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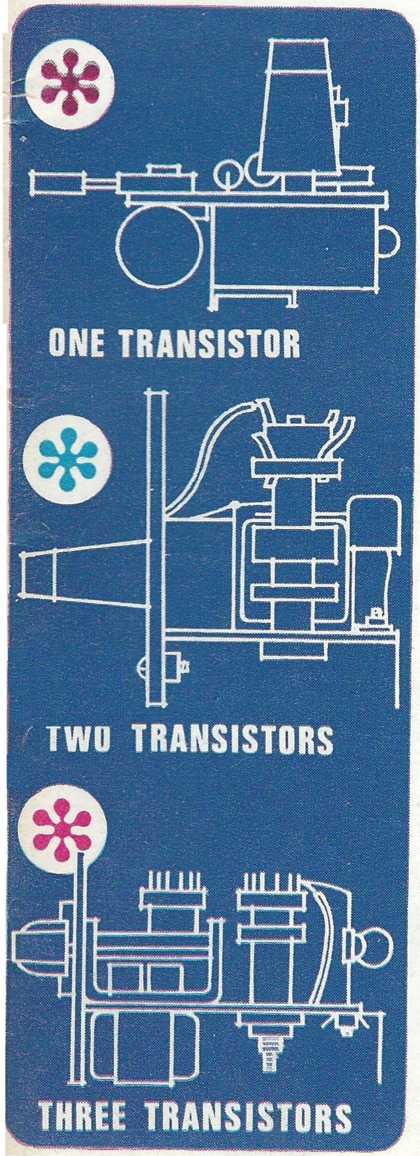

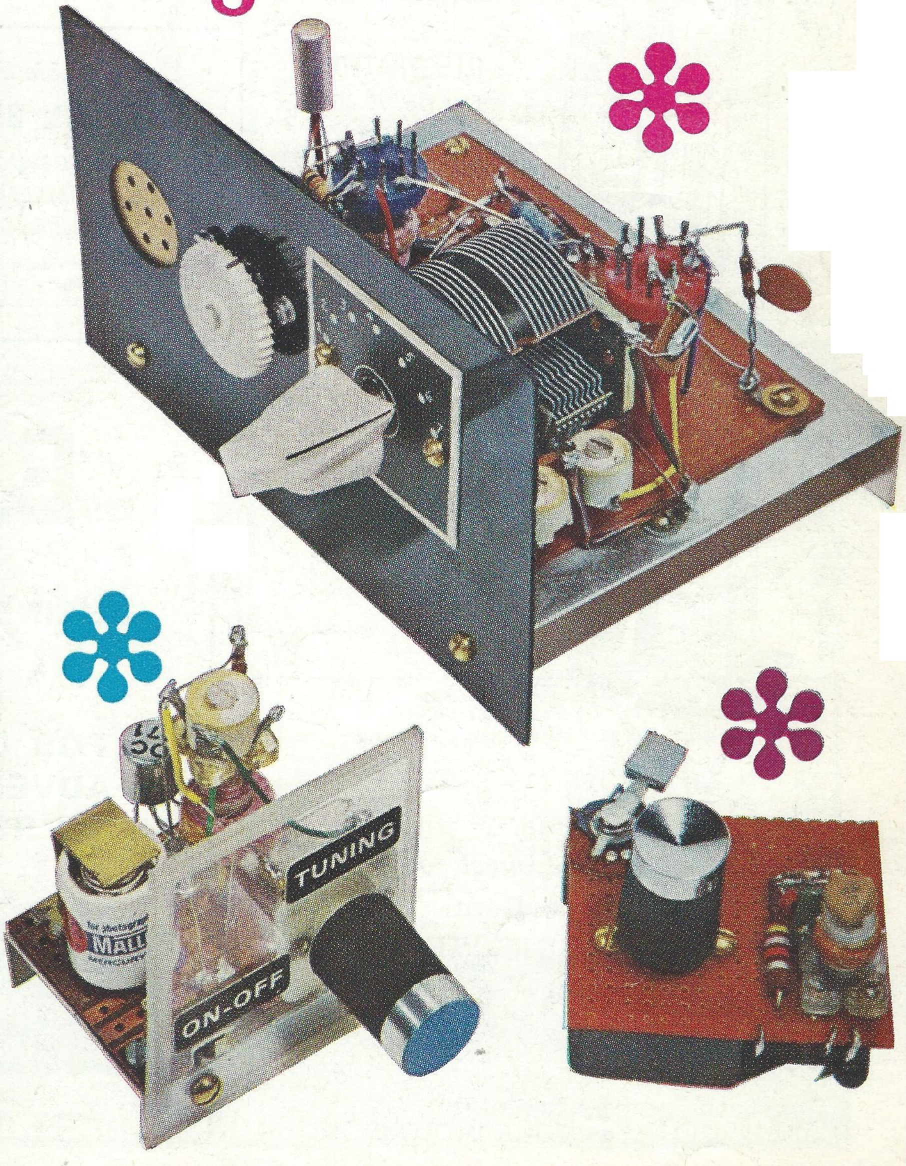

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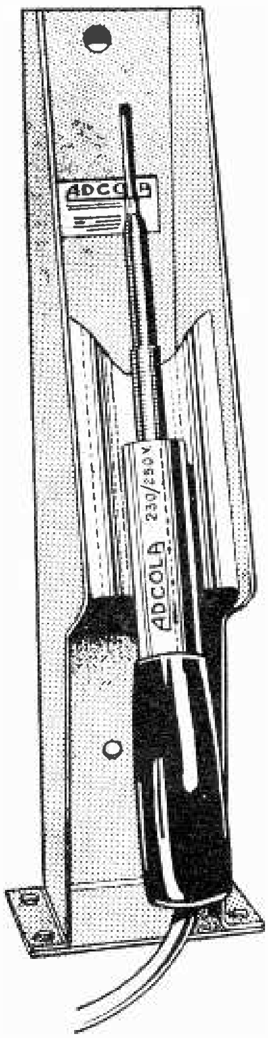

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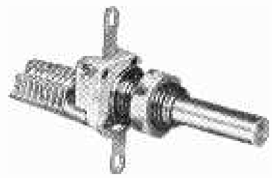

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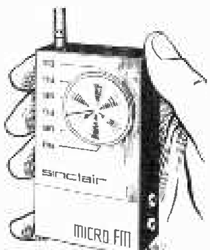

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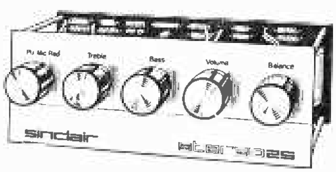

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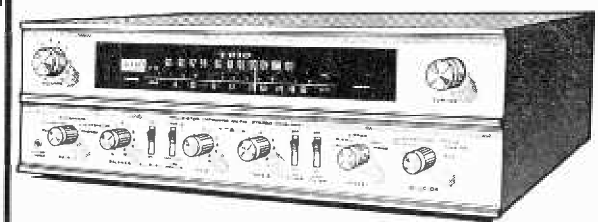

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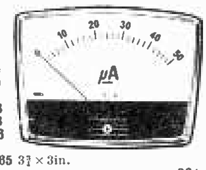

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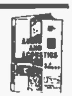

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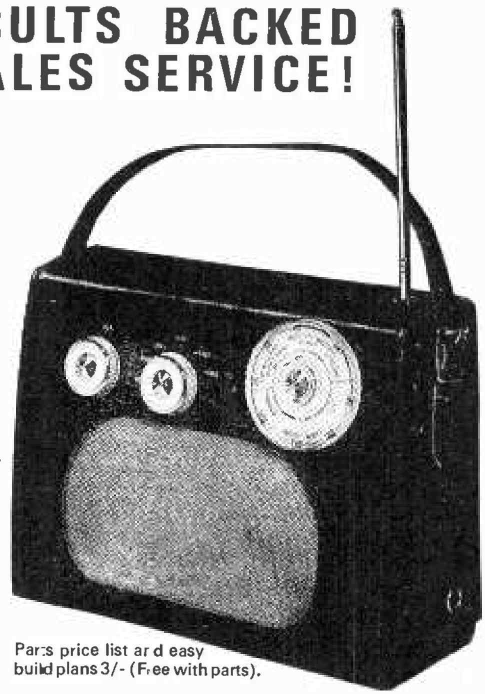
THE MAGNIFICENT ROAMER 7 MK IV



SEVEN WAVEBAND PORTABLE AND CAR RADIO WITH A SUPER SPECIFICATION GIVING OUTSTANDING PERFORMANCE !

- **7 FULLY TUNABLE WAVEBANDS—MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND.**

- Extra tuning of Luxembourg, etc.
- Built in ferrite rod aerial for Medium and Long Waves.
- 5 Section 22 inch chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening.
- Socket for Car Aerial.
- Powerful push pull output.
- 7 transistors and two diodes including Philco Micro-Alloy R.F. Transistors.
- Famous make 7in. x 4in. P.M. speaker for rich-tone volume.
- Air spaced ganged tuning condenser.
- Separate on/off switch, volume control, wave change switches and tuning control.
- Attractive case with hand and shoulder straps. Size 9in. x 7in. x 4in. approx.
- 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. 6/6

Parts price list and easy build plans 3/- (Free with parts).

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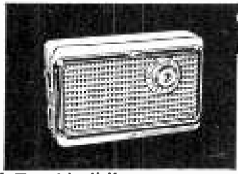

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive case with red speaker grille. Size 6¼ 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 parts).

Total building costs
42/6 P. & P. 3/6

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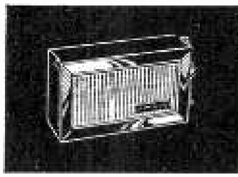
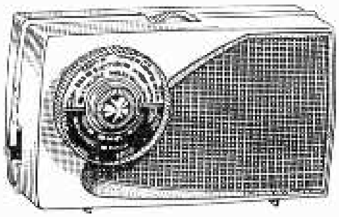


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive black and gold case. Size 5½ x 1¼ 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 3in. moving coil speaker etc. Easy build plans and parts price list. 1/6 (FREE with parts).

Total building costs
39/6 P. & P. 3/6



NEW MELODY MAKER SIX

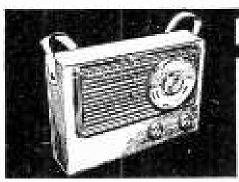
3 WAVEBAND PORTABLE — **8 stages—6 transistors and 2 diodes**

Covers Medium and Long Waves and EXTRA BAND FOR EASIER TUNING OF LUXEMBOURG, etc. Top quality 3in. Loudspeaker for quality output. Two RF stages for extra boost. High "Q". Ferrite Rod Aerial. Push-pull output. Handsome pocket size case with gilt fittings. Size 6¼ x 3¾ x 1½in.

This amazing receiver may be built for only **69/6** P. & P. 3/6

Parts Price List and easy build plans 2/– (Free with parts).

ROAMER SIX

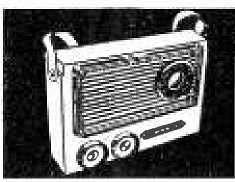


SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

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 parts).

Total building costs
79/6 P. & P. 3/6

SUPER SEVEN



THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case size 7¼ x 5¼ x 1½in. with gilt fittings. 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 parts).

Total building costs
69/6 P. & P. 3/6

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SENSATIONAL VALUE IN HIGH FIDELITY STEREO SYSTEMS

Consisting of (1) Garrard 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 III Loudspeaker Units. Extremely attractive cabinets finished Satin Teak Veneer, tinted Perspex 'hinged' lid. Performance comparable with equipment at twice the cost and saving approx. £18 on above units. Special inclusive price **69½ Gns.** Terms: Dep. £19 and 12 mthly payments of £5. Total £79. Send S.A.E. for leaflet.

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 for above saving £12.** Carr. 25/-. Special Price **46 Gns.** Perspex cover 59/9 extra with above. Terms: Dep £7.6 and 9 mthly pymts £5.3 (total £53.13).

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. Please state choice. Response 40–18,000 c.p.s. Exceptional performance at low cost.

HF510L	5"	8W	55/9	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.

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 IIIS Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815 speaker with roll rubber surround and 15000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Response 30–20,000 c.p.s. Impdnce 3 or 15 ohms. Gives smooth realistic sound output. **16 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.**

RECORD PLAYING UNITS

Ready to plug 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. **22 Gns.** Carr. 15/-.

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Normally approx. 32 gns. Carr. 15/-. ONLY **27½ Gns.**

AUDIOTRINE PLINTHS

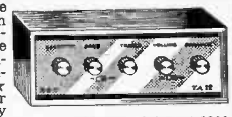
for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. **66/-** Available with clear Perspex cover as ill. Carr. 7/6 **£5.19.11** Or deeper type cut for TA12, Super 15 or 30 4 Gns. or with cover £6.19.11. Perspex cover sold separately at 3 gns. Limited number slightly damaged but repaired by Manufacturer. 39/9 to clear.

INTEREST CHARGES REFUNDED

on Credit Sales settled in 3 months.

R·S·C TA12 13 WATT STEREO AMPLIFIER

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



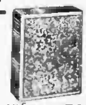
Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge, Radio tuner, Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3–15 ohms ★ For 200–250v. A.C. mains ★ Frequency 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 15 GNS. Or Deposit £4.16.0 and 9 mthly pymts. 29/- (Total 17 GNS.). Carr. 7/9 **11 GNS.** **Teak finish cabinet as above 73/6 or as in stereo system 4 Gns.**

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.** Or **Senior 15 watt** inc. HF 126 15,000 line Speaker 6 Gns. Carr. 6/6. Carr. 5/9

FR3b 3-Speaker System inc. HF 122L 12in. 20 watt Bass 'speaker with roll rubber cone surround for very low fundamental resonance, 5in. 10,000 line middle speaker, high flux cone type tweeter, appropriate choke/capacitor cross-overs. Imped. 15 ohms. Frequency response 20–20,000 c.p.s. Circuit and recommended cabinet size supplied. Only **11 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. 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 2¾ 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. Post Paid 8 Gns. **6 Gns.**

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.** Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.

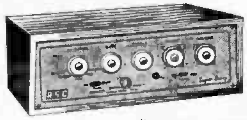
★High-sensitivity ★200-250v. A.C. Mains operation. ★Sharp A.M. Rejection. ★Drift-free reception. ★Output ample for any amplifier (approx. 500 m.v.). ★Simple alignment instructions. ★Output available for feeding tuning meter. ★Output for feeding Stereo Multiplexer. ★Tuner head using silicone Planar Transistors. ★Designed for standard 80 ohm co-axial input. Visually matching 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

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 10 Kc/s. **NEG FEEDBACK:** 52dB.
BASS CONTROL: +17dB 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 4 Gns. and 9 monthly payments 31/1 (Total £18.3.9). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 3½ Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST



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.**
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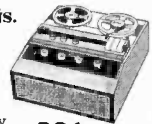
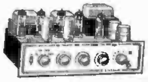
REALISM AT INCREDIBLY LOW COST Please send S.A.E. for leaflet.
CAN BE ASSEMBLED IN AN HOUR
ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS.
Incorporating latest Magnavox Tapedeck. High quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leathercloth. Size 14¾ x 17 x 8¼in. and circuit. Purchased separately would total approx. £36. Performance equal to units in the £60–£70 class. **Deposit 4 gns.** and 9 monthly payments 59/6 (Total 29½ gns). 4 Track Model 3 gns. extra. Carr. 19/6. **26½ GNS.**



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



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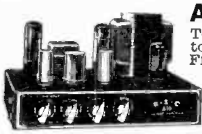
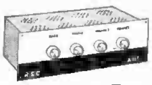
14 Gns. Carr. 12/6

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. Carr. 12/6 **12 Gns.**
Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months' guarantee for **15 gns. TERMS: Deposit £4.13.0** and 9 monthly payments of **28/9** (Total **£17.11.9**). Send S.A.E. for leaflet.

R.S.C. A11T 15 WATT HIGH FIDELITY AMPLIFIER

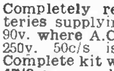


DUAL PURPOSE P.A. or HI-FI. SOLID STATE CIRCUITRY. ★3 input sockets. ★2 vol. controls for mixing purposes. ★Input Selector. ★Output for speakers between 3 and 15 ohms. ★Separate Bass and Treble Controls. Suitable for Gram, Radio, Tape, Microphone, or Guitar P.U. For Vocal and Instrumental groups. Frequency Response 20–40,000 c.p.s. —3dB. Hum level —80dB. Harmonic Distortion 0·2% at 10 watts R.M.S. Operation on 200–250v. A.C. mains. Size 9¼ x 2¾ x 5¼in. Complete Kit of parts with comprehensive wiring diagrams and instructions. **9 Gns.** Carr. 9/6
Or Factory built with 12 mths. guarantee **13 gns.** Carr. 9/6. Terms: Deposit £4 and 9 monthly payments 25/6 (Total £15.9.6).

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

An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes" plus Bass and Treble controls.
49½ Gns. Carr. 30/- or dep. **£7.17.6** and 9 monthly payments 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.

R.S.C. BATTERY/MAINS CONVERSION UNITS



Type BM1 An all-dry battery eliminator. Size 5½x4½x 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 assembled 59/11.

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.

R.S.C. MAINS TRANSFORMERS

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

MIDGET CLAMPED TYPE 2½ × 2¾ × 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., 5v. 3a.	69/9
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 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 5,000Ω or 7,000Ω to 3Ω	7/9
Push-Pull 8 watts EL84 to 3Ω or 15Ω	11/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15Ω	21/9
Push-Pull EL84 to 3 or 15Ω 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 15Ω	29/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15Ω	55/9

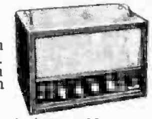
SMOOTHING CHOKES 150mA, 7-10H, 250Ω 12/9; 100mA. 10H, 200Ω 9/11; 80mA, 10H, 350Ω 7/9; 60 mA, 10H, 400Ω 4/11.

R.S.C. COLUMN SPEAKERS

R·S·C HI-FI CENTRES LTD.

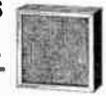
Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. **Type C48, 25-30 watts.** Fitted four 8in. high flux 7 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 44/- and 9 mthly pmts 34/9 (Total £18.1.6) Carr. 10/-. **15 Gns.**
Type C412, 40 watts. Fitted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



In Teak veneered or Rexine covered Cabinets
10 Watt 12,000 lines 3 or 15 ohms **5 Gns.** 20 Watt 12,000 lines 3 or 15 ohms **8 Gns.**

LOUDSPEAKERS

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

12in. 10 watt HIGH FLUX	12in. 20 watt DUAL CONE	12in. HEAVY DUTY 30 watts. Dual Cone. Normally £13 approx.
59/11	**£5.15.0**	**£6.19.9**

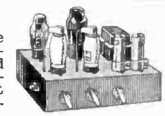
FANE 'POP' 100 LOUDSPEAKER

18" 100 Watt POST FREE
Fantastic power handling. Guaranteed 2 years. **19 Gns**

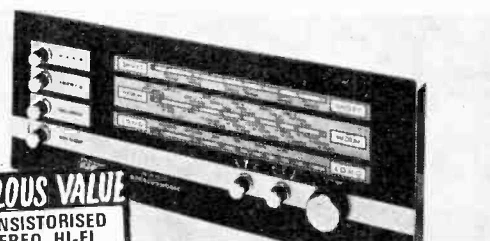
R.S.C. GRAM AMPLIFIER KIT. 4 watts output. Negative feedback. Controls: Vol., Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit etc. supplied. ONLY **49/11**

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**

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**



FABULOUS VALUE

TRANSISTORISED STEREO HI-FI RECORD PLAYER

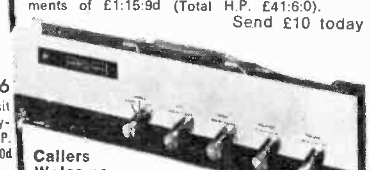
Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10" x 6" speakers and the latest BSR 4 Speed Stereo/Mono Record Changer.
Advanced solid state amplifier only 4½" deep, 14 transistors plus 4 diodes, separate Bass and Treble—10 watts total power. Frequency response 50-15,000 c/s.
EASY TO INSTALL
NO TECHNICAL KNOWLEDGE REQUIRED
ONLY **26** GNS. +P&P 17/6
H.P. terms available. Deposit £6:16:6d and 12 monthly payments of 38/5d (Total H.P. £29:17:6d). Send £7:14:0d today.

FANTASTIC BARGAIN OFFER!

"TRANSCONTINENTAL"

FULLY TRANSISTORISED STEREOPHONIC RADIOGRAM CHASSIS

Complete with 2-10" x 6" speakers and the latest BSR Mono/Stereo Record Changer—a complete radiogram at half normal price ONLY
10 Watts Total output
17 Transistors & 10 diodes **34½ GNS.** P&P 17/6
EASILY FITTED NO TECHNICAL KNOWLEDGE NECESSARY
H.P. available £9:2:6d deposit plus 18 monthly payments of £1:15:9d (Total H.P. £41:6:0).
Send £10 today



Callers Welcome

POST THIS COUPON NOW!

PLEASE SEND ME FREE DETAILS OF YOUR RANGE
Name ....
Address ....

LEWIS radio 100 CHASE SIDE, SOUTHGATE. Dep.P68 LONDON, N.14. TELEPHONE PAL 3733/9666

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, band-pass 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 19½ x 13½ 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/-.

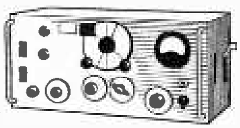
SOLATRON CD711S.2. DOUBLE BEAM OSCILLOSCOPE

An extremely high quality oscilloscope originally costing £400. Switched beam. Identical Y1, Y2 Amplifiers D.C. to 9 Mc/s. Sensitivity 3mV/CM to 100 V/CM. Time base 10µ/sec. to 10 M/secs. Calibrator. X amplifier D.C. to 2·5 Mc/s. Z Modulation. 110/200/250V. A.C. Supplied in good working order. £65, carriage £2, or available as received from Ministry unserviced. £50. Carriage £2. (Handbooks £2 extra.)

AVO CT.38 ELECTRONIC MULTIMETERS

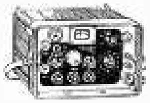
High quality 97 range instrument which measures A.C. and D.C. Voltage. Current, Resistance and Power output. Ranges D.C. volts 250mV-10,000 v. (10 megΩ-110mgΩ input). D.C. current 10µA 25 amps. Ohms: 0-1,000 megΩ. A.C. volt 100 mV-250V. (with R.F. measuring head up to 250 Mc/s). A.C. current 10µA-25 amps. Power output 50 micro-watts-5 watts. Operation 0/110/200/250v. C. Supplied in perfect condition complete with circuit lead and R.F. probe £25. Carr. 15/-.

MARCONI TEST EQUIPMENT



TF.144G STANDARD SIGNAL GENERATOR. 85 Kc/s.-25 Mc/s. 200/250V. A.C. £25. Carr. 30/-. TF.1267 Transmission Test Set. Brand New £75. T.F. 195M. BEAT FREQUENCY OSCILLATOR. 0–40 Kc/s. 200/250V. A.C. £20. Carr. 30/-. All above offered in excellent condition, fully tested and checked and offered at a fraction or original cost.

AM/FM SIGNAL GENERATORS



Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20–80 Mc/s. AM/C.W./FM. Incorporates precision dial, level meter, precision attenuator 1 µV-100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. 20/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

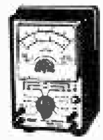
An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwith 5·5 Mc/s. Sensitivity 33MV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.

LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER

2 pF–2,000 mfd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V A.C.

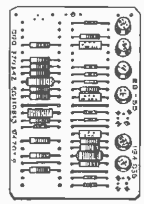
Brand New £15. Carr. 7/6.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10 / 30 /100/300V. R.M.S. 4cps.-1·2 Mc/s. Decibels −40 to +50 dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. £17.10.0. Carr. 5/-.

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/-.

2-WAY RADIOS

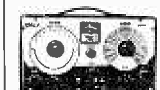
Super quality. Brand new and guaranteed.

3 transistor	£6.15.0 pr.
4 transistor	£6.19.6 pr.
6 transistor	£8.12.6 pr.
6 transistor De Luxe	£12.10.0 pr.
10 transistor	£22.10.0 pr.
13 transistor 500 MW	£31.10.0 pr.

Post extra.

These cannot be operated in U.K.

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/P600Ω 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.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s—260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240V. A.C. Brand new with instructions. £15.0.0. P. & P. 7/6. S.A.E. for details.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

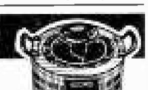
Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms, 200/250V A.C. Supplied brand and new guaranteed with instruction manual and leads, £15. Carr. 7/6.

AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.

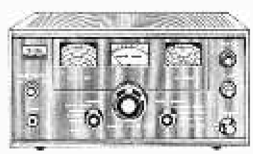
Model 47A £9.19.6.
Model 8 £18.
P. & P. 7/6 each.

Variable Voltage TRANSFORMERS



Brand new, guaranteed and carriage paid
High quality construction. Input 230V. 50–60 cycles
Output full variable from 0–260 volts. Bulk quantities available.
1 amp.—£5.10.0; 2·5 amp.—£6.15.0; 5 amp.—£9.15.0;
8 amp.—£14.10.0; 10 amp.—£18.10.0; 12 amp.—£21.0.0;
20 amp.—£37.0.0.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



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. SSB-CW ● ANL ● Variable BFO ● S meter. ● Sep. band spread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. £37.10.0. Carriage 12/6.

AUTO TRANSFORMERS

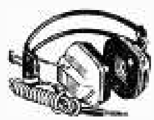
0/115/230V. Step up or step down. Fully shrouded.

500 W.	£3.10.0	P. & P. 6/6.
1,000 W.	£5.10.0	P. & P. 7/6.
1,500 W.	£6.10.0	P. & P. 8/6.
3,000 W.	£7.10.0	P. & P. 12/6.
7,500 W.	£15.10.0	P. & P. 20/-.

SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

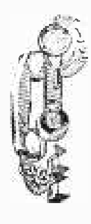
An extremely high quality oscilloscope with time base of 10Q/sec. to 20 m/sec. Internal Y amplifier. Separate mains power supply 200/250V. Supplied in excellent condition with cables, probe, etc., as received from Ministry. £8.19.6. Carriage 30/-.

ECHO HS-606 STEREO HEADPHONES



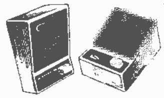
Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. 67/6. P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM



Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £5.19.6. P. & P. 3/6.

INTERCOM/BABY SITTER



Transistorised Intercoms, ideal for home / office / workshop etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions, 2 station 59/6. P. & P. 2/6. 4 station £6.12.6. P. & P. 5/-.

NOMBREX TRANSISTORISED TEST EQUIPMENT

All Post Paid with Battery

Model 22. Power Supply 0–15V DC	£14.10.0
Model 30. Audio Generator.	£19.10.0
Model 31. R.F. Signal Generator.	£12.10.0
Model 32. C.R. Bridge.	£10.10.0
Model 33. Inductance Bridge.	£20.0.0
Model 66. Inductance Bridge.	£18.0.0
Model 61. Power Supply.	£6.10.0

COSSOR DOUBLE BEAM OSCILLOSCOPES

Type 1035. General purpose. A.C. Coupled. Type 11049 L.F. D.C. Coupled. £35 each. Carr. 30/-.

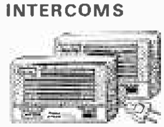
LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

0–20 Kc/s. Output 5K or 500 ohms. 200/250 V. A.C. offered in excellent condition. £12.10.0. Carriage 10/-.

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.

MAINS INTERCOMS



No wires, no installation, just plug into A.C. power point and operate. Extremely sensitive. £8.12.6. P. & P. 3/-.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.

3in., 225ft. L.P. acetate	3/6
3¼in. 600ft. T.P. mylar	10/-
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1,200ft. D.P. mylar	15/-
5in. 1,800ft. T.P. mylar	32/6
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/-
5¾in. 1,800ft. D.P. mylar	22/6
5¾in. 2,400ft. T.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

EVERSHED VIGNOLES SERIES II 500 VOLT MEGGERS. Perfect condition £21. P. & P. 10/-.

CT.53 SIGNAL GENERATORS. 8·9–15·5 and 20–300 Mc/s. Output 1µV-100 MV. Mains operated. Perfect condition less charts. £12.10.0. Carr. 15/-.

WS.88 TRANS/RECEIVERS. A and B sets available. Complete with valves. 39/6 each. P. & P. 4/6. Accessories available.

No. 10 MICROPHONE AND HEADSET. Moving coil Accessory for 19 set. Unused. 15/-. P. & P. 4/-.

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LUCAS 20/0/20 AMMETERS. Brand new boxed. Suitable car/motorcycle. 12/6. P. & P. 2/-.

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Z12 12 watt amplifier, 89/6. PZ4 Power Supply Unit 99/6. Stereo 25 Preamp., £9.19.6. Q14 Speakers, £6.19.6. Micromatic Radio Kit. 49/6. Built 59/6. Micro FM Radio Kit £5.19.6. All Post Paid.

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Or with two Q14 Speakers. £35.

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Also see oppos. page

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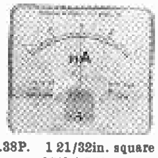
CLEAR PLASTIC METERS



5mA 37/6	300V. D.C. ...37/6
10mA 37/6	15V. A.C. 37/6
50mA 37/6	300V. A.C. ...37/6
100mA 37/6	S Meter 1mA ..39/6
500mA 37/6	VU Meter 59/6
1 amp. 37/6	1 amp. A.C.* ..37/6
5 amp. 37/6	5 amp. A.C.* ..37/6
10V. D.C. 37/6	10 amp. A.C.* .37/6
20V. D.C. 37/6	20 amp. A.C.* .37/6
50V. D.C. 37/6	30 amp. A.C.* .37/6

Type MR.38P. 1 21/32in. square fronts.

50µA 37/6	750mA 25/-
50-0-50µA ...35/-	1 amp 25/-
100µA 35/-	2 amp 25/-
100-0-100µA .32/6	5 amp 25/-
200µA 32/6	3V. D.C. 25/-
500µA 37/6	10V. D.C. 25/-
500-0-500µA .25/-	20V. D.C. 25/-
1mA 25/-	50V. D.C. 25/-
1-0-1mA 25/-	100V. D.C. ...25/-
2mA 25/-	150V. D.C. ...25/-
5mA 25/-	300V. D.C. ...25/-
10mA 25/-	500V. D.C. ...25/-
20mA 25/-	750V. D.C. ...25/-
50mA 25/-	15V. A.C. 25/-
100mA 25/-	50V. A.C. 25/-
150mA 25/-	150V. A.C. ...25/-
200mA 25/-	300V. A.C. ...25/-
300mA 25/-	500V. A.C. ...25/-
500mA 25/-	S meter 1 mA ..29/6
	VU meter 39/6

Type MR.45P. 2in. square fronts.

50µA 42/6	10V. D.C. 27/6
50-0-50µA ...39/6	20V. D.C. 27/6
100µA 39/6	50V. D.C. 27/6
100-0-100µA .35/-	300V. D.C. ...27/6
500µA 29/6	15V. A.C. 27/6
1mA 27/6	300V. A.C. ...27/6
5mA 27/6	S meter 1mA .35/-
10mA 27/6	VU meter 42/6
50mA 27/6	1 amp. A.C.* .27/6
100mA 27/6	5 amp. A.C.* ..27/6
500mA 27/6	10 amp. A.C.* .27/6
1 amp. 27/6	20 amp. A.C.* .27/6
5 amp. 27/6	30 amp. A.C.* .27/6

Type MR.52P. 2½in. square fronts.

50µA 59/6	100-0-100µA .45/-
50-0-50µA ...49/6	500µA 42/6
100µA 49/6	1 mA 37/6

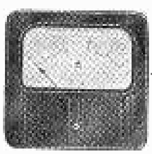
Type MR.85P. 4¼in. × 4¼in. fronts.

50µA 69/6	15 amp. 49/6
50-0-50µA ...59/6	30 amp. 49/6
100µA 59/6	20V. D.C. 49/6
100-0-100µA .59/6	50V. D.C. 49/6
200µA 55/-	150V. D.C. ...49/6
500µA 52/6	300V. D.C. ...49/6
500-0-500µA .49/6	15V. A.C. 49/6
1mA 49/6	300V. A.C. ...49/6
1-0-1 mA 49/6	S Meter 1mA ..55/-
5mA 49/6	VU meter 69/6
10mA 49/6	1 amp. A.C.* ..49/6
50mA 49/6	5 amp. A.C.* ..49/6
100mA 49/6	10 amp. A.C.* .49/6
500mA 49/6	20 amp. A.C.* .49/6
1 amp. 49/6	30 amp. A.C.* .49/6
5 amp. 49/6	

Type MR.65P. 3⅜in. × 3⅜in. fronts.

