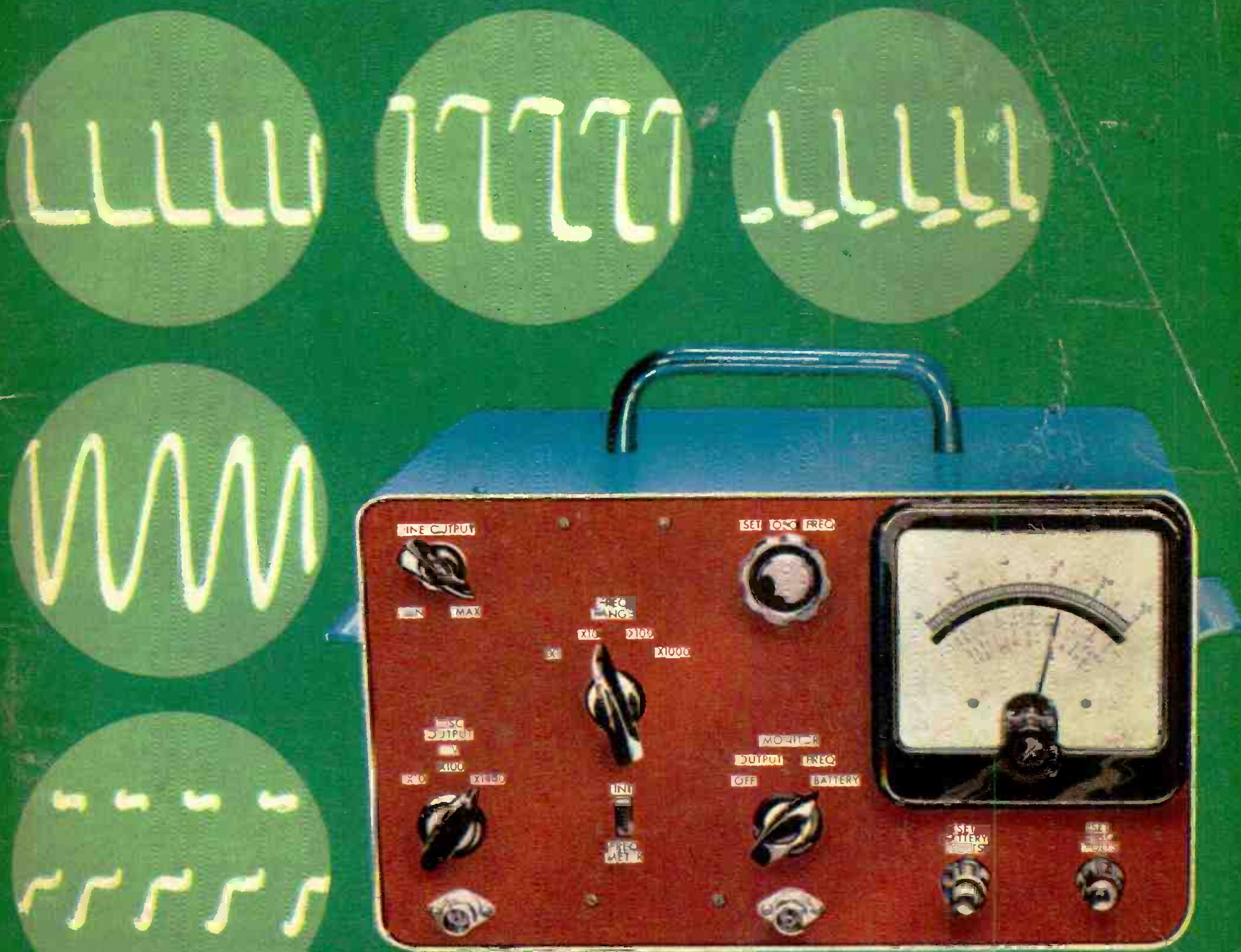
PRACTICAL WIRELESS

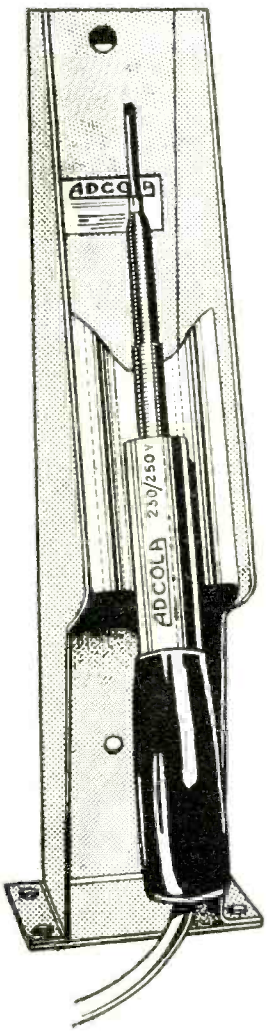
FEBRUARY 1968

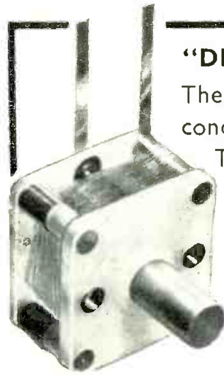
2'6

Combined AUDIO OSCILLATOR & FREQUENCY METER



FULL CONSTRUCTIONAL DETAILS


ADCOLA
230/250V



RADIONIC

PROBABLY THE WORLD'S BEST SYSTEM FOR:

BEGINNERS
TEACHERS
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Clear, simple, versatile, this rugged system can build almost any electronic circuit. Ideal for the experimenter; the teacher; and the complete beginner. Already used by well over 1,000 schools in the U.K.

Selected by the Council of Industrial Design for all British Design Centres. Featured in Sound and Television broadcasts.

Beautifully engineered; battery operated; no soldering; no prior knowledge needed. Results guaranteed by our technical department. People say:
"I can only describe the results as brilliant, absolutely brilliant."
"You have opened up a new world."
"Nothing could paint the picture clearer than building these sets."
"The kit has been used by my son (aged 10) with complete success."
"Most impressive—a stroke of genius whoever devised it."

UNIQUE! Our "No soldering" printed circuit board for superhet portable. Simply insert components and tighten nuts.

No. 1 Set	**£5.18.6**	**14 Circuits (Earphone)**
No. 2 Set	**£6.19.6**	**20 Circuits (Earphone)**
No. 3 Set	**£10.19.6**	**22 Circuits (7 x 4in. Loudspeaker output)**
No. 4 Set	**£14.19.6**	**26 Circuits (include 6 Transistor and reflex superhets)**

Prices (Post Free)

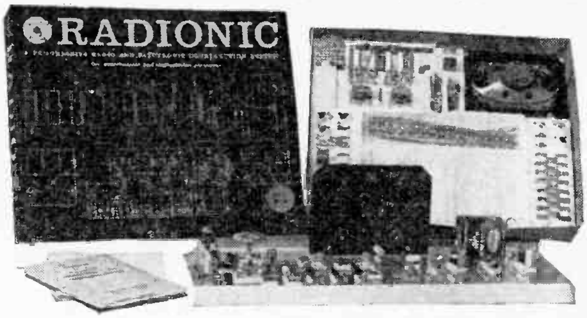
(Plus P.T. increases of 1/8; 1/11; 3/1; 4/2d respectively)

Full details from:

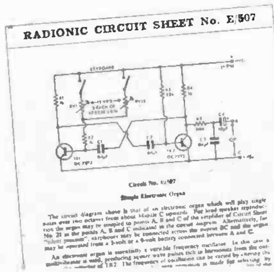
RADIONIC PRODUCTS LIMITED
STEPHENSON WAY, THREE BRIDGES
CRAWLEY, SUSSEX

Tel. CRAWLEY 27028 (Trade Enquiries invited)

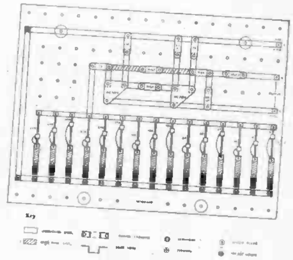
RADIO & ELECTRONIC CONSTRUCTION SYSTEM



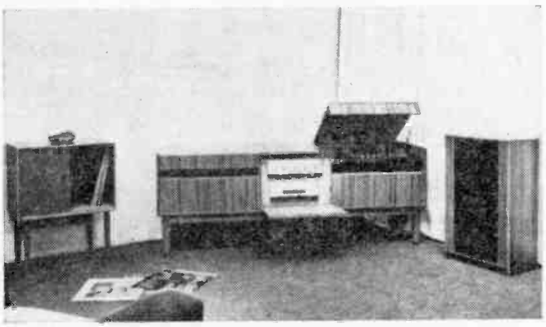
A No. 4 SET and 6-TRANSISTOR SUPERHET



Theoretical Circuit


Practical Layout

Our 'E' Series of basic electronic circuits is available separately. (See E507 above.) Send for details of E/508 computer.



HOUSING HI-FI?

Whatever your set-up there's a **Record Housing Cabinet** to meet your needs. Amplifiers, tuners, turntables, loudspeakers, records, tapes, tape decks and even a complete tape recorder—you name it we'll house it! The room setting above features our **Scan Record Cabinet** (left) **£8.8.0, New Andante Equipment Cabinet** (centre) **£38.17.0,** and **Folded Horn Speaker Enclosure** (right) **£11.19.0.** These are examples of the Record Housing range of equipment cabinets, speaker cabinets and record cabinets—over 20 different models priced from 7 gns. Send for free catalogue and list of over 600 stockists (U.K. only).

FREE HI-FI HOUSING ADVISORY SERVICE.

Simply tell us the equipment you propose to house and we will be pleased to recommend the most suitable cabinet. Remember—housing Hi-Fi is our business.

RECORD HOUSING

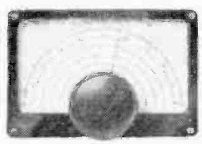
(Dept. P.W.2), Brook Road, London, N.22. Tel: 01-888 7487

Eddystone

SLOW MOTION DIALS

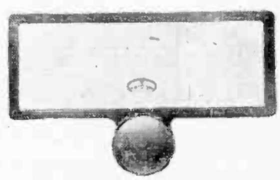
Catalogue No. 598 epicyclic dial

This full vision dial incorporates an epicyclic, ball-bearing drive mechanism of improved design and giving a reduction ratio of approximately 10 to 1. The movement is smooth and free from backlash. Dial escutcheon measures 6″ long by $4\frac{1}{8}$″ wide, finished ripple black. Four lines are provided on the semi-circular scale for individual calibrations, the outer line being marked from 0 to 100 over 180°. Supplied complete with black instrument knob $2\frac{1}{8}$″ diameter.



Catalogue No. 898 gear driven dial

A high grade assembly for precision instrument applications. Gear driven, flywheel-loaded mechanism, with a reduction ratio of 110 to 1, giving smooth, positive control. Pointer travel is 7″. A circular vernier scale, marked 0 to 100, is read in conjunction with the lowest line on the main scale, which has five lines for individual calibration. Overall dimensions $9\frac{1}{4}$″ by $5\frac{3}{4}$″. Diecast escutcheon finished glossy black to match $2\frac{1}{8}$″ diameter instrument knob. Complete with fixing screws and mounting template.



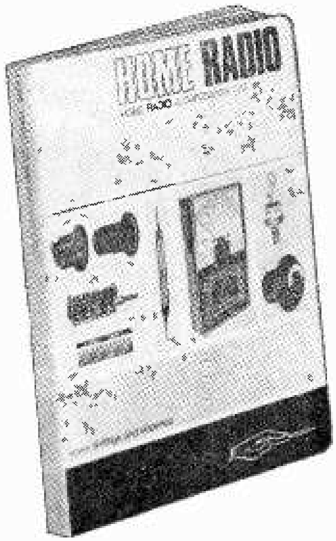
Eddystone Radio Limited

Eddystone Works, Alvechurch Road, Birmingham 31

Telephone: Priory 2231. Cables: Eddystone Birmingham. Telex: 33708

A MARCONI COMPANY LTD/ED8

HOME RADIO (Mitcham) LTD. Dept. PW, 187 London Road, Mitcham, Surrey, CR4 2YQ *Phone 01-648 3282*



A NEW YEAR HAS BEGUN, so why not make

A NEW YEAR RESOLUTION

AND WHAT BETTER ONE THAN THE PURCHASE OF A

NEW Home Radio Catalogue

Yes, now it can be told, the 4th Edition of the famous Home Radio Catalogue is now ready for you! In actual fact we have been distributing this New Edition since the 1st December, 1967, but this is the first advertisement bringing it to your notice. This is a completely new Edition—not just a reprint. It is *bigger* (and we are sure *better*) than ever—256 pages, over 7,000 items listed and over 1,300 illustrations. In spite of the increased size the price *remains* at 7/6, plus 2/– postage and packing, and we are still giving in each catalogue **5 vouchers,** each worth 1/– if used as directed. Also in each catalogue will be found a **5/– voucher** which can be used towards the purchase of a Weller Soldering Iron, our unique **Bargain List,** a useful **Book Mark** giving all the well-known Electronic Abbreviations, an **Order Form** and an **addressed envelope.**

There is no better way of starting the New Year than by purchasing the latest edition of this famous components catalogue. Send the coupon with your P.O. or cheque for 9/6 today.

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AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy cast construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range. Impedance 3 or 15 ohms. Response 40–18,000 c.p.s. Exceptional performance at low cost.

HF510	5"	8W	49/9	HF120	12"	15W	69/9
HF800D	8"	8W	59/9	HF120D	12"	15W	79/9
HF811D	8"	10W	£4.19.9	HF126	12"	15W	89/9
HF101D	10"	15W	£5.19.9	HF126D	12"	15W	5 gns.

RECORD PLAYING UNITS

All types available on Credit Terms.

Ready for plugging into Amplifier or Tape Recorder.

RP2 Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus, plinth and cover. Normally approx. £26. Carr. 15/- **22 Gns.**

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge Normally over £35. Carr. 15/-. ONLY **27½ Gns.**

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets of latest styling Satin Teak or Walnut acoustically lined (and ported where appropriate). Credit terms available on all units.

DORSET Size 16 x 11 x 9in. Response 45–18,000 c.p.s. Rating 8–10 watts. Fitted Audiotrine HF810D speaker. Impedance 3 or 15 ohms. **£8.19.9**

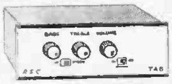
STANTON II Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815D speaker with roll rubber surround and 15000 line magnet. Handsome Scandinavian design cabinet. Response 30–20,000 c.p.s. Impedance 3 or 15 ohms. Gives smooth realistic sound output. **15 Gns.**

DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D speaker. Rating 15 watts. Impedance 3 or 15 ohms. Response 30–20,000 c.p.s. Provides really pleasing sound quality. **12½ Gns.**

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40–20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

LINEAR TAPE PRE-AMPLIFIER. Type LP/1 Switched Equalisation. Positions for Recording at 1⅞in., 3¾in., 7½in. per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most Tape Decks. Terms available. **10½ Gns.**

R.S.C. TA6 6 Watt HIGH FIDELITY SOLID STATE AMPLIFIER



200-250v. AC mains operated Frequency Response 30–20,000 c.p.s. —2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike. Gram. Radio or Tape. Input selector switch. Output for 3–15 ohm speakers. Max. sensitivity 5mV. Fully enclosed enamelled case. 9½ x 2½ x 5½in. Attractive brushed silver finish facia plate 10½ x 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 Or factory built with 12 months guarantee £7.19.11. **6 Gns.**

SENSATIONAL VALUE IN HIGH FIDELITY STEREO SYSTEMS

SUPERB 30 WATT SYSTEM

Consisting of (1) General Mk II SP25 4-speed Turntable with Pick-up. Heavy 12in. turntable, hydraulic lowering device and many other features inc. Plug in P.U. head. Fitted CS90 P.U. Cartridge Ready wired on plinth (baseboard). Fitted plugs for instant use. (2) Super 30 Amplifier fully wired and fitted in cabinet above. (3) Pair of Stanton II Loudspeaker Units. Performance comparable with equipment at twice the cost and saving approx. £16 on above units.

Extremely attractive cabinets finished Satin Teak Veneer. tinted Perspex 'hinged' lid. Special inclusive Price **69 Gns.** Carr. 35/-

Terms: Deposit £18.10.0 and 12 monthly payments of £5. Total £78.10.0. Send S.A.E. for leaflet.

Supplied less Stanton Loudspeaker at 49½ gns. or Deposit £7.17.6 and 9 monthly paymts £5.10.10 (total 55 gns.).

R·S·C·13 WATT HI-FI STEREO SYSTEM

Inc. Garrard SP25 MkII Player Unit (with heavy cast turntable) on plinth. ready wired. with plugs and fitted Goldring CS90 high compliance ceramic cartridge with diamond stylus. Assembled TA12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. Total £56. Special Price or Deposit £5.3.2 and 9 mthly. pymts. £5.3.2 (Total £51.11.8). Carr. 25/- **44 Gns.**

Perspex cover 50/- extra with above.

R·S·C·TA12 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner. Tape recorder. 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3–15 ohms ★ For 200–250v. A.C. mains ★ Frequency Response 30–20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 100mV (3) 100mV (4) 2mV ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams and instructions. Factory built with 12 mth gntee 14 gns. Or Deposit 55/- and 9 mthly. pymts. 31/- (Total £16.14.0). Carr. 10/6 **11 GNS.**

Teak finish cabinet as above 73/6 or as in stereo system 86/6.

AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. Available with clear Perspex cover as ill. Carr. 7/6 **66/-** **£5.19.11**

Or deeper type cut for TA12, Super 15 or 30 86/6 or with cover £6.19.11.

Perspex cover sold separately at 3 gns. Limited number damaged but repaired by Manufacturer. 39/9 to clear.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.** Carr. 5/9

Or **Senior 15 watt inc. HF 126** 15,000 line Speaker 6 Gns. Carr. 6/6.

FR3 3-SPEAKER SYSTEM Inc. Audiotrine HF126 12in. Bass unit, 5in. 10 watt mid-range speaker HF510M. High flux 4in. Tweeter. Cross-over units for mid and high frequencies and circuit. In suitable cabinet will provide quality comparable with very expensive units. Rating 15 watts. Impedance 15 ohms. Carr. 7/6 **9 Gns.**

HI-FI 'SPEAKER ENCLOSURES

Teak veneer finish. Modern design. Acoustically lined and ported.

JE8 Size 20 x 11 x 8in. Gives pleasing results with any 8in. Hi-Fi 'speaker. **4 Gns.**

SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. **5 Gns.**

SE10 For outstanding results with 10in Hi-Fi 'spkr. Size 24 x 15 x 10in. **6 Gns.**

SE12 For excellent performance with 12in Hi-Fi 'spkr and Tweeter. Size 25 x 16 x 10½in. **7 Gns.**

R.S.C. TFM1 TRANSISTORISED VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.**

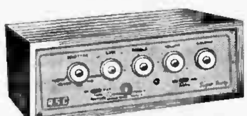
Or factory built 15½ gns. Or in Teak finished cabinet as illustrated 19 gns. Terms: Deposit £5 and 9 monthly payments 39/-. Total £22.11.0.

★High-sensitivity ★200-250v. A.C. Mains operation. ★Sharp A.M. Rejection ★Drift-free reception. ★Output ample for any amplifier (approx. 500 m.v.). ★Simple alignment instructions. ★Output available for feeding tuning meter. ★Output for feeding Stereo Multiplexer. ★Tuner head using silicone Planar Transistors. ★Designed for standard 80 ohm co-axial input. Made to visually match our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only first grade transistors and components used. A quality product at half the cost of comparable units. Stereo version, all parts 19½ gns. Assembled 25½ gns. Carr. 10/-.

R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST



FULLY TRANSISTORISED 200/250v. A.C. Mains. **OUTPUT 10 WATTS R.M.S.** cont. into 15 ohms. **15 WATTS R.M.S.** cont. into 3–4 ohms. **LATEST MULLARD TRANSISTORS.** AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107. **5 POSITION INPUT SELECTOR SWITCH EQUALISATION** to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads. **FULL TAPE MONITORING FACILITIES. SENSITIVITIES:** Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV. **FREQUENCY RESPONSE:** ±2dB 20–20,000 c.p.s. **TREBLE CONTROL:** +15dB to —14dB at 10Kc/s. **NEG FEEDBACK:** 52dB. **BASS CONTROL:** +12dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB. **HARMONIC DISTORTION** at 10 Watts 1,000 c.p.s. 0·25%. Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**

Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 49/- and 9 monthly payments 35/- (Total £18.4.0). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 4 Gns. extra.

ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s.

CONTROL: 5 position Input Selector, Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Fascia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control. apply also to Super 15.

THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **19 Gns.**

Unit factory built 26½ Gns. or deposit 83/9 and 9 monthly payments 59/3. (Total £30.17.0). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £4.15.6 and 9 monthly paymts 67/- (Total £34.18.6). *Send S.A.E. for leaflet*

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R·S·C HI-FI CENTRES LTD.

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries please. Hi-Fi Catalogue 4/6.

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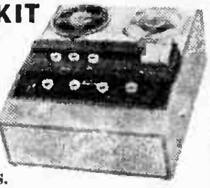
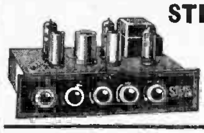
AUDIOTRINE HI-FI TAPE RECORDER KIT



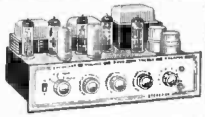
REALISM AT INCREDIBLY LOW COST Please send S.A.E.
CAN BE ASSEMBLED IN AN HOUR for leaflet.
ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.
Incorporating latest Magnavox Tapedeck. High quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leathercloth. Size 14¼ x 17 x 8½in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £50–£60 class. **Deposit 4 gns. and 9 monthly payments 59/6** (Total 29½ gns). 4 Track Model 3 gns. extra. Carr. 19/6 **26½ GNS.**

STEREO/TEN HIGH QUALITY AMPLIFIER



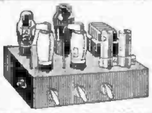
5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Valves ECC83, (2) EL84, (2) EZ81. For 2–3 ohm speakers. Complete kit with full wiring diagrams and instructions. Or supplied factory assembled with 12 months' guarantee for 11 gns. Carr. 11/6 **£8.15.0**
Terms: Dep. 36/- and 9 monthly payments 25/- (Total £13.4.9).

R.S.C. STEREO/20 HI-FI AMPLIFIER



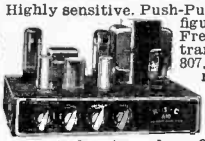
PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM. RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 20 millivolts max. **Harmonic Distortion:** 0·2% ★**Four-position tone compensation and Input Selector Switch.** ★**Stereo/Mono switch.** ★**Neon panel indicator.** ★**Handsome Perspex Frontplate.** ★**Separate Bass and Treble controls.** Output transformers are high-quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 months' guarantee 19 gns. Or Deposit £3 and 9 monthly payments 43/2 (Total £22.8.6). *Send S.A.E. for leaflet.*
14 Gns. Carr. 12/6

R.S.C. 4/5 watt A5 HIGH GAIN AMPLIFIER



A highly-sensitive 4-valve quality amplifier for the home, small club, etc. Suitable for all crystal or ceramic P.U. heads and most "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feedback 15dB. For A.C. mains 200–250v. Speaker output 3 ohms. Complete Kit with point-to-point wiring diagrams and instructions. **£4.17.9**

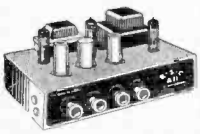
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All first grade components. Valves EF86, EF86, ECC83 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 12 millivolts so **that any kind of Microphone or Pick-up is suitable.** Designed for **Clubs, Schools, Theatres, Dance Halls or Outdoor Functions,** etc. For use with **Electronic Organ, Guitar, String Bass,** etc. Gram. Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months guarantee for 15 gns. **TERMS: Deposit** 48/- and 9 monthly payments of 33/7 (Total £17.10.3). Send S.A.E. for leaflet.
Carr. 12/6 **12 Gns.**

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER

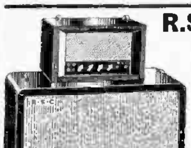
PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP.



Two input sockets with associated controls allowing mixing of "mike" and gram. etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer. INDIVIDUAL CONTROLS FOR BASS AND TREBLE Frequency response ±3dB 30-20,000c/s. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s, all types "mikes". Comparable with the best designs. For **Musical Instruments** such as **String Bass, Electronic Guitars,** etc. **Reserve Power** 300v. 30mA. and 6.3v. 1.5a. for **Radio Tuner** or **Tape Pre-amp.** Size approx. 12 x 9 x 7in. For A.C. mains 200–250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Full instructions and point-to-point wiring diagrams **£8.15.0.** Carr. 11/6 (or factory built **£11.15.0**). Metal cover with 2 handles available for **25/-. TERMS ON ASSEMBLED UNITS. Deposit** 36/6 and 9 monthly payments of 25/9 (Total £13.8.3). Send S.A.E. for leaflet.

R.S.C. A11T TRANSISTORISED VERSION of above complete kit 9 gns. Carriage 9/6.

R.S.C. BASS-REGENT 50 WATT AMPLIFIER



AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.

★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response.
★ 4 Jack inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".
★ Separate Bass and Treble Controls giving "lift" and "cut".

49½ Gns. Carr. 30/- Or dep. £7.17.6 and 9 mthly pymts of £5.10.10. (Total 55 gns.) Send S.A.E. for leaflet.

ALSO B20 BASS inc. 15in. 25w. SPKR 29½ Gns. G15 inc. 12in. 20w. SPKR 19½ Gns.

G80 80 WATT AMPLIFIER

2 Channels, 6 inputs, Tremolo, 2 Columns and 1 Bass Speaker unit with two 15in. Extra Heavy Duty Speakers. **99 Gns.** Carr. £3

LINEAR TREMOLO/PRE-AMP UNITS

Suitable for use with any of our Amplifiers. Controls: Speed (frequency of interruptions) Depth (for heavy or light effect) Vol and Switch. **4½ Gns.**

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or Ready for use 59/11.

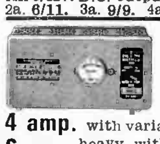
POWER PACK KIT

Consisting of Mains transformer. Metal Rectifier. Electrolytics. smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied with case in lieu of chassis 26/11. Or assembled 39/11. **22/11**

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9. 10a. 25/9.

R.S.C. 6/12v CAR BATTERY CHARGERS



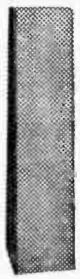
Complete kit of parts incl. Ammeter and Circuit.

4 amp. with variable charge rate selector **49/9**
6 amp heavy duty with variable charge rate selector **69/9**
Both types 200–250 A.C. mains. Ready built 10/- extra.

LONDON-GLASGOW

New branches now open—see addresses

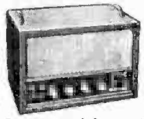
R.S.C. COLUMN SPEAKERS



Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 25-30 watts.** Fitted four 8in. high flux 7 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 44/- and 9 mthly pmts 34/9 (Total £18.1.6 Carr. 10/- **15 Gns.**
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **22 Gns.** Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

30 WATT HI-FI AMPLIFIER

for Guitar, Vocal or Instrumental Group



A 2 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Peak rating 60 watts. Latest valves. Strong Rexine covered cabinet with handles. Attractive black/gold perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **18 Gns.** Carr. 12/6 Deposit 3 gns. and 9 monthly payments of 39/8 (Total £21).

12in. HIGH QUALITY L'SPEAKERS

In teak veneered cabinets. Size 15 x 15 x 7in.
10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. **5 Gns.**
20 Watt Model. 15 ohm. Size 18 x 18 x 10in. Gauss 12,000 lines. **8 Gns.**
Rexine covered £1 extra. **Terms available.**
30 Watt Model. Rexine covered 10 Gns.

LOUDSPEAKERS

Limited number at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available over £8.

12in. 10 watt HIGH FLUX **59/11**
12in. 20 watt DUAL CONE Heavy Duty. Carr. 6/9. **£5.11.9**
12in. HEAVY DUTY 30 watts. Dual cone Normally £13 approx. Carr. 10/- **£6.19.9**
15in. EXTRA HEAVY DUTY 40 watts Massive units. Usually 18 Gns. Carr. 15/-. **12 Gns.**

FANE 'POP' 100 L'SPEAKER

18" 100 Watt Post Free **19 Gns.**
Fantastic power handling. Guaranteed 2 years.

R.S.C. GRAM AMPLIFIER KIT. 4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit. etc. supplied. Only 49/11.

TWO-WAY TELEPHONE AMPLIFIERS

Speak and Listen with both hands free. Compact transistorised Dry Battery operated. **£3.19.9**

TRANSISTOR SALE

Mullard OC71 OC72. OC81. 2/11
OC44. OC45. 3/11.
OC75. 7/9.
AF117. 6/9.
Post 6d. for 3.

INTEREST CHARGES REFUNDED

on H.P. and Credit Sale Accounts settled in 3 months. Deposit 3/- in the £1

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primaries 200-250v. 50c/s. Screened.

MIDGET CLAMPED TYPE 2⅜ × 2⅜ × 2¼in.

250v., 60mA, 6.3v. 2a.	14/11
250-0-250v., 60mA, 6.3v. 2a.	15/11
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 130mA, 6.3v. 4a., c.t., 6.3v. 1a. For Mullard 510 Amplifier	41/9
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	42/9
425-0-425v. 200mA, 6.3v. 4a. c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6.3v. 4a., 6.3v. 4a., 5.v 3a.	69/9
450-0-450v. 250mA, 6.3v. 4a., c.t., 5.v 3a.	79/9
TOP SHROUDED DROP-THROUGH TYPE	
250-0-250v. 70mA. 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 3.5a.	21/9
250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a.	22/9
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier	39/9
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	39/11

FILAMENT or TRANSISTOR POWER PACK Types 6.3v. 1.5a. 6/9; 6.3v. 2a. 7/9; 6.3v. 3a. 9/9; 6.3v. 6a. 19/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1.5a. 19/9; 0-9-18v. 1½a. 15/9; 0-12-25-42v. 2a. 27/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 13/11; 2½a. 16/11; 3a. 18/11; 5a. 21/11; 6a. 25/11; 8a. 31/11

AUTO (Step UP/Step DOWN) TRANSFORMERS
0-110/120v.-200-230-250v. 50-80 watts 14/9
150 watts, 29/11; 250 watts 49/9; 500 watts 99/9

OUTPUT TRANSFORMERS

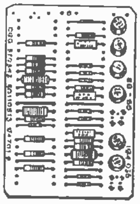
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	7/9
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	11/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15 Ω	21/9
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	19/9
Push-Pull Ultra Linear for Mullard 510, etc.	35/9
Push-Pull 15-18 watts, sectionally wound 6L6. KT66, etc., for 3 or 15 Ω	29/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	55/9

SMOOTHING CHOKES

150mA,	7-10H,	250 Ω	12/9
100mA,	10H,	200 Ω	9/11
80mA,	10H,	350 Ω	7/9
60mA.	10H,	400 Ω	4/11

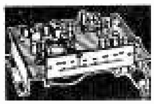
R·S·C HI-FI CENTRES LTD.

PRINTED CIRCUITS

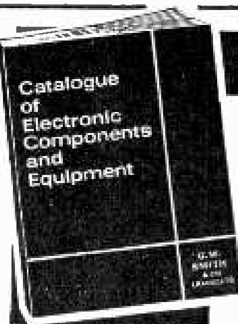


Five assorted printed circuit boards with transistors, diodes, resistors, condensers, etc. Guaranteed minimum 20 transistors. Ideal for experimenters. 5 boards for 10/-. P. & P. 2/-.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 x 4 x 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6.10.0. P. & P. 2/6. Stereo multiflex adaptors 5 gns.



Send today 5/- P&P 1/-

CATALOGUE

★ ELECTRONIC COMPONENTS
★ TEST EQUIPMENT
★ COMMUNICATIONS EQUIPMENT
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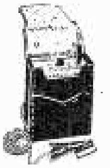
We are proud to introduce our first comprehensive catalogue of Electronic Components and equipment. Over 150 pages fully illustrated, listing thousands of items, many at bargain prices. Free discount coupons with every catalogue. Everyone in electronics should have a copy.

F.M. WIRELESS MICROPHONES



94–104Mc/s. Transistorised. Operates from 9V battery. Complete with additional secret tie-clip microphone. List £12.10.0 ONLY £6.15.0. P. & P. 2/6.
These cannot be operated in U.K.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.
Model 47A £9.19.6.
Model 8 £18.
Model 9 £20.
P. & P. 7/6 each.

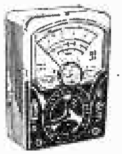
TE-900 20,000 Ω VOLT GIANT MULTIMETER

6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000V A.C. 0/25/12·5/10/50/250/1,000/5,000V D.C. 0/50µA/110/100/500 mA 10A D.C. 20K/200K/20M Ω. £12.19.6. P. & P. 5/-.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms, 200/250V A.C. Supplied brand new and guaranteed with instruction manual and leads, £15. Carr. 7/6.

NEW MODEL 500



30,000 o.p.v. With overload protection, mirror scale 0·5/1/2·5/10/25/100/250/500/1,000V D.C. 0/2·5/10/25/100/250/500/1,000V A.C. 0/50µA/5/50/500mA 12A D.C. 0/60k Ω/6/60M Ω. £8.17.6 Post Paid.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable R F attenuator. Operation 200/240V A.C. Brand new with instructions £12.10.0. P. & P. 7/6. S.A.E. for details.

MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0·7–0·9967. B: 5–200. Ico: 0–50 micro-amps 0–5mA. Resistance for diode 200 Ω–1M Ω. Supplied complete with with instructions, battery and leads. £5.19.6. P. & P. 2/6.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pF–2,000 mfd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V A.C.
Brand New £15. Carr. 7/6.

VARIABLE VOLTAGE TRANSFORMERS

Brand New—fully Shrouded. Input 230V 50/60c/s. Output 0·260 Volts.

1A	£4.10.0
2·5A	£5.17.6
5A	£9.0.0
8A	£13.10.0
10A	£17.0.0
12A	£19.10.0
20A	£32.10.6

Post extra.

ARF-100 COMBINED AF-RF SIGNAL GENERATOR

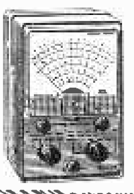
AF. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P HIGH IMP. 21V. P/P 600 Ω 3·8V P/P. TF 100Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF. output and % mod. on R.F. 220/240V A.C. £27.10.0. Carr. 7/6.

SILICON RECTIFIERS

200V P.I.V. 200mA	2/-
200V P.I.V. 6A	5/6
400V P.I.V. 3A	7/6
1,000V P.I.V. 5A	7/6
400V P.I.V. 6A	5/6
400V P.I.V. 8A	7/6
1,000V P.I.V. 650mA	6/6
800V P.I.V. 500mA	5/6
800V P.I.V. 5A	7/6
400V P.I.V. 500mA	3/6
70V P.I.V. 1A	3/6
150V P.I.V. 165mA	1/-
150V P.I.V. 25A	19/6
700V P.I.V. 100A	49/6
400V P.I.V. 3A (S.C.R.)	7/6
100V P.I.V. 5A (S.C.R.)	13/6
200V P.I.V. 5A (S.C.R.)	15/6
400V P.I.V. 5A (S.C.R.)	17/6

Discounts for quantities. Post extra.

TE-65 VALVE VOLTMETER



High quality instrument with 28 range. D.C. volts 1·5–1,500V A.C. volts 1·5–1,500V Resistance up to 1,000 MΩ. 220/240V A.C. operation. Complete with probe and instructions. £15. P. & P. 6/-. Additional probes available: R.F. 35/-. H.V. 42/6.

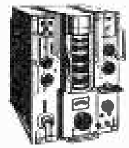
CLEAR PLASTIC PANEL METERS

First grade quality Moving Coil panel meters available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Available as follows: Type MR 38P, $1^{21}/_{32}$in. square fronts.

50µA	32/6	100-0-100µA	27/6	200mA	22/6	100V D.C.	22/6
100µA	29/6	500-0-500µA	22/6	300mA	22/6	150V D.C.	22/6
200µA	27/6	1-0-1mA	22/6	500mA	22/6	300V D.C.	22/6
500µA	25/-	1mA	22/6	750mA	22/6	500V D.C.	22/6
50-0-50µA	29/6	2mA	22/6	1A D.C.	22/6	750V D.C.	22/6
		5mA	22/6	2A D.C.	22/6	15V A.C.	22/6
		10mA	22/6	5A D.C.	22/6	50V A.C.	22/6
		20mA	22/6	3V D.C.	22/6	150V A.C.	22/6
		50mA	22/6	10V D.C.	22/6	300V A.C.	22/6
		100mA	22/6	20V D.C.	22/6	500V A.C.	22/6
		150mA	22/6	50V D.C.	22/6	'S' meter 1mA	29/6

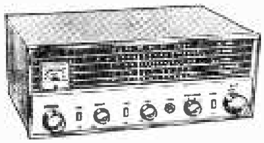
POST EXTRA. Larger sizes available—send for lists.

ADMIRALTY B.40 RECEIVERS



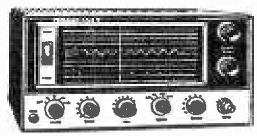
Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O., calibrator, I/F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19¼ x 13¼ x 16in. Weight 114 lbs. Offered in good working condition, £22.10.0. Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s., £17.10.0. Carr. 30/-.

HAM-1, 4 BAND COMMUNICATION RECEIVER



4 wavebands covering 535 Kc/s. to 30 Mc/s. 5 valve superhet circuit incorporates S meter B.F.O., BANDSPREAD TUNING, BUILT-IN 4in. SPEAKER, FERRITE AERIAL AND EXTERNAL TELESCOPIC AERIAL. Operation 220/240V A.V. Supplied brand new with handbook. NOW £17.17.0. Carr. 10/-.

NEW LAFAYETTE MODEL HA-700 AM/CW/SSB AMATEUR COMMUNICATION RECEIVER

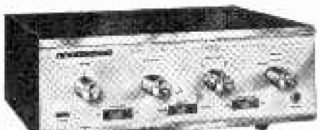


8 Valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150–400 Kc/s, 550–1,600 Kc/s, 1·6–4·0 Mc/s, 4·8–14·5 Mc/s, 10·5–30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter. B.F.O. product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2k Ω or speaker 4 or 8 Ω. Operation 220/240V A.C. Size 7½ x 15 x 10in. Supplied brand new and guaranteed with handbook 36 GNS. Carr. 10/-. S.A.E. for leaflet.

R.C.A. AR88 SPEAKERS

8in. 3 ohm speakers in metal case. Black crackle finish to match our 88 Receivers. Available Brand New and Boxed with leads. 59/6 Carr. 7/6.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



19 transistors, 8 diodes, IHF music power, 30W at 8 Ω. Response 30–20,000 ±2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16 Ω. Separate L. and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complimentary metal case. Size 10¼ x $3^{9}/_{16}$ x $7^{13}/_{16}$in. Operation 115/230V A.C. £25 Carr. 7/6.

GARRARD DECKS

SRP12 player mono or stereo £4.4.0; 1000 changer mono or stereo £5.15.6; 2000 changer mono or stereo £6.19.6; A50 mono or stereo £7.17.6. 3000 changer mono or stereo £7.19.6; AT6 Mk. II mono or stereo £8.19.6; 3000 Sonotone stereo £8.19.6. AT60 changer mono or stereo £10.10.0; AT60 Mk. II mono or stereo £11.11.0; A70 Mk. II less cartridge £12.12.0; A70 Mark II Sonotone stereo £14.14.0; LAB80 Mk. II changer less cartridge £24; 401 transcription deck £27; All plus 5/- P. & P.

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

Lasky's Radio

DON'T MISS THIS!

GREAT NEWS!

THIS YEAR LASKY'S CELEBRATE THEIR 35th ANNIVERSARY

35 Great Years of service to you based on fair prices and value

To celebrate our success and your satisfaction we are publishing a 12-page, fully illustrated colour

"35th Birthday Pictorial" Catalogue

Printed in large 16 x 11in. modern magazine format—the "Birthday Pictorial" contains thousands of different items from our vast stocks of Radio, Hi-Fi, TV, Test Gear, Components, Communications and other equipment.

PLUS many bargain offers and prices exclusive to Lasky's

AND in addition every copy of the "Birthday Pictorial" is numbered and automatically enters you in our great "Birthday Draw" with over £100 in Gift Vouchers to be won.

All goods shown in the "Birthday Pictorial" are available over the counter from any of our branches—or by post to any address in the U.K. or overseas—bringing the benefits of shopping at Lasky's to you in your home.

PUBLICATION DATE—

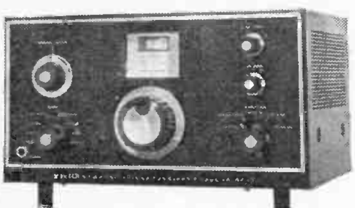
November. Make sure of your copy NOW—just send your address and a 4d. stamp for postage.

A MUST FOR EVERY ELECTRONICS HOBBYIST AND HI-FI ENTHUSIAST!

COMMUNICATION RECEIVERS

NOW AVAILABLE FOR THE FIRST TIME IN GREAT BRITAIN—TWO NEW

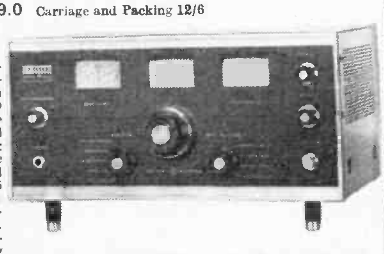
TRIO RECEIVERS



MODEL JR-500SE

This high performance receiver is made especially to cover the amateur bands and utilises a crystal controlled double heterodyne circuit for extra sensitivity and stability. Brief spec.: Covers all the amateur bands in 7 separate ranges between 3·5 and 29·7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. Special features: Crystal controlled oscillator ● Variable BFO ● VFO ● AVC ● ANL ● S meter ● SSB-CW ● Stand-by switch ● Special double gear dial drive with direct reading down to 1 kHz ● Remote control socket for connection to a transmitter. Audio output 1 watt. For use on 115/250 V A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 × 13 × 10 in. Weight 18 lbs. Fully guaranteed, complete with instruction manual and service data.

