

PRACTICAL WIRELESS

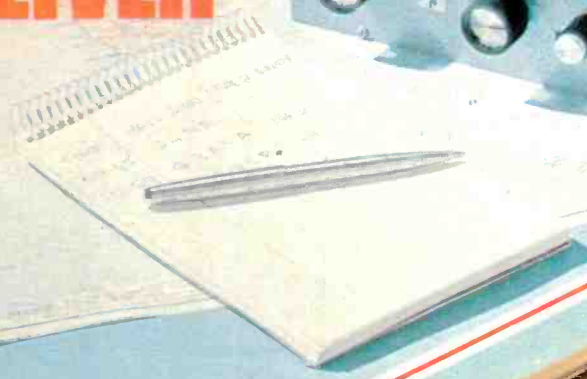
FEBRUARY 1976

35p

'STEP-BY-STEP'

**GENERAL
COVERAGE
RECEIVER**

PART 1



**2 Channel
Stereo Mixer**

**Plus
CURING RADIO BREAKTHROUGH-Part 1**



PRACTICAL WIRELESS

VOL. 51 NO. 10

ISSUE 828

FEBRUARY 1976

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

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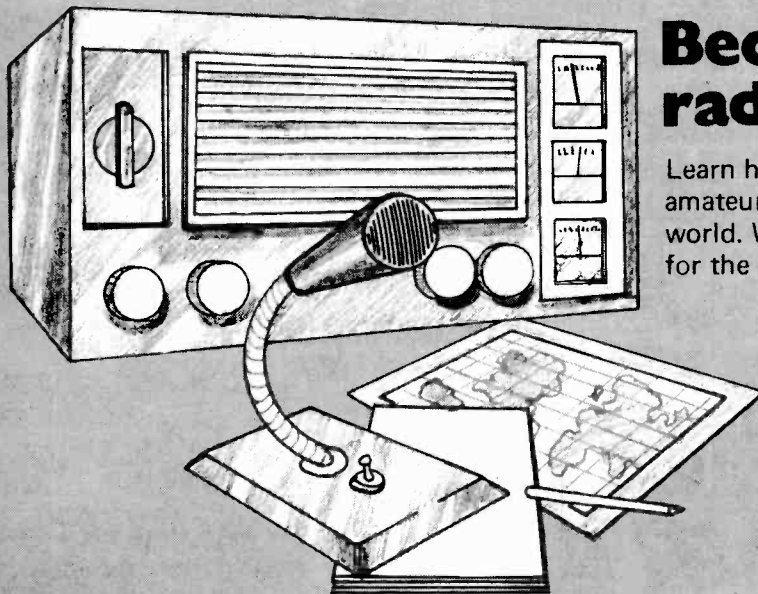
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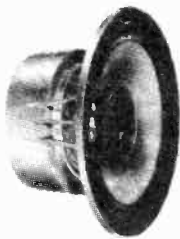
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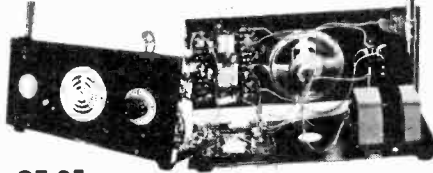
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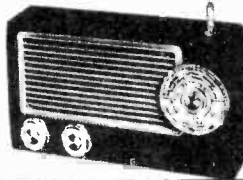
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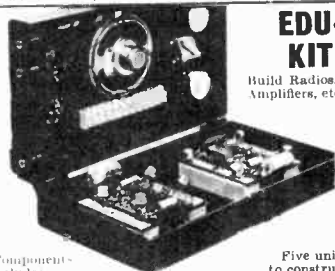
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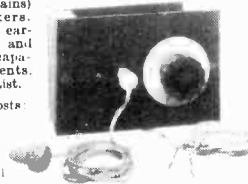
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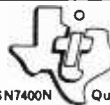
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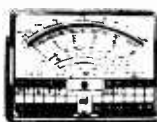


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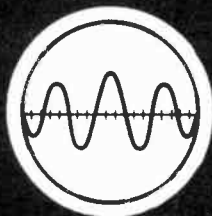
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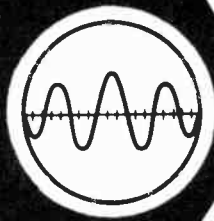
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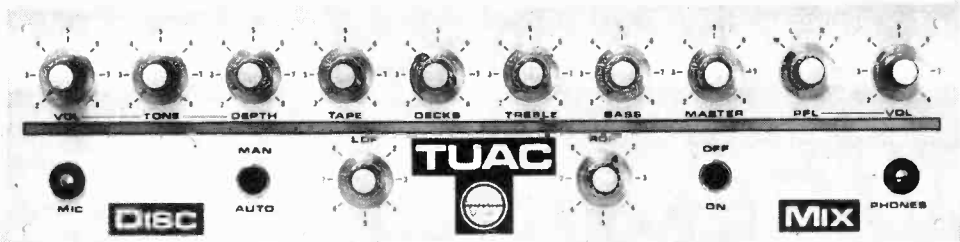


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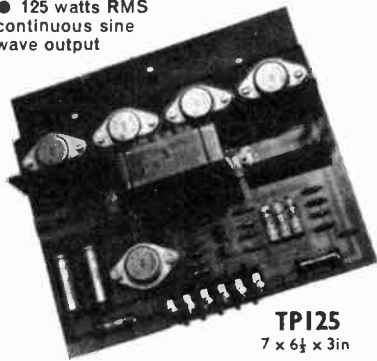
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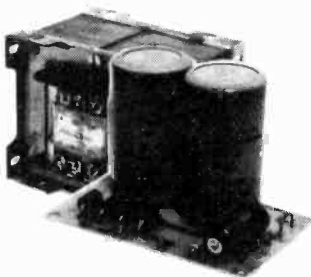
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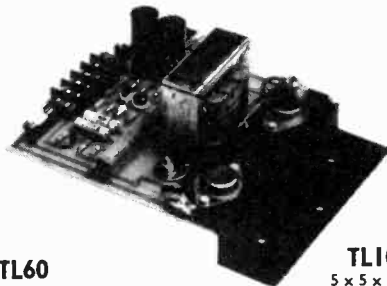
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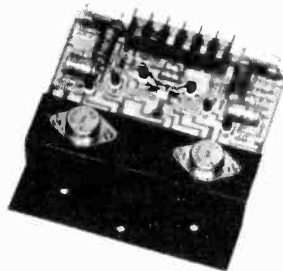
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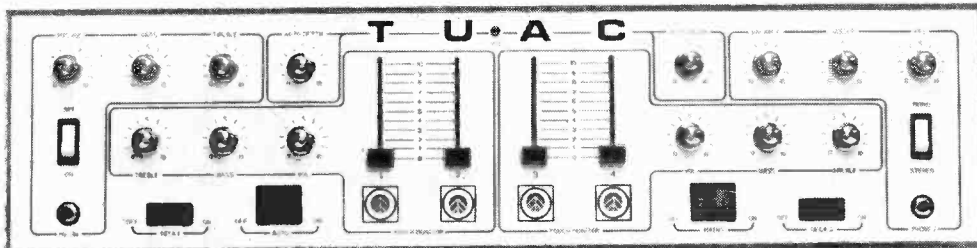
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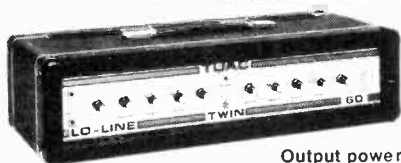
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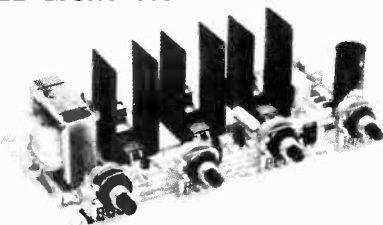
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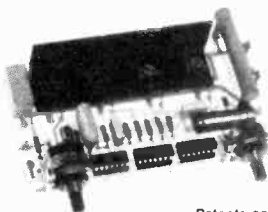
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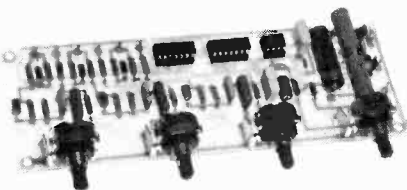
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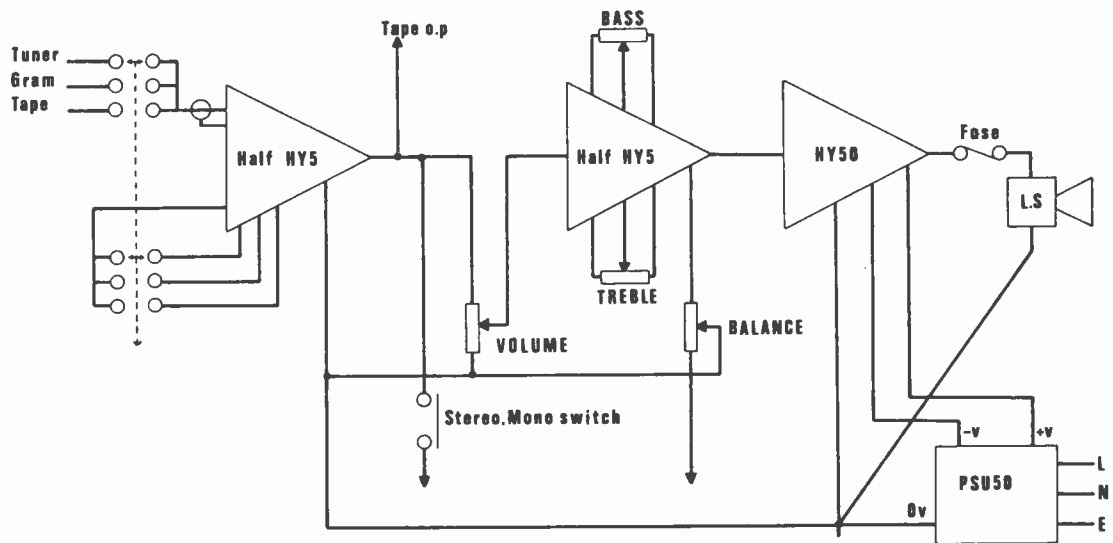
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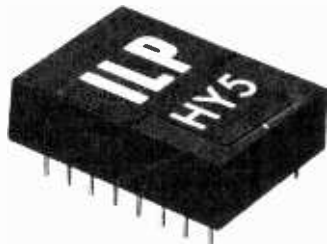


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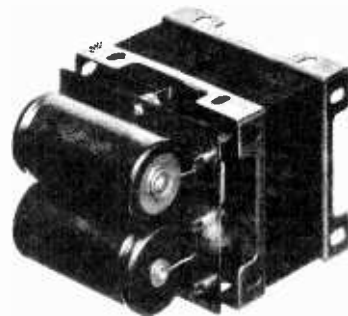


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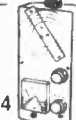


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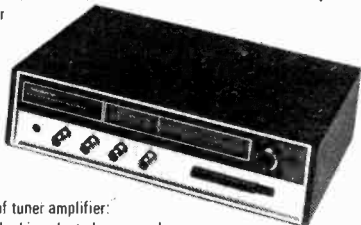
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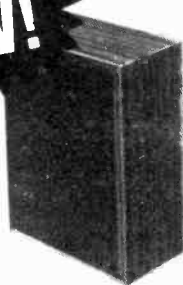


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Less Cartridge	p & p £1.50
C141 (not illustrated)	£12.00
Auto, with Cue Filled Stereo Cartridge	p & p £1.50
C123 (not illustrated)	£10.00
Auto, with Stereo Crystal Cartridge	p & p £1.50
All plinths finished in matching Teak veneer.	

EMI 350 KIT

£7.25 +£1.20 p & p.

Complete with crossover Components and circuit diagram

System consists of a 13" x 8" approx. woofer with a 3" tweeter, crossover components and circuit diagram. Frequency response: 20 Hz to 20 KHz. Power handling 15 watts RMS into 8 ohms. (Peak 30 watts.)

RTVC*

VISCOUNT IV STEREO SYSTEM

System 1a. £69.00

The new 20+20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodised fascia to harmonise with any decor. Polished trim and knobs.

The VISCOUNT IV has a comprehensive range of controls - volume, bass, treble, balance, mono/stereo, mode selector, and scratch filter.

Front panel socket for stereo headphones. And a host of sockets at the rear - for left and right speakers, tape recorder, auxiliary, tuner, disc and microphone.

SPECIFICATION: 20 watts RMS per channel 40 watts peak. Suitable 8-15 ohms speakers. Total distortion @ 10 watts better than 0.2%. Six switched inputs: 1. Magnetic P.U. - 3 millivolts @ 47 K ohms (R.I.A.A.), 2. Crystal/ceramic P.U. - 50 millivolts @ 50 K ohms (R.I.A.A.); 3, 4, 6. Tape Tuner/Aux. - 140 millivolts @ 50 K ohms (flat frequency response), 5. Microphone - 3 millivolts @ 50 K ohms (flat frequency response).

CONTROLS: Push button ON/OFF, stereo/mono, scratch filter, 6 position rotary selector. Individual rotary controls for treble, bass, balance and volume. Headphone socket, tape out socket, Aux, mains output. Frequency response: 25 Hz to 25 KHz @ full rated output. Signal to noise ratio: better than -50 dB on all inputs. **Tone control range:** Bass ± 15 dB @ 50 Hz; Treble ± 12 dB @ 10 KHz. **Power requirements:** 200-250V A.C. mains @ 60 watts. Approx. size: 15½" x 3" x 10".

MP60 type deck with magnetic cartridge, de luxe plinth and cover.

Two Duo Type IIa matched speakers - enclosure size approx. 19½" x 10½" x 7½" in simulated teak. Drive unit 13" x 8" with 3" tweeter. 15 watts handling. 30 watts peak.

Complete System with these speakers **£69.00** +£6.50 p & p.

System 2. £85.00

Viscount IV amplifier (As System 1a)

MP60 type deck (As System 1a)

Two Duo Type III matched speakers

- Enclosure size approx. 27" x 13" x 11½". Finished in teak simulate.

Drive units 13" x 8" bass driver, and two 3" (approx.) tweeters. 20 watts RMS, 8 ohms frequency range - 20 Hz to 18,000 Hz.

Complete System with these speakers **£85.00** +£7.60 p & p.

PRICES: SYSTEM 1a

Viscount IV R103 amplifier	£27.50 + £1.90 p & p.
2 Duo Type IIa speakers	£30.00 + £6.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover	£22.00 + £3.30 p & p.
Total if purchased separately:	£79.50
Available complete for only:	£69.00 +£6.50 p & p.

PRICES: SYSTEM 2

Viscount IV R103 amplifier	£27.50 + £1.90 p & p.
2 Duo Type III speakers	£46.00 + £7.50 p & p.
MP60 type deck with Mag. cartridge de luxe plinth and cover	£22.00 + £3.30 p & p.
Total if purchased separately:	£95.50
Available complete for only:	£85.00 +£7.60 p & p.



20x20 SYSTEM

Scotland and the Orkneys P & P Surcharge System 1a £1.75 System 2 £3.50

PUSH BUTTON CAR RADIO KIT - THE TOURIST TT*



NO SOLDERING REQUIRED

NOW BUILD YOUR OWN PUSH BUTTON CAR RADIO

Easy to assemble construction kit comprising fully completed and tested printed circuit board on which no soldering is required. All connections are simple push fit type making for easy assembly. Fine tuning push button mechanism is fully built and tested to mate with printed circuit board.

TECHNICAL SPECIFICATION: (1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) Integrated circuit output stage, pre-built three stage IF Module.

Controls volume manual tuning and fine push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide 2" high and 4½" deep approx. **£9.50** + £1.05 p & p. Speaker including baffle and fixing strip **£2.00** + 45p p & p. Car Aerial Recommended - fully retractable **£1.60** + 40p p & p.

The Tourist 1 Kit For the experienced constructor. If you can solder on a printed circuit board you can build this model. Same technical specification as Tourist TT. **Price £8.20** + £1.05 p & p.

* STEREO 21 QUALITY SOUND FOR LESS THAN £24.00



Stereo 21, easy to assemble audio system kit. No soldering required.

The unit is finished in white P.V.C. and the acrylic top presents an unusually interesting variation on the modern deck plinth. Includes - BSR 3 speed deck, automatic, manual facilities together with stereo cartridge.

Two speakers with cabinets. Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

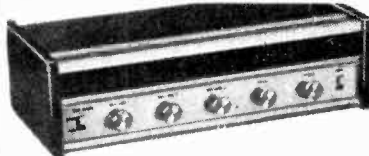
Specifications - For the technically minded: Input sensitivity 600mV. Aux. input sensitivity 120mV. Power output 2.7 watts per channel. Output impedance 8-15 ohms. Stereo headphone socket with automatic speaker cutout. Provision for auxiliary inputs - radio, tape, etc., and outputs for taping discs.

Overall Dimensions. Speakers approx 15½" x 8" x 4". Complete deck and cover in closed position approx. 15½" x 12" x 6".

Complete only £23.20 + £3.00 p & p.

Extras if required. Optional Diamond Stylus **£1.60**. Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance **£5.80**.

* DISCO AMPLIFIER



Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties. Output 20 watts RMS into 8 ohms (suitable for 15 ohms).

Inputs * 4 electrically mixed inputs. * 3 individual mixing controls. * Separate bass and treble controls common to all 4 inputs. * Mixer employing F.E.T. (Field Effect Transistors). * Solid State circuitry. * Attractive styling.

INPUT SENSITIVITIES - Input - 1). Crystal mic. guitar or moving coil mic, 2 and 10mV. (Selector switch for desired sensitivity.) - Inputs - 2), 3), 4). Medium output equipment - ceramic cartridge, tuner, tape recorder, organs, etc. - all 250mV sensitivity. AC Mains. 240V operation. Size approx: 12½" x 6" x 3½".

£20.00 + £1.35 p & p.

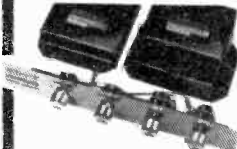
8 TRACK HOME CARTRIDGE PLAYER



Elegant self selector push button player for use with your stereo system. Compatible with Viscount IV system, Unisound module and the Stereo 21. Technical specification Mains input. 240V. Output sensitivity 125mV.

Yours for only **£16.20** + £1.70 p & p.

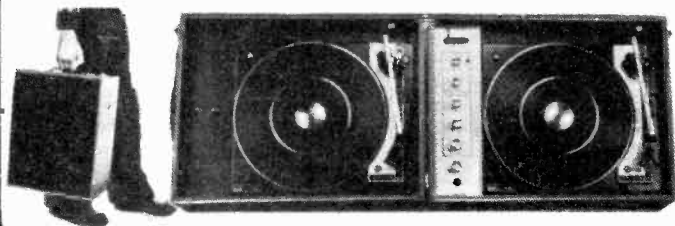
BUILD YOUR OWN STEREO AMPLIFIER*



For the man who wants to design his own stereo - here's your chance to start, with Unisound - pre-amp, power amplifier and control panel. No soldering - just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V. AC only.

Also available with 2 speakers (7"x4") **£10** + £1.75 p & p. **£8.95** + £1.05 p & p. Also available with the 'Compact' (see opposite page) easy build speaker kit **£13.50** + £2 p & p.

PORTABLE DISCO CONSOLE*



INCORPORATES: Pre-Amp with full mixing facilities, including switched input for mic with volume control, switched input for auxiliary with volume control, bass and treble controls, volume control and blend control for turntables. Two B.S.R. MP60 type single ply professional series decks, fitted with crystal cartridges.

TECHNICAL SPECIFICATION:
Pre-amp - Output - 200mV.
Auxiliary inputs - 200mV and 750mV into 1 meg. Mic input - 6mV into 100K. 240 volt operation.
Turntables capacity - 7", 10" or 12" records Rumble, wow and flutter Rumble Better than -35dB. Wow Better than 0.2%. Flutter Better than 0.06% (Gaumont kalee meter).
Finish - Satin black mainplate with black turntable mat inlaid with brushed aluminium trim. Tonearm and controls in black and brushed aluminium.

Console size - Unit Closed - 17½" x 13½" x 8½" (app.)
Unit Open - 35½" x 13½" x 4½" (app.)
This disco console is ideally matched for the Reliant IV and Disco 50 or any other quality amplifier.
The unit is finished in black PVC with contrasting simulated teak edging, diamond spun control knobs with matching control panel.

Yours for only **£49.00** + £6.50 p & p.

All prices include VAT at current rates

Mail orders to Acton. Terms C.W.O. All enquiries stamped addressed envelope. Goods not despatched outside U.K.

Leaflets available for all items listed thus *. Send stamped addressed envelope. All items subject to availability. Prices correct at 1st Jan. 1976 and subject to change without notice.

Minimum order on ACCESS/BARCLAYCARD-£11.



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DIGITAL DISPLAY

It certainly seems that the era of the quartz controlled digital wrist watch is with us and the price war is going to make them a much more attractive proposition than their mechanical counterpart. Added to their apparent advantages are their novelty value, the "one upmanship" value to their current owners (their status symbol will not last for much longer) and the fact that the constructor with reasonably average ability can make his own from the several attractively priced kits that are now available.

We wonder, however, if the excitement over these devices is a little premature. In their present form are they really a good substitute for their mechanical cousins? We think that the present generation of digital watches leaves a lot to be desired and while we admire the technological achievements in bringing this revolution about we hope that in the next year or so matters might be improved.

For example, do they really tell us the time we require? When we look at our present day wrist watches we are usually making a mental calculation as to "how long we have to wait to catch a train" or "if the bus went five minutes ago what time should we return if they run every 45 minutes". We seldom need to be told the precise time and would rather have an indication of the time difference between now and a future or past event. The conveniently divided face of a conventional watch shows us, at a glance, in multiples of five minutes exactly what we are after without any form of arithmetic calculation—15 minute periods are even easier to assess. On the other hand a digital watch requires us to carry out a definite arithmetic calculation which, although simple, is open to error. If you haven't got a digital watch make a mental note to check elapsed time on one of the public digital displays at a railway station and then see how much easier it is with your antique analogue display wrist watch.

We see two possible solutions to this problem. The first most obvious one is a totally different type of display which simulates a conventional watch face. Admittedly the technical problem is enormous and, at the present time the cost would be prohibitive. One would require at least sixty positions of display elements running radially round the face and then one should be able to select the length and positions of any two elements to depict the hour and minute hands. The numerical value of the positions round the clock face could be engraved in the case material or, conceivably, these could be made to light up as miniature LED displays. A second type of display which might be more practicable in the light of current manufacturing costs is a couple of "Line of Light" displays each one made up of 60 dots.

Our second solution would be to make more use of the logic capabilities of LSI integrated circuits. Rather than build calculators into a wrist watch would it not be better to have a chip which will accept a specified time from a miniature keyboard? The display would immediately show the difference in time (either positive or negative) between now and then. While we like the arithmetic nicety of our second solution we cannot, honestly, see it catching on because of the inconvenience factor.

It would be interesting to hear if readers have any views on this subject and at the same time it would be nice if someone could explain to us the value of a digital wrist watch that automatically compensates for leap years on a four year cycle when the batteries run down every year!

LIONEL E. HOWES—*Editor*

PRACTICAL WIRELESS MAGAZINE REQUIRES A TECHNICAL EDITOR

If you feel that you are the person to fill this challenging and rewarding position write to the **Editor, Practical Wireless, IPC Magazines Ltd., Fleetway House, Farringdon Street, London EC4 4AD.**

Radio Licence Fees

THE Wireless Telegraphy (General Licence Charges) (Amendment) Regulations 1975 were laid before Parliament to apply from 1 December, 1975, an 'across-the-board' increase of 60% to all fees for the standard radio licences, except broadcast receiving licences. Fees for standard radio licences have remained unchanged since 1968.

Standard-form licences are specified in the Schedule to the Wireless Telegraphy (General Licence Charges) Regulations 1968. They include licences which authorise the transmission and reception of radio by ships, aircraft, mobile radio-telephones, radio-microphones, radio-paging devices, radars, radio beacons, radio amateurs and model control.

The Home Office states that the increases are now necessary because the income from fees is no longer sufficient to cover the cost of licensing and administering the particular uses of radio.

The new rates are as follows: Private Mobile Radio £6.50 for the first two stations and £3.60 for each subsequent station. Ships £5.50; Aircraft £4; Model Control £2.40 (5 years); Amateur £4.80; Induction Communication £4.80 (5 years); Induction Communication (with return speech) £6.50; Radio Paging £7.20; Radio Paging (27MHz) (with return speech) £16; Radio Paging (UHF systems) (with return speech) £26.40; and Radio Microphone £4.80.

BARRIE Electronics telephone number was printed incorrectly in both the December and January issues. It should have read 01-488-3316/7/8. We apologise for any inconvenience caused.

Oui Oui

THE next Paris Components Show, or to give it the correct title, Le Salon des Composants Electroniques, will be held at the Parc des Expositions, Porte de Versailles from April 5th to 10th, 1976.

Eagle Laboratories

THE TEST and development laboratories at Eagle International of Wembley have recently been acoustically treated and re-equipped with new Bruel & Kjaer instruments at a cost of £12,000. These instruments are the standard for acoustic and electro-acoustic measurements anywhere in the world.

Eagle International are manufacturers and distributors of high-fidelity, in-car, public address, intercom and test equipment and a wide range of electrical and electronic components. The new laboratory instruments will enable the most accurate measurements of frequency response, signal-to-noise ratio, distortion, etc., to be made on amplifiers and tape recorders. Comparison measurements can be made on loudspeakers and microphones. The effect of acoustic treatment in the laboratories has been to reduce the reverberation time at 1kHz from 2.0 seconds to less than 0.2 seconds.

Picture shows Percy Gander, Technical Director of Eagle International, testing an Eagle A2006 Amplifier on the Bruel & Kjaer instruments in the re-equipped laboratories at Precision Centre, the company's Wembley headquarters.



Practical Wireless, February 1976

Heard but not seen

3M has recently put into full-scale operation its new tape manufacturing facility at Gorseinon, near Swansea. The £3½m scheme includes an automatic cassette assembler known as the 'Snowflake', and a number of cassette winders known as 'Raindrops'. These, coupled with the firm's tape coating machine, are now producing a range of cassettes which exhibit marked improvements over the previous hand-assembled models.

Scotch Dynarange, New High Energy, Chrome and dual-layer Classic cassettes are now all manufactured on 3M's automatic assembly lines. The mechanics are common to each range within the Scotch family 3M's Recording Materials Division is so confident about the trouble-free operation of its cassettes that it is currently calling them "The Jambusters" in a national retail campaign which highlights their jam-free properties.

Detailed improvements in Scotch cassette design include the following: (1) Larger, permanently fixed one-piece pressure pad for better head-to-tape contact and signal uniformity; (2) Posi-Trak backing—a tape back-coating process for a smooth wind and reduction of static-induced dust attraction which can lead to annoying drop-outs (3) Fixed polished metal guideposts which eliminate the mechanical movement associated with nylon wheels and so reduce wow and flutter.

In addition, 3M claims that its ultrasonic welding technique produces a warp-free housing for the tape. The company points out that the 'Snowflake' machine will accept only components that are made to very fine tolerances, and will in fact physically reject any part which is below specification. No fewer than 25 quality control checks are made during cassette manufacture, including the tests made during manufacture of the tape itself.

Any Scotch cassette found to be faulty will be replaced immediately by the retailer under 3M's no quibble guarantee. Recording Materials Division, 3M United Kingdom Limited, 380-384 Harrow Road, London W9 2HU Tel: 01-286 6044.

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High and Mighty

MEMBERS of the South West Face British Everest Expedition took with them a Hacker Super Sovereign RP75MB five-band receiver. It was supplied by Hackers in a special weather protective casing.

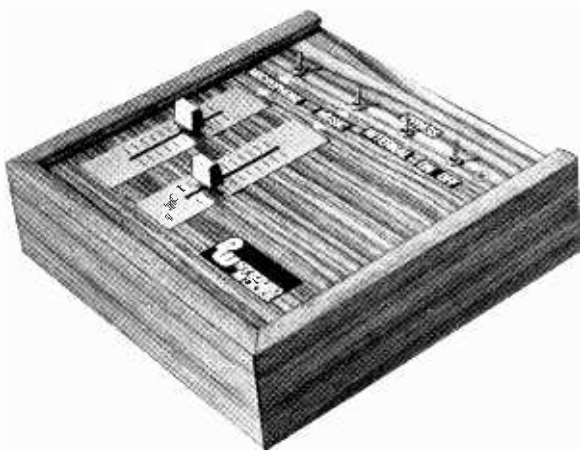
Semicomps move

SEMICOMPS Limited have moved to new premises at Wellington Road, London Colney, St. Albans, Herts, AL2 1EZ. Telephone: Bowmans Green 24522. S.C.S. Components, the division responsible for sales to the amateur and TV service industry, will move at the same time to the above address.

Coincidental with the move is the installation of an L 8500 Burroughs computer programme to handle all functions of the Company other than stock control. This machine is being installed in anticipation of an upturn in business activity during 1976 and will enable at least a 50 per cent increase in orders without the need for additional staff.

2 CHANNEL STEREO MIXER

A. Joyce C.Eng MIERE



THE majority of stereo music centres have the facility for recording via a microphone, or from either a radio, disc player or auxiliary sources. The facility of microphone recording is usually under-employed, as results at recording especially with music accompaniment are usually poor. If an extra record player or other source is used for this purpose, the difficulties of correct balance and room acoustics become very evident and impair the results obtained.

Attempts at making tapes for home movie accompaniment etc. prove to be difficult due to the editing and mixing limitation. However, if a tape deck is chosen as the additional alternative source, and a mixer unit is constructed, all the drawbacks are overcome. The ability to feed the input of the tape deck into the music centre, and vice-versa,

enables one to edit tapes in both directions, although it must be said that unit matching may be necessary. The ability to use the source to act as an accompaniment to the microphone, requires the use of a mixer, and in either editing or mixing, all re-recordings are achieved electronically and are relatively unaffected by room acoustics. The unit described here, was designed with all of these requirements in mind.

CIRCUIT CONSTRUCTION

It would be fairly easy to evolve a printed circuit board for the amplifiers, but the plain veroboard and terminal pin method was chosen, since this permits easy alteration to component values for

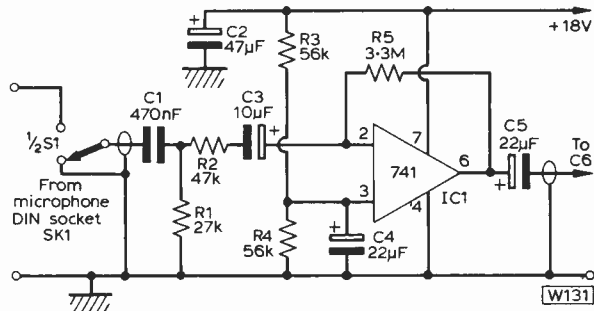


Fig. 1: Circuit diagram of one of the microphone amplifiers. The other is identical, but its components have been given the suffix 'a', in the component list.

experimentation, and places no restrictions on the physical size of components. Two 0.1in matrix plain veroboard panels 140 x 45mm are used, with one being employed for the microphone amplifier, Fig. 1,

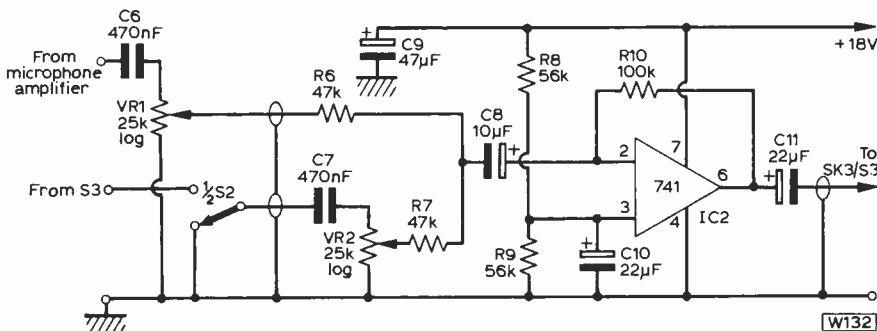


Fig. 2: The mixer amplifier shown left has two inputs. The music input feeding direct from the DIN socket, and the microphone input feeding via the mic. amplifier. Again the second channel is identical with components suffixed 'a'.