50µA 65/-	50V. D.C. 39/6
50-0-50µA ...52/6	150V. D.C. ...39/6
100µA 52/6	300V. D.C. ...39/6
100-0-100µA .49/6	15V. A.C. 39/6
500µA 45/-	50V. A.C. 39/6
1mA 39/6	150V. A.C. ...39/6
5mA 39/6	300V. A.C. ...39/6
10mA 39/6	500V. A.C. ...39/6
50mA 39/6	S meter 1mA ..45/-
100mA 39/6	VU meter 65/-
500mA 39/6	50mA A.C.* ...39/6
1 amp. 39/6	100mA A.C.* ..39/6
5 amp. 39/6	200mA A.C.* ..39/6
10 amp. 39/6	500mA A.C.* ..39/6
15 amp. 39/6	1 amp. A.C.* ..39/6
20 amp. 39/6	5 amp. A.C.* ..39/6
30 amp. 39/6	10 amp. A.C.* .39/6
50 amp. 39/6	20 amp. A.C.* .39/6
10V D.C. 39/6	30 amp. A.C.* .39/6
20V. D.C. 39/6	

BAKELITE PANEL METERS



*Moving iron, all other moving coil.

Type MR.65. 3½in. square fronts.

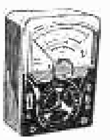
25µA 67/6	500mA 32/6	30V. A.C.* ...32/6
50µA 45/-	1 amp. 32/6	50V. A.C.* ...32/6
50-0-50µA ...42/6	5 amp. 32/6	150V A.C.* ..32/6
100µA 42/6	15 amp. 32/6	300V. A.C.* ..32/6
100-0-100µA .42/6	30 amp. 32/6	1 amp. A.C.* ..32/6
500µA 39/6	50 amp. 32/6	5 amp. A.C.* ..32/6
1mA 32/6	5V. D.C. 32/6	10 amp. A.C.* .32/6
1.0.1mA 32/6	10V. D.C. 32/6	20 amp A.C.* ..32/6
5mA 32/6	20V. D.C. 32/6	30 amp. A.C.* .32/6
10mA 32/6	50V. D.C. 32/6	50 amp. A.C.* .32/6
50mA 32/6	150V. D.C. ...32/6	VU meter 59/6
100mA 32/6	300V. D.C. ...32/6	

NEW RANGE OF "SEW" EDGEWISE METERS

MODEL PE70. Dimensions 3 17/32 × 1 11/32 × 2¼in. deep overall. Available as follows:

50 microamp.......57/6	500 microamp......49/6
50-0-50 microamp ..55/-	1 milliamp........45/-
100 microamp......55/-	300 volt A.C. 45/-
100-0-100 microamp 52/6	VU meter 62/6
200 microamp......52/6	Post extra.

MULTIMETERS *for EVERY purpose!*



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. 0/60hΩ/6/60MΩ. £8.17.6. Post Paid.

MODEL TE.80. 20,000 O.P.V. MULTIMETER

0/10/50/100/500/1,000V A.C.0/5/25/50/250/500/1,000V D.C. 0-50µA. 5/50/500mA. 0/6k/60k/600k/6 meg. £4.17.6. P.P. 3/-

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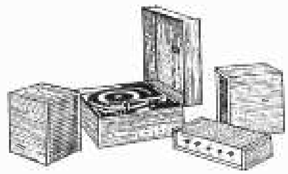
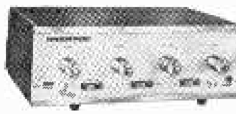
RADON 404 STEREO SYSTEM



Comprising Hi-Fi Solid State integrated stereo amplifier, 8 watts per channel, two matching compact speaker units, Garrard SP25 transcription record unit with stereo cartridge in cabinet. Blond oak satin finish. All necessary plugs and leads supplied. Nothing more to buy!

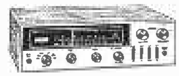
PRICE **48 Gns.** Carr. 15/-.
(Also available in teak 12/- extra.)

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER



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

LAFAYETTE LR-500T

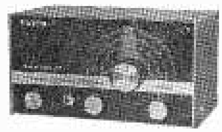


60 Watt Solid State AM/FM Stereo Multiplex Tuner Amplifier. The latest most advanced stereo receiver in the world. Incorporates 4 integrated Circuits, 2 Fet's, 30 Transistors, 17 Diodes, 60 Watts IHF Power. Complete flexibility of operation plus full range of stereo inputs. Distinctively styled metal cabinet with simulated walnut wood grain case. Operation 115/230V. A.C. £75.

LAFAYETTE LA-85T

85 watt. Solid State Amplifier. Latest 1968 model. 4 Stereo Inputs. Speaker outputs for 4, 8 or 16 ohms plus convenient output for direct stereo taping. 9 versatile controls. Response 22–22,000 cps ± 1 db. H.D. less than 1%. Brushed aluminium, gold anodised extruded front panel. Simulated walnut wood grain case. 115/230V. A.C. operation. £47.10.0. Carr. 10/-.

UNR-30. 4-BAND COMMUNICATION RECEIVER

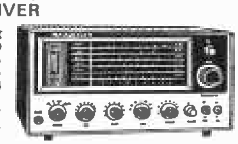


Covering 550 Kc/s–30 Mc/s. Incorporates variable BFO for CW/SSB reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6. **£12.10.0**

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

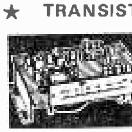
8 Valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150–400 Kc/s, 550/1,600 Kc/s, 1·6–4·0 Mc/s, 4·8–14·5 Mc/s, 10·5–30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, B.F.O. product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2kΩ or speaker 4 or 8Ω. Operation 220/240V A.C. Size 7¼ × 15 × 10in. Supplied brand new and guaranteed with handbook. 36 GNS. Carr. 10/-. S.A.E. for leaflet.

LAFAYETTE MODEL HA-500 SSB/AM/CW 80 THROUGH 6 METRE RECEIVER



New outstanding Ham Bands only receiver covering the 80/40/20/15/10/6 metre bands. Incorporates 10 valves, product detector, two mechanical filters, S Meter, dual conversion on all bands, crystal calibrator, B.F.O. noise limiter, aerial trimmer, I.F.s. 2.608 Mc/s and 455 Kc/s. Output 8 ohms and 500 ohms. Operations 220/240 volts A.C. Supplied brand new and guaranteed with handbook 42 Gns. Carr. 10/-. 100 Kc/s. crystal, 35/-.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108 Mc/s. Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiflex adaptors 5 gns.

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FOR THIS SPECIFICATION

$\frac{1}{4}$ 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″ x 5″ speakers. Operates on 230V a.c. supply.

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

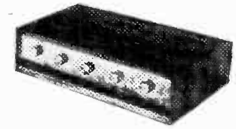
Latest STEREO AMPLIFIER, TSA-12

12 x 12 watts output.

Kit £30.10.0 *less cabinet*

Ready-to-Use £42.10.0

Cabinet £2.5.0 extra



FOR THIS SPECIFICATION

17 transistors, 6 diode circuit. ± 1 dB, 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.

High-performance CAR RADIO, CR-1

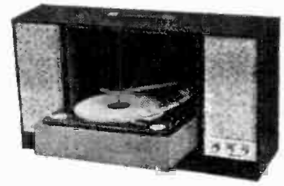
Superb long and medium wave entertainment wherever you drive. Complete your motoring pleasure with this compact outstanding unit.

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 speaker) £12.18.6 incl. P.T.
8″ x 5″ Loudspeaker £1.10.0 extra.

Latest 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 $15\frac{9}{16}$ x $3\frac{7}{8}$ x $10\frac{1}{4}$in.



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 **£28.6.0** incl. P.T. Ready-to-Use **£35.4.0**

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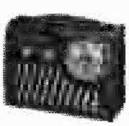
"OXFORD" PORTABLE UXR-2

Oxford

This De-Luxe, 7 transistor, 3 diode portable radio covers long and medium wave-bands with an easy-tune dial and uses battery-saving circuitry to ensure longer life and more hours of listening pleasure. Choice of Brown or Black real leather case.
KIT £15.10.0 incl. P.T.

PORTABLE UXR-1

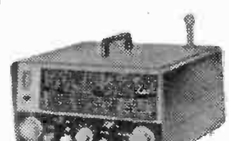


UXR-1

This luxury 6-transistor, 1 diode receiver covers long and medium wavebands. Its robust case is now available in real brown leather or choice of colours: Navy blue, coral pink, lime green (please state second choice).
KIT £12.8.0 incl. P.T. colour case
KIT £14.8.0 incl. P.T. real leather

"Mohican" General Coverage Receiver, GC-1U

Powerful 10 transistor, 5 diode circuit. Tunes 580 to 1550 kc/s and 1·69 to 30 Mc/s in five bands. Bandspread on all bands. Fixed-aligned ceramic IF trans-filters for best selectivity. Pre-assembled and aligned 'front-end' for fast, easy assembly. Built-in 6 x 4in. speaker. Tuning meter for pin-point tuning. Completely self-contained for portability—can be operated on 230 volt AC with Model UBE-1. Kit £2.17.6 extra.



Kit **£37.17.6.** Ready-to-Use **£45.17.6.**

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50 WATT AMPLIFIER

An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS
4 electronically mixed channels, with 2 inputs per channel, enables the use of 8 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets.

SENSITIVITIES AND INPUT IMPEDANCES

Channel 1	4mV at 470K	} These 2 channels (4 inputs) are suitable for microphone or guitars.	
Channel 2	4mV at 470K		
Channel 3	200mV at 1m	} Suitable for most high output instruments (gram, tuner, organ etc.).	
Channel 4	200mV at 1m		

Input sensitivity relative to 10w output.

TONE CONTROLS ARE COMMON TO ALL INPUTS
Bass Boost +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s.
Treble Boost +11dB at 15 KHz/s. **Treble Cut** −12dB at 15 KHz/s.
With bass and treble controls central −3dB points are 30 Hz/s and 20 KHz/s.

POWER OUTPUT
For speech and music 50 watts rms. 100 watts peak.
For sustained music 45 watts rms. 90 watts peak.
For sine wave 38·5 watts rms. Nearly 80 watts peak.
Total distortion at rated output 3·2% } at 1KHz/s
Total distortion at 20 watts 0·15% }
Output to match into 8 or 15 ohms speaker system.
NEGATIVE FEED BACK 20dB at 1KHz/s.
SIGNAL TO NOISE RATIO 60dB.
MAINS VOLTAGES
Adjustable from 200–250v A.C. 50–60 Hz/s.
A protective fuse is located at the rear of unit.
VALVE LINE UP
Double purpose ECC83 x 3, EL34 x 2 and GZ34.

Price
27 gns
P & P 20/-

FOUR *PLUS* FOUR *Stereo Amplifier*

A superb high quality, yet inexpensive stereo amplifier. Due to the great demand we are now able to offer this precision made instrument at a fantastically low price. The high quality, reliability and styling has been maintained in spite of its low price.

SPECIFICATIONS
Elegant styled cabinet (sizes 16" wide 5" high 8½" deep) in black rexine and woodgrained sides. Brushed aluminium front panel with contrasting black / silver knobs.

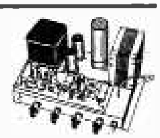
CONTROLS
Stereo/Mono switch. Gram/Aux switch. Volume left. Volume right. Treble (cut and lift). Bass (cut and lift). Separate on/off switch. Neon pilot indicator.

INPUTS AND OUTPUTS
(per channel)
Gram, aux, tape out and speaker out. A switched mains socket is also provided at the rear of unit. Employs Mullard valves throughout. ECC83 and 2 x ECL 86 with a metal bridge rectification.

TECHNICAL SPECIFICATIONS
Gram sensitivity 40mV at 1 KHz. Aux sensitivity 50mV at 1 KHz. (Sensitivities are given for rated output). 4 watts r.m.s. (8 watts r.m.s. in monaural position). Output matches into standard 3 ohms speaker system. Suitable 10" x 6" speakers are available at **29/6** each, plus 5/- p. & p. Bass control at 100 Hz lift + 9dB cut — 10dB. Treble control at 10 KHz lift + 8dB cut — 13dB. Total harmonic distortion 0·35% at 3 watts and 2% for rated output at 1 KHz. Negative feedback 13dB at 1 KHz. Mains supply 220–250V A.C. 50–60 Hz.

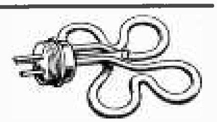
Price
13 gns
P & P 15/-

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



Size: 9" x 6" x 1¾". 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



3,000W WITH AUTOMATIC EJECTION
200/240v. Size of hole required 1 3/16"
List Price **32/-**. Our PRICE
15/-. P. & P. 1/6.

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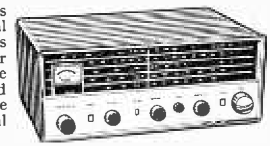
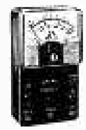
STAR SR 150 COMMUNICATION RECEIVER



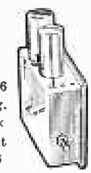
Frequency range 535Kc/s—30Mc/s four wave bands, four valve plus metal rectifier superhet circuit incorporates B.F.O. band spread tuning, "S" meter external telescopic aerial — ferrite aerial, built-in 4" speaker, easy to read dial. For 240V A.C. operation complete brand new with full instructional manual. **17 gns.** plus 10/- P. & P.

POCKET MULTI-METER



Size 3⅞ x 2½ x 1⅜in Meter size 2¼ x 1⅜in 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.

CYLDON U.H.F. TUNER

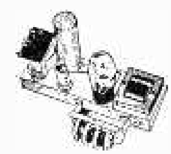


Complete with PC88 and PC86 Valves. Full variable tuning. New and unused. Size 4½ x 5½ x 1½in. Complete with circuit diagram. **35/-** p. & p. 3/6

THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13½ x 8 1/16 x 4½ inches. By famous manufacturer. List Price £7. Our price **69/6** plus 3/6 P. & P.

3 to 4 Watt AMPLIFIER



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.

600 mW FOUR TRANSISTOR AMPLIFIER

Features N.P.N. and P.N.P. complementary symmetrical output stage, 2¼" x ⅞" x ⅞" Speaker. Output impedance 12 ohms frequency response 3dB points 90 c/s and 12 Kc/s. Price **19/6** plus 1/- P. & P. 7 x 4" Speaker to suit, **13/6** plus 2/- P. & P.

2½ watt ALL TRANSISTOR AMPLIFIER

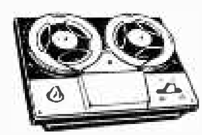
AC mains 240V. Size 7" x 4½" x 1¾". Frequency response 100 c/s—10 Kc/s Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0** plus P. & P. 3/6. Suitable 8" x 5" 10,000 line high flux speaker, **18/6** plus 2/- P. & P.

NEW TRANSISTORISED SIGNAL GENERATOR

Size 5½ x 3½ x 1½in. For IF and RF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. P. & P. 3/6. **39/6**

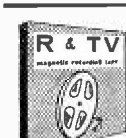
BSR TAPE DECKS

200/250V A.C. mains



Type TD2 Tape speed 3¾ twin track.
Type TD10 2-track, 3 speed, plus rev. counter.
Type TD10 4-track, 3 speed, plus rev. counter.
Due to 33⅓% Purchase Tax which is now applicable on these items, prices will be announced as soon as available.

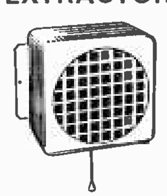
FIRST QUALITY P.V.C. TAPE



5¾"	Std.	850ft.....	9/-	5"	L.P.	850ft.	..10/6
7"	Std.	1200ft.....	11/6	3"	T.P.	600ft.	..10/6
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/-

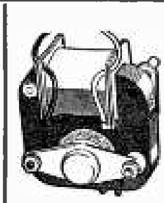
P. & P. on each 1/6, 4 or more post free.

EXTRACTOR FAN



AC Mains 230/250 v. complete with pull switch. Size 6" x 6" x 4". Price **27/6** plus 5/- P. & P.

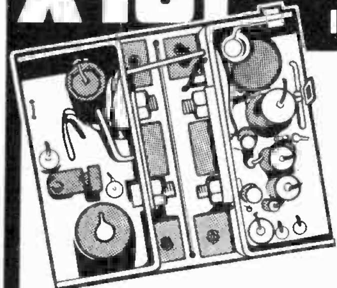
AC MAINS MOTOR



1400 R.P.M.
230/250v
PRICE
9/6
P. & P. 3/-

X101

10 WATTS (RMS) SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Its great versatility ranges from: A simple intercom. to a modern HI-FI STEREO AMPLIFIER (2 are required for Stereo).

The X101 is a brilliant new addition to our highly successful range of products. Its professional performance and advanced solid-state circuitry techniques ensures reliability, combined with high fidelity reproduction at AN UNBEATABLE PRICE.

SPECIFICATIONS

R.M.S. Power Output: 13 W (music power), 10 W (Sine Wave).
Sensitivity: for rated output 1 mV into 3 K ohms load.
Frequency Response: minus 3dB points are 20 Hz and 40 KHz.
Total Distortion: at 1KHz for rated output 1·5%, for 5 W output 0·35%.
Output Impedance: 3 ohms (3–15 ohms may be used).
Supply Voltage: 24 V D.C. at 800 mA (6–24 V may be used) output at 14 V D.C. supply with 3 ohms speaker. 7 watts.
Size: 2½" x 3" x 1⁹/₁₆".

The fully comprehensive instruction manual does not only show the basics, such as circuit diagram and connections, but also gives practical easy-to-understand detailed information about the X101. Standard equalisation networks are given for most types of conventional inputs. They include: Tape Head, Mag. P.U., Xtal P.U., Tuner, Mic, etc.
Built & Tested **49/6** + 2/6 p. & p.

Control assembly: (Including resistors and capacitors).
1. Volume: PRICE 5/-. 2. Treble: PRICE 5/-.
3. Comprehensive bass and treble: PRICE 10/-.
The above 3 items can be purchased for use with the X101.

POWER SUPPLIES FOR THE X101

P101 M (for mono) p. & p. 2/6 **35/-**
P101 S (for stereo) p. & p. 2/6 **42/6**

PR 101/M

A HIGH QUALITY MONAURAL PRE-AMP & CONTROL UNIT

Particularly suitable for use with the X101 if a ready-built, comprehensive, multi-input system is desired.

CONTROLS

Selector Switch, Tape Speed Equalisation Switch (3¾ and 7½ i.p.s.), Volume, Treble, Bass, 3 position scratch filter and 3 position rumble filter.

SPECIFICATION

Sensitivities for 200 mV output at 1 KHz.

Tape Head: 3 mV (at 3¾ i.p.s.) **Radio:** 100 mV
Mag. P.U.: 2 mV **Aux.:** 100 mV
Cer. P.U.: 80 mV
Tape/Rec. Output: 100 mV
Equalisation for each input is correct to within ±2dB (R.I.A.A.) from 20 Hz to 20 KHz.
Tone Control Range: Bass ±13dB at 60 Hz
Treble ±14dB at 15 KHz
Total Distortion: (for 200 mV output) < 0·02%
Signal Noise: > –60dB
Supply Voltage: 24 V D.C.

59/6 plus 2/6 p. & p.

A STEREO VERSION (PR101/S) WILL BE ANNOUNCED SHORTLY

The CLASSIC

HIGH QUALITY SOLID-STATE AMPLIFIER (MONO)

SPECIFICATION

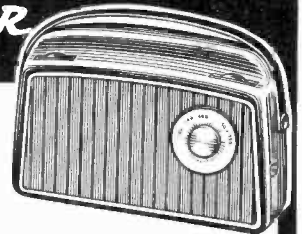
Switched inputs for: Tape Head, Mag. P.U., Cer. P.U., Radio and Aux. **Mains Input:** 220–250 V A.C. 50 Hz.

THE CLASSIC IS THE COMBINATION OF THE ABOVE DESCRIBED ITEMS (X101, P101/M AND PR101/M) ON ONE COMMON CHASSIS: ITS PERFORMANCE AND SPACE-AGE STYLING MAKE IT THE IDEAL CHOICE FOR THE VALUE-CONSCIOUS HI-FI ENTHUSIAST. AVAILABLE WITHIN 4 WEEKS.

8 gns p. & p. free

NEW! THE Dorset

TRANSISTOR PORTABLE RADIO



CAN BE USED AS BABY ALARM

600 milliwatt solid state 7 transistor plus diode and thermistor. Completely modulised high quality portable radio featuring complementary NPN and PNP output stage. The comprehensive easy-to-follow drawings supplied make this the easiest-ever transistor radio set of parts, with the following features:

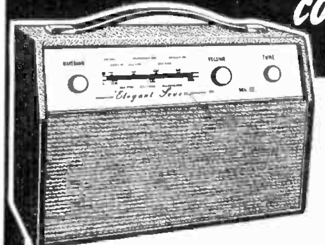
5gns plus 7/6 postage and packing. *Circuit and parts list 2/6 free with parts.*

- Simple connections to only 6 tags on the R.F./I.F. module, 3 I.F. stages, osc. coil and 3 transistors which with their associated components are completely wired.
- Only 4 connections on the A.F. module to complete the 4 transistor 600 milliwatt solid state amplifier.
- Pre-aligned R.F./I.F. module built and tested.
- A.F. module built and tested.
- Fully tunable over M.W. and L.W. bands. M.W. 540–1640 Kc/s (557–183 metres). L.W. 150–275 Kc/s (2000–1100 metres).
- Intermediate Frequency 470 Kc/s.
- Sensitivity: M.W. at 1 Mc/s 10 microvolts plus or minus 3dB. L.W. at 200 Kc/s 40 microvolt plus or minus 4dB.
- High Q internal ferrite rod aerial on both wavebands.
- Class 'B' modulised output stage with thermistor controlled heat stabilisation. Class 'B' output stage ensures long battery life. Current drain is proportional to the output level. Total current drain of the receiver under no signal conditions is 10–12 mA. At reasonable listening level 20–30 mA.
- Extension sockets for car aerial input, tape recorder output (Independent of volume control) and External Speaker.
- All components (except speaker) mount on the printed circuit board. Easy-to-follow instructions. Size of cabinet 12in. long 8in. high and 3in. deep.
- Finger-tip controls.

Special Offer—Power Supply Kit to purchasers of Dorset Portable Radio parts incorporating mains transformer, rectifier and smoothing condenser, AC mains 200/250V output 9V 100mA, 9/6 extra.

ELEGANT SEVEN Mk III

COMBINED PORTABLE and CAR RADIO



Buy yourself an easy to build 7 transistor radio and save at least £10.0.0. Now you can build this superb transistor superhet radio for under £4.10.0. No one else can offer such a fantastic radio with so many de luxe star features.

SPECIAL OFFER

£4.9.6

POWER SUPPLY KIT
To purchasers of 'Elegant Seven' parts, incorporating mains transformer, rectifier and smoothing condenser. A.C. mains 200/250 volts. Output 9v 100mA. 9/6 extra.

Plus 7/6 P. & P. Parts List and circuit diagram 2/6 FREE with parts.

★ De luxe wooden cabinet size 12½" x 8½" x 3½".
★ Horizontal easy to read tuning scale printed grey with black letters, size 11½" x 2".
★ High 'Q' ferrite rod aerial.
★ I.F. neutralization on each separate stage.
★ D.C. coupled push pull output stage with separate A.C. negative feedback.
★ Room filling output 300mW.
★ Ready etched and drilled printed circuit board back printed for foolproof construction.
★ Fully comprehensive instructions and point-to-point wiring diagrams.
★ Car aerial socket.
★ Fully tunable over medium and long wave. 168·535 metres and 1250–2000 metres.
★ All components ferrite rod and tuning assembly mount on printed board.
★ 5" P.M. speaker.
★ Parts list and circuit diagram 2/6, free with parts.

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10 GNS WRAPS UP YOUR SPEAKER PROBLEMS

with Wharfedale's Unit 3 Speaker kit

Wharfedale have designed a new genuine high fidelity system that *you can build yourself*. With the Unit 3 Kit you get: an 8″ speaker (with a magnetic field of 12,000 oersteds) which covers the bass and middle ranges; the new Wharfedale tweeter with acoustiprene dome; an electrical cross-over unit; acoustic wadding, wiring, etc., and a complete assembly instruction leaflet, in fact, everything you need to build a compact speaker system.

You can build the Unit 3 Kit into one of two cabinet sizes. In the smaller cabinet the system will give a faithful and rich reproduction of all musical sounds from 65 - 17,000 Hz. The larger cabinet increases the range from 40 - 17,000 Hz.

WHARFEDALE

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PRACTICAL WIRELESS

VOL 44 No 2

issue 736

JUNE 1968

TOPIC OF THE MONTH

Edward in Wonderland

JUST WHAT *is* happening to the GPO these days? It seems to be fast sinking into a kind of dream world, with the PMG, Mr. Edward Short, playing Alice.

The latest case of midsummer madness appears to have been stimulated by pressure from an M.P. (Mr. George Wallace) for an extension of facilities in the "B" licence conditions. As a result, Mr. Edward Short announced that holders of "B" licences will soon be allowed to use the 144–146Mc/s band in addition to the existing 427Mc/s band.

OK, nothing objectionable here. But—out of the blue and to the great surprise of everyone—the PMG announced at the same time that he is to introduce a new "Beginner's Licence" in the autumn. What frequencies? What power? What conditions? What limitations? What facilities? What—to come down to it—is it all in aid of?

You may well ask. Nobody knows. The announcement came as a complete surprise to the R.S.G.B., who were not even consulted on the issue. And we would lay odds that the Radio Services Branch of the GPO knew no more about it.

The whole episode is highly unsatisfactory to everyone. The only conclusion one can arrive at is that the PMG sprang this one out of the hat (and seemingly on the spur of the moment) without even consulting the departments and society responsible for devising and maintaining the laws of amateur radio.

For in effect Mr. Short has proclaimed: "In the autumn, we are to introduce a new amateur licence for beginners. In the meantime, we are going to work out what it's all about." Legislation by White Paper we have seen and deplored. Now it seems we are to have legislation by casual announcement. Pragmatism has struck amateur radio.

Let us wish those now faced with the task of sorting out the details the very best of British luck, for they are certainly going to need it!

W. N. STEVENS—*Editor.*

Following the Government reshuffle, which took place after the above leader was written, the new PMG is Mr. Roy Mason. Our comments, however, remain valid.

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

JULY ISSUE WILL BE PUBLISHED ON JUNE 7th

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 36s. per year to any part of the world.

NEWS AND COMMENT...

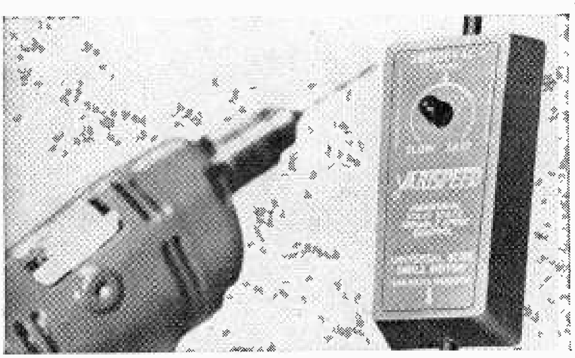
ULTRA INTRODUCE AUDIO AMPLIFIERS

Ultra Electronics Limited (UEL), Western Avenue, London, W3, England, announce a new range of solid state audio amplifiers, providing outputs of 10W, 25W, and 50W.

The 10W general purpose amplifier, type TA10 (illustrated), has been introduced to meet the growing number of small P.A. and sound reinforcement applications in industry and commerce. The unit accepts three inputs, two low impedance microphones, plus music with full mixing facilities. Outputs are provided for both low and high impedance speaker systems.

The 25W and 50W amplifiers accept five inputs, four microphones and one music, plus full mixing and tone control facilities. These two units also incorporate priority override facilities if required.

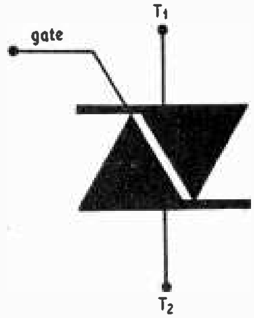
ELECTRONIC SPEED CONTROL



M. & J. Supplies & Sales have recently introduced a new low cost electronic drill speed controller, Vari-speed. It is housed in a robust unbreakable polypropylene case measuring $5 \times 2\frac{1}{2} \times 2$in. It operates on standard 220/250V a.c. household supplies and, the makers claim, is suitable for all standard power drills with a chuck capacity of up to $\frac{3}{8}$in. The Vari-speed incorporates advanced type thyristors, and provides smooth precise control from zero to full drill speed without loss of power, at the turn of a knob, claim the makers.

The Vari-speed is completely safe and is supplied with easy-to-follow instructions. It is guaranteed for twelve months and is available from M. & J. Supplies Ltd., 30/40 Dalling Road, Hammersmith, London W.6, priced at 39s. 6d. plus p.p. 2s. 6d. or write for a fully descriptive leaflet.

WESTINGHOUSE TRIAC



TRIAC (from TRIode A.C. switch) is a semiconductor device which can block voltage in either direction, be triggered on in either direction by positive or negative gate signals and can, therefore, conduct current in either direction. This single device can then be compared to an inverse parallel connected pair of thyristors.

Up to its rated blocking voltage the triac blocks in both directions and only a small leakage current flows. If the applied voltage exceeds the rated blocking voltage the device will turn on without gate signal. Because this effect occurs in both directions the triac is self-protecting against high voltage transients and will merely turn on, remaining undamaged provided the load current and the rate of rise of current are within the triac capability.

The triac is triggered by applying either positive or negative pulses between gate and terminal T1, which removes that region of the V-I characteristic between open gate breakover and conduction in either direction so that the characteristic becomes essentially that of a diode rectifier.

TEACHING MORSE

A London company that can teach anyone to touch type in 12 hours is developing a revolutionary method for teaching Morse code. If all goes well, it may be possible later this year to learn Morse up to Radio Amateur Examination requirements with only a few hours training.

Based on a technique similar to that successfully used to teach thousands of people to touch type, Sight and Sound of Oxford Street are confident that they will be able to teach Morse far quicker than by conventional means.

Development work is at an advanced stage using a visual signal board containing all the letters of the alphabet, numbers and punctuation, which flashes pulses of light from each character representing the Morse.

NEW LICENCE FOR RADIO AMATEURS

Two changes in amateur radio licensing arrangements were announced in Parliament by the Postmaster-General, the Rt. Hon. Edward Short, M.P.

A new "Beginners" licence is to be introduced in the autumn. The details of this licence have not yet been settled, but its purpose is to encourage interest in radio in people (especially young people) who have not yet reached the standards of qualification needed for a full "A" or "B" licence.

Holders of the Amateur (Sound) Licence "B" (for which Morse qualifications are not required) have now been authorised to operate in the frequency band 144–146Mc/s. Hitherto, amateurs wishing to use any band below 427Mc/s have had to obtain "A" licences, for which a Morse test is necessary.

NEWS AND COMMENT...

LASERS AND SPEEDOS

Among the many developments to be introduced at the Instruments, Electronics and Automation Exhibition held at Olympia, May 13th–18th, is a new American laser memory for computers. It can not only store massive amounts of information—645 million items of digital data on a square inch of tape—but can accept information at the formidable speed of 12 million binary digits a second. A laser with a finely focused beam "burns" minute holes in the tape surface. These holes can be detected by a second laser reading beam.

Another new application of electronics is an easy-to-read car speedometer which presents the road speed in digits. There is no needle: the speed appears in inch-high numerals. The development has been made possible by the use of microcircuitry. A tiny silicon chip, carrying the equivalent of 300 transistors. is used. This is a standard production component and the speedometer circuit in fact uses only three-quarters of its capability. But, by using a microcircuit already in production, the cost of the speedometer is kept to a minimum. The producers, General Instrument (UK) Ltd., say that it is already comparative in cost to conventional electronic instruments and could well compete in price with mechanical speedometers in a year's time.

ST. DUNSTAN'S ON THE AIR

War-blinded amateur radio operators met for their annual airing of the callsign GB3STD at St. Dunstan's, Ovingdean, near Brighton, on March 22–24th.

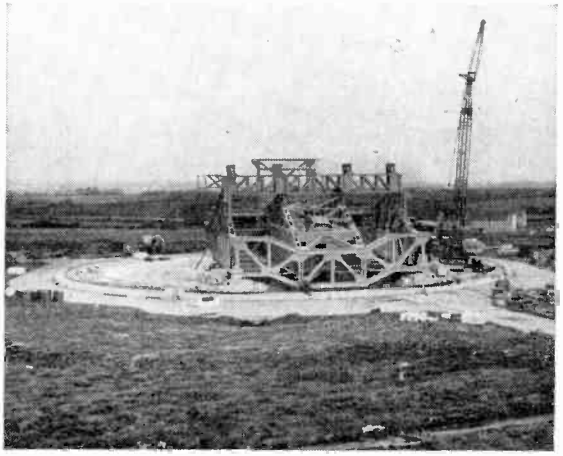
While the modern s.s.b. station was on the air busily making contacts with other amateurs all over the world, everyone was asking the same question—would they be able to contact Miss Iris de Reuck, ZS2PY, in Port Elizabeth, South Africa? Miss de Reuck is St. Dunstan's only blinded girl radio ham, and last year she opened the conference—by radio! The photograph shows war-blinded, former Marine Commando, John "Tiny" Pointon, G3MTX, on the mike.

The interesting menu included lectures by R. J. Hughes (R.S.G.B.) on transmitters and receivers for beginners, and Dr. R. G. Manton (BBC Aerial and Planning Dept.) on aerials.

