therefore decided not to publish a rifle project but then Dick Smith gave us a plastic gun which included a pickup transistor and a lens.

What we have presented here is the gun and the circuit used in a commercial unit and it does work. Its limitations are that it will work only over a short range (about 1 metre) and the sensitivity control is extremely sensitive. Due to these limitations we decided not to present this as a complete project as we normally do but we are just printing the circuit to allow you to decide on your own means of construction.

If better optics are used longer range and less critical adjustment should result.

Modifications

The control pots on the Selecta-Game wear out quickly in continuous use unless wire-wound types are used. However, wire-wound pots of the correct value are not readily available, so we have designed a circuit which will allow 10 k pots (which are easily obtained) to be used. This involves modifying the game to add two transistors, two diodes and four resistors.

Some of the ICs do not like to operate on 6 V and as the batteries do not last long this has proven troublesome. Therefore we suggest you use a 9 V battery (or 6 x 1.5 V cells). This may change the internal adjustment slightly, necessitating re-alignment.

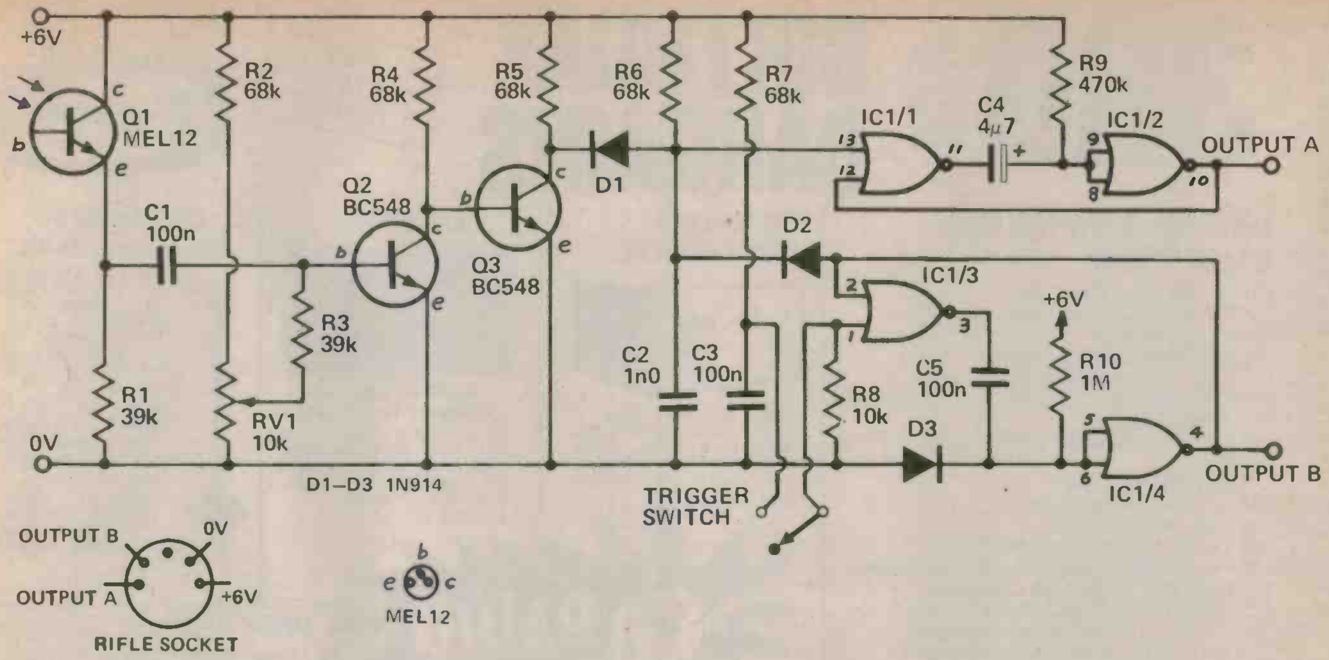

Fig 1. Circuit diagram of the gun.

This is the plastic gun assembly used in a commercial game. These guns (including lens and switch, but not the phototransistor) are available from Dick Smith Electronics for $6.50 each.

PARTS LIST
TV GUN

Resistors all ½ W 5%	
R1	39 k
R2	68 k
R3	39 k
R4-R7	68 k
R8	10 k
R9	470 k
R10	1 M
RV1 Potentiometer	10 k lin rotary
Capacitors	
C1	100 n polyester
C2	1n0 "
C3	100 n "
C4	4 μ7 16 V electro
C5	100 n polyester
Semiconductors	
Q1	MEL 12 *
Q2,3	BC548
D1 - D3	1N914
IC1	4001 (CMOS)

* Q1 is part of gun.

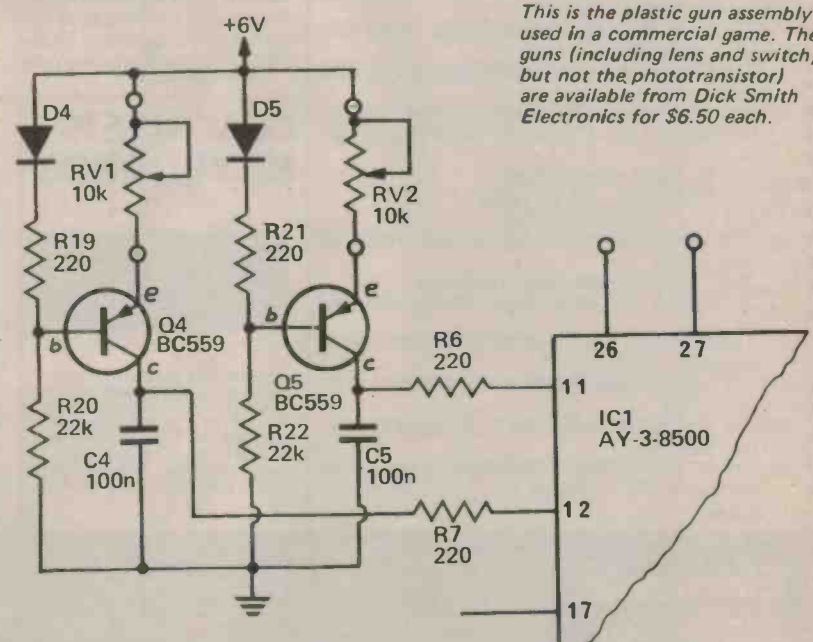

Fig 2. Modified circuit to allow wirewound potentiometers to be used.

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

DOLLAR STRETCHERS $2.00 PACS.

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- ☐ 180 5 WAFER SWITCHES MSP rotary, std.mtg. ¼" diam. shaft, 1to4 bank, various positions, all new.
- ☐ 319 MSP. CAR SPEAKER 5"x4" — 15ohms.
- ☐ 320 8 ohm TWEETER 75mm-8 ohms.
- ☐ 321 3 Edge Connectors, 46 way, double sided 0.156" pitch, Plessey.
- ☐ 300 1-12V MINI RELAY — PCB mtg, 2A c/0 contacts, 200ohm coil.
- ☐ 217 10-TIC44 SCR's -40V 600mA rating, mini T092 plastic pkge.
- ☐ 181 1-SUPER SENSITIVE MICROPHONE. Hearing aid type by Shure, 1" diam.x¾" high, low imp. Ex. Govt. use.
- ☐ 318 15 Neons, 60-90V pigtail.
- ☐ 211 6-2N3055-1, 40V Ce rating.
- ☐ 231 2-10 Amp Microswitches.
- ☐ 193 10 Asst. Switches:- Toggle, slide, rotary, all new, useful.
- ☐ 266 2-2SB337 Germ.Power Transistors.
- ☐ 204 25 Asst. IC's- Mostly Digital, marked, all tested OK.
- ☐ 198 50 TO-18 Asst. TRANSISTORS PNP&NPN, tested OK, marked.
- ☐ 218 250 Mixed Bulk RESISTORS:- 1/8W, ¼W, ½W, up to 10W.
- ☐ 156 10-20pf TRIMMER CAPS. Air-spaced, mini, cer. base.
- ☐ 154 4-100pf CERAMIC TRIMMERS. High Quality Air-Spaced, PC or chassis mtg., communications specs.

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E.A. January Issue — 240V input, 13.6V DC output at 1.5A. Complete kit to power your CB radio at home. $16.50 ☐

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5W MARINE CB 27.880 MHz

6 Channels.

"SIDE BAND BRAND" Rig, PA, ANL, Squelch, S/PWR meter, 3 mths guarantee, ext. speaker socket or inbuilt speaker. $109.00 ☐

23 CHANNEL 5 WATT

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LOWEST PRICE 3W STEREO AMP

LOWEST PRICE 3W STEREO AMP.

Big sound with great features: VOL, BASS, TREBLE controls, headphone & tape (5P din) sockets, slumber switch, LM380 IC's, complete with base for BSR, mains transformer and power lead etc.

Lowest priced Command amplifier	$30.00 ☐
Perspex lid and hinges to suit.	$10.50 ☐
BSR de-luxe turntable to suit	$29.00 ☐
Matching speaker boxes with 2 way speakers	PR$48.00 ☐

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- 500 ½W " " ☐
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KITS FOR ETI PROJECTS

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

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

Key to companies:

- **A** Applied Technology Pty. Ltd. of Hornsby, NSW.
- **C** Amateur Communications Advancements, PO Box 57, Rozelle, NSW.
- **D** Dick Smith Pty. Ltd. of Crows Nest, NSW.
- **E** E.D. & E. Sales, Victoria.
- **J** Jaycar Pty. Ltd. of Haymarket, NSW.
- **L** Delsound Pty. Queensland.
- **N** Nebula Electronics Pty. Ltd. of Rushcutters Bay, NSW.
- **O** Appollo Video Games of Hornsby, NSW.
- **P** Pre-Pak Electronics of Croydon, NSW.

PROJECT ELECTRONICS

ETI 043	Heads or Tails	A
ETI 044	Two-Tone Doorbell	A
ETI 061	Simple Amplifier	A
ETI 064	Intercom	A
ETI 066	Temperature Alarm	A
ETI 068	LED Dice	A

TEST EQUIPMENT

ETI 101	Logic Power Supply	E
ETI 102	Audio Signal Generator	E,D
ETI 103	Logic Probe	E
ETI 107	Widerange Voltmeter	E
ETI 108	Decade Resistance Box	E
ETI 109	Digital Frequency Meter	E
ETI 111	IC Power Supply	E
ETI 112	Audio Attenuator	E
ETI 113	7-Input Thermocouple Meter	P,E
ETI 116	Impedance Meter	E
ETI 117	Digital Voltmeter	E,A
ETI 118	Simple Frequency Counter	E,A
ETI 119	5 V Switching Regulator supply	E
ETI 120	Logic Probe	L,E
ETI 121	Logic Pulser	L,E
ETI 122	Logic Tester	E
ETI 123	CMOS Tester	E
ETI 124	Tone Burst Generator	E
ETI 128	Audio Millivoltmeter	L,E
ETI 129	RF Signal Generator	L,E
ETI 131	General Purpose power supply	E,N
ETI 132	Power Supply	N

SIMPLE PROJECTS

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

MOTORISTS' PROJECTS

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

AUDIO PROJECTS

ETI 401	Audio Mixer FET Four Input	E
ETI 403	Guitar Sound Unit	E
ETI 406	One Transistor Receiver	E
ETI 407	Bass A p	E
ETI 408	Spring Reverb. Unit	E
ETI 410	Super Stereo	E
ETI 412	Music Calibrator	E
ETI 413	100 Watt Guitar Amp	P,L,E,J,D
ETI 413	x 200 Watt Bridge Amp	E
ETI 414	Master Mixer	E,J
ETI 414	Stage Mixer	E
ETI 416	25 Watt Amplifier	E
ETI 417	Amp Overload Indicator	E
ETI 419	Guitar Amp Pre-Amp	P,E,D
ETI 420	Four-channel Amplifier	L,E
ETI 420E	SQ Decoder	E
ETI 422	International Stereo Amp	L,E,D
ETI 422B	Booster Amp	E
ETI 422	50 Watt Power Module	E
ETI 423	Add-on Decoder Amp	E
ETI 424	Spring Reverberation Unit	L,E
ETI 425	Integrated Audio System	E
ETI 426	Rumble Filter	E
ETi 427	Graphic Equaliser	L,E,J
ETI 430	Microphone Line Amp	E
ETI 433	Active Crossover	E,J
ETI 435	Crossover Amp	E,J
ETI 438	Audio Level Meter	L,E
ETI 440	Simple 25 Watt Amp	L,E
ETI 441	Audio Noise Generator	L,E
ETI 443	Compressor-Expander	E,J
ETI 444	Five Watt Stereo	E,N
ETI 445	Preamp	J,E,D
ETI 446	Audio Limiter	J,E
ETI 447	Phaser	E,J
ETi 449	Balanced Mic Preamp	J
ETI 480	50 W, 100 W Power Amp	A
ETI 480P	Power Supply	A
ETI 482A	Preamp Module	A
ETI 482B	Tone Controller	A

MISCELLANEOUS

ETI 502	Emergency Flasher	E
ETI 503	Burglar Alarm	E
ETI 505	Strobe	L,E,D
ETI 506	Infra-Red Alarm	E
ETI 509	50-Day Timer	E
ETI 512	Photographic Timer	E
ETI 513	Tape Slide/Synchroniser	E
ETI 514	Flash Unit — Sound Operated	E
ETI 515	Flash Unit — Light operated	E
ETI 518	Light Beam Alarm	E
ETI 522	Photographic Timer	E
ETI 523	Sweep Generator	E
ETI 525	Drill Speed Controller	E
ETI 526	Printimer	E
ETI 527	Touch Control Light Dimmer	E
ETI 528	Home Burglar Alarm	P,E
ETI 529	Electronic Poker Machine	E
ETI 533	Digital Display	L,E,A
ETI 534	Calculator Stopwatch	A,D
ETI 539	Touch Switch	E
ETI 540	Universal Timer	E
ETI 541	Train Controller	E
ETI 543	Double Dice	A
ETI 544	Heartrate Monitor	A

ELECTRONIC MUSIC

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

COMPUTER PROJECTS

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

RADIO PROJECTS

ETI 701	TV Masthead Amplifier	E,D
ETI 702	Radar Intruder Alarm	D
ETI 703	Antenna Matching Unit	E
ETI 704	Crosshatch/Dot Generator	L,A,D,E
ETI 706	Marker Generator	E
ETI 707	Modern Solid State Converters	C,E
ETI 708	Active Antenna	E
ETI 710	2 metre Booster	C,E
ETI 711B	Single Relay Remote Control	A
ETI 711C	Double Relay Remote Control	A
ETI 711R	Receiver	A
ETI 711AR	Remote Control Transmitter	A
ETI 711DR	Remote Control Decoder	A
ETI 740	FM Tuner	A
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ELECTRONIC GAMES

ETI 804	Selecta-Game	O,A,D

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If you need to generate or measure waves, consider the economics of these instruments in meeting your needs.

Function Generator.
Twelve waveforms.
0.02Hz–2MHz
50Ω output impedance
Model bwd160A

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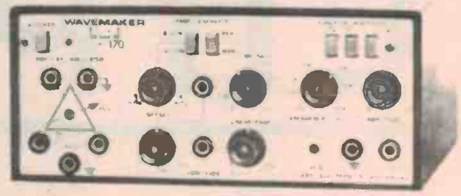

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W7

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New equipment arriving March '77.

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IT'S NEW FROM 'SOUNDOUT'

Series IIIA Stereo

- Fibreglass housing — red & white.
- New cue lights.
- Garard 125SB belt drive t/tables.
- Lock down lid.
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- 2 x 170 watt inbuilt rugged amplifiers.
- Plus all facilities of series III stereo.

SOLE AUSTRALIAN AGENTS FOR SOUNDOUT — LIGHTOMATION — OPTOKINETICS — MODE ELECTRONICS

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NEW EA 7 DIGIT FREQUENCY METER

WOW

20MHz ONLY $99.50 Cat K-3436

200MHz

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All-new circuit and format; very easy and economic design to build. Two versions; one 20MHz and the other 200MHz — simply add another IC to make the change (other parts are included in 20MHz kit)

FEATURES:
- 7 digit LED display
- Mains or 12V operation
- Easy to use
- Uses readily available components
- Simple setting up procedure

All you do is add a 95H90 IC (Cat Z-5360) at just $15.00, and you turn your 20MHz DFM into a 200MHz DFM! No other parts to buy! For a total of just $114.50 you have a 7 digit 200MHz frequency meter!

200MHz for $114·50? WOW!

NEW! MIDLAND INTERNATIONAL 13-895

IDEAL BASE!! OR MOBILE (!)

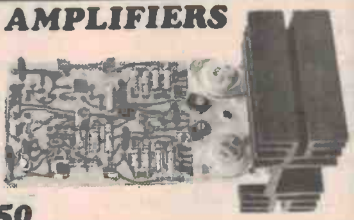
Same as the famous 893, but has inbuilt 115 transformer. With optional 240/115 tranny, the 895 is an ideal base! AM & SSB OPERATION ON FULL 23 CHANNELS. HIGH PERFORMANCE MODEL, WITH DUAL CONVERSION RECEIVER & MIC GAIN CONTROL! REAL VALUE! Cat D-1702

$279.50

CONTRARY TO THE RECENT CB REPORT, these rigs are not 'obsolete' in the USA. They are current production models which meet approval specifications.