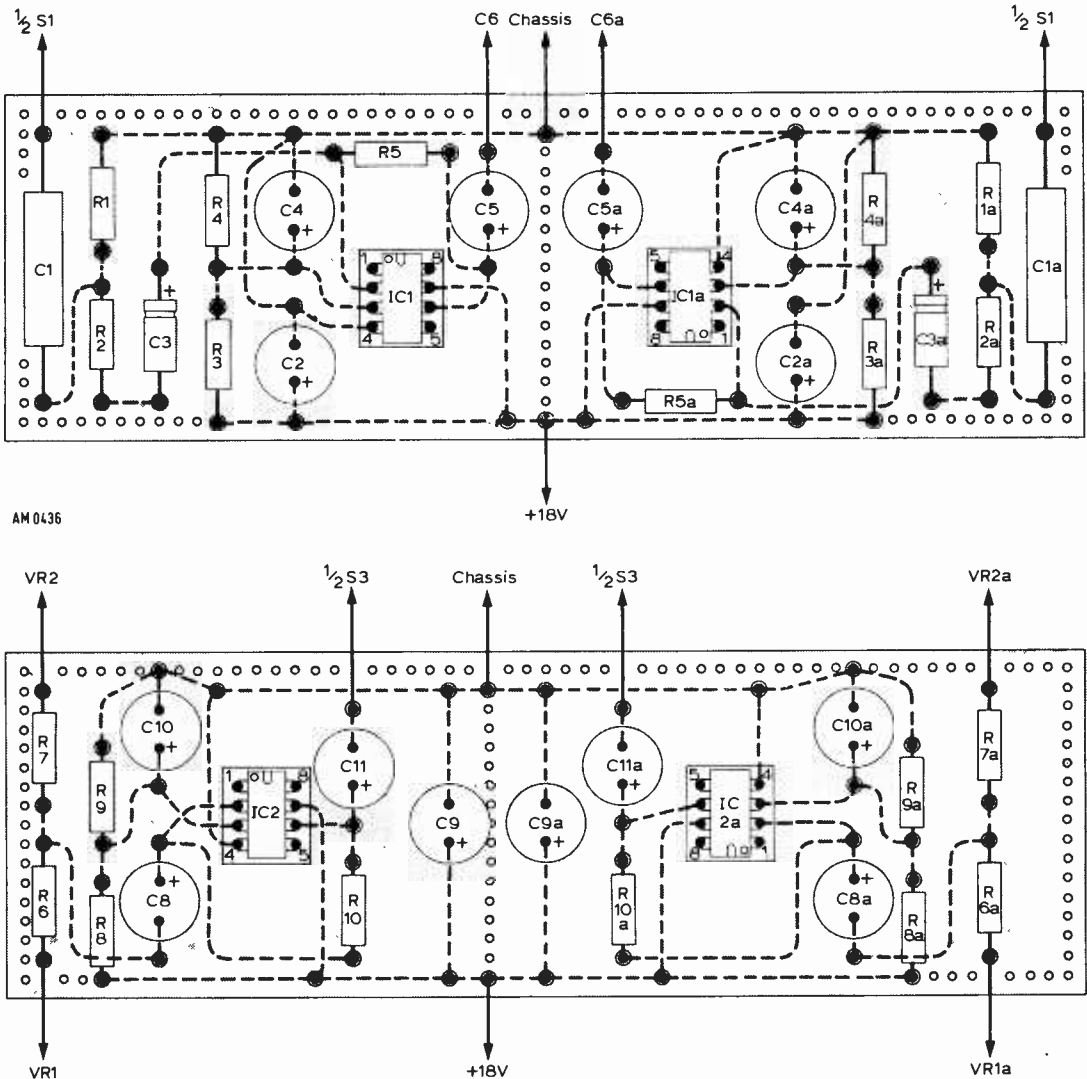
and the other for the mixer amplifier, Fig. 2. Both having right and left channels, the left channels being virtually mirror images of the right channels. The earth rails are kept to the bottom of the boards so that they are near to the chassis connections. The positive rails are mounted near to the top of the boards so that a cross wire from the power supply suitably connects the positive supply to the boards.

When starting the construction, it is advisable to place the components on the board and then push in the terminal pins as dictated by the spacing. The component wires may then be given a loop around the pin and the surplus cut away. When all the particular wires to a pin have been made, soldering can take place. After the veroboard wiring has been completed a thorough check should be made, and if all is OK, they should be put to one side for future chassis mounting. All inter-amplifier connections and switching leads Fig. 3, are made with screened cable, the outer of which is earthed. Colour coding of the leads is employed to assist in checking and/or fault finding.

The power supply unit Fig. 4, is constructed on the chassis which is to be described later. The transformer has two sets of LT windings which should be paralleled to obtain the 15-0-15V output. The bridge rectifier is bolted to the smoothing capacitor bracket, while the regulator transistor is clamped to the aluminium screen with its connecting pins facing inwards. The screen incidentally, acts as a very useful heat sink. An LED was added in the prototype, and connected in series with an appropriate resistor. The value of which determines the intensity of light output and current drain on the supply.

AMPLIFIER GAINS AND UNIT MATCHING

The gains of the amplifiers are determined by the ratio of the feedback resistors, (R5 and R10 in Figs. 1 and 2,) to that of the input impedance (approx. 50k Ω). The mixer amplifier values given will have a voltage gain of two, and the microphone amplifiers a



Almost all of the components are mounted on the two plain Veroboards. The top board contains the microphone amplifier while the lower one contains the mixer amplifier. These boards are shown full size.

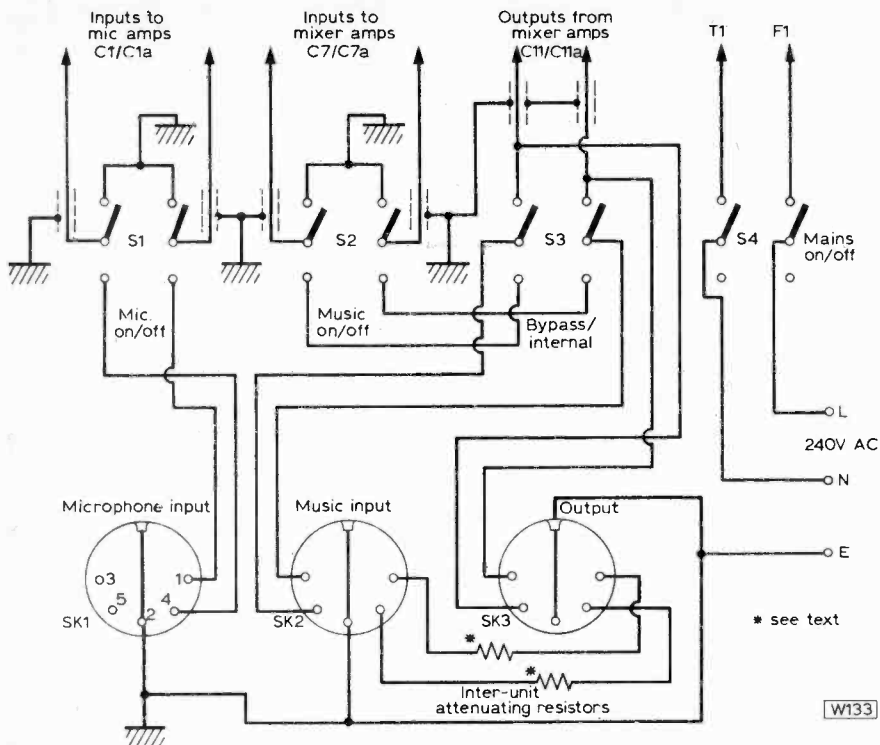


Fig. 3: Inter-amplifier connections and switching leads. Screened cable is used from the switches to the boards, and from the slider pots to the boards.

voltage gain of 66. Some alteration of these values may be necessary depending upon the input levels, although a higher voltage gain for the microphone amplifiers is not advisable, as the frequency response of the output may suffer.

Values are not given for the inter-unit attenuating resistors, as these should be selected to satisfy the input/output levels and impedances of the basic units.

CHASSIS CONSTRUCTION

The top and rear of the unit acts as the chassis, with all the components mounted underneath. It is made from 20SWG aluminium sheet 256 x 200mm,

bent at right angles to form a top 204mm x 200mm, with a back about 52mm in depth. This then slides into the base retaining case from the rear, along the side top-edge grooves. It holds itself by the front and side grooves and may be secured with screws in the side back edge cut aways, or into an additional back strut fixed on the hardboard base. This forms a solid box construction with easy chassis access.

The component parts which require basic chassis mounting are placed on the underside of the top panel section to achieve a reasonably spaced layout, Fig. 5. Their positions are marked, and the slots for the slider potentiometers are cut. The holes for the end brackets of these pots are additionally used for

★ components list

Resistors

R1/R1a	27k Ω	R6/R6a	47k Ω
R2/R2a	47k Ω	R7/R7a	47k Ω
R3/R3a	56k Ω	R8/R8a	56k Ω
R4/R4a	56k Ω	R9/R9a	56k Ω
R5/R5a	3-3M Ω	R10/R10a	100k Ω
All $\frac{1}{2}$ W 10%		R11	1.5k Ω
VR1	25k Ω slide tandem log. potentiometer		
VR2	25k Ω slide tandem log. potentiometer		

Capacitors

C1/C1a	470nF 100V poly.
C2/C2a	47 μ F 40V elect.
C3/C3a	10 μ F 40V elect.
C4/C4a	22 μ F 40V elect.
C5/C5a	22 μ F 40V elect.
C6/C6a	470nF 250V DC poly.
C7/C7a	470nF 250V DC poly.
C8/C8a	10 μ F 40V elect.
C9/C9a	47 μ F 40V elect.
C10/C10a	22 μ F 40V elect.

C11/C11a	22 μ F 40V elect.
C12	4700 μ F 40V elect.
C13	4700 μ F 40V elect.
C14	220nF 100V poly
C15	470nF 100V poly

Semiconductors

MVR1	7818KC voltage regulator
D1	TIL209 LED
Br1	BY164 Bridge rectifier or similar
IC1/IC1a	741
IC2/IC2a	741

Miscellaneous

F1, 100mA fuse. T1, 6VA miniature mains 0-15, 0-15V (RS Components). S1, S2, S3 and S4, DPDT sub-miniature toggle switches. SK1, SK2 and SK3, 5-way 180° DIN sockets. Veroboard, 0.1in. matrix 140 x 45mm plain type 2 off. Fuse holder. 2 Slide control knobs and bezels. Screened cable. Lead through terminal pins. 4 IC 8pin sockets. 20SWG aluminium sheet. Wood for cabinet.

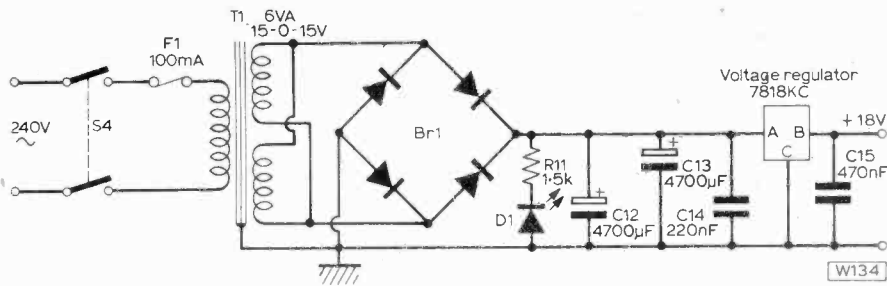


Fig. 4: Regulated power supply circuit diagram. The transformer T1, is a 6VA 0-15V, 0-15V 240V type with the two secondaries wired in parallel. C12 and C13 may be substituted for a single 10,000µF electrolytic.

securing the veroboard panels in a vertical position. This minimises top panel drill holes, while the screw-heads are ultimately concealed by adhesive bezels.

The holes for the power supply screen fixing, and holes for sockets, pilot lamp, switches, fuse and mains lead are now marked and drilled, and the

wood effect formica or adhesive contact vinyl.

The top and sides of the aluminium chassis may also be covered in the wood effect vinyl and the self-adhesive slider bezels put on top of this before the knobs are finally fitted and general labelling carried out.

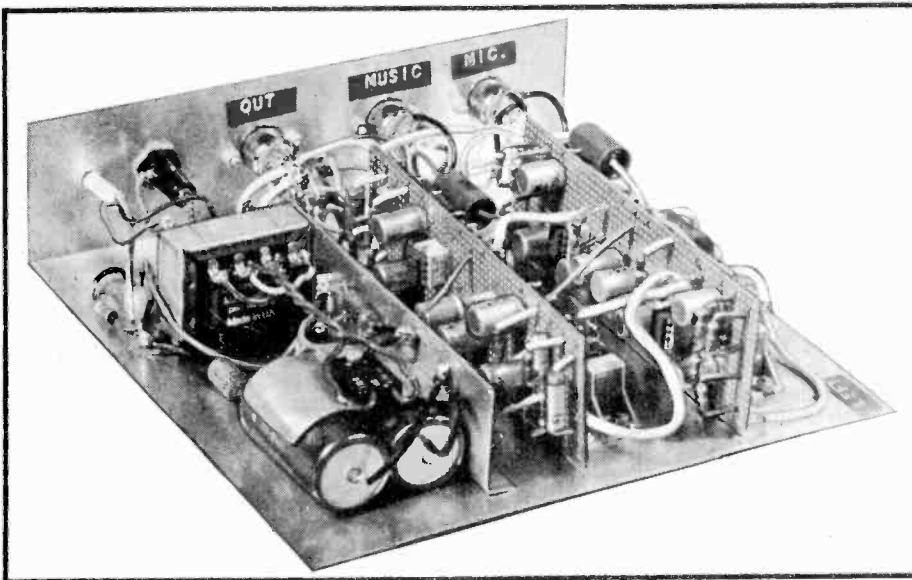


Fig. 5: Internal photograph showing component layout, board positioning and power supply. The voltage regulator is mounted on the aluminium screen adjacent to the transformer and smoothing capacitors.

fixed components mounted. The power supply smoothing capacitors are now secured by a clamp fixed to the internal screen which also holds the regulator transistor. The veroboard panels are now mounted and a check made that sufficient clearance still exists. All inter-board and switch connections can now be made, with a final check being made before power is applied.

CASE CONSTRUCTION

The case size of the prototype was pre-determined by making it identical in size to the tape deck, and in this instance was 215mm x 220mm by 10mm deep. The retaining case of the unit has a hardboard base, with 12mm thick wooden sides and front. These are rebate grooved 6mm from the inside top edges. The sides only are additionally cut away at the back to a depth equal to the rebate groove. The front and sides are then glued and pinned at the corners and base. A finish can be applied to the case, by either using

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DISCO

SYSTEM

PART 3

A.C. AINSLIE* & C. TOMS'



IN THIS the final part of the P.W. Disco system articles, we will look at construction of the cabinet, interwiring and construction of the mains and mixer panels, fault finding and use of the Disco.

MIXER CONSTRUCTION

The photographs and drawings clearly show details of mixer construction (Fig. 11). As noted before, tandem pots are required for stereo, together with a balance control and mono/stereo switch. A mono mixer would use single gang pots and would not have either the balance control or the mono/stereo switch.

The drawings are for a stereo mixer but for clarity only one section of each of the tandem controls has been shown. The wiring for the second channel is simply duplicated.

The chassis for the mixer is a piece of 1½mm (1/16in) double-sided copper laminate which is earthed, and screens the input circuitry. All earth connections are simply made by soldering directly to the copper.

The completed mixer is so simple that a visual check should reveal any faults.

MAINS PANEL

To reduce the possibility of hum pickup, the mains switching, fuses and light modulator controls are mounted on a separate mains panel which is situated at one end of the sloping console panel well away from the mixer (Fig. 12).

On/off switches for the amplifier and sound-to-light unit are mounted on the mains panel together with their two respective fuses, the light modulator intensity control, and three over-riding switches, one for each light channel. These switches short out the thyristor in each channel giving full output of each colour for special effects.

PANEL PREPARATION

Both the mixer and mains panel can be conveniently made from 1.5mm (1/16in) fibreglass laminate. After drilling all necessary holes the panel can be covered with non-glossy white 'Fablon' and lettering applied with Letraset. A thin spraying of clear polyurethane or Letracote gives the surface some protection. The Fablon is cut away with a modelling knife to expose the component mounting holes. When fixing the controls to the panel a washer should be used underneath the pot nut to prevent the Fablon pulling when the nut is tightened.

PLINTH ASSEMBLY

Arrangements have been made for a complete cabinet kit to be available in knock-down form as shown in the diagram (Fig. 13). Constructors who enjoy woodwork can prepare the pieces as shown in the cutting list. Attention must be paid to the long mitre joints of the panels E, F and G. These



The two turntables mounted in the deck board with the front panel attached ready for joining to the plinth assembly.

*Consultant TW.K.F. Electronics

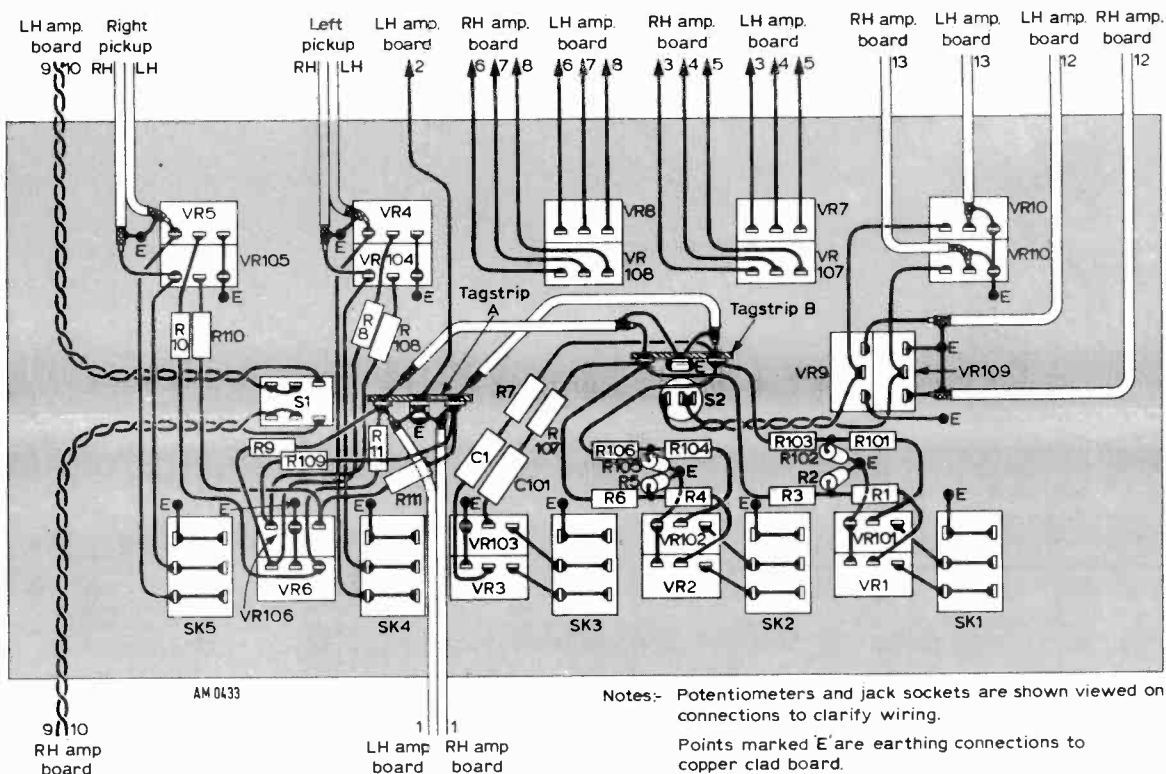


Fig. 11: Construction of the mixer, made from double-sided copper board, one of the sides being used as a common earth plane.

must be cut very accurately and the mitre angle maintained to ensure that the edges mate.

Assembly is quite straightforward and is summarised in the steps below. 1in x 1in timbers are used for all right-angled joints.

1. Screw side panels G to baseboard C.
2. Screw lampholder panel D to baseboard C and side panels G.
3. Screw panel A to baseboard C and side panels G, first cutting out for the spot bulbs.
4. Screw panel F to baseboard C and side panels G.

At this stage all the electronics should be installed.

A professional finish can be ensured by using countersunk mirror screws which have brightly chromed flat heads. The three lampholders for the light display are fixed to panel D spaced as shown in the diagram so that the reflectors will coincide with the apertures in the front panel.

The light modulator p.c.b. is mounted on 25mm (1in) stand-off insulators as shown in the photograph. The mains wiring between the p.c.b. and the lampholders and switches is twisted lightly together to reduce radiated interference.

The plinth base is drilled for large ventilation holes and the power transistor heatsinks (two for stereo) are mounted directly above. By spacing the heatsinks 38mm (1½in) from the bottom of the plinth, plenty of space is left for free circulation of cooling air. Although by no means essential a small instrument cooling fan could be set into the base to provide additional draught.

Stand-off insulators are used to mount the amplifier boards adjacent to the heatsinks.

INTERWIRING

Both the mixer and mains panels are now fitted on to the control panel using small chrome-plated wood screws. The control panel is then dropped in place. Screened cable is used for the connections between the mixer and amplifier boards. The braidings should all be connected together and earthed at one end—this is most easily done at the mixer.

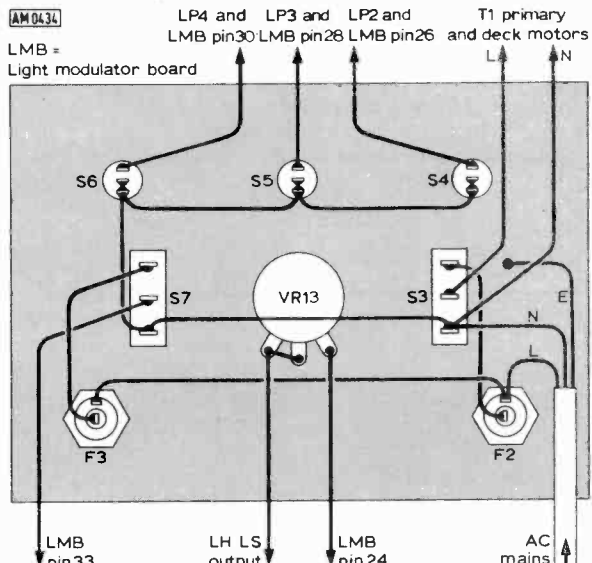
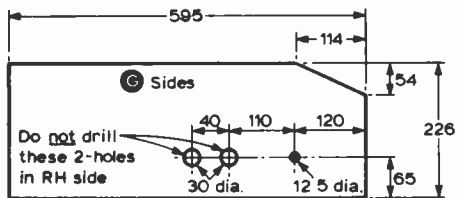
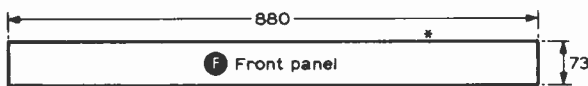
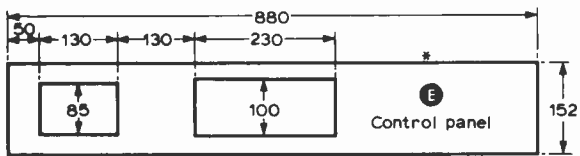
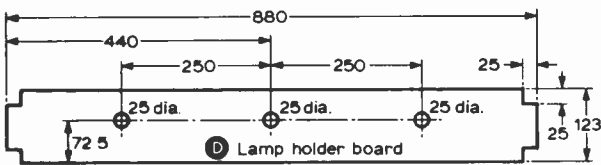
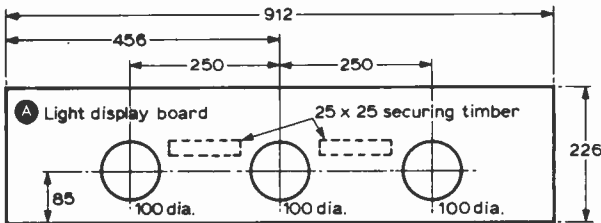
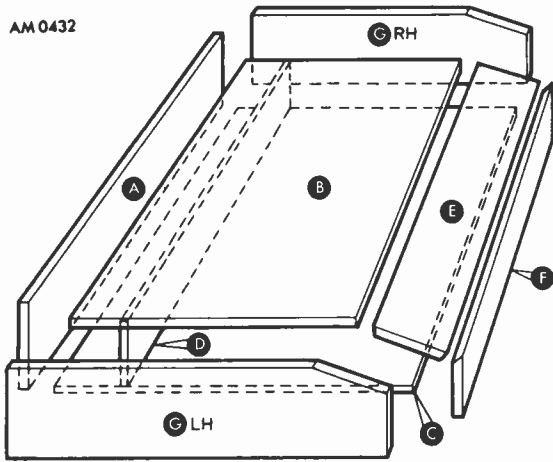


Fig. 12: Interwiring of the mains panel. This again is made from double-sided copper laminate board.

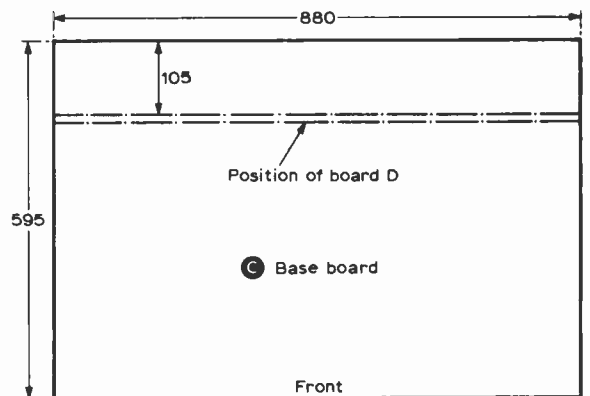
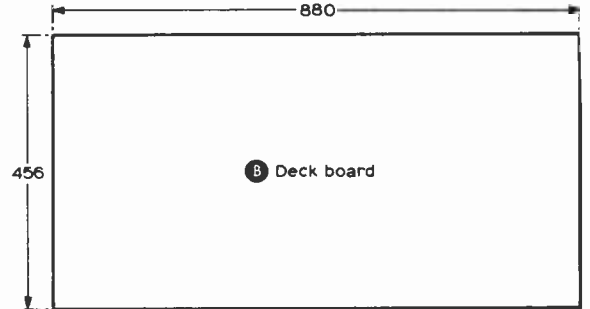
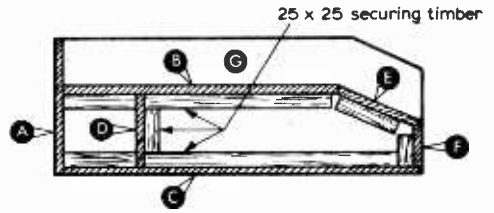


* Mitre edges to fit

Fig. 13: Cutting details for the wood used in constructing the plinth. The deck board must have cutouts made to accept the particular turntables used.

Note:- All dimensions in mm.

Material:-
Boards C and D....12.5mm chipboard
Boards A, B, E, F and G....15mm veneered chipboard



Next the mains panel is carefully connected, taking great care to check the connections against the circuit diagrams. When dealing with mains voltages there must not be the slightest possibility of an error occurring.

The mains earth goes from the input plug to the light modulator board and the main earth point. The following earth returns should all be taken direct to this earth point: power supply negative; right-hand amplifier power earth; left channel

speaker return; right channel speaker return; turntable metalwork.

A short link of heavy gauge flexible wire connects the left-hand amplifier power earth to the corresponding point on the right-hand p.c.b. The earth connection from the mixer is also connected to the right-hand amplifier earth.

It is at this stage that the unit can be tested if the separate sections have not already had bench tests. Adjustments are made as detailed earlier.

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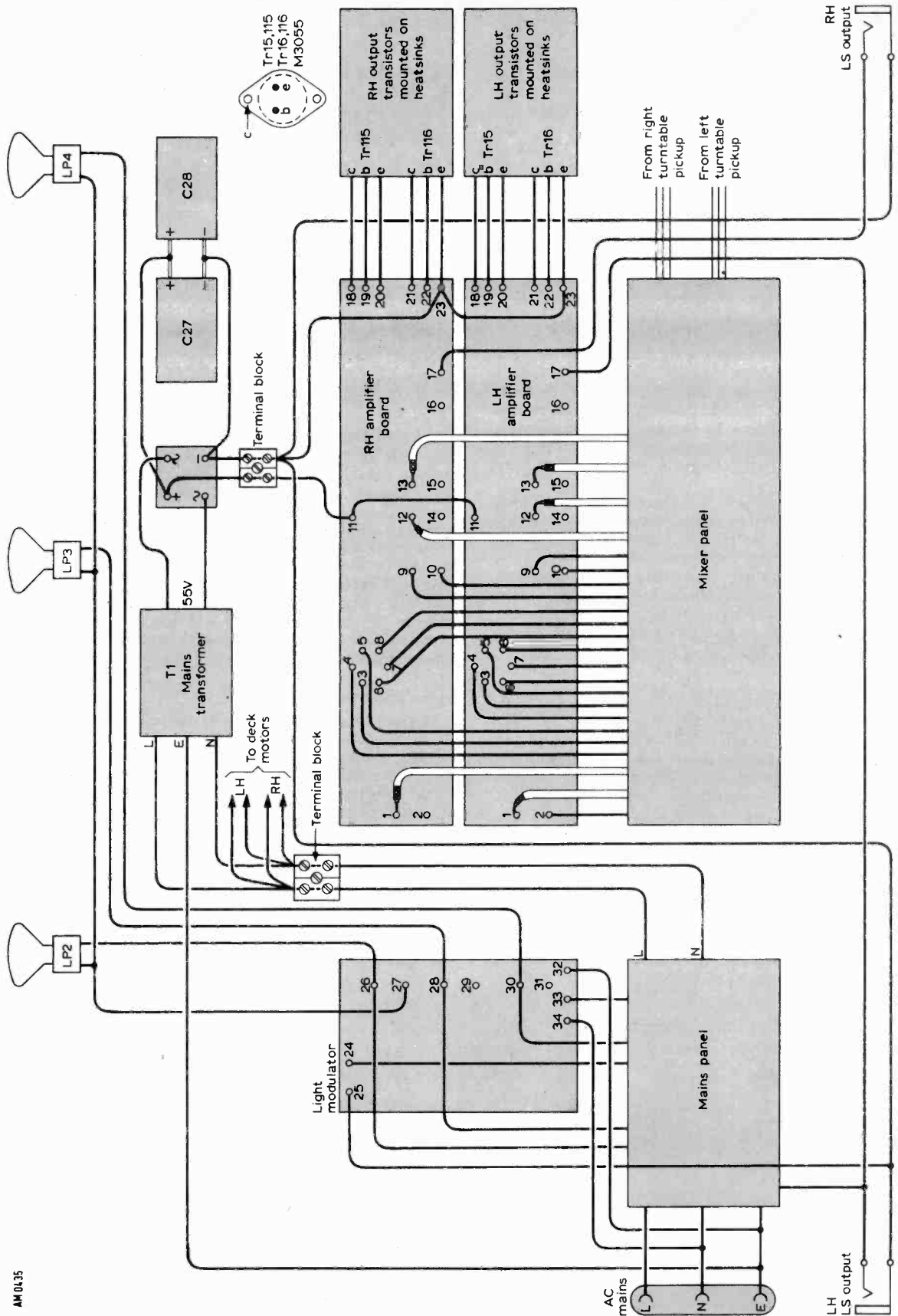


Fig. 14: Interwiring details for the complete stereo Disco console. For connections from mixer use screened lead earthed at mixer end only. Speaker output socket common leads should be taken to the common earth point provided by the terminal block near D2.