Verdict was—a very successful weekend, and a special vote of thanks to the four 30 foot antennas on the roof who did such a grand job of squirting the r.f. in just the right places.

If you know someone who is blind, why not nip round and read this out to them. They'd appreciate it, and you never know, you might be responsible for giving another blind person an interest. Oh yes—they did work Iris in Port Elizabeth; well done both stations.

GOONHILLY AERIAL No. 2



Post Office engineers report encouraging progress with the construction of Aerial No. 2, which is now taking shape as a recognisable structure on the skyline near the existing aerial at the Goonhilly Earth Station in Cornwall.

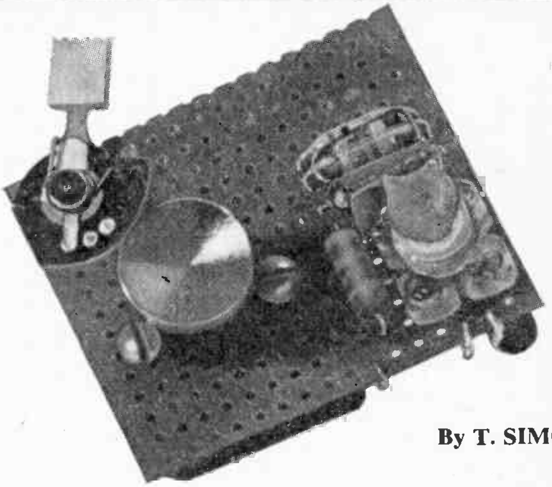
The 75½ft. radius, 340ft. long track, running from 66° to 326° E. of N. has been laid and levelled. Some 200 tons of steel have so far been used in the construction of the aerial base structure, which is mounted on a large centre pivot and a pair of bogies which run on the azimuth track. The 25½ft. long screw, weighing about 30 tons, required for the elevation drive, has been landed on the base structure and the four elevation bearings positioned on the massive cross beam. Work is also proceeding on cladding the base structure to provide apparatus rooms for the sophisticated equipments required for a commercially orientated earth station.

Manufacture of most of the telecommunications equipment, including the operational control console, is nearing completion and the British manufactured equipment is now undergoing the initial phases of system testing at the contractors' works. Meanwhile, at the works of an Ipswich contractor, the fabrication of the 90ft. reflector with its large backing structure and stainless steel plated petals proceeds. The weight on the elevation bearings, including that due to the counterbalance weights, is expected to be some 300 tons.

The aerial is required to work to an improved type of synchronous satellite positioned over the Atlantic Ocean later this year, thus releasing the first Goonhilly aerial from operational duty. The first aerial will then be equipped to work to an Indian Ocean satellite in 1969.

3 SIMPLE RECEIVERS FOR Beginners

ONE TRANSISTOR



By T. SIMON

NUMBER ONE . . . *in a brand new series of articles describing the design and construction of simple single-band receivers suitable for the novice. This month's set uses only one transistor in a reflex circuit suitable for the medium waveband.*

THERE are many people who would like to build a small uncomplicated radio receiver but begin to pale at the sight of several stages of transistor or valve circuitry together with numerous other components. Valve equipment has the disadvantage for the beginner of requiring a power supply, which adds to the cost, coupled with the increased hazard of getting a shock. All things considered, perhaps the best "first project" would be a simple transistor receiver capable of covering the medium waveband. It should be devoid of complicated switching and fairly simple and straight forward, both in circuit and construction. If you think along these lines and you would like to build a small set, perhaps for the bedside or even for a youngster, then the following circuit is recommended.

The receiver uses only one transistor and two diodes all of which are easily obtainable from a number of advertisers in this magazine, and they are very cheap too. The voltage required to power the set is nominally 8·4 volts obtained from a special Mallory battery. This battery is more expensive than the usual type used but will last very much longer. An ordinary PP3 or equivalent may be used which has a fractionally higher voltage—9 volts.

Circuitry

Figure 1 shows the circuit of the complete receiver. The signal is tuned in by VC1 in conjunction with L1—one of the windings on the small ferrite rod. A small secondary winding L2 is necessary to couple the signal developed to the base of Tr1. This small winding is required because the impedance of the tuned circuit VC1/L1 is a high whereas the input to the base of Tr1 is low impedance which is what L2 provides. The two resistors R1/R2 supply the base of Tr1 with bias.

After amplification at radio frequency by Tr1 the signal arrives at Tr1 collector. It cannot travel up to the phones terminal because of the high impedance offered by the tuned circuit C2/L3. It therefore travels through C3 to the two diodes. These detect the signal and D1 feeds this (now an audio signal) back again to the base of Tr1. The transistor now amplifies the signal again, this time at audio frequency and it again appears in amplified form at the collector. The tuned circuit C2/L3, although presenting a high impedance to radio frequencies only has a very low impedance at audio frequencies and thus the audio signal is allowed to pass unhindered to the phones.

Decoupling

In some circuits you will see a large value (10—100μF) wired from the positive line to earth in order to bypass any signals which might find their way onto the positive line and thus modulate the power supply—a most undesirable feature. In the

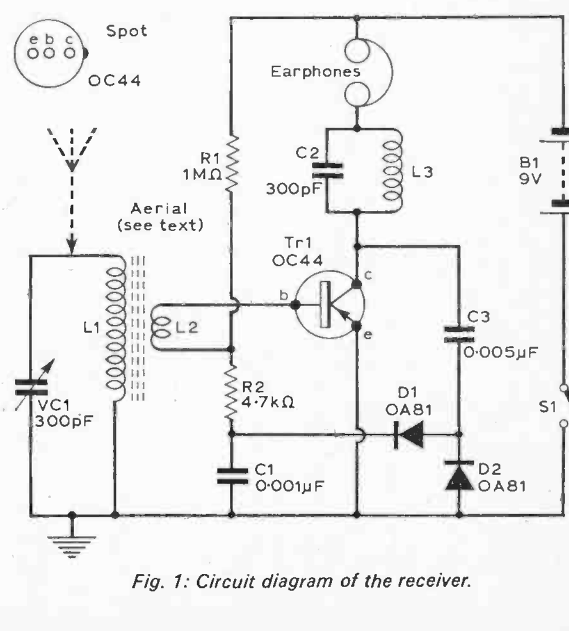


Fig. 1: Circuit diagram of the receiver.

circuit of Fig. 1 such a capacitor was not found necessary though if trouble were experienced, it would be very easy to wire one in. A value of 100μF would be suitable and a midget electrolytic type of 12 volt working would be satisfactory. If you do find this necessary, note that the electrolytic must be wired in the right way round. The positive end is usually marked but if you are in any doubt, ask your supplier which end is which and mark it accordingly.

Construction

First, obtain a small piece of veroboard $1\frac{3}{4} \times 1\frac{7}{16}$in. The piece used in the prototype has holes 0·04in. diameter but the veroboard with the larger diameter holes will suit equally well if it is found easier to obtain.

Mark out and drill the three holes for the variable capacitor VC1 and mount this with the aid of two 6BA bolts. These should not be longer than $\frac{5}{32}$in. from the underside of the head to the end of the protruding thread. If they are made any longer, they could easily push right through into the capacitor itself and damage the plates inside. If it is necessary to cut the existing bolts down to size, thread a nut onto the bolt first, cut the excess length off with a fretsaw fitted with a metal cutting blade, and gently unscrew the nut. This will re-form the end of the bolt and remove any burr. If this is not done, the burr could cause the bolt to seize up and enter the threaded holes on the tuning capacitor at an angle and could ruin the thread.

The coil L3 is a modified Osmor QHF5 with the top winding removed. This is easily done by cutting through the coil former gently with a fretsaw, but remove the core first. The two tags normally employed as terminals for this winding are used as anchor tags. It is quite in order to substitute a midget r.f. choke for this coil and C3 if one is to hand, but this will rob you of two convenient terminals for wiring up later on and also require a modification to suit in mounting the choke.

Enlarge the four holes to accommodate the coil L3 with a 6BA clearance drill. This is slightly smaller than $\frac{1}{8}$in. in diameter. The coil tags will fit easily into the holes indicated and L3 is held in place by slightly bending these tags over on the reverse side of the board. When soldered connections are made to these tags, this will further help to hold the coil onto the board.

Mount the remaining small components, including the two diodes, onto the board by bending their wire ends at right angles to their bodies and inserting these wires into the relevant holes. Soldering up may now commence, the only two components not on the board are the transistor, which is soldered last of all, and the ferrite rod and its two coils. Note that C2 is soldered to the top tags of the coil "above chassis", and that C3 is wired in "below chassis" as shown in Figs. 3 and 4.

Winding L1/L2

Obtain a piece of ferrite rod $1\frac{3}{4}$in. long and $\frac{3}{8}$in. diameter. If a longer piece is bought this can be "cut" to size by scoring the ferrite at $1\frac{3}{4}$in. from one end. Place the rod in the vice at the scored mark, and tap the rod sharply with a hammer, whereupon the rod will break at the score mark.

Wind on close wound turns of 24 s.w.g. enamelled copper wire until the rod is full i.e., as many turns as possible. These may be secured with a scrap of insulating tape at each end. Now wind four turns of the same gauge wire over the centre of the first winding again making these turns close wound and twist the two free ends together. The two free ends of the first winding may now be twisted together.

The ferrite rod is held to the veroboard with glue. Small strips of polystyrene such as used for packing are cut to the length of the rod and the width of VC1 respectively. These are smeared with "Evo-Stik" and pressed onto the board and side of the capacitor VC1. Their exposed surface is now lightly smeared with the same glue and the ferrite rod pushed firmly into place and allowed to set. This particular glue will dissolve the polystyrene and thus the rod can be pushed well into it forming a good adhesion. The on/off switch is mounted in a similar

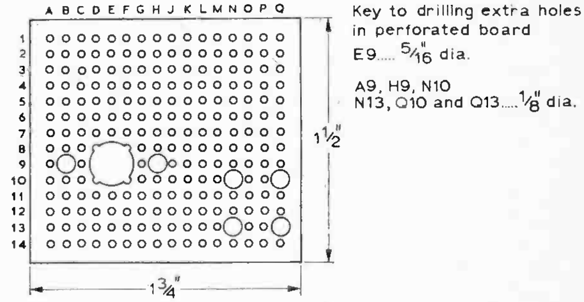


Fig. 2: Drilling details of the veroboard chassis.

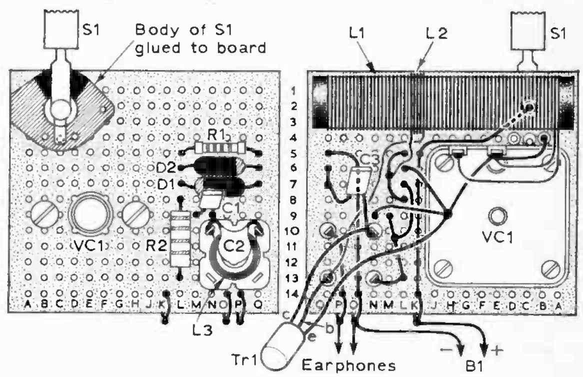


Fig. 3 (left): Layout of components on upper side of veroboard.

Fig. 4 (right): Wiring of the other side of the veroboard.

fashion with the aid of small pieces of polystyrene and glue. The small terminals will fit exactly into the holes on the veroboard and protrude through for soldering. Allow the glue to set well before using the switch.

Completion

Wire the coil into the circuit and note that one wire of the coupling winding (L2) goes to a spare unused tag on the coil L3.

Lastly, wire in the transistor using a pair of long-nosed pliers as a heat shunt. Three "take-off" points are made for the headphones and earth by looping wires through the last holes on the board as shown in Figs. 3 and 4.

Check all wiring thoroughly to ensure no mistakes. This applies particularly to the transistor and the two diodes where confusion could easily arise. In the original receiver, the diodes were selected for their different appearance to avoid confusion when wiring up as to which one was D1 and which was D2.

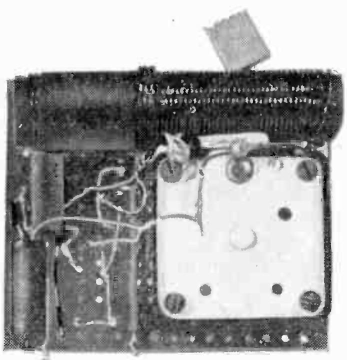
Testing

Connect a pair of high resistance headphones to the appropriate tags on the board. Connect the battery leads ensuring correct polarity—check once again, just to make sure. Switch on and swing the tuning capacitor from max. to min.

If you are in an area of good signal strength the ferrite rod will provide sufficient pickup without an aerial or earth. If this is not the case, connect an earth lead to one terminal of VC1 and an aerial to the other as indicated in Fig. 1. It is probable that two stations will be received, Radio 1 and Radio 4 in the London area.

Conclusion

This little receiver will give hours of pleasure and cost very little to run since battery drain is very low, less than two milliamperes. A suitable case could be made from plastic or thin wood if required and details are left to individual taste. In the event of a case being used, the spindle of the tuning capacitor will prove too short to protrude through to allow a knob to be fitted. In this instance, a small extension coupling could be fitted to VC1 spindle.



The photograph shows the wiring on the "underside" of the veroboard. Note that the transistor and the capacitor C3 are wired in on this side of the veroboard.

★ components list

Resistors:
R1 1MΩ
R2 4·7kΩ

Capacitors:
C1 0·001μF
C2 300pF
C3 0·005μF
VC1 300pF Jackson Dilecon

Semiconductors:
Tr1 OC44
D1 OA81
D2 OA81

Coils:
L1, L2 } See text
L3 Osmor QHF5

Miscellaneous:
Ferrite rod $1\frac{3}{4}$ x $\frac{3}{8}$in.; 24 s.w.g. enam. copper wire; veroboard $1\frac{3}{4}$ x 1in.; miniature switch (Henry's Radio); battery—Mallory TR146; high resistance headphones (2,000Ω); two 6BA bolts; Evo-Stik glue; scraps of polystyrene; wire; solder etc.

An OC171 could be used in place of the OC44 specified, the only minor circuit modification would be to take the screen lead from the OC171 to the positive or earth line.

Various other r.f. types were tested in the prototype, making adjustments where necessary, however, the type specified has the advantage of being easily obtainable and at a very reasonable price. Some n-p-n types were tested and worked, but it is not recommended that this be done since various polarities must be reversed, and the arrangement offered no great improvement in performance over the humble OC44.

This set will not have super sensitivity nor compare with the more advanced type of t.r.f. receiver and superhet, but it should receive local stations in most areas with the aid of an aerial.

NUMBER TWO . . . *in next month's* Practical Wireless—*a two-transistor receiver using even fewer components. Circuitry, photographs and full constructional details.*

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

WANTED

. . . circuit for a transistorised converter giving 230-250V, 50c/s and at least 60 watts from 12 volt input.—J. Ross, 5 Vulcan Crescent, North Hykeham, Lincs.

. . . wanted for Hallicrafters S27—circuit diagram, acorn valve holders, mains transformer ratings.—J. Sartorius, 35 Lingham Lane, Moreton, Wirral, Cheshire.

. . . record/playback head for a Walter 101 tape recorder.—A. Holmwood, 8 Dock Street, Pembroke Dock, Pembs.

. . . issues of *Practical Television* January-December 1962, 1963, 1964, 1965 (except April), 1966, and July, September, October, November, December, 1961.—L. Huxton, 187 Drake's Drive, St. Albans, Herts.

. . . issues of *Practical Wireless* March, June, September, 1965; March, May, November, December, 1966; January-December, 1967.—I. Nicholls, 15a Iverson Road, Kilburn, London, N.W.6.

. . . two optical units from projection television complete with focus and scanning coils, three e.h.t. units complete with three field and line output transformers.—C. Jervis, 32 Moathouse Lane East, Wednesfield, Staffs.

. . . handbook for B40 receiver.—R. Hooper, 206 Teignmouth Road, Torquay, Devon.

. . . numerous copies of *Practical Wireless* and *Practical Television*, personal collection only.—J. Foy, 101 Sandringham Road, Birmingham 22B.

. . . manual for TCS receiver.—L. Levell, Popes Hill, Newham, Glos.

. . . issues of *Practical Wireless* 1951-1966.—L. Levell, Popes Hill, Newham, Glos.

. . . copy of October 1965 *Practical Wireless*.—H. McConnel, Blackyett, Kirtlebridge, nr. Lockerbie, Dumfriesshire.

. . . issues of *Practical Wireless*—July, August, September, November 1966 and June, July, August 1967.—J. Rigg, 139 Broad Lane, Rochdale, Lancs.

. . . manual or circuit diagram of receiver type P58 (300-650Mc/s).—R. Hayward, "Sunnyfields", Lighthouse Road, St. Margaret's Bay, Kent.

. . . with anybody my own age ($16\frac{1}{2}$), interested in s.w.l., radios and fishing.—R. Russell, Stanley House, Wellington College, Crowthorne, Berks.

. . . *Practical Wireless* January 1958 and April 1959.—D. Barron, 77 Naworth Drive, Newcastle upon Tyne.

. . . *Practical Wireless* July 1963 for information on Signal Injector.—W. Fell, 77 James Street, Frenchwood, Preston, Lancs.

. . . *Practical Wireless* March 1965.—R. Sharpe, 99 Halcyon Road, Newton Abbot, Devon.

. . . circuit of a 100-watt amplifier using 807's, KT88's or EL34's etc.—P. Watson, "Ferrlea", Latimer Road, Alvechurch, nr. Birmingham.

. . . *Practical Wireless* March and April 1966.—B. Dunn, 8 Lancaster Drive, Clayton-le-Moors, Accrington, Lancs.

. . . tapespond with anyone my own age (15), interested in amateur radio. My machine is a cassette $1\frac{7}{8}$ i.p.s.—J. Stewart, 8 Semerled Avenue, Paisley, Renfrewshire, Scotland.

. . . adding an "S" meter to the R107 receiver.—M. Howarth, 4 Spencer Street, Burnley, Lancs.

. . . *Practical Wireless* October 1964 containing article on the "Spectreuphon".—P.O. Wilmer, C. J., Officers' Mess, R.A.F. Leeming, Northallerton, Yorks.

. . . correspond with someone my own age (12), interested in simple radio and wireless.—R. Walker, 72 Rutland Avenue, Nuneaton, Warwickshire.

. . . help and advice regarding construction to save another set from the dustman.—I. Murray, 77 Heath Lane, Upper Hale, Farnham, Surrey.

. . . tapespondant my own age (14), interested in s.w. amateur radio, and who has a receiver. My T/R is a Ferguson 3224 two-track $3\frac{3}{4}$ i.p.s.

. . . *Practical Wireless*—over a hundred copies from 1957-1968.—A. Starreveld, 127 Welldon Crescent, Harrow, Mddx.

. . . February 1965 issue of *Practical Television* and January 1967 issue of *Practical Wireless*. Also any details of converting televisions into oscilloscopes.—M. Davies, Beechcroft, Northwood, Wem, Salop.

. . . circuitry (buy or borrow) for a high quality monophonic amplifier with an output from 30 to 70 watts.—D. Brown, Electronics Society, Lymm Grammar School, Oughtrington Lane, Lymm, Cheshire.

. . . correspondence with anyone interested in short wave listening, and hi-fi (I am thirteen years old).—A. Cockerill, 23 Cortina Avenue, High Barnes, Sunderland, Co. Durham.

. . . Issues containing mods to the 19 set *Practical Wireless*, March to April 1966.—C. Guellard, 121 Heol-y-Frenhines, Bridgend, Glamorgan.

. . . *Practical Wireless* October and November 1963.—A. Hearey, 8c Moveen House, Benmore Drive, Belfast.

ADAPTABLE LOW COST hi-fi SYSTEM

W. CAMERON

The author discusses some of the points arising from readers queries on his hi-fi system, that appeared recently, as a series of articles in this magazine (December 1967—March 1968)

BECAUSE of the wide interest shown in his recent series of articles, the author has selected the most frequent or interesting queries from readers with his answers to them, for the benefit of others who may be interested in exploring the possibilities of increasing the versatility of the amplifier.

Tape facilities

An additional socket may be fitted to provide an output for "Record", and connected via a resistor to the positive side of C3 (Fig. 1). The resistor will be typically 470kΩ, but can be between 100kΩ and 1MΩ, the actual value chosen to give a suitable output level for the particular tape recorder.

This will provide a fixed output, unaffected by the volume control in the amplifier.

The "Aux" input can be used for playback if a suitable series resistor is fitted. This should be chosen so that the tape recorder does not overload the amplifier. The value of resistor will be between 100kΩ and 1MΩ, depending on the output level from the recorder.

Low output cartridges

The amplifier as it is, has just not sufficient gain to give full output when ceramic cartridges with an output less than 100mv/c are used. However, a substantial increase in gain can be made by reducing R5 to 4·7Ω or even 2Ω. A further increase may be obtained by reducing R6a to 330Ω.

Alternative transistors

It was advised earlier in the article that transistors Tr1 to Tr4 should be of the specified types. More recent tests have shown, however, that the amplifier gives identical results when other transistors are used as follows:

For driver 2G371, use OC81D or OC71
for o/p pair 2G381 use OC81 or AC128
2G339 use AC127
} LFK3 Pack

The pre-driver can be either a 2G371 or OC71. A guide to approximate voltage readings in the driver amplifier is given in the table opposite.

Higher output power

Higher voltages may be used on the output transistors to provide a higher power output.

Voltages up to a maximum of 60V can be used (i.e. 30V negative and 30V positive with respect to common).

Sufficient drive is available from the driver amplifier, to drive the output stage to about 30W into 15Ω or 45W into 7Ω, when the total h.t. across the output pair of transistors Tr5 and 6 is 60V. R19 and R20 should then be 0·75Ω, R14 and R15, 500Ω 5W, R15 and R17, 3·3Ω half watt, and R18, 330Ω 1W.

R5 in the driver amplifier should be reduced in value to 2·2Ω.

The supply voltage to the driver amplifier must remain at 12V max, and this can conveniently be obtained via a voltage regulator from the negative supply line. A suggested regulator circuit is shown (Fig. 2).

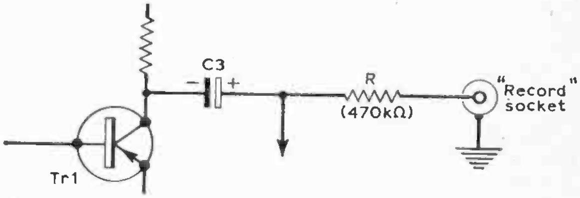


Fig. 1: An output for "Record" can be taken from the positive side of C3 via R.

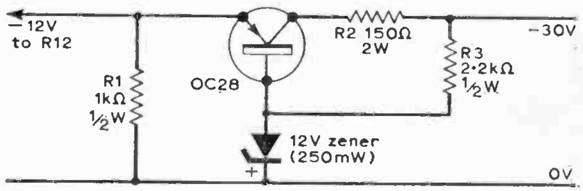


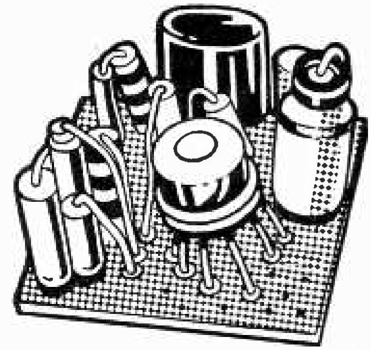
Fig. 2: A small heat sink is required for the OC28. The resistor R2 avoids unnecessary dissipation in the OC28.

TABLE

Voltage	E	B	C
Tr1a	0·35	0·5	0·8
Tr1	0·65	0·8	4·0
Tr2	0·1	0·3	5·7
Tr3	6·0	6·1	12·0
Tr4	5·8	5·75	0

Approx. voltage readings. Driver amplifier h.t. supply 12 volts. Measured with 20,000Ω/V meter.

Integrated Circuit Preamplifier



LESLIE McNAMARA B.Sc.

REGULAR readers of this magazine will be familiar with the recent developments in integrated circuitry, and not a few will have introduced themselves to these devices through one or other of the published practical projects.

All will appreciate that a particular circuit can be marketed at an attractive price only if the manufacturer can reasonably expect to spread the cost of designing and tooling up for that type over a large number of units sold. The amateur electronics market, of course, is much too small to justify such an investment, so that we can expect to be offered only types which are already an economic proposition on other grounds, such as industrial or military applications for the same design. If really large orders for a special type are not available, the supplier's only hope is to produce units which are sufficiently flexible as to permit the same unit to operate effectively in a variety of applications.

The device to be described takes this line of reasoning to its ultimate extreme, and in fact it will be seen from the approach to the successful application to be described that opportunities for its use are limited only by the resourcefulness of its users.

The unit is the R.C.A. type CA3018 Multiple Transistor Array, containing four epitaxially diffused n-p-n silicon transistors in a single monolithic chip, and supplied in a 12-lead package to TO-5 standard specifications. All four transistors are electrically identical; two are completely independent, but as the substrate (the silicon base into which the transistor junctions are diffused) requires an earth connection, for a reason to be explained later, only five terminals are available for the other two transistors, so they appear as a "super-alpha pair", with the emitter of Tr3 and Tr4 base, taken to a common terminal.

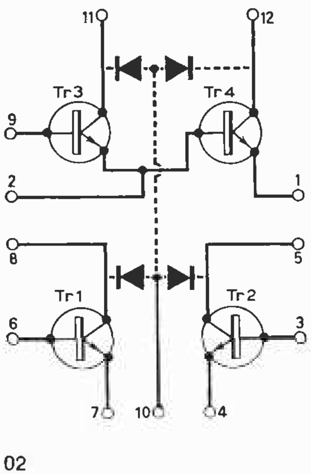


Fig. 1: Circuit diagram of the CA3018 integrated circuit.

Since the transistors are fabricated by the epitaxial diffusion technique, their high frequency performance is extremely good, extending up to 200Mc/s, while as silicon units, they can function at higher temperatures than germanium types, with consequent higher dissipations. However, all are n-p-n varieties, so that if there is a requirement for complementary circuitry, external p-n-p units must be added. Further, due to the method of manufacture, there are effectively diode junctions between the transistor collectors and the substrate; in practical circuits these are rendered inoperative, since the earth connection to the substrate, already mentioned, applies a reverse bias to these junctions. It is therefore evident that the designer has taken pains to eliminate any undesirable side effects of the fabrication process. In transistors Tr1, Tr2 and Tr4, he has even arranged the internal emitter leads to screen the bases from the collectors of the transistors, so reducing to a minimum stray capacitative feedback between input and output circuits; in a similar fashion the substrate lead shields the base from the collector of Tr3. These precautions maintain the stability of the unit in high-frequency high-gain amplifiers.

In any application for which transistors of closely matched performance are required, the CA3018 is particularly useful, since its elements are fabricated side by side in the same chip of silicon under the same conditions. They will, therefore, be closer than even the most carefully selected discrete transistors, and furthermore in operation will be subjected to identical thermal and other effects which can force even closely matched transistors to drift apart. These features are attractive in differential amplifiers, or in v.h.f. applications.

Preamplifier Details

To introduce this unit to readers it was decided to develop a version of a previously investigated and developed circuit; application of the same technique to other situations would presumably have equally satisfactory results, and a few particularly promising circuits are mentioned. The application worked out in detail is a high impedance preamplifier, the original of which was described by F. L. Thurston in P.W., Jan. 1967. Readers are referred to that article for a full description of the method of operation of the circuit, as a bare minimum of details are repeated here for the understanding of the modified version.

Mr. Thurston explained the limitations placed on the performance of crystal microphones in transistorised circuits by the generally much lower input impedance of the solid state amplifier which fails to

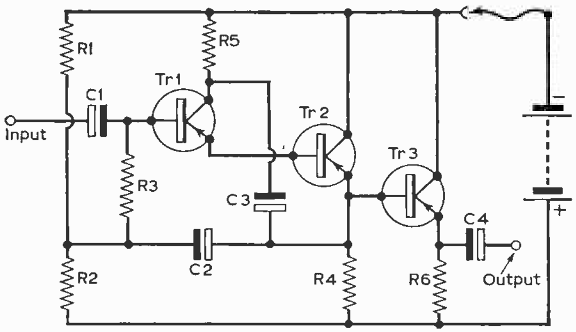


Fig. 2: Circuit diagram of the sub-miniature high impedance amplifier (Practical Wireless Jan. 1967).

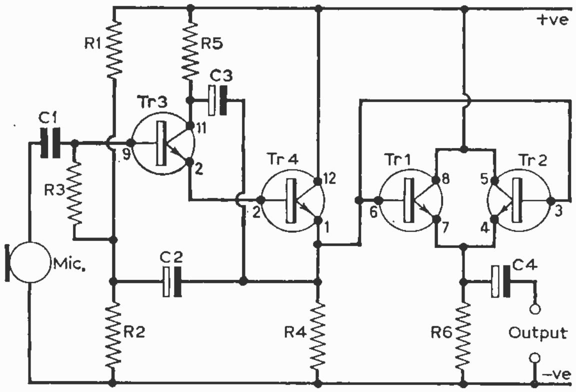


Fig. 3: Integrated circuit version of the high impedance sub-miniature amplifier (preamplifier).

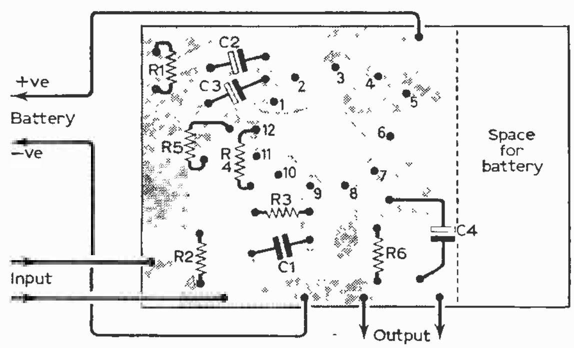


Fig. 4: Printed circuit layout for the sub-miniature amplifier (preamplifier).

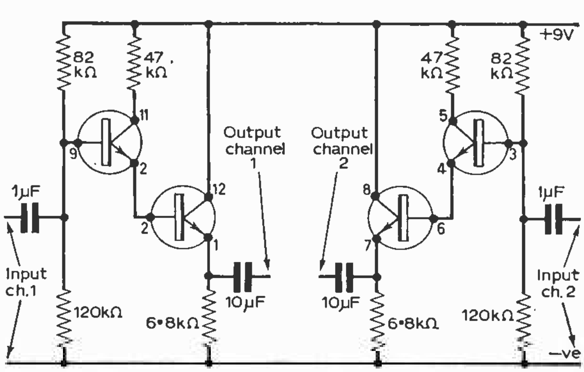


Fig. 5: A twin super-alpha circuit suitable for providing a better match for the two channels of a stereo record player.

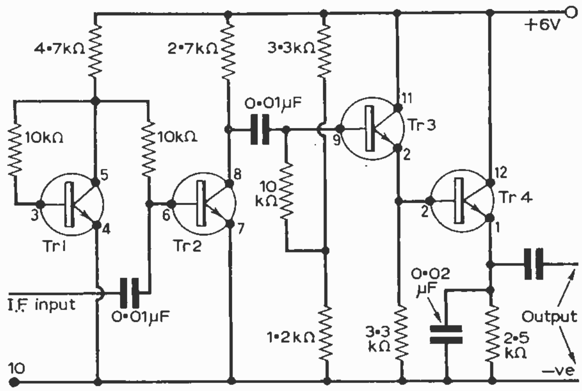


Fig. 6: An untuned final amplifier and detector stage for a.m. radio applications. Selectivity would be provided by earlier tuned transformers.

★ components list (Fig. 3)

Resistors:

R1	100kΩ	R4	10kΩ
R2	150kΩ	R5	47kΩ
R3	330kΩ	R6	4·7kΩ

Capacitors:

C1	0·1μF miniature
C2	2μF to 30μF
C3	2μF to 30μF
C4	30μF

Integrated Circuit CA3018 (RCA Great Britain Ltd., Lincoln Way, Windmill Rd., Sunbury-on-Thames, Middlesex.)

match the high output impedance of the microphone. Even an emitter follower is marginally effective with some microphones, and the article went on to describe the result of "bootstrapping" a circuit of this type to increase its impedance still further, to a value of several megohms, quite sufficient for any amateur purposes. In turn, this was followed by an emitter follower output stage to eliminate the possibility of an external load shunting the output impedance of the preamp and losing effectiveness by mismatching at that point. Fig. 2 is a reprint of Mr. Thurston's original circuit diagram, in which these features are evident. Comparing that with Fig. 3, the integrated circuit development, it is obvious that Tr3 and Tr4, the super alpha pair in the I.C. are ideally arranged to replace Tr1 and Tr2 in the discrete arrangement. The availability of two closely matched separate transistors, Tr1 and Tr2 can then be exploited to reduce further the output impedance of the system by parallel operation, replacing Tr3 of Fig. 2.

Both circuits are illustrated to avoid any confusion between them, and so that their differences as well as there similarities will be evident. The chief of these is that due to the opposite polarity of the transistors fabricated in the CA3018, the battery polarity and that of each one of the electrolytic capacitors in the circuit also must be reversed.