LASKY'S PRICE **£61.19.0** Carriage and Packing 12/6



MODEL 9R-59DE

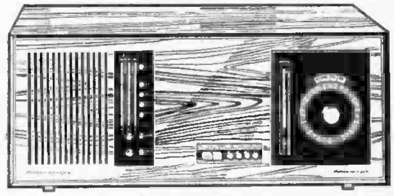
Brief spec.: 4 band receiver covering 550 Kc/s to 30 Mc/s continuous and electrical band spread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. Special features: SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. band spread dial ● IF frequency 455 Kc/s ● Audio output 1·5 W ● Variable RF and AF gain controls. For use on 115/250 V A.C. Mains. Beautifully designed control layout finished in light grey with dark grey case, size: 7 × 15 × 10in. Weight 19 lbs. Fully guaranteed, complete with instruction manual and service data.

LASKY'S PRICE **£36.15.0** Carriage and Packing 12/6.

HUGE PURCHASE OFFER

DEFINITELY THE MOST AMAZING BARGAIN OF THE YEAR!!!

SHAUB-LORENZ



MUSIC CENTER MODEL 5001 COMBINED 126 TRACK TAPE RECORDER AND VHF/MW/LW/SW RADIO

An incomparable piece of equipment—combining 126 track tape recorder and 4 band radio in one unit of outstanding modern design. The recorder section of the Music Center gives an almost unbelievable 46 hours continuous unrepeated playing time—that's right 46 hours on 126 tracks.

Brief spec.: TAPE section: 20 transistor and 9 diode circuit, a wide magnetic tape records 126 separate tracks of 22 minutes each. Every track is able to record/replay instantly and runs from track one to 126 completely automatically so that you need not touch the machine for the total 46 hours record/replay time. Rewind time for each 22 minute track only 25 seconds. Tape speed 10·5 cm/sec. Frequency response 14–40,000 Hz. Inputs for direct recording from VHF, external microphone, record player. Pause control. RADIO—AMPLIFIER Section: 7 transistors and 6 diode circuit, 4 bands VHF/Medium/Long/Short with exclusive "Auton control" which takes over the precise tuning into the station required. Bass and Treble controls. Output 10 watts. Built-in 10in. speaker and tweeter. Sockets for extension speakers. Beautifully finished dark polished wood cabinet size 31 x 13 x 11in. Brand New, Boxed and fully guaranteed.

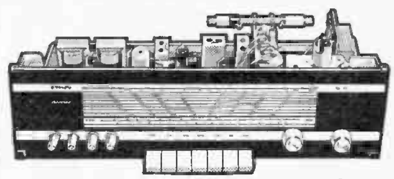
Lasky's huge purchase enables us to offer this amazing equipment at a fantastic saving. Value over £200.

LASKY'S PRICE **£61.19.0** Carriage and Package anywhere in the U.K. 30/-.

IDEAL FOR CLUBS, DISCOTHEQUES AND ESPECIALLY THE HI-FI ENTHUSIAST

ANOTHER BULK PURCHASE SCOOP

STEREO AM/FM RADIOGRAM CHASSIS BY FAMOUS GERMAN MAKER



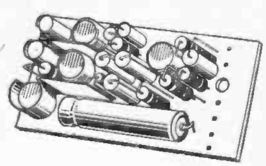
Long, medium and short wave bands coverage, plus VHF/FM mutiplex. Piano key wave change, separate fly wheel tuning on AM and FM, bass, treble and balance controls and magic eye tuning indicator. Ferrite rod aerial. The very latest printed circuitry. Output 5 watts per channel. Complete with multiplex decoder. 5 valves, line-up: ECC85, ECH801, ECC83, ELL80, EAF801. Full vision tuning scale size: 21 x 6in. Overall dimensions: 21 x 6½ x 8in. Made to very highest standards.

LASKY'S PRICE **£38.6.6** Carriage and Packing 10/-.

ALSO AVAILABLE WITHOUT MULTIPLEX **£33.12.0** C. & P. 8/6

SPECIAL INTEREST ITEMS!

NEW—LASKY'S MINIATURE TRANSISTOR AMPLIFIER MODULES



Incorporating the very latest circuitry to provide high sensitivity and good quality in conjunction with extreme small size and compactness. High quality Newmarket transistors used throughout. All designed to operate on 9v. miniature battery.

Add 1/- on each for Post and Packing.

TYPE LRPC 1. 3 transistor. Input sens. 50mV. Output 150mW. Output imp. 40 Ω. Size 2 x 1 x ¾in. ...... PRICE 27/6

TYPE LRPC 4. 5 transistor. Input sens. 150mV output 330mW output imp. 15 Ω. Size 2¼ x 1¼ x ¾in. ...... PRICE 18/-

TYPE LRPC 5. 6 transistor. Input sens. 8mV output 3W output imp. 3 Ω. Size 5¼ x 1¾ x 1in. ...... PRICE 59/6

LRPC 9. High to Low input matching pre-amplifier. Input imp. 1 meg ohm output imp. 2 k/ohms. Size 1¼ x 1¼ x ¾in. ...... PRICE 10/6

LRPC 10. Magnetic tape replay preamp. designed so that a 450 mH head can be matched into any of the audio amp. modules listed above. Sizes 2¼ x 1¼ x ¾in. ...... PRICE 10/6

Note the LRPC 9 and 10 are ideal for use with the LRPC 1, 4 or 5 and are available at the reduced price of 7/6 if bought with the LRPC 4.

GORLER UT 340 FM/VHF TUNING HEART

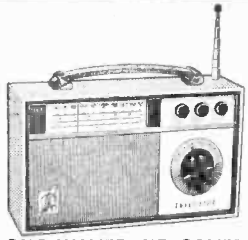
Permeability tuned—covering 87 to 108 Mc/s. For use with one ECC85 valve. In metal case size 3 x 2¼ x 1¾in. Circuit supplied.

LASKY'S PRICE **15/11** Post 2/-. ECC85 valve 9/- extra.

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

Lasky's Radio

CONSTRUCTORS BARGAINS



THE SKYROVER De Luxe

7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31–94M and also 4 separate switched bandspread ranges, 13M., 16M., 19M. and 25M., with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. Superhet, 470 Kc/s. All Mullard Transistors and Diodes. Uses 4 U2 batteries. 5in. Ceramic Magnet P.M. Speaker. 500 mW Output. Telescopic and Ferrite Rod Aerial. Tone Control. Volume Control. Tuning Control and Waveband Selector. In wood cabinet, size $11\frac{1}{4} \times 6\frac{3}{4} \times 3$in. covered with washable material, plastic trim and carrying handle. Car aerial socket fitted.

Can now be built for **£8.19.6** Post 5/- extra

H.P. Terms: 60/- deposit and 11 monthly payments of 12/9. Total H.P.P. £10.0.3.

Four U2 batteries 3/4 extra.

Data 2/6 extra: refunded if you purchase the parcel. All components available separately.

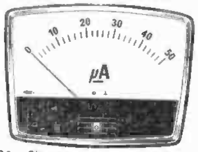
LONG WAVEBAND COVER FOR THE SKYROVER

A simple additional circuit provides coverage of the 1100/1950M. bands (including 1500M. Light programme). This is in addition to all existing Medium and Short wavebands. All necessary components with construction data.

Only **10/-** extra Post Free.

This conversion is suitable for receivers that have already been constructed.

LASKY'S CLEAR PLASTIC PANEL METERS



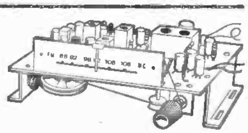
Precision made in Japan by HIOKI. Each meter boxed and fully guaranteed with all fixing nuts and washers. Sizes are of front panel. Add 1/6 Post on each.

Type KR-52 $3 \times 2\frac{1}{4}$in. (illustrated)

1mA DC	32/6	100µA	47/6
5mA DC	32/6	500µA	37/6
300 V DC	32/6	1mA S Meter	39/6

Type MK-38A $1\frac{5}{8}$in. square		Type KR-65 $3\frac{3}{8} \times 3$in.	
1 mA DC	22/6	1 mA DC	36/-
5 mA DC	22/6	5 mA DC	35/-
300V DC	22/6	300 V DC	35/-
100µA	29/6	100µA	49/6
500µA	27/6	500µA	42/6
1 mA S Meter	29/6	1 mA S Meter	39/6
Type MK-45A 2in. square		**Type MK-65A 3in. square**	
1 mA DC	25/-	1 mA DC	36/-
5 mA DC	25/-	5 mA DC	35/-
300V DC	25/-	300 V DC	35/-
500µA	25/-	500µA	39/6
1 mA S Meter	35/-	1 mA S Meter	37/6

TRANSISTOR FM TUNER CHASSIS



Fully tunable—range 88 to 108 Mc/s. Completely wired on printed circuit. 10·3 Mc/s. IF. 6 transistors and 3 diodes. Slow motion tuning drive. Size $6\frac{1}{4} \times 4 \times 2\frac{1}{2}$in. Operates from any 9v. D.C. source. Full data and circuit supplied.

LASKY'S PRICE **£6.10.0** Post 5/- extra.

MULTIPLEX ADAPTOR MODEL

Now you can enjoy stereo sound with the model FM Tuner above. Brief spec.: MPX input sensitivity 100mV. Output 150mV. Self powered by a 9v. battery. 4 transistor and 6 diode circuit. Size $5\frac{1}{4} \times 2 \times \frac{3}{4}$in. Also suitable for use with other FM tuners with MPX input.

LASKY'S PRICE **99/6** Post 5/-

PACKAGE PRICE IF BOUGHT TOGETHER **£11** Post 5/-

SPECIAL PURCHASE—VALVE UHF TV TUNERS

Well-known British makers surplus stocks. Now available for the first time to the Home Constructors. Add 2/6 Post and Packing on each.

In metal case size $4 \times 6 \times 1\frac{1}{4}$in. Fully tunable—complete with PC86 and PC88 valves.

LASKY'S PRICE **29/6** Without valves **7/6**

TRANSISTORS ALL BRAND NEW AND GUARANTEED

GET 81, GET 85, GET 86 2/6; 873A. 874P 3/6; OC45, OC71, OC81D 4/6; OC44, OC70, OC76, OC81 5/6; (match pair 10/6); AF117, OC200 6/6; OC42, OC43, OC73, OC82D 7/6, OC201, OC204 15/-; OC205, PC206 19/6; OC28 24/6; OC75 8/-.

TRANSFILTERS by BRUSH CRYSTAL CO. Available from stock.

TO—01B 465 kc/s. ±2 kc/s.
TO—01D 470 kc/s. ±2 kc/s.
TO—02B 465 kc/s. ±1 kc/s.
TO—02D 470 kc/s. ±1 kc/s.
TF—01B 465 kc/s. ±2 kc/s.
TF—01D 470 kc/s. ±2 kc/s.

9/6 each Post 6d.

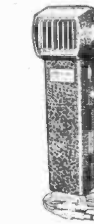
SPECIAL INTEREST ITEMS!

JUST ARRIVED — FANTAVOX TAPE CASSETTE PLAYER

This machine is the first of its type and is designed specifically to replay pre-recorded tape cassettes made for the PHILIPS and other cassette systems. The cassette is simply slipped into the machine and is immediately ready to play. Each cassette gives over 40 minutes play (twin track), no loss of time if rewinding—simply turn cassette over. Constant tape speed $1\frac{7}{8}$ i.p.s. Only two controls off/play and vol. Fully transistorised, powerful vol., built in speaker, socket for personal earpiece. Operates on 6 penlight batteries. Very attractively styled shockproof plastic cabinet size $6\frac{1}{4} \times 4\frac{1}{4} \times 2$in. with wrist strap. Complete with earpiece and batteries. There are now over 200 musicassette titles available: jazz, pop, shows and classics. This machine allows you to play the music of your choice anywhere—anytime.

LASKY'S PRICE **£9.19.6** Post 5/-

NEW VOICE ACTUATED MICROPHONE



MODEL B 5001

This new voice actuated microphone is designed for use with tape recorders with facilities for remote control. The microphone is fitted with a three position switch allowing normal hand remote control, voice sensitivity action and off. The degree of voice or sound level required to operate the recorder can be adjusted. The microphone is self powered by one 9V (PP3 type) battery giving 6 to 10 hrs. operating time. Super sensitive 6 transistor circuit. Strong black plastic case. Length $7\frac{1}{4}$in. Designed for hand held use or lying flat. Fitted with 2·5 and 3·5 mm. plugs for fitting polarised sockets.

LASKY'S PRICE **£6.19.6** Post 3/6

TWO BAND TRANSISTOR CAR RADIO BARGAIN!

THE ROYAL CR-62

A new high quality imported all transistor superhet car radio that really breaks the quality/price barrier. A unique feature of this set are the four M/W band station preselection button which you yourself set to your own four favourite stations—this is in addition to full M/W band cover over 535–1605 Kc/s and full L/W band cover over 150–300 Kc/s (IF frequency 455 Kc/s.). Externally adjustable aerial trimmers ensure maximum output. Six transistor (including one drift type) and one diode circuit provides powerful 2W output. The set is adjustable for use on either positive or negative ground 12V systems (external line fuse fitted). Standard mounting size $6\frac{3}{4} \times 5\frac{3}{4} \times 2$in.—front panel $\frac{1}{2}$in. larger all round—finished in anodised aluminium with black push buttons. Complete with mounting brackets, full installation instructions and 2 baffle boards (for round or elliptical speaker). Fully guaranteed.

LASKY'S PRICE **£9.19.6** Post 5/–

6 × 4in. elliptical 8Ω dynamic speaker 17/6 extra—Post FREE.

SPECIAL OFFER—LOCKING CAR AERIAL Model S3003 five section 402 extension heavy chrome telescopic wing mounting type with unique locking device to protect the antenna when closed. Complete with mounting bracket, lead and plug and two "keys". **LASKY'S SPECIAL PRICE 39/6 Post Free with the Royal CR-62. Post Sep. 2/6.**

MUSICASSETTES

There are now over 200 Musicassette titles available—jazz—pop—shows—classics—on Philips, Mercury, Fontana, C.B.S., Pye, Reprise, Chess, W.B., Kama Sutra, Page 1. *Send S.A.E. for full list.*

NEW INTERNATIONAL TAPE

FAMOUS AMERICAN MADE BRAND TAPE AT RECORD LOW PRICES

3in.	Message tape, 150ft.	2	6	$5\frac{3}{4}$in.	Long play, 1200ft. Acetate	12	6
3in.	Message tape, 225ft.	3	9	$5\frac{3}{4}$in.	Standard play, 850ft. PVC	11	6
3in.	Message tape, 300ft.	7	6	$5\frac{3}{4}$in.	Long play, 1200ft. Mylar	15	0
$3\frac{1}{4}$in.	Triple play, 600ft. Mylar	10	0	$5\frac{3}{4}$in.	Triple play, 2400ft. Mylar	45	0
4in.	Triple play, 900ft. Mylar	17	6	7in.	Standard play, 1200ft. Acetate	12	6
5in.	Double play, 1200ft. Mylar	15	0	7in.	Standard play, 1200ft. Mylar	12	6
5in.	Long play, 900ft. Acetate	10	0	7in.	Long play, 1800ft. Mylar	19	6
5in.	Standard play, 600ft. PVC	8	6	7in.	Double play, 2400ft. Mylar	26	0
5in.	Triple play, 1800ft. Mylar	35	0	7in.	Long play, 1800ft. Acetate	15	0
$5\frac{3}{4}$in.	Double play, 1800ft. Mylar	22	6	7in.	Triple play, 3600ft. Mylar	50	0

P. & P. 1/- extra per reel. 4 reels and over Post Free.

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel.: 01-723 3271
Open all day Saturday, early closing 1 p.m. Thursday

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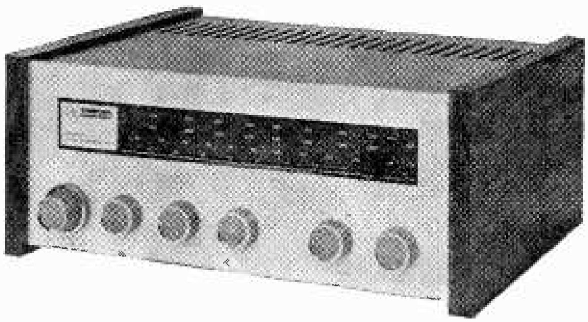
Armstrong

high fidelity sound

series 27 TUNER-AMPLIFIERS for the BUDGET SYSTEM



127 STEREO TUNER-AMPLIFIER (illustrated)	£40.1.6
127M MONO TUNER-AMPLIFIER	£29.18.9
227 MONO TUNER-AMPLIFIER	£40.1.6
OPTIONAL CASE, teak and vinyl hide	£3.15.9

Three-tuner amplifiers, identical in size and similar in styling, each with the same high performance AM-FM Tuner incorporated. The 227M provides 10 watts power output whilst the 127M, with 5 watts output is designed for those whose power requirements are more modest. The 127 is the stereo version of 127M, having two amplifiers, each of 5 watts output. All three have similar facilities; pick-up and tape inputs, tape recording output, bass and treble tone controls.

For full details and technical specifications of all models, including the new series 400, plus list of stockists, post coupon or write mentioning 2PW68.

ARMSTRONG AUDIO LTD., WARLTERS ROAD, N.7
Telephone 01-607 3213

name ....

address ....

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2PW68

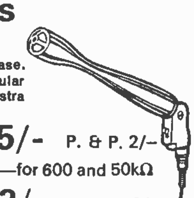
WIRECOMP ELECTRONICS

ANOTHER GREAT SALE

HIGH QUALITY EQUIPMENT AT UP TO 75% BELOW LIST!

Microphone Bargains

AIWA DM-13



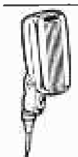
Dynamic 50kΩ impedance. Fitted with on/off switch in base. Size 7½in. long x 1¼in. diameter. In polished alloy tubular case with connector and screened lead. Ideal for orchestra work.

List price was 5 gns. *SALE PRICE* **35/-** P. & P. 2/-

DUAL IMPEDANCE VERSION OF ABOVE—for 600 and 50kΩ

List price was 6 gns. *SALE PRICE* **42/-** P. & P. 2/-

AIWA DM-20

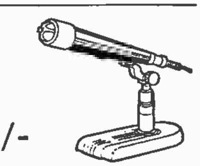


Fitted with on/off switch in the base. Dynamic 50k Ω or 600Ω impedance. Polished alloy case. Size 2 x 4 x 1½in. with screened lead.

List price was £5.19.6. *SALE PRICE* **29/6** P. & P. 2/6

(Please state imp. required when ordering.)

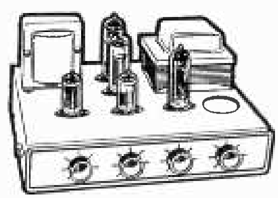
AIWA DM-8



Dynamic high impedance 600Ω. Stick microphone, die-cast metal body. In matt black with polished chrome trim. Supplied with metal table base and on/off switch. Size: 6¼in. long x 1¼in. diameter. Including base

List price was £5.19.6. *SALE PRICE* **35/-** P. & P. 3/6.

BH-14 Hi-Fi Mono Amp Kit



High quality 14 watt power amplifier with separate volume controls on each input, also bass and treble controls. Inputs 1·5mV; 2–40mV. Output impedance 3 or 15 ohms. 5 Valves; Line-up: 2x EL84, 1 EF86, ECC83 and EZ81. Frequency Response 15 c/s–20 kc/s. Ideal for the discerning Hi-Fi enthusiast, or as guitar amp. Gold hammer finish with distinctive perspex front panel. Complete kit of parts with detailed construction data.

Listed at 10 gns. *SALE PRICE* **£5.19.6** P. & P. 7/6.

Optional extra: Protective cover 12/6.

Peak Sound Amplifier Kit SA 8-8

A combined stereo transistor amplifier with integrated pre-amp/control unit. Output 8 watts per channel at 3–15 ohms. Fitted with sep. vol. controls for each channel and bass and treble controls. Input sens. 180mV. Freq. response 20–20,000 c/s. Size, when built, only: 10 x 3½ x 3ins. Circuit uses 14 transistors in all. Full instructions supplied.

List price was £12.19.6. *SALE PRICE* **£6.19.6** P. & P. 3/6

Loudspeaker BARGAINS

2in. round, 80 ohms	*SALE PRICE*	4/6
2⅝in. round. 3 ohms	*SALE PRICE*	6/6
3in. square. 8 ohms	*SALE PRICE*	8/6
E.M.I. 2½in. tweeter (plastic cone). 15 ohms	*SALE PRICE*	17/6

Post and packing 1/– each extra.

Water Temperature Thermostats

British made, orig. for use in high quality washing machine, range adjustable between 114°F and 230°F. Rating 200/250V A.C., 20 amps (also D.C. up to 125 V.A.). Size 2¼ x 1¾ x 1¼ with 18in. capillary tube and 6in. bulb. Single hole fixing. 3/16in. spindle.

SALE PRICE **5/11** (Today's value 32/6) Post free

DON'T DELAY — ALL ITEMS SUBJECT TO AVAILABILITY

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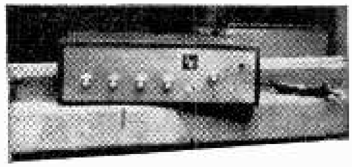
MAIL ORDERS TO:

378 HARROW ROAD, PADDINGTON, LONDON, W.2

E.S.V. Stereo amplifier



BARGAIN—A fully Transistorised Amplifier as illustrated—Stereo 5/5 Channel—Mono 10—Fully built in Black padded Leather Cabinet—Five controls—Disc-Radio-Tape/Bass/Treble/Balance/Volume. Mono-Stereo function — Indicator Neon on brushed silver fascia panel — Stereo Tape Recorders and High Sensitivity Stereo Pick-up may be fed directly to the Amplifier. List Price 26 gns. Our Price **19 gns.** MK II Brand new & guaranteed. P.P. 8/6.

LOUDSPEAKER ENCLOSURES—16 gns—**8 gns**—p.p. 12/6. As main distributors for Electra Hi-Fi Equipment we are prepared to offer this reduction to introduce this beautiful speaker. Enclosure Black simulated Leather Finish with Conidura Silver Fascia. Fully damped interior handling 5 watts at 8 ohms. Demonstrated gladly.

SPECIAL BARGAIN OFFER OF HI-FI PACKAGE DEAL.

Transistor Stereo Amplifier	£19	19	0
Two Electra Hi-Fi Enclosures	£16	16	0
Garrard 3000—Low Mass	£9	13	0
Sonotone 9TA/H.C. S/S Cartridge	£1	10	0
Special X/A Plinth—Fully Damped	£4	10	0
	£52	**8**	**0**

To introduce this superb equipment **46 gns.** p.p. free. (Fully wired—with all leads ready to plug in).

RADIO CHASSIS By Famous Manufacturer 19 gns. **Our Price 13 gns** + p.p. 6/-. 12 Transistor—L.W.–M.W.–F.M.—**Ferrite Rod Aerial** for all Bands. This Chassis is supplied complete with **Speaker.** Offer unrepeatable. **12 Months' guarantee.**

RADIO CHASSIS By Famous Manufacturer 15 gns. **Our Price 9 gns** + p.p. 6/-. 10 Transistor—L.W.–M.W.–S.W.—Ferrite Rod Aerial. A Beautiful Chassis. Supplied with matching Speaker. 12 Months' Guarantee. Limited Number. Cannot be repeated!

STEREO RADIO CHASSIS BY BRITISH NATIONAL MANUFACTURER. A superb instrument (valve) giving 5 watts P/C. Long–Medium–Short wave bands. Ferrite Rod on Long and Medium. Push Button Control. Vernier Dial with Log. Passivated Chassis. Supplied complete in every way. All knobs, leads, etc. **Usual Retail Price 21 gns—Our Price 16 gns**—p.p. 21/-. Twelve months' guarantee—and as special introductory offer—**FREE TWO 8in. ROUND SPEAKERS.**

BARGAIN—BARGAIN—BARGAIN—A complete Transistor Radiogram Fully Built—Tested and Guaranteed at 16 gns only p.p. 15/-. Specification: Tuning Range 540–1600 kc./I.F. 455 kc. Speaker—Voice Coil Impedance 8 ohms. Power Output undistorted at 300 m/w. Maximum 500 m/w. Maximum Drain. Radio Playing 100 m/a. Record Playing 150 m/a. 220 volts, 50–60 c.p.s. A.C. Record Speed 33⅓–45–78 r.p.m. Record Size 7–10–12in. Pick-up, Ceramic, Cartridge, Sapphire, Low Mass Arm. Very limited stocks only. Personal callers welcome.

COMMUNICATION TYPE RECEIVER—TRANSISTOR PORTABLE—by Standard Corporation. Fully built, tested, 12 months' guarantee. Coverage 150 kc. to 26 mc., 4 switched bands. Vernier Dial with Lens Magnification. Fine Log Vernier Incorporated. Eight Transistor, 1 Diode, 1 Thermistor. Output 900 m/x–92 m/m speaker Incorporated Whip Antenna. 2 Ferrite Rods. Two Jacks. Headphone, etc. Housed in superb Black leather carrying case. **Has been retailed at 26 gns. Our Price 16 gns** only, p.p. 10/-.

E.S.V.—3 WATT AMPLIFIER—62/-. Our Price **50/-** + p.p. 3/6. A.C. 220/240v. (Non-Live Chassis) Fully Built. Tested. Complete with Valves (E.L. 84) output—2 Controls. Flying Panel.

E.S.V. 3 WATT AMPLIFIER UNIT—75/-. Our Price **57/6** + p.p. 3/6. Complete with Valves (U.C.L. 82 Output) Fully Built. Tested. Mounted on Board. Complete with Speaker (5in. round)—Knobs supplied all leads attached—ready for instant connection to your turntable. Fully guaranteed.

E.S.V. RECORD PLAYER CABINET—75/-. Our Price **55/-** + p.p. 5/6. Strongly Built Wooden Cabinet. Two Tone. Complete with either B.S.R. or Garrards Cut-Out Board. Gilt Fittings. Strong Carrying Handle. Will suit any Gramophone Amplifier. Ample space for Speaker.

RECORD PLAYERS By Famous Manufacturer 19 gns. **Our Price 12 gns**—p.p. 15/-. Brand New in original carton with guarantee. Garrard Deck-GP-91 Cartridge 3 watts out-put. 3 control Amplifier. Beautiful Two Tone Cabinet. Hi-Fi Tonal Quality. One of the nicest Record Players available today. Limited stocks.

CAR RADIO 12 gns. Our Price **8 gns** + p.p. 8/6 Well known Brand Name. Fully Tested before despatch—in maker's own cartons with maker's guarantee. 2 Waveband—L.W.–M.W. Fully Transistorized. Speaker and Fitting Kit supplied, at no extra cost, also, instructions for fitting. 12 volt. Please state Negative or Positive earth. Limited stock only available.

TRANSISTOR RADIO—S.W.B. Our Price **4 gns** + p.p. 3/6. A Fully built and Tested S.W.B. Radio. Complete in every way operates equally well in Home or Car. The performance of this Radio has to be heard to be believed. Limited stocks.

TAPE RECORDER—9 gns. Our Price **6 gns** × p.p. 6/-. Famous Manufacturer. Brand New and Boxed. Battery Operated. Six Transistor–Push Button System. Remote Control Mic. Business, Pleasure, Education. A constant companion. Remote Control. Styling and quality found only in Higher Priced Recorders. High Fidelity allows for good pick-up of conversations at meetings and conferences. Record in Car, Train or Boat. Cannot be repeated.

BARGAIN—SLIMLINE T.V. RECEIVERS—19in. in Mint Condition. Complete, tested, working but less I.F. Strips. Make ideal Monitors. Various Famous makes. Our Price only **£10.0.0.** I.F. strips if required **25/-** only. P.p. 25/- (T.V. and Strip). Personal collection advised otherwise despatched at customer's risk.

BARGAIN — STOCK CLEARANCE — UNREPEATABLE — REMINGTON RAZORS. Brand New in Presentation Case—220v.–110v. while stocks last. **Our Price £4.15.0** + p.p. 10/6. Less than trade price.

CARTRIDGES — CARTRIDGES — CARTRIDGES — THE LOWEST PRICES.

E.R. Crystal Mono—H/C	**15/6** each
E.R. Ceramic Mono—H/C	**15/6** each
Sonotone 9TA/H.C/S.S	**30/-** each
T.C.8 H—Mono	**25/-** each
T.C.8 M—Mono	**25/-** each
T.C.8 S—Stereo	**42/-** each
C.1—Stereo	**45/-** each
AT/60—Stereo—Ceramic	**25/-** each

All Cartridges supplied with Universal Brackets at no extra charge. Fixing screws if required. New and guaranteed before despatch.
p.p. on all above 2/6.

GARRARD 4 SPEED DECKS

SRP-22 Mono Cartridge	**£4**	**7**	**6**
1000 Mono Cartridge	**£6**	**19**	**0**
2000 Mono Cartridge	**£7**	**10**	**0**
3000 less Cartridge	**£9**	**13**	**0**
SP-25 less Cartridge	**£10**	**17**	**6**
Lab 80 less Cartridge	**£24**	**10**	**0**
A-70 less Cartridge	**£15**	**19**	**6**

B.S.R. 4 SPEED DECK

UA/25 Mono Cartridge	**£5**	**10**	**0**

p. & p. 8/6 on each of the above.

SPOTLIGHT
Manufactured for Butlers for the Air Ministry—Universal Bracket—dozens of uses—Bench—Car—Photography—Mirrorised Reflector supplied, less bulb, in carton at fraction of price. Our price **15/-** each. P.p. 6/6.

SPEAKERS—8 x 5—10,000 qus.—42/-. Our Price **25/-** + p.p. 3/6. One of the most famous speakers in the world. Ceramic Magnetic and certified rating of 5 watts.

SCOOP! Diodes—over 1,000,000 in stock—ideal substitute O.A.81 vision detector.
Note OUR price **£1.0.0** per 500. P.p. 2/-. (In 500 lots only).

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HI-FI AMPLIFIERS

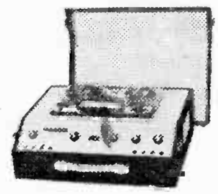
TS-23

AA-22U

TRANSISTOR STEREO AMPLIFIER, Model AA-22U. 20 + 20W ± 1dB over 15 to 30,000 c/s into 8Ω. 5 stereo inputs each channel. Versatile controls. 20 transistor, 10 diode circuit. Modern low silhouette styling . . . matches AFM-1, AFM-2 Tuners. Kit **£39.10.0.** Assembled **£57.10.0** (Cabinet £2.5.0 extra).

Low-priced 3+3 watt **TRANSISTOR AMPLIFIER, TS-23**
Breaks the price barrier in quality stereo amplifer cost. Incorporates all the essential features for good quality reproduction from gram, radio and other sources. 3W rms (15Ω) each channel. Good frequency response. Modern, compact, slim-line styling. Ganged controls. 6 position selector switch. 16 transistor, 4 diode circuit. Walnut veneered cabinet, optional extra. Kit (Amplifier) **£17.15.0** Cabinet **£2.0.0** extra.

New! STEREO TAPE RECORDER, STR-1



Fully portable—own speakers

Kit £45.18.0

Assembled price on request

FOR THIS SPECIFICATION

● ¼ track stereo or mono record and playback at $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ ips ● Sound-on-sound and sound-with-sound capabilities ● Stereo record, stereo playback, mono record and playback on either channel ● 18 transistor circuit for cool, instant and dependable operation ● Moving coil record level indicator ● Digital counter with thumb-wheel zero reset ● Stereo microphone and auxiliary inputs and controls, speaker/headphone and external amplifier outputs . . . front panel mounted for easy access ● Push-button controls for operational modes ● Built-in stereo power amplifier giving 4 watts rms per channel ● Two high efficiency 8″ × 5″ speakers. ● Operates on 230V a.c. supply.

Versatile recording facilities. So easy to build—so easy to use.

FULL SPECIFICATION SHEET AVAILABLE

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Finished models provide years of superlative performance

HIGH PERFORMANCE CAR RADIO CR-1

Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

● 8 Latest semi-conductors (6 transistors, 2 diodes) ● For 12 volt positive or 12 volt negative earth systems ● Powerful output (4 watts) ● Pre-assembled and aligned tuning unit ● Push-button tone and wave change controls ● Positive manual tuning ● Easy circuit board assembly ● Instant operation, no warm-up time ● Tastefully styled to harmonise with any car colour scheme ● High quality output stage will operate two loudspeakers if desired. Can be built for a total price.

Kit (less spkr.) **£12.17.0** incl. P.T. (6″ x 4″ LS £1.4.5 extra).

RADIOS

Oxford

"OXFORD" LUXURY PORTABLE Model UXR-2. 7 transistor, 3 diode circuit. 7″ x 4″ LS. Push button LW/LM and Tone. Specially designed for use as a domestic or personal portable receiver. Many features, including solid leather case.
Kit **£14.18.0** incl. P.T.

UXR-1

TRANSISTOR PORTABLE. Model UXR-1. Pre-aligned I.F. transformers, printed circuit. Covers L.W. and M.W. Has 7″ x 4″ loudspeaker. Real hide case.
Kit **£12.11.0** incl. P.T.

JUNIOR EXPERIMENTAL WORKSHOP Model EW-1. More than a toy! Will make over 20 exciting electronic devices, incl.: Radios, Burglar Alarms, etc. 72 page Manual. The ideal present!
Kit **£7.13.6** incl. P.T.

TRANSISTOR STEREO FM TUNER. Elegantly designed to match the Stereo Amplifier, model AA-22U seen above. Many special features include built-in power supply. Available in two units sold separately, can be built for a TOTAL PRICE KIT (STEREO) **£24.18.0** incl. P.T. Cabinet **£2.5.0** extra (MONO) version **£20.19.0** Kit.

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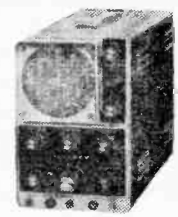
LONDON—223 Tottenham Court Road, W.1.
Opens Mon-Fri 9 am-5.30 pm. Sat 9 am-1 pm.

BIRMINGHAM—17-18 St Martins House, Bull Ring.
Tue-Sat 9 am-6 pm. Thur 9 am-8 pm. Closed Mon.

TEST INSTRUMENTS

Our wide range includes:

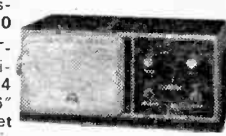
3″ LOW-PRICED SERVICE OSCILLOSCOPE. Model OS-2. Compact size 5″ x $7\frac{3}{8}$″ x 12″ deep. Wt. only $9\frac{3}{4}$lb. "Y" bandwidth 2 c/s-3 Mc/s ±3dB Sensitivity 100mV/cm. T/B 20 c/s-200 kc/s in four ranges, fitted mu-metal CRT Shield. Modern functional styling.
Kit **£23.18.0** Assembled **£31.18.0**



OS-2

5″ GEN.-PURPOSE OSCILLOSCOPE. Model 10-12U. An outstanding model with professional specification and styling. "Y" band width 3 c/s-4·5 Mc/s ±3dB. T/B 10 c/s-500 kc/s. Kit **£35.17.6.** Assembled **£45.15.0**

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model 1M-13U. Circuit and specification based on the well-known model V-74 but with many worth-while refinements. 6″ Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling.
Kit **£18.18.0** Assembled **£26.18.0**



VVM, 1M-13U

VALVE VOLTMETER. Model V-7A. 7 voltage ranges d.c. volts to 1,500 A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0·1Ω to 1,000MΩ with internal battery. D.C. input resistance 11MΩ. dB measurement, has centre-zero scale. Complete with test prods, leads and standardising battery.
Kit **£13.18.6** Assembled **£19.18.6**

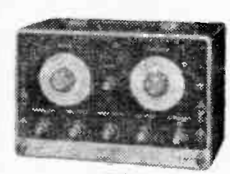
V-7A

MULTIMETER. Model MM-1U. Ranges 0–1·5V to 1,500V a.c. and d.c.; 150μA to 15A d.c.; 0·2Ω to 20MΩ $4\frac{1}{2}$″ 50μA meter.
Kit **£12.18.0** Assembled **£18.11.6**

R.F. SIGNAL GENERATOR. Model RF-1U. Up to 100 Mc/s fundamentals and 200 Mc/s on harmonics. Up to 100mV output. Large accurate calibrated dial scales. Factory wired and aligned coil and band switch assemblies. Ideal for the service shop. Kit **£13.18.0.** Assembled **£20.8.0.**

RF-1U

TV ALIGNMENT GENERATOR. Model HFW-1. Covers 3·6 Mc/s—220 Mc/s with 0-42 Mc/s max. sweep width. Stable all-electronic sweep circuit. Built-in marker oscillators—5 Mc/s crystal and 20 to 60 Mc/s variable. AGC circuit. Positive action return trace blanking Kit **£38.18.0.** Assembled **£49.15.0.**



HFW-1

TRANSISTOR POWER SUPPLY. Model IP-20U. Up to 50V, 1·5A output. Ideal for Laboratory use. Compact size.
Kit **£35.8.0** Assembled **£47.8.9**

Prices and specifications subject to change without notice

New! STEREO AMPLIFIER, TSA-12

12 × 12 watts output.

Kit £30.10.0 *less cabinet*

Assembled £42.10.0

Cabinet £2.5.0 extra

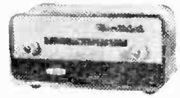
FOR THIS SPECIFICATION

● 17 transistors, 6 diode circuit ● ±1dB, 16 to 50,000 c/s at 12 watts per channel into 8 ohms ● Output suitable for 8 or 15 ohm loudspeakers ● 3 stereo inputs for Gram, Radio and Aux. ● Modern low silhouette styling ● Attractive aluminium, golden anodised front panel ● Handsome assembled and finished walnut veneered cabinet available ● Matches Heathkit models TFM-1 and AFM-2 transistor tuners.

Full range power . . . over extremely wide frequency range. Special transformerless output circuitry. Adequately heat-sinked power transistors for cool operation—long life, 6 position source switch.

FULL SPECIFICATION SHEET AVAILABLE

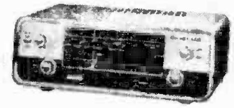
VALVE TUNERS



TUNERS

←FM

AM/FM→



★ **HI-FI FM TUNER.** Model FM-4U. Covers 88-108 Mc/s. Flywheel tuning. Pre assembled and aligned, R.F. tuning unit (£2.15.0 incl. P.T.) with I.F. output of 10·7 Mc/s and I.F. amplifier unit, with power supply and valves (£13.13.0). For free standing or cabinet mounting. Total Kit **£16.8.0**

★ **HI-FI AM/FM TUNER.** Model AFM-1. Covers AM 16 to 50, 200-550 and 900-2000 metres FM 88-108 Mc/s. Pre-aligned Tuning Heart (AFM-T1—£4.13.6 incl. P.T.) and I.F. amplifier (AFM-A1—£22.11.6). Printed circuit board, 8 valves, Built-in power supply. Total Kit **£27.5.0**

★ Models available in two units for your convenience.

MULTIPLEX DECODER, Model SD.1. Convert above models to stereo at low cost. Transistorised circuit. Self powered. Compact, matching unit. Kit **£8.10.0.** Assembled **£12.5.0**

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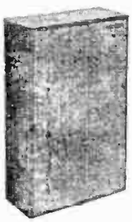
SPEAKER SYSTEMS

SSU-1



Berkeley

HI-FI SPEAKER SYSTEM. Model SSU-1. Ducted-port bass reflex cabinet "in the white". Two speakers. Vertical horizontal models with legs, Kit **£12.12.0** without legs, Kit **£11.17.6** incl. P.T.

The **BERKELEY SLIM-LINE SPEAKER SYSTEM,** fully finished walnut veneered cabinet for faster construction. Special 12" bass unit and 4" mid/high frequency unit. Range 30–17,000 c/s. Size 26" x 17" only 7⅞" deep. Modern attractive styling. Excellent value. Kit **£19.10.0** Assembled **£24.0.0**

COTSWOLD SPEAKER SYSTEMS. Outstanding performance for price.
MFS: Size 36" x 16½" x 14" deep.
Kit £25.12.0 Assembled £33.4.0
STANDARD: Size 26" x 23" x 14½" deep.
Kit £25.12.0 Assembled £33.4.0

- Deferred terms available in UK over £10.
- Extended terms over £75 UK only.
- Full specification sheet of any model available upon request
- Prices quoted are Mail Order, retail prices in general slightly higher.

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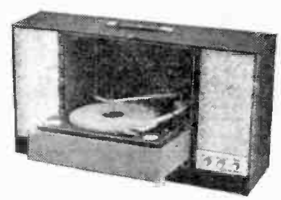
36 pages, many models in colour . . . Hi-Fi Audio, Radio . . . Amateur gear, Britains largest selection of top quality, electronic kits.

Mail for your own copy Today! ➔

New! Portable Stereo Record Player, SRP-1

Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250v ac mains operation. Overall cabinet size 15 9/16 x 3⅞ x 10¼in.

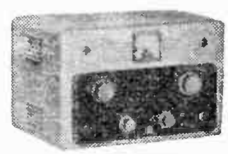


Compact, economical stereo and mono record playing for the whole Family—plays anything from the Beatles to Bartok. All solid-state circuitry gives room filling volume.

KIT **£27.15.0** incl. P.T. Assembled price on request.

"AMATEUR" EQUIPMENT

80-10m TRANSMITTER, DX-40U. Power inputs 75W. C.W., 60W peak CC phone. Output 40W to aerial. Provision for VFO.
Kit £29.19.0 Assembled £41.8.0



DX-40U

AMATEUR BANDS RECEIVER Model RA-1. To cover all the Amateur Bands from 160-10 metres. Many special features, including: half-lattice crystal filter; 8 valves; signal strength "S" meter; tuned R.F. Amp. stage.
Kit £39.6.6 Assembled £52.10.0

RA-1

160-10M TRANSMITTER. Model DX-100U. Careful design has achieved high performance and stability. Completely self-contained.
Kit £81.10.0 Assembled £106.15.0

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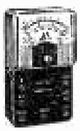
VIKING TRANSISTOR

40-50 WATT AMPLIFIER

OPERATING INSTRUCTIONS GENERAL. An extremely reliable lightweight amplifier capable of giving 40–50 watts of undistorted sound, made possible by the use of the latest semi-conductors (transistors) and techniques which ensure space-age reliability under the most rugged conditions. It is designed as a general purpose amplifier particularly suitable for use with musical instruments that require exceptionally high treble response (not recommended for Bass Guitar). Tremolo facilities are available on Channel 1 only. INPUTS—CONTROLS—CHANNEL 1 (Tremolo): this contains two high gain input jack sockets controlled by **Volume Control 1** which is mounted directly above the two sockets marked tremolo. BASS 1: gives a controlled boost to the lower frequencies on Channel 1 only. TREBLE 1: gives a controlled boost to the high frequencies on Channel 1 only. TREMOLO: this operates on Channel 1 only and the variations of intensity and speed of the Tremolo beat is adjusted by the controls DEPTH and SPEED. A socket is provided in the rear of the amplifier so that the Trémolo may be switched on and off by the use of a footswitch plugged into the socket. If you wish the Tremolo to be used without the footswitch, this is possible as the footswitch is only used to short out the effect. INPUTS AND CONTROLS—CHANNEL 2 (Normal): this contains two high gain input jack sockets controlled by **Volume Control 2** which is mounted directly above the sockets marked **Normal.** TREBLE: gives a controlled boost to the treble frequencies on Channel 2 only. MAINS VOLTAGE: fully adjustable, 200–250 volts, A.C. 50 cycles. POWER OUTPUT: 40–50 watts sine wave British rating. Very little distortion. OUTPUT IMPEDANCE: 3 ohms. Price **21 gns.** plus £1 postage and packing.