BASE STATION OPTION: 240V/115V STEPDOWN TRANSFORMER Cat M-1158: $28.00

NEW ETI 50 & 100W AMPLIFIERS



Handy modules in kit form for both 50 & 100 watt amps. Ideal for guitars, stereos (you'll need two!) PA systems, etc. High performance modules, very easy construction. Also has power supply module with rails for preamps & a speaker protector, too!

50 WATT MODULE (Cat K-3440) — **19·50**

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AUSTRALIA'S MOST SOUGHT AFTER HAND HELD!

5W 6CH HAND HELD

HEAVY DUTY UNIT

INCREDIBLE BULK BUY OF THESE FAMOUS SANYO RIGS HAS ENABLED US TO PASS SAVINGS ON TO YOU! Both are 5W (maximum legal power — both feature advanced design and compact size. 6 ch. capacity, one fitted with 27.88MHz emergency channel. These are selling at lower than pre-devaluation prices! NEXT SHIPMENT WILL BE OVER $100! Both 12V operated — h/h dual power source!

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MIC INCLUDED!

5W 6CH Marine or CB TINY

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To operate any of these units legally in Australia you need a P&T Dept license.

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The most sophisticated sensitive radar detector available...'

'In normal situations, detects radar beams at up to twice the distance they can track you . . .'

$115

- AUDIO & VISUAL ALARM
- EASY MOUNTING (SUPPLIED)
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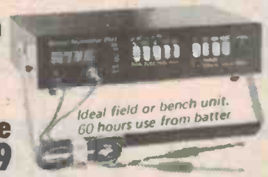
- DETECTS RADAR BEAMS AROUND TWICE DISTANCE THEY CAN TRACK YOU

Contrary to popular belief, radar detectors ARE COMPLETELY LEGAL to have in your car. They are easy to fit, and simple to use (dashboard or sun visor mount — both provided). Cat A-8502 . . . . $115.00

FAMOUS SINCLAIR DM-2

3½ DIGIT 8mm 20 RANGE



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The famous Drake SSR-1 Wadley Loop receiver offers coverage from broadcast to 10 metres in 30 tuneable ranges. Dial accuracy is within 5kHz; receiver is a triple conversion circuit (45MHz, 2–3MHz, 455kHz) with 0.3uV sensitivity. 3-way power, 240V, ext 12V or internal batteries. An ideal professional receiver!

Cat D-2801 . . . . now $300.00

YES! IT WILL PICK UP CBrs TOO

SEE THE REVIEW IN THE MARCH ISSUE OF EA

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IDEAL BEGINNER'S KIT!

This kit is a handyman's dream, so very simple to build, and so incredibly useful when it's finished. Controls the speed of your electric drill down to almost zero RPM. Think of the things you could do with that! Complete with mains lead, plug & socket, etc. Cat K-3080 . . . . $9.75

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Simple dig. clock

This is an incredibly complicated clock — which you can build in a matter of minutes! All the 'works' are pre-assembled on a PCB — all you do is connect the transformer & a few switches! A real kit for the beginner! Cat K-3434 . . . . $19.75

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$7.50

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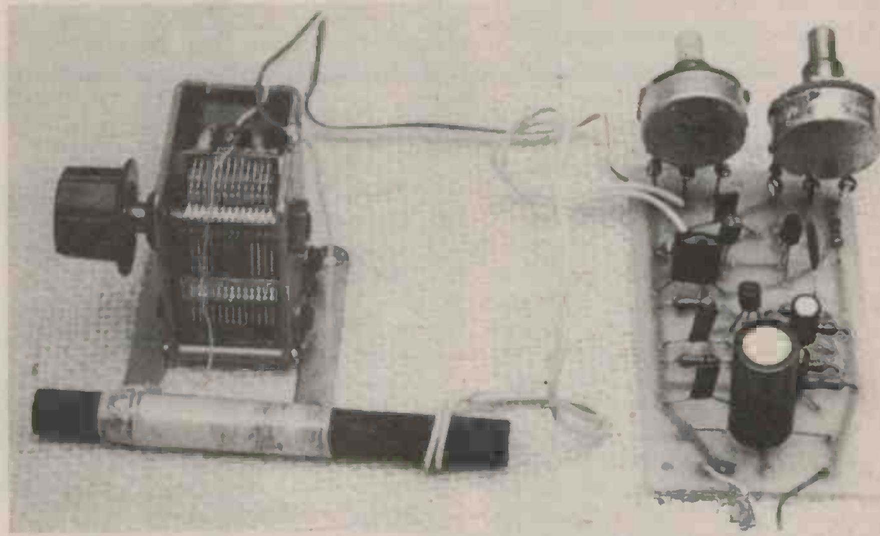
SIMPLE AM TUNER

project electronics

One of the most exciting projects for the beginner to build is a broadcast-band receiver. If you have already built the ETI 061 amplifier then you are half-way there.



THIS SIMPLE YET VERY effective AM radio receiver is intended to be used in conjunction with our ETi 061 amplifier – published in this Project Electronics series in October 1976. The radio may also be connected to any existing hi-fi amplifier or system.

Unlike most simple radios, this unit has its own inbuilt antenna. This consists of a ferrite rod approx 6 mm in diameter and between 100 mm and 200 mm in length.

To make the antenna simply wind about 75 turns of 26 SWG insulated wire neatly around one end of the rod. Secure the ends of the winding with sticky tape.

The tuning range covered depends on the value of the tuning capacitor and the number of turns wound around the ferrite rod. Most tuning capacitors adjust from 0 - 415 pF and our coil was wound to suit one of these. Tuning capacitors adjustable from 0–180 pF are also in common use and if you use one of these simply wind on about 30% more turns.

To raise the highest tuneable frequency simply remove turns. As an interesting experiment why not wind on more turns than you know you need (start with 100 or so) and then remove five turns at a time to see what happens.

We have added an optional feedback circuit to this radio. This circuit increases the radio's ability to separate stations that are close together in frequency. It also increases the amplification of the circuit.

In many areas this part of the circuit will not really be required – it can be omitted at first and then added if the radio will not adequately separate stations.

The components concerned are:–
Resistor R1
Potentiometer RV2
Capacitor C3
T2 – two turn coil on ferrite rod.

If the feedback circuit is not used simply omit the above components. If it is used T2 should be made by twisting a couple of turns of wire around the ferrite antenna rod at the opposite end from the main coil.

General construction is straightforward as long as the layouts shown here are used. The unit should be assembled on Veroboard or pc boards – it is not advisable to try to build it using tag strips or other methods.

When housing the finished project do remember that radio waves won't readily pass through metal – so make the enclosure out of wood – or use a suitable plastic case.

Potentiometer RV1 is an 'RF gain' control. Both this and the feedback control potentiometer (RV2) should be turned up until slight distortion is heard – and then backed off a little bit. In practice it will usually be found that RV2 will not need resetting once the initial optimum point has been found.

The output from the receiver appears

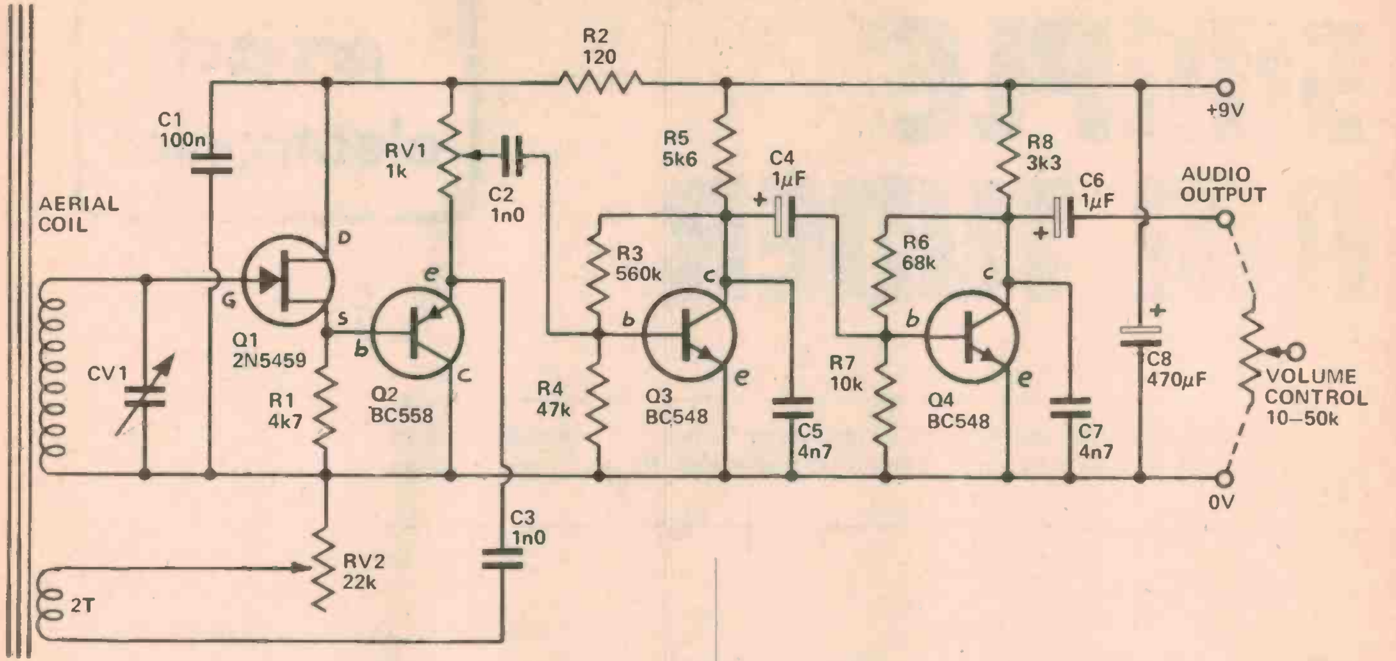


Fig 1. Circuit diagram of the tuner.

How It Works — ETI 062

The antenna coil and the tuning capacitor form a resonant circuit which has a low impedance all frequencies except that of the station that is to be received, thus the antenna picks up all signals but only the particular signal required will appear at the gate of Q1.

Transistor Q1 is a 'field effect transistor'. Field effect transistors (often abbreviated to FETs) have a very high input impedance. The one used here is connected as a 'source follower' the voltage at the source follows the voltage at the gate except that the source voltage is about two volts dc higher. The purpose of this FET is to act as a buffer between the antenna coil and the rest of the circuit.

Transistor Q2 is used simply to remove any load from Q1 — necessary to prevent Q1 oscillating. The voltage gain of the circuit is unity up to the emitter of Q2.

Transistor Q3 amplifies the signal from Q2 and, due to the bias point chosen plus the action of capacitor C5, acts as a detector (it rectifies the signal). This has the effect of blocking the radio-frequency signal — the signal passed on to the next stage is an audio waveform which corresponds to the audio signal fed in to the transmitter at the radio station.

The signal at this point is still quite small so transistor Q4 provides additional amplification.

To avoid the cost and complexity of automatic gain control we have instead included a manual RF gain control.

A small portion of the signal from Q2 is fed back to the antenna via C1 and the two turn coil. This increases receiver sensitivity. The radio will oscillate if RV2 is turned up too high — maximum sensitivity occurs just before oscillation.

PARTS LIST ETI 062

R1	Resistor	4k7	½ W 5%
R2	"	120 ohms	" "
R3	"	560 k	" "
R4	"	47 k	" "
R5	"	5k6	" "
R6	"	68 k	" "
R7	"	10 k	" "
R8	"	3k3	" "
RV1	Potentiometer	1 k	lin rotary
RV2	"	22 k	lin rotary

(Above pots should preferably, but not essentially have plastic shafts, non-metallic knobs must be used)

C1	Capacitor	100 n	disc ceramic
C2,3	"	1n0	ceramic
C4	"	1 µ	16 V electro
C5	"	4n7	polyester
C6	"	1 µ	16 V electro
C7	"	4n7	polyester
C8	"	470 µ	16 V electro
Q1	Transistor	2N5459	
Q2	"	BC557, 558 or 559	
Q3,4	"	BC547, 548 or 549	
CV1	Variable capacitor 0-180 or 0-415 p		

Aerial rod
PC board ETI 062

across the point marked 'audio output' and the 0 V line. A screened lead and suitable jack plug should be connected to these points so that the radio signals may be fed into the ETI 061 amplifier — or your home hi-fi system.

A volume control may be added by connecting the output of the radio to the amplifier via a potentiometer (anything between 10 k and 50 k will do).

Battery voltage is not critical — the radio will work well from any voltage from about 9 V to about 15 V.

This is an essentially simple circuit and if built as shown should work first time. If the unit does not work check all connections, particularly transistor connections, check that the tuning capacitor's moving vane is not shorting to the fixed vanes. If the feedback circuit does not seem to work — reverse the two-turn coil on the ferrite rod.

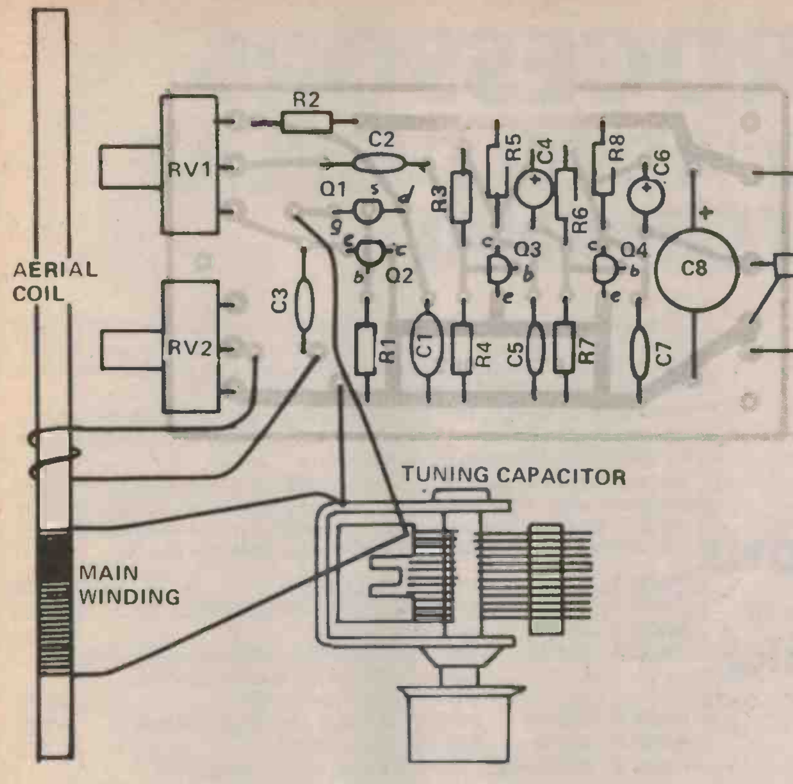


Fig 2. Component overlay using the PCB.

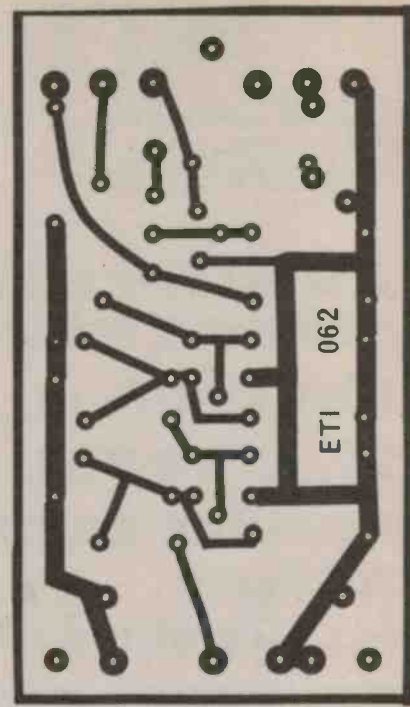


Fig 3. Printed circuit board layout for the tuner. Full size 90mm x 50mm.

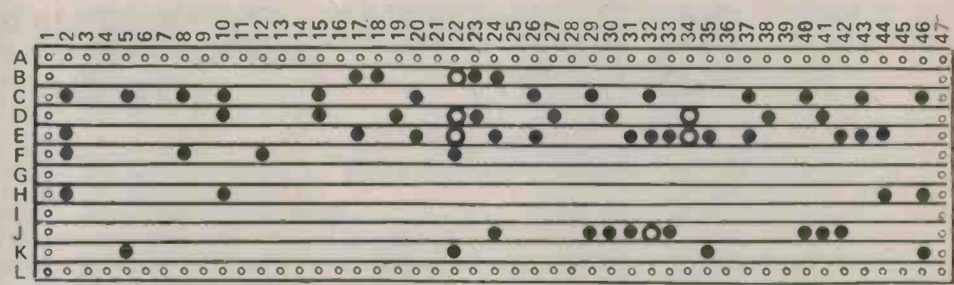


Fig 5. The underside of the Veroboard showing the breaks in the tracks (circles) and the solder joints (dots).