It is unnecessary to repeat the details of construction and operation of units such as this, which follow established practice familiar to readers; Fig. 4 shows

—*continued on page 115*

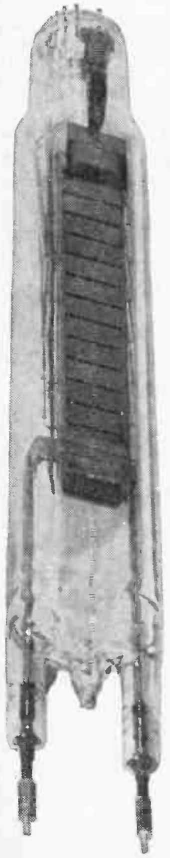
THE PHYSICS EXHIBITION 1968

ALEXANDRA PALACE

THE world of the physicist is indeed a fascinating one, and at the 1968 Physics Exhibition I was privileged to enter this precision fairyland. Here, the English language becomes confusing as such terms as Lenticular Stereogram are cheerfully bandied about. There was a YIG on show, and a modulated one at that. A portable laser was offered as was a 60kV multiple arc low inductance spark gap—just the thing for local broadcasting!

A glance around this exhibition soon indicated quite clearly how the sharp divisions between the various professions are fast diffusing, and in many cases it is difficult, if not impossible, to determine where Chemistry and Physics ends and Electronics begins. The pace of research is accelerating at such a rate that speculation about next year's exhibits becomes nothing more than an educated guess.

Afraid of the dark? For some exhibitors darkness doesn't exist and even if it does there's no problem. **EMI Electronics Ltd.,** displayed their photomultiplier type 9740. This is a production model of a photomultiplier originally intended for nuclear applications, which could be used for modulated light detection in a modern communications system. It employs the crossed electric and magnetic field technique and produces an output pulse of some 20mA from a single electron at the input.



The E.M.I. 9740 photomultiplier which can produce an output pulse of 20mA from a single electron input.

Also of interest from EMI is their Thermal Imaging Equipment. Here, the image or scene is scanned by mirrors and fed to a detector, which in turn feeds the display signal to the indicator. Since the wave length involved is in the micron-band region, i.e., infra-red, it doesn't matter if the scene is in daylight or total darkness. If you're thinking of knocking one up you should also know that the detection is done by indium antimonide detectors cooled to liquid air temperature by a Joule-Thomson cooler. No, you can't modify the frig!

English Electric Valve Co. Ltd. can really claim to see in the dark. Their Image Isocon can produce good television pictures when the photocathode illumination is only 10^{-4}ft. candles. Even when this

Photograph of parked cars taken in sunlight by conventional means. Compare this with the same view shown at the foot of the page.

drops to 10^{-6}ft. candles, the makers claim that acceptable pictures are still obtainable. Certainly the one on show lived up to this claim. In the darkened room it was quite impossible to detect anything but the faintest outline of the scene, and this only after being in there for quite some time to allow the eye to adjust. However, outside, the scene was clearly displayed with great clarity and detail on the monitor screen.

Associated Semiconductor Manufacturers Ltd., is a joint Mullard/G.E.C. company responsible for the development and manufacture of Mullard semiconductors. Three items of interest, all connected with transistor devices. First—a technique called Ion-Implantation.

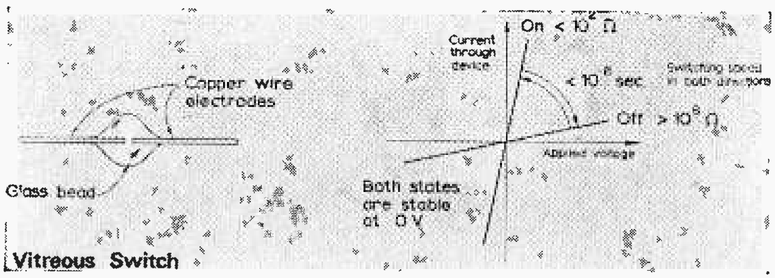
A semiconductor is first made very pure and then certain controlled amounts of impurity are added. It is often necessary to perform some of these processes at high temperatures. However, with Ion-Implantation, the dopant is ionised, and these ions accelerated to a high energy and then passed through a strong magnetic field to remove unwanted ion impurities. The "pure" ion beam then bombards the semiconductor surface through photo-engraved windows in an opaque mask. The implanted atoms

This is the result using thermal imageing equipment in total darkness—not even a moon!

occupy lattice sites and become electrically active.

By this method a very wide range of dopants, many of which cannot be thermally diffused, can be introduced into the semiconductor lattice. The process does not require the high temperatures of thermal diffusion and thus the number of unwanted impurities entering the crystal is limited. Work on this is also being carried out at the UKAEA at Harwell.

Both n-p-n bipolar transistors and p-channel MOST's can be fabricated on the same epitaxial material (on p-type substrate). The n-layer forms the bipolar collector region and the MOST substrate. A p-diffusion is used for the bi-polar base and



A simple bead of special glass capable of use as a memory store in computer applications.

the MOST source and drain regions. The bipolar emitter can be formed by a second n-diffusion. A gate oxide and metallisation are also added. By these means integrated circuits may be made which exploit the best characteristics of both devices, the MOST providing the high input resistance and the bipolar supplying the gain.

Some of the snags with the FET and MOST are low gain and the need to neutralise plus a limited power dissipation. Using a technique involving Silicon Nitride, A.S.M. Ltd., have produced a high power version which they call a MNST. It has a transconductance more than twice that of MOST equivalent, and with very good a.c. stability. One high power FET is claimed to have a gain of greater than 10dB, will supply 11 watts p-e-p of single sideband, and has intermodulation distortion products better than −30dB. These figures are all for 20Mc/s. Look out all you transistor-loving Hams, it looks like it's back to the old high-impedance valve type circuitry soon.

Electric Power Storage Ltd., displayed their truly remarkable fuel cells. Batteries convert chemical energy into electrical energy directly. However, conventional storage batteries cannot be used to produce electricity continuously because the active material in the electrodes undergoes chemical change and reconversion by recharging. In batteries of fuel cells, the active material is in the form of a fuel continuously fed into the electrodes. Thus, with a continuous supply of the relevant fuel, these cells can generate power continuously and still retain the advantage of a higher efficiency compared with generating systems utilising internal combustion and steam turbines.

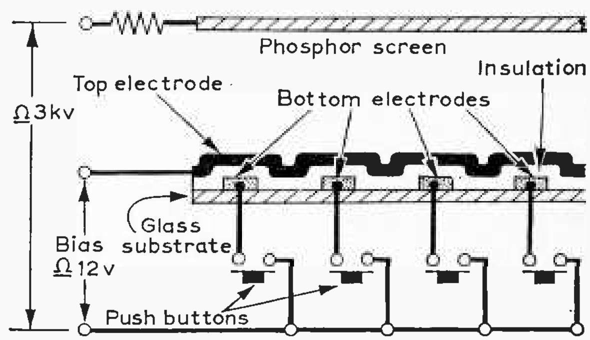
A cell 6 × 6¾ × 3½in. can deliver 100 amps at 0·55V, and cells of this type have operated continuously for over 12,000 hours. A battery comprising 63 such cells producing 3½kW, has been operating a truck at the company's laboratories for 2 years.

Want to build a sophisticated breathalyser? The Research Department of Anaesthetics, **Royal College of Surgeons** might have a circuit for you. They're using a helium-neon laser with a YIG modulator to measure alcohol in the breath. Sorry—kits not available.

Most solid state electronic devices rely for their operation on the transport of electrons through a very pure, nearly perfect, single crystal. Interest has been revived recently, however, in the electrical properties of much less perfect material. In the limit, this class is represented by vitreous materials. Such materials are characterised by an absence of ordered arrangements extending over distances of more than two or three atomic diameters.

The device demonstrated by **S.T.L. (Research)** comprised two thin wire metal electrodes separated by a thin layer of special glass which can be in either of two resistive states: an "off" state, with a resistance in excess of $10^{-8}\Omega$ and an "on" state with a resistance of less than $10^2\Omega$. The device switches from the "off" to the "on" state when the terminal voltage exceeds a critical value, typically 20 volts. Switching from the "on" to the "off" state is effected by a steep-edged pulse from a low-impedance source. The switching in both directions is better than 10^{-8} sec. In its application as a memory element, the device will retain information indefinitely, in open-circuit, short-circuit, or under load conditions. Read-out is not frequency limited, and is non-destructive. The size of the bead on show was about 3/32in. diameter.

Also, from **S.T.L.,** comes a Cold-cathode Optical Display Panel. Basically, a bank of push-buttons was used, these being depressed in any desirable pattern.



Cold cathode optical unit shown by S.T.L.

This identical pattern was then immediately displayed on a small flat illuminated screen some 4in. square and 1in. deep. Letters of the alphabet were easily formed as were digits. Makes one think about very small flat cathode ray tubes and possible applications in other fields.

National Research Development Corporation exhibited a non-mechanical ammeter. This has no moving parts and uses simple toroids to detect the current. Read-out is arranged by using small neons. The ammeter accuracy is solely determined by the spread of the characteristics of the ferrite toroids and the number of turns on the windings. With low-temperature coefficient square loop ferrites, high absolute accuracies of the order of 1% can be achieved by using up to fifty read-out neons. ■

YOUR ? QUESTIONS ANSWERED

Impedance Problems

I have read that it is not desirable to tape record using a high impedance microphone and a long lead, but that it is better to use a low impedance microphone with a step-down transformer at the end of a short lead, connected to a long lead followed by a step-up transformer at the recorder.

If this is so, can you give details of types, specifications e.g. ratios etc., required for the transformers together with details of screening the leads?—C. Whitehead (Edinburgh).

Although it is possible to use two microphone transformers in the way you suggest, with balanced line connection and the screen of the lead connected only to the amplifier end of the microphone step-up transformer at the tape recorder end, we would suggest that a cheaper and much more effective way is to construct a simple two-transistor matching unit at the microphone end, suitable to drive the medium impedance input of the average tape recorder. A bootstrap circuit into a 10kΩ load should be about 250mV sensitivity—the input impedance of the average tape recorder microphone socket would be higher and the sensitivity lower, so that a suitable drive with better signal-to-noise ratio would be obtained.

The objection to using transformers is that the crystal microphone, which we presume you are using, is a capacitative source and to load it with the inductance of the transformer is to invite a loss of low frequencies. Quite frankly, we think your best method is to get a dynamic microphone (probably cheaper, too) and preserve the frequency response.

Sound on Sound!

I have a modest audio set-up which works very well with the exception of one factor. When the transistor amplifier is switched on, but no signal applied, I can hear nothing less than BBC-1 TV sound coming from the speaker. The sound is faint with much background noise, but it is most definitely BBC-1 TV.

There is no TV connected to my system, in fact the nearest set is at the other side of the house, and even when this set is off, I can still "receive" BBC TV1.—S. Becket (London, S.E.12).

Interference of the type you mention often arises due to a rectifying contact somewhere in the amplifier system. We therefore suggest that you check that the input socket of the amplifier is making good contact with the input plug. If the loudspeaker is fed via a plug-and-socket arrangement, check that these connections are good ones. If the interference is present with the input socket of the amplifier short circuited, then it may be being picked up on the loudspeaker leads. Try adding a capacitor of 50pF or 100pF across the loudspeaker itself.

If you are still unable to get rid of the interference, we suggest you contact the Radio Services Branch of your local GPO and ask one of their officers to help you.

Locked I.F.T's

To align, say, a transistor set with a signal generator, the service sheet may say "align the core of an i.f.t. or slide L2 along the ferrite rod". These are usually covered with paraffin wax. What is the *professional* way of dealing with this. Hot iron, or solvent, in which case, which solvent, or ? Also, how should circlets be removed without damage?—H. E. Thornton (Surrey).

If cores are fixed in position with wax, the usual way of dealing with them is to melt the wax with a soldering iron or other source of heat. Generally, it is best to withdraw the cores completely and clean the wax from the threads so that adjustment is made easy. The best way of locking cores in position is to use a core-locking compound available from a number of our advertisers including Home Radio.

We are not quite clear what you mean by "circlets". If you mean circlips, these can be removed with a pair of pliers especially made for the job.

Pickup Arm Pivot

Could you give me any information about locating the position of the pivot of a pickup arm?

I fitted a turntable and motor on a board together with the pickup arm, but when I tried it, the stylus head slid across the record (twelve inch) from the outside edge to a position about one inch from the end of the track.—B. Downward (Staffs).

You do not state what turntable, motor and pickup you are using, so it is impossible to give you precise placing for the pickup pivot in relation to the turntable.

The essential thing is to reduce tracking error, and the maker will have curved the arm, offsetting so that the pickup head angles toward the centre of the record and the stylus deviates as little as possible from its required arc—thus cancelling out compliance variations.

In the absence of the details, which should be supplied by the makers, we suggest you draw a line at a tangent to the edge of the turntable (or a 12in. disc if the turntable exceeds this). Then measure the exact distance between stylus and pivot of arm. Mark off this distance from the centre boss of the turntable until it meets the tangent. This is the pivot point. Make sure the turntable is level and the cartridge correctly aligned and the stylus properly seated.

Improving Reception

I would be grateful if you could offer some help regards my radio—Pye Q5 transistor. I am anxious to gain good reception from Radio Eirean on medium waves (550 metres). Could you advise me in the purchase of a tuner or some other means of getting a better signal on my set. At the moment the signal is fairly good during the hours of darkness, but there is nothing during daylight hours.—J. Broune (N.W.1).

We doubt very much whether you will be able to improve the reception of the station you mention to any degree during the day. However, you could try the effect of using an aerial-tuning unit such as are described in the Amateur Radio Handbook published by the Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1. This book and other books of interest will be in your local lending and reference libraries.

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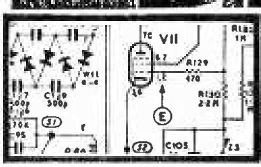
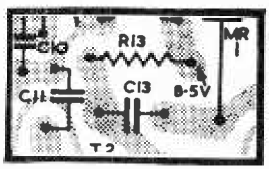
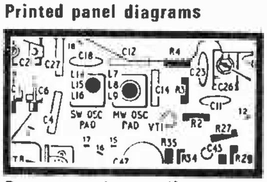


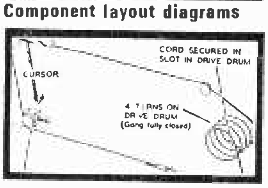
Circuit diagrams



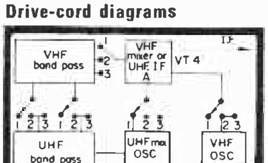
Printed panel diagrams



Component layout diagrams



Drive-cord diagrams



Block diagrams

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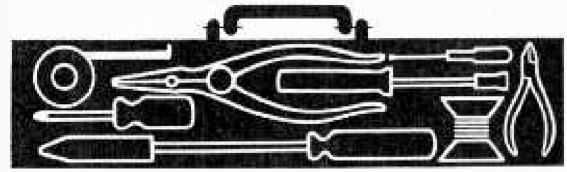
repairing radio sets

PART 3

GORDON J. KING

This month we look at the transistor under signal conditions and then go on to examine what happens when associated components fail or change their value.



PART 1 (April 1968 issue) investigated the basic principles of semiconductor diodes and transistors and expounded how they work from the d.c. point of view. In radio equipment, however, transistors and diodes are concerned essentially with r.f., i.f. and a.f. signals—to amplify, detect, convert and generate them—the d.c. conditions being, so to speak, the "stage" set-up to make signal handling possible. In some semiconductor applications, d.c. switching is the prime consideration, but this is certainly not true of radio receivers.

In this article, therefore, we examine the transistor mainly under signal conditions; and by being aware of what is *normal* behaviour in signal circuits, we shall be in a strong position to determine whether the operation in practice veers towards the abnormal —and if so, why.

When commencing to repair a transistor radio set, for instance, irrespective of the fault condition or symptom, it pays to have clearly in mind that the set *was* designed to work within its specifications and that it *has* been working properly, so that any abnormal operation *must* be caused by a fault somewhere in the circuit or in a component, no matter how impossible these things may seem at the time. Although this might appear pretty obvious, it is surprising how many "repairers" endeavour to restore "normal" working by changing the circuit or component values, from the original design, to establish conditions (albeit, unwittingly) to mask the fault.

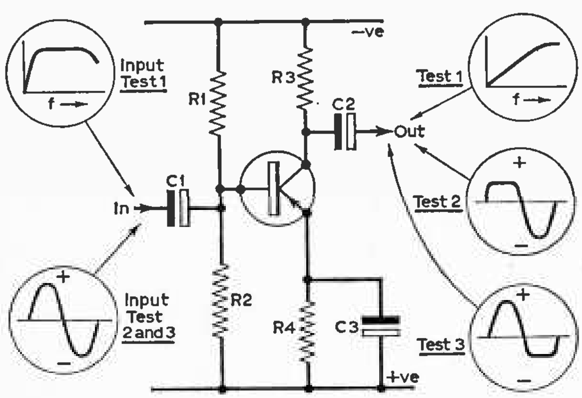


Fig. 14: Basic common-emitter circuit showing dynamic tests (see text).

This may not, of course, be true when the inactive equipment under initial test is home-designed or constructed from a published design, for then one lesser skilled in the arts cannot be certain that the design is without flaw. The best approach when the construction is from a published design, and fails to work as apparently it should, is to assume to start with, anyway, that the design is correct and that the trouble is due to bad construction or to mixed-up component values. Indeed, many efforts of the home-constructor fail to work properly, simply because transistor lead-outs have been wrongly connected and because resistor and capacitor codes have been misread. Although this series of articles is focused towards repairing commercially-produced equipment, it will have value also to the home-constructor—giving him hints and tips as to what might be wrong.

No matter how complex the equipment under repair may be, it is composed of components of known ways of working. A capacitor acts as a capacitor and a transistor as a transistor whether it is in a single-stage transister hook-up or in the most complicated of colour television sets. This is a good maxim to remember. Another one is that any fault is caused by an open-circuit, a short-circuit or degrees between these two absolute conditions. Servicing thus resolves to a logical approach to the problem in hand, starting first with an awareness of the trouble or symptom (and this is not always obvious), going on to locating the section responsible (diagnosing) and then finding and replacing (or repairing) the defective component.

CIRCUIT BLOCKS

Past articles in this series (March-September 1967) have indicated fault symptoms (and more will be given later in this new series, dealing with the repairing of specific faults in transistor sets) and have shown how the area in the set responsible can be located and how repairs can be effected. While these have applied to valved equipment, the same general principles apply to transistor equipment. However, since transistor equipment has a somewhat different mode of operation d.c.-wise, at least, it will be desirable to look at "transistor circuit blocks" and see how faults in components associated with these can influence the transfer of signals from input to output.

Figure 14 shows the basic common-emitter amplifier which can be used for r.f., i.f. and a.f. signals; but to start with, let us suppose that this is handling a.f. signals, applied through C1 and taken out through C2. Base bias is set by R1 and R2 to provide the correct signal working point for the transistor, giving a specific value of collector current (see Part 1). R3 is the collector load across which the amplified signal is developed, while R4 helps to stabilise the d.c. point and avoid thermal runaway.

The a.f. signal is superimposed, so to speak, on the base bias, and since the base impedance is not very high, C1 is an electrolytic whose value is in terms of microfarads, depending on the required bass response aimed for by the designer. C3 bypasses signal developed across the emitter resistor and thus prevents degenerative feedback.

Now, let it be supposed that all these components, in conjunction with the transistor, have been worked out by the designer to yield optimum operating conditions. This means that signal up to the level rating of the stage passes through with specified amplification and minimal distortion. It is best to assume that the stage is isolated (and highlighted) from a piece of equipment containing a number of stages of diverse types. Let us see now what happens when components fail or change in value.

C1 Shorting

This will certainly affect the base bias because its input end will be connected to a component or circuit carrying a potential differing from that at the junction of R1 and R2. Thus, the base bias will change to a lower or higher value, depending on the nature of the circuit connected to the input of C1. The effects resulting from this are considered under R1 and R2.

C1 Open-Circuit

This is easy as it will simply stop the signal arriving at the base. Thus, the symptom will be zero output from C2.

C1 Reduced in Value

This will still allow some signal through to the base, but the coupling impedance will rise at the normal low frequencies, and so the signal transfer to the base will become less effective as the signal frequency is reduced, giving an output as shown in *Test 1* from a flat input signal at the base, as shown. The result is a loss of low-frequency response but an abundance of treble output.

R1 Open

This is another easy one as it would simply cut off base bias. The standing collector current would drop to zero (almost), as also would the output signal.

R1 Reduced in Value

This would upset the designed-for base bias by causing it to rise. The collector current would be higher than normal and the amplifier would bottom on peaks of negative signal cycles. This would reflect as clipping of the positive peaks at the output, as shown in *Test 2*. This happens because the common-emitter stage changes the phase of the signal. Thus, saturation or bottoming on negative half-cycles will show on positive half-cycles at the output.

R1 Increased in Value

This reduces the base bias, reducing the standing collector current. On low-level inputs this may not produce any adverse symptom, but towards maximum output the transistor would tend to clip (cut-off) on positive half-cycles, showing up as clipping of the negative half-cycles at the output, as shown in *Test 3*.

R2 Open

This would cause a substantial rise in base bias and collector current and might, under certain conditions, ruin the transistor. The clipping effect on signal would be the same as with R1 reduced in value (see *Test 2*).

R2 Reduced in Value

This would give symptoms as those for R1 increased in value.

R2 Increased in Value

This would give symptoms as those for R1 reduced in value.

N-P-N TRANSISTOR

All that has so far been said applies to the p-n-p transistor in Fig. 14. If an n-p-n transistor is used the clipping on the output waveform is the reverse of that shown in Tests 2 and 3.

R3 Open

This could cut off collector voltage and mute the stage completely.

R3 Reduced in Value

The main effect here would be a reduced voltage gain, while a complete short-circuit (unlikely with a resistor) would not have a great deal of effect on the d.c. conditions but would reduce the signal output to zero.

R3 Increased in Value

This could result in a rise of signal voltage gain, depending on the exact nature and design of the stage, but excessive value increase would be more likely to result in limited output signal level before the onset of waveform clipping.

R4 Open

Normally this would mute the stage, cutting off all output signals, but in practice slight leakage across the parallel electrolytic, which with the resistor open-circuit is often overloaded voltage-wise, retains a degree of emitter circuit conduction and gives the symptom of low gain and output voltage with excessive distortion and clipping.

R4 Reduced in Value

This has virtually no effect on the performance at all.

R4 Increased in Value

This reduces the emitter current and increases the voltage developed across the emitter resistor because of the resistance increase. However, the fall in current tends to counteract the voltage rise to some extent. The main effect is a reduction in base bias, reducing the collector current further, and giving symptoms similar to those caused by R1 increased in value and R2 decreased in value.

C3 Open

Contrary to some people's thoughts on this defect, the stage does not tend towards oscillation or instability. In fact, if anything, it becomes more stable because the signal voltage across the emitter resistor with the capacitor effect removed produces negative current feedback. In other words, the stage drops in sensitivity and with a given input signal voltage, the output voltage falls.

C3 Shorting

This has similar effects as the emitter resistor decreasing in value. While a short in the capacitor may not affect the stage working to any large extent unless, perhaps, negative feedback is taken from the emitter circuit, the defect will impair the d.c. stability, causing the transistor to veer towards overload should its temperature rise unduly and should the combined values of R3 and R4 allow a collector/emitter current of destroying magnitude. In a stage

such as that shown in Fig. 14, R3 is usually of such a high value that even the short-circuit current through it would be insufficient to ruin the transistor. However, without R4 the stage might be encouraged to run towards its bottomed condition.

C2 Open

As with C1, this would cut-off signal passage to the subsequent stage and give the symptom of zero output.

C2 Shorting

While this would not affect the signal passage to the output of the stage in isolation, it would most certainly affect the d.c. conditions of the stage which C2 feeds. This is because the potential at the collector of the transistor in Fig. 14 is bound to differ substantially from the required potential at the input (possibly base) of the next stage.

C2 Reduced in Value

Again, as with C1, this would give a falling bass response into the subsequent stage, producing a response characteristic as shown in *Test 1*.

It will be noticed that capacitors have not been considered as increasing in value. This very rarely happens, and even if it does, the circuit set-up can usually take a bit of extra capacitance without a significant change in its dynamic working conditions. This is not true, however, so far as critically-valued capacitors are concerned in tuned circuits and time-constant circuits, as we shall see.

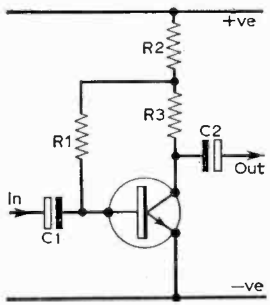


Fig. 15: Simplified common-emitter stage, often used with silicon transistors.

Figure 15 shows a similar amplifier, but this time employing an n-p-n transistor without the base potential-divider. Part 1 (April 1968) explained the d.c. aspects of this, and signal-wise it is virtually the same as that in Fig. 14. C1 feeds the signal in and C2 feeds it out. R3 is the collector load, while R1 sets the base bias in terms of current from the positive supply passing through the resistor and base circuit. R2 is a stabilising resistor, and in some circuits the junction of R2 and R3 is bypassed to the "earthy" side of the circuit through an electrolytic capacitor of some 10μF or so.

This kind of circuit is sometimes found in a.f. amplifiers of tape recorders and record reproducers embodying a silicon transistor. This type of transistor is less sensitive than germanium to temperature and junction leakage effects, which is one reason why R1 alone is used for base bias, as distinct from the potential-divider (R1 and R2) in Fig. 14.

In passing, it is worth noting that either the positive or negative side of the circuit may be made "earthy". For instance, thes chassis point in Fig. 15 can be connected either to the plus line or the negative line. It is usual practice to return any decoupling or bypassing capacitors to the side selected as "earthy", but this is not *always* the case.

AUDIO OUTPUT STAGE

There are two basic audio driver/output stages in current use, one uses transformers for coupling to the driver stage and to the loudspeaker, and the other is so-called *transformerless*. We shall look at both of these.

The scheme with transformers is shown in Fig. 16 Here Tr1 is the driver transistor in a common-emitter circuit. This is the same as the circuit in Fig. 14 except that the collector is loaded to the primary of the driver transformer T1 instead of to a load resistor.

Tr2 and Tr3 are the push-pull output transistors in the common-emitter mode with their bases fed from the secondary of T1. Base bias is applied to both of them by the potential-divider R1 and R2 connected to the centre-tap of T1 secondary, and a degree of protection against thermal runaway is given by the emitter resistor R3, common to both transistors.

The collectors are loaded to the primary of the speaker transformer T2, and negative potential is applied to them by the centre-tap on the primary connecting to supply negative. Push-pull operation implies that the signal drive to the base of one of the output transistors is negative-going while simultaneously to the base of the other it is positive-going. This is achieved by the "phase-splitting" action of the driver transformer with its centre-tapped secondary. The amplified signals are then reconstituted in the tapped primary of the speaker transformer.

The output transistors are adjusted for class B working. This means that the collector current is almost zero under zero signal drive, and is attained by careful tailoring of the values of R1 and R2. That is, the base bias is adjusted for just a little above zero total collector current without signal input. Now, when drive occurs, collector current rises alternately to follow the signal waveform and the average total collector current then rises to a maxi-

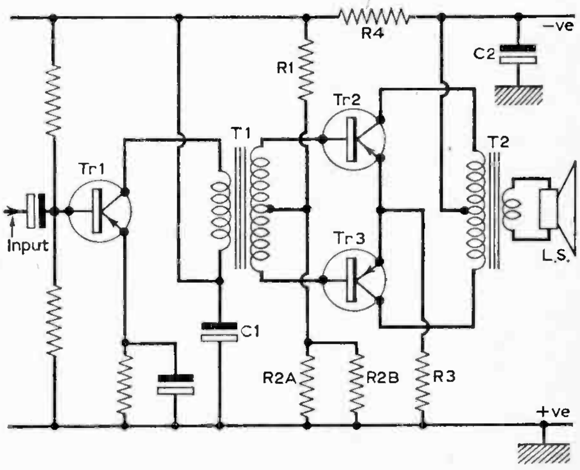


Fig. 16: Transformer-phased and speaker-coupled push-pull stage.

mum value depending on the output power delivered by the stage. A current meter connected in series with the supply would indicate substantial kicks of current with increasing output power.

CROSSOVER DISTORTION

The output transistors are biased so that a little collector current flows under quiescent conditions to avoid an effect called *crossover distortion*. This happens by the effective switching on and off of the output transistors alternately due to the positive and negative half-cycles of drive signal. If the transistors are switched right off (i.e., biased for zero collector current), the reconstituted wave at the output is asymmetrical, since the two halves fail to fit together accurately. However, by adjusting the base bias for a small collector current this distortion does not occur (see Fig. 17).

This means that the biasing is critical, and stabilisation has to be used to ensure that the biasing remains accurate over the normal temperature working range of the equipment and transistors. This is where the thermistor (R2B) comes in. R2, in fact, is composed of R2A in parallel with R2B, the thermistor.

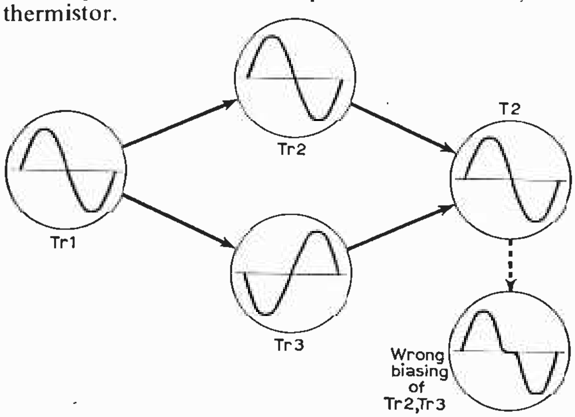


Fig. 17: Showing the phasing in a push-pull audio stage, and the effects of "under-biasing" the output transistors, resulting in crossover distortion.

Without the thermistor, an increase in transistor temperature would increase the collector current, while a decrease in temperature would reduce the current. The thermistor is effectively "geared" to the ambient temperature, so should the collector current rise (due to temperature increase) the resistance of the thermistor would fall, and since this is in the bottom leg of the base potential-divider it pulls back the base current and hence the collector current. Conversely, with an opposite change in temperature.

R3 is a very low value, to avoid power loss, a typical value being 4·7Ω, so it does not have a great protective influence regarding thermal runaway, but heat-sinks on which the output transistors are mounted greatly reduce the possibility of this happening.

R4 in conjunction with C1 gives supply decoupling, and with C1 open-circuit l.f. instability might result. Motor-boating *(Symptom 7* on the record) will occur should the main electrolytic bypass, C2, go open-circuit, especially when the battery veers towards exhaustion. Sometimes, due to a high resistance battery and C2 open, a whistle of about 500c/s develops. It can be immediately cleared by replacing C2.

Bad distortion can be caused by low battery voltage, bad output transistors and incorrect biasing. The latter should lead straight away to checks of R1 and R2, including the thermistor and its mounting.

The transformerless circuit is shown in Fig. 18. Here Tr3 and Tr4 are the push-pull output transistors, driven by Tr1 and Tr2 in complementary d.c. connection. Both Tr1 and Tr2 are in common-emitter mode (the emitter of Tr1 getting its circuit through the emitters of Tr3 and Tr4 for stabilisation), the former being an n-p-n device can be coupled directly from its collector to the base of the latter which is p-n-p. This circuit was considered from the d.c. point of view in Part 1.

The bases of both output transistors are driven together from Tr2 collector, again, with d.c. coupling. This is possible, as mentioned in Part 1, because Tr3 is p-n-p and Tr4 n-p-n. Thus, a positive-going signal half-cycle, for instance, will drive the former into cut-off and the latter into conduction; conversely with a negative-going signal half-cycle. The current pulses "pumped" into the speaker from the output stage emitters through C1 reconstitute as

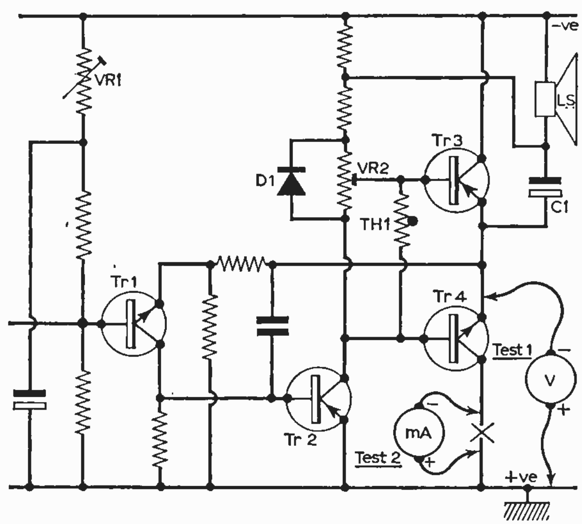


Fig. 18: Transformer-less complementary push-pull output stage, showing two tests for biasing.

full waveform output power.