All that now remains is to cut out the plinth top panel to suit the two turntables and screw it to the back panel, A. The two decks are mounted in the plinth and wired to both mains and the mixer. The plinth top panel simply screws to the rest of the console. The control panel can be secured after the final tests.

The pickup cartridges are mounted as in the deck manufacturer's instructions and the turntables set to the required tracking weight for the cartridge (4g for the 9TAHC).

EXTERNAL INPUTS

External inputs are provided for TAPE (150mV), MICROPHONE (4mV), AUXILIARY (300mV) and two external pickups, PU1 and PU2 (20mV).

The TAPE and AUX inputs will accept the outputs from most radio tuners, cassette or tape recorders and any other equipment offering a "line" output. Equipment such as TV receivers and certain radios and record players have live chassis power supplies and no attempt should be made to connect these to the inputs of the Disco Console, or indeed to any other equipment.

The microphone input is intended for use with medium quality dynamic types. Should any tendency towards bass boom be noticed, then the bass boost switch can be set at the "off" position.

The pickup inputs are effectively in parallel with the pickup cartridges installed in the console and serve as external pickup sockets or as outputs for feeding to a headphone monitor amplifier for cueing or Pre Fade Listen (PFL).

MIXING

Operation of the Mixer is self-explanatory and the layout of the control panel assist easy operation. Each input has an associated LEVEL control which is used to adjust the overall balance between inputs and for smooth selection of one or other input.

The CROSS FADE control is used to swing from one turntable to the other for a smooth change of record. At intermediate positions of the control the two turntables are mixed.

The BALANCE and VOLUME controls are used together with the BASS and TREBLE controls to adjust the sound level and tone for the room. Adjustment of the BALANCE control may be necessary to compensate for differing loudspeaker efficiencies on each channel.



The completed Disco system.

OPERATION OF THE DISCO CONSOLE

The amplifier used in this design will deliver its maximum power of 100W into a load of 4Ω. Naturally speakers of adequate power rating should be used if the unit is to be played loud and a number of speakers can be combined on each channel to achieve the required impedance. For example, two 8Ω 50W loudspeakers or four 15Ω 25W speakers in parallel would be suitable.

To minimise power loss the connecting cable should be heavy duty. When several speakers in different cabinets are to be paralleled, least power loss will occur if the parallel connections are made near to the Console. In this way the length of cable carrying the combined speaker currents will be reasonably short.

LOUDSPEAKER

Heavy duty loudspeaker drive units suitable for Disco applications are widely advertised in the electronics magazines. Generally a single unit is designed to cover a fairly wide frequency response and additional tweeters are rarely used: high power tweeters are very expensive. Sealed infinite baffle enclosures are usually employed, the constant volume air damping serving to restrain cone movement. To reduce internal resonance or "boxiness" the internal walls are lined with wadding to absorb any reflections.

When two or more drive units are fitted in a cabinet it is important to connect them *in phase* so that the cones move together. Otherwise the air damping will not be effective. Phasing can be simply

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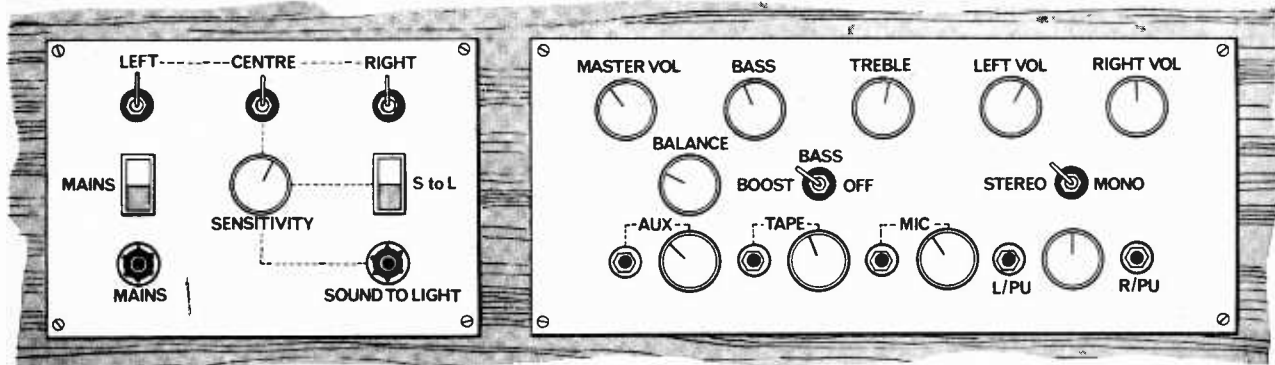


Fig. 15: Layout of the controls on the front of the mixer and mains panels which are mounted on the sloping front panel of the Disco console.

Radio Break-through

A look at interference in Hi-Fi equipment..... Part 1

H. LEEMING G3LLL, FSERT, T. Eng.(CEI)

A GLANCE at the problem pages in the various audio magazines soon indicates two complaints which have become uncomfortably common with audio equipment in the last few years. The first problem is the unwanted break-through of radio stations, the second being "noises off" originating from refrigerators and other thermostatically controlled devices. Several articles have appeared in which these problems and possible cures have been discussed, but what has not been pointed out is that these problems originate from the same deficiencies in the audio system in that it is too sensitive to radio frequencies.

NATURE OF INTERFERENCE

It may come as a surprise to realise that refrigerators generate radio waves, but when pioneers such as Marconi were spanning the Atlantic the power they fed into the aerial system was generated by a spark, and the code they sent consisted of what we would now consider to be little more than bursts of interference. Whilst 'fridges and switches and other units which generate sparks radiate over a wide frequency range, Marconi's "interference" was concentrated as much as possible around one frequency by means of a tuned circuit, but the principle is the same.

Obviously it should be possible to suppress refrigerators and light switches to stop them interfering with audio equipment, but this is rather a pointless operation as it still leaves the audio equipment wide open to any other radio waves which are strong locally.

High fidelity amplifiers (if they are to be worthy of the name) must amplify small signals over a wide range of frequencies until they are powerful enough to operate the loudspeakers, and a good case can be made out (in the interest of minimum distortion and best transient response etc.) for having the frequency range over which they operate somewhat wider than the normal audio range.

The frequency response of an amplifier is, perhaps, something with which the advertiser can impress the uninitiated, and hence even before the "transistor invasion," we started to see specifications such as "flat from 1c/s to 1Mc/s." The fact that some of these units also produced cannon-like crashes from every switch or thermostat in the house, and brought through a local radio amateur or taxi radio operator seemed to be ignored in the interests of progress! Valiant attempts were made to pass the problem on to the refrigerator manufacturers, station operators, Post Office engineers or anyone else who would hold it in their lap with the hope, perhaps, that if the problem was ignored long enough it would go away!

Radio frequency interference (RFI) has, however, refused to go away, and with the advent of the printed circuit board and the transistor, the situation has certainly not improved, much domestic audio equipment being far too sensitive to any form of electromagnetic radiation. With the numbers of refrigerators, freezers, central heating systems and radio transmitters of all kinds mushrooming at the same time as sales of inadequately protected audio equipment, it looks like things are going to get considerably worse before they get better!

Fortunately some of the more enlightened audio manufacturers have sat up and taken notice, and it is to be hoped that their efforts, perhaps urged on with the threats which recent legislation seems to hold over the retail trade, will eventually result in more adequately protected equipment. In the meantime it is hoped that the following will put the matter in perspective and hopefully help readers to cure troubles with existing installations and perhaps even influence designers of audio equipment.

SOME THEORY

Before the audio content can be extracted from an amplitude modulated (AM) radio wave it has to be detected. In the detector stage of a receiver the active device, usually a diode, is connected so as to be non-linear. However all valves and transistors will detect radio waves to some extent if they are subjected to a strong enough signal, pushing them on to the non-linear part of their characteristics.

Compare the circuit of a simple crystal receiver with that of the first stage of a transistorised amplifier, Fig.1. Here the similarity is very apparent, particularly if it is remembered that the transistor is only a development of old-fashioned crystal diode. The complete crystal set naturally incorporates an

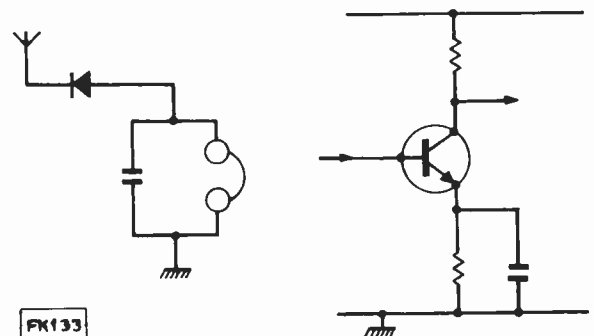


Fig. 1: A simple untuned crystal receiver, left, can be compared with a typical transistor audio amplifier stage.

aerial and a tuned circuit to enable one to select the required station. The audio system does not deliberately incorporate either, but any wire will act as an aerial and in the absence of tuning any strong local signals are picked up on the, often, too generous speaker, pick-up, tape, mains or other inter-connecting leads.

It is possible to fit filter chokes to the various leads and, in most cases, to cure RFI troubles even where an inadequately protected amplifier is involved. On the basis that protection is better than a cure we shall look at basic amplifier design and see what can be done by the manufacturer. Service engineers and the more knowledgeable enthusiast will see the possible modifications that may be incorporated in existing equipment.

The writer would warn that alterations to the circuit panels of amplifiers should only be undertaken by those who have the experience and test equipment needed to sort out any difficulties that may arise. Radio amateurs in particular are warned that it is bad policy to undertake internal modifications to other people's equipment as one tends then to be automatically blamed for any subsequent faults that may arise.

SIGNAL HANDLING CAPABILITIES

Before a stage can detect radio frequencies it has to be pushed to the non-linear part of its characteristic. Stages which are designed to handle a few millivolts of audio are therefore much more likely to act as unwanted detectors than are driver and output stages which will handle much larger signals without overloading. Improvements in transistor technology have tended to extend the frequency response of all small audio transistors well into the VHF range so that their improved characteristics have made the problem worse. This is a point worth remembering should an old amplifier suddenly develop RFI problems after it has been serviced, as it is just possible that by replacing an old transistor with a modern type, unwanted VHF or UHF reception may occur where it was not previously evident.

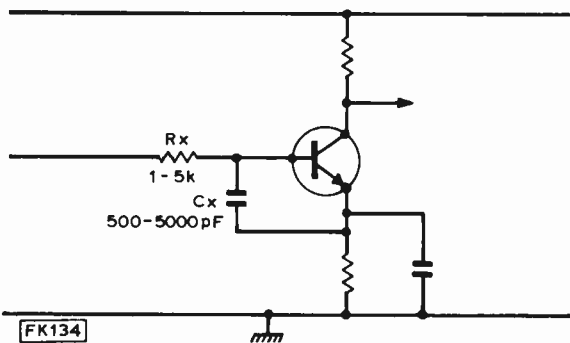


Fig. 2: A resistor and capacitor connected as shown here can frequently eliminate interference from an audio stage.

Most unwanted noises in amplifiers tend to originate in the input stages not because these stages make the most noise, but because the input stages are followed by a great deal of amplification and hence the smallest inputs are greatly magnified. The same argument applies to RFI problems as the smallest amount of signal detected in, say, the pick-up input stage will still produce a very considerable sound from the loudspeaker. Fig. 2 shows how RFI

protection can be added to such a stage. Note that the sensitive part of the transistor is the base/emitter junction so the capacitor must be connected as shown and not between base and chassis.

CAPACITORS

Capacitors in practice possess inductance, and even resistance, as well as the required capacity. Maximum possible effectiveness in reduction of RFI susceptibility would necessitate a perfect capacitor soldered in with zero length leads. In practice the best type of capacitor to use is the disc ceramic and if this is soldered in with the shortest possible leads the inductance and resistance will be small enough to make it effective up to the VHF range. The best value of capacitor is a compromise as it is desirable not to affect the response of the amplifier at the higher audio frequencies.

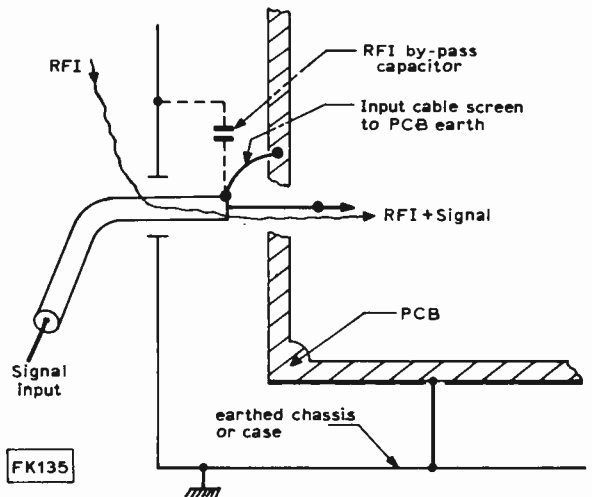


Fig. 3: RFI is often introduced into amplifiers via input cables when their screening is not properly earthed. Capacitor shown dotted should be fitted to all such cables.

When modifying a stereo amplifier it is as well to add the capacitors in one channel only so that any adverse effect on the frequency or square-wave performance can be judged by comparison with the unmodified channel. Usually it is best to fit the largest values of capacitors possible without affecting the audio response unless the RFI is above 5 MHz or so when there is no need to fit a capacitor more than a few hundred pF. Remember, that to be effective at the higher frequencies the leads must be very short, as an inch of connecting wire will add enough inductance to make the capacitor completely ineffective in the VHF region.

Above 100 MHz or so it becomes increasingly impossible to make C_x (Fig.2) effective and here R_x comes into its own. If R_x is several hundred times the input impedance of the transistor unwanted VHF and UHF signals will be reduced in proportion. In cases of trouble with break-through of radar, or other extremely high frequency signals, the length of lead from R_x to the transistor and R_x itself may even act as an aerial. In these extreme cases a cure can usually be effected by slipping a few ferrite beads on to the base lead of the transistor. This modification converts the lead into an RF choke and can be quite effective in the VHF range as well.

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- TP12* 4 BY127 Silicon rectifiers 1000 pIV 1 amp. Plastic T.V. rectifier.
- TP13* 5 OCP71 Light sensitive transistors.
- TP14 20 OC71 germanium PNP audio pre amp transistor, black glass type.
- TP15 20 OC81 germanium PNP audio output transistor, white glass type.
- TP16 20 OC200/1/2/3 transistors, PNP silicon TO-5, unmarked.
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- TP19 100 Diodes, mixture of germanium, gold bonded, silicon, etc. a useful selection of many types, marked and unmarked.
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- TP30 20 NPN silicon planar transistors, TO-18 similar to BC108 etc. un-coded.
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Besides protecting the individual sensitive stages of an amplifier, it is also advisable to restrict the ways that radio frequencies can gain entrance to the circuit boards of amplifiers, especially in the low level stages. Naturally on any properly installed equipment one would expect all pick-up, tape, radio and any other low level connections to be well screened, but as will be seen this screening is not at all effective at the radio frequencies with which we are concerned.

As an examination of most amplifiers will show, the "earthy" side of the input socket is not connected to chassis but is returned to the main printed circuit panel. This is done to achieve a one-point earth arrangement in the interest of minimum hum. Fine as this arrangement may be from a hum point of view, it is very unsatisfactory as far as RFI is concerned, as radio frequency signals which are present on the outside of the screen of the connecting cables go down to earth via the amplifier's printed circuit panel. Printed circuits can have quite an appreciable impedance at radio frequencies which results in radio frequency voltages being developed across the board and, likely as not, being injected into the sensitive stages of the amplifier, Fig.3.

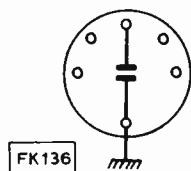



Fig. 4: After treatment of transistors all input sockets should have by-pass capacitors fitted with the shortest possible leads.

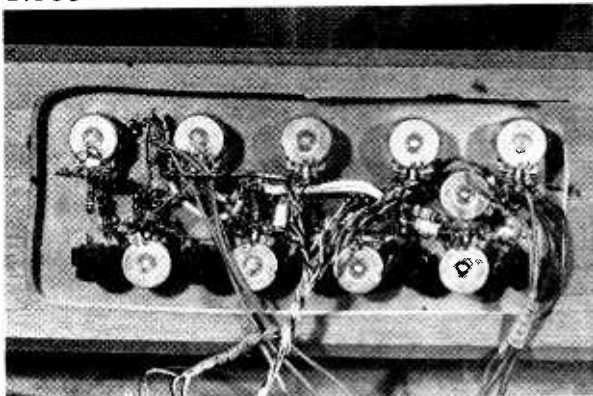
Fortunately there is a simple remedy for this problem, this being to connect a capacitor from the earthy side of each input socket directly to chassis, as shown. Once again the value of the capacitor will be somewhat of a compromise, a few hundred pF being the best at the higher frequencies, and perhaps say $0.1\mu\text{F}$ or so if troubles are due to a station on the long waves. In practice a disc ceramic capacitor of about $0.01\mu\text{F}$ connected with the shortest possible leads between the earthy side of the input sockets and chassis will be found quite effective at most frequencies.

THE SUGDEN A21 AMPLIFIER

Several years ago the Sugden A21 stereo amplifier did not contain very much RFI protection. It gave excellent sound quality and sold well but retailers, such as my company, found that customers were complaining of hearing calls from local radio amateurs, taxi stations or clicks and plops from thermostats and electric lights. Fortunately James Sugden, the designer, was (unlike some who could be named!) only too anxious to improve his product in any way possible. A high power amateur radio transmitter was used to carry out some tests. The results of these tests were that capacitors were added between base and emitter of each of the four transistors in the preamplifiers, and one added directly behind each of the input sockets, Fig.4. 

TO BE CONCLUDED

DISCO STEREO SYSTEM—continued from page 850.



The completely interwired mixer panel viewed from the rear.

checked by connecting a 4.5V battery across the speaker terminals and seeing that both cones move in the same direction.

Phasing is also important when connecting a number of cabinets to the console and it is useful to colour code loudspeaker leads to eliminate guesswork—the usual code is that when the red lead is positive the cone moves outwards.

With an output power of 100W per channel, this Disco Console is capable of producing very high sound levels and apart from the general nuisance aspect it should be remembered that research has shown that regular exposure to high sound levels can be damaging to the hearing mechanism.

With the best will in the world it is possible to construct a piece of equipment which turns out to be faulty on 'switch-on'. Any faults in the pre-amp section can be easily traced but the power amplifier poses some problems as it is a DC coupled design.

To reduce the possibility of damage three 24V 12W bulbs can be connected in series in place of the 2A DC fuse during testing. The lamps will limit the short circuit current to a relatively safe 500mA, while still giving virtually the full supply voltage if the amplifier is not drawing excess current. Under no signal conditions the amplifier should operate with Tr15 emitter (Tr16 collector) at half supply voltage. Tr11 emitter should be at almost full supply voltage.

When a new amplifier has been put together using 'off-the-shelf' components which may have been stored a while it may be that the electrolytics are not properly formed, giving rise to an initial surge at 'switch-on' which may damage Tr9 or Tr10. To reduce the possibility of damage in this way only fresh electrolytics should be used, otherwise stored components should be formed before use.

Note: In the components list in Part 1, under Power Amplifier, Miscellaneous, the heatsinks specified should be as follows: R.S. Type 154 heatsinks for Tr11, Tr111, Tr13, Tr113, Tr14, Tr114; and TO3 insulating kits for Tr15, Tr115, Tr16, Tr116.

Also it has been found that an improvement in performance is obtained by increasing R19 to 560Ω .

In Fig. 2 C13 should be $10\mu\text{F}$ as stated in the components list.

In the Light Modulator components list, p 782 January 1976, C30 should be $8\mu\text{F}$ and C32 should be $0.5\mu\text{F}$ as in Fig. 5, p 783.

NOTE: In Part 2 Fig. 5, bottom of secondaries of T2, T3 and T4 should go to cathodes of SCR's and not to anodes (neutral) line. In Fig.6 C11 should read C12 and vice versa.

HOTLINES

ON RECENT DEVELOPMENTS

THE U115B

ONE of the dreams of amateur radio set builders was a radio which was contained on a single chip. One popular path to this dream was the ZN414 IC which contains a very useful t.r.f. approach. I hear that a new chip will shortly be introduced to professional set manufacturers which could be of great interest to home constructors. The magic number to remember is U115B.

The U115B is reported to contain, on its 2mm² surface, all the major functional bits and pieces for an a.m. receiver plus an f.m. demodulator. It appears that the only components external to this IC are the various tuned circuits—tuning capacitor and coil, i.f.t.'s, etc. and a potentiometer to control volume although it is also reported that certain discrete devices are also needed for the f.m. circuitry. If one was only interested in a.m. then presumably very few external components would be required to build a superhet receiver.

One problem often associated with this type of chip is that there is only sufficient drive available at the output to give very small power, and further stages of audio amplification are commonly needed. Not so with the U115B. The chip contains tuner, local oscillator, mixer for a.m. reception, demodulator ditto, i.f. stage, a.f. amplifier, and an f.m. demodulator. The range for acceptable working voltage is very wide; from 3V to 11V, and the twist in the tail is that it will provide 800mW into 8Ω which, of course just conveniently happens to be one of the standard impedances for loudspeakers.

L.E.D. DISPLAYS

Digital displays are now commonplace and are employed in a wide variety of applications. Those which use the l.e.d. approach usually require some form of driver stage to literally drive the l.e.d. arrays and some form of memory is also often employed too. I was pleased to note that one manufacturer is marketing an l.e.d. array in which the numbers are formed by a series of l.e.d.'s

arranged in a dot pattern. That in itself is not, of course, so special. However, something else is built in on the same chip—all the necessary decode and drive circuitry. If that isn't enough, a memory is also included and the whole thing has just eight pins in a dual in-line configuration.

The display itself is almost 0.3in. high and it is also TTL compatible. All you (the user) have to do is simply to address the device directly with a four-line BCD input. I fear that before very long, even more circuitry will end up on the chip—perhaps even the user will find himself there one day.

CQ!

Early Amateur radio stations comprised a transmitter, receiver and frequency meter. The latest commercial stations offered to the Amateur are compact, table-top units which house all these separate items in a single package. I see that an instrument manufacturer has followed this approach and now offers an oscilloscope, digital multimeter and a digital counter all in a single, compact case. It really is a very desirable property, but I will not mention further details (a) because of lack of space, (b) so's not to make you discontented with what you have and (c) the price would ruin your New Year. Keep smiling!

ENERGY

I note with interest that in the US much work is bubbling on the photocell front. Energy from the sun, and with no moving parts is a great attraction—and the energy so gained is free—my life. Of course, one hears lots of rumours about cell efficiencies etc. but practical details are harder to come by. However, I hear that one array of cells on order (to be delivered shortly) will provide some 40kW of energy. Elsewhere I hear that a number of companies in the US are ready to supply panels of cells around 6 x 4ft providing some 5½W

per square foot. There is even mention of 50-cent cells by 1980.

While on the subject of power, hands up if you've heard about the latest in long-life batteries. Not those that your dealer is always trying to "cell" you (sorry, pun intended) but those using nickel and hydrogen. These new beasts are claimed to offer up to four times the watt/hours per pound as is currently available from state-of-the-art nickel-cadmium cells. No further information at present but sufficient to say that the US military are already designing these batteries into their satellite programme. Definitely batteries that will be out of this world!

AHH SO!

Damn clever those Chinese—but are the Japanese even more clever? Certainly one electronics company is trying hard to prove that this is the case. Early in 1976, one Japanese company is to launch what is thought by many (including mistress Ginsberg) to be the most elaborate channel selection device ever. It has been developed specially for use with colour televisions and it allows the owner/viewer to programme in his selection of chosen TV programmes for the day. The readout on the TV screen itself displays the time selected and the channel selected at that particular time. Once programmed, the device will automatically select or tune the appropriate channel at the correct time. Up to 16 programmes can be selected and "dialled" in.

The circuit is rumoured to contain a chip which is only just over 5mm² and contains nearly 8,250 transistors. No mention of price but what with extra sophistication driving the prices up, plus more than a little help from inflation, I really do wonder if The Six Million Dollar Man will be watched on the Six Million Dollar TV Set!



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- ln_x Natural Logarithm Key
- x^x to the xth Power Key
- y^x y to the xth Power Key
- $\sqrt[x]{y}$ The xth Root of y Key
- x:y Exchange Key
- STO Store Key
- RCL Recall Key
- Σ Sum and Store Key
- - Subtract Key
- \times Multiply Key
- \div Divide Key
- = Equals Key
- x^2 Square Key
- \sqrt{x} Square Root Key
- $1/x$ Reciprocal Key
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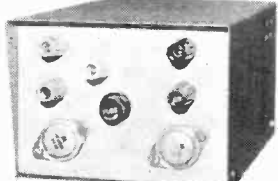
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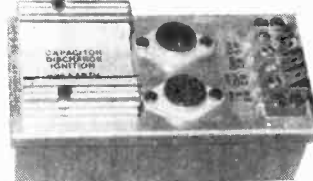
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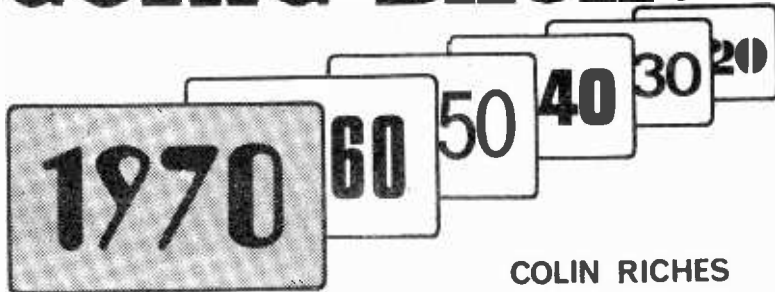
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ASTRO ELECTRONICS, Spring Bank Rd., West Park, Chesterfield.

GOING BACK...



COLIN RICHES

Faraday Lecture

THE 1975-76 Faraday Lecture, organised by the Institution of Electrical Engineers, is being given by F. Howard Steele, Director of Engineering at the Independent Broadcasting Authority. His lecture, "The Entertaining Electron", unravels the technical mysteries of television.

The first presentation of the Lecture took place in The City Hall, Cardiff on Monday, November 24th at 6.30 p.m.

Mr. Steele is assisted by two deputy lecturers: Alan James, the IBA's Network Manager and Dr. Boris Townsend, Head of the IBA's Engineering Information Service.

Each year the Institution of Electrical Engineers invites an eminent electrical or electronic engineer to present the Faraday Lecture. The Lecture was instituted in 1924 to commemorate Michael Faraday, the British physicist who in 1831 discovered electro-magnetic induction and so set in motion a whole new industry.

The lecture tour programme is as follows: Birmingham, The Town Hall, 26-27 January, 1976; London, The New London Theatre, 3, 4, 5, 6 February, 1976; Exeter, The Great Hall, Exeter University, 26 February, 1976; Bradford, St George's Hall, 9 March, 1976; Nottingham, The Albert Hall, 11 March, 1976; Liverpool, Philharmonic Hall, 19 March, 1976; Manchester, Free Trade Hall, 22-23 March 1976; Glasgow, The Kelvin Hall, 21 April, 1976; Edinburgh, The Usher Hall, 23 April, 1976; Newcastle, The Newcastle City Hall, 27 April, 1976; Portsmouth, The Guildhall, 4 May 1976.

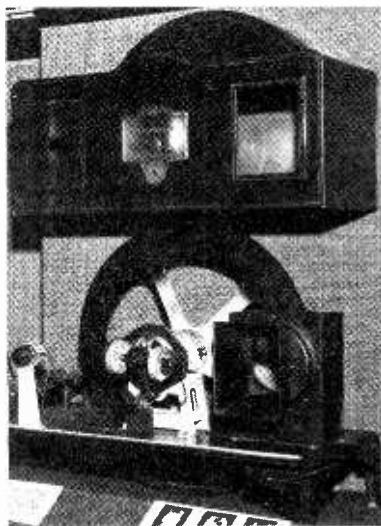
The presentation follows the Faraday tradition in its many

practical demonstrations and working models—but it also borrows from television production techniques in exploiting audiovisual aids including film, videotape and large screen television displays.

The Lecture makes full use of a special, complex mobile stage in explaining both the technology and the role of engineering in the production and presentation of television programmes.

The latest technological developments that may help to mould the shape of television during the coming decade are explained in a manner that seeks to make them understandable and meaningful to the interested layman, in an informative yet entertaining manner.

The Lecture ranges over the developments of the technology, from the earliest Baird 30-line television, to optical waveguides, quadrasonic sound and Oracle teletext.



Baird's 'Televistor'
—Science Museum Photograph.

Modern colour television operations will be explained with the aid of film and video-tape recordings, with some of the first displays to be given in the United Kingdom by means of a new "large-screen" television display system.

The advances made possible in the unfolding pattern of television technology with the aid of computers will be emphasised by teletext, by the latest DICE standards conversion and by such applications on adaptive aerials that adjust under the control of a small computer to minimise interference from several different sources.

The mobile stage will permit a series of demonstrations in which the aim will be to show how science and engineering have become so much a part of everyday living that the viewer takes the technology virtually for granted—but technologists continue to seek new ways of using "the entertaining electron" to create ever more convincing illusions and to expand home entertainment systems into new and exciting fields.

Tickets for the Lecture are free and are available from Mrs. B. Newman, IEE, Savoy Place, London, WC2R 0BL. The Lecture lasts approximately 1¼ hours.

Baird Television 1930

THE "Televistor" (see left) was manufactured by the Plessey Company for Baird Television and was priced at 25 guineas. It was intended for reproduction of Baird's 30-line transmissions which the BBC radiated on an experimental basis from 1929 onwards.

The picture signal from the owner's radio receiver varied the brightness of a special neon lamp having a rectangular luminous electrode. The lamp was viewed through the 30 small holes arranged in a spiral round the outside of the large disc which rotated at 125 revolutions per second. This form of scanning had been patented by Nipkow in 1884.

A magnifying lens in front of the disc increased the effective picture size to about 50 × 75mm.

The motor driving the disc was synchronised by means of a cogged wheel on its shaft which was in between the pole-pieces of an electromagnet energised by the picture signal.