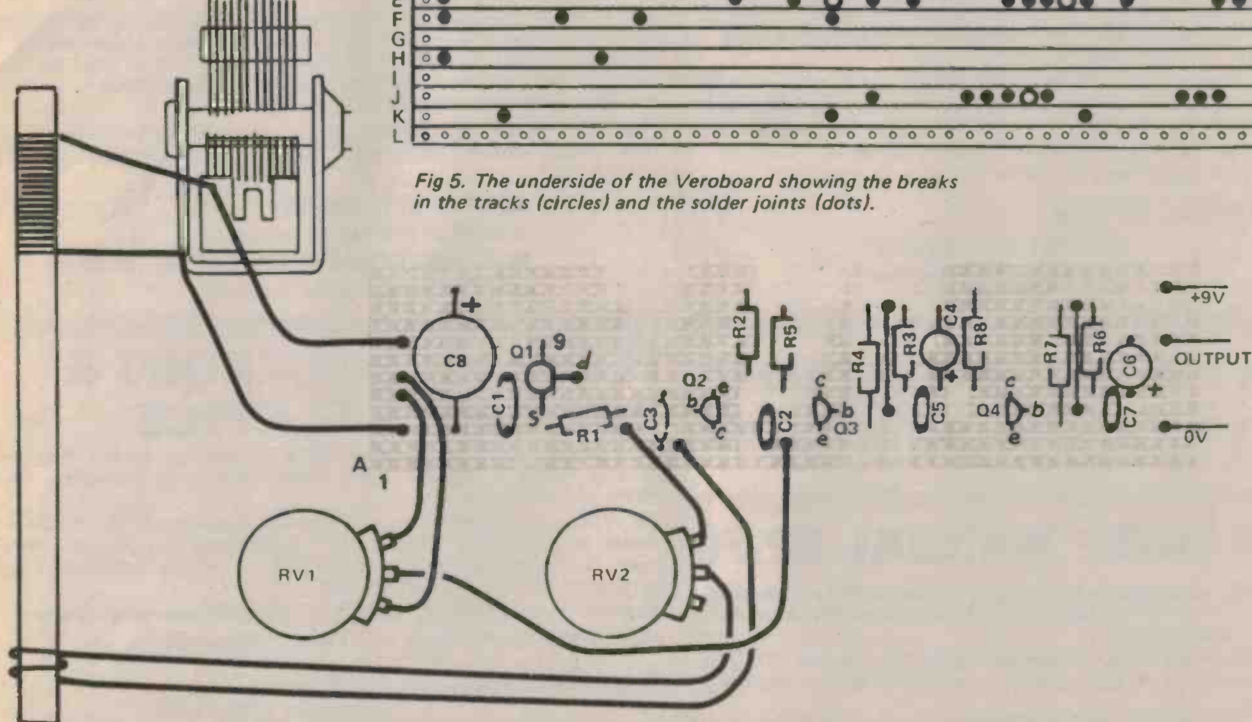


Fig 4. Component overlay for the Veroboard version. Note the two links required.

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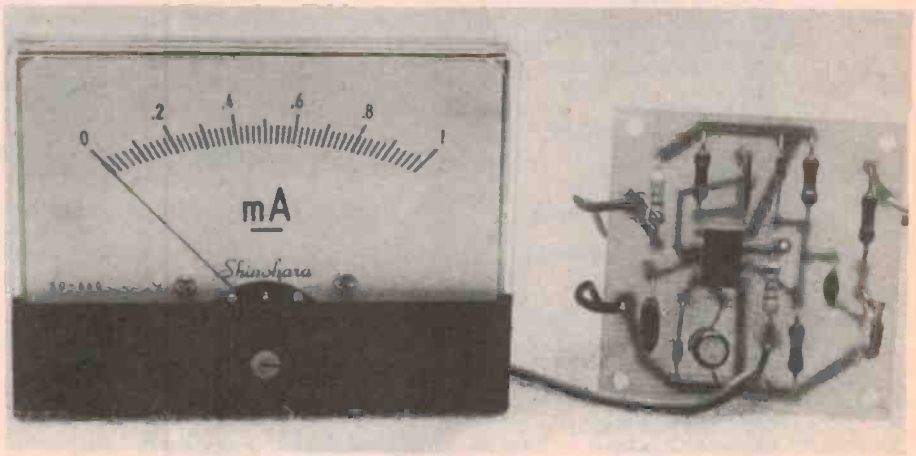
TACHO

project electronics

Car tachometer circuits are generally complex and expensive devices. But here's one that can be put together for only a few dollars!



UNTIL TEN OR SO YEARS AGO, car tacho's were cumbersome mechanical devices usually driven via a flexible cable from skew gearing attached to the shaft of the vehicle's dynamo — or sometimes via the distributor shaft.

The advent of transistor technology changed all this and since then almost all car tacho's are electronically operated.

The basic principle is much the same for all electronic tacho's an electrical signal taken from the low tension side of the distributor is converted into a voltage proportionate to engine rpm and this voltage is displayed on a meter calibrated accordingly.

Most car tacho's are complex and expensive devices — but here's one with a difference! It is simple yet extremely effective. Its simplicity is due to our using one single integrated circuit rather than the more conventional multiplicity of individual transistors.

The unit will operate on both positive and negative earth vehicles and will also operate successfully and without modification with most types of electronic ignition systems as well as the more common electro-mechanical systems.

Construction

As there are so few components, construction is very simple and straightforward. Do make sure though that the 555 IC is soldered in the right way round — ditto the two diodes. Compare your work against our layout drawing as a final check.

Any type of meter that has one milliamp full scale deflection can be used. This is a very common type of instrument and you should be able to obtain one new or secondhand with no difficulty. Ideally you should choose one that has 180° or 280° movement but these tend to be rather expensive. The meter size should be chosen to suit your proposed housing.

When the meter has been assembled connect it to the vehicle's battery and connect the input to the contact breaker side of the coil. The only satisfactory way to calibrate the unit is to persuade a friendly garage to connect up their own tacho at the same time and compare readings — or to check the unit on another car already fitted with a tacho. If you do it the latter way bear in mind that if yours is a four cylinder car then you must check using another four cylinder car, etc.

Another but slightly less satisfactory way of calibrating is to ascertain, from the vehicle's specification, the engine speed per thousand rpm in top gear and calibrate accordingly.

Potentiometer RV2 is used to adjust calibration — the value specified provides a range of adjustment suitable for virtually all vehicles. The adjustment is, however, rather coarse. If the tacho is to be exclusively on one vehicle it is possible to reduce the value of RV2 to 25 k or lower. If this is done it will probably be necessary to increase the value of R4 accordingly.

Before making the final calibration adjust RV1 to eliminate any false triggering — check at all engine speeds. This unit may be used with either positive or negative earth vehicles — simply connect the battery leads as shown. Note however that this unit cannot be used with 6 volt systems — so for those owners of early model VWs and BMWs we're sorry but . . . .

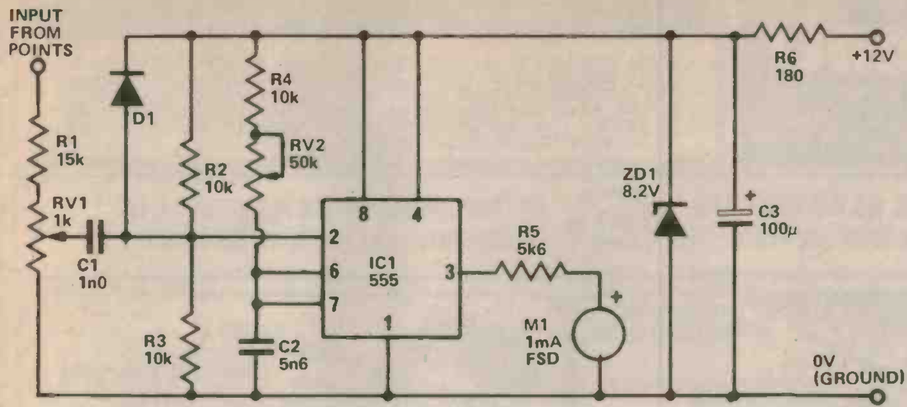


Fig. 1. Circuit diagram of the tacho.

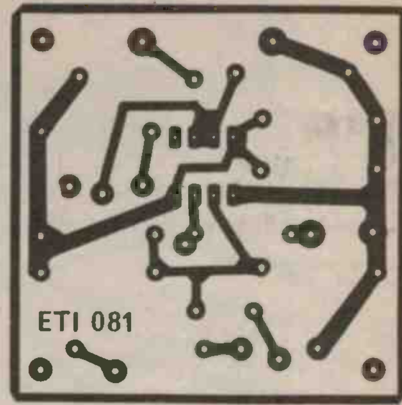


Fig. 2. Printed circuit layout. Full size 50 mm x 50 mm.

How It Works – ETI 081

The 555 timer IC is used as a monostable which, in effect, converts the signal pulse from the breaker points to a single positive pulse the width of which is determined by the value of R4 + RV2 and C2. The mathematical formula is T = 1.1 x R x C where R = R4 +RV2 (the section of RV2 in use) and C = 5.6×10^{-9} (Farads), and T = pulse length in seconds.

Resistors R2 and R3 set a voltage of about 4 volts at pin 7 of IC1. The IC is triggered if this voltage is reduced to less than approx 2.7 volts (1/3 of supply voltage) and this occurs due to the voltage swing when the breaker points open.

An adjustment potentiometer RV1 enables the input level to be set to avoid false triggering.

Zener diode ZD1 and the 180 ohm resistor stabilize the unit against voltage variations.

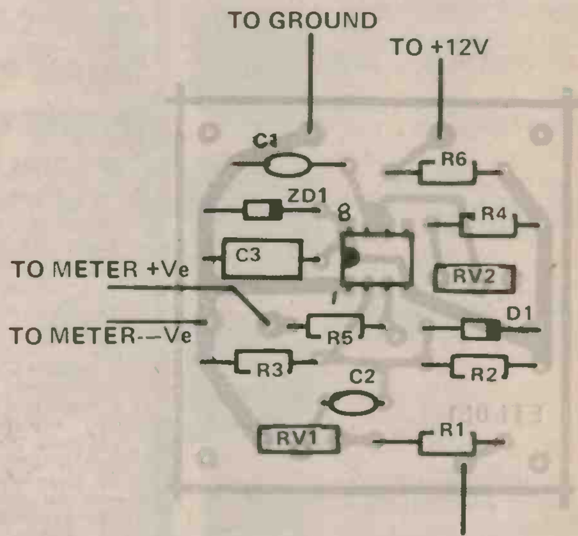
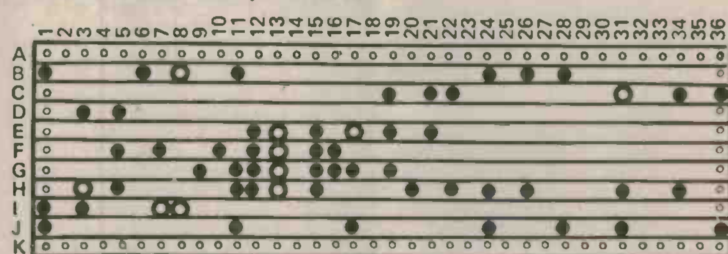


Fig. 3. Component overlay of the PCB version.

Fig. 4. The underside of the Veroboard showing the breaks in the tracks (circles) and the solder joints (dots).



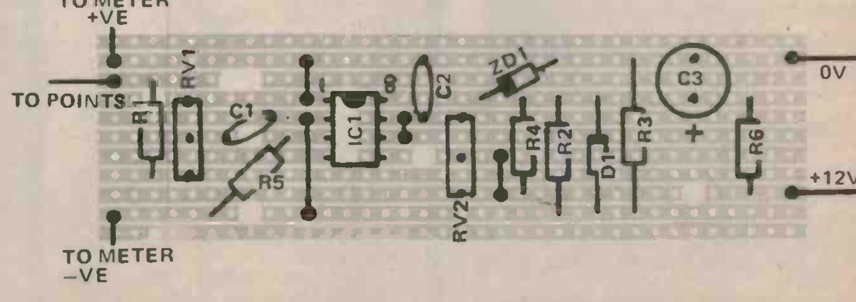


Fig. 5. Component overlay for the Veroboard version.

PARTS LIST ETI 081

R1	Resistor	15 k	½ W 5%
R2-R4	"	10 k	" "
R5	"	5k6	" "
R6	"	180 ohms	" "
RV1	Trim Potentiometer	1 k	
RV2	" "	50 k	
C1	Capacitor	1n0 polyester	
C2	"	5n6 polyester	
C3	"	100 μ 10 V electro	
D1	Diode	1N914	
ZD1	Zener	8.2 V 300 mW	
IC1	Timer NE555		

PC Board ETI 081
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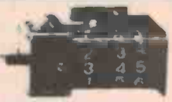

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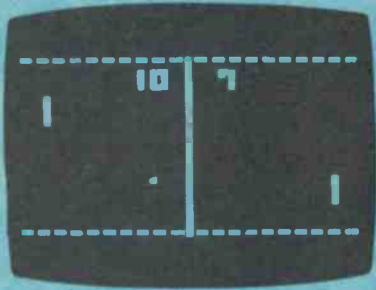

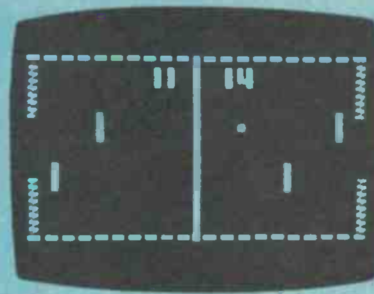

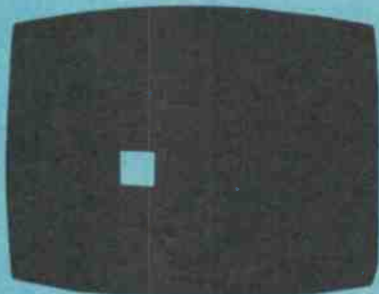

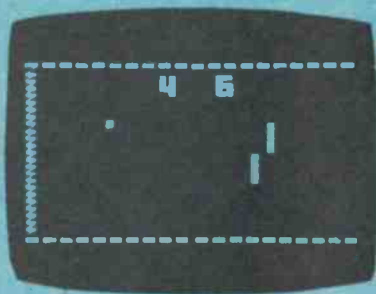

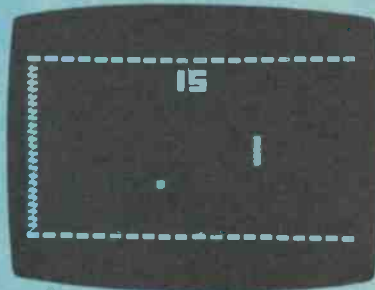

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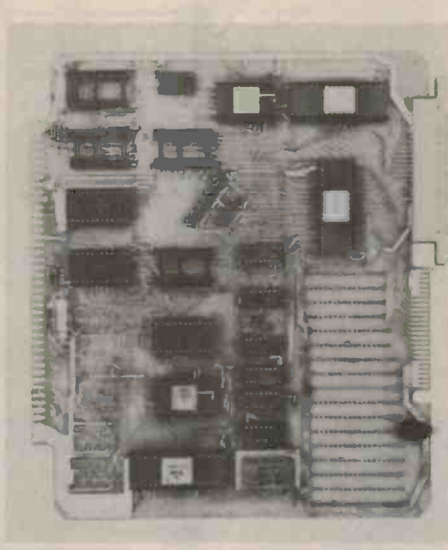
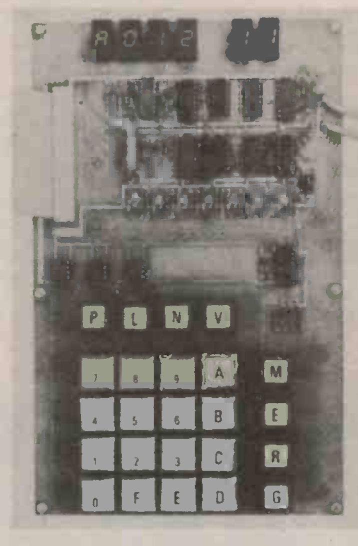
ETI's COMPUTER SECTION

NEXT MONTH IN PRINT-OUT we put together Motorola's new D2 evaluation kit, a microcomputer that comes with its own terminal. Then we check out JBUG, the new monitor program designed especially for the D2. Twice the size of the old monitor MIKBUG, JBUG includes special routines to save your programs on a low cost audio cassette recorder as well as other new features.





FROM THE EDITOR'S CONSOLE...

Ever been in the situation where you have a fantastic piece of gear you want to build but don't have a suitable pc board to build it on, and can't get one.

And the thought of having to work out a pc board layout yourself just turns you off. Or maybe you don't have the facilities for laying out your own boards or making them. Another turnoff is the high cost of one-off commercially-made boards.

This is a problem now being faced by more and more hobbyists who are beginning to use some of the new LSI chips now available. These devices, of which the microprocessor is an example, have from 16 to 40 pins, so by the time there are more than five or six chips in a circuit the number of interconnections has become quite large, and unmanagerable.

Traditionally the electronics technician and hobbyist has used the age-old process of soldering to make these interconnections and with the popularity of this method it is not surprising that the average technician has developed great skill. Many other methods have been devised and tried (some such methods have been crimping, screwing and welting, etc.) but none have come close to soldering.