This circuit, too, is arranged for a little quiescent current in the output pair collectors, and temperature stabilisation is provided by the diode D1 and the thermistor Th1 in the base circuit. VR1 and VR2 preset potentiometers are for adjusting the biasing of the output stage, and this is achieved by connecting a high resistance voltmeter at the connected emitters of Tr3 and Tr4 and adjusting VR1 for a reading of 4·8V *(Test 1)*. Next, by connecting a milliammeter in Tr4 collector circuit and adjusting VR2 for a *quiescent* current of 4·5mA *(Test 2)*. This is the current for the least crossover distortion.

Note that these voltage and current values relate to circuits in which Tr1, Tr2, Tr3 and Tr4 are transistors type AC127, AC128, AC128 and AC127 respectively (or equivalents, of course).

The other conditions relating to component faults in this circuit correspond almost equally to those already expounded, so there is no need to repeat them here.

I.F. AMPLIFIER "BLOCK"

To finish this episode, let us investigate an i.f. "circuit block". Such is given in Fig. 19. In spite of the tuned circuits, this has very much in common with the basic circuit in Fig. 14, R1 and R2 form the base potential-divider, but this time the secondary of the i.f. transformer T1 is interposed. This fails to alter the d.c. conditions and makes sure that the i.f. signal is applied straight to the transistor base. The "earthy" side of the winding is made low impedance signal-wise by C1 to chassis. In other words, this makes one side of the winding "earthy" so far as the i.f. signal is concerned.

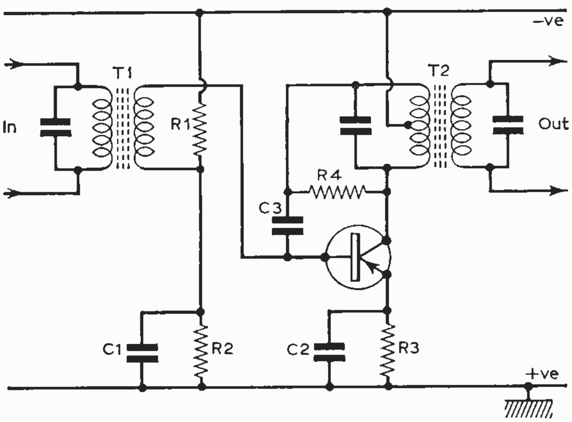


Fig. 19: I.F. amplifier "circuit block" described fully in text.

The emitter resistor, R3, is still here, but this time it is bypassed by a lower value capacitor (C2) since the signal frequency is that much higher than audio.

The collector is loaded into the primary winding of i.f. transformer T2, while C3 feeds back anti-phase some of the signal at the collector to the base to provide neutralisation. R4 is simply a damping resistor across the primary.

Now let us investigate the effect of component faults on the operation.

R1 and R2 Open or Changed Value

The effect will be almost the same as that detailed for a.f. amplifiers, but there are slight differences. For instance, if the change results in increased base bias and collector current the stage could go into oscillation owing to the working gain of the transistor being higher than designed for. Moreover, the change could alter the loading and capacitances as "seen" by the tuned circuits and thus alter the tuning. Further, the feedback capacitance could change, and this will affect the neutralisation, again resulting in instability.

C1 Open

This will take the "earth" from the lower end of T1 secondary and prevent tuning.

C1 Shorting

This will remove the base bias and render the stage inoperative.

R3 Open or Changed Value

Symptoms would be similar to those described for an audio "block", but an increase in value could reduce gain, while a decrease in value could increase gain and alter the tuning and encourage instability.

C2 Open

Gain will be reduced, and here there could be a tendency towards instability, depending upon the phase sensitivity of the tuned circuits and stage generally.

C3 Shorting

See under R3.

C3 Faulty

This will certainly upset the neutralisation and possibly cause instability and/or "peaky" tuning.

R4 Open or High

This will also encourage instability and give rise to "peaky" tuning.

Faults in I.F. Circuits

Faults in the i.f. transformers will be revealed by the inability to obtain correct i.f. alignment within the range of the dust-iron cores. If the d.c. conditions of the transistor are correct, and C1 normal, the trouble in this event could be caused by (i) broken cores, (ii) windings slid down former and (iii) altered value parallel tuning capacitors in the i.f. cans.

TO BE CONTINUED

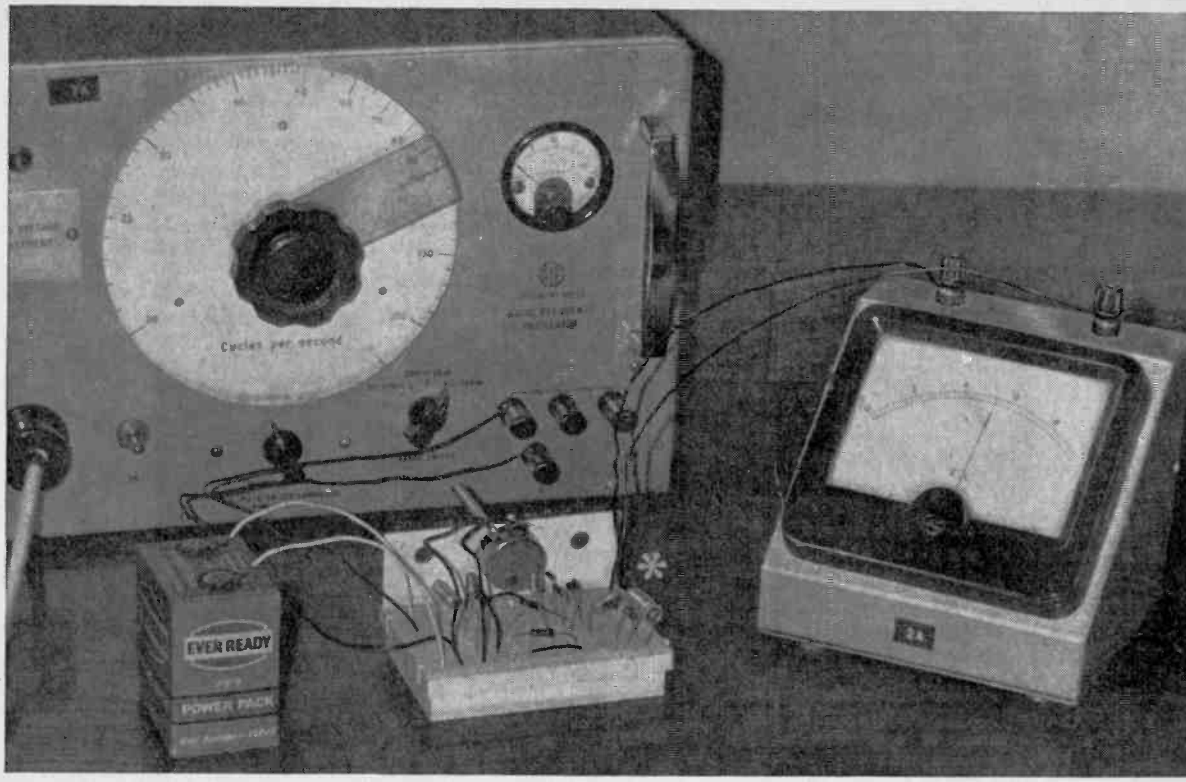
INTEGRATED CIRCUIT PREAMPLIFIER

—*continued from page 103*

a plan for an etched circuit for those who agree with this writer in preferring such an approach. Others would follow Mr. Thurston's use of veroboard, and in this context a new variety suitable for use with integrated circuits may be mentioned. As for the performance of the circuit, it was stated in the article January 1967 that an input impedance of the order of 10 megohms could be expected, and the prototype integrated circuit version bears this out. As Mr. Thurston implied, this promises applications outside the audio range, e.g. as the basis of a transistorised voltmeter, the unit would draw no more than about 0·2μA from a circuit under test, compared with the 50μA of a good multimeter; it could equally function as an oscilloscope buffer amplifier.

For the experimenter, two further circuits are illustrated, but constructional details are omittted. In the first of these (Fig. 5), Tr1 and Tr2 are connected as a super alpha pair, externally, just as Tr3 and Tr4 are wired into this configuration by connections within the I.C. can. Due to the features of the manufacturing process already mentioned, the I.C. now can operate as a pair of closely matched high impedance preamps., perfectly suited to the task of matching a crystal stereo record cartridge into a "hi-fi" amplifier. Fig. 6 is even more interesting, as an untuned A.M. final amplifier and non-linear detector for a radio receiver.

It is the aim of this article to stimulate interest in these and other possible applications of this unit so that it will achieve the commercial success which alone can ensure a continuous supply of these exciting innovations in our hobby. ■



EXPERIMENTAL TRANSISTOR

MANY excellent circuits have been described for a.c. millivoltmeters, with wide frequency response, high input impedance and other desirable characteristics. Unfortunately they require carefully selected components and offer the user facilities not always wanted. For example, in testing amplifiers it may be sufficient to measure the frequency response across the output terminals where the impedance is low, and the simplest of measuring instruments will be adequate. The frequency response need only be from 20c/s to 20kc/s, and this is easily obtained with sensitivity down to 10mV or so.

The circuit described here has a full scale sensitivity of between 10 and 500mV with corresponding input impedance ranging from about 12kΩ to just over 100kΩ. It can use almost any pair of transistors, germanium or silicon, together with a bridge of general purpose diodes. The meter used in the original was a surplus 0·5mA movement, but any similar moving-coil unit of between, say, 50mA and 2mA sensitivity could be used. Because of the flexibility of this circuit, a particular version will be covered first and then a list of modifications and alternatives will be suggested. This should enable one to be made up out of the most limited spares box.

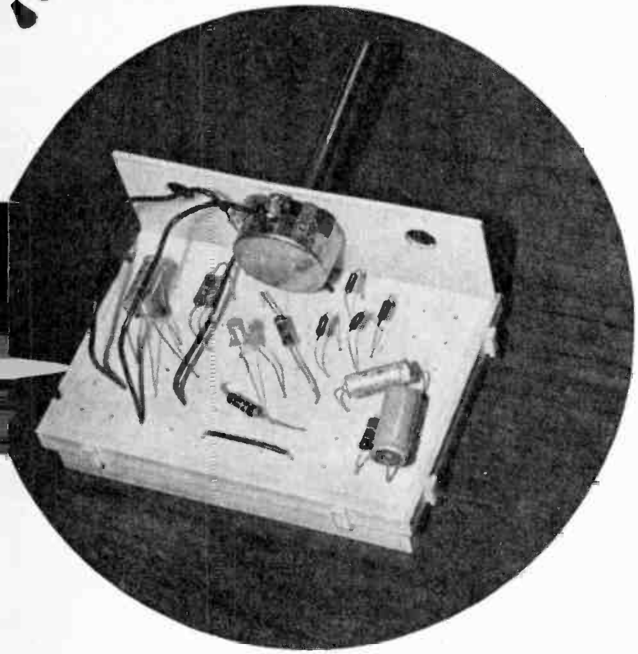
CIRCUIT

From Fig. 1 it can be seen that the circuit is a two-transistor direct-coupled amplifier. There are two feedback paths. The first is from the emitter of Tr2 to the base of Tr1 and provides the base current for the first transistor.

The emitter of Tr2 is by-passed at audio-frequencies so that this feedback (which is negative shunt feedback) does not lower the input impedance. Its operation can be understood by assuming that, for example, the current in the first transistor tries to increase. This could be due to increasing temperature, and would result in a falling collector voltage. The base-emitter voltage of Tr2 is small and relatively constant, i.e., this fall in collector voltages transmitted to the emitter of Tr2. There is now a smaller voltage across R2 which reduces the base current of Tr1. Hence the original change is opposed by the feedback. If this feedback were allowed to operate at audio frequencies, the large changes in current through R2 would have to be supplied by the source, and the circuit would have a low input impedance—this is clearly undesirable where the aim is to measure a voltage from a source which might itself have a relatively high impedance.

It is the second feedback path that helps particularly with such problems. There are basically four functions performed by this feedback: (i) it raises the input impedance because it is fed back in series with Tr1 emitter, this requiring a greater input voltage for a given input current; (ii) it stabilises the gain, ensuring that the meter current is determined primarily by the value of VR1; (iii) it linearises the circuit's response to small signals by raising the output impedance and swamping the varying impedance of the diodes; (iv) it extends the frequency response of the amplifier.

As usual there must be some penalties paid for these rewards. Most important is the loss of gain, and, as a rough guide, the gain is reduced by the same factor as the stability, impedance etc. are improved. To explain a little further, assume that with VR1 = O,



MILLIVOLTMETER

PETER WILLIAMS B.Sc.

a 1mA meter reads full scale for an input of 1mV. If VR1 is increased to 9, for example, and we still require a full-scale reading on the meter, then the input voltage would have to be 10mV—1mV still for the base-emitter and 9mV for VR1. The sensitivity is now reduced by a factor of ten, but the input impedance is similarly increased, since the transistor is still receiving the same signal (1mV) and hence draws the same base current, while the overall input voltage is ten times up.

A most important point about negative feedback

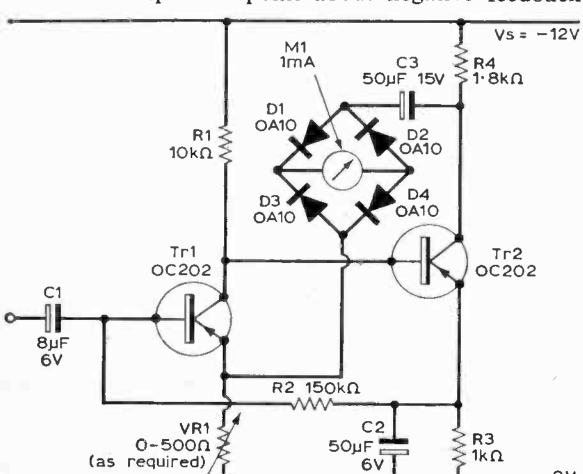


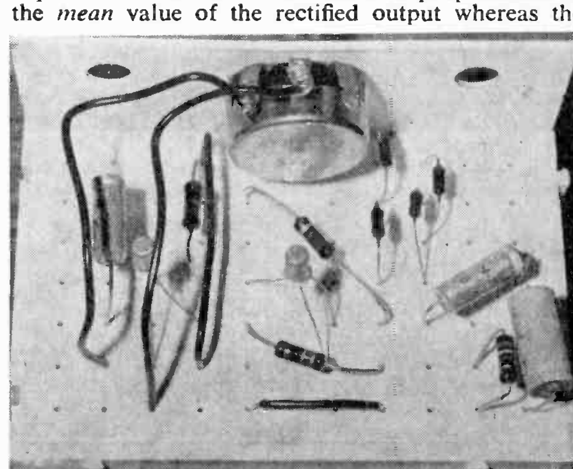
Fig. 1: Circuit diagram of the basic version. Component values are non-critical.

must be stressed at this stage. In multi-stage amplifiers each transistor will contribute phase-shift at high frequencies and should this total ever reach 190 degrees, then the feedback has been reversed. At these frequencies the gain will be *greater* than in the absence of feedback. Normally the gain without feedback will have fallen considerably, and this positive feedback may or may not be sufficient to cause oscillations.

ANALYSIS

On a simple analysis, a two-stage amplifier will have only two significant phase-shifting networks each able to contribute up to 90 degrees. This in turn will only be achieved at frequencies tending to infinity where the stage gains approach zero. Positive feedback can hardly do any harm to an amplifier with zero gain! The above is a considerable over-simplification of "real life" and some two-stage amplifiers may oscillate where there are other sources of phase shift present. In addition, the phase shift may still produce an increase of gain in a feedback amplifier just prior to cut-off as shown in Fig. 2. This is a plot of meter current against frequency for a constant amplitude of input voltage. With most transistors such a peak will only appear well outside the audio band and can be easily eliminated if desired. Figure 3 shows the fall-off in input impedance with rising frequency. As the gain of the amplifier falls so does the effectiveness of the feedback.

The actual sensitivity of the circuit is meter current divided by input voltage, and could be expressed in such units as mA/volt. This indicates that the circuit has a "gm" or transconductance and it is found to be mainly dependent on VR1. For an amplifier of infinite gain, $gm = \frac{1}{VR1}$ since then all the input voltage appears across VR1, and all the output (meter) current flows through it. With larger values of VR1 we would expect this ideal to be approached since the base-emitter voltage would be small. This neglects an important point about the meter response which was glossed over in the earlier explanation. The meter deflection is proportional to the *mean* value of the rectified output whereas the

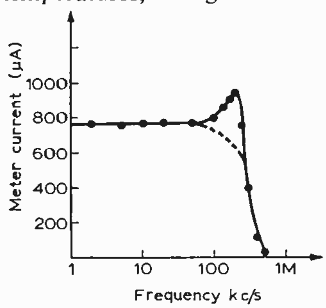


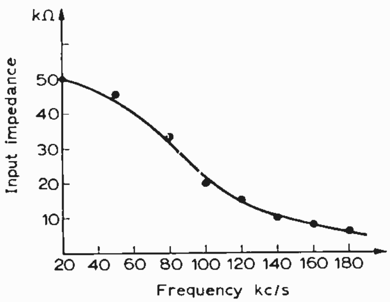
Top view of the layout of components assembled on the S-Dec. Positioning is not unduly critical.

input is specified in terms of its root-mean-square (r.m.s.) value. These are different for all except perfect square waves, though for most waveforms, including sine-waves, the difference is within 10% or so.

It is customary in measuring instruments using moving-coil meters for the measurements, to calibrate the meter in terms of the r.m.s. value of a perfect sine-wave while the reflection is proportional to the mean value. Thus, for sine-waves, the reading can be taken as correct while for other waveshapes there will be varying but small errors. Figure 4 shows the actual input voltages required for full-scale output on a 0·5mA movement using a range of values for R2.

If the circuit is to be built using surplus germanium transistors, then biasing may be more of a problem. Resistor R2 would probably have to be reduced to allow for the increase in leakage currents at higher temperatures, though this is somewhat offset by the lower value of V_{be} on the first transistor (it must be remembered that the potential at the emitter of Tr2 is equal to the sum of that V_{be} and the voltage dropped across R2). Choose R2 such that the emitter of Tr2 is at about 2 to 3V above ground.





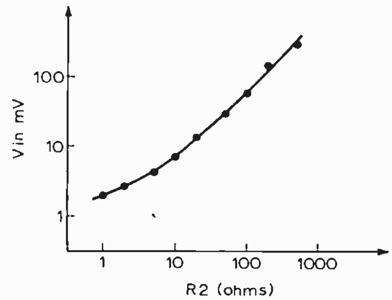


Fig. 2 (left): Phase shift in the amplifier can increase gain at frequencies close to cut-off. This peak in response can be removed (as in dotted curve) by the addition of a CR network between collector and base of Tr2. (Meter current for R2=20, Vin=20mV).
Fig. 3 (centre): Input impedance/frequency. Below 20kc/s the input impedance remains fairly constant.
Fig. 4 (right): Input voltage/R2 for constant meter current of 0·5mA. The curve shows that a minimum signal of around 1·5mV is required even with R2=0. For high values of R2, input voltage becomes proportional to R2 which alone determines circuit sensitivity.

CHOICE OF TRANSISTOR

It is good practice to choose the transistor with lower leakage as the first stage of such an amplifier. This reduces the above bias problem and often produces less noise, since some of the noise-generating mehanisms in transistors are also sources of leakage current. The frequency response is likely to be worse than that of the original version, but there should be no difficulty in covering the audio band. Should there be any "peaking" of response as occurred in the circuit of Fig. 1, then a capacitor and resistor in series may be connected between collector and base of Tr2. The values used in the original are shown in Fig. 5—again the components would have to be selected to suit the transistor. A larger value capacitor would have to be used if the problem were to arise with cheap germanium transistors.

At the other extreme, the many excellent epoxy and plastic cased planar silicon transistors would perform excellently in this circuit. The problem might be that, retaining their gain to frequencies in the multimegacycle range, they will be prone to high frequency oscillation due to stray coupling between input and output. The CR network described above should provide a solution if screening is difficult. If the transistors used are n-p-n then the polarity of supply voltage and electrolytics should be reversed.

While considering capacitors it is worth noting that their value is rarely critical. This is fortunate in that the manufacturing tolerance is broad—they may be up to 50% or more above their marked value. Reducing all the quoted values by a factor of two would still leave the circuit able to cover the audio band adequately. The voltage rating of C1 need only be a few volts unless the source voltage contains an appreciable d.c. term. C2 will typically have about 3V across it and a rating of 6V or above should be satisfactory. The voltage across C3 will be less than the supply voltage, but for safety a voltage rating of, say, 15V would be better.

Nor are resistor values critical, and they could be scaled up or down by factors of two or more without impairing the basic operation, of course, with low values of resistance the input impedance would also fall, and would be roughly proportional to the resistance values. If wide tolerances in the components leave less than, say, 2·5V across Tr2, then VR1 should be reduced. The upper and lower limits of the resistors are set by leakage and dissipation problems respectively. If another value of supply voltage is preferred, then it should be sufficient to select R2 for a voltage across Tr2 of a quarter to a third of the supply voltage. Various versions of the circuit have been used with supplies between 6V and 30V.

The choice of meter and bridge circuit is equally wide. To allow full drive to the meter, the standing current in Tr2 has to be greater than the peak current required by the meter. It is suggested that a standing current in Tr2 of about 5× the meter full-scale reading should be suitable. In the interests of battery drain and transistor dissipation it is probable that currents above 10mA would be undesirable. This limits the choice of meter movements to a maximum of 2 or 3mA. Probably cost will place a limit on the most sensitive meter that could be used, though for currents below 100mA the bridge would benefit from the use of silicon diodes. This is because the germanium diodes have a reverse leakage current that might become an appreciable fraction of the meter current at high temperatures. Meters of full-scale sensitivity between 50mA and 2mA have proved satisfactory in circuits of this type. ■

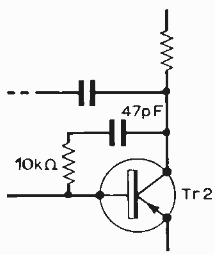


Fig. 5: Additional components reduce gain of amplifier at high frequencies and remove peak response.

practically wireless commentary by HENRY

No. 45

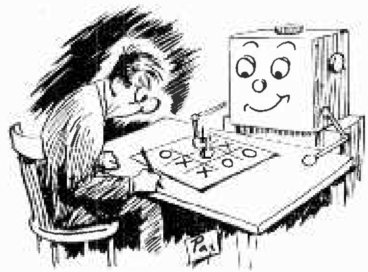
Hard on Hardware

YOU are always going on about computers, Henry: have you seen the latest news?

About the Edinburgh University computer that taught itself to balance a pole on a moving cart for 90 minutes, you mean? That must have been fun for Professor Donald Michie. The best his students could do was five seconds flat.

No, I was not being frivolous. I was referring to the chess matches.

Old hat! Computers have been



Whacking men at noughts and crosses.

whacking man at chess and noughts and crosses since the abacus was invented by Confucius' nephew.

That is just the point. This was a Russian . . .

Confucius' Red nephew then. What's the difference? Moscow has been crowing ever since their M-20 beat an American version last year.

Actually it was the M-20 that was involved in this incident, in a contest sponsored by the Uralsky Rabochy *and the Soviet Academy of Sciences' Institute of Theoretical and Experimental Physics.*

You must be making this up!

Don't be sceptical, Henry. I am indebted for my information to Janus *of* Electronics Weekly, *and the Soviet chess champion, Lev Polugayevsky. The contest went on for four months. Playing against the computer were chess fans from 80 towns in the Urals, the first mass competition to involve an electronic computer.*

Evidently, you haven't heard about Operation Match.

Frivolity again! I am not concerned with computer selection of dating couples. The point I am trying to impress upon you is that the USSR competition was arranged by feeding moves suggested by fans to the M-20 computer, which worked under the same program it had used to beat the Americans in the straight computer match last year.

So what! First prize a trip to Siberia; second prize a longer trip. The computer always wins, so what's the point?

I'll tell you. During the play, the computer exhibited some "human" weaknesses. It began by taking an opposing pawn without due caution and after 19 moves, the computer resigned.

SAY THAT AGAIN!

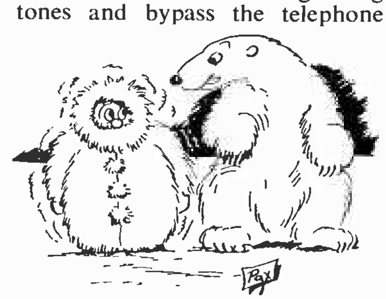
After nineteen moves the computer resigned. It could foresee an inevitable mate in three further moves. This would seem to indicate a triumph for the human mind, and some hope for the future of mankind in a world rapidly becoming more and more dominated by—

OK, OK,—but surely it is obvious that the computer was just bemused by the variation in approach, in style of play, by the 80 groups of fans, many of them probably mere enthusiastic amateurs. Had Lev Whatsisname-sky been playing solo against the computer, there would have been a harder-fought game, but no doubt about the outcome.

Janus *suggested the machine may have been corrupted by previous contact with the bourgeois American imperialist model.*

Now who is being frivolous? We must be careful how we treat our electronic brains. Look at what happened at St. Louis, and again at Harvard, for example. In the first case, an engineer fed a computer with the listed numbers in four local exchanges and the machine gave him back all the non-listed numbers, which he used to get access to private-leased trunk lines. The *Wall Street Journal* doesn't tell us whether the computer was arrested as an accessory.

In the second case, students at Harvard used a computer, a recorder (the type you blow through), and their native ingenuity to imitate signalling tones and bypass the telephone



First prize a trip to Siberia

company's billing computer, getting free calls anywhere. They even obtained access to Defence Department trunk lines—when they were finally caught. There is a thousand dollar fine for this Federal offence, but apparently these lads got away with it, after they had told the Trunks and Telegraphs Company exactly how they performed their anti-social swindle.

It couldn't happen here, Henry.

Couldn't it just! Although the PMG has so far ordered no computers for hire to outside users, he has made provision for a £500,000 commitment on commercial National Data Processing Service business in 1968-9, and sums of £2·5-3m. pounds are envisaged for the next two years. What with the Science Research Council coming out in favour of project 50, the ICT supercomputer designs, we are well on the way to your "machine-dominated age".

Five steps to hi-fi

PART TWO ...... TURNTABLE DRIVES

IAIN SMITH

THE quality of reproduction of your equipment is limited by the capabilities of its poorest component. It is no good having the best pick-up in the world working with a bad turntable drive. It is with this in mind that we come to the question of turntables and their associated driving gear.

Over the past half-century, many experiments have been conducted to determine the best possible form of drive from the motor to the turntable and hence the record. Berliner's spring drive motivated the centre spindle about which the turntable rotated and this method was carried on into the era of the electric gramophone. The rim drive was then devised and this is the most widely used form of drive today. This drive relies on friction. The motor shaft, which is vertical, is fitted with a pulley. The pulley may be stepped in diameters corresponding to the number of different speeds required, usually three or four. It may also be tapered on models which have infinitely variable speed over the range. The pulley drives a rubber-tyred wheel which runs on the inside of the turntable rim. To effect speed selection the pulley is moved in a vertical direction against the appropriate pulley diameter. This is shown in Fig. 2.

Squirrel Cage Motors

The type of motor most commonly used in cheap and moderately priced equipment is the shaded pole squirrel cage induction motor so called because a movement of flux across the pole face sets up a "rotating" field causing the rotor to turn at a speed just below synchronous speed. The movement of flux across the pole face is caused by copper bars set in one side of each steel pole face thereby causing a flux lag due to the different materials. This type of motor has one drawback in that speed fluctuates with load, and a turntable, due to record groove modulations, is under a constantly fluctuating load.

Synchronous Motors

More expensive, or transcription, units overcome this problem by utilising synchronous motors. They are normally slow running in order to increase the pulley diameter. This increases the motor inertia and stability. Apart from sometimes using synchronous motors the only major difference between a transcription unit and a less expensive drive is the quality of components used. In a transcription unit bearings, spindles, turntable and motor are of heavier construction in order to give the sort of continuous service expected in broadcasting studios. On transcription units a ±5% speed variation control may be fitted for correction purposes. This is an eddy current brake with an aluminium disc attached to the motor shaft. By movement of the control a magnet is moved across the disc increasing the load on the motor.

Wow and Flutter

Earlier on inertia was mentioned in connection with the motor pulley. Inertia plays an important part in record reproduction. Ideally the turntable should be of heavy cast construction to provide a flywheel effect, and help in ironing out high rate fluctuations in speed known as "flutter". One effect of flutter is to make soprano voices sound as if they are gargling. A heavy turntable also helps overcome "wow" which is similar to flutter i.e. fluctuation in speed, but at a much lower rate.

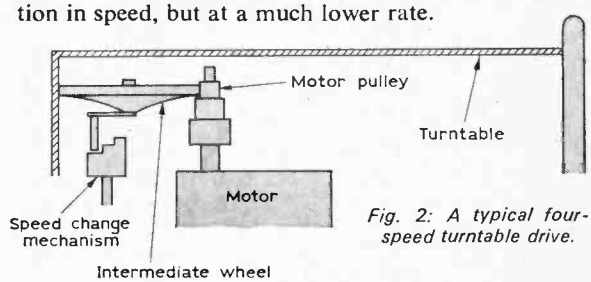


Fig. 2: A typical four-speed turntable drive.

Both flutter and wow are expressed as a percentage of variation of the nominal running speed. A figure of 0·05% or less is acceptable and would not be noticed. Higher figures probably would not be noticed either but it is always best in hi-fi to aim high. A heavy turntable will also help to reduce "rumble", This is a low frequency background noise caused by the mechanics of the drive system.

How heavy should your turntable be? As a rough guide it should be so heavy that it takes more than 60 seconds to stop from 33⅓ r.p.m. when disconnected completely from the drive. It should also be more than 10 inches diameter. If your turntable is heavy and stops in much less than 60 seconds then this could either be due to the bearing needing attention or the turntable being out of balance or both.

Turntable Truth

One factor so often neglected in cheap turntables (from bitter experience) is turntable truth, i.e., the variation of the turntable surface. The British Standard Specification for the reproduction of gramophone records states that the turntable surface should be true to within 0·020in. Now this may satisfy the British Standards Institute but it does not satisfy a high fidelity fan. Turntable truth in the order of 0·005in. or less is a must. Many record player manufacturers claim that this is unnecessary accuracy and that even 0·050in. is far truer than many records. This argument is rather like motor-car manufacturers claiming that there are so few rough stretches of road now that suspension is obsolescent. It is obvious to see that excessive variation in turntable truth causes undue record wear because of the record having to lift the pick-up mass.

If your turntable drive shows obvious signs of speed variation then it is probably due to the drive slipping. All driving surfaces such as motor pulley, intermediate wheel and turntable rim should be thoroughly cleaned with a grease solvent. If the trouble is still experienced, then the motor should be suspected.

Summing Up

To sum up this part the following points should be noted when purchasing a turntable drive:

1. All bearings etc. should be heavy duty type.
2. Flutter and wow should be a minimum.
3. The turntable should be of heavy cast construction.
4. Turntable truth should be 0·005in. or thereabouts.
5. Rumble should be at a low level.

To be continued

AN APOLOGY

We much regret that, due to circumstances beyond our control, it has proved impossible to include the *Portable Keyless Organ* and the *Variable Frequency Oscillator* in this month's issue as was our intention.

We apologize to readers and give our assurance that these articles will be featured as soon as possible in Practical Wireless.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

Not always true!

It would appear that Mr. R. Haworth (March 68) has misinterpreted "You get what you pay for." (July 67). If he reads my letter again he will find it referred to the very controversial subject of kits with suggestions for the would-be buyer.

The unfortunate who haven't a spares shop around the corner naturally turn to mail order, some not realising that care is needed to avoid falling into this pit of suffering, others just asking for trouble.

One correspondent had five complaints on his order and says the next order from the same firm was even worse. Now surely if one orders a pair of trousers and receives the wrong size and a leg missing they don't send a repeat order in the hopes that the next pair will be all right. Mr. H. waited ten days for his not-too-clear price list, after five days I'd have moved on. Any advertiser interested in inquiries for orders will act promptly and all the old excuses we hear about regarding delays give more reason to shop elsewhere. Some firms give a very good service even if it does cost a few extra coppers.

Errors do of course occur even with the conscientious types, just the same as the guy who neatly writes out his order then forgets to add his address, or errors printed in P.W. circuits and parts lists.

Readers have a very good and varied choice of advertisements in PRACTICAL WIRELESS, thousands of orders large and small must be dealt with each year. I wonder what percentage of customers are satisfied. How about a vote, or would that put an end to this now drawn-out subject of suffering.

Just think though if everything was perfect, the educated would be unable to write in and correct the mistakes, others couldn't tell us how they'd been caught. Mr. H. wouldn't have lost his 1s. 3d. and then I couldn't have passed away two hours typing this with one finger on a 1920 Oliver typewriter.

To finish off, a word of thanks to the poor guy who has to sort out all these heartaches besides giving us a good interesting magazine month after month, Mr. W. N. Stevens. Thanks also to Henry who solves reader's problems on their super noiseless specials without the aid of strait-jacket or ether.—**K. Marlow** *(Surrey)*.

Not quite so

In the March issue of PRACTICAL WIRELESS, your correspondent M. Francis suggests that a 110V (75 watt) soldering iron can be used from 220 volts a.c. if a BY100 is put in series.