Dear Sir,



Electronic plumber

Working on the principle of "fools rushing in, etc." and realising all that was needed was a good plumber with a small blow-lamp I had a go at the Tele-Tennis project. I went a bit mad with the ferric chloride bottle but after a couple of attempts the boards were made and the thing worked. All praise for the clear instructions which I realise must frustrate the pundits as even I was able to cope.

There is one problem arising. Now, being an electronics expert, as acknowledged by my daughters, they consider that a small organ of a couple of octaves would be a piece of cake by Christmas! So what about it, PW?

—P. J. Gale (Aylesbury)

P.S.—Yes! The kids are better at the damned game than me!
(Thank you for the few kind words Mr. Gale, your wish was granted in the January issue. We hope it will make a suitable Christmas project for very many of our readers. Incidentally, we think you are being just a bit too modest about your constructional abilities!)

Short thanks

I would like to thank the gentleman who sent me 'PW' July 72 for which I asked in your CQ column.

He did not enclose name and address but it was postmarked Leeds.

Incidentally, I have on three occasions replied to a "CQ" offering assistance to a query but in no case have I received an answer.—
W. G. Philpott (Rye, Sussex).

Boost your signal

Reading your October issue of PW, I noticed the article on a signal booster for portable radios. I lost no time in constructing a mock-up of the design and can confirm its efficiency. However, I think you will find that it is unnecessary to amplify the output of the coil if a reasonably good aerial is used. If the coil is made to a similar design as the ferrite rod aerial in the I.C. tuner (also in the supplement) all that is necessary is for the unit to be positioned, with the core aligned with that in the set. I find it desirable to wind this coil in such a way that it tunes from 200 to 550m when the aerial and earth are connected to the extra ends. There will be some signal loss if taps, separate coupling coil or series capacitor are employed. This means finding the number of turns by experiment.

I have not yet tried the long waves, but I think the results should be similar, though I suppose the coupling would not be quite so efficient.

I feel sure your readers would be glad to know that signal boosting can be obtained this way without the complication of transistors and associated extra components.—K. H. Smith (Ross-on-Wye).

What price progress?

Derek Bell's notes in the December issue of Practical Wireless (Shortwave broadcasts, p701), about the oldest set in regular use, prompts me to write about an Amplion "Delegate" which my wife bought at a jumble sale a year ago, for twenty pence.

Having replaced a broken dropper resistor, and receiving nothing but a cultured hiss, I was led, by intuition and experience to the oscillator/mixer valve, where however, voltages seemed normal. Replacing the valve gave no joy. After hours of cogitating, I was reduced to quite purposeless poking at the valve-holder tags with a plastic knitting needle. Suddenly, the set burst into life, but died again when the prod was removed.

When the valve-holder was

broken open, I found that the interior connection had corroded away. If I had done what the books say, and measured the voltages at the valve pins, instead of the valve-holder tags, I should have been all right!

The only clue to the age of the set, is the marking of the various Radio 4's as "London Regional", "North Regional", and Radio 2 as "Light". It uses a barretter (imagine!), and is contained in a lovely inlaid walnut rectangular cabinet 330×205×165mm. The speaker is hidden behind a beautiful set of tiny louvres. It is a little cracker; the aerial socket is connected to the outer braiding of a disused TV aerial, and on SW, the Voice of America may easily be received. I think it has a wider frequency response than most modern portable AM receivers, and is in regular daily use.

One wonders just where miniaturisation has taken us; this set uses five large valves, whopping IF transformers, large air coils, and a barretter to boot. Yet in size, it is no larger than the average modern portable set.

H. Padmore (Blackpool)

Socket-to-me

At the time of writing, one of your advertisers, CT Electronics, has for sale small signal TO18 (BC107/8/9) transistor sockets. After having purchased a fair number of these sockets, I've found a simple way of modifying them for 4 and 6 lead IC's like the μ A703 used in the SW Pre-amplifier September '75.

The correct socket for this device costs around 35p, but the 'CT' sockets cost 4½p each. Two are required for each four or six lead device.

To construct these, file the 'open' edge of the socket until the two small pips on the underside are half removed. The filed edges of the two sockets should now be Araldited together making a single unit. This arrangement will hold the IC tightly with a little careful bending of the leads, and is of course very much cheaper.—
M. J. Shepherd (Canvey Island).

Snap in

IN NEXT MONTH'S PRACTICAL WIRELESS

our TUNER CASSETTE

Have you ever wished that you could get some radio programmes on your cassette player? Build this simple tuner unit and load it into your player whenever you get fed up with your tapes.



also:

CMOS Crystal Calibrator &



Using seven cheap CMOS devices this calibrator provides outputs to well above 30MHz from a 1MHz crystal. Decade dividers provide outputs down to 1Hz if required, for checking counters and other digital circuitry at speeds slower than normal.

UP-DATED

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ALL THE
REGULAR FEATURES
ON SALE IN FEBRUARY

'STEP BY STEP'

GENERAL COVERAGE RECEIVER

F.G.R.

PART 1

THIS receiver covers approximately 500kHz to 30MHz and is constructed so that it can be developed by the addition of extra stages, which in turn give better reception and extra facilities such as the reception of CW and SSB. Because a large, comprehensive receiver has circuitry which can represent quite a long period spent on construction, before it is finished and can be operated, there is considerable advantage in beginning with a simpler circuit, to which further stages can be added. A working receiver is then obtained quickly. Difficulty in locating a fault in a relatively complicated receiver is also avoided, as the working of extra stages will be checked as they are added.

CIRCUIT DETAILS

Shown in Fig. 1 is a block diagram of the whole circuit, but only stages 2, 3, 5 and 7 need be wired initially to obtain a receiver of good general performance. A brief description of the function of each section in Fig. 1 should be of help in understanding how the receiver is improved as optional stages are added.

(1) The RF amplifier is a protected dual-gate FET giving a worth-while increase in sensitivity. Being tuned the RF stage also helps to eliminate second channel interference. An RF gain control is

fitted as strong signals can overload the mixer.

(2) FET mixer, to which the aerial may be taken directly when making the basic receiver. Output from this stage is at the intermediate frequency of 1.6MHz.

(3) FET separate oscillator. It must be noted that the devices in stages (1), (2) and (3) use valve type coils, not transistor types.

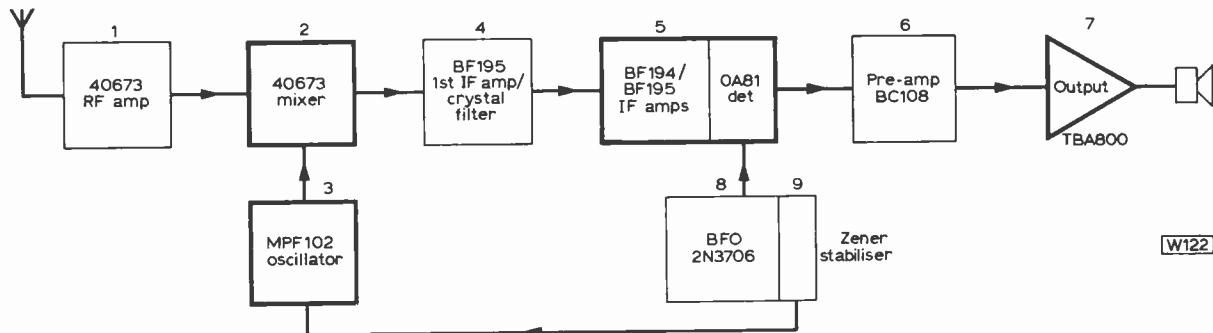
(4) An optional intermediate frequency stage to increase sensitivity and selectivity. It can be used as a crystal filter with a single crystal and phasing capacitor. The maximum selectivity obtainable with such a circuit is high, but selectivity is easily degraded or the crystal cut out to provide optional levels of selectivity, and for the reception of AM.

(5) This section has two IF amplifiers, with five 1.6MHz tuned circuits. So there are seven tuned circuits in all when (4) is used giving the IF section good skirt selectivity to reject unwanted signals.

(6) This is an optional pre-amplifier to boost audio signals, and may not be felt necessary in some cases.

(7) An audio IC which requires few components and gives sufficient loudspeaker volume from a 9V battery supply. As with any receiver having considerable gain it is of course, possible to overload

Fig. 1: below, is a block diagram to show the functions of the various stages. Those stages in heavy outline are the essential ones for the basic receiver. Fig. 2, right, is the circuit for the first three stages but the RF stage, Tr1, can be omitted initially, as explained in the text.



W122



AYER G30GR

This simple-to-build design makes life very easy for those building their first receiver. The set is soon operational on any required range with just one set of coils. Further optional stages can be added, one at a time, finishing off with the switching of the four ranges to provide coverage of the medium wave band and all the short wave bands. Facilities provided by the complete receiver include:

- RF Amplifier ● Bandsread Tuning ●
- Beat Frequency Oscillator ● Crystal IF
- Filter ● Noise Limiter ● Mains Power
- Supply Unit.

output (or even other) stages, so the gain and volume controls have to be operated in a sensible manner.

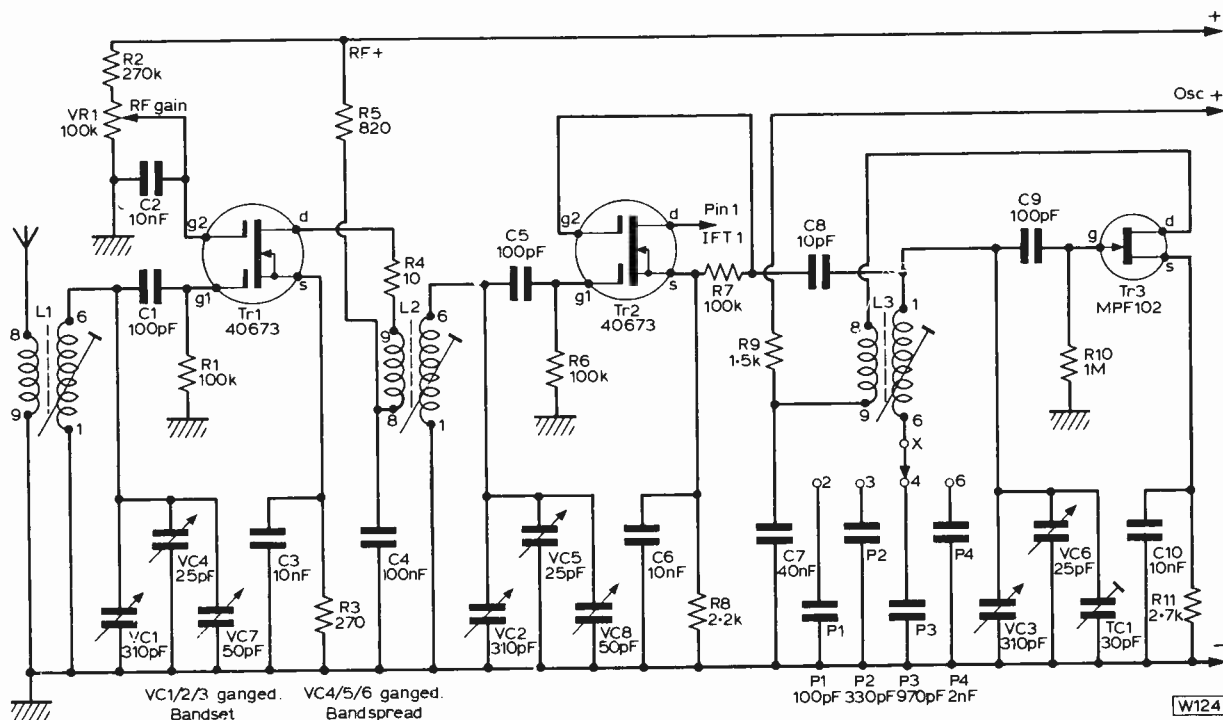
(8) The beat frequency oscillator/carrier oscillator allows reception of CW and SSB signals. As an envelope detector can give satisfactory CW and SSB reception, in addition to AM, when the relative strengths of CW/SSB on the one hand, and BFO on the other, are suitable, this type of detector is provided in section (5).

(9) A regulated supply for the oscillators is not essential but avoids frequency modulation effects, particularly when the extra stages or BFO are in use.

TUNING ARRANGEMENTS

A 3-gang capacitor tunes stages (1) (2) and (3). Layout is arranged to allow addition of a ganged bandsreading capacitor later, which is useful for Amateur or other narrow short wave bands. To obtain best performance without banks of pre-set trimmers, stages (1) and (2) have panel trimmers. These allow the peaking up of weak signals at any frequency and with almost any aerial.

The bands covered are approximately as follows



W124

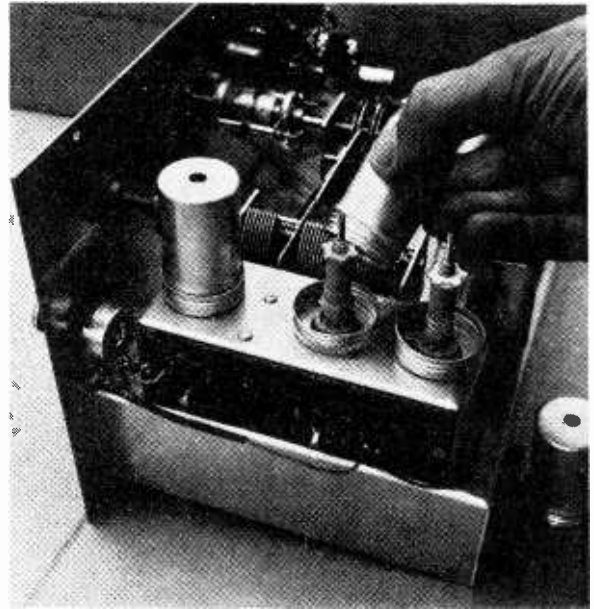
("Range 1" being the maker's long wave band, which is omitted):

Band 1 (Range 2)	1500 to 500kHz
Band 2 (Range 3)	1.7 to 5.0MHz
Band 3 (Range 4)	5.0 to 12MHz
Band 4 (Range 5)	13 to 30MHz

Coverage may be adjusted to include the 1500-1700kHz sector, but it should be understood that instability must be expected around the 1.6MHz region in this case, the receiver IF.

Bandchanging is by plug-in coils. Advantages of this are the simplicity plus avoidance of a multi-way switch. There is also no need to purchase coils for bands not wanted. A set of coils can be changed in a few moments, and even this is not necessary if most interest is in one particular range of frequencies. However, the layout is arranged so that bandswitching can be added later, the switch and coils occupying the space below the RF/mixer/oscillator assembly.

It is not necessary that the optional stages are added in the order in which they are described, as some other combination might be preferred. For example, the BFO could be added to sections 2, 3, 5 and 7, instead of later.



View of the RF-Mixer-Oscillator unit of Fig. 2. The aluminium containers in which the coils are supplied are used as screening cans.

METALWORK

Assuming that the bandspreading and other extra controls will be fitted eventually, it is best to punch or drill for these at the beginning. Unused holes in the panel can be covered, or have the controls only installed. The layout of units will be seen from Fig. 3. The panel is 12x7in and the chassis is 10½x6½x2in. Place panel and chassis together and mark the holes on the chassis. To fit the cabinet the panel edge is about 3/8in below the chassis. Panel and chassis are held together by the controls, or initially, by bolts with large washers.

The bandsetting and bandspreading capacitors have their spindle centres 3/4in apart. Bolt the main tuning capacitor directly to the chassis. Slotted or enlarged holes, with washers, will allow the exact

position to be adjusted a little, if necessary, to line up with the drive correctly. As the bandspreading capacitor is smaller it is raised with 4BA nuts so that its shaft is at the same height. Small holes can be drilled in the chassis later, provided metal fragments are not allowed to fall into the capacitors or other components, but large holes should be made before mounting any parts.

The cabinet could be prepared later. Punch or cut holes (at least 1in in diameter) opposite aerial, earth and speaker sockets. If the top is to be made to open, to reach plug-in coils or the battery, either of two methods can be used. Both have been found satisfactory, but the second takes longer.

(1) (The easy way!) Drill out the six rivets which hold the top to back and sides. Pivot the top by two 6BA bolts through the side rivet holes near the

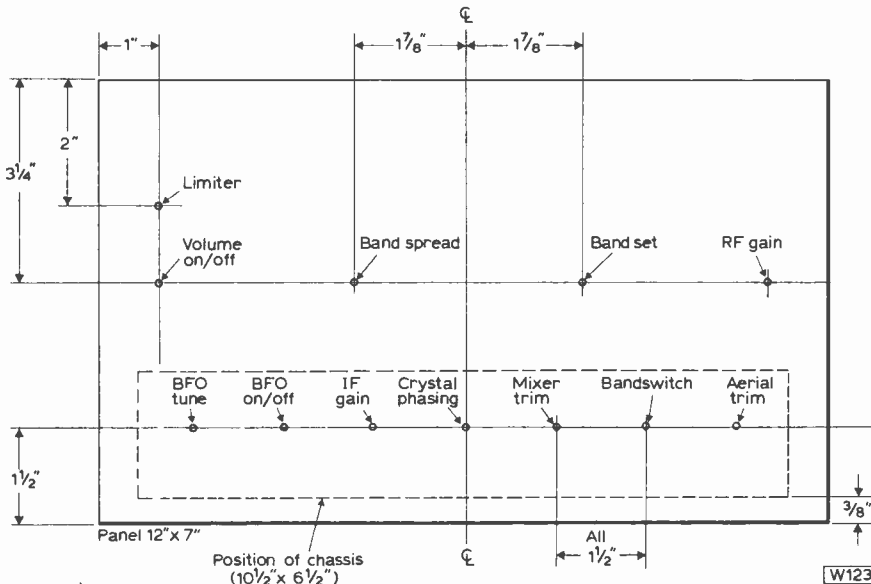


Fig. 3: Details for marking out the front panel. Most of the holes will be 1/16in diameter but check with actual components used. It is advisable to drill all the holes from the start even if the optional stages are not added until later. After fitting the chassis to the panel check that they fit into the cabinet properly.

★ components list

RF—MIXER—OSCILLATOR

Resistors

R1 100k Ω	R5 820 Ω	R9 1.5k Ω
R2 270k Ω	R6 100k Ω	R10 1M Ω
R3 270 Ω	R7 100k Ω	R11 2.7k Ω
R4 10 Ω	R8 2.2k Ω	VR1 100k Ω linear pot.

Capacitors

C1 100pF	C6 10nF	P1 100pF	} 5%
C2 10nF	C7 40nF	P2 330pF	
C3 10nF	C8 10pF	P3 970pF	
C4 100nF	C9 100pF	(500 + 470)	
C5 100pF	C10 10nF	P4 2nF	

VC1-2-3 3 x 310pF (Jackson Type L) gang
VC4-5-6 3 x 25pF (Jackson Type 00) gang
VC7 VC8 50pF air-spaced variable (Jackson Type C804)
TC1 30pF Beehive or ceramic trimmer

Semiconductors

Tr1 40673	Tr2 40673	Tr3 MPF102
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Inductors

L1-L2-L3 Miniature plug-in coils, valve type, (Denco) L1 Blue L2 Yellow L3 White (Ranges as required)

Miscellaneous

Valveholders B9A, 3-off. Flanged runner, universal chassis, 8 x 2in. Plain panel 5 x 2in. (Home Radio). Tuning drives:—Bandset, Jackson 4103 or similar; bandspread, Jackson slow motion drive 4511/DRF with dial 3in. dia. (Home Radio). Cabinet 12 x 7 x 7in. type W and chassis 10½ x 6½ x 2in. type K (H. L. Smith, 287 Edgware Road, London W2.) Knobs. Insulated sockets for aerial and earth. Jack socket for headphones or speaker, see text. Plain veroboard 0.15in. 5 x 2in. Note:—Cabinet type W includes panel.

BASIC IF AMPLIFIER

Resistors

R12 47k Ω	R15 390 Ω	R18 10k Ω
R13 1k Ω	R16 120k Ω	R19 1k Ω
R14 330k Ω	R17 27k Ω	

Capacitors

C11 8 μ F 6V	C14 200 μ F 10V
C12 10nF	C15 10nF
C13 100nF	

Semiconductors

Tr4 BF194	Tr5 BF195	D1 OA81
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Miscellaneous

IFT1, type IFT18/1.6. IFT2, type IFT18/1.6. IFT3, type IFT17 (all Denco). Plain veroboard 0.15in. 3 x 1½in.

AUDIO AMPLIFIER

Resistors

R20 56 Ω	R21 1 Ω	VR2 100k Ω log. pot with switch S1.
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Capacitors

C16 1 μ F 6V	C19 100 μ F 10V	C22 250 μ F 10V
C17 4.7nF	C20 330pF	C23 470 μ F 10V
C18 75pF	C21 2.2nF	C24 100nF

Miscellaneous

IC1 TBA800. Plain veroboard 0.15in. 2½ x 2in. For power supply circuit:—R22 220 Ω R23 1k Ω (or 3.3k Ω see text) C25 1000 μ F 10V.

BEAT FREQUENCY OSCILLATOR

Resistors

R24 270k Ω	R25 270 Ω
-------------------	------------------

Capacitors

C26 250pF	C28 4.7nF
C27 400pF	C29 6.8pF
VC9 10pF air spaced variable (Jackson C804)	

Miscellaneous

Tr6 2N3706 or similar D2 6.2V 400mW zener. S2, miniature slide on-off switch. Coil former 7mm with core. Plain veroboard 0.15in. 2½ x 1½in.

CRYSTAL FILTER

Resistors

R26 120k Ω	R29 330 Ω
R27 39k Ω	R30 270k Ω
R28 150 Ω	VR3 100k Ω linear pot.

Capacitors

C30 470pF 1%	C32 100nF
C31 470pF 1%	C33 100nF
VC10 25pF air spaced variable (Jackson C804)	

Miscellaneous

Tr7 BF195. IFT4, IFT18/1.6 (Denco). Crystal 1.6MHz, and holder, HC6U preferred. Extension shaft, coupler and bush. Plain veroboard 2½ x 1in.

AUDIO PRE-AMPLIFIER

Resistors

R31 5.6k Ω	R32 1.8M Ω	R33 8.2k Ω	R34 5.6k Ω
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Capacitors

C34 100nF	C35 100 μ F 10V
-----------	---------------------

Semiconductor

Tr8 BC108

All resistors are ¼ or ½W 5 or 10%

back. Fit a small knob or terminal head to lift the lid, which closes on the side flanges of the case.

(2) Mark off about 1in from the sides, front and back. Drill small holes to start a metal saw and cut out this piece. Clean the edges with a file, and fit a cabinet hinge (or two small hinges) at the back. The opening part rests on two 6x1in strips bolted inside and projecting into the aperture. Fit a lifting knob.

RF, MIXER AND OSCILLATOR

The circuit of these stages is shown in Fig. 2. The RF stage can be omitted, as described, but is included here so that the method of connecting it

is clear. If the RF stage is not used, connect the aerial to 9 of coil L2, taking pin 8 to chassis. Tr1 and all components up to C4 and R5 are then not required.

VC1/2/3 is the ganged capacitor for main tuning, while VC4/5/6 is for bandspreading. Capacitors VC7 and VC8 are panel trimmers to peak the aerial circuit L1 and mixer circuit L2. With the oscillator trimmer TC1 set at about half capacitance, no other trimmers need be fitted.

A "Blue" coil is used for L1, a "Yellow" coil for L2, and a "White" (1.6MHz osc.) coil for L3. P1 to P4 are individual padders, automatically in circuit for each range. Pin X of the "White" coils is different for each range, so that only the required padder is

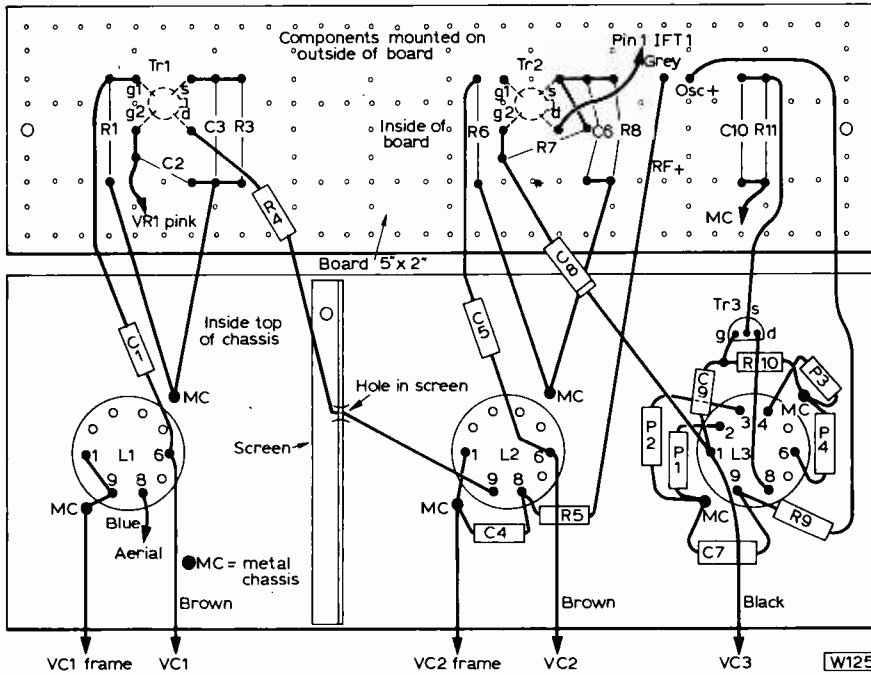


Fig. 4: Layout of parts in the RF-Mixer-Oscillator unit as viewed from the inside with the veroboard folded back for clarity. All leads should be kept as short as possible. NOTE: if the 40673 transistors are received with a wire shorting ring round the lead-outs this should not be removed until the unit is about to be tested.

actually in circuit. Potentiometer VR1 controls Tr1 gain by changing the gate 2 voltage. Tr3 is the separate oscillator and it can be supplied either from the 9V line, or from a zener stabilised circuit, when the BFO is fitted.

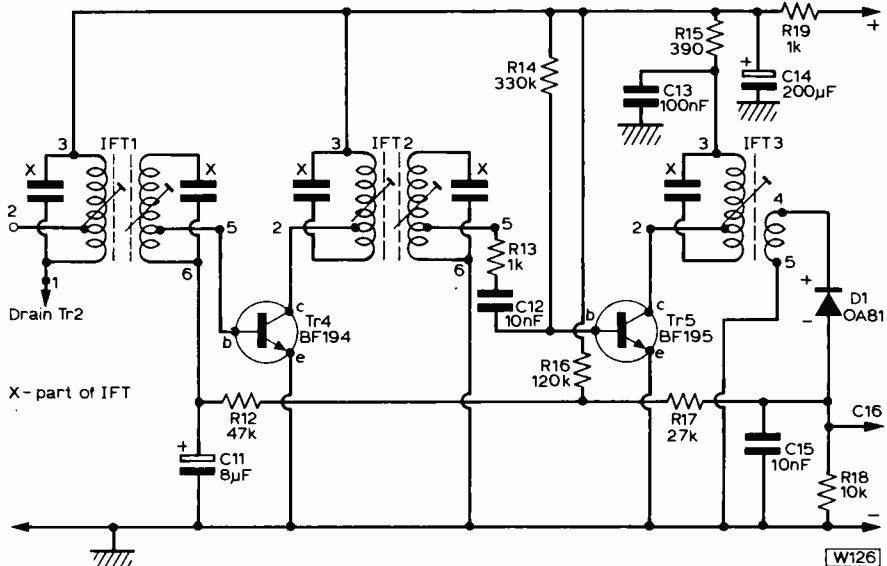
It will be realised that three coils (Blue, Yellow and White) are used for any one band, but that coils need not be obtained for bands not required. Range 4 is best for general short wave reception, while Range 2 can be omitted if no MW reception is wanted. Range 3 coils would cover both LF Amateur bands, 80 and 160m. Coverage on each band depends on the core setting of L3 and all cores are adjusted so that some threaded rod projects. With TC1 suitably adjusted. VC7 and VC8 should

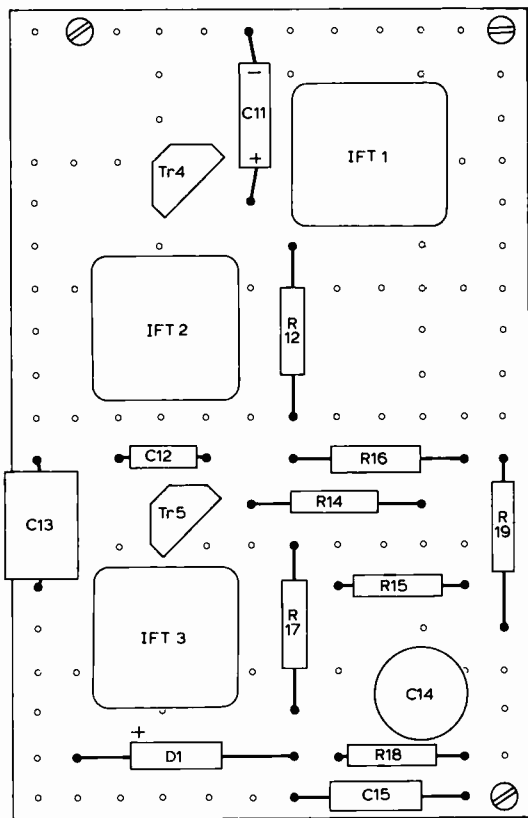
peak signals near the high frequency end of a band (VC1/2/3 nearly open). The cores of L1 and L2 are then set so that little re-adjustment of VC7 or VC8 will be needed near the low frequency end of the band (VC1/2/3 nearly closed).

Some misadjustment of L1 or L2 will cause no loss of efficiency, provided VC7 or VC8 is not fully open, or fully closed for best results. As initial wrong positioning of L1 or L2 cores, or VC7 or VC8 can result in complete loss of signals, check these if needed when first using a new range of coils. Subsequently, if L3 or TC1 is adjusted to obtain correct coverage, readjust the aerial and mixer to suit.

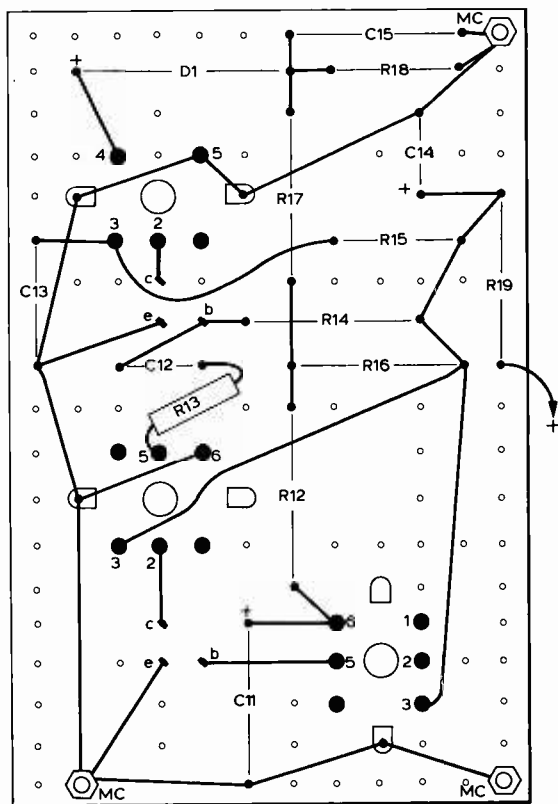
It should be noted that the IF transformers are

Fig. 5: Circuit of the IF amplifier stages and detector diode D1. Ensure that the diode is connected the right way round. Fig. 6: on the next page, shows the component and wiring sides of the IF amplifier board. Check that the BF194 goes into the Tr4 position and the BF195 into the Tr5 location.