However, the situation is changing now that LSI digital electronics is within the reach of all enthusiasts. A feature of digital electronics is the uniformity of packaging and the high density of

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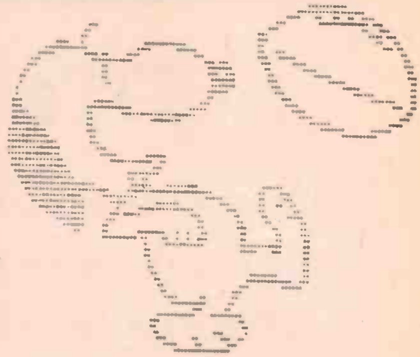
terminals per device. In fact devices may be packed so close together on pc boards, and require so many interconnections that the printed circuit techniques demands multi-layer boards. These boards are too expensive and difficult for the hobbyist to obtain, so many are turning to wire wrapping as an alternative.

Wire wrapping is a process in which an insulated wire is stripped for a short distance at each end and twisted around a sharp-cornered terminal. By careful choice of wire and the method of twisting, it is possible to form a low-resistance, corrosion-free, long-life connection.

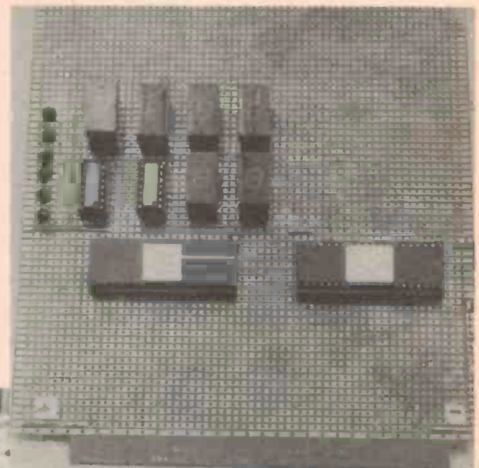
The choice of wire type and size is very important for successful wire wrapping. First the conductor must be solid (single strand), otherwise mechanical stability and contact reliability is lost. Secondly the conductor must meet certain elasticity requirements. A brittle conductor for example, would break under the considerable flexing and straining experienced during a wrap.

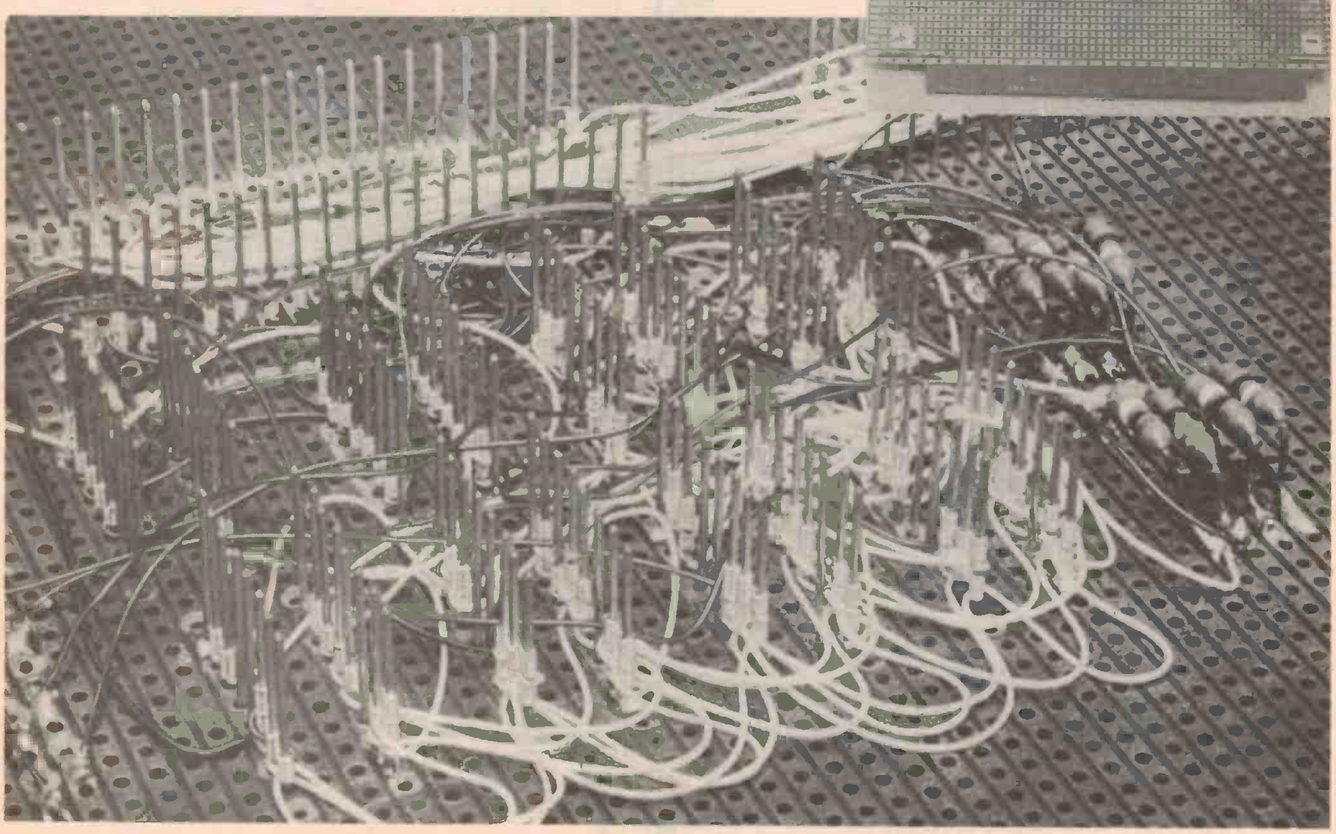
Fortunately copper has the required characteristics and the user may choose from bare copper, tin-plated copper or silver plated copper wire. Popular wire insulation includes Kynar and other PVC types. The most popular thickness for wire carrying current levels associated with digital signals is 26-30 gauge (AWG).

For those who would like to know more about wire wrap techniques there are some short notes on the following pages that will be of practical use.

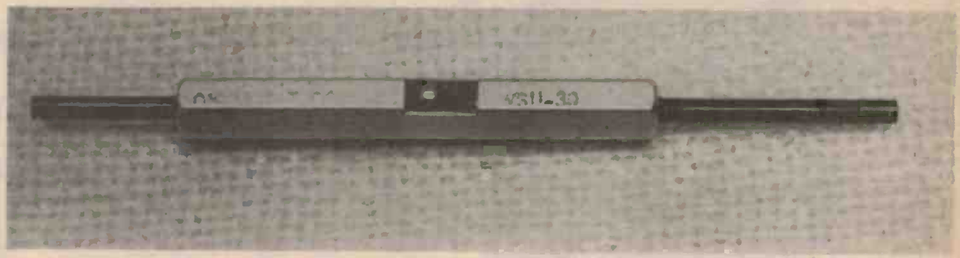


An example of wire-wrapping in practice. The small photo shows the front view of a 6800 microcomputer operator front panel. The large photo is the back view showing how the front panel was put together. The board holding the sockets is a piece of Veroboard that happened to have a suitable edge connector.

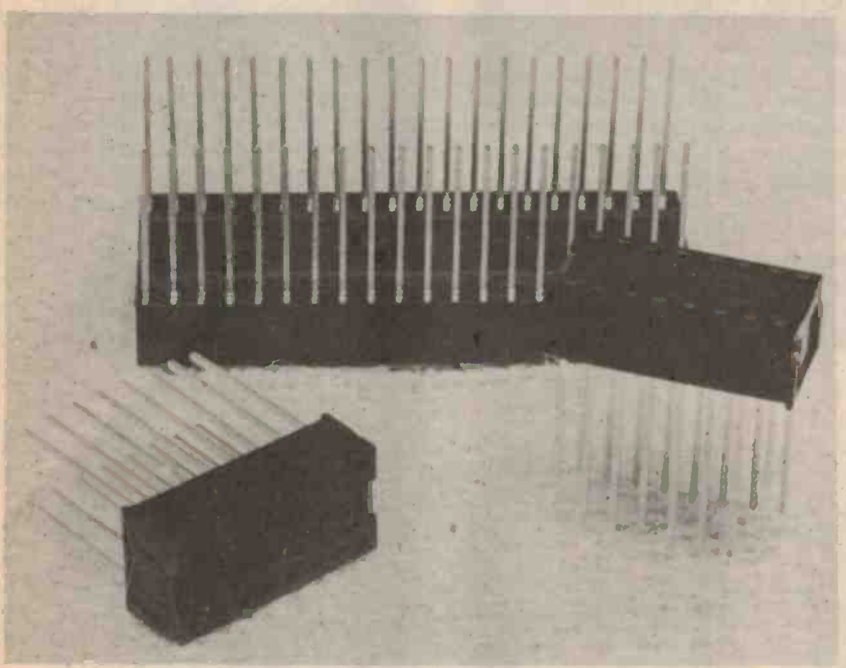




The disadvantage with wire wrapping is the need for special IC sockets. They are twice as expensive as ordinary sockets and increase the volume occupied by assembly. Not evident in this photo is the squareness of the socket's pins or their sharp corners. The pins come gold plated or tin plated, with the gold type more expensive.

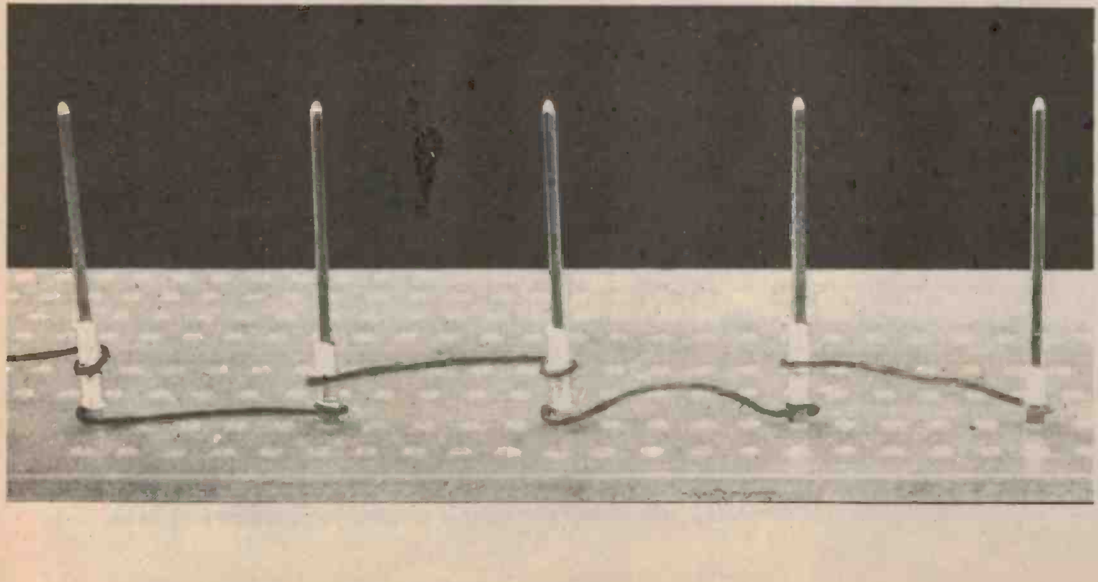


An example of a low cost hand wrapping tool, the Hobby—Wrap 30. The barrel on the right hand side is used to wrap a connection and the barrel on the left hand side to unwrap the connection. This is useful when a wiring error has to be corrected or a modification made to the design. The small plate in the middle of the handle is for wire stripping and will give nick free results on 30 gauge wire, if used correctly.



It is often necessary to connect several IC pins to one bus, for example the Data Bus. One way to do this is to create a chain of point-to-point wraps, the method shown in the photo is recommended. Here wires have the same wrap level at each end.

In the long run this method minimises the propagation of changes should a modification be required. An alternative method of modifying the wiring is to cut the old wire with a pair of sidecutters, as close to the pin as possible and then put in a new wire.



Continued on page 75 . . .

microbiology

The internal operation of a microprocessor.

THIS MONTH IN MICROBIOLOGY we focus on the very popular 8080. The 8080 is a complete 8 bit microprocessor designed for use as the central processor unit in a general purpose digital computer. It is fabricated on a single LSI chip using n-channel silicon gate mos technology. The 8080 is best thought of as a computer system minus memory and I/O.

Most of the control circuits and all the data manipulating circuits are on the 8080 chip. However, an external clock generator is required and this usually takes the form of a two phase crystal oscillator. To understand the 8080 with some detail you will have to become quite familiar with the internal layout shown in Fig. 1. But for now we will try for a general understanding and leave a more detailed explanation till next month.

When power is initially applied to the 8080 the processor begins operating immediately. As power comes up, however, the contents of the internal registers are subject to random factors and cannot be specified. For this reason it is necessary to apply a RESET signal to the 8080. This initializes one of the special registers called the program counter and forces its contents to 0000. The program counter is a 16-bit register and its contents represents the address of the memory location being accessed for the next program instructions.

After each instruction is executed the program counter is incremented by one and the process repeats itself. Since the program counter is initialized to 0000 by the Reset signal, memory location 0000 will be the memory location accessed for the first instruction. The 8080 does this by outputing the contents of the Program Counter onto the 16 bit address bus and at the same time the Timing and Control section outputs control signals telling the memory that a memory read operation is occurring.

When memory receives the control signals it interprets the number on the address bus as an address and uses it to fetch the contents of the specified

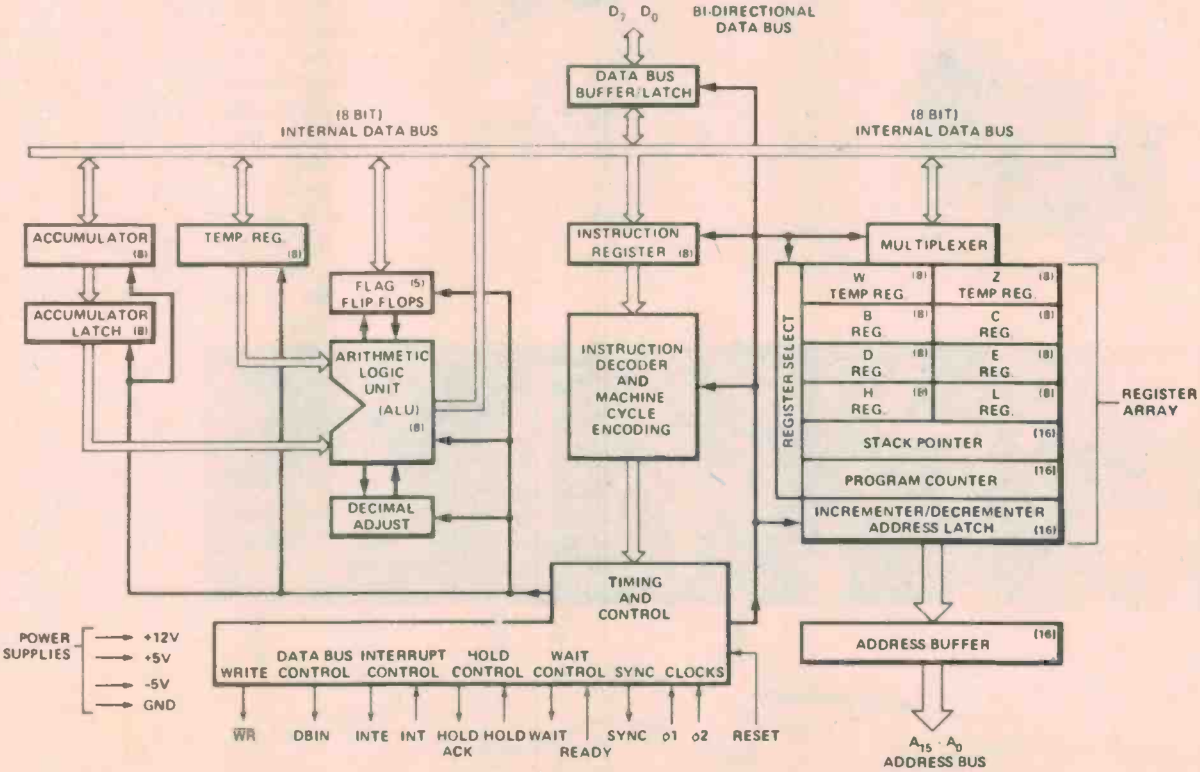


Fig. 1. A functional block diagram of the internal workings of the 8080. The arrows on the single and double lines show the direction of signal flow. The single black lines are control signals and the double lines are parallel data paths of 8 or 16 signals. The numbers in brackets represent the number of bits in that register. Arrows that point to or come from nowhere are pins on the IC that connect to other ICs.

memory location. The contents are then placed on the 8 bit data bus and sent back to the 8080 where they are buffered by the Data Bus Buffer and loaded into the instruction register. Here they remain while the 8080 control circuits decode and execute the instruction. This first part of an instruction execution is common to all instructions and is called the Fetch Cycle.

The remaining part depends on what is the instruction. Different instructions will be decoded differently to do different operations. This second part of the instruction cycle is often referred to as the execute cycle.

After each instruction is loaded into the instruction register it must be executed. This is done by the control circuits inside the 8080. Each one of the two hundred odd instructions will cause a unique set of control signals to be generated. These control signals will manipulate the working registers of the 8080 to perfom the required instruction.

Some instructions are executed in a way that is completely internal to the 8080 while others involve memory and I/O parts. One such instruction involving only internal circuits is the 'MOV A,B' which loads into register A the value currently held in register B. An example of the other type of instruction is the 'OUT 2A'. This instruction is used to transfer the contents of the A register to some external I/O device, for example a printer. To do this, once the fetch cycle is completed, the 8080 first accesses memory again to find out what is the address of the I/O. Having found this out, the 8080 sends the address out on the 16 bit address bus, the contents of the A register out on the data bus, and special control signals to turn memory off and inform the appropriate I/O to take note of the contents of the data bus. Once finished the 8080 goes into the fetch cycle of the next instruction.