VALVE VERSION OF THE ABOVE AMPLIFIER 40–50 watt, A.C. mains 200/250 volts for 3 and 15 ohm speakers. Price **27 gns.** plus £1 postage and packing (No tremolo facilities on this amplifier).

POCKET MULTI-METER

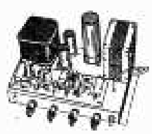


Size 3¾ x 2½ x 1¼in. Meter size 2½ x 1¼in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test prods, battery and full instructions, 42/6. P. & P. 3/6. FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

600 mW SOLID STATE 4-TRANSISTOR AMPLIFIER

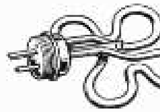
Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response. Automatic heat compensation. Combined AC/DC feed back. Class B output stage. i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition (1Q) current drain is approx. 12mA at 9 volts (4mA in the output pair). Printed circuit construction, size 2½" x ⅞" x ⅞". Speaker output impedance 12 ohms. Output power 600mW at 5% distortion, 400mW at 2·5% distortion, 750mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35–40mA at full power (speech and music), average 65mA. Sensitivity for 50mW output is 10mW. Frequency response —3dB points 90c/s and 12Kc/s. Price **15/-**, plus 1/- P. & P. 7" x 4" speaker to suit, 13/6 plus 2/- P. & P.

8-watt 4-valve PUSH-PULL AMPLIFIER & METAL RECTIFIER



Size: 9" x 6" x 1½". A.C. Mains, 200–250V, 4 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. **£4.4.0.** P. & P. 11/-, 8" x 5" speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P.

GEC KETTLE ELEMENT



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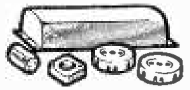

Incorporating GEC Choke size 8½" x 1¾" x 1¾" 2 bi-pin holders, starter and starter holder. P. & P. 5/6. **11/6**

Similar to above: 80W. Fluorescent Light Kit incorporating GEC choke size 11¾" x 1¾" x 1¾" 2 bi-pin holders, starter and starter holder. P. & P. 6/6. **17/6**

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3-4 watt Amplifier built and tested. Chassis size 7 x 3½ x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6. £2.5.0 plus 5/6 p. & p.

"MUSETTE" 6-Transistor Superhet Portable Radio

★ 2½" Speaker. ★ 6 Transistor Superhet Output 200mW. ★ Plastic Cabinet in red, size 4¾" x 3" x 1¾" and gold speaker louvre. ★ Horizontal Tuning Scale. ★ Ferrite Rod Internal Aerial. ★ IF 460 kc/s. ★ All components Ferrite Rod and Tuning Assembly mount on printed board. ★ Operated from PP3 Battery. ★ Fully comprehensive instructions and point-to-point wiring diagram. ★ Printed Circuit Board. ★ Tunable over medium and long waveband. ★ Car aerial and earpiece socket.

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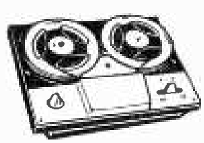

Type TD2 Tape speed 3¾ twin track, **£6.19.6.**
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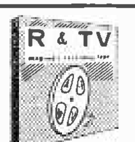

5¾" Std. 850ft.	9/–	5" L.P. 850ft.	10/6
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3" L.P. 240ft.	4/–	5" T.P. 1800ft.	25/6
5¾" L.P. 1200ft.	11/6	5¾" T.P. 2400ft.	32/6
7" L.P. 1800ft.	18/6	7" T.P. 3600ft.	42/6
5¾" D.P. 1800ft.	18/6	4" T.P. 900ft.	15/–

P. & P. on each 1/6, 4 or more post free.

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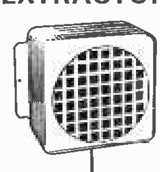

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Communications Receiver 540-10 metres

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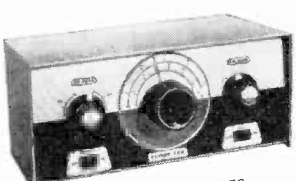
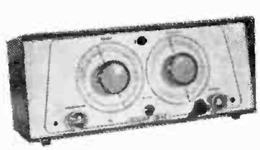
***Ideal for SWLs *5 valves (inc. two twin triodes) giving 7 valve line-up *Excellent on amateur and shipping frequencies *Calibrated signal strength meter (illuminated) *Automatic volume control *Separate B.F. oscillator for morse and S.S.B. signals *Two speed vernier tuning**

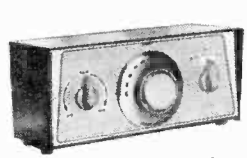
The Codar CR.70A is an excellent general coverage communications receiver for the keen short wave listener. Very reasonably priced at just £19.10.0 the CR.70A is outstanding value for money. In four stable ranges, the receiver covers from 540 metres medium wave, right through the shipping and coastguard frequencies all the short wave and international amateur bands up to and including 10 metres, where the rapidly improving conditions that now prevail allow the regular reception of world-wide call-signs! The CR.70A has a high 'Q' aerial input stage giving extremely high gain with low noise level. Double tuned, iron cored I.F. transformers produce high selectivity. Ready to plug into 200-250 volt AC mains, the CR.70A needs only your aerial and a 2-3 ohm loudspeaker. The cabinet measures only 13" x 5¾" x 7¾" and the control panel is finished in black and white with chrome trim knobs. Fully guaranteed for 12 months! Buy your Codar equipment from your radio hobby store or direct from Codar. The order form will also bring fully descriptive leaflets (6d stamps appreciated).



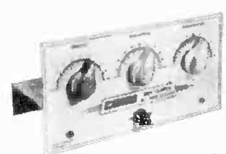
T28 RECEIVER FOR 160 & 80 METRES AMATEUR BANDS
9 transistors, bandspread 1.8-2Mc/s and 3.5-4Mc/s 12 volts, only 8" x 4" x 3½", ideal portable, mobile or home receiver. Efficient BFO, printed circuits. ONLY £15.10.0. Carr. 4/6.



CR45 MAINS T.R.F. SHORT-WAVE RECEIVER
World wide reception. *Separate electrical band-spread. *3 slow motion drives. *Output 3 watts for 2/3 ohm speaker. *Valves ECC81, EL84, EZ80. Size 12" x 5½" x 7". CODAR-KIT CR.45K with 3 coils (10-28, 25-75, 60-176 metres). £9.10.0. Carr. 6/-, or ready built CR.45 £11.7.0. Carr. 6/-. Extra coils 5/- each.



R.F. PRE-SELECTOR MODEL P.R.30 1.5-30Mc/s
Provides up to 20dB gain plus substantial image rejection, improved signal/noise ratio and selectivity. Power requirements 180-250 volts 12mA H.T. 6.3 volts, .3 amp L.T. Size 8½" x 5" x 4". Ready built complete with cables, plugs and instructions. £5.10.0. Carr. 4/6. Self-powered P.R.30x £7.4.0. Carr. 4/6.



MINI-CLIPPER—OUR FAMOUS SHORT-WAVE RECEIVER
*Can be built in one evening. *Complete with valve, one coil 25-75 metres and 4 page instruction manual. Price 39/6. Carr. 3/-. Extra coils 5/- each.

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PRACTICAL WIRELESS

VOL 43 No 10

issue 732

FEBRUARY 1968

TOPIC OF THE MONTH

Lots of Agony

HAVE you got problems? If so, don't despair—we all have them, whether it be a receiver that clicks and pops, an amplifier that howls like a banshee, a difference of opinion with the income tax man, trouble with the neighbours, wife or girl friend, difficulties in balancing the budget or any of the other myriad problems, big or small, of today.

You may take your problems to a solicitor, doctor, bank manager, psychiatrist or other professional consultant—or you may write to the agony column of your favourite paper. But if you have a problem about radio you will probably write to Practical Wireless (though some pieces of equipment we hear about would be better taken to a psychiatrist!)

We get letters seeking advice on why a set behaves oddly, or refuses to behave at all, where to obtain bits and pieces, how to contact manufacturers or agencies, how to make various calculations—in fact on almost every theoretical and practical aspect of radio. To use the jargon of the agony column, we have heard from them all—from *Anxious* of Arnos Grove to *Zealot* of Zanzibar. And, through our panel of experts, we try to help each and every one.

This is not always easy, for many seemingly simple cries of anguish require much research and investigation. And when you consider that we handle on average around 500 queries each month, the magnitude of the task of pleasing everyone will be seen to be considerable.

Taking the obvious cue, we would like to make an appeal to anyone wishing to use our Query Service to read carefully the conditions set out each month on the inside back cover page. Failure to observe these conditions may lead to delays or even an absence of a reply. Although the cost of running this service is considerable, we feel that it is doing a very useful job, so please help us to help you by reading those notes!

And, as we said before, if you *do* have a problem, don't despair. It has been said that a person with no problems cannot be doing anything worth while!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

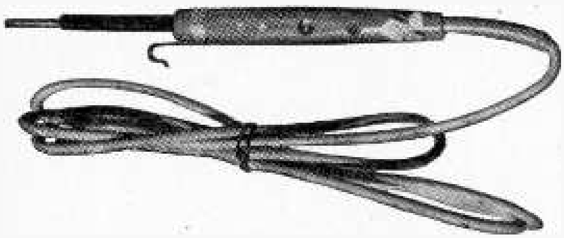
CONSTRUCTIONAL

OTHER FEATURES

MARCH ISSUE WILL BE PUBLISHED ON FEBRUARY 9th

NEWS AND COMMENT...

NEONS FOR LITESOLD IRONS



Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, are now supplying, to special order, four models from their Litesold range of soldering instruments fitted with neon indicators to show when the supply is switched on. There has been considerable demand for this feature to reduce the risk of accidental burns to operators and equipment. These indicators are available on the 10, 18, 20 and 25 watt models.

The neon indicators are mounted entirely within the moulded nylon handles and are visible over a very wide angle through domed, clear-perspex lenses let into the handles. It is planned to use handles moulded in natural nylon for this application as soon as possible, to allow the lenses to be dispensed with and to permit the indication to be visible from any angle.

Instruments with neon indicators are available for all voltages from 100 to 250 volts, a.c. or d.c. prices are from 35s. 6d. to 37s. 6d. each.

LEAFLETS ON SOUND AND CONTROL SYSTEMS

Rank Audio Visual Limited, Woodger Road, Shepherds Bush, London, W.12, have introduced two new fully illustrated leaflets dealing with sound and control systems which the company market.

The leaflet on control systems is about the use of this equipment in modern lecture theatres. It explains how all electrically operated functions can be controlled so that lecturers can be freed from time-consuming operations, thus giving them greater flexibility with all equipment available for their use.

The sound systems leaflet confines itself to loudspeakers and gives information on a wide range of speakers for lecture theatres, cinemas, hotels, churches and industrial locations.

PROPAGATION FORECASTS

Weekly radio propagation reports and forecasts for the international radio bands are now being broadcast on Radio New York Worldwide's weekly programme DXing Worldwide. *The programme is heard by radio amateurs, shortwave listeners and the almost 4,000 members of the Radio New York Worldwide Listeners' Club.*

Using data gathered from consultants throughout Western Europe and from the American Telecommunications Disturbance Forecast Center, the propagation reports inform thousands of listeners about listening conditions on the international radio bands. DXing Worldwide *is broadcast every Saturday at 1735 GMT (1235 EST) on 15,440, 17,845 and 21,530 Mc/s and every Sunday at 1935 GMT (0235 EST) on 15,440, 17,760 and 21,530 Mc/s.*

COMPONENTS SHOW TO BE INTERNATIONAL

At a recent meeting of the Council of the Radio and Electronic Component Manufacturers' Federation it was decided unanimously to give international status to the Radio and Electronic Components Show by admitting foreign exhibitors and products. The Regulations for the next Exhibition, which will be held at Olympia in May 1969, sponsored by the Federation and organised by Industrial Exhibitions Limited, will be amended accordingly.

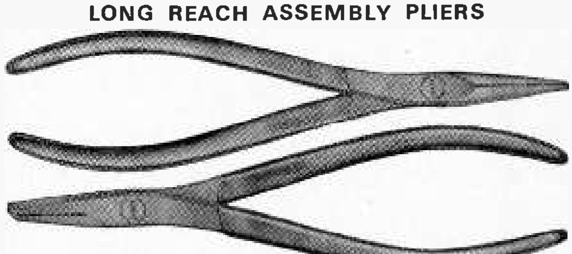
The decision is the outcome of discussions in recent months which have taken account of opinions expressed by exhibitors and visitors during and subsequent to this year's exhibition at Olympia. A referendum conducted by the Federation early in August among RECMF exhibitors and non-member exhibitors produced a decisive vote in favour of relaxing the restrictions on the display of foreign components and materials.

TELEGRAPH CENTRE

A new telegraph relay centre, which will progressively speed up and generally streamline the handling of overseas telegrams, has been opened by the GPO at Cardinal House, Farringdon Road, London. Initially, it will handle 35,000 to 40,000 telegrams a day, most of them automatically. The system has been planned for a measure of expansion and, when fully equipped, will be the largest automatic centre in the world network.

The new installation, which marks an important step forward in Post Office plans for mechanising overseas telegraphs, combines an advanced form of electromechanical switching with electronic control. It has a unique system of magnetic storage designed for traffic which is unavoidably delayed owing to deterioration of radio conditions. Messages entering the system are stored momentarily while the routing code carried in each message is examined automatically and the required forward route selected. This process takes only a few seconds and wherever the outgoing line is free, messages are sent on their way immediately. On very busy routes, messages are stored in order of priority and of arrival time for retransmission in due turn.

LONG REACH ASSEMBLY PLIERS



The two pliers illustrated, produced by Elliott-Lucas of Cannock, Staffs., have proved extremely popular with various Government Departments, including the Ministry of Defence and are also particularly useful to electricians, motor mechanics and the general handyman. These long-handled, short-nosed pliers can be used in places inaccessible to normal tools, and the fine serrated jaws ensure an even, firm grip. Both types are made from high tensile steel and insulated to withstand 5,000 volts.

NEWS AND COMMENT...

CQ NEW MEMBERS

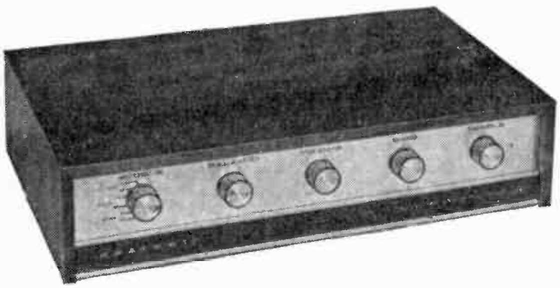
The Redbridge Amateur Radio Society has now obtained adequate premises at the Presbyterian Church, Oakfield Road, Ilford, Essex and meetings are held on the first and third Monday of each month, commencing at 8 p.m.

All readers in and around the Ilford area are welcome to come along and it is hoped, to join us.

It is proposed to install transmitting and associated equipment in due course for those interested in this aspect of the hobby. Lectures will be held and there will be "junk sales" from time to time.

The Society Hon. Sec., Mr. T. L. Stoakes, G3JTS, of 62 Dudley Road, Ilford, Essex, will be pleased to give any further details (telephone 478–7346) most evenings.

12 + 12W STEREO AMPLIFIER



From Daystrom Ltd., Gloucester, comes the new Transistor 12 + 12W Stereo Amplifier, Model TSA-12. It has 17 transistors and 6 diodes in the circuit, and gives a full range power over the frequency range of 16–50,000c/s. The attractive low silhouette styling harmonises with both modern and traditional decor and matches the well-known Heathkit slim-line tuners, models TFM-1 and AFM-2.

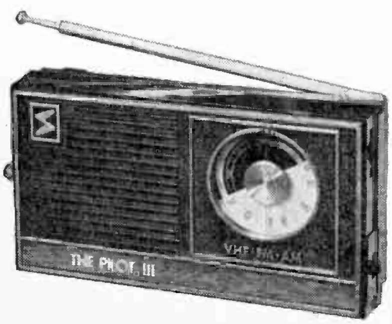
It can be used in a cabinet or free standing with the optional walnut veneered cabinet.

Available as a kit, it costs £30 10s. and factory assembled, the price is £42 10s. The walnut veneered cabinet is £2 5s. extra, and mounting trim and brackets are £1 18s.

AND NOW THE PILOT 3

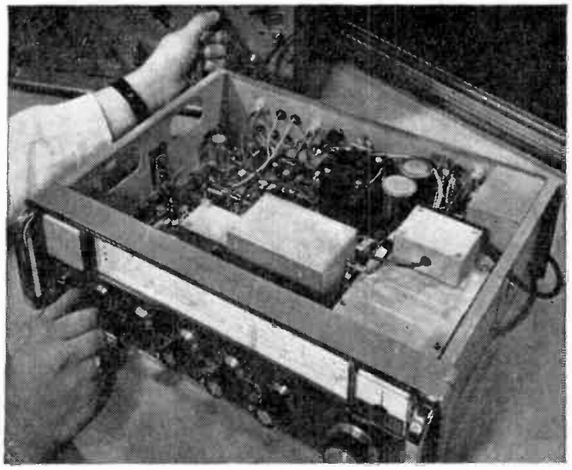
H. O. Thomas Electronics Ltd., introduce their aircraft band receiver—the Pilot 3.

A completely portable set measuring only 6 x $1\frac{1}{2}$ x $3\frac{1}{4}$in. it will receive normal broadcasts on a.m./f.m. wave bands and pilot to control tower messages on the special v.h.f. band of 108–130Mc/s.



The superhet circuit consists of 10 transistors and 5 diodes with telescopic aerial for v.h.f./f.m. The recommended retail price of 13 gns. includes leather case, battery and earpiece.

EDDYSTONE'S NEW VHF RECEIVER



Eddystone Radio Limited, announce the 990R v.h.f. solid state receiver. It is completely solid state (using 39 transistors and 14 diodes).

The equipment can be operated directly from a battery supply, and a mains power unit forms an integral part of the receiver.

The tuning range of the 990R extends from 27 to 240 Mc/s, and is covered in four switched bands. The local oscillator arrangement provides for free running throughout the range of the receiver or permits up to eight crystal controlled channels to be selected. The flexibility is further increased by the provision of a socket for the connection of an external synthesiser. Filters are included giving bandwidths of 30kc/s and 200kc/s, although other bandwidths can be provided. The 990R is designed to be operated with the Eddystone Panoramic Display Unit (Type EP17R) if required, to provide an analytical display of all signals received over a given section of the frequency spectrum.

The receiver is equipped with an internal crystal calibrator, giving reference signals at 10 Mc/s intervals. It has a tuning meter, also a muting system which silences the receiver in the absence of a signal: this reduces operator fatigue on long listening watches.

There is an output from the unit to operate an external loudspeaker (a small internal unit is provided) a 600Ω output for remote lines, and provision for a telephone headset. A line amplifier is incorporated to provide the line signals and this has its own level control.

Retail price is £345.

WINNER OF EDDYSTONE PRIZE ANNOUNCED

Bruce Taylor, a 25-year-old student at Edinburgh University, is winner of the Eddystone Radio essay competition, which the firm organised earlier this year, among radio enthusiasts all over Britain. Mr. Taylor, who is currently engaged on Ph.D. work, is an active radio amateur and wins a high performance EA12 Eddystone communications receiver, worth £185. He received from the judges high praise for an essay describing a new approach to radio receiver design. Each competitor was asked to write an essay of not more than 1,500 words on one of four subjects.

THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA

continued from the January issue

THE two-gang tuning capacitor VC1, VC2 should be fixed to the mounting bracket type "A". This should then be mounted on the chassis as shown in Fig. 6. The method of mounting the slow motion drive is shown in Fig. 6 and Fig. 17. It will be necessary to adjust the position of the drive on the tuning capacitor spindle to allow the dial fixing flange to protrude through the front panel sufficiently to give clearance for the dial when this is fitted later.

The coil screening cans are supplied complete with the Denco coils and instructions for fitting the cans to the B9A valveholders are enclosed with each coil. The Veroboard panel is fixed to the chassis by ¾in. x 6BA screws and suitably spaced by extra 6BA nuts.

Components which are not actually required in the Clubman receiver are marked "X". These components will be required in later versions of the receiver and the drillings for these components should be carried out at the commencement rather than at a later date when components already installed could easily be damaged.

The i.f. and a.f. stages are built on a Veroboard panel (0·2 x 0·2in. matrix) and if the layout shown in Fig. 15 is followed closely no problems should be encountered. Most of the faults that arise when Veroboard is used are due to accidental wrong connections. To avoid this problem the following hints may be of assistance.

1—Cut the Veroboard to size using a small Eclipse junior or similar hacksaw. Saw from the copper side so as to avoid tearing the copper strip. Saw lightly and smoothly.

2—Fix strips of masking tape about ¼in. wide on both sides of the panel on the long edge and the short edge.

3—Write in the reference numbers and letters so that every hole can be positively and easily identified from both sides of the panel.

4—Remove the copper strip as shown in Fig. 15 using the correct Vero tool or alternatively a suitable drill, held in the hand. Double check the drilling.

5—Mount and solder the components one at a time starting with the link wires, then the smallest diameter components and working up to the largest. Bend the wires to the correct centres, insert through the panel, turn over the panel and solder the connections, then cut off the surplus wire. It is useful to lay the panel component side down on a foam plastic pad when soldering the components as this will keep them gently pressed to the panel.

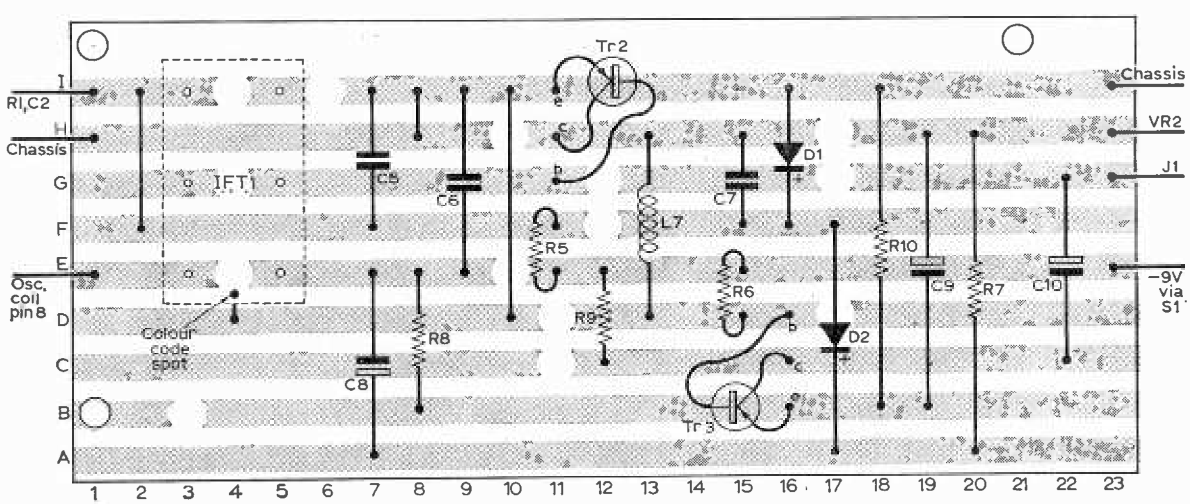


Fig. 15: Component layout on the Veroboard panel.

6—Double check the circuit reference, value and position of each component before soldering.

7—When mounting the i.f. transformer it is necessary to open up the holes in the Veroboard to clear the soldering tags. This may be done by drilling with a suitable drill or filing with a needle file.

Wiring of the Frequency Changer Stage

The layout of components and wiring is shown in Fig. 16. The earth wiring and the connections to VC1 and VC2 are installed first. The leads from VC1 to pin 6 of the aerial coil holder and from VC2 to pin 1 of the oscillator coil holder are of 18s.w.g. tinned copper wire and form a sturdy method of fixing TC1 and TC2. 18s.w.g. wire is also used to connect the centre tags of TC1 and TC2 to the earth tags nearby.

The remaining components including Tr1 are wired in next, following the layout shown.

The wiring from the frequency changer stage to the remainder of the chassis is then installed. The wiring of the front panel controls is shown in Fig. 17. The wiring of the headphone jack, on/off switch and battery complete the construction of the receiver and after a check of all components, connections and wiring, the receiver is ready for testing.

Testing and I.F. Alignment

If you have an ohmmeter it would be advisable to check that there are no short-circuits between the battery negative lead and the chassis. With the receiver switched on a reading of approximately 2—3kΩ should be obtained. If everything appears in order the battery may be connected and the receiver switched on. The total current drain from the battery should be about 6mA. This may be measured by connecting a suitable milliammeter in series with a battery lead. A table of voltages is given for checking.

If a signal generator is available, alignment may be carried out in the usual way, as follows:

1—Set the signal generator to 470kc/s with the modulation "on".

2—Inject the signal between chassis and Tr1 base. The connection to the base should be via a suitable (0·01μF) coupling capacitor.

3—Set the a.f. gain control to maximum.

4—Adjust i.f.t.1 primary and secondary tuning cores for maximum output. The output of the signal generator should be reduced as the output increases so as to avoid overloading the i.f. stage.

5—Disconnect the signal generator. If all is in order a rushing noise (mixer noise) should be noticeable in the headphones.

If no signal generator is available, the i.f. stage may be aligned on noise as follows:

1—Set the a.f. gain to maximum.

2—Listen carefully for a weak rushing noise in the headphones.

3—Adjust one tuning core only, of i.f.t.1, from fully-in to half-out position. At some point in this range there will be a noticeable increase in noise level, the core should be set to this position.

TABLE OF VOLTAGES

(Voltmeter 20kΩ/Volt, 10 Volt Range)

	Tr1	Tr2	Tr3
Emitter	−1·4V	OV	−1·6V
Base	−1·5V	−0·2V	−1·8V
Collector	−7·4V	−1·8V	−4·7V

R.F. Alignment

Before r.f. alignment is commenced it is essential that the dial is correctly positioned in relation to the tuning capacitor. Turn the tuning capacitor to maximum capacity (fully closed position). Loosen the slow motion drive on the tuning capacitor spindle and set the dial to indicate exactly 1·6Mc/s. Tighten the s.m. drive. If a suitable signal generator is available, the alignment should be carried out as follows:

1—Set the a.f. gain and r.f. gain controls to maximum.

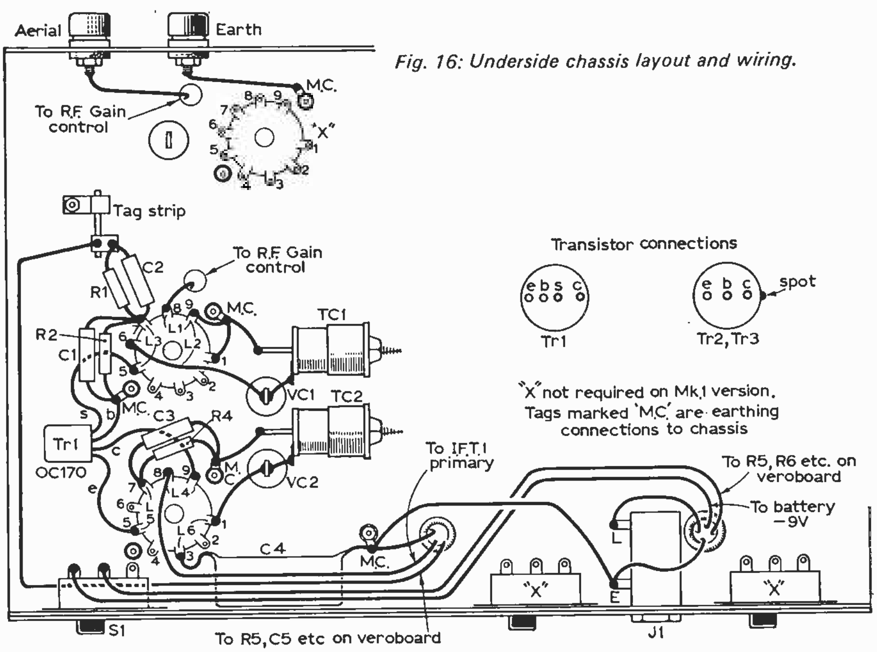
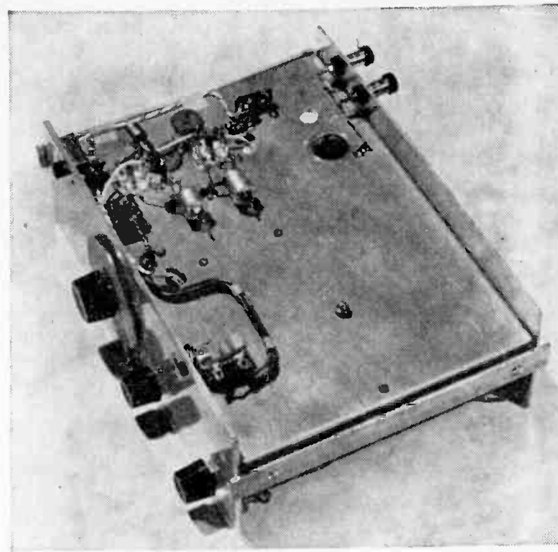


Fig. 16: Underside chassis layout and wiring.

2—Connect the signal generator to the earth and aerial terminal via a standard dummy aerial or a 470Ω resistor.
3—Set the signal generator and the receiver dial to 1·6Mc/s.
4—Adjust L6 core to receive the signal.
5—Set the signal generator and the receiver dial to 5·0Mc/s.
6—Adjust TC2 to receive the signal (see note regarding second channel).
7—Repeat 3 to 6 until no further adjustment is necessary to set the range.
8—Set the signal generator to 1·8Mc/s and tune in the signal.
9—Adjust L2 for maximum output, reducing the signal generator output as necessary to avoid overloading the receiver.
10—Set the signal generator to 4·5Mc/s and tune in the signal.
11—Adjust TC1 for maximum output, reducing signal generator output as necessary.
12—Repeat 8 to 11 until no improvement results.



Underside view of the basic (Mk. I) receiver.

Second Channel

Note that when setting the oscillator at the h.f. end of the tuning range, 4—5Mc/s, two responses can usually be found. When both these responses can be found during the adjustment of the oscillator trimmer TC2, the setting of the trimmer furthest out is the correct one, e.g. the higher of the two oscillator frequencies, thus putting the oscillator above the incoming signal.

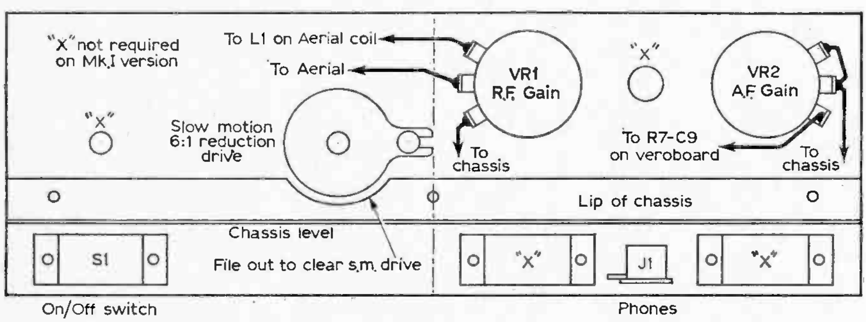


Fig. 17: Front panel layout and wiring details.

If a signal generator is not available, a rough alignment may be carried out as follows:
1—Connect an aerial and earth to the receiver.
2—Set the r.f. and a.f. gain controls to maximum.
3—Set TC1 and TC2 to approximately the middle of their range of adjustment.
4—Tune in any signal at approximately 1·9Mc/s.
5—Adjust L2 for maximum signal.
6—Tune around to locate the Decca Navigator Beacon which is on 1·9Mc/s.
7—If the dial indicates higher than 1·9Mc/s adjust L6 core anticlockwise or if lower than 1·9 adjust L6 clockwise until the Beacon can be tuned in at 1·9 on the dial.
8—Tune in the Beacon at 1·9Mc/s and adjust L2 for maximum signal. It may be necessary to reduce the r.f. gain control to prevent overloading and consequential misleading results.
9—A check of calibration may be made at the other end of the tuning range by identifying amateur stations operating in the 80 metre band (3·5—3·8Mc/s). If the calibration is incorrect TC2 should be adjusted in a similar way to L6 adjustment at 1·9Mc/s.
10—When the calibration is correct, tune in a signal at approximately 4·5Mc/s and adjust TC1 for maximum signal.
11—Check and if necessary repeat 6, 7, 8, 9 and 10.
12—Under normal evening listening conditions when tuning from 1·8 to 3 Mc/s, the receiver should appear quite "lively" and "very lively" up to 5Mc/s.

Performance

The performance of the receiver when fully aligned is given below:

Sensitivity:	1·8Mc/s	10μV
	5·0Mc/s	5μV

(For 5 microwatts output, 6dB s/n ratio, input signal modulated 30%)

Selectivity:	3dB down	6kc/s
	20dB down	25kc/s

Purpose of R3

On one of the four prototype receivers constructed, there was slight instability at 5Mc/s due to excessive oscillator amplitude and it was found necessary to fit a resistor of 1kΩ in the position shown. Using the wiring layout given in Fig. 16, it is unlikely that any instability will be experienced and R3 should be omitted.

Operating the Receiver

The aerial input circuit is suitable for an untuned aerial of random length. For best results the aerial should be 40—100 feet long and mounted clear of buildings etc. It is essential to use an earth, this may conveniently be an earth rod or a connection to a cold-water pipe. The a.f. stage output impedance, at the jack socket, is approximately 1·5kΩ and is suitable for most high or medium impedance headphones, ex-government CLR types have proved to be quite satisfactory.

The operation of the receiver is very straightforward, but as there is no automatic gain control, use must be made of the manual r.f. gain control. For normal listening it is usual to set the a.f. gain control to a little less than maximum and to adjust the r.f. gain control according to the strength of the received signal. This will prevent overloading by very strong signals.

Alternative Versions

As previously mentioned, the Clubman Mk I is the basic simple receiver and is constructed so that additional features may be added later. Details of future versions are as follows:

Mk II—Full i.f. amplifier with beat frequency oscillator and automatic gain control.

Mk III—As Mk II but with r.f. amplifier

Mk IV—As Mk III but with power output stage and loudspeaker.

Mk V—As Mk IV but with d.f. aerial.

Other frequency ranges may be added at any time by inserting the appropriate Denco plug-in coils.

TO BE CONTINUED

CQ! CQ! CQ! CQ! CQ! CQ!

TAPESPONDENTS WANTED

. . . anyone of my own age (14) and preferably someone who possesses a 19set as I do My recorder is a Defiant T15 two-track machine with a tape speed of 3¾i.p.s.—N. Johnson, 7 Millais Place, Tilbury, Essex.

. . .any female enthusiast of my own age (20). I have a Philips EL3541 recorder with a speed of 3¾i.p.s. and taking 5in. spools.—M. Fisher, 169 Almondbury Bank, Almondbury, Huddersfield, Yorkshire.

. . . a correspondent or tapespondent of either sex, living outside the British Isles and with any interests, and approximately my own age (15). My recorder is a Fidelity Argyll Major 4 (BSR deck) 3¾i.p.s. only, four track and spool size up to 5¾in.—C. Davies, 55 St. Lawrence Avenue, Bolsover, Chesterfield, Derbyshire.

. . . anyone anywhere of my own age (16½) who is interested in amateur radio and electronics generally. My tape recorder can play 2 or 4 track tapes up to 7in. at 1⅞, 3¾ and 7½i.p.s. All tapes will be returned.—N. Wilson, 6 Lammas Green, Sydenham Hill, London, S.E.26.

. . . anyone in North America and with an interest in Hi-Fi and commercial radio. I can record up to 7in. spools on ¼ track.—R. Cowell, 30 Copers Cope Road, Beckenham, Kent.

CORRESPONDENTS WANTED

. . . somebody of my own age (19) who is interested in radio receivers.—C. Davison, 5 Bank Terrace, Caledon, Co. Tyrone, N. Ireland.

. . . any other short wave listener interested in mobile short wave listening.—D. Adams, A5197, 16 Meadow Lane, Woodvale, Southport, Lancashire.

. . . anyone of my own age (14) who is interested in simple wireless.—J. Butler, 56 St. Margaret's Road, Marsh Mills, Plympton, Plymouth, Devon.

. . . any electronics enthusiast anywhere in the world.—F. Webber, 79 The Walronds, Tiverton, Devon.

. . . anyone who is interested in electrical and electronics experimenting.—A. R. Diamond, Diamond Radio and Electronics Service, Kachary Road, Hafizabad, West Pakistan.

INFORMATION WANTED

. . . any information on a GEC model BC4650 radio.—A. Golics, 317 Northway, Lydiate, Liverpool Lancashire.

. . . a simple erase oscillator (transistor) circuit for use with a BSR TD10 4-track deck.—I. Thompson, 16 Rotterdam Street, Thurso, Caithness, Scotland.

. . . any information at all on the "Hambander" made by Radiovision of Leicester Ltd.—R. Slaney, 34 Garn Road, Maesteg, Glamorgan.

. . . a source of supply for an XL101 crystal for a B40 receiver.—G.Sharp, Station Road Wistow, Selby, Yorkshire.

. . . circuit diagram and any other details for an Eddystone B34 7-valve communications receiver having headphone output and separate power unit.—S. Sellars, 67 Cripley Road, Farnborough, Hampshire.

. . . buy or borrow the handbook for the R1475 receiver and any other details would be welcome.—S. Haseldine, BRS A5114, 31 Ellesmere Road, West Bridgford, Nottinghamshire.

. . . any information regarding a mains unit for a 19 set Mk. 3. Also the official handbook for this set.—B. Parker, 197 Moselle Avenue, Wood Green, London, N.22.

. . . information for converting a R1392 v.h.f. receiver from crystal tuning to normal tuning. Also the loan of a manual or circuit diagram would be appreciated.—J Keenan, Belton, 7 Parkmount, Bangor, Co. Down, N. Ireland.

. . . a book of instructions for using Taylor Valve Tester, model 45A.—G. Williams, 11 Cornfield Close, Llanishen, Cardiff, South Wales.

. . . a handbook for an Admiralty B40 receiver.—M. Robinson, "Melita", Dunton Road, Lawndon, Basildon, Essex.

. . . circuits or information regarding slow scan TV equipment. The line scan being 25c/s with 120 lines per picture.—M. Busson, 12 Coulton Court, Pontnewynydd, Pontypool, Monmouthshire.

. . . circuit or handbook required for the MR44 receiver.—S. Smith, 19 Hyde Road, Kenilworth, Warwickshire.

. . . circuit diagram for the Grundig set type 2068WE.—J. Plange-Kaye, Gemeco, P.O. Box 3743, Accra.

. . . data on oscilloscope model 10 ref. 105B/180 ex-A.M. Circuit diagram and details of any mods would be appreciated.—J. O'Neill, Main Street, Gortin, Co. Tyrone.

. . . data of any mods to the 19 set Mk. 3 as a receiver.—A. Pattinson, 40 Huddleston Road, Millom, Cumberland.

. . . a blueprint of an r.f. amplifier using valves.—B. Churchward, 30 South Avenue, Exeter, Devon.

. . . information on the ex-R.A.F. set R1466.—F. Lewis, 24 Roundmoor Walk, Castle Vale, Birmingham 35, Warwickshire.

. . . any information on Raymond 5V M.L.S. receiver. I require the model number of serial number A44856.—T. Jones, 45 Coalbourne Gardens, Cradley, Halesowen, Worcestershire.

. . . the h.t. and l.t. voltages required for the 48 set Mk. 1 of 1942 issue.—J. Cranke, Suffolk House, The Broadway, Totland Bay, Isle of Wight.

. . . HRO MX service manual, to buy or loan.—J. Duxbury, 1 High Street, Riley's Hill, Accrington, Lancashire.

. . . circuit diagram of a Portadyne TV 179.—P. Lewington, 17 Hanley Road, London, N.4.

. . . service sheet, manual or any other information on the radar video and sync pattern generator, preferably type C, also any information on adjusting and setting up this instrument.—R. Ballardine, 51 North Street, Dalry, Ayrshire.

. . . information on the ex-R.A.F. set R1466.—F. Lewis, 24 Roundmoor Walk, Birmingham, 35.

. . . information on the carrying out of the modification to convert a model 314 series 8/10/44 valve tester to test B9A, B8A and B7G valves.—D. Earle, 236 Lodge Road, Winson Green, Birmingham 18.

. . . data on bringing the frequency from 100Mc/s—125Mc/s to 68Mc/s—100Mc/s on a R 1132A receiver.—G. Buckle, 4 The Green, Raskelf, York.

ISSUES FOR DISPOSAL

. . . *Practical Wireless* from January to November, 1967 and also odd copies from 1964, 1965. Will sell or swop for components, etc.—A. S. Holmwood, 8 Dock Street, Pembroke Dock, Pembrokeshire.

ISSUES WANTED

. . . January 1958 and April 1959 issues of *Practical Wireless* containing the Beginners' Constructional Course and Comprehensive Valve Tester.—D. L. Baronr, 77 Naworth Drive, Newcastle upon Tyne.

P.W. DATA RULE

PART 4

by I. J. KAMPEL

THIS is part 4 in a continuing short series of articles explaining in simple terms the use of the Data Rule, presented free with the November 1967 issue of this magazine, and now available at 5s. from the PRACTICAL WIRELESS Blueprint Department.