Board 3"x 1 3/4"



W127

pre-aligned to 1.6MHz by the maker, so their cores should be left alone, except for a final small adjustment. The aerial, mixer and oscillator coils, however, are supplied in metal cans and for this reason are not set, and the cores must be screwed so that several turns of rod project, as described.

To leave the chassis clear below, the coil holders are fixed to the top of a metal frame 5x2x1 1/2 in high, see photograph. This is readily made by taking an 8x2 in flanged "universal chassis" side and cutting a 90-degree portion out of each flange 1 1/2 in from the ends, so that a right-angled bend can be made. Secure a piece of 0.15 in matrix plain perforated board with 6BA bolts. Wiring can then be carried out as in Fig. 4. The board is shown flat so that the wiring can be seen. Bolt a 2x1 1/2 in metal screen between aerial and mixer coil holders (it can be cut from a spare universal chassis side) and fit a coil can lid at each holder position. This is done by punching valveholder holes in the lids and holding them with the bolts which secure the coil-holders.

Fig. 4 shows the lead-outs for the RF mixer, and oscillator devices. "MC" points are tags bolted to the box. Connections should be short and direct and wiring and components for the aerial and RF circuits should be clear of Tr1 drain and later tuned circuit components. It is helpful to put short pieces of coloured sleeving on the FET leads, say red for drain, white for gate 1, brown for gate 2, and leave source leads bare.

Leads for external circuits are required, and may also be colour coded for easy identification later. A wire (blue) from pin 8 L1 is long enough to pass through the chassis to the aerial socket. Leads run from pin 6 of L1 (brown), pin 6 of L2 (brown) and pin 1 of L3 (black) to VC1, VC2 and VC3. A lead (pink) from Tr1 G2 circuit runs to VR1. A connection (grey) goes directly from drain of Tr2 to the IF amplifier. Positive circuit connections can be made to pins or by flying leads. Two leads run from MC tags at L1 and L2, Fig. 4, to the rotor contact plates of the ganged capacitor, to provide short RF circuits.

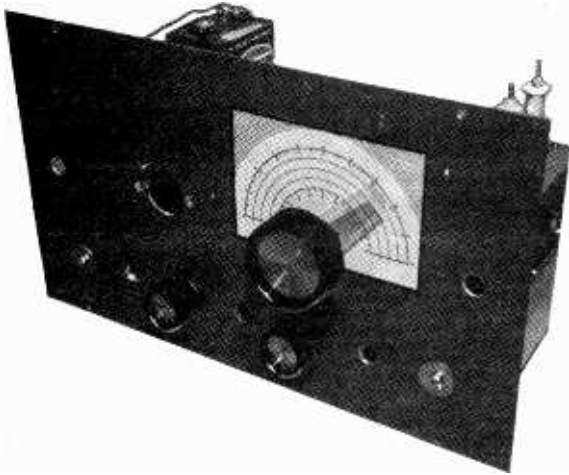
When this unit is finished it is placed near the ganged capacitor when it can be tilted sufficiently to allow soldering the leads to VC1/2/3. These should be as short as possible. The unit is set in position on the chassis and secured with self-tapping screws from below. Cut down Tr1 G2 lead and solder to VR1. R2 is soldered directly to VR1. A lead from VR1 runs to positive on the board.

A vertical screen was found necessary between RF and mixer leads to the bandspreading capacitor, when this was fitted, see photographs. It can be cut from a universal chassis runner. Wires running down from the tuning capacitor to the panel trimmers should also be clear of each other. Trimmer TC1 is soldered to stiff leads from VC3.

When coils are fitted, small holes in the top of the screening cans allow the cores to be adjusted. Screening of all the coils is essential when the RF stage is fitted. The possibility of the RF stage becoming unstable as the RF gain control is advanced depends somewhat on frequency, as well as on loading by the aerial and the shielding mentioned is to prevent this.

BASIC IF AMPLIFIER

This is unit (5) in Fig. 1 and employs the circuit in Fig. 5. The mixer drain will be connected to pin 1 of IFT1. When the additional IF amplifier is made,



Front view of the receiver with only the basic stages fitted. The unused holes can be blanked off. They also act as a strong incentive to complete the optional stages.

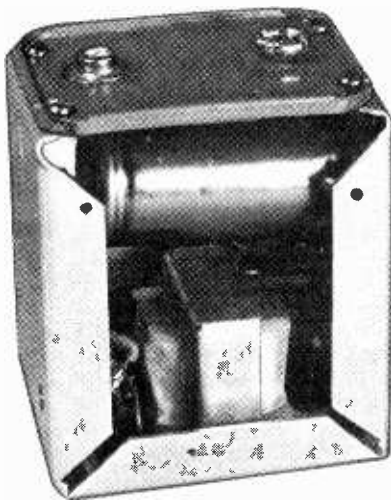
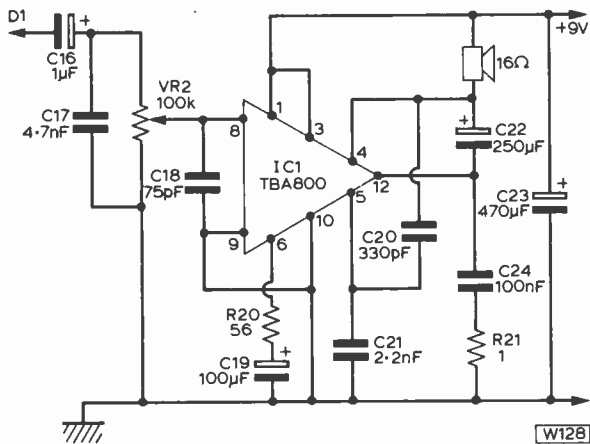


Fig. 7: centre, is the circuit of the TBA800 audio output stage. Capacitor C17 is connected directly across VR2 and C16 is wired directly between D1 and VR2 so they do not appear in Fig. 8. Initially, test and align the receiver with a battery for power. Later a mains power unit can be built and used for routine listening. Such a unit is shown in the photograph above and details of its construction will be given next month.

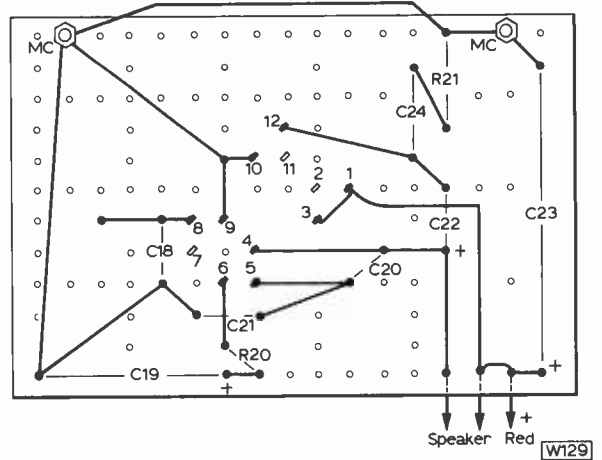
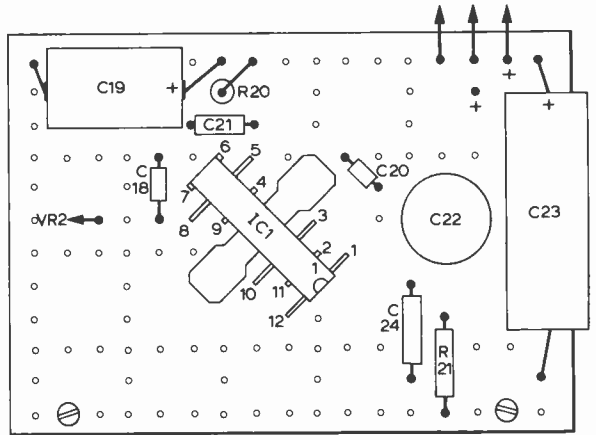
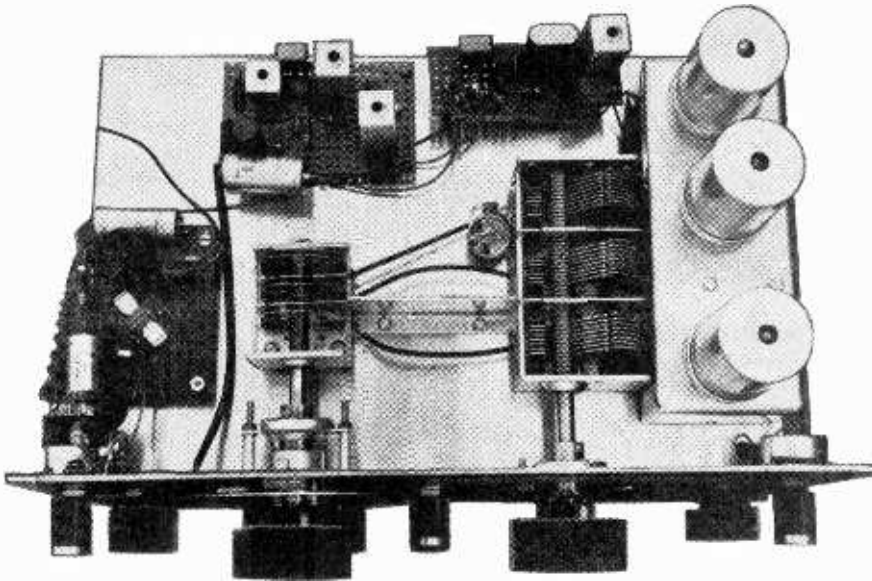


Fig. 8: The circuit of the audio stage Fig. 7 is laid out on veroboard as shown here. The holes in the board may need enlarging slightly to take the pins of the IC. Note that the socket for the loudspeaker, fed from this board, must be completely isolated from the panel.

this connection is removed. The mixer drain is then connected to the IFT of the extra stage and the collector circuit of this stage is taken to pin 2 of IFT1 in Fig. 5.

In Fig. 6 is shown the assembly and wiring of the IF amplifier. First drill three holes for the 6BA bolts MC and the lower core access holes of IFT1 and IFT2. The IF section is located behind the bandspread capacitor. Place the bare board on the chassis and mark or drill the holes mentioned. Components are then fitted as shown in Fig. 6. The three MC tags are then secured with 1/2 in bolts. Extra nuts on these allow the board to be mounted so that leads clear the chassis. External connections can be made on the board or leads.

When this section is fitted and working a slight adjustment to the cores may be necessary, for best results. Use a correctly shaped tool (such as the Denco TT5) as a wedge-shaped blade may crack the cores so that they jam. Clip a 10kΩ/V or similar high-resistance meter, set to the 2.5 or 10V range, from diode negative to chassis. Tune in a stable signal correctly (a BBC local MW transmission is suitable) and adjust VC7 and VC8 for maximum meter reading. Then rotate the five cores of the IFTs a little either way, as required, to give the best meter reading.



Plan view of the completed receiver with all stages fitted. The small board to the right of the IF amplifier board is the extra IF stage with a crystal filter to be described next month. The smaller gang capacitor to the left is for bandspreading.

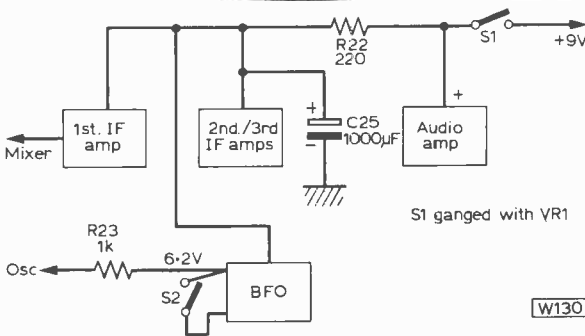
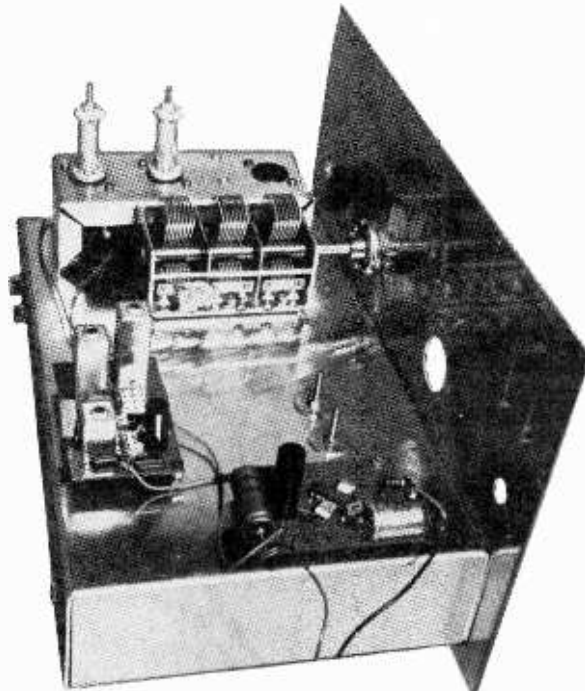


Fig. 9: Details of the battery supply circuit. The stabilised supply at 6.2V is part of the BFO circuit and can be used to feed the first oscillator stage if required. The photograph below is the back of the basic receiver with the audio board in the foreground, the IF amplifier at left centre and the mixer and oscillator assembly at the far end.



AUDIO AMPLIFIER

Fig. 7 shows the circuit of this section which is wired on a separate board, as in Fig. 8. This is prepared and fitted to the chassis near VR2, in a similar way to the IF board. Though a 1Ω resistor is not difficult to obtain two 2.2Ω resistors in parallel can be used instead. Note that the speaker output jack socket contacts must both be isolated from the metal chassis. This requires a socket of all-insulated type, or with a "dead" bush, or the use of insulating washers. An alternative is a pair of separate sockets for wander plugs.

This stage should take about 8 to 10mA, rising to 20 to 30mA with average volume. The TBA800 tabs are bent up to clear the board, but are not soldered to a heat sink. An 8Ω speaker may be used, but current drain is a little higher than when a 15Ω unit is connected.

BATTERY CIRCUIT

Fig. 9 will be of assistance in wiring the battery circuit. Battery positive goes to the switch on the volume control VR2. A lead from here runs to positive on the audio amplifier. The board has a spare positive pin, to which a 220Ω resistor is soldered, and the lead from here runs to the positive pin provided on the IF amplifier board. A 1000μF 10V capacitor is connected from this pin to a chassis tag. When the 1st or additional IF stage is fitted, this positive point supplies it also, as in Fig. 9.

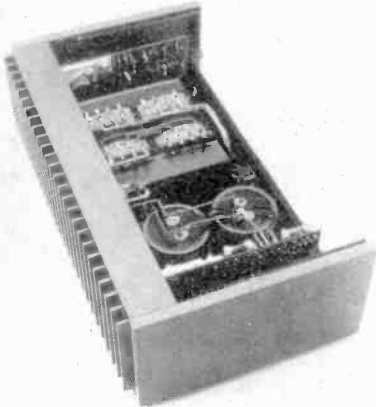
When the BFO is not fitted, supply the oscillator stage Tr3 via a 3.3kΩ resistor from the positive tag of the IF board (1000μF capacitor positive). This point also supplies the RF and IF gain controls. When the BFO is fitted, it provides a 6.2V stabilised point, which is connected to the BFO switch, as in Fig. 9. This point also supplies the oscillator Tr3 via a 1kΩ resistor. This resistor, and the 3.3kΩ resistor mentioned, is additional to the resistor in the RF/mixer/oscillator assembly, so that it can be easily changed when the stabilised circuit is available.

NEXT MONTH:—ADDING THE BFO, EXTRA IF STAGE WITH CRYSTAL FILTER, INTRODUCING BAND-SWITCHING.

PRODUCTION LINES

colin riches

'CURRENT DUMPING' QUAD AMPLIFIER



Quad announced their 'current dumping' amplifier a short time ago and we can now show a picture of the unit. 'Current dumping' describes a new technique used in the output stages.

Essentially, a current dumping amplifier comprises a heavy-duty high power amplifier (the current dumper) which provides nearly all of the current drawn by the load—and a high quality low power amplifier which provides the control. These are so arranged that any error in the high power section is exactly compensated by an error signal from the low power section. Thus performance is solely dependent upon the low power amplifier, which can be made very good indeed.

Since the output device linearity is not important, biasing is unnecessary and crossover and thermal tracking problems disappear. The output devices themselves need not be matched thus allowing inherently more reliable types to be employed.

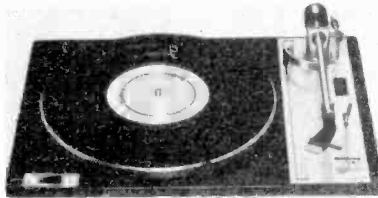
The Quad 405 is the first practical realisation of this new circuit technique. Designed to drive modern low efficiency loudspeakers, the 405 has an output of 100W per channel into 8Ω with a claimed total distortion of less than 0.01% at mid frequencies.

The Quad 405 costs £115 plus VAT. Quad, The Acoustical Manufacturing Co. Ltd., (Dept. P.W.), Huntingdon, PE18 7DB.

GOLDRING DECK KIT

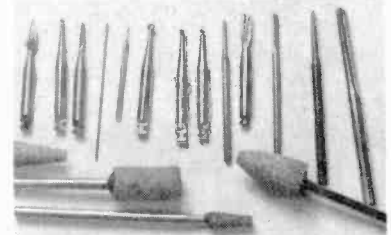
A belt-driven turntable constructional kit has recently been announced by Goldring Limited.

Called Model CK2, it comes complete with detailed instructions so putting it all together is fairly simple. The deck has two speeds (33½ and 45 RPM) selected by a rocker switch. Simplified belt coupling to a small low-speed synchronous motor reduces rumble. Wow and flutter is said to be kept within a 0.15%. The pickup arm is counterbalanced with adjustable stylus pressure from 0.5g. There is a removable plug-in shell and an anti-skate device.



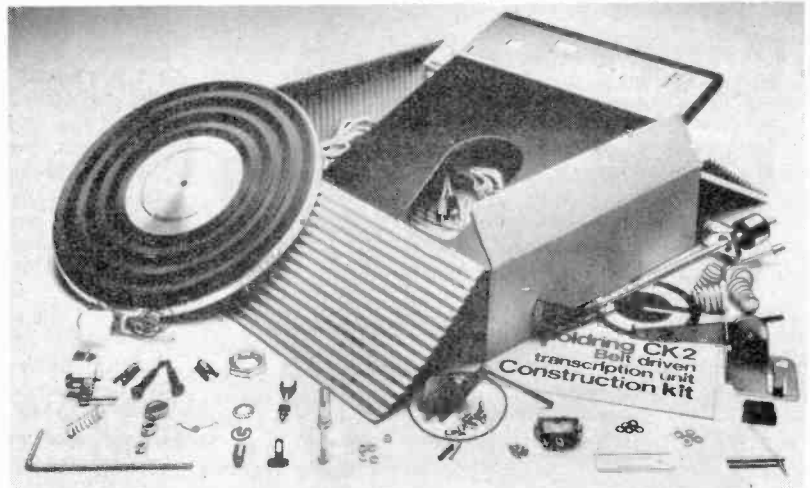
The kit, which is an easy-to-assemble version of the G.102 Turntable assembly, costs £27. Further information may be obtained from Goldring Limited, (Dept. P.W.), 10 Bayford Street, Hackney, London, E8 3SE. Telephone 01-985-1152.

12V MINI DRILL



Precision Petite Ltd. of Teddington market a miniaturised drill (125mm in length) for 12V operation which has been designed for comfortable holding in the hand thus enabling extremely precise work to be carried out—even drilling holes of some tenths of a millimetre. A very comprehensive range of tools and accessories ranging from grindstones to milling and routing burrs is available and the firm will be pleased to supply full details on receipt of a stamped addressed envelope.

The drill on its own costs £7 with postage and packing of 35p and a drill stand for vertical drilling is £3.75 (+58p post and packing). A complete kit of accessories—comprising 30 tools costs £15.01 (p.p. 75p) and a transformer for mains operation if required is priced at £5.50 (p.p. 75p).—Precision Petite Limited, (Dept. P.W.) 119a High Street, Teddington, Middlesex, TW11 8HG. Tel. 01-977-0878.



AMPLIFIER KITS

Our advertisers Radio Component Specialists of Croydon tell us that they have released a new amplifier in kit form. Called the RCS 'Minor' 10W amplifier, it comes in two versions—mono or stereo. The mono kit uses 13 semiconductors and the stereo version 22 semiconductors. Volume, bass, treble and mains on/off controls are mounted through the front panel which has white lettering on a black background.

The specification reads: 10W into 8 ohms; 7W into 15 ohms. Response = 20Hz to 30kHz with distortion at less than 0.5%. Noise = -60dB. Input, up to 200mV. Size of completed unit, 240mm x 75mm x 50mm (9½ x 3 x 2in.).

The kit comes complete with full instructions, printed circuit board, fascia panel and all components. The mono version is £12.50 and the stereo version £20 (VAT included). Postage on either kit is 45p.—*Radio Component Specialists, (Dept. P.W.) 337 Whitehorse Road, Croydon. Tel. 01-684 1665.*

HEATHKIT WIND INDICATOR



The Heathkit ID-1590E Digital Electronic Wind Speed and Direction Indicator kit features a bright 2-digit planar gas discharge readout to display wind speed. During construction, one picks out the two readout modes one requires from three available—miles, knots or km per hour. A switch on the rear panel chooses either of two selected modes and front panel lights show which is in use. A rear-panel switch and controls on two circuit boards calibrate the ID-1590E.

The wind direction indicator uses incandescent bulbs to mark 8 principal compass points. Two adjacent bulbs light at the same time to indicate an intermediate direction.

Installation is said to be very simple—the remote transmitter boom clamps onto any 1 to 1.5in. rooftop TV aerial mast and is connected to the receiver unit with optional cable. The kit for the ID-1590E costs £49 including 8% VAT and delivery within the UK. Cables come in three lengths—50ft (£5.30), 100ft. (£9.20) and 150ft. (£14.30). *Heath (Gloucester) Limited (Dept. P.W.), Bristol Road Gloucester, GL2 6EE.*

Practical Wireless, February 1976



STEREO CAR RADIO

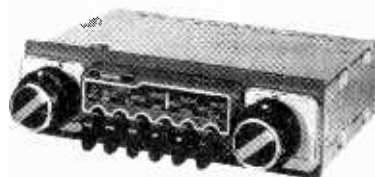
Radiomobile Limited, announce an AM-FM stereo car radio, model 1190 FMS. It employs a six button tuner, combined with manual tuning, facilitating simple pre-setting of any 3 FM, 2 Medium wave and 1 Long wave station. Amplifier produces 5 watts per channel and a bass/treble tone control is provided. A balance control allows adjustment from left to right channels. The FM stereo tuner employs Active Interference Rejection—a complete circuit module.

Automatic Frequency Control circuitry provides spot-on tuning and a DIN socket provides the facility of accepting the input from a stereo tape deck.

Technical Specifications:

Power supply: 12V negative earth; current consumption: 0.5A (up to 2.5A at maximum output).

Tuning ranges (Minimum): FM: 87.5–104.5MHz, MW: 525–1620kHz, LW: 150–275kHz. Semiconductors: 70 (41 transistors, 3 integrated circuits, 26 diodes). Speaker impedance: 1.75–3.5 ohms per channel. Tape socket sensitivity: 30mV for 5 watts output per channel. Further details and latest prices from *Gill Turner, Radiomobile, Good Relations Ltd., (Dept. P.W.) Kimbolton House, 117 Fulham Road, London, S.W.3.*



The Radiomobile 1190 AM/FM radio.

CASIO CALCULATORS

Casio, the multi-million pound Japanese calculator and electronics group, has established a subsidiary company in the U.K. known as Casio Electronics Co. Ltd. The firm's primary aim is to market a range of low-cost pocket calculators and a recently developed electronic watch.

In Japan, Casio claim to have 54%

of the domestic market and claim that they are the world's largest manufacturer in this field. This new UK subsidiary joins similar organisations in Germany and the USA.

The Casio Personal Mini calculator. Recommended price £6.95, but some of our advertisers are offering them for under £5!



One of the firm's most successful calculators is the Casio Personal Mini which has already sold over 5 million units in three years. This model divides up to 6 digits, adds, subtracts and multiplies up to 12. Should the wrong button be pressed, pressing the 'correct' (C) button automatically cancels the previous in-

struction. There is also a 4-way constant facility. The readout is on a green digitron tube panel, unnecessary zeros being suppressed. An LSI chip is employed and power consumption is 0.2W. Provision is made for a mains PSU but the Personal Mini has its own internal batteries which give about 10 hours' continuous use. (HP11's).

At the other end of the range is the FX-101 10-digit scientific calculator with independent memory and scientific notation. It handles a broad range of calculations up to $10^{\pm 99}$, and has a very impressive specification. Recommended price of the Personal Mini is £6.95—but see P.W. adverts for discount prices. Full details may be obtained on the whole range of Casio equipment from *Mr. R. G. Rayner, General Sales Manager, Casio Electronics Co. Ltd., (Dept. P.W.) 28 Scrutton Street, London, EC2A 4TL.*

Now...the most exciting Sinclair kit ever

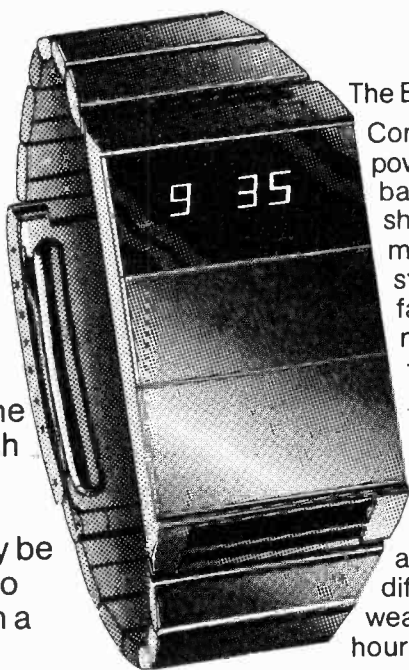
The Black Watch kit

At £17.95, it's

★ **practical** – easily built by anyone in an evening's straightforward assembly.

★ **complete** – right down to strap and batteries.

★ **guaranteed.** A correctly-assembled watch is guaranteed for a year. It works as soon as you put the batteries in. On a built watch we guarantee an accuracy within a second a day – but building it yourself you may be able to adjust the trimmer to achieve an accuracy within a second a week.



The Black Watch by Sinclair is unique. Controlled by a quartz crystal... powered by two hearing aid batteries... using bright red LEDs to show hours and minutes and minutes and seconds... it's also styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash.

The Black Watch kit is unique, too. It's rational – Sinclair have reduced the separate components to just four.

It's simple – anybody who can use a soldering iron can assemble a Black Watch without difficulty. From opening the kit to wearing the watch is a couple of hours' work.

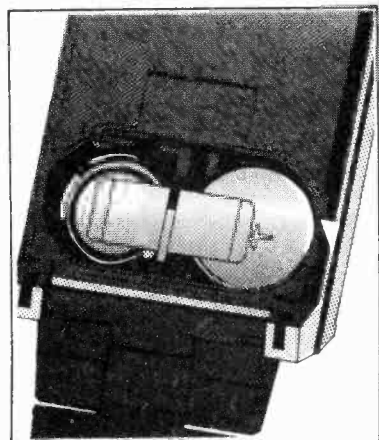
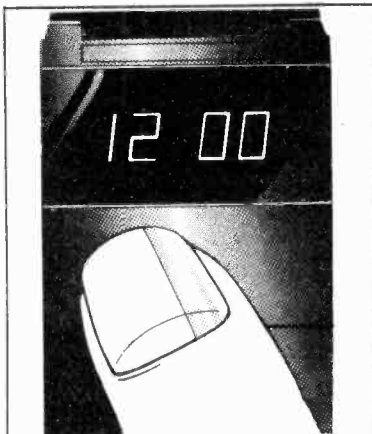
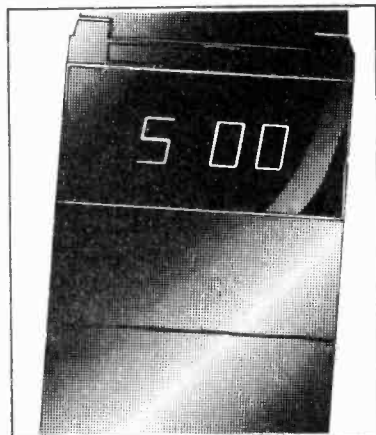
The special features of The Black Watch

Smooth, chunky, matt-black case, with black strap. (Black stainless-steel bracelet available as extra – see order form.)

Large, bright, red display – easily read at night.

Touch-and-see case – no unprofessional buttons.

Runs on two hearing-aid batteries (supplied). Change your batteries yourself – no expensive jeweller's service.



The Black Watch – using the unique Sinclair-designed state-of-the-art IC.

The chip...

The heart of the Black Watch is a unique IC designed by Sinclair and custom-built for them using state-of-the-art technology – integrated injection logic.

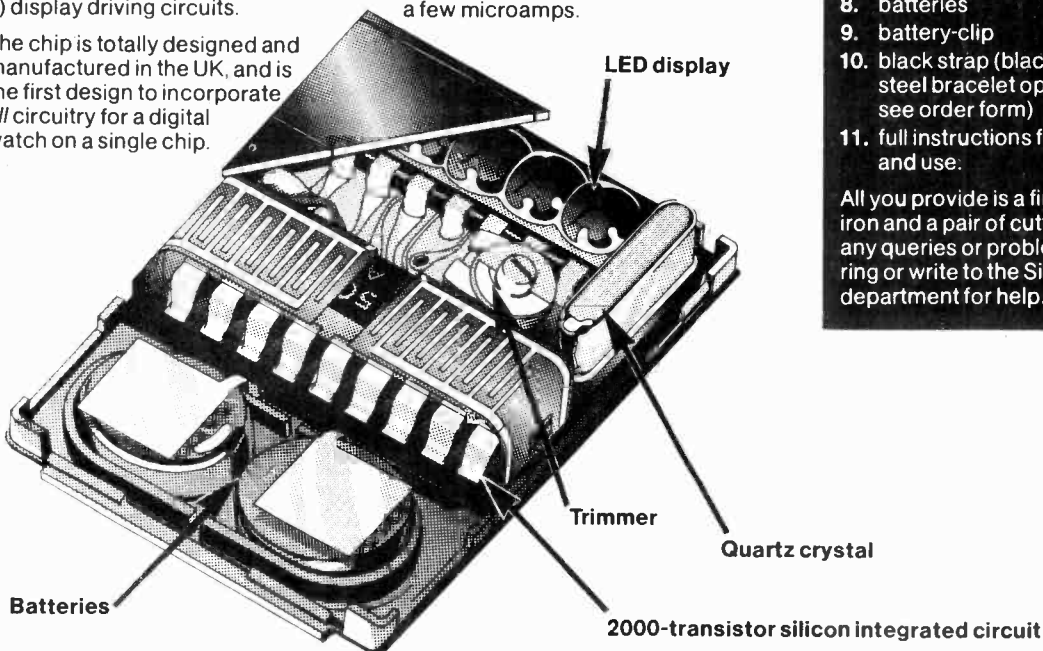
This chip of silicon measures only 3 mm x 3 mm and contains over 2000 transistors. The circuit includes

- a) reference oscillator
- b) divider chain
- c) decoder circuits
- d) display inhibit circuits
- e) display driving circuits.