Figure 1 is a block diagram of the internal organisation of the 8080. Note there are three distinct functional areas, the Register Array on the right hand side of Figure 1, the Instruction Register and Control Logic in the centre and the Arithmetic and Logic Unit on the left hand side.

The Register Array consists of six 16 bit static registers. Three of these are organised into six 8 bit general purpose registers and are called B, C. D, E. H and L. These registers may be addressed individually or in pairs for 16 bit operation. It is the contents of these registers that are manipulated by the programmer to achieve his end result.

The Program Counter and Stack Pointer are registers that can also be manipulated by the programmer. The program counter functions as described above while the stack pointer holds the address of a part of memory used as temporary storage by the 8080. It is often necessary to save the contents of the registers when the mpu is executing one part of the program and has to jump to another part for a short time, for example, when it calls a subroutine to find a random number. In all, the stack allows the easy temporary storage of the contents of the program counter, flags, accumulator and all six general purpose registers.

The ALU section performs the arithmetic, logic and shift/rotate operations called for by different instructions. Associated with the ALU is an 8 bit accumulator, an 8 bit temporary register and a 5 bit flag register. The Accumulator in the ALU section is called the A register by the programmer.

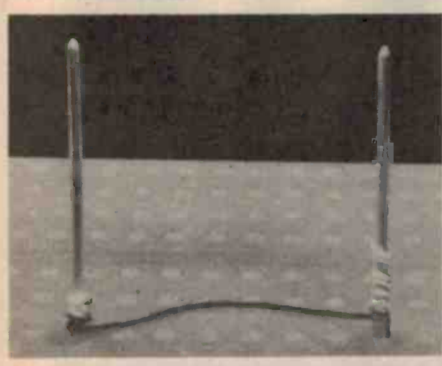
Consider an instruction that calls for adding the contents of register B to register A (the Accumulator). First the contents of the Accumulator would be latched into the Accumulator Latch and its output made available to the ALU. Meanwhile the contents of the B register would be sent via the multiplexer and the internal data bus to be loaded into the Temporary Register. The output of the Temporary Register goes to the other input of the ALU. This means the ALU now has the contents of the Accumulator and register B as inputs. These it adds together and outputs onto the internal data bus. The contents of the bus is now loaded into the Accumulator, thus the register B has been added to the register A (the Accumulator).

Had the operation in the ALU resulted in a carry, an output equal to zero, a sign or parity change then the corresponding bit in the Flag flip flop would have changed.

Next month we look at the instruction set in order to find out and understand what the 8080 allows the programmer to do.

... Continued from page 73

Example of a less than adequate attempted wrap.



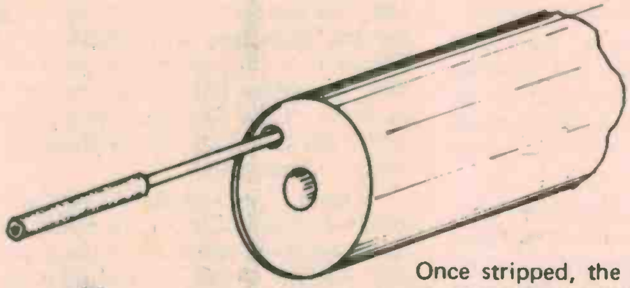
On the right is an example of the impatient wrap, called so because of your impatience to see the results. It is caused by physically lifting the wrapping tool off the post as it is turned. Instead slight downward pressure gives better results. Should such a wrap occur, you will have to remove the wire from the post and rewrap the connection. On the left we have an example of the 'wrat's nest' wrap. It is a jumbled mess of layers of wire over a previously wrapped layer. Power operated wrapping tools have a spring loaded mechanism which allows retraction of the bit within the sleeve. The photo shows the result should this mechanism jam and not work. If this happens consistently removing the bit and cleaning it may fix the problem.

If you are using a hand tool then the problem is a heavy hand, that is, too much downward pressure applied. Ease up on the pressure and try again.

The most common mistake in wire wrapping is to wire to the wrong pin. From the back all the pins look alike and you have the added burden of turning the numbering sequence back the front. A way around this problem is to lay a piece of white adhesive tape down the centre of the socket and to label the pins with their numbers and IC identification number. Don't use the IC type number because you might have other ICs of the same type in the design.

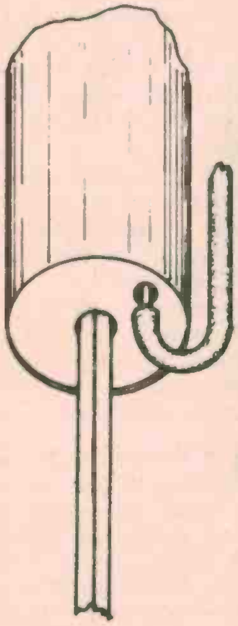
FOUR EASY STEPS IN WIRE-WRAPPING

The first step in a successful wrap is to strip the insulation from the end of the wire. The length of the insulation removed translates directly into the number of turns on the completed wrap. A length of 25 mm for 30 AWG wire is a good starting point that can be modified with experience. Considerable care must be taken to ensure that the method of stripping does not nick the wire. The wire experiences considerable flexing and strain during the wrapping process and could break off if nicked. If this happens later, and you are unaware that it has, then you have a possible fault that could take hours to find and remedy.



1

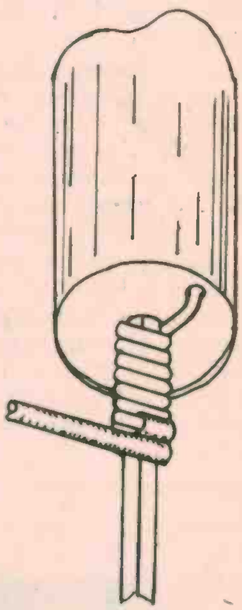
Once stripped, the wire is inserted into the wrapping tool bit. The centre of the bit has an alignment hole which fits over the wire wrap post. To one side of the alignment hole is a smaller hole, it is this hole that takes the wire. The wire should be inserted as far as the start of the insulation.



2

The wrapping tool is now placed over the wrapping post and the post inserted into the centre hole. The wrapping tool should slide smoothly over the post and any friction encountered should be investigated. During this operation action is needed to prevent the wire from slipping out of the barrel, a gentle bend that brings the wire parallel to the wrapping tool is usually sufficient.

The next step is to complete the wrap by rotating the wrapping tool on the wrapping post. This rotation causes the wire to be pulled out of the small hole and so wrap itself around the post. For low contact resistance and good mechanical strength the wire must wrap tightly around the post. For this to happen the force applied to rotating the tool should be smooth and continuous. A right handed person will find this is best done by using clockwise rotation. Note also that the free end of wire will have to be secured to prevent the insulated section of wire from trying to follow the tool around the post.



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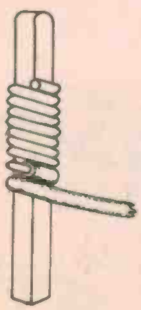
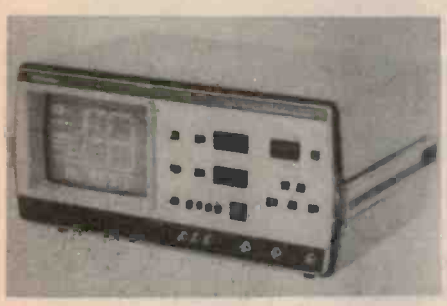


4

If all goes well, the finished wrap will look like this. The wrapping action begins at the bottom with a single turn of insulated wire followed by successive layers of stripped wire. As a rule of thumb, eight turns of bared wire is sufficient for good mechanical strength and low contact resistance. Using less than seven turns for 30 gauze wire compromises the integrity of the wrap. Although not evident in the drawing the first wrap should be as close to the socket as possible, (i.e., away from the end of the post that the wrapping tool fits over), this allows for more than one wrap per post. The single turn of insulated wire adds mechanical stability as well as less chance of electrical shorts to the wrap. Such a wrap is called a modified wrap; without the extra turn it is called a regular wrap.

THE BACK PAGE

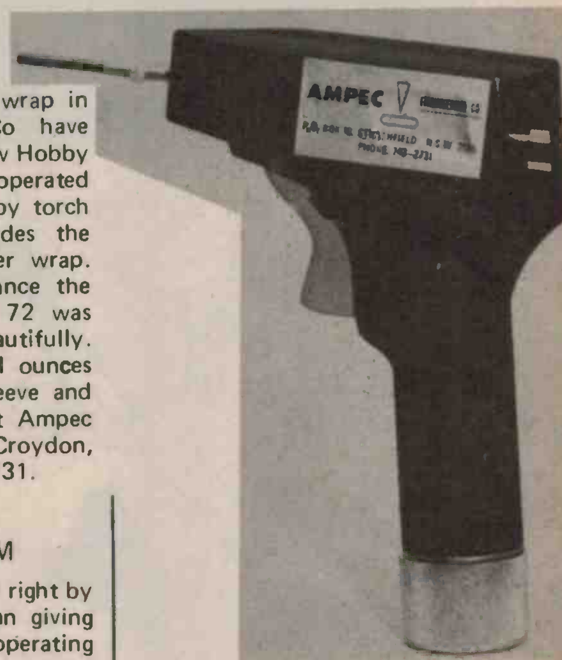


ELMEASCO Instruments Pty Ltd announce their of the new model 168-D Microprocessor Analyser. The 168-D allows the user to capture data from a microprocessor system at up to a rate of 10 MHz. The data is stored in the 256 word memory for later examination. This means the user can observe software program execution within the system in realtime, and in the context of the hard-wired logic that surrounds the microprocessor.

For further information contact Elmeasco Instruments on 02 736 2888.

For those who like to wire wrap in style Ampec Engineering Co have just the instrument. It's the new Hobby Wrap model BW630 battery-operated wire wrapping tool. Powered by torch batteries the BW630 provides the muscle to produce wrap after wrap. To quickly test its performance the front panel shown on page 72 was produced and it performed beautifully.

The BW630 weighs only 11 ounces and comes with a built-in sleeve and bit. For more details contact Ampec Engineering at 42 The Strand, Croydon, NSW 2132, or phone 02 747 2731.



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COMPUTER SEXISM

A computer in the USSR did all right by male mathematicians but began giving trouble when a woman tried operating it. Both male chauvinist pigs and women will be disappointed to learn that the reason was not that the lady's input was unacceptable to the computer because of its alleged feminine illogic or that the computer became overheated at the sight of her beauty, but rather that her dress was made of synthetic fiber producing an electric field that affected the computer.

●●●●

Two new definitions!

Punched card: A short piece of 80 channel paper tape.

Program: The footprints of hundreds of bugs. Once the bugs are eliminated, the program is whats left.

NEWS

NEW IMPROVED SC/MP

Samples are now available of a new N-channel MOS version of the "SC/MP" 8-bit single-chip microprocessor that is twice as fast and which uses only one-fourth as much power as the P-channel version. As well the "SC/MP-II" chip needs only a single source of +5 volts for operation, an improvement over the first model which required a +5 volt and a —7 volt supply.

The "SC/MP-II" is fully compatible with its predecessor in terms of pin configuration, object code, and software, and with slight modifications to the crystal frequencies, it will be compatible with all of the "SC/MP" support equipment.

For further information contact NS Electronics Pty. Ltd. on Melbourne 729-6333 and Auckland 49-1282.

DOES YOUR CAR NEED A BUS DRIVER?

In what is being called the largest single semiconductor buy in history the giant American auto manufacturer, General Motors has named Motorola Semiconductors as the principal supplier of microcomputer chips for their range of automobiles,

According to industry sources, by 1980 Motorola could be shipping between 2 million and 6 million sets of microcomputer devices per year to General Motors. With each set expected to be seven to nine chips, the income per annum to Motorola could exceed $100 million.

Under the agreement Motorola is to furnish General Motors subsidiary, Delco Electronics, with the LSI semiconductor design and processing technology needed to build complex MOS devices. This will allow Delco to become a second source once it puts up the 25,000 square-foot MOS facility it has announced it plans to build.

Motorolas selection as supplier was apparently helped by the experience General Motors gained with its current Tripmaster program. This is a dashboard mounted information system based on a microcomputer. Built around the 6800 family it is being offered as an option in this years cadillac Seville.

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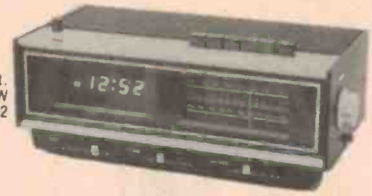

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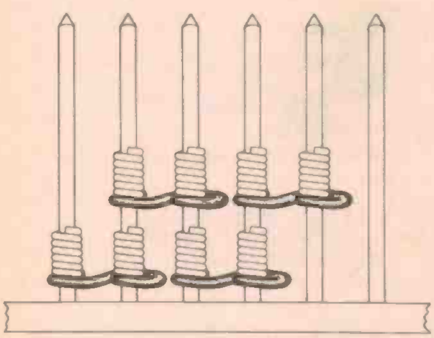

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VIDEO DISPLAY UNIT

COMPUTER TERMINAL PROJECTS

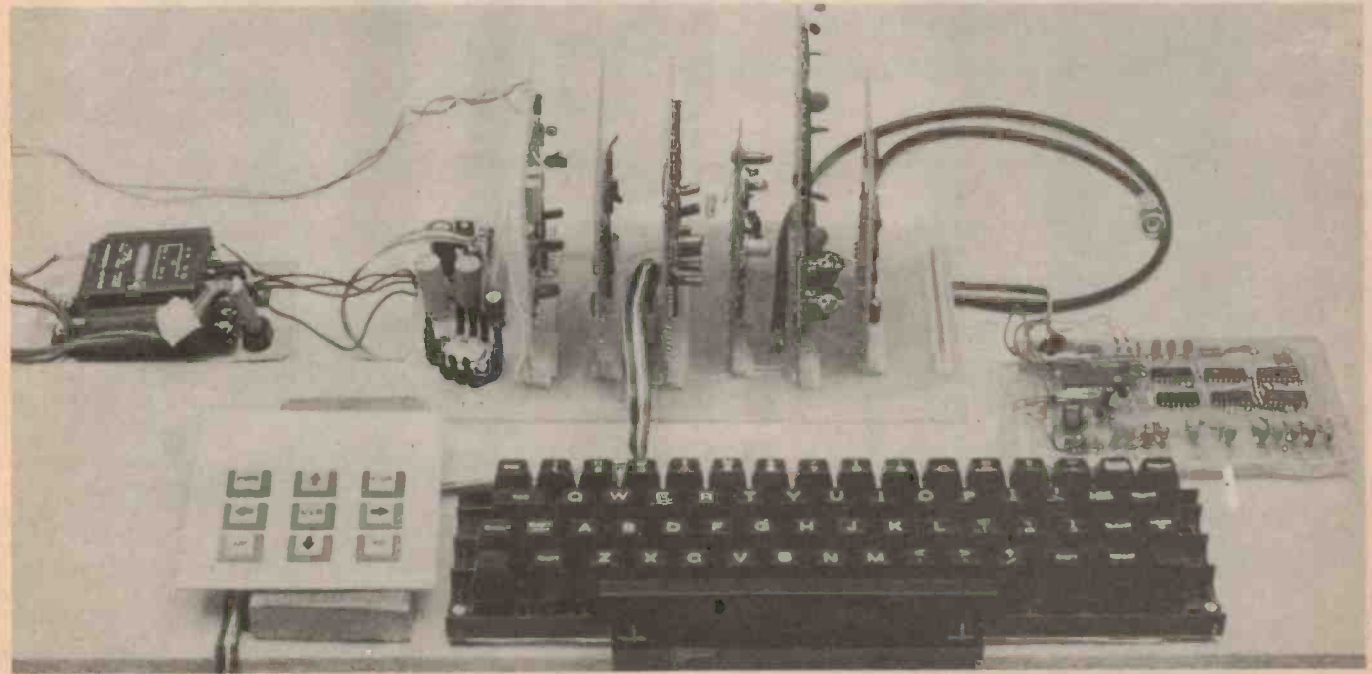
This final part of our VDU project gives details of the UART board and the mother board. When used with an encoded keyboard this project will communicate with computers designed for use with a teletype.

THIS MONTH WE COMPLETE THE description of the VDU project with details of the UART board (Universal Asynchronous Receiver Transmitter) and the mother board. To save a little cost the power supply has been relocated onto the mother board. Sockets are provided for the keyboard, the editing keyboard and a socket which allows a computer to directly interface with the memory. This is useful for games and similar applications as it allows the complete memory to be changed or rewritten at high speed (about 1 ms) where it would take up to 100 s via the serial input.

While the UART board is described for this project it can be used separately as all the programmable functions of the S1883 are available. We also have provided both TTL and opto coupler inputs and outputs (serial) and provided two 555 clocks for different baud rates. The 4800 Hz output is used for the 300 baud rate and also for a cassette interface which we may publish later.

The power supply has been changed slightly to include a −12 V IC regulator as it was found that the simple zener supply was not suitable for both the ROM and the UART. The resistor in the 5 V line to the editing keyboard has also been included.