I am afraid this is not so. Ohm's law tells us that the iron, if connected without the diode, will dissipate 300 watts on a 220 volt supply. Thus, with the diode, its dissipation will only be reduced to 150 watts, which will soon lead to its destruction.

A. Jefford's suggestion, to use a 75 watt bulb in series, is technically correct, provided the 75 watt bulb is a 110 volt one. I would imagine a 100W or 150W 220 volt bulb to be more suitable but the position is complicated by varying filament resistance with temperature.

Has Mr. J. MacFarlane considered using a "simmerstat" energy regulator. He could then adjust this to be on for 25% of the time. This also has the advantage that he can cut back to "background heat" when the soldering iron is on standby.

For best results the simmerstat should be adjusted to go on and off fairly rapidly, thus ensuring an even temperature.—**C. P. Finn** *(Nuneaton, Worcs.)*.

It won't work

With reference to Mr. N. Francis' letter in the March 1968 issue suggesting that 110 volt mains equipment can be run from the 220 volt mains if a diode is placed in series, I should like to point out the fallacy.

Power is proportional to the square of voltage; so that 110 volt equipment will dissipate four times the intended power on 220 volts. If one-half of the mains cycle is removed, the power will still be double.

I have of course neglected the small increase in resistance of a filament at the higher temperatures obtained.—**Peter J. A. Moult** *(London, S.W.1)*.

"Not the only one"

With reference to the letter from R. Haworth in the March issue, he definitely is lucky!

My first encounter with one well-known firm was last November when they supplied the wrong capacitor. It took five letters and five weeks to obtain a reply enclosing a refund and stating that the component was out of stock!

At my second encounter with this firm in January; my order arrived—a bundle of GPO sticky tape and broken Veroboard, for which privilege the firm levies a surcharge of 2s. 6d.—"To maintain the high standard of our postal service." Three of the components were totally incorrect, so back to the firm went a very rude letter. By return of post I received a post card: "Please return incorrect items for immediate replacement" it stated. It was a further TWO WEEKS before I eventually received a refund—the components were out of stock!—**D. G. Chappell** *(Bangor, Caerns.)*.

Auto clocks, etc.

I was interested to read the encouraging remarks by Mr. Blunden of Guildford, regarding my letter which appeared in the January issue of P.W., in connection with the Auto-Clocks etc.

One would form the opinion that he is in the employment of the Electricity Board or similar undertaking using such clocks.

The remarkable thing is that the description he so far gave, was of the same idea as I approached the British firm with, who turned it down saying it had no practical value.

I would be interested to hear more, if Mr. Blunden will write me and let me have his address so that I can communicate with him privately on this interesting matter.
—**Herbert S. Barker** *(15 Buttermere Drive, Dalton-in-Furness, Lancashire)*.

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1FD9	3/3
1G6	6/-
1H5GT	7/-
1L4	2/6
1LD5	5/-
1LN5	4/6
1N5GT	7/9
1P1	6/-
1P10	4/9
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2X2	3/-
3A4	3/6
3A5	8/-
3B7	5/-
3D6	3/9
3Q4	5/3
3Q5GT	6/6
3S4	4/9
3V4	5/6
4D1	3/9
5R4GY	8/9
5U4G	4/9
5V4G	8/-
5Y3GT	5/9
5Z3	7/6
5Z4G	7/6
6/30L2	12/6
6A8G	7/6
6AC7	3/-
6AG5	2/6
6AG7	5/9
6AJ5	8/6
6AK5	4/9
6AK6	6/-
6AK8	6/-
6AL5	2/3
6AM4	16/6
6AM5	2/6
6AM6	3/3
6AQ5	4/9
6AR6	20/-
6AT6	3/9
6AU6	5/6
6AV6	5/-
6B8G	2/6
6BA6	4/6
6BE6	4/3
6BG6G	20/5
6BH6	6/6
6BJ6	7/-
6BQ5	4/6
6BQ7A	7/-
6BR7	9/-
6BR8	8/-
6BS7	16/6
6BW6	7/-
6BW7	5/6
6BX6	4/6
6C5GT	6/-
6C6	3/9
6C9	10/9
6CD6G	19/6
6CD7	9/6
6CH6	6/-
6CW4	12/-
6D3	7/6
6D6	3/-
6E5	9/6
6F1	9/6
6F6G	4/-
6F6M	7/6
6F12	3/3
6F13	3/6
6F14	15/-
6F15	10/9
6F17	12/6
6F18	8/6
6F23	11/6
6F24	10/-
6F25	10/-
6F28	10/6
6F32	3/-
6G6G	2/6
6H6GT	1/6
6J5G	3/9
6J5GT	4/6
6J6	3/-
6J7G	4/9
6J7GT	8/6
6K6GT	5/-
6K7G	1/3
6K7GT	4/6
6K8G	3/-
6K8GT	7/6
6L6GT	7/9
6L18	7/6
6L19	19/-
6LD20	6/6
6N7GT	7/-
6P1	12/-
6P25	12/-
6P26	12/-
6P28	25/-
6Q7G	5/-
6Q7GT	8/9
6R7G	5/6
6SA7GT	7/-
6SG7	7/9
6SH7	3/-
6SJ7	5/-
6SK7	4/6
6SL7GT	4/9
6SN7GT	4/6
6SQ7GT	6/-
6SS7	2/-
6ST7	12/6
6U4GT	9/6
6U5G	5/-
6U7G	7/-
6V6G	3/6
6V6GT	6/6
6X4	3/6
6X5GT	5/3
6Y7G	12/6
7A7	12/6
7AN7	6/-
7B6	10/9
7B7	7/-
7C5	40/-
7C6	6/-
7H7	5/-
7R7	12/6
7V7	5/-
7Y4	6/6
9BW6	9/6
9D2	3/-
9D7	7/6
10C1	9/-
10C2	12/-
10D1	7/-
10D2	11/8
10F1	15/-
10F9	9/-
10F18	9/-
10LD3	6/6
10LD11	10/-
10P13	15/6
10P14	15/6
12A6	5/-
12AC6	8/-
12AD6	9/-
12AE6	7/6
12AT6	4/6
12AT7	3/6
12AU6	4/9
12AU7	4/6
12AV6	5/9
12AX7	4/6
12AY7	9/9
12BA6	5/-
12BE6	5/3
12BH7	6/-
12E1	17/6
12J5GT	2/6
12J7GT	6/6
12K5	8/-
12K7GT	3/6
12K8GT	7/9
12Q7GT	3/6
12SA7GT	6/9
12SC7	4/-
12SH7	3/-
12SJ7	5/-
12SK7	3/-
12SQ7GT	8/-
12SR7	5/-
12Y4	2/-
13D1	5/-
13D3	9/-
14H7	9/6
14S7	19/6
18	12/6
19	10/6
19AQ5	5/-
20D1	13/-
20D4	20/5
20F2	11/6
20L1	13/-
20P1	17/6
20P3	18/-
20P4	17/6
20P5	17/-
25A6G	7/6
25L6G	4/9
25Y5	6/-
25Y5G	8/6
25Z4G	6/3
25Z5	7/-
25Z6G	8/6
30C1	7/-
30C15	13/6
30C17	13/-
30C18	9/6
30F5	11/6
30FL1	15/-
30FL12	15/-
30FL14	12/6
30L1	6/-
30L15	14/-
30L17	13/-
30P4	14/6
30P4MR	14/6
30P12	13/-
30P19	12/3
30PL1	15/-
30PL13	15/-
30PL14	15/-
30PL15	15/-
35A5	15/-
35D5	11/9
35L6GT	6/3
35W4	4/6
35Z3	10/-
35Z4GT	4/6
35Z5GT	5/6
42	5/-
43	10/-
50A5	21/10
50B5	6/3
50C5	5/9
50CD6G	41/-
50L6GT	6/-
52KU	14/6
53KU	14/6
72	6/6
77	5/-
78	4/9
85A2	8/6
90AG	67/6
90AV	67/6
90CG	34/-
90CV	33/6
90C1	16/-
150B2	14/6
150C2	5/-
161	15/-
185BT	35/-
301	20/-
302	16/6
303	15/-
305	16/6
306	13/-
807	11/9
956	2/-
1821	10/6
5763	10/-
7193	10/6
7475	2/6
A1834	20/-
ACO44	14/-
AC2PEN	19/6
AC2PEN/DD	19/6
AC6PEN	4/9
AC/PEN (5)	19/6
AC/PEN (7)	19/6
AC/THI	10/-
AC/TP	19/6
AC/VP1	12/-
AC/VP2	11/-
ATP4	2/3
AZ1	8/-
AZ31	7/9
AZ41	6/6
B36	4/9
B319	6/-
BL63	10/6
CK506	6/6
CL4	19/6
CL33	19/6
CV6	10/6
CV63	10/6
CV271	12/6
CV428	19/-
CY1	16/4
CY1C	6/6
CY31	7/9
D1	1/3
D15	15/6
D63	5/-
D77	2/3
DAC32	7/-
DAF91	3/3
DAF96	6/-
DCC90	8/-
DD4	10/6
DD41	12/6
DDT4	7/6
DF33	7/9
DF72	30/-
DF91	2/6
DF96	6/-
DF97	10/-
DH30	15/6
DH63	5/-
DH76	3/6
DH77	3/9
DH81	10/9
DH101	25/-
DH107	16/11
DK32	7/6
DK40	10/6
DK91	4/9
DK92	7/6
DK96	6/6
DL33	6/6
DL35	4/9
DL72	15/-
DL75	30/-
DL92	4/9
DL94	5/6
DL96	6/-
DL810	10/6
DM70	6/-
DM71	9/9
DW4/350	8/6
DW4/500	8/6
DY86	5/9
DY87	5/9
E80F	24/-
E83F	24/-
E88CC	12/-
E180F	17/6
EA50	1/6
EA76	13/-
EABC80	6/-
EAC91	3/3
EAF42	7/6
EB34	7/6
EB41	4/9
EB91	2/3
EBC3	20/6
EBC41	7/3
EBC81	6/3
EBC90	3/9
EBC91	4/-
EBF80	5/9
EBF83	7/-
EBF89	5/9
EBL21	10/3
EC52	4/3
EC53	12/6
EC54	6/-
EC70	4/9
EC86	11/6
EC88	11/-
EC91	4/-
EC92	6/6
ECC31	15/6
ECC32	4/6
ECC33	29/1
ECC34	29/6
ECC35	4/9
ECC40	9/6
ECC81	3/6
ECC82	4/6
ECC83	4/6
ECC84	6/-
ECC85	5/-
ECC88	7/-
ECC189	9/-
ECC804	12/6
ECC807	27/-
ECF80	7/-
ECF82	6/9
ECF86	8/6
ECF804	42/-
ECF805	12/6
ECH3	23/3
ECH21	9/6
ECH33	22/8
ECH35	6/-
ECH42	8/9
ECH81	5/6
ECH83	7/-
ECH84	6/6
ECL80	6/-
ECL82	6/-
ECL83	9/-
ECL84	12/-
ECL85	11/-
ECL86	7/9
ECLL800	23/9
EF22	12/6
EF36	3/-
EF37A	7/-
EF39	5/-
EF40	8/9
EF41	9/-
EF42	3/6
EF50	2/6
EF54	6/-
EF73	6/6
EF80	4/6
EF83	9/9
EF85	4/6
EF86	6/3
EF89	4/9
EF91	3/3
EF92	2/6
EF97	8/-
EF98	9/-
EF183	6/3
EF184	6/3
EH90	7/6
EL32	3/-
EL33	12/-
EL34	9/6
EL35	10/-
EL36	8/9
EL37	16/6
EL41	8/-
EL42	7/6
EL81	8/-
EL83	6/9
EL84	4/6
EL85	7/6
EL86	8/-
EL91	2/6
EL95	5/-
ELL80	13/-
EM71	14/-
EM80	5/9
EM81	6/9
EM84	6/-
EM85	11/-
EM87	6/6
EY51	6/6
EY81	7/-
EY83	9/-
EY84	9/6
EY86	6/-
EY87	6/-
EY88	7/6
EY91	3/-
EZ35	5/3
EZ40	6/-
EZ41	6/6
EZ80	3/9
EZ81	4/3
EZ90	3/6
FW4/500	6/6
FW4/800	8/6
GZ30	7/6
GZ32	9/-
GZ33	12/6
GZ34	10/-
GZ37	14/6
H30	5/-
HABC80	9/3
HL2	7/6
HL13C	4/-
HL23DD	5/-
HL41	3/9
HL41DD	19/6
HL42DD	8/-
HN309	26/6
HVR2	8/9
HVR2A	8/9
IW3	5/6
IW4/350	5/6
IW4/500	6/-
KBC32	20/5
KF35	12/6
KL35	11/6
KLL32	21/7
KT2	5/-
KT8	15/-
KT32	4/9
KT36	29/1
KT41	19/6
KT44	5/9
KT61	12/-
KT63	4/-
KT66	16/6
KT74	12/6
KT76	7/6
KT88	27/6
KTW61	5/9
KTW62	12/6
KTW63	5/-
KTZ41	6/-
LN309	10/3
LP2	9/6
LZ319	7/-
LZ329	7/-
MHD4	7/6
MHLD6	12/6
MU12/14	4/-
MX40	12/6
N37	23/3
N78	38/4
N108	26/7
N152	7/6
N339	25/-
N359	7/6
P61	2/6
PABC80	7/6
PC86	9/9
PC88	9/9
PC95	6/9
PC97	5/9
PC900	9/-
PCC84	6/-
PCC85	6/9
PCC88	10/6
PCC89	9/9
PCC189	8/3
PCF80	7/-
PCF82	6/-
PCF84	8/-
PCF86	8/-
PCF801	7/6
PCF802	9/6
PCF805	9/6
PCF806	11/6
PCF808	12/6
PCL81	9/-
PCL82	6/6
PCL83	10/3
PCL84	8/3
PCL85	8/3
PCL86	8/3
PCL88	15/-
PEN45	7/-
PEN45DD	19/6
PEN46	4/-
PEN383	9/6
PEN384	11/6
PEN453DD	19/6
PENA4	19/6
PEN/DD 4020	17/6
PFL200	18/6
PL33	9/-
PL36	9/9
PL38	19/9
PL81	7/6
PL81A	7/6
PL82	5/9
PL83	6/-
PL84	6/3
PL302	12/3
PL500	13/6
PL504	15/-
PM84	9/3
PX4	14/-
PY31	6/6
PY32	10/-
PY33	10/-
PY80	5/-
PY81	5/-
PY82	5/-
PY83	5/6
PY88	7/3
PY800	6/-
PY801	6/-
PZ30	9/6
QP21	5/-
QQVO3/10	30/-
QS75/20	10/6
QS150/15	9/6
R10	15/-
R11	19/6
R12	6/6
R16	34/11
R17	17/6
R18	9/6
R19	6/9
RK34	7/6
SP13C	12/6
SP42	12/6
SP61	2/-
TDD4	7/6
TH4B	10/-
TH233	6/9
TP22	5/-
TP25	5/-
TP2620	7/6
TY86F	11/10
UABC80	5/3
UAF42	9/6
UB41	10/6
UBC41	6/6
UBC81	6/6
UBF80	5/6
UBF89	5/9
UBL21	9/-
UC92	5/6
UCC84	8/-
UCC85	6/6
UCF80	8/3
UCH21	9/-
UCH42	8/6
UCH81	6/-
UCL82	7/-
UCL83	9/6
UF41	7/-
UF42	9/-
UF80	6/9
UF85	7/3
UF86	9/-
UF89	5/6
UL41	9/-
UL46	9/6
UL84	6/-
UM80	5/-
UR1C	6/6
UU5	7/-
UU8	16/6
UY1N	10/3
UY21	9/-
UY41	6/6
UY85	5/6
U10	9/-
U12/14	7/6
U16	15/-
U17	5/-
U18/20	6/6
U19	40/-
U22	5/9
U25	13/-
U26	11/-
U31	6/3
U33	13/6
U35	16/6
U37	34/11
U45	15/6
U50	5/9
U52	4/9
U76	4/6
U78	3/6
U107	17/6
U191	12/6
U251	12/6
U281	8/9
U282	12/3
U301	12/6
U329	12/6
U403	6/6
U404	7/6
U801	18/-
U4020	6/-
VMP4G	17/-
VP4	14/6
VP4A	14/6
VP4B	11/-
VP13C	7/-
VP23	2/6
VP41	5/-
VR75	21/-
VR105	5/-
VR150	5/-
VT61A	7/-
VT501	3/-
VU111	6/-
VU120	12/-
VU120A	12/-
VU133	7/-
W42	11/-
W61M	24/6
W63	10/6
W76	3/6
W77	2/6
W81M	6/-
W101	26/2
W107	10/6
W729	10/-
X24	16/6
X41	10/-
X61	6/-
X64	5/6
X65	5/6
X66	7/6
X76M	7/9
X81M	29/1
X101	29/1
X109	26/-
Y63	5/-
Y65	5/-
Z63	4/9
Z77	3/3
Z329	11/6
Z729	6/3
Z759	23/-
Transistors and diodes	
2G225	10/6
2N404	6/-
2N2297	4/6
AA120	3/-
AA129	3/-
AAZ13	3/6
AC107	3/6
AC113	5/-
AC114	8/-
AC126	2/-
AC127	2/-
AC128	2/-
AC154	5/-
AC155	6/6
AC156	4/-
AC157	5/-
AC165	5/-
AC166	5/-
AC167	12/-
AC168	7/6
AC169	6/6
AC176	11/-
AC177	5/6
ACY17	3/4
ACY18	5/3
ACY19	6/3
ACY20	4/9
ACY21	5/9
ACY22	3/6
ACY28	4/3
AD140	8/-
AD149	8/-
AF102	18/-
AF114	4/-
AF115	3/-
AF116	3/-
AF117	3/4
AF119	3/-
AF124	7/6
AF125	3/6
AF126	7/-
AF127	3/6
AF139	11/-
AF178	10/-
AF179	13/6
AF180	9/6
AF181	14/-
AF186	20/-
AFZ12	5/-
ASY27	8/6
ASY28	6/6
ASY29	10/-
AY100	26/-
BA115	2/8
BA116	9/-
BA129	2/6
BA130	2/-
BCY10	5/-
BCY12	5/-
BCY33	5/-
BCY34	5/-
BCY38	5/-
BCY39	5/-
BCZ11	3/6
BC107	4/-
BC108	3/9
BC109	4/6
BC113	5/-
BC115	3/-
BC116	5/-
BC118	4/6
BD119	9/-
BFY50	5/-
BFY51	4/6
BFY52	5/-
BF154	5/-
BF159	5/-
BF163	4/-
BF167	2/6
BF173	2/6
BF180	12/-
BF185	8/-
BY100	3/6
BY101	11/6
BY105	10/6
BY114	6/6
BY126	6/6
BY234	4/-
BY236	4/-
BY238	4/-
BYZ12	5/-
BYZ13	5/-
CG12E	4/-
CG64H	4/-
GD3	6/6
GD4	6/6
GD5	5/6
GD6	5/6
GD8	4/-
GD9	4/-
GD10	4/-
GD11	4/-
GD12	4/-
GD14	10/-
GD15	8/-
GD16	4/-
GET102	4/9
GET103	4/-
GET105	18/-
GET111	15/6
GET113	4/-
GET115	17/-
GET116	7/6
GET119	4/6
GET573	8/6
GET587	8/6
GET872	10/-
GET873	4/-
GET874	23/6
GET882	10/-
GET887	4/6
GET889	4/6
GET890	4/6
GET896	4/6
GET897	4/6
GEX13	3/6
GEX35	4/6
GEX36	10/-
GEX45/1	7/-
GEX55/1	15/-
GEX66	15/-
GT3	5/-
M1	2/10
M3	2/10
OA5	1/9
OA9	2/6
OA10	6/6
OA47	2/-
OA70	3/-
OA73	3/-
OA79	1/9
OA81	1/9
OA85	1/6
OA86	4/-
OA90	2/6
OA91	1/9
OA95	1/9
OA182	2/-
OA200	1/-
OA202	2/-
OA210	9/6
OA211	13/6
OAZ200	12/-
OAZ201	10/6
OAZ202	9/-
OAZ203	9/6
OAZ204	9/-
OAZ205	9/-
OAZ206	9/-
OAZ207	10/6
OAZ210	7/-
OAZ213	7/-
OAZ224	13/-
OC19	25/-
OC22	5/-
OC23	7/-
OC24	14/6
OC25	5/-
OC26	5/-
OC28	5/-
OC29	16/6
OC30	7/-
OC35	10/-
OC36	7/6
OC38	11/6
OC41	10/-
OC42	6/9
OC43	12/6
OC44	2/-
OC44PM	8/3
OC45	1/9
OC45M	8/-
OC46	3/-
OC65	22/6
OC66	25/-
OC70	2/3
OC71	2/-
OC72	2/-
OC73	16/-
OC74	8/-
OC75	2/-
OC76	3/-
OC77	3/4
OC78	3/-
OC78D	3/-
OC79	8/-
OC81	2/-
OC81D	2/-
OC81M	5/-
OC81Z	5/6
per pair	
OC82	2/3
OC82D	2/6
OC83	2/-
OC84	3/-
OC123	4/6
OC139	12/-
OC140	19/-
OC169	3/9
OC170	2/6
OC171	3/4
OC172	4/-
OC200	5/-
OC201	23/-
OC202	5/6
OC203	5/6
OC204	10/6
OC205	7/6
OC206	10/6
OC812	8/-
OCP71	27/6
ORP12	15/-
SX1/6	3/6
TS2	12/6
TS3	15/-
V10/15A	12/-
XA102	19/6
XA103	15/-
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
ZE12V7	1/9

MATCHED TRANSISTOR SETS 1—OC44 and 2—OC45 8/6; 1-OC81D and 2-OC81 7/6; 1 OC82D and 2-OC82 8/6; Set of three—OC83 (GET118/119) 8/6; LP15 package (AC113, AC154, AC157, AA120) 12/6; Postage 6d. per set.
S.T.C. 1 watt Zener diodes. 2·4v: 2·7v: 3·0v: 3·6v: 4·3v: 13v: 16v: 18v: 30v. All 3/6d. each.

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF ABOVE GOODS LOOSE OR BOXED, BUT MUST BE NEW

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THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA

continued from the May issue

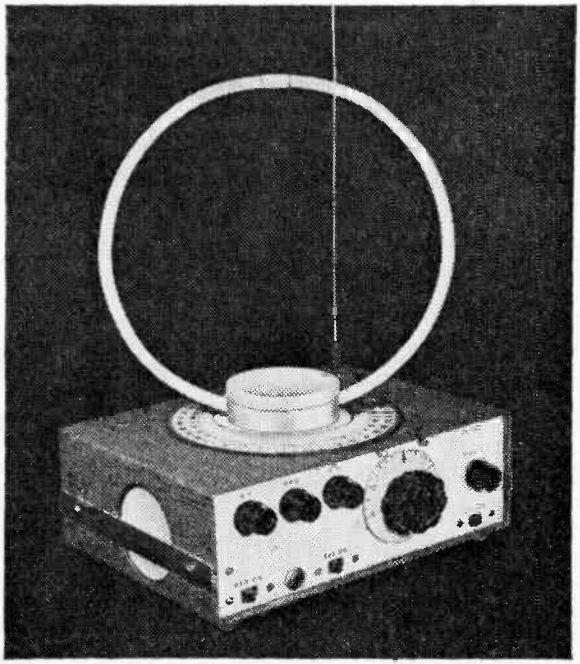
PROBABLY the amateur radio club activity in which short wave listeners can most actively participate is the Direction Finding Contest. In this contest a portable amateur transmitting station is usually hidden in a park or in the country. The station makes short transmissions of about 1 minute duration, every 30 minutes, usually at some specified frequency in the 1·8-2·0Mc/s band. Contestants have to locate the hidden station using a d.f. receiver, the first contestant to discover the location of the transmitter being the winner.

To determine the position of a transmitting station it is necessary for the receiver to have a directional receiving aerial. This aerial can take the form of a large diameter coil, as used in many of the older portable receivers and known as a loop or frame aerial, or a ferrite rod aerial.

The radio wave arriving at the receiving aerial consists of an oscillatory electric field with an associated magnetic field at right angles to it. Considering the magnetic field only, for the moment, this cuts across the turns of wire in the loop aerial and produces a signal voltage. The signal voltage induced in a loop aerial by a magnetic field arriving from different directions is called a polar diagram and that, for an ideal loop, is shown in Fig. 34a.

It will be seen that the direction for minimum induced voltage is much more sharply defined than that for the maximum voltage. The minimum position is used when detecting the direction from which a signal is being received, as this enables the greatest accuracy to be obtained. In practice an ordinary loop of wire will also have voltages induced into it by the electric field and so the minimum positions will be distorted and give an unreliable indication of direction. It is necessary, therefore, to eliminate the electric field by surrounding the loop of wire with an electrostatic shield. This can be done by winding the loop inside a circle of metal tube. A small break has to be left in the tube so as not to form a "shorted turn". This form of construction is employed in the Clubman Mk V aerial system as shown in Fig. 36.

An electrostatically shielded loop aerial will have two sharply defined minimum positions at 180 degrees from each other. The direction of the station will be at 90 degrees from one or other of these minima, but it is not possible to detect which is the correct direction. To overcome the problem, a vertical rod aerial is provided, which responds mainly to the electric field. The effect of coupling the signal from the vertical rod "sense" aerial to the signal from the loop aerial is to change the shape of the polar diagram to give only one maximum and one minimum position both in line with the direction of the loop, as shown in Fig. 34b. By checking with a signal, whose direction of origin is known, and marking the aerial accordingly, it is then possible to check at any time the true direction by switching-in the "sense" aerial.



The Mk V Clubman; employing direction finding facilities.

Loop Aerial Metalwork

Standard metal parts for making the loop aerial are not available as such, but no difficulty should be encountered in obtaining the necessary items. The loop is made of 5/16in. o.d. copper tube (petrol

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1H5GT	7/3	12AU7	4/9	DK91	5/6	EF184	6/6	PENA4	6/9	UCH42	9/9
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6AM6	3/6	30L1	6/-	EBF80	6/-	EZ40	7/6	PY81	5/3	**Transistors**	
6AQ5	4/9	30L15	14/-	EBF89	6/3	EZ41	7/6	PY82	5/-	AC107	3/6
6AT6	4/-	30L17	13/-	EC90	2/9	EZ80	4/6	PY83	5/9	AC127	2/-
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6BA6	4/6	30P12	11/-	ECC82	4/9	KT61	8/9	PY800	6/9	AF102	18/-
6BE6	4/3	30P19	12/-	ECC83	7/-	KT81	15/-	PY801	6/9	AF115	3/-
6BG6G	15/-	30PL1	12/6	ECC84	5/6	N78	14/9	R19	6/6	AF116	3/-
6BJ6	6/9	30PL13	14/6	ECC85	4/9	PC86	9/6	R20	12/9	AF117	3/3
6F13	3/6	30PL14	14/6	ECC804	11/9	PC88	9/6	U25	11/6	AF118	3/-
6F14	9/-	25L6GT	8/-	ECF80	7/-	PC97	8/6	U26	11/6	AF124	7/6
6F23	12/6	35W4	4/6	ECF82	6/9	PC900	9/-	U47	13/6	AF125	3/6
6K7G	2/6	35Z4GT	5/-	ECF86	9/-	PCC84	6/-	U49	13/6	AF126	7/-
6K8G	4/3	85A2	7/3	ECH35	6/-	PCC89	10/6	U52	4/6	AF127	3/6
6L18	6/-	6063	12/6	ECH42	10/-	PCC189	9/9	U78	3/6	OC22	5/-
6V6G	3/6	AZ31	9/-	ECH81	5/9	PCF80	7/-	U191	11/-	OC26	5/-
6V6GT	6/6	B36	4/9	ECH84	7/3	PCF82	6/-	U301	13/6	OC44	2/3
6X4	3/6	B729	12/6	ECL80	6/9	PCF86	9/9	U801	18/9	OC45	2/3
6X5GT	5/9	CCH35	10/-	ECL82	6/9	PCF800	11/6	UABC80	6/3	OC71	2/6
7B6	10/9	DAC32	7/3	ECL86	8/3	PCF801	7/9	UAF42	7/9	OC72	2/6
7B7	7/-	DAF91	3/9	EF39	3/9	PCF802	9/6	UB41	6/6	OC75	2/-
7C5	15/-	DAF96	6/-	EF41	9/6	PCF805	9/-	UBC41	7/9	OC81	2/3
7C6	6/9	DCC90	8/6	EF80	4/9	PCF806	11/6	UBF80	6/-	OC81D	2/3
7H7	5/6	DF33	7/9	EF85	5/6	PCF808	12/6	UBF89	6/9	OC82	2/3
7Y4	6/6	DF91	2/9	EF86	6/3	PCL82	7/3	UBL21	9/-	OC82D	2/6
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piping from the local garage) and is mounted on a circular "tin" having a diameter of about 2¾in. (Four Square tobacco tin). About 2ft. 2in. of copper tube is required. This is gently bent by hand to form a circle having an internal diameter of 8in. It is useful to draw an 8in. circle on paper and keep fitting the loop to it. Excessive bending and unbending will cause the copper tube to harden and produce an irregular shape. When a good circle of the correct internal diameter has been obtained the ends should be cut with a small hacksaw to leave a 1½in. gap between the ends of the loop. All burrs should be removed carefully. The tin box should now have one ⅜in. diameter hole cut in the centre of the bottom and two 5/16in. diameter holes cut on opposite sides, near the top. It is not easy to drill large diameter holes in thin tin, so a small file is used to open up a small (⅛in.) pilot hole. The ends of the copper tube are now passed through these holes to form the completed shape of the loop aerial. The ends of the tube inside the tin box should still be 1½in. apart. The copper tube is now soldered to the tin. This may be done using a heavy soldering iron, by heating with a blow torch or simply by heating on a gas stove. The last method was in fact used quite successfully. The loop and tin box are placed on an odd piece of steel sheet over a gas stove burner. The loop is checked as being vertical and then the temperature raised slowly until solder will run when touched on the copper tube. The soldering of the tube into the tin box is carried out using ordinary cored soft solder, no extra flux was found to be necessary.

Wiring the Aerial

With the tube soldered to the tin box it is now possible to cut a piece out of the top of the loop so as to leave a ¼in. gap. This is necessary, or the "shorted turn" of the tube would not allow any signal to be received. Again the ends of the tube must be carefully de-burred. The next stage is the winding of the aerial coil. This is done using thin plastic-covered wire. The type actually used was 7/·0048in. tinned copper wire with pvc covering having an outside diameter of 0·031in. (stranded pvc wire). A length of about 14 feet is required. The end of the wire is fed around the inside of the loop of tube, commencing at the bottom. When one turn is completed the end should be taped with Sellotape to the next turn. Make a neat job of the taping and this will prevent the end jamming as the remaining turns are wound on, by feeding in the wire. A total of six turns is required and these should fit in the tube without much difficulty. When the winding is completed one end is taken as "earthy" and soldered to the tin. A small length of single screened cable is connected with the screening braid soldered to the tin and the inner joined to the other end of the aerial winding.

Before fitting to the receiver, the loop may be painted a suitable colour.

The completed loop aerial is fitted to the receiver using a ¼in. spindle bush. This bush has an o.d. of ⅜in. and passes through the ⅜in. diameter hole in the bottom of the tin and in the top of the cabinet. See Fig. 37. To enable the direction of the aerial to be measured, a circular protractor (obtainable from an office stationery store) is drilled in the centre with a ⅜in. diameter hole and glued to the underside of the tin. (Evo-Stik is a suitable adhesive). The 90 degree and 270 degree marks should be in line with the loop. The top of the receiver cabinet is drilled as shown in Fig. 37 and a white circle of Fablon or Contact material equal in diameter

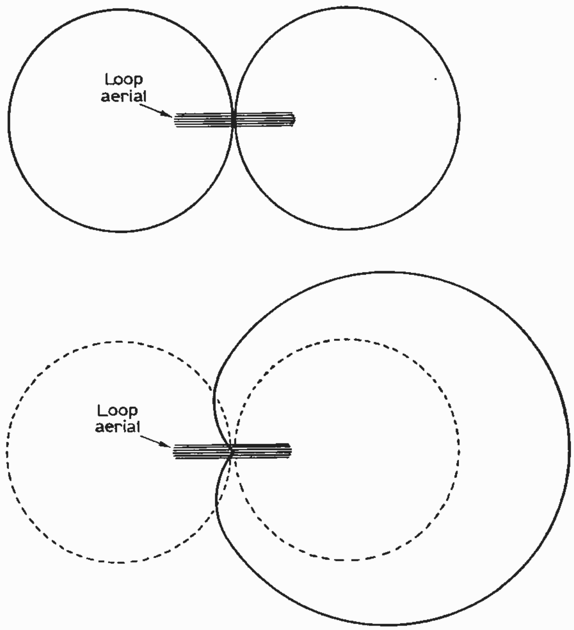


Fig. 34a (upper): Polar diagram of voltage induced in a loop aerial. Fig. 34b (lower): Effect of coupling a short vertical aerial to the loop.