The chip is totally designed and manufactured in the UK, and is the first design to incorporate *all* circuitry for a digital watch on a single chip.

...and how it works

A crystal-controlled reference is used to drive a chain of 15 binary dividers which reduce the frequency from 32,768 Hz to 1 Hz. This accurate signal is then counted into units of seconds, minutes, and hours, and on request the stored information is processed by the decoders and display drivers to feed the four 7-segment LED displays. When the display is not in operation, special power-saving circuits on the chip reduce current consumption to only a few microamps.



Complete kit £17.95!

The kit contains

1. printed circuit board
2. unique Sinclair-designed IC
3. encapsulated quartz crystal
4. trimmer
5. capacitor
6. LED display
7. 2-part case with window in position
8. batteries
9. battery-clip
10. black strap (black stainless-steel bracelet optional extra – see order form)
11. full instructions for building and use.

All you provide is a fine soldering iron and a pair of cutters. If you've any queries or problems in building, ring or write to the Sinclair service department for help.

Take advantage of this no-risks, money-back offer today!

The Sinclair Black Watch is fully guaranteed. Return your kit within 10 days and we'll refund your money without question. All parts are tested and checked before despatch – and correctly-assembled watches are guaranteed for one year. Simply fill in the FREEPOST order form and post it – today!

Price in kit form: £17.95 (inc. black strap, VAT, p&p).

sinclair

Sinclair Radionics Ltd,
London Road, St Ives,
Huntingdon, Cambs., PE17 4HJ.
Tel: St Ives (0480) 64646.

Reg. no. 699483 England. VAT Reg. no. 213 8170 88.

To: Sinclair Radionics Ltd, FREEPOST, St Ives, Huntingdon, Cambs., PE17 4BR.

Please send me

Total £

..... (qty) Sinclair Black Watch kit(s) at £17.95 (inc. black strap, VAT, p&p).

* I enclose cheque for £..... made out to Sinclair Radionics Ltd and crossed.

..... (qty) black stainless-steel bracelet(s) at £2.00 (inc. VAT, p&p).

* Please debit my *Barclaycard/Access/American Express account number

Name _____

Address _____

PW2

Please print. FREEPOST – no stamp required.

*Delete as required

SIMPLE ULTRASONIC

IF one wishes to control a relay from a remote unit without the use of any connecting wires, one must utilise some form of wave signal which travels between a transmitter and a receiver. Radio waves and microwaves are very suitable for this purpose, but the equipment required is usually fairly complex and expensive and a licence must be obtained before the equipment can be used. Another possibility involves the use of light waves which fall on a photosensitive cell. In this case the main problem is that the system is also sensitive to daylight. Sound waves can be used, but the region is then rather unpleasant to work in and the equipment responds to spurious noises.

ULTRASONICS

Ultrasonic communication utilises waves in the air which are just like sound waves except that their frequency is so high that one cannot hear them. This article describes a very simple transmitter unit and receiver unit which can be used for the remote control of a relay in the receiver. The relay closes when 40kHz waves from the transmitter fall on a transducer in the receiver.

Although ultrasonic transmitter and receiver units have been published from time to time, the units to be described here have the advantage that very simple circuits are employed; the only active devices required are a single IC in each of the two units.

The maximum range at which satisfactory operation can be attained is generally of the order of 10m. It is not possible to quote an accurate value for the range, since it varies considerably with the presence of reflecting objects. The range is considerably greater in an indoor corridor than in the open air, since the walls of the corridor reflect the waves towards the receiver unit. The waves are attenuated as they pass through the air and this limits their maximum range for reliable control.

TYPICAL APPLICATIONS

Ultrasonic beams can be used to operate a relay and the closing of the relay contacts can then be used to perform any desired switching operation. For example, an ultrasonic transducer can be mounted on the front bumper of a car. When the driver reaches his home, a pulse from the transmitter is used to actuate a relay which automatically opens the garage doors without the driver leaving his seat. When the car is taken out of the garage, a similar pulse can be used to close the doors. Another use for a very small ultrasonic unit could be for the remote switching of radio or television channels from

an arm-chair, where the coil turret of a receiver is made to rotate one step each time a pulse is received from the transmitter.

If one wishes to communicate with one's neighbour, it is illegal to connect the two houses with wires, since this would infringe the Post Office monopoly (Post Office Act, 1969, Section 24.1). However, the writer has obtained confirmation from the Post Office that the use of ultrasonic waves for communication does not infringe their monopoly and no licence is required. Therefore transmitted waves could be modulated and sent in the form of Morse signals.

Finally, the equipment described here could also be employed as an intruder alarm. If the beam passes across a corridor, any interruption of the beam by an intruder will cause the relay to open and this can be used to sound an alarm. The intruder will not detect the ultrasonic beam, so if the alarm sounds at a remote point, the intruder will have no means of knowing that his presence has been detected.

TRANSDUCERS

The ultrasonic transmitting transducer used in this project generates ultrasonic waves in the air when a suitable alternating voltage is applied across its terminals. This voltage may be a square or a sine wave, but the frequency must be close to the resonant frequency of the transducer. A similar transducer is used in the receiver, and when ultrasonic air waves strike this receiver a voltage at the ultrasonic frequency appears across the transducer terminals. This voltage is generally very small (typically ranging from about 50 μ V to 100mV) and must therefore be amplified considerably in the receiver unit before it can be used to control a relay.

The transducers themselves act like a small loudspeaker and a small microphone which will operate only near to their resonant frequency. They have the same circuit symbol as a loudspeaker. A miniature transducer type SE05B has been chosen for use in this equipment and it is available in two types which are designated "40T" and "40R". The SE05B-40T type should be used in the transmitter and the SE05B-40R in the receiver. Although the equipment will function with the 40T and 40R units interchanged or with two units of the same type, optimum results can be expected only if the 40T

SYSTEM

BRIAN DANCE M.Sc

Practical Wireless, February 1976

unit is used in the transmitter and the 4OR unit in the receiver.

The 4OT and 4OR units have an identical appearance, being mounted in small aluminium cases about 1cm in diameter by 1cm in length. One of the two connecting pins at the back of the device is connected to the metal case, which should be earthed.

Internally the transducers contain piezoelectric ceramic bimorph plates which resonate mechanically at the 40kHz ultrasonic frequency. Another type of transducer which operates at 25kHz is available from the same supplier and is suitable for use in the same type of circuit, but the frequency of oscillation of the transmitter circuit must be reduced by increasing C2 or R3 of Fig. 1. Air trans-

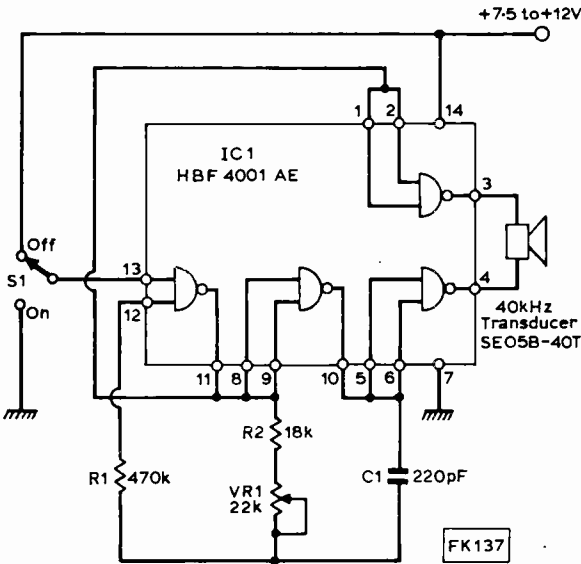


Fig. 1: Schematic of the HBF4001AE integrated circuit, showing the four two-input NOR gates. This IC is used as the heart of the transmitter.

ducers are not normally used at frequencies above about 100kHz, since the attenuation of the waves in air increases with frequency and efficiency of energy transfer to and from the air becomes smaller at higher frequencies.

TRANSMITTER LOGIC

An oscillator circuit is required which will feed a 40kHz signal at a level of a few volts to the transducer. A simple transistor astable circuit can be used, but the use of an IC simplifies the design.

The transmitter circuit used in the prototype is shown in Fig. 1. It employs the SGS-ATES HBF 4001 AE COS/MOS quad 2-input NOR gate. The two NOR gates on the left hand side form a square wave oscillator, the frequency of which can be varied by means of VR1. The two NOR gates on the right hand side are buffer amplifiers which drive the transducer in push-pull. All of the NOR gates in the device are interchangeable, so the pin connections shown in Fig. 1 can be varied considerably if one wishes. The transmitter can be switched on and off by a switch in the supply line where a current of about 6mA flows in the case of an 11V supply. However, it may be more convenient to use the switching

system shown, where the current through S1 is very minute. The switching can also be performed by a logic signal applied to pin 13 in the circuit shown.

COS/MOS devices have input impedances of the order of a million megohms and are therefore susceptible to damage by electrostatic charges. The manufacturers recommend that:

1. The device leads should be kept in contact with conductive material except when they are connected in a circuit.
2. Soldering iron tips should be earthed.
3. Devices should not be removed or inserted into circuits whilst the power is applied.
4. Signals should not be applied to unused inputs when the power is not applied.

In practice, however, the devices are well protected, although it's wise to obey the rules to avoid disappointment. It's also wise to employ a mica or polystyrene capacitor for C2 of Fig. 1 or a ceramic type with a tolerance of not more than $\pm 20\%$.

RECEIVER

The IC used in the receiver is the ULN-2212 manufactured by Sprague Electric Ltd. This is a 16 pin DIL device which has been developed for use in television sound systems; it contains an IF amplifier, an electronic volume control and a 1W audio power amplifier. In the application being described, the 40kHz signal from the transducer is amplified by the IF section of the device and then converted into a steady voltage. This voltage is fed to the input of the power amplifier section which can provide enough output current to control a large relay. Thus the use of this device greatly simplifies the external circuitry.

The receiver circuit is shown in Fig. 2. The transducer signal is fed to the internal differential amplifier connected to pins 10 and 11. The resistor R2 keeps the bias at pin 10 at about the same value as that at pin 11, and C2 decouples pin 11 so

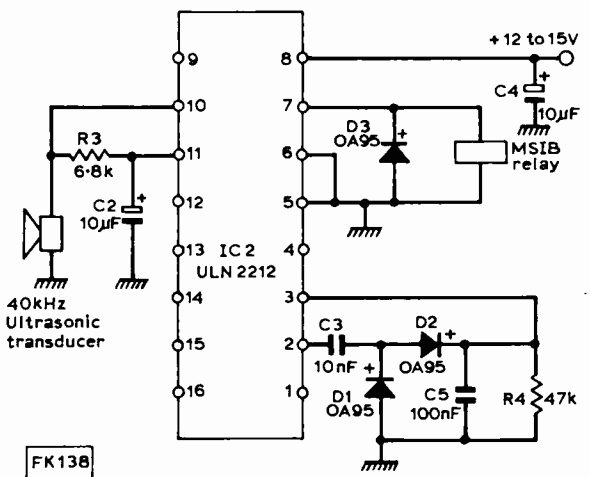


Fig. 2: The Ultrasonic receiver chip, ULN2212 shown here, contains an IF amplifier, electronic volume control, and a 1W audio amplifier.

that there is very little 40kHz voltage at this point. The 40kHz amplifier incorporates its own limiter

circuit, so the output is almost constant for input signals exceeding about 200 μ V at pin 10.

The 40kHz output can be taken from pin 16, but an output signal of larger amplitude is obtainable from pin 2. The electronic volume control circuit is connected inside the device between pins 16 and 2. The output from pin 2 is connected via C3 to the diode pump circuit of D1 and D2. When C3 discharges, the current passes through D2 into C5. It then charges again via D1 during the other part of the 40kHz waveform. Thus the upper end of C5 becomes positive when an ultrasonic signal is falling on the receiver transducer.

POWER AMPLIFIER

The input of the power amplifier is connected to pin 3 and the output to pin 7. In the application for which the ULN-2212 is intended, an audio signal is capacitively coupled to pin 3 and this pin is at a slightly positive potential (about +2V). In this case, the output at pin 7 is half the supply line voltage.

The presence of R4 in the input circuit to the power amplifier reduces the potential at this non-inverting input, and the output at pin 7 falls to a fraction of a volt when no ultrasonic signal is present. The relay therefore remains open. If an ultrasonic signal now falls on the transducer, the output from the diode pump biases pin 3 to a potential more positive than its quiescent value. The output voltage rises to about +11 to +13V and the relay closes. It will open again whenever the ultrasonic signal is interrupted.

When the current ceases to flow through the relay coil, a relatively high transient voltage is developed across this coil owing to its inductance. This transient voltage is short circuited to earth by the diode D3. If this diode is omitted, the transient voltage may possibly damage the IC. The absolute maximum supply voltage which may be fed to the device is 18V, but it is wise to keep the supply voltage below this value to avoid the possibility of damage. The ULN-2212 incorporates a circuit which provides automatic shutdown of the power stage if the silicon chip becomes excessively hot. The supply current with the relay open is about 35mA, but this increases considerably when the relay closes, the value depending on the type of relay. The output current from pin 6 is automatically limited to 800mA by the internal circuit of the IC and this protects the device from damage if the output is earthed.

RELAY TYPE

The relay chosen for the prototype is the economical Keyswitch type MS1B with a 12V 26mA coil. Its contacts can switch 5A at up to 250V AC and this is adequate for most applications, since it represents 1.25kW. The direct current which can be controlled by this relay is smaller than the alternating current, since alternating voltages fall to zero twice per cycle and this breaks any arc which is formed.

The ULN-2212 can however, provide enough output current to control a large relay which may require about 120mA at 12V. However, it is wise to mount such a relay away from the receiver transducer, since the vibrations may cause a malfunction.

SETTING UP

The frequency of the transmitter may be set to approximately the optimum value by adjusting VR1 with a plastic tool, so that the transmitter unit takes a maximum current from the power supply. It is then delivering maximum power to the transducer. This current varies with the power supply voltage to the transmitter, being typically about 3.5mA (7 $\frac{1}{2}$ V supply), 5mA (9V supply), 7mA (10 $\frac{1}{2}$ V supply), 9mA (12V supply) and 11mA (13 $\frac{1}{2}$ V supply). The transmitter output power and, therefore, the maximum range of satisfactory operation falls considerably if the transmitter power supply voltage is reduced below 7 $\frac{1}{2}$ V.

A final adjustment of VR1 may be made by connecting a 20k Ω /V meter across R1. If the receiver is switched on, the voltmeter should read about 1 $\frac{1}{2}$ V. If the two transducers are facing each other and the transmitter is switched on, the reading should increase to about 3V. The transducers are then separated and turned so that they no longer face each other and the meter reading will start to fall. VR1 is then adjusted for maximum reading.

The transducers can be obtained from Hall Electronics, 48 Avondale Road, London E17 8JG for £3.75 per pair inc. VAT and p/p. The ULN2212 is available from Phoenix Electronics, 139 Havant Road, Drayton, Portsmouth PO6 2AA for £3.50 inc. VAT and p/p. The HBF4001AE is available as the CD4001AE from advertisers. Pw

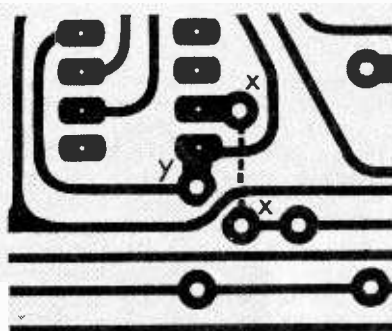
CORRECTION

SIMPLE HOME PROJECTS—3 December 1975

Random Number Selector

In the circuit diagram, pins 3 and 7 on IC2 should also be connected to pin 11. This may be done by a solder bridge as shown here at 'y'.

A link is also required between the points marked 'x' and this is made on top of the PCB. It can be clearly seen in the photograph of the finished unit, immediately to the right of capacitor C2, centre bottom.



agazines Ltd. 1975

Enlarged section of the PCB showing solder bridge at 'y' and wire link on top of the board at 'xx'.

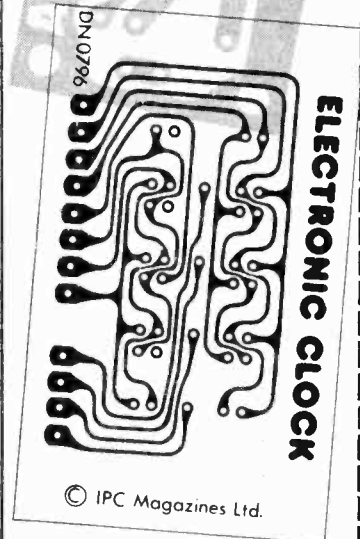
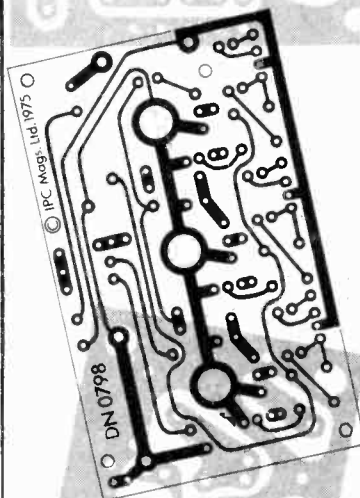
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I.C. OF THE MONTH

Number 56

SIGNETICS SD6000 VHF RF AMP/MIXER

THE use of integrated circuits has enormously simplified the design of VHF receivers, but at present discrete components are still employed in the front-end unit, since no suitable ICs for use at about 100MHz are available. The development of the new SD6000 IC by Signetics for use as a VHF amplifier and mixer therefore marks an important step in FM receiver design.

The SD6000 is encapsulated in a normal 8 pin dual-in-line plastic package and can be used to design tuners which have a better performance than the best of those which employ bipolar devices.

positive than +25V or more negative than -0.3V. No special precautions are required when handling the SD6000 or when soldering it into a circuit.

The two devices are positioned in the package in such a way that coupling between them is minimised. This assists stability and minimises radiation of the local oscillator signal from the aerial. The D-MOS fabrication technique enables precisely controlled channels, less than 1 micron long, to be produced with extremely low parasitic capacitances, the resulting D-MOS devices being ideal for VHF use. Although the internal construction of D-MOS devices differs from that of other enhancement MOSFETs, the principles of operation are the same.

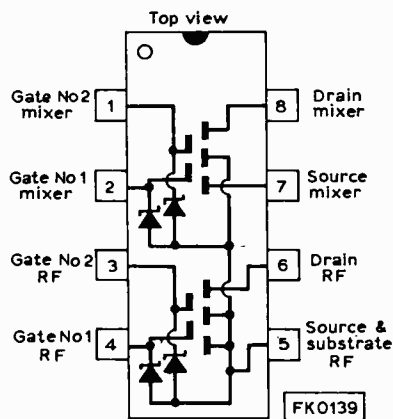


Fig. 1: Internal view of the SD6000 showing the protective zener diodes, the two dual-gate MOSFET devices, and the pin connections.

INTERNAL CIRCUIT

As shown in Fig. 1, the SD6000 contains two dual-gate MOSFET devices. These are 'N' channel enhancement components made by ion implantation and the special D-MOS (Diffused Metal Oxide Silicon) technique used to fabricate the earlier Signetics D-MOS discrete devices. Each of the gates is protected by a zener diode which will bypass to the substrate (pin 5) any static or other voltages more

ADVANTAGES

Dual-gate D-MOS devices have inherently linear characteristics, wide dynamic range and excellent cross-modulation characteristics. They provide high gain and have a very low noise figure. The feedback capacitance from drain to gate is only about 0.03pF. Gate leakage currents and drain to source leakage currents are typically 1nA, whilst the maximum permissible drain current is 50mA.

A PRACTICAL CIRCUIT

The SD6000 has been specifically designed for use in the RF amplifier and mixer stages of high performance FM receivers, but it will doubtless find other VHF applications. A typical FM front-end circuit with a ganged tuning capacitor for a signal frequency range of 88MHz to 108MHz is shown in Fig. 2, but varicap diode tuning has also been employed with the device.

The circuit provides a typical power gain of 30dB at 100MHz, the typical noise figure being only 2.5dB (maximum noise figure 3dB). Commercially available tuner units seldom have a noise figure of less than 6 to 7dB, whilst some have a much higher noise figure. Both the noise figure and the available gain of the RF stage are fairly independent of the drain

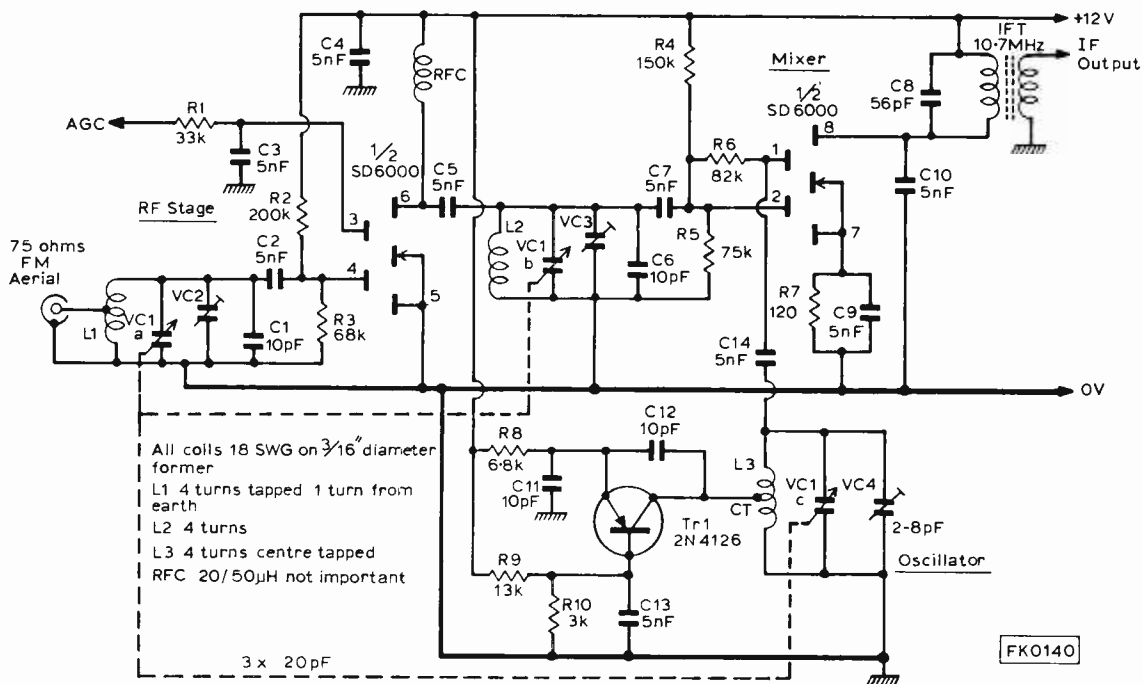


Fig. 2: A typical circuit for an FM tuner using the SD6000 in the RF and mixer stages. The above circuit covers a frequency range from 88MHz to 108MHz.

current provided that the latter exceeds about 7mA, see Fig. 3.

The bandwidth of the RF amplifier is about 2.5MHz at the -3dB point and that of the mixer 300kHz, the latter value being mainly controlled by the properties of the tuned circuit in the output transformer. AGC is applied to the second gate of the RF stage (pin 3); the 50dB typical operating

of circuit enables very high isolation to be obtained between the local oscillator circuit and the input and hence reduces radiation from the oscillator frequency. The oscillator stability is about 40kHz/V change in the supply line and +10kHz/°C temperature change.

The typical conversion gain of the mixer stage plotted against the drain current is shown in Fig. 5, the high and constant conversion gain of 19dB being obtained at drain currents of 4 to 11mA. As in the case of the RF stage, the D-MOS construction of the mixer provides excellent cross modulation performance and very low noise. The conversion transconductance is typically 10mmhos.

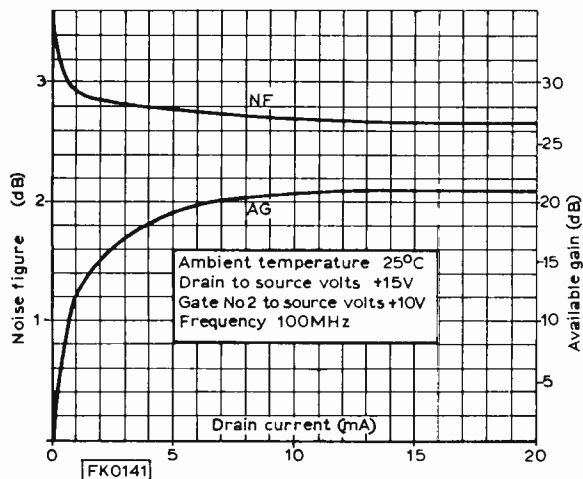


Fig. 3: Graph of the noise figure and available gain of the RF stage plotted against the drain current.

range of the AGC is extremely wide. The change of gain with the gate 2 voltage at 100MHz is shown in Fig. 4 for the case where gate 1 is at +10V and the drain to source potential is 15V.

A PNP 2N4126 provides the oscillator voltage to gate 2 of the mixer through C14, the signal voltage from the RF stage being applied to gate 1. This type

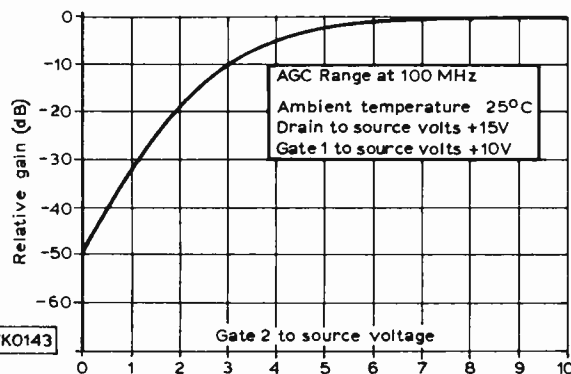


Fig. 4: Curve of the AGC characteristic of the RF gain. The 50dB gain change is equivalent to a change of voltage gain of 316 times.

PRECAUTIONS

When using the SD6000, it should be remembered that the absolute maximum value of the drain to source current is the unusually low one of 50mA.

continued on page 890



AMATEUR BANDS

by Eric Dowdeswell G4AR

MY comments in the December issue, on honesty in log-keeping, seem to have met with quite a lot of support. **P. B. Flatman** of Ipswich, back on the bands after a three year break, always makes a point of hearing the call sign of a station twice, preferably phonetically, before putting it in his log. He admits that some of the entries in his earlier logs just could not have been heard, although they had been entered in all good faith at the time. 'P.B.' also got going on one of my own pet 'hates', namely the amateur who asks the DX station for his call sign several times and then gives the DX 'S9+20dB'! Mistakenly, of course, he thinks the flattery will somehow persuade the DX to send the QSL card by return of post!

In the same way, a station in a CW contest will give a report of 599 to every station worked. Why? Because 599 sent in the shortened form is - . - . and it saves a lot of time which can be important when working 50 or 60 stations an hour. The fact that the information is quite false seems to be overlooked in the race for points and more points. But, getting back to the 'S9=20dB' phobia, more rubbish is spoken on and about 'S' meters than anything else. Why do people place such implicit faith in a meter that does nothing more than show a rise or a fall in signal strength? There must be at least six factors affecting its readings and no two locations are going to have the same factors so why do operators think that S9 on a FT101 in John O'Groats is the same as S9 on a different FT101 in Cornwall? A lot of rubbish!

Martin Kessel (Stoke-on-Trent) has been inactive due to revision work for the RAE, which I trust he has now duly passed. He's been trying to get a one valve regen set going on the 2m band but in defence of our hobby and his local viewers I trust he never succeeds! **Philip Williams** BRS35031 of Bridgnorth enjoyed the lift on 2m in late October, as did many other readers, copying many stations deep into Europe with his TC7 Mk II with the G8AEV converter and an 8-element yagi at 20ft at a QTH which is 200ft a.s.l.

Alan Rae, recently GM8GRO, went on to take the Morse test and is now GM4ENN and sporting a Swan transceiver on the HF bands. It's always good to lose readers from this column in this way! **Alan**

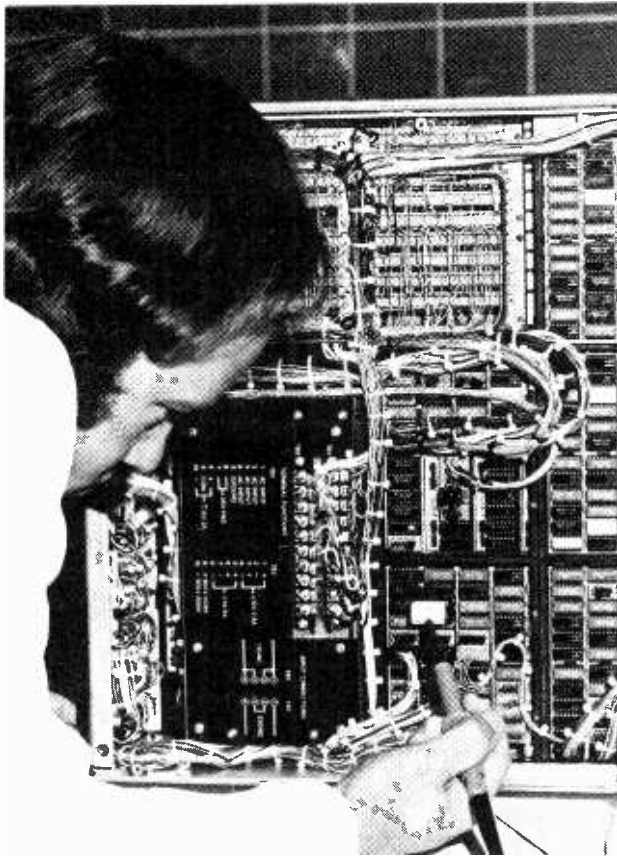
Doherty BRS34968 (Portrush Co. Antrim) comments on the fantastic aerial systems being used by PA0GMW on 80m in the search for DX. Alan uses a G5RV for the HF bands and a 132 centre-fed wire for the LF's. Any more detailed info on the GMW aerial farm would be welcome. Alan reports cards received from KM6EA, HI8XKP, YB0ABV, among many others.

Mike Bennett (Slough) picked up a couple of rare ones in VK9XX on Christmas Island and FR7ZL/G on the Glorieuses Is. on 15 and 20m respectively. **Paul Barker** (Sunderland) has been busy swapping his SSB hat for his SSTV one as conditions allowed, finding EA3ADW and 9K2DO excellent copy in the latter mode on 20m and LU2JC and W1BGW on 15m. **Tim Charles** (Colchester) has been looking for ZL3RB on 160m following reports of successful QSOs with Europe but getting up on sked is a problem with Tim! He has now heard 21 countries on Top Band, the latest being 9H1CG. He has been hearing all continents on 80m plus his first JA's on the band, peaking between 15-1600, so presumably they are coming over the pole. Tim also mentions PA0GMW working the west coast Americans on the long path in the middle of the afternoon, plus KH6 and many JA's. This is on 80m, by the way! GMW's secret is now revealed, it's Quads on 80m. Yes, in the plural! Tim is another who, hopefully, will have passed his RAE, taken on December 1st.

Barry Middleton G4DBS asks me to reveal all, about the Lincoln Short Wave Club G3IXH, of which he is Hon. Sec. More members are wanted, particularly younger ones, so trot off to the Lecture Room, Lincoln Astronomical Society, Westcliffe Street, off Burton Road, Lincoln at 1930 any Wednesday. The club operates a net on 2m at 2000 hours every Thursday with G4DBS and G4DFH as control stations and again on Sundays at 1100 hours on 80m or 3700kHz to be precise, with G3TOA in charge.