While we do not intend at this stage to publish a modulator we believe some ready-made ones will be available through the trade. If you wish to build your own then the modulator out of the TV game project (ETI 804) can be adapted. An effect of using a modulator is to remove some of the sharpness of the characters and you will find that the vertical sections of the characters will not be as bright as the horizontal sections.



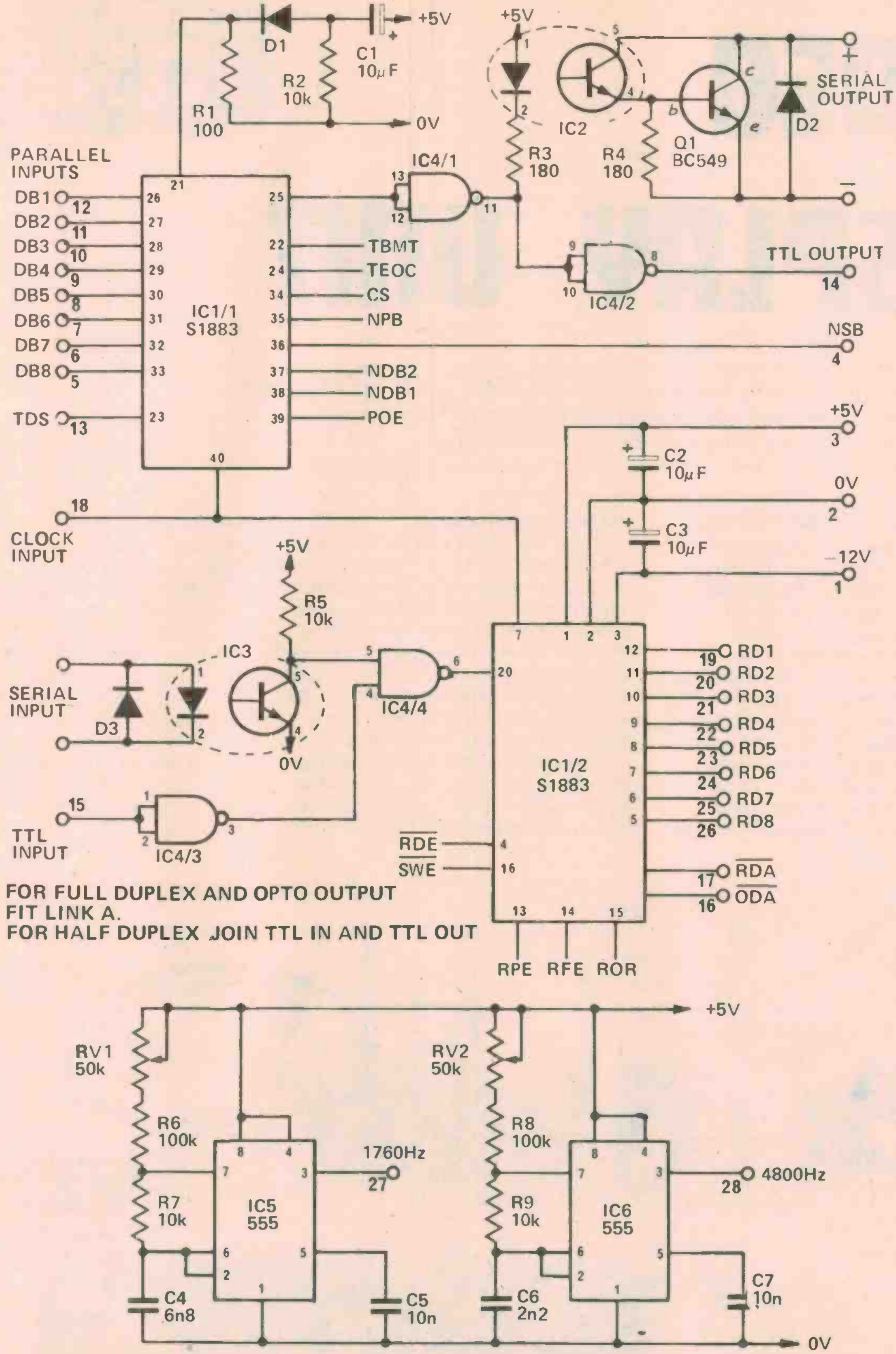


Fig 1. Circuit diagram of the UART board.

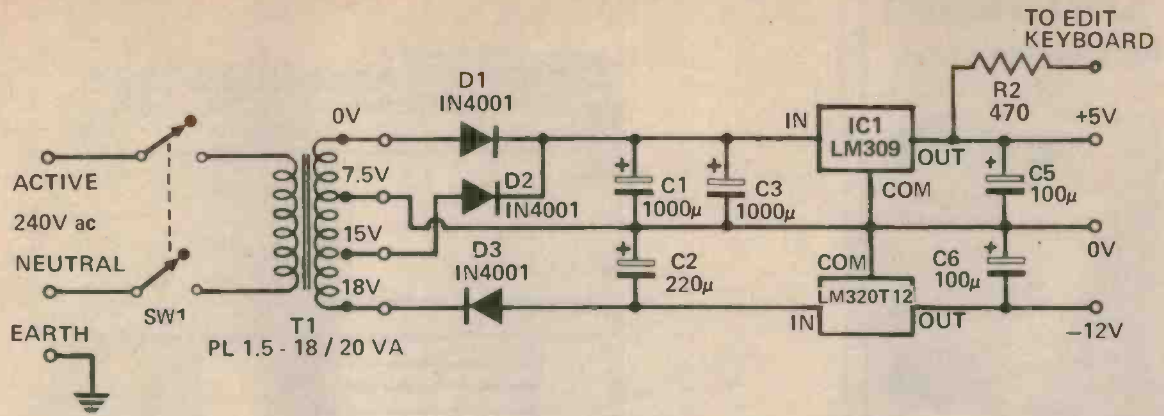


Fig 2. Circuit diagram of the modified power supply as fitted to the mother board.

How It Works ETI 632

UART BOARD

Most of the work is done by the main IC S1883. It takes the parallel output of the keyboard, and converts it to serial form. This is then transmitted either as a TTL level signal or via an opto coupler to the processor. The output of the processor comes in via the TTL or the opto coupler input in serial form and the main IC then converts this back into parallel form so the VDU can handle it.

The IC needs an external clock at 16 times the baud rate (or 1760 Hz for 110 baud and 4800 Hz for 300 baud). If only one speed is required one of the 555s can be deleted.

The IC can be programmed to give various formats. It is conventional to use a start bit, seven character bits, an even parity bit and two stop bits for 110 baud and the same format with only one stop bit for 300 baud.

The IC can operate up to 10,000 baud if necessary, the only change required is in the timing components around the 555.

We used two oscillators for the 110 and 300 baud, although we could have simply switched the timing network, because the 4800 Hz can be used for a cassette interface module (we may publish one later).

On switch-on capacitor C1 gives a positive pulse on the reset input. For a more detailed list of the pin connections to the UART is given in Table 1.

Mother Board

We moved the power supply onto the mother board as it simplifies construction and also we found a better −12 V regulator was needed to supply both the UART and the ROM. Also a 470 ohm resistor is needed in the positive lead to the editing keys.

A socket is provided for those who want to interface to the memory directly and the 10 address lines, 8 data lines, the read/write input and a VDU enable line are provided. Bidirectional bus translators are required for the data lines while tristate buffers are needed for the address and R/W inputs. A low to the enable input disables the VDU control of memory while a low on the R/W puts the memory in the write mode. The bus translators should be organised such that both control systems are not enabled at the one time.

Construction

Assemble the UART board with the aid of the overlay. The links shown solid should be installed and the dotted links should be used only where a "0" is required for the desired format. If you use the VDU at 110/300 baud use links at RDE, SWE, NDB1, and NPB. This gives a start bit, seven ASCII bits and a parity bit. In our prototype we switched NSB externally as we used 1 stop bit for 300 baud and two for 110 baud. There are internal pull-up resistors on the inputs and any not linked to ground will assume a "1" state.

When assembling the mother board start with the links as some of them are close to the connector strips. Remember that there is a resistor between the 632B and 632A boards. While there may appear to be a lot of links, it still is a lot easier than hardwiring the boards.

When installing the sockets, plug in the appropriate board and ensure it is vertical before soldering. Note that on all the boards the component side is away from the power supply components. The power supply can now be assembled.

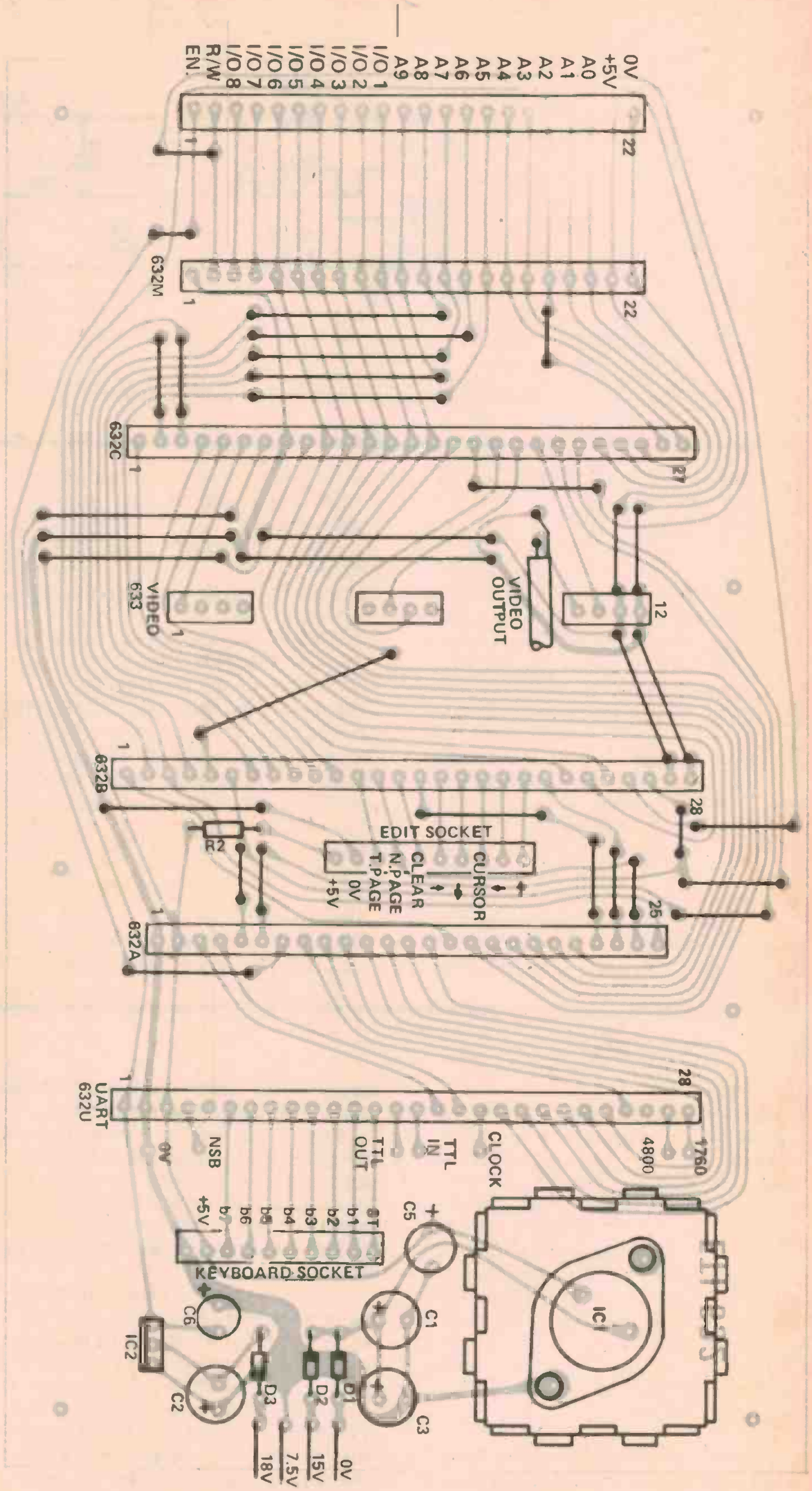
The output of the keyboard should be terminated in the correct plug, the connections for which can be worked out from the mother board overlay. The editing keys are similarly connected. All the editing keys, except New Page and Full Page, switch to +5V (via R2) with the NP and FP connecting to 0 V. We did not provide a socket for the baud rate switch although individual connectors can be used on to suitable pins in the mother board.

ERRATA
VDU FEB. '77

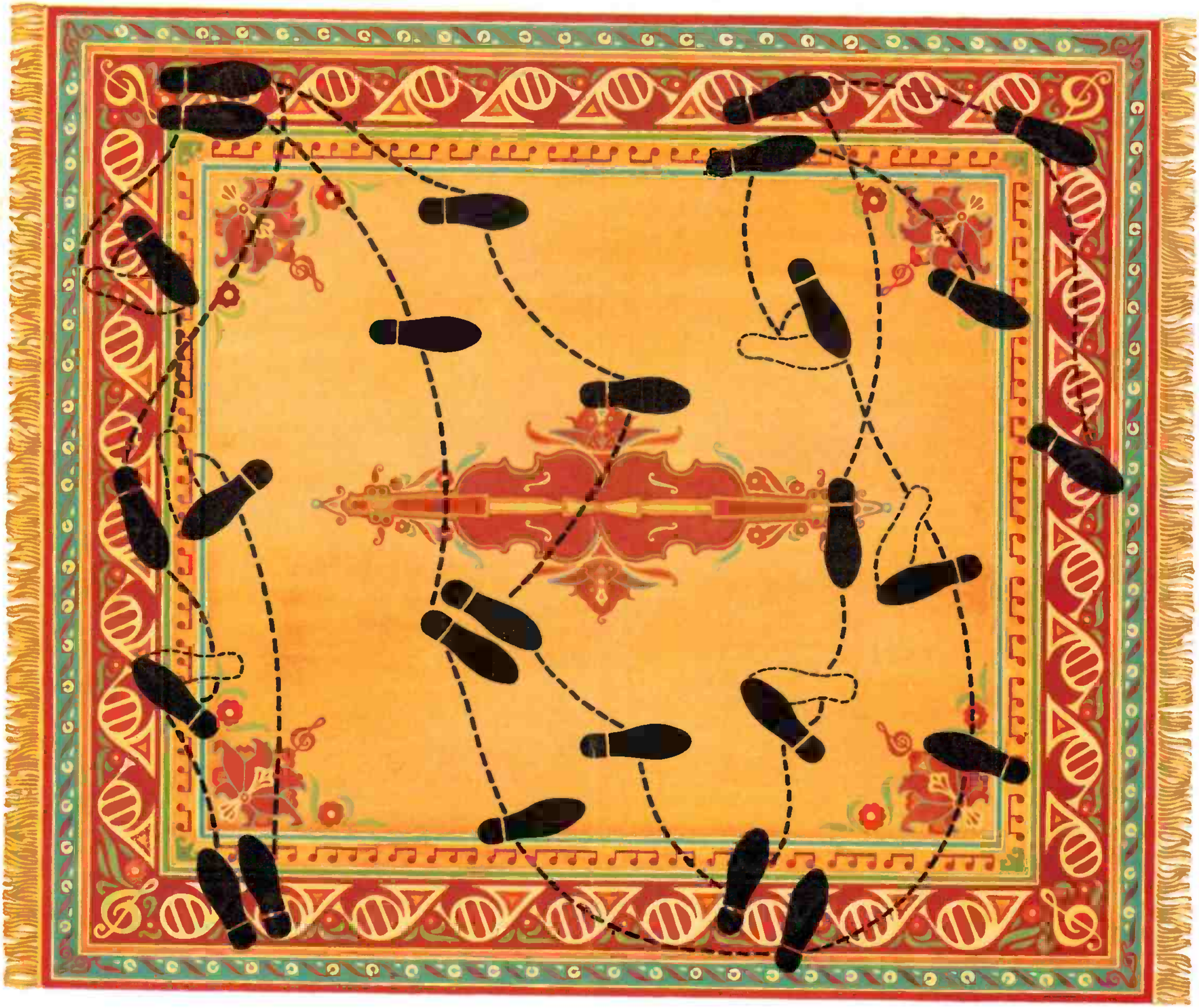
Parts List ETI 632 A
IC4 should be 4051
IC5 should be 74123
IC6-7 should be 74LS367

Interconnections page 77
V7-C18 (Not V9-C18)
C2 – B4 (not C2–B3)
C3 – B3 – B25 (not C3 – B4 – A26)
B15 – A22 (not B15 – A23)
B21 – A23 (not B21 – A22)
+5V – C9 (not C8)
0V – C8 (not C7)
Add
−12V – C7
M2 – B25

Testing page 74
Also connect −12V



0V
+5V
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
I/O 1
I/O 2
I/O 3
I/O 4
I/O 5
I/O 6
I/O 7
I/O 8
R/W
EN.
632M
632C
VIDEO 633
VIDEO OUTPUT
632B
EDIT SOCKET
R2
CLEAR
N.PAGE
T.PAGE
CURSOR
+5V
0V
632A
UART 632U
0V
NSB
TTL OUT
TTL IN
CLOCK
4800
1760
+5V
b7
b6
b5
b4
b3
b2
b1
ST
KEYBOARD SOCKET
C1
C2
C3
C5
C6
IC1
IC2
D1
D2
D3
18V
7.5V
15V
0V