This month we are examining the other side of the rule, scales—N, O, P, Q, R, S, T, U, V, W, X; POWER, VOLTAGE, CURRENT and RESISTANCE relationships. The scales which will be considered initially are the N, O, Q and T scales which deal with maximum voltage or current in resistance, at a fixed power dissipation. Operation with these scales, together with the arrow marks in the middle window, indicates the maximum current that may be passed through a given resistance, at a given power rating. The mathematical requirement for this calculation is as follows: $I_{max} = \sqrt{\frac{P_{max}}{R}}$ Thus, for direct indication of I_{max}, the calculator must firstly divide P_{max} by the resistance, and then take the correct square root of this answer, to indicate the current.

LOG CYCLES

In the first of this series of articles, it was shown that every number could be represented on log scales, where an infinite number of log cycles are placed end to end, each cycle, moving to the right, increasing by a factor of 10. It was explained that this was obviously not practical, and therefore only a single cycle is usually considered, and we accept that the decimal point must be placed by inspection. In certain applications, we may only have a limited number of numbers to consider, and if these numbers can be bound within the confines of a small number of adjacent cycles, the proposition is not impossible. Such is the case with the present requirement. The initial step is division, therefore a power scale adjacent to a resistance scale, the resistance scale on the slider, will divide power by resistance. On the single cycle slide rule the end mark would then point to the answer, being the end mark of the single cycle presented. In our case we have more than one cycle, and any fixed point is taken on the slider and referred to another scale on which the answer of the division is displayed.

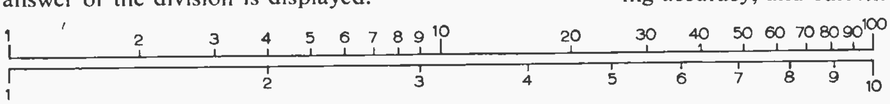


Fig. 13: Two log cycles above one log cycle to give direct reading of square roots.

Now 1Ω to 1MΩ should cover most resistances which we shall want to consider, therefore let the slider be set out in as many cycles as are necessary to cover this range. See scale O on the rule for this: it is seen that six log cycles are required. Now, at any point on the slider, pointing to another six cycle log scale of identical length would give us the answer to the division, however we do not really want this answer, for this is simply an intermediate answer. What we require is the square root of this answer. Before explaining this fully, we shall digress for a moment.

If we take a single log cycle, and then place a scale above this to represent a square of this scale, the result will be as in Fig. 13, two log cycles fitting into the exact length of the previous one cycle. This principle may be continued, and "n" cycles fitting into the length of one basic cycle would give the *n*th power. The reader will know that there are two roots to a square root, three to a cube root, etc., and this conforms, since, considering significant figures only for a moment, we see that the square root of 4 may be either 2 or 6·325 (the square root of 40 in practice, correcting for decimal point). N.B., negative roots are discounted.

Since the upper scale in the figure has been marked 1 to 100, rather than 1 to 10 twice, we can get the correct root directly, and the root giving the answer 6·325 is seen to be the square root of 40 and not of 4, whereas this would not have been *mathematically confirmed*, although perfectly logical, if the second half of the upper scale had been marked from 1 to 10 again, giving us two choices.

Returning to our problem, it will be seen that if we want to take the square root of our intermediate answer, instead of displaying the answer on a 6 log cycle scale, we should display it directly on a 3 log cycle scale, and by doubling up on scale length, we shall effectively take the square root. Now the indicating arrow on the slider is positioned logically to give maximum efficiency, therefore, as the slider moves out of the envelope to the left, the indicating arrow will start on the far right, sweeping along to the left. We must also consider indications when the slider is pulled out to the right, and so another indicating arrow will be used, starting on the far left, and sweeping another scale. Obviously one of the two arrows will be out of action at any given time, since it may be out of the envelope.

On the rule, the Q and T scales provide the I_{max} answers, these being two separate 3 log cycle scales, exactly twice the length of the upper power and resistance scales. Since actual values are marked on the scales, the answer may be read of in terms of precise current in all cases. It will be seen that good fortune is with us on this calculation, for, due to the square root procedure, our scale has expanded, giving greater reading accuracy, and current limits stretching from 300μA to 400A, sufficient enough for most circumstances!

The power scale, apart from the normal graduations, is also marked, in colour, in the normal power ratings of resistors, thus making it that much easier for the standard values. To find I_{max} for a given P and R, simply adjust the slider to place the resistance, in scale O, opposite the power, in scale N. The I_{max} arrow in the central window will then point to the value of I_{max} in either scale Q or scale T.

As an example, consider a resistor of 56Ω and a power rating of 3W. To determine the maximum current which can be passed through it, place 56Ω (scale O) adjacent with 3W (scale N), and read off the answer, 232mA, in scale Q, opposite the black I_{max} arrow in the window exposing scales R and S.

The next consideration will be V_{max} for a resistor and fixed power rating. This could be simply obtained from the value of I_{max}, but, assuming that this is not known we want a direct answer, not via I_{max}. The mathematical problems must be considered again before the slide rule mechanisms required are examined. The mathematical formula being $V_{max} = \sqrt{P_{max}.R}$ Thus the calculator must first multiply power by resistance, and then take the square root. The first step, according to normal slide rule technique, is to place an end mark or reference, on the slider, against one of the quantities on the envelope, in this case power, to read off the product opposite the resistance value. In the rule it is not so convenient to set a reference against the power, and to read off the product adjacent to the resistance, and it is to be preferred if, like the previous case of division, the power and the resistance quantities may be placed adjacent. To do this, the reciprocal of one must be taken, and we shall thus divide the reciprocal of power by the resistance, thus giving the intermediate answer, which will then be transferred to a double-size scale to take the square root. This time the voltage reading is read from the slider, scales R and S, where one of the two voltage marks in colour, marked "V", indicates V_{max}.

To find V_{max} then, proceed as follows. Set the resistance value adjacent to the power rating, *the latter this time set in scale P,* and then read off V_{max} in scale R or scale S, according to the slider setting.

For example—find V_{max} for a 56Ω resistor rated at 3W.

Place the 56Ω mark in scale O adjacent to 3W in scale P. Read the value $V_{max} = 12{\cdot}96V$ in scale R opposite the coloured "V" mark in scale Q. When this mark does not indicate a voltage, the identical mark in scale T will give it.

There should be no doubt about which scales to use, for the coloured arrows show that for I_{max} the upper power scale is used in conjunction with the envelope scales of the central window, and that for V_{max} the lower power scale is used in conjunction with the slider scales in the central window. The top two windows thus are chiefly concerned with evaluation of problems involving power, to give direct readings, without reverting to two steps, from the $P = VI$, and $V = IR$ relationships. For these later Ohm's Law type calculations, the central window and the lower window are used. The lower window gives current-resistance relationships at set voltage, or current-power relationships at set voltage, and the voltage in both cases is set on the central window, scales R and S, as in the previous case, opposite one or other of the coloured "V" marks.

To get reasonable accuracy on these scales it is necessary for them to be as large as possible, hence the choice of the same cycle lengths as for the central window, also enabling space to be saved on the rule by duplicating, and using the voltage scale already available. Because of this we have to sacrifice the extreme limits of the lower window scales, however the most useful range is included, and if values go out of the range, it is not difficult to interpret these results, as will be shown.

If two of the three quantities voltage, current or resistance are known, the third may be found by reference to the central window scales, and the upper of the lower window scales. It is immediately obvious that the upper of the lower window scales is to be used, due to the triangle symbol to the right. The familiar symbol reminds us that the upper quantity in the triangle is the product of the two lower quantities, and either of the lower quantities is the upper quantity divided by its adjacent lower quantity.

For a VIR relationship, given V, set V in the central window, and read off I or R opposite R or I respectively, in the upper two lower window scales. If V is unknown, set I and R to be adjacent in the lower scales, and read V in the central window. Let us take an example. What current will flow in 2kΩ to give a voltage of 20V?

Set 20V in scale R opposite the coloured "V" mark in scale Q, and read the answer, 10mA, in scale V, opposite 2kΩ in scale U.

Now to take an example where the value required is out of the limits of the scale. What voltage will 300μA develop across 40kΩ? Looking at scale V we see that 300μA is in the cycle to the left of the furthest left-hand cycle. Thus it cannot be placed adjacent to 40kΩ. Let us bear in mind that we are one cycle out, however, and set the value, ×10, opposite 40kΩ, i.e., set 3mA opposite the resistance value. We now read 120 volts in the central window. We now remember that the slider should really be one cycle to the right, therefore we see that if this was so, the "V" mark would then be pointing to 12V, i.e., $120V \times 10^{-1}$, and 12V is the required answer.

AN ALTERNATIVE

An alternative method of evaluation would have been to multiply the current and resistance out on the L and M scales, however, the previous method requires even less effort to fix the magnitude of the voltage answer.

The central window is now used in conjunction with the lower of the two lower window scales, in exactly the same way as previously described for VIR relationships. In the previous case one reciprocal scale was used, and in this case, two are used, so always check, when reading off a value, which way the scales are going, thus ensuring that you are not a factor of 10 out in your answer. Let us consider the following. Find the power dissipated in a load, when the load current is 80mA, and the voltage developed across it is 5V. Set 5V in scale R, and read off answer, 400mW, in scale X, opposite 80mA in scale W.

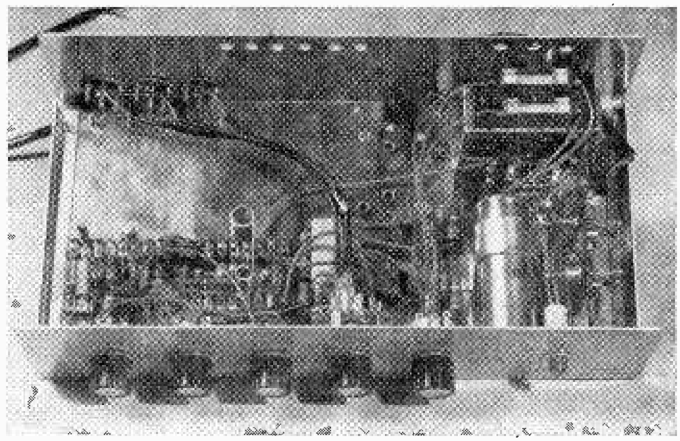
A further example of "off-the-scale" procedure. Find the power dissipated in a load with 25V developed across it, with a current of only 1·5μA. Setting the rule to 25V shows at once that the current is well off the rule in scale W, and so is the power. The factor of the power answer beyond the limits of the rule will be the same as that of the current reading, so approach the problem in this way. We see that, for a current of 15mA, the power is 375mW. Now, $15mA = 1{\cdot}5\mu A \times 10^4$, therefore multiply the power at this higher current by 10^{-4}, giving $375mW \times 10^{-4}$, or 37·5μW, the correct answer.

It will be appreciated that this latter example is an extreme case, and not a very likely calculation. Most calculations should fall within the scale limits of the rule, and it will be seen that the lower window scales have been extended out as far as possible to ensure this.

If the reader has followed these last three articles on the use of the rule, he should now be able to make full use of the rule, and be more than ready to make good use of a conventional slide rule. Next month, the final article in this series gives some practical examples of the Data Rule in use, thus displaying some of its potential uses.

To be continued

ADAPTABLE LOW COST hi-fi SYSTEM



W. CAMERON PART 3

THE BASIC AMPLIFIER DESCRIBED IN PREVIOUS ISSUES IS USED TO DRIVE A HIGH POWER OUTPUT STAGE

TWO methods of driving power transistors suggest themselves. Firstly the driver amplifier could be modified so that direct coupling could be used, driving from the emitter of Tr3 and collector of Tr4 into the bases of the power transistors.

This method is widely used and works very well. Its main disadvantage as far as the writer is concerned is the unbalanced drive conditions between the driver and output transistors.

The second method, and the one adopted, is to use a driver transformer as coupling. This maintains the balance between each half of the push-pull stages.

The general disadvantages of transformer coupling are those of poor frequency response due largely to leakage inductance, and distortion and losses associated with magnetisation of the core.

The leakage inductance can be overcome by using very close coupling between windings, in this case by winding primary and secondaries together, so that the turns of each winding lie side by side. Magnetisation of the core is avoided by keeping d.c. from the primary. The coupling capacitor C6 serves as isolation to this end. The small currents in the secondaries are of no consequence as they are opposed, the two secondaries being out of phase.

Because there are no magnetising currents in the windings, and because the driving power required by the output transistors is in the order of only tens of milliwatts, the driver transformer can be quite small. Originally the transformer was made up from a discarded output transformer from a transistor radio. This had a centre core of approximately $\frac{3}{8}$in. square section. It was stripped and rewound with three strands of 15 yards each 30s.w.g. enamelled wire, i.e. trifilar wound.

If the wire is wound reasonably evenly it will go on to the coil former comfortably and will total about 180 turns.

The three "starts" are brought out on one side of the transformer, and the three "finishes" on the other, so that there is no danger of mixing up the phasing of the windings.

The efficiency of a transformer depends largely on the core material, and it was suspected that in this transformer the core might be of doubtful quality. A simple test on its power transfer indicated an efficiency of 75%, with a slight fall off at the extremities of the audio range, at 30c/s and 20kc/s.

An identical transformer was made up on a Unisil core. This showed an efficiency of 90% over the entire audio range.

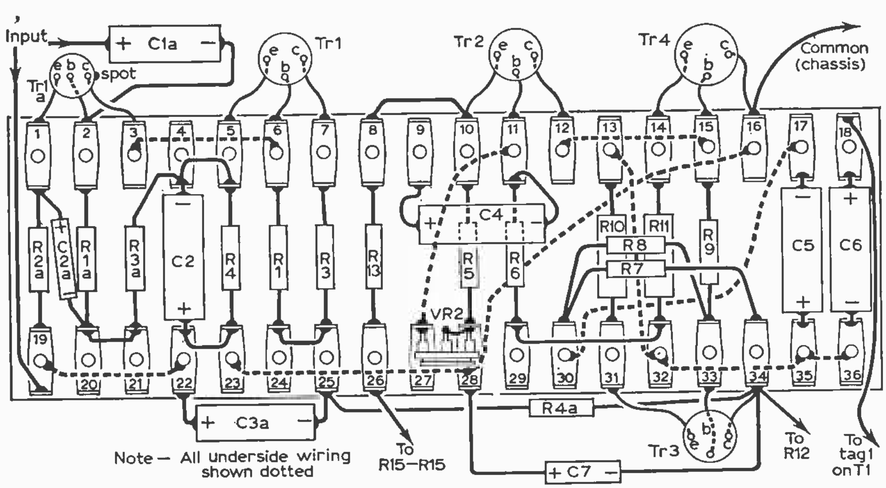


Fig. 10: Tagboard wiring when the basic unit is used to drive a high power output stage.

Although this core is specified, the results with the original are quite acceptable in practice. This is mentioned so that the experimenter with a junk box full of old transformers will not be deterred if cost is to be a consideration.

It is usual when developing an amplifier to start from the output and work towards the front end. But in this case we already have the driver amplifier, to two problems immediately come to mind.

The first, the method of coupling the driver

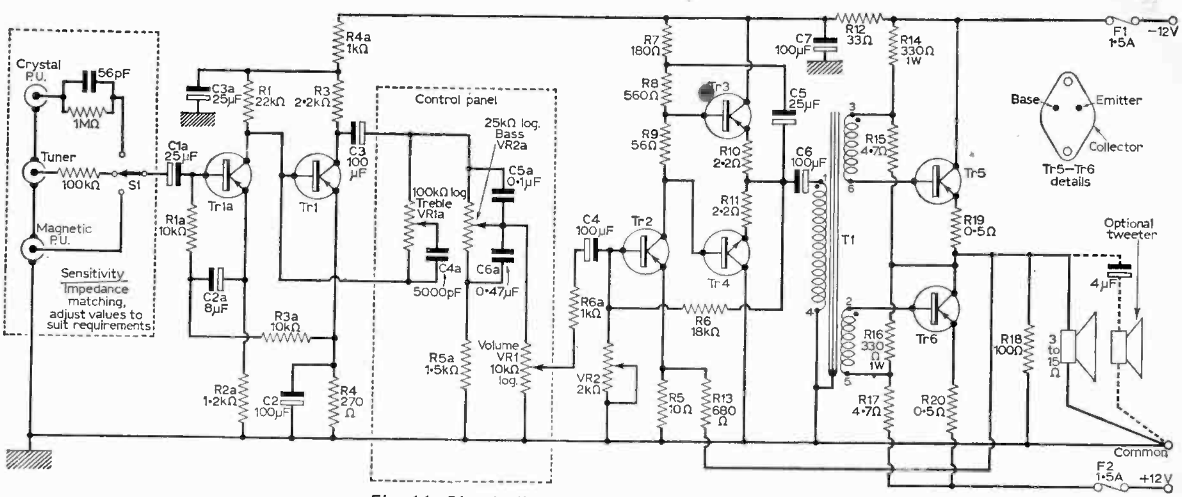


Fig. 11: Circuit diagram of the complete amplifier.

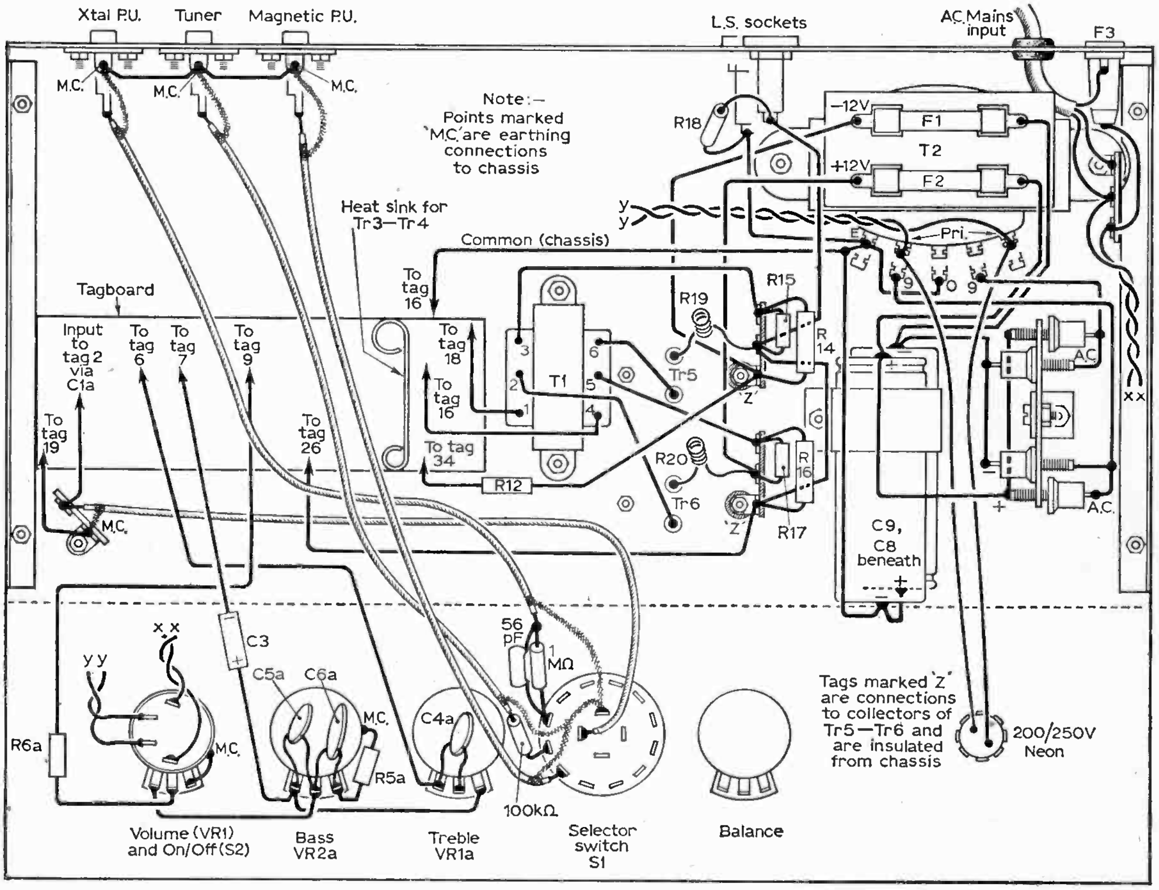


Fig. 12: Chassis details. Before mounting Tr5 and Tr6 refer to notes on insulation in text.

to the power transistors. The method adopted of using a transformer proves to be a good choice as the driver will work well into any load impedance, and also, because adequate drive is available, it is unnecessary to consider the optimum primary impedance, a point which simplifies the design and winding of the transformer.

The second, the h.t. required for the driver amplifier is only 12V, whereas for a reasonable power output the h.t. for the power amplifier should be not less than 24V. To meet this requirement the h.t. supply is centre tapped, the centre tap is taken to chassis so providing a 12V negative line and a 12V positive line with respect to chassis. This has the advantage that as the junction of the two power transistors will be at zero potential, the speaker is simply returned to chassis without the need of a coupling capacitor.

Another word about the driver transformer will not be amiss. When the amplifier is driving a 15Ω speaker, the load imposed on the driver via the transformer primary is about 100Ω, and 50Ω when driving a 3Ω speaker. As mentioned previously, this will not trouble the driver because of its good output regulation. The increased drive requirement for a 3Ω load is met by an automatic reduction in negative feedback through the loop via R13. It might reasonably be supposed that the advantage of negative feedback would be nullified by phase lag in the driver transformer. However, phase lag is only apparent above 20kc/s and the circuit is stable up to about 100kc/s. R6a acts as a stopper, and prevents h.f. instability which might occur when the volume control slider is at the earthy end. It also serves as a means of raising the input impedance of Tr2 to avoid severe damping of the tone controls when the volume control is at maximum.

Because of the relatively high impedance of the driver transformer, a coupling capacitor of 100μF is sufficient for C6.

CONSTRUCTION

Most constructors will no doubt have their own ideas of layout to suit their particular requirements, but the layout should be logical. For example the placement of driver transformer and output transistors should be physically like that shown in the circuit diagram. For the amplifier to come back on itself so that the output is near the input would be asking for trouble.

The output transistors can each be mounted directly on their own heat sinks, insulated from the chassis and from each other. The heat sinks in this case can be of blackened aluminium 3in. square (or 9 sq. in. of any shape). Alternatively if a regular aluminium chassis type of construction is to be used, the transistors may be bolted to the chassis and insulated with the special mica insulators and bushes made for this purpose. The insulators should be smeared with silicone grease. The bushes are required for *all* mounting nuts and bolts (only two are shown with bushes in Fig. 12).

The 0·5Ω emitter resistors for the output pair were each made from 18in. of 22s.w.g. enamelled eureka wire. The wire is doubled to make a 9in. length with its two ends coming together, and wound on a 1/16in. rod. Removed from the rod it becomes a self-supporting, reasonably non-inductive resistor. The two ends are tinned and formed to fit conveniently into the circuit.

The speaker is not returned to the actual chassis, but to the common in the power supply, i.e. the junction of the two smoothing capacitors. This will avoid distortion which might otherwise be caused by the presence of high peak currents in the chassis and which can result in spurious feedback to earlier stages.

As might be expected, because the driver does not have to deliver its full output to fully drive the output pair, the overall sensitivity has increased. 10mV r.m.s. into the input will now drive the amplifier to full output.

★ components list

Resistors:

R1a	10kΩ	R8	560Ω
R2a	1·2kΩ	R9	56Ω (see text)
R3a	10kΩ	R10	2·2Ω
R4a	1kΩ	R11	2·2Ω
R5a	1·5kΩ	R12	33Ω
R6a	1k	R13	680Ω
R1	22kΩ	R14	330Ω 1 watt
R2	Basic amp. only	R15	4·7Ω 1%
R3	2·2kΩ	R16	330Ω 1 watt
R4	270Ω	R17	4·7Ω 1%
R5	10Ω	R18	100Ω
R6	18kΩ	R19	0·5Ω
R7	180Ω	R20	0·5Ω

All 10%W unless otherwise stated.

Capacitors:

C1a	25μF electrolytic
C2a	8μF electrolytic
C3a	25μF electrolytic
C4a	5,000pF paper or polyester
C5a	0·1μF paper or polyester
C6a	0·47μF paper or polyester
C1	Basic amp. only
C2	100μF electrolytic
C3	100μF electrolytic
C4	100μF electrolytic
C5	25μF electrolytic
C6	100μF electrolytic
C7	100μF electrolytic
C8	5,000μF electrolytic
C9	5,000μF electrolytic

All electrolytics 15V min. wkg.

Potentiometers:

VR1a	100kΩ log	VR1	10kΩ log
VR2a	25kΩ log	VR2	2kΩ skeleton pre-set

Semiconductors:

Tr1a	OC45	Tr1	2G371
Tr2	2G371 } Package		
Tr3	2G381 } Package		
Tr4	2G339 } Package		
Tr5	OC26 or OC28 } pair		
Tr6	OC26 or OC28 } pair		

Miscellaneous:

T1 Made up on a Unisil core. Type GN Core Kit—Unisil—Belclere.

T2 Mains trans. Sec. 9-0-9, or 10-0-10 volts at 2 amps.

Rectifier: STC FSX 1733 (18V). Radiospares Rec. 20 or 4 x 1 amp 50 p.i.v. silicon (18V or 20V) e.g. Mullard BYX22-200

Group panel Radiospares 18 way.

Miniature mains neon. F1 and F2 1·5A, F3 200mA.

However, this will not materially affect the value of the impedance raising series resistors discussed in the pre-amplifier section last month. If there is any doubt about the value of input series resistors that should be used, it is best to start with a higher value than thought necessary and reduce it until the optimum is reached.

—*continued on page 769*

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MARCONI SIGNAL GENERATOR TYPE TF 801B/3/S. Frequency range 12-485 Mc/s. in five ranges. Directly calibrated frequency dial. Output waveform: C.W. sinewave A.M., pulse A.M. (from ext. source only). Internal modulation frequency 1,000 c/s. Output: a, normal—continuously variable directly calibrated from 0.1µ v.—0.5 v. b, high: up to 1 v. modulated or 2 v. unmodulated, output impedance 50 ohms. Fine frequency tuning control, carrier on/off switch, built-in crystal calibration for 2 Mc/s and 10 Mc/s. Stabilised voltage supply. In excellent "as new" condition. Fully checked and guaranteed. **£115.** Carr. 30/-. Including necessary connectors, plugs and instruction manual.

FIELD TELEPHONES TYPE "F" housed in portable wooden cases. Excellent for communication in- and out-doors for up to 10 miles. For pair including batteries and 1/6th mile field cable on drum. **£5.10.0.** Carriage 10/-.

TELEPHONE HANDSET. Standard G.P.O. type; new 12/-. P. & P. 2/-.

"S" Meter for H.R.O. Receivers. Brand new **£2.10.0.** Carriage paid U.K.

CRYSTALS for H.R.O. In original National Union Housing. 25/-. P. & P. 2/-.

VARIOMETER for No. 19 sets, **17/6.** P. & P. 3/-.

LABORATORY TYPE VOLTMETERS. 160V AC/DC 3" mirror Scale in wooden boxes, 9¼" x 8¾" x 3¼" with carrying handle, new, **32/-.** P. & P. 3/-.

ALL TEST & COMMUNICATION EQUIPMENT has been thoroughly prepared in our Laboratories by fully qualified Electronic Engineers.

SIGNAL GENERATOR TYPE TS 418. Signal frequency 100–1,000 Mc/s. direct calibration. Pulse rate 40–400 c (X1 or X10), pulse delay variable, less than 3µsec. to more than 300µsec. Pulse width variable less than 1µsec. to more than 10µsec. Polarity internal or external sources, positive or negative pulses. AM and CW. Output attenuator 0·2µV to 200mV continuously variable. In fully tested condition, **£150.** Carriage paid.

Meters. 4¼" x 4¼" x 4" long mirror scale panel mounted, calibrated 0–1mA, **55/-.** P. & P. 3/-.

29/41ft. AERIALS each consisting of ten 3ft. ⅞in. dia. tubular screw-in sections. 11ft. (6-section) whip aerial with adaptor to fit the 7in. rod, insulated base, stay plate and stay assemblies, pegs, reamer, hammer, etc. Absolutely brand new and complete ready to erect, in canvas bag. **£3.9.6.** P. & P. 10/6.

MINIATURE METERS. General Electric 1½" round flush, clip mounted. 1mA DC **22/6**; 25mA DC **20/-**; 75mA DC **18/-**; 150mA DC **16/-.** P. & P. 3/-.

MARCONI SIGNAL GENERATOR TYPE TF144G 85 Kc/s-25 Mc/s. Excellent laboratory tested condition with all necessary accessories with instruction manual. **£45.** P. & P. 15/-.

BOONTON STANDARD SIGNAL GENERATOR MODEL 80. Frequency 2–400 Mc/s in six ranges. AM 400 and 1,000 c/s and external modulation. Provision for pulse modulation. Piston type attenuator, 0·1µV-100mV. Separate meter for modulation level and carrier level. Precision flywheel 117V AC input with instruction manual. **£95.** Carriage 30/-.

SUB MINIATURE "PENNY" SIZE METERS. 1" round, flush, ring nut mounted 500 mA FDS, Calibrated 0–1 mA, **20/-.** P. & P. 3/-.

INSET MICROPHONE for telephone handset **2/6.** P. & P. 2/-.

RADIO FREQ.: THERMOCOUPLE METERS

350mA	2" round plug-in	14/6
1 Amp	2½" round proj.	17/6
1 Amp	2¾" square panel	22/6
5 Amp	2" round panel	17/6

P. & P. 3/- each

DC MOVING COIL METERS

0–5µA	2½" round proj.	25/-
200µA	2" round panel sealed Calibre-30	22/6
750–0–750µA	2" round plug-in	20/-
1mA	2½" round clip fix, metal clad	27/6
1MA	2½" round panel	30/-
1mA	2" round panel sealed	27/6
5mA	2" round clip fix panel or proj.	20/-
5–0–5mA	1½" round panel	17/6
10–0–10mA	2½" round panel	17/6
0–30mA	2½" round panel	17/6
10mA	2¾" square panel	25/-
25mA	2¾" square panel	25/-
50mA	2¾" square panel	25/-
75mA	2½" plug in	14/-
100mA	1½" proj.	17/6
100mA	1½" round panel	17/6
100mA	2½" round panel	19/-
100mA	3½" round panel	25/-
2 Amp	2½" round panel	22/6
5–0–5 Amp	2½" round panel	25/-
8 Amp	2½" round panel	25/-
25 Amp	3½" round proj.	27/6
50 Amp	2½" round panel	27/6
20 VDC	2" square panel	19/-
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1·5kV with res.	2" round panel	27/6
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WHEATSTONE BRIDGE. American made. Measures 0·001Ω to 10MΩ with internal galvanometer. **£27.10.0.**

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CRYSTAL CONTROLLED CONVERTER

L. CASE

As we once more approach the sunspot maximum the 10-metre amateur band is beginning to show signs of life and under suitable propagation conditions distances of several thousand miles can be covered using only very low power transmitters. Unfortunately many receivers in present use either do not cover the band at all or suffer from poor sensitivity and/or stability at these higher frequencies. A suitable solution to this problem is the use of a crystal controlled converter in front of the main receiver which is then utilised as a tunable i.f./a.f. amplifier on one of its lower frequency ranges. On account of the very high stability of the crystal-controlled oscillator used in the converter the final stability over the 28 to 29·7Mc/s range will depend solely upon the main receiver's freedom from drift over the i.f. range used, and should be chosen with this in mind. Another point to be considered when selecting the i.f. is the problem of i.f. breakthrough. A good test is to remove the receiver's aerial and tune over the i.f. range, when very few or, better still, no signals should be heard. The i.f. used in the converter to be described is 2·05 to 4·05Mc/s for 28 to 30Mc/s reception but other ranges can be used and details will be given to enable suitable modifications to be carried out.

From Fig. 1 it will be seen that signals are fed from the aerial to L1; which is tuned by VC1a, and then coupled via the base coupling link to transistor Tr1. After amplification the signal is fed via coil L2; tuned by VC1b, to the base of the mixer transistor Tr2. Also fed to the mixer transistor, this time via the emitter, is the output from the crystal controlled oscillator which is operating on a frequency of approximately 25·95Mc/s. The difference frequency (in the range 2·05 to 4·05Mc/s) is extracted from the collector of transistor Tr2, and fed to the aerial and earth sockets on the main receiver via a short length of coaxial cable.

The converter is most easily constructed in three stages commencing with the crystal oscillator and working back towards the aerial, making sure that each section operates successfully before commencing the next. The output from the crystal oscillator can be monitored on the main receiver, or detected by means of a suitable wavemeter tunable around 26Mc/s, and peaked for maximum output by means of the iron dust core of L3. To set up the mixer and r.f. sections the main receiver should be set to about 3·1Mc/s and a 29Mc/s signal coupled loosely to L1 or L2 adjusting the appropriate cores and trimmers for maximum signal strength. This procedure should be carried out with VC1 set at half capacity.

Other i.f. ranges are possible and are achieved merely by changing the quartz crystal, which incidentally is operating on its third harmonic. Small changes would

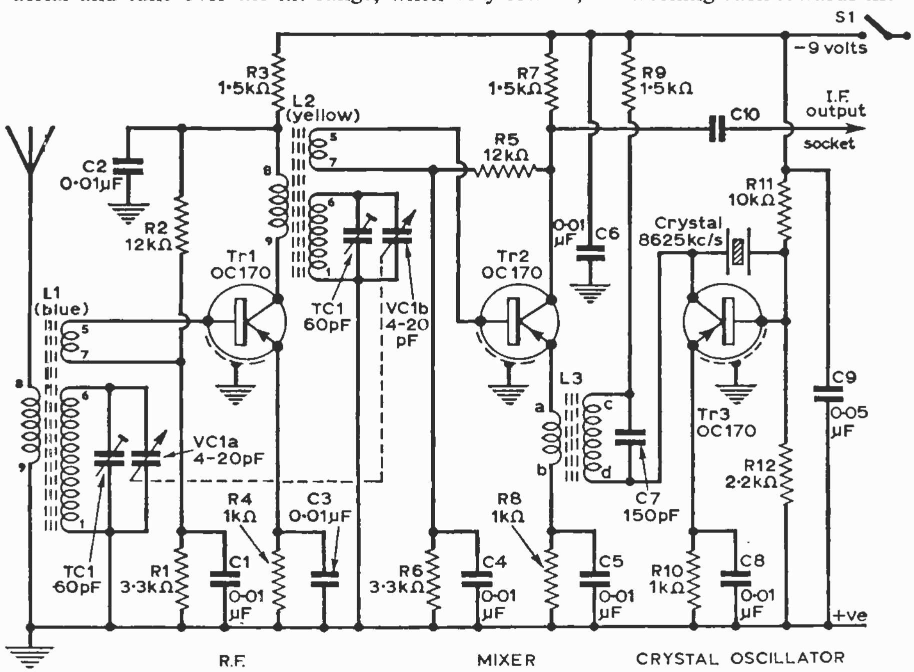
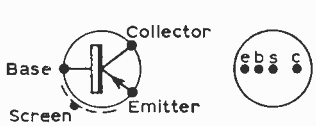
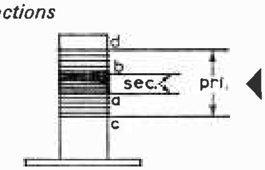


Fig. 1 (above): Theoretical circuit of the converter.

Fig. 2 (below): Transistor base connections



Connections for OC170, OC171

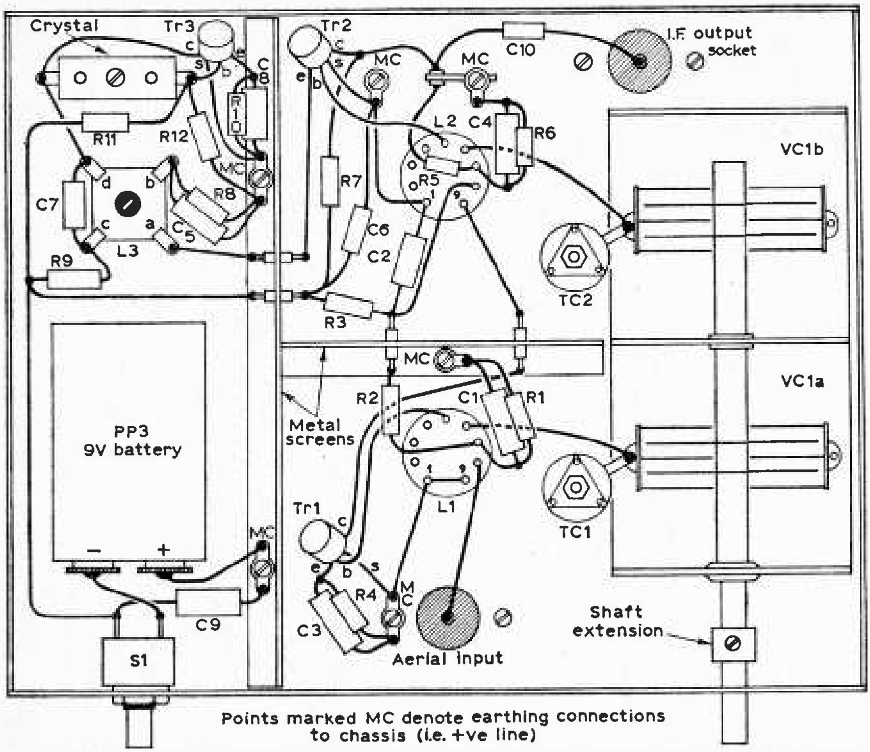


Details for winding L3

COIL WINDING DETAILS (L3)

Primary c d:
12 turns 24 s.w.g. enamelled copper wire, close wound on 0·3in. diameter coil former, with iron dust core.

Secondary a b:
4 turns 24 s.w.g. enamelled copper wire, wound over primary winding.



Points marked MC denote earthing connections to chassis (i.e. +ve line)

Fig. 3: Component layout and wiring details.

entail no circuit alterations only a variation in the position of the L3 core, whilst larger changes would require adjustment of the value of C7. For a 1·8 to 3·8Mc/s i.f. a crystal having a fundamental frequency of approximately 8,773kc/s would be required providing output from the oscillator at about 26·2Mc/s; only slight adjustment of the L3 core being necessary. For a 7·6 to 9·6Mc/s i.f. a 6,800 kc/s crystal should be used providing an output from the oscillator at 20·4Mc/s. In this case C7 would have to be increased to 200pF.

All wiring should be in insulated wire or tinned copper wire covered with Systoflex. Where leads are shown in the wiring diagram (Fig. 3) passing through metal dividing panels—simply drill an oversize hole —*do not* use lead through capacitors for this purpose.

All components are mounted and wired inside an Eddystone diecast box with two screens separating the r.f. mixer and oscillator stages. Each stage is centred around its own tuning coil, all earth returns being made to the box walls via solder tags held by 6BA nuts and bolts. Coaxial sockets are used for both the aerial input and i.f. output terminations. ■

★ components list

Resistors:

R1	3·3kΩ	R7	1·5kΩ
R2	12kΩ	R8	1kΩ
R3	1·5kΩ	R9	1·5kΩ
R4	1kΩ	R10	1kΩ
R5	12kΩ	R11	10kΩ
R6	3·3kΩ	R12	2·2kΩ

All 10% $\frac{1}{4}$W unless otherwise stated.

Capacitors:

C1 0·01μF ceramic
C2 0·01μF ceramic
C3 0·01μF ceramic
C4 0·01μF ceramic
C5 0·01μF ceramic
C6 0·01μF ceramic
C7 150pF silver mica
C8 0·01μF ceramic
C9 0·05μF ceramic
C10 50pF silver mica
TC1, TC2 3–30pF concentric trimmers
VC1 Twin gang 20/25pF max. (Jackson type 0)

Semiconductors:

Tr1, 2, 3 OC170 or OC171

Inductors:

L1 DENCO transistor type BLUE RANGE 5
L2 DENCO transistor type YELLOW RANGE 5
L3 See table 1

Miscellaneous:

8625kc/s xtal type FT243 with holder, Eddystone diecast box $4\frac{11}{16}$ x $3\frac{11}{16}$ x $2\frac{1}{16}$in. S1 single pole on/off, battery clips, PP3 battery, two co-ax sockets, nuts, bolts, solder tags etc.

DE LUXE PLAYERS

4-Speed Mono Players 2-tone Cabinets 17 × 15 × 8½in. High flux loudspeaker and High Quality Amplifiers ready built. Quality output. Volume and Bass controls. Special instructions enable assembly in 30 minutes, only 5 wires to join. 12 months' guarantee.

TO BUILD YOURSELF

Post 2/6 per item.

PORTABLE CABINET As illustrated. To fit standard player or autochanger. **69/6**

RCS AMPLIFIER 3 WATT. Ready made and tested with UCL82 triode pentode valve and loudspeaker. **59/6**

SUPERIOR AMPLIFIER. Ready made and tested. Guaranteed better sound! Fully isolated AC Mains Transformer 4 watt output. ECL86 triode pentode valve. Volume and tone controls with knobs. Quality Loudspeaker. **89/6**

SINGLE PLAY MONO		AUTOCHANGE MONO	
BSR TU9	£3.7.6	BSR Superslim	£5.19.6
Garrard SRP22	£4.19.6	Garrard 1000	£5.19.6
Garrard SP25	£10.19.6	Garrard 2000	£6.19.6
Philips AG1016	£12. 9.6	Garrard 3000	£8. 9.6
Garrard A.70	£14.19.6		
Garrard LAB80	£24.19.6		
Garrard 401	£29.19.6		

All with mono LP/78 cartridge

GARRARD TEAKWOOD BASE WB.1. Ready cut for mounting 1000, 2000, 3000, SP25, AT60. **75/-**
GARRARD PERSPEX COVER SPC.1 for WB.1 58/-

A.18 TRANSCRIPTION TONE ARM with template and two plug-in shells. OUR PRICE **90/-** Decca Deram Stereo Diamond Cartridge £4.10.0 extra or Stereo Moving Coil Diamond 20–18,000 cps £5.5.0. extra.