Neil Whiteside A8859 (Hitchin) also enjoyed the exceptional conditions on 2m and commented upon the number of Continentals working through the repeater GB3PI. **Stephen Budd** A8713 (Worthing) caught VX9A on Sable Island for a new country, now approved as such by the ARRL although any normal person would call it VE1! QSLs to VE3GMT. **Andrew Swiffin** A8603 (Cheadle) now has a Pye Ranger for 4m and is busy building the PW 2m converter so it looks as though he has got fed up with HF bands! Actually he has been round all the bands from 15 to 80m with good effect.

Steve Cottis A8961 (Harrogate), aged 14, was told he was too young to join the local RAE course. Rubbish, said I, and told him to get in there and insist upon his rights. Good heavens, 14 year olds



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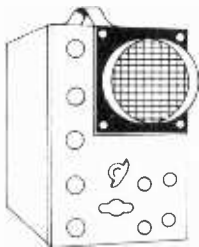
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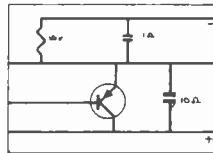
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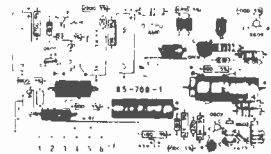
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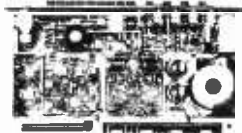
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are passing the RAE and Morse test every day, or so it seems! However, this does not mean that I go along with the present system which I have always believed to be an utterly futile examination. It ought to be linked to a practical examination but more of this anon.

Log extracts

A. Swiffin:— 80m OE2SCL/YK 15m TJ1EZ (QSL PA0EZ) YB1AB ZS3BK 5T5BJ 5X5NK

S. Budd:— 20m YJ8AN VX9A FK8CJ VR4DX 15m CR9AJ PZ9AJ VX9A ZD8AA 4W1AF 9N1MM 10m FH8CY 9Q5SW

N. Whiteside:— 2m HB9AMH/P IB6BTI OZ60L SM7WT

T. Charles:— 160m K1PBW VE1BCZ W2PV W9LI 9H1CG 80m FP8CT HP3AU JAIERK UA9CM VS6DO ZL3LV 20m VP2GM 2m DM2CZI HB9ZF SM6BZC SP5JC

M. Bennett:— 20m BV2B FG0MM FR7ZL/G 8R1X 15m VK9XX 9N1MM 10m C9MIF

P. Williams:— 2m DJ6GO DC1QD PA0JHW

P. Flatman:— 15m EA9FC FM7AQ KZ5AS FR7BE TG9MP ZS4AW 20m FY0BHI 9X5PT

M. Kessel:— 80m 9X5SP 5L7F 9H1C

A. Doherty:— 160m EA8CR 80m JA1JRK 5L7F 9Y4NP 40m JA1DJL JX2HK 20m KG4GG PZ1DR VP8HZ VK1SD VX9A VE8RE 6W8FP SSTV 20m EA3ADW I2PHO 9K2DO OE8TWK 15m LU2JC W1BGW

All stations are SSB except those in bold which are CW.

BROADCAST BANDS

SHORT WAVE BROADCASTS

by *Derek Bell*

OUR COLUMN this month opens with a letter from someone who derives more enjoyment than most of us from roaming the world via the short wave spectrum. This is **John Buxton** of Shepton Mallet who is disabled and therefore has many hours of the day and night to pass away. As a change from sending logs, since his present set is so poorly calibrated, John sends a chatty letter urging a listen to "Beat of the Drum" on Voice of Turkey, Sundays around 2215 on 9515. It is, says John, a very funny show. I can perhaps help John, because there is an organisation that is set up to help just such DXers as John. This is Handicapped Aid Programme run by Ted Hindle, 13 Thirlmere Road, Preston, Lancs. Not only does this worthy cause help the handicapped DXer with equipment but would like surplus equipment from anyone who cares to help. This gear is checked over and then sent to someone in need.

Practical Wireless, February 1976

By the time this is read the new schedules will have settled down. **Paul Cowburn** from Leyland writes that the following have been announced:—

Radio Israel 2000 on 9815 7412 7395

Radio Finland 1400 1830 2030 on 11755 6120 9550

Radio R.S.A. 2050 to 2150 on 15155 11900 9525 7270

No doubt there are a few more which I will pass on as they come to hand.

Andrew Walker of Leeds asks for advice on when to send International Reply Coupons. As a rule-of-thumb I always recommend that IRCs be sent to stations that rely on donations, such as religious or charity stations, but a great many state or commercial stations ask for IRC's and one has to hope to hear the stations themselves insist on IRCs in their chat.

Recently this column featured "National Public Radio" and your scribe confessed to being puzzled by this station. Both **A. Harris** of London and **Stewart Fenwick** of Clackmannan write to enlighten us. It seems that this phrase is used in the news broadcasts of the American Forces Radio and Television Service. Stewart, in fact, sends the address as NPR 20/25 M Street, North West Washington, DC, 20036 USA.

Niels Montanana raises the old question of how one identifies a foreign language when one does not speak it? The solution is to have one or two key phrases in the old memory box and I suppose that the one most stations use is the equivalent of "This is so-and-so calling". The following quick course of language lessons may help:—

French "Ici Radio so-and-so"

German "Hier ist Radio so-and-so" (Pron. "hear isst")

Portuguese "Aqui Radio etc (Pron. "ah key")

Russian "Govorit Moskva" (Pron. gov-or-it)

Holland, by the way, uses a similar phrase to the German one.

David Lovatt, the proud new owner of a Codar CR70A, has latched on to a station that perplexes him, namely Radio Television Ivoirienne. This is a French language station that serves the Ivory Coast Republic and comprises five transmitters the largest one being a hundred kilowatt transmitting on 1241 and 11920 in English from 1830 to 1955.

David has had a QSL from the Turin standard frequency station on 5000 with 5kW. Such stations are very good for calibrating the set since there is an electronic tick every second exactly on the frequency.

Roy Patrick from Mackworth, Derby, writes to let us know that IBRA Radio is now sending a special QSL for the Malta relay programme Radio Mediterranean. Roy uses a Trio 9R59DS with the ever faithful Joystick aerial and he is a tropical bands fan and, although a little late, the following may well be worth noting:—

Radio Rumbos, Venezuela, 4970 late evenings or 0500.

Ecos del Torbes 4980 evening or early morning

Radio Continenta 5030 evenings or early morning so if you are an early bird or night owl why not try for one of the hundreds of South Americans.

From Rugely, Staffs, in fact from the QTH of **John Godwin**, comes news that HCJB Quito are to build a 500kW transmitter in order to beam the gospel into the USSR. Also, John says, Radio Sri Lanka are now putting out a show for the UK every evening on 15120 from 1900 to 2000. The clue to



identification is a jazz version of "Tea for Two", used as a link. For QSLs write to Sri Lanka Broadcasting, Colombo, Sri Lanka.

With a pre-war HRO plus his Joystick aerial John set out bright and early searching for VLT9 Papua on 9520, but, to his delight, he happened on Radio New Zealand on 9540 with its service for the Pacific Islands. The best times, John says, are between 0800 and 0900 from this 7.5kW station.

As a change from the winter of the UK let us turn to a DXer who has his 130 foot long wire secured "half way up a coconut tree". This is **E. M. Sivaguru** of Port Dickson, Malaysia, who has a Philips B5X06T. He logs such DXotics as:—

11500 Radio Nederland, Tananarive relay, at 1520

11860 Voice of Free China, Taiwan, at 1405

153925 Voice of Prophecy, India, at 1615

17810 FEBC, Radio Int. Manila, at 1630

and has a quiet chortle at the UK radio twiddler who has to listen hard for Australia, NZ or suchlike southern hemisphere transmitters which E.M. can pull in, as they say, "on a piece of wet string".

Turning now to QSLs **John Higginbotham** has harsh words to say about Radio Baghdad who it seems are sending out QSLs and "skeds" together but the skeds are for 1974! **J. W. Farrer** sends a list of the reply times from various broadcasters and tops is Radio Australia with an airmail reply taking 105 days, while Radio Finland takes 10 days and our own BBC World Service takes 25 days.

Some time ago news reached your column that Radio Israel was to start a DX show. **P. K. Gulati** has sent in the first report on this show. It is aired on 15100 every Saturday night at 2030 and another DX show mentioned is that of Radio Austria on 9690 every Sunday at 0915 and repeated at 1805 on the same frequency.

It is time to wind up so wishing you 73s for 76 I will close apologising for those letters that space has ruled out due to the very heavy postbag this month.

BROADCAST BANDS

MEDIUM WAVE DX

by **CHARLES MOLLOY**

PAUL BOOKBINDER writes from Maidenhead with news of his first transatlantic DX on the medium waves. Using a Grundig Satellit 1000 with built-in ferrite rod aerial he logged WINS on 1010kHz at 0300. "Reception was good but only lasted about ten minutes; very interesting to hear local domestic news and traffic reports direct from New York". Paul, who is building a medium wave loop aerial has been active on the long waves too and has

received a QSL card from Kiev, Ukraine on 209kHz. Congratulations Paul on a fine achievement, you should really pull in the DX once your loop is in use.

Glyn Morgan of Tredegar, Gwent, has been having trouble with his HA230 communications receiver. He is temporarily using an Astrad VEF 17 transistor portable with internal aerial for his DXing and his catches include WCBS in New York City on 770kHz, Tenerife in the Canary Islands on 620kHz and an unidentified Arabic station on 863kHz (probably Ksar-es-Souk, Morocco). Glyn prefers to use his Astrad in its portable form to take advantage of the directional effect of the internal aerial. A ferrite rod aerial behaves in the same way as a loop. Interference is reduced and there is often an improvement in signal-to-noise ratio too but the loop has much greater pick-up which makes it more suitable for the serious DXer. Hope your HA230 is soon back in service Glyn though you seem to be doing very well without it.

More news of transatlantic medium wave DX comes from **Samuel White** who lives in Larne in Northern Ireland. Using a Strad 553W receiver with a 60ft. long outdoor aerial he heard CJON in St John's in Newfoundland on 930kHz "quite clear at good volume". Reception on the lower frequencies is now better than it has been for many years owing to the approach of the minimum of the current sunspot cycle. DXers may agree with **Lawrence Bennett** of Bristol who writes "Because of the recent poor conditions on shortwave I decided to try my hand at Medium Wave DXing". Lawrence has received a number of good QSL cards and souvenirs from German stations and he mentions a book on DXing issued by Sender Freies Berlin, 566kHz. You have to null-out Athlone on the same channel to receive this one.

Twelve-year-old **Michael Walker** of Leeds has got hold of an old 6 valve Emud receiver which is of German origin. He used it with a 30ft. outdoor aerial to hear Sweden Calling DXers from Radio Sweden on 1178kHz. Michael received a QSL card and a copy of the DXers Newsletter issued by this programme. The English version of Sweden Calling DXers is broadcast weekly on a Tuesday at 2300 and often includes items of interest to the medium wave DXer.

An interesting letter comes from **F. A. Ainsley** of Hartlepool in Cleveland who confesses to being a keen medium wave DXer both in Australia and England. He has been experimenting with loop and vertical aerials and has managed to combine the two at the input of his homemade receiver in such a way as to produce a single null similar to that obtained when direction finding equipment is in the Sensing mode. With this null pointing towards Europe he managed to log WCBS in New York City on 770kHz, WINZ in Miami and WBT in Charlotte, North Carolina.

BROADCAST BANDS

Short Wave reports by the 15th of the month to Derek Bell c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS

Logs covering any Amateur band/s in band/alphabetical order by the 25th of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashted, Surrey, KT21 2TW.

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SPECIAL PRODUCT REPORT

Sinclair OXFORD~300

THE "Oxford" series of calculators is Sinclair's bid to increase their penetration of the calculator market. The Oxford 300 is aimed at the growing "electronic slide rule" market and it looks like being a success.

The pocket-size scientific calculator field was pioneered by Hewlett Packard, closely followed by Texas Instruments who have become market leaders in the US. Hewlett Packard's HP35 was the first machine on the market which, competitively priced, virtually overpowered the existing calculator market overnight and made H-P a great deal of money. Since the launch of the HP35 in 1972, the market has expanded to allow prices to fall until today simple calculators start at under £10. Most of the scientific calculators are in the £50 to £150 range, so at £30 plus 8% VAT, the Sinclair Oxford 300 is worth a close examination.

Sinclair have produced three models in the Oxford range, the 100, 200 and 300, in an attempt to capture the market of calculator users from schoolboys and housewives, through commercial and business users, to scientists and engineers. They hope to claim a 35% share of the market by the end of 1975.

CONSTRUCTION

The Oxford 300 consists of a keyboard, a printed circuit board containing the main circuits and a display unit. The keyboard has 19 keys and a switch, all mounted on a paxolin assembly fitted into the case. The keys have a nice positive feel, making a click when operated. Replacement of a faulty keyboard would take enough time to be significant in cost.

The calculating power is contained in a single integrated circuit soldered, together with an interface IC and a few other components on to a neat printed circuit board which is mounted on plastic pillars and retained by three push fit pop studs. With only 17 connections, this board is easily changed but, since it contains the computing IC replacement would be expensive. The display unit is welded to the case and is the most difficult part to remove. The general standard of construction inside this calculator may be described as top domestic quality.

PACKAGING

Whilst one can be reasonably enthusiastic about the Oxford 300's internal construction, the same cannot be said about the outside packaging. According to Sinclair, "final styling of the Oxfords was determined by an exhaustive market research exercise in which a number of alternative case styles were researched for their modern and professional appearance, convenience and customer acceptability". The others must have been bad for this black case can only be described as dull.

A second criticism is the on/off switch, disguised as a function button on the main keyboard. It is a slider switch, rather difficult to operate and a potential failure point. A degree/radian switch is fitted on the back of the case in a position much more suitable for an on/off switch. Swapping these two switches would seem to be both logical and more functional.

The keyboard is of the dual function type in which a "function" key is used to obtain the alternative functions. This type of keyboard has the advantage that price is kept to a minimum as opposed to the discrete function keyboard which may have 40 or more keys for the same capability. The necessity of using a function key in an algebraic machine



not only increases the number of operations necessary when performing calculations but it also means that considerable care has to be exercised as well.

The Oxford range is not designed with pocket use in mind although they should fit the average size pocket. The display is angled in such a way that it can be read with the machine on a desk. The keys are larger than most pocket calculators making desk top operation easier.

All three calculators in the range are mains or battery operated and should not be confused with the rechargeable battery facilities offered on more expensive machines.

FACILITIES

Algebraic logic is used as opposed to reverse Polish scientific notation as employed in the Sinclair Scientific calculator. This simplifies operation for the average user since calculations are carried out in the same way as they are written down. The Oxford provides a constant facility on all four arithmetic functions. There is also a very flexible memory with M+ (add to memory), M- (subtract from memory), MEx (exchange display and memory), MC (memory clear) and MR (memory recall) functions available. Trig functions sin, cos, tan and arcsin, arccos and arctan are provided with a switch to select either degree or radian operation. Other functions provided are $\log_e x$, e^x , \sqrt{x} , $1/x$ and a π key. There is no x^2 function which can be rather frustrating at times although squaring can be carried out using the constant facility.

Sinclair provide an adequate booklet showing examples of how to use the calculator. The display gives results in eight digit floating decimal point format or in scientific notation with a five digit mantissa and a two digit signed exponent. Numbers can be entered in either notation, the machine automatically adjusting the notation when the operation key is pressed. There is a machine clear and a last entry clear facility provided by pressing the clear key either once or twice. Each of the four arithmetic functions has the ability to store a constant so that if, for example $k \times a =$ is entered then subsequent numbers may be multiplied by k simply by pressing say $b =$ to give $k \times b$.

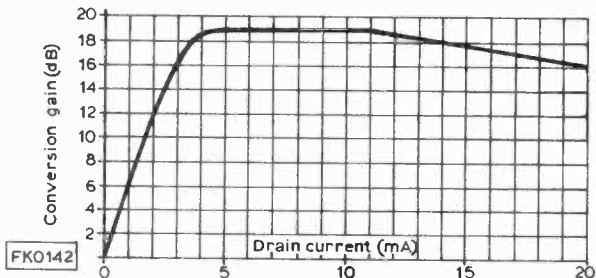
CONCLUSION

The Oxford 300 is a powerful little package that will appeal to many users at the price offered. The functions provided are more than adequate for the run of the mill scientific problem and the algebraic notation certainly makes it easier to use than the Sinclair Scientific.

DW



Fig. 5: Graph of the mixer unit conversion gain, plotted against drain current.



Readers may wish to use a power supply during their experiments which will not give more than 50mA, to prevent possible damage to the SD6000. The absolute maximum permissible drain to source voltage is 20V.

As with all VHF circuits, precautions must be taken when using the SD6000 to keep all wires carrying radio frequencies very short. The writer found the SD6000 circuits he has tried reasonably immune from spurious oscillation, but nevertheless begin-

ners are strongly advised to experiment at lower frequencies before moving to the 100MHz region.

The use of the SD6000 will enable FM tuners, including car radio VHF receivers, to be made which have a better performance and somewhat simpler circuitry than those which have been available up to now.

The SD6000 is available from Chromasonic Electronics, 56 Fortis Green Road, London N10 3HN for £1.22 plus 20p p/p.

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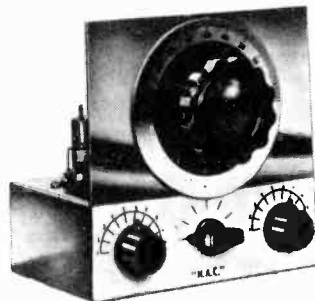
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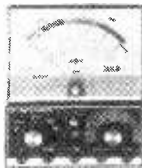
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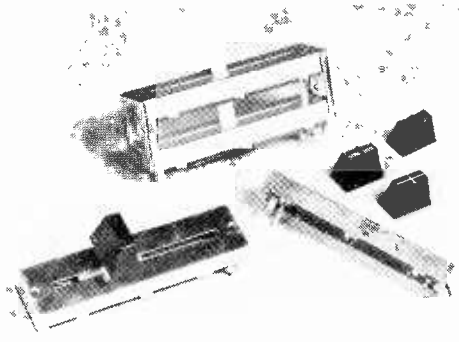


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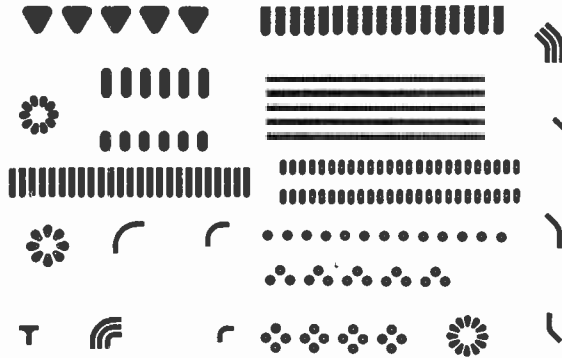
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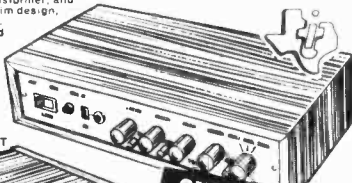
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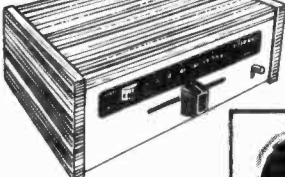
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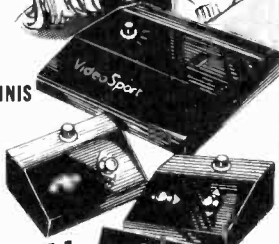
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7403	0-12	0-09	7453	0-12	0-10		
7404	0-10	0-09	7454	0-12	0-10		
7405	0-10	0-09	7460	0-12	0-10		
7406	0-28	0-25	7470	0-26	0-24		
7407	0-28	0-25	7472	0-22	0-20		
7408	0-14	0-10	7473	0-26	0-22		
7409	0-14	0-10	7474	0-27	0-23		
7410	0-08	0-07	7475	0-44	0-40		
7411	0-20	0-18	7476	0-28	0-25		
7412	0-20	0-18	7480	0-40	0-35		
7413	0-26	0-25	7481	0-95	0-90		
7416	0-28	0-25	7482	0-72	0-62		
7417	0-27	0-24	7483	0-80	0-68		
7420	0-10	0-09	7484	0-85	0-80		
7422	0-25	0-23	7485	1-20	0-95		
7423	0-26	0-24	7486	0-30	0-25		
7425	0-26	0-24	7489	2-70	2-50		
7426	0-26	0-24	7490	3-70	3-32		
7427	0-26	0-24	7491	0-60	0-50		
7428	0-36	0-34	7492	0-43	0-35		
7430	0-12	0-10	7493	0-38	0-35		
7432	0-25	0-22	7494	0-45	0-40		
7433	0-35	0-32	7495	0-58	0-50		
7437	0-25	0-22	7496	0-68	0-63		
7438	0-25	0-22	74100	1-00	0-90		
7440	0-12	0-10	74101	0-30	0-25		
7441	0-64	0-58	74105	0-30	0-25		
7442	0-60	0-52	74107	0-30	0-25		
7443	0-95	0-90	74110	0-50	0-45		
7444	0-95	0-90	74111	0-80	0-75		
7445	0-95	0-85	74118	0-90	0-82		
7446	0-95	0-85	74119	1-30	1-20		
7447	0-68	0-65	74121	0-26	0-25		
					74199	1-80	1-70

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C.'s in booklet form. Price 35p.

I.C. SOCKETS

BPS8 9p. BPS14 10p. BPS16 11p.

LINEAR IC

741P 8PIN 20p.

TIMERS

NE555 42p. DUAL NE556 85p.

TRANSISTORS

Type	Price	Type	Price	Type	Price	Type	Price
AC128	10p	BF258	26p	2N3055	40p	IN4148	4p
AC153K	18p	BF259	30p	2N3702	8p	IN4001	3p
AC176K	20p	BFX29	18p	2N3703	8p	IN4002	4p
AC153/176K	15p	BFX84	15p	2N3704	9p	IN4003	4p
MP	38p	BFX85	20p	2N3705	8p	IN4004	5p
AC187K	20p	BFX86	16p	2N3706	8p	IN4005	5p
AC188K	18p	BFY50	15p	2N3707	7p	IN4006	6p
AC187K/188K	MP	BFY51	15p	2N3708	7p	IN4007	7p
OC71	38p	BFY52	15p	2N3709	7p		
BC107	9p	BFY53	14p	2N3710	7p		
BC108	6p	2N696	10p	2N3711	7p		
BC109	6p	2N697	11p				
BC118	8p	2N706	6p				
BC154	20p	2N706A	6p				
BC147	8p	2N708	7p				
BC148	8p	2N1613	15p				
BC149	10p	2N1711	15p				
BC157	12p	2N1893	18p				
BC158	10p	2N2217	15p				
BC159	10p	2N2218	14p				
BC169C	7p	2N2218A	15p				
BC170	5p	2N2219	14p				
BC171	5p	2N2219A	14p				
BC172	5p	2N2221	14p				
BC182 L & K	10p	2N2221A	15p				
BC183	10p	2N2222	14p				
BC184	12p	2N2222A	14p				
BC212 L & K	10p	2N2369	12p				
BC213	10p	2N2369A	12p				
BC214	12p	2N2904	12p				
BC251	6p	2N2904A	12p				
BC327	12p	2N2905	13p				
BC328	12p	2N2905A	13p				
BC337	11p	2N2906	13p				
BC338	11p	2N2906A	10p				
BF115	10p	2N2907	11p				
BF167	10p	2N2907A	11p				
BF173	10p						
BF198	12p						
BF199	12p						
BF194	9p						
BF195	9p						
BF196	11p						
BF197	11p						
BF257	22p						

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1A/400V TO5 25p
5A/50V TO66 25p
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F.E.T.
2N3819 12p

VOLTAGE REGS.
L129 (UA7805) 85p
L130 (UA7812) 85p
L131 (UA7815) 85p

UNI-JUNCTION
UT46= TIS43 20p

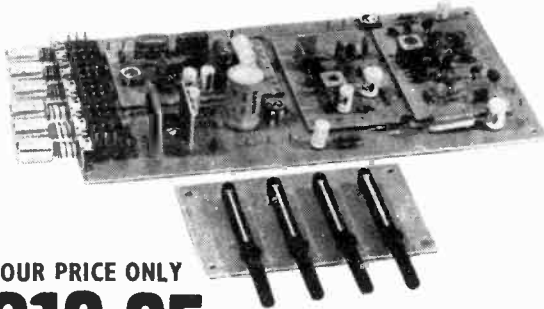
L.E.D.
TIL209/ FLV117 RED 5 for 50p

DIODES
OA10 15p
OA47 5p
OA85- OA81 5p
OA91 5p
OA200/ BAX13 5p
OA202/ BAX16 5p
IN914 4p

PCB MARKER PENS 65p

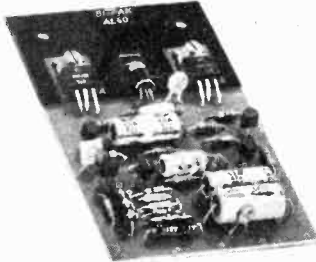
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25 Watts
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- Thermal Feedback. ● Latest Design Improvements.
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- Overall size 63mm. 13mm.

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SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5A at 35V. Size: 63mm, 105mm, 30mm. Incorporating short circuit protection.

INPUT VOLTAGE	33-40V. A.C.	
OUTPUT VOLTAGE	33V. D.C. Nominal	
OUTPUT CURRENT	10mA-1.5 amps	£3.00
OVERLEAD CURRENT	1.7 amps approx.	
DIMENSIONS	105mm x 63mm x 30mm	
TRANSFORMER BMT80	£2.60 + 62p. postage	



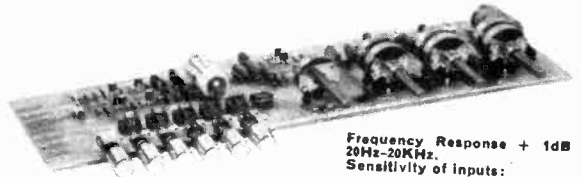
STEREO FM TUNER

Fitted with Phase Lock-loop

- ★ FET Input Stage
- ★ VARI-CAP diode tuning
- ★ Switched AFC
- ★ Multi turn pre-sets
- ★ LED Stereo Indicator

Typical Specification:
Sensitivity 3μ volts
Stereo separation 30db
Supply required 20-30v
at 90 Ma max.

STEREO PRE-AMPLIFIER PA 100



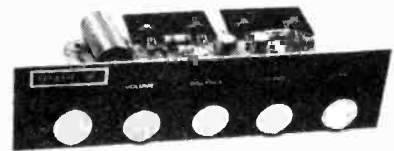
Frequency Response + 1dB
20Hz-20KHz.
Sensitivity of inputs:
1. Tape Input 100mV into
100K ohms
2. Radio Tuner 100mV into
100K ohms
3. Magnetic P.U. 3mV into
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P.U. Input equalises to R1AA
curve within 1dB from 20Hz to
20KHz. Supply 20-35V at 20mA.
Dimensions—299mm x 89mm x
35mm.

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MK60 AUDIO KIT: Comprising: 2 x SPM80, 1 x BTM80, 1 x PA100, 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. **COMPLETE PRICE £27.55 plus 62p postage.**
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7 + 7 WATTS R.M.S.

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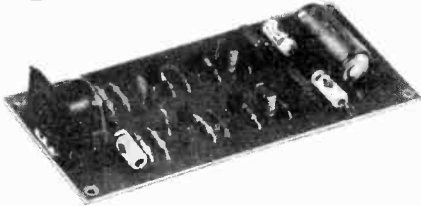
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AL10-20-30

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Sensitivity for Rated O/P -Vs = 25v. RL = 80ohm
f = 1KHz 75mV. RMS. Size: 75mm x 63mm x 25mm.

AL10 3w R.M.S. **£2.30** AL2: 5w R.M.S. **£2.65** AL30 10w R.M.S. **£2.95**

NEW PA12 Stereo Pre-Amplifier completely redesigned for use with AL10 20 30 Amplifier Modules. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.
Frequency Response 20Hz-20KHz ($\pm 3dB$)
Bass and Treble range $\pm 12dB$
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Input Sensitivity 300mV
Supply requirements 24V. 5mA
Size 152mm x 84mm x 33mm

PA12
£6.50

PS12 Power supply for AL10/20/30, PA12, S450 etc. Input voltagr 15-20v A.C. Output voltage 22-30v D.C. Output Current 800 mA Max. Size 60mm x 43mm x 25mm.

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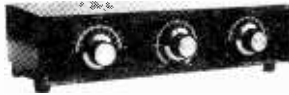


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TR3	0-0-9v	100 mVA	Primary
TR4	0-0-6v	100 mVA	Primary
TR5	3-0-3v	100 mVA	Primary

Our Price **£1.25** each + 8%

ANTEK SOLDERING IRONS AND SPARES

X25 25 watt = **£2.45**
X25 Spare Element = **£1.20**
X25 Spare Bits No. 50, 51, 52 = **44p** each
C240/2 15 watt = **£2.45**
C240/2 Spare Element = **£1.10**
C240/2 Spare Bits No. 2, 3, 6 = **32p** each
BT3. Soldering Iron Stand Suitable for all models = **£1.10** + 8% VAT

LOW PRICE TRANSISTORS
BF303B = 15p TIP42A = 75p
AC142K = 25p OC75 = 25p
BC149B = 15p AA129 = 6p

POWER SUPPLY UNITS + 8%
FP1 switched 3, 4, 5, 7, 9 and 12 volts at 500 mA, with on/off switch and pilot light. Size: 130mm x 55mm x 75mm. **ONLY 44.00**
FP2 switched 6 - 7 - 9 volt Battery Eliminator. Approx. size 2 1/2" x 2 1/2" x 3 1/2". Ideal for cassette recorders. **23.25**
PP3 Car converter. From 12v Pos. or Neg. to = 6 - 7 - 9 volt. Easy to fit and transistor regulated. **£2.90**

VEROBOARD + 8%

2 1/2 x 3 1/2	88p	28p	18p	Plain-15
2 1/2 x 6	41p	41p	20p	
3 1/2 x 3 1/2	41p	41p		
3 1/2 x 5	47p	49p	24p	
1 7/8 x 2 1/4	1.24p	89p	69p	
1 7/8 x 3 1/4	1.89p	1.32p	97p	
1 7/8 x 5	2.16p		I-37p	

Pin insertion tool **81p**
Spot face cutter **59p**
Pkt 36 pins (state .1 or .15) **30p**

LOUDSPEAKERS + 25%
2 1/2" 8 ohm **80p**
2 1/2" 40 ohm **60p**
2 1/2" 80 ohm **60p**
3" 8 ohm ceramic **£1.25**
6 1/2" 8 ohm dual cone ceramic **£3.50**
10" 8 ohm dual cone ceramic **£3.75**
8" x 5" 8 ohm Permant Magnet **£1.90**

LOW VOLTAGE STEREO AMPLIFIER
8 Transistor Stereo Amplifier with Vol'e, Base, Balance and Tone Controls. Approx. 3 watts into 8 ohm per channel needs a 9/12 volt DC supply and is complete on a 2 1/2" x 7 1/2" PCB board.
Ideal for domestic record players, etc. A Bargain at **£5 + 25% VAT.**

10-INCH 8 OHM DUAL CONE
Manufactured by "ELAC" to a very high standard these loudspeakers are a real bargain.
SPEC:- Size - 10" Dual Cone.
Power - 10 Watts
Frequency - 40-12000Hz
+ 25% Our Price = **£3.75** each

MAINS KEYNECTOR

Keynector connects any Electrical Equipment to the mains supply in seconds. Ideal for bench, garage demonstrations, etc. Multi connections can be made (max. load 13A fused). **£2.85** + 8%

ALUMINIUM BOXES + 8%

Metal project boxes give your work a professional finish

L	W	H	
AB7	2 1/2	5 1/2	54p
AB8	4	4	82p
AB9	4	2 1/2	54p
AB10	4	2 1/2	69p
AB11	4	2 1/2	54p
AB12	3	2	48p
AB13	6	4	69p
AB14	7	5	84p
AB15	8	5	99p
AB16	10	7	£1.25
AB17	10	4 1/2	£1.08
AB18	12	5	£1.20
AB19	12	5	£1.50

ABS PLASTIC BOXES + 8%
Handy boxes for construction projects. Moulded extrusion rails for P.C. or chassis panels. Fitted with 1mm front panels.
1005 = 105mm x 73mm x 45mm = **55p**
1006 = 106mm x 78mm x 47mm = **72p**
1007 = 184mm x 124mm x 60mm = **£1.28**
1021 = 106mm x 74mm x 45mm (sloping front) = **55p**

TELESCOPIC AERIAL
Nine section fully swivelling telescopic aerial with 4BA single bolt fixing or two hole fixing bracket. Fully extended - **48"** Fully closed = **7"**
Our Price **50p** + P/P + VAT @ 25%

LOW NOISE LOW PRICE CASSETTES + 8%
Good quality tapes in well made screw type cassettes. Presented in single plastic cases.
C60 - **81p** C90 - **42p** C120 - **53p**
10% Discount on ten or more cassettes of one type

CLEAR PLASTIC PANEL METERS

Size 50mm x 46mm x 35mm these meters require a 36mm hole for mounting.