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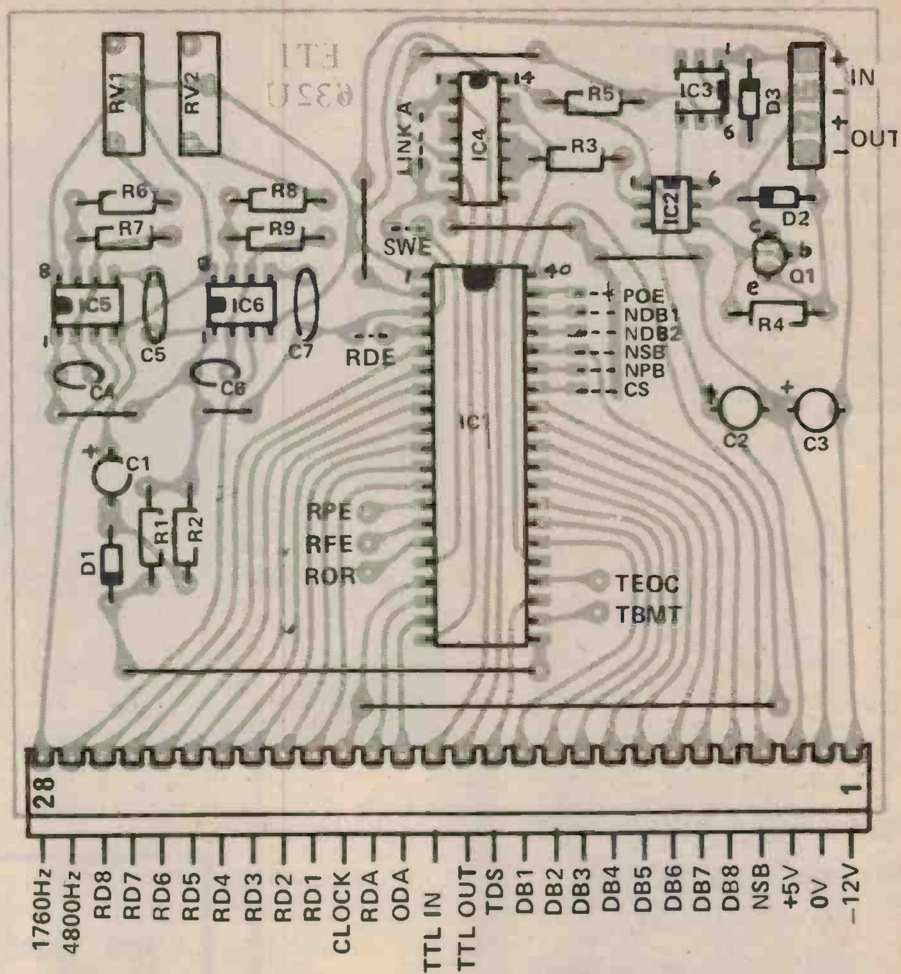
EPICURE

AUR21

Project 632



PARTS LIST ETI 632U

Resistors all ½ W 5%

R1	100 ohms
R2	10 k
R3,4	180 ohms
R5	10 k
R6	100 k
R7	10 k
R8	100 k
R9	10 k
RV1	multiturn trim 50 k
RV2	multiturn trim 50 k

Capacitors

C1—C3	10 µ 16 V electro
C4	6n8 polyester
C5	10 n polyester
C6	2n2 polyester
C7	10 n polyester

Semiconductors

D1—D3	Diode	1N914
Q1	Transistor	BC549
IC1	Integrated Circuit	S1883
IC2,3	Integrated Circuit	IL74
IC4	Integrated Circuit	7400
IC5,6	Integrated Circuit	NE555

Miscellaneous

PC board ETI 632 U
Utilux socket A2145A (28 pins)

PARTS LIST MOTHER BOARD including Power Supply

R2	Resistor 470 ohms	½ W	5%
C1	Capacitor 1000 µ	16 V	electro
C2	Capacitor 220 µ	25 V	electro
C3	Capacitor 1000 µ	16 V	electro
C5,6	Capacitor 100 µ	25 V	electro
IC1	Integrated Circuit LM309 K		
IC2	Integrated Circuit LM320 T-12		

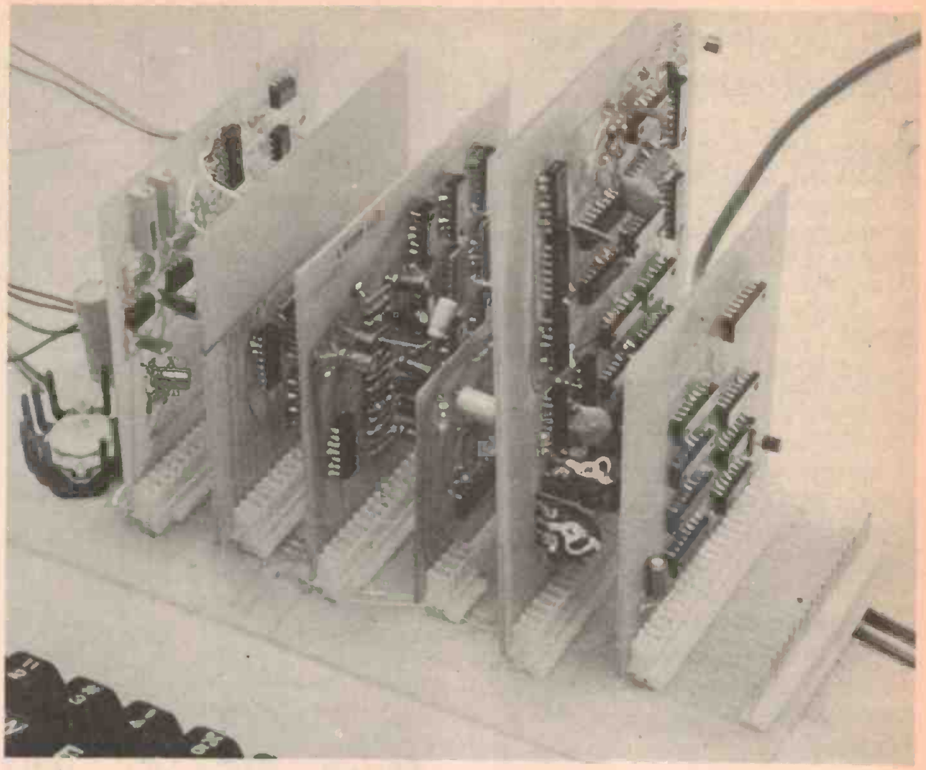
Heat sink DSE 3400 or similar
PC board ETI 632
184 pins of Utilux A2402 connector

* Note: R1, and C4 were used in the original power supply and are not used or have been changed. We therefore have not reused these numbers.

Using with a processor

On some processors a line-feed is outputted along with the carriage-return and it is not possible to change this. As the VDU has an automatic LF with CR a double line space results. This can be overcome by breaking the track to pins 3 and 4 on the socket on the ETI632 B board.

Also remember when writing programs that the display can only accept 64 characters and will not decode the full 256 permutations of an eight-bit word.



PIN CONNECTION TO UART

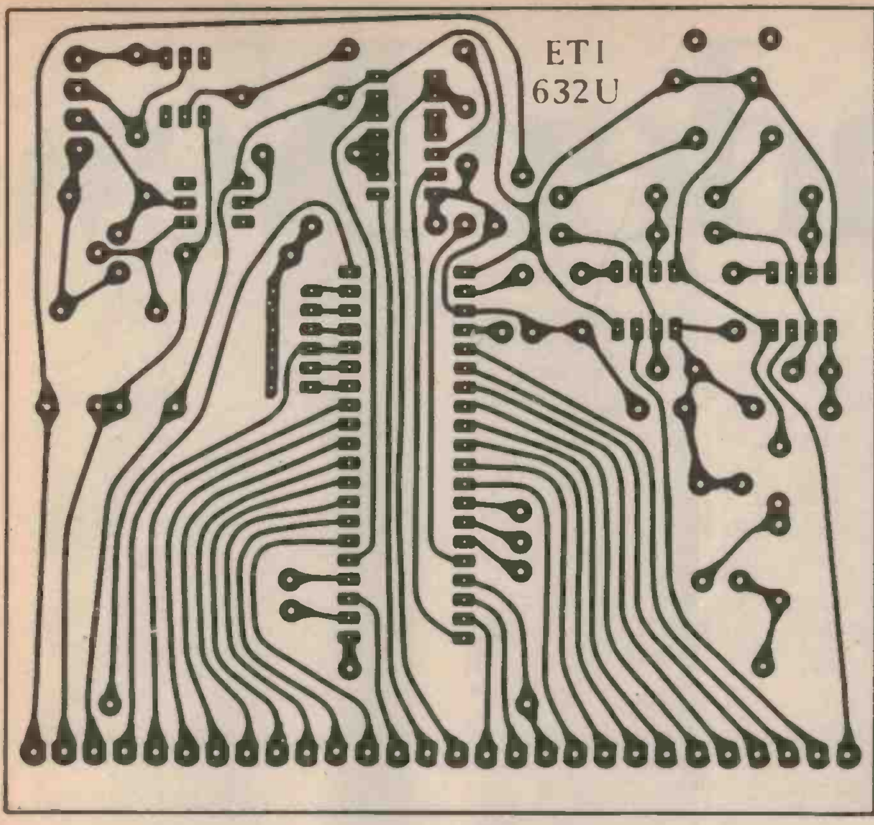
PIN	LABEL	CONNECTION
1	V_{SS}	+5 V ±5%
2	V_{GG}	−12 V ±5%
3	V_{DD}	0 V
4	RDE	RDI—RD8 Tristate if "1"
5	RD8	
6	RD7	
7	RD6	
8	RD5	Parallel data outputs
9	RD4	
10	RD3	
11	RD2	
12	RD1	
13	RPE	"1" indicates parity error
14	RFE	"1" indicates framing error
15	ROR	"1" indicates second character without reseting ODA
16	SWE	"1" Tristates ODA, ROR, RFE, RPE and TBMT
17	RCP	Receiver clock pulse — 16 x Baud rate
18	RDA	"0" input resets ODA
19	ODA	"1" indicates character received
20	RSI	Serial input
21	RESET	"1" resets all internal registers
22	TBMT	"1" indicates new character can be accepted
23	TDS	"1-0-1" pulse starts transmission
24	TEOC	"1" indicates no character is being transmitted
25	TSO	serial output
26	DB1	
27	DB2	
28	DB3	
29	DB4	Parallel data inputs
30	DB5	
31	DB6	
32	DB7	
33	DB8	
34	CS	control strobe "1" loads POE, NDBI, NDB2, NPB and NSB
35	NPB	"0" gives parity, "1" is no parity
36	NSB	
37	NDB2	These set the number of character and stop bits used. See Table 1
38	NDB1	
39	POE	"0" gives odd parity, "1" gives even parity
40	TCP	Transmitter clock pulse — 16 x Baud rate.

TABLE 1

NSB	NDB2	NDB1	Character Bits	Stop Bits
0	0	0	5	1
0	0	1	6	1
0	1	0	7	1
0	1	1	8	1
1	0	0	5	1.5
1	0	1	6	2
1	1	0	7	2
1	1	1	8	2

CONNECTIONS FOR VDU

110 BAUD	300 BAUD
NSB = 1	NSB = 0
NDB2 = 1	NDB2 = 1
NDB1 = 0	NDB1 = 0
CS = 1	CS = 1
NPB = 1	NPB = 1
POE = 1	POE = 1
TCP = RCP = 1760 Hz	TCP = RCP = 4800 Hz



SPECIFICATION ETI 632, VDU

Display	64 ASC11 character set
Memory	1024 characters
Display format	32 characters/line
	25 lines on screen
Baud rates	Any two up to 10,000
Output	Video
Power consumption	About 5 W
Writing mode	Always on bottom line
	Line moves up on LF
Edit keys	Clear all
	Back Space
	Forward Space
	Roll up (line feed)
	Roll down
	New page (puts memory location zero on bottom line)
	Top of page (puts memory location zero at top of screen)
Duplex	Full or half
Data Outputs	Opto coupled outputs (20mA)
	TTL Outputs
	Direct access to memory by processor if required

PCB MASTERS FOR THE VDU PROJECT

In this article we have not published the pcb design for the mother board. Last month we also decided not to publish the design for some of the VDU pcbs. Printed circuit boards will be commercially available for this project but if you wish to make your own the negatives are available from the company who designed the project. Send $25 to Nebula Electronics, Ryrie House, 15 Boundary Street, Rushcutters Bay, NSW 2011, for a complete set.

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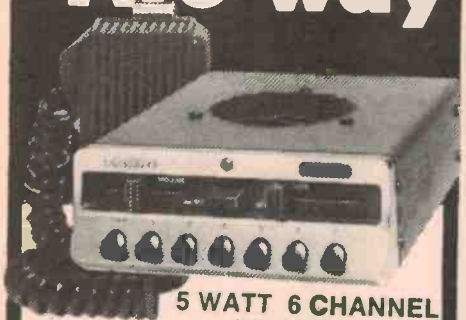

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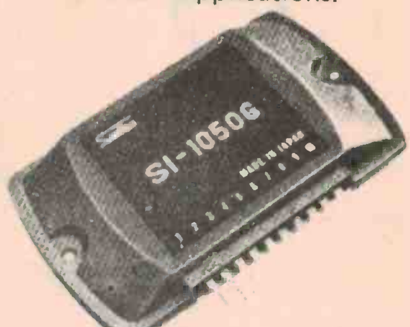

Models: S1-1010G, S1-1020G
S1-1030G, S1-1050G

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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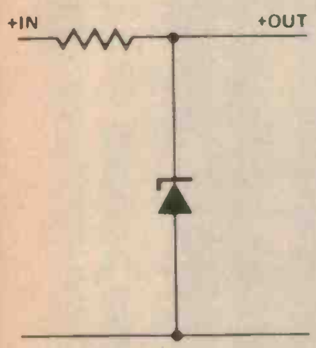
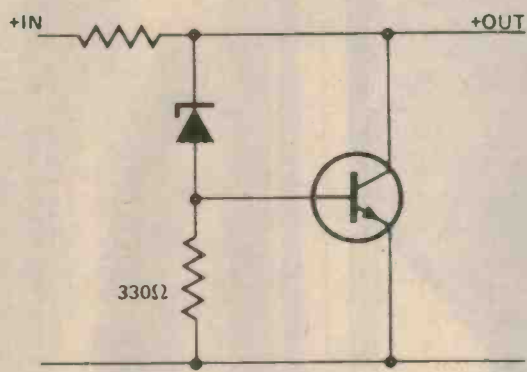
Ideas for experimenters

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.



(1)



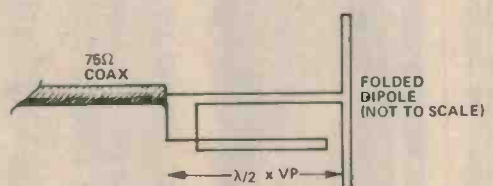
(2).

Assist that zener

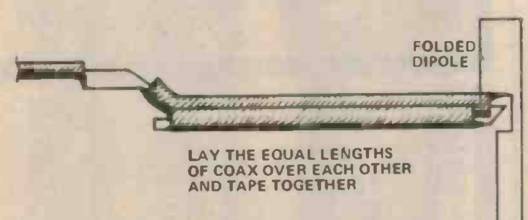
The simple zener shunt of diagram (1) may not handle sufficient current if the zener available is of low wattage.

A power transistor will do most of the work for the zener in circuit (2).

The output voltage is increased by 0.7V but it is stabilisation rather than exact voltage which is often required.



SCHEMATIC



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4:1 Balun

This is a ribbon balun suitable for a 4:1 impedance match. It will operate over a limited frequency range and has been tried on 2 and 11 metres. On 11 metres a quarter wavelength was found to operate satisfactorily. On 2 metres the quarter wavelength was found to be fairly critical in length, so the half wavelength was used.

Length is calculated from $C = n\lambda$ and $VP = 0.88$, $\lambda = c/n = 3 \times 10^8/f$ (Hz) therefore a half wave length would be $\lambda/2 \times 88/100$.

Velocity of propagation can be calculated using an antenna noise bridge, although for most TV ribbon the figure lies between 0.83 to 0.88.