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key
⅜in.14/6 ⅝in. 15/9 1⅛in. 18/- 1½in.20/6 $2\frac{3}{32}$in. 37/9
½in.14/9 1in. 18/- 1¼in. 18/6 1¾in.22/6 2½in. 44/3
¾in.15/6 $1\frac{1}{16}$in.18/- 1⅜in. 20/- 2in. 34/3 1in. sq. 31/6

ACOS XTAL, GP67, 15/-. PICK-UP ARM complete with ACOS LP-78 Turnover Head and Styli 20/-.
SPEAKER FRET Tygan various colours, 52in. wide, from 10/- ft.; 26in. wide from 5/- ft. SAMPLES S.A.E.
EXPANDED METAL Gold or Silver 12 × 12in. 6/-.

FULL WAVE BRIDGE CHARGER RECTIFIERS:
6 or 12 v. outputs, 1½ amp., 8/9; 2 a. 11/3; 4 a., 17/6.
CHARGER TRANSFORMERS. P. & P. 2/6. Input 200/250 v. for 6 or 12 v., 1½ amps., 17/6; 2 amps., 21/-; 4 amps., 25/-.

MOVING COIL MULTIMETER TK 25. 0-1,000v. A.C./D.C., ohms 0 to 100k. etc., **47/6**
MOVING COIL MULTIMETER EP10K. 0-1,000v. A.C./D.C., ohms 0 to 3 meg. etc., **79/6**
MOVING COIL MULTIMETER EP20K. 0-2,500v. D.C. 20,000 ohms per volt. 0-1,000v. A.C. Ohms 0 to 6 meg. 50 Microamps (Full list Meters S.A.E.) **99/6**

NEW MULLARD TRANSISTORS

OC71 6/-; OC72 6/-; OC81D 6/-; OC81 6/-; AF115 8/-; AF114 8/6; OC44 6/-; OC45 6/-; OC171 6/-; OC170 6/-; AF117 6/-; OC26 12/6; AD140 15/-; OC35 15/-; Holders 1/-.

REPANCO TRANSISTOR TRANSFORMERS
TT45. Push Pull Driver. 9:1 CT. OC71, OC81D .. 6/-
TT46. Push Pull Output. CT 8:1. OC72, OC81 .. 6/-
TT49. Interstage etc. 4·5:1 5/- TT52. Output 3 ohms. 20:1 5/-

TRANSISTOR MAINS ELIMINATORS. FAMOUS "POWER MITE". 9 VOLT. SAME SIZE AS PP9 BATTERY. FULLY SMOOTHED. 150mA. FULL WAVE CIRCUIT. **45/-**
SPECIAL 9 VOLT 500mA POWER PACK........ 49/6

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RA2W 6 in. Ferrite Aerial with car aerial coil	12/6	Spare Cores	6d.
Osc. P50/1AC	5/4	Driver Trans. LFDT4	9/6
I.F. P50/2CC 470 kc/s	5/7	Printed Circuit, PCA1.	9/6
3rd I.F. P50/3CC	6/-	J.B. Tuning Gang	10/6
		Weyrad Booklet	2/-

Telescopic Chrome Aerials 6in. extends to 23in. 5/-.

VOLUME CONTROLS
Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-. STEREO L/S 10/6. D.P. 14/6.

80 Ohm Coax 6d. yd.
Semi-air spaced Cable 100 yd. drum 50/- post free.
FRINGE LOW LOSS Ideal 625 lines yd. **1/6**

COAXIAL PLUG 1/-. PANEL SOCKETS 1/-. LINE SOCKETS 2/-. OUTLET BOXES, SURFACE OR FLUSH 4/6. BALANCED TWIN FEEDERS 1/- yd., 80 or 300 ohms. CAR AERIAL PLUGS 1/6; SOCKETS 1/3; LINE SOCKET 2/-

EAGLE SA200 INTEGRATED STEREO AMPLIFIER

7½ watts per channel. Inputs for gram, tape, tuner, mike, aux. tape output socket. Separate volume controls for each channel. Separate bass and treble controls. Stereo/Mono selector. Stereo headphone socket. Impedance. 4, 8 or 16 ohms. STILL ONLY **£25** POST FREE

THE E.A.R. RECORD PLAYER CABINET
Strongly built wooden cabinet covered in Blue and Grey leathercloth. Size 15 × 17 × 8in. Motor Board 14½ × 12½in. ready cut out for B.S.R. Monarch UA12/14/15/16/25 decks. Gilt fittings, strong carrying handle. Amplifier space size 14 × 7 × 3in. is completely enclosed. The baffle board is cut out for a 6½in. dia. speaker. Post 5/6. **59/6**

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350 v.	2/3	100/25 v.	2/-	8/600 v.	9/6
4/350 v.	2/3	250/25 v.	2/6	16/600 v.	12/6
8/450 v.	2/3	500/25 v.	4/-	16+16/500 v.	7/6
16/450 v.	3/-	8+8/450 v.	3/6	32+32/450 v.	6/-
32/450 v.	3/9	8+16/450 v.	3/9	50+50/350 v.	7/-
25/25 v.	1/9	16+16/450 v.	4/3	60+100/350 v.	11/6
50/50 v.	2/-	32+32/350 v.	4/6	100+200/275 v.	12/6

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250 mfd. 15v. 2/6; 500, 1000 mfd. 12v. 3/6; 2000 mfd. 25v. 9/6.
CERAMIC. 500 v. 1 pF. to 0.01 mfd., 9d. Discs 1/-.

PAPER TUBULARS
350v.-0.1 9d., 0.5 2/6; 1 mfd. 3/-; 2 mfd. 150v. 3/-.
500v.-0.001 to 0.05 9d.; 0.1 1/-; 0.25 1/6; 0.5 3/-.
1,000v.-0.001, 0.0022, 0.0047, 0.01, 0.02, 1/6; 0.047, 0.1, 2/6.
E.H.T. CONDENSERS. 0.001 mfd., 7kV., 6/6; 20kV., 10/6.

SILVER MICA. Close tolerance (plus or minus ½ pF.), 5 to 47 pF., 1/-; ditto 1% 50 to 800 pF., 1/-; 1,000 to 5,000 pF., 2/-.
TWIN GANG. "0-0" 208 pF. +176 pF., 10/6; 365 pF. miniature 10/-; 500 pF standard with trimmers, 9/6; 500pF. midget less trimmers, 7/6; 500 pF. slow motion, standard 9/-; small 3-gang 500 pF. 18/9. Single "0" 365 pF. 7/6. Twin 10/-.
SHORT WAVE. Single 10 pF., 25 pF., 50 pF., 75 pF., 100 pF., 160 pF., 5/6 each. Can be ganged. Couplers 9d. each.
TUNING. Solid dielectric. 100 pF., 300 pF., 500 pF., 3/6 each.
TRIMMERS. Compression ceramic 30, 50, 70 pF., 9d.; 100 pF., 150 pF., 1/3; 250 pF., 1/6; 600 pF., 750 pF., 1/9.

250v. RECTIFIERS. Selenium ½ wave 100mA 5/-; BY100 10/-.
CONTACT COOLED ½ wave 60mA 7/6; 85mA 9/6.
Full wave 75mA 10/-: 150mA 19/6; T.V. rects. from 10/-.

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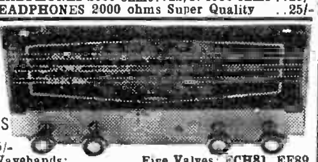
HEATER TRANS. 6.3 v. 1½ a., 8/6; 6.3 v. 4 a.	12/6
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp.	12/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a.	30/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60,	35/-

AUTO TRANSFORMERS 0-115-230 v. Input/Output, 60w. 18/6; 150w. 30/-; 500w. 92/6; 1000w. 175/-.

CRYSTAL MIKE INSERTS
1½ × ⅜in. 6/6; ACOS 1⅜ × ⅜in. 8/6. ACOS 39. 1in. dia. 12/6
MOVING COIL MIKE with Remote Control Switch..19/6

ALL PURPOSE HEADPHONES
LOW RESISTANCE HEADPHONES, 3-5 ohms. 25/-
H.R. HEADPHONES 2000 ohms..12/6. 4000 ohms..15/-
H.R. HEADPHONES 2000 ohms Super Quality ..25/-



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ALUMINIUM PANELS 18 s.w.g. 12 × 12in., 5/6; 14 × 9in., 4/6; 12 × 8in., 3/6; 10 × 7in., 2/9; 8 × 6in., 2/- 6 × 4in., 1/6.

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200/250 v. A.C. Leaflet S.A.E. Post 2/6. **35/-**

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15" BAKER WOOFERS

20-10,000 cps. Bass Resonance 18-25 cps. Massive Ceramic Ferrobar Magnet. Flux density 15,000 lines. Rated 20 watts. 15 ohms. Overall depth only 6½in. Weight 15lb.

Made to sell at $60

OUR PRICE **£11.19.6** Carriage, packing and insurance 10/6.

'Group 25'	'Group 35'	'Group 50'
12in. 25w. **5 gns.**	12in. 35w. **8½ gns.**	15in. 50w. **18 gns.**

"BONDACOUST" Wadding for Cabinet lining 15/- sq. yd.

E.M.I. Cone Tweeter 3½" square. 3-20kc/s. 10w. 17/6.
Quality Horn Tweeters 2-18kc/s. 10w. 27/6. Crossover 14/6
LOUDSPEAKERS P.M. 3 OHMS. 2½in., 3in., 4in., 5in., 7in. × 4in., 15/6 each 8in. 22/6; 6½in. 18/6; 10in. 30/-; 12in. 30/-; (15 ohms 35/-); 10 × 6in. 30/-; 8 × 5in. 21/-;
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practically wireless commentary by HENRY

No. 41

Ripe for development

AS we tentatively push the door open on 1968, ease our way through and kick it hard behind us on Quality and Reliability Year, we who call ourselves radio enthusiasts may be excused a twinge of trepidation. Are we due for an electronic revolution? Will the promised developments in integrated circuits, flip-chips, modular power supplies, thin-film magnetic stores, active aerials and homodyne techniques help us in our quest for better sound, better discrimination between wanted and unwanted signals, clearer and less "touchy" television pictures and true video recording?

"Why not?", says the eternal optimist within me. All of a sudden, the problems of '67 will resolve, the new devices will rush upon the market and redundant radio engineers will cushion themselves with Social Security as they subside into old age.

The scene is a typical suburban one-up, one-down on the fourth layer of a pedestrian annex. Mrs. Sparks has just donned her working apron, a silicone-treated radiation-proof mini-wafer, and pressed the button that operates the microwave oven. A subdued "ting" reminds Joe Sparks that it

Kick the door hard behind us.

is time he washed his hands. He slides them nonchalantly down the sides of his contoured chair and a jet-spray followed by a hot-air puff is activated as the capacity switch is energised.

As he begins to rise, the chair straightens and assists him to a balanced vertical position, resuming its cup-shaped readiness when Joe moves toward the nearer wall. The wall diffuses from soft green to bright pink, then blues into the ground-scene outside.

"Someone's coming", he announces, and with automatic response the outer door begins to open and the Welcome mat slides from its recess. There is a barely audible puff as the elevator rises to door level and ejects its white-coated occupant. Here, at least, things have not changed: across the newcomer's back rides the legend, "Whiz Radio".

He nods toward the nested shelves. *"Again?"*, he says. The marbled faces of the ornamental units answer him dumbly and he whips an inductive plate from a cache in his coat and brings picture and sound to life in one swift movement. Joe looks shamefaced. *"I let it burn out,"* he says. *"Left a book on it—the pages curled and—poof!"*

Poof indeed. The Whizkid raises an elegant eyebrow. *"Book?"* he says. Books, of course, are illegal. (Cf. Bradbury's *Fahrenheit 451*). All reading is done by cartridge insertion in a slot. Not cassette, except for those archaic magnetic recording devices. Nowadays, we emulsify film. Recording is a one-shot process. *"Use a cassette and cast it off"* was the slogan that went out with cigarette coupons.

"I'll have to report this," says Whiz. He uses the videophone, and swings it to register the room's interior and poor Joe's abashed face. Mrs. Sparks no longer cares, having wolfed both tablets of super-cooked dinner and injected herself with the digestive sugar-alcohol ration.

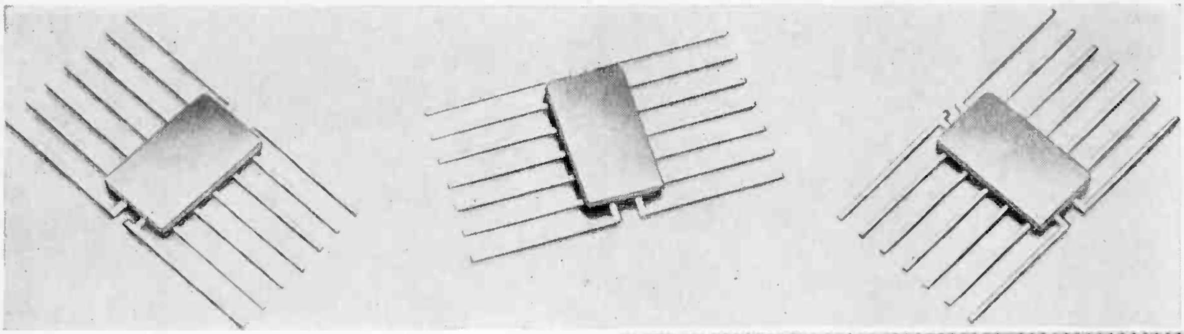
. . . assists him to a vertical position

The threat of the phone disconnection does not worry her. She long since switched over to "Conversational Robophone" for calling her friends. All titbits of scandal, selected by programmed register, are recorded and relayed. Except for the time when the Robo went wrong and chatted to one of its opposite numbers for two-and-a-half days, she has never had any electronic trouble.

There was a whisper, she remembers, that he and his trade would soon be redundant, just like Joe. Soon, computers would re-energise dud power supplies, rebuild I.C. blocks from basic material in the pre-formed walls as they failed. There had been talk of telepathic links having been established, needing no receptors except the human brain. It was not impossible; flying saucers were a myth only a short time ago. . . .

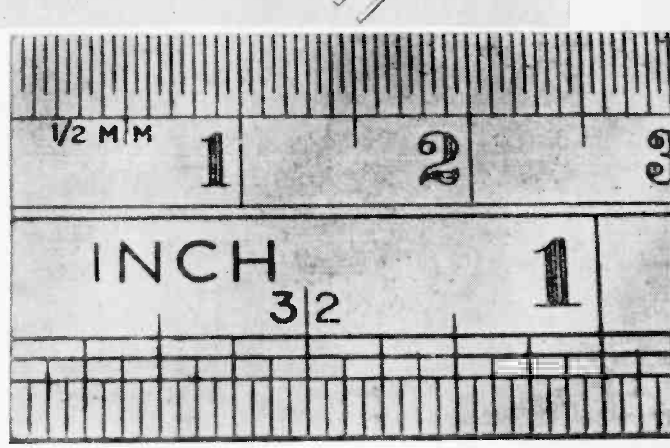
So she muses, and so Joe sulks, and so Mr. Whiz sweats on the threat of an automated future. As that door into 1968 creaks ajar, do we really need to worry?

No! Not so long, I submit, as someone like Mr. Robin Scott, Controller of BBC's Radio 1 and 2, advises those in pockets of poor reception: *"Try inserting a small length of wire in the aerial socket."* What socket???



THE MANUFACTURE OF INTEGRATED CIRCUITS

by D. CAMERON



THE story of integrated circuits is one of the most fascinating in the history of electronic devices. The I.C. represents the most challenging and fast moving area in the industry today, for as fundamental components of automation and instrumentation I.C.'s are the building blocks from which much of current and nearly all of future electronic equipment will be built. And, as regular P.W. readers are aware, they are already being used experimentally in home constructor projects.

Since the development of the I.C. is a relatively new process, it is now as good a time as any to run through the manufacturing methods, describing the basic principles involved. To this end, we visited the factory of a British manufacturer to obtain first-hand facts. And the one we selected was that of Mullard Ltd. at Southampton, which is claimed to be unique in being the first purpose-built semiconductor factory in the United Kingdom.

Mullard already has a £4M stake in integrated circuits and projected future investment approaches £15M, excluding buildings and development costs. The Southampton works has grown up with semiconductor technology and has bred a new type of worker, who has grown up with semiconductors and acquired a "feel" for the subject. Many of the engineering and production staff, in fact, have spent their whole working lives to date with semiconductors.

Production areas

The production areas for most processes are critical in respect of dust, temperature and humidity, and air locks are used extensively in access to the superclean rooms.

Amongst the types of I.C.'s being produced at Southampton are: FC range (DTL) of which 19 types are in production; FJ range (TTL) of which 10 types are in production; FK range (E2CL) with 6 types in production; 2 types of linear circuits and various customised I.C.'s.

The general procedure is to batch type numbers through the line. The early processes are generally common to all type numbers through successive stages of diffusion up to, perhaps, the ninth or tenth oven when specific type numbers are separated out for the processes which determine their final electrical characteristics. After the diffusion process there is further separation into temperature ranges and again further separation, in assembly, into the different types of encapsulation.

The basic slice of silicon used at Southampton is $1\frac{1}{2}$in. in diameter and will typically accommodate 600 circuits. The 2in. slice now being engineered and soon to be in production will accommodate 350 complete integrated circuits of the complex types such as a dual JK or a decade counter, or up to 1,000 simple gate circuits.

As many as 90 different production operations are required to manufacture an integrated circuit. As some of these operations each require several hours it will be appreciated why a silicon slice entering the production line may not emerge as a complete encapsulated fully-operational circuit for three weeks. If an individual circuit were to be "chased" through the line without regard to cost or convenience it would still take a working week to pass through every process!

The manufacturing process is in two broad phases, Diffusion and Assembly. Diffusion is a term loosely covering all stages from the basic slice of silicon to the finished slice carrying hundreds of completed circuits. Assembly includes separating the circuits from each other by breaking up the slice, adding connecting leads, encapsulating, finishing and labelling.

Diffusion

The number of operations in the diffusion process and their exact detail depend upon the type of circuit being manufactured but, in general, the early stages are common to all types. The following may be regarded as typical.

(1) A perfectly flat, polished, slice of p-type silicon, pre-doped (i.e. including a controlled amount of impurity) to a degree depending on the device type, is given a rigorous cleaning. This first stage is vitally important as any extraneous impurity will ruin every subsequent stage. Equally rigorous cleaning procedures are repeated after every major stage of production.

(2) The cleaned slice is oxidised by heating to a very high temperature in a furnace while wet oxygen is passed over the slice. This process produces a silicon oxide surface about 1 micron thick. The thickness of the oxide has to be accurately controlled as it must act as a mask through which "windows" will be formed at a later stage.

(3) The first photo-resist is applied. This is a light-sensitive material which is spun on in liquid form at high speed to form an absolutely even layer. No irregularities are acceptable. The slice with the photo-resist is then baked to dry out the solvents. Because the photo-resist is light-sensitive the process must be completed in minimal daylight. Yellow Perspex is used, for example, to filter out ultra-violet light and the slices awaiting, or being moved to, the next stage are kept in light-proof metal boxes.

(4) The slice with its photo-resist is exposed to the first mask under a high-intensity, ultra-violet light source. The mask is composed of 200—1,000 identical images, each being a precision micrograph of a meticulously drawn master transparency.

(5) The areas of the photo-resist which were unexposed by the mask are washed off with solvents using a spray technique. The exposed parts remain. The slice is then baked to dry off the solvents leaving a hardened layer of photo-resist bearing the mask pattern.

(6) The slice is etched in acid. Areas bearing photo-resist are unaffected but the acid will dissolve the silicon oxide in the non-protected areas and expose the silicon base.

(7) The remaining photo-resist is removed with acids and the slice washed, rinsed and dried. By this stage the slice has a pattern of circuits on it delineated by the presence or absence of silicon oxide.

(8) The slice is subjected to arsenic diffusion. High quality silica boats are used to carry the bulk quantity of slices in a furnace at a temperature of 1,200deg.C. in an atmosphere of arsenic vapour. Those areas of the slice not protected by an oxide coating will receive a diffusion of arsenic which penetrates the slice to a depth of about 2 microns.

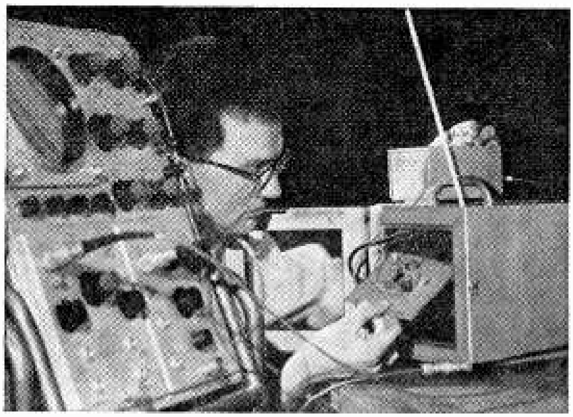
(9) The slices are removed from the capsule and placed in an open-tube furnace at atmospheric pressure for 16 hours at 1,200deg.C. This is the longest of the diffusion processes. The arsenic continues to move into the silicon slice but only at a slow rate. A penetration of about 7 microns is necessary. During this process a coating of silicon oxide forms over the slice.

(10) This stage grows an epitaxial layer on the "active" (i.e. patterned) side of the slice. The objective is to deposit an N-type silicon layer on the slice. Arsenic is used as the dopant in this grown layer. After etching off the silicon oxide with acid and a thorough wash, rinse and dry, the slice is laid flat, active side uppermost, in an epitaxial reactor. In the reactor the slice is heated to 1,100—1,200deg.C. while a gas containing (a) silicon tetrachloride and (b) arsenic pentachloride is passed over it. The result is that (a) provides a build-up of silicon on the slice and (b) gives the layer an N-type doping. The thickness of the epitaxial layer deposited is proportional to time in the furnace. A typical epitaxial layer will be 10 microns thick.

(11) The slice, basically of P-type material, now has a diffusion of N-type material in areas dictated by the first mask and an overall epitaxial layer of N-type material covering the whole of the active side of the slice. This stage is an oxidising process

Here, under very clean conditions, a high-precision camera is being used to photographically reduce a large scale drawing of an integrated circuit mask.

Bonding a silicon integrated circuit chip into a $\frac{1}{4}''$ x $\frac{1}{8}''$ flat pack.



Advanced linear integrated circuits have been used in this i.f. section of an experimental u.h.f. communications receiver designed by Mullard applications engineers. Here the performance of the i.f. section is about to be measured at high temperatures.

as in stage (2) to grow a layer of silicon oxide over the epitaxial layer. As before, the oxide coating will be about 1 micron thick.

(12) Processes (3) and (4) are repeated but this time using the second mask. The big problem in this stage is accurate registration of the second mask on the minute steps which can just be seen on the slice from the first mask and subsequent processes. Absolute alignment is essential. The present masking is to define those areas of the circuit which are to be electrically isolated from each other. After a repetition of processes (5), (6) and (7) the next stage can take place.

(13) This stage is a deposition of P-type material over the whole slice. Boron is a P-type material and the process involves heating the slice in an open-tube furnace while a gas containing boron vapour is blown through.

(14) The boron deposited in the previous stage is now diffused through the epitaxial layer. While the boron is being driven in, an oxide layer is formed over the slice which will leave a stepped layer which may be used to register the next masking process.

(15) Processes (3), (4), (5), (6) and (7) are again repeated, this time to open up "windows" for forming the bases of the transistors and the resistors in the circuit.

(16) This stage is known as the B and R (Base and Resistor) diffusion and is similar to the isolation diffusion which preceded it except that smaller quantities of impurities are used and the diffusion is shallower, typically 2 to 3 microns. The value of the resistors formed will depend on the shape of the resistor and the amount of boron diffused. Accurate control is possible.

(17) Processes (3), (4), (5), (6) and (7) are repeated, this time to open up "windows" for the emitter and collector.

(18) A phosphorous P-type deposition is made using the same techniques as in (13) but using a phosphorous source.

It is at this stage that production processes become more specific. The circuit could go forward immediately to phosphorous diffusion but if the transistors are to be fast-operating types a quantity of gold has to be diffused. In this case a layer of gold is evaporated on to the back of the slice.

(19) The circuit at this stage has a phosphorous deposit on the active side either with or without a gold layer on the non-active side. The gold, if used, will diffuse through the whole slice in the same time that the phosphorous will penetrate only 2 microns. Diffusion takes place as in earlier processes.

(20) The phosphorous diffusion completes the manufacture of the transistors and the boron has already formed the resistors in the circuit. It is still necessary, however, to gain access to the base, collector and emitter of each transistor and to the ends of the resistors for making the electrical connections and, finally, to wire all the circuit components together in the desired electrical configuration. This stage, then, goes once again through the now familiar processes of (3), (4), (5), (6) and (7) to open up all the connecting points of the individual components.

(21) A layer of aluminium is evaporated over the active surface. It is typically 1·5 microns thick and is in firm mechanical contact over the whole area.

(22) Stages (3), (4), (5), (6) and (7) are repeated using the final mask which delineates the interconnection pattern of the circuit. The surplus aluminium is etched away in the manner that silicon oxide was etched off in previous processes, but a different acid is used. The interconnection pattern remains.

(23) The final stage is to subject the slice to micro-alloying. This consists of high temperature baking in which the aluminium interconnections and terminations fuse together with the silicon to give low resistance and mechanically reliable joints. The maximum temperature is critical. Overheating will destroy the circuit.

Assembly

The assembly processes vary with the type of integrated circuit but with all types the principles are much the same. Testing is inextricably involved in the assembly process and some representative tests are mentioned here. Others are dealt with in a separate section.

The following stages of assembly are typical for a device in a flat-pack encapsulation. Similar processes are used for dual-in-line encapsulation.

(1) The complete slice carrying some 600 integrated circuits is received in assembly electrically pre-tested and with all reject circuits plainly marked with a red dye. The first stage in assembly is to break up the slice into individual circuits. This is achieved by diamond scribing on a machine which, in effect, scratches the silicon surface into a number of squares, each containing one circuit. The silicon slice is then cracked along each line by a roller moving in two directions over hard rubber. The silicon breaks cleanly along the scribe lines separating each complete circuit from its neighbour. The slices are cracked outside the clean areas as it is a "dirty" operation producing silicon dust. The individual circuits are now known as dice. The silicon dust is separated from the dice by an electrostatic separator.

(2) The individual dice enter the clean area where they are subjected to 100% visual inspection. Dice marked by red dye are rejected first. The remainder are examined: (a) For damage from scribe and crack; (b) For imperfections in the aluminium arising from bad handling or faulty processing; (c) Under a metallurgical microscope which shows up, from the colour of the oxide, any blemishes; (d)

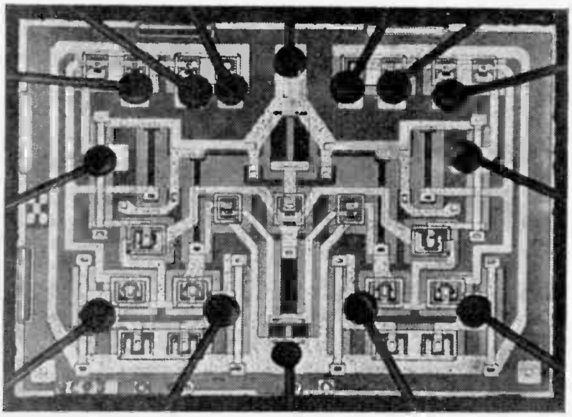
Other imperfections such as pinholes which may affect reliability. Operator training and experience is important at this stage as discretion must be exercised. The basic rule is "when in doubt, throw it out".

(3) Circuits surviving the visual inspection are passed to bonding which is in two stages: (a) The individual die is mounted on a flat-pack header and by a heat process the die is bonded to the header; (b) The die is now moved up to the leads which enter the header through glass seals. Nail-head bonding will be demonstrated using a 25 micron diameter gold wire. The flat-pack is pre-heated on a hot-plate to the ideal bonding temperature. The art of bonding is to use the right temperature at the right pressure for the right time. All these are critical and the process must be repeated on up to 28 joints per circuit, with each joint 100% serviceable and reliable. Apart from the joints themselves there is skill and technique in judging the length of the gold interconnection. An overlong loop will foul the final encapsulation. An overshot direct join may foul the edge of the die. The operators use micromanipulators throughout the process and complete it by cropping off the excess leads left by the lifting off of the capillary wire.

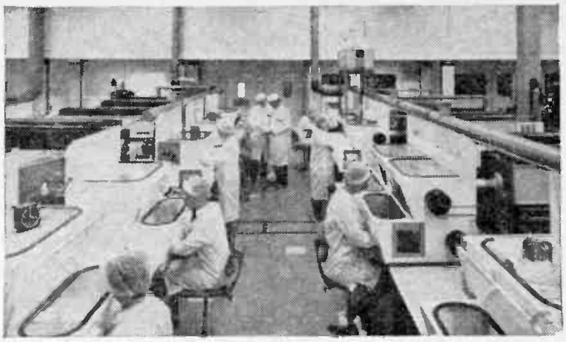
(4) The dice mounted on headers and wired up are now baked in a dry nitrogen atmosphere for 16 hours in an oven which is physically coupled to the sealing line. At the sealing line the operators work through dry boxes to position the lids and solder preforms as the circuits come from the drying oven. The circuits then pass through a series of resistance-heated jigs which hermetically seal them without any possibility of further contamination.

(5) The sealed circuits are subjected to a series of temperature cycles over the range −45deg.C. to +125deg.C. before a final check on the effectiveness of the hermetic seal. The temperature cycling mechanically "works" the assembly and will precipitate any weakness in the sealing.

(6) This stage checks the quality of the hermetic seal. A number of methods are possible but the demonstration will be the bomb test in which the assemblies are immersed in a liquid under a pressure of 8 lb./sq.in. After this treatment the liquid is washed away from the exterior and dried off. The frame is then cropped off in a machine which simultaneously measures any electrical leakage path between the connecting leads. Any leakage



Photomicrograph of an E^2CL double logic gate silicon integrated circuit.



Part of a large clean room containing the integrated circuit diffusion centre. In our picture operators are loading and unloading diffusion furnaces.

disclosed indicates that the liquid (which is electrically conducting) has penetrated the encapsulation and the circuit must be rejected.

(7) Having survived the bomb test, the circuit is subjected to full static and dynamic electrical testing. Between them, these tests check all functions of the circuit for correct operation within the specification. The number of tests depends on the type and complexity of circuit but the figure can reach 80 or more tests on each unit. To set up test gear and to record each measurement by hand would be a hopelessly uneconomic procedure and therefore the dynamic testing is fully automated under computer control.

(8) Completed circuits which have passed all tests are now labelled and sent to stores.

Testing and quality testing

Various methods are employed to test the circuits during the production stages. One method is to introduce a large test transistor and other components in the pattern on the slice. This will be located in the most convenient place and with large enough areas to facilitate probe testing. Static electrical measurements on the test transistor will give an indication of the quality of all the production transistors on the slice.

The finished slices are tested by computer controlled automated probe testers. A single testing station of this type costs up to £75,000 depending on the facilities required. The latest equipment makes a measurement every 5 milliseconds and a bank of three probe testers, fully automated test between them four complete circuits—that is 200-300 measurements—per second. Quick-look print-out is available to show the spread of results and a complete computer tape of every measurement can be produced for computer analysis. In the probe tester, any circuit on the slice found to be outside specification is automatically marked with a red dye for subsequent rejection.

The full dynamic automated test procedure is applied again after assembly of the circuit.

Reliability testing on an inherently reliable device such as an integrated circuit loses all meaning in the long-established life-test sense. To life-test 10,000 circuits for, say, 10,000 hours yields no information at all if, as will most certainly be the case, there are no failures. The modern technique is to take production samples and to subject them to overstressing. Breakdowns are scientifically analysed and remedies applied in the production processes. ■

Mods to the PCR

C.L.K. CRAWFORD

THE well-known surplus receivers, types PCR, PCR2 and PCR3, are very good value for money but fall short of being true communication receivers in three respects; selectivity, bandspread and lack of a b.f.o. However, their solid, stable and spacious design is capable of worth-while development. This article describes some simple inexpensive modifications which provide a b.f.o. and greatly improved selectivity, bringing the PCR more than half-way to being an acceptable communications set. The further addition of a crystal controlled front end converter, such as those described in the ARRL handbook and others, would bring the PCR nearly all the way and at a total cost still below that of a "real" surplus communications receiver.

FIRST STEPS

The first necessity, if the set is a PCR or PCR2, is to substitute a band covering from 50 to 200 metres for the existing long-wave band. Sets of "trawler-band" coils for this purpose are available commercially.* The PCR3 already covers the necessary range.

The next step is improvement of selectivity. This is simply done by increasing the "Q" of the i.f. stages by regenerative feedback, achieved by bringing the i.f. amplifiers near to, but just short of self-oscillation by introducing capacity between the anode and grid of each i.f. valve.

SIMPLE MOD

Figure 1 shows two simple modifications. The anode of each i.f. valve is connected to a four or five inch length of screened cable with the screen earthed. The other end of the cable has the screen removed for about an inch, leaving the insulated inner conductor protruding. This protrusion is led to a point about a quarter of an inch from the grid cap of the same valve. When close enough, the valve will oscillate. In the case of the first i.f. the point chosen is a little short of producing oscillation, and is anchored with tape or other means. In the case of the second i.f. the inner is anchored near enough to make the valve oscillate. The point of oscillation is then controlled by a 5kΩ variable resistor in the cathode line to earth. This gives variable selectivity. It behaves similarly to the reaction control in a straight set, but is much more stable and controllable.

The 5kΩ control can be mounted on the panel. A convenient place is vertically above the a.f. gain control. The original bias resistor stays in the cathode circuit as does the by-pass capacitor. The moderately improved selectivity in the first i.f. stage combined with judicious use of the oscillation control of the second stage gives a remarkable improvement.

This arrangement can also provide a somewhat vigorous b.f.o. action by turning up the oscillation control and short-circuiting the a.v.c. line to earth. A 50pF variable capacitor can be connected across the last i.f.t. primary, preferably through a capacitor in series, to block off the h.t., the i.f.t. dust core being detuned to compensate. S.S.B. signals can be received quite well, but the arrangement compromises both gain and selectivity.

The full capability can be realised with a simple transistor b.f.o. built in a tobacco tin and mounted horizontally under the chassis, bolted to the mixer stage coil box. The circuit is shown in Fig. 2. At this frequency almost any arrangement of the components inside the tin is acceptable, provided the coil is made accessible for tuning its dust core. The 9 volt supply is provided by a potential divider from the 200 volt h.t. and decoupled with a 50μF electrolytic. A double pole on-off switch is mounted on the panel of the PCR. One pole switches the b.f.o. on by connecting the h.t., and the other shorts the a.v.c. line to earth simultaneously.

The coil is made from a spare 465kc/s dust core

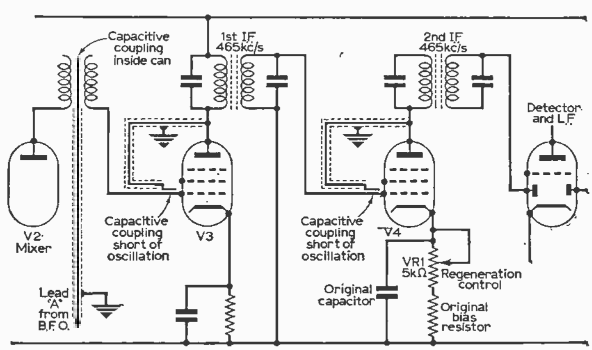


Fig. 1: Simple method for increasing the selectivity of the i.f. stages.

* Repanco

i.f. transformer. Remove the secondary entirely and cut off the coil former close to the primary. Wind about one-third of the turns from the discarded secondary on top of the primary to make a tightly coupled transformer. If there is a fixed capacitor wired across the primary leave it alone. The coil should be firmly fixed in the tin with a hole for tuning the slug. The writer pushed the coil former into a hole punched in the base of the tin and secured it with epoxy resin not forgetting to remove the wax. A half-cylindrical depression can be made in the base of the tin and the OC45 transistor laid in it. Over it, is placed a short strip of aluminium foil and this is held down with sticky tape. This heat sink contributes to the stability of the oscillator, which, in practice is surprisingly good. Note that the tin is earthed and forms the negative connection for the 9 volt line. This allows the b.f.o. tuning capacitor to have one side earthed. This capacitor should be of 50pF maximum to swing the b.f.o. frequency sufficiently up or down from the 465kc/s central frequency. It is mounted on the front panel where convenient. The high-low tone control switch on the PCR might be discarded to make room. Simply cutting the wires results in the "top cut" condition. This is the opposite of what might be expected because the tone control is in the negative feedback line. Capacitor C2 is the padding capacitor in the b.f.o. tuned circuit. It may exist already in the converted i.f. transformer, but if not, it may be necessary to experiment during lining-up to find the right value to restore the resonant frequency of 465kc/s.

COUPLING

The b.f.o. output is taken from the collector of the OC45 by a screened cable about nine inches long. The last four inches have the screen removed and the insulated inner wire is pushed up through a hole in the bottom of the first i.f. transformer. This gives sufficient capacitive pick-up. The output of the b.f.o. is low to achieve stability and is not sufficient to be fed to the detector stage.

LINING-UP

Check the voltages on the transistor. The total should be 9 volts with about 1 volt between transistor base and the positive line. Remove the mixer valve in order to stop the local oscillator. Switch on the PCR and close the double pole b.f.o. switch. Tuning the dust core slug should produce carrier wave noise in the loudspeaker. The i.f. regeneration control previously described may be advanced to make the second i.f. valve oscillate. A strong beat note will be heard and can be varied in pitch by means of the b.f.o. tuning capacitor. Failure to hear the b.f.o. oscillate, provided the circuit is correct, will be due to either the leads on the coil secondary winding being the wrong way round, or insufficient or too much capacitance across the tuned coil. To check, remove the fixed capacitor C2 and substitute a 250pF variable. When the right value is found re-substitute with an equivalent value capacitor and adjust the slug with the lid of the tin closed.

Set the main b.f.o. tuning capacitor to exactly half-way and tune the slug to obtain zero beat. The b.f.o. is now oscillating at 465kc/s. Tuning the b.f.o.

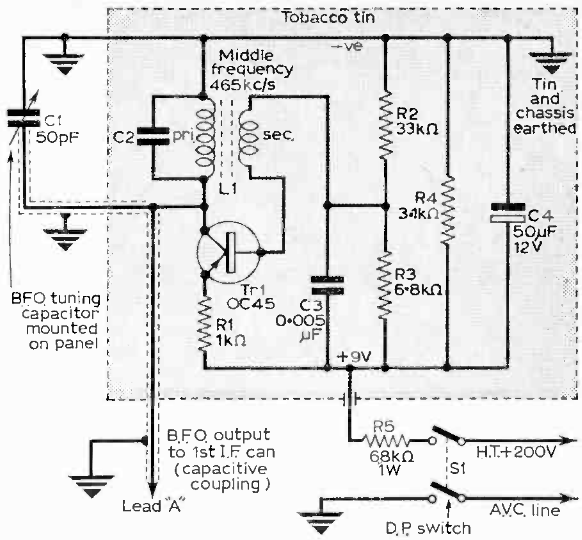


Fig. 2: Simple transistor b.f.o. suitable for use with the PCR. Note: there is no battery, the unit drawing power from the h.t. line and R4 should be 3kΩ.

capacitor clockwise to increase capacity lowers the beat frequency for receiving upper sideband and vice versa.

Turn back the i.f. regeneration control and replace the mixer. This b.f.o. does not, in practice, swamp the a.v.c. as the i.f. regeneration oscillator undoubtedly does, but it is preferable to short out the a.v.c. simultaneously with b.f.o. operation to obtain greater sensitivity. If very strong s.s.b. signals overload the receiver, the main tuning trimmer at the bottom right corner of the panel can be used effectively as an r.f. gain control. It would now be prudent to re-align the i.f.t.'s.

★ components list

Resistors:
- R1 1kΩ (¼ watt)
- R2 33kΩ (¼ watt)
- R3 6·8kΩ (¼ watt)
- R4 3kΩ (¼ watt)
- R5 68kΩ 1 watt.
- VR1 5kΩ pot.

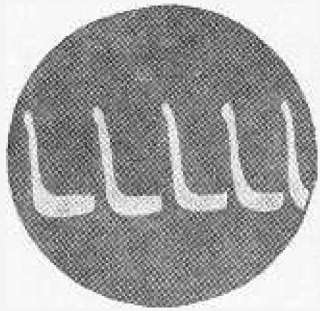
Capacitors:
- C1 50pF variable.
- C2 see text.
- C3 0·005μF
- C4 50μF 12V electrolytic

Miscellaneous:
465kc/s i.f.t. (L1), d.p.d.t. switch (S1), chassis and case, OC45 transistor, wire, solder etc.

Once lining-up has been completed there is no further call for the ability of the second i.f. stage to oscillate. To prevent perplexity should the regeneration control be accidentally advanced it is worth while screwing a stop into the panel at the point of maximum Q short of oscillation. One b.f.o. at a time is quite enough! ■

Readers might be interested to know that the last article on the PCR appearing in PRACTICAL WIRELESS *was PCR Mods by W V Woods, June 1965 issue. Unfortunately this issue is now long out of print, but readers might try their local libraries since some of the larger ones do keep bound volumes of our magazine. We cannot supply any copies of this issue and mention this for reference purposes.*

Combined AUDI & FRE



SOME time ago, the author built a combined audio oscillator and millivoltmeter using valves. Although this equipment gave excellent service over the years, it recently came "under review" when the author decided to re-organise his home laboratory. The author decided to discard the well proven "vacuum" devices and rebuild "solid state". This change in itself brought about many advantages, the most important being an improvement in the frequency stability of the oscillator due to the absence of the temperature differential caused by the heat generated by the valves, etc.

The author had never really been quite satisfied with the frequency calibrations on the fine frequency dial as they were based on a log scale (due to the variable capacitor used for the fine frequency function).

It was therefore decided to adopt a different method of frequency calibration so that it is not only easier to set up initially, but is much more convenient during use. An inherent disadvantage of relying on frequency calibrated dials is that the oscillator frequency can drift, perhaps more than is acceptable, without the operator being aware of the fact, resulting in erroneous conclusions being drawn. Even if the operator knows that the oscillator is drifting he cannot always be sure to what extent, or in which direction.

What is required is a means of indicating oscillator frequency, that is independent of the oscillator itself, and can therefore indicate the extent and direction of drift. If such a means can be used to indicate frequency external to the oscillator, as well as having a linear scale, it makes the task of calibrating, and subsequent use, a much simpler one.