ME6	-0 to 50 micro amp Full Scale
ME7	-0 to 100 micro amp Full Scale
ME8	-0 to 500 micro amp Full Scale
ME9	-0 to 1 mA Full Scale
ME10	-0 to 5 mA Full Scale
ME11	-0 to 10 mA Full Scale
ME12	-0 to 50 mA Full Scale
ME13	-0 to 100 mA Full Scale
ME14	-0 to 500 mA Full Scale
ME15	-0 to 1 amp Full Scale
ME16	-0 to 50 volts
ME17	-0 to 300 volts A.C. Full Scale
ME18	"8" Meter
ME19	"VU" Meter

OUR PRICE **£2.90** + 8%



WAVER SWITCHES

1 Pole 12 Way
2 Pole 2 Way
2 Pole 3 Way
2 Pole 4 Way
2 Pole 6 Way
3 Pole 4 Way
4 Pole 3 Way



27p each

SCOOP PURCHASE MW-LW-FM STEREO TUNER

We supply a MW-LW-FM-Stereo Tuner fully wired and aligned on a 6" x 4" x 1 1/2" printed board, plus the Ferrite Aerial and switch which you connect following our complete instructions.
Now you only need a 9-12 volt D.C. supply and you can feed this tuner into any Stereo Amplifier.
FANTASTIC VALUE AT £7.00 + 25% VAT

MINIATURE RELAYS IC EXTRACTION TOOL

Brand new range of British made Relays. Size 1 1/2" x 1" x 1/2". All two changeovers with 250v 1-5A contacts and suitable for fitting on 1mm Veroboard.
Type Voltage Cur. Ohms rent
27/A 12v 17M/A 700
21/A 12v 28M/A 430
12/A 6v 33M/A 185
All **£1.30** each

TWO WAY STEREO ADAPTOR

Stereo jack plug to two stereo line sockets complete with 110 mm of cable. For plugging two stereo inputs into one. A bargain at **65p** + 25%

CABLE LESS SOLDERING IRON WAHL "MO-TIP"

- ★ Completely Portable
- ★ Heats in 5 seconds
- ★ Solders up to 150 joints or more per charge
- ★ Recharges automatically in its own stand
- ★ No AC leakage or induced current to damage delicate components
- ★ Heats to 700 deg. F
- ★ Fine Tip for delicate and general purpose soldering
- ★ Only 8" long and weighs just 6 ozs.

OUR PRICE £9.75 + 8% (spare bits are available)

FERRIC CHLORIDE

Anhydrous ferric chloride in double sealed one pound poly packs.
Our Price **65p** + P/P + VAT @ 8% per lb.

3 KILOWATTS PSYCHEDELIC LIGHT CONTROL UNIT

Three Channel Bass, Middle, Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 1000W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed). **£18.50** plus 75p P. & P. + 8%



BARGAIN TRANSFORMERS

12-0-12 volt 500m/a
240 volt primary transformer bargain, approx size = 60mm x 40mm x 50mm fixing centres = 75mm
Our Price = **£1.20** + 8%

P.C. ETCHING KIT

This kit contains all that the constructor will need to etch the circuits of his own design.
Contents:- Plastic etching dish. Sample copper clad board. Laminated Cutter. 1 lb Ferric Chloride. Large Plastic Spoon. Etch Resist Pen. Full Etching Instructions.
Complete and Big Kit Value at **£3.75p** + 8%

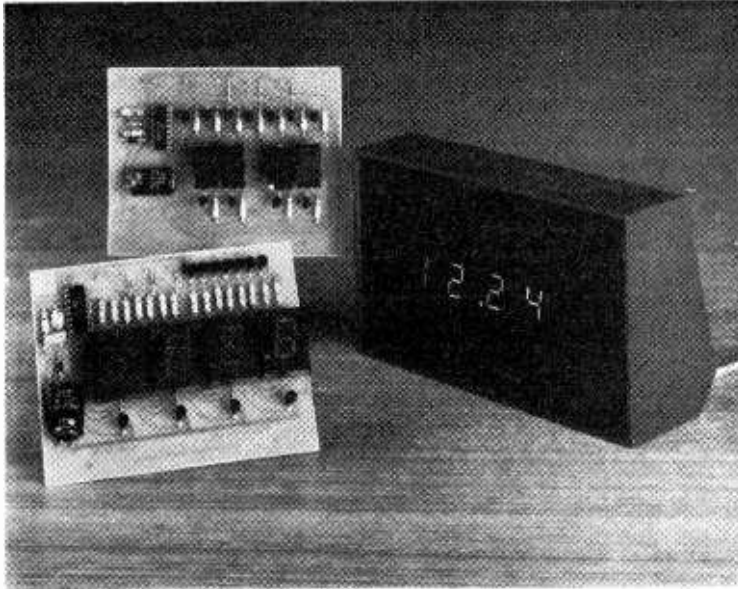
VAT-All prices are excluding VAT. Please add to each item the VAT rate indicated.

CRESCENT RADIO LTD. P.W. U.K. POSTAGE 50p UNLESS OTHERWISE STATED

All mail to No. 1 ST. MICHAELS TERRACE WOOD GREEN, LONDON N22 4SJ. Phone: 01-835 4474

Callers Welcome at 15 Mayes Road & 13 South Mall, Edmonton N9.

Greenbank Electronics Established 1970



DIGITAL CLOCK P.C.B. KITS FROM

£9.35 (plus 10p post
and VAT @ 8%)

Features:—

- ★ High quality fibreglass P.C.B. 112 × 89mm (both types), a suitable case is available as illustrated, or you can make your own.
- ★ All components mount on one side of the board for neatness and simple construction.
- ★ AY-5-1224 chip and L.E.D.s 'plug-in' for easy assembly and servicing.
- ★ Uses L.E.D. display (believed to have the longest life time of all electronic display types known at present).
- ★ A single 12V, 500mA, 50 Hz supply is the only input required (e.g. our 2 × 6V Min. Tr., see below).
- ★ Full eight page instructions provided, and back up assistance if you need it—success guaranteed! Suitable for even the absolute beginner.
- ★ Easily converted to give additional 4 range 'stop-watch' facility, for e.g. darkroom timer.
- ★ All parts available individually at no increase in price—buy only what you need.
- ★ An excellent idea for a most acceptable gift.

The illustration shows the two P.C.B. kits already assembled, one has 8mm high digits, the other has 16mm high digits. Also shown is an example of a completed clock.
Free on request: Data on AY-5-1224 and MK50253 clock chips, 4 and 6 digit alarm clock suggested circuits, quartz crystal timebase, and L.E.D. displays, (if you can send an S.A.E., it makes things a little easier for us).

CLOCK/'STOPWATCH' P.C.B.s

Type 1224-704E/PCB for 8mm high display 95p. Type 1224-747E/PCB for 16mm high display 95p.

COMPONENT KITS

Include: P.C.B., AY-5-1224 Chip, 4 L.E.D. digits, transistors, diodes, resistors, capacitors, mounting socket pins, full instructions. Ref: 1224-704E/Kit (8mm high digits) £9.35

Also, as above but using 16mm high digits (P.C.B. is same size). Ref: 1224-747E/Kit £12.59

(Either P.C.B. kit can be supplied assembled and tested for an additional 75p)

CLOCK CHIPS

AY-5-1224 4 digit £3.66 MK 50253 4/6 digit alarm £5.50
(CT 7001 discontinued)

L.E.D.s (Please check availability)

DL-Series 7 seg. displays, common anode and common cathode types: 0.3" single digits, 'Economy' 70p, 'Prime' £1.48; 0.5" double digits, 'Economy' £1.80, 'Prime' £3.75; 0.6" single digits, 'Economy' £1.50; 'Prime' £2.45, 0.2" single red L.E.D. indicator 12p

MINIATURE TRANSFORMERS

6VA Types with 240V primary, approximate dimensions W.45mm H.38mm D.40mm, fixing centres 53.5. Secondary voltages available: 2 × 4½V, 2 × 6V, 2 × 12V, 2 × 15V, 2 × 20V, all same price £1.52.

CMOS

Popular types 4001, 4011 gates 15p (Range is being extended—send for list.) New CA 3130 R.C.A. COS/MOS op-amp 75p.

ANTEX SOLDERING IRONS

C.240 15 watt miniature type £2.45. X.25/240 25 watt £2.45.

Terms: C.W.O. Add VAT to all prices at 8%. Post etc., U.K. 10p per order, export 75p (no VAT). All orders processed on day of receipt

GREENBANK ELECTRONICS (Dept. W1P)

94 New Chester Road, New Ferry, Wirral, Merseyside, L62 5AG, England. Tel:—051-645 3391

So you want to save money and be sure of quality as well ?

AUTOLUME

Automatic side light switch to keep you within the law. See price list £4.98 inc. V.A.T.

VARIWIPE

Controls wipers stroke by stroke as required. Easy to fit. See P.W. Dec. Details in price list. £5.98 inc. V.A.T.

ELECTROWINK

Car flash unit for caravan, emergencies, etc. Electronic. No mods. needed to your car. See our price list. £4.48 inc. V.A.T.

S.A.E. brings full latest list. Everything over £3 sent postal paid.

RESISTORS

£12 values 10Ω to 10MΩ. Mostly carbon film, some good quality composition, ½, ¼ watt supplied as available. ½p ea. 100 one value 60p. ¼ watt. 5% carbon film, 1p ea. 100 one value 75p.

CAPACITORS

Small electrolytics, 1µF to 50µF, up to 50V, supplied as available 4p each. Others too numerous to list. Min. ceramics, most values to 10n, 50V 1.5p each. Polyester, polystyrene and others.

TRANSISTORS

Good quality marked, tested by TI, Ferranti, Micro Electronics, but with unfamiliar numbers. Will replace popular types such as BC107, 108, 109, 177, 178, 179, 207, 204, 182, 212, etc. 7p each.

100 PNP or NPN for £5.50.

50 PNP and 50NPN for £5.50. BARGAIN BAGS

100 assorted resistors, ½ to ¼ W, mostly carbon film, all good quality. 80p each.

100 assorted small electrolytics. £2.50

100 assorted miniature ceramics £1.00.

SCIENTRONIC

40, HIGH ST., SOMERSHAM, HUNTINGOON, CAMBS., PE17. 3JA. Tel: Somersham 0487 4321

PRACTICAL WIRELESS T.V. SOUND TUNER

IF Sub-Assembly (G8) £6.80. P & P 55p.

Mullard ELC1043 Varicap UHF Tuner £4.20. P & P 30p.

3-way Station Control Unit £1.20. P & P 25p.

6-way Station Control Unit (Special Offer) £1.00.

Resistors, Caps, Semiconds etc. £5.22. P & P 55p.

Printed Circuit Board £1.00. P & P 25p.

Add 25% VAT to price of goods. P & P all items 65p.

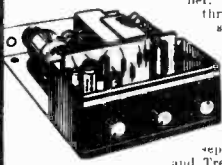
Callers welcome at shop premises.

MANOR SUPPLIES

172 WEST END LANE, LONDON NW6

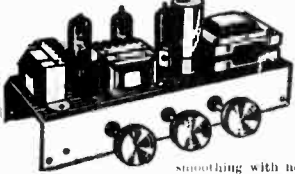
(Near W. Hampstead Tube Stn.) Tel. 01-794 8751

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz-20kHz ±3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, cutoutcheon panel, input and output plugs. Overall size 3 1/8" high x 6" wide x 7 1/2" deep. AC 200/250V. **PRICE £15.00. P. & P. 85p.**

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240V. Using 7 heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2 x ECL82 Triode Pentodes, 1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 8 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" w. x 4 1/4" d. Overall height including valves 6". Ready built & tested to a high standard. **£12.50. P.&P. 95p.**

ALL-PURPOSE POWER SUPPLY UNIT 200/240V. A.C. Input. Four switched fully smoothed D.C. outputs giving 6v. and 7v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/4" x 2 1/4". **PRICE £6-35 P. & P. 85p.**

VMAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £1-80 yd. length. P. & P. 35p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.6 watts. Volume and tone controls. Chassis size only 7in. wide x 3in. deep x 6in. high overall. A.C. mains 200/240V. Supplied absolutely Brand New completely wired and tested with good quality output transformer. **P. & P. 85p BARGAIN PRICE £5-00**

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations 0-5-10-15-20-25-30-35-40-50v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long x 3 1/4in. wide x 3in. deep. Price £2.75 P. & P. 75p.

MAINS TRANSFORMER. For power supplies. Pri. 200/240V. Sec. 9-0-9 at 500 mA. £1.35. P. & P. 35p. Pri. 200/240V. Sec. 12-0-12 at 1 amp. £1.50. P. & P. 55p. Pri. 200/240V. Sec. 10-0-10 at 2 amp. £2.20. P. & P. 70p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER

For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz-25KHz. Gain 26dB. Solid encapsulation size 1 1/2" x 1 1/4" x 1". Brand new complete with instructions. Price £1.50. P. & P. 15p.

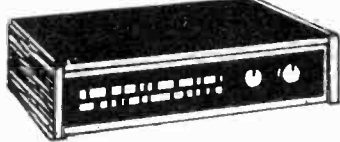
STEREO-DECODER

SIZE 2" x 3" x 1/2" ready built. Pre-aligned and tested. Sens. 20-560 mV for 9-18V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6-25 plus 20p. P. & P. Stereo beacon light if required £4.50 extra.



QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. **PRICE £8.50. P. & P. 90p.** ALSO AVAILABLE mounted on board with output transformer and speaker. **PRICE £7.75. P. & P. £1.**

HARVERSON MAINS OPERATED SOLID STATE STEREO FM TUNER



Enjoy fabulous stereo radio at this fabulous low introductory price!

Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-gain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mV. Approximate size 12 1/2" wide x 8" deep by 2 1/2" high. Supplied ready built, fully tested and fully guaranteed (not available in kit form). **Price £27.50 Post and Packing £1-20.**

LATEST ACOS GPN118C mono compatible cartridge with T/O stylus for LP/EP/78. Universal mounting bracket. **£1.75 P. & P. 18p.**

CERAMIC STEREO CARTRIDGE. Universal Mounting brackets and turnover switch. 70mV per channel output. **ONLY £2-06 + 18p. P. & P.**

SONOTONE STAKO COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78. **ONLY £2-62 P. & P. 10p.** Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3.18. P. & P. 18p.**

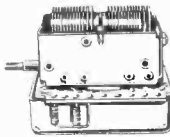
LATEST CRYSTAL T/O TEREO / COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £1.98 P. & P. 18p.

LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono nr stereo records on mono equipment. Only £1.75. P. & P. 18p.

SPECIAL OFFERS

Mullard LP1159 R.F.-I.F. Double Tuned Amplifier Module for nominal 470 KHz. Size approx. 2 1/2" x 1 1/2" x 7 7/8 Volt ± earth. Brand new pre-aligned. Full specification and connection details supplied. **£2.50. P. & P. 12p.**

Five VHF/FM Tuner Head covering 88-108 MHz 10-7 M/Hiz I.F. output 7-8 Volt ± earth. Supplied pre-aligned, with full circuit diagram and connection details. Beautifully made with precision-gearred. FM and 32.5 Pf = 32.5 Pf A.M. Tuning (8 gauge only) £3-50 + P. & P. 35p.



PRECISION MADE

Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" x 2 1/2" x 1 1/2", supplied complete with chrome finished switch buttons **£1-50 ea + 10p. P. & P.**

HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16 1/2" high x 10 1/2" wide x 9" deep (approx.). Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, H.F. tweeter unit and crossover. **AVAILABLE IN NOMINAL 4 Ohm, 8 Ohm or 16 Ohm impedance (state which).**

OUR PRICE £12.50 each Carr. £1-60. Cabinet Available Separately **£7-50**, Carr. £1-20.

Also available in 8 ohms with EM113" x 8" bass speaker with parasitic tweeter **£11-00**, Carr. £1-60.

LOUDSPEAKER BARGAINS

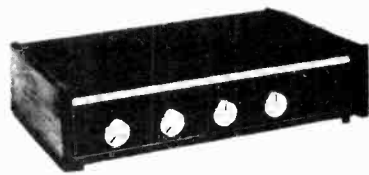
5in. 3 ohm **£1.45**, P. & P. 35p. 7 x 4in. 3 ohm **£1.69**, P. & P. 48p. 10 x 6in. 3 or 16 ohm **£8.50**, P. & P. 75p. E.M.I. P x 5in. 3 ohm with high flux magnet **£2-06**, P. & P. 50p. E.M.I. 13 x 8in. with high flux ceramic magnet with parasitic tweeter 3, 6 or 15 ohm **£4.12**, P. & P. 85p. E.M.I. 13 x 8in. 3, 8 or 16 ohm with inbuilt tweeter and crossover network **£5.50**, P. & P. 95p. E.M.I. tweeter. Approx. 3 1/2". Available 3 or 8 or 16 ohms. **£2.00 + 25p. P. & P.**

"POLY PLANAR" WATER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

Size 11 1/2" x 14 1/2" x 1 1/2" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. **Only £7.68** each. P. & P. 70p.

Now also available 8". 10 watts, r.m.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 7". Ideal for Hi-Fi or for use in cars **£5-18 + 40p. P. & P.**

HARVERSON SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise, level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 8 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost power to ±12dB. Treble cut approx. to -16dB. Negative feedback 18dB over main amp. Power requirements 30v. at 1-0 amp. Overall Size 12" w. x 8" d. x 2 1/2" h.

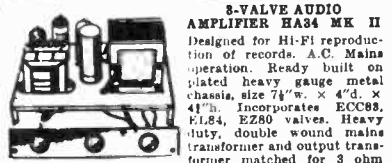
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT £15.00 P. & P. 55p (Magnetic input components 35p extra)
POWER PACK KIT £5.35 P. & P. 85p
CABINET £5.35 P. & P. 75p

(P. & P. only £1-00 if all units purchased at same time). Full after sales service

Also available ready built and tested **£32-50. P. & P. £1.**

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc. and will then provide mixing and fading facilities for medium powered Hi-Fi Discoteque use, etc.

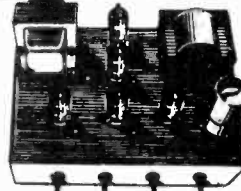


8-VALVE AUDIO AMPLIFIER HA34 MK II Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2" w. x 4 1/4" x 4 1/4". Incorporates ECC83, EL84, E280 valves. Heavy duty double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4 1/2 watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for **only £7.75. P. & P. 85p.**

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7420	15p	74123	75p
7422	19p	74141	70p
7423	36p	74151	77p
7425	33p	74153	92p
7427	48p	74154	164p
7430	15p	74155	82p
7432	28p	74155	82p
7437	28p	74180	107p
7440	15p	74161	107p
7441	79p	74162	107p
7442	64p	74163	107p
7448	75p	74164	136p
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7453	17p	74180	107p
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NE566	PLL Funct. Gen	180p
NE567	PLL Tone Decoder	180p
2567	Dual 567	400p
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14 Pin DIL	48p	5V	7805	150p
		12V	7812	150p
		15V	7815	150p
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		24V	7824	150p

OP TO ELECTRONICS

OCPT70	33p	Displays	LEDS		
OCPT1	120p	3015F	TIL209	16p	
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ORP61	85p	DL707	160p	(Green)	
2N5777	43p	DL747	250p		

SCR-THYRISTORS OTHERS

1A 50V TO5	43p	BT108 1A 700V	150p
1A 100V TO5	45p	Plastic	
1A 400V TO5	58p	C106D 4A/400V	59p
3A 100V Stud	53p	2N4444 8A/600V	290p
3A 400V Stud	81p	TO66	
7A 100V		2N3525 5A/400V	86p
TO5-HS	87p	TO92	
7A 400V		MCR101 $\frac{1}{2}$ A/15V	27p
TO5-HS		Plastic	
16A 400V		2N5060 8A/30V	35p
Plastic	290p	2N5082 8A/100V	48p
16A 800V		Plastic	250p
2N5084 8A/200V	50p		

TRIACS

	100V	400V	500V		
3 Amp	92p	120V	130p	40430	110p
6 Amp	95p	150p	180p	40485	110p
10 Amp	117p	180p	200p	40669	185p
15 Amp	156p	220p	270p	BR100	25p

BRIDGE REC-TIERS

1A 50V	27p	BY100	31p	1N914	4p
1A 100V	39p	BY128	15p	1N4001	6p
1A 200V	51p	BY127	15p	1N4004	7p
1A 600V	37p	OA47	9p	1N4148	5p
2A 50V	37p	OA70	9p	3-3v to 33v	
2A 100V	44p	OA81	9p	400mV	11p
2A 200V	47p	OA85	11p	1W	22p
2A 400V	58p	OA90	7p	OTHER	
2A 600V	69p	OA95	9p	AEY11	54p
4A 100V	85p	OA200	7p	BB105	33p
6A 100V	78p	OA202	7p	ZIJ	120p

TRANSISTORS

AC126/713p	BU105	175p	2N2484	32p	
AC128	12p	BU106	572p	2N2604/5	32p
AC141/280p	MJE340	49p	MJE2955	2N2928B	9p
AC176	12p	MJE2955		2N2928V	10p
AC187/814p					
AD149	46p	MJE3055			11p
AD167/238p					
AF114/517p					
AF118/717p	MPSA06				37p
AF139	35p				
AF239	43p	MPSA12			62p
BC107/816p	MPSU06				78p
BC109C	11p				
BC147/8	9p				
BC149	16p				
BC151	14p				
BC158/913p	OC28				96p
BC169C	15p	OC35	70p		
BC177	26p	OC71	29p		
BC178	17p	OC72	25p		
BC179	29p	OC83	35p		
BC182/312p	TIP2955				78p
BC184	14p	TIP29A	50p		
BC187	32p	TIP30A	60p		
BC212	14p	TIP31A	56p		
BC213	12p	TIP32A	63p		
BC214	17p	TIP33A	97p		
BCY70	29p	TIP34A	124p		
BCY71	24p	TIP35A	243p		
BD131	39p				
BD132	43p				
BD135	54p				
BD139	79p				
BD140	87p				
BF115	24p				
BF167	25p				
BF173	27p				
BF191	12p				
BF195	16p				
BF257	34p				
BFR39/40					
BFR78/90	37p				
BFY84	28p				
BFY85/82/2p					
BFY87	22p				
BFY88	22p				
BFY50	17p				
BFY51	16p				
BFY52	17p				
BRY39	39p				
BSX19/20	17p				
BU105	175p				
BU106	572p				
MJE340	49p				
MJE2955					
MJE3055					
MPSA06					
MPSA12					
MPSU06					
MPSU56					
OC28					
OC35	70p				
OC71	29p				
OC72	25p				
OC83	35p				
TIP2955					
TIP29A	50p				
TIP30A	60p				
TIP31A	56p				
TIP32A	63p				
TIP33A	97p				
TIP34A	124p				
TIP35A	243p				
TIP36A	257p				
TIP41A	70p				
TIZT208	11p				
ZTX300	16p				
ZTX500	19p				
ZTX504	60p				
2N897	14p				
2N898	32p				
2N908	13p				
2N908	19p				
2N930	19p				
2N1131/2					
2N1306	39p				
2N1613	22p				
2N171	22p				
2N1893	32p				
2N2219	22p				
2N2221/2					
2N2369	15p				
2N2484	32p				
2N2604/5	32p				
2N2928B	9p				
2N2928V	10p				
2N3053	11p				
2N3054	18p				
2N3055	49p				
2N3442	19p				
2N3702/314p					
2N3704/514p					
2N3706	12p				
2N3707	14p				
2N3708/911p					
2N3773	275p				
2N3866	75p				
2N3904	22p				
2N3905/622p					
2N4056	19p				
2N4060	18p				
2N4289	25p				
40361	41p				
40362	43p				
40410	59p				
40594	24p				
40595	82p				
FETS					
BF244	45p				
MPPF02	37p				
MPPF03/4					
MPPF05	37p				
2N3819	7p				
2N3820	71p				
2N3823	54p				
2N4557	32p				
2N4558/932p					
3N128	81p				
3N424	82p				
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SYSTEM 7000

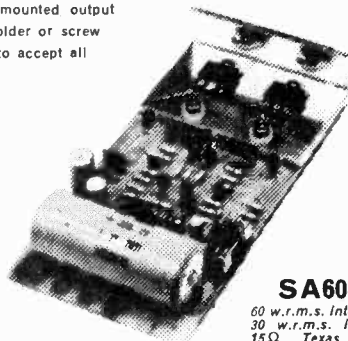
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Texas 15A output transistors.
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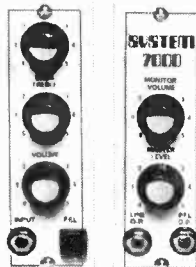
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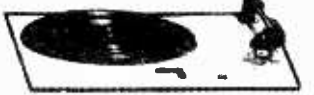
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Heavy duty 4-speed motor with
separate pick-up arm fitted
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compatible cartridge.



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Fitted with auto stop, stereo/compat. cartridge. Base-
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Turn on or off at full or intermediate settings.
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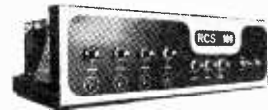
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OA79 8p	4007/A 16p	4045/A 111p
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4012/A 16p	4050/A 109p
4013/A 16p	4051/A 109p
4014/A 16p	4052/A 109p
4015/A 16p	4053/A 109p
4016/A 16p	4054/A 109p
4017/A 16p	4055/A 106p
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747C 70p	M252 820p
748C 28p	
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AY-1-5051 120p	MCI304 140p
AY-1-5052 85p	MCI310P 122p
AY-1-3500* 610p	MCI312 150p
AY-1-3507* 610p	MCI310CG 55p
AY-5-4007* 735p	MFC4000B 65p
CA3018 145p	MFC6040* 99p
CA3020 145p	NE555* 55p
CA3048 22p	NE556* 8p
CA3075 150p	NE562* 270p
CA3081 150p	NE565* 304p
CA3089E 150p	NE567 240p
CA3089C 235p	NE568 140p
CA3123E 140p	SL414A 178p
ICL8038* 270p	SN7603 150p
LM300H 170p	SN7615 200p
LM301 38p	TAA550 49p

BRIDGE RECTIFIERS (plastic case)

1A500 20p	1A100V 24p	1A200V 26p	1A400V 27p	1A600V 29p	3A100V 38p
1A100V 24p	1A200V 26p	1A400V 27p	1A600V 29p	3A100V 38p	3A200V 38p
2A500 38p	2A200V 34p	2A400V 48p	2A600V 84p	5A400V 90p	7A400V 125p
2A100V 38p	3A100V 38p	3A200V 38p	3A400V 90p	3A600V 90p	5A400V 125p
4A100V 38p	4A200V 38p	4A400V 90p	4A600V 90p	10E15 29p	MCR101 55p
6A100V 64p	6A400V 80p	BY122 54p	BY164 54p	TIC44 29p	2N4444 191p

SCR's (Thyristors)

1A 50V 38p	1A 100V 42p	1A 200V 47p	1A 400V 52p	1A 600V 78p	3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p
1A 100V 42p	1A 200V 47p	1A 400V 52p	1A 600V 78p	3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p	7A 400V 125p
1A 200V 47p	1A 400V 52p	1A 600V 78p	3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p	7A 400V 125p	10E15 29p
1A 400V 52p	1A 600V 78p	3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p	7A 400V 125p	10E15 29p	MCR101 55p
1A 600V 78p	3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p	7A 400V 125p	10E15 29p	MCR101 55p	TIC44 29p
3A 100V 38p	3A 200V 38p	3A 400V 74p	3A 600V 90p	5A 400V 90p	7A 400V 125p	10E15 29p	MCR101 55p	TIC44 29p	2N4444 191p

TRIACS*

3A 400V 100p	6A 400V 120p	6A 500V 150p	10A 500V 165p
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2 1/2 x 3 1/2" 50p	4 x 4 1/2" 50p	4 x 2 1/2 x 1 1/2" 50p	4 x 3 1/2 x 1 1/2" 50p	6 x 4 1/2 x 1 1/2" 80p	6 x 3 1/2 x 1 1/2" 80p	8 x 4 1/2 x 1 1/2" 80p	8 x 3 1/2 x 1 1/2" 80p	10 1/2 x 3 1/2" 120p	10 x 4 1/2 x 3 1/2" 120p	12 x 3 1/2 x 3 1/2" 120p	12 x 3 x 3 1/2" 120p	12 x 3 x 3 1/2" 120p
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DIAC*

ST2 20p

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Rng. 1-5 B.Y.R.W 69p	1-5 Green 74p
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SWITCHES*

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PUSH BUTTON:

Push on/Off, spring loaded 44p	Miniature Non Locking 15p	Push to Make 25p	Push to Break 25p	ROCKER (white): 10A 250V SP changeover centre off 25p	ROCKER (black): on/off 10A 250V 20p	ROCKER: illuminated (white) lights when on. 3A 240V 46p	ROTARY: 1p/2w, 2p/5w, 2p/2w, 2p/4w, 3p/3w 3p/4w, 4p/2w, 4p/3w 25p
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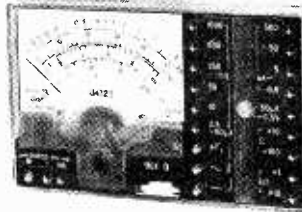
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AC/DC MULTIMETER TYPE U4315

42 ranges covering:

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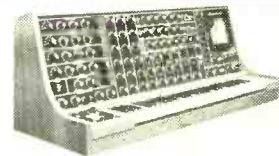


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