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CA3028A	2.60	CD4069	.65	LM372H	7.50	SL449	1.60	11C90	18.50
CA3035		CD4070	.55	LM372N	4.50	SL620C	9.50	95H90	14.50
CA3039		CD4071	.55	LM373N	4.70	SL621C	9.50	2102-2	3.75
CA3046	LM3046	CD4072	.60	LM374N	4.90	SL623C	17.40	2513N	17.50
CA3053		CD4075	.60	LM375N	4.90	SL610C		S1883	
CA3059		CD4076	3.60	LM377N	3.50	SL612C		S50242	15.00
CA3060		CD4078	.60	LM379	7.50	SL613C		MA1002	13.50
CA3079		CD4081	.60	LM380N	2.75	SL622C		7805CP	2.90
CA3080		CD4082	.60	LM381N	3.20	SL624C	8.80	·7824CP	
CA3081		CD4085	1.75	LM382N	2.60	SL630C		7400	.48
CA3082		CD4086	1.75	LM387N	2.75	SL640C	10.60	7401	.48
CA3083		CD4093	1.90	LM395K	6.90	SL641C	10.60	7402	.48
CA3086	LM3086	CD4502		LM555CN	1.20	SL645C	12.60	7403	.48
CA3089E	2.90	CD4503		LM555H	2.20	SL680C		7404	.48
CA3090Q	6.90	CD4510	3.30	LM556N	2.95	SL901B	3.90	7405	.48
CA3091		CD4511	3.50	LM562B	10.90	SL917B	6.50	7406	1.09
CA3120E		CD4514	6.75	LM565N	3.50	SL1310	1.60	7407	1.09
CA3123		CD4515	6.75	LM566CN	2.50	SL3046	1.20	7408	1.09
CA3127E		CD4516	3.20	LM567CN	3.50	SP8505	8.60	7409	.48
CA3128E		CD4518	2.90	LM709N	.95	SP8515	12.90	7410	.48
CA3091D		CD4519	1.40	LM710CN	1.25	TAA300	2.90	7411	.54
CA3130T	2.25	CD4520	2.60	LM710CH		TBA570	2.90	7413	1.15
CA3140T	2.25	CD4528	1.90	LM723H	1.70	TBA700	4.90	7414	2.70
CA3600		CD4539	2.10	LM723N	1.25	TBA810A	4.90	7416	1.00
CD4000	.55	CD4555	1.90	LM725N	5.90	TB1750A	3.90	7417	1.15
CD4001	.55	CD4556	1.90	LM733CH	4.60	TCA220	2.25	7420	.48
CD4002	.55	CD4720	12.60	LM733N	2.50	TCA290A	4.90	7422	1.95
CD4006	2.30	CD4724	3.95	LM741CH	1.20	TCA420A	4.90	7425	.95
CD4007	.55	CD40097	1.90	LM741CN	.75	TCA580	6.50	7426	.70
CD4008	2.35	CD40098	1.90	LM747CH	5.30	TCA730	6.90	7427	.66
CD4009	1.90	CD40174	3.00	LM747CN	2.50	TCA740	6.80	7430	.48
CD4010	1.90	CD40175	3.00	LM748CN	1.20	TDA1005	5.50	7432	.66
CD4011	.55	CD40192	3.00	LM1303N	2.60	UAA170	3.25	7437	.90
CD4012	.55	CD40194	3.00	LM1310N	3.50	UAA180	3.25	7438	.90
CD4013	.90	CD40195	3.00	LM1458N	2.50	UA723C	LM723	7440	.48
CD4014	2.40	DM8097		LM1488N	6.90	UA757	3.80	7441	2.80
CD4015	2.40	DM		LM1489N	5.75	ULN2208	2.45	7442	2.20
CD4016	.90	HEF see	"CD"	LM1496N	1.90	ULN2209	2.45	7445	2.20
CD4017	2.40	LH0070		LM1808N	3.90	ULN2111	2.45	7446	2.10
CD4018	2.50	LM114H	4.90	LM3028	CA3028	74C00	.55	7447	2.20
CD4019	1.40	LM301AN	1.95	LM3046	3.60	74C02	.80	7448	2.40
CD4020	2.60	LM301CN	.95	LM3086	3.75	74C04	.80	7450	.48
CD4021	2.40	LM304H	3.80	LM3900	1.75	74C10	.65	7451	.48
CD4022	2.30	LM305AH	3.80	LM3905	3.90	74C14	2.80	7453	.48
CD4023	.55	LM307N	1.60	LM3909	1.50	74C20	.75	7454	.48
CD4024	1.80	LM308H	3.50	MC1035P	2.90	74C85	.75	7460	.48
CD4025	.55	LM308V	2.20	MC1312P	5.50	74C86	2.00	7470	.85
CD4026	3.20	LM309K	2.60	MC1314P	8.30	74C90	2.50	7472	.75
CD4027	1.10	LM310H	4.90	MC1315P	14.00	74C154	5.70	7473	.80
CD4028	1.95	LM310N	3.90	MC1350P	1.90	74C160	3.60	7474	.95
CD4029	2.75	LM311A	3.60	MC1351P	1.90	74C162	4.50	7475	1.35
CD4030	1.00	LM311H	7.50	MC1454G	5.40	74C174	3.60	7476	.90
CD4031	4.90	LM312H	6.60	MC1458	LM1458	74C192	4.50	7480	1.60
CD4035	2.50	LM317K	6.90	MC1468L	6.50	74C901	1.95	7482	2.30
CD4037		LM318N	5.90	MC1488	LM1488	74C925	16.70	7483	2.30
CD4040	2.75	LM319H	9.20	MC1496K	2.75	80C95	2.20	7485	2.95
CD4041	2.75	LM319N	6.90	MC1590G	6.75	MISC		7486	.85
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CD4043	2.40	LM320T	4.50	MC1648P	4.90	GL4484	1.80	7490	.90
CD4044	2.40	LM322N	4.50	MC4044P	4.90	GL5253	.90	7491	1.90
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CD4050	.95	LM340K	4.95	SL415A	2.70	9001	1.80	74100	3.65
CD4051	2.25	LM340T	2.70	SL425A	1.80	9368.	3.85	74107	.95

SEMICONDS		BC548	.55	MPF102	.65	2N3053	1.20	2N5485	MPF106
AC125	1.80	BC549C	.55	MPF103	.85	2N3054	1.70	2N5590	MRF603
AC126	1.80	BC559	.55	MPF104	1.10	2N3055	1.35	2N5591	
AC127	1.80	BC639	1.20	MPF105	.65	2N3564	.65	2N6027	1.35
AC128	1.80	BC640	1.20	MPF106	1.15	2N3565	.55	2N6084	
AC132	1.50	BD131	1.20	MPF121	1.60	2N3566	.95	BA102	.80
AC187	1.50	BD132	1.60	MRF603	6.90	2N3568	.95	OA47	.60
AC188	1.50	BD139	1.20	TIP31C	1.20	2N3569	.50	OA90	.35
AD149	2.60	BD140	1.20	TIP32C	1.30	2N3638	.55	OA91	.35
AD161/62	4.50	BD237	1.80	TIP120	3.20	2N3638A	.60	5082-2800	3.20
AS322	.18	BD238	1.80	TIP125	3.30	2N3642	.55		
AS367		BD437	2.80	TIP142		2N3643	.55		
AT1138	2N301	BD438	2.80	TIP147		2N3694	.65	40440	2N3731
ASY17	2.65	BF173	1.25	TIP2955	1.70	2N3731	5.95	40637A	2.85
BC107	.35	BF180	1.20	TIP3055	1.70	2N3819	1.35	40673	1.95
BC108	.35	BF194	.85	TT800	2N4037	2N3866	2.75	40822	
BC109	.35	BF200	1.30	TT801	1.20	2N4037	1.25	40841	1.90
BC177	.40	BFY50	1.20	2N301	2N869	2N4249	.65	BZX61	.75
BC178	.40	BFY51	1.50	2N706A	1.20	2N4250	.65	BZX79	.42
BC179	.40	BPX25	4.90	2N918	1.60	2N4355	.65	BZX70	1.50
BC182		BSX19	.75	2N2222A	1.20	2N4356	.65	BZY93	2.60
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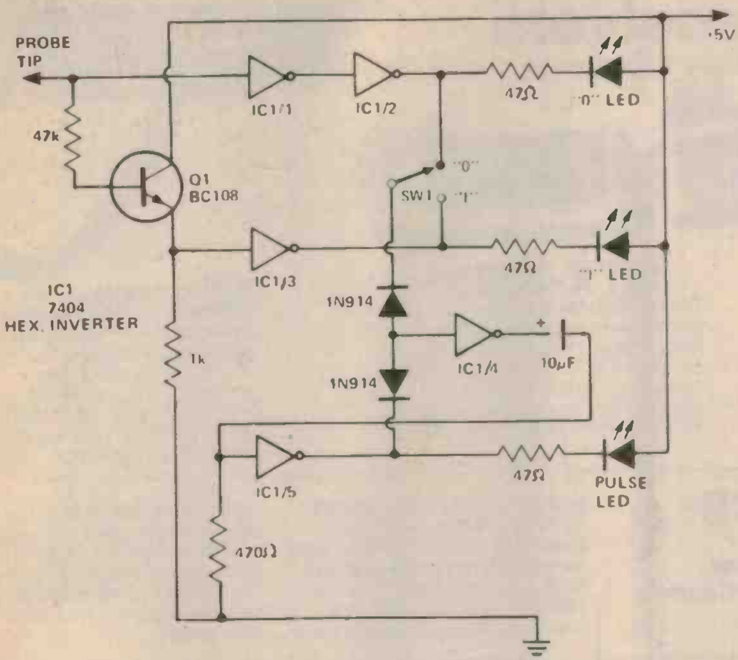
BC337	.55	MJ802	8.90	2N2904A	1.50	2N5457	MPF103	PB60	6.50
BC429		MJ2955	2.60	2N2905	1.20	2N5458	MPF104	MEL12	1.40
BC547	.55	MJ4502	8.90	2N2919		2N5459	MPF105	FCD820	1.90



Low cost logic probe cum pulse catcher

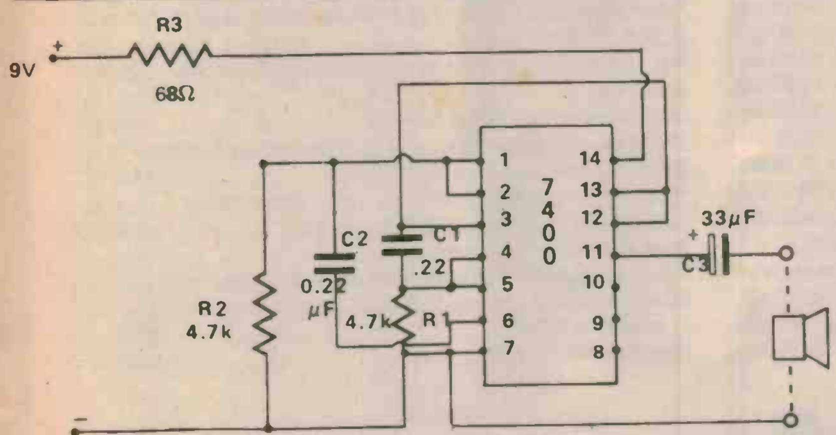
When working on digital equipment it is very often desirable to know the state of various points of the circuit. Usually an oscilloscope is used, however a very short duration pulse is usually hard to see unless the scope is a sophisticated wide-bandwidth type.

This logic probe has its own readout which illuminates a LED indicating whether the point tested is a logical "0" or "1".

It also indicates the presence of a high speed pulse, whether positive or negative going, (SW1 selects the polarity). This LED will also indicate a pulse train.

An inexpensive TTL Hex inverter is used. Power is derived from the five volt supply to the circuit being tested.

Having connected the earth and +5V leads a simple check is to connect the probe tip to the 5 V supply and then to earth. The "1" and "0" LEDs should light in turn.



Unusual multivibrator

This device uses 3 gates of the 7400 TTL IC. Gates 1 and 2 together with associated components form a simple astable multivibrator. The output is fed directly to gate 3 which acts as the output stage. If the output is taken to a transducer as shown above, its impedance should normally be 85 ohms or higher. But depending on the characteristics of the IC used, even 8 ohm earpieces can be driven. The prototype circuit was used as a tone generator for use in editing tapes and for separating recorded items on tape.

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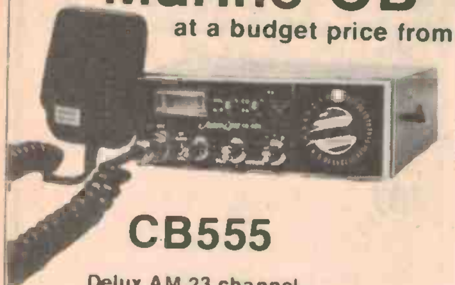

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22uF	7c	8c	9c	11c
33uF	8c	9c	10c	13c
47uF	9c	10c	11c	14c
100uF	11c	12c	13c	17c
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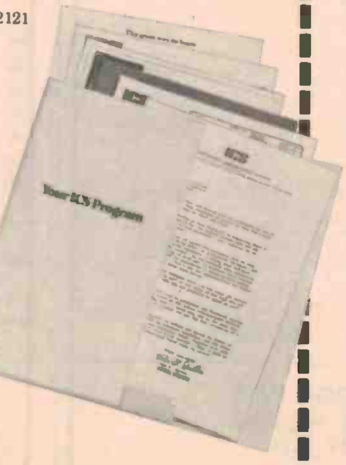

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Please Explain

This new feature is our response to the many requests we get from readers who want explanation or information on topics they read about in the magazine. If you have a question please send it to Please Explain, ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW. 2011.

CB Skip

Listening to the CB band I hear people talking of 'working skip' and 'when the skip comes in'. I gather this is something to do with long distance communications, but what does it really mean?

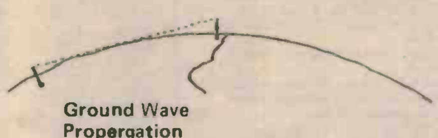
F.K., Parramatta

Normal communications on the 27 MHz band result from a 'groundwave' propagation, there is a direct straight-line link between the transmitting antenna and the receiving antenna.

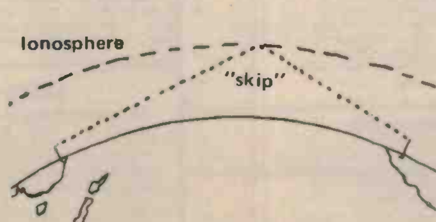
'Skip' propagation occurs when rather than a straight link connecting the two antennas, the radio wave from the transmitter travels up to the ionosphere and is then reflected back to earth (to the receiving station). A simple diagram illustrates how the communication distance is much greater with 'skip'.

On 27 MHz radio waves are not always reflected back to earth. There are many factors influencing propagation, mainly tied in with the ultraviolet emissions from the sun. Ultraviolet light seems to ionise the reflective layers, but the sun's emissions of UV depend on the sunsport cycle, which is currently at a low. This means skip will slowly increase in the next five years (as we approach the next maximum).

The day/night changes in the ionosphere are noticeable, too. After the sun goes down the ionospheric layers become less reflective and skip communication is not possible. As you go higher in frequency it becomes harder to communicate by skip, and the maximum useable frequency varies from hour to hour and week to week, etc. These days it is usually not possible to communicate by skip on frequencies as high as 27 MHz.



Ground-wave propagation follows a straight line from one antenna (the transmitter) to another (the receiver).



"Skip" occurs when the radio waves bounce off the ionosphere and return to earth.

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74H11	.25	74H53	.25	74H103	.60
74H20	.25	74H55	.25	74H106	.72
74H21	.25	74H60	.25	74H108	.72

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CB Australia

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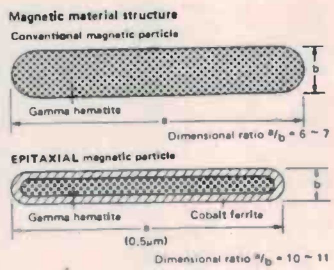
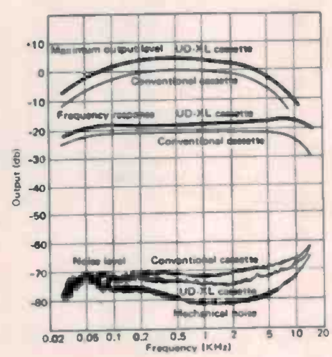


Compared to chrome tape, sensitivity has been improved by more than 3.5dB. Because EPITAXIAL is non-abrasive, it extends to the life of the head. Consequently, the UD-XL delivers smooth, distortion-free performance during live recording with high input. When using UD-XL it is recommended that tape selector be in the NORMAL position.



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WT.GD. 76M

Some slightly lesser decks for a lot less bucks.

Not everyone is going to rush out and buy the highest priced deck on the market because not everyone needs it. Or wants it. Pioneer knows where you're at.

For those who want to match the best cassette deck available to their present system and budget, we are pleased to announce the return of the "basic" cassette deck. Basically outstanding in tonal quality, basically designed for mechanical precision and basically priced for good value.

While front access design makes them easy to use, advanced Pioneer features make them great to listen to.

Just as an example, in the CT-F8080, a DC servomotor provides accurate record/play speed. A second motor for fast-forward and rewind. As a result, wow/flutter is within ±0.17%.

The long life Ferrite Solid head and Dolby* noise reduction system join to reduce tape noise and deliver excellent high frequency reproduction. Solenoid operated controls are user engineered for convenience and advanced equalizer circuitry accommodates any type of tape commercially available today.

In the CT-F7070 and CT-F6060, many of these impressive features are available at equally impressive prices. Proving once again, that we're listening to what you want to listen to.

Pioneer's basic cassette decks. Created for those who want to buy only what they need. So, in this case, less is more.

	Cassette Position	Drive System	Control Operation	Tape Selector	Wow & Flutter	Signal/Noise Ratio	Frequency Response
CT-F8080	Vertical	2 motors	Solenoid	Independent BIAS, EQ	Within 0.17% (DIN)	Dolby OFF: 53dB Dolby ON: 63dB (normal tape over [illegible])	20–16,000Hz 30–13,000Hz (±3dB)
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 (±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 (±3dB)

*Dolby is the trademark of Dolby Laboratories, Inc.

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