The main advantage of a linear scale is that only a number of spot frequencies are required for initial calibration, obviating the only too laborious chore of calibrating a dial in the traditional manner.

Such a means is indeed feasible and is based upon the charge, and discharge of a capacitor. Capacitor discharge frequency meters, to give them their correct title, are frequently encountered, usually in a somewhat simplified form, as tachometers or electronic "rev" counters in many present-day motor vehicles. It was in fact, whilst experimenting with such an instrument, that the author decided to experiment further and see if the idea could be extended to cover a much wider frequency range.

The complete frequency generating and measuring circuits utilise eight transistors, two zener, and four point contact diodes. Between them they generate audio frequencies of 20c/s to 200kc/s in four ranges, with low inherent distortion, and also measure internally or externally generated frequencies within the same bandwidth, to a high degree of accuracy. The frequency and amplitude stability of the oscillator is also of a high order. Neither is affected to any appreciable extent by the load placed across the output.

A.F. OSCILLATOR

This utilises four transistors, and is based on the ubiquitous Wein bridge, the essentials of which are shown in Fig. 1. The frequency determining components are C_1 R_4 and C_2 R_3 the whole oscillating at a frequency of

$$fo = \frac{1}{2\pi\sqrt{R_4C_1R_3C_2}}$$

Normally R3 = R4 and C1 = C2 and therefore this formula can be simplified to

$$fo = \frac{1}{2\pi CR}$$

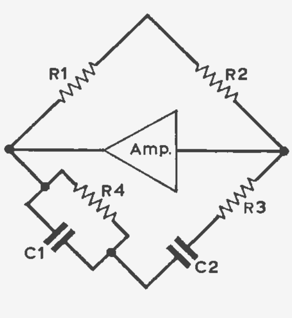


Fig. 1: The frequency determining components of the Wien bridge.

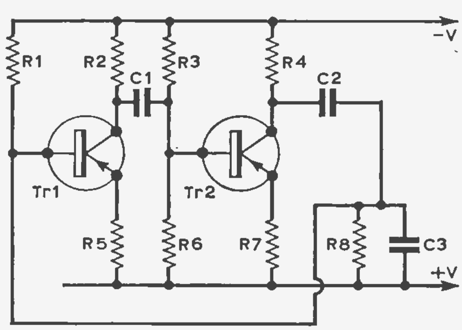


Fig. 2: Elementary Wien bridge.

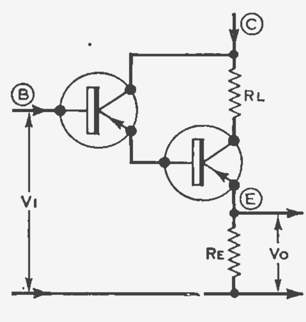


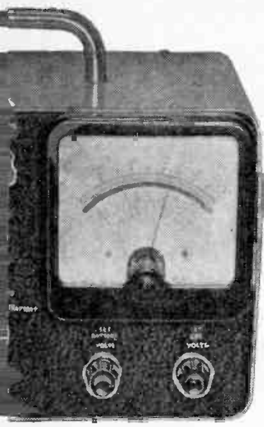
Fig. 3: Compound or Darlington pair.

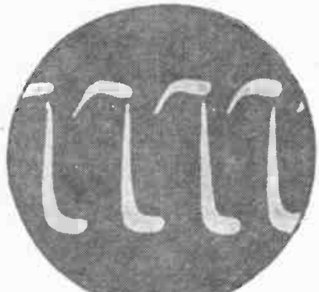
O OSCILLATOR
QUENCY METER

SPECIFICATION

Oscillator:	
Freq. Ranges:	20c/s–200c/s 200c/s–2kc/s 2kc/s–20kc/s 20kc/s–200kc/s
Response:	100c/s–50kc/s $\pm$0·5dB 40c/s–150kc/s $\pm$1·5dB 20c/s–200kc/s $\pm$2·5dB
Distortion:	100c/s–50kc/s 0·5% 40c/s–100kc/s 1%
Output:	1000mV 100mV 10mV plus continuously variable
Output Z:	approx 2kΩ
Frequency Meter:	
Ranges:	20c/s–200c/s 200c/s–2kc/s 2kc/s–20kc/s 20kc/s–200kc/s
Accuracy:	5%
Input signal voltage:	min. 350mV max. 5V
Linearity:	5% of f.s.d.

H. T. KITCHEN





When a signal is applied to this network, phase shift takes place across R_4 C_1 at every frequency except one. At *this* frequency which has been defined as fo, the phase shift will be zero and the applied signal will be attenuated by some 10dB (or three times).

Although Fig. 1 comprises the frequency determining components they will not bring about the desired oscillations but will require connecting to an amplifying and phase-shifting circuit before they can do so, and Fig. 2 shows the basis of such a circuit. In this Tr1 and Tr2 are connected as undecoupled common emitter amplifiers in order to raise the input impedance sufficiently to allow the circuit to oscillate.

The operation of the circuit shown in Fig. 2 is as follows. As the transistors are connected in the common emitter mode, the inputs are to the bases and the outputs are from the collectors. Since there is a phase shift of 180 degrees between each base and collector, the overall feedback is 360 degrees between Tr1 base and Tr2 collector and is therefore in phase with Tr1 base. As this feedback is via the Wein bridge arms, ideal conditions exist for oscillation to take place at a frequency determined by the values of R_4, C_2 and R_8 C_3.

Although Fig. 2 is convenient for explaining the overall operation of the Wein bridge, it is unsuitable as a source of a.f. signal for all but the most uncritical needs and the reasons why it should be so must be understood if one is to appreciate the increase in complexity (and hence cost!) of the final circuit (Fig. 4).

The audio oscillator will be used as a source of signals for the evaluation of all types of audio equipment, and it must provide a signal that has a minimum of amplitude and frequency distortion. To provide a pure signal the transistors must provide a specific and fixed amount of gain. Should the gain vary the frequency (through phase shift) and the waveform (through a nonlinear frequency response) will suffer. The gain must therefore be stabilised, and the easiest way of doing so is by the application of, that panacea of all electronic ailments, negative feedback.

In Fig. 4 this is achieved by fixed amounts of n.f.b. introduced by means of the undecoupled emitter resistors R, R7 and VR2 and also by means of the thermistor R8. Since this thermistor is a power operated device, any increase in the emitter voltage of Tr2 will result in a corresponding decrease in the thermistor's resistance allowing an increased feed-back voltage to be impressed across R7, thus compensating for the original increase across Vr2.

It will be noted that the final circuit of Fig. 4 is different from that of Fig. 2 in so far as the transistors are concerned. This is necessary because although the undecoupled common emitter transistors Tr1 and Tr2 raised the input resistance sufficiently high enough to provide oscillations to occur, they did not raise it as high as desirable. For optimum efficiency, the input impedance should be infinity in order that the Wein bridge is not damped. Although this is not possible in practice it can be raised into the MΩ region (which is after all very high when compared to the low input impedance of a common emitter amplifier) by the adoption of the Darlington pair, shown in skeleton form in Fig. 3, which performs its task of impedance transformation somewhat as follows.

The emitter of Tr1 and the base of Tr2 are connected together so that the same current flows through both. The emitter current of Tr2 is greater than its base current by a factor equal to its current gain thus making the base current of Tr1 extremely low, which is the same as saying that its input impedance is very high. For many purposes the Darlington pair can be considered as a single transistor with an overall gain which is the product of the two individual current gains.

The amount of distortion contained in the output from Tr2 is dependent on the base bias of Tr1 which must therefore be kept within close limits. The base

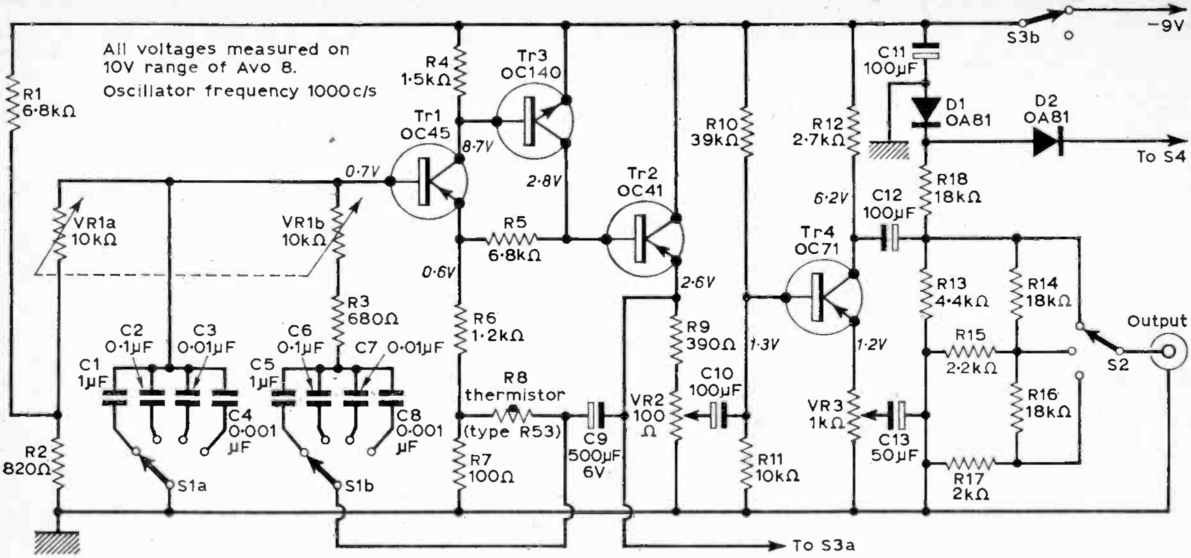


Fig. 4: The complete oscillator circuit.

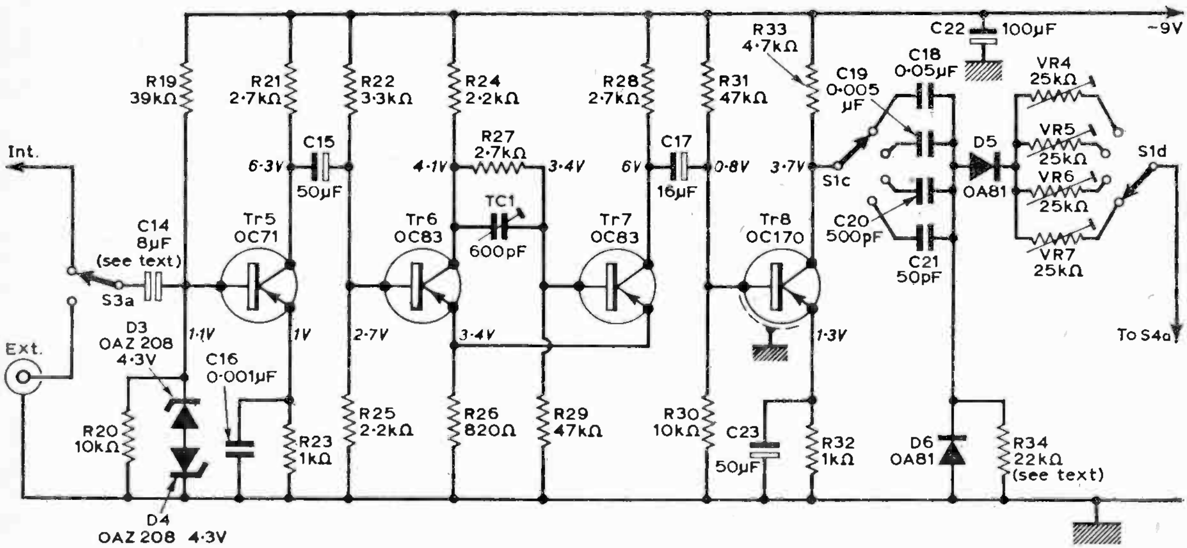


Fig. 5: Circuit of the frequency meter—less the indicator (meter) circuitry (see Fig. 6).

bias for Tr1 is therefore derived from a potential divider comprising the close tolerance resistors R1 R2. It must be remembered that individual transistors will vary in their bias requirements and R1 R2 may require adjustment. Since few readers will have access to a distortion factor meter, all that can be done is to inspect the waveform on a good oscilloscope, though even this procedure is not without its drawbacks since the signal will have to contain a fairly large amount of distortion (say 5% plus) before it becomes obvious.

Although it is quite possible to extract the oscillator output from across the emitter load of Tr2 it was considered highly desirable to interpose a buffer stage in the shape of Tr4 between the oscillator and the output socket for two reasons. Firstly, and most important, it isolates the oscillator from the effects of varying loads across the output so that the oscillator frequency is substantially unaffected irrespective of the fact that the load is a complete or partial short circuit, or open circuit. This avoids the need for constant retuning of the oscillator as the output is connected across the various input impedances of the equipment under test. Secondly, it provides a very convenient means of presetting the output voltage within fairly wide limits by the application of variable negative feedback in its emitter circuit.

The metering circuit used for monitoring the oscillator output is substantially aperiodic at the frequencies concerned and it is therefore possible to use a low frequency transistor for Tr4 and still compensate for falling output, by bringing the output displayed on the meter to a fixed reference point by varying the feedback applied to Tr4. Variable negative feedback is controlled by VR3.

★ components list

Resistors:

R1	6·8kΩ 5% hi stab	R19	39kΩ
R2	820Ω 5% hi stab	R20	10kΩ
R3	680Ω	R21	2·7kΩ
R4	1·5kΩ	R22	3·3kΩ
R5	6·8kΩ	R23	1kΩ
R6	1·2kΩ	R24	2·2kΩ
R7	100Ω	R25	2·2kΩ
R8	R53 thermistor	R26	820Ω
R9	390Ω	R27	2·7kΩ
R10	39kΩ	R28	2·7kΩ
R11	10kΩ	R29	47kΩ
R12	2·7kΩ	R30	10kΩ
R13	4·4kΩ 5% hi stab	R31	47kΩ
R14	18kΩ 5% hi stab	R32	1kΩ
R15	2·2kΩ 5% hi stab	R33	4·7kΩ
R16	18kΩ 5% hi stab	R34	22kΩ see text
R17	2kΩ 5% hi stab	R35	500kΩ 2% see text
R18	18kΩ see text		

(all 10% ¼W. except where stated)

Potentiometers:

VR1 a, b	10+10kΩ log law
VR2	100Ω linear
VR3	1kΩ linear
VR4	25kΩ linear preset
VR5	25kΩ linear preset
VR6	25kΩ linear preset
VR7	25kΩ linear preset
VR8	500Ω linear preset

Capacitors:

C1	1μF p.	C14	8μF reversible elec.
C2	0·1μF p.	C15	50μF
C3	0·01μF p.	C16	0·001μF p.
C4	0·001μF p.	C17	16μF
C5	1μF p.	C18	0·05μF p.
C6	0·1μF p.	C19	0·005μF p.
C7	0·01μF p.	C20	500pF s.m.
C8	0·001μF p.	C21	50pF s.m.
C9	500μF 6V.wkg.	C22	100μF
C10	100μF	C23	50μF
C11	100μF		(15V.W. elec. except where stated)
C12	100μF		
C13	50μF	TC1	600pF trimmer

p = paper

Semiconductors:

Tr1	OC45	Tr5	OC71	D1, 2, 5, 6	OA81
Tr2	OC41	Tr6	OC83		
Tr3	OC140	Tr7	OC83	D3, 4	OAZ208
Tr4	OC71	Tr8	OC170		4·3V Zener

Switches:

S1	2 wafer	4 pole 4 way
S2		1 pole 3 way
S3		2 pole 2 way slide switch
S4		3 pole 4 way

Meter:
50μA. 1200Ω internal resistance.

As VR3 is rotated clockwise negative feedback is reduced, and the output increased to a maximum of some 1,500mV r.m.s. The maximum output at the collector of Tr4 is then reduced in 20dB steps by the coarse step attenuator S2, so that outputs of 1,000mV, 100mV and 10mV are available at the output socket.

The coarse attenuator has a characteristic impedance of approximately 2kΩ. Resistor values, specified in the coarse attenuator, can be obtained from the range of preferred values and will still be near enough to provide the required value of attenuation. The load imposed across the output socket should not be allowed to fall below some 2kΩ when S3 is in the 1,000mV position otherwise waveform clipping will almost certainly occur if any attempt is made to obtain maximum rated output.

THE FREQUENCY METER

This requires a minimum input of some 350mV for reliable operation, inputs below this figure will not trigger off the multivibrator. Higher input voltages do not affect the frequency accuracy of this circuit to any noticeable degree though obviously the transistor's ratings must not be exceeded otherwise it is liable to come to a premature end. This is dealt with at greater length later on in the article.

S3 enables the frequency meter to be switched so that either the internally generated frequency or an externally generated one can be measured.

The principle of the frequency meter is quite simple and is based on the periodic discharge of a capacitor, hence the name "capacitor discharge frequency meter". There is however rather more to it than simply discharging a capacitor and it is therefore intended to examine the working of the frequency meter in rather more detail. Since a moving iron or moving coil meter with rectifiers, responds equally to the positive and negative peaks of a symmetrical waveform, it is obviously useless to feed in the frequency to be measured to such an instrument.

It is necessary to convert the input sinewaves to square waves, and these are differentiated into a series of very sharp positive and negative pulses corresponding to the leading edges of the square waves. Suppose we have 10 pulses per second going into the meter and they deflect the pointer by one scale division. Now suppose we increase the number of pulses to 20 thus doubling the energy dissipation. The meter pointer will indicate two scale divisions. Increasing the number of pulses per second to 100 will cause the pointer to deflect 10 scale divisions. In other words the meter deflection is linearly proportional to frequency. If it is desired to increase the frequency of the pulses over the full scale deflection of 100, the discharging capacitor is decreased by the same factor as the frequency is increased, thus making it possible to provide four 10 to 1 ranges covering frequencies from 20c/s to 200kc/s.

We are now in a position to examine the circuit that performs these varied functions and Fig. 6 is the appropriate diagram. Switch S3a selects either the internal or the external frequency to be measured and feeds it via C14 to the base of the amplifier transistor Tr5. The emitter is decoupled by C16, which serves to equalise the low and high frequency outputs from Tr5. It achieves this because its reactance and hence its decoupling effect is negligible at low frequencies.

It was mentioned earlier that the input voltage did not affect the frequency calibration of the meter **provided** it did not fall below some 350mV, though **excessive** voltages were liable to damage the transistor. The author decided that some form of safety device was desirable and this function is performed by the two zener diodes D3 D4 which are connected back-to-back across R20, in the base circuit of Tr5. They do not have any effect upon the normal operation of the frequency meter but safeguard Tr5 should an excessive voltage be applied to C14, and this could easily happen in one or both of two ways. Firstly, there is the danger of over-driving the circuit by the application of an excessive alternating voltage and secondly there is the very real danger of C14 passing an excessive leakage current. The zener diodes being connected back-to-back would break down if a voltage of either polarity, exceeding the zener voltage, was impressed across them. It is intended to monitor only the internally generated frequencies there is little point in incurring the expense of these diodes and they can be omitted.

From the collector of Tr5 the signal passes to Tr6 which forms with Tr7 an emitter coupled astable multivibrator, or more commonly known as a Schmitt trigger. It is in this stage that the incoming frequency is converted to square waves. The 500pF trimmer capacitor TC1 connected in parallel with

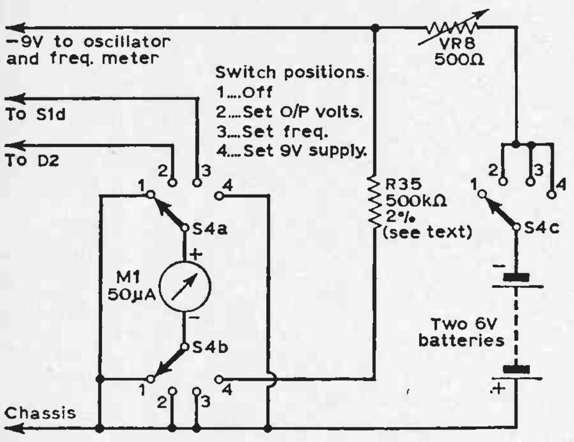


Fig. 6: Metering and power supply circuits.

R27 couples the collector Tr6 to the base of Tr7 and is known as a "speed up" capacitor. Its primary function is to match the time constants of R24 plus strays to the time constant of the base impedance of Tr7. Correctly adjusted, it sharpens up the edges of the square waves generated by this stage which assists in its correct differentiation later on in the circuit. The square waves emerging from the collector of Tr7 are of fixed amplitude and are passed on to the pulse amplifying stage Tr8. It had originally been intended to differentiate the output from Tr7 directly but experiments showed the desirability of incorporating an intermediate buffer/amplifier stage and Tr8 was added. Although Tr5 will probably amplify nothing more exotic than sine waves, Tr8 has to amplify square waves which are exceedingly rich in harmonics, extending theoretically to infinity. The use of a v.h.f. transistor is therefore very necessary at this stage.

The square wave emerging from the collector of Tr8 is differentiated by C18 to C21 and R34 and we have come at last to the capacitors which give the meter its title. The waveform at this point consists of a series of very sharp positive and negative peaks which are chopped by D5 D6 which remove the negative-going peaks and pass the positive-going ones, via the range equalising pre-set resistors VR4 to VR7, and then S1d, S4a, and finally to the meter.

METERING FACILITIES

The use of a moving coil meter for the measurement of frequency enables a number of other functions to be also monitored. Fig. 6 shows the switching required to monitor not only the frequency range but also the oscillator output voltage and the voltage of the supply line. A three-pole four-way switch S4 is used and is wired to fulfil the following functions.

In position 1 everything is at off. S4c disconnects the battery supply whilst S4a,b isolate the meter from all circuits and, being connected together, impose a short circuit across it. This short circuit acts as a magnetic "brake" on the meter pointer by short circuiting the e.m.f. generated in the meter coil. The pointer's excursions are therefore curtailed and the risk of mechanical danger to the meter is considerably reduced when transporting the instrument.

In position 2 the battery is connected into circuit by S4c thus permitting the audio oscillator and frequency meter to function. At the time of designing the circuit, it was considered very desirable to incorporate an independent means of checking and if necessary, altering the oscillator output voltage so that output variations due to circuit or transistor limitations could be compensated for. The output voltage is varied by VR3, and it is monitored by the meter in the following fashion. S4b connects the negative pole of the meter to chassis and S4a connects it to the two rectifier diodes D1 D2. The non-linearity of such a system is of no interest since only one fixed reference point is required on the meter scale, R18 being adjusted to bring the pointer to the pre-determined point when the output is precisely 1V r.m.s. No doubt the meter could be calibrated to indicate output voltages below 1V but this is a point for the individual to decide for himself.

Position 3 of S4 connects the negative pole of the meter to chassis and the positive pole to S1d which allows the meter to indicate frequency, providing VR4 to VR7 have been correctly adjusted.

Position 4 of S4 is used to set the supply voltage and is in the nature of an economy drive. Without this facility one or two zener diodes would have had to be specially purchased, adding to the overall cost whereas it was a simple expedient to modify the switching to allow the supply voltage to be monitored. Since the previous two voltages have been positive-going with respect to chassis it is necessary to reverse the meter polarity in order to read the negative supply voltage and this function is performed by S4a,b which connect the positive pole of the meter to chassis and the negative pole, via R35, to the supply voltage. R35 can either be selected to indicate voltage directly, as on the prototype, or else selected to bring the meter pointer to some predetermined point which can be the same as the output voltage calibration point, when the supply voltage is precisely 9V.

TO BE CONTINUED

? YOUR QUESTIONS ANSWERED ?

TAPE RECORDER CONNECTION

I would like some information regarding the provision of a low output connection from a tape recorder for feeding into an external amplifier.—G. Barker (Goole, Yorkshire).

To take an output from your tape recorder for feeding an external amplifier should not be too difficult. We suggest you add a coaxial socket somewhere on the unit and connect screened cable to it —inner to inner contact, and outer to outer contact. The other end of the cable connect as follows: outer to chassis, and inner to the "top" of the volume control on the recorder.

If the recorder is of the a.c./d.c. type (unlikely) or the chassis is directly connected to one side of the mains supply, make no external connections to it other than those for which the makers made provision.

SHORT WAVE CLUB

Could you please let me have details of the International Short Wave Club.—C. Jenkins (Portsmouth, Hampshire).

For information on the International Short Wave Club, we suggest that you contact the secretary, B. J. C. Brown, 60 White Street, Derby.

ROTARY TRANSFORMER SMOOTHING

I have recently purchased a rotary transformer. The input is 12V and the output is 240V at 260W. With this unit, I hope to drive a small a.c./d.c. v.h.f. set which requires 140W. Could you let me know what smoothing requirements are necessary?—W. Butt (Sittingbourne, Kent).

If your rotary converter gives a d.c. output then you should not need much smoothing. We suggest you try connecting an 8μF or 16μF capacitor across the output. The capacitor should be rated at 300V or 350V. Bear in mind that any interference which may be produced may be derived from the brushes on the machine, rather than the output. You may find it necessary to situate the rotary converter a long way from the receiver.

TAPE RECORDER WHISTLE

I have just completed building a tape recorder kit. Everything works all right but there is a whistle being recorded on the tape. A Mr. R. C. Hawkins in P.W. March, 1964, stated that he found a whistle on his stereo outfit and traced this to the beat note between the two erase oscillators. Could this be similar trouble on my mono outfit?—J. Brady (Bishopriggs, Glasgow).

We assume that the whistle you mention occurs only when you are recording radio programmes. If so, it is probably due to a harmonic of the bias oscillator beating with the incoming radio signal. The remedy is to alter the tuning of the bias oscillator slightly. Since the coil has no core, you will have to alter the tuning capacitance across it. Only alter it just sufficiently to clear the trouble.

If the whistle occurs on everything you record, check all the components in the oscillator stage.

THE MW COLUMN

WE are now getting well into the main DX season and most of the commonly heard North Americans are providing reasonably good reception. But as for Asia in the afternoon period, this has been very poor, although one or two (such as Anhwei on 940kc/s) have been heard. However, Asia has been quite good in the later period, from about 2130 onwards. On balance Asiatic reception has so far been far from comparable with the last few years and we can only hope that by January things will have improved.

Kabul, Afghanistan, has been quite good on 1280 around 1730 and Anhwei has been very good from sign-on at 2130 fighting it out with the Brazilian *Journal do Brasil* on the same frequency. Taiwan on 750 has been good around 1830 and has also been noted around 2130. Hanoi was heard briefly once on 1010 around 2300 but there has so far been no sign of Shensi (900) and Pyonyang (850), although Hupeh on 770 was very good on one evening at 2200.

Western North America has been heard at times, mainly via the Seattle stations KOMO (1000) and KING (1090) around 0500-0600. A tentative logging of KXL Portland on 750 at 0630 rounds off West Coast loggings but KXYZ Houston (1320) and KMOX St. Louis (1120), together with WBBM (780) WCFL (1000), both in Chicago, shows that interesting Americans are still popping up.

Reader Glyn Morgan has been active and has noted Zahedan, Iran, on 770 at 1730, Ahmedhabad/Baroda on 850 at 0036, *Radio Splendid* Argentina at 0000, *Nuevo Mundo* very good on 850 at 0040, *Radio Journal do Brasil* good at 0030 on 940, LR1 *Radio El Mundo* at 0030 mixed with A.I.R. Delhi on 1070, Peking at 2205 on 1230, Dakar good as usual on 764, Conakry (Guinea) at 2300 on 1403, PRG3 *Radio Tupi* on 1280. Glyn also reports CBN 640, CBH 860, WOR 710, WWL 870 and XEW *La Voz America Latina* on 900.

My own log includes Belize (now moved to 830), Surinam (725), XEOY (1000), TGRR *Radio Reloj* (1120), ZMB1 Bermuda (1340), PRH6 *Radio Inconfidencia* (1340), plus some run-of-the-mill stations like CFDR Dartmouth (790), WGY Schenectady (810) mixed with WVKM Puerto Rico, WHAS Louisville (840), CBH Halifax (860), WABI Bangor (910), WINS New York (1010), WBAL Baltimore (1090), CHER Sydney (950), *Radio Americas* Swan Island (1157), WAVY Portsmouth (1350). Also noted Sao Tome on 759.

Some of the Latin Americans heard recently include YVLH *R. Giradot* (650), YND *Union Radio* (675), YVKS *R. Caracas* (750), CX16 *R. Carve* (850), YVQR *R. Aeropuerto* (910), LR3 *R. Belgrano* (950), HIJP *R. Comercial* (1020), TIFC (1070), YVQJ *R. Rumbos* (1070), YVQT *R. Carupano* (1110), HJCT *Voz de la Coast* (1190), XECO *R. Eco* (1380), PRB2 *R. Clube Paraneanse* (1440).

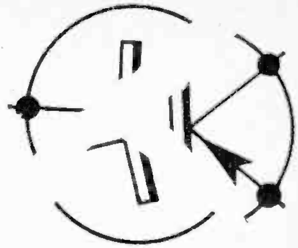
I look forward to hearing from any reader with interesting news of M.W. DX stations.

ALISTAIR WOODLAND

RECLAIMING FAULTY TRANSISTORS

M. K. TITMAN B. SC.

PART 1



DUD transistors are usually thrown irritably into the rubbish bin. But are they really useless? Only one of the two p-n junctions may be damaged, the remaining junction may exhibit all the characteristics of a diode or zener diode. High frequency transistors may yield a high frequency diode or, a power transistor, a power zener or rectifier. Fifty per cent of the transistors damaged in experimental circuits sustain damage to one junction only and a fifty per cent yield of useful diodes or zeners can result.

A dud transistor is usually detected by resistance measurement techniques of each junction individually. An ohmmeter is applied to the collector-base and base-emitter junctions in turn to measure the forward and reverse resistance. Therefore in the first instance a simple check of the diodes is carried out to determine if they are short circuit or open circuit. As most transistor failures have this catastrophic failure characteristic, then this method is sufficient to check whether the transistor has failed or not.

By building the simple test apparatus described, we can determine whether a transistor has failed or not and whether the remaining junction is useful as a diode or zener diode. We can also test diodes and zener diodes.

Circuit description

The circuit is shown in Fig. 1. It can be powered by either batteries or a bench supply and the voltage can be determined by what is available. A 30V supply was chosen since this was greater than the common supplies to transistor circuits, although a lower voltage, say 24V or 20V, can be used.

The circuit consists of a constant current generator which supplies a current to the junction under test.

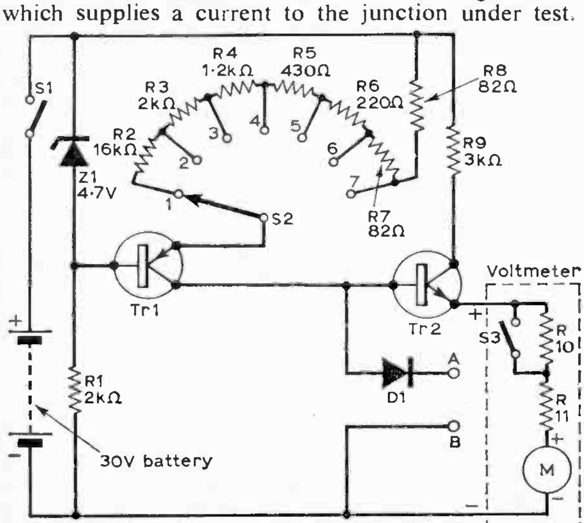


Fig. 1: Complete circuit of the unit.

The current can be switched over a range determined by S2 and the resistors R2 to R8. Tr1 is the basis of the constant current generator. The base potential is set by the zener diode Z1. The collector current is therefore determined by the equation.

$$I_c = \frac{V_z - V_{be}}{R}$$

where I_c is the collector current
V_z is the voltage across the zener diode
V_{be} is the base-emitter potential of the transistor and is nominally 0·7V for silicon and 0·3V for germanium
R is the emitter resistor R2–R8.

The approximate currents for the circuit shown are:

S2 Position	Current to test Junction or Diode	S2 Position	Current to test Junction or Diode
1	200μA	5	10mA
2	1mA	6	25mA
3	2mA	7	50mA
4	5mA		

Tr2, R9 and D1 form a circuit which will allow any meter from 50μA movement (20,000 ohms/volt) to 1mA (1,000 ohms/volt) to be used. However, if a 100μA movement meter or less is used, D1, R9 and Tr2 can be deleted and the meter connected directly across terminals A to B.

S1 is a push-button switch which connects the supply voltage only when a reading is required. This gives a saving in battery drain and the batteries will generally last for their normal shelf life.

The circuit is inherently safe since any terminal may be shorted without damage to the test circuit or the semiconductor on test.

Where a meter is to be incorporated in the test circuit, the circuit shown in the voltmeter box may be substituted in place of an external voltmeter and the connections made internally. The switch will vary the sensitivity of the meter when closed from 25V f.s.d. to 10V f.s.d. The two resistors R10 and R11 may be calculated from the formulae:

$$R10 = \frac{15}{Im}$$

and $$R11 = \frac{10 - Im\,Rm}{Im}$$

where Im is the meter current for full scale deflection and Rm is the meter resistance.

The meter may be any moving coil meter up to 1mA full scale deflection.

Construction

The construction will largely depend on whether a meter is incorporated in the test set. A suggested front panel layout is shown in Fig. 2. To ease con-

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Model 3000 with Sonotone 9TAHC Stereo Cartridge	£8.19.6
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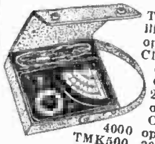
ALL TRANSISTOR 6 WATTS PER CHANNEL STEREO HI-FI SYSTEM OFFERING A PERFORMANCE EQUAL TO IF NOT BETTER THAN SIMILAR SYSTEMS COSTING UP TO DOUBLE THE PRICE.

Modern styling plus advanced circuitry using latest silicon transistors throughout. The famous GARRARD 3000 Record Changer fitted lightweight tubular arm with SONOTONE 9TAHC STEREO/MONO DIAMOND CARTRIDGE will play all sizes of records. (4 speeds 78, 45, 33⅓, 16⅔ r.p.m.) Will play up to 9 records automatically, also provision for manual play. Amplifiers and controls are mounted below record player and incorporate Bass, Treble, Volume and Balance controls and On/off, Gram/Radio, Mono/Stereo slide switches. TWO IDENTICAL LOUDSPEAKER SYSTEMS each incorporating separate bass speakers and high frequency units with crossover network provide full frequency reproduction and are complete with 10ft. leads and plugs for connection to amplifier. Will fit easily on to bookshelves, room dividers or existing furniture. BRIEF SPEC. Player/Amplifier unit, size 16½ x 14 x 8½in. 200/250v. A.C. operation. Inputs for Radio Tuner/Tape Recorder also outputs for Tape Recorder. Loudspeaker Systems. Size (each) 13 x 7 x 8in. Supplied complete with instruction booklet, ready to plug in and play. SEND YOUR ORDER NOW OR CALL AND HEAR THIS MARVELLOUS HI-FI STEREO SYSTEM (Teak finish). Only 59 gns. plus 20/- Carriage and Insurance. (Rosewood 2 gns. extra).

MULTIMETERS



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TTC G1100	16 ohms	£3.19.6
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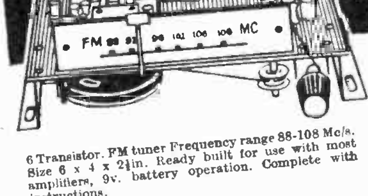
TRANSISTOR FM TUNER ONLY £6-7-6 P&P 4/-



6 Transistor. FM tuner Frequency range 88-108 Mc/s. Size 6 x 4 x 2¼in. Ready built for use with most amplifiers, 9v. battery operation. Complete with instructions.

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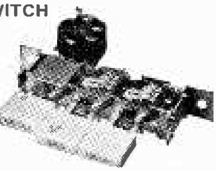
3-PUSH SWITCH



For test meter, hi-fi amp., etc. 1st button operates mains on/off switch, the other two operate change-over switches. Knobs engraved On/Off Bass, Treble but engraving easily removed leaving clean surface for remarking, **2/9** each **24/-** doz.

SATCHWELL OVEN THERMOSTATS

Type TO. With capillary tube and sensor. 20 amp. A.C. type and as fitted to many cookers. Adjustable by control knob (not supplied). **12/6** each.

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Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA. (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6**, plus 3/6 postage.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A.—15-20 w. **19/6.** Kit B—30-40 w. **17/6.** Kit C—80 w. **17/6.** Kit D—125 w. **22/-.** Kit E—65 w. **19/6.** Kit MF1 is for 6in., 9in. and 12in. miniature tubes **19/6.** Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

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4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at **3/6** each **36/-** dozen, your assortment.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. **10/-** post free.

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An excellent opportunity to re-equip your house or workshop, or if you are a contractor to restock for future ring main jobs. We offer 12 GEC switch sockets, Brown Bakelite surface mounting. Latest ring main type listed at **6/6** each. You can have a box of 12 for **30/-** only—thus showing you a saving of **£2.8.0.** Postage and insurance 4/6 extra.

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Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven kiln, immersion heater or to make flame-start or fire alarm. **8/6** plus 2/6 post and insurance.

Type "D". We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses, one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. **7/6.** P. & P. 1/1.

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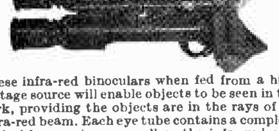
Type "F". Class encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price **18/-** plus 2/- post and insurance.

See in the Dark INFRA-RED BINOCULARS



These infra-red binoculars when fed from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for T.V. cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order but sold without a guarantee. Price **£3.17.6,** plus 10/- carr. and ins. Handbook 2/6.

GARRARD AUTO RECORD PLAYER Model 2000

This is one of the latest products of the World's most experienced maker of fine record reproducers. Its superior features include—automatic playing of up to 8 mixed size records—stopping and starting without rejecting—manual playing—pick-up pivots to give low stylus pressure—large diameter turn-table for max. stability adjustments include pick-up height—pick-up dropping position and stylus pressure. Size is 13¼ x 11⅜in. clearance 4⅜in. above, 2¼in. below—fitted with latest hi-compliance cartridge for stereo—and mono. L.P. and 78. Supplied complete with mounting template and service sheet. Offered this month at the Special Snip price of **£6.19.6** plus 7/6 carriage and insurance.

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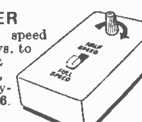
DRILL CONTROLLER



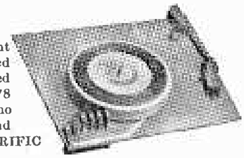
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by fingertip control, Kit includes all parts, case, everything and full instructions **19/6.** plus 2/6 post and insurance. Or available made up **32/6.**

750mW TRANSISTOR AMPLIFIER

4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed-back loops—sensitivity 5mV. Price **19/6.** Post and insurance 2/6. Speakers 3in. **12/6,** 5in. **13/6,** 6 x 4in. **14/6.**

THIS MONTH'S SNIP

THE 'TECHNICAL' GRAM MOTOR

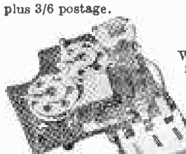


4 speed, gram. motor with lightweight pick up, motor electronically balanced and free from wow and flutter. Speed change by push button—16, 33, 45, 78 r.p.m. Price **39/6.** Cartridge extra mono 10/6, stereo 15/- plus 4/6 post and insurance. DON'T MISS THIS TERRIFIC BARGAIN.

DOOR INTERCOM

Know who is calling and speak to them without leaving bed, or chair. Outfit comprises microphone with call push button, connectors and master inter-com. Simply plugs together. Originally sold at £10. Special snip price **79/6** plus 3/6 postage.

BATTERY OPERATED TAPE DECK



With Capstan control. This unit is extremely well made and measures approx. 6 x 5 x 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5 volts. Supplied complete with 2 spools ready to install. Record, Replay head is the sensitive M4 type intended for use with transistor amplifier. Price **£4.15.0.** Post and ins. 4/6.

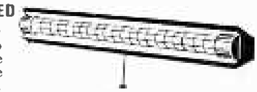
TUBULAR HEATERS

New and unused made by G.E.C.—rated at 60 watts per ft.—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc., curtains or papers can touch them without fear of scorching or fire Supplied complete with fixing brackets and available in the following sizes.
8ft., **30/-**; 10ft., **36/-**; 12ft. **42/-.**
Also in twin assemblies (one pipe above the other) up to **52/-.**
Prices which are about ½ of list price includes carriage by B.R.S.

'PILOT' CAPSTAN DRIVEN TAPE RECORDER

Capstan Driven, 4 Transistors
SPECIFICATION: 200/7,000 c.p.s.—400 mW, output—double track—twin speed (3¾ and 7½) fast rewind time—5in. spool gives one hour playing with standard tape. Complete with batteries, microphone, tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop. Special Snip Price This Month **£9.19.6** post and insurance 6/6.

INFRA-RED HEATERS



Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wave length (3 microns). Price for 750 watts element, all parts, metal casing as illustrated, **19/6,** plus 3/6 post and insurance. Pull switch 3/- extra.

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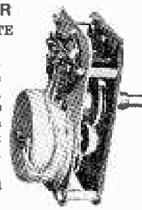
12in. High fidelity loudspeaker. High flux permanent magnet type with either 3 or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price **29/6.** With built-in Tweeter **35/-,** plus 3/6 post and insurance.

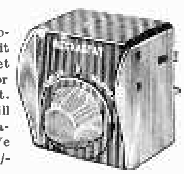
GEARED MOTOR

HALF REV. PER MINUTE



Made by famous Smith Electric, mains operated and quite powerful. Size 3¼ x 2¼ x 1½in. deep. Secondary use as process timer. Internal switch can be made to break circuit within a period up to 2 mins. **17/6.** P. & P. 2/6 unless ordered with other goods.

BECKASTAT



An Instant Thermostat. Simply push it into 15A wall socket and plug your fire or other appliance into it. Knob setting. Will save its cost in a season. Normally £3. We offer at **19/6,** plus 2/- post.

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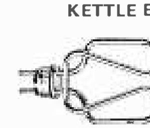
All parts to make light operated switch/burglar alarm/counter, etc. Kit comprises printed circuit, Laminated Boards and chemicals, Latching relay, Infra-red sensitive Photocell and Hood, 2 Transistors, cond., Terminal block. Plastic case. Essential data, circuits and P.C. chassis plans of 10 photo-electric devices including auto. car parking light, modulated light alarm. Simple invisible ray switch—counter—stray light alarm—warbling tone electronic alarm—projector lamp stabiliser etc., etc. Only **39/6,** plus 2/- post and insurance.