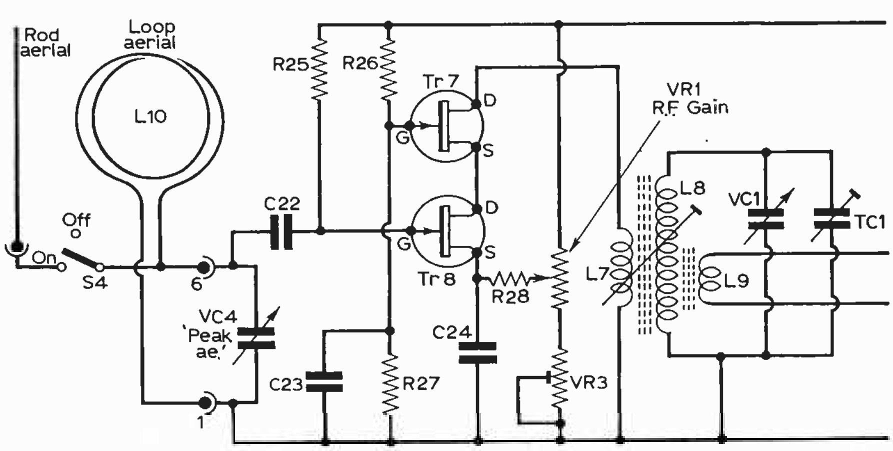


Fig. 35: Circuit details of the d.f. system including the receiver front-end.

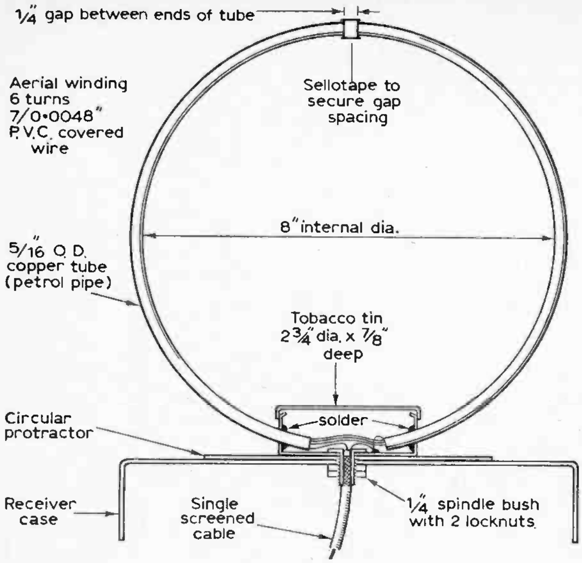


Fig. 36. Constructional details of the loop aerial.

to the protractor is stuck to the top of the cabinet so that the protractor markings are easily readable. A cursor line is marked on this at right angles to the front of the cabinet. The spindle bush is held in place with two locknuts and the aerial should be free to rotate easily without feeling "sloppy". The screened cable from the aerial is connected to a B9A valveholder plug, the outer to pin 1 and the inner to pin 6. This plug is plugged into the aerial coil socket and connects the loop aerial as shown in Fig. 35. (The aerial coil as used in the Clubman III and IV is removed.) The sense aerial consists of a short rod of 14s.w.g. tinned copper wire soldered in a 4mm. banana plug and mounted in a 4mm. socket as shown in Fig. 37. This socket is connected to the slide switch S4 and then to pin 6 of the B9A valveholder plug as shown in Fig. 35.

Operation

The signal is tuned-in in the normal way but with the a.v.c. switched off and the r.f. gain control adjusted as required. The signal is peaked up with the "PEAK AE" control. The sense switch S4 is put to the off position and the loop aerial rotated for minimum signal. Both minimum positions should be tried. If one is not the exact complement of the other the average should be taken. Switch in the "sense" aerial by putting S4 to the "on" position

★ components list

2ft. 2in.	$\frac{5}{16}$in o.d. copper tube
1	Tobacco tin. $2\frac{3}{4}$in. diameter
14ft.	7/·0048in. stranded "Miniature" pvc wire. Radiospares
1	Spindle bush. $\frac{1}{4}$in. $\frac{3}{8}$in. thread. Denco
1	Circular protractor. Office supplies
1	B9A valveholder plug
1	4mm. banana plug
1	4mm. socket
1	Slide switch (S4)

Fablon or Contact; single screened cable; Sellotape and Evo-Stik; nuts, screws etc.

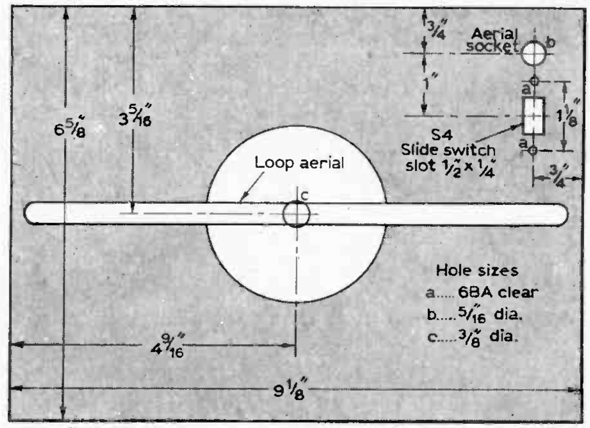


Fig. 37. Plan of cabinet top cover showing positioning of the loop aerial, "sense" aerial and slide switch S4.

and determine which is the true direction of the signal. The "sense" direction must initially be checked and the aerial marked as described previously.

The technique of operating in d.f. contests is, unfortunately beyond the scope of this article, but a lot of fun can be had and experience gained by checking the location in the Amateur Radio Call Book of the various amateur signals heard.

CLUBMAN (MARCH 1968)

In Fig. 18, the positions of S3 (b.f.o. switch) and S2 (a.v.c. switch) are incorrect. Fig. 22 shows these components in their correct position.

TO BE CONTINUED

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

As we are nearly at the height of another maximum in the sunspot cycle, conditions will be best for DX on 25, 21 and 17Mc/s during daytime, and at night—15, 11 and 9Mc/s. During summertime, conditions are best for reception of stations within Europe on lower frequencies and these last right through most nights. So now on to this month's frequency predictions.

South Africa: From 0800-1400, 25 and 21Mc/s; 1400-1600, 25, 21 and 17Mc/s; 1600-1800, 25, 21, 17 and 15Mc/s; 1800-2000, 25, 21, 17, 15 and 11Mc/s; 2000-2400, 21, 17, 15, 11, 9, 7 and 6Mc/s; 2400-0200, 17, 15, 11, 9, 7 and 6Mc/s; 0200-0400, 11, 9 and 7Mc/s; 0400-0600, 11, 9 and 7Mc/s at first, then after 0500 use 21, 17, 15, 11 and 9Mc/s; 0600-0800, 21, 17, 15 and up until 0700, 11Mc/s.

West Africa: 0800-1800, 25, 21, 17 and 15Mc/s; after 1700 add 11Mc/s; 1800-2000, 25, 21, 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 2000-2200, as for 1800-2200 except 25Mc/s; 2200-0200, 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 0200-0600, as for 2200-0200 but add 4 and 3Mc/s; 0600-0800, 25, 21, 17, 15 and 11Mc/s.

East Africa: 0800-1600, 25, 21, 17 and 15Mc/s; 1600-1800 as for 0800-1600 except after 1700 add 11Mc/s; 1800-2200, 21, 17, 15, 11, 9, 7, 6 and 5Mc/s; 2200-2400, 17, 15, 11, 9, 7 and 6Mc/s; 2400-0200, 17, 15, 11, 9 and 7Mc/s; 0200-0400, 21, 17, 15, 11 and 9Mc/s; 0400-0800, 21, 17 and 15Mc/s, up until 0600 also 11Mc/s.

South Asia: 0800-1400, 21, 17 and 15Mc/s; 1400-1600, 21, 17, 15 and 11Mc/s; 1600-1800, 21, 17, 15, 11 and 9Mc/s; 1800-2200, 17, 15, 11, 9, 7, 6, 4 and 3Mc/s; 2200-0200, 15, 11, 9, 7, 6 and 5Mc/s; 0200-0400, 15, 11 and 9Mc/s; 0400-0800, 21, 17 and 15Mc/s.

South East Asia: 0600-1200, 21 and 17Mc/s; 1200-1400, 21, 17 and 15Mc/s; 1400-1600, 21, 17, 15 and 11Mc/s; 1600-1800, 21, 17, 15, 11 and 9Mc/s; 1800-2000, 21, 17, 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 2000-2200 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 2200-2400, 17, 15, 11 and 9Mc/s; 2400-0200, 15 and 11Mc/s; 0200-0400, 15Mc/s only, but after 0300 add 17Mc/s; 0400-0600, 21, 17 and 15Mc/s.

North East Asia: 0400-1200, 17 and 15Mc/s; 1200-1600, 21, 17 and 15Mc/s; 1600-1900, 17, 15 and 11Mc/s; 1900-2200, 15 and 11Mc/s; 2200-0400, 15Mc/s only.

Australia via Asia: 0400-1200, 21Mc/s only; 1200-1600, 17Mc/s only, after 1300 add 15Mc/s; 1600-1800, 15 and 11Mc/s after 1700 add 9Mc/s; 1800-2200, 11, 9, 7 and 6Mc/s; 2200-2400, 17, 15 and 11Mc/s; 2400-0100, 15Mc/s only; 0100-0400, circuit closed for Broadcast Bands.

South America (North of Amazon): 1200-2000, 25 and 21Mc/s; 2000-2300, 21, 17Mc/s after 2100 add 15Mc/s; 2300-0100, 21, 17, 15, 11 and 9Mc/s; 0100-0400, 17, 15, 11 and 9Mc/s; 0400-0600, 17, 15 and 11Mc/s; 0600-1200, 17 and 15Mc/s.

Those were the frequency predictions for May as supplied by Cable and Wireless Ltd., London. I have had various letters about queries on hearing stations on various bands which I gave as not open at the times they were heard. Firstly, these predictions do not apply 100% of the time, when conditions are extra high as to the daily sunspots, some bands will stay open longer. Days when conditions are below normal, bands will tend to close earlier. One or two stations in particular have confused listeners about these predictions. First station has been *R. Peking*, China. People think where the studios are so are the transmitters, but this is not always so. *R. Peking* has a dozen or so s.w. transmitter sites scattered all over China. For Europe, they beam from sites on the USSR border, to Japan from East China coast as well as for North America, and South East Asia from sites around Canton. Thousands of miles of studio cable links are used. Now *Radio Australia*, for its 0645-0745 transmission, is beamed to Europe at 128deg. from Shepperton, Victoria via New Zealand, South Pacific, South America and Atlantic Ocean to Europe. But the afternoon transmission on 11,740Mc/s from 1500-1730 is beamed via Asia at 308deg. from Shepperton.

Now on to the DX-tips for May, deadline again is the 20th of this month.

AUSTRALASIA

Australia: In July, the *Radio Australia* transmitter site at Darwin, Northern Territory, will start operations. When the site is completed there will be 3 × 250kW s.w. transmitters and antennas to cover all of the continent of Asia. There have also been alterations to the *Radio Australia* schedule printed in the March issue. English to South Asia now from 1500-1730 on 11,740 and 9,540. A new Mandarin transmission to S.E. Asia now from 1430- 1500 on 11,790 and 9,540. The Vietnamese transmission now from 0515-0615 on 21,740 and 17,820. Thai transmission 1330-1430 on 11,790 and 9,540, English to N.E. Asia from 1100-1215 now on 15,390 and 11,810. English to Mid-Pacific now from 1800-2100 on 11,840. English to North America now from 1115-1215 on 11,710 and 9,580 instead of 1215-1315 on 11,710. English to Africa now 0330-0500 on 17,820 and 15,320. French to Africa now 0500-0600 on 15,320 only.

New Zealand: *Radio New Zealand* now uses 11,780 and 9,755 for transmissions to the Pacific Isles from 1700-1945, and 0600-0800 on Sundays and 0600-0845 on weekdays for 9,755, 11,780 runs daily 0600-0845 to Pacific Isles.

NORTH AMERICA

Canada: *Radio Canada* as of May 5th will transmit to Europe from 0555-0630 on 11,760 and 9,625, 0715-0800 on 11,765 and 9,625, to Australasia from 0825-0935 on 9,630 and 5,970. To Europe from 2001-2152 on 21,595, 17,820 and 15,320.

A REALLY good month for DX with a high rate of activity on all six amateur bands. It does my ageing cranium a power of good to think of all those happy little heads tightly clamped between the cans, hooking country after country. You lucky lot!

My recent eavesdrop on topband proved very fruitful. Hoards of G stations lurking on all modes, plus some nice topband DX. DL9KRA was heard as was ZC4RB and ZB2AY. The DL9 station acting as a sort of "Grand Net Master" in organising ZC4/G contacts. Also on the band but on c.w. were OL1AGS and OK1ATP plus a few GM and GW's. With the news that the MP4's are now licensed for 160 it looks like an interesting summer. All the above were heard between 2400 and 0300 hrs. GMT.

VK5KO and ZL3RB are at it on this band, and there are quite a number of W stations loose too. Fred, G3SVK, hopes to do an expedition to the Channel Islands this year (listen for GC3SVK), and hopes to do all four islands.

On the other bands there's been some pretty good conditions too, with twenty really going strong closely followed on the outside by fifteen and ten.

H.F. LUCKY DIP

D. Higgins (Lanarkshire), KT340, 40ft. wire indoors, sends in a terrific log. Here's the best from the fifteen metre catch—CN8BV, CN8FV, CP5AR, CP6FT, CR6GS, CR6KL, CT2AP, EL2F, EP3AM, ET3USA, F9UC/FC, FP8CS, G3UHR/P/VO2, HC1CP, HI8LAL, HI8TT, HK3AIR, HK5BDS, HK7FI, HL1KH, HR1KA, JA1GEA, JA2KZQ, JA3JGB, JA7EHU, JA8BFO, K1KCT, K2IXY, K3HTZ, K4SVQ, K5CKB/MM, K6AHV, K7PVE, K8ZTT/M, K9OZY, KØPSG, KA1XWJ, KG4DH, KG6ALY, KP4DQ, KR8EA, KV4AD, KZ5MV, LU1DAV, LU5DBS, LU8DKA, OA4AI, OA6AB, OX3BX, PAØGKS/W2, PJ2CE, PY2SO, SL3ZV, SVØWQ, TF2WKM, TI2MC, TJ1AL, TU2BQ, VE7BQF, VK2FA, VK3QX, VK5GM, VK6XX, VS9MB, WA5RAH/P/KG6, W6CHY, W7EOJ/MM, XE3RE, YN1JBL, YV1CS, ZC4CN, ZC4RB, ZD7KH, ZD8HAL, ZL3GJ, ZS6AR, 5Z4KK, 7P8AR, 7XØAH, 9G1BG.

F. McVerry (Lanarkshire), BC set plus RF24 unit as a front end, 40ft. indoor end-fed, also had a go on fifteen metres s.s.b. Rewards include—CE1DF, CP5DG, CR6IV, DU1AC, EA6BJ, EA8EX, EP3RB, HC1EG, IS1PPB, JA1AYT, KH6FEK/P5, KZ5AA, LU1DAB, LX1DB, MP4MBC, OA4ON, OX3BX, PJ2CR, TI8CAB, VO8OA, VP2AA, VP8JC, VQ9JW, VS9MB, W6FSJ, XE1AA, YN1JBL, YS1XEE, ZD3D, ZD7KH, ZS5CC, ZS6AR, 4X4VB, 5H3JL, 6W8PY, 6O1GB, 8P6BC, 9U5CR.

D. Grant (Kent), KT340, dipole at 20ft. went s.s.b'ing on twenty for—CN8EK, CT1MZ, EA3NJ, EP2DW, HB9WW, KL7EBK, KR6KN, TF2WKS, UT5RP, VE3GS, VK9OM, VO1FB, VP2AA, W6TNS/TA, W1—Ø, ZB2BM, 3V8BZ.

D. Clark (Bucks), modified P.W. progressive s/het plus PR30, 60ft. end-fed NW/SE, says that twenty has been open in the early evenings to most of Africa, while VK and ZL has been appearing around 2000hrs. His list for twenty s.s.b. includes—CT2AA, G3WBL/5A, HKØBKW, HS1AZ, HZ1AB, VK3AAV, VK4TY, W6TNS/TA, XE2YP, XW8BS, YN1GLF (Nicaragua), XW8BS (Laos), ZD7KH, ZD9BE (Brian, on Tristan Da Cunha), ZL1LBO, 4S7PB (Ceylon), 5H3KJ, 5Z4KO, 6W8DY, 6Y5AR, 7P8AR (Lesotho), 7Q7PBD, 8P6CC, 8R1G (Guyana), 9J2BC, 9K2BV, 9N1MM (Nepal), 9Q5PI, 9Y4DS.

A. Darragh (Yorks.), AR88D, 40 metre dipole, has been doing some homework on ten metres. If you don't listen on this band, look what you're missing—CR6BF, CX2CO, EL6IV, KR6TAB, KV4AD, LU6DRB, OA4BI, OD5BZ, PJ2CQ, PZ1DF, UT5SH, VK2FU, VK5XV, VK6DI, VS9MB, VU2KX, YA5RG, YV1SB, ZC4AK, ZE1PPG, ZS5LB, ZS9L, 4S7PB, 5N2AAF, 9H1BA, 9G1FV, 9J2BC, 9L1DW, 9M2BO, 9N1MM, 9Q5PT, 9Y4DS.

LOW CYCLES

D. Henbry (Sussex), HA500, 7ft. vertical rod at 30ft. sends in an interesting log of happenings on 3·5 and 7·0Mc/s. On eighty s.s.b.—G3WBL/5A, K2DX, K3UZE, K4DHZ, OY4OV, VO1AL, VO1GL W1FZJ/KP4, W2GO, W2JKI, W3BGN, W3BMS, W4BVV, W6EWN/3, WA8VQT, WB2FON, ZD3F. On dreaded forty, David hooked—CN8AW, K2GXI, W3BGN, W3KT, W3MFH, W3WJD, W4BVV, WB4DRZ, ZS1JA. David is working on the "Clubman" receiver and is hoping to make it a Mk 3. Gd luck OM.

N. Prince (G3VSI) aboard MV *Oreton* described his QTH as " . . . at sea". His digits are now able to massage the controls of an IMR54 receiver with a " . . . crystal filter and dozens of controls, fed by a twin inverted L, 73ft. horizontal and 29ft. vertical, 24·4 metres above sea level". He informs that up in the Arctic Circle, generally 160 and eighty are very noisy, but no ham stations, while twenty, fifteen and ten are very quiet. So if you're going portable this year, give the Arctic Circle a miss—settle for Margate instead!

C. Morris (Worcs), "homebrew receiver" plus Joystick indoors, will be moving to a QRN-free QTH soon. His log for topband c.w. from the old noisy location includes—DL5YZ, DL9KRA, EI9J, GW, GM, GI, GC3IEW, HB9TT, K2ANR, K3EKO, OK, PAØGMU, VP2VL (British Virgin Islands).

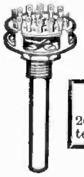
NEWS

For the contest enthusiasts the following are down in my diary for the merry month of May. Incidentally, even if you are not a keen contest type, the contests are the best times to listen since you can always be sure of a great deal of activity. On May 4th—5th, 432/1296Mc/s contest, you need special gear for this one; 4th—5th, RSF c.w. contest. You should hear quite a bit of r.f. during this one—if you can read c.w.; 19th, 2 metre portable contest; 1st and 2nd June, DARC contest. This is another c.w. one which is on all five bands 3·5—28Mc/s.

Mobile rallies include—May 12th, Thanet R.S. at Ramsgate; 12th, Northern A.R.M.S., Harewood Park, near Leeds; 26th, Scarborough A.R.S., at Bridlington. Listen on topband for the talk—in stations. Deadline for logs this month is, as usual, the 20th.

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

MINIATURE WAFER SWITCHES



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.

A.E.I. FRACTIONAL H.P. MOTOR. 200/250v 50/60 c.p.s. enclosed continuous rating 1/40 h.p. Ex. equip., perfect order. **19/6** plus 4/6.

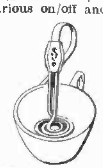
A.C. FAN. Powerful mains motor with 6½in. blade. Ideal blow or extract. **17/6** plus 3/6.

1·2v NICKEL CADMIUM CELLS. Dia. ⅝in. by ⅜in. thick (approx.). **3/6** each. Charger for two cells **12/6.**

OIL THERMOSTAT. Teddington type T.B.B. with capillary tube and sensor adjustable by knob (not supplied) controls ½ h.p. motor or up to 15 amp. resistive load. **9/6.**

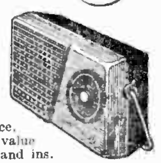
5 PUSH SWITCH. One push operates mains on/off switch the other four operate various on/off and change/over switches. **2/6.**

QUICK CUPPA



Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **19/6**, post and insurance 1/6.

NO SOLDERING POCKET 3



Lots of fun to build and good results when finished. Complete kit with detailed instructions and crystal earpiece. Batteries 1/2 extra—£5 value only **19/6**, plus 3/- post and ins.

B7G Valve Holders with bottom screen—ptfe insulation finest for UF and VHF, **1/-** each, **10/-** doz.

Fractional H.P. Motor. 240v. 50 cps—open construction—ideal for ventilation fan blower heater, etc. **19/6** plus 4/6 p. & p.

Clock Motor, 230v. 50 c.p.s. synchronous—self starting. **6/6.**

Pentode Output Transformer. Standard size, 40–1, ex equipment but OK. **4/3** each, **48/-** doz. Post paid.

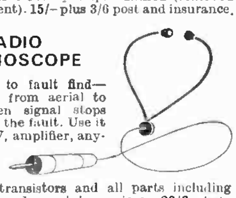
E.H.T. Condenser, 0·1 mfd. 5 KV, **8/6** each.

Neon Mains Tester. **1/3** each. **12/-** doz.

Power Pack Transformer. 12v. ½ amp. 240v. primary. **9/6** each.

MAINS TRANSFORMER. Upright mounting with primary tapped 200, 220, 240v. H.T. secondary is 250–0–250v. at 100 mA., and it has two L.T. secondaries of 6·3v. 1½ amp.—unused (removed from equipment). **15/-** plus 3/6 post and insurance.

RADIO STETHOSCOPE



Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **29/6**—twin stethostet instead of earpiece **7/6** extra—post and insurance 2/9.

50 OHM 50 WATT WIRE WOUND POT-METER. **8/6** each.

1 MEG MINIATURE. Pot-meter Morganite standard ¼in. spindle **1/-** each, **9/-** per dozen.

1 MEG MINIATURE Pot-meter Morganite preset screwdriver control. **9d.** each, **8/-** per dozen.

PRE-SET 100K by Welwyn with intrical bakelite knob. **1/-** each. **9/-** per dozen.

100K POT-METER. Miniature type with double pole switch and standard ¼in. spindle, by Morganite. **2/-** each, **18/-** per dozen.

BLANKETSTAT GLASS. Enclosed, normally closed circuit, will open should blanket overheat. **4/6** each.

THERMAL RELAY. Can be used to delay the supply of HT while heaters warm up, or will enable 15 amp. loads to be controlled by miniature switches or relays. Regular list price over £2. Price **7/6** each.

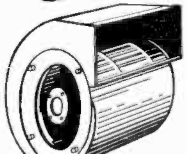
SIEMENS HIGH SPEED RELAY. Twin 1000 ohm coils. Platinum points changeover contacts—Ex equipment. **8/6** each.

TOGGLE SWITCH BARGAIN. 10 amp. 250v. normal one hole fitting **2/9** each or **30/-** per doz.

DRILL CONTROLLER

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

CENTRIFUGAL FAN



Centrifugal blower or extractor by Torrington, very low noise but large capacity air flow, designed for central heating and air conditioning, ideal also for fume extraction over cooker, duct type outlet, 200/250v. 50 c.p.s. motor. **£3.19.6.** Post and insurance 7/6.

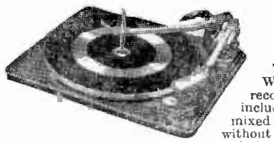
FOOD MIXER

The famous Dutch made food mixer, 2 speed interchangeable beaters 220-240 Volt. Normally 7 gns. Our price **59/6** plus 6/6 postage.

THIS MONTH'S SNIP

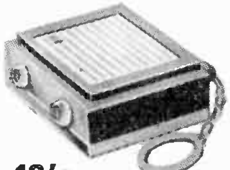
Full-Fi 12in. loudspeaker. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of this country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts r.m.s.—Cone Moulded fibre—Freq. response 30–10,000 c.p.s.—Input Impedance 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12⅝in. over mounting lugs—Baffle hole 11in. diam.—Mounting holes 4—Holes ¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5⅛in. A £6 speaker offered for only **£3.9.6** plus 7/6 post and insurance.

GARRARD AUTO RECORD PLAYER Model 3000



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 turntable for max. stability. Adjustments include pick-up height—pick-up dropping position and stylus pressure. Size is 13¼ x 11⅜in. clearance 4⅝in. above, 2⅛in. below. Fitted with the very superior ceramic stereo cartridge type 9TAHC with diamond stylii which is listed at over £4. Price complete **£9.19.6**, carr. and insurance 7/6.

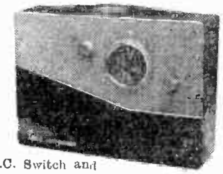
BARGAIN OF THE YEAR
MICRO-SONIC



7 transistor Key chain Radio in very pretty case, size 2⅞ x 2⅛ x 1⅛in.—complete with soft leather zipped bag. Specification: Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 Kc/s, or 455 Kc/s. Power output: 40 mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type. In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new, **19/6**, plus 2/6 post and ins., less batteries.

19/6

SUPERTONE G.C.V.



Saves you work—
It's partly built
Like its predecessors this latest Companion has full fi performance—such as only a good wooden cabinet and bilux 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.

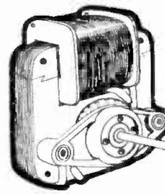
SOLID STATE IGNITION

Big things are claimed of Electronic ignition systems and if you would like to try for yourself a circuit was described in "Practical Electronics" (Sept. 1966). This requires a silicon controlled rectifier, four transistors and other components available as a kit. Price **£6.15.0** post free.

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, provided 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 TV 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.

MAINS MOTOR



Precision made—as used in record decks and tape recorders—ideal also for extractor fans, 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.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500 mA (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.

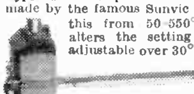
FLOOD LAMP CONTROL

Our dim and full switch is ideal for controlling photo flood lamps: it gives two lamps in series, two lamps full brilliance and lamps off. Similar control of other appliances can be arranged where used in pair or where circuit can be split exactly in half. Technically the switch is known as a double-pole change over with off. Our price **4/6.**

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. **9/6** plus 1/- post. Suitable box for wall mounting **5/-.** P. & P. 1/-.

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.

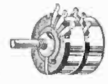


Type "D". We call this the Ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (16 yds. 10/-) is wound round the pipes. **7/6.** P. & P. 1/1.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. **7/6**, plus 1/- post.

Type "F". Glass encased for controlling the temp. of liquids—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.

GANGED POTS



Standard type and size with good length of spindle—made by Morganite. List price is 10/- each but if you act quickly you can have them at **12/-** doz. (or **1/6** each if less than doz.). Following valves in stock all "lin"—10K+10K—100K+100K—500K+500K, all new and unused. Post 2/9 on 1st doz. then 1/- per doz. 6 doz. or more post free.

When 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.

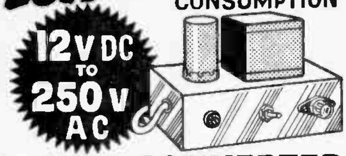
ELECTRONICS (CROYDON) LIMITED

(Dept. P.W.) 102/3 TAMWORTH RD., CROYDON, SURREY *(Opp. W. Croydon Stn.)*

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

FANTASTIC

LOW BATTERY CONSUMPTION



POWER CONVERTER

New type low drain converter unit The main feature of this unit is its very low battery drain, not to be confused with dynamotors or rotary converters. 12 volt D.C. input gives 250 volts A.C. output suitable for radios, fluorescent lighting, and A.C. only equipment. Complete and brand new with full connecting leads and battery clips Price **£4.10.0**, carriage 10/-.

TALKIE-PHONE SET

A Two-way **Intercom Set**. Ideal for all 2-way communication, indoor/outdoor use. Home/office use They will work up to great distances. No G.P.O. licence required. Made to high standard. Government specifications As used by Tank Commanders. The complete set ready to use, including batteries' **£2.10.0.** Carriage 10/-. Bargain offer to *Practical Wireless* readers: Two complete sets **£5**, post free. Limited stocks.

MONSTER BARGAIN PARCEL

Comprises 10 assorted electronic units of remarkable value to the constructor, plus 50 useful components and parts Money back if not delighted. 19/6, carr. 5/6.

COMMUNICATION RECEIVER

TYPE
T.R.G.D.X./20.C.

Brand new fully transistorised Communications Receiver. Specifications: 4 complete ranges 550 Kc/s to 30 Mc/s, covering all amateur bands, shipping and trawler bands, and broadcast bands. A highly efficient double tuned superhet, comprising R/F aerial tuning section, A.V.C. and built in B.F.O. for C.W. or SSB reception. Ideal for fixed or mobile reception. Operates from Standard 9 volt battery, provided that fits internally. Gives 3 watts audio output. With speaker and headphone output. Hammer finished robust steel case of pleasing modern design with all controls on well set-out front panel. Size approx. 9 x 7 x 6in. British manufacture. Due to huge purchase we can offer these excellent receivers at less than half their normal price. Complete with handbook **£16.10.0**, carr. and ins. 15/- Headphones if required 18/6 extra, p.p. 3/6. FREE. FREE. First orders received up to ten days after publication date of this advertisement will receive free a wonderful battery eliminator enabling you to run this receiver and most transistor radios direct from the mains.

COLLAPSIBLE AERIAL

IN 5 SECTIONS
CLOSED 13½"
OPEN 5'-6"

A fully adjustable highly efficient whip aerial. Made to exacting specifications. Copper plated sections. Brass base. An ideal aerial for TX/RX use. Easily adaptable for cars, scooters, walkie talkies etc. Brand new in maker's boxes. Only £1 each, post and packing 2/6. Two aerials 35/-, p.p. 2/6.
All orders to: Dept. P.W. 11.

GLOBE SCIENTIFIC LTD
24 CAWOODS YARD, MILL STREET
MARSH LANE, LEEDS 9. Leeds 35900

Aerial Tuner units for Tx/Rx use. Will load almost anything. Calibrated control dial. Housed in compact steel case. Ideal for all radio amateurs and S.W.L.s, 25/-, p. and p. 7/6.

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THE 'TEN-FIFTY' TRANSMITTER

A.S. CARPENTER G3TYJ

SOME interested visitors commented recently that they thought it must be an expensive business becoming a licensed radio amateur, and it may be true that equipment produced commercially for use in amateur stations does tend to be "pricey". A great deal of enjoyment can be found, however, without expensive and sophisticated commercially made apparatus, much of which is designed nowadays with single sideband (SSB) as the main operating mode in mind. Despite criticism, CW remains a favourite operating mode by a large number of radio amateurs, for it is certainly effective and allows use of comparatively simple equipment.

Although an input of up to 150W is permitted on the amateur h.f. bands, excellent DX results are obtainable with considerably less power. Into this category comes the "Ten-Fifty" Transmitter which is a four-band rig embracing the 7·0, 14·0, 21·0 and 28·0Mc/s amateur bands. To build the "Ten-Fifty" some 30 hours of construction time are needed at a total components cost of not more than £10, even when all new items are purchased.

The transmitter is optionally crystal or v.f.o. controlled. When using crystal control—and this is the method initially recommended—a single type FT-243 item in the range 7010-7050kc/s enables all four

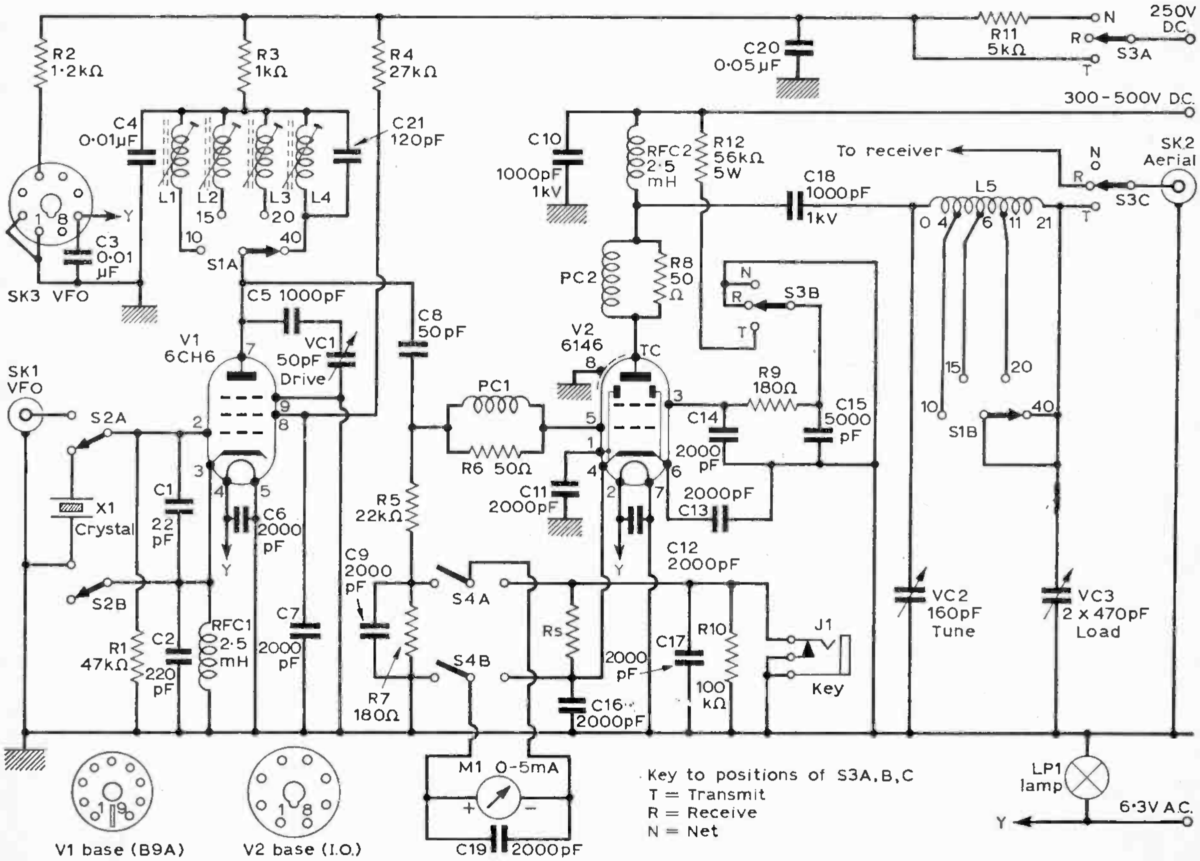


Fig. 1: Complete circuit of the transmitter.

bands to be worked via harmonic action of the oscillator. Alternatively, a v.f.o. covering 7000-7050kc/s may be used, and a suitable powering socket is provided together with an input socket on the rear chassis apron of the transmitter. A suitable v.f.o. will be described in a later article.

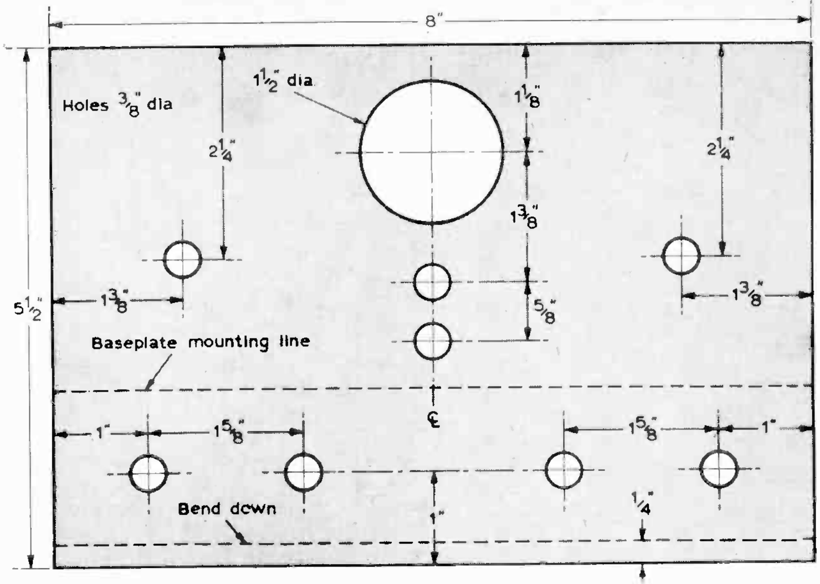


Fig. 2 (above): Essential panel drilling details and size.

Circuitry

The complete and fairly conventional circuit diagram is given in Fig. 1. A 6CH6 valve, V1, operates as a crystal oscillator when switch S2 is set as shown due to grids No. 1 and 2 forming with the cathode the elements of a triode. The crystal frequency plus multiples thereof appear at the anode of the valve and are extracted via capacitor C8. The required harmonic is selectable due to S1A which enables the fundamental frequency f to be taken or frequencies of 2f, 3f and 4f via coils L1-L4. These easily-wound coils are required to tune over a very limited range only; coarse tuning is provided by dust iron cores.

Peaking is accomplished by means of panel-fitted VC1. When VC1 is peaked some 4-5mA drive may be secured but this is more than is required, 2·4mA being adequate. Fixed capacitor C5 prevents VC1 from becoming "hot" to d.c. and these two items are effectively across their appropriate coils due to C4. Winding details for coils L1-L5 are given in Table I. When S2A is moved to its alternative position and a v.f.o. connected to socket SK1, V1 operates as a conventional r.f. amplifier.

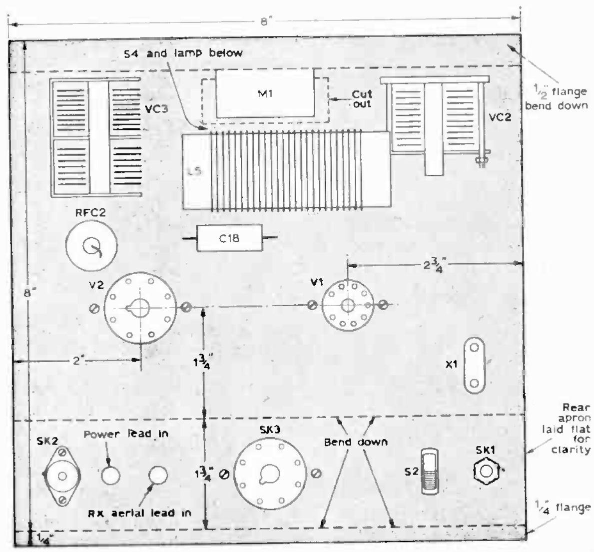
Power Amplifier

The p.a. stage utilises the popular 6146 valve in conjunction with a familiar pi-tank output circuit. Anti-parasitic stoppers are included in both grid and plate circuits and a modern miniature moving coil meter may be switched, via S4, to indicate either grid or cathode current. A 0-5mA meter movement, scaled 0-5, is utilised for grid current indication, the readings being mentally multiplied by a factor of ten to show 0-50W, full scale corresponding to a current of 100mA when 500V d.c. is applied. To enable 100mA to be taken on the 5mA f.s.d. meter resistor Rs is fitted its value being approximately 0·4Ω. This item consists of a few turns of fine copper wire wound on to a 100Ω resistor.

TABLE I

Coil No.	Wire gauge	Turns	Former diameter	Spacing	Core	Band metres
L1	30s.w.g. enamelled	8	0·25in.	Close	Iron	10
L2	30s.w.g. ,,	13	0·25in.	Close	Iron	15
L3	30s.w.g. ,,	20	0·25in.	Close	Iron	20
L4	30s.w.g. ,,	23	0·25in.	Close	Iron	40
L5	18s.w.g. tinned ("tapped" at 4, 6, 11 turns from "hot" end)	21	1·25in.	Wire dia.	Air	Tank

Fig. 3 (below): Above-chassis layout and dimensions. Chassis plate and flanges laid flat for clarity.



In the tank circuit, sections of coil L5 are switched simultaneously with the oscillator anode coils via S1B, capacitors VC2 and VC3 being the usual tuning and loading items respectively. Cathode keying is used satisfactorily with chokes PC1 and PC2 as the anti-parasitic items. As is common an external power supply unit is used with the transmitter and for full output, requirements are 500V d.c. @ 120mA plus 6·3V a.c. 3·0A.

Function Switching

A simple 3-position yaxley-type switch, S3, selects either "Net", "Receive" or "Transmit" as required. When the switch is in position 1 the "Ten-Fifty" is "hot" and the aerial connected. Moving S3 to position 2 "kills" the transmitter and connects the aerial to

the associated receiver whilst position 3 permits V1 to operate only for netting purposes. The v.f.o. power supply socket is "hot" h.t.-wise in both "Net" and "Transmit" positions of the function switch.

Since it is undesirable to carry large d.c. potentials on a rotary swich the p.a. plate circuit is left complete at all times the 6146 valve screen circuit being controlled by S3B; here the d.c. operating potential is not allowed to be more than 150V. It may be noted that in selecting the central switch position for "Receive" (or "Stand-by") a single movement only is required, to right or left, for "Net" and "Transmit" respectively.

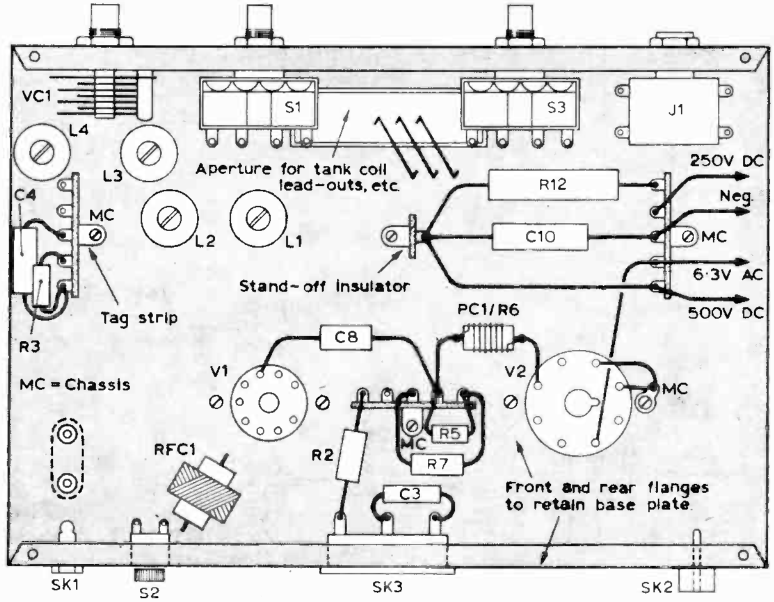


Fig. 4: Below-chassis layout of principal components.

Constructional

Basically, two pieces of 16 s.w.g. aluminium are required on which to build the "Ten-Fifty" and details of one of these—the panel —are given in Fig. 2. All metalwork is easily prepared using simple tools. Two small flanges are provided on the chassis underside so that a flat aluminium base plate may finally be located; this baseplate protects under-chassis components and also confers rigidity.

Essential dimensions and layout of the main components both above- and below-chassis may be seen in Figs. 3 and 4 respectively and it is doubtful if any improvements can be made. Some interaction among coils L1-4 is likely and it is advisable to place them so that the 10-metre coil, L1, is closest to the bandswitch S1, with coil L2 nearby. All wiring—to the coils in particular—should be carried out with stiff copper wire adequately sleeved. Coils L1-L4 are adjusted when in circuit to their appropriate operating frequencies of 7, 14, 21 and 28Mc/s using a g.d.o., each coil core is peaked with the vanes of VC1 half enmeshed.

Testing

Initially, the h.t. voltage used should be no more than 300V d.c. With S3 at "Receive" a 40W domestic lamp bulb is connected to socket SK2, switch S2 moved to "Crystal", a crystal in the frequency range 7010-7050kc/s plugged in and switch S4 moved to indicate grid current. A test-meter set to read 0-100mA is then inserted in the circuit at the h.t. end of choke r.f.c. 2. With the key connected, power is applied and S3 rotated to "Net" whereupon an indication should be seen on the panel meter; grid current should now be peakable via VC1 to at least 4mA when the key is depressed. Grid current is then set to 2·4mA, the key released, the function switch returned to "Receive" and S4 set to read anode or plate current.

When the vanes of both VC2 and VC3 have been fully enmeshed the function switch is placed at "Transmit". Care is now required and the key should be quickly depressed and released whilst noting the maximum reading on M1. Should the meter appear to be over-driven place S4 at "Grid" and use the

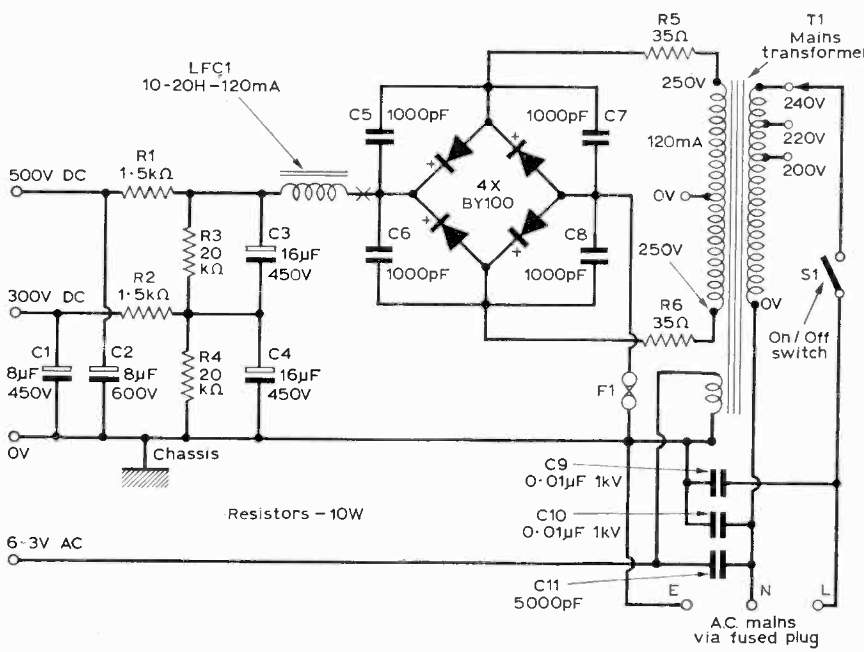


Fig. 5: A suitable solid-state power supply.

externally connected meter to load up.

To load the "Ten-Fifty" depress the key then quickly rotate VC2 to reduce the current indicated to the lowest possible level. Monitor the grid current and readjust drive to 2·4mA if necessary. Next open VC3 slightly to increase anode current, immediately reducing it again via VC2. When this procedure has been repeated several times the lamp "load" will begin to glow and a wavemeter should then be brought into use to verify that output is occuring in the appropriate band as selected by S1. Thereafter, it is merely a case of adjusting resistor Rs to obtain a half scale reading on meter M1 when a current of 50mA is indicated on the externally connected test-meter; this may require several attempts to be made.

The "Ten-Fifty" Transmitter is now virtually complete and with the lamp load and external meter removed a trial QRP call may be made via the station aerial provided there is no risk of causing interference to others; it should be appreciated, however, that re-loading into the aerial proper will normally be necessary.

Later, the 6146 valve may be fed from a source voltage capable of giving a d.c. input of 50W and if meter M1 indicates a full scale reading for 100mA the required voltage is 500V d.c.

★ components list

Resistors:

R1	47kΩ	R8	50Ω
R2	1·2kΩ 1W	R9	180Ω 1W
R3	1kΩ	R10	100kΩ
R4	27kΩ	R11	5kΩ 2W
R5	22kΩ	R12	56kΩ 5W
R6	50Ω	Rs	See text
R7	180Ω		

Capacitors:

C1	22pF silver mica
C2	220pF silver mica
C3	0·01μF (10,000pF ceramic)
C4	0·01μF (10,000pF ceramic)
C5	1000pF ceramic
C6	2000pF ceramic
C7	2000pF ceramic
C8	50pF silver mica
C9	2000pF ceramic
C10	1000pF (0·001μF) 1000V d.c.
C11	2000pF ceramic
C12	2000pF ceramic
C13	2000pF ceramic
C14	2000pF ceramic
C15	0·005μF (500pF) ceramic
C16	2000pF ceramic
C17	2000pF ceramic
C18	1000pF (0·001μF) 1000V d.c.
C19	2000pF ceramic
C20	0·05μF paper 500V
C21	120pF silver mica
VC1	50pF air spaced variable trimmer
VC2	160pF air spaced (Wavemaster)
VC3	2 x 470pF (nominal) twin-gang

Valves:

V1	6CH6	V2	6146

Switches:

S1	2-pole, 4-way
S2	DPDT slide type
S3	3-pole, 3-way
S4	DPDT toggle type

Sockets:

SK1	Miniature jack type
SK2	Coaxial TV type
SK3	I.O. valve holder

Chokes:

RFC1—2·5mH miniature
RFC2—2·5mH transmitter type

Miscellaneous:

B9G skirted valveholder, I.O. valveholder ceramic. Dust-cored coil formers, ¼ and ⅜in. (see text). Meter—MRP2, 0-5mA f.s.d. Crystal X1 see text. Aluminium for panel and chassis, case, etc. Control knobs (5), etc.

Power Supply Circuit

A suitable method of obtaining the required operating voltages may be seen in the simple solid-state p.s.u. arrangement given in Fig. 5 and h.t. potentials should not rise to a dangerous level under key-up conditions with this configuration which is self-discharging. No high d.c. potentials are left across the unit at switch-off but bleed resistors R3 and R4 must on no account be omitted; slight changes to the values of R3 and R4 are permissible, however, if it is found that the intermediate d.c. potential is inadequate.

POWER SUPPLY UNIT

★ components list

Resistors—10 Watt:

R1	1·5kΩ	R4	20kΩ
R2	1·5kΩ	R5	35Ω-5W
R3	20kΩ	R6	35Ω-5W

Capacitors:

C1	8μF 450V electrolytic
C2	8μF 600V electrolytic
C3	16μF 450V electrolytic
C4	16μF 450V electrolytic
C5-8	1000pF ceramic 500V
C9	0·01μF paper, 1KV
C10	0·01μF paper, 1KV
C11	5000pF ceramic 500V

Miscellaneous:

4 x BY100; LFC1—10to20H Choke, 120mA. Mains Transformer 250–0–250V 120mA, 6·3V 3A; On/off Toggle, 250V a.c.; Torch bulb 0·3A; Chassis—see text.

The simple p.s.u. may be built on a chassis measuring 8 x 5 x 2in., but all "hot" points should be kept below chassis in the interests of safety. Adequate ventilation must be provided and the output socket can be a I.O. valveholder. If a 0·3A torch bulb is wire in the circuit at point "X" it will offer a degree of protection to the rectifiers should a short-circuit accidentally occur; it will also provide an excellent visual keying indicator. ■

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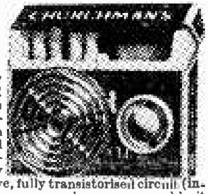

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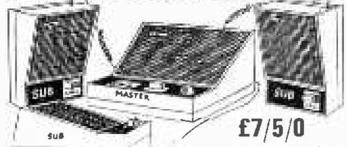

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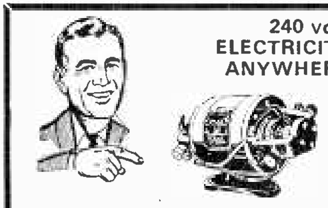

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(continued on next page)

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1/6 per 100 less in 100's of one ohmic value
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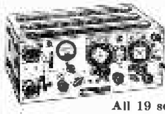

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(continued on next page)

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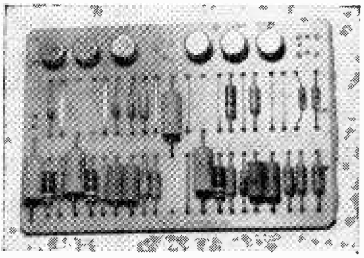

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160V: 0·01µF, 0·015µF, 0·022µF, **6d.** 0·033µF, 0·047µF, **7d.** 0·068µF, 0·1µF, **8d.** 0·15µF, **10d.** 0·22µF, **11d.** 0·33µF, **1/2.** 0·47µF, **1/5.** 0·68µF. **2/1.** 1µF, **2/6.**
400V: 0·001µF, 0·0015µF, 0·0022µF, 0·0033µF, 0·0047µF, 0·0068µF, 0·01µF, **6d.** 0·015µF, 0·022µF, **7d.** 0·033µF, **8d.** 0·047µF, 0·068µF, **9d.** 0·1µF, **10d.** 0·15µF, **1/1.** 0·22µF, **1/5.** 0·33µF, **2/1.** 0·47µF, **2/6.**
Polystyrene: ±5%. 160V: 5pF, 10pF, 15pF, 22pF, 33pF, 47pF, 56pF, 68pF, 100pF, 150pF, 220pF, 330pF, 470pF, 680pF, 820pF, **5d.** 1,000pF, 1,500pF, 2,200pF, **6d.** 3,300pF, 4,700pF, 5,600pF, **7d.** 10,000pF, **8d.** 15,000pF, 22,000pF, **9d.**
POTENTIOMETERS (Carbon): Long life, low noise. ¼W at 70°C. ±20% ≦¼M, ±30% > ¼M. Body dia., ¾in, Spindle, 1in × ¼in. **2/-** each. Linear: 100, 250, 500 ohms, etc., per decade to 10M. Logarithmic: 5k, 10k, 25k, etc., per decade to 5M.
SKELETON PRE-SET POTENTIOMETERS (Carbon): Linear: 100, 250, 500 ohms, etc., per decade to 5M.
Miniature: 0·3W at 70°C. ±20% ≦¼M, ±30% > ¼M. Horizontal (0·7in × 0·4in P.C.M.) or Vertical (0·4in × 0·2in P.C.M.) mounting, **1/-** each.
Submin. 0·1W at 70°C. ±20% ≦1M, ±30% > 1M. Horizontal (0·4in × 0·2in P.C.M.) or Vertical (0·2in × 0·1in P.C.M.) mounting, **10d.** each.
RESISTORS (Carbon film): High stability, very low noise. ¼W at 70°C. Body ⅓in × ⅛in. Values in each decade: 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91 from 4·7Ω to 1M. ±5%, **2d.** each. 1·2M, 1·5M, 1·8M, 2·2M, 2·7M, 3·3M, 3·9M, 4·7M, 5·6M, 6·8M, 8·2M, 10M. ± 10%, **2d.** each.
SEMI-CONDUCTORS (All new): OA5, OA81, **1/6.** OC44, OC45, **1/9.** OC71, OC72, OC73, OC81, OC81D, OC82D, OC170, OC171, **2/3.** OC140, AF115, AF116, AF117, **3/-.**
SILICON RECTIFIERS: 0·5A at 70°C. 400 P.I.V., **3/-.** 800 P.I.V., **3/3.** 1,250 P.I.V., **3/9.** 1,500 P.I.V., **4/-.**
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DK96	7/-	EF80	4/9	PCC84	5/6	PY82	5/-
DL92	3/9	EF85	5/3	PCC89	10/-	UABC80	5/9
DL93	2/6	EF86	6/-	PCF80	6/6	UBF89	6/3
DL96	7/-	EF91	1/9	PCL82	6/3	UCH81	6/3
EABC80	5/6	EF93	3/6	PCL83	9/-	UCL82	6/9
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6¼″	4⅞″		11	6		14	6		16	6
8¼″	3⅞″		12	6		16	0		17	9
8¼″	6⅞″		17	9	1	1	6	1	5	0
10¼″	7⅞″	1	3	0	1	8	0	1	11	9
12¼″	3⅞″		17	9	1	1	9	1	4	9
12¼″	5⅞″	1	2	3	1	7	0	1	10	6
12¼″	8⅞″	1	8	9	1	14	6	1	18	9
14¼″	3⅞″	1	0	6	1	5	0	1	7	3
14¼″	9⅞″	1	15	0	2	4	9	2	7	0
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16¼″	10″	1	19	3	2	10	0	2	17	6

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8″ × 6″	7	9	12″ × 8″	10	9	16″ × 10″	16	0

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5U4G	5/-	6CY7	11/-	6SR7	7/-	12SF5	9/-
5U4GB	6/6	6D6	3/-	6SS7	3/-	12SF7	7/-
5V4G	7/6	6DK6	8/-	6T8	6/6	12SG7	5/-
5Z3	7/6	6DS4	15/-	6U4GT	12/6	12SH7	4/-
5Z4G	7/-	6EA8	11/-	6U8	6/6	12SJ7	4/-
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6AF4A	9/-	6F15	11/-	6Z4	5/-	20D1	9/-
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35Z3	10/-	7360	30/-	DY87	6/6	ECF200	13/-
35Z4GT	8/6	7586	22/6	DY802	9/-	ECF201	13/-
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50CD6G	27/6	9003	9/-	EAF42	8/6	ECH81	5/3
50L6GT	7/6	A2293	18/-	EB91	3/-	ECH83	7/6
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EL86	8/-	PCC88	11/-	PY81	5/6	UF42	9/-
EL90	5/6	PCC89	10/6	PY82	5/-	UF43	8/-
EL95	5/-	PCC189	11/-	PY83	5/6	UF80	6/6
EL360	22/-	PCC805	15/-	PY88	7/6	UF85	7/3
EL821	8/-	PCC806	15/-	PY301	14/-	UF86	9/-
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OC26	6/-	OC202	13/-	AFY19	22/6	2N410	3/6
OC28	12/6	OC203	10/6	AFZ11	17/-	2N412	3/6
OC29	14/9	OC204	12/6	AFZ12	10/-	2N444A	5/-
OC35	13/-	OC205	15/-	ASY26	6/6	2N696	6/6
OC36	12/6	OC206	22/6	ASY28	6/6	2N697	7/6
OC42	5/-	AC107	10/-	ASZ20	7/6	2N706	3/4
OC43	9/-	AC125	5/6	ASZ21	12/6	2N753	6/6
OC44	4/-	AC126	6/6	BC107	7/6	2N1132	37/-
OC45	3/6	AC127	7/6	BCY30	7/-	2N1301	7/-
OC58	12/6	AC128	6/6	BCY33	7/6	2N1304	6/-
OC70	4/-	AC176	7/6	BCZ11	10/-	2N1756	15/-
OC71	3/6	ACY17	8/6	BFY50	8/6	2N2068	20/-
OC72	5/-	ACY18	5/6	BFY52	6/6	2N2369A	4/6
OC73	7/6	ACY19	6/6	BSY26	5/-	2N2926	5/6
OC75	6/-	ACY20	5/-	BSY28	5/-	2N3819	13/-
OC76	5/-	ACY21	6/-	BSY65	5/-	2S002	20/-
OC77	8/-	ACY22	3/6	GET103	5/-	2S003	20/-
OC78	5/-	AD140	16/-	GET104	8/-	2S004	15/-
OC78D	5/-	AD149	16/-	GET113	4/-	2S005	50/-
OC81	5/-	AF102	18/-	GET114	4/-	2S006	20/-
OC81D	3/-	AF114	6/6	GET115	8/6	2S012	140/-
OC83	5/-	AF115	6/-	GET116	10/-	2S018	60/-
OC84	5/-	AF116	6/6	GET872	6/-	2S102	22/-
OC122	12/6	AF117	5/-	GET875	6/-	2S103	25/-
OC139	7/6	AF118	10/-	MAT101	8/6	2S104	15/-
OC140	9/6	AF124	7/6	MAT120	7/6		
OC141	12/6	AF125	6/6	MAT121	8/6		

COMPLEMENTARY PAIRS (PNP/NPN)
AC128/AC176 (Germanium) 13/-; 2N697/2N1132 (Silicon) 27/-; ASY26/ASY28 (Germanium) 12/-.

SPECIAL OFFER OF TRANSISTORS

AM/FM and SW KIT comprising two AF125 (mixer/oscillator), two AF126 (IF), one AC126 (audio) and two AC128 (push/pull output). 21/- post paid.
GERMANIUM GENERAL PURPOSE. 2G371A or B, 2G813. 25/- per doz. assorted.

25 WATT SOLDERING IRONS

200-250 watt exceptionally well made lightweight soldering irons with polished wooden handles and chromium plated body. Angle bit of sufficient length for long life. No breakable plastics used in construction. PRICE 16/- (P.P. 2/-). Spare, bits 1/9, Spare elements 3/6.

THYRISTORS

3/40, 400 p.i.v. 3 amp, stud mounted. Gate voltage 3·0v. at 20mA max.	7/6
BLUE SPOT, 200 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max.	12/6
GREEN SPOT, 400 p.i.v. 5 amp, stud mounted. Gate voltage 3·25v. at 120mA max.	17/6

AVALANCHE SILICON RECTIFIERS

Type RAS508AF, 960 p.i.v. at 6 amps. max., stud mounted 10/6

FOR P.W. CLUBMAN RECEIVER

One each OC170, OC45, OC71. Two OA81 and TC1, TC2 Trimmers (3–30pF Beehive), 19/-, post free.

DRY REED INSERTS

Glass dry reed inserts approx. ⅛in. dia. x 1in. long with axial leads. One "make" contact of 100mA capacity at 50V. Can be operated by permanent magnet or 30-50 Amp-turns relay coils. PRICE 18/- per doz. post free.

TEXAS SILICON FULL-WAVE BRIDGE RECTIFIERS
1B20K10 100 piv, 2 amps, dimensions 1·4 x1·4x·6in. 25/-
1B40K10 100 piv, 4 amps, dimensions 1·4x1·4x·6in. 30/-
1B100M10 100 piv, 10 amps, dimensions 2¼x2¼x1in. 85/-.
Postage 1/6 per rectifier.

MOVING COIL METERS

We announce the introduction of a range of first quality moving coil meters with 1.5% accuracy. Meters are available in 3in. round flange, and 3in. and 4½in. square flanges. Please write for illustrated leaflets.

SILICON POWER RECTIFIERS

BY100, 700 p.i.v., 450mA, W.E.	4/6
BYZ10, 800 p.i.v., 6 Amps, S.M.	9/-
BYZ12, 400 p.i.v., 6 Amps, S.M.	5/-
BYZ13, 200 p.i.v., 6 Amps., S.M.	7/6
BYZ19, as BYZ13 but stud negative	7/6
DD000, 50 p.i.v., 500mA, W.E.	3/-
DD006, 400 p.i.v., 500mA, W.E.	6/6
DD058, 800 p.w., 500mA, W.E.	7/6

Note: W.E.—Wire Ended; S.M.—Stud Mounted.

GERMANIUM POINT CONTACT DIODES

OA5, 100 piv/115 mA	3/-
OA6, 60 piv/115 mA Gold Bonded	4/-
OA79, 30 piv/35 mA, 40 mc/s	2/3
OA81, 115 piv/60mA, High Back Resistance	2/-
OA95, 90 piv/50 mA subminiature	2/-

25% discount for orders of 24 or more of each type.

Our 1967/68 price list of Valves, Tubes and Semiconductors is now ready. In addition to listing prices of some 2,300 types it is a useful reference work giving: Valve and Tube Equivalents, Specification of Microwave Tubes, Cathode Ray Tubes and Semiconductors. Send S.A.E. (Quarto) now to get your copy free of charge.

PRACTICAL WIRELESS blueprints

The following blueprints are available from stock. **Descriptive text is not available** *but the date of issue is shown for each blueprint. Send, preferably, a postal order to cover cost of the blueprint (stamps over 6d. unacceptable) to Blueprint Department, Practical Wireless, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.*

Blueprint	Issue	Price
The Strand Amplifier; The PW Signal Generator	(Oct. 1962)	5/-
The Berkeley Loudspeaker Enclosure; The Luxembourg Tuner	(Dec. 1962)	5/-
The PW Troubadour; The PW Everest Tuner	(June 1962)	7/6
The PW Britannic Two; The PW Mercury Six	(May 1962)	6/-
Beginner's Short Wave Two; S.W. Listener's Guide	(Nov. 1963)	5/-
PW "Sixteen" Multirange Meter; Test Meter Applications Chart	(Jan. 1964)	5/-
The Celeste 7-transistor Portable Radio; The Spinette Record Player	(June 1963)	5/-
Transistor Radio Mains Unit; 7 Mc/s Transceiver	(June 1964)	5/-
The Citizen	(December 1961)	5/-
The Mini-amp	(November 1961)	5/-
The Beginner's Short Wave Superhet	(Dec. 1964)	5/-
The Empire 7 Three-band Receiver	(May 1965)	5/-
Electronic Hawaiian Guitar	(June 1965)	5/-
Progressive SW Superhet	(February 1966)	5/-
Beginner's 5-Band Receiver; Home Intercom Unit	(Dec. 1966)	5/-

★ **PLEASE NOTE THAT WE CAN SUPPLY NO BLUEPRINTS OTHER THAN THOSE SHOWN IN THE ABOVE LIST. NOR ARE WE ABLE TO SUPPLY SERVICE SHEETS FOR COMMERCIAL RADIO, TV OR AUDIO EQUIPMENT.** ★

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The PW Query Service is designed primarily to answer queries on articles published in the magazine and to deal with problems which cannot easily be solved by reference to standard text books. In order to prevent unnecessary disappointment, prospective users of the service should note that:

(a) We cannot undertake to design equipment or to supply wiring diagrams or circuits, to individual requirements.

(b) We cannot undertake to supply detailed information for converting war surplus equipment, or to supply circuitry.

(c) It is usually impossible to supply information on imported domestic equipment owing to the lack of details available.

(d) We regret we are unable to answer technical queries over the telephone.

(e) It helps us if queries are clear and concise.

(f) **We cannot guarantee to answer any query not accompanied by the current query coupon and a stamped addressed envelope.**

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This coupon is available until 7th June 1968 and must accompany all queries in accordance with the rules of our Query Service.

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