Multi Purpose Neon Test Unit

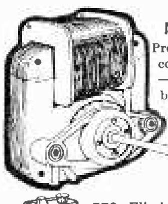
Robust, useful and instructive—tests insulation—capacity—continuity—resistor—volume controls—also acts as signal injector and L.T. fault finder—kit comprises neon indicator—4-way wafer switch—ebonite tubes—resistors-condensers—terminals, etc. with diagram only **9/6,** plus 2/- post and insurance.

KETTLE ELEMENT



Made by famous, "Best" company, suitable for most kettles. 1⅞in. dia. hole. 1500 watts. 230/250v. Normally **30/-** each. Our Price **15/-** each, plus 2/6 P. & P.

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower heater, etc. New and perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

PP3 Eliminator. Play your pocket radio from the mains! Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. Only **6/6** plus 1/- post.

Where postage is not definitely stated as an extra then orders over **£3** are post free. Below **£3** add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

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also at **266 LONDON ROAD, CROYDON, SURREY** *S.A.E. With enquiries please*

struction an extra blank wafer on the rotary switch S2 will provide tags for all the components. It should be noted that if a TO5 case transistor is used as Tr1, then a heat sink should be used.

Operation

Transistor Testing: The test circuit may be used to determine whether a failure such as open circuit or short circuit junctions has occurred in a transistor.

With S2 in the TEST/200μA positon terminal A is connected to the base of the transistor. Terminal B is connected to the emitter and collector in turn when the voltmeter reading should be less than 1V for an npn transistor or greater than 4V for a pnp. For the pnp case the test set is measuring directly the maximum reverse voltage which each junction can tolerate. Now connect terminal B to the base and terminal A to the collector then emitter. The results for pnp and npn transistors above should be reversed. Thus we have tested each junction in turn.

To test collector to emitter, connect A to the collector and B to the emitter and vice versa when the reading should be greater than 4V in each case.

This test will only indicate if a particular junction is open circuit or short circuit. If one of the junctions is faulty then the other junction may be tested for its usefulness as a diode or zener diode as below.

Diode Testing: To test a diode, or a transistor junction for use as a diode, connect to A and B. Measure the voltage which, if the diode is connected as shown in the front panel diagram, should be less than 1V. If so, then increase the current using S2 when the voltage should remain below 1V. Return S2 to the TEST/200μA position and reverse the connections to A and B. The voltmeter now indicates the maximum voltage which can be applied in the reverse (non-conducting) direction.

From this test we have established that the diode is useful and is capable of passing 50mA in the forward direction and can be used in circuits where the supply voltage is less than the reverse voltage reading. If the reverse voltage was less than 25V then it may also be useful as a zener diode which can be tested as shown below.

Zener Diode Testing: The zener diode or junction

★ components list

COMPONENTS LIST

Resistors:

R1	2kΩ 5% $\frac{1}{2}$W	R7	82Ω
R2	16kΩ	R8	82Ω
R3	2kΩ	R9	3kΩ 5% $\frac{1}{4}$W
R4	1·2kΩ	R10	see text
R5	430Ω	R11	see text
R6	220Ω		

all 2% $\frac{1}{4}$W unless otherwise specified

Semiconductors:

Tr1 OC22, OC36, 2N1132
Tr2 BFY50—52, BFX34, 2N2221, 2N697
D1 1N914 (30V 50mA silicon)
Z1 OAZ200, ZB4·7, ZF4·7 (4·7V 5% 25mA zener)

Meter:

50μA to 1mA f.s.d. (see text)

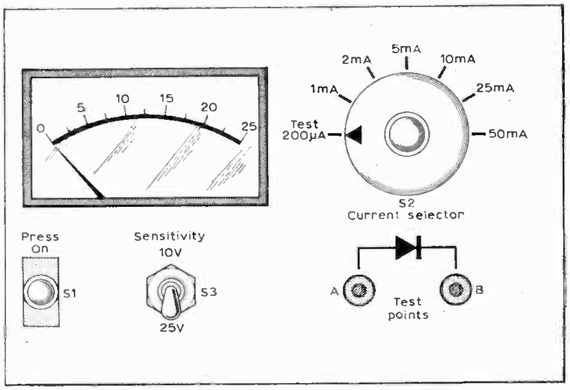


Fig. 2: Front panel layout

from a dud transistor is connected to terminals A and B, with A the positive connection. The reading is the zener voltage for 200μA with S2 on the TEST/200μA position. The current is then increased in steps and voltage readings taken. The voltage regulation with current is found and the voltage for a given operating current determined. The slope of the graph of voltage against current gives the zener dynamic resistance.

A word of warning however. A power transistor base-emitter junction can be used as a power zener up to the full 50mA or more but a small transistor can only take from 100mW to 250mW. So the voltage reading times the current must not exceed 250mW for a small transistor and the component should be felt for overheating.

Results

Below are some results using this test circuit on two dud transistors. First the transistors were tested and one was found to be open circuit—collector to base and the other short circuit—base to emitter.

The useful collector base junction of the high frequency transistor was tested as a diode and the voltage remained at 0·7V up to 50mA. The voltage in the reverse direction was greater than 25V. Thus it was useful as a high frequency diode in circuits of less than 25V supply voltage.

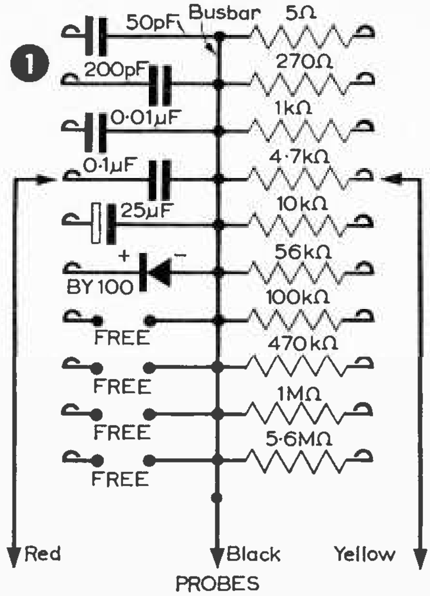
The base emitter junction of the second transistor yielded the results below in the zener diode tests. It was therefore useful as a zener diode of 7·45V at 5mA and capable of 25mA maximum as it was a TO18 case transistor. From the change in voltage with current the dynamic resistance was 40Ω, which is useful in most applications.

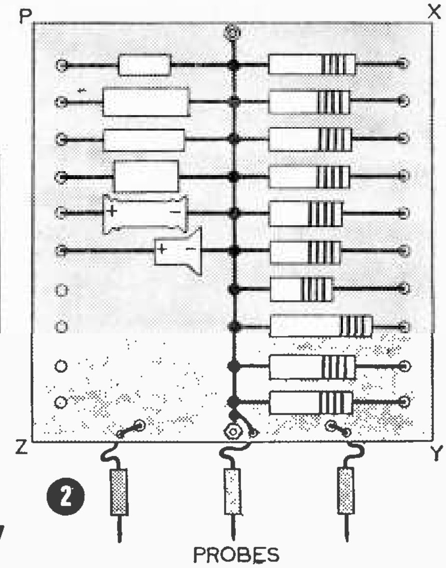
Voltmeter Reading	S2 Current Setting
7·2V	200μA
7·25V	1mA
7·3V	2mA
7·45V	5mA
7·7V	10mA
8·25V	25mA

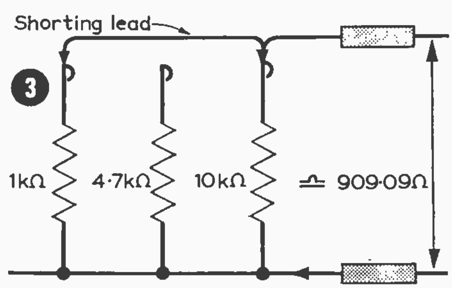
to be continued

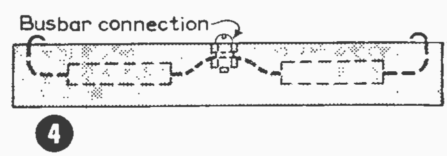
SIMPLE SUBSTITUTION BOX

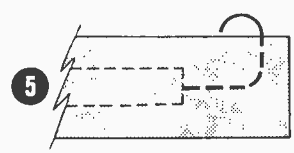
G. A. PICKBURN

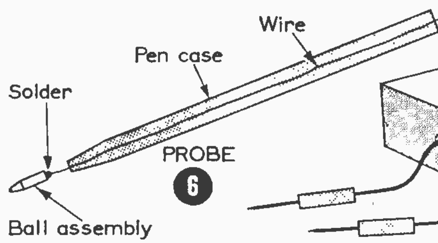


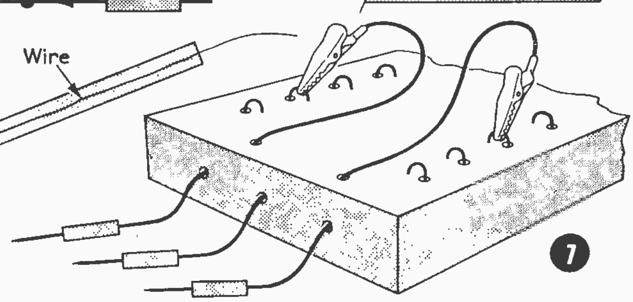












THE cost of commercially produced switched substitution boxes being relatively high, it was considered worth while designing a compact homebrew unit. Multiway switches are not employed for two reasons: (a) they increase the cost and, (b) their contacts are prone to intermittent faults. An original type of terminal was devised to eliminate the need for wander-type sockets which, at 6d. each, would almost certainly prove more expensive than switches. Having reduced the cost to little more than that of the substitution components alone, the next consideration was that of range. The values indicated on Fig. 1 provide a general range which could be modified to suit the particular needs of individual constructors. (1% tolerance resistors could be included to provide calibration standards for bridges, etc.)

Two "hot" (i.e. not connected to the common terminal) leads are incorporated allowing two components in the box to be used simultaneously, a feature not often found in commercial units. A shorting lead could be provided with the box to enable the user to select intermediate values by connecting the shorting lead to put two components in parallel (see Fig. 3). Room has been left in the box for additional substitution components, such as a neon or low voltage bulb, to be added. When purchasing components, do not forget to consider their breakdown voltage, current, and power dissipation ratings. (A use for the P.W. Data Rule!)

CONSTRUCTION

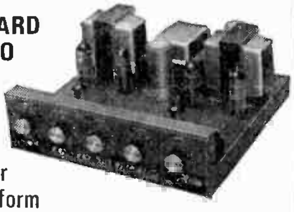
The common busbar is fitted first, one side of all components being connected to it. Take care to

BARGAIN OPPORTUNITIES FROM TRS

Amplifiers

KITS AND READY BUILT

MULLARD STEREO 10-10 BY TRS



Built or in kit form

Valve amplifier to exact Mullard spec. With pre-amp tapped o/p transformer, 3 and 15Ω, all controls. H.T. and L.T. outlets, mono stereo and speaker phase switching. Complete with escutcheon, knobs, plugs, etc. Ready built. (p.&p. 12/6) **£20.0.0**
Kit for building above, with instructions. (p. & p. 12/6) **£17.10.0**

MULLARD 5-10 MONO

5 valve, 10W basic amplifier kit complete. (p. & p. 7/6). **£9.19.6**
with passive control network and panel £11.19.6.
2 valve pre-amp kit £6.12.6.

MULLARD 3-3 MONO

3 valve 3W amplifier with controls, absolutely complete kit including panel knobs, etc. (p. & p. 7/6). **£7.12.6**

MULLARD MONO PRE-AMP

Complete kit with 2 valves, front panel, controls, etc. for use with 5-10 or other good power amp. **£6.12.6** Built and tested. **£8.10.0** Carriage on either, 5/6.

STEREO 2+2 PRE-AMP

Double 2 valve integrated pre-amp (4 valves in all) for use with TRS MULLARD 10-10. In kit form, with valves, front panel etc. Ready built 13 gns; Complete kit 10 gns. (P. P. either 10s 6d). S.A.E. brings details.

7 VALVE AM/FM RG CHASSIS

A superbly powerful high performance instrument for the keenest enthusiasts. Provides tuning on long, medium and F.M. wavebands. Excellent sensitivity. Permeability tuning on F.M. Large clear dial, A.V.C., good neg. feedback. Magic eye. 3W output. A.C., 200/250V. Circuit diagrams available. Aligned, tested and ready for use. (Carr. and ins. 7/6). S.A.E. brings full details. **£13.19.6**

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Z.12 Amplifier, ready built and tested. Ideal for battery operation, for guitars, hi-fi, etc. etc. As advertised. **89/6**

STEREO 25 PRE-AMP/CONTROL UNIT
Input selector, tone and volume controls. Ready built with elegant front panel as advertised. **£9.19.6**

PZ.3 Mains power unit to drive two Z.12's and Stereo 25. **79/6**

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AMPLIFIER KIT (P/P 4/-) **£9.10.0** POWER PACK KIT (P/P 4/-) **£2.10.0**

MODERN SLIMLINE WOOD CABINET **£2.10.0** (P/P 5/-)

COMPLETE ASSEMBLY £14.10.0 post free if ordered at same time

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LM 3000 Record Player with 9T.A. Stereo Cartridge. Brand new as from factory £8.15.0

AT.60 Mk II De-luxe Auto-changer, die-cast turntable. Less cartridge £11.19.6

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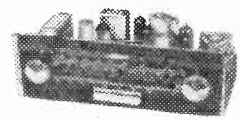
6 VALVE AM/FM TUNER



Med and V.H.F. 190m-550m., 85 Mc/s.-103 Mc/s. 6 valves and metal rectifier. Self-contained power unit A.C Magic-eye. 3 push-button controls. Diode and high output Sockets. Illuminated 2-colour Perspex dial 11¼in x 4in. Recommended for use with the T.R.S. Mullard "3-3" or "5-10" Amplifiers featured here.
Bargain Price. Complete kit of parts, inc. Power Pack as illustrated. 11 Gns. Carr. 7/6. Ditto less Power pack 10 Gns. Carr. 7/6. Circuit and Const. details, 4/6. Free with kit.

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Kit based on Mullard design. 6 Transistors. Beacon indicator. All coils pre-checked and aligned. (Carr. & Packing 2/6) **5 Gns.**

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Kit formerly 59/6 *now* **49/6** *Built formerly* 79/6 *now* **59/6**

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7 Transistor pocket size combined FM Tuner/Rcvr. With earpiece and telescopic aerial. Kit **£5.19.6**

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Teak finished, 21″ high x 15″ wide x 7½″ cut to take tweeter and 8″ or 10″ speaker to order. Acoustically proportioned for finest possible audio quality. Supplied ready to take units.
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Please add 7/6 as part of cost of packing and carriage.

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8″ FR.8 Dual concentric, 15 watts loading **£5.15.0**

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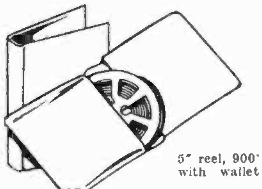

With each reel of this tape by an internationally famous manufacturer we give you a beautifully made wallet strongly made in simulated leather with space for a reel of tape each side. This is professional quality full frequency tape with metallised leader/stop foils. These library wallets solve once and for all the problems of storing tapes efficiently and tidily.

5″ reel, 900′ with wallet **12/6**
5¾″ reel, 1200′ or 7″ reel, 1200, with wallet **17/6**
7″ reel, 1800′ with wallet **22/6**

TAPE REELS 7″, 2/3; 5¾″, 2/-; 5″, 2/-; 3″, 1/3.

VOLUME CONTROLS. LOG and LINEAR. We carry very large stocks in the widest possible range of values, single and ganged. 5K-2MΩ. 3in. spindles. Morganite Midget Type 1⅛in. diam. Guar. 1 year. LOG or LIN ratios less Sw., 3/6. D.P. Sw. 5/-. Twin Stereo less Sw. 7/6. D.P. Sw. 9/6 (100K to 2 Meg. only).
STEREO BALANCE CONTROLS. Log/Anti-Log 5KΩ. ½, 1, 2 Meg. 9/- each. **TYGAN FRET** spkr. fabric, 12 x 12in. 2/-; 12 x 18in. 3/-; 12 x 24in. 4/-, etc. **BONDACOUST Speaker Cabinet Acoustic Wadding,** approx. 1in. thick, 18in. wide, any length cut, 2/3 ft. 6/- yd.
VEROBOARD—All standard sizes including 2½in. x 5in. 3/8; 2½in. x 3¾in. 3/-; 3¾ x 5in. 5/2; 3¾ x 3¾in. 3/8; 2½ x 17in. 12/6. All accessories and tools in stock.
RESISTORS—Modern ratings, full range 10 ohms to 10 megohms, 10% ¼-½ w. 4d. ea. 5% Hi-Stab., ¼-½ w. 6d. ea. (below 100 ohms and over 1 mcg. 9d. ea.). 1% Hi-Stab, ½ w. 1/6d. ea. (below 100 ohms 2/- ea.).
WIREWOUND RESISTORS. 25 ohms to 10 K. 5 w. 1/3; 10 w. 1/6; 15 w. 2/-. **CONDENSERS** Silver Mica. All values 2 pf. to 1,000 pf 6d. ea. Ditto ceramics 9d. Tub. 450 v. T.C.C., etc. .001 mfd. to 0.1 mf./350 v. 10d. .02 mf. to 0.1 mfd. 500 v. 1/-. .25 T.C.C. 1/9. 5 T.C.C. 2/-. **CLOSE TOL. S/MICAS.** 10% 5 pf-500 pf 8d. 600-5,000 pf 1/-. 1% 2 pf.-100 pf. 9d. 100 pf. 9d. 100 pf-500 pf. 11d. 375 pf. 5,000 pf. 1/6. **ALUM. CHASSIS.** 18 g. Plain undrilled, folded 4 sides, 2in. deep. 6 x 4in. 4/6; 8 x 6in. 5/9; 10 x 7in. 6/9; 12 x 6in. 7/6; 12 x 8in., 8/- etc.
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5ft. spool of "Cir-Kit"	2/-
Matrix Board 5″ x 3¾″	4/-
3¾″ x 2½″	2/9
3¾″ x 2″	1/9

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TRS TRANSFORMERS

and chokes of all types available singly or in prototype short runs at very competitive prices. Enquiries invited. S.A.E. with private enquiries please.

WHEN ORDERING

Cash with order please. Unless stated otherwise add p/p as follows—½lb., 1/-; 1 lb., 1/9; 2 lbs., 3/6; 6 lbs., 5/-; 10 lbs., 6/6; 14 lbs., 8/-; Over, 10/6.

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Tel.: 01-684 2188. Hours 9 a.m.—6 p.m. 1 p.m. Wednesdays
A few doors from Thornton Heath Stn. (S.R. Victoria section)

observe polarity where electrolytics and rectifiers are concerned. As a rule negative can be connected to the common rail. The busbar consists of a piece of thick copper wire, about 20 s.w.g., fastened between two small bolts. An extra nut should be

★ components list

Resistors: all ½ watt
5Ω
270Ω
1kΩ
4·7kΩ
10kΩ
56 kΩ
100kΩ
470kΩ
1MΩ
5·6MΩ

Capacitors:
50pF 300V
200pF 300V
0·01μF 1500V
0·1μF 200V
25μF 25V

BY100 rectifier.

Miscellaneous:
Plastic Box 5 x 3 x 1in. (with lid if required), BY100, 2 x 6BA nuts and bolts plus 2 extra nuts, short length (6in.) 20 swg bare copper wire, 2 insulated crocodile clips, 3 insulated probes, wire for leads.

employed to act as a spacer between the box and the busbar (Fig. 4).

The wire to the other end of each component passes through a separate hole and is bent over on itself (Fig. 5). This prevents the wire slipping back into the box and also provides a convenient tag to which the crocodile clips of the test leads can be connected.

LEADS

The leads themselves (preferably colour coded) are approximately 12 to 15 inches long and pass through holes in one end of the box being knotted on each side to anchor them securely. The common lead is soldered direct to the busbar. The other two leads go through two holes in the top of the box and, with crocodile clips attached, become flying leads which are attached to any of the wire "tags" (see Fig. 7). The other ends of the leads can be terminated in crocodile clips, wander plugs, or probes as desired. Where crocodile clips are employed they should be the insulated type to prevent accidental contact with adjacent tags.

PROBES

Suitable probes can be manufactured from expended ballpoint pens by removing the internal assembly, and pulling out the tube which contained the ink. A wire can them be passed down the body of the pen and be soldered to the metal ball assembly which is then refitted into the body of the pen (Fig. 6). The addition of "Panel Signs" type transfers to identify each component completes the unit.

The use of a metal box is not advised because of the difficulty of insulating the "hot" end of the components from the box. Also, no drilling instructions are given because the size of components, particularly capacitors, is not standard.

There are many uses to which this unit can be put. Its principal advantage is, of course, that it provides a selection of components which are easily substituted during fault-finding procedure. ■

LOW COST HI-FI SYSTEM

—continued from page 742

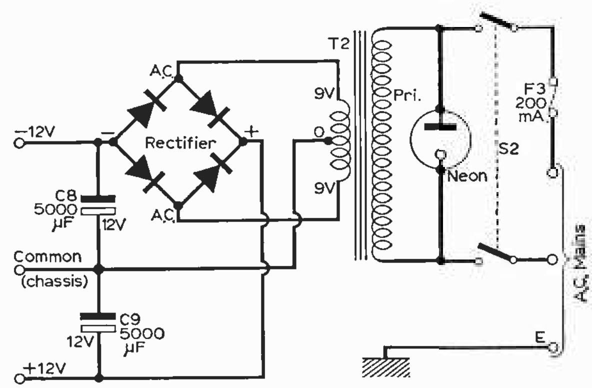


Fig. 13: Circuit of the power supply system used.

REFINEMENTS

An obvious refinement is the inclusion of a rotary switch to select various inputs. A suitable arrangement is shown in the complete circuit diagram, Fig. 11. The wiring to and from the switch should be of screened lead to minimise hum pick-up.

Another concerns the 56Ω resistor R9 which is a compromise value chosen to give freedom from crossover distortion throughout a wide range of transistor and resistor spreads; its value could be adjusted more precisely if the constructor has access to an oscilloscope and audio generator. If so it should be replaced with a 100Ω pre-set shunted with a thermistor type VA1040. The pre-set should be adjusted to the lowest value giving complete freedom from crossover distortion. The thermistor will hold the voltage difference reasonably constant throughout changes in temperature within the amplifier.

No attempt has been made to provide output short-circuit protection, but if reasonable care is taken to ensure that the speaker leads and connections do not become short-circuited whilst the amplifier is delivering appreciable power, no harm will be done.

POWER SUPPLY

A circuit of the power supply is shown in Fig. 13. A mains transformer with a centre tapped secondary delivering 10-0-10V at 2 amps is required. One delivering 9-0-9V is suitable and probably easier to obtain. The 10V transformer will supply 12·5V on load from the rectifier, whilst a 9V transformer will deliver 11·5V, each side of common.

The rectifier arrangement, depending on the way one looks at it, can be considered either as a bridge rectifier supplying 24V or two centre tapped full wave rectifiers in series supplying 12V each in opposite polarity.

The rectifier can be a selenium bridge, or four silicon types mounted on paxolin board and wired as shown. The silicon rectifiers will give rather better regulation, but the selenium is cheaper. Silicon types should have a minimum p.i.v. of 50V at 1 amp. A suitable rectifier at reasonable price is the Mullard BYX 22-200.

NEXT MONTH: FULL STEREO VERSION

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

ASIA

Afghanistan: *Radio Afghanistan* (Ansari Watt, Kabul) has English 1800–1830 on 11,800 and a 19mb outlet. Variously reported as 15,265 and 15,225.

Cambodia: *La Voix du Cambodge* (28 Avenue Breah Mohaksatryany Kossomak, Phnom-Penh) now operates its second network on 9,695 at 0030–0420 and 1100–1500.

China (People's Republic): *Radio Peking* (Fu Hsin Men, Peking) can be heard in English at 1800–1830 over approximately 9,845. Also in Spanish at 0001 around 15,205.

Indonesia: *Radio Republik Indonesia* (P.O. Box 157, Djakarta) has the following frequency utilisation for its foreign service: 0900–0930 11,770; 1100–1200 and 1430–1530 9,865/11,770; 1900–2000 and 2330–2400 9,865.

Israel: *Kol Israel* (Broadcasting House, Jerusalem) now has a Russian Transmission at 2145 on 9,009/9,625/9,725.

Japan: N.A.K. (Tokyo)—frequencies for the 1730–1900 Middle East and North African service are now 7,195/9,670. Some changes made in the General Service are 1600–1630, 1700–1730, 1800–1830 9,505/9,560/9,605; 1900–1930, 2,000–2030, 2100–2130, 9,560/9,605/15,105.

Philippines: *South East Radio Voice* (Dumaguete City, Philippines) has now started operation. First transmissions from this new missionary station have been at 1100–1300 and 2330–0130 to Thailand and Burma over 15,420.

NORTH AMERICA

Canada: *Canadian Broadcasting Corporation* (P.O. Box 6000, Montreal) now has the following frequency utilisation. To Europe 0558–0630 5,955/9,625; 1055–1345 17,820/21,595; 1345–1830, 17,820/21,595 and 15,320 except 1516–1529 and 1630–1700 when beamed to Northern Canada; 2000–2152, 11,720/15,320/17,820; to Africa and Europe 0725–0820 5,990/9,625; to Africa 11,925/15,390/17,820; to south Pacific 0825–0935 5,970/9,625; to North America and Antilles 1215–1315, 9,625/11,720; 1315-1345, 11,720; to Northern Canada 0058–0230 5,970/9,625/11,720; 0230–0706 9,625/11,720; 1055–1213 9,625; 1516–1529 and 1631–1700 15,320; 2200–2250 9,625/11,720/15,190; to Caribbean and Latin America 2300–0045 9,625/11,715/15,190.

U.S.A.: *Voice of America* (U.S. Information Agency, Washington, D.C., 20547) now transmits as follows in English to Europe 0300–0730 3,980/5,960/5,995/7,200/7,270/9,540/9,635/9,740/11,790; 0500–0730 6,040/1,196; 1400–2330 3,980*/5,960/15,290*; 1730–2330 6,060; 1800–2300 11,760; 1400–2245 15,205; 1400–1800 17,855; 1400–2000 17,780; 1600-1800, 2100–2330* 1,196 (*–2345 Sundays).

Radio New York Worldwide (485 Madison Avenue, New York, N.Y. 10022) now transmits as follows to Europe 1600–1830 21,530; 1900–2200 15,440; 1600–1945 17,845; 2000–2200 11,805; to Africa 1600–2200 21,530; to Latin America 1600–1700 17,730; 1700–2200 17,760; 1600–1900 21,465; 1900–2200 21,530.

CENTRAL AMERICA

Cuba: *Radio Habana* Cuba (Apartado Postal 7026, Habana) now transmits in English at 2010–2140 on 15,230; 2050–2150 15,270/11,760; 0100–0450 9,525; 0100–0600 11,760; 0330–0600 6,135; 0630–0800 9,655.

EUROPE

Albania: *Radio Tirana* (Rue Ismail Quemal, Tirana) transmits in English as follows: to Europe 0630–0700 9,715/7,265; 1630–1700 41m; 1830–1900 and 2030–2100 41m/6,090; 2200–2230 49–31–215m; 0030–0100, 0130–0200, 0300–0330, 0430–0500, 1930–2000 49–31m; 0930–1000, 1100–1130, 1400–1430 31–25m; 1530–1600 25m; 1730–1800 31m.

Austria: *Osterreichischer Rundfunk* (P.O. Box 700A, 1040 Vienna) now has the following frequency usage: on 6,000 0430–2000; 6,155 0500–1300, 1700–2200, 2300–0400; 7,245 0500–1300, 2000–2200; 9,770 1000–1200, 1300–1700, 2300–0400; 11,750 1800–2000; 11,785 1300–1700; 15,430 0000–0200; 9,525 2300–0200; 11,760 0200–0400; 15,201 1800–2100; 17,855 0400–1000; 17,750 1600–1800; 15,410 0600–1000; 9,610 1700–2000; 17,730 1400–1600; 17,755 1000–1200; 15,400 1200–1400.

Germany: *Deutsche Welle* (5 Koln, Bruderstrasse 1, P.O.B. 344) now uses 15,275/17,875/21,560 to Africa 0955–1145.

Monaco: *Trans World Radio* (Ru de la Poste 5, P.O. Box 141, Monte Carlo) has English on 7,295 Sundays 0730–1100; Mondays-Fridays 0730–0900; Saturdays 0715–0945. Also on 7,170 Sundays 1515–1630.

Thanks for help go this month to the International Short Wave Club, Radio New York Worldwide, Swiss Broadcasting Corporation, A Colics, A. J. Jenkins and David C. Oates.

THIS last month has been full of surprises and openings liberally sprinkled throughout the r.f. spectrum. On topband there's been some very good periods when both G DX and EU DX has flooded the band. The 1·8Mc/s addicts might be interested to hear that there is a new wire up at G3JDG. This one is 150ft. long and pursues a somewhat tortuous route up and over the top of the house, down the garden, across the bottom and back up the other side. The earthing system has likewise been substantially improved and supplemented with a counterpoise. Sufficient to say that the new antenna draws some 400mA when loaded to 9·5 watts input. Even birds hop off the end when I transmit now. I'll probably be responsible for a new species of bird—the toast-footed crow, or perhaps the sporranless sparrow. Thirty minutes listening on 1·8Mc/s raised—GM, GW, EI, OK, and OF. These were easily readable strong signals with little or no QSB.

J. Farrar (Herts), sends in a very FB log for topband. The list includes—DJ2LG, DJ6TR, DJ7SW, DL9KRA, HI8XAL, K1PBW, K4UCQ, K8RRH, PAØGMU, PAØSNG, TF3AC, W1BB/1, W2EQS, W2KHT, W4VS, W8ANO, W8EMJ, ZB2AY, ZC4RB, 6W8CW, 9H1AM, plus many GI, GW, GM and GD3TNS.

The h.f. bands seem to have fallen out of favour this month, and many s.w.l's had a go on the lower frequencies. Twenty metres, usually the favourite of most DX types, got barely a mention, while eighty metres, seldom mentioned in the past, has risen to the top of the table.

EIGHTY

D. Henbry (Sussex), HA-500, vertical rod at 30ft., found this bunch roaming 3·5Mc/s—HP1XP/MM, K1PNE, K1YIW, K2RBT, OX3CJ, VE2BMY, VO1EL, VO1FX, W1HKK, W2GO, W3BMS, W4SIB, W2WMT, 3B1FV. On seven megs. David's best were WA8FSU and XE1CCW.

J. Bradley (Ireland), R1224A, 50ft. at 15ft. Excursions on eighty produced—CN8AW, CT1PQ, LA3XI, ON4UN, OZ6PG, PAØDDT, SM7ABO, SP6AAT, SP8AVB, TF5TP, UP2OV, UR2IV, VE1AOZ, VE1WA, VE2TJ, W1FRR, W1WQC, W2GO, YU2RAZ, ZB2BC. Not bad for someone who has been at it only six weeks.

R. Jones (Bristol), modified 19 set, 66ft. at 15 feet 80 metres s.s.b.—CN8AW, DJ, DK, DL, DM, EL2VB, HB91B, HB9AJH, K1YIW, K2RBT, K3UZA, LA5KG, LA3XI, OE8BFK, OHØNI, OK1WGW, ON4ZA, ON5JX, VE2BMY, WA2WMT/P, W2ZQV, W3OWN, YU2NFJ.

F. McVerry (Lanarkshire), 7-valve s/het, 40ft. indoor antenna—CN8AW, DJ1MC, DJ7XJ/P/OZ, DL3BA, EI6AI, EI7A, EL3C, GC8HT, HB9ABV, K1YIW, LA, OE, OK, OY9IM, OZ, PA, SM, TF5TP, UP2KNP, VE1AOZ, VE1AX, VE1WA, VE2TJ, VO1FX, W1FH, W1FRR, YU2RAZ, ZB2AP, 9H1AM.

HIGHER UP

Peter Ryder gets the first prize this month for a bit of determined listening on—yes, seven megs. Peter logged these all on phone, either s.s.b. or a.m.—DL2SLU, DJ4WD, OH2HE, UB5KBJ, SM2AJE, CN8AV, I1CWX, EP2BQ, VK6XO (Cor!), PAØNZ, LA7JH, K1KLM, K4CGC, WA2UJS, W3GKM, W3CDL, W4OMW, W8BQH, WA9UPV, WØHTH, YV4IQ, ZC4MO, ZC4RB, 3C3SH. The receiver is an 840C, the antenna—Joystick in the corner of the room at ground level.

Twenty metres has been given the cold shoulder by most s.w.l's. for some strange reason. Usually there are piles of logs for this band but this month nobody was all that interested, at least if they heard anything they went all secretive and didn't want Uncle Dave to know. (Ah well, I'll save on the Christmas presents.)

D. Henbry (see eighty metres) had a listen and managed—AP2MR, KC4USP, PZ1BW, VP8FL, VP8HZ, VP8IU, VP8JC, VP8JD, VP8JI (proper little hot bed of activity from VP8), WB6QKK/KM6, XE1OOB, XE1WS, ZD7KH, ZS3LU, 5V1KG, 5V4EG, 9E3USA, 9G1KG, 9J2WR, 9L1JJ. David says that he has now heard 40 zones thanks to the XE stations down in Mexico. He also logged VK6CF on ten metres at 5 and 5.

R. Schofield (Liverpool), RA-1, joystick with a.t.u., certainly shows that twenty metres is still quite lively. He grabbed this bagfull on s.s.b.—CE1FC, CE1FE, CE6EQ, CX2SO, HB9AED, HK4BAW, HR1JKM, HV3FJ, HV8JJG, I1ZML, K1BT/M, K2KXB, K3WMV, K4YYL, OD5EN, OE8HFL, OF5SM, PY2AED, PY4OD, SM5DZG, UB5KKN, VE1AEP, VE2DLX, VE3AWP, VE7TG, VS9ARS, W5WMU, W6URY, XE1EET, YD5AE, YV5MQ, ZD7KHL, 3C3ELA, 4X4AX, 9M4VJ. On fifteen s.s.b., Roy raised—KØFPL, OE2EGO, SL1ZV, UY5XS, VE5ZL, W1HN, W2JMW, W4FSE, WB4TYI, W8PNX, W9ZNO, 4X4TP.

G. Richards (Isle of Wight), 5 valve domestic receiver, 12ft. of wire indoors, had a go on fifteen and was duly rewarded with the dulcet tones of—CO7GC, CR6KK, CT1LM, CT1RW, CT2AB, EA7CL, EA6BJ, EA8FP, HK1DFI, I1CMD, IS1ATZ, K2JDW, OD5BU, W1DRP/M/2, WA1BJY, W2DYV, WA2JOK, WB2WOR, W4HAK, W5PGS, W7RSP, W8HBO, WA9QAM, WØDYZ, YV5CG, 7XØWW. Wait till he gets a communications receiver and a decent aerial!

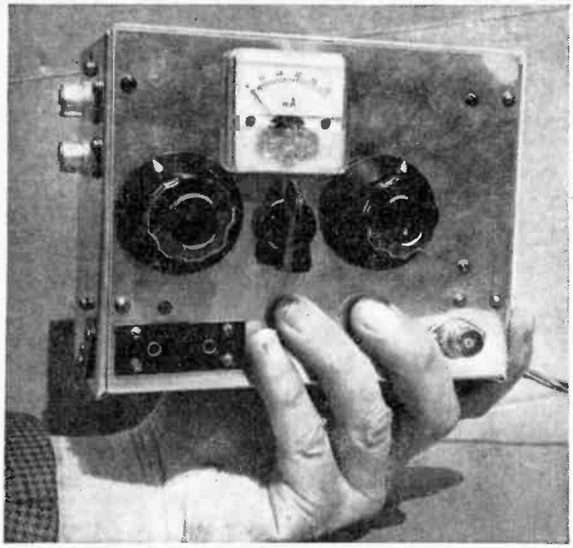
In the classic words of the immortal bard—"Cor, bless me old cotton socks". It's that band again, yes, ten metres. Next year it should be carrying most of the DX. Want "in"? OK, get yourself a ground plane antenna, a sheet of paper and a pencil, and start writing them down.

Paul Baker (S. Wales) HE30, 150ft. 45ft., high isn't waiting for next year, he's started now. His bag of loot for ten metre plunderings include—CE3FN, CR4BC, EL2T, EP3AM, ET3ROL, HBØUG, HC2OA, HS1WF, HZ1AB, I1TRA (Ischia Island) (look it up!), JA1COZ, JA1FRT, JA8XJ.

NEWS AND CONTESTS

Watch the low end of 160 for some nice DX. ZC4, 6W8, ZB2, and a number of EU stations are showing. You will probably run into Stew—W1BB/1 who is one of the stalwarts of 160 DX.

Contests, just one for the 160 enthusiasts—Affiliated Societies Contest, 13—14th, January. Deadline for next month is 20th. BCNU.



MINIATURE phone transmitter

A LICENCE IS REQUIRED TO OPERATE THIS EQUIPMENT

F. G. RAYER G3OGR

THIS transmitter measures 6 x 5 x 3in., and runs at 9 watts input on the 160 or 80 metre amateur bands. The circuit is shown in Fig. 1. The crystal oscillator, V1, provides output at the crystal frequency or doubles depending on the inductance of L1. Crystal control has proved very useful for portable working, but a v.f.o. is a decided asset.

The transmitter has provision for an external v.f.o. whose drive is applied via the v.f.o. socket. The output from V1 is applied to the 5763 p.a. stage giving some 2—4mA of drive which develops some 44—88 volts across R4.

A standard pi-tank output circuit is used to feed the aerial. It is unusual in that a ferrite rod is used as a coil former. The p.a. stage draws around 30mA at 300 volts, the current being registered by M1 which also serves to aid tuning up and loading the p.a. stage. Note: the maximum ratings for the 5763 are 300 volts, 50mA or 15 watts dissipation.

The modulator consists of a double triode using both sections in cascade. These drive a 6BW6 in class A and provide choke modulation. Capacitor C9 is used to prevent r.f. from leaking into the amplifier, while C10 and C12 are selected to help emphasise the middle frequencies. No audio (mike) gain control was found necessary provided one speaks at a reasonably constant distance from the mike.

Three-position control switching is incorporated: **Transmit** with h.t. applied to all stages and aerial connected to the pi-tank, **Net** with h.t. applied only to the oscillator and **Receive,** when the aerial is switched to receiver and the h.t. removed from the transmitter.

A cheap case was constructed using a "universal chassis" box (Home Radio) measuring 5 x 6 x 3in. The 5 x 3in. runners form the sides, the 6 x 3in. runners are used for the top and bottom,

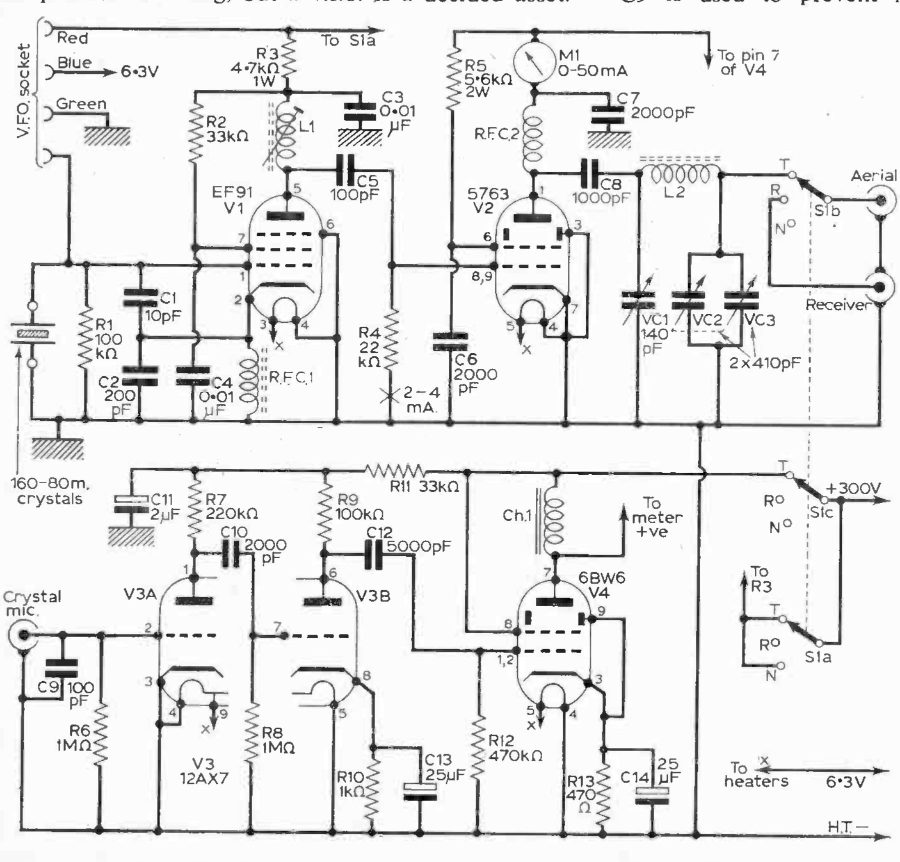


Fig. 1: Circuit diagram of the r.f. and modulator section of the transmitter. A suitable P.S.U. is shown in Fig. 4.

TRANSISTOR STEREO 8+8

A really first-class Hi Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W mono). Integrated pre-amp with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work, Cir-Kit board, attractive front panel, 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: Freq. response ± 3dB 20–20,000 c/s. Bass boost approx. to + 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 25V at ·6 amp.

PRICES

Amplifier Kit	£9 10 0	P. & P. 4/6.
Power Pack Kit	£2 10 0	P. & P. 4/-.
Cabinet (as illus.)	£2 10 0	P. & P. 5/6.

(Special offer—**£14.10.0**, post free if all above ordered at same time.)

Circuit diagram, construction details and parts list (free with kit) 1/6 (S.A.E.)

QUALITY RECORD PLAYER AMPLIFIER

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 3in. d. x 6in. h. Ready built and tested. **PRICE 69/6.** P. & P. 6/- .

ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. **PRICE 89/6.** P. & P. 7/6.

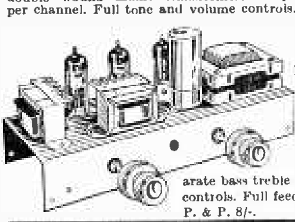
DE-LUXE QUALITY PORTABLE RECORD PLAYER CABINET

Uncut motor board size 14½ x 12in. Clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or Garrard Autochanger or Single Player Unit (except AT60 and SP25) Size 18 x 15 x 8in. Price **£3.9.6.** Carr. 9/6.

STEREO AMPLIFIER

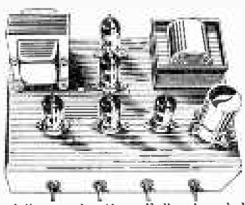
Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.

ONLY **£4.19.6** P. & P. 8/-



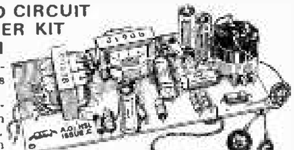
Super De-luxe version with ECL86 valves separate bass treble and balance controls. Full feedback 8 gns P. & P. 8/-.

10/14 WATT HI-FI AMPLIFIER KIT



A Stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6 (Free with parts). **All parts sold separately.** ONLY **£7.9.6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets. **£9.5.0.** P. & P. 8/6. Carrying case for above **28/6.** P. & P. 7/6.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



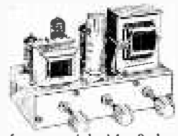
- Peak output in excess of 1½ watts.
- All standard British components.
- Built on printed circuit panel, size 6 x 3in.
- General size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors GET 114 or 81 Mullard OC81D and matched pair of OC81 o/p.
- 9 volt operation.
- Everything supplied, wire battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram 1/6. (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, **52/6.** P. & P. 3/-.
A pair of TA1s are ideal for stereo.

BRAND NEW TRANSISTOR BARGAINS

GET 15 (Matched Pair) 15/-; V15/10p, 10/-; OC71 5/-; OC76 6/-; AF117 7/6.
Set of Mullard 6 transistors OC44, 2—OC45 OC81D matched pair OC81 **25/-**, ORP12 Cadmium Sulphide Cell **10/6.** All post free.

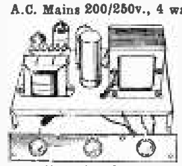
3-VALVE AUDIO AMPLIFIER HA34



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83 EL34, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4.5.0.** P. & P. 6/-.

HSL 'FOUR' AMPLIFIER KIT

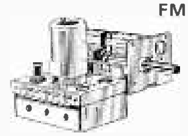
A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.



- Heavy duty double-wound mains transformer with electrostatic screen.
- Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss.
- Heavy negative feedback loop over 2 stages ensures high output at excellent quality with very low distortion factor.
- Suitable for use with guitar, microphone or record player.
- Provision for remote mounting of controls or direct on chassis.
- Chassis size only 7½in. wide x 4in. deep. Overall height 4¾in.
- All components and valves are brand new.
- Very clear and concise instructions enable even the inexperienced amateur to construct with 100% success.
- Supplied complete with valves output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy).

PRICE 79/6. P. & P. 6/-.
Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).
This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

FM/AM TUNER HEAD



Beautifully designed and precision engineered by Dormer and Wadsworth Ltd. Supplied ready fitted with twin ·0005 tuning condenser for AM connection. Prealigned FM section covers 86–102 Mc/s. I.F. output 10·7 Mc/s. Complete with ECC85 (6L12) valve and full circuits diagram of tuner head. Another special bulk purchase enables us to offer these at **27/6** each. P. & P. 3/-. Order quickly! Limited number also available with precision geared 3:1 reduction drive, **30/-.** P. & P. 3/-.

MATCHED PAIR AM/FM I.F.'s

Comprising 1st I.F. and 2nd I.F. discriminator (465kc/s /10·7Mc/s). Size 1 x 1½ x 2¾in. high. Will match above tuner head. **11/-** pair. P. & P. 2/-.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PCC84 and PCF80 valves 34-38 Mc/s I.F. Biscuits for Channel 1 to 5 and 8 and 9. Circuit diagram supplied. **ONLY 25/-** each. P. & P. 3/9.

GORLER F.M. TUNER HEAD

88–100 Mc/s. 10·7 Mc/s I.F. **15/-** plus 2/- P. & P. (ECC85 valves **8/6** extra).

TWIN TELESCOPIC AERIAL

Comprising two 3-section heavily chromed rods. Closed 12in. each extending to 32in. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket, coax lead and plug. Suitable for F.M. or TV. **12/6.** P & P. 2/6.

VIBRATORS. Large selection of 2, 4, 6, 12, 24 and 32 volt. Non sync **8/6**; Sync **10/-.** P. & P. 1/6 per vibrator. S.A.E. with all enquiries.

S.T.C. SILICON AVALANCHE HALF-WAVE RECTIFIERS

Type RAS. 508 AF. 6 amps. 960 P.I.V. 1in. long × ¼in. dia. approx. List **50/-** OUR PRICE **8/6.** Post Free.

4-SPEED PLAYER UNIT BARGAINS

Mains Models. All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU/12 .... **£3.9.6** Carr. 5/6.
GARRARD SP25 De Luxe .. **£10.19.6** Carr. 5/6.
B.S.R. GU7 with unit mounted pickup arm. **£4.18.8** Carr. 5/6.

AUTO CHANGERS (Carr. 6/6 on each)

Latest B.S.R. UA25 Super Slim **£6. 2.6**
GARRARD 1000 with Hi-Fi cartridge **£6.19.6**
GARRARD 2000 **£7.10.0.** GARRARD 3000 **£8.15.0**
LATEST GARRARD AT60 Mk. II **£12.0.0**

All the above units are complete with mono head and sapphire stylus or can be supplied with compatible stereo head for 12/6 extra.

BRAND NEW CARTRIDGE BARGAINS

ACOS GP 69/1 MONO CARTRIDGE. For E.P. and L.P. Complete with stylus. **ONLY 12/6.** P. & P. 1/-.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE with diamond stylus **50/-** or with sapphire stylus **40/-.** P. & P. 1/- each.

BRAND NEW 3 OHM LOUDSPEAKERS

5in., **12/6**; 6½in. **15/-**; 8in. **22/6**; 10in. **27/6**; 7in. x 4in. **16/-**; 10in. x 6in. **27/6.**
E.M.I. 8in. x 5in. with high flux magnet, **21/-.**
E.M.I. 13½ x 8in. with high flux ceramic magnet, **42/-** (15 ohm **45/-**). P. & P. 5in. 2/-, 6½ & 8in. 2/6, 10 & 12in. 3/6 per speaker.

35 OHM SPEAKERS

3½in.**12/6**; 7 x 4in. **21/-.** P. & P. 2/- per speaker.

E.M.I. 3½" HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohms, **15/-.** P. & P. 2/6.

BRAND NEW HEAVY DUTY 12in. SPEAKERS. Response 45 c/s—13 Kc/s. 1½in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at **£9/6.** P. & P. 5/-. Also 25 watt Guitar Model available at **£5.5.0.** And 35 watt Guitar Model **£6.8.0.**

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually **35/-** yard. Our PRICE **13/6** per yard length. P. & P. 2/6 (min. one yd.). S.A.E. for samples.

LATEST COLLARO MAGNAVOX 363 STEREO TAPE DECK. Three speeds, 4 track, takes up to 7 in. spools, **£12.10.0.** Plus 7/6 Carr. & ins. (Tapes extra).

QUALITY PORTABLE TAPE RECORDER CASE. Brand new. Beautifully made. Only **49/6.** P. & P. 8/6.

Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser 35/-. P. & P. 3/-.

ACOS CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity, **18/6.** P. & P. 1/6.

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SPECIAL OFFER! MOVING COIL STICK MIKE. Fitted on/off switch for remote control. High quality. High or low impedance. (State imp. required.) BARGAIN PRICE 30/- P. & P. 2/6.

NEON A.C. MAINS INDICATOR. For panel mounting, cut out size 1¼ x ⅝ x ⅞in. deep inc. terminal. White case with lens giving brighter light. For mains 200/250v. **2/6** each. P. & P. 6d. (6 or more post free).

MAINS TRANSFORMER. For transistor power supplies. Tapped pri. 200-250 v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6.3 v. at .5 amp for dial lamps etc. Drop thro mounting. Stack size 1¾ x 3¾ x 3¼in. **27/6.** P. & P. 4/6.

MAINS TRANSFORMER. For Transistor power supplies. Pri. 200/240 v. Sec. 9-0-9 v. at 500 mA, **11/-.** P. & P. 2/6. Pri 200/240v. Sec. 12-0-12 at 1 amp **14/6** P. & P. 2/6.

MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1¼ x 1½ x ⅞in. Output trans. tapped for 3 ohms and 15 ohm output. **10/-** pair, plus 2/- P. & P.

7-10 watt OUTPUT TRANSFORMERS to match pair of ECL 86's in push-pull to 3 ohm output. ONLY **11/-.** P. & P. 2/6.

10-12 watt OUTPUT TRANSFORMERS. Size 2¼ x 2in. Clamp fitting. For two EL84's in push pull. State 3 or 15 ohm impedance. **12/6** P. & P. 2/6.

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Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station.

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, S.W.19 Tel.: 01-540 3985

SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

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PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

while a further 6 x 3in. runner acts as a chassis. Valveholders are positioned as shown in Fig. 2, V1 and V3 requiring cans. Cut away the corner flanges for about 7/16in. on the chassis to enable this part to fit inside the flanges of the case sides. Two 6BA bolts secure the chassis to the panel at a height of 1$\frac{3}{8}$in. When the box is assembled, bolt the end flanges of the chassis to the sides. The left side (Fig. 2) carries two coaxial sockets for the aerial and receiver connections. These are $\frac{3}{4}$in. from the front, and 1in. and 1$\frac{3}{4}$in. from the top. This side also carries the v.f.o. input socket.

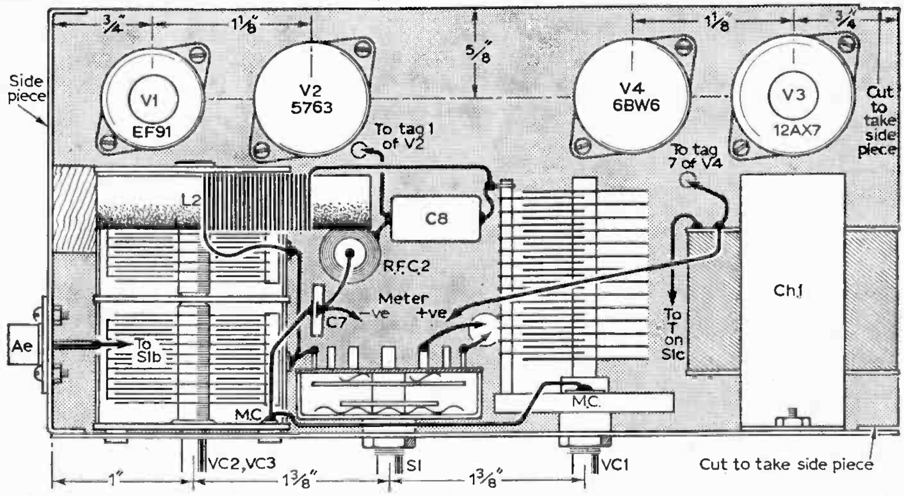

Fig. 2: Top chassis layout of the main components.

The variable capacitors and the switch are mounted 2$\frac{1}{2}$in. from the bottom of the panel. The exact capacitors listed need not be used but larger components would be too big to fit. The lead from S3 to the receiver socket is kept against the panel away from the aerial socket.

The cathode bias resistor R13 is purposely made larger than usual to reduce the current taken by V4 and consequently the current passing through the modulation choke CH1. The meter is 1$\frac{21}{32}$in. square-fronted type positioned directly above the switch S1.

TANK COIL

The tank coil L2 is wound on a ferrite rod 2 x $\frac{3}{8}$in. diameter wound with 20 turns close wound of 22s.w.g. on a strip of paper wound round the rod. The rod is a push fit in a $\frac{3}{8}$in. diameter hole in a small block of wood bolted to the side of the case.

Under-chassis wiring follows a logical common-sense pattern, two small tag strips providing anchor points. It is easier to wire up V1 before fitting the side runner. A suitable crystal holder can be mounted as shown.

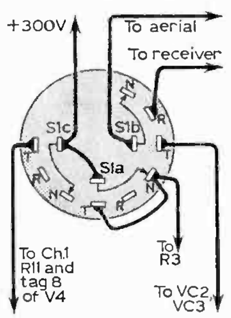

Fig. 3: Wiring details of the control switch.

Coil L1 is an Osmor QA5. If 160 metre operation is envisaged L1 should be mounted directly and resonated on initial setting up to 1·9Mc/s. If the transmitter is to be used on 80, then 30 turns should be removed from L1 and the coil resonated at 3·7Mc/s.

The tank coil, wound as described, will function on 80. For topband this is replaced by a coil consisting of 44 turns 26s.w.g. DCC wire close wound on a ferrite rod 2$\frac{1}{4}$in. long by $\frac{3}{8}$in. diameter. Almost any multi-way connector socket may be used for the v.f.o. socket providing there are at least four terminals available.

The heater consumption of the transmitter is 1·8A plus what the v.f.o. draws. The h.t. drain is about 80mA plus (say) 20mA for the v.f.o. The circuit of Fig. 4 shows details of a suitable power supply unit.

TESTING

Insert all valves except V3. Plug in the appropriate crystal and connect a mA meter between the lower end of R4 and chassis. This position is shown by a cross in Fig. 1. Turn the control switch to the Net position and adjust the core of L1 for maximum reading on the mA meter. This is not critical but should read around 2—4mA. If a v.f.o. is used, set to the middle of the band. The meter is now removed and R4 returned to chassis.

Connect a dummy load, switch control-switch to transmit and load transmitter up to 9 watts input. If a 15 watt bulb is used the pi-tank is tuned for maximum brightness with 9 watts input. Plug in the mike and V3. The transmission may now be monitored on the station receiver.

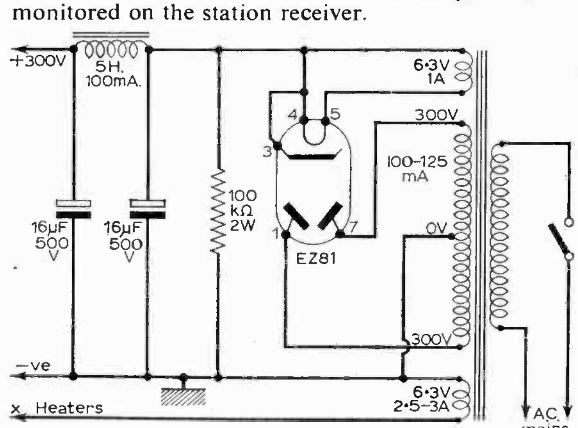

Fig. 4: Circuitry for a suitable power supply unit.

After testing, the remaining side, top and bottom members may be bolted on using self-tapping screws or nuts and bolts. The back consists of a 6 x 5in. piece of expanded metal fret providing ventilation. It is held on with self-tapping screws.

Plug in the aerial and the receiver input to their appropriate sockets and the transmitter is ready to go on the air. Results will depend on the efficiency of the aerial used. With an end-fed 130ft. wire contacts have been made on 160 metres in the range 50—100 miles, and on 80 metres from 100—300 miles.

CW MODE

For c.w. operation, cathode keying of the p.a. is satisfactory. Disconnect pin 7 of V4 and connect a 5000pF capacitor directly from this pin to chassis. Run a screened lead from pin 7 to a key jack. A 470Ω resistor and a 5000pF capacitor in series form a key-click suppressor across the key contacts.

★ components list

Resistors (½-watt 10% unless stated):

R1	100kΩ	R8	1MΩ
R2	33kΩ	R9	100kΩ
R3	4·7kΩ 1-watt	R10	1kΩ
R4	22kΩ	R11	33kΩ
R5	5·6kΩ 2-watt	R12	470kΩ
R6	1MΩ	R13	470Ω 1-watt
R7	220kΩ		

Mica or disc ceramic capacitors (unless stated):

C1	10pF	250V
C2	200pF	250V
C3	0·01μF	350V
C4	0·01μF	350V
C5	100pF	350V
C6	2000pF	500V
C7	2000pF	1kV
C8	1000pF	1kV
C9	100pF	250V
C10	2000pF	350V
C11	2μF	350V electrolytic
C12	5000pF	350V
C13	25μF	6V electrolytic
C14	25μF	50V electrolytic
VC1	Eddystone 140pF 600V variable	
VC2/3	Jackson 02	2-gang 410pF

Valves:

V1	EF91
V2	5763
V3	12AX7
V4	6BW6

Inductors:

L1	Osmor QA5
L2	see text
RFC1	2·5mH miniature type
RFC2	2·5mH short wave type
CH1	5H 60mA choke

Miscellaneous:
Meter 0–50mA, crystal holder, B7G valveholder with can, three B9A valveholders one with can, three co-ax sockets, case, universal chassis from Home Radio (Mitcham) Ltd., 3-pole 3-way rotary switch, tag strips, three knobs, 4-way socket.

Switching from phone to c.w. may be effected by an on/off switch across the modulation choke or by separate contacts on the key jack performing the same function. Alternatively, fit a 2-pole 2-way slide switch to remove h.t. from the entire audio section, and apply h.t. to V1 and V2 only for c.w. operation. ■

Work is now being carried out on a companion v.f.o. and it is hoped to publish details shortly.

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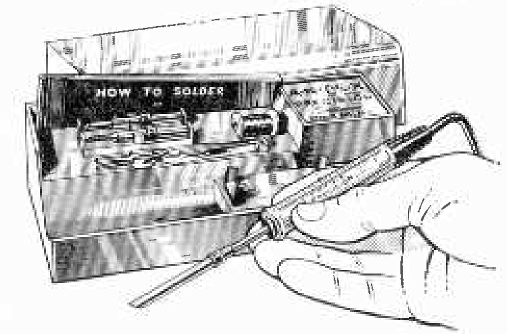

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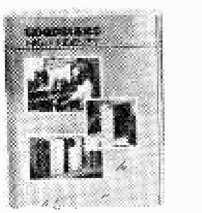

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LETTERS...

Can anyone help?

As a regular reader of your magazine for some years' standing, I would like to take this opportunity to thank you for the excellent publication which always includes a wide variety of topics both interesting and useful to the novice as well as the professional reader. Living on the Continent one learns to appreciate a good magazine of this kind, as there is no equivalent publication available here.

At the same time I wonder if you would be kind enough to include a personal request for information in one of your future issues.

I have recently acquired the Government surplus communication receiver R107, unfortunately however without the appropriate valves. I would therefore be very much obliged if any reader could supply me with details about the valve line-up and especially about equivalent valve types for replacement, as the availability of components used in surplus equipment is very limited on the German market. I would also like to buy or loan manual, circuit diagram and modification instructions for fitting an "S"-meter.—**J. Theimer** *(415 Krefeld Hafels Str. 36, Germany).*

Prolongs active life

Having been a reader of P.W. for a considerable number of years I have found the free blueprints and calculators of great interest.

After constant use, especially the calculators, they soon become useless pieces of cardboard.

I have found a method, perhaps not an original one, which will preserve these gifts and give them a longer and much more useful life.

By covering the calculators with transparent Fablon they become more rigid and serviceable, any dirt, grease etc., can be rubbed off with a damp cloth and does not render the calculator useless.

This method used on the P.W. Data-Rule will increase its life expectancy from a few months to a number of years.—**W. Bell** *(Co. Durham).*

Bomber bits

I have undertaken the renovation of a Halifax bomber for the Skyfame Museum at Staverton Airport. But I am greatly in need of certain electrical and radio equipment.

They are as follows:—

A.R.I. 5085 receiver
A.R.I. 5153 indicator
A.R.I. 5085 indicator
M.K. XIV computer

I require if possible only the outer casing of this equipment as it is only for display purposes. I also require three valves for an Air Ministry type receiver 1155.

I wonder if any readers will be able to help me?—**I. Juggins** *("Bismore", Field End, Churchdown, Gloucester).*

Switched F.M. tuner

Constructors of the "Switched F.M. Tuner" (P.W., August) should take care with their choice of transistors Tr3 and Tr4 which form a d.c.-feedback pair in the i.f. stages.

The use of transistors of only moderate gain in these positions will result in both transistors "bottoming" with consequent blocking of the signal. To overcome this difficulty I have found that changing R11 to 39kΩ, R15 to 100Ω, and R16 to 680Ω results in a high stage gain using OC45 transistors with gains of 80 for Tr3 and Tr4. As the OC45 transistors can be relied on not to pass the 2Mc/s interstation beat, C12 may be omitted and the i.f. gain increased by a small amount.

To prevent any instability due to the very high gain in the i.f. stages, C21 should be increased to at least 100μF. I have added a fourth switch position and trimmer capacitor and have found that the tuner gives excellent results with the new local station "Radio Sheffield".

Finally, I am not hopeful that the tuner can be easily modified to provide an acceptable stereo-multiplex signal for subsequent decoding because the lowest instantaneous i.f. frequency can be less than 50kc/s and this is *less* than the maximum frequency content in a stereo-multiplex signal.—**D. A. W. Taylor** *(Sheffield).*

Switched F.M. tuner

I have built the Switched F.M. Tuner described in the August and September issues of PRACTICAL WIRELESS, and it works excellently without drift. OC45's were used for Tr3 and Tr4, R16 being increased to 1·2kΩ. Unmarked 2N2926 types were used for Tr5, 6 and 7, R21 being increased to 220kΩ to reduce the collector current of Tr6. A break was made in the Veroboard copper strip between V31 and V32, as indicated on the circuit diagram.—**M. Howley** *(London, S.W.6).*

Amateur communications receivers

I would be deeply grateful if you would ask your readers of P.W. if any one of them has made the "Amateur Communications Receiver" described in July and August 1961 issue of P.W.

I am making this receiver, and I am having difficulties in finding details of the three sets of coils used. I would be deeply grateful if any reader would write to me. **M. Kolodko** *(58 Freeman Road, Didcot, Berks.).*

Wireless Intercom

I regret to declare that my "Wireless Intercom" featured in the November edition of PRACTICAL WIRELESS contained an error. This is entirely my fault, and I am sorry for the inconvenience it will have caused. The mistake lies in the value of C4 which serves only to provide an earth return circuit for the r.f. carrier wave, and not for the a.f. signal. Whereas it is printed as 0·5μF, it should be 1,000pF.—**P. J. Smith** *(Horsham, Sussex).*

CQ Eastbourne SWL's

Would anyone who would like to help start a short wave club in the Eastbourne area please write to me at the address below, or telephone me at Heathfield 2454? — **G. M. Chapman** *(Woodcot, Upper High Street, Heathfield, Sussex).*

new books

Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in heavy type should be quoted.

TRANSISTOR BIAS TABLES (Volume 2—Silicon)
By E. Wolfendale, B.Sc.(Eng.), M.I.E.E. Published by Iliffe Books Ltd. 82 pages. Size 10 x 7½in. Price 25s.

THIS is a companion volume to the author's Transistor Bias Tables covering germanium types (see Jan. 1967 PRACTICAL WIRELESS, page 670). It is a collection of tables for those designing or building transistor amplifiers but this time a more sophisticated computer programme has been written which has enabled a greater degree of optimisation to be built into the compilation.

The tables provide the values of the three resistors required for the conventional bias circuit for a silicon transistor. Eleven values of collector current are given and for each there are six values of supply voltage each occupying a full page. Other information includes values of transistor parameters in the conventional bias circuit and the range of junction temperatures over which the transistor is required to operate.

If you already have Volume 1, you will need this one.—*WNS*.

TAPE RECORDER SERVICING MECHANICS
By H. Schroder. Published by Iliffe Books Ltd. 122 pages, 8¾ x 5½in. Price 21s.

CREDIT for a good piece of technical writing must be shared with R. C. Glass, City University, London, who edited this work, which appears to have originated from AEG(Telefunken). The subject-matter is very readable and logically laid out. Following a chapter on tape recorder mechanism, the author gets to grips with measurements of tensions and pressures and then progresses to electrical operation.

There is some interesting data on head and tape characteristics and measurements, only faulted by the omission of the equalisation standards agreed upon internationally last year. We were glad to note that the influence of h.f. bias was given some prominence, and clearly argued. A few circuits are quoted as examples, but these are all valved.

Electrical measurements are discussed, with some good explanations of why some tests have to be made in special ways, and with compensating networks, filters, and so on. This should interest the student, if not the average owner, who is mainly concerned with repair of his own machine. Whether or not it will prove, as claimed by the publishers, a reference book for the City and Guilds Course remains to be seen.

Certainly, I should have liked to have seen the page and a bit on Repair Hints enlarged. Such advice as: "*. . . if treble is missing, and quick realignment of the playback head does not improve matters, a check measurement should be made with a new head in good condition,*" smacks more of factory methods than normal workshop techniques.

Nevertheless, the book is a reasonably-priced asset to the den and will repay amateur and professional alike. It is the most practical at its price yet available.—*HWH*.

TAPE RECORDERS
By P. Spring. Published by Focal Press Ltd. 207 pages. 8¾ x 5¾in. Price 42s.

THE complete title of this book *Tape Recorders—Performance Analysis and Service Techniques*, gives a better idea of the work. It is written for the service engineer and student of tape recording, and assumes that the reader has a fundamental knowledge.

The author makes no bones about it: "*. . . recorders are often highly sophisticated devices,*" he says. "*. . . where they differ from radio or TV, they do so in a dramatic fashion and it is this which makes even skilled engineers reluctant to tackle what is often no more than a small and routine problem . . .*" Practising engineers will certainly agree, having handled some of the machines butchered to solve an original small problem.

The author, Paul Spring, has been concerned with magnetic recording since its early days, and is chief engineer of Grundig (Gt. Britain) Ltd. He has applied his characteristic lucidity to the production of this book and the results do him justice.

There are 16 chapters. The first two are theoretical, dealing with Sound, and the third covers Magnetic Properties. From there on, the book is intensely direct and practical: Frequency compensation, Dropouts and the Basic Mechanism.

Electrical tests follow (numerous useful hints and reasons for certain precautions) then on to a meaty 36-page treatise on mechanical tests and adjustments. Although Grundig systems are given prominence, alternative methods of tape recorder drive transport are also described, and coverage is fairly complete, but servo brake mechanisms and compensating tension devices are not given the weight they deserve.

Chapters follow on Sockets and Standards, on Impedance Matching, Special Effects recording, Automatic Level, Brushless d.c. Motors (very interesting) and a short look at crossfield bias, and cassette recorders. Finally, a kind of summary, called "Typical Dimensions and Values", a handy source of reference, though regrettably short, and an appendix of relevant tables. This must be regarded as the best general reader's book on the subject, at its price, yet available anywhere.—*H.W.H.*

HOME RADIO CATALOGUE

Home Radio (Components) Ltd. have recently introduced a new edition (4th) of their popular catalogue. This edition in which many new items have been added, and many sections completely revised, covers an extremely wide range of equipment and components. The popular 1/– voucher feature has been retained. This new catalogue is a must for the home constructor, and is a very useful source for reference purposes. The cost is 7/6d. (plus post and packing 2/–) and is available from Home Radio (Components) Ltd., 187 London Road, Mitcham, Surrey, CR4, 2YQ.

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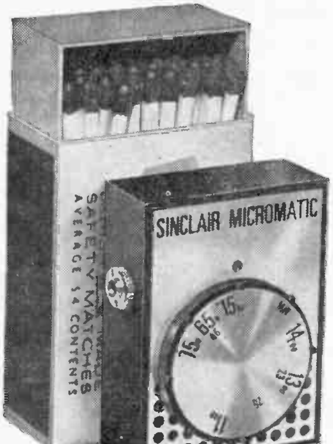

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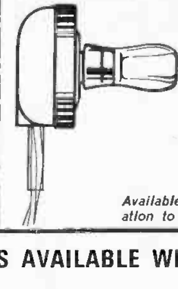

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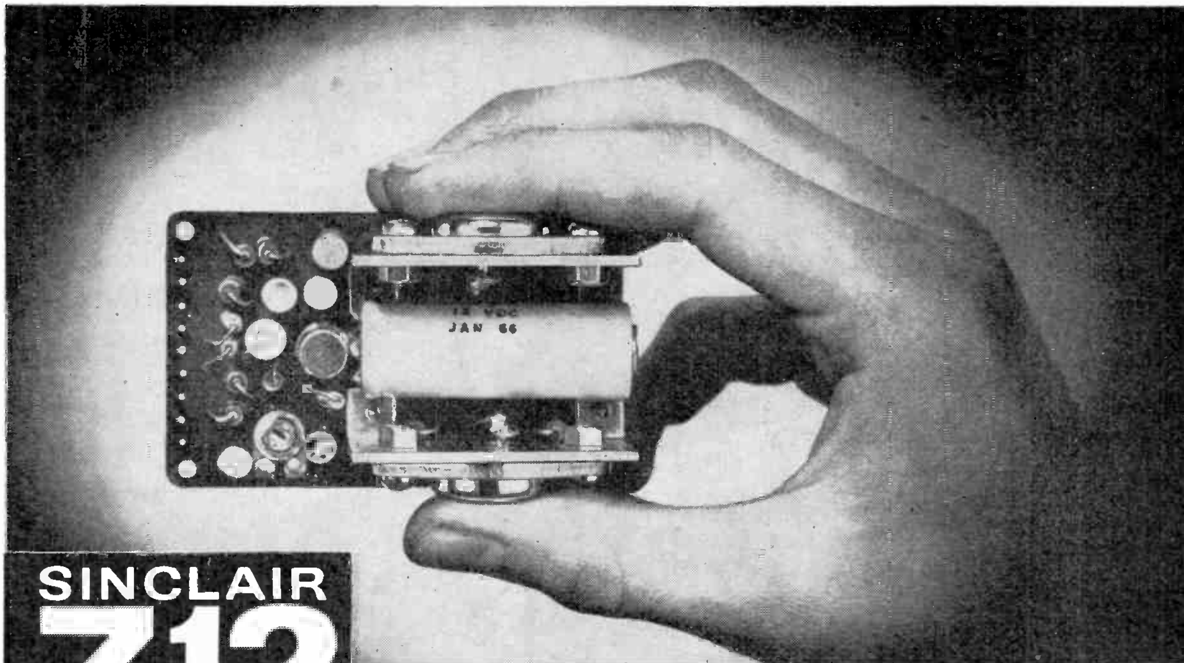

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COMBINED 12 WATT HI-FI AMP AND PRE-AMP

ONLY 3" x 1¾" x 1"

RESPONSE FROM 15-50,000Hz ±1dB

● **IDEAL FOR BATTERY OPERATION**

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"I have installed your Stereo 25 with two Z.12 Amplifiers. I have not heard anything better on sets costing four times as much."

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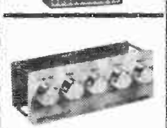
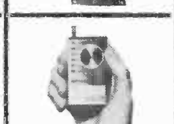

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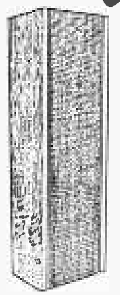
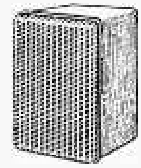
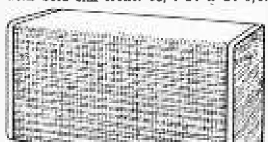
SPEAKER SYSTEMS



THE CAXTON COLUMN This is a column cabinet. Size 22½ × 5 × 6½in., fitted with 3 speakers. This will handle 10 watts and will improve the quality of any tape recorder, or record player. Finished in wood grain cloth and sandstone Vynair. A real bargain at £3 plus 10/- P. & P.



THE MILTON. A Hi-Fi Bookcase Cabinet. Size 9 × 5 × 6in. with 5in. speaker. Finished in Teak cloth with bold silk front. 30/-. P. & P. 3/6.



THE STEREO. A superior extension cabinet fitted with two 7 × 4in. speakers. Size 16 × 9 × 8½in. Finished in fawn Vynair with natural teak ends. £3. P. & P. 5/-.

THE IMP. Extension Speaker Cabinet. Wedge shaped, size 7½ × 6½in. fitted with 7 × 4in. speaker. Covered with attractive walnut with fawn Vynair front. Keyhole slot in back. Only 25/6. Post 2/6. **Note:** All cabinets new and made with ½in. chipboard. All speakers ex TV reconditioned hi flux magnet. All carefully tested before despatch.

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Table top or wall mounting enclosure for 13½ × 8in. speakers 37/6. P. & P. 4/6.
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AF118	3/6
AF119	3/6
AF178	10/-
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OC23	10/-
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OC35	5/-
OC36	7/6
OC41	2/6
OC42	2/6
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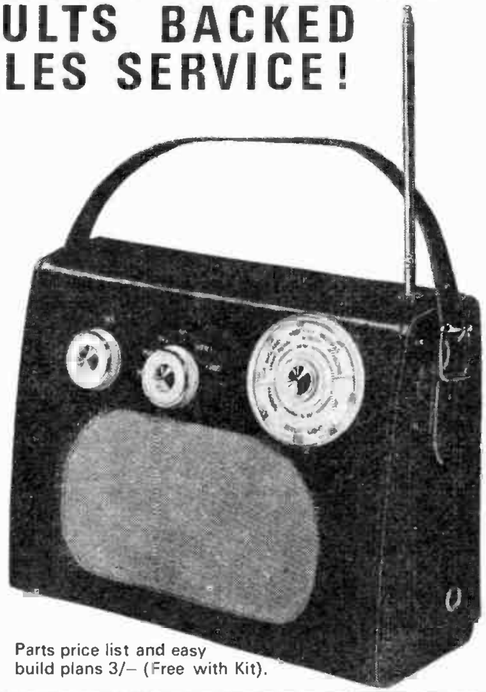

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- Extra tuning of Luxembourg, etc.
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- First grade components.
- Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build with guaranteed results.

Total building costs **£5.19.6** P. & P. 5/6

Parts price list and easy build plans 3/– (Free with Kit).

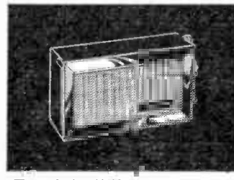
TRANSONA FIVE

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive case with red speaker grille. Size 6½ x 4½ x 1½in. Fully tunable. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone super dynamic 3in. speaker, all first grade components. Easy build plans and parts price list 1/6. (FREE with kit).

Total building costs **42/6** P. & P. 3/6

POCKET FIVE



MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive black and gold case. Size 5½ x 1½ x 3½in. Fully tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone 2½in. moving coil speaker etc. Easy build plans and parts price list. 1/6 (FREE with kit).

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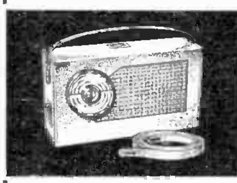
MELODY SIX



TWO WAVEBAND PORTABLE WITH 3in. SPEAKER

Handsome leather-look case size 6½ x 3½ x 1½in. with gilt trim and hand and shoulder straps. Fully tunable over both Medium and Long Waves. Incorporates pre-tagged circuit board, 8 stages—6 transistors and 2 diodes, ferrite rod aerial, push-pull output, wave change slide switch, tuning condenser, volume control, 3in. moving coil speaker etc. Easy build plans and parts price list 2/-. (FREE with kit).

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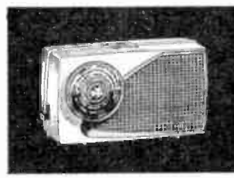
MELODY MAKER 6

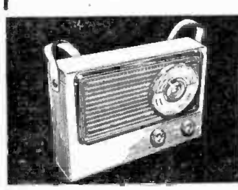


THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Smart pocket size case, 6½ x 3¾ x 1½in. with gilt fittings. Fully tunable over both Medium and Long Waves with extra M.W. band for easier tuning of Luxembourg, etc. 8 stages—6 transistors and 2 diodes, top grade 3in. speaker, 2 R.F. stages for extra boost, high "Q" ferrite rod aerial. Easy build plan and parts price list 2/- (FREE with kit).

Total building costs **69/6** P. & P. 3/6

ROAMER SIX

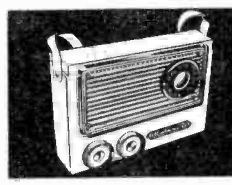


SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings, size 7½ x 5½ x 1½in. World wide reception. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. All top grade components, 8 stages—6 transistors and 2 diodes including Philco Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra.) Easy build plans and parts price list 2/– (FREE with kit).

Total building costs **79/6** P. & P. 3/6

SUPER SEVEN



THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case size 7½ x 5½ x 1½in, with gilt fittings and carrying strap. The ideal radio for home, car or outdoors. Covers Medium and Long Waves and Trawler Band. Special circuit incorporating 2 R.F. Stages, push pull output, ferrite rod aerial, 7 transistors and 2 diodes, 3in. speaker (will drive larger speaker) and all first grade components. Easy build plans and parts. Price list 2/- (FREE with kit).

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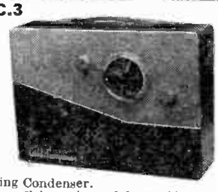

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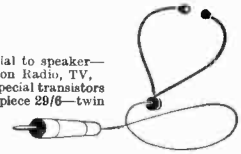
It's partly built

Like its predecessors this latest Companion has full fi performance—such as only a good wooden cabinet and biflux speaker can give, and due to its being partly built you will have it going in an evening. Note these features.

- 7 Transistors, superhet circuit.
- Two-tone Cabinet, size 11 x 8 x 3in.
- All circuit requirements—Push-pull output—A.V.C. and feed back, etc.
- Printed circuit board all wired only connections, e.g. to Volume control W.C. Switch and Tuning Condenser.
- Pre-aligned IF stages complete with full instructions. Price only **£4.9.6** plus 6/6 post and insurance.

RADIO STETHOSCOPE



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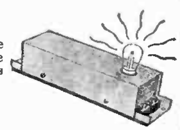

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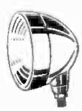

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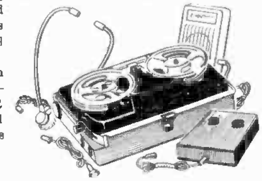

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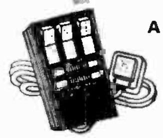

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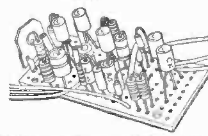

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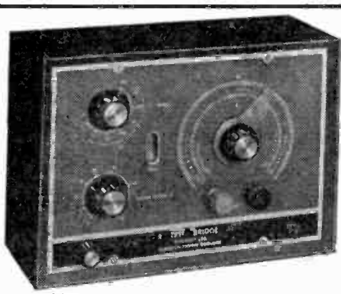

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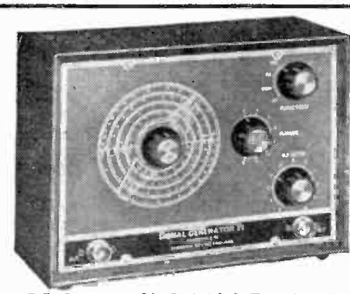

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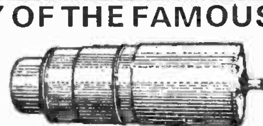

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1µF	15 volt	6µF	12 volt	40µF	6·4 volt
1µF	50 volt	6µF	15 volt	50µF	6 volt
1·25µF	16 volt	6µF	150 volt	50µF	9 volt
2µF	3 volt	8µF	3 volt	50µF	12 volt
2µF	9 volt	8µF	6 volt	64µF	2·5 volt
2µF	70 volt	8µF	25 volt	64µF	9 volt
2µF	150 volt	8µF	350 volt	100µF	3 volt
2µF	350 volt	8µF	50 volt	100µF	6 volt
1µF	350 volt	8µF	275 volt	100µF	9 volt
2·5µF	16 volt	10µF	6 volt	150µF	12 volt
2·5µF	25 volt	10µF	10 volt	150µF	25 volt
3µF	3 volt	10µF	12 volt	200µF	3 volt
3µF	12 volt	10µF	25 volt	200µF	4 volt
3µF	25 volt	12µF	3 volt	200µF	16 volt
8µF	450 volt	12µF	20 volt	250µF	2·5 volt
3·2µF	6 volt	16µF	30 volt	250µF	12 volt
3·2µF	6·4 volt	16µF	150 volt	250µF	9 volt
3·2µF	64 volt	20µF	3 volt	320µF	2·5 volt
4µF	4 volt	20µF	6 volt	350µF	9 volt
4µF	12 volt	20µF	9 volt	350µF	10 volt
4µF	25 volt	20µF	15 volt	400µF	2·5 volt
4µF	64 volt	25µF	6 volt	400µF	15 volt
4µF	100 volt	25µF	12 volt	500µF	4 volt
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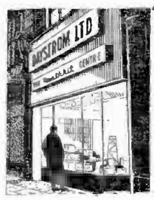

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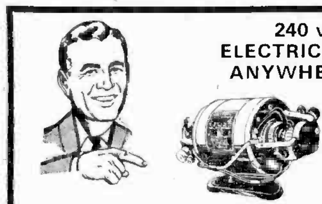

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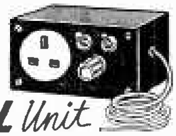

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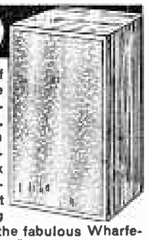

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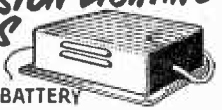

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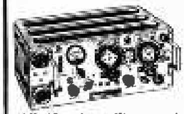

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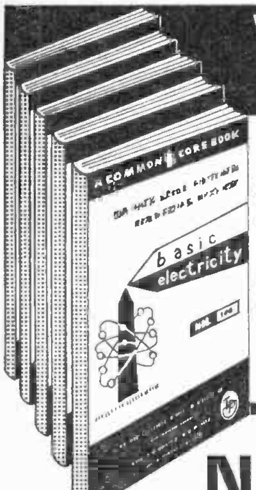

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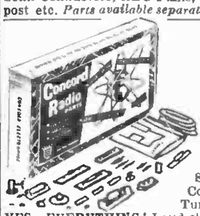

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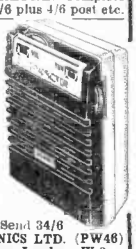

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31 